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ABSTRACT

This Final Programmatic Environmental Impact Statement (PEIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from development activities for six commercial wind energy leases in an area offshore New Jersey and New York known as the New York Bight (NY Bight), as well as the change in those impacts with avoidance, minimization, mitigation, and monitoring (AMMM) measures. The six commercial leases analyzed in this Final PEIS are OCS-A 0537, 0538, 0539, 0541, 0542, and 0544, which were issued by the Bureau of Ocean Energy Management (BOEM) on May 1, 2022. Each lease holder is likely to submit at least one Construction and Operations Plan (COP) as required under 30 Code of Federal Regulations (CFR) 585.600(a) and conduct project-specific environmental analyses. The programmatic analysis in this Final PEIS follows the execution of the six NY Bight leases and precedes the environmental analysis of the COPs. This Final PEIS will not result in the approval of any activities. The PEIS serves as a first tier document that the second tier project-specific environmental analyses of each COP may tier from or incorporate by reference (40 CFR 1501.11-12).

This Final PEIS was prepared in accordance with the requirements of the National Environmental Policy Act (42 United States Code 4321 et seq.) and implementing regulations (40 CFR parts 1500–1508).

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Contents

Executive Summary

ES.1 Introduction ES-1
ES.2 Purpose of and Need for the Proposed Action ES-3
ES.3 Public Involvement ES-5
ES.4 Alternatives ES-6
ES.4.1 Alternative A – No Action Alternative ES-6
ES.4.2 Alternative B – No Identification of AMMM Measures at the Programmatic Stage ES-6
ES.4.3 Alternative C – Proposed Action, Identification of AMMM Measures at the Programmatic Stage ES-9
ES.4.4 Preferred Alternative ES-10
ES.5 Environmental Impacts ES-10

Chapter 1 Introduction

1.1 Overview 1-1
1.2 Background 1-3
1.3 Purpose of and Need for the Proposed Action 1-4
1.4 Regulatory Overview 1-6
1.5 Relevant Existing NEPA and Consulting Documents 1-8
1.6 Programmatic Approach to the NEPA Process 1-8
1.7 Methodology for Assessing the Representative Project Design Envelope 1-9
1.8 Methodology for Assessing Impacts 1-10
1.8.1 Past and Ongoing Activities and Trends (Existing Baseline) 1-11
1.8.2 Planned Activities 1-12
1.9 Approach to Mitigation for the NY Bight Lease Areas 1-12

Chapter 2 Alternatives

2.1 Alternatives Analyzed in Detail 2-1
2.1.1 Alternative A – No Action Alternative 2-2
2.1.2 Alternative B – No Identification of AMMM Measures at the Programmatic Stage 2-3
2.1.3 Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage 2-17
2.2 Alternatives Considered but Not Analyzed in Detail 2-18
2.3 Non-Routine Activities and Events 2-23
2.4 Summary and Comparison of Impacts by Alternative 2-25

Chapter 3 Affected Environment and Environmental Consequences

3.1 Impact-Producing Factors 3.1-1

3.2 AMMM Measures Identified for Analysis in the Programmatic Environmental Impact Statement 3.2-1

3.3 Impact Analysis Terms and Definitions 3.3-1

3.3.1 Activities Terminology 3.3-1

3.3.2 Impact Terminology 3.3-2

3.4 Physical Resources 3.4.1-1

3.4.1 Air Quality and Greenhouse Gas Emissions 3.4.1-1

3.4.2 Water Quality 3.4.2-1

3.5 Biological Resources 3.5.1-1

3.5.1 Bats 3.5.1-1

3.5.2 Benthic Resources 3.5.2-1

3.5.3 Birds 3.5.3-1

3.5.4 Coastal Habitat and Fauna 3.5.4-1

3.5.5 Finfish, Invertebrates, and Essential Fish Habitat 3.5.5-1

3.5.6 Marine Mammals 3.5.6-1

3.5.7 Sea Turtles 3.5.7-1

3.5.8 Wetlands 3.5.8-1

3.6 Socioeconomic Conditions and Cultural Resources 3.6.1-1

3.6.1 Commercial Fisheries and For-Hire Recreational Fishing 3.6.1-1

3.6.2 Cultural Resources 3.6.2-1

3.6.3 Demographics, Employment, and Economics 3.6.3-1

3.6.4 Environmental Justice 3.6.4-1

3.6.5 Land Use and Coastal Infrastructure 3.6.5-1

3.6.6 Navigation and Vessel Traffic 3.6.6-1

3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys) 3.6.7-1

3.6.8 Recreation and Tourism 3.6.8-1

3.6.9 Scenic and Visual Resources 3.6.9-1

Chapter 4 Other Required Impact Analyses

4.1 Unavoidable Adverse Impacts of the Proposed Action 4.1-1

4.2 Irreversible and Irretrievable Commitment of Resources 4.2-1

4.3 Relationship Between the Short-term Use of the Human Environment and the Maintenance and Enhancement of Long-term Productivity 4.3-1

List of Appendices

Appendix A	Consultation and Coordination
Appendix B	Supplemental Information and Additional Figures and Tables
Appendix C	Tiering Guidance
Appendix D	Planned Activities Scenario
Appendix E	Analysis of Incomplete and Unavailable Information
Appendix F	Assessment of Resources with Moderate (or Lower) Impacts
Appendix G	Mitigation and Monitoring
Appendix H	Seascape, Landscape, and Visual Impact Assessment
Appendix I	NHPA Section 106 Summary
Appendix J	Introduction to Sound and Acoustic Assessment
Appendix K	References Cited
Appendix L	Glossary
Appendix M	List of Preparers and Reviewers
Appendix N	Distribution List
Appendix O	Scoping Report
Appendix P	Responses to Comments on the Draft Programmatic Environmental Impact Statement

List of Tables

Table		Page
ES-1	RPDE parameters for one representative NY Bight project	ES-7
ES-2	Summary and comparison of impacts among alternatives	ES-11
1-1	History of BOEM planning and leasing activities in the NY Bight	1-3
2-1	Alternatives analyzed in detail	2-1
2-2	RPDE parameters for one representative NY Bight project	2-4
2-3	Alternatives considered but not analyzed in detail	2-19
2-4	Summary and comparison of impacts among alternatives	2-27
3.1-1	Primary IPFs addressed in this analysis	3.1-1
3.3-1	Definitions of potential beneficial impact levels	3.3-3
3.4.1-1	Adverse impact level definitions for air quality and GHG emissions	3.4.1-5
3.4.1-2	Issues and indicators to assess impacts on air quality and GHG emissions	3.4.1-5
3.4.1-3	Ongoing and planned offshore wind in the geographic analysis area for air quality and GHG emissions	3.4.1-8
3.4.1-4	COBRA estimate of annual avoided health effects with 8.6 GW reasonably foreseeable offshore wind power	3.4.1-10
3.4.1-5	Total construction emissions (U.S. tons, except GHGs in metric tons) for a single NY Bight project	3.4.1-13
3.4.1-6	Operations and maintenance (O&M) emissions (U.S. tons, except GHGs in metric tons) from a single NY Bight project	3.4.1-15
3.4.1-7	COBRA estimate of annual avoided health effects with a single NY Bight project	3.4.1-16
3.4.1-8	Estimated social cost of GHGs associated with a single NY Bight project	3.4.1-17
3.4.1-9	Net emissions of CO_2 for a single NY Bight project	3.4.1-19
3.4.1-10	Recommended Practices for air quality and greenhouse gas emissions impacts and related benefits	3.4.1-25
3.4.2-1	Key water quality parameters with characterizing descriptions	3.4.2-3
3.4.2-2	303(d) non-attainable waterbodies per State authority found in the geographic analysis area	3.4.2-5
3.4.2-3	Water quality conditions in estuarine coastal areas for the USEPA Regions 2 and 3 to stations based on data collected in 2005, 2010, and 2015	3.4.2-7
3.4.2-4	Adverse impact level definitions for water quality	3.4.2-8
3.4.2-5	Issues and indicators to assess impacts on water quality	3.4.2-8
3.4.2-6	Ongoing and planned offshore wind in the geographic analysis area for water quality	3.4.2-10

3.4.2-7 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for water quality 3.4.2-24

3.4.2-8 Recommended Practices for water quality impacts and related benefits 3.4.2-26

3.5.1-1 Bats present in New Jersey and New York and their conservation status 3.5.1-3

3.5.1-2 Impact level definitions for bats 3.5.1-8

3.5.1-3 Issues and indicators to assess impacts on bats 3.5.1-8

3.5.1-4 Ongoing and planned offshore wind in the geographic analysis area for bats 3.5.1-9

3.5.1-5 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for bats 3.5.1-19

3.5.1-6 Recommended Practices for bat impacts and related benefits 3.5.1-21

3.5.2-1 Adverse impact level definitions for benthic resources 3.5.2-11

3.5.2-2 Issues and indicators to assess impacts on benthic resources 3.5.2-11

3.5.2-3 Ongoing and planned offshore wind in the geographic analysis area for benthic resources 3.5.2-13

3.5.2-4 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for benthic resources 3.5.2-37

3.5.2-5 Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for benthic resources 3.5.2-40

3.5.2-6 Recommended Practices for benthic resources impacts and related benefits 3.5.2-42

3.5.3-1 Annual percentage of Atlantic seabird population (1993–2019) that overlaps with anticipated offshore wind energy development on the OCS 3.5.3-6

3.5.3-2 Bird presence in the offshore project area by bird group 3.5.3-7

3.5.3-3 Adverse impact level definitions for birds 3.5.3-10

3.5.3-4 Issues and indicators to assess impacts on birds 3.5.3-10

3.5.3-5 Ongoing and planned offshore wind in the geographic analysis area for birds 3.5.3-12

3.5.3-6 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for birds 3.5.3-30

3.5.3-7 Recommended Practices for bird impacts and related benefits 3.5.3-33

3.5.4-1 Species typically found in coastal areas of New Jersey and New York 3.5.4-6

3.5.4-2 Species known to inhabit forested wetland, forested lowland, and upland habitats and pinelands of New Jersey and New York 3.5.4-6

3.5.4-3 Summary of potential threatened and endangered species in or in the vicinity of the geographic analysis area for coastal habitat and fauna 3.5.4-7

3.5.4-4 Adverse impact level definitions for coastal habitat and fauna 3.5.4-8

3.5.4-5 Issues and indicators to assess impacts on coastal habitats and fauna 3.5.4-9

3.5.4-6 Ongoing and planned offshore wind in the geographic analysis area for coastal habitat and fauna 3.5.4-11

3.5.4-7 Recommended Practices for coastal habitat and fauna impacts and related benefits 3.5.4-19

3.5.5-1 Federally listed fish species potentially occurring in the NY Bight area 3.5.5-5

3.5.5-2 Fish and invertebrate groupings based on hearing anatomy 3.5.5-9

3.5.5-3 Acoustic thresholds for fishes for exposure to pile-driving sound 3.5.5-12

3.5.5-4 Fishery Management Plans and species including life stage within the NY Bight lease areas 3.5.5-13

3.5.5-5 Adverse impact level definitions for finfish, invertebrates, and EFH 3.5.5-16

3.5.5-6 Issues and indicators to assess impacts on finfish, invertebrates, and EFH 3.5.5-16

3.5.5-7 Ongoing and planned offshore wind in the geographic analysis area for finfish, invertebrates, and EFH 3.5.5-20

3.5.5-8 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for finfish, invertebrates, and EFH 3.5.5-49

3.5.5-9 Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for finfish, invertebrates, and EFH 3.5.5-55

3.5.5-10 Recommended Practices for finfish, invertebrates, and essential fish habitat impacts and related benefits 3.5.5-57

3.5.6-1 Marine mammal species and NMFS management stocks with geographic ranges that include the offshore project area 3.5.6-5

3.5.6-2 Marine mammal functional hearing groups 3.5.6-16

3.5.6-3 The acoustic thresholds for onset of PTS and TTS for marine mammals for both impulsive and non-impulsive sound sources 3.5.6-19

3.5.6-4 Probabilistic disturbance SPL thresholds (M‐weighted) used to predict a behavioral response 3.5.6-20

3.5.6-5 Representative calf/pup and adult mass estimates used for assessing impulse-based onset of lung injury and mortality threshold exceedance distances 3.5.6-21

3.5.6-6 U.S. Navy impulse and peak pressure threshold equations for estimating numbers of marine mammals and sea turtles that may experience mortality or injury due to explosives 3.5.6-21

3.5.6-7 U.S. Navy impulse and peak pressure threshold equations for estimating distances to onset of potential effect for marine mammal and sea turtle mortality and slight lung injury due to explosives 3.5.6-21

3.5.6-8 Adverse impact level definitions for marine mammals 3.5.6-22

3.5.6-9 Issues and indicators to assess impacts on marine mammals 3.5.6-23

3.5.6-10 General description of potential impacts for ongoing non-offshore-wind and offshore wind activities' IPFs 3.5.6-24

3.5.6-11	Ongoing and planned offshore wind in the geographic analysis area for marine mammals	3.5.6-28
3.5.6-12	Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for marine mammals	3.5.6-85
3.5.6-13	Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for marine mammals	3.5.6-96
3.5.6-14	Recommended Practices for marine mammal impacts and related benefits	3.5.6-100
3.5.7-1	Sea turtles likely to occur in the NY Bight area	3.5.7-4
3.5.7-2	Seasonal sea turtle density estimates in the New York offshore project area derived from NYSERDA annual reports	3.5.7-4
3.5.7-3	Hearing capabilities, including hearing frequency range and peak sensitivity in sea turtles, by species	3.5.7-9
3.5.7-4	Acoustic thresholds for sea turtles currently used by NMFS GARFO and BOEM for auditory effects from impulsive and non-impulsive signals, as well as thresholds for behavioral disturbance	3.5.7-10
3.5.7-5	Definitions of potential adverse impact levels for sea turtles	3.5.7-12
3.5.7-6	Issues and indicators to assess impacts on sea turtles	3.5.7-12
3.5.7-7	Ongoing and planned offshore wind in the geographic analysis area for sea turtles	3.5.7-15
3.5.7-8	Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for sea turtles	3.5.7-45
3.5.7-9	Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for sea turtles	3.5.7-52
3.5.7-10	Recommended Practices for sea turtles impacts and related benefits	3.5.7-56
3.5.8-1	Wetlands in the New Jersey geographic analysis area	3.5.8-3
3.5.8-2	Wetlands in the New York geographic analysis area	3.5.8-5
3.5.8-3	Adverse impact level definitions for wetlands	3.5.8-7
3.5.8-4	Issues and indicators to assess impacts on wetlands	3.5.8-8
3.5.8-5	Ongoing and planned offshore wind in the geographic analysis area for wetlands	3.5.8-10
3.5.8-6	Other offshore wind projects’ impacts on wetlands in the geographic analysis area	3.5.8-11
3.5.8-7	Recommended Practices for wetlands impacts and related benefits	3.5.8-17
3.6.1-1	Summary of managed species and managing agencies	3.6.1-4
3.6.1-2	Landings (metric tons) for states in the geographic analysis area for years 2012 through 2022	3.6.1-7
3.6.1-3	Revenue ($1,000s) for states in the geographic analysis area for years 2012 through 2022	3.6.1-8

3.6.1-4 Top 10 species by landings weight from states in the geographic analysis area in 2022 .... 3.6.1-9
3.6.1-5 Fishing gear types and seasons for the region of the NY Bight lease areas 3.6.1-9
3.6.1-6 Highest total landings by weight (in pounds) from 2008 to 2021 for the six NY Bight lease areas 3.6.1-10
3.6.1-7 Highest total revenue from 2008 to 2021 for the six NY Bight lease areas 3.6.1-11
3.6.1-8 Highest landings (pounds) by species from 2008 to 2021 for the six NY Bight lease areas 3.6.1-11
3.6.1-9 Revenue from the most impacted species from 2008 to 2021 for the six NY Bight lease areas 3.6.1-12
3.6.1-10 Total landings (pounds) by port from 2008 to 2021 for the six NY Bight lease areas 3.6.1-13
3.6.1-11 Total revenue by port from 2008 to 2021 for the six NY Bight lease areas 3.6.1-14
3.6.1-12 Landings (pounds) by fishing gear type from 2008 to 2021 for the six NY Bight lease areas (numbers are rounded to the nearest thousand) 3.6.1-14
3.6.1-13 Total revenue by fishing gear type from 2008 to 2021 for the six NY Bight lease areas 3.6.1-15
3.6.1-14 For-hire recreational fish catch (pounds) from New Jersey and New York in 2021 .... 3.6.1-37
3.6.1-15 Fish count of the most impacted species caught in for-hire and recreational fishing in the six NY Bight lease areas from 2008–2021 .... 3.6.1-37
3.6.1-16 Small business revenue as a proportion of the total revenue across all business entities inside the NY Bight lease areas 3.6.1-38
3.6.1-17 Adverse impact level definitions for commercial fisheries and for-hire recreational fishing 3.6.1-40
3.6.1-18 Issues and indicators to assess impacts on commercial fisheries and for-hire recreational fishing 3.6.1-40
3.6.1-19 Ongoing and planned offshore wind in the geographic analysis area for commercial fisheries and for-hire recreational fishing 3.6.1-43
3.6.1-20 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for commercial fisheries and for-hire recreational fishing 3.6.1-54
3.6.1-21 Recommended Practices for commercial fisheries and for-hire recreational fishing impacts and related benefits 3.6.1-58
3.6.2-1 Cultural context for the NY Bight cultural resources geographic analysis area 3.6.2-5
3.6.2-2 Definitions of cultural resource types used in the analysis 3.6.2-6
3.6.2-3 Adverse impact level definitions for cultural resources by type 3.6.2-9
3.6.2-4 Issues and indicators to assess impacts on cultural resources 3.6.2-10
3.6.2-5 Ongoing and planned offshore wind projects excluding the NY Bight lease areas in the geographic analysis area 3.6.2-12

3.6.2-6 NY Bight lease area descriptive statistics 3.6.2-20

3.6.2-7 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for cultural resources 3.6.2-28

3.6.2-8 Recommended Practices for cultural resources impacts and related benefits 3.6.2-32

3.6.3-1 New York and New Jersey employment, unemployment, per capita income, and population living below poverty level (2019)..3.6.3-5

3.6.3-2 New York and New Jersey employment contribution by commercial sector (2019) 3.6.3-6

3.6.3-3 Total number of establishments, wages, and GDP for ocean industry economy of New York (2019) 3.6.3-8

3.6.3-4 Total number of establishments, wages, and GDP for ocean industry economy of New Jersey (2019) 3.6.3-8

3.6.3-5 Adverse impact level definitions for demographics, employment, and economics 3.6.3-9

3.6.3-6 Issues and indicators to assess impacts on demographics, employment, and economics...3.6.3-9

3.6.3-7 Ongoing and planned offshore wind that may contribute to impacts on demographics, employment, and economics 3.6.3-12

3.6.4-1 Low-income and minority populations in the geographic analysis area.........................3.6.4-7

3.6.4-2 Impact level definitions for environmental justice 3.6.4-17

3.6.4-3 Issues and indicators to assess impacts on environmental justice 3.6.4-18

3.6.4-4 Ongoing and planned offshore wind activities that may contribute to impacts on environmental justice...3.6.4-20

3.6.4-5 Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for environmental justice..3.6.4-37

3.6.4-6 Recommended Practices for environmental justice impacts and related benefits 3.6.4-39

3.6.5-1 Land use by type...3.6.5-4

3.6.5-2 Adverse impact level definitions for land use and coastal infrastructure 3.6.5-5

3.6.5-3 Issues and indicators to assess impacts on land use and coastal infrastructure 3.6.5-5

3.6.5-4 Ongoing and planned offshore wind that may contribute to impacts on land use and coastal infrastructure 3.6.5-7

3.6.5-5 Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for land use and coastal infrastructure......................................3.6.5-14

3.6.5-6 Recommended Practices for land use and coastal infrastructure impacts and related benefits 3.6.5-15

3.6.6-1 Representative ports that may be used during construction of the NY Bight projects...3.6.6-8

3.6.6-2 AIS vessel traffic data for 2017–2019...3.6.6-9

3.6.6-3 SAR incident data in the geographic analysis area (2011–2020) 3.6.6-12
3.6.6-4 Percent change in accident frequencies within three regional offshore wind project lease areas 3.6.6-12
3.6.6-5 Adverse impact level definitions for navigation and vessel traffic 3.6.6-16
3.6.6-6 Issues and indicators to assess impacts on navigation and vessel traffic 3.6.6-16
3.6.6-7 Ongoing offshore wind in the geographic analysis area for navigation and vessel traffic 3.6.6-17
3.6.6-8 Estimated number of vessel round trips per year within New York State waters for construction of offshore wind projects offshore of New York 3.6.6-30
3.6.6-9 Estimated number of vessel round trips per year within New York State waters for O&M of offshore wind projects offshore of New York 3.6.6-30
3.6.6-10 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for navigation and vessel traffic 3.6.6-32
3.6.6-11 Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for navigation and vessel traffic 3.6.6-32
3.6.6-12 Recommended Practices for navigation and vessel traffic impacts and related benefits 3.6.6-34
3.6.7-1 Onshore POIs 3.6.7-9
3.6.7-2 Adverse impact level definitions for other uses 3.6.7-14
3.6.7-3 Issues and indicators to assess impacts on other uses 3.6.7-14
3.6.7-4 Ongoing and planned offshore wind in the geographic analysis area for scientific research and surveys 3.6.7-16
3.6.7-5 Ongoing and planned offshore wind in the geographic analysis area for marine minerals extraction, national security and military use, aviation and air traffic, cables and pipelines, and radar systems 3.6.7-17
3.6.7-6 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for other uses (marine minerals, military use, aviation, scientific research, and surveys) 3.6.7-29
3.6.7-7 Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for other uses (marine minerals, military use, aviation, scientific research, and surveys) 3.6.7-31
3.6.7-8 Recommended Practices for other uses (marine minerals, military use, aviation, scientific research, and surveys) impacts and related benefits 3.6.7-33
3.6.8-1 Adverse impact level definitions for recreation and tourism 3.6.8-6
3.6.8-2 Issues and indicators to assess impacts on recreation and tourism 3.6.8-7
3.6.8-3 Ongoing and planned offshore wind projects in the geographic analysis area for recreation and tourism 3.6.8-8

3.6.8-4	Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for recreation and tourism	3.6.8-19
3.6.8-5	Recommended Practices for recreation and tourism impacts and related benefits	3.6.8-21
3.6.9-1	Landform, water, vegetation, and structures	3.6.9-5
3.6.9-2	Open ocean, seascape, and landscape conditions	3.6.9-8
3.6.9-3	Area of ocean, seascape, and landscape areas in the zone of potential visual influence for 1,312-foot wind turbines for all six NY Bight projects	3.6.9-10
3.6.9-4	Area of ocean, seascape, and landscape areas in the zone of potential visual influence for 853-foot wind turbines for all six NY Bight projects	3.6.9-11
3.6.9-5	Susceptibility definitions for rating criteria of open ocean, seascape, and landscape	3.6.9-12
3.6.9-6	Value definitions for rating criteria of open ocean, seascape, and landscape	3.6.9-12
3.6.9-7	Sensitivity definitions for rating criteria of open ocean, seascape, and landscape	3.6.9-13
3.6.9-8	Open ocean, seascape, and landscape sensitivity	3.6.9-14
3.6.9-9	Jurisdictions with ocean views	3.6.9-15
3.6.9-10	Representative offshore analysis area view receptor contexts and key observation points	3.6.9-17
3.6.9-11	View receptor sensitivity ranking criteria	3.6.9-18
3.6.9-12	Key observation point viewer sensitivity ratings	3.6.9-19
3.6.9-13	Adverse impact level definitions for scenic and visual resources	3.6.9-21
3.6.9-14	Issues and indicators to assess impacts on scenic and visual resources	3.6.9-22
3.6.9-15	Ongoing and planned offshore wind projects in the geographic analysis area for scenic and visual resources	3.6.9-24
3.6.9-16	Magnitude of view summary for all NY Bight lease areas to nearest onshore viewpoint for 1,312-foot and 853-foot WTGs	3.6.9-31
3.6.9-17	1,312-foot WTG NY Bight lease areas impact on open ocean, seascape, and landscape character	3.6.9-37
3.6.9-18	853-foot WTG NY Bight lease areas impact on open ocean, seascape, and landscape character	3.6.9-38
3.6.9-19	Criteria for measuring magnitude of change impacts	3.6.9-39
3.6.9-20	Impact levels on the viewer experience (sensitivity level and magnitude of change) for the 1,312-foot WTGs	3.6.9-40
3.6.9-21	Impact levels on the viewer experience (sensitivity level and magnitude of change) for the 853-foot WTGs	3.6.9-41
3.6.9-22	Magnitude of view summary for the six NY Bight lease areas to nearest onshore viewpoint for 1,312-foot WTG	3.6.9-44

3.6.9-23 Magnitude of view summary for the six NY Bight lease areas to nearest onshore viewpoint for 853-foot WTG 3.6.9-44
3.6.9-24 1,312-foot WTG impact on open ocean character, seascape character, and landscape character from six NY Bight projects 3.6.9-44
3.6.9-25 853-foot WTG impact on open ocean character, seascape character, and landscape character from six NY Bight projects 3.6.9-45
3.6.9-26 Impact levels on the viewer experience for WTGs from six NY Bight projects 3.6.9-47
3.6.9-27 Cumulative and additive impacts within the NY Bight geographic analysis area for the 1,312-foot WTGs 3.6.9-51
3.6.9-28 Cumulative and additive impacts within the NY Bight geographic analysis area for the 853-foot WTGs 3.6.9-56
3.6.9-29 Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for scenic and visual resources 3.6.9-61
3.6.9-30 Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for scenic and visual resources 3.6.9-62
3.6.9-31 Recommended Practices for scenic and visual resources impacts and related benefits 3.6.9-64
4.1-1 Potential unavoidable adverse impacts of the Proposed Action 4.1-1
4.2-1 Irreversible and irretrievable commitment of resources by resource area for the Proposed Action 4.2-1

List of Figures

Figure		Page
ES-1	NY Bight lease areas	ES-2
1-1	NY Bight lease areas	1-2
1-2	Renewable energy process: leasing to decommissioning	1-9
2-1	Representative onshore and offshore infrastructure	2-7
2-2	Representative wind turbine	2-9
2-3	Monopile foundation	2-10
2-4	Jacket foundation	2-11
2-5	Suction bucket foundation	2-11
2-6	Gravity-based foundation	2-12
2-7	Radial configuration topologies	2-14
2-8	Network configuration topologies	2-15
3-1	No Action Alternative analysis	3-2
3-2	No Action Alternative cumulative analysis	3-2
3-3	Action alternatives analysis	3-3
3-4	Action alternatives cumulative analysis	3-3
3.4.1-1	Air quality and GHG emissions geographic analysis area and attainment status	3.4.1-2
3.4.2-1	Water quality geographic analysis area	3.4.2-2
3.5.1-1	Bats geographic analysis area	3.5.1-2
3.5.1-2	Bat occurrences in the NJDEP EBS	3.5.1-6
3.5.2-1	Benthic resources geographic analysis area	3.5.2-2
3.5.2-2	New York Bight topography highlighting the Hudson Shelf Valley, New York and New Jersey wind energy areas, and artificial reefs	3.5.2-5
3.5.3-1	Bird geographic analysis area	3.5.3-2
3.5.3-2	Total avian relative annual abundance distribution map	3.5.3-5
3.5.3-3	Four examples of curlews approaching offshore wind farms that show avoidance in the vertical plane by increasing flight altitudes.	3.5.3-18
3.5.3-4	Four examples of curlews approaching offshore wind farms that show avoidance in the horizontal plane by changing flight directions	3.5.3-19
3.5.3-5	Non-directional flights within or in the vicinity of two offshore wind farm clusters made by two curlews tagged as breeding in north Germany.	3.5.3-20
3.5.3-6	Total avian relative abundance distribution map for the higher collision sensitivity species group	3.5.3-26

3.5.3-7 Total avian relative abundance distribution map for the higher displacement sensitivity species group 3.5.3-27
3.5.4-1 Coastal habitat and fauna geographic analysis area 3.5.4-2
3.5.5-1 Finfish, invertebrates, and EFH geographic analysis area 3.5.5-2
3.5.5-2 HAPCs within the NY Bight from Cape Cod, Massachusetts, to Cape Henlopen, Delaware 3.5.5-15
3.5.6-1 Marine mammals geographic analysis area 3.5.6-4
3.5.7-1 Sea turtles geographic analysis area 3.5.7-2
3.5.8-1 Wetlands geographic analysis area 3.5.8-2
3.5.8-2 Wetlands in the New Jersey geographic analysis area 3.5.8-4
3.5.8-3 Tidal and freshwater wetlands in the New York geographic analysis area 3.5.8-6
3.6.1-1 Commercial fisheries and for-hire recreational fishing geographic analysis area 3.6.1-2
3.6.1-2 VMS bearings for VMS activity in Lease Area OCS-A 0537, January 2014–December 2021 .... 3.6.1-17
3.6.1-3 VMS bearings for VMS activity in Lease Area OCS-A 0538, January 2014–December 2021 .... 3.6.1-18
3.6.1-4 VMS bearings for VMS activity in Lease Area OCS-A 0539, January 2014–December 2021 .... 3.6.1-19
3.6.1-5 VMS bearings for VMS activity in Lease Area OCS-A 0541, January 2014–December 2021 .... 3.6.1-20
3.6.1-6 VMS bearings for VMS activity in Lease Area OCS-A 0542, January 2014–December 2021 .... 3.6.1-21
3.6.1-7 VMS bearings for VMS activity in Lease Area OCS-A 0544, January 2014–December 2021 .... 3.6.1-22
3.6.1-8 VMS bearings for transiting VMS in Lease Area OCS-A 0537, January 2014–December 2021 .... 3.6.1-23
3.6.1-9 VMS bearings for transiting VMS in Lease Area OCS-A 0538, January 2014–December 2021 .... 3.6.1-24
3.6.1-10 VMS bearings for transiting VMS in Lease Area OCS-A 0539, January 2014–December 2021 .... 3.6.1-25
3.6.1-11 VMS bearings for transiting VMS in Lease Area OCS-A 0541, January 2014–December 2021 .... 3.6.1-26
3.6.1-12 VMS bearings for transiting VMS in Lease Area OCS-A 0542, January 2014–December 2021 .... 3.6.1-27
3.6.1-13 VMS bearings for transiting VMS in Lease Area OCS-A 0544, January 2014–December 2021 .... 3.6.1-28
3.6.1-14 VMS bearings for fishing VMS in Lease Area OCS-A 0537, January 2014–December 2021 .... 3.6.1-29

3.6.1-15 VMS bearings for fishing VMS in Lease Area OCS-A 0538, January 2014–December 2021 ....3.6.1-30
3.6.1-16 VMS bearings for fishing VMS in Lease Area OCS-A 0539, January 2014–December 2021 ....3.6.1-31
3.6.1-17 VMS bearings for fishing VMS in Lease Area OCS-A 0541, January 2014–December 2021 ....3.6.1-32
3.6.1-18 VMS bearings for fishing VMS in Lease Area OCS-A 0542, January 2014–December 2021 ....3.6.1-33
3.6.1-19 VMS bearings for fishing VMS in Lease Area OCS-A 0544, January 2014–December 2021 ....3.6.1-34
3.6.1-20 Number of for-hire recreational angler trips in New Jersey from 2012 to 2021 ....3.6.1-35
3.6.1-21 Number of for-hire recreational angler trips in New York from 2012 to 2021 ....3.6.1-36
3.6.1-22 Location of artificial reefs and for-hire recreational fishing areas offshore New Jersey and New York relative to the six NY Bight lease areas 3.6.1-39
3.6.2-1 Cultural resources geographic analysis area and programmatic visual APE 3.6.2-4
3.6.3-1 Demographics, employment, and economics geographic analysis area 3.6.3-2
3.6.3-2 Population density in New York and New Jersey counties (2020) 3.6.3-3
3.6.3-3 Ocean economy employment, New Jersey counties 3.6.3-7
3.6.3-4 Ocean economy employment, New York counties 3.6.3-7
3.6.4-1 Populations with environmental justice concerns in the geographic analysis area 3.6.4-3
3.6.4-2 Populations with environmental justice concerns in the New Jersey geographic analysis area 3.6.4-8
3.6.4-3 Populations with environmental justice concerns in the New York geographic analysis area 3.6.4-9
3.6.4-4 Commercial and recreational fishing engagement or reliance of coastal communities in New York 3.6.4-12
3.6.4-5 Commercial and recreational fishing engagement or reliance of coastal communities in New Jersey 3.6.4-13
3.6.5-1 Land use and coastal infrastructure geographic analysis area 3.6.5-2
3.6.5-2 Land uses in geographic analysis area 3.6.5-3
3.6.6-1 Navigation and vessel traffic geographic analysis area 3.6.6-2
3.6.6-2 TSS, separation zones, precautionary areas, and USCG proposed fairways, anchorages, and precautionary areas in the geographic analysis area 3.6.6-6
3.6.6-3 AIS track logs by vessel type in relation to NY Bight lease areas 3.6.6-11
3.6.6-4 SAR missions near the NY Bight lease areas 3.6.6-13
3.6.6-5 Aids to Navigation near the NY Bight lease areas 3.6.6-15

3.6.7-1	Marine minerals, aviation and air traffic, military and national security, radar systems, cables, and pipelines geographic analysis area	3.6.7-2
3.6.7-2	Scientific research and surveys geographic analysis area	3.6.7-3
3.6.7-3	Marine mineral resources	3.6.7-5
3.6.7-4	National security, military sites, and airspace	3.6.7-8
3.6.7-5	Cables and pipelines	3.6.7-10
3.6.7-6	National security, radars, and unexploded ordnances	3.6.7-12
3.6.8-1	Recreation and tourism geographic analysis area	3.6.8-2
3.6.9-1	Scenic and visual resources geographic analysis area and lease visibility buffers	3.6.9-3
3.6.9-2	Scenic and visual resources geographic analysis area and cumulative impacts analysis area	3.6.9-4
3.6.9-3	Scenic resources overview map	3.6.9-6
3.6.9-4	Offshore facility viewsheds of six NY Bight projects	3.6.9-7
3.6.9-5	Long Beach, New Jersey	3.6.9-16
3.6.9-6	Atlantique Beach, New York	3.6.9-16
3.6.9-7	The effect of earth curvature and atmospheric refraction on visibility of a distant object	3.6.9-33

Abbreviations and Acronyms

Abbreviation	Definition
°C	Celsius
°F	Fahrenheit
µPa	micropascal
AAQS	ambient air quality standards
AC	alternating current
ACPARS	Atlantic Coast Port Access Route Study
AIS	Automated Identification System
Alternative C	Proposed Action
ALWTRP	Atlantic Large Whale Take Reduction Plan
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMMM	avoidance, minimization, mitigation, and monitoring
AMO	Atlantic Multi-decadal Oscillation
AMSL	above mean sea level
ANSI	American National Standards Institute
Argonne	Argonne National Laboratory
ASLFs	ancient submerged landform features
ASMFC	Atlantic States Marine Fisheries Commission
ATON	Federal Aids to Navigation
BIA	Biologically Important Area
BMP	Best Management Practice
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CAFRA	Coastal Area Facility Review Act
Call	Call for Information and Nominations
CBRA	Coastal Barrier Resources Act
CFR	Code of Federal Regulations
CH_4	methane
CLCPA	Climate Leadership and Community Protection Act
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	CO2 equivalent
CO_2-eq/kWh	CO2e per kilowatt-hour
COBRA	CO-Benefits Risk Assessment
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
COP	Construction and Operations Plan

Abbreviation	Definition
COWI	BTMI Engineering
CPAPARS	Consolidated Port Approaches Port Access Route Studies
CWA	Clean Water Act
DASR	Digital Airport Surveillance Radar
dB	decibel
dbA	A-weighted decibel
DC	direct current
DMAs	Dynamic Management Areas
DOC	Department of Commerce
DoD	Department of Defense
DOE	Department of Energy
DOI	Department of Interior
DP	dynamic positioning
DPS	distinct population segment
EA	Environmental Assessment
EBS	Ecological Baseline Studies
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EMFs	Electric and magnetic fields
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAD	Fish Aggregating Device
FMP	Fishery Management Plan
FOV	field of view
FTE	full-time equivalent
G&G	geophysical and geotechnical
G.I.	gastrointestinal
GARFO	Greater Atlantic Regional Fisheries Office
GDP	gross domestic product
GHG	greenhouse gas
GIS	Geographic information system
GSOE	Garden State Offshore Energy
GW	gigawatts
GWP	Global Warming Potential
HAPC	habitat areas of particular concern
HAP	hazardous air pollutant
HAT	highest astronomical tide
HDD	horizontal directional drill
HMS	Office of Highly Migratory Species
HRG	high-resolution geophysical

Abbreviation	Definition
HRVEA	Historic Resource Visual Effects Assessment
HVAC	high voltage alternating current
HVDC	high voltage direct current
Hz	hertz
IMO	International Maritime Organization's
IOOS	Integrated Ocean Observing System
IPCC's	Intergovernmental Panel on Climate Change's
IPF	impact-producing factor
IUCN	International Union for Conservation of Nature
IWG	Interagency Working Group
kHz	kilohertz
KOP	key observation point
kV	kilovolt
LMA	Lobster Management Areas
LME	Large Marine Ecosystems
Lpk	peak-to-peak sound pressure levels
Lpk	peak-to-peak sound pressure levels
M/SI	mortality and serious injury
MAFMC	Mid-Atlantic Fishery Management Council
MARA	Marine Archaeological Resources Assessment
MBTA	Migratory Bird Treaty Act of 1918
MDAT	Marine-Life Data and Analysis Team
MEC	munitions and explosives of concern
MHHW	Mean Higher High Water
MPRSA	Marine Protection, Research, and Sanctuaries Act
MT	metric tons
MW	megawatt
N.J.S.A.	New Jersey Statutes Annotated
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NABCI	North American Bird Conservation Initiative
NARW	North Atlantic right whale
NAS	noise attenuation systems
NASEM	National Academies of Sciences, Engineering, and Medicine
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFMC	New England Fishery Management Council
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NGTC	National Guard Training Center
NHPA	National Historic Preservation Act

Abbreviation	Definition
NJDEP	New Jersey Department of Environmental Protection
NJ-NY PA	New Jersey and New York Under Section 106 of the National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_X	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSRAs	Navigation Safety Risk Assessments
NY Bight	New York Bight
NY Bight PA	Programmatic Agreement for NY Bight
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority's
O&M	operations and maintenance
O_3	ozone
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OPERAS	Operational Areas
OSHA	Occupational Safety and Health Administration
OSRP	Oil Spill Response Plan
OSS	offshore substation
PAM	passive acoustic monitoring
PAPE	preliminary APE
PATON	Private Aids to Navigation Permit
Pb	lead
PBR	potential biological removal
PCB	polychlorinated bisphenol
PDC	Project Design Criteria
PDE	Project Design Envelope
PEIS	Programmatic Environmental Impact Statement
PM	particulate matter
PM_{10}	particulate matter with diameter of 10 microns and smaller
$PM_{2.5}$	particulate matter with diameter of 2.5 microns and smaller
POI	point of interconnection
Programmatic APE	programmatic area of potential effects

Abbreviation	Definition
Programmatic Marine APE	marine portion of the Programmatic APE
Programmatic Visual APE	visual portion of the Programmatic APE
PSN	Proposed Sale Notice
PSO	protected species observer
PTS	permanent threshold shifts
RNA	Regulated Navigation Area
ROD	Record of Decision
RODA	Responsible Offshore Development Alliance
ROW	right-of-way
RPDE	Representative Project Design Envelope
RP	Recommended Practice
RSLL	Received Sound Level Limit
RSZ	rotor-swept zone
RVMP	Reduced Visibility Monitoring Plan
RWSC	Regional Wildlife Science Collaborative
SAA	state agreement approach
SAFMC	South Atlantic Fishery Management Council
SAR	Search and Rescue
SAR	Search and Rescue
SAV	submerged aquatic vegetation
SBP	sub-bottom profiler
SCFWH	Significant Coastal Fish & Wildlife Habitat
SC-GHG	social cost of greenhouse gases
SEL_{24h}	sound exposure level over 24 hours
SEQR	State Environmental Quality Review Act
SF_6	sulfur hexafluoride
SHPOs	State Historic Preservation Officers
SIP	State Implementation Plan
SLIA	seascape and landscape impact assessment
SMA	Seasonal Management Area
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasures
SPL	sound pressure level
SUA	special use airspace
SWPPP	stormwater pollution prevention plan
TARA	Terrestrial Archaeological Resources Assessment
TCP	traditional cultural properties
TDWR	Terminal Doppler Weather Radar
TSS	Traffic Separation Scheme

Abbreviation	Definition
TTS	temporary threshold shifts
UME	Unusual Mortality Event
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
VIA	visual impact analysis
VOCs	volatile organic compounds
VTR	Vessel Trip Report
WEAs	Wind Energy Areas
WNS	white-nose syndrome
WTG	wind turbine generator

Executive Summary

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Executive Summary

ES.1 Introduction

This Final Programmatic Environmental Impact Statement (PEIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from development activities for six commercial wind energy leases in an area offshore New Jersey and New York known as the New York Bight (NY Bight), as well as the change in those impacts with avoidance, minimization, mitigation, and monitoring (AMMM) measures. The six commercial leases analyzed in this Final PEIS are OCS-A 0537, 0538, 0539, 0541, 0542, and 0544 (hereafter referred to as the NY Bight leases or NY Bight lease areas), totaling over 488,000 acres (197,486 hectares) (Figure ES-1), which were issued by the Bureau of Ocean Energy Management (BOEM) on May 1, 2022. Each lease holder is likely to submit at least one Construction and Operations Plan (COP) as required under 30 Code of Federal Regulations (CFR) 585.600(a). The programmatic analysis in this Final PEIS follows the execution of the six NY Bight leases and precedes the environmental analysis of the COPs. This Final PEIS will not result in the approval of any activities. The PEIS serves as a first-tier document that the second-tier project-specific environmental analyses of each COP may tier from or incorporate by reference (40 CFR 1501.11-12).

BOEM has prepared this Final PEIS to (1) identify and analyze AMMM measures that could avoid, minimize, mitigate, and monitor impacts on resources in the six NY Bight lease areas and (2) focus future project-specific environmental analyses. This Final PEIS evaluates the potential impacts from anticipated wind energy development within the NY Bight lease areas to inform BOEM in identifying AMMM measures that BOEM may require as conditions of approval for activities proposed by lessees in COPs. This Final PEIS will also facilitate the timely review of COPs submitted for the NY Bight lease areas by focusing the project-specific environmental analysis on project impacts not considered in the PEIS or those impacts that warrant further consideration. The project-specific analyses will occur after this PEIS is issued and may tier from or incorporate by reference this PEIS and could also incorporate revised, additional, or different AMMM measures as needed. This PEIS does not, by itself, impose any mitigation measures on future COPs, and instead depends on subsequent COP-specific environmental analysis. This PEIS is therefore not the consummation of the agency’s decision-making for these measures as applied to specific COPs.

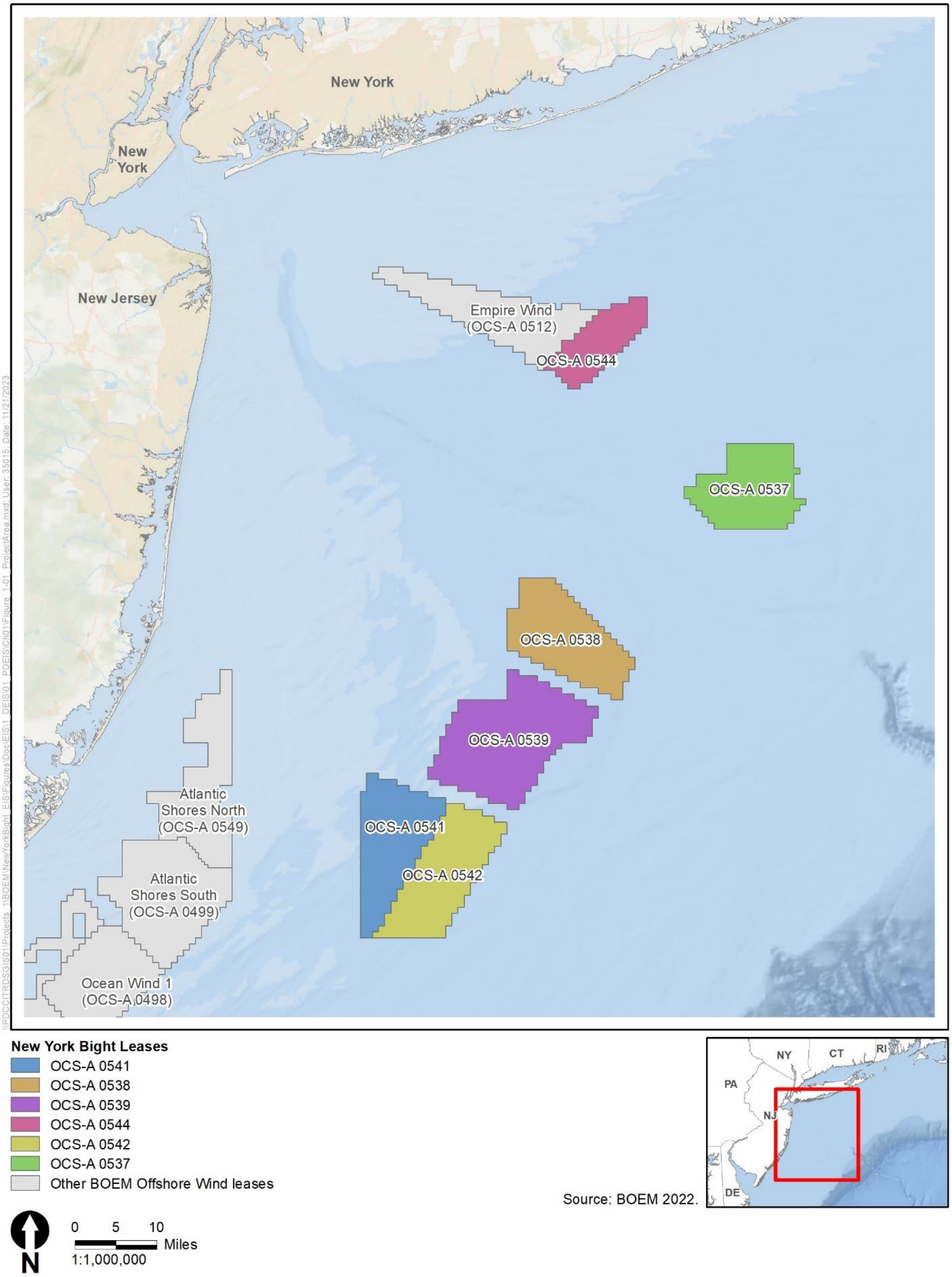

Figure ES-1. NY Bight lease areas

This Final PEIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321 et seq.) and its implementing regulations (40 CFR parts 1500–1508). Additionally, this Final PEIS was prepared consistent with the U.S. Department of the Interior's NEPA regulations (43 CFR part 46), longstanding federal judicial and regulatory interpretations, and Administration priorities and policies.

ES.2 Purpose of and Need for the Proposed Action

The Proposed Action (Alternative C) for the Final PEIS is the identification of AMMM measures at the programmatic stage that could avoid, minimize, mitigate, and monitor impacts. BOEM may require some or all of these measures as conditions of approval for activities proposed by lessees in COPs submitted for the six NY Bight lease areas. BOEM may require additional or different measures based on future, site-specific NEPA analysis or the parameters of specific COPs. BOEM may also modify the measures at the COP-specific NEPA stage to tailor them to the characteristics of the proposed project and the site(s) of proposed activities, and to ensure conformity with project-specific consultations and authorizations. These AMMM measures are considered programmatic insofar as they may be applied to COPs for the six NY Bight lease areas, not because they necessarily will apply to COPs under BOEM's renewable energy program outside of the NY Bight lease areas. The Final PEIS analyzes the potential impacts of development in the NY Bight area and how those impacts can be avoided, minimized, or mitigated by AMMM measures. However, the Proposed Action will not result in the approval of any activities.

The purpose of the Proposed Action is to describe issues, analyze degree of potential impacts, and identify, as appropriate, AMMM measures. BOEM is preparing this Final PEIS because of the close proximity of the six NY Bight lease areas, their similar level of development due to the leases being awarded from the same auction, the close timing of the anticipated COP submissions, and the high, near-term demand from the states of New York and New Jersey for electricity generated by offshore wind. This PEIS will reduce redundancies across COP-specific NEPA analyses, including very similar affected environments, impacts, and mitigation measures, and will allow for future project-specific NEPA documents to be focused on the project-specific impacts not considered in the PEIS or those impacts that warrant further consideration. The Proposed Action is needed to help BOEM make timely decisions on COPs submitted for the six NY Bight lease areas. Timely decisions further the United States policy to make Outer Continental Shelf (OCS) energy resources available for expeditious and orderly development, subject to environmental safeguards (43 USC 1332(3)) and other requirements listed at 43 USC 1337(p)(4), including protection of the environment, among several other factors. Project-specific NEPA analysis for individual COPs could tier from or incorporate by reference this PEIS and could apply revised, additional, or different AMMM measures as needed. This PEIS does not, by itself, impose any mitigation measures on future COPs. This PEIS is therefore not the consummation of the agency's decision-making for these measures as applied to specific COPs. BOEM intends to use AMMM measures identified at the programmatic stage to inform the selection of appropriate AMMM measures at the COP decision stage. That is, the ROD for each COP NEPA document may rely on a combination of the analysis done in this PEIS and in the COP NEPA document to support the need for measures included as terms or conditions of approval.

A broader approach to the NEPA analysis for the minimum of six COPs expected for the NY Bight lease areas is consistent with Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," issued on January 27, 2021. In that order, President Biden stated that the policy of his administration is "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure." To support the goals outlined in Executive Order 14008, the administration has also announced plans to increase renewable energy production, with a goal of 30 gigawatts (GW) of offshore wind energy capacity by 2030.

Development of the leaseholds would assist with meeting several state mandates for renewable energy. New Jersey's goal of 11 GW of offshore wind energy generation by 2040 is outlined in New Jersey Executive Order No. 307, issued on September 21, 2022. New York's requirement of 9.0 GW of offshore wind energy generation by 2035 is outlined in the Climate Leadership and Community Protection Act, signed into law on July 18, 2019. Additionally, an estimated 16–19 GW of offshore wind energy may be necessary to ensure New York State achieves its Climate Act mandates (New York State Climate Action Council 2022). Based on a conservatively estimated power ratio of 3 megawatts per square kilometer, BOEM estimates that full development of leases in this area has the potential to create up to 5.6 to 7 GW of offshore wind energy.[1]

Through the development of this Final PEIS, BOEM is addressing the following objectives:

- Analyzing potential impacts if development is authorized in the six NY Bight lease areas.
- Analyzing AMMM measures for the six NY Bight lease areas.
- Analyzing focused, regional cumulative effects.
- Tiering of project-specific environmental analyses.

The analysis in this PEIS was developed for integration with site-specific NEPA reviews. Project-specific analyses that tier from or incorporate by reference this PEIS will evaluate whether a project would have greater, equal, fewer, or different impacts than those that were analyzed in the PEIS by considering the level of action analyzed and the particularities of the site. Future COP-specific NEPA documents will focus on providing site- and project-specific analyses that were not already addressed by the PEIS. Refer to Appendix C, *Tiering Guidance*, for specific recommendations by resource topic regarding how the PEIS may be incorporated by reference in the future COP-specific NEPA documents; this appendix also

[1] New York Bight Final Sale Notice, December 21, 2021. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/ATLW-8-NY-Bight-Final-Lease-Sale-Decision-Memorandum.pdf.

identifies additional analysis that would likely be required as part of the COP-specific NEPA analysis once detailed and site-specific project information is available.

ES.3 Public Involvement

On July 15, 2022, BOEM issued a Notice of Intent (NOI) to prepare a PEIS consistent with NEPA regulations (42 USC 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives [87 *Federal Register* 42495]. The NOI commenced a public scoping process for identifying issues and potential alternatives for consideration in the PEIS. The formal scoping period was from July 15, 2022, through August 30, 2022. BOEM held three virtual public scoping meetings on July 28, 2022, August 2, 2022, and August 4, 2022, to solicit feedback and to identify issues and potential alternatives for consideration in the PEIS. Throughout the scoping period, federal agencies, Tribal Nations, state and local governments, and the general public had the opportunity to help BOEM identify potentially significant resources and issues, impact-producing factors (IPFs), reasonable alternatives, and potential mitigation measures to analyze in the PEIS, as well as to provide additional information. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the National Historic Preservation Act (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. The NOI requested comments from the public in written form, delivered by hand or by mail, or through the regulations.gov web portal.

BOEM received a total of 43 comments during the scoping period. BOEM reviewed and considered all scoping comments in the development of the Final PEIS. A scoping report summarizing the submissions received and the methods for analyzing them is available in Appendix O, *Scoping Report*, of this Final PEIS. In addition, all public scoping comments received can be viewed online at http://www.regulations.gov by typing “BOEM-2022-0034” in the search field. As detailed in the scoping summary report, the resource areas or NEPA topics most referenced in the scoping comments were the Purpose and Need, the Proposed Action, Public Engagement, Commercial and For-Hire Recreational Fishing, Marine Mammals, Navigation and Vessel Traffic, and Scenic and Visual Resources.

On January 12, 2024, BOEM issued a Notice of Availability of the Draft PEIS, initiating a 45-day public comment period from January 12 to February 26, 2024 (88 *Federal Register* 2249). BOEM held five public meetings to solicit feedback and identify issues for consideration in preparing the Final PEIS. Three in-person meetings were held in North Dartmouth, Massachusetts; Stony Brook, New York; and Toms River, New Jersey on February 5, 7, and 8, 2024, respectively. Two virtual meetings were held on January 31 and February 13, 2024. On February 29, 2024, BOEM announced an extension to the comment period, which concluded on March 13, 2024 (88 *Federal Register* 14901). BOEM assessed and considered all 1,568 comments received on the Draft PEIS in preparation of the Final PEIS. See Appendix A, *Consultation and Coordination,* for additional information on public involvement.

ES.4 Alternatives

BOEM considered a reasonable range of alternatives during the PEIS development process that were identified through coordination with cooperating and participating agencies and Cooperating Tribal Governments and through public comments received during the public scoping period and Draft PEIS comment period. The Final PEIS evaluates the No Action Alternative and two action alternatives (one of which has sub-alternatives). The alternatives are as follows:

- Alternative A – No Action Alternative
- Alternative B – No Identification of AMMM Measures at the Programmatic Stage
- Alternative C – Proposed Action, Identification of AMMM Measures at the Programmatic Stage
    - Sub-alternative C1 – Previously Applied AMMM Measures
    - Sub-alternative C2 – Previously Applied and Not Previously Applied AMMM Measures

Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Chapter 2, Section 2.2, *Alternatives Considered but Not Analyzed in Detail*.

ES.4.1 Alternative A – No Action Alternative

Alternative A, the No Action Alternative, assumes that no offshore wind development occurs on any of the six NY Bight lease areas. Any potential environmental and socioeconomic impacts, including benefits, associated with the development of the NY Bight lease areas would not occur. However, all other existing or other reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario*, would continue. The current resource conditions, trends, and impacts from ongoing activities under the No Action Alternative serve as the baseline against which the direct and indirect impacts of all action alternatives are evaluated. Analysis of this alternative provides context for the analyses of Alternatives B and C and could be used for tiering for COP-specific NEPA analysis.

In the absence of the NY Bight projects, other reasonably foreseeable future impact-producing offshore wind and non-offshore-wind activities would be realized, which could cause changes to the existing baseline conditions. The continuation of all other existing and reasonably foreseeable future activities described in Appendix D without the NY Bight projects serves as the baseline for the evaluation of cumulative impacts.

ES.4.2 Alternative B – No Identification of AMMM Measures at the Programmatic Stage

Alternative B considers the potential impacts of future offshore wind development for the six NY Bight lease areas without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. However, the analysis in Alternative B assumes that development of the NY Bight projects would be required to comply with federal and international requirements. Alternative B serves to compare how impacts would change with the

AMMM measures analyzed in Alternative C. BOEM will not approve any projects at the COP-NEPA stage without AMMM measures. Selection of Alternative B would mean that no measures are identified at the programmatic stage and that all measures in Appendix G may be re-assessed at the COP NEPA stage. To serve this comparative purpose, the analysis of Alternative B evaluates the impacts of (1) a single representative project developed in one NY Bight lease area without AMMM measures identified in Appendix G, and (2) the overall impacts of a full build-out of six representative projects in the NY Bight lease areas without the AMMM measures in Appendix G. BOEM intends for the analysis of a single representative offshore wind project (which is representative of a future project within any of the six NY Bight lease areas) to be used for tiering and incorporation by reference for each future COP-specific NEPA document. This PEIS assumes that full buildout of one NY Bight lease area is the same as one NY Bight project and is the most impactful development scenario. While lessees may elect a phased development approach resulting in more than one project per lease area, this PEIS analyzes the most impactful development scenario that could occur per lease area. By analyzing one project in the PEIS, BOEM provides a similar analysis to what would be analyzed in a COP-specific NEPA document. The analysis of six representative offshore wind projects (corresponding to the six NY Bight lease areas) provides a format for evaluating comprehensive cumulative impacts by examining offshore wind activities within the NY Bight area as a whole.

Because the analysis in this Final PEIS was prepared before any NY Bight COPs were submitted, BOEM developed a Representative Project Design Envelope (RPDE) to use for environmental analysis. The RPDE is a range of technical parameters that describes a single wind energy project that could occur within the NY Bight lease areas as described in Chapter 2, Section 2.1.2, *Alternative B – No Identification of AMMM Measures at the Programmatic Stage,* and presented in Table ES-1. The RPDE parameters in Table ES-1 are being used for the analysis of one NY Bight project. Because the locations and parameters of onshore components (e.g., points of interconnections, substations, onshore export cables) of the NY Bight projects will not be known until COPs are submitted, they are not included in the RPDE. The analysis of resource impacts in Chapter 3 generally considers impacts associated with onshore components, but BOEM expects additional site-specific analysis will be required for the COP-specific NEPA analysis.

For the analysis of six NY Bight projects, BOEM anticipates development of 1,103 wind turbine generators (WTGs), 22 offshore substations (OSSs), 44 offshore export cables totaling 1,772 miles (2,852 kilometers), and 1,582 miles (2,546 kilometers) of interarray cables across the six NY Bight lease areas.

Table ES-1. RPDE parameters for one representative NY Bight project

Element	Project Design Element	Typical Range
WTGs	Number of WTGs	50 – 280 turbines
	WTG spacing	WTGs would conform to a grid layout with a minimum spacing of 0.6 x 0.6 nautical mile (1.1 x 1.1 kilometers).[1]
	Turbine rotor diameter	721–1,214 feet (220–370 meters)
	Total turbine height[2]	853–1,312 feet (260–400 meters)

Element	Project Design Element	Typical Range
	WTG foundation type	Monopiles or piled jackets are most likely. Additional options include suction mono-bucket, suction bucket jacket, tri-suction pile caisson, and gravity-based structures.
	WTG seabed footprint, with scour protection (per foundation)	0.24 acre (0.10 hectare) (monopile) to 2.88 acres (1.7 hectare) (jacket foundation)
OSSs	Number and type of OSSs	1–5 OSSs[3] High voltage alternating current (HVAC) OSS and high voltage direct current (HVDC) converter OSS may be used.
	OSS foundation type	Monopiles or piled jackets are most likely. Additional options include suction bucket jackets and gravity-based structures.
	OSS seabed footprint, with scour protection (per foundation)	0.51 acre (0.21 hectare) (monopile) to 8.05 acres (3.26 hectares) (jacket foundation)
WTG and OSS Foundations	Foundation installation methods	Piled foundations (monopile and jacket): hydraulic impact hammering, vibratory hammering, water jetting, pile drilling, or a combination of methods. Other foundations: suction bucket and gravity-based installation.
	Scour protection types	Rock placement, mattress protection, sandbags, and stone bags.
Interarray Cables	Total interarray cable length	33–550 miles (53–885 kilometers)
	Interarray cable diameter	5–12 inches (13–30 centimeters)
	Interarray cable seabed disturbance (width)	66–131 feet (20–40 meters)
	Interarray cable burial depth	3–9.8 feet (0.9–3 meters) is the anticipated potential range of burial depth; 6 feet (1.8 meters) is the typical target burial depth. Depths may vary based on site-specific factors (e.g., soil type, cable/pipeline crossings).
	Interarray cable installation methods	Three approaches: pre-lay trenching, simultaneous lay and bury, or post-lay burial. Most common methods are mechanical or jet plowing. Additional options include jet trencher, precision installation (using a remotely operated vehicle/diver), mechanical cutter, controlled flow excavator, and vertical injection.
	Cable protection types	Rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers.
Export Cables	Number of export cables	1–9 export cables
	Total export cable length	30–929 miles (48–1,495 kilometers)
	Export cable voltage	220–420 kilovolt (kV) HVAC 320–525 kV HVDC
	Export cable diameter	6.1–13.8 inches (15.5–35.1 centimeters) HVAC 6.3–16 inches (16–40.6 centimeters) HVDC
	Export cable seabed disturbance (width)	66–131 feet (20–40 meters), per cable including cable protection footprint[4]
	Export cable burial depth	3–19.6 feet (0.9–6 meters) is the anticipated potential range of burial depth; 6 feet (1.8 meters) is typical target burial depth. Depths may vary based on site-specific factors (e.g., soil type, cable/pipeline crossings, crossing of navigation

Element	Project Design Element	Typical Range
		channels or other federal civil work projects, and other federal or state requirements).
	Export cable installation methods	Three approaches: pre-lay trenching, simultaneous lay and bury, or post-lay burial. Most common methods are mechanical or jet plowing. Additional options include mechanical cutter, jet trencher, controlled flow excavator, vertical injection, suction hopper dredging, precision installation (using a remotely operated vehicle/diver), horizontal directional drilling (HDD), direct piping, open-cut trenching, and jack-and-bore.
	Cable protection types	Rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers.

[1] Spacing for OCS-A 0544 would be informed by lease stipulations, which require either two common lines of orientation or a 2-nautical mile setback from the neighboring Lease Area OCS-A 0512. For the purposes of analysis, two common lines of orientation based on the proposed spacing in the COP for OCS-A 0512 were assumed, resulting in a spacing of approximately 0.68 x 0.68 nautical miles for OCS-A 0544 only.
[2] All elevations are provided relative to mean sea level.
[3] Number of OSSs includes substation platforms as well as other types of offshore platforms, such as booster stations, or a separate offshore platform that may be used to comply with New York State Energy Research and Development Authority's, meshed ready requirements or New Jersey Board of Public Utilities' offshore transmission network. Transmission infrastructure may be developed, owned, and operated by either a transmission developer or a lessee. Please refer to Appendix B, *Supplemental Information*, for additional information on transmission infrastructure development efforts in NJ and NY.
[4] Cable protection is anticipated to only a portion of the total export cable length, depending on site-specific factors.

ES.4.3 Alternative C – Proposed Action, Identification of AMMM Measures at the Programmatic Stage

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. These measures may be required as conditions of approval for activities by NY Bight lessees in their COPs through the COP review and approval process. Appendix G (Table G-1) identifies the AMMM measures that make up the Proposed Action. Most of the AMMM measures included in Appendix G have been previously applied as terms and conditions of approval for COPs proposing offshore wind activities on the Atlantic OCS or through related consultations, while a smaller number of measures have not previously been required. Alternative C consists of two sub-alternatives:

- **Sub-alternative C1: Previously Applied AMMM Measures.** Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations. The analysis for Sub-alternative C1 is presented as the change in impacts from those discussed under Alternative B.
- **Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures.** Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied. Therefore under this alternative, the analysis is presented as the change in impacts from those discussed under Sub-alternative C1.

Other than the identification of AMMM measures, all design parameters for Alternative C would be the same as described under Alternative B for project components and activities to be undertaken for construction and installation, operations and maintenance (O&M), and conceptual decommissioning. AMMM measures identified under Sub-alternative C1 and Sub-alternative C2 are being analyzed in this PEIS for one NY Bight project and the impacts of a full build-out of six NY Bight projects in the NY Bight area.

ES.4.4 Preferred Alternative

BOEM has identified Sub-alternative C1 as the preferred alternative in the Final PEIS. The preferred alternative is identified to let the public know which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected for action when a ROD is issued. No Final agency action is being taken by the identification of the preferred alternative in the Final PEIS, and BOEM is not obligated to select the preferred alternative.

ES.5 Environmental Impacts

This Final PEIS uses a four-level classification scheme to characterize the potential beneficial impacts and adverse impacts of alternatives as either **negligible**, **minor**, **moderate**, or **major**. Resource-specific adverse impact level definitions are presented in each Chapter 3 resource section. Section 3.3.2 in Chapter 3 defines potential beneficial impact levels across all resources.

BOEM analyzes the impacts of past and ongoing activities in the absence of the NY Bight projects as the No Action Alternative. The No Action Alternative serves as the existing baseline against which all action alternatives are evaluated. Under the No Action Alternative, the environmental and socioeconomic impacts and benefits of the action alternatives would not occur. BOEM also separately analyzes cumulative impacts of the No Action Alternative, which considers all other ongoing and reasonably foreseeable future activities described in Appendix D. In this analysis, the cumulative impacts of the No Action Alternative serve as the baseline against which the cumulative impacts of all action alternatives are evaluated. Table ES-2 summarizes the impacts of each alternative and the cumulative impacts of each alternative; refer to the Chapter 3 resource sections for additional analysis supporting these impact determinations.

Table ES-2. Summary and comparison of impacts among alternatives

Resource	Alternative A – No Action Alternative	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
3.4.1 Air Quality and Greenhouse Gas Emissions				
Alternative Impacts	Moderate	One Project and Six Projects: Minor to moderate; minor beneficial	One Project and Six Projects: Minor to moderate; minor beneficial	One Project and Six Projects: Minor to moderate; minor beneficial
Cumulative Impacts	Moderate; minor to moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial	Moderate; moderate beneficial
3.4.2 Water Quality				
Alternative Impacts	Negligible to minor	One Project and Six Projects: Negligible to minor, with exception of a large accidental release, which could result in a moderate impact	One Project and Six Projects: Negligible to minor, with exception of a large accidental release, which could result in a moderate impact	One Project and Six Projects: Negligible to minor, with exception of a large accidental release, which could result in a moderate impact
Cumulative Impacts	Negligible to minor, with exception of a large accidental release, which could result in a moderate impact	Negligible to minor, with exception of a large accidental release, which could result in a moderate impact	Negligible to minor, with exception of a large accidental release, which could result in a moderate impact	Negligible to minor, with exception of a large accidental release, which could result in a moderate impact
3.5.1 Bats				
Alternative Impacts	Negligible	One Project and Six Projects: Negligible to minor	One Project and Six Projects: Negligible to minor	One Project and Six Projects: Negligible to minor
Cumulative Impacts	Negligible to minor	Negligible to minor	Negligible to minor	Negligible to minor
3.5.2 Benthic Resources				
Alternative Impacts	Negligible to minor	One Project: Negligible to moderate; moderate beneficial Six Projects: Negligible to major; moderate beneficial	One Project: Negligible to moderate; moderate beneficial Six Projects: Negligible to moderate; moderate beneficial	One Project: Negligible to moderate; moderate beneficial Six Projects: Negligible to moderate; moderate beneficial
Cumulative Impacts	Negligible to moderate; minor beneficial	Negligible to major; moderate beneficial	Negligible to major; moderate beneficial	Negligible to major; moderate beneficial

Resource	Alternative A – No Action Alternative	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
3.5.3 Birds				
Alternative Impacts	Negligible to minor	One Project and Six Projects: Negligible to moderate; minor to moderate beneficial	One Project and Six Projects: Negligible to moderate; minor to moderate beneficial	One Project and Six Projects: Negligible to moderate; minor to moderate beneficial
Cumulative Impacts	Negligible to moderate; minor to moderate beneficial	Negligible to moderate; minor to moderate beneficial	Negligible to moderate; minor to moderate beneficial	Negligible to moderate; minor to moderate beneficial
3.5.4 Coastal Habitat and Fauna				
Alternative Impacts	Negligible to moderate	One Project and Six Projects: Negligible to minor	One Project and Six Projects: Negligible to minor	One Project and Six Projects: Negligible to minor
Cumulative Impacts	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.5.5 Finfish, Invertebrates, and Essential Fish Habitat				
Alternative Impacts	Negligible to moderate	One Project: Negligible to moderate; minor beneficial Six Projects: Negligible to major; minor to moderate beneficial	One Project: Negligible to minor; minor beneficial Six Projects: Negligible to moderate; minor to moderate beneficial	One Project: Negligible to minor; minor beneficial Six Projects: Negligible to moderate; minor to moderate beneficial
Cumulative Impacts	Negligible to moderate	Negligible to major; minor to moderate beneficial	Negligible to major; minor to moderate beneficial	Negligible to major; minor to moderate beneficial
3.5.6 Marine Mammals				
Alternative Impacts	Negligible to moderate for mysticetes (except North Atlantic right whale [NARW]), odontocetes, and pinnipeds; negligible to major impacts for NARW; minor beneficial for odontocetes and pinnipeds	One Project and Six Projects: Negligible to moderate for mysticetes (except NARW), odontocetes, and pinnipeds; negligible to major for NARW; minor beneficial for odontocetes and pinnipeds	One Project: Negligible to moderate for mysticetes (except NARW), odontocetes, and pinnipeds; negligible to minor for NARW; minor beneficial for odontocetes and pinnipeds. Six Projects: Negligible to moderate for all marine mammals (including NARW); minor beneficial for odontocetes and pinnipeds	One Project: Negligible to minor for all marine mammals (including NARW); minor beneficial for odontocetes and pinnipeds. Six Projects: Negligible to moderate for all marine mammals (including NARW); minor beneficial for odontocetes and pinnipeds

Resource	Alternative A – No Action Alternative	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
Cumulative Impacts	Negligible to moderate for mysticetes (except NARW), odontocetes, and pinnipeds; negligible to major for NARW; minor beneficial for odontocetes and pinnipeds	Negligible to moderate for mysticetes (except NARW), odontocetes, and pinnipeds; negligible to major for NARW; minor beneficial for odontocetes and pinnipeds	Negligible to moderate for mysticetes (except NARW), odontocetes, and pinnipeds; negligible to major for NARW; minor beneficial odontocetes and pinnipeds	Negligible to moderate for mysticetes (except NARW), odontocetes, and pinnipeds; negligible to major for NARW: minor beneficial odontocetes and pinnipeds
3.5.7 Sea Turtles				
Alternative Impacts	Negligible to moderate	One Project and Six Projects: Negligible to moderate; minor beneficial	One Project and Six Projects: Negligible to moderate; minor beneficial	One Project and Six Projects: Negligible to moderate; minor beneficial
Cumulative Impacts	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial	Negligible to moderate; minor beneficial
3.5.8 Wetlands				
Alternative Impacts	Negligible to moderate	One Project and Six Projects: Negligible to moderate	One Project and Six Projects: Negligible to moderate	One Project and Six Projects: Negligible to moderate
Cumulative Impacts	Negligible to moderate	Negligible to moderate	Negligible to moderate	Negligible to moderate
3.6.1 Commercial Fisheries and For-Hire Recreational Fishing				
Alternative Impacts	Negligible to major on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	One Project and Six Projects: Negligible to major on commercial fisheries and for-hire recreational fishing; minor to moderate beneficial on for-hire recreational fishing	One Project and Six Projects: Negligible to moderate on commercial fisheries and for-hire recreational fishing; minor to moderate beneficial on for-hire recreational fishing	One Project and Six Projects: Negligible to moderate on commercial fisheries and for-hire recreational fishing; minor to moderate beneficial on for-hire recreational fishing
Cumulative Impacts	Negligible to major on commercial fisheries and for-hire recreational fishing; minor beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and for-hire recreational fishing; moderate beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and for-hire recreational fishing; moderate beneficial on for-hire recreational fishing	Negligible to major on commercial fisheries and for-hire recreational fishing; moderate beneficial on for-hire recreational fishing

Resource	Alternative A – No Action Alternative	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
3.6.2 Cultural Resources				
Alternative Impacts	Minor to major	One Project: Moderate to major Six Projects: Major	One Project: Moderate to major Six Projects: Major	One Project: Moderate to major Six Projects: Major
Cumulative Impacts	Major	Major	Major	Major
3.6.3 Demographics, Employment, and Economics				
Alternative Impacts	Negligible to minor	One Project and Six Projects: Negligible to minor; minor beneficial	One Project and Six Projects: Negligible to minor; minor beneficial	One Project and Six Projects: Negligible to minor; minor beneficial
Cumulative Impacts	Negligible to minor; minor beneficial	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial	Negligible to minor; moderate beneficial
3.6.4 Environmental Justice				
Alternative Impacts	Negligible to moderate	One Project and Six Projects: Negligible to major; moderate beneficial	One Project and Six Projects: Negligible to major; moderate beneficial	One Project and Six Projects: Negligible to moderate; moderate beneficial
Cumulative Impacts	Negligible to moderate; minor beneficial	Negligible to major; minor to moderate beneficial	Negligible to major; minor to moderate beneficial	Negligible to moderate; minor to moderate beneficial
3.6.5 Land Use and Coastal Infrastructure				
Alternative Impacts	Minor	One Project: Minor; minor beneficial Six Projects: Moderate; minor beneficial	One Project: Minor; minor beneficial Six Projects: Moderate; minor beneficial	One Project: Minor; minor beneficial Six Projects: Moderate; minor beneficial
Cumulative Impacts	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial	Moderate; minor beneficial
3.6.6 Navigation and Vessel Traffic				
Alternative Impacts	Moderate	One Project and Six Projects: Major	One Project and Six Projects: Major	One Project and Six Projects: Major
Cumulative Impacts	Moderate	Major	Major	Major

Resource	Alternative A – No Action Alternative	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)				
Alternative Impacts	Negligible for marine mineral extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems; major for NOAA's scientific research and surveys	One Project and Six Projects: Minor for aviation and air traffic, cables and pipelines, and most military and national security use; moderate for U.S. Coast Guard (USCG) Search and Rescue (SAR) operations, marine mineral extraction, and radar systems; major for scientific research and surveys	One Project and Six Projects: Minor for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; moderate for USCG SAR operations and marine mineral extraction; and major for scientific research and surveys	One Project and Six Projects: Minor for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; moderate for USCG SAR operations; and major for scientific research and surveys. For marine mineral extraction, AMMM measures applied to one NY Bight project would result in minor impacts; impacts for six NY Bight projects would remain moderate.
Cumulative Impacts	Minor for aviation and air traffic, cables and pipelines, and most national security and military uses; moderate for marine mineral extraction, radar systems and USCG SAR operations; major for scientific research and surveys	Minor for aviation and air traffic, cables and pipelines, and most military and national security use; moderate for USCG SAR operations, marine mineral extraction, and radar systems; major for scientific research and surveys	Minor for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; moderate for USCG SAR operations and marine mineral extraction; and major for scientific research and surveys	Minor for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; moderate for marine mineral extraction and USCG SAR operations; and major for scientific research and surveys
3.6.8 Recreation and Tourism				
Alternative Impacts	Negligible to minor	One Project: Negligible to minor, minor beneficial Six Projects: Minor to moderate; minor beneficial	One Project: Negligible to minor, minor beneficial Six Projects: Minor to moderate; minor beneficial	One Project: Negligible to minor, minor beneficial Six Projects: Minor to moderate; minor beneficial
Cumulative Impacts	Negligible to minor, minor beneficial	Minor to moderate, minor beneficial	Negligible to moderate, minor beneficial	Negligible to moderate, minor beneficial

Resource	Alternative A – No Action Alternative	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
3.6.9 Scenic and Visual Resources				
Alternative Impacts	Negligible to major	One Project and Six Projects: Negligible to major	One Project and Six Projects: Negligible to major	One Project and Six Projects: Negligible to major
Cumulative Impacts	Negligible to major	Negligible to major	Negligible to major	Negligible to major

Impact rating colors are as follows: orange = major; yellow = moderate; green = minor; light green = negligible. All impact levels are assumed to be adverse unless otherwise specified as beneficial. Where impacts are presented as multiple levels, the color representing the most adverse level of impact has been applied.

Chapter 1

Introduction

1.1 Overview

This Final Programmatic Environmental Impact Statement (PEIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from development activities for six commercial wind energy leases in an area offshore New York and New Jersey known as the New York Bight (NY Bight), as well as the change in those impacts with avoidance, minimization, mitigation, and monitoring (AMMM) measures. The six commercial leases analyzed in this Final PEIS are OCS-A 0537, 0538, 0539, 0541, 0542, and 0544 (hereafter referred to as the NY Bight leases or NY Bight lease areas), totaling over 488,000 acres (Figure 1-1), which were issued by the Bureau of Ocean Energy Management (BOEM) on May 1, 2022. Each leaseholder is likely to submit at least one Construction and Operations Plan (COP) as required under 30 Code of Federal Regulations (CFR) 585.600(a). Following submission of the COPs, BOEM and other relevant agencies will conduct project-specific environmental analyses and consultations. The programmatic analysis in this Final PEIS follows the execution of the six NY Bight leases and precedes the environmental analysis of the COPs. This Final PEIS will not result in the approval of any activities. The PEIS serves as a first-tier document that the second-tier project-specific environmental analysis of each COP may tier from or incorporate by reference (40 CFR 1501.11-12).

BOEM has prepared this Final PEIS to (1) identify and analyze AMMM measures that could avoid, minimize, mitigate, and monitor impacts on the resources in the six NY Bight lease areas and (2) focus future project-specific environmental analyses. This Final PEIS evaluates the potential impacts from anticipated wind energy development within the NY Bight lease areas to inform BOEM in identifying AMMM measures that BOEM may require as conditions of approval for activities proposed by lessees in COPs. This Final PEIS will also facilitate the timely review of COPs submitted for the NY Bight lease areas by focusing the project-specific environmental analysis on project impacts not considered in the PEIS or those impacts that warrant further consideration. The project-specific analyses will occur after this PEIS is issued and may tier from or incorporate by reference this PEIS and could also incorporate revised, additional, or different AMMM measures as needed. This PEIS does not, by itself, impose any mitigation measures on future COPs. The decision on which measures may be included as terms or conditions of COP approval comes after COP-specific environmental analysis. This PEIS is thus not the consummation of the agency's decision-making for these measures as applied to specific COPs.

This Final PEIS was prepared following the requirements of the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321 et seq.) and implementing regulations (40 CFR parts 1500–1508). Additionally, this Final PEIS was prepared consistent with the U.S. Department of the Interior's NEPA regulations (43 CFR part 46), longstanding federal judicial and regulatory interpretations, and Administration priorities and policies.

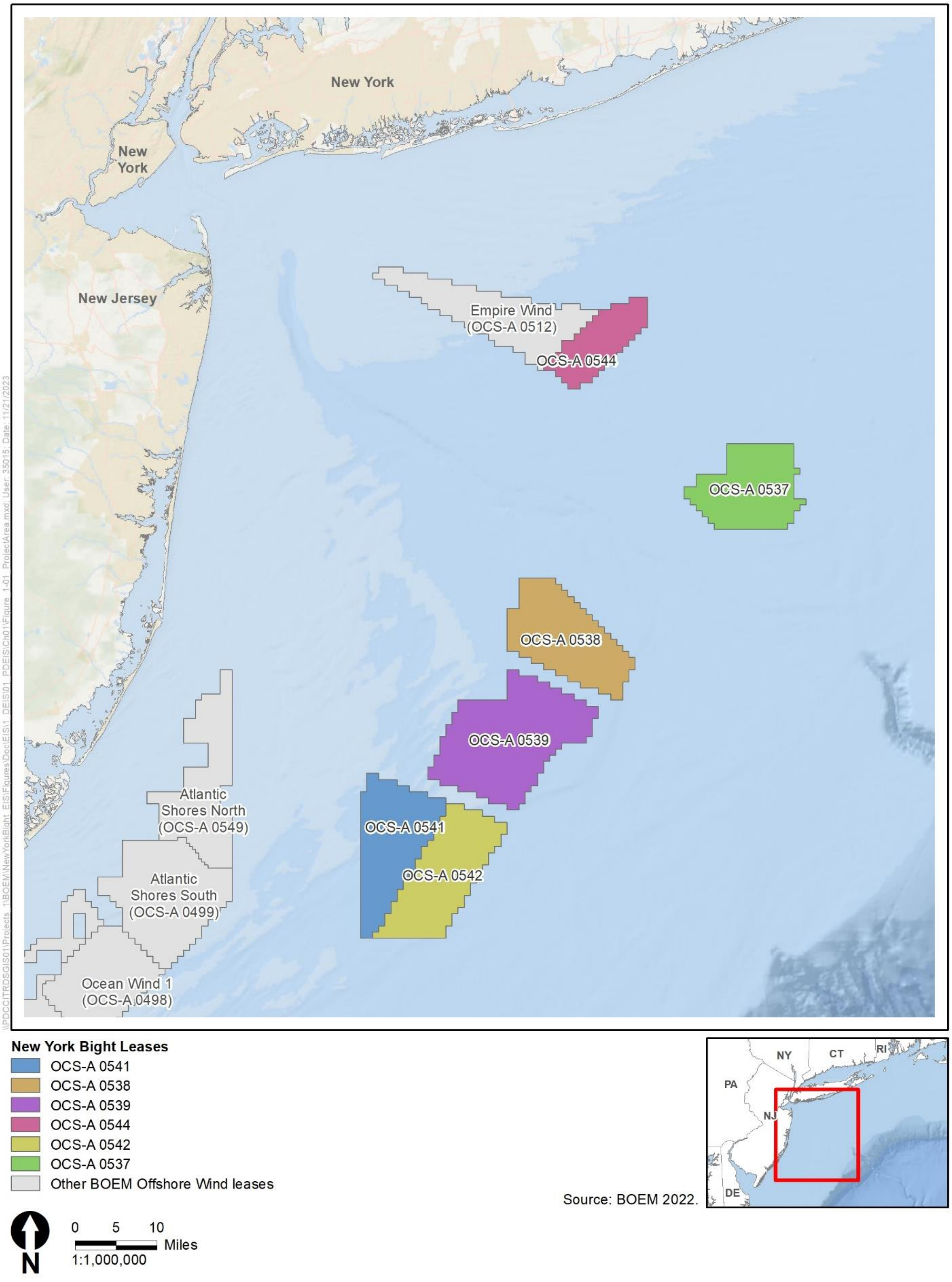

Figure 1-1. NY Bight lease areas

1.2 Background

In 2009, the U.S. Department of the Interior announced final regulations for the Outer Continental Shelf (OCS) Renewable Energy Program, which was authorized by the Energy Policy Act of 2005. The Energy Policy Act provisions implemented by BOEM provide a framework for issuing renewable energy leases, easements, and rights-of-way (ROWs) for OCS activities (see Section 1.4, *Regulatory Overview*). BOEM's renewable energy program occurs in four distinct phases: (1) regional planning and analysis, (2) lease issuance, (3) site assessment, and (4) construction and operations. The history of BOEM's planning and leasing activities within the NY Bight is summarized in Table 1-1.

On May 1, 2022, through a competitive leasing process under 30 CFR 585.211, BOEM awarded Commercial Leases OCS-A 0537, 0538, 0539, 0541, 0542, and 0544 in the NY Bight area (Figure 1-1). The leases grant the lessees the exclusive right to submit COPs to BOEM proposing the construction, operation, and conceptual decommissioning of offshore wind energy facilities in the lease areas. The leases include stipulations designed to mitigate potential environmental impacts from site assessment and site characterization, including requirements to comply with Project Design Criteria (PDC) and Best Management Practices (BMPs) resulting from programmatic consultations under the Endangered Species Act (ESA), as well as requirements consistent with BOEM's Programmatic Agreement under Section 106 of the National Historic Preservation Act (NHPA).[1] Through an intergovernmental renewable energy task force that included the States of New York and New Jersey and numerous federal agencies, Tribal Nations, and local governments, BOEM identified these lease areas for consideration in development of commercial-scale offshore wind energy projects, subject to the appropriate reviews and approvals.

Table 1-1. History of BOEM planning and leasing activities in the NY Bight

Year	Milestone
2016	On December 30, 2016, BOEM received an unsolicited lease request from PNE Wind USA, Inc. for 40,920 acres (16,560 hectares) offshore New York. The proposal included the installation of up to fifty 8–10 megawatt (MW) wind turbines, yielding a potential 400 MW of wind energy generation.
2017	In October 2017, New York State submitted to BOEM their *Area for Consideration for the Potential Locating of Offshore Wind Energy Areas,* which included recommendations for areas to be considered for wind energy development offshore of New York.
2018	On April 11, 2018, BOEM published a Call for Information and Nominations (Call) to obtain nominations from companies interested in commercial wind energy leases within the proposed area in the NY Bight (83 *Federal Register* 15602). The public comment period closed on July 30, 2018. In response to the Call, BOEM received eight nominations from developers for specific portions of the call area for which they wished to obtain a commercial lease.
2021	In March 2021, BOEM identified nearly 800,000 acres (323,750 hectares) as Wind Energy Areas (WEAs) in the NY Bight. The WEAs were identified in offshore locations that appeared the most

[1] Several AMMM measures included in Appendix G are similar to PDCs and BMPs resulting from the ESA consultations that apply to site characterization and site assessment at the leasing stage (e.g., PDCs and BMPs for Atlantic Data Collection (boem.gov)). These AMMM measures are meant to ensure the continued application of the existing PDCs and BMPs, with edits incorporated to promote clarity and to ensure consistency with construction and operations requirements.

Year	Milestone
	suitable for wind energy development, taking into consideration coexistence with other ocean users. BOEM received input from the public and other governmental agencies through the Call and Intergovernmental Renewable Energy Task Force meetings as part of the process.
2021	On March 29, 2021, BOEM released a Notice to Stakeholders announcing its intent to prepare an Environmental Assessment (EA) for commercial wind leasing and site assessment activities within the Call Area.
2021	On June 14, 2021, BOEM published a Proposed Sale Notice (PSN) for Commercial Leasing for Wind Power on the Outer Continental Shelf in the New York Bight (86 *Federal Register* 31524).
2021	On August 10, 2021, BOEM announced the availability of a Draft EA that assesses the potential impacts of the issuance of commercial and research leases within the identified WEAs of the NY Bight area and granting of rights-of-way and rights-of-use and easement in the region. The availability of the Draft EA initiated a 30-day public comment period that was subsequently extended to September 23, 2021.
2021	On December 16, 2021, BOEM announced the availability of a Final EA. Within the EA, BOEM issued a "Finding of No Significant Impact," which concluded that the issuance of up to 10 commercial and research leases within the WEA and granting rights-of-way and rights-of-use and easement in the region, to provide lessees the exclusive right to submit plans to assess the physical characteristics of the areas and to perform site characterization and assessment activities, would not significantly affect the environment (BOEM 2021).
2022	On January 14, 2022, BOEM published the Final Sale Notice for the sale of six lease areas in the NY Bight area (87 *Federal Register* 2446). In response to comments received on the PSN and consultation with federal agencies, the originally proposed lease areas were rotated and reduced in size to address ocean user conflicts. Additionally, one lease area identified in the PSN was removed in response to issues raised by the fishing industry and Department of Defense, resulting in six lease areas being included in the Final Sale Notice.
2022	On February 23, 2022, BOEM held an offshore wind auction for six lease areas in the NY Bight. Bluepoint Wind, LLC[2] was the winner of Lease Area OCS-A 0537; Attentive Energy LLC was the winner of Lease Area OCS-A 0538; Community Offshore Wind, LLC[3] was the winner of Lease Area OCS-A 0539; Atlantic Shores Offshore Wind Bight, LLC was the winner of Lease Area OCS-A 0541; Invenergy Wind Offshore LLC was the winner of Lease Area OCS-A 0542; and Vineyard Mid-Atlantic LLC[4] was the winner of Lease Area OCS-A 0544.
2022	On July 15, 2022, BOEM published a Notice of Intent (NOI) to prepare a PEIS for the six NY Bight lease areas.
2024	On January 12, 2024, BOEM published a Notice of Availability (NOA) for a Draft PEIS, initiating a 45-day public comment period for the Draft PEIS that was subsequently extended to March 13, 2024.
2024	On October 25, 2024, BOEM published an NOA for a Final PEIS initiating a minimum 30-day mandatory waiting period, during which BOEM is required to pause before issuing a Record of Decision.

1.3 Purpose of and Need for the Proposed Action

The Proposed Action (Alternative C) for the Final PEIS is the identification of AMMM measures at the programmatic stage that could avoid, minimize, mitigate, and monitor impacts. BOEM may require some or all of these measures as conditions of approval for activities proposed by lessees in COPs submitted

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[2] Name changed after lease issuance from OW Ocean Winds East, LLC to Bluepoint Wind, LLC.

[3] Name changed after lease issuance from Bight Wind Holdings, LLC to Community Offshore Wind, LLC.

[4] Name changed after lease issuance from Mid-Atlantic Offshore Wind LLC to Vineyard Mid-Atlantic LLC.

for the six NY Bight lease areas. BOEM may require additional or different measures based on future, site-specific NEPA analysis or the parameters of specific COPs. BOEM may also modify the measures at the COP-specific NEPA stage to tailor them to the characteristics of the proposed project and the site(s) of proposed activities, and to ensure conformity with project-specific consultations and authorizations. These AMMM measures are considered programmatic insofar as they may be applied to COPs for the six NY Bight lease areas, not because they necessarily will apply to COPs under BOEM's renewable energy program outside of the NY Bight lease areas. The Final PEIS analyzes the potential impacts of development in the NY Bight area and how those impacts can be avoided, minimized, or mitigated by AMMM measures. However, the Proposed Action will not result in the approval of any activities.

The purpose of the Proposed Action is to describe issues, analyze degree of potential impacts, and identify, as appropriate, AMMM measures. BOEM is preparing this Final PEIS because of the close proximity of the six NY Bight lease areas; their similar level of development due to the leases being awarded from the same auction; the close timing of the anticipated COP submissions; and the high, near-term demand from the states of New York and New Jersey for electricity generated by offshore wind. This PEIS will reduce redundancies across COP-specific NEPA analyses, including very similar affected environments, impacts, and mitigation measures, and will allow for those documents to be focused on the project-specific impacts not considered in the PEIS or impacts that warrant further consideration. The Proposed Action is needed to help BOEM make timely decisions on COPs submitted for the six NY Bight lease areas. Timely decisions further the United States policy to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards (43 USC 1332(3)) and other requirements listed at 43 USC 1337(p)(4), including protection of the environment, among several other factors. Project-specific NEPA analysis for individual COPs could tier from or incorporate by reference this PEIS and could apply revised, additional, or different AMMM measures as needed. This PEIS does not, by itself, impose any mitigation measures on future COPs. This PEIS is thus not the consummation of the agency's decision-making for these measures as applied to specific COPs. BOEM intends to use AMMM measures identified at the programmatic stage to inform the selection of appropriate AMMM measures at the COP decision stage. That is, the Record of Decision (ROD) for each COP NEPA document may rely on a combination of the analysis done in this PEIS and in the COP NEPA document to support the need for measures included as terms or conditions of approval.

A broader approach to the NEPA analysis for the minimum of six COPs expected for the NY Bight lease areas is consistent with Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," issued on January 27, 2021. In that order, President Biden stated that the policy of his administration is "to organize and deploy the full capacity of its agencies to combat the climate crisis to implement a Government-wide approach that reduces climate pollution in every sector of the economy; increases resilience to the impacts of climate change; protects public health; conserves our lands, waters, and biodiversity; delivers environmental justice; and spurs well-paying union jobs and economic growth, especially through innovation, commercialization, and deployment of clean energy technologies and infrastructure." To support the goals outlined in Executive Order 14008, the administration has also announced plans to increase renewable energy production, with a goal of 30 gigawatts (GW) of offshore wind energy capacity by 2030.

Development of the leaseholds would assist with meeting several state mandates for renewable energy. New Jersey's goal of 11 GW of offshore wind energy generation by 2040 is outlined in New Jersey Executive Order No. 307, issued on September 21, 2022. New York's requirement of 9.0 GW of offshore wind energy generation by 2035 is outlined in the Climate Leadership and Community Protection Act, signed into law on July 18, 2019. Additionally, an estimated 16–19 GW of offshore wind energy may be necessary to ensure New York State achieves its Climate Act mandates (New York State Climate Action Council 2022). Based on a conservatively estimated power ratio of 3 megawatts per square kilometer, BOEM estimates that full development of leases in this area has the potential to create up to 5.6 to 7 GW of offshore wind energy.[5]

Through the development of this Final PEIS, BOEM is addressing the following objectives:

- Analyzing potential impacts if development is authorized in the six NY Bight lease areas.
- Analyzing AMMM measures for the six NY Bight lease areas.
- Analyzing focused, regional cumulative effects.
- Tiering of project-specific environmental analyses.

The analysis in this PEIS was developed for integration with site-specific NEPA reviews. Project-specific analyses that tier from or incorporate by reference this PEIS will evaluate whether a project would have greater, equal, fewer, or different impacts than those that were analyzed in the PEIS by considering the level of action analyzed and the particularities of the site. Future COP-specific NEPA documents will focus on providing site- and project-specific analyses that were not already addressed by the PEIS. Refer to Appendix C, *Tiering Guidance*, for specific recommendations by resource topic regarding how the PEIS may be incorporated by reference in the future COP-specific NEPA documents; this appendix also identifies additional analysis that would likely be required as part of the COP-specific NEPA analysis once detailed and site-specific project information is available.

1.4 Regulatory Overview

The Energy Policy Act of 2005, Public Law 109-58, amended the Outer Continental Shelf Lands Act (OCSLA) (43 USC 1331 et seq.)[6] by adding a subsection 8(p), which authorizes the Secretary of the Interior to issue leases, easements, and ROWs in the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas," which include wind energy projects.

[5] New York Bight Final Sale Notice, December 21, 2021. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/ATLW-8-NY-Bight-Final-Lease-Sale-Decision-Memorandum.pdf.

[6] Public Law No. 109-58, Section 119 Stat. 594 (2005).

The Secretary delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing the authority for renewable energy leasing under the OCSLA (30 CFR 585) were promulgated on April 22, 2009.[7] These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove COPs submitted for lease areas within the NY Bight (30 CFR 585.628).

Subsection 8(p)(4) of OCSLA states: "[t]he Secretary shall ensure that any activity under [subsection 8(p)] is carried out in a manner that provides for –

(A) safety;
(B) protection of the environment;
(C) prevention of waste;
(D) conservation of the natural resources of the outer Continental Shelf;
(E) coordination with relevant Federal agencies;
(F) protection of national security interests of the United States;
(G) protection of correlative rights in the outer Continental Shelf;
(H) a fair return to the United States for any lease, easement, or right-of-way under this subsection;
(I) prevention of interference with reasonable uses (as determined by the Secretary) of the exclusive economic zone, the high seas, and the territorial seas;
(J) consideration of:
    (i) the location of, and any schedule relating to, a lease, easement, or right-of-way for an area of the outer Continental Shelf; and
    (ii) any other use of the sea or seabed, including use for a fishery, a sealane, a potential site of a deepwater port, or navigation;
(K) public notice and comment on any proposal submitted for a lease, easement, or right of-way under this subsection; and
(L) oversight, inspection, research, monitoring, and enforcement relating to a lease, easement, or right-of-way under this subsection."

As stated in M-Opinion 37067, *Secretary's Duties under Subsection 8(p)(4) of the Outer Continental Shelf Lands Act When Authorizing Activities on the Outer Continental Shelf*, ". . . subsection 8(p)(4) of the OCSLA imposes a general duty on the Secretary to act in a manner providing for the subsection's enumerated goals. The subsection does not require the Secretary to ensure that the goals are achieved to a particular degree, and [s]he retains wide discretion to determine the appropriate balance between two or more goals that conflict or are otherwise in tension."[8]

BOEM's evaluation of wind energy development is governed by various applicable federal statutes and implementing regulations. In conjunction with the Final PEIS, BOEM has undertaken programmatic consultations to comply with Section 7 of the ESA and Section 106 of the NHPA. Appendix A,

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[7] Renewable Energy and Alternate Uses of Existing Facilities on the Outer Continental Shelf, 74 *Federal Register* 19638–19871 (April 29, 2009).

[8] M-Opinion 37067 at page 5, http://doi.gov/sites/doi.gov/files/m-37067.pdf.

Consultation and Coordination, provides a description of BOEM's consultation efforts with Tribal Nations and federal, state, regional, local stakeholders during development of the Final PEIS.

BOEM is committed to continuing consultation with Tribal Nations during the future COP-specific environmental analyses under NEPA and Section 106 of the NHPA. For each COP, BOEM will invite Tribal Nations to participate as Cooperating Tribal Governments under NEPA and as Section 106 consulting parties.

1.5 Relevant Existing NEPA and Consulting Documents

The following NEPA documents were utilized to inform the preparation of this Final PEIS and are incorporated in their entirety by reference.

- Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, OCS EIS/EA MMS 2007-046 (MMS 2007).
    - This PEIS examined the potential environmental consequences of implementing the Alternative Energy and Alternate Use Program on the OCS and established initial measures to mitigate environmental consequences.
- Final Environmental Assessment for Commercial and Research Wind Lease and Grant Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf of the New York Bight, OCS EIS/EA BOEM 2021-073 (BOEM 2021).
    - This environmental assessment analyzed the issuance of leases and grants within the Wind Energy Areas in the NY Bight. The analysis focused on the effects of site characterization and site assessment activities that take place after the issuance of commercial and research wind energy leases.

Additional environmental studies conducted to support decisions concerning offshore wind energy development are available on BOEM's website: https://www.boem.gov/renewable-energy-research-completed-studies.

1.6 Programmatic Approach to the NEPA Process

This Final PEIS establishes a framework for subsequent environmental documents related to activities proposed by lessees in COPs for lease area specific actions and identifies and analyzes possible AMMM measures to be used across the NY Bight lease areas. This document analyzes a broad range of direct, indirect, and reasonably foreseeable environmental impacts associated with offshore wind development within the NY Bight lease areas, in addition to other past, present, and reasonably foreseeable future offshore wind and non-offshore-wind projects in the NY Bight. This Final PEIS will not result in the approval or authorization of development of offshore wind infrastructure at any of the lease areas within the NY Bight. The PEIS was initiated shortly after leases were awarded and precedes the environmental review of the COPs. Figure 1-2 shows the timing of the PEIS relative to BOEM's renewable energy process for a typical OCS lease.

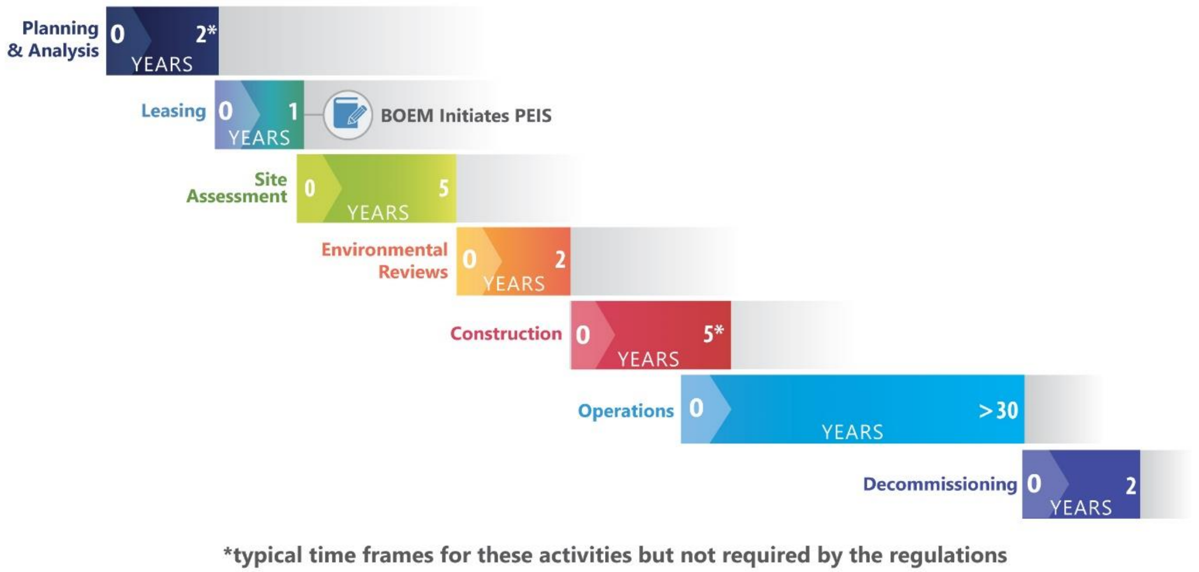

Figure 1-2. Renewable energy process: planning to decommissioning

The level of detail included in the Final PEIS may vary across resources, and, in some sections, impacts may be described as hypothetical. For example, effects may be described in terms of what impacts would be expected if specific types of activities were to occur. The impacts of site-specific actions, along with further analysis of actions described as hypothetical in the Final PEIS, will be addressed when specific information about development activities is known in subsequent COP-specific NEPA evaluations tiering from this Final PEIS. CEQ NEPA implementing regulations at 40 CFR 1501.11 enable agencies to tier NEPA analyses when it would eliminate repetitive discussions of the same issues, focus on the actual issues ripe for discussion, and exclude from consideration issues already decided.

1.7 Methodology for Assessing the Representative Project Design Envelope

A Project Design Envelope (PDE) allows lessees to define and bracket proposed characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of components such as wind turbine generators (WTGs), foundations, submarine cables, and offshore substations (OSSs). Because the analysis in this Final PEIS was prepared before any NY Bight COPs were submitted, BOEM developed a Representative Project Design Envelope (RPDE) to use for environmental analysis. The RPDE is a range of technical parameters that describe a wind energy project that could occur in any of the six NY Bight lease areas. Most parameters contain a minimum and maximum value or multiple options that could be selected to provide bounds for the analysis. To develop an RPDE that reflects realistic project technical details specific to the NY Bight, BOEM mined existing COPs and solicited input from the NY Bight lessees, American Clean Power, National Renewable

Energy Laboratory, and the States of New York and New Jersey. The RPDE is not meant to represent a specific lease area. Rather, it is an informed range of parameters to describe a hypothetical project within the six NY Bight lease areas to help guide environmental analysis in this Final PEIS and focus subsequent COP NEPA analysis. In general, the maximum values in the RPDE represent the maximum scenario of development that could occur in any of the six NY Bight lease areas. For example, it is not expected that any of the NY Bight lease areas would contain more than 280 WTGs, which is the upper end of the RPDE. Additionally, the RPDE is not meant to be prescriptive or to establish limits for future development, as new and emerging offshore wind technologies that have not yet been proposed in existing COPs or analyzed in the RPDE may be part of the development scenario for the NY Bight lease areas.

This Final PEIS assesses the impacts of the RPDE that are described in Chapter 2, *Alternatives*, by using the "maximum-case scenario" process. The maximum-case scenario is composed of each design parameter or combination of parameters that could result in the highest impact level for each physical, biological, socioeconomic, and cultural resource. This Final PEIS evaluates potential impacts of the Proposed Action and alternative using the maximum-case scenario to assess the design parameters or combination of parameters for each environmental resource. This Final PEIS considers the interrelationship between aspects of the RPDE rather than simply viewing each design parameter independently. Certain resources may have multiple maximum-case scenarios, and the most impactful design parameters may not be the same for all resources. Chapter 2 includes a table outlining the RPDE design parameters.

The RPDE, resulting environmental analysis, and Final PEIS are meant to inform subsequent project-specific COP NEPA analyses expected from the six NY Bight lease areas. BOEM is required to complete additional NEPA analysis for each of the NY Bight projects prior to approving, approving with modifications, or disapproving each project-specific COP. BOEM will evaluate each COP received and determine which parts of the PEIS may be incorporated by reference and the additional level of analysis needed for each COP-specific NEPA document, which will be based in part on whether the proposed project is similar to the range of parameters analyzed in the Final PEIS.

1.8 Methodology for Assessing Impacts

This Final PEIS assesses the impacts from both a single representative project that could be developed within any one of the NY Bight lease areas and from the totality of six projects within the NY Bight lease areas. BOEM intends for the analysis of a single representative offshore wind project (which is representative of a future project within any of the six NY Bight lease areas) to be used for tiering and incorporation by reference for each future COP-specific NEPA document. By analyzing one project in the PEIS, BOEM provides a similar analysis to what would be analyzed in a COP-specific NEPA document. The analysis of six representative offshore wind projects (corresponding to the six NY Bight lease areas) provides a format for evaluating comprehensive cumulative impacts by examining offshore wind activities within the NY Bight area as a whole. This PEIS assumes that full buildout of one NY Bight lease area is the same as one NY Bight project and is the most impactful development scenario. While lessees may elect a phased development approach resulting in more than one project per lease area, this PEIS analyzes the most impactful development scenario that could occur per lease area.

In addition to analyzing impacts from one NY Bight project and six NY Bight projects, the PEIS examines the impacts from past, present (ongoing), and reasonably foreseeable future (planned) actions that could contribute to cumulative impacts when combined with impacts from the Proposed Action and alternative. Ongoing and planned actions and environmental stressors occurring within the geographic analysis area include (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) dredging and port improvement projects; (5) marine minerals use and ocean-dredged material disposal; (6) military use; (7) marine transportation; (8) fisheries use, management, and monitoring surveys; (9) global climate change; (10) oil and gas activities; and (11) onshore development activities. Appendix D, *Planned Activities Scenario*, describes the past and ongoing actions that BOEM has identified as potentially contributing to the existing baseline, and the planned actions potentially contributing to cumulative impacts when combined with the impacts from the alternatives over the specified spatial and temporal scales.

1.8.1 Past and Ongoing Activities and Trends (Existing Baseline)

Each resource-specific *Environmental Consequences* section in Chapter 3, *Affected Environment and Environmental Consequences,* of this Final PEIS includes a description of the baseline conditions of the affected environment. The existing baseline considers past and present activities in the geographic analysis area, including those related to offshore wind projects with an approved COP (e.g., Vineyard Wind 1 [OCS-A 0501], South Fork Wind [OCS-A 0517], Ocean Wind 1 [OCS-A 0498],[9] Revolution Wind [OCS-A 0486], Empire Wind [OCS-A 0512],[10] Sunrise Wind [OCS-A 0487], New England Wind [OCS-A 0534], and Coastal Virginia Offshore Wind [CVOW]-Commercial [OCS-A 0483]) and approved past and ongoing site assessment surveys, as well as other non-wind activities (e.g., Navy military training, existing vessel traffic, climate change). The existing condition of resources as influenced by past and

[9] On October 31, 2023, Orsted publicly announced its decision to cease development of Ocean Wind 1 and Ocean Wind 2. However, Ocean Wind LLC (the lessee for Ocean Wind 1) has not withdrawn its COP for lease OCS-A 0498. Therefore, BOEM has analyzed the project within this Final PEIS as described in the approved COP. On February 29, 2024, pursuant to 30 CFR 585.418, BOEM approved a 2-year suspension of the operations term of Ocean Wind LLC's commercial lease (Renewable Energy Lease Number OCS-A 0498), lasting until February 28, 2026. This suspension was approved in response to the lessee's January 19, 2024, request for a suspension of the operations term for the lease, submitted pursuant to Section 8(p)(5) of the OCSLA, 43 USC 1337(p)(5) and BOEM's implementing regulations at 30 CFR 585.416. Orsted North America Inc. (the lessee for Ocean Wind 2) has not relinquished or reassigned lease OCS-A 0532; therefore, BOEM has analyzed development of the lease area in this Final PEIS consistent with the assumptions identified in Appendix D.

[10] In January 2024, Empire Offshore Wind, LLC (the lessee for Empire Wind 1 and 2) announced it was terminating the Offshore Wind Renewable Energy Certificate (OREC) Agreement for the Empire Wind 2 project. Empire Offshore Wind, LLC has not informed BOEM of any material changes to the activities approved in its COP. Therefore, BOEM has analyzed development of the lease area in this Final PEIS consistent with the assumptions identified in Appendix D.

ongoing activities and trends comprises the existing baseline condition for impact analysis. Other factors currently impacting the resource, including climate change, are also acknowledged for that resource and are included in the impact-level conclusion.

1.8.2 Planned Activities

It is reasonable to predict that future activities may occur over time and that, cumulatively, those activities could impact the existing baseline conditions discussed in Section 1.8.1. Cumulative impacts are analyzed and concluded separately in each resource-specific *Environmental Consequences* section in Chapter 3 of this Final PEIS. The baseline condition for the cumulative impact analysis consists of past and present activities (existing baseline) with the addition of future planned activities described in Appendix D. Planned offshore wind projects include projects for which a lease has been executed but no COP has been approved. The impacts of planned offshore wind projects are predicted using information from and assumptions based on COPs submitted to BOEM that are currently undergoing independent review.

1.9 Approach to Mitigation for the NY Bight Lease Areas

The Final PEIS analyzes the potential impacts of future offshore wind development in the NY Bight lease areas both with and without the AMMM measures listed in Appendix G, *Mitigation and Monitoring*. Structuring the analysis in this way allows for a comparison to the change in impacts with AMMM measures. BOEM's approach to mitigation is to first avoid potential impacts and then to mitigate unavoidable impacts such that the severity or duration of those impacts is minimized to the extent practicable. The Final PEIS takes a regional approach to the analysis of potential impacts by considering and evaluating a suite of AMMM measures that, if selected in whole or in part, could avoid or minimize impacts associated with the development of offshore wind in the NY Bight lease areas. Additionally, the Final PEIS includes a summary of Recommended Practices (RPs) for analysis in subsequent NEPA documents that may reduce impacts on that resource if implemented. These RPs were not analyzed as AMMM measures in the Final PEIS because they may not apply to all six lease areas, may depend on project-specific details that could not be analyzed in the Final PEIS, may be outside of BOEM's jurisdiction but have been routinely applied through previous consultations, or may need further development before application.

Even with AMMM measures and RPs, it is possible that development in the NY Bight lease areas would result in unavoidable adverse impacts. BOEM is exploring the inclusion of compensatory mitigation measures to address these specific and anticipated impacts that cannot be avoided or minimized by offshore wind energy development in the NY Bight lease areas. Compensatory mitigation is compensation or offsets for remaining unavoidable impacts after all appropriate and practicable avoidance and minimization measures have been applied, by replacing or providing substitute resources or environments through the restoration, establishment, enhancement, or preservation of resources and their values, services, and functions. Compensatory mitigation measures should offset as directly as possible the negative impacts (i.e., benefit the species or habitats suffering the residual effects). As of now, BOEM has identified compensatory mitigation to address residual impacts on fisheries and birds. For example, compensatory mitigation for piping plover and red knot has been applied as a term and condition of approval for the Empire Wind project offshore of New York. BOEM has not yet identified compensatory mitigation to address residual impacts from noise on the marine environment, but it continues to propose language and frameworks for employing the full mitigation hierarchy to reduce residual impacts on human-nature marine ecosystems.

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Chapter 2

Alternatives

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This chapter (1) describes the alternatives carried forward for detailed analysis in this Final PEIS, including the Proposed Action, No Action, and other action alternative; (2) describes the non-routine activities and events that could occur during construction, operations and maintenance (O&M), and conceptual decommissioning of offshore wind projects in the NY Bight area; and (3) presents a summary and comparison of impacts among alternatives and resources affected.

CEQ NEPA implementing regulations require the identification of a preferred alternative in the Final PEIS. BOEM has identified Sub-alternative C1 as the preferred alternative. The preferred alternative is identified to let the public know which alternative BOEM, as the lead agency, is leaning toward before an alternative is selected for action when a ROD is issued. No final agency action is being taken by the identification of the preferred alternative in the Final PEIS, and BOEM is not obligated to select the preferred alternative.

2.1 Alternatives Analyzed in Detail

Under NEPA, a reasonable range of alternatives framed by the purpose and need must be developed for analysis for any major federal action. The alternatives should be "reasonable," which the Department of the Interior has defined as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action" (43 CFR 46.420(b)). There should also be evidence that each alternative would avoid or substantially lessen one or more potential, specific, and significant socioeconomic or environmental effects. Alternatives that could not be implemented if they were chosen (for legal, economic or technical reasons) or do not resolve the need for action and fulfill the stated purpose in taking action to a large degree are not considered reasonable alternatives.

BOEM considered alternatives that were identified through coordination with cooperating and participating agencies, Cooperating Tribal Governments, and through public comments received during the public scoping period for the PEIS and the Draft PEIS comment period. The alternatives analyzed in detail were carried forward for analysis after being reviewed using BOEM's screening criteria presented in Section 2.2, *Alternatives Considered but Not Analyzed in Detail*. The alternatives carried forward for detailed analysis in this Final PEIS are summarized in Table 2-1 and described in detail in Sections 2.1.1 through 2.1.3. Alternatives considered but dismissed from detailed analysis and the rationale for their dismissal are described in Section 2.2.

Table 2-1. Alternatives analyzed in detail

Alternative	Description
Alternative A – No Action Alternative	Alternative A, the No Action Alternative, assumes that no offshore wind development would occur on any of the six NY Bight lease areas. Any potential environmental and socioeconomic impacts, including benefits, associated with offshore wind development of the six NY Bight lease areas as described under Alternative B or the AMMM measures as described under the Proposed Action, would not occur. The current resource conditions, trends, and impacts from ongoing activities under the No Action

Alternative	Description
	Alternative serve as the baseline against which the direct and indirect impacts of all action alternatives are evaluated. In the absence of the NY Bight projects, other reasonably foreseeable future impact-producing offshore wind and non-offshore-wind activities are expected to occur, which could cause changes to the existing baseline conditions. The continuation of all other ongoing and reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario,* without the NY Bight projects serves as the baseline for the evaluation of cumulative impacts.
Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Alternative B, No Identification of AMMM Measures at the Programmatic Stage, considers the potential impacts of future offshore wind development in the NY Bight lease areas without the AMMM measures identified in Appendix G that could avoid, minimize, mitigate, and monitor those impacts. Alternative B evaluates impacts of both a single NY Bight project and the full build-out of six NY Bight projects without the AMMM measures identified in Appendix G. However, the analysis in Alternative B assumes that development of the NY Bight projects would be required to comply with federal and international requirements. The analysis under Alternative B allows for a comparison to the change in impacts that could result with the AMMM measures analyzed under Alternative C.
Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage • Sub-alternative C1 (Preferred Alternative): Previously Applied AMMM Measures • Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures	Under Alternative C, the Proposed Action, BOEM would identify AMMM measures at the programmatic stage that could avoid, minimize, mitigate, and monitor impacts. Alternative C is further broken down into sub-alternatives, which evaluate impacts of a single NY Bight project with previously applied AMMM measures (C1) as well as previously applied and not previously applied AMMM measures (C2). These sub-alternatives also analyze the overall impacts of a full build-out of six NY Bight projects with AMMM measures.

2.1.1 Alternative A – No Action Alternative

Alternative A, the No Action Alternative, assumes that no offshore wind development occurs on any of the six NY Bight lease areas. Any potential environmental and socioeconomic impacts, including benefits, associated with the development of the NY Bight lease areas would not occur. However, all other existing or other reasonably foreseeable future activities described in Appendix D, *Planned Activities Scenario,* would continue. The current resource conditions, trends, and impacts from ongoing activities under the No Action Alternative serve as the baseline against which the direct and indirect impacts of all action alternatives are evaluated. Analysis of this alternative provides context for the analyses of Alternatives B and C and could be used for tiering for COP-specific NEPA analysis.

In the absence of the NY Bight projects, other reasonably foreseeable future impact-producing offshore wind and non-offshore-wind activities would be realized, which could cause changes to the existing baseline conditions. The continuation of all other existing and reasonably foreseeable future activities described in Appendix D without the NY Bight projects serves as the baseline for the evaluation of cumulative impacts.

2.1.2 Alternative B – No Identification of AMMM Measures at the Programmatic Stage

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. However, the analysis in Alternative B assumes that development of the NY Bight projects would be required to comply with federal and international requirements. Alternative B serves to compare how impacts would change with the AMMM measures analyzed in Alternative C. BOEM would not approve any projects at the COP NEPA stage without AMMM measures. Selection of Alternative B would mean that no measures are identified at the programmatic stage and that all measures in Appendix G may be re-assessed at the COP NEPA stage. To serve this comparative purpose, the analysis of Alternative B evaluates the impacts of (1) a single project developed in one NY Bight lease area without the AMMM measures identified in Appendix G, and (2) the overall impacts of a full build-out of six projects in the NY Bight lease areas without the AMMM measures in Appendix G. This PEIS assumes that full build-out of one NY Bight lease area is the same as one NY Bight project and is the most impactful development scenario. While lessees may elect a phased development approach resulting in more than one project per lease area, this PEIS analyzes the most impactful development scenario that could occur per lease area.

2.1.2.1 One Project

The analysis of one project under Alternative B assumes that one representative NY Bight project would be developed in one lease area and considers the potential impacts of that development on the environment. BOEM intends for the analysis of one project to be used for tiering and incorporation by reference at the COP-specific NEPA stage, including providing context that can be used in COP-specific NEPA analyses and against which proposed actions at the COP-specific stage may be compared. By analyzing one project in the PEIS, BOEM provides a similar analysis to what would be analyzed in a COP-specific NEPA document.

The analysis of Alternative B is based upon an RPDE developed with input from the six NY Bight lessees, American Clean Power, National Renewable Energy Laboratory, and the States of New York and New Jersey, as presented in Table 2-2 (refer to Section 1.7, *Methodology for Assessing the Representative Project Design Envelope,* for additional information regarding the development and use of the RPDE). The RPDE is not associated with any particular lease area and is instead representative of development that could occur associated with any of the six NY Bight lease areas. Additionally, the RPDE is not meant to be prescriptive or to establish limits for future development. The RPDE contains a minimum and maximum value for most parameters or multiple options that could be selected to provide bounds for the analysis. In general, the maximum values in the RPDE represent the maximum scenario of development that could occur in the NY Bight lease areas. For example, it is not expected that any of the NY Bight lease areas would contain more than 280 WTGs, which is the upper end of the RPDE.

Table 2-2. RPDE parameters for one representative NY Bight project

Element	Project Design Element	Typical Range
WTGs	Number of WTGs	50–280 turbines
	WTG spacing	WTGs would conform to a grid layout with a minimum spacing of 0.6 x 0.6 nautical miles (1.1 x 1.1 kilometers)[1]
	Turbine rotor diameter	721–1,214 feet (220–370 meters)
	Total turbine height[2]	853–1,312 feet (260–400 meters)
	WTG foundation type	Monopiles or piled jackets are most likely. Additional options include suction mono-bucket, suction bucket jacket, tri-suction pile caisson, and gravity-based structures.
	WTG seabed footprint, with scour protection (per foundation)	0.24 acre (0.10 hectare) (monopile) to 2.88 acres (1.7 hectare) (jacket foundation)
OSSs	Number and type of OSSs	1–5 OSSs[3] High voltage alternating current (HVAC) OSS and high voltage direct current (HVDC) converter OSS may be used.
	OSS foundation type	Monopiles or piled jackets are most likely. Additional options include suction bucket jackets and gravity-based structures.
	OSS seabed footprint, with scour protection (per foundation)	0.51 acre (0.21 hectare) (monopile) to 8.05 acres (3.26 hectares) (jacket foundation)
WTG and OSS Foundations	Foundation installation methods	Piled foundations (monopile and jacket): hydraulic impact hammering, vibratory hammering, water jetting, pile drilling, or a combination of methods. Other foundations: suction bucket and gravity-based installation.
	Scour protection types	Rock placement, mattress protection, sandbags, and stone bags.
Interarray Cables	Total interarray cable length	33–550 miles (53–885 kilometers)
	Interarray cable diameter	5–12 inches (13–30 centimeters)
	Interarray cable seabed disturbance (width)	66–131 feet (20–40 meters)
	Interarray cable burial depth	3–9.8 feet (0.9–3 meters) is the anticipated potential range of burial depth; 6 feet (1.8 meters) is the typical target burial depth. Depths may vary based on site-specific factors (e.g., soil type, cable/pipeline crossings)
	Interarray cable installation methods	Three approaches: pre-lay trenching, simultaneous lay and bury, or post-lay burial. Most common methods are mechanical or jet plowing. Additional options include jet trencher, precision installation (using a remotely operated vehicle/diver), mechanical cutter, controlled flow excavator, and vertical injection.
	Cable protection types	Rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers.

Element	Project Design Element	Typical Range
Export Cables	Number of export cables	1–9 export cables
	Total export cable length	30–929 miles (48–1,495 kilometers)
	Export cable voltage	220–420 kV HVAC 320–525 kV HVDC
	Export cable diameter	6.1–13.8 inches (15.5–35.1 centimeters) HVAC 6.3–16 inches (16–40.6 centimeters) HVDC
	Export cable seabed disturbance (width)	66–131 feet (20–40 meters), per cable including cable protection footprint[4]
	Export cable burial depth	3–19.6 feet (0.9–6 meters) is the anticipated potential range of burial depth; 6 feet (1.8 meters) is typical target burial depth. Depths may vary based on site-specific factors (e.g., soil type, cable/pipeline crossings, crossing of navigation channels or other federal civil work projects, and other federal or state requirements).
	Export cable installation methods	Three approaches: pre-lay trenching, simultaneous lay and bury, or post-lay burial. Most common methods are mechanical or jet plowing. Additional options include mechanical cutter, jet trencher, controlled flow excavator, vertical injection, suction hopper dredging, precision installation (using a remotely operated vehicle/diver), horizontal directional drilling (HDD), direct piping, open-cut trenching, and jack-and-bore.
	Cable protection types	Rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers.

[1] Spacing for OCS-A 0544 would be informed by lease stipulations, which require either two common lines of orientation or a 2-nautical mile setback from the neighboring Lease Area OCS-A 0512. For the purposes of analysis, two common lines of orientation based on the proposed spacing in the COP for OCS-A 0512 were assumed, resulting in a spacing of approximately 0.68 x 0.68 nautical miles for OCS-A 0544 only.

[2] All elevations are provided relative to mean sea level.

[3] Number of OSSs includes substation platforms as well as other types of offshore platforms, such as booster stations, or a separate offshore platform that may be used to comply with New York State Energy Research and Development Authority's meshed ready requirements or New Jersey Board of Public Utilities' offshore transmission network. Transmission infrastructure may be developed, owned, and operated by either a transmission developer or a lessee. Please refer to Appendix B, *Supplemental Information*, for additional information on transmission infrastructure development efforts in NJ and NY.

[4] Cable protection is anticipated to be limited to only a portion of the total export cable length, depending on site-specific factors.

The following subsections describe the construction and installation, O&M, and conceptual decommissioning of a single representative NY Bight project. The narrative is intended to provide an overview of the expected development of an offshore wind farm in the NY Bight area.

2.1.2.1.1 Construction and Installation

A NY Bight project would include the construction and installation of both onshore and offshore facilities. Construction and installation of a NY Bight project is anticipated to start between 2026 and 2030. Construction for offshore wind projects can take on average 3 to 5 years. The timing of construction is anticipated to vary for each NY Bight project and would be subject to vessel and supply chain availability.

Onshore Activities and Facilities

Proposed onshore elements of one NY Bight project include export cable landfall sites, sea-to-shore transition, onshore export cable routes, onshore substation or converter station, and connection to a point of interconnection (POI) (Figure 2-1). Because the analysis in this Final PEIS was prepared before any of the NY Bight COPs were submitted by lessees, actual locations of landfalls and onshore facilities are unknown at this time. Because the location of landfalls and onshore facilities are unknown, this Final PEIS describes the types of impacts from construction and operation of onshore components generally and largely defers the analysis of onshore components to the COP-specific NEPA documents. It should also be noted that onshore elements are included in BOEM's analysis in the Final PEIS to support the evaluation of a complete project and for future tiering; however, BOEM's authority extends only to the activities on the OCS.

The offshore export cable will come ashore at a landfall location (Figure 2-1). Multiple installation methods can be used to make the sea-to-shore transition including open cut (i.e., trenching) or trenchless methods such as horizontal directional drilling (HDD). HDD involves drilling bore holes for the cables between an entry point offshore and an onshore exit point at the landfall location, which allows the cables to remain buried below the beach, intertidal zone, or other environmentally sensitive areas. Open cut methods are typically used in situations where trenchless methods cannot be used due to conflicts with existing infrastructure, loose soil and sediment, or limited workspace. Open-cut methods require open-cut trenching and dredging or jetting to facilitate installation at target burial for approach to landside. Jetting uses pressurized water jets to create a trench within the seabed, where the export cable then sinks into the seabed or waterway as displaced sediment resettles and naturally backfills the trench. Dredging excavates or removes sediment, creating a channel to allow the cable to make landfall or transit across a waterway or wetland crossing at the target installation depth. Various dredging methods could be used, such as clamshell dredging, suction hopper dredging, or hydraulic dredging. Installation at landfall locations could also include pulling export cables through previously constructed conduits.

From the landfall location, onshore export cables would carry the electricity to the onshore substations or converter stations (Figure 2-1). Onshore export cables are typically buried in a trench and would typically follow existing rights-of-way where possible. The onshore substations transform and prepare the power received from the export cables to be connected into the existing grid at the POI. Projects with large nameplate capacity or that include long transmission lines carrying very large power capacities may choose to use HVDC instead of HVAC. If HVDC is used, an onshore HVDC converter station would be necessary to convert power from the onshore export cables to HVAC to allow interconnection to the existing transmission infrastructure. Typically, either an overhead connection or an underground transmission line with an overhead tie-line may be used from the onshore substation/converter station to a POI at a nearby facility. If HVAC is used, an HVAC booster station may be required along the export cable route to offset against power losses between the offshore wind farm and the grid.

The transmission POI is the location where the power generated by the offshore wind project is connected into the existing electrical grid. This can be done at new facilities constructed for the project or at existing facilities that have been modified to accommodate the interconnection of the offshore wind project. Examples of potential POIs in New York and New Jersey that could be used by the NY Bight projects are listed below. Other POIs may ultimately be chosen by the NY Bight lessees. Potential configurations of transmission grid interconnections between the NY Bight projects and the POIs are described in the *Transmission Interconnection Configurations* subsection.

Examples of potential onshore POIs for the NY Bight projects:

- New York - Rainey, Ruland Road, Gowanus, East Garden City, Freshkills, Port Jefferson, Farragut, Shore Road, Newbridge Road, Syosset, Northport, West 49th Street, Mott Haven, Brookhaven
- New Jersey – Ravenswood Generating Station, E.H. Werner, Larrabee Collector Station[1]

In New York and New Jersey, efforts are underway to develop transmission infrastructure that would allow multiple offshore wind projects to interconnect at an offshore (New York) and nearshore (New Jersey) point of interconnection. Appendix B, *Supplemental Information and Additional Figures and Tables*, provides additional detail regarding the transmission infrastructure development efforts in New York and New Jersey.

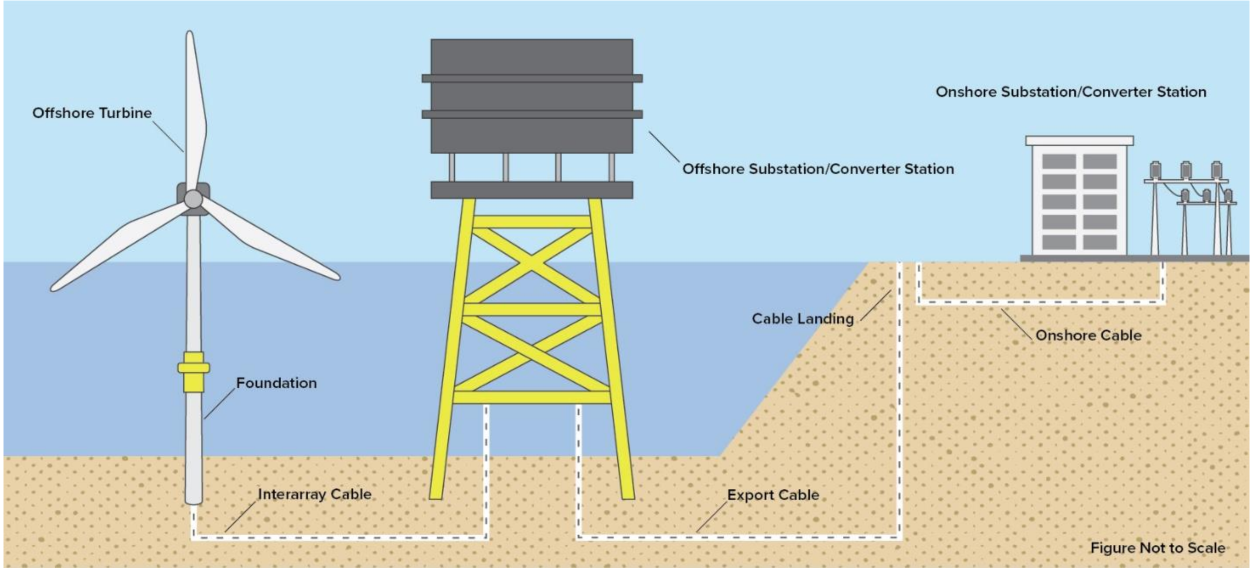

Figure 2-1. Representative onshore and offshore infrastructure

[1] In March 2023, the State of New Jersey issued an offshore wind solicitation with a requirement for projects to interconnect at the Larrabee site, available here: https://www.nj.gov/bpu/pdf/boardorders/2023/20230306/8D%20ORDER%20OSW%20Third%20Solicitation.pdf.

Offshore Activities and Facilities

The offshore components that collectively make up the offshore project area include WTGs and their foundations, OSSs and their foundations, scour protection for foundations, interarray cables, and offshore export cables (Figure 2-1). The proposed offshore project elements would be located on the OCS as defined in OCSLA, except the portion of the offshore export cables that would be located within state waters.

One NY Bight project would install between 50 and 280 WTGs within a NY Bight lease area in a grid layout at a minimum spacing of 0.6 by 0.6 nautical mile (1.1 by 1.1 kilometers). The WTGs considered would have a rotor diameter up to 1,214 feet (370 meters) and a blade tip height that extends up to 1,312 feet (400 meters) above mean sea level (AMSL) (Figure 2-2).

A single NY Bight project would install 1–5 OSSs that would serve as common collection points for power from the WTGs as well as the origin for the offshore export cables that deliver power to shore (Figure 2-1). NY Bight lessees may use HVAC or HVDC technology to transmit power from the wind farms to shore.[2] Different equipment would be required on each OSS depending on whether HVAC or HVDC technology is used. An HVAC system is typically used to transport energy onshore when the wind farm is within about 30 miles (50 kilometers) of the shore (Middleton and Barnhart 2022). Due to the distance of the NY Bight lease areas to shore (which at their closest points are between 20 and 39 nautical miles [35 and 72 kilometers] offshore), if HVAC OSSs are chosen, an HVAC booster station, or a reactive compensation station, may be required along the export cable route to offset against power losses between the offshore wind farm and the grid. HVAC booster stations are generally similar in size and foundation type to an OSS. HVDC systems operate by converting the alternating current (AC) high voltage electricity produced by the WTGs to direct current (DC) for transport to shore, and then once onshore convert the electricity back to AC for distribution to the grid. HVDC systems do not experience the same losses in power experienced on AC transmission lines at long distances and do not require booster stations along the export cable route. Because of the large amount of heat generated during the conversion of AC to DC at the HVDC converter OSS located in the wind farm, these systems must be cooled when operating. The most common type of cooling system that is commercially available is an open loop system that intakes cool, filtered sea water and discharges warmer water back into the ocean. Chemicals such as bleach (sodium hypochlorite) may be used in order to prevent growth in the system and keep pipes clean (Middleton and Barnhart 2022).

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[2] The states of New York and New Jersey have offshore wind procurements that require use of HVDC technology.

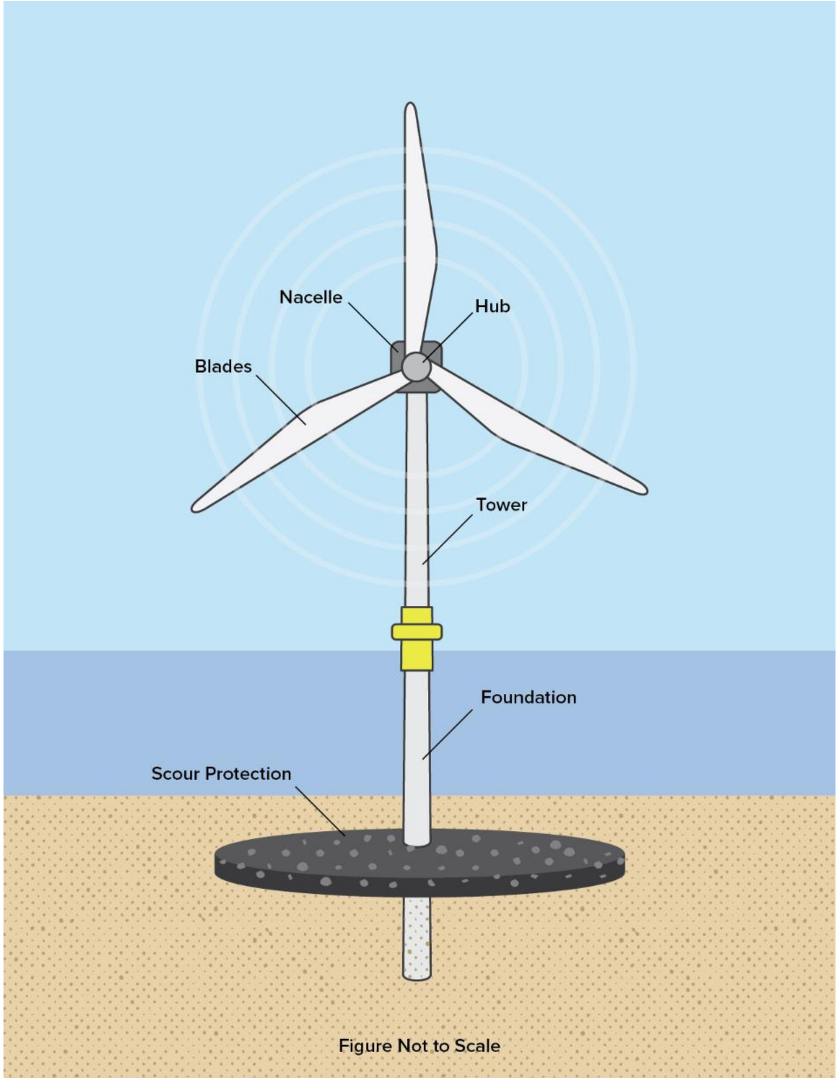


Figure 2-2. Representative wind turbine

WTGs and OSSs would be mounted on one or a combination of the following foundation types: monopile, piled jacket, suction bucket (could be mono-bucket, suction-bucket jacket, or tri-suction pile caissons), or gravity-based foundations (Figure 2-3 through Figure 2-6). Monopile and piled jacket are anticipated to be the most likely foundation types to be used for the NY Bight projects. Monopile foundations typically consist of a single steel cylindrical pile that is embedded into the seabed and is made up of sections of rolled steel plate welded together. A transition piece is fitted over the monopile and secured via bolts or grout, to which the tower is attached. Piled jacket foundations are large lattice structures fabricated of steel tubes welded together and typically consist of three- or four-legged structures to support WTGs and OSSs. For monopile and piled-jacket substructures, the foundations would be driven to the target seabed penetration depths by hydraulic impact hammering, vibratory hammering, water jetting, drilling, or a combination of methods. During the installation of suction-bucket jacket foundations, the open bottom of the bucket would settle on the seabed, then water and air would be pumped out of the bucket to create a negative pressure, which embeds the foundation bucket into the seabed. Gravity-based foundations sit on top of the sea floor and have sufficient mass and diameter to provide the stability and stiffness required to resist overturning loads. Gravity-based foundations would be lowered into position by adding water, solid ballast, or a combination of both. Prior to installation, pre-construction surveys, such as geophysical and geotechnical (G&G) or high-resolution geophysical (HRG) surveys, may be needed to refine the foundation design. Installation of survey and research equipment, such as met ocean buoys, may be required for monitoring. For all foundation types, seabed preparation activities, such as dredging to level the seabed and remove soft seabed surface layers, may be required for installation, although this would be most common for suction-bucket and gravity-based foundations. Scour protection, consisting of rock placement, mattress protection, sandbags, and stone bags may be applied around foundations if required.

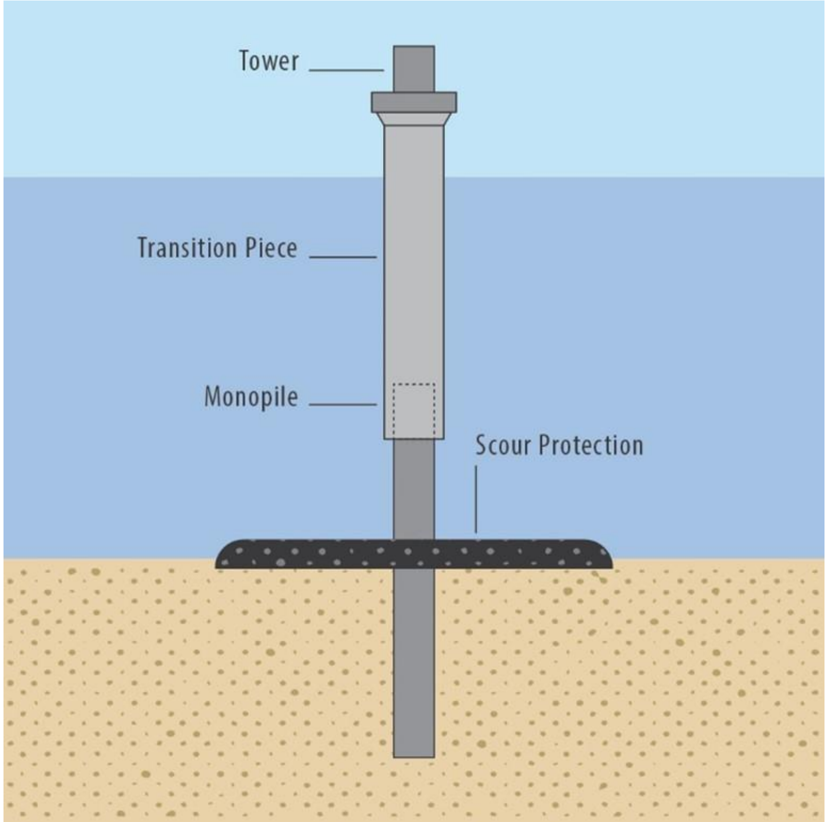


Figure 2-3. Monopile foundation

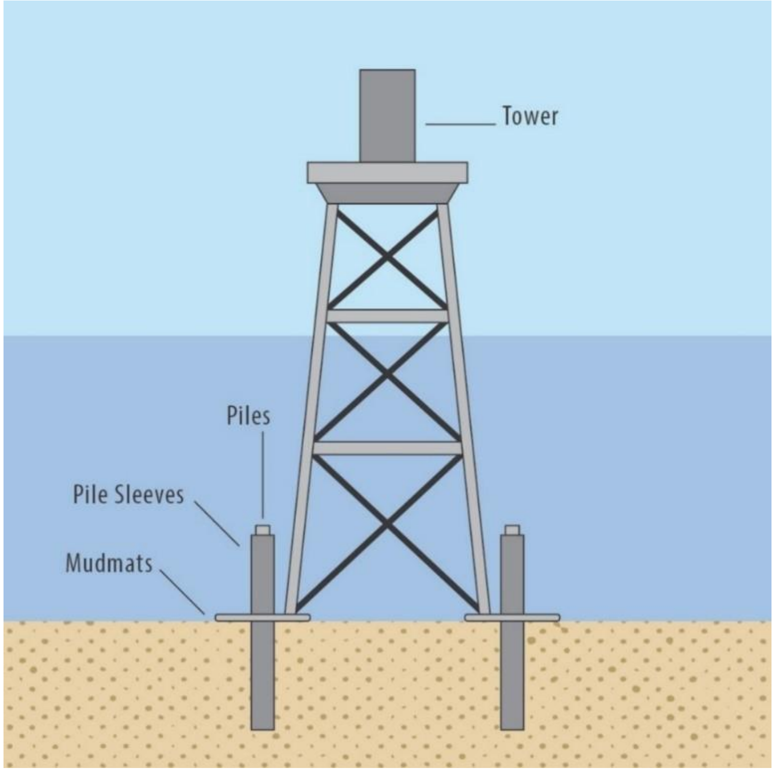


Figure 2-4. Jacket foundation

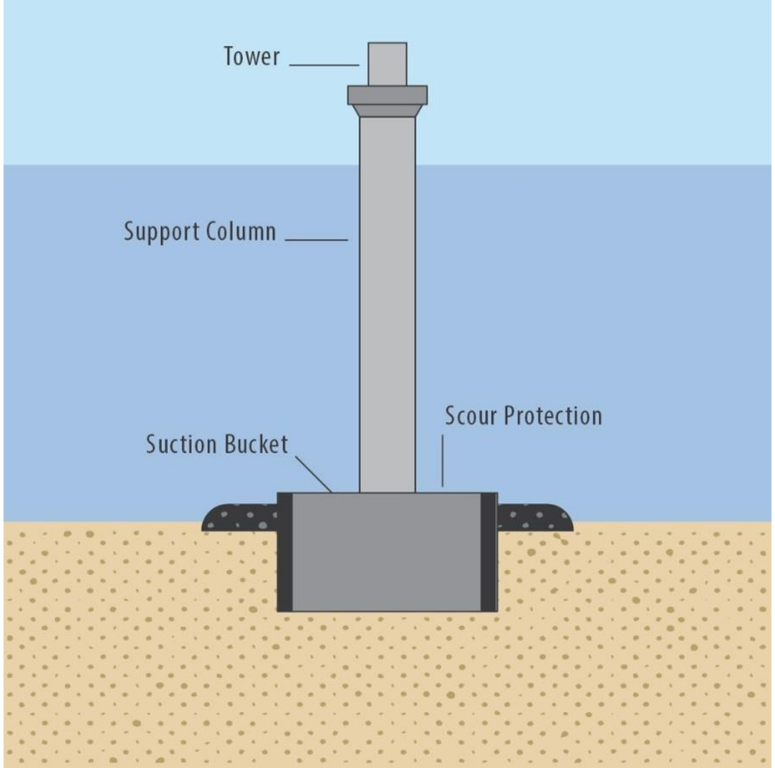


Figure 2-5. Suction bucket foundation

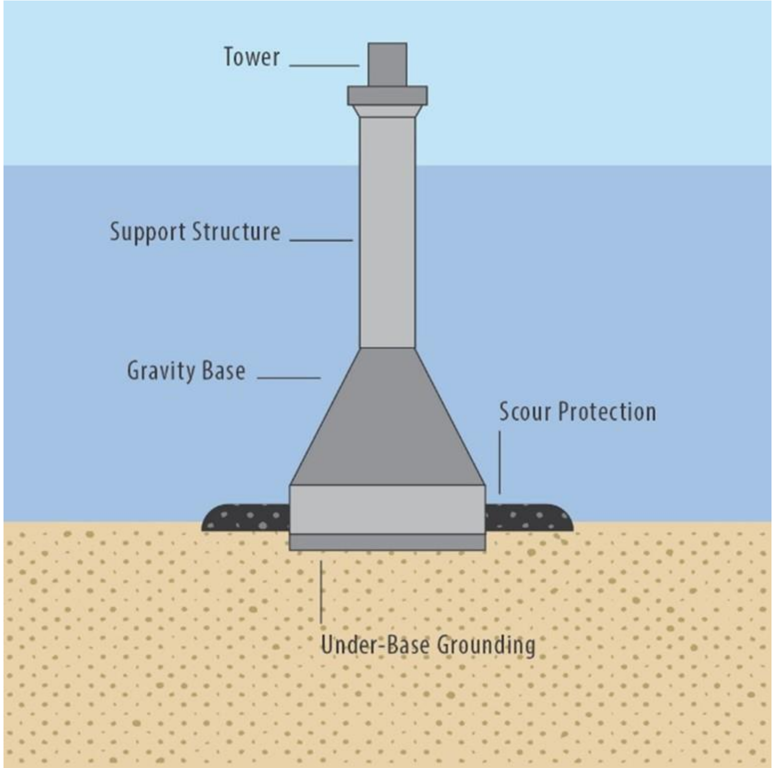


Figure 2-6. Gravity-based foundation

The WTGs and OSSs are expected to be lit and marked in accordance with Federal Aviation Administration (FAA), U.S. Coast Guard (USCG), and BOEM guidelines to aid safe navigation within the NY Bight lease areas. BOEM's 2021 *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* includes recommendations for lighting and marking of offshore structures. For example, BOEM recommends that Automated Identification System (AIS) transponders be placed in each lease area and be capable of transmitting signals marking the locations of all WTGs and OSSs.

Between 1 and 9 export cables would be installed per NY Bight project to deliver electricity from the OSSs to the landfall sites. The combined length of all export cables per one representative NY Bight project would be between 30 and 929 miles (48 to 1,495 kilometers) to reach the landfall locations. Pre-lay trenching, simultaneous lay and bury, and post-lay burial approaches to cable installation are considered under the RPDE. Several cable installation methods are considered under the RPDE, with mechanical and jet-plowing as the most common installation method. Other methods considered under the RPDE include mechanical cutter, jet trencher, controlled flow excavator, vertical injection, suction hopper dredging, precision installation (with remotely operated vehicles [ROVs] or divers), HDD, direct piping, open-cut trenching, and jack-and-bore. Offshore export cables would have a target burial depth of 6 feet (1.8 meters) but may be shallower or deeper—from between 3 and 19.6 feet (0.9 and 6 meters) below the surface—depending on site-specific conditions. The required burial depth within federal navigational channels is typically 15 feet (4.6 meters) below authorized dredged depth, but non-federally managed areas do not have the same requirement.

One NY Bight project would install up to 550 miles (885 kilometers) of interarray cables used to connect WTGs to OSSs. Interarray cables and offshore export cables would be installed similarly, with mechanical or jet plowing being the most common method for interarray cable burial. Interarray cables would have a target burial depth 6 feet (1.8 meters) but may be shallower or deeper—between 3 and 19.6 feet (0.9 and 6 meters) below the surface—depending on site-specific conditions.

Cable protection for both export cables and interarray cables would likely be installed at any cable crossing location and for areas where target cable burial depth cannot be achieved. Cable protection methods considered under the RPDE include rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers.

Prior to cable installation, BOEM anticipates that site preparation activities would be completed including, but not limited to, boulder relocation or removal, unexploded ordnance (UXO) clearance, pre-lay grapnel run, and pre-installation surveys to ensure the submarine export cable and burial equipment would not be affected by debris or other hazards during the burial process. A pre-lay grapnel run may be completed to remove seabed debris, such as abandoned fishing gear, wires, etc., from the siting corridor. Pre-lay grapnel runs involve the utilization of a grapnel rope that is lowered to the seabed using a tug vessel and on-board winch as support. The grapnel rope and ground chain are towed within the footprint of the WTGs and OSS platforms to remove any debris that may be present and could hinder construction operations on the seafloor. As the grapnel is dragged across the bottom, the grapnel penetrates the seafloor snagging and catching debris. Additionally, pre-sweeping may be required in areas of the submarine export cable corridor with bedforms such as megaripples and sand waves. Pre-sweeping involves smoothing or leveling of the seafloor by removing ridges and edges using dredging equipment to remove the excess sediment. Dredged material generated from pre-sweeping activities may either be sidecast near the installation site or removed for reuse or proper disposal.

During construction and installation, support vessels typically travel between the offshore project area and port facilities where equipment and materials are staged. Appendix B, *Supplemental Information and Additional Figures and Tables,* provides information about typical offshore wind vessels. Multiple ports with capabilities to support offshore wind development are present within the region. The following representative ports are considered in the analysis for the Final PEIS. These and other ports both within and outside of the New York and New Jersey region may ultimately be used by the NY Bight projects. Additional specificity will be provided in the COP NEPA documents.

- New York – Howland Hook/Port Ivory, Port of Albany, Port of Coeymans, South Brooklyn Marine Terminal, Brooklyn Navy Yard, Arthur Kill Terminal
- New Jersey – New Jersey Wind Port, Paulsboro Marine Terminal

Transmission Interconnection Configurations

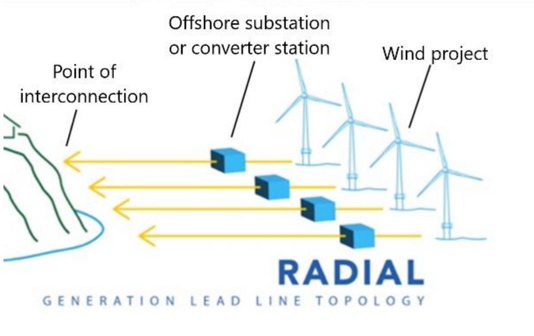
When multiple offshore wind projects are located in a single region offshore, as is the case for the NY Bight projects, different configurations can be used to connect wind projects to the grid, including the shared use of offshore transmission equipment. Each offshore transmission configuration—or topology—has its own advantages and requires different levels of coordination between transmission and wind project operators. Four configurations are described below, classified as either radial or network configurations. Any of these configurations could be employed for the NY Bight projects. Each of the configurations would likely require different amounts of cable, OSSs, and other offshore and onshore infrastructure that could result in differing levels of environmental impacts. Under Alternative B, BOEM is analyzing the maximum case scenario for cable and OSS infrastructure, which is anticipated to encompass the infrastructure requirements for any of these transmission configurations, as reflected in the RPDE presented in Table 2-2. Shared transmission infrastructure, such as backbone configurations, may be developed independent of any generation by transmission developers. These projects may also be developed in order to improve grid resilience, and create the ability to move power from one part of the onshore grid to another. In these cases, BOEM would issue a ROW grant as opposed to a lease. The grant may not be associated with a specific lease or leases at the time of development, but it could allow for future expansion and connection to new or existing offshore wind projects. A lessee using such a system would request an easement to the project on the OCS.

In the figures that follow, depicting different transmission configurations, each turbine represents an individual offshore wind project (e.g., one NY Bight project).

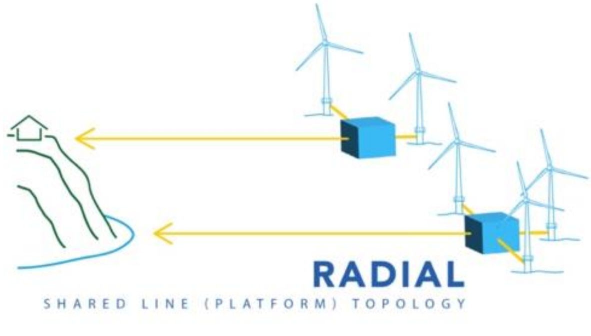
Radial Configurations

Radial configurations collect power from a wind project at an OSS that connects to a single onshore interconnection point. In radial configurations, power from a wind project will always flow to the same onshore POI. Generation lead line topology and shared line (platform) topology are two types of radial configurations (Figure 2-7):

- **Generation lead line topology** is where each wind project connects to a dedicated OSS that transfers power to a single onshore interconnection point.
- **Shared line (platform) topology** is where two or more wind projects connect to an OSS that transfers power to a single onshore interconnection point.



Generation lead line topology



Shared line (platform) topology

Source: DOE 2023.

Figure 2-7. Radial configuration topologies

Network Configurations

Network configurations collect power from a wind project at an OSS that is connected to a series of other OSSs that transfer power to different onshore interconnection points. In a network configuration, power from a wind project can flow to multiple onshore interconnection points and such a configuration allows power to flow in multiple directions throughout the offshore transmission network. Grid operators may utilize a network configuration for purposes of managing congestion and reliability. Backbone topology and meshed grid topology are two types of network configurations (Figure 2-8)[3]:

- **Backbone topology** is where multiple OSSs are linked together along a single pathway—or backbone—to connect between two onshore interconnection points.
- **Meshed grid topology**, also known as an offshore grid, is where multiple OSSs are linked together to create a meshed grid that connects three or more onshore interconnection points.

Backbone topology | Meshed grid topology

Source: DOE 2023.

Figure 2-8. Network configuration topologies

2.1.2.1.2 Operations and Maintenance

For analysis purposes, BOEM assumes that each of the NY Bight projects would have an operating period of 35 years. The NY Bight leases each have operations term of 33 years that commences on the date of COP approval. A NY Bight lessee would need to request and be granted an extension of its operations term from BOEM under the regulations at 30 CFR 585.425 et seq. in order to operate a NY Bight project for 35 years. While no NY Bight lessee has made such a request, this PEIS uses the longer period in order to avoid possibly underestimating any potential effects from operations and maintenance.

[3] In July 2022, the State of New York released an offshore wind solicitation with a requirement for projects using HVDC to follow meshed ready requirements, available here: https://www.nyserda.ny.gov/All-Programs/Offshore-Wind/Focus-Areas/Offshore-Wind-Solicitations/2022-Solicitation.

Onshore Activities and Facilities

One NY Bight project would include regular inspection and preventative maintenance, as needed, for onshore substations and converter stations, onshore export cables, and grid POIs. Onshore substations and converter stations are typically designed to serve as unmanned stations and would not be expected to have an operator onsite during typical operation. Scheduled maintenance of the onshore export cables would also be performed; any necessary maintenance would be accessed through manholes and completed within the installed transmission infrastructure.

Offshore Activities and Facilities

Planned maintenance of WTGs would include regularly scheduled inspections and routine maintenance of mechanical and electrical components. The types and frequency of inspections and maintenance activities would be based on detailed original equipment manufacturer specifications. Annual maintenance campaigns are expected to be needed for general upkeep (e.g., bolt tensioning, crack and coating inspection, safety equipment inspection, cleaning, high-voltage component service, and blade inspection) and replacement of consumable components (e.g., lubrication, oil changes).

BOEM anticipates OSSs would also undergo annual maintenance to both medium-voltage and high-voltage systems, auxiliary systems, and safety systems as well as topside structural inspections. Portions of the topsides may require the reapplication of corrosion-resistant coating. Routine maintenance and refueling would also be performed on generators located on the OSSs.

WTG and OSS foundations would be inspected both above and underwater at regular intervals to check their condition, including checking for corrosion, cracking, and marine growth. Scheduled maintenance of foundations may also include safety inspections and testing; coating touch up; preventative maintenance of cranes, electrical equipment, and auxiliary equipment.

2.1.2.1.3 Conceptual Decommissioning

Conceptual decommissioning of a NY Bight project would be required in accordance with 30 CFR Part 285. Under 30 CFR Part 285, NY Bight lessees would be required to remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seabed of all obstructions created. Absent permission from the Bureau of Safety and Environmental Enforcement (BSEE), all projects would have to achieve complete decommissioning within 2 years of termination of the lease and either reuse, recycle, or responsibly dispose of all materials removed.

Lessees would be required to submit a decommissioning application upon the earliest of the following dates: 2 years before the expiration of the lease, 90 days after completion of the commercial activities on the commercial lease, or 90 days after cancellation, relinquishment, or other termination of the lease (30 CFR 285.905). Upon completion of the technical and environmental reviews, BSEE may approve, approve with conditions, or disapprove the lessee's decommissioning application. The lessees would need to obtain separate and subsequent approval from BSEE and BOEM to retire in place any portion of a project. Approval of retiring any portion of a project in place would require compliance under NEPA and other federal statutes and implementing regulations. If a COP is approved or approved with modifications, the lessee would have to submit a bond (or another form of financial assurance) that would be held by the U.S. government to cover the cost of decommissioning the entire facility in the event that the lessee would not be able to decommission the facility.

Onshore Activities and Facilities

At the time of conceptual decommissioning, some components of the onshore electrical infrastructure may still have substantial life expectancies. Onshore export and transmission cables may be retired in place; however, if removal is required, the cables would be pulled and sent to repurposing or recycling facilities. Depending on the needs at the time, onshore facilities may be left in place for possible future use or demolished and materials recycled.

Offshore Activities and Facilities

Conceptual decommissioning of the WTGs and OSSs would typically follow a "reverse installation" process, with turbine components or the OSS topside structure removed prior to foundation removal. The procedures used for decommissioning the WTG and OSS foundations would depend on the type of foundation. Foundations that penetrate the seabed would be cut 15.0 feet (4.6 meters) below the mudline in accordance with 30 CFR 285.910 or may be removed completely.

Offshore export cables and interarray cables would either be retired in place or removed from the seabed. The decision regarding whether to remove these cables and any overlying cable protection would be made based on future environmental assessments and consultations with federal, state, and municipal resource agencies.

2.1.2.2 Six Projects

Alternative B also analyzes the impacts of six representative NY Bight projects to evaluate the overall impacts of a full offshore wind build-out in the NY Bight lease areas. While lessees may elect a phased development approach resulting in more than one project per lease, for purposes of analysis, this PEIS assumes one project per lease area. The same types of design parameters described for one NY Bight project would apply to six NY Bight projects, except that the number and length of each parameter is scaled for six projects. The analysis of six NY Bight projects includes up to 1,103 WTGs, 22 OSSs, 44 offshore export cables totaling 1,772 miles (2,852 kilometers), and 1,582 miles (2,546 kilometers) of interarray cables. The values for these parameters were provided by the NY Bight lessees or were calculated by BOEM based upon information provided by the lessees and represent the expected maximum number/length of WTGs, OSSs, and cables that would be developed for the six NY Bight projects.

2.1.3 Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the six NY Bight lease areas with the AMMM measures identified in Appendix G, *Mitigation and Monitoring,* that could avoid, minimize, mitigate, and monitor those impacts. These measures may be required as conditions of approval for activities proposed by NY Bight lessees in their COPs through the COP review and approval process. Appendix G (Table G-1) identifies the AMMM measures that make up the Proposed Action. Most of the AMMM measures included in Appendix G have been previously applied as terms and conditions of approval for COPs proposing offshore wind activities on the Atlantic OCS or through related consultations, while a smaller number of measures have not previously been required. Alternative C consists of two sub-alternatives:

- **Sub-alternative C1 (Preferred Alternative): Previously Applied AMMM Measures.** Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations. The analysis for Sub-alternative C1 is presented as the change in impacts from those discussed under Alternative B.
- **Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures.** Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied. Therefore, under this alternative, the analysis is presented as the change in impacts from those discussed under Sub-alternative C1. In the case where there are no AMMM measures applied under Sub-alternative C1, the analysis for Sub-alternative C2 is described as the change in impacts from those discussed under Alternative B.

This PEIS will not result in the approval of any activities. Other than the AMMM measures, all design parameters for Alternative C would be the same as described under Alternative B for project components and activities undertaken for construction and installation, O&M, and conceptual decommissioning. AMMM measures identified under Sub-alternative C1 and Sub-alternative C2 are being analyzed in this PEIS for one NY Bight project and the impacts of a full build-out of six NY Bight projects in the NY Bight area.

2.2 Alternatives Considered but Not Analyzed in Detail

BOEM considered the alternatives described in the table below (Table 2-3) and excluded them from detailed analysis because they did not meet the purpose and need or did not meet the screening criteria. These alternatives are presented with a brief discussion of the reasons for their elimination as prescribed in CEQ regulations at 40 CFR § 1502.14(a) and DOI regulations at 43 CFR § 46.420(b-c). BOEM used the following screening criteria to determine if an alternative should be analyzed in detail in this PEIS:

- Does the alternative meet the purpose of and need (*i.e., tiering, streamlining of project-specific NEPA*) for the Proposed Action?
- Is the alternative defined in relation to the identification of avoidance, minimization, mitigation, or monitoring measures (the decision to be made)?
- Is there scientific evidence to support that the alternative would avoid or substantially lessen one or more significant socioeconomic or environmental effects?

- Is the alternative inconsistent with the federal and state policy goals below?
  - The United States' policy under OCSLA to make OCS energy resources available for expeditious and orderly development, subject to environmental safeguards…[4]
  - Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, issued on January 27, 2021.
  - The Departments of the Interior (DOI), Energy (DOE), and Commerce (DOC) shared goal to deploy 30 GW of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use.[5]
  - The goals of affected states, including state laws that establish renewable energy goals and mandates, where applicable.
- Is it substantially similar in design to an alternative that is analyzed in detail? Does the alternative substantially duplicate other less harmful or less expensive alternatives? Would it have substantially similar effects as an alternative that is analyzed in detail? If this is the case, BOEM may eliminate the alternative.
- Is the alternative technically and economically feasible (i.e., not implausible or speculative)?

Table 2-3. Alternatives considered but not analyzed in detail

Alternative Dismissed	Justification for Dismissal
Pilot Project: One commenter said that an alternatives analysis must consider a pilot project. The commenter stated that a small, local pilot project that uses the proposed technology and could be robustly evaluated before, during, and after construction is the only way to address shortcomings in the project (e.g., a need for quantitative and qualitative scientific observation, logistical planning, clearance of military hazards) and begin the path toward responsible development of offshore wind energy in the NY Bight waters through a process that reflects fair, responsible, and good governance. Similarly, another commenter said that a limited test project alternative must be considered. A test project would facilitate gathering information on benefits and impacts before a large project is implemented. Another commenter said that the PEIS must provide a comprehensive, transparent, and fair analysis of the potential risks and impacts associated with offshore wind energy development activities in the New York	The purpose of this PEIS is not to approve any projects; the decision to approve, approve with modifications, or disapprove a COP will not occur until after COPs are submitted and another level of NEPA analysis is completed. A pilot project does not address a specific environmental or socioeconomic concern. Moreover, BOEM does not have the authority to prevent developers from submitting COPs and developing commercial-scale projects until after a pilot project is proposed and built. This alternative would effectively be the same as selecting the No Action alternative.

[4] 43 USC 1332(3)

[5] FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs | The White House https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administrationjumpstarts-offshore-wind-energy-projects-to-create-jobs/

Alternative Dismissed	Justification for Dismissal
and New Jersey Bight, and thus, from the outset, should include an alternatives analysis that contains both a pilot project and a true No Action Alternative.	
Land based alternatives: One commenter suggested that BOEM consider a land-based alternative and characterized onshore energy development as the most rapid and efficient method to achieve energy efficiency, resource conservation, global warming mitigation, and to prevent the Jersey Shore ocean from becoming a "dumping ground."	The proposed alternative is outside of BOEM's jurisdiction. Onshore wind energy projects are being developed and permitted by other agencies with jurisdiction. Additionally, the proposed alternative does not meet the purpose and need for this PEIS, which is to analyze potential impacts of offshore wind development in the NY Bight lease areas and to identify AMMM measures.
Lease Area Size: One commenter suggested that BOEM only consider alternatives that maximize site utilization. Specifically, they noted that any alternatives that further significantly reduce site utilization would both be unnecessary and run counter to federal and state clean energy goals. Another commenter cited a BOEM provision on the prevention of waste and stated that alternatives and AMMM measures should be evaluated based on whether and to what extent they would have foreseeable impacts on the energy generation potential of an offshore wind lease.	The intent of this PEIS is to analyze impacts of maximum site utilization in the six NY Bight lease areas, and not to reduce the size of the lease areas. However, sensitive habitats are identified in this PEIS, as well as AMMM measures* to avoid these habitats where practicable, which could reduce site utilization if selected. This PEIS does not approve any specific projects. The suggested alternative is more appropriate for consideration at the COP NEPA stage because the alternatives must align with the project's purpose and need and primary goals of the applicant/lessee. For example, if a project's purpose and need and goal are tied to the delivery of an awarded Power Purchase Agreement generation capacity, BOEM can't include an alternative that would reduce the number of WTGs needed to meet that generation capacity. (This includes considering transmission losses.)
Alternative Construction Methodologies: Evaluate alternative offshore installation methodologies that allow simultaneous trenching and cable laying to minimize impacts to water quality and benthic habitat.	It is more appropriate to analyze these alternative installation methodologies as part of the impacts analysis at the COP NEPA stage. The PEIS includes a high-level analysis of emerging technologies, that includes alternative installation methodologies, as well as an AMMM measure* that encourages the use of new and emerging technology.
Alternatives for Manufacturing, Staging and Assembly: Evaluate available alternatives for staging and assembly of offshore wind components including utilizing jack-up barges and platforms in the NY Bight.	Because no COPs for these six lease areas have been submitted, information is not known about the manufacturing or staging and assembly facilities that will be used. However, the PEIS analyzes several representative ports that may also be used as staging facilities.
Alternatives for Appurtenant Structures: Identify scenarios for co-locating with offshore infrastructure such as existing and future transmission infrastructure, telecommunications, and battery storage projects.	Because the size and design of the NY Bight wind energy facilities are unknown at this stage, an AMMM measure* in the PEIS is being considered that would involve co-locating project-related infrastructure wherever practicable as a way to reduce impacts. Therefore, analyzing the proposed alternative would result in speculation and would be unnecessary given that there is an AMMM measure that will be analyzing

Alternative Dismissed	Justification for Dismissal
	the reduction in impacts intended by the proposed alternative.
Alternative Submarine Cable Configurations: Evaluate co-locating submarine cables to minimize impacts to sensitive environmental resources, including but not limited to, complex benthic habitats, saltmarshes, submerged aquatic vegetation (SAV), etc.	Because the location of cables for the six lease areas is unknown, an AMMM measure* is being considered that would involve co-locating infrastructure and use of shared transmission infrastructure wherever practicable as a way to reduce impacts. Therefore, analyzing the proposed alternative would result in speculation and would be unnecessary given that there is an AMMM measure that will be analyzing the reduction in impacts intended by the proposed alternative.
Alternative Turbine Layouts: Evaluate a range of turbine layout scenarios to ensure sufficient energy generation and promote co-existence with fishing industries.	Because the specific locations of the individual turbines within the six lease areas are unknown, the PEIS analyzes a hypothetical project with the closest spacing possible for the turbine layout. AMMM measures* in the PEIS are being considered that would require consistent turbine layouts across adjacent lease areas as well as increased spacing as ways to reduce impacts. Therefore, analyzing the proposed alternative would result in speculation and would be unnecessary given that there are AMMM measures that will be analyzing the reduction in impacts intended by the proposed alternative.
Alternative Habitat Impact Minimization Measures: Include a conceptual habitat impact minimization alternative to avoid highly sensitive and significant habitat types and possibly avoidance areas.	Because the location of infrastructure is unknown at this stage, AMMM measures* analyze the benefits of avoiding highly sensitive and significant habitat types wherever practicable. Therefore, analyzing the proposed alternative would result in speculation and would be unnecessary given that there are AMMM measures that will be analyzing the reduction in impacts intended by the proposed alternative.
Benthic Habitat Impact Minimization: Development of an alternative that would remove high value habitat areas from consideration of development such as the mid-shelf scarp, sand ridge and trough complexes, hard bottoms, SAV, and other sensitive habitats, irreplaceable and difficult to replace resources, and Prime Fishing Grounds/Areas. Avoidance of these vulnerable habitats should also be considered for the cable routes, either as part of this alternative or as a sub-alternative. Some of these vulnerable habitat areas and their locations are known (such as the mid-shelf scarp), but others should be identified through site-specific surveys and benthic habitat mapping efforts.	As described in BOEM's Final Lease Sale Decision Memorandum for the NY Bight, BOEM previously considered removing areas from NY Bight lease areas.[6] Specifically, in response to the commercial fishing industry, BOEM excluded the area adjacent to the scallop access area, included a buffer between select leases, and removed areas of high value benthic diversity. Removal of additional high value habitat would need to be considered at the project-specific COP NEPA stage when project details are known. Because the location of cables is unknown at this stage, AMMM measures* analyze the benefits of co-locating infrastructure and avoiding high value habitat areas wherever practicable. Therefore, analyzing the proposed alternative would result in speculation and

[6] https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/ATLW-8-NY-Bight-Final-Lease-Sale-Decision-Memorandum.pdf.

Alternative Dismissed	Justification for Dismissal
	would be unnecessary given that there are AMMM measures that will be analyzing the reduction in impacts intended by the proposed alternative.
Pelagic Habitat Impact Minimization: Development of an alternative that considers effects of development within the six lease areas and in combination with other proposed offshore wind development in the region on pelagic habitats in the NY Bight, including the Mid-Atlantic Bight Cold Pool. This alternative would consider the size and scale of development in the six lease areas and in combination with other proposed wind developments to understand the range of interactions between wind development and the Mid-Atlantic Bight Cold Pool. This alternative may require analysis and modeling to evaluate the effects of project structures on the formation and maintenance of the Mid-Atlantic Bight Cold Pool. Modeling can examine varying options of lease development to assess how the size and scale of different development approaches may vary in their effects on the Cold Pool. This would allow for the evaluation of options for considering different project scales and design to minimize impacts to the Cold Pool.	The cumulative effects analysis considers potential impacts from full build-out of the six NY Bight lease areas as well as other reasonably foreseeable future offshore wind in the geographic analysis area of each of the resources being analyzed. Potential impacts on the Mid-Atlantic Bight Cold Pool are analyzed within the affected resource sections such as fish and benthic resources.
Fisheries Impact Minimization: Development of an alternative that considers the Proposed Action (full build-out) of the six leases areas implemented with sufficient and consistent WTG spacing across lease areas to increase the likelihood that fishing can still occur. This alternative should consider a range of WTG spacing options identified in coordination with the fishing industries operating in these areas. This alternative should also consider removal of key fishing areas from development and identify these areas with consideration of anticipated shifts in fishing grounds in prioritizing WTG locations.	AMMM measures* analyze the effects of consistent turbine layouts across adjacent lease areas as well as increased spacing as ways to reduce impacts. The PEIS highlights popular fishing areas within the NY Bight area that would benefit from avoidance or additional mitigation measures to reduce impacts. Turbine spacing and alternative turbine layouts for each lease area in the NY bight would be considered at the project-specific COP NEPA stage when project details are known.
Cable Route Coordination: Development of an alternative that considers potential cable landing locations for the six lease areas and identifies and evaluates options for coordinated and consolidated routes for the export cables. This alternative would evaluate routes that would reduce impacts to marine resources and consider how export cable routes from each of the six individual leases areas could be consolidated into fewer, common corridors to further avoid and minimize impacts to resources.	Because the location of cables is unknown at this stage, an AMMM measure* analyzes the benefits of co-locating infrastructure, including transmission infrastructure, wherever practicable. State power solicitations may also dictate routing measures for export cables and associated substations developed from the Atlantic Offshore Wind Transmission Study and the BOEM/DOE transmission planning effort, the New York State Energy Research and Development Authority's (NYSERDA) Offshore Wind Cable Corridor Constraints Assessment,[7] associated New York Public Service Commission orders, and the results of the New

[7] https://www.nrel.gov/docs/fy24osti/88003.pdf.

Alternative Dismissed	Justification for Dismissal
	Jersey state agreement approach[8] (SAA) and other state and Independent System Operator/Regional Transmission Organization transmission planning processes, to maximize the utility of POIs. Therefore, analyzing the proposed alternative would result in speculation and would be unnecessary given that there is an AMMM measure that will be analyzing the reduction in impacts intended by the proposed alternative.
Land Based Cable Alternative (avoid estuaries and embayment): Development of an alternative that ensures all export cable routes for interconnections with the grid avoid crossing through estuaries and embayments. Rather than impacting these sensitive coastal ecosystems, this alternative would only consider use of land-based cable routes that avoid estuaries and embayments and associated adverse impacts to marine resources.	The location of cables and onshore components are unknown at this stage. An AMMM measure* analyzes the benefits of adjustments to project design and methodologies for cable installation to avoid sensitive habitats, such as estuaries and embayments, wherever practicable. Therefore, analyzing the proposed alternative would result in speculation and would be unnecessary given that there is an AMMM measure that will be analyzing the reduction in impacts intended by the proposed alternative.
Construction Timing: One commenter suggested considering how the timing of construction of multiple projects could influence overall ocean noise may result in the development of alternatives that better reduce noise impacts (e.g., via a regional construction schedule, noise avoidance measures, and more stringent noise reduction and attenuation requirements).	In this PEIS, BOEM analyzes development of six projects and AMMM measures related to reducing noise impacts through avoidance, monitoring efforts, and shutdown procedures. However, alternatives analyzing detailed project schedules are more appropriate at the COP NEPA stage when more information is known about vessel availability and construction timing.
Saltmarsh and SAV Concern: One commenter suggested that BOEM should identify alternatives that avoid impacts on saltmarshes and SAV.	An AMMM measure* analyzes the benefits of adjustments to project design and methodologies for cable installation to avoid sensitive habitats, such as saltmarshes and SAV, wherever practicable.

* In response to comments, some suggested alternatives that were addressed as AMMM measures in the Draft PEIS have been reclassified as Recommended Practices (RPs) in the Final PEIS. However, BOEM continues to consider these suggested alternatives as not suitable for full analysis because they rely on COP-specific project details and may be more suitable for analysis during COP NEPA. In this Final PEIS, the RPs are summarized outside the Alternative C analysis and can be found at the end of each resource section in Chapter 3.

2.3 Non-Routine Activities and Events

Non-routine activities and events during construction and installation, O&M, and conceptual decommissioning are considered as part of the alternatives to allow for a full analysis of impacts. Examples of such activities or events could include corrective maintenance activities, collisions involving vessels or vessels and marine life, allisions (a vessel striking a stationary object) involving vessels and WTGs or OSSs, cable displacement or damage by anchors or fishing gear, chemical spills or releases, severe weather and other natural events, fires, terrorist attacks, and structural failures. These activities

[8] https://www.nj.gov/bpu/pdf/boardorders/2022/20221026/8A%20ORDER%20State%20Agreement%20Approach.pdf.

or events are impossible to predict with certainty. This section provides a brief assessment of each of these potential events or activities. Impacts resulting from the accidental release of chemicals and debris from non-routine activities and events are described in Chapter 3, as applicable.

- *Repair or replacement activities:* These activities could be required as a result of other low-probability events, or as a result of unanticipated equipment wear or malfunction. Key project components would typically be stored at a nearby O&M facility to allow for expeditious repairs.
- *Collisions and allisions:* These could result in vessel damage, spills (described below), or injuries or fatalities to humans and/or wildlife (addressed in Chapter 3, *Affected Environment and Environmental Consequences*). Collisions and allisions are anticipated to be unlikely based on the following factors:
    - Adherence to Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) and the U.S. Inland Navigation Rules
    - The lighting and marking plan that would be implemented (as described in Section 2.1.2.1.1, *Construction and Installation,* under *Onshore Activities and Facilities*), as well as the USCG Private Aids to Navigation Permit (PATON)
    - National Oceanic and Atmospheric Administration (NOAA) vessel speed restrictions
    - The proposed spacing of WTGs and OSSs
    - The inclusion of proposed project components on NOAA navigation charts
- *Cable displacement or damage by vessel anchors or fishing gear:* This could result in safety concerns and economic damage to vessel operators and may require corrective action by developers such as the need for one or more cable splices to an export or interarray cable(s).
- *Chemical spills or releases:* For offshore activities, these include inadvertent releases from refueling vessels, spills from routine maintenance activities, and any more significant spills as a result of a catastrophic event. All vessels would be certified to conform to vessel O&M protocols designed to minimize risk of fuel spills and leaks. Developers would prepare an Oil Spill Response Plan (OSRP) and would be expected to comply with USCG and BSEE regulations relating to prevention and control of oil spills. Onshore, releases could potentially occur from construction equipment or HDD activities. All wastes generated onshore would comply with applicable state and federal regulations, including the Resource Conservation and Recovery Act and the Department of Transportation Hazardous Materials regulations.
- *Severe weather and natural events:* The NY Bight lease areas are subject to extreme weather, such as storms and hurricanes, which may impose hydrodynamic load and sediment scouring. The return rate of hurricanes may become more frequent than the historical record, and the future probability of a major hurricane will likely be higher than the historical record of these events due to climate change. The engineering specifications of the WTGs and their ability to sufficiently withstand weather events is independently evaluated by a certified verification agent when reviewing the Facility Design Report and Fabrication and Installation Report according to international standards, which include withstanding hurricane-level events. One of these standards calls for the structure to

be able to withstand a 50-year return interval event. An additional standard includes withstanding 3-second gusts of a 500-year return interval event, which would correspond to Category 5 hurricane windspeeds. If severe weather caused a spill or release, the actions outlined above would help reduce potential impacts. Severe flooding or coastal erosion could require repairs, with impacts associated with repairs being similar to those outlined in Chapter 3 for construction activities.

- *Seismic activity:* The NY Bight is located along the Western Atlantic continental margin, which is not an area considered tectonically active. The impacts from seismic activity would be similar to those assessed for other non-routine events or activities.
- *Fires:* Malfunction of WTGs or OSSs could potentially cause a fire. An Emergency Response Plan may be prepared by lessees as part of the COP to provide clear instructions regarding procedures during emergency incident scenarios, which include fires. The impacts from fires would be similar to those assessed for severe weather and natural events.
- *Terrorist attacks:* BOEM considers these unlikely, but impacts could vary depending on the magnitude and extent of any attacks. The actual impacts of this type of activity would be the same as the outcomes listed above for severe weather and natural events. Therefore, terrorist attacks are not analyzed further.
- *Structural failure:* Failure of WTGs, met tower(s) or OSS(s) could result in safety concerns and potentially release chemicals and gases (e.g., lubricating oils, hydraulic oils, sulfur hexafluoride (SF_6), coolants, and fuels), which are addressed earlier in this document under *Chemical spills or releases*, and debris (e.g., fragments of man-made materials) into the marine and coastal environment. Corrective actions may be required and could include recovery of marine and onshore debris, salvage of the damaged structure, use of explosives, and repair. These operations would likely require unplanned mobilization and utilization of various vessels and equipment such as cranes and possible damage to the seafloor from retrieval of fallen and sunken debris.

2.4 Summary and Comparison of Impacts by Alternative

Table 2-4 provides a summary and comparison of the impacts under the Proposed Action and other alternatives assessed in Chapter 3. This Final PEIS uses a four-level classification scheme to characterize the potential beneficial impacts and adverse impacts of alternatives as either **negligible**, **minor**, **moderate**, or **major**. Resource-specific adverse impact level definitions are presented in each Chapter 3 resource section. Section 3.3.2 in Chapter 3 defines potential beneficial impact levels across all resources.

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Chapter 3

Affected Environment and Environmental Consequences

This chapter analyzes the impacts of the Proposed Action and alternatives by establishing the existing baseline of affected resources; predicting the direct and indirect impacts; and then evaluating those impacts when added to the baseline and considered in the context of the reasonably foreseeable impacts of future planned activities. This chapter thus addresses the affected environment, also known as the existing baseline, for each resource area and the potential environmental consequences to those resources from implementation of the alternatives described in Chapter 2, *Alternatives*. In addition, this section addresses the impact of the alternatives when combined with other past, present, or reasonably foreseeable planned activities, i.e., cumulative impacts, using the methodology and assumptions outlined in Chapter 1, *Introduction*; Section 3.3, *Impact Analysis Terms and Definitions*; and Appendix D, *Planned Activities Scenario*. Appendix D describes other ongoing and planned activities within the geographic analysis area for each resource. These actions may be occurring on the same time scale as the NY Bight projects or could occur later in time but are still reasonably foreseeable. Construction of the NY Bight projects is expected to commence between 2026 and 2030 (Appendix D).

In accordance with Section 1502.21 of the CEQ regulations implementing NEPA, BOEM identified information that was incomplete or unavailable for the evaluation of reasonably foreseeable impacts analyzed in this chapter. The identification and assessment of incomplete or unavailable information is presented in Appendix E, *Analysis of Incomplete and Unavailable Information*.

The No Action Alternative is first analyzed to predict the impacts of the baseline (as described in Section 1.8.1), the status quo. The existing baseline considers past and present activities in the geographic analysis area, including those related to ongoing offshore wind projects and non-offshore-wind activities. A subsequent analysis is conducted to assess the cumulative impacts on baseline conditions as future planned offshore wind and non-offshore-wind activities occur (as described in Section 1.8.2). Separate impact conclusions are drawn based on these separate analyses. Figure 3-1 illustrates the components of the No Action Alternative analysis, and Figure 3-2 illustrates the components of the No Action Alternative cumulative analysis.

This Final PEIS analyzes the impacts of the action alternatives (Alternatives B and C) when added to the baseline condition of resources (as described in Section 1.8.1) for one NY Bight project and six NY Bight projects. It then separately evaluates cumulative impacts by analyzing the impacts of the action alternatives for six NY Bight projects when added to both the baseline (as described in Section 1.8.1) and the impacts of planned activities (as described in Section 1.8.2). Figure 3-3 illustrates the components of the action alternatives analysis, and Figure 3-4 illustrates the components of the action alternatives cumulative analysis.

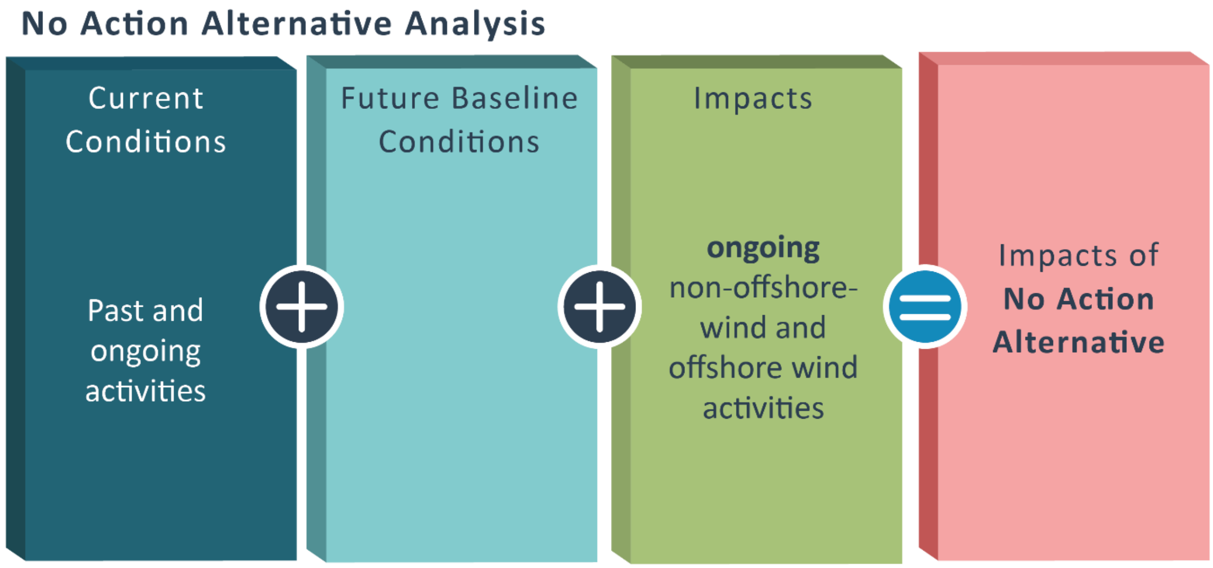

Figure 3-1. No Action Alternative analysis

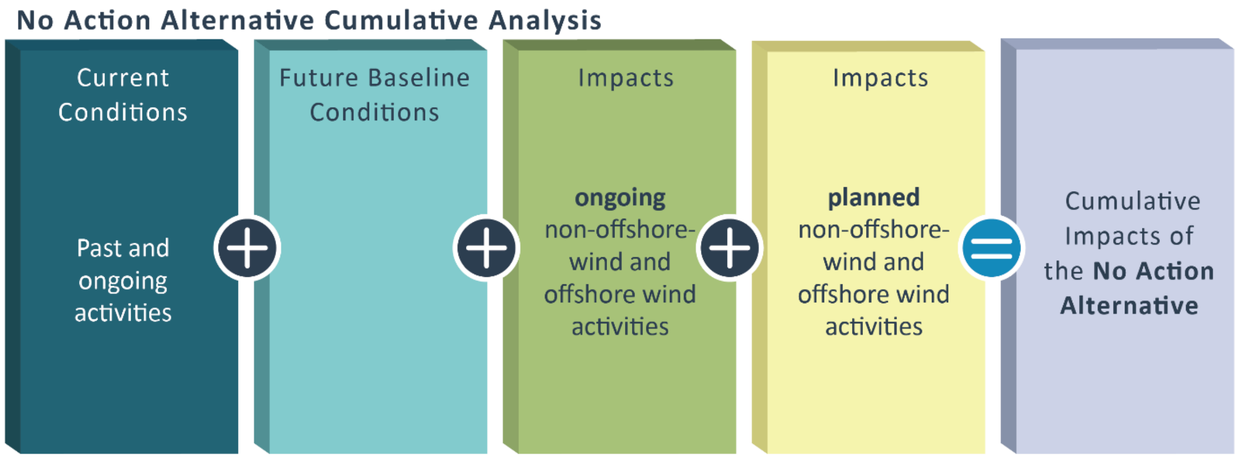

Figure 3-2. No Action Alternative cumulative analysis

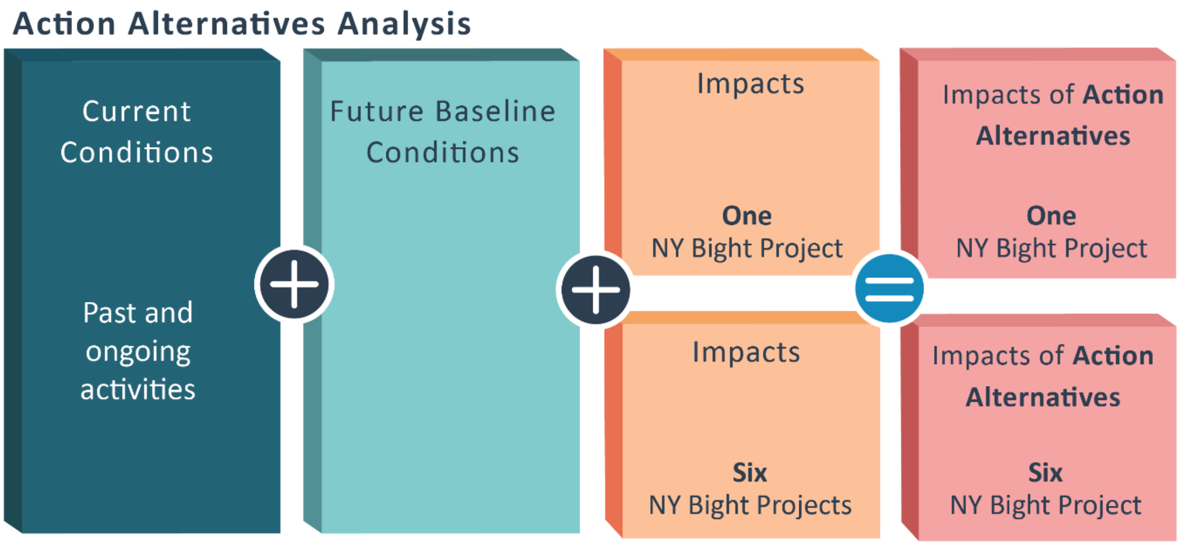

Figure 3-3. Action alternatives analysis

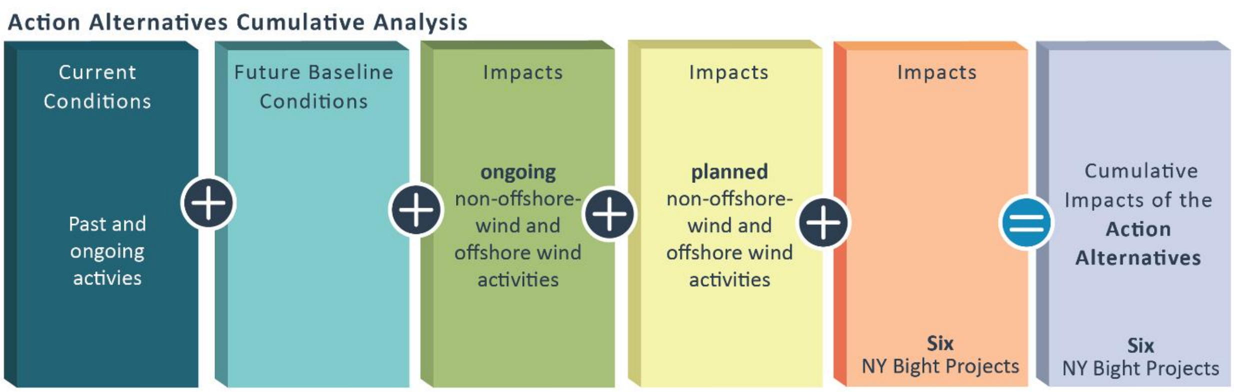

Figure 3-4. Action alternatives cumulative analysis

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3.1 Impact-Producing Factors

BOEM completed a study on the North Atlantic OCS of IPFs to consider in an offshore wind development planned activities scenario (BOEM 2019). This document incorporates that study by reference. The study provides the following:

- Identifies cause-and-effect relationships between renewable energy projects and the human environment (includes but is not limited to physical, biological, and socioeconomic conditions and cultural resources) potentially affected by such projects.
- Classifies those relationships into IPFs through which renewable energy projects could affect resources.
- Identifies the types of actions and activities for consideration in a cumulative impacts analysis.
- Identifies actions and activities that may affect the same resources as renewable energy projects and states that such actions and activities may produce the same IPFs.

The study identifies the relationships between IPFs associated with specific past, present, and reasonably foreseeable future actions in the North Atlantic OCS.

As discussed in the study, reasonably foreseeable future actions other than offshore wind projects may affect the same resources as the NY Bight projects or other offshore wind projects, possibly via the same or additional IPFs (BOEM 2019). BOEM determined the relevance of each IPF to each resource analyzed in this Final PEIS. If BOEM found an IPF not associated with the action alternatives, it did not include it in the analysis.

Table 3.1-1 provides brief descriptions of the primary IPFs involved in this analysis, including examples of sources or activities that result in each IPF. The IPFs cover all phases, including construction, operation and maintenance, and conceptual decommissioning.

Table 3.1-1. Primary IPFs addressed in this analysis

IPF	Sources or Activities	Description
Accidental releases	• Mobile sources (e.g., vessels) • Installation, operation, and maintenance of onshore or offshore stationary sources (e.g., wind turbine generators, offshore substations, transmission lines, and interarray cables)	Refers to unanticipated release or spills into receiving waters of a fluid or other substance, such as fuel, chemical contaminants, hazardous materials, suspended sediment, invasive species, trash, or debris. Accidental releases or spills are distinct from routine discharges, consisting of authorized operational effluents which are restricted via treatment and monitoring systems and permit limitations. While accidental releases and spills are not authorized or

IPF	Sources or Activities	Description
		permitted, they are considered reasonably foreseeable.
Air emissions	• Combustion related stationary or mobile emission sources (e.g., generators [both on/offshore], or support vessels, vehicles, and aircraft) • Non-combustion related sources, such as leaks from tanks and switchgears	Refers to emission sources that emit regulated air pollutants (gaseous or particulate matter) into the atmosphere. Releases can occur on- and offshore.
Anchoring	• Anchoring of vessels • Attachment of a structure to the sea bottom by use of an anchor, mooring, or other installation method	Refers to seafloor disturbances (anything below Mean Higher High Water [MHHW]) related to any offshore construction or maintenance activities. Refers to an activity or action that disturbs or attaches objects to the seafloor.
Cable emplacement and maintenance	• Dredging or trenching • Cable placement • Seabed profile alterations • Sediment deposition and burial • Cable protection of concrete mattress and rock placement • Mooring lines	Refers to seafloor disturbances (anything below MHHW) related to the installation and maintenance of new offshore submarine cables. Cable placement methods include trenchless installation (such as HDD, direct pipe and auger bore), jetting, vertical injection, control flow excavation, trenching, and plowing.
Discharges/intakes	• Vessels • Structures • Onshore point and non-point sources • Dredged material ocean disposal • Installation, operation, and maintenance of submarine transmission lines, cables, and infrastructure • HVDC converter cooling system	Refers to routine permitted operational effluent **discharges** of pollutants to receiving waters. Types of discharges may include: bilge water, ballast water, deck drainage, gray water, fire suppression system test water, chain locker water, exhaust gas scrubber effluent, condensate, seawater cooling system intake and effluent, and HDD fluid. Water pollutants include produced water, manufactured or processed hydrocarbons, chemicals, sanitary waste, and deck drainage. Rainwater, freshwater, or seawater mixed with any of these constituents is also considered a pollutant. These **discharges** are restricted to uncontaminated or properly treated effluents that require BMPs or numeric pollutant concentration limitations as required through U.S. Environmental Protection Agency (USEPA) National Pollutant Discharge Elimination System (NPDES) permits or USCG regulations. Refers to the **discharge** of solid materials, such as the deposition of sediment at approved offshore disposal

IPF	Sources or Activities	Description
		or nourishment sites and cable protection. Discharge of dredged or fill material in the ocean seaward of the baseline, including material excavated from waters of the United States, including the 3-mile territorial seas, may be regulated through the Clean Water Act and must be evaluated for suitability for ocean disposal and permitted under the Marine Protection, Research, and Sanctuaries Act (MPRSA), unless it meets an exclusion or is deposited within the immediate footprint of the construction area. Lessees would need to consult with USEPA and the U.S. Army Corps of Engineers (USACE) to determine the appropriate permitting pathway. Refers to entrainment/impingement as a result of construction equipment use and **intakes** used by cable laying equipment and in HVDC converter cooling systems. Also refers to heated effluent from these systems.
Electric and magnetic fields (EMFs) and cable heat	• Substations • Power transmission cables • Interarray cables • Electricity generation	Power generation facilities and cables produce **electric fields** (proportional to the voltage) **and magnetic fields** (proportional to flow of electric current) around the power cables and generators. Three major factors determine levels of impact from the magnetic and induced electric fields from offshore wind energy projects: (1) the amount of electrical current being generated or carried by the cable, (2) the design of the generator or cable, and (3) the distance of organisms from the generator or cable. Refers to **thermal effects** of the transmission of electrical power, dependent on cable design and burial depth.
Land disturbance	• Vegetation clearance • Excavation • Grading • Placement of fill material • Land use changes	Refers to land disturbances (anything above MHHW) during onshore construction activities such as onshore cable installation and substation construction.
Lighting	• Vessels or offshore structures above or under water • Onshore construction and infrastructure	Refers to aviation and marine navigation lighting and construction lighting associated with offshore wind development that may produce light

IPF	Sources or Activities	Description
		onshore and offshore, as well as both above and under water.
Noise	• Impact and vibratory pile-driving and drilling • G&G surveys • UXO surveys and detonation/deflagration • Vessels • Aircraft • Cable laying or trenching • Site preparation (e.g., boulder clearance, sand wave clearance, pre-lay grapnel run, dredging) • Turbine operation • Onshore construction	Refers to noise from various sources, and includes sound pressure, particle motion, and substrate vibration effects. Commonly associated with construction activities, G&G surveys, and vessel traffic. May be impulsive (e.g., pile-driving) or broad spectrum and continuous (e.g., from project-associated marine transportation vessels). May also be noise generated from turbines themselves or interactions of the turbines with wind and waves.
Port utilization	• Expansion and construction • Maintenance • Use • Revitalization	Refers to activities or actions associated with port activity, upgrades, or maintenance that occur only as a result of the project from increased economic activity. Includes activities related to port expansion and construction such as placement of dredged materials, dredging to deepen channels for larger vessels, and maintenance dredging.
Presence of structures	• Onshore structures including towers and transmission cable infrastructure • Offshore structures including wind turbine generators and foundations, offshore substations, and scour/cable protection • HVDC converter cooling systems	Refers to the post-construction, long-term and permanent presence and operation and maintenance of onshore or offshore structures. Includes subsequent changes such as altered hydrodynamic patterns or seafloor disturbance associated with the presence of foundations and potential for non-native species establishment.
Survey gear utilization	• Monitoring surveys • Site preparation activities and post-construction surveys (i.e., geophysical, geotechnical)	Refers to capture, collection, and entanglement of marine species during monitoring surveys and habitat impacts from biological/fisheries survey activities. Refers to entanglement and bycatch during monitoring surveys, site preparation activities, and post-construction surveys.
Traffic	• Aircraft • Vessels (construction, O&M, surveys) • Vehicles • Towed arrays/equipment	Refers to marine vessel and onshore vehicle use, including use in support of construction, operation and maintenance, conceptual decommissioning activities, and surveys such as G&G, fisheries monitoring, and biological monitoring surveys. Refers to interaction of traffic with species.

3.2 AMMM Measures Identified for Analysis in the Programmatic Environmental Impact Statement

BOEM identified the AMMM measures analyzed in the Final PEIS from review of offshore wind COPs; COP EISs; scoping comment letters, input from cooperating and participating agencies, and Cooperating Tribal Governments; public comments on the Draft PEIS; internal input; and previous consultations. As part of the Proposed Action (Sub-alternative C1 [Preferred Alternative] and Sub-alternative C2), AMMM measures would be identified such that the potential impacts of the NY Bight projects could be reduced. BOEM analyzed AMMM measures that would be applicable to more than one NY Bight lease area, are reasonable and enforceable, and allow for flexibility where appropriate. BOEM may require some or all of these measures as conditions of approval for activities proposed by lessees in COPs submitted for the six NY Bight lease areas. BOEM may require additional or different measures based on future, site-specific NEPA analysis or the parameters of specific COPs. BOEM may also modify the measures at the COP-specific NEPA stage to tailor them to the characteristics of the proposed project and the site(s) of proposed activities, and to ensure conformity with project-specific consultations and authorizations. Appendix G, *Mitigation and Monitoring,* provides a description of the AMMM measures identified by BOEM for analysis under the Proposed Action in this Final PEIS.

BOEM has categorized the AMMM measures to reflect the relevant resource area(s) the measure applies to and assigned a unique measure identification number. AMMM measure identification numbers start with a prefix corresponding to the resource or resources the impacts on which they were designed to mitigate, including BB (birds and bats), BEN (benthic), BIR (birds), COMFIS (commercial fisheries and for-hire recreational fishing), CUL (cultural), EJ (environmental justice), MM (marine mammals), MMST (marine mammals and sea turtles), MUL (multiple), NAV (navigation), OU (other uses), ST (sea turtles), STF (sea turtles and ESA-listed fish), VIS (scenic and visual), and WQ (water quality). Measures that could potentially be applied across more than two resource areas were grouped under the multiple (MUL) category. Each resource section in Chapter 3 includes table(s) summarizing the AMMM measures applicable to the resource. The full description of the AMMM measures can be found in Appendix G.

Although not part of the Proposed Action, BOEM has also identified RPs for analysis in subsequent NEPA documents. These RPs were not analyzed as AMMM measures in the Final PEIS because they may not apply to all six lease areas, may depend on project-specific details that could not be analyzed in the Final PEIS, may be outside of BOEM's jurisdiction but have been routinely applied through previous consultations, or may need further development before application. Some of these RPs have been previously applied whereas others have been suggested through internal input, scoping letters, cooperating and participating agency input, input from Cooperating Tribal Governments, Draft PEIS public comments, and related consultations. The complete text of the RPs is included in Table G-2 of Appendix G, and each resource section in Chapter 3 includes a table summarizing the RPs applicable to the resource. These RPs are not being considered for programmatic application at this time, but BOEM encourages NY Bight lessees to analyze and consider implementing these RPs as they may further avoid and minimize environmental impacts.

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3.3 Impact Analysis Terms and Definitions

Based on previous environmental reviews, subject-matter expert input, consultation efforts, and public involvement to date, BOEM has identified the resources addressed in Section 3.4, *Physical Resources*, 3.5, *Biological Resources*, and 3.6, *Socioeconomic Conditions and Cultural Resources*, as those potentially affected by the Proposed Action and action alternatives. Each resource section includes adverse impact level definitions and geographic analysis area descriptions and maps.

In this section, BOEM identifies and defines terminology used in the Final PEIS impact analysis.

3.3.1 Activities Terminology

When assessing impacts on the resources, BOEM considers all ongoing and planned activities within the geographic analysis area. For the purposes of analysis, these activities are grouped into two categories: offshore wind and non-offshore-wind (i.e., activities other than offshore wind). The following definitions are used in this Final PEIS:

- **Non-offshore-wind**: Environmental stressors and activities include the following: (1) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (2) tidal energy projects; (3) dredging and port improvement 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. For more detailed definitions of these activities, refer to the Planned Activities Scenario (Appendix D).
- **Offshore wind**[1,2]
    - **Ongoing offshore wind**: Other offshore wind energy development activities that meet both of the following criteria: (1) the activity is not a part of the Proposed Action or any of the

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[1] Within this Final PEIS, BOEM analyzes Ocean Wind 1 (OCS-A 0498) as an ongoing offshore wind project and Ocean Wind 2 (OCS-A 0532) as a planned offshore wind project. On October 31, 2023, Orsted publicly announced its decision to cease development of Ocean Wind 1 and Ocean Wind 2. However, Ocean Wind LLC (the lessee for Ocean Wind 1) has not withdrawn its COP for lease OCS-A 0498. Therefore, BOEM has analyzed the project within this Final PEIS as described in the approved COP. On February 29, 2024, pursuant to 30 CFR 585.418, BOEM approved a 2-year suspension of the operations term of Ocean Wind LLC's commercial lease (Renewable Energy Lease Number OCS-A 0498), lasting until February 28, 2026. This suspension was approved in response to the lessee's January 19, 2024, request for a suspension of the operations term for the lease, submitted pursuant to Section 8(p)(5) of the OCSLA, 43 USC 1337(p)(5) and BOEM's implementing regulations at 30 CFR 585.416. Orsted North America Inc. (the lessee for Ocean Wind 2) has not relinquished or reassigned lease OCS-A 0532; therefore, BOEM has analyzed development of the lease area in this Final PEIS consistent with the assumptions identified in Appendix D.

[2] In January 2024, Empire Offshore Wind, LLC (the lessee for Empire Wind 1 and 2) announced it was terminating the OREC Agreement for the Empire Wind 2 project. Empire Offshore Wind, LLC has not informed BOEM of any material changes to the activities approved in its COP. Therefore, BOEM has analyzed development of the lease area in this Final PEIS consistent with the assumptions identified in Appendix D.

alternatives presented in this Final PEIS; and (2) the activity is currently under construction, operation, or has an approved COP in place as of September 20, 2024.

- **Planned offshore wind:** Other reasonably foreseeable future offshore wind energy development activities that meet the following criteria: (1) the activity is not a part of the Proposed Action or any of the alternatives presented in this Final PEIS; and (2) a renewable energy lease has been executed for a project, but there is not an approved COP at the time of publication of this Final PEIS.

3.3.2 Impact Terminology

In accordance with the most recent CEQ NEPA regulations (40 CFR 1501.3), federal agencies are required to evaluate the potentially affected environment and degree of the effects of the action when considering if effects are significant.

This Final PEIS uses a four-level classification scheme to characterize the potential beneficial and adverse impacts of the Proposed Action and alternatives. Impact levels described in BOEM's *Programmatic Environmental Impact Statement for Alternative Energy Development and Production, and Alternate Use of Facilities on the Outer Continental Shelf* (MMS 2007) were used as the initial basis for establishing adverse impacts specific to each resource. These resource-specific adverse impact level definitions were then further refined based on prior NEPA analyses, scientific literature, and best professional judgment and are presented by resource section in this chapter. The impact classification used in the analyses is considered an adverse impact unless specified with a bolded "beneficial." Beneficial impacts may not be present for each resource and are discussed in the relevant resource sections.

When evaluating beneficial impacts and assigning an impact level to each resource, BOEM used a more general impact definition. Table 3.3-1 defines potential beneficial impact levels across all resources in the Final PEIS.

Overall determinations consider the context, intensity (i.e., severity), directionality (adverse or beneficial), and duration of the effects and provide the basis for the impact level determination by resource. When considering the magnitude of impacts, the analysis should determine whether the impacts are geographically localized, regional, or widespread. With regard to temporal extent, the Final PEIS assumes that potential construction effects generally diminish once construction ends; however, ongoing O&M activities could result in additional impacts during the anticipated 35-year life[3] of the NY Bight projects. Additionally, lessees for the NY Bight projects would have up to an additional 2 years to complete conceptual decommissioning activities. Therefore, the Final PEIS considers the timeframe

[3] For analysis purposes, BOEM assumes that the NY Bight projects would have an operating period of 35 years. The NY Bight leases each have an operations term of 33 years that commences on the date of COP approval. The NY Bight lessees would need to request and be granted an extension of its operations term from BOEM under the regulations at 30 CFR 585.425 *et seq*. in order to operate the NY Bight projects for 35 years. While the NY Bight lessees have not made such a request, this PEIS uses the longer period in order to avoid possibly underestimating any potential effect.

beginning with construction and ending when the NY Bight projects' conceptual decommissioning is complete, unless otherwise noted.

When considering duration of impacts under NEPA, this Final PEIS uses the following terms:

- **Short-term effects:** Effects lasting less than the duration of construction (3–5 years).[4] An example would be road closures or traffic delays during onshore cable installation. Once construction is complete, the effect would end.
- **Long-term effects:** Effects lasting longer than the duration of construction and for the life of the NY Bight projects (35 years). An example would be the loss of habitat where a foundation has been installed and later removed during conceptual decommissioning.
- **Permanent effects**: Effects lasting the life of the NY Bight projects and beyond. An example would be the conversion of land to support new onshore facilities.

Some impacts of the NY Bight projects may not be measurable at the programmatic level, such as the beneficial impacts on benthic resources due to artificial habitat or climate change due to a reduction in greenhouse gas emissions.

The following definitions are used to describe the impact of the Proposed Action and each alternative in relation to ongoing and planned non-offshore and other offshore wind activities:

- **Undetectable**: The impact contributed by the Proposed Action or alternatives to ongoing and planned non-offshore and other offshore wind activities is so small that it is extremely difficult or impossible to discern or measure.
- **Noticeable**: The impact contributed by the Proposed Action or alternatives, while evident and measurable, is still relatively small in proportion to the impacts from the Proposed Action or alternatives when combined with ongoing and planned non-offshore and other offshore wind activities.
- **Appreciable**: The impact contributed by the Proposed Action or alternatives is measurable and constitutes a relatively large portion of the impacts from the Proposed Action or alternatives when combined with ongoing and planned non-offshore and other offshore wind activities.

Table 3.3-1. Definitions of potential beneficial impact levels

Impact Level	Physical, Biological, and Cultural Resources	Socioeconomic Resources
Negligible	Impacts would be so small that it is extremely difficult or impossible to discern or measure.	Impacts would be so small that it is extremely difficult or impossible to discern or measure.

[4] The construction period for each individual lease area is currently unknown. Therefore, BOEM is assuming a 3- to 5-year construction period for each lease area for analysis purposes in this PEIS.

Impact Level	Physical, Biological, and Cultural Resources	Socioeconomic Resources
Minor	Small and measurable effects that would comprise at least one of the following: • Improvement in ecosystem health • Favorable increase in the extent and quality of habitat for both special status species and species common to NY Bight project area • Favorable increase in populations of species common to the NY Bight project area • Improvement in air or water quality • Limited spatial extent or short-term duration of improved protection of physical cultural resources	Small and measurable effects that would comprise at least one of the following: • Improvement in human health • Increase in employment (job creation and workforce development) • Improvements to infrastructure/facilities and community services • Favorable economic improvement (increase in local business expenditures, gross domestic product, labor income, property values, supply chain needs, and tax revenue) • Increase in tourism • Improvements for individuals or communities that result from enhanced protection of cultural resources • Equitable access for underserved communities to beneficial effects
Moderate	Notable and measurable effects comprising at least one of the following: • Improvement in ecosystem health • Favorable increase in the extent and quality of habitat for both special status species and species common to the NY Bight project area • Favorable increase in populations of species common to the NY Bight project area • Improvement in air and water quality • Extensive/complete spatial extent, or long-term duration of, improved protection of physical cultural resources	Notable and measurable effects comprising at least one of the following: • Improvement in human health • Increase in employment (job creation and workforce development) • Improvements to infrastructure/facilities and community services • Favorable economic improvement (increase in local business expenditures, gross domestic product, labor income, housing demand, supply chain needs, and tax revenue) • Increase in tourism • Improvements for individuals and communities that result from enhanced protection of cultural resources • Equitable access for underserved communities to beneficial effects
Major	National, regional, or population-level effects comprising at least one of the following: • Improvement in ecosystem health • Favorable increase in extent and quality of habitat for both special status species and species common to the NY Bight project area • Favorable increase in populations of species common to the NY Bight project area • Improvement in air or water quality • Permanent protection of physical cultural resources (i.e., preservation easements)	Large local, or notable national or regional effects comprising at least one of the following: • Improvement in human health • Increase in employment (job creation and workforce development) • Improvements to infrastructure/facilities and community services • Favorable economic improvement (increase in local business expenditures, gross domestic product, labor income, housing demand, supply chain needs, and tax revenue) • Increase in tourism • Improvements for individuals and communities that result from enhanced protection of cultural resources • Equitable access for underserved communities to beneficial effects

Table 2-4. Summary and comparison of impacts among alternatives

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
3.4.1 Air Quality and Greenhouse Gas Emissions	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **moderate** impacts on air quality because of air pollutant emissions, greenhouse gas (GHG) emissions, and accidental releases. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in overall **moderate** impacts due to emissions of criteria pollutants, volatile organic compounds (VOCs), and hazardous air pollutants (HAPs), mostly released during construction and conceptual decommissioning. Offshore wind projects likely would lead to reduced emissions from fossil-fuel power plants and consequently **minor to moderate beneficial** impacts on regional air quality after offshore wind projects are operational.	*Alternative B:* A single NY Bight project and six NY Bight projects would likely result in **minor to moderate** impacts from pollutant emissions. There would be a **minor beneficial** impact on air quality near the NY Bight project area and the surrounding region overall to the extent that the wind energy produced would displace energy produced by fossil-fuel power plants (greater beneficial impact for six NY Bight projects than for one NY Bight project). *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **moderate** impacts mainly due to construction and operational activities. Six NY Bight projects and other offshore wind projects would have **moderate beneficial** impacts on air quality in the region surrounding six NY Bight projects to the extent that energy produced by offshore wind projects would displace energy produced by fossil-fuel power plants.	*Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures, and impacts on air quality are anticipated to be the same as those under Alternative B for a single NY Bight project and six NY Bight projects. There would be **minor to moderate** impacts from pollutant emissions and **minor beneficial** impacts to the extent that the wind energy produced would displace energy produced by fossil-fuel power plants (greater beneficial impact for six NY Bight projects than for one NY Bight project). *Cumulative Impacts of Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures, and cumulative impacts on air quality are anticipated to be the same as those under Alternative B. They would be **moderate** and **moderate beneficial**.	*Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures. Therefore, impacts under Sub-alternative C2 would be the same as those under Sub-alternative C1 and Alternative B. There would be **minor to moderate** impacts from pollutant emissions and a **minor beneficial** impact to the extent that the wind energy produced would displace energy produced by fossil-fuel power plants (greater beneficial impact for six NY Bight projects than for one NY Bight project). *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures, and cumulative impacts on air quality are anticipated to be the same as those under Alternative B and Sub-alternative C1. They would be **moderate** and **moderate beneficial**.
3.4.2 Water Quality	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **minor** impacts on water quality, primarily due to accidental releases, sediment suspension, port utilization, presence of structures, discharges/intakes, and land disturbance. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would likely result in **negligible** to **minor** impacts because any potential detectable impacts are not anticipated to exceed water quality standards. A moderate impact could occur if there was a large-volume, catastrophic release. However, the probability of catastrophic release occurring is very low, and the expected size of the most likely spill would be very small and of low frequency.	*Alternative B:* A single NY Bight project or six NY Bight projects would likely result in **negligible** to **minor** impacts on water quality, although a large accidental release could result in **moderate** impacts. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would result in **negligible** to **minor** impacts. A large volume, catastrophic release could result in a **moderate** cumulative impact on water quality.	*Sub-alternative C1:* Four previously applied AMMM measures have been identified that could reduce impacts on water quality, including those that could potentially reduce trash and debris entering the water, reduce sediment disturbance and turbidity, and reduce pollutant impacts. Because the effectiveness of these measures is dependent on many factors and cannot be reasonably quantified, impacts on water quality under Sub-alternative C1 are expected to be the same as those under Alternative B for one NY Bight project and six NY Bight projects, **negligible** to **minor**, except in the case of a large accidental release when impacts could be **moderate.** *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely result in **negligible** to **minor** impacts, except in the case of a large accidental release where cumulative impacts on water quality could potentially be **moderate**.	*Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for water quality; therefore, the impacts under Sub-alternative C2 are the same as those under Sub-alternative C1. They would be **negligible** to **minor**, except in the case of a large accidental release when impacts could be **moderate.** *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for water quality; therefore, the cumulative impacts under Sub-alternative C2 are the same as those under Sub-alternative C1. They would be **negligible** to **minor**, except in the case of a large accidental release where cumulative impacts on water quality could potentially be **moderate**.
3.5.1 Bats	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** impacts on bats. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative, when combined with all other	*Alternative B:* A single NY Bight project and six NY Bight projects would likely result in **negligible** to **minor** impacts, primarily driven by the amount (unknown) of bat habitat (i.e., forest) that would be altered or removed.	*Sub-alternative C1:* Three previously applied AMMM measures have been identified that could reduce impacts on bats. The AMMM measures would improve the overall understanding of bats in the offshore environment from monitoring and dead/injured bat reporting and could reduce potential impacts on bats through adaptive management. While the AMMM measures could	*Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for bats; therefore, the impacts on bats under Sub-alternative C2 are the same as those under Sub-alternative C1, and they would be **negligible** to **minor**.

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
	planned activities (including other offshore wind) would likely result in overall **negligible** to **minor** impacts from noise, presence of structures, and land disturbance.	*Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **negligible** to **minor** impacts.	potentially reduce impacts in the offshore environment, they still do not eliminate the potential for a range of potential impacts onshore because the locations of the onshore project components are not known, and, therefore, the related forest impacts could still vary under Sub-alternative C1. Thus, the impacts under Sub-alternative C1 are not expected to be different than those under Alternative B for one NY Bight project and six NY Bight projects, which would range from **negligible** to **minor** depending on the amount and extent of bat habitat impacts. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **minor**.	*Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for bats; therefore, the cumulative impacts on bats under Sub-alternative C2 are the same as those under Sub-alternative C1, and they would be **negligible** to **minor**.
3.5.2 Benthic Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **minor** impacts on benthic resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative when combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** impacts from the installation of cables, turbines, and other offshore structures from other offshore wind projects and **minor beneficial** impacts from presence of structures.	*Alternative B:* A single NY Bight project would likely result in **negligible** to **moderate** impacts, primarily driven by disturbance due to placement of offshore structures and temporary benthic habitat disturbances during construction. These offshore structures could also have **moderate beneficial** impacts. Six NY Bight projects would likely result in **negligible** to **major** impacts, with **moderate beneficial** impacts for species that are able to colonize the newly added hard surfaces. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **negligible** to **major** impacts from the scale increase in benthic disturbance fragmenting benthic habitat and the number of permanent structures, though **moderate beneficial** impacts are also anticipated for species that are able to colonize the newly added hard surfaces.	*Sub-alternative C1:* Twelve previously applied AMMM measures have been identified that could reduce impacts on benthic resources. AMMM measures could improve siting of infrastructure to avoid sensitive benthic habitats; minimize boulder relocation and scour protection to lessen benthic habitat disturbance; ensure that construction methods and material are environmentally sound and enable colonization of benthic communities; and require proper training, monitoring, and reporting to minimize impacts and aid habitat recovery. Combined, these actions would likely decrease benthic disturbances overall; however, the impact rating for a single NY Bight project is still expected to be **negligible** to **moderate**, and the impact rating for six NY Bight projects is also still expected to be **negligible** to **moderate**. **Moderate beneficial** impacts are expected for species that are able to colonize the newly added hard surfaces, and those attracted by new food sources. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **major** with **moderate beneficial** impacts.	*Sub-alternative C2:* One not previously applied AMMM measure has been identified that could reduce impacts from noise by requiring a received sound level limit to minimize sound levels during impact pile-driving activities. A single NY Bight project and six NY Bight projects would likely result in the same impacts as those of Sub-alternative C1. Impacts would be **negligible** to **moderate** for both a single NY Bight project and six NY Bight projects, with **moderate beneficial** impacts. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with previously applied and not previously applied AMMM measures would likely be **negligible** to **major** with **moderate beneficial** impacts.
3.5.3 Birds	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **minor** impacts on birds. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative, when combined with all other planned activities (including other offshore wind), would likely result in **negligible** to **moderate** impacts from accidental releases, lighting, cable emplacement and maintenance, noise, presence of structures, traffic (aircraft), and land disturbance, and **moderate beneficial** impacts from the presence of offshore	*Alternative B:* A single NY Bight project and six NY Bight projects would likely result in **negligible** to **moderate** impacts with the primary risk from operation of WTGs and potential removal of onshore habitat, **minor beneficial** impacts associated with foraging opportunities for some marine birds, and **minor** to **moderate beneficial** impacts to small land bird populations due to the reduction in ozone from offshore wind energy generation displacing fossil fuels. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with	*Sub-alternative C1:* Seven previously applied AMMM measures have been identified that could reduce impacts on birds. The AMMM measures would improve the overall understanding of birds in the offshore environment from monitoring and dead/injured bird reporting and could reduce potential impacts on birds through adaptive management. The lighting minimization and reduction AMMM measures (including ADLS) and perching deterrent AMMM measure could also reduce bird collision risk. Compensatory mitigation would help to compensate for impacts on ESA-listed birds. Even though the presence of birds on the OCS is generally low, the AMMM measures could provide some reduction in	*Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for birds; therefore, the impacts on birds under Sub-alternative C2 are the same as those under Sub-alternative C1. They would be **negligible** to **moderate** and **minor** to **moderate beneficial**. *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for birds; therefore, the cumulative impacts on birds under Sub-alternative C2 are the same as those under Sub-alternative C1. They would be **negligible** to **moderate** and **minor** to **moderate beneficial**.

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
	structures. In addition, the displacement of fossil fuels in the generation of electricity by offshore wind would further reduce ozone and consequently result in **minor** to **moderate beneficial** impacts to populations of small land birds.	ongoing and planned activities, including other offshore wind activities would likely result in **negligible** to **moderate** impacts and **minor** to **moderate beneficial** impacts.	potential impacts; however, Sub-alternative C1 may not be substantially different than Alternative B for impacts in the offshore environment. While the AMMM measures could reduce impacts in the offshore environment, they still do not eliminate the potential for a wide range of potential impacts because the locations of the onshore project components are not known and, therefore, the related habitat impacts could still vary widely under Sub-alternative C1. Thus, the impacts under Sub-alternative C1 would not be different than those under Alternative B for one NY Bight project and six NY Bight projects, which would likely range from **negligible** to **moderate** and **minor** to **moderate beneficial**. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **moderate** and **minor** to **moderate beneficial**.	
3.5.4 Coastal Habitat and Fauna	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **moderate** impacts on coastal habitat and fauna. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative, when combined with all other planned activities (including other offshore wind) would likely result in **negligible** to **moderate** impacts from accidental releases, noise, traffic, and land disturbance.	*Alternative B:* A single NY Bight project and six NY Bight projects would likely result in **negligible** to **minor** impacts with the primary risk from the short-term potential onshore removal of habitat, which could lead to impacts in the form of fauna mortality and habitat alteration, although BOEM anticipates faunal mortality to be rare. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **negligible** to **moderate** impacts primarily through the short-term to permanent impacts from onshore habitat loss related to onshore substations and cables.	*Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures for coastal habitat and fauna; therefore, the impacts on coastal habitat and fauna under Sub-alternative C1 would be the same as described in Alternative B and would be **negligible** to **minor.** *Cumulative Impacts of Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures for the coastal habitat and fauna; therefore, the cumulative impacts on coastal habitat and fauna under Sub-alternative C1 would be the same as those under Alternative B and would be **negligible** to **moderate**.	*Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for coastal habitat and fauna; therefore, the impacts on coastal habitat and fauna under Sub-alternative C2 are the same as those under Sub-alternative C1 (comparable to Alternative B) and would be **negligible** to **minor.** *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any AMMM measures not previously applied for coastal habitat and fauna; therefore, the cumulative impacts on coastal habitat and fauna under Sub-alternative C2 are the same as those under Sub-alternative C1 (and Alternative B) and would be **negligible** to **moderate**.
3.5.5 Finfish, Invertebrates, and Essential Fish Habitat	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **moderate** impacts on finfish, invertebrates, and EFH resources. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative when combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** impacts primarily through resource exploitation, dredging, bottom trawling, bycatch, anthropogenic noise, new cable emplacement, and the presence of structures.	*Alternative B:* A single NY Bight project would likely result in impacts ranging from **negligible** to **moderate** depending on the impact producing factor (IPF), including the presence of structures; for six NY Bight projects, impacts would range from **negligible** to **major** depending on IPF. Six NY Bight projects would contribute to the overall impact rating primarily through the simultaneous disturbance with new cable emplacement and WTGs/OSSs and the permanent impacts from the presence of structures (cable protection measures and foundations). For both one and six projects, **minor beneficial** impacts would result from the presence of structures for finfish, invertebrates, and EFH. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with	*Sub-alternative C1:* Twenty previously applied AMMM measures have been identified that could reduce impacts on finfish, invertebrates, and EFH resources, including measures that would likely reduce impacts from cable emplacement by minimizing boulder relocation and scour protection to lessen benthic habitat disturbance; employing methods and material that are environmentally sound and enable colonization of and habitat use; inspecting cable burial; and implementing measures to minimize noise impacts. Some of the measures would mitigate impacts from fisheries monitoring survey gear utilization. Other measures aim to reduce impacts from the presence of structures by routine monitoring for debris and reducing impacts from anchoring. Impacts are expected to range from **negligible** to **minor** with potentially **minor beneficial** impacts for one NY Bight project and **negligible** to **moderate** with	*Sub-alternative C2:* Two not previously applied AMMM measures have been identified that could reduce impacts: one to prevent impingement or entrainment of fish larvae and juveniles and one that would reduce noise impacts. Sub-alternative C2 would not change the overall rating of **negligible** to **minor** with potentially **minor beneficial** impacts for one NY Bight project, **negligible** to **moderate** for six NY Bight projects, and **minor** to **moderate beneficial** impacts. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with previously applied and not previously applied AMMM measures would likely be **negligible** to **major** with a potential for **minor** to **moderate beneficial** impacts.

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
		ongoing and planned activities, including other offshore wind activities, would likely range from **negligible** to **major** and **minor** to **moderate beneficial**. Impacts would be most pronounced if construction of six NY Bight projects and other ongoing and planned actions happened simultaneously. If six NY Bight projects and other planned offshore wind projects were staggered, then the impact rating could decrease by allowing the resource to recover from each project.	potentially **minor** to **moderate beneficial** impacts for six NY Bight projects, depending on the IPF. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **major** with a potential for **minor** to **moderate beneficial** impacts.	
3.5.6 Marine Mammals	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative is expected to result in **negligible** to **moderate** impacts on all marine mammals except North Atlantic right whales (NARW), and **negligible** to **major** impacts on NARW, depending on the IPF. **Moderate** impacts are expected for non-NARW marine mammals due to non-offshore wind related fishing gear utilization, pile driving and UXO detonation noise, and vessel strikes. For NARW, impacts differ since the human-caused mortality currently exceeds the species' potential biological removal due to the existing baseline conditions. **Major** impacts on NARW would be expected from vessel strikes and non-offshore wind related fishing gear utilization; **moderate** due to presence of structures and noise from impact pile-driving and UXO detonation; and **negligible** to minor for all other IPFs. Additionally, the presence of structures could include **minor beneficial** impacts for some species (e.g., odontocetes and pinnipeds) that benefit from increased prey availability, which may be offset by the potential risks associated with entanglement from fishing gear. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would likely result in **negligible** to **moderate** impacts on mysticetes (except the NARW), odontocetes, and pinnipeds because the anticipated impacts would be notable and measurable, but populations are expected to recover completely when IPF stressors are removed. Impacts on NARW would be **negligible** to **major**, with **major** impacts expected to result from vessel strikes and non-offshore wind related fishing gear utilization due to the existing baseline conditions, as loss of an individual would result in population-level effects that threaten the viability of the species. Additionally, the presence of structures could include **minor beneficial** impacts for non-ESA-listed odontocetes and pinnipeds due to the artificial reef effect.	*Alternative B:* For one or six NY Bight projects, BOEM expects impacts to be **negligible** to **moderate** for all marine mammals except NARW, and **negligible** to **major** for NARW, depending on the IPF. Moderate impacts are expected for non-NARW marine mammals due to unmitigated UXO detonations and unmitigated impact pile-driving for one or six NY Bight projects. Moderate impacts are also expected for non-NARW mysticetes due to vessel traffic. For NARW, impacts would differ since the human-caused mortality currently exceeds the species' potential biological removal due to anticipated impacts of vessel traffic, entanglement due to derelict fishing gear resulting from the presence of structures, unmitigated UXO detonations, and unmitigated impact pile-driving for one or six NY Bight projects. For all other IPFs, for one or six NY Bight projects, BOEM expects impacts to range from negligible to minor for mysticetes (including NARW), odontocetes, and pinnipeds. BOEM further expects, for one or six NY Bight projects, **minor beneficial** impacts on non-ESA-listed odontocetes and pinnipeds due to the presence of structures, though such impacts may be offset by the increased risk of entanglement due to derelict fishing gear on the structures. *Cumulative Impacts of Alternative B:* Cumulative impacts of one or six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely range from **negligible** to **major** for NARW, due to the existing baseline conditions, and **negligible** to **moderate** for non-NARW mysticetes, odontocetes, and pinnipeds, depending on the IPF, and could include **minor beneficial** impacts for odontocetes and pinnipeds due to the presence of structures. Major impacts are expected for NARW due to vessel strikes and non-offshore wind-related fishing gear utilization	*Sub-alternative C1:* Thirty previously applied AMMM measures have been identified that could reduce impacts on marine mammals, including measures aimed at reducing impacts from noise, vessel traffic (vessel strike), and the presence of structures (secondary entanglement). Overall, BOEM expects impacts from Sub-alternative C1 to be **negligible** to **moderate** for all marine mammals except NARW for one NY Bight project with the inclusion of AMMM measures, and **negligible** to **minor** for NARW. For six NY Bight projects, BOEM expects impacts to be **negligible** to **moderate** for all marine mammals, including NARW. For one or six NY Bight projects, with inclusion of the AMMM measures under Sub-alternative C1, BOEM expects impacts from vessel strikes to be reduced to negligible for all marine mammals (including NARW); impacts resulting from presence of structures (secondary entanglement) for one or six NY Bight projects are expected to be reduced to minor for all marine mammals (including NARW); and impacts resulting from UXO detonation noise under one or six projects would be reduced to minor for all marine mammals (including NARW), when compared to Alternative B. Impacts resulting from impact pile-driving noise would be reduced to minor for NARWs from Alternative B for one project since many AMMM measures are specific to NARWs, and would remain moderate for non-NARW marine mammals for one project. Impacts from pile-driving noise would be moderate for all marine mammals (including NARW) for six NY Bight projects under Sub-alternative C1, which is reduced from major for NARW under Alternative B with the application of AMMM measures. For all other IPFs, for one or six NY Bight projects, BOEM expects impacts to range from negligible to minor for	*Sub-alternative C2:* One not previously applied AMMM measure has been identified that could reduce impacts from noise from impact pile-driving. Overall, BOEM expects impacts from Sub-alternative C2 to be **negligible** to **minor** for all marine mammals (including NARW) for one NY Bight project with the inclusion of AMMM measures. For six NY Bight projects, BOEM expects impacts to be **negligible** to **moderate** for all marine mammals, including NARW. Impacts from pile-driving noise for one project for NARWs would remain minor with the AMMM measure under Sub-alternative C2, but would be reduced from moderate to minor under Sub-alternative C2 for all other mysticetes, odontocetes, and pinnipeds. Impacts from pile-driving noise for six projects for all marine mammals, including NARWs, would remain moderate**,** even with the additional AMMM measure under Sub-alternative C2. For all other IPFs, for one or six NY Bight projects, BOEM expects impacts to range from negligible to minor for mysticetes (including NARW), odontocetes, and pinnipeds. One or six NY Bight projects could also include **minor beneficial** impacts to odontocetes and pinnipeds from the presence of structures. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **major** for the NARW, due to the existing baseline conditions, and **negligible** to **moderate** for non-NARW, mysticetes, odontocetes, and pinnipeds, and could include **minor beneficial** impacts for odontocetes and pinnipeds. Major impacts are expected for NARW due to vessel strikes and non-offshore wind related fishing gear utilization due to the existing baseline conditions, as loss of an individual would result in population-level effects that threaten the viability of the species.

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
		due to the existing baseline conditions, as loss of an individual would result in population-level effects that threaten the viability of the species.	mysticetes (including NARW), odontocetes, and pinnipeds. One or six NY Bight projects could also include **minor beneficial** impacts to odontocetes and pinnipeds from the presence of structures. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **major** for the NARW, due to the existing baseline conditions, and **negligible** to **moderate** for non-NARW, mysticetes, odontocetes, and pinnipeds, and they could include **minor beneficial** impacts for odontocetes and pinnipeds. Major impacts are expected for NARW due to vessel strikes and non-offshore wind-related fishing gear utilization due to the existing baseline conditions, as loss of an individual would result in population-level effects that threaten the viability of the species.	
3.5.7 Sea Turtles	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **moderate** impacts on sea turtles. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative, when combined with all other planned activities (including other offshore wind) would likely result in overall **negligible** to **moderate** impacts from accidental releases and discharges, EMF and cable heat, port utilization, cable emplacement and maintenance, noise, presence of structures, traffic, and survey gear utilization. **Minor beneficial** impacts for sea turtles are expected to result from the presence of structures primarily due to an increase in foraging opportunity as a result of the artificial reef effect, though such impacts may be offset by the increased risk of entanglement due to derelict fishing gear on the structures.	*Alternative B:* One or six NY Bight projects are expected to result in **negligible** to **moderate** impacts mainly from pile-driving noise, UXO detonations, and the presence of structures related to fishing gear entanglement. **Minor beneficial** impacts for sea turtles are expected to result from the presence of structures primarily due to an increase in foraging opportunity as a result of the artificial reef effect, though such impacts may be offset by the increased risk of entanglement due to derelict fishing gear on the structures. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **negligible** to **moderate** impacts and **minor beneficial** impacts.	*Sub-alternative C1:* Twenty-seven previously applied AMMM measures have been identified that could reduce impacts on sea turtles. AMMM measures under Sub-alternative C1 would reduce some impacts on sea turtles compared to Alternative B. Potential impacts on sea turtles from accidental releases, noise, presence of structures, traffic, and survey gear utilization may be reduced under Sub-alternative C1. Potential impacts on sea turtles from discharges and intakes, cable emplacement and maintenance, EMF and cable heat, port utilization, and lighting are not expected to change under Sub-alternative C1. Overall, when considering all IPFs together under Sub-alternative C1, expected impacts would still range from **negligible** to **moderate** and **minor beneficial** for sea turtles for one NY Bight project or six NY Bight projects. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **moderate** with **minor beneficial** impacts.	*Sub-alternative C2:* One not previously applied AMMM measure has been identified that could reduce impacts associated with the noise IPF on sea turtles; however, this AMMM measure is not expected to reduce impact levels compared to Sub-alternative C1. The overall impact level of **negligible** to **moderate** and **minor beneficial** would not change for one NY Bight project or six NY Bight projects. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with previously applied and not previously applied AMMM measures would likely be **negligible** to **moderate** with **minor beneficial** impacts.
3.5.8 Wetlands	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **moderate** impacts on wetlands. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **moderate** impacts given that permanent wetland impacts could occur, and any activity would be required to comply with federal, state,	*Alternative B:* A single NY Bight project and six NY Bight projects would likely result in **negligible** to **moderate** impacts on wetlands, depending on the area of wetland affected, the types of wetland affected, and duration of impact. For projects that would incur wetland impacts, compensatory mitigation would be required to reduce impacts on wetlands pursuant to Clean Water Act (CWA) Section 404(b)(1) guidelines. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with	*Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures for wetlands; therefore, the impacts on wetlands under Sub-alternative C1 are the same as those under Alternative B. They would be **negligible** to **moderate** for one NY Bight project and six NY Bight projects. *Cumulative Impacts of Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures for wetlands; therefore, the cumulative impacts on wetlands under Sub-alternative C1 would be the same as those	*Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for wetlands; therefore, the impacts on wetlands under Sub-alternative C2 are the same as those under Sub-alternative C1 and would be **negligible** to **moderate** for one NY Bight project and six NY Bight projects. *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for wetlands; therefore, the cumulative impacts on wetlands under Sub-alternative C2 are the

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
	and local regulations related to the protection of wetlands and mitigation of impacts.	ongoing and planned activities, including other offshore wind activities, would be **negligible** to **moderate.**	under Alternative B and would likely be **negligible** to **moderate.**	same as those under Sub-alternative C1 and would be **negligible** to **moderate**.
3.6.1 Commercial Fisheries and For-Hire Recreational Fishing	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **major** impacts on commercial fisheries and for-hire recreational fishing, driven largely by effects of climate change. **Minor beneficial** impacts on for-hire recreational fishing may also occur from the presence of offshore structures resulting in fish aggregating effects. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **major** impacts on commercial fisheries and for-hire recreational fishing, largely dependent on fisheries managers' ability to adapt to the effects of climate change. The presence of structures may also induce a **minor beneficial** impact on for-hire recreational fishing.	*Alternative B:* A single NY Bight project and six NY Bight projects would likely result in **negligible** to **major** impacts on commercial fisheries and for-hire recreational fishing, driven largely by the presence of structures. **Minor** to **moderate beneficial** impacts on for-hire recreational fishing may also occur from the presence of offshore structures resulting in fish aggregating effects. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **negligible** to **major** impacts on commercial fisheries and for-hire recreational fishing, driven largely by the presence of structures. **Moderate beneficial** impacts on for-hire recreational fishing may also occur from the presence of offshore structures resulting in fish aggregating effects.	*Sub-alternative C1:* Eight previously applied AMMM measures have been identified that could reduce impacts on commercial fisheries and for-hire recreational fishing. The AMMM measures would compensate commercial and for-hire recreational fishermen for loss of income due to unrecovered economic activity and shoreside businesses for losses indirectly related to the expected development and provide monetary compensation for lost gear or income, with several proposing design measures to reduce potential fishing gear snags. Other AMMM measures propose the development of monitoring plans or adaptive management plans that would increase data and knowledge that might facilitate the development of future mitigation measures to reduce impacts on commercial fisheries and for-hire recreational fishing. If applied, the AMMM measures could reduce overall impacts on commercial fisheries and for-hire recreational fishing for one NY Bight project and six NY Bight projects from negligible to major to **negligible** to **moderate**, a reduction driven largely by the compensatory mitigation that would mitigate impacts on commercial and recreational fishing operations. There may also be **minor** to **moderate beneficial** impacts on for-hire recreational fishing. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely remain unchanged at **negligible** to **major** because some commercial and for-hire recreational fisheries and fishing operations could experience substantial disruptions indefinitely, even with the AMMM measures. There may also be **moderate beneficial** impacts on for-hire recreational fishing.	*Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for commercial fisheries and for-hire recreational fishing; therefore, the impacts on commercial fisheries and for-hire recreational fishing are the same as those under Sub-alternative C1 for one and six NY Bight projects. They would be **negligible** to **moderate**, with **minor** to **moderate beneficial** impacts on for-hire recreational fishing. *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for commercial fisheries and for-hire recreational fishing; therefore, the cumulative impacts on commercial fisheries and for-hire recreational fishing under Sub-alternative C2 are the same as those under Sub-alternative C1. They would be **negligible** to **major**, with **moderate beneficial** impacts on for-hire recreational fishing.
3.6.2 Cultural Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **minor** to **major** impacts on cultural resources due to accidental releases, anchoring, cable emplacement and maintenance, survey gear utilization, land disturbance, lighting, and presence of structures. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **major** impacts on cultural resources.	*Alternative B:* Development of one NY Bight project would likely result in **moderate** to **major** impacts overall on cultural resources depending on the NY Bight lease area subject to development. Development of six NY Bight projects would likely result in **major** impacts overall. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would result in **major** impacts due to the extent of onshore and offshore development and extent of known cultural resources in the region subject to impacts.	*Sub-alternative C1:* Six previously applied AMMM measures designated for cultural resources could reduce impacts on cultural resources associated with accidental releases, anchoring, cable emplacement and maintenance, survey gear utilization, land disturbance, lighting, and presence of structures. However, site-specific information is needed to fully evaluate the effects on cultural resources. Therefore, development of one NY Bight project would likely result in the same or similar **moderate** to **major** impacts overall on cultural resources as Alternative B. Similarly, six NY Bight projects would likely result in the same or similar **major** impacts overall on cultural resources as Alternative B.	*Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for cultural resources; therefore, the impacts on cultural resources are the same as those under Sub-alternative C1. They would be **moderate** to **major** for one NY Bight project and **major** for six NY Bight projects. *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for cultural resources; therefore, the cumulative impacts on cultural resources under Sub-alternative C2 are the same as those under Sub-alternative C1 and would be **major.**

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
			Cumulative Impacts of Sub-alternative C1: Cumulative impacts of six NY Bight projects with previously applied AMMM measures, when combined with ongoing and planned activities, including other offshore wind activities, would result in the same or similar **major** impacts overall on cultural resources as Alternative B.	
3.6.3 Demographics, Employment, and Economics	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **minor** impacts on demographics, employment, and economics. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would likely result in **negligible** to **minor** impacts and **minor beneficial** impacts on demographics, employment, and economics.	*Alternative B:* A single NY Bight project and six NY Bight projects would both likely result in impacts ranging from **negligible** to **minor** depending on the IPF, as well as **minor beneficial** impacts on demographics, employment, and economics. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would result in **negligible** to **minor** impacts and **moderate beneficial** impacts on demographics, employment, and economics.	*Sub-alternative C1:* No previously applied AMMM measures have been identified that could directly reduce impacts on demographics, employment, and economics; however, AMMM measures that reduce impacts on commercial fisheries and for-hire recreational fishing and recreation and tourism could benefit regional employment and economics. The impact rating for demographics, employment, and economics is anticipated to remain **negligible** to **minor** with **minor beneficial** impacts for one NY Bight project and six NY Bight projects. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in the same **negligible** to **minor** impacts and **moderate beneficial** impacts on demographics, employment, and economics.	*Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for demographics, employment, and economics; therefore, the impacts on demographics, employment, and economics are the same as those under Sub-alternative C1. They would be **negligible** to **minor** with **minor beneficial** impacts for one NY Bight project and six NY Bight projects. *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for demographics, employment, and economics; therefore, the cumulative impacts on demographics, employment, and economics under Sub-alternative C2 are the same as those under Sub-alternative C1. There would be **negligible** to **minor** impacts and **moderate beneficial** impacts.
3.6.4 Environmental Justice	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **moderate** impacts on communities with environmental justice concerns. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would likely result in **negligible** to **moderate** impacts and **minor beneficial** impacts on communities with environmental justice concerns due to potential air quality improvements as a result of reduced reliance on fossil fuels for energy.	*Alternative B:* A single NY Bight project and six NY Bight projects would both likely result in impacts ranging from **negligible** to **major**, and **minor** to **moderate beneficial** impacts on communities with environmental justice concerns. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would result in **negligible** to **major** impacts and **minor** to **moderate beneficial** impacts on communities with environmental justice concerns.	*Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures specifically for communities with environmental justice concerns; therefore, the impacts on communities with environmental justice concerns are the same as those under Alternative B. There would be **negligible** to **major**, and **minor** to **moderate beneficial** impacts from one or six NY Bight projects. *Cumulative Impacts of Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures specifically for communities with environmental justice concerns; therefore, the cumulative impacts on communities with environmental justice concerns under Sub-alternative C1 are the same as those under Alternative B. There would be **negligible** to **major** adverse impacts and **minor** to **moderate beneficial** impacts.	*Sub-alternative C2:* Two not previously applied AMMM measures have been identified that could reduce impacts on communities with environmental justice concerns through implementation of an Environmental Justice Communication Plan and regular reporting for the plan. The impacts on communities with environmental justice concerns for one NY Bight project and six NY Bight projects are anticipated to be reduced to **negligible** to **moderate** with **minor** to **moderate beneficial** impacts. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with AMMM measures would likely be reduced to **negligible** to **moderate** with **minor** to **moderate beneficial** impacts.
3.6.5 Land Use and Coastal Infrastructure	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **minor** impacts on land use and coastal infrastructure. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative, when combined with all other planned activities (including other offshore wind) would likely result in overall **moderate** impacts from	*Alternative B:* A single NY Bight project would likely result in **minor** impacts, from accidental releases, lighting, port utilization, presence of structures, land disturbance, and traffic on land use and coastal infrastructure and **minor beneficial** impacts from greater economic activity and increased employment opportunities. Six NY Bight projects would likely have **moderate** impacts because of the increased onshore	*Sub-alternative C1:* BOEM has not identified any previously applied AMMM measures, and impacts on land use and coastal infrastructure are anticipated to be the same as those under Alternative B. They would be **minor** and **minor beneficial** for one NY Bight project and **moderate** and **minor beneficial** impacts for six NY Bight projects.	*Sub-alternative C2:* One not previously applied AMMM measure has been identified that may reduce impacts on land use and coastal infrastructure through development of an Environmental Justice Communication Plan. However, the impacts on land use and coastal infrastructure are anticipated to be the same as those under Alternative B. They would be **minor** and **minor beneficial** for one NY Bight project

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
	accidental releases, lighting, port utilization, presence of structures, land disturbance, and traffic and **minor beneficial** impacts from use of ports and related infrastructure.	land disturbance and infrastructure and **minor beneficial** impacts from port utilization. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **moderate** impacts and **minor beneficial** impacts.	*Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects would likely be the same as those under Alternative B and would be **moderate** and **minor beneficial**.	and **moderate** and **minor beneficial** for six NY Bight projects. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with the AMMM measure would likely be the same as those under Alternative B, and they would be **moderate** and **minor beneficial**.
3.6.6 Navigation and Vessel Traffic	*No Action Alternative:* Continuation of existing regional environmental trends and activities under the No Action Alternative would likely result in **moderate** impacts on navigation and vessel traffic. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would likely result in **moderate** impacts because, although the overall effect would be notable, vessels would be able to adjust to account for disruptions.	*Alternative B:* A single NY Bight project and six NY Bight projects would likely result in **major** impacts on navigation and vessel traffic due to changes in navigation routes, delays in ports, degraded communication and radar signals, and increased difficulty of offshore USCG Search and Rescue (SAR) or surveillance missions within the lease area(s). *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely be **major** due to the increase in risk of allision and navigational complexity in the geographic analysis area.	*Sub-alternative C1:* One previously applied AMMM measure has been identified that could reduce impacts for navigation and vessel traffic by reporting the location of boulders that are being relocated. The impacts on navigation and vessel traffic would remain **major** for one NY Bight project and six NY Bight projects. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely remain **major**.	*Sub-alternative C2:* One not previously applied AMMM measure has been identified that could reduce impacts for navigation and vessel traffic by avoiding placement that would affect navigational features. The impacts on navigation and vessel traffic would remain **major** for one NY Bight project and six NY Bight projects. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with previously applied and not previously applied AMMM measures would likely remain **major**.
3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)	*No Action Alternative:* The No Action Alternative would likely result in **negligible** impacts for aviation and air traffic, cables and pipelines, military and national security uses, radar systems, and marine mineral extraction; and **major** impacts for NOAA's scientific research and surveys. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would likely result in **minor** impacts for aviation and air traffic, cables and pipelines, and most national security and military uses; **moderate** impacts for marine minerals extraction, USCG SAR operations, and radar systems; and **major** impacts for scientific research and surveys.	*Alternative B:* One NY Bight project and six NY Bight projects under Alternative B would likely result in **minor** impacts for aviation and air traffic, cables and pipelines, and most military and national security uses; **moderate** for marine mineral extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys. *Cumulative Impacts of Alternative B:* Impacts from six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely be **minor** for aviation and air traffic, cables and pipelines, and most military and national security uses; **moderate** for marine minerals extraction, radar systems, and USCG SAR operations; and **major** for NOAA's scientific research and surveys.	*Sub-alternative C1:* Three previously applied AMMM measures have been identified that could reduce impacts on other uses by 1) requiring the establishment of agreements and operational changes to reduce potential radar interference, and 2) developing survey mitigation agreements or plans. Impacts would likely be reduced for radar systems. Impacts from one NY Bight project and six NY Bight projects under the Proposed Action would likely be **minor** for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; **moderate** for USCG SAR operations and marine mineral extraction; and **major** for NOAA's scientific research and surveys. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **minor** for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; **moderate** for marine minerals extraction and USCG SAR operations; and **major** for NOAA's scientific research and surveys.	*Sub-alternative C2:* Three not previously applied AMMM measures have been identified that could reduce impacts on other uses. Radar-specific AMMM measures would require coordination with radar operators to identify mitigation efforts. Marine mineral specific AMMM measures would require removal of infrastructure from a marine mineral resource area during decommissioning, demonstrate no significant impacts on mineral resources, and require coordination on cable installation to avoid marine mineral resources. Impacts from one NY Bight Project and six NY Bight projects under the Proposed Action would likely be **minor** for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; **moderate** for USCG SAR operation; and **major** for NOAA's scientific research and surveys. Impacts on marine mineral resources from one NY Bight project would likely be **minor**, while six NY Bight projects would result in **moderate** impacts. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with previously applied and not previously applied AMMM measures would likely be the same under Sub-alternative C2 and Sub-alternative C1. Impacts would likely be **minor** for aviation and air traffic, cables and pipelines, radar systems, and most military and national security uses; **moderate** for marine minerals extraction and USCG SAR

Resource	Alternative A – No Action	Alternative B – No Identification of AMMM Measures at the Programmatic Stage	Sub-alternative C1 (Proposed Action/Preferred Alternative) – Previously Applied AMMM Measures	Sub-alternative C2 (Proposed Action) – Previously Applied and Not Previously Applied AMMM Measures
				operations; and **major** for NOAA's scientific research and surveys under Sub-alternative C2.
3.6.8 Recreation and Tourism	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **minor** impacts on recreation and tourism. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would likely result in **negligible** to **minor** impacts and **minor beneficial** impacts on recreation and tourism.	*Alternative B:* A single NY Bight project would likely result in impacts ranging from **negligible** to **minor**, and **minor beneficial** on recreation and tourism. Development of six NY Bight projects would likely result in **minor** to **moderate** impacts and **minor beneficial** impacts. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would likely result in **minor** to **moderate** impacts and **minor beneficial** impacts on recreation and tourism.	*Sub-alternative C1:* One previously applied AMMM measure has been identified that would likely reduce impacts on recreation and tourism associated with lighting. However, the AMMM would not reduce the overall impact. The impacts on recreation and tourism would likely be **negligible** to **minor** and **minor beneficial** for one NY Bight project, and **minor** to **moderate** and **minor beneficial** for six NY Bight projects. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely be **negligible** to **moderate,** with **minor beneficial** impacts.	*Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for recreation and tourism; therefore, the impacts on recreation and tourism under Sub-alternative C2 are the same as those under Sub-alternative C1. Impacts would be **negligible** to **minor** and **minor beneficial** for one NY Bight project, and **minor** to **moderate** and **minor beneficial** for six NY Bight projects. *Cumulative Impacts of Sub-alternative C2:* BOEM has not identified any not previously applied AMMM measures for recreation and tourism; therefore, the cumulative impacts on recreation and tourism under Sub-alternative C2 are the same as those under Sub-alternative C1. They would be **negligible** to **moderate,** with **minor beneficial** impacts.
3.6.9 Scenic and Visual Resources	*No Action Alternative:* Continuation of existing environmental trends and activities under the No Action Alternative would likely result in **negligible** to **major** impacts on scenic resources and viewer experiences. *Cumulative Impacts of the No Action Alternative:* The No Action Alternative combined with all planned activities (including other offshore wind activities) would result in **negligible** to **major** impacts on open ocean character, seascape character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, and accidental releases to the landscape or seascape.	*Alternative B:* A single NY Bight project and all six NY Bight projects would result in impacts ranging from **negligible** to **major** on open ocean, seascape, and landscape character areas and viewer experiences. *Cumulative Impacts of Alternative B:* Cumulative impacts of six NY Bight projects, when combined with ongoing and planned activities, including other offshore wind activities, would result in **negligible** to **major** impacts on open ocean character, seascape character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, and accidental releases to the landscape or seascape.	*Sub-alternative C1:* One previously applied AMMM measure has been identified that could reduce impacts on scenic resources and viewer experiences associated with lighting. Implementation of ADLS that activates the aviation hazard lighting system in response to detection of nearby aircraft would reduce nighttime lighting impacts. Overall impacts for a single NY Bight project and all six NY Bight projects would continue to range from **negligible** to **major**. *Cumulative Impacts of Sub-alternative C1:* Cumulative impacts of six NY Bight projects with previously applied AMMM measures would likely result in **negligible** to **major** impacts on open ocean character, seascape character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape.	*Sub-alternative C2:* One not previously applied AMMM measure has been identified (VIS-7). This measure includes preparing and implementing a visual resource monitoring plan to evaluate and verify the accuracy of the visual simulations and effectiveness of the ADLS. This AMMM measure would improve accountability but would not alter the impact determination. Overall impacts for a single NY Bight project and all six NY Bight projects with previously applied and not previously applied AMMM measures would continue to range from **negligible** to **major**. *Cumulative Impacts of Sub-alternative C2:* Cumulative impacts of six NY Bight projects with previously applied and not previously applied AMMM measures will likely be the same under Sub-alternative C2 and Sub-alternative C1, and they would be **negligible** to **major.**

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3.4 Physical Resources

3.4.1 Air Quality and Greenhouse Gas Emissions

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on air quality from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.4 Physical Resources

3.4.2 Water Quality

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on water quality from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.5 Biological Resources

3.5.1 Bats

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on bats from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.5 Biological Resources

3.5.2 Benthic Resources

This section discusses potential impacts on benthic resources, other than fishes and commercially important benthic invertebrates, from the Proposed Action, alternatives, and ongoing and planned activities in the geographic analysis area. The benthic resources geographic analysis area, as shown in Figure 3.5.2-1, includes an area within a 10-mile (16.1-kilometer) buffer around the six NY Bight lease areas and extends to the shore. The geographic analysis area is based on where the most widespread impact (i.e., suspended sediment) from the NY Bight projects could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to winds and ocean currents. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to the NY Bight project activities would likely be on a smaller spatial scale than 10 miles (16.1 kilometers); project-specific sediment transport modeling would be required to verify this[1]. The geographic analysis area includes offshore waters from Montauk Point on Long Island, New York, southwest into the NY Bight, and west to Cape May, New Jersey, and includes both the offshore project areas and potential export cable corridors that may traverse inshore benthic habitats in coastal inlets, estuaries, and bays in state waters. Terrestrial resources in coastal areas are discussed in Section 3.5.4*, Coastal Habitat and Fauna*; tidal wetlands are discussed in Section 3.5.8, *Wetlands*; and finfish, invertebrates, and essential fish habitat (EFH) are discussed in Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*.

The benthic resources impact analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

[1] Other approved and proposed wind farms offshore of New York and New Jersey found that sediment deposition from the seafloor disturbance during cable emplacement was estimated to fall very close to the disturbance. Empire Wind 1 results found deposition of 0.004 inch (0.01 centimeter) within 246 feet (75 meters). Atlantic Shores found deposition of ≥ 0.04 inch (1 millimeter) in thickness would occur within 656 feet (200 meters) of the Monmouth export cable corridor (ECC) centerline, within 164 feet (50 meters) of the Atlantic export cable corridor centerline, and within 361 feet (110 meters) of the centerline for jet trenching installation of the interarray cables.

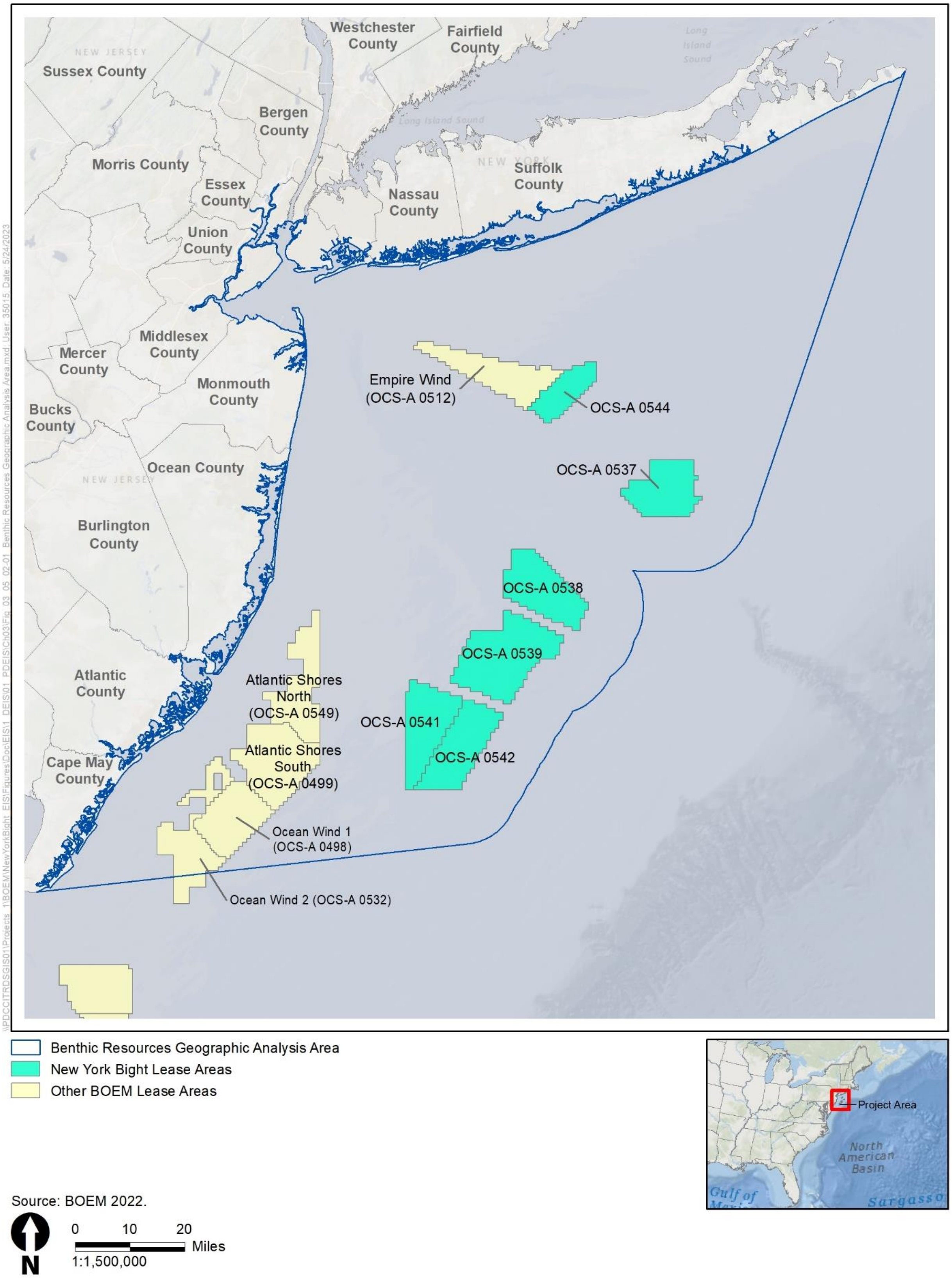


Figure 3.5.2-1. Benthic resources geographic analysis area

3.5.2.1 Description of the Affected Environment and Future Baseline Conditions

The NY Bight is an offshore area extending from Montauk Point on the eastern side of Long Island, New York, southwest to Cape May, New Jersey. Because the potential cable routes are unknown at this time, the benthic resources affected environment characterization covers inshore resources up to the shoreline, within the NY Bight.

The description of benthic resources in this section is supported by studies conducted by BOEM for specific projects within the NY Bight, along with studies from literature review. Typical benthic resource descriptions are provided in the PEIS for alternative energy (MMS 2007b), the EA for wind leases offshore of New York (BOEM 2016), and the Draft EA for the NY Bight (BOEM 2021). COPs for offshore wind activities within the Mid-Atlantic Bight and NY Bight, including Empire Wind 1 and 2 (Empire Wind 2022; Tetra Tech Inc. 2021), Atlantic Shores South (Atlantic Shores 2022), and Ocean Wind 1 (Ocean Wind 2022), have added specific information about various benthic resources and features. Guida et al. (2017) characterized offshore WEAs of the northeast, including off New Jersey and New York, which are nearby but do not overlap with the NY Bight lease areas (as shown by the yellow lease areas in Figure 3.5.2-1). This study used numerous sources to compile data, including: bathymetric data from NOAA-National Centers for Environmental Information (NOS 2015); physical and biological oceanography data from Northeast Fisheries Science Center (NEFSC) and National Marine Fisheries Service (NMFS); fisheries independent trawl survey data for demersal fish and shellfish from NEFSC; and surficial sediment data from the usSEABED U.S. Geological Survey website (USGS n.d.). Information pertaining to New York and New Jersey was included and used to support project-specific studies and provide regional benthic characterizations. The benthic resources and features found within the New York Bight WEAs may not all be present within each of the six leases covered by this PEIS. Similarly, there may be benthic resources and features within the NY Bight WEAs that are not already documented within the previous characterizations or surveys.

Regional oceanography is driven by multiple factors, with subsurface currents as the most influential. The Gulf Stream waters move warm water from the south northward along the shelf, and the cold waters of the Labrador Current move south along the coast. This combination creates consistent eddies and gyres in the Mid-Atlantic Bight. The cold northern waters sink under the warmer waters, creating the Mid-Atlantic Bight Cold Pool around 66 feet (20 meters) of water depth. This thermocline extends along the entire shelf of the Mid-Atlantic Bight and overlaps the six NY Bight lease areas to varying degrees from May through September (Horwitz et al. 2023). The cold pool develops in the spring, ensures vertical stratification through the summer and fall (Lentz 2017; Miles et al. 2021; Friedland et al. 2022; Horwitz et al. 2023), and is a notable oceanographic feature. The Mid-Atlantic Bight Cold Pool holds nutrients over the shelf during the spring and summer, which in turn promotes phytoplankton productivity and affects species distributions. Some evidence indicates that the Mid-Atlantic Bight Cold Pool is both warming and shrinking as a result of climate change, which will likely affect ecosystem productivity and species distributions in the Mid-Atlantic Bight (Friedland et al. 2022).

The Hudson Shelf Valley is a unique benthic feature that splits the NY Bight to the north and south, extending from the mouth of the Hudson River to the OCS (Figure 3.5.2-2). At the head, it is 3.1 to

6.2 miles (5 to 10 kilometers) wide and broadens at mid-shelf until it creates a submerged delta on the OCS, and is not clearly connected to the Hudson Canyon on the outer shelf break. It is oriented roughly northwest to southeast (120˚N) (Lentz et al. 2014) and acts as a barrier to the southward transportation of sediments from Long Island (Vincent et al. 1981). The Hudson Shelf Valley was the estuarine outflow path during the post-glacial rise of sea level and is the only submerged river valley on the continental shelf of the Mid-Atlantic Bight that has not been filled with sediment (Lentz et al. 2014; Vincent et al. 1981). The Valley is 65.6 to 98.4 feet (20 to 30 meters) deeper than the surrounding shelf (Lentz et al. 2014). This prominent feature influences the regional circulation of the NY Bight waters, which affects the benthic community structure providing the building blocks of the oceanic food web in this area.

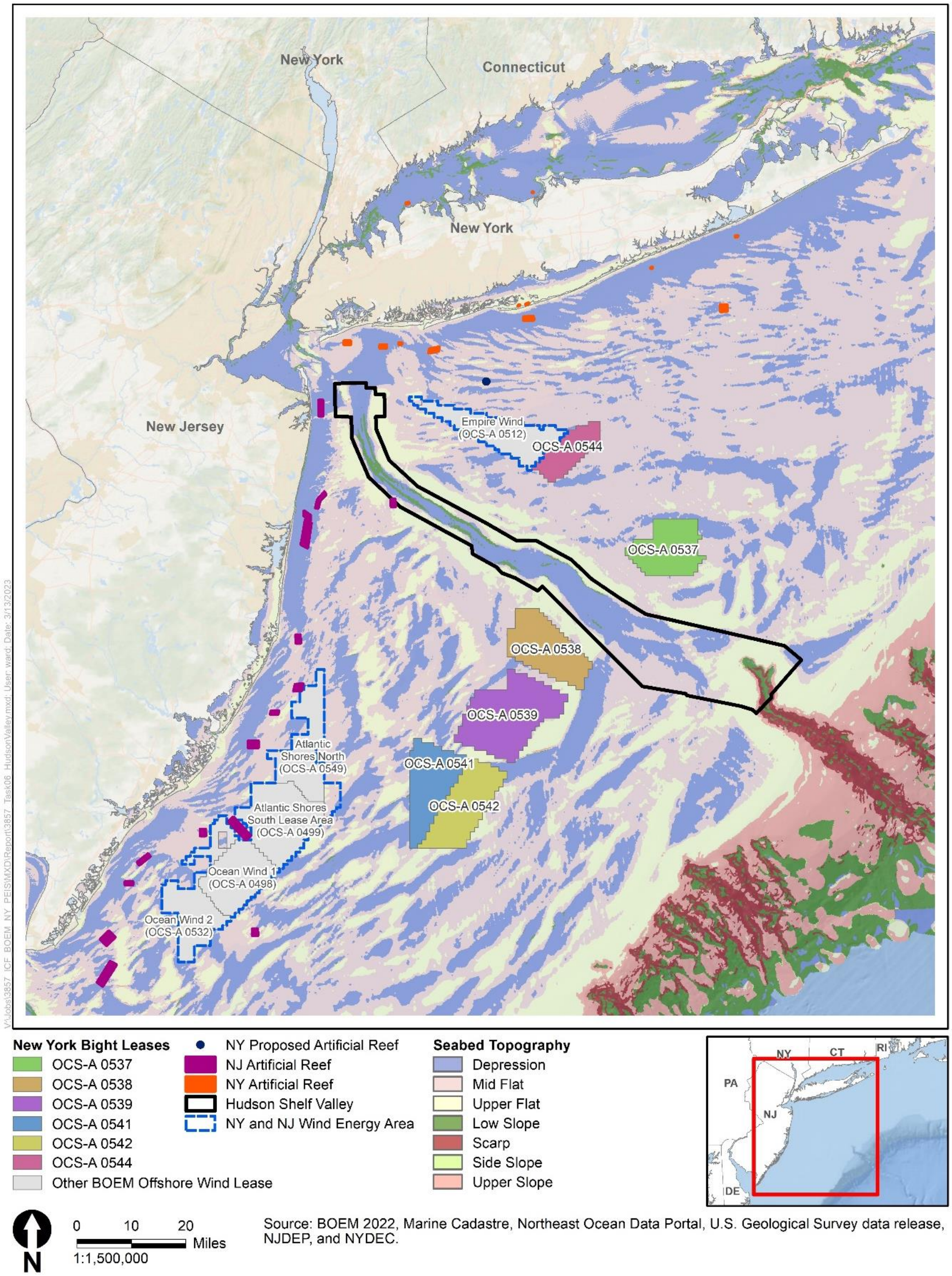


Figure 3.5.2-2. New York Bight topography highlighting the Hudson Shelf Valley, New York and New Jersey wind energy areas, and artificial reefs

3.5.2.1.1 Offshore Benthic Resources

The New York WEA (as characterized in Guida et al. 2017) lies northeast of the Hudson Shelf Valley in water depths of 59 to 135 feet (18 to 41 meters) (Figure 3.5.2-2). Much of the WEA is flat with irregular sand ridges cresting at 3.3 to 6.6 feet (1 to 2 meters) in height. Each of the WEAs are primarily sand-dominant and contain geological bedform features such as sand ripples or waves, which indicate sediment mobility (Guida et al. 2017). The New York WEA is dominated by medium sand with a patch of silt and one of very coarse sand (Guida et al. 2017). Guida et al. (2017) found that water salinity ranged from 29.8 to 33.9 grams per kilogram and water temperatures ranged from 36 to 71°F (2 to 22°C) (between 2003 and 2016). Vertical stratification varied seasonally as much as 77°F (25°C) at the surface and 59°F (15°C) at the bottom (Guida et al. 2017). The New Jersey WEA (Figure 3.5.2-2) is at the southern end of the Mid-Atlantic Bight in water depths of 46 to 125 feet (14 to 38 meters) (Guida et al. 2017). The seafloor is generally flat, except where patches of sand ridges occur. The slope towards the OCS occurs through a series of sand ridges and depressions. Similar to the New York WEA, the New Jersey WEA is dominated by medium sand. Coarse sand is more common in the northern section, while fine sand is found along the southern edges (Guida et al. 2017).

Landward of the offshore canyons and outer shelf, within the geographic analysis area, the middle continental shelf contains escarpments that act as bathymetric steps along New Jersey (Duncan et al. 2000). The mid-shelf wedge is composed of clay-rich and sand-rich geologic components and is defined by the seaward boundary of the mid-shelf scarp (Nordfjord et al. 2009). The high slope and rapid change in depth on the eastern side of the mid-shelf scarp would overlap with portions of Lease Areas OCS-A 0538 and OCS-A 0539 specifically. These bathymetric features alter physical oceanographic patterns, affect ecological patterns including the benthic community composition and the fish species, and serve as productive fishing grounds (BOEM 2016, 2021).

The inner continental shelf is characterized by a seabed morphology consisting of relatively flat, migrating sand waves and ripples with occasional larger sand ridges. Sand ridges average 16 to 98 feet (5 to 30 meters) high and are spaced kilometers apart from one another (Ashley 1990). The sand ridges are usually grouped forming sand shoal complexes, with lengths 6.2 to 31 miles (10 to 50 kilometers), spaced apart by 1.2 miles (2 kilometers), and crest heights up to 32.8 feet (10 meters) on the seaward (east) side (BOEM 2012; Atlantic Renewable Energy Corporation and AWS Scientific, Inc. 2004). These ridges are oriented with an angle toward the coastline from northeast to southwest (BOEM 2012), to the direction of bottom current flow (Atlantic Renewable Energy Corporation and AWS Scientific, Inc. 2004). Smaller features such as sand ripples, megaripples, and sand waves are also present along the sand ridges (BOEM 2012; Guida et al. 2017). Sand ripples are defined as having a wavelength less than 16 feet (5 meters), and a height less than 1.6 feet (0.5 meter) (BOEM 2020). Megaripples have a wavelength of 16 to 197 feet (5 to 60 meters) and a height of 1.6 to 4.9 feet (0.5 to 1.5 meters) (BOEM 2020). Sand waves are larger bedforms with wavelengths that exceed 197 feet (60 meters) (BOEM 2020). Sand waves average 7 to 16 feet (2 to 5 meters) high and are separated by an average of 328 to 1,312 feet (100 to 400 meters) (Ashley 1990). Sand waves are usually found on the sides of sand ridges and are dynamic features but may stay intact through several seasons (BOEM 2012). The presence of sand ripples throughout the WEAs indicates sediment mobility (Guida et al. 2017). Megaripples, the smallest of these geological bedforms, can cover up to 15 percent of the inner shelf in large patches of 9.8 to 16.4 feet (3 to 5 meters) with heights of 1.6 to 3.3 feet (0.5 to 1 meters) and change seasonally (BOEM 2012). Winter storms can reshape the upper 20 to 39 inches (50 to 100 centimeters) of sediments within a few hours (BOEM 2012). Submerged shoals located offshore New Jersey, Maryland, and Virginia between the WEAs and the shore have been identified as long-term sources of sand (sand borrow sites) for coastal erosion management (MMS 2007b).

Surficial sediment types are generally sandy but vary in coarseness with mixtures of silt or gravel (Williams et al. 2007; Guida et al. 2017). The sand ridge and trough features are stable features that provide habitat complexity and are common throughout the eastern OCS (Rutecki et al. 2014). Troughs are characterized by finer sediments and higher organic content, while ridges are characterized by coarser sediments. These characteristics subsequently determine infauna and meiofaunal assemblages, which may influence the communities of shellfish and higher trophic-level fish. These features aid in trophic interactions, linking planktonic communities and higher-level predators. For example, the sand lance (*Ammodytes* spp.), which resides in the sand ridge and trough features, heavily relies on a diet of copepods and other zooplankton and is, in turn, relied upon as a key prey source for 45 species of fishes (e.g., Atlantic sturgeon, cod, herring, mackerel), 2 squid species, 9 marine mammals, and 16 seabirds (Staudinger et al. 2020).

Sand ridges themselves are microhabitats that provide vertical relief and bottom complexity that are important to forage species and serve as a refuge for prey, such as the sand lance. The presence of novel structures and hard substrates within the ridge and trough system could affect these ecosystem dynamics. A 2-year study conducted on the inner continental shelf of the Mid-Atlantic Bight showed greater species diversity, abundance, and richness in trough habitats than in ridge habitats, as well as seasonal trends (Slacum et al. 2010; BOEM 2021). Shoal habitats occur in high-energy environments and migrate in a generally southwest direction within the NY Bight area (Rutecki et al. 2014).

Glauconite sands could potentially be present within the six NY Bight lease areas and are typically at the upper layers of the seafloor. There are different classification levels of glauconite sands, which determine if the environment is suitable for WTG installation (BOEM 2023).

Epibenthic and megafauna sampling within the New York and New Jersey WEAs provided information about the benthic community structure in the NY Bight. Grab samples within the New York WEA were numerically co-dominated by polychaetes and amphipods, and beam trawls were dominated by sand shrimp and sand dollars (*Echinarachnius parma*) (Guida et al. 2017). Trawl records over a 14-year sampling period showed that the little skate (*Leucoraja erinacea*) was the dominant megafauna year-round, joined by Atlantic herring (*Clupea harengus*) in the cold seasons and longfin squid (*Doryteuthis pealeii*) and sea scallops (Pectinidae) in the warmer seasons (Guida et al. 2017). Sand lance are also known to be present within the NY Bight, although accurately capturing their presence can be challenging due to their narrow morphology and burrowing behavior. In the New Jersey WEA, polychaetes alone numerically dominated the grab samples, and epibenthic fauna was dominated by sand shrimp, sand dollars, and dwarf warty sea slugs (*Pleurobranchaea tarda*) (Guida et al. 2017). The megafauna records did not show a year-round dominant species. Atlantic herring, little skate, and spiny dogfish (*Squalus acanthias*) dominated the cold seasons, while the warm seasons were dominated by Atlantic croaker (*Micropogonias undulatus*), longfin squid, and scup (*Stenotomus chrysops*) (Guida et al. 2017).

Benthic invertebrates in the NY Bight area also include commercially viable species such as the Atlantic surfclam (*Spisula solidissima*) and ocean quahog (*Arctica islandica*), which have experienced mortality of large adults and declining recruitment (NEFSC 2017), and Atlantic sea scallops. Ocean quahogs, Atlantic surfclams, and Atlantic sea scallops are more abundant in water depths exceeding 98 feet (30 meters) in the NY Bight (Grothues et al. 2021; Guida et al. 2017). The shifting of increased abundance in deeper water supports the theory that warming in shallow offshore waters is driving these bivalves into deeper, cooler waters (Grothues et al. 2021). As ocean temperatures increase, the distribution and biology of Atlantic surfclam are also changing, with likely effects on fishery productivity (Munroe et al. 2016). Other shallow coastal benthic commercial and recreational invertebrate species in the NY Bight include hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), and bay scallops (*Argopecten irradians*). Although these species were not mentioned in the survey results, they inhabit sandy to muddy areas, including eelgrass beds (Grotheus et al. 2021). See Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.5.5 for additional information.

Studies of the U.S. Atlantic coast have shown spatial shifts of benthic species in response to the warming ocean temperatures from 1990 to 2010 (Hale et al. 2017). With predicted continual temperature increases in the waters of the NY Bight area, it is expected that the shift of marine species distribution northward and to deeper waters would continue (BOEM 2021).

Artificial reefs provide valuable habitats to foster the biodiversity of marine invertebrates and finfish. These reefs are constructed from building materials, outdated infrastructure, and shipwrecks (NYSDEC n.d.; NYSDEC 2022) (Figure 3.5.2-2). The New York State Department of Environmental Conservation manages 12 artificial reefs along the north and south sides of Long Island, 8 of which lie within the NY Bight area. These reefs are relatively close to shore and outside of the lease areas but will be important in the planning of the export cable routes (NYSDEC 2022). The Carl N. Shuster Horseshoe Crab Reserve intersects the benthic resources geographic analysis area in the southwestern corner along Cape May, New Jersey (Ocean Wind 2022). This information will inform possible landing sites for export cable routes. The New Jersey Department of Environmental Protection also has an artificial reef program containing 17 artificial reef sites totaling 25 square miles (16,000 acres) (NJDEP 2021; Geo-Marine Inc. 2010; NYDOS 2013). Through their ventless trap survey, biologists are able to clearly track artificial reef utilization, focusing on seasonal and spatial changes of the reef community (NJDEP 2021). Some natural reefs may occur on a small scale on rock outcrops and boulders, as well as shell deposits of a volume to constitute biogenic benthic substrate and structure (BOEM 2012; Atlantic Renewable Energy Corporation and AWS Scientific, Inc. 2004). Northern star coral (*Astrangia poculata*) is a non-reef building stony coral that can live in the colder waters of the NY Bight and has been reported within the NY Bight area (Steimle and Zetlin 2000). NOAA's Deep-Sea Coral Research and Technology Program compiles a national database of the known locations of deep-sea corals and sponges in U.S. waters, which shows scattered presence of sea pens and sponges within the geographic analysis area, including calcareous sponges and demosponges on the eastern edge or just outside of the geographic analysis area (NOAA 2023; Hourigan et al. 2015). These corals, sponges, and sea pens along with oysters (*Crassostrea virginica*), mussels (*Mytilus edulis*), and polychaete worms (*Sabellaria vulgaris*) act as ecosystem engineers that build structural complexity in otherwise flat environments and affect community composition (Steimle and Zetlin 2000; Miatta and Snelgrove 2022).

The NY Bight area is heavily trafficked. The U.S. military operates out of multiple military installations along the New York and New Jersey coastlines, including the U.S. Navy, U.S. Army, U.S. Air Force, and USCG (BOEM 2021). Operational Areas (OPERAS) encompass most of the NY Bight area. Recently, the USCG planned new shipping safety fairways in the NY Bight area, which may require dredging and the clearing of potential navigation hazards or obstructions on the seafloor. See Section 3.6.7, *Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys),* for more information.

3.5.2.1.2 Inshore Benthic Resources

Coastal and inshore benthic resources along the New Jersey and New York shorelines include sandy beaches, coarse-grained beaches, cliffs, shellfish beds in tidal flats, SAV (seagrasses and attached macroalgae), mollusk reef biota, coastal dune systems, barrier island forests, and both salt and freshwater marshes (BOEM 2021). See Section 3.5.4, *Coastal Habitat and Fauna,* for additional information on terrestrial species and habitats.

SAV habitat is composed of marine, estuarine and riverine rooted, vascular plants. SAV communities can be separated into high salinity (18–30 practical salinity units), brackish (5–18 practical salinity units), and freshwater (0–5 practical salinity units) communities. Seagrasses are SAV that create highly productive habitats in shallow coastal waters across the NY Bight. Eelgrass (*Zostera marina*) is the dominant meadow forming perennial seagrass in New York and New Jersey estuaries. Widgeongrass (*Ruppia maritima*) is a smaller annual species of SAV that can also be found occasionally in some brackish and estuarine waters around New York and New Jersey (Office of Response and Restoration 2023), including Fire Island National Seashore within Great South Bay (LaFrance Bartley et al. 2022). In New Jersey, seagrasses are most prevalent in the shallow (less than 5 feet [1.5 meters]) portions of the Navesink, Shrewsbury, Manasquan, and Metedeconk Rivers, and in Barnegat, Manahawkin, and Little Egg Harbor Bays. In New York, seagrasses are present throughout the shallow bays on the south side of Long Island and are most prevalent in West, Middle, and East Hempstead Bays; South Oyster Bay; the eastern and western portions of Great South Bay; and Moriches Bay. Small occurrences are also suspected in bays on Staten Island (New York Natural Heritage Program 2023). The draft offshore wind cable corridor constraints assessment prepared by NYSERDA (2022) includes additional information and figures showing the location of mapped seagrass beds in New York.

Macroalgae present in New York and New Jersey include *Fucus vesiculosus*, *Gracilaria* sp., Hypnea, *Grinnellia americana*, Polysiphonia, Agardhiella, *Ulva intestinalis*, Acrosiphonia, *Codium fragile*, and *Ulva lactuca* (Stewart Van Patten and Yarish 2009). Macroalgae serves as a food source for many benthic invertebrate species and provides shelter for benthic fish and invertebrates. Elasmobranchs and other fish use macroalgae along with gravel or shell hash to anchor their egg cases and prevent drift (Grothues et al. 2021). Macroalgae provides valuable habitat for the Atlantic sea scallop (*Placopecten* *magellanicus*) as larvae attach to macroalgae and other benthic organisms such as hydroids (BOEM 2021). Native species of macroalgae also provide important habitat for adult and juvenile summer flounder (*Paralichthys dentatus*), juvenile monkfish (*Lophius americanus*), Atlantic herring (*Clupea harengus*) eggs, juvenile and adult Atlantic cod (*Gadus morhua*), juvenile ocean pout (*Macrozoarces americanus*), juvenile and adult Pollack (*Pollachius virens*), juvenile red hake (*Urophycis chuss*), juvenile white hake (*Urophycis tenuis*), and winter flounder (*Pseudopleur onectes americanus*) eggs and juveniles (BOEM 2021).

SAV beds form one of the most productive plant communities in the world. They function as spawning and nursery habitats for numerous fish and invertebrate species, and also provide feeding grounds for both resident and transient fish, invertebrate, mammal, and bird species (Zieman 1982; Thayer et al. 1984; Orth et al. 1984; Day et al. 1989; Heck et al. 1989; Mattila et al. 1999). In addition to their productivity, SAV species are important ecosystem engineers, trapping and stabilizing sediments, providing wave attenuation and nutrient cycling benefits, and overall providing irreplaceable ecosystem services (New York State Coastal Management Program 2020). They also function as a carbon sink, which can provide a mitigating effect against changes associated with climate change.

The New York Department of State has designated over 250 Significant Coastal Fish & Wildlife Habitats (SCFWHs). Habitats are assessed by the New York Department of Environmental Conservation based on a series of criteria, including ecosystem rarity, species vulnerability, human uses, population level, and replaceability. On the south side of Long Island and along the coast of Raritan Bay, there are a total of 40 SCFWHs comprising a total of approximately 166,201 acres (67,259 hectares; NYDOS 2013).

Mollusk reefs are widespread in estuarine and coastal bay systems along the U.S. Atlantic coast. On the eastern seaboard, the eastern oyster (*Crassostrea virginica*) is the primary reef-building species and can form reefs or bars that cover extensive areas of bottom in estuarine areas. Oyster reefs can be either subtidal or intertidal.

The eastern oyster and blue mussel *(Mytilus edulis*) are found in the waters of New York and New Jersey (NYSDEC 2021). Eastern oysters attach themselves to rocks, shells or other oysters, and, over time, the accumulation forms a reef. Blue mussels live close together forming dense beds that host a rich community of benthic invertebrates including crustaceans and marine worms. Mollusk reefs are documented in the coastal waters south of Long Island.

3.5.2.2 Impact Level Definitions for Benthic Resources

Definitions of potential impact levels are provided in Table 3.5.2-1. Beneficial impacts on benthic resources are described using the definitions described in Section 3.3.2 (see Table 3.3-1).

Table 3.5.2-1. Adverse impact level definitions for benthic resources

Impact Level	Definition
Negligible	Regardless of the duration of effects from IPFs, there would be no measurable impacts on species or habitat, or they would be extremely difficult or impossible to discern or measure.
Minor	The duration of effects from IPFs may be short- to long term in nature. Most impacts on species are expected to be avoided; if impacts occur, they may result in the loss of a few individuals. Impacts on sensitive habitats are avoided; impacts on other habitats are short term in nature.
Moderate	The duration of effects from IPFs may be short term, long term, or permanent in nature. Impacts on species are unavoidable but are not expected to 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 impacts at a regional level or in population-level effects on species that rely on those habitats.
Major	The duration of effects from IPFs may be short term, long term, or permanent in nature. Impacts would affect the viability of the population and would not be fully recoverable. Impacts on habitats would be long term to permanent or expected to result in regional level or population-level impacts on habitats or species that rely on those habitats.

Accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, electric and magnetic fields and cable heat, noise, port utilization, and presence of structures are contributing IPFs to impacts on benthic resources. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.5.2-2.

Table 3.5.2-2. Issues and indicators to assess impacts on benthic resources

Issue	Impact Indicator
Underwater noise and vibration	Qualitative estimate of potential disturbance, injury, or mortality on infauna and epifauna based on extent, frequency, and duration of noise or vibration
Crushing, deposition, and entrainment	Estimated extent of potential disturbance, injury, and mortality-level effects on infauna and epifauna from dredging, crushing, or burial by construction equipment and materials placement; entrainment by construction equipment; and burial effects from suspended sediment deposition
Seabed profile and water column alteration	Effects on water column and benthic habitats by habitat displacement by structures, habitat modification by placement of scour protection and concrete mattresses, and alteration of softbottom or complex benthic habitat function
Water quality impacts	Duration and intensity of suspended sediment impacts; accidental spills, and releases of trash and debris
Power transmission	Exposure above ambient EMF levels based on extent, duration, and proximity of contact with or exposure to infrastructure; species sensitivity[1]

[1] EMF sensitivity varies widely; no effect threshold guidance has been established. The minimum EMF levels needed to produce behavioral responses observed in available research are one or more orders of magnitude larger than the anticipated EMF effects likely to result from the NY Bight projects. Electrosensitive fish can detect low-frequency bioelectric fields at very weak levels but are unable to detect higher frequency fields > 20 Hertz (Bedore and Kajiura 2013).

3.5.2.3 Impacts of Alternative A – No Action – Benthic Resources

When analyzing the impacts of the No Action Alternative on benthic resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore-wind and ongoing offshore wind activities on the baseline conditions for benthic resources. 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, which are described in Appendix D, *Planned Activities Scenario*.

3.5.2.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for benthic resources described in Section 3.5.2.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities within the geographic analysis area. Ongoing non-offshore-wind activities that contribute to impacts on benthic resources include bottom-tending commercial fishing gear, dredging for navigation and beach renourishment, and laying submarine cables. Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on benthic resources include ongoing construction of South Fork Wind (OCS-A 0517), Ocean Wind 1 (OCS-A 0498), Empire Wind (OCS-A 0512) 1 and 2, and Sunrise Wind (OCS-A 0487). Ongoing construction of South Fork Wind, Ocean Wind 1, Empire Wind 1 and 2, and Sunrise Wind would have the same types of impacts on benthic resources as those described in Section 3.5.2.3.2, *Cumulative Impacts of the No Action Alternative,* for all ongoing and planned offshore wind activities in the geographic analysis area.

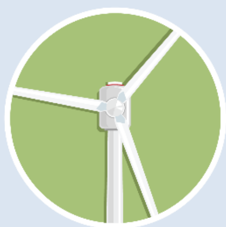
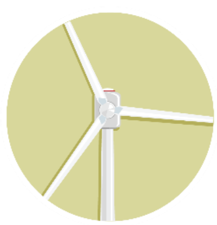
Marine communities are influenced by changes in physiochemical conditions (including temperature, pH, storm frequency and severity, and nutrient availability) that may be influenced by climate change. Mollusk reefs and SAV are susceptible to changes in water quality and physical disturbance and can be adversely affected by increased sedimentation, loss or disturbance of habitat due to vessel interactions and dredging, contaminant spills, and introduction of invasive species. Following physical disturbance of the benthos, sessile and slow-moving species may have limited ability to relocate and avoid the rapid onset of adverse conditions; these species may therefore experience range retractions rather than shifts. Alternatively, if an environmental change is gradual relative to the organism's life cycle, even relatively sessile species may adjust. Changes in long-term thermal trends also can influence seasonal movement patterns of marine species. Further, climate change-induced warming of offshore water temperatures in the NY Bight area is expected to continue, with a corresponding range shift for sessile and sedentary benthic species to the north and possibly offshore into deeper waters as a response (Powell et al. 2020). These range shifts of benthic communities to the north and south will affect ecosystem structure and function (Hale et al. 2017). Additionally, warming ocean temperatures and other climate change–related factors may induce favorable environmental conditions for invasive species (Zhang et al. 2020).

3.5.2.3.2 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 NY Bight projects). Planned non-offshore-wind activities within the NY Bight area that contribute to impacts on benthic resources include the construction of new structures or new submarine cables, transmission systems (e.g., PBI), and pipelines, oil and gas activities, marine minerals extraction, port expansions, increasing onshore construction, and commercial and recreational fishing (refer to Appendix D for a description of planned activities).

Table 3.5.2-3 lists the ongoing and planned offshore wind activities in the geographic analysis area. Up to 803 WTGs (excluding the six NY Bight lease areas) are anticipated to be constructed within the geographic analysis area (Table D-2; Appendix D) and would contribute to impacts on benthic resources. Two other projects, South Fork Wind (OCS-A 0517) and Sunrise Wind (OCS-A 0487), would install offshore export cables within the geographic analysis area.

Table 3.5.2-3. Ongoing and planned offshore wind in the geographic analysis area for benthic resources

Ongoing/Planned	Projects by Region
Ongoing – 5 projects[1] 	**MA/RI** • South Fork Wind (OCS-A 0517)[2] • Sunrise Wind (OCS-A 0487)[2] **NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512)
Planned – 3 projects[3] 	**NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499)

MA = Massachusetts; NJ = New Jersey; NY = New York; RI = Rhode Island
[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.
[2] Lease areas are outside the geographic analysis area. The projects' offshore export cables would intersect the geographic analysis area.
[3] Status as of September 20, 2024.

BOEM expects ongoing and planned non-offshore-wind activities and ongoing and planned offshore wind activities to affect benthic resources through the following primary IPFs.

Accidental releases: A gradual increase in vessel traffic over the next 35 years would increase the risk of accidental releases as a result of ongoing and planned activities, including ongoing offshore wind. Releases of hazardous materials mostly consist of fuels, lubricating oils, and other petroleum compounds that tend to float in seawater; as such, accidental releases would occur at or near the ocean surface in association with vessel operations, and they are unlikely to contact benthic resources in offshore waters. Although the NY Bight area does not currently have any offshore oil drilling, some large crude and refined oil vessels transit through and dock at port. Accidental releases of trash and debris may occur from vessels; however, the impacts on benthic resources would be negligible due to the small scale of such accidental releases. Accidental releases of fuel, fluids, or hazardous materials in shallow offshore and inshore waters may cause habitat contamination from releases, cleanup activities, or both, and cause harm to the species that build biogenic coastal habitat. As described in Section 2.3, Non-Routine Activities and Events, accidental releases of chemicals, gases, or man-made debris may occur as a result of a structural failure and potentially impact benthic resources.

Invasive species can be accidentally released, especially during ballast water and bilge water discharges from marine vessels (Pederson et al. 2021). The trans-oceanic shipping industry has also increased the spread of invasive species. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020), the impacts of invasive species on benthic invertebrates and finfish could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna or modify habitat. Increased vessel activity can facilitate range expansion for invasive species.

Anchoring: Anchoring from vessels related to ongoing commercial activities, recreational activities, military use, and offshore wind would continue to cause short-term to permanent impacts in the immediate area where anchors and chains meet the seafloor. Because eelgrass beds in the geographic analysis area are close to shore where limited anchoring is expected to occur, ongoing and planned offshore wind activities would have minimal effect on eelgrass. Sessile and slow-moving species would be most likely to be affected by anchoring. Impacts from anchoring would be localized with short-term elevated turbidity and mortality of softbottom benthic resources that are likely to recover relatively quickly (Kraus and Carter 2018; Dernie et. al. 2003); however, recovery is expected to take longer in complex or gravel habitats. Given the relatively small amount of seafloor affected by anchoring, the short-term turbidity, and the relatively fast recovery expected in most habitats, benthic impacts would be negligible.

Cable emplacement and maintenance: There are 27 submarine telecommunication cables (18 active and 9 out of service) within the vicinity of the NY Bight project area. The NYSERDA identified 21 potential onshore points of interconnection for future offshore wind cables to interconnect to the existing New York State transmission grid (NYSERDA 2017a). Route clearance to remove debris from the seafloor prior to cable installation may alter the seabed profile. Route clearance activities of ongoing and planned projects may include pre-sweeping (i.e., sand wave leveling). Cable maintenance of ongoing and planned cables could also disturb the benthic communities. Submarine cable and transmission system installation would produce sedimentation as would any ongoing cable maintenance activities that contact the seafloor. The sedimentation tolerance for benthic organisms varies among species, and is primarily based on their type of motility, feeding structures, and feeding modes (Hendrick et al. 2016; Trannum et al. 2010; Jumars et al. 2015). The sensitivity threshold for shellfish varies by species but can be generalized as deposition greater than 0.79 inch (20 millimeters) (Colden and Lipcius 2015; Essink 1999; Hendrick et al. 2016). Smit et al. (2008) evaluated the significance of depositional thickness on impacts to benthic communities. Estimates from that study indicated median (50 percent) and low (5 percent) effect levels of 2.13 inches (54 millimeters) and 0.25 inch (6.3 millimeters) of sediment deposition, respectively. That is, an estimated sediment deposition of 2.13 inches (54 millimeters) affected 50 percent of the benthos in the study, and a sediment burial thickness of 0.25 inch (6.3 millimeters) affected 5 percent of the studied benthos. The level of impact from sediment deposition and burial would also depend on the time of year that it occurs, especially if it overlaps temporally and spatially with sites characterized by high benthic organism abundance and diversity. Spring and summer are the primary spawning seasons for many benthic invertebrates as well as fish that lay demersal eggs. Therefore, sedimentation during those seasons would likely have a greater impact due to the localized disruption during sensitive life cycle stages. Sedimentation caused by dredging or other pre-installation clearing methods would result in local and short-term disturbances, which could have long-term negative effects on eggs and larvae of demersal species and benthic invertebrates. Due to the life cycles of demersal finfish and invertebrate species, adverse impacts may be far-reaching (see Section 3.5.5). For example, since sand lance have demersal eggs and bury within the substrate, disturbances to benthic habitats from seabed preparation and cable emplacement are likely to have disproportionate impacts on them, relative to other forage fishes, and could result in decreased production (Staudinger et al. 2020). Elevated turbidity and sediment deposition would also impact seagrasses in inshore waters. Increased turbidity decreases the amount of light availability and may inhibit growth or recovery from disturbance (de Boer 2007; LaFrance Bartley et al. 2022).

Cable protection measures are required to guard exposed cables and prevent abrasion with other cables. Cable protection approaches include rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers, according to the RPDE parameters provided in Table 2-2. The magnitude of impacts would depend on the temporal (season) and spatial (habitat type) factors of the activities. The presence of these introduced hard surfaces may result in new habitats for hardbottom species and in increases in biomass for benthic fish and invertebrates (Kerckhof et al. 2019; Raoux et al. 2017). The addition of new hardbottom substrate in a predominantly softbottom environment would enhance local biodiversity, even if only short term (Kerchof et al. 2019); enhanced biodiversity associated with hardbottom habitat is well documented (Pohle and Thomas 2001; Fautin et al. 2010; Causon and Gill 2018; Degrear et al. 2020). This indicates that marine structures would generate beneficial impacts for the benthic community. However, some impacts such as the loss of softbottom habitat may be adverse. These novel surfaces may also foster range expansion of invasive species as seen when an invasive species is present within the area. Although softbottom is the dominant habitat type in the region, the species that rely on this habitat are not likely to experience population-level impacts (Guida et al. 2017; Greene et al. 2010). A successional sequence of impacts on benthic resources by the presence of artificial hard substrates is likely but might not be foreseeably defined due to a current lack of knowledge, particularly on long-term changes and large-scale effects (Dannheim et al. 2020). Cable emplacement activities in sensitive habitats such as SAV or mollusk reefs would have a greater impact and require longer periods for recovery. In areas where cable protection is added, the benthic community would be permanently impacted.

As described in Section 3.5.2.1, seafloor features in the geographic analysis area include a series of ridges and troughs. Troughs are characterized by finer sediments and higher organic matter, while ridges are characterized by relatively coarser sediments. This morphology is superimposed with smaller scale bedforms such as sand ripples and sand waves, which suggest active sediment transport with frequent sediment mobilization, resuspension, and deposition occurring due to tides, currents, and storm activity. Pre-lay grapnel runs and other pre-installation activities for new cables, such as pre-sweeping, would disturb these benthic features and the communities they support. Installation methods can impact recovery and vary based on the environment where trenching will occur. Kraus and Carter (2018) studied seabed recovery following the burial of subsea cables on the continental shelf. Their results showed that water-jetted trenching methods take roughly 8–15 years to infill trenches depending on sediment availability, mobility, and water depth. They concluded that along the mid-shelf where water depths range from 98–263 feet (30–80 meters), recovery usually takes 2 years, though it may exceed 5 years if the adjacent sediment supply is low (Kraus and Carter 2018). In general, the recovery of softbottom benthic environments from physical disturbance ranges from a few months to a few years depending on the installation and substrate composition (with sandy substrates recovering more quickly than silt/clay) (Kraus and Carter 2018; Brooks et al. 2006; Kritzer et al. 2016; Lindholm et al. 2004). These sand-dominated substrates are resilient by nature and are capable of tolerating disturbances because the sediment is regularly disturbed by wave action, nor'easters, offshore storms, and hurricanes (Rutecki et al. 2014). Storms are known to cause massive changes along coastal environments, relocating large volumes of sediment from the dunes and beaches. Hurricane Sandy in 2012 created a new tidal inlet at Fire Island National Seashore along the south coast of Long Island, consequently altering environmental conditions within the Great South Bay (LaFrance Bartley et al. 2022). A study of tidal flats found significant changes in the richness, abundance, and biomass of microbenthic species following storms (Corte et al. 2017). Offshore storms can alter abundance of some infauna in a manner similar to inshore marine habitats (Posey et al. 1996), reaching a maximum depth of roughly 300 feet (90 meters) below the water surface (NOAA n.d.). Past studies following sand mining operations showed that the time scales for recolonization also vary by taxonomic group, with polychaetes and crustaceans recovering in the first several months and deep burrowing mollusks recovering within several years (Brooks et al. 2006). Wave action may also affect sediment transport in water depths shallower than approximately 66 feet (20 meters). During these periods of naturally induced sediment transport, short-term increases in turbidity affecting water quality may occur (see Section 3.4.2, *Water Quality*). Field testing of the recovery from sand removal from a shoal in Virginia concluded that sand dredging had no long-term impact on macrofaunal abundance. (Hobbs 2006).[2] Overall disturbance of sand waves and sand shoal troughs would be short-term, given that sand ripples, waves, and shoals are dynamic, adaptable features, with sand ridges requiring more time for full recovery than sand troughs; this would still be deemed a short-term and minor impact.

Discharges/intakes: Increase in discharge and intake would be expected due to an increase in vessel activity within the NY Bight area waters and ports. Permitted offshore discharges would include uncontaminated bilge water, ballast, grey water, and treated liquid wastes. It is generally expected that maritime activity including offshore development, recreation, and shipping would increase in the foreseeable future.

Water intake can occur through planned activities, such as cooling systems for power plants or other energy sources, which is the case for the Sunrise Wind Farm (Woods Hole Group 2021; Middleton and Barnhart 2022). Intake of smaller volumes can also occur with some cable trenching methods. This water intake increases the likelihood of entrainment and impingement of planktonic organisms

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[2] There is an ongoing BOEM-funded study to investigate these potential changes within the New York Bight (https://www.boem.gov/sites/default/files/documents/environment/environmental-studies/MM-20-01_2.pdf).

(Barnthouse 2013; Heimbuch 2007). Intake and physical contact with a barrier (screen) due to high intake velocity can negatively impact larval benthic invertebrates and larval fish (Barnthouse 2013; Heimbuch 2007). Benthic larvae and other planktonic organisms would experience unavoidable mortality within a small range of the activity.

Electric and magnetic fields and cable heat: EMF would result from ongoing and planned transmission or communication cables. DC cables placed on the seafloor would generate a static magnetic field, changing the natural geomagnetic field. Cables carrying AC, which produce low-frequency EMF, are the most commonly used in offshore wind farms to date. EMF effects from offshore wind cables on benthic habitats would vary in extent and significance depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). Hutchison et al. (2018, 2020) collected in-situ measurements of EMF along two HVDC cables; the Cross Sound Cable (150 kV and 330 MW) runs across Long Island Sound, and the Neptune Cable (500 kV and 660 MW) connects Sayreville, New Jersey to Long Island, New York. The EMF measured from the DC cables ranged from 478 to 653 milligauss (47.8 to 65.3 microtesla). This deviates from the background magnetic field (513 milligauss (51.3 microtesla) by a range of 4 to 187 milligauss (0.4 to 18.7 microtesla) for the Cross Sound Cable and 13 to 207 milligauss (1.3 to 20.7 microtesla) for the Neptune Cable. The DC magnetic fields typically extend 5 to 10 meters on either side of the cable (Hutchison et al. 2020). While the EMF intensity diminishes rapidly with distance, it is considered a long-term impact as it is expected to be present in the environment for the life of the project. The maximum magnetic field expected for an offshore wind energy project's export cable EMF is about 165 milligauss (16.5 microtesla), dropping to 40 milligauss (4.0 microtesla) 3.26 feet (1 meter) above the cable, a decrease in field strength of 76 percent (CSA and Exponent 2019). To put these values in perspective, the strength of the Earth's DC magnetic field is approximately 516 milligauss (51.6 microtesla) along the southern New England Coast (CSA and Exponent 2019), and normal values of the Earth's geomagnetic field can range from 200 to 750 milligauss (20 to 75 microteslas), depending on the geographical location (Diez-Caballero et al. 2022). At this time, no thresholds of the acceptable or unacceptable levels of EMF emissions have been determined for the marine environment (Hogan et al. 2023).

The impact of EMF on benthic habitats is an emerging field of study; as a result, there is a high degree of uncertainty regarding the nature and magnitude of the effects on all potential receptors (Gill and Desender 2020). Recent reviews by Bilinski (2021), Gill and Desender (2020), Albert et al. (2020), CSA and Exponent Inc. (2019), and most recently Albert et al. (2022) of the effects of EMF on marine organisms in field and laboratory studies concluded that measurable, though minimal, effects can occur for some species, particularly electrosensitive species such as shark and skate species. One recent study conducted in a laboratory setting concluded that spatial distribution, swimming speed, acceleration, and distance moved of lesser sandeel (*Ammodytes marinus*) larvae in raceway tanks were not affected by EMF exposures of 500 to 1,500 milligauss (50 to 150 microtesla) (Cresci et al. 2022). Animal enclosure studies on the little skate and American lobster (*Homarus americanus*) were also conducted by Hutchison et al. (2018, 2020). Results found an increase in exploratory (interpreted as foraging) behavior in skates in response to EMF up to 653 milligauss (65.3 microtesla) and a similar but more subtle response in lobsters. A study by Harsanyi et al. (2022) found that exposing gravid European lobster

(*Homarus gammarus*) and edible crab (*Cancer pagurus*) to static DC EMFs of 28,000 milligauss (2,800 microtesla) throughout embryonic development resulted in an increased occurrence of larval deformities, decreased larval size, and reduced larval swimming test success rates. It is noteworthy that the levels of EMF tested in Harsanyi et al. 2022 are said to be outside of the limits expected from offshore wind cables.

All non-DC types of submarine cables generate limited magnetic fields (Sharples 2011), and no biologically significant impacts on benthic resources have been reported from EMF from AC cables (Thomsen et al. 2016; CSA Ocean Sciences Inc. and Exponent 2019). No differences in the invertebrate community were noted between unburied energized and non-energized cables in the Pacific (Love et al. 2016), and a review of recent studies indicates that benthic communities located along cable routes are generally similar to nearby undisturbed habitats (Gill and Desender 2020). Additionally, no long-term impacts of EMF on clam habitat have been observed as a result of existing power cables connecting mainland Massachusetts and Nantucket (Hutchison et al. 2021).

The maximum current (amperage) that a cable can carry without exceeding its temperature rating, ampacity, is strongly influenced by the heat transfer in the surrounding marine environment (Callender et al. 2021). Models have demonstrated that the permeability of the sediment where the cable is placed is an important factor. Parameters such as ambient water temperature, burial depth, and spacing between cables affect the ampacity of DC submarine cables (Mardiana 2011). The effects of EMF and heat on most invertebrate taxa (embryonic and juvenile crustaceans and mollusks, horseshoe crabs, etc.) remain understudied (Gill and Desender 2020). Based on current literature, the impact of EMF on benthic resources is expected to be negligible.

Noise: The siting, construction and installation, O&M, and conceptual decommissioning of offshore structures, including those for offshore wind is expected to introduce several types of underwater sound into the marine environment (physical descriptions of sounds associated with these activities can be found in Appendix J, *Introduction to Sound and Acoustic Assessment*). While the intensity and extent of noise from construction are difficult to fully characterize, impacts on benthic communities are generally local and short term.

There remains a knowledge gap regarding sound thresholds and recovery from impact in almost all invertebrates (Carroll et al. 2017), which confounds the ability to assess potential impacts on benthic resources from exposure to noise. English (2017) reported marine invertebrates to be less susceptible than mammals and fish to loud noise and vibration, as their bodies do not generally possess air-filled spaces; however, they also reported that noise at high levels can cause short-term behavioral responses in marine invertebrates. Many previous studies relied on effects from sound pressure but did not focus on the potential effect of particle motion (Hawkins et al. 2014; Hawkins and Popper 2017). Although these gaps exist, current studies concerning the effects of noise on invertebrates suggest assessment of impacts on benthic species from noise is speculative and would likely be negligible.

Noise from construction, pile-driving, G&G survey activities, O&M, and trenching/cable burial could contribute to impacts on benthic resources in inshore waters as well as offshore waters. The most impactful noise is expected to result from pile-driving. Noise from pile-driving would occur during installation of foundations for offshore structures. This noise would be produced intermittently during installation of each foundation. One or more projects may install more than one foundation per day, either sequentially or simultaneously. Noise transmitted through water and through the seabed could cause short-term stress and behavioral changes to individuals in proximity to the pile-driving activity. The extent of impacts depends on pile size, hammer energy, and local acoustic conditions, such as the sound velocity profile, salinity, temperature, and sediment composition where the pile will be installed. As detailed in Appendix J, sound levels produced during impact pile-driving have been reported as having a source level, expressed as root-mean-square sound pressure level (SPL), of 204 dB re 1 µPa m (Dominion Energy 2020) and source levels expressed as peak-to-peak sound pressure levels (Lpk) from 233 and 245 dB re 1 µPa m (Amaral et al. 2018b). As noted in Appendix J, most fish and invertebrate species use particle motion to detect underwater noise rather than sound pressure, so this component is important for understanding the risk of effect on these species. Particle acceleration levels measured approximately 1,640 to 2,887 feet (500 to 880 meters) from impact pile-driving of WTG foundations ranged from 30 to 116 dB re 1 $\mu m/s^2$ for smaller jacket piles (i.e., 4.3-foot (1.3-meter) diameter piles) and 6-megawatt WTGs monopiles with noise mitigation systems in place (Amaral et al. 2018; Sigray et al. 2022). The highest particle acceleration levels were observed closer to the seabed and in the 100-200 hertz frequency range with decreasing acceleration levels above and below these frequencies (Amaral et al. 2018; Sigray et al. 2022). Sigray et al. (2022) also estimated the Lpk sound pressure levels corresponding with these particle acceleration levels to be 170 to 175 dB re 1 µPa for unmitigated pile driving (Sigray et al. 2022). Based on these data, because benthic invertebrate species predominantly detect noise using particle motion, the affected areas would only cover a relatively small area around each pile, and increased particle acceleration levels would only be present during active pile driving. Therefore, these areas would likely be recolonized in the short-term after cessation of pile driving. A recent study of giant scallop (*Placopecten magellanicus*) exposed to impact and vibratory pile driving of 0.9-foot (0.3-meter) steel piles installed off of a dock at Woods Hole Oceanographic Institute showed a significant increase in valve closures and a reduction in coughing behavior when exposed to peak substrate vibration levels of 109.9 dB re 1 $\mu m/s^2$ within 26 feet (8 meters) of the activity (Jézéquel et al. 2022). Additionally, results of this study showed that responses to pile driving were similar across exposure events in a given day, indicating no short-term acclimatization for this species, and juveniles studied were more sensitive to exposure that the adults and subadults studied (Jézéquel et al. 2022).

Noise from G&G surveys of cable routes and other site characterization surveys for offshore wind facilities could also disturb benthic resources in the immediate vicinity of the investigation and cause temporary behavioral changes. Equipment employed during G&G surveys for site characterization (shallow and medium-penetration sub-bottom profilers, side-scan sonar, multibeam echosounder, and magnetometer) generate sound waves that are similar to common deep-water echosounders. Impacts from vessel and equipment noise, including geotechnical sampling (e.g., coring), are expected to be unmeasurable. G&G surveys of cable routes would be performed intermittently through all phases of an offshore wind project, but mostly during construction. G&G noise resulting from offshore wind site characterization surveys is less intense than that from seismic surveys used in oil and gas exploration; while seismic surveys create high-intensity, impulsive noise to penetrate deep into the seabed, offshore wind site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves for shallow penetration of the seabed.

Noise from trenching/cable burial, O&M, and construction activities other than pile-driving and G&G surveys is expected to occur associated with ongoing and planned offshore wind projects but these activities would have little impact on benthic resources. Other anthropogenic underwater sounds in the geographic analysis area come from many different sources including vessel traffic, seismic surveys, active sonar used for navigation of large vessels, and chart plotting. These low- and mid-frequency noises in oceanic waters (Henderson et al. 2008) dominate the ambient sound levels in frequencies below 200 hertz (Arveson and Vendittis 2000; Veirs et al. 2016). A recent study by Hudson et al. (2022) showed that recorded vessel sounds in shallow waters can induce stress signals for blue crabs, which may in turn affect their ability to compete with the European green crab, an invasive species. In addition, global shipping traffic in the NY Bight area is expected to grow, which may require port modifications, with associated noises. The extent of the impact from noise depends on the level of exposure, equipment used to produce the sound, and ambient noise levels.

Port utilization: Marine transportation in the region is diverse and sourced from many ports and 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 motorboats and sailboats. Research vessels also frequent these waters. The ports of New York and New Jersey support large volumes of shipping traffic for the Northeast Atlantic, with major shipping traffic lanes. In response to future offshore wind projects in the NY Bight area, multiple additional fairways and a new anchorage may be established to route existing vessel traffic around wind energy projects (NROC 2022). Also, a new barge service is proposed to run twice each week in state waters between Newark, New Jersey, and Brooklyn, New York. The Raritan Bay area of New Jersey (including Sandy Hook, New Jersey) is home to several ports that would support offshore wind activities. These planned and ongoing dredge projects and port expansion projects may impact benthic communities by increasing noise as construction takes place, as well as producing dredge effects. Port expansion could include dredging, deepening, and new berths. Dredging for port expansion or modifications or of navigable waterways can cause localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources, alter the seabed profile, and increase sediment deposition. 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 the season. Dredging typically occurs in sandy or silty habitats that are relatively quick to recover from disturbance (Wilber and Clarke 2007); however, full recovery of the benthic faunal assemblage may require several years (Boyd et al. 2005). If maintenance dredging occurs frequently, the benthic community may not be able to recover in the same location as the impact. Although local impacts would likely be fatal for the organisms directly impacted by construction or dredging activities, overall, a limited spatial and temporal impact on benthic resources in the geographic analysis area is expected, and impacts would be negligible. Specific ports and expansions will be further discussed in project-specific COPs and COP NEPA documents.

Survey gear utilization: Survey gear utilization refers to fisheries monitoring survey gear, site characterization equipment, and commercial fishing gear. Post-ROD preconstruction, construction, and post-construction fisheries monitoring surveys for other offshore wind projects would continue to harvest finfish and macroinvertebrates. These surveys could include trawl surveys (impacting finfish and squid) and clam dredge surveys (ocean quahog and surfclam).

HRG equipment that would be used for nearby offshore wind projects would, at a minimum, use side-scan sonar, sub-bottom profiler, magnetometer, and multibeam echosounder. Following the HRG surveys, geotechnical surveys using vibracores, sediment grabs, and cone penetration tests would likely occur as well. Some of this gear would come in contact with benthic resources, which can disrupt the habitat and cause mortality by crushing if under the gear. Other gear would add short-term sound inputs, which may temporarily disturb finfish and invertebrates as well as impact EFH. Impacts from these surveys are expected to be negligible due to the short duration and scale of spatial impact.

Multiple fishing grounds are located within the NY Bight area, including Cholera Bank, Middle Ground Bank, and Angler Bank, and a variety of regulated gear types and fishing techniques are currently used in the lease areas (NYSERDA 2017b). Menhaden (*Brevoortia tyrannus*), mackerel (*Scomber scombrus*), butterfish (*Peprilus triacanthus*), and summer flounder (*Paralichthys dentatus*) all provide high commercial fishing revenue in New York, New Jersey, and Rhode Island (BOEM 2021). See Section 3.6.1 for more information. Several managed invertebrate species occur in the NY Bight area, many of which utilize the benthic environment, including longfin inshore squid, Atlantic sea scallops, Atlantic surfclams, ocean quahogs, horseshoe crabs (*Limulus polyphemus*), blue crabs (*Callinectes sapidus*), and American lobsters (BOEM 2021). Anthropogenic structures are known to attract certain fish species, which rely on them for shelter, camouflage to avoid predators, and to find prey. Some of these structure-oriented species are commercially viable such as black sea bass, striped bass, lobster, and Atlantic cod (Claisse et al. 2014; Smith et al. 2016). Structures locally increase, attract, or concentrate fish species, thereby affecting the accuracy of stock assessment (Gill et al. 2020). Furthermore, the survey design and sampling methods may need to be altered to maintain safe operations within wind farms (Gill et al. 2020). The gear used would affect benthic invertebrate communities, especially those that disturb the seafloor (trawls, dredges). Scallop and clam dredgers as well as bottom trawlers are ranked second and third for the highest landings within the NY Bight lease areas. See Section 3.6.1 for more details. Dredging and trawling are methods used to land clams, scallops, and other benthic species. Disturbance of benthic invertebrate communities by commercial fishing activities can adversely affect community structure and diversity and limit recovery from offshore wind farms (Avanti Corporation and Industrial Economics 2019), although this impact is less notable in sandy areas that are strongly influenced by tidal currents and waves (Nilsson and Rosenberg 2003; Sciberras et al. 2016). This repetitive impact of regulated bottom-tending fish gear would be moderate.

Presence of structures: The presence of structures from ongoing and planned activities, including offshore wind, can lead to impacts on benthic resources through entanglement and gear loss/damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic resources, and habitat conversion. These impacts may arise from foundations, scour/cable protection, buoys, and met towers. Anthropogenic structures, especially in the form of tall vertical objects such as turbines, alter local water flow (hydrodynamics) at a fine scale and increase seabed scour, which may alter sediment grain sizes and benthic community structure (Lefaible et al. 2019). The consequences for benthic resources of such hydrodynamic disturbances are anticipated to be localized; refer to the presence of structures IPF under Alternative B for additional discussion regarding hydrodynamic impacts. These marine structures (e.g., towers, turbines, foundations, scour protection, cable protection) create uncommon vertical relief in a predominantly softbottom seascape. The structures also generate turbulence that transports nutrients upward toward the surface, increasing primary productivity at localized scales (Danheim et al. 2020). These changes have been reported to increase food availability for filter-feeders on and near the structures, creating a beneficial impact (Degrear et al. 2020). The consequences for benthic resources from such hydrodynamic disturbances are anticipated to be localized, vary seasonally, and have minor impacts.

Structure-oriented fishes would be attracted to these locations as they create reef-like habitats (Mavraki et al. 2021). With an increase in structure-oriented species, predation in the vicinity of these structures also has the potential to increase, negatively affecting these benthic habitats (Raoux et al. 2017). These impacts are expected to be localized but long term, continuing for as long as the structures remain in place, and would result in a minor impact.

Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but not well understood. New cables, towers, turbines, buoys, or piers would create relief. Benthic species dependent on hardbottom habitat could benefit from an increase in hard surfaces and increase benthic diversity. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018), or predators are attracted to the area. This novel habitat could also be colonized by invasive species (e.g., certain tunicate species).

Installation of offshore structures and associated scour protection would convert softbottom to hardbottom, resulting in the displacement of softbottom species. Softbottom is the dominant habitat type in the region. Species that rely on this habitat would be adversely affected and may be outcompeted as a result of habitat conversion, but they are not likely to experience population-level impacts (Guida et al. 2017; Greene et al. 2010). Softbottom species would also not likely experience the beneficial impacts from the added hard surfaces as would be experienced by benthic species dependent on hardbottom habitat. Presence of structures would result in moderate impacts for softbottom species.

The impacts on benthic resources resulting from the presence of structures would persist as long as the structures remain. Though species impacts are unavoidable, they would not result in population-level effects. BOEM anticipates that impacts from the presence of structures would be moderate as well as minor beneficial.

3.5.2.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, benthic resources would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing short-term, long-term, and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) primarily through dredging and fishing using bottom-tending gear, the presence of structures, new cable emplacement, construction noise, anchoring, and climate change. Short-term, long-term, and permanent impacts are expected from repetitive channel deepening, dredging, trawling for commercial fisheries (Pitcher et al. 2022; Thrush and Dayton 2002; Hinez et al. 2009; Kaiser et al. 2002), and the ongoing installation of export cables and presence of offshore wind structures. Impacts on species are unavoidable but are not expected to result in population-level effects, especially if sensitive habitats are avoided and disturbances are temporally and spatially distributed. The No Action Alternative would likely result in **negligible** to **minor** impacts on benthic resources.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and benthic resources would be affected by natural and anthropogenic IPFs. In addition to ongoing activities, planned activities may also contribute to impacts on benthic resources. Short-term disturbance and permanent loss of habitat within the benthic community would occur as a result of planned offshore wind development. Minimal softbottom habitat would be converted into hardbottom that would provide novel habitat for hardbottom species, as well as creating a “reef effect” around the structures, foundations, cable, and scour protection features. Any impacts resulting from habitat disturbance or conversion would not be expected to result in population-level effects within the geographic analysis area. When combined with all other planned activities within the geographic analysis area, the No Action Alternative would likely result in **negligible** to **moderate** impacts and **minor beneficial** impacts on benthic resources.

3.5.2.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Benthic Resources

3.5.2.4.1 Impacts of One Project

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts.

Accidental releases: The risk of accidental releases associated with a single NY Bight project is expected to increase due to more vessel traffic and this could result in short-term and highly localized impacts. As stated in Section 3.4.2, *Water Quality*, the risk of a spill from an offshore structure would be low, and collisions and allisions are anticipated to be unlikely based on the following factors that would be considered for a single NY Bight project and applied at the project-specific NEPA stage: USCG requirement for lighting on vessels, established NOAA vessel speed restrictions, the lighting and marking plan that would be implemented, and the inclusion of a single NY Bight project’s components on navigation charts. In the unlikely event an allision or collision involving vessels or components associated with one single NY Bight project resulted in a large spill, these impacts would be short- to long-term depending on the type and volume of material released and the specific conditions (e.g., depth, currents, weather conditions) at the location of the spill. Overall, the probability of an oil or chemical spill occurring that is large enough to affect benthic resources is low and the degree of impact would depend on the spill volume.

From 2000 to 2009, the average spill size for vessels other than tank ships and tank barges was 88 gallons (333 liters) (USCG 2011); BOEM anticipates that the volume would be similar should a spill occur. The most likely release, diesel fuel, is lighter than water; therefore, it would float on the surface (Tarr et al. 2016) where it would potentially be dispersed into the water column by surface waves, before dissipating very rapidly, evaporating, and biodegrading within a few days (MMS 2007a). The potential for spilled oil from the offshore project area to reach the benthic resources is very low due to the biodegradation from weathering (Tarr et al. 2016). NOAA's Automated Data Inquiry for Oil Spills (ADIOS; an oil weathering model) was used to predict the dissipation of a maximum spill of 2,500 barrels, a spill far larger than what is assumed as a non-routine event during a single NY Bight project. Results of the modeling analysis showed that the dissipation of spilled diesel fuel is rapid, not allowing the fuel to sink to the bottom and result in impacts on benthic habitats or species. The amount of time it took to reach diesel fuel concentrations of less than 0.05 percent varied between 0.5 and 2.5 days, depending on the ambient wind (Tetra Tech Inc. 2015), suggesting that 88 gallons (333 liters) would reach similar concentrations much faster and limit the environmental impact of such a spill.

Accidental releases of trash and debris may occur from vessels during any phase of a single NY Bight project. Vessel operators, employees, and contractors would be briefed on marine trash and debris awareness elimination as described in BSEE NTL No. 2015-G03 ("Marine Trash and Debris Awareness and Elimination"), per BOEM guidelines for marine trash and debris prevention. BOEM assumes all vessels and personnel would comply with these preventative guidelines. Marine debris also includes lost survey equipment. Although unlikely, equipment may break loose or be carried away by currents. BOEM will work with the lessee/operator to develop a recovery plan to address these potential losses. In the event of a release, it would be an accidental, localized event in the vicinity of projects; therefore, project-related marine debris would only have an indirect, short-term effect on benthic resources.

Invasive species can be released accidentally, especially during ballast water and bilge water discharges from marine vessels. This includes invasive species that could compete with, prey on, or introduce pathogens that negatively affect benthic species. Although the likelihood of invasive species becoming established as a result of offshore wind activities is very low, their impacts on benthic resources could be strongly adverse, widespread, and permanent if the species were to become established and out-compete native fauna; however, such an outcome is considered highly unlikely. The increase in this risk related to a single NY Bight project would be small in comparison to the risk from ongoing activities (e.g., trans-oceanic shipping).

Additionally, construction vessels would comply with USCG regulations, and interim requirements of the Vessel Incidental Discharge Act (85 *Federal Register* 67818). The low likelihood and small size of the potential releases suggest impacts from accidental releases for one NY Bight project would be difficult to measure. BOEM anticipates the impacts on benthic resources from accidental releases would be short term and negligible.

Anchoring: Vessel anchoring would increase as a result of one NY Bight project. Vessel stabilization through dynamic positioning (DP) would avoid contact with the seafloor, while spud barges or jack-up vessels would directly affect the benthos. Impacts on the benthos would generally be limited to the diameter of the spud cans (through deck pilings) or jack-up legs if spud barges or jack-up vessels are used. Total mortality would likely occur for benthic organisms within direct contact (via crushing and burial). Anchor drag would increase impacts, potentially resulting in scarring or additional damage to benthic habitats. Contact with the sediment will also increase short-term turbidity. Impacts from anchoring would be localized, and, although some organisms would be killed, the benthic community is likely to recover relatively quickly (Dernie et. al. 2003). Anchoring on hardbottom or sensitive substrates (gravelly, SAV, mollusk reefs) may impart somewhat longer-term impacts. Impacts from anchoring relative to a single NY Bight project occur during all phases but would be limited. Overall, a relatively small portion of the seafloor would be affected by anchoring and short-term turbidity. When also accounting for a relatively quick recovery period, impacts from anchoring for one NY Bight project would be short term and minor.

Cable emplacement and maintenance: New cables would be required as a result of a single NY Bight project. Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, UXO clearance, and pre-lay grapnel runs. A pre-lay grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the path of construction. Additionally, pre-sweeping may be required in areas of the submarine export cable and interarray cable corridors with megaripples and sand waves. Pre-sweeping, i.e., sand wave leveling, involves smoothing the seafloor by removing ridges and edges using a suction hopper dredge vessel (see *Discharges/intakes* for discussion on entrainment) or a mass-flow excavator from a construction vessel to remove the excess sediment. Dredged material generated from pre-sweeping activities may either be sidecast near the installation site or removed for reuse or proper disposal. This activity disturbs the benthic community within the path of construction and increases turbidity temporarily. This type of activity may fall under the purview of the MPRSA; if the material is dredged or excavated from sand waves in the navigable waters of the United States, lessees would coordinate with USACE and/or EPA as needed.

HDD methods would likely be used to install offshore export cables and avoid affected sensitive nearshore and intertidal habitat or seagrass beds. Trenchless installation would likely occur from an offshore punch-out location from the cable landing. The offshore export cables would be brought to shore through a series of conduits at the cable landing location. These conduits would be established under the shoreline at depths typically ranging from 10 to 125 feet (3 to 38 meters) below grade. Temporary disturbance to the inshore sediment would occur during installation of the offshore export cables. Most impacts on benthic species are expected to be avoided; if impacts occur, they may result in the loss of a few individuals relative to the population of the species. The offshore export cables would likely be sited to avoid sensitive or rare habitats, such as artificial reefs, clam beds, SAV beds, and hardbottom habitats, but if avoidance is not possible, longer-term impacts on these features could result. Once the lessees have proposed cable routes that traverse state waters, that state will have an opportunity for review to ensure that the proposed route minimizes impacts to the greatest extent possible.

Up to 550 miles (885 kilometers) of interarray cables would be used to connect WTGs to OSSs. The diameter of the cable would be 5 to 12 inches (12.7 to 30 centimeters). The interarray cables would have a minimum target burial depth of 3 to 9.8 feet (0.9 to 3 meters). Several cable installation methods are considered under the RPDE for the interarray cables, with mechanical and jet-plowing as the most common installation techniques. Mechanical cutter, jet trencher, control flow excavator, jet plowing, vertical injection, suction hopper dredging, precision installation (with ROVs or divers), HDD, direct piping, open-cut trenching, and jack-and-bore are also considered as additional options. A new emerging technology is the installation of unarmored interarray cables in protective high density polyethylene pipelines. Direct and indirect benthic impacts from the cable installation could vary based on the machinery and techniques used and could require further analysis based on project-specific methods (e.g., impact determinations could increase or decrease based on installation methods and the sensitivity of the benthic habitat present).

According to the RPDE parameters for one representative NY Bight project, up to nine export cables could be installed to deliver electricity from the OSSs to the landfall sites. Export cable corridor widths would range from 66 to 131 feet (20 to 40 meters) per cable, including the cable protection footprint, and would traverse 30 to 929 miles (48 – 1,495 kilometers) to reach the landfall locations. Both HVAC and HVDC voltage cables could be used for a single NY Bight project. HVAC cables would carry 220 to 420 kilovolts and would range from 6.1 to 13.8 inches (15.5 to 35.1 centimeters) in diameter. HVDC cables would carry 320 to 525 kilovolts and would range from 6.3 to 16 inches (16 to 40.6 centimeters) in diameter. The target burial depth of export cables would range from 3 to 19.6 feet (0.9 to 6 meters). A burial depth of 15 feet (4.6 meters) within federal navigation channels is required; therefore, a minimum of 3 feet (0.9 meter) would only occur where it is not practical to bury the cable deeper. The cable installation methods under consideration under the RPDE for the export cables are the same as those described for interarray cables. As with interarray cables, the direct and indirect impacts would vary based on chosen installation and would require further investigation. Multiple installation methods can be used to make the sea-to-shore transition, including open cut (i.e., trenching) or trenchless methods such as bore or HDD. Although active construction would temporarily disturb benthic habitat, the habitat would rapidly return to preconstruction conditions in non-complex habitats after burial is complete (Boyd et al. 2005). A sediment transport model for the adjacent Empire Wind project Lease Area OCS-A 0512 (Empire 2022) indicated that the displacement of sediments would be low. Sediment particles would typically remain suspended for 4 hours, before returning to background levels.

The sediment texture is strongly linked with the composition of the benthic invertebrate community (Rutecki et al. 2014). The medium-grained sand that makes up the majority of the NY Bight area provides softbottom (non-complex) habitat for benthic infaunal organisms typical of this region. Disturbance of sand waves and ridges would be short term, given that sand waves and ridges are changing, mobile features and would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that initially formed them (Kraus and Carter 2018). These sand-dominated substrates are resilient by nature and are capable of tolerating disturbances because the sediment is regularly disturbed by wave action, and tropical and extratropical cyclones (Rutecki et al. 2014). Recovery rates following sand mining operations showed that the time scales for recolonization also vary by taxonomic group, with polychaetes and crustaceans recovering in the first several months and deep burrowing mollusks recovering within several years (Brooks et al. 2006). Polychaetes were dominant in benthic grab samples from both the New York and New Jersey WEAs (Guida et al. 2017).

Where cable crossings occur, or seabed conditions do not allow for cable burial to the desired depth, concrete mattresses, frond mattresses, rock bags, and seabed spacers would offer cable protection. Recovery rates of these disturbed surfaces would depend on the species present and their recovery capabilities, the extent of disturbance, and the nature of the protection material. This newly incorporated hardbottom also provides new habitat for encrusting organisms.

Cable laying operations would be occurring in areas with primarily sand substrate, where possible. Impacts from new cable emplacement are expected to be mostly short term, though cable protection impacts would be long term. A fraction of benthic species would experience unavoidable fatal injuries or mortality; however, population-level effects are not likely. BOEM anticipates the impacts on benthic resources from cable emplacement would be short term and minor.

Discharges/intakes: Construction of a single NY Bight project would include up to approximately 51 vessels operating in a lease area or over the offshore export cable route at any given time (Section 3.6.6, *Navigation and Vessel Traffic*). Various vessel types (installation, cable-laying, support, transport/feeder, and crew vessels) would be deployed throughout the NY Bight project area during the construction and installation phase. Discharge and intake would increase due to increased vessel traffic. Routine discharges include bilge water, ballast, grey water, and treated liquid wastes. Impacts from discharges from vessel traffic associated with one NY Bight project would be similar to those described under the No Action Alternative. All vessels would comply with USCG ballast water discharge and other regulatory requirements, which would minimize impacts on the marine environment. BOEM anticipates the impacts on benthic resources from discharges would be short term and negligible.

Water intake can cause entrainment and impingement of larvae and juvenile benthic invertebrates and fish. If the NY Bight lessees use HVDC converter OSSs with open loop cooling systems, the intake of seawater for cooling water will entrain plankton. Impacts would depend in part on the design and technology used in an HVDC converter OSS, as intake velocity and seawater filter used on the intake can help minimize or even eliminate the impacts on juvenile and adult fish (Sunrise Wind, LLC. 2022). These HVDC systems intake cool sea water and discharge warmer water back into the ocean (Middleton and Barnhart 2022). The warm water discharged is generally considered to have a minimal effect as it will be mixed with the surrounding water and returned to ambient temperatures (Sunrise Wind, LLC. 2022; Woods Hole Group 2021). For the South Coast Wind Project (Lease Area OCS-A 0521), the maximum temperature of discharge water from an HVDC converter OSS would be 90°F (32°C), which was modeled to result in a 1.4°F (1°C) water temperature increase up to 155 feet (47 meters) from the discharge point (TetraTech and Normandeau Associates, Inc. 2023). Given the small temperature increase and small area of effect, impacts on benthic organisms as a result of the thermal plume are anticipated to be negligible. If the intake velocity is low, most strong-swimming juvenile fishes and smaller adults would be able to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast-swimming larvae. Those organisms entrained may be stressed or killed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure and mechanical damage (turbulence in pumps and condensers). Placement of the intake pipe opening and velocity of the pump system can mitigate effects on invertebrate and benthic species (Middleton and Barnhart 2022).

A study of the effects of a Queens power plant on fish stocks in the New York-New Jersey Harbor Estuary and Long Island Sound found that the conditional mortality rates for entrainment of eggs, larvae, and young-of-the-year were very low and ranged by species (Heimbuch et al. 2007). Estimated entrainment rates for tautog and Atlantic menhaden were 0.02 percent and 0.11 percent, respectively, with estimated conditional mortality rates of 0.00 percent for tautog and winter flounder. Overall, Heimbuch et al. (2007) determined that the effects from entrainment were extremely small relative to the effects from fishing mortality. Impacts would be staggered over time and localized. There is no evidence that the volumes and extent of anticipated discharges or entrainment activities would have an impact on benthic resources. Due to the limited area scope and intake volumes, impacts from entrainment and impingement associated with converter OSS structures would be mostly confined to the immediate area of the OSS intake and would be localized, and negligible, although long-term.

Electric and magnetic fields and cable heat: Cables connecting WTGs, OSSs, and onshore substations for a single NY Bight project would result in additional EMF and cable heat. Past studies have demonstrated that EMF strength diminishes rapidly with distance. Copping et al. (2016) reported that although burrowing infauna may be exposed to stronger EMFs from offshore wind activities, there was no evidence that the EMFs anticipated to be emitted from those devices would affect any species. Biologically notable impacts on invertebrates and finfish have not been documented from AC cables (Thomsen et al. 2016; CSA Ocean Sciences Inc. and Exponent 2019), but alterations of behavior have been documented for benthic species (skates and lobster) near operating DC cables, emitting up to 653 milligauss (65.3 microtesla) in a lab setting (Hutchison et al. 2018). The impacts from EMF were localized and affected the animals only while they were relatively close to the EMF source and did not present a barrier to movement (Hutchinson et al. 2018). No differences in benthic community structures have been observed in invertebrate communities exposed to unburied cables, and no differences have been observed between benthic communities in energized cables compared to controls (cables out of service) (Love et al. 2016; Gill and Desender 2020).

Additional interarray and export subsea cables for a single NY Bight project have the potential to increase the temperature of the surrounding environment from the thermal radiation emitted from the cables (Boehlert and Gill 2010; Hogan et al. 2023). Cable heat could theoretically affect benthic community structure, displacing species laterally or vertically due to their avoidance of changing sediment temperatures. These changes could affect the composition and availability of invertebrate prey resources for benthic feeding species, although the physical extent of these effects would be limited relative to the amount of unaffected foraging habitat available. Heat emission is higher in AC than in DC cables at equal transmission rates. A study measuring sediment heat from two AC cables (33 kV and 132 kV) at the Nysted wind farm found that the greatest temperature difference to a control site was 2.5°C (a change of 4.5°F) (Taormina et al. 2018). Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters, but impacts on bottom-dwelling organisms are expected to be insignificant and would be limited to a small area around the cable. The predicted thermal effect is a small rise in temperature within a few centimeters of the cable (Boehlert and Gill 2010). Whether this small temperature change will represent a stressor to benthic communities is not yet fully understood. No acceptable or unacceptable threshold levels of EMF emissions are currently identified for the marine environment (Hogan et al. 2023). EMFs would be minimized by shielding and by burying cables to the target depth or employing cable protection. Impacts on the benthic community from EMF and cable heat are not anticipated or would be very low, and therefore, extremely difficult to measure. BOEM anticipates the impacts would be negligible.

Noise: Additional sounds would be added to the marine environment as a result of one NY Bight project. These additional sounds would occur from construction, pile-driving, G&G survey activities, O&M, and trenching/cable burial and could contribute to impacts on benthic resources. Additional noise from the installation of up to 285 offshore structures using monopile or jacket foundations would be unavoidable. Suction bucket or gravity-based foundations would emit the least amount of noise, as most other foundation types (including monopile and jacket) would require pile-driving and would produce the most substantial noise within the project area (ICF 2021). Although concrete foundations would produce the lowest sound levels during turbine operations (compared to steel monopile and jacket foundations), these foundations are often used in very shallow waters and may not be applicable for the proposed NY Bight projects (Tougaard et al. 2020). Therefore, steel foundations, like those proposed for other approved offshore wind projects in this region, would be assumed for use.[3] Inshore, pile-driving may be used during installation of cofferdams in shallow offshore waters at the associated offshore trenchless (HDD) installation punch-out locations, if used. Noise from impact pile-driving is transmitted through the water column to the seabed. These activities, if used, would add noise to the nearshore and shallow offshore environments.

There remains a knowledge gap in the understanding of sound thresholds and recovery from impact in almost all invertebrates (Carroll et al. 2017), which complicates the ability to assess potential impacts on benthic species from exposure to noise. English (2017) reported marine invertebrates to be considered less susceptible than finfish to loud noise and vibration as their bodies do not generally possess air-filled spaces, but also reported that noise at high levels can cause short-term behavioral responses in marine invertebrates. The responses to noise originate from the particle motion created from the noise source. The effects of the detectable particle motion on invertebrates are typically limited to within a few meters of the source or less (Edmonds et al. 2016; Popper and Hawkins 2018; Payne et al. 2007). However, recent lab research (Jones et al. 2020, 2021) indicates that longfin squid can sense and respond to vibrations from impact pile-driving noise at a greater distance based on recorded sound exposure experiments. This suggests that other infaunal species may exhibit a behavioral response to vibration effects at greater distances. This noise would be produced intermittently during installation of each foundation. Noise transmitted through water and through the seabed can cause injury to or mortality of benthic resources in a limited area around each pile and can cause short-term stress behavioral changes to individuals over a greater area. The extent depends on pile size, hammer energy, and local acoustic conditions. The affected areas would likely be recolonized in the short term.

Glauconite sands may be present in the NY Bight lease areas. Depending on the classification of the glauconite sands present, there can be challenges associated with potential offshore wind development

[3] However, during the project-specific COP NEPA analysis, each developer will identify the specifics of their proposed foundations and re-assess potential impacts if a different material is proposed.

in these areas. Specifically, some glauconite sands are difficult, or even impossible, to drill through and cause high friction and increased noise during pile-driving. If developers discover glauconite sands during construction and installation, noise levels will likely increase as they determine if the glauconite is passable. This temporary increase in noise could have potential impacts on benthic organisms.

Noise from G&G surveys during inspection, monitoring, or both, of offshore export cables may occur during construction and operations. G&G noise resulting from cable route surveys can disturb inshore fauna, and those in shallow offshore waters in the immediate vicinity of the investigation. HRG surveys include high frequency sound sources from medium-penetration sub-bottom profilers (e.g., sparkers, boomers) and shallow-penetration, non-parametric sub-bottom profilers (e.g., Compressed High-Intensity Radiated Pulses) that generate less-intense sound waves than the seismic surveys used for oil and gas exploration that create high-intensity impulsive sound that penetrates deep into the seabed (Erbe and McPherson 2017). Impacts from vessel and equipment noise from these geophysical surveys of cable routes could disturb benthic resources in the immediate vicinity of the investigation and cause temporary behavioral changes. Although there is limited data regarding the effects of sound on benthic invertebrates, a review of available studies indicated that such sound pulses have minimal effects (Carroll et al. 2017). The intensity and extent of the resulting noise impacts from G&G surveys are difficult to generalize but would likely be short term and localized; therefore, the impacts of G&G survey noise on benthic resources would likely be negligible, as most impacts on species are expected to be avoided. Construction sounds in inshore and shallow offshore waters may also increase, which could also disturb benthic resources in the immediate vicinity of the investigation and cause temporary behavioral changes.

Recent modeling of underwater turbine noise from wind farms found that operational noise from a turbine was at least 10 to 20 decibels less than the levels measured from commercial ships at the same distance (Tougaard et al. 2020) and were not able to be separated from areas with high ambient noise levels (Holme et al. 2023) such as the NY Bight. The size of the turbine affects the noise produced by the turbine, with larger turbines generating more noise (Tougaard et al. 2020). The noise is created in the nacelle and transferred to the seafloor through the foundation (Tougaard et al. 2020); therefore, foundation type also alters the volume of sound carried to the benthic community, and larger turbines will require larger foundations, increasing the noise (Tougaard et al. 2020).

The duration of impact pile-driving would be relatively short term (around 4 hours per day/pile) and spaced out over time. Due to the temporary, localized nature of noise produced during construction, population-level effects are not likely. BOEM anticipates the impacts on benthic resources from noise would be negligible.

Port utilization: Port utilization would increase as a result of a single NY Bight project due to an increase in vessel traffic. If port expansions or modifications were necessary for one NY Bight project, they would be completed in accordance with state and federal regulations and permits and would be completed in collaboration with multiple entities (e.g., port owners, governmental agencies, states, other offshore wind developers). Port expansion could include dredging, deepening, and new berths. Maintenance dredging as well as port expansion activities would cause mortality of any organisms that come into direct contact with machinery, increase turbidity for a short duration, and increase deposition, which may smother some benthic organisms at varying life stages. Increased vessel traffic would be split between the ports used by the NY Bight project. Representative ports that may be used by the NY Bight project in New York and New Jersey are: Port of Albany, Port of Coeymans, Brooklyn Navy Yard, South Brooklyn Marine Terminal, Howland Hook/Port Ivory, Arthur Kill Terminal, Paulsboro Marine Terminal, and New Jersey Wind Port. Impacts from port utilization on benthic communities would be localized and short-term and would be hard to measure and vary seasonally. Impacts on benthic resources are expected to be negligible.

Presence of structures: A single NY Bight project would result in the installation of up to 285 structures. WTGs and OSSs would be arranged in a 0.6 nautical mile by 0.6 nautical mile (1.1 kilometer by 1.1 kilometer) grid layout. WTGs and OSSs would be mounted on one or a combination of the following foundation types: monopile, piled jacket, suction mono-bucket, suction bucket jacket, tri-suction pile caisson, or gravity-based foundations. Monopiles or piled jackets are the most likely foundation types, per the RPDE. Maximum water depth and the geological conditions of the proposed WTG location will help to inform the foundation type (ICF 2021). Installation of any of the foundations will disturb the seafloor, benthic species, and communities; however, potential impacts are expected to vary based on the foundation types selected. For example, relatively little suspended sediment is expected to occur from the installation of suction bucket foundations compared to gravity-based foundations or monopiles, which would require more extensive seabed preparation (ICF 2021). Foundation scour protection could consist of rock placement, mattress protection, sandbags, stone bags, and nature-inclusive materials. If required, the amount of scour protection would also vary based on the type of foundation. The scour protection increases the footprint of benthic disturbance. Gravity-based or suction bucket foundations would be expected to have large scour effects, compared to monopiles (ICF 2021).

Regardless of foundation type, the installation of structures would cause total mortality for all infauna and sessile species within the construction footprint, and permanently displace softbottom benthic species. Monopile and piled jacket are anticipated to be the most likely foundation types used. Each WTG would require 0.24 acre (0.1 hectare) per monopile foundation or 2.88 acres (1.17 hectares) per jacket foundation, most of which is related to the scour protection. Each OSS seabed footprint would require 0.51 acre (0.21 hectare) per monopile or 8.05 acres (3.26 hectares) per jacket structure including scour protection. If suction bucket or gravity-based foundations are used, the footprint of these structures would likely be larger than monopile or piled jacket, resulting in greater benthic mortality. Once in place, these offshore structures increase the risk for entanglement and gear loss or damage. The lost gear, moved by currents, could catch on the cabling, foundation, turbine, and or substation infrastructure, resulting in increased seafloor disturbance and injury or mortality to benthic species, including scavengers. Entangled gear may attract predators who would therefore also be at greater risk of entanglement. The impacts at any one location would likely be localized and short term as entangled nets and gear could be removed during routine maintenance activities.

Tall vertical structures such as WTGs and OSSs extract kinetic energy from the atmosphere, which can lead to changes in atmospheric patterns. Atmospheric wakes, characterized by reduced downstream mean wind speed and turbulence along with wind speed deficit, are documented in offshore wind farms. Many of the past studies modeling atmospheric wakes incorporate data inputs from European ecosystems to design WTG layouts and predict potential scour. At a regional scale, if turbine spacing is close enough to create a cumulative effect, then wind wake effects can lead to reduced wind stress and wave energy downwind with upwelling or downwelling dipoles at the edges of the wake (Van Berkel et al. 2020; Floeter et al. 2022).

The presence of vertical structures in the water column could cause a variety of hydrodynamic effects, including reducing the wind-driven mixing of surface water, increasing vertical mixing as the water flows around the structure, introducing turbulence, and influencing local current speed and direction. Christiansen et al. (2022) found that the sea level alterations in the North Sea wind farms did form dipoles at a large scale that can trigger lateral and vertical changes in water temperature and salinity distributions, but the magnitude of these changes is small and indistinguishable from the interannual variability. European models found that the extraction of the atmospheric energy could decrease the sea surface shear and vertical mixing (Christiansen et al. 2022; Floeter et al. 2022), which could strengthen vertical stratification (Horwitz et al. 2023). However, recent modeling of taller WTGs in the Mid-Atlantic Bight illustrated a cooling of the surface could occur, which would reduce the stratification expected (Golbazi et al. 2022; Horwitz et al. 2023).

The presence of turbine foundations results in potential modification of benthic habitats through scour and deposition (Dannheim et al. 2020) from the swift water. Turbulent wakes have been observed and modeled at the scale of kilometers (Cazenave et al. 2016). These changes are expected to be on a fine scale and minimal due to the use of scour protection for each foundation of the WTGs and OSSs.

Few studies have evaluated the secondary impacts of the atmospheric wakes, the interface with the sea surface, and the regional changes of oceanographic patterns (i.e., Mid-Atlantic Bight Cold Pool) and primary productivity. Modeling conducted for the Mid-Atlantic Bight Cold Pool found a notable overlap between the cold pool and the proposed NY Bight WEAs (Horwitz et al. 2023). The overlap varied substantially on a seasonal basis with greatest overlap in May and decreasing thereafter (Horwitz et al. 2023). A hydrodynamic model was run for four different WTG build-out scenarios of the offshore Rhode Island and Massachusetts lease areas that confirmed offshore wind projects have the potential to alter local and regional physical oceanic processes (e.g., currents, temperature stratification), via their influence on currents from WTG foundations and by extracting energy from the wind (Johnson et al. 2021). The turbines reduce the current force, magnitude, and wave height, all while creating downstream wake (Johnson et al. 2021). Van Berkel et al. (2020) conducted a synthesis of European studies and the implications for fishes. They concluded that investigations of abundance and diversity were challenging in terms of distinguishing the wake effects from the natural spatiotemporal variability (Van Berkel et al. 2020). Notably, the wake effect would also vary based on the type of foundation used. Jacket foundations would be expected to have a smaller wake effect compared to monopiles. The scour effects would also be expected to vary, with monopiles creating the least scour and therefore the least amount of scour protection needed (ICF 2021). On a local scale, changes in nutrient upwelling and related primary productivity were observed in Van Berkel et al. (2020), along with chlorophyll profiles and the demersal community structure near the turbines (<164 feet [<50 meters]). However, at a larger scale (>124 miles [>200 kilometers]), these patterns do not stand out from a background of natural spatiotemporal variability (Van Berkel et al. 2020). The overall impact on stratification is directly related to the scale of development (Carpenter et al. 2016; Van Berkel et al. 2020). The introduction of nutrients from deep waters into the surface mixed layer can lead to a local increase in primary production (Floeter et al. 2017). These changes in the primary productivity are especially important with added structures that provide new habitat for filter feeders such as blue mussels (Slavik et al. 2019). A recent review by the National Academies of Sciences, Engineering, and Medicine (2023) focused on the potential impacts on plankton productivity and movement and concluded that the hydrodynamic impacts would be difficult to distinguish from natural variability and other outside forces such as climate change.

European wind farms have served as the setting for many of the studies on ocean atmospheric interactions to date. Many studies have included that caution should be taken in extrapolating expected results outside of European waters. For example, the environmental conditions in Mid-Atlantic waters greatly vary from those in European wind farms. European wind farm facilities differ as they are in shallower waters with weak seasonal stratification, in sheltered areas along the coasts, and are arranged with tight spacing of turbines (Lentz 2017; Hogan et al. 2023). Modeled European lease areas also use shorter, smaller capacity turbines, which complicates the comparison for projects in the Mid-Atlantic Bight (Methratta et al. 2020; Golbazi et al. 2022; Horwitz et al. 2023). Hydrographically, European studies represent conditions in the Mid-Atlantic Bight during weakly stratified periods (unlike the stratified conditions when the cold pool is present) (Miles et al. 2021; Horwitz et al. 2023). Nevertheless, further investigations that incorporate the environment of the Mid-Atlantic OCS are necessary (Horwitz et al. 2023).

The placement of each structure would attract structure-oriented species that would benefit from the creation of hard substrate (Claisse et al. 2014; Smith et al. 2016). The increase in food availability for filter-feeders on and near the structures leads to increased densities of mobile invertebrates (e.g., crabs, lobsters), the attraction of pelagic and demersal fish, and foraging opportunities for marine mammals, creating a reef effect (Coates et al. 2015; English et al. 2017; Danheim et al. 2020; Degrear et al. 2020; Bennun et al. 2021). The reef effect can differ based on the type of foundation and scour used. For example, jacket foundations could have a larger reef effect compared to monopiles due to the lattice structure (ICF 2021). The addition of new hardbottom substrate in a predominantly softbottom environment will enhance local biodiversity (Pohle and Thomas 2001; Fautin et al. 2010; Degraer et al. 2020). This indicates that marine structures would generate some beneficial impacts on local ecosystems even though some impacts, such as the loss of softbottom habitat, may be adverse. Soft bottom is the dominant habitat type in the region; the species that rely on this habitat are not likely to experience population-level impacts (Greene et al. 2010; Guida et al. 2017). The diversity of these structure-associated assemblages may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). A successional sequence of impacts on benthic resources by the presence of artificial hard substrates cannot be foreseeably defined due to the current lack of knowledge, particularly on long-term changes and large-scale effects (Dannheim et al. 2020).

These new hard surfaces also provide additional attachment points for invasive species that may be brought through new shipping activities and enable range expansion. Gravity-based foundations would have a slightly higher risk of spreading invasives, compared to other fixed foundation types, since they are typically towed from the port (ICF 2021). Due to the pre-existing network of artificial reefs in the NY Bight area, it is unlikely that additional structures from one NY Bight project would measurably increase the potential for the steppingstone effect of invasives.

Softbottom (sand) 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). The potential effects of wind farms on offshore ecosystem functioning have been studied using simulations calibrated with field observations (Raoux et al. 2017; Pezy et al. 2018). These studies found increased biomass for benthic fish and invertebrates. However, some impacts, such as the loss of softbottom habitat and increased predation pressure on forage species near the structures, may be adverse.

The impacts on benthic resources resulting from the presence of structures would persist as long as the structures remain. Though species impacts are unavoidable, they would not result in population-level effects. BOEM anticipates that impacts from the presence of structures would be moderate as well as moderate beneficial from the reef effect.

Survey gear utilization: There would be an increase in the amount and types of gear used as a result of one NY Bight project. Surveys for site assessment and characterization would occur prior to the construction of one NY Bight project. The presence of offshore infrastructure increases the risk of loss of survey gear. The lost gear, moved by currents, could disturb, injure, or kill benthic species, as well as attract scavengers or higher trophic level predators. A common method for retrieving lost equipment is using grapnel lines, which are dragged along the bottom until the lost gear is caught and can be retrieved. In addition to dragging grapnel line along the bottom, after the line catches the lost equipment, it will drag all the components along the seafloor until recovery, resulting in additional benthic impacts. The geographic distribution, temporal spacing, and fast recovery (Dernie et al. 2003; Brooks et al. 2006) of these intermittent impacts at any one location would likely be unmeasurable; therefore, BOEM anticipates the impacts would be negligible.

3.5.2.4.2 Impacts of Six Projects

The same IPFs described under one NY Bight project (accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, electric and magnetic fields and cable heat, survey gear utilization, noise, port utilization, and presence of structures) would apply to six NY Bight projects. There would be greater impacts for these IPFs due to the orders of magnitude increase of offshore development and benthic disturbance under six NY Bight projects. If multiple projects are being constructed within the same timeframe, the impacts on benthic resources would be greater than those identified under one NY Bight project. Impacts from accidental releases, anchoring, discharge/intake, electromagnetic fields and cable heat, survey gear utilization, and port utilization are still expected to be negligible, despite the increase in the number of projects.

Impacts from cable emplacement and maintenance under six NY Bight projects would be minor to moderate, an increase from minor impacts under a single NY Bight project. Six NY Bight projects would increase the amount of seafloor disturbance, especially if multiple projects' cable installation occurred concurrently or consecutively close to each other. Increases in mortality from pre-lay grapnel runs, contact with installation equipment, and sediment deposition/burial, especially during sensitive life stages, would be substantial.

Impacts from the presence of structures under six NY Bight projects would range from moderate to major, a potential increase from moderate under one NY Bight project. Six NY Bight projects would increase the amount of short-term disturbance from increased noise and benthic disturbance, as well as substantially augment the amount of long-term disturbance as long as structures remain. Should the installations of multiple projects occur concurrently or consecutively and in proximity to each other, the impacts would be major, as there would not be ample time for resources to recover, which could result in regional population-level impacts. The increased number of structures would allow novel surfaces for colonization of benthic organisms (e.g., sponges, blue mussels, sea anemones), and create an artificial reef effect, whereby more sessile and benthic organisms would likely colonize these structures over time (Li et al. 2023). A recently published study by Li et al. (2023) found that the artificial reef effect from wind farms in the North Sea could lead to a doubling of species richness and an increase of species abundance by up to two orders of magnitude. Although many wind farms within the North Sea prohibit bottom trawling, the conclusions on the results of trawling avoidance benefits remain inconclusive (Li et al. 2023). Li et al. (2023) concluded that there are no net adverse impacts during the operation of the wind farm on the benthic communities that previously inhabited the sand bottom. In turn, the increase in colonizers would provide increased food sources and habitats to other invertebrates. The addition of scour and cable protection would have similar effects. Therefore, moderate beneficial impacts would also likely occur for structure-oriented species.

3.5.2.4.3 Cumulative Impacts of Alternative B

The cumulative impacts from the construction and installation, O&M, and conceptual decommissioning of six NY Bight projects combined with ongoing and planned activities range from negligible to major. Major cumulative impacts could result due to repetitious disturbances to the benthic resources, which would not allow time for the resources to recover, and the amount of permanent disturbance from the additional structures. These disturbances include anchoring, cable emplacement, and presence of structures. However, the area of benthic habitat disturbed could vary widely depending on the specific siting of offshore export cables and landfall locations. Repetitive use of bottom-tending gear would moderately impact benthic communities and adversely affect community structure. Moderate beneficial impacts for hard bottom sessile invertebrates and structure-oriented species would also occur from the addition of hard surfaces associated with the presence of structures.

3.5.2.4.4 Conclusions

Impacts of Alternative B. For construction, installation, and conceptual decommissioning of Alternative B for a single NY Bight project, BOEM anticipates **negligible** to **moderate** impacts on benthic resources depending on the IPF. The type of habitats that would be disturbed is a determining factor in predicting the recovery of the benthic community. Substantial differences in impacts depend on the frequency of the disturbances, the seasonal scheduling of construction activities, and the use of bottom-tending commercial fishing gear within the geographic analysis area. IPFs generating negligible impacts on benthic resources include accidental releases, discharges/intake, electric and magnetic fields and cable heat, survey gear utilization, noise, and port utilization. The presence of structures IPF would produce moderate impacts on benthic resources through displacement of softbottom species, habitat conversion to hardbottom from the structures, and associated scour protection. The cascading atmospheric and hydrographic changes, though not fully understood, are also likely to impact the benthic community structure. These modifications are unavoidable and would last the lifetime of the project. **Moderate beneficial** impacts are expected for species that are able to colonize the newly added hard surfaces, and those attracted by new food sources. BOEM anticipates that the impacts for six NY Bight projects would range from **negligible** to **major** for benthic resources depending on IPF, and **moderate beneficial** impacts. There would be an increase in the amount of seafloor disturbance, both short term and permanent, as well as sediment deposition/burial.

Cumulative Impacts of Alternative B. BOEM anticipates that the cumulative impacts of six NY Bight projects on benthic resources in the geographic analysis area would likely be **negligible** to **major**, with **moderate beneficial** impacts. In the context of other reasonably foreseeable environmental trends, the impacts contributed by Alternative B to the cumulative impacts on benthic resources would be noticeable. The long-term presence of WTGs and OSSs (Table D-2; Appendix D) and their associated cables would impact a proportionally large amount of benthic resources within the geographic analysis area and may fragment the habitat regionally.

3.5.2.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Benthic Resources

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives—Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.5.2.5.1 Sub-Alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS and related consultations (Table 3.5.2-4).

Table 3.5.2-4. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for benthic resources

Measure ID	Measure Summary
BEN-1	This measure proposes avoidance of boulders greater than 1.6 feet (0.5 meters) in diameter within the lease area and along the export cable corridor if practicable and minimization of relocation distance if avoidance is not possible. If boulders need to be relocated, the lessee must submit a Boulder Identification and Relocation Plan for review and concurrence.
COMFIS-3	This measure would require the lessee to develop and implement a Fisheries and Benthic Habitat Monitoring Plan that should include shellfish, such as surfclam and scallop.
MUL-1	This measure proposes training, recovery, prevention, and reporting to reduce and eliminate trash and debris in order to reduce impacts from entanglement, ingestion, smothering of benthic species, and pollutants in the water column.
MUL-2	This measure proposes submittal and implementation of an anchoring plan to avoid or minimize impacts from turbidity and anchor placement on sensitive habitats, including hardbottom and structurally complex habitats, as well as any known or potential cultural resources.
MUL-3	This measure proposes that if there are bathymetric changes in berm height greater than 3.3 feet (1 meter) above grade, lessees must develop and implement a Berm Remediation Plan to restore created berms to match adjacent natural bathymetric contours (isobaths), as feasible.
MUL-4	This measure proposes the use of specific cable protection measures (e.g., natural or engineered stone, bioactive concrete, nature-inclusive designs for cable and scour protection) within complex hardbottom habitat to reduce impacts from cable emplacement on benthic resources.
MUL-10a	This measure restricts vessel anchoring and benthic sampling in areas with corals and live bottom habitats and states that they must maintain an anchoring/sampling buffer of 150 meters from any known locations of threatened or endangered corals.
MUL-16	This measure proposes development and implementation of a plan for post-storm event monitoring of facility infrastructure, foundation scour protection, and cables. BSEE reserves the right to require post-storm mitigations to address conditions that could result in safety risks and/or impacts to the environment.
MUL-19	This measure proposes monitoring of cables at specific intervals after installation to determine cable location, burial depths, and site conditions to determine if burial conditions have changed and whether remedial action is warranted.
MUL-20	This measure proposes implementation of soft start techniques during impact pile-driving to reduce noise impacts on marine mammals, sea turtles, and finfish.
MUL-41	This measure proposes inspecting scour protection performance in accordance with an inspection plan subject to agency review.

Impacts of One Project

As compared to Alternative B, identification of proposed AMMM measures under Sub-alternative C1 would reduce impacts on benthic resources from some IPFs, including accidental release, anchoring, cable emplacement and maintenance, electric and magnetic fields and cable heat, noise, presence of structures, and survey gear utilization. Impacts for other IPFs would remain the same as described under Alternative B.

Accidental release: The training on and reporting of marine trash and debris under MUL-1 would help to reduce the amount of marine debris introduced to the benthic environment by increasing awareness and implementing prevention plans. It also requires marking of materials onboard to help with the recovery of items that are accidentally lost overboard. Applying this AMMM measure could reduce the risk of entanglement, ingestion, or smothering of benthic organisms.

Anchoring: AMMM measures MUL-2 and MUL-10a would restrict all vessel anchoring in areas with sensitive live bottom habitats, such as eelgrass, corals, and sponges. MUL-2 would require lessees to prepare an anchoring plan to detail all areas where anchoring is being used and to consider benthic habitat data to avoid and minimize impacts to the maximum extent practicable. Implementation of the plan and review of the plan by regulatory agencies would minimize the potential anchoring impacts on sensitive benthic habitats, including hardbottom and structurally complex habitats.

Cable emplacement and maintenance: AMMM measure BEN-1 would reduce the impacts of offshore export cable emplacement on benthic resources by requiring lessees to site the cables in locations that avoid boulders or, where avoidance is not possible, minimize relocation distance of the boulders, which would minimize disturbance to benthic communities. MUL-3 would require a Berm Remediation Plan for any berm 3.3 feet (1 meter) above grade or greater created during the construction of a NY Bight project to be restored to match adjacent natural bathymetric contours, which would minimize the long-term effects on benthic habitat from cable installation. Incorporating cable protection measures that encourage epibenthic growth, add rugosity, and vertical relief would provide unique habitats to increase local biodiversity. AMMM measure MUL-4 could foster epibenthic growth and three-dimensional complexity to cable protection by incorporating nature-inclusive design.

Electric and magnetic fields and cable heat: AMMM measure MUL-19 includes periodic inspections of cables to ensure proper cable burial depth and integrity. BOEM anticipates EMF and cable heat would have negligible impacts on benthic resources. Periodic inspections would also help ensure that the cables are free from any entanglement hazards, including recreational or commercial fishing gear that may disturb benthic communities and or entrap benthic fish and other organisms, further minimizing impacts on benthic resources.

Noise: AMMM measure MUL-20 could reduce noise impacts on benthic resources. MUL-20 proposes soft start methods for impact pile-driving at the beginning of each day's monopile installation, and at any time following a cessation of impact pile-driving of 30 minutes or longer. This would allow motile organisms a chance to retreat from the noise, prior to reaching maximum intensity; however, it would not benefit sessile or infauna invertebrates (Robinson et al. 2007).

Presence of structures: Once in place, the presence of structures would continue to impact benthic organisms throughout the life of the project. Under AMMM measure COMFIS-3, the lessee would be required to develop and implement a Fisheries and Benthic Habitat Monitoring Plan, which would allow further data collection and analysis to include shellfish and benthic habitats. This comparison of preconstruction to post-construction surveys would help to determine successional changes in the benthic community following disturbance. Under MUL-41, lessees would be required to inspect and monitor scour protection performance. While monitoring would not directly reduce effects on benthic resources, a monitoring plan would provide information about impacts on scour around foundations that could be used to mitigate environmental effects from scour.

MUL-3 would minimize the long-term effects on benthic habitat from seabed disturbance by requiring that berms of 3.3 feet (1 meter) or greater created during the construction of a NY Bight project be remediated to match adjacent natural bathymetric contours. BOEM would also require that a monitoring plan be developed for post-storm events (MUL-16), which would establish how lessees monitor facility infrastructure, foundation scour protection, and cables following storm events. While monitoring would not directly reduce effects on benthic resources, a monitoring plan would provide information about impacts on seabed conditions from storm events, and BSEE would retain the ability to require post-storm mitigation to address environmental impacts caused by the storm event.

These measures, if applied, would have the overall effect of reducing impacts on benthic communities; however, impact ratings for a single NY Bight project would remain negligible to moderate. The presence of structures would have a moderate impact on the benthic community, which would continue as long as they remain.

Survey gear utilization: The restrictions in MUL-10a also apply to seafloor sampling gear and activities. Sensitive bottom habitats should be avoided as practicable, and vessels in coastal waters should operate in a manner to minimize propeller wash, which disturbs the seafloor communities. All seafloor sampling must occur at least 492 feet (150 meters) away from threatened or endangered coral species.

Impacts of Six Projects

The same IPF impact types and mechanisms described under a single NY Bight project also apply to six NY Bight projects. However, there would be more potential for impacts for these IPFs due to the greater amount of offshore and onshore development under six NY Bight projects, although these impacts would be reduced to a greater extent with the identification of AMMM measures under Sub-alternative C1. This level of impact reduction is dependent on the amount of complex habitat avoided and the reduction in benthic disturbance. The temporal and spatial separation of the six NY Bight projects would also affect the level of impact on finfish, invertebrates, and EFH.

Previously applied AMMM measures would decrease the overall disturbances to benthic resources and avoid sensitive habitats during the cable emplacement and siting of infrastructure for six NY Bight projects. These actions would in turn decrease benthic disturbances, reducing the overall impact level range to negligible to moderate.

Cumulative Impacts of Sub-Alternative C1 (Preferred Alternative)

The construction and installation, O&M, and conceptual decommissioning of six NY Bight projects with previously applied AMMM measures combined with ongoing and planned activities would impact the benthic resources across the geographic analysis area, although at a reduced level compared to Alternative B. AMMM measures would decrease the overall disturbances to benthic resources and avoid sensitive habitats during the cable emplacement and siting of infrastructure for six NY Bight projects.

However, combined with other planned offshore wind projects and other ongoing and planned activities, six NY Bight projects would contribute negligible to moderate cumulative impacts, along with moderate beneficial impacts. However, six NY Bight projects would contribute to negligible to major cumulative impacts, along with moderate beneficial impacts if projects are constructed concurrently or consecutively in proximity to each other, as recovery time would be eliminated and the localized impacts could overlap.

3.5.2.5.2 Sub-Alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied (Table 3.5.2-5).

Table 3.5.2-5. Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for benthic resources

Measure ID	Measure Summary
MUL-22	This measure proposes a received sound level limit minimizing sound levels during impact pile-driving activity to reduce impacts from noise.

Impacts of One Project

Implementing MUL-22 under Sub-alternative C2 could potentially reduce impacts on benthic resources compared to those under Sub-alternative C1 for the noise IPF. Impacts for other IPFs would remain the same as described under Sub-alternative C1.

Noise: AMMM measure MUL-22 could reduce noise impacts on benthic resources. As described in Alternative B, if developers discover glauconite sands during construction and installation, noise levels will likely increase as they determine if the glauconite is passable. This temporary increase in noise could have potential impacts on benthic organisms. With the application of MUL-22, operators will be required to remain under a certain received sound limit. This would apply if glauconite sands were discovered as well. Therefore, the operators would need to use different methodology, technology, or infrastructure, or apply quieting techniques to reduce their received sound limit if glauconite sands are discovered. Although MUL-22 is intended to directly reduce impacts on marine mammals, the received sound limit would help prevent any temporary increases in noise from pile-driving through glauconite soils and subsequent impacts on benthic resources, including vibrations of the sediment. BOEM anticipates the impacts on benthic resources from noise to remain negligible.

Impacts of Six Projects

The same IPF impact types and mechanisms described under a single NY Bight project also apply to six NY Bight projects. However, there would be more potential for impacts from these IPFs due to the greater amount of offshore and onshore development under six NY Bight projects. MUL-22 may not substantially change the potential impacts of noise on benthic resources; therefore, BOEM anticipates the impacts on benthic resources under Sub-alternative C2 to remain the same as described under Sub-alternative C1.

Cumulative Impacts of Sub-Alternative C2

The construction and installation, O&M, and conceptual decommissioning of six NY Bight projects with previously applied and not previously applied AMMM measures combined with ongoing and planned activities would result in impacts on benthic resources across the geographic analysis area, although at a reduced level compared to under Alternative B. AMMM measures would decrease the overall disturbances to benthic resources and avoid sensitive habitats during the cable emplacement and siting of infrastructure for six NY Bight projects. However, combined with other planned offshore wind projects and other ongoing and planned activities, six NY Bight projects would contribute to negligible to major cumulative impacts, along with moderate beneficial impacts, if projects are constructed concurrently or consecutively in proximity to each other, as recovery time would be eliminated and the localized impacts could overlap.

3.5.2.5.3 Conclusions

Impacts of Alternative C. Through the identification of AMMM measures, Sub-alternative C1 would reduce impacts from the initial disturbance of benthic habitats and species including accidental release, anchoring, and cable emplacement and maintenance. Throughout the life of the project, a reduction in impacts would occur from electric and magnetic fields and cable heat, noise, and the presence of structures. The implementation of Sub-alternative C2 would further reduce noise impacts from pile-driving activities. Overall, the identification of AMMM measures would benefit benthic species although the impact levels for Sub-alternatives C1 and C2 would likely remain **negligible** to **moderate** depending on the IPF during installation, construction, and conceptual decommissioning of a single NY Bight project. With six NY Bight projects, identification of AMMM measures under Sub-alternative C1 and C2 would reduce impacts compared to Alternative B, resulting in **negligible** to **moderate** impacts depending on IPF. For both one and six projects, **moderate beneficial** impacts are expected under both Sub-alternatives C1 and C2 for species that are able to colonize the newly added hard surfaces, and those attracted by new food sources.

Cumulative Impacts of Alternative C. BOEM anticipates that the cumulative impacts on benthic resources in the geographic analysis area would likely be **negligible** to **major**, with **moderate beneficial** impacts for both Sub-alternatives C1 and C2. The impacts for six NY Bight projects with AMMM measures incorporated would be reduced at a functional level, although impact determinations would not change for both Sub-alternatives C1 and C2. The implementation of Sub-alternative C2 would further reduce noise impacts from pile-driving activities compared to Sub-alternative C1. In the context of other reasonably foreseeable environmental trends (Appendix D), the impacts contributed by Sub-alternatives C1 and C2 to the cumulative impacts on benthic resources would be noticeable. If all six NY Bight projects are constructed concurrently, impacts would likely be major, as recovery time would be eliminated. Moderate beneficial impacts for species that are able to colonize the newly added hard surfaces, and those attracted by additional food sources and shelter, are expected as well.

3.5.2.6 Recommended Practices for Consideration at the Project-Specific Stage

BOEM is recommending that lessees consider analyzing the RPs in Table 3.5.2-6 to further reduce potential benthic resource impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.5.2-6. Recommended Practices for benthic resources impacts and related benefits

Recommended Practice	Potential Benefit
BEN-3: Follow BOEM Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 with regards to pre-, during- and post-construction benthic monitoring survey plan design.	Following the BOEM Guidelines for benthic habitat survey information would ensure adequate survey and mapping resolution to identify sensitive habitats, establish pre-construction baseline conditions that may be used to assess whether detectable changes occurred during construction, and reduce uncertainty.
MUL-5: Use equipment, technology, and best practices to produce the least amount of noise possible to reduce noise impacts.	Depending on the methods implemented, this RP could reduce impacts on benthic organisms, but project-specific information is required before the effectiveness of this RP can be fully evaluated.
MUL-10b: Prohibit geotechnical or bottom disturbing activities from April through July, during the sturgeon spawning/rearing season, within freshwater reaches of the Hudson and Delaware Rivers.	Since benthic invertebrate spawning has been shown to be strongly associated with water temperatures, imposing time-of-year restrictions on benthic surveys as a result of this RP could likely benefit invertebrate spawning and development.
MUL-12: Incorporate ecological design elements where practicable. Examples include nature-inclusive design products as an alternative to traditional concrete, which could enhance and encourage the growth of marine flora and fauna (e.g. oyster beds or other artificial reefs).	Incorporation of ecological designs for cable protection and scour protection would provide suitable habitats and benefit benthic communities.
MUL-18: Coordinate transmission infrastructure among projects such as by using shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables on benthic resources.	The six NY Bight projects would need to coordinate the use of shared transmission infrastructure and parallel routing with existing and proposed linear infrastructure, where practicable. Implementation of this RP would reduce impacts associated with the IPFs of cable emplacement and maintenance and presence of structures. By consolidating transmission infrastructure, this RP could reduce the number of offshore export cables and OSSs between the six NY Bight projects, which could reduce sediment disturbance from cable emplacement activities and reduce total benthic habitat disturbance from fewer cables and OSS foundations. Transmission configurations that could be adopted by NY Bight lessees to optimize and share the use of offshore transmission equipment under MUL-18 include shared line (platform), backbone, and meshed grid topologies, which are described in Chapter 2, Section 2.1.2.1.1 under *Transmission Interconnection Configurations*. Configurations that effectively reduce the amount of cable installed and number of OSSs would benefit benthic resources.

Recommended Practice	Potential Benefit
MUL-21: Use the best available technology, including new and emerging technology, when possible.	As described in Section 3.4.2, *Water Quality*, a closed-loop subsea cooler system is an emerging technology that, if applied, would eliminate entrainment risks to benthic resources and may minimize localized hydrodynamic and thermal plume impacts because intake and discharge of seawater would not occur. This RP could also decrease the impacts of presence of structures on benthic resources by using best available technology (e.g., jet plows, closed loop cooling system) where practicable.
MUL-23: Avoid or reduce potential impacts on important environmental resources by adjusting project design.	Depending on the project design elements implemented, MUL-23 could reduce benthic impacts associated with cables by using shared cable crossing locations to reduce overall seabed footprint, using HDD to avoid benthic resources such as SAV, and avoiding routing through estuaries and embayments to reduce impacts on numerous sensitive habitats and vulnerable life stages of marine species. Avoidance of these habitats, which would not likely recover quickly from disturbance, leaves complex habitats and their associated benthic communities undisturbed. MUL-23 could reduce benthic impacts from presence of structures by adjusting project design, which could include adjusting WTG layouts to avoid sensitive habitats, such as the mid-shelf scarp, an important bathymetric feature that overlaps portions of Lease Areas OCS-A 0538 and OCS-A 0539.
MUL-26: Coordinate regional monitoring and survey efforts to standardize approaches, understand potential impacts to resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. Develop monitoring and survey plans that meet regional data requirements and standards.	Coordinating regional monitoring and survey efforts would maximize the monitoring efficiency. The data gathered would be evaluated and considered for future mitigation and monitoring needs, which will serve to reduce impacts.
MUL-27: Employ methods to minimize sediment disturbance.	Using mid-line buoys to minimize cable sweep and reduce sediment disturbance will reduce impacts on benthic communities.
MUL-28: Develop an Inadvertent Returns Plan that details preferred drilling solutions and methods.	This RP reduces accidental releases by proposing the recirculation of drilling fluids used during HDD construction activity and use of biodegradable drilling solutions. Development and implementation of an Inadvertent Returns Plan would address prevention, control, and cleanup of the potential inadvertent return during HDD activity, ensuring fewer impacts on water quality near the site of HDD operations near shore. Water quality is important for benthic filter feeding planktonic larvae and juveniles.
MUL-39: Use of electrical shielding on underwater cables.	Using standard designs that have electrical shielding would mitigate the intensity of EMF.

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3.5 Biological Resources

3.5.3 Birds

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on birds from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.5 Biological Resources

3.5.4 Coastal Habitat and Fauna

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on coastal habitat and fauna from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.5 Biological Resources

3.5.5 Finfish, Invertebrates, and Essential Fish Habitat

This section discusses potential impacts on finfish, invertebrates, and EFH from the Proposed Action, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area for finfish, invertebrates, and EFH, as shown on Figure 3.5.5-1, includes the U.S. Northeast Continental Shelf Large Marine Ecosystems (LME), which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras, North Carolina, likely encompassing the majority of movement ranges for most species in this group. Due to the size of the geographic analysis area, the analysis in this PEIS focuses on finfish and invertebrates that would be likely to occur in the NY Bight project area and be affected by NY Bight project activities.

EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (16 USC 1802(10)). This section provides a qualitative assessment of the impacts of each alternative on finfish, invertebrates, and EFH, which has been designated under the MSA as “essential” for the conservation of federally managed fish and invertebrate species. See Section 3.5.2, *Benthic Resources*, and Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, for a discussion of benthic invertebrate species and fisheries.

The finfish, invertebrates, and EFH impact analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

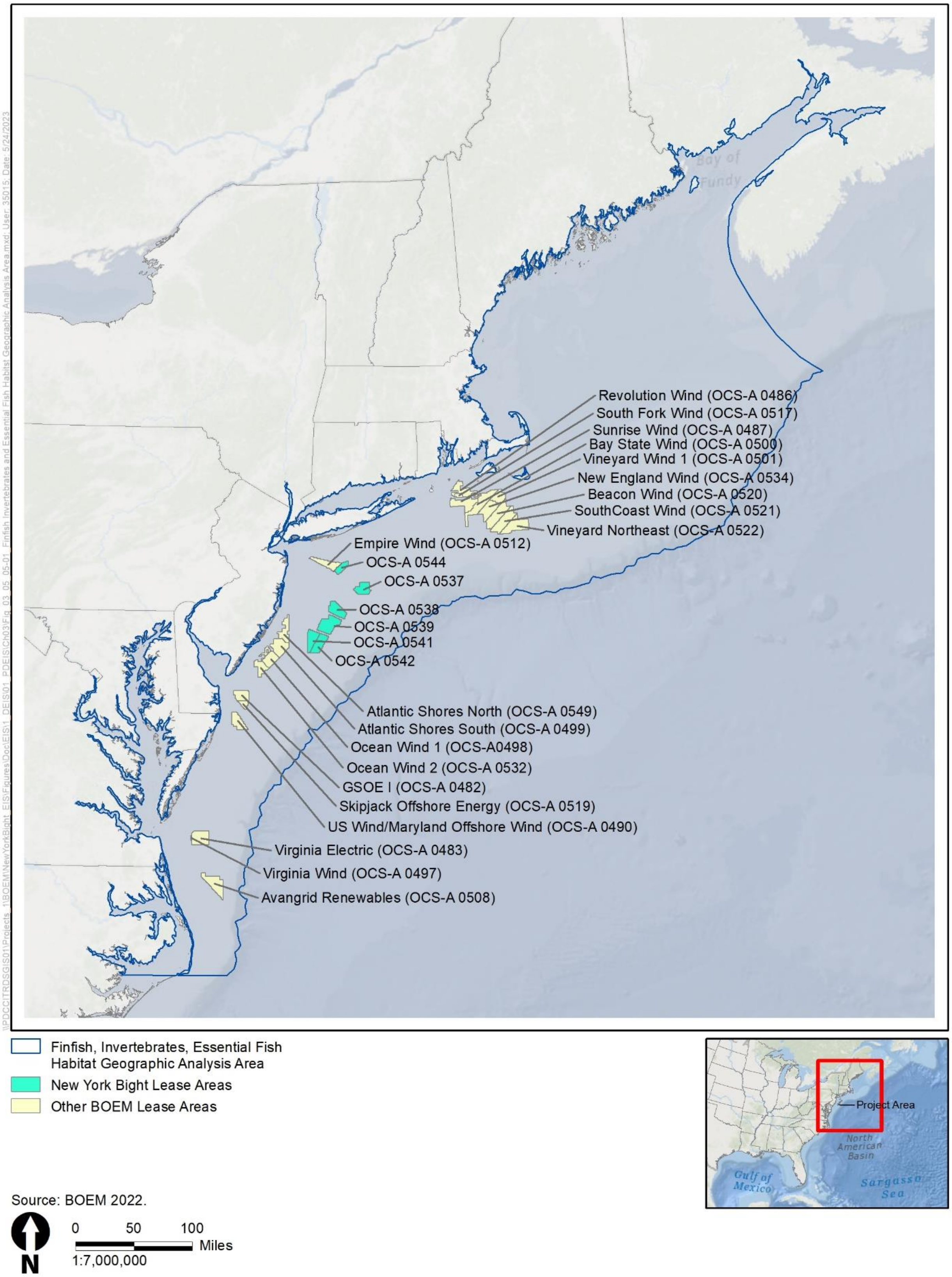


Figure 3.5.5-1. Finfish, invertebrates, and EFH geographic analysis area

3.5.5.1 Description of the Affected Environment and Future Baseline Conditions

Within the Northeast Shelf LME geographic analysis area that extends beyond the NY Bight lease areas, species discussed include deep water marine species, estuarine, and diadromous species that use both freshwater and marine habitats within one of their life stages.

EFH is designated in most of the Mid-Atlantic Bight, and Southern New England subregions of the LME (Guida et al. 2017) for 3 shellfish, 2 squid, and 49 finfish species. EFH for some species includes estuarine habitat along the coast. The State of New York has designated 40 areas comprising a total of approximately 166,201 acres (67,259 hectares) on the south shores of Long Island and in Raritan Bay as Significant Coastal Fish & Wildlife Habitats (NYDOS 2013). Areas of other habitat for finfish and invertebrates, including seagrasses, are discussed in Section 3.5.2, *Benthic Resources*.

3.5.5.1.1 Finfish

The geographic analysis area was selected based on the likelihood of capturing the majority of the movement range for most finfish species that would be expected to pass through the NY Bight area, within the northern portion of the Mid-Atlantic Bight. This area is large and has diverse and abundant fish assemblages that can be generally categorized based on life history and preferred habitat associations (e.g., pelagic, demersal, resident, highly migratory species).

The Mid-Atlantic fish fauna is a mix of demersal and pelagic species with boreal and warm temperate, cold temperate, and subtropical affinities. There are well over 100 species of fish that have the potential to occur within the NY Bight area. At the family level, demersal species of the region are represented by a very diverse suite of taxa, including (but not limited to) skates (Rajiidae), dogfishes (Squalidae), requiem sharks (Carcharhinidae), searobins (Triglidae), hakes (Phycidae, Merlucciidae), anglerfishes (Lophiidae), seahorses and pipefishes (Syngnathidae), sculpins (Cottidae), seabasses (Serranidae), drums (Sciaenidae), scup (Sparidae), and flatfishes (Paralichthyidae, Pleuronectidae, Scophthalmidae) (Robins and Ray 1986).

The Mid-Atlantic demersal assemblage characteristically varies over space and time, driven primarily by seasonal changes in water temperature such as those driven by the seasonal evolution of the Mid-Atlantic Bight Cold Pool (Fabrizio et al. 2014; Hopkins and Cech 2003; Kohut and Brodie 2019; Secor et al. 2019; Sims et al. 2001). When water temperatures increase in the spring, warm temperate, and some subtropical, fish species move into the Mid-Atlantic from the south; at the same time, several cold-water species migrate back to areas north of the Mid-Atlantic. After shelf waters cool during fall and early winter, warm temperate species migrate back south and offshore while some of the cold temperate species move into the area (BOEM 2014). Rises in sea temperatures and a gradual shift of the Gulf Stream current closer to the Mid-Atlantic coastline are also thought to be responsible for northward shifts in species distributions (Pinsky et al. 2013; Andres 2016; Baudron et al. 2020).

Pelagic species found in the Mid-Atlantic are also represented by a diverse suite of taxa that form schools of varying sizes and migrate seasonally. Many large-scale migrations of pelagic fishes in the Mid-Atlantic are related to spawning. General patterns include (1) cross-shelf movements to offshore spawning areas, (2) movements along the shelf to southerly spawning areas, and (3) movements between coastal rivers and the coastal ocean for spawning or the reverse (diadromy).

Five fish species that are federally listed as endangered or threatened under the ESA may occur in the NY Bight area (Table 3.5.5-1); however, only two are most likely to be present, the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and the giant manta ray (*Manta birostris*).

The Atlantic sturgeon is an estuarine-dependent anadromous species, meaning they spawn in rivers and inhabit brackish estuarine habitats as juveniles (ASSRT 2007). Atlantic sturgeon generally stay within these estuarine habitats from 1–5 years and, once mature, spend their adult lives in the open ocean (ASSRT 2007). The critical habitat designation (82 *Federal Register* 39160) for Atlantic sturgeon distinct population segments (DPSs) is for habitats that support successful Atlantic sturgeon reproduction and recruitment. The NY Bight Atlantic sturgeon DPS critical habitat includes four rivers: the Connecticut, Housatonic, Hudson, and Delaware Rivers. Potential vessel ports located in Albany and Coeymans, New York, will utilize transit routes through designated critical habitat for the NY Bight DPS in the Hudson River, and potential vessel ports located in Paulsboro, New Jersey, will utilize transit routes through designated critical habitat for the NY Bight DPS in the Delaware River. Vessel ports located in Delaware Bay are in the vicinity of the NY Bight DPS Delaware River designated critical habitat whereas vessel ports located in Chesapeake Bay are in the vicinity of the Chesapeake Bay DPS. None of the representative ports analyzed in this PEIS are in the Delaware Bay or Chesapeake Bay.

The giant manta ray has a distributional range that includes offshore New York, New Jersey, Delaware, and Maryland and therefore may be present in the NY Bight area. Giant manta rays undergo seasonal migrations, which are thought to coincide with the movement of zooplankton, ocean current circulation and tidal patterns, seasonal upwelling, sea surface temperature, and possibly mating behavior (NMFS 2022). Giant manta rays utilize a wide variety of depths during feeding, including aggregations in waters less than 33 feet (10 meters) deep and dives of 656 to 1,476 feet (200 to 450 meters), which are likely driven by vertical shifts in their prey location (NMFS 2022).

The shortnose sturgeon (*Acipenser brevirostrum*) inhabits river systems along nearly the entire U.S. Atlantic coast from Saint John River, New Brunswick, Canada to St. Johns River, Florida (NMFS 1998). Adult shortnose sturgeon will occasionally move to the mouth of estuaries and travel between river systems, but primarily inhabit freshwater or estuarine environments. This species is not expected to occur in the NY Bight lease areas as they rarely leave their natal rivers (Bemis and Kynard 1997; Zydlewski et al. 2011). Project vessels could encounter shortnose sturgeon when traveling from the lease areas to ports, but the likelihood of a project vessel striking a shortnose sturgeon is low. Therefore, the species is discounted for further analysis.

The oceanic whitetip shark (*Carcharhinus longimanus*) is usually found offshore in the open ocean, on the outer continental shelf, or around oceanic islands in deep water greater than 604 feet (184 meters), which is outside of NY Bight lease areas. Atlantic salmon (*Salmo salar*) are not known to occur within or near the NY Bight; the only potential for overlap with their distribution would be along their migration route in the Gulf of Maine. This area may be transited by vessels, but there is no evidence of interactions between vessels and Atlantic salmon, and vessel strikes are not identified as a threat in the listing determination (74 *Federal Register* 29344) or their recent recovery plan (USFWS and NMFS 2018).

Table 3.5.5-1. Federally listed fish species potentially occurring in the NY Bight area

Common Name	Scientific Name	Federal Status
Atlantic Sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered/Threatened (Carolina, Chesapeake, Gulf of Maine, NY Bight, South Atlantic DPSs)
Giant Manta Ray	*Manta birostris*	Threatened
Shortnose Sturgeon	*Acipenser brevirostrum*	Endangered
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Threatened
Atlantic Salmon	*Salmo salar*	Endangered (Gulf of Maine DPS)

Regional effects of climate change, such as ocean acidification, increasing sea temperatures, and changes in ocean circulation patterns, are influencing finfish and invertebrates, and EFH. The impacts of climate change are likely to affect habitat suitability for and species distributions of finfish and invertebrates in the geographic analysis area, including EFH. In particular, rises in sea temperatures in the geographic analysis area are thought to be responsible for documented northward shifts in species distributions (Gaichas et al. 2015; Hare et al. 2016; Lucey and Nye 2010). The finfish community structure of the Mid-Atlantic and southern New England OCS is also shifting due to fishing pressure and modification of coastal and estuarine habitats.

3.5.5.1.2 Invertebrates

Invertebrate resources assessed in this section include the planktonic zooplankton community and megafauna species that have benthic, demersal, or planktonic life stages. Macrofaunal and meiofaunal invertebrates associated with benthic resources are assessed in Section 3.5.2. In general, the sediments are primarily sand, with pockets of gravel in the north and with muddy pockets in the center and south (Guida et al. 2017). The benthic infauna is dominated by polychaetes, while the epifauna is dominated by sand shrimp, New England dog whelk snails, and sand dollars (Guida et al. 2017). Additional invertebrates within the geographic analysis area include crustaceans (e.g., amphipods, crabs, lobsters), mollusks (e.g., gastropods, bivalves), echinoderms (e.g., sand dollars, brittle stars, sea cucumbers), and various other groups (e.g., sea squirts, burrowing anemones) (Guida et al. 2017). Benthic invertebrates are commonly characterized by size (i.e., megafauna, macrofauna, or meiofauna).

Megafaunal invertebrate species that have demersal, epibenthic, and infaunal life stages and are found within the NY Bight lease areas include sea scallops (*Placopecten magellanicus*), surfclams (*Spisula solidissimus*), and ocean quahogs (*Arctica islandica*) (Guida et al. 2017). Benthic megafauna would also include crab, lobster, and whelk species that inhabit the NY Bight. These species reside either on the seafloor (scallops, crab, lobster, and whelk) or buried within the seafloor sediments (ocean quahog and surfclams). Pelagic macroinvertebrates in the region include the commercially important longfin squid (*Doryteuthis pealeii*), which move offshore in fall and remain there through the winter, then return to inshore waters for the spring and summer.

Zooplankton are a type of heterotrophic plankton in the marine environment that range from small, microscopic organisms to large species, such as jellyfish. These invertebrates play an important role in marine food webs and include both organisms that spend their whole life cycles in the water column (holoplankton) and those that spend only certain life stages (larvae) in the water column (meroplankton). In the marine environment, zooplankton dispersion patterns vary on a large spatial scale (from meters to thousands of kilometers) and over time (hours to years). Zooplankton exhibit diel vertical migrations up to hundreds of meters; however, horizontal large-scale distributions are dependent on ocean currents and the suitability of prevailing hydrographic regimes. Northward shifts of more than 10 degrees latitude have been attributed to the increase in atmospheric temperatures (Burkill and Reid 2010), which heat ocean surface temperatures. Increasing zooplankton abundance trends in the Mid-Atlantic Bight have been positively correlated to rising sea surface temperatures and have also been shown to be positively associated with the Atlantic Multi-decadal Oscillation (AMO) index, the climatic variable that relates to the natural mode of variability found in North Atlantic. The AMO index has been increasing steadily since the mid-1970s indicating that waters over the entire North Atlantic have been slowly warming (Kane 2011).

Some of the megafaunal invertebrates found in the geographic analysis area are migratory while others are sessile or have more limited mobility. Generally, mobile invertebrates with broad habitat requirements are more adaptable to disturbance and anthropogenic impacts compared to invertebrates that require specific habitats during one or more life stages, or have limited mobility.

Though annual temperatures vary, seasonal fluctuations as large as 59°F (15°C) at the seafloor play a large role in migratory patterns and timing (Guida et al. 2017). Patterns of thermal stratification are also present, beginning in April and increasing through the summer. By September and October, vertical turnover occurs, and the temperature gradient is negligible. A steep decline of up to 54°F (12°C) is present by early winter (Guida et al. 2017). These patterns in temperature play a large role in signaling seasonal migrations and the settlement of demersal and benthic organisms.

The most recent trends in invertebrate species have been summarized in the State of the Ecosystem report for the Mid-Atlantic that includes the NY Bight lease areas (NOAA 2021). They indicated that long-lasting climactic events such as heatwaves can greatly impact invertebrate species, including commercially important species such as lobster, with populations shifting northward in response to rising sea temperatures. In the same regard, changes in the Mid-Atlantic Bight Cold Pool were observed. The cold pool is a mass of colder water trapped on the ocean floor over the continental shelf. This distinctive feature of the Mid-Atlantic is becoming increasingly warmer, and the water column is becoming homogenized earlier in the year. These changes to ocean temperature contribute to observed ecosystem-level changes.

3.5.5.1.3 Importance of Sound to Fish and Invertebrates

Many fishes and invertebrates produce sounds for basic biological functions like attracting a mate and defending territory. A recent study revealed that sound production in fishes has evolved at least 33 times throughout evolutionary time, and that the majority of ray-finned fishes are likely capable of producing sounds (Rice et al. 2022). Fish may produce sounds through a variety of mechanisms, such as vibrating muscles near the swim bladder, rubbing parts of their skeleton together, or snapping their pectoral fin tendons (Ladich and Bass 2011; Rice et al. 2022). Similarly, many marine invertebrates produce sounds, ranging from the ubiquitous snapping shrimp "snaps" (Johnson et al. 1947) to spiny lobster "rasps" (Patek 2002) to mantis shrimp "rumbles" (Staaterman et al. 2011). Some sounds are also produced as a byproduct of other activities, such as the scraping sound of urchins feeding (Radford et al. 2008a) and even a "coughing" sound made when scallops open and close their shells (Di Iorio et al. 2012).

There are some species that do not appear to produce sounds, but still have acute hearing (e.g., the goldfish), which has led authors to surmise that animals glean a great deal of information about their environment through acoustic cues, a process called "auditory scene analysis" (Fay 2009). All of the sounds in a given environment—biological, abiotic, and anthropogenic—comprise the "soundscape" (Pijanowski et al. 2011). Soundscapes naturally vary over space and time, and there is increasing evidence that some fish and invertebrate species can distinguish between soundscapes of different habitats (Kaplan et al. 2015; McWilliam and Hawkins 2013; Radford et al. 2008b). In fact, some pelagic larvae may use soundscapes as a cue to orient towards suitable settlement habitat (Lillis et al. 2015; Montgomery 2006; Radford et al. 2007; Simpson et al. 2005; Vermeij et al. 2010) or to induce molting into their juvenile forms (Lillis et al. 2013; Stanley et al. 2015). It seems that the unique acoustic signatures of marine habitats provide vital information to the range of species that reside within and around them.

Compared to marine mammals, scientists have only scratched the surface in understanding the importance of sound to the vast number of extant fish and invertebrate species. Yet there is sufficient data thus far to conclude that underwater sound is vitally important to their basic life functions, such as finding a mate, deterring a predator, or defending territory (Popper and Hawkins 2018; 2019). Thus, these lower taxonomic groups must be able to detect components of marine soundscapes, and this detectability could be adversely affected by the addition of noise from anthropogenic activity.

Hearing Anatomy

All fishes and invertebrates are capable of sensing the particle motion component of a sound wave (for information about particle motion, see Appendix J, *Introduction to Sound and Acoustic Assessment*). The inner ear of fishes is similar to that of all vertebrates. Each ear has three otolithic end organs, which contain a sensory epithelium lined with hair cells, as well as a dense structure called an otolith (Popper et al. 2021). As the back-and-forth particle motion moves the body of the fish (which has a density similar to seawater), the denser otoliths lag behind, creating a shearing force on the hair cells, which sends a signal to the brain via the auditory nerve (Fay and Popper 2000).

In addition to particle motion detection, which is shared across all fishes, some species are also capable of detecting acoustic pressure (Fay and Popper 2000). Special adaptations of the swim bladder (e.g., anterior projections, additional gas bubbles, or bony parts) bring it in close proximity to the ear; as the swim bladder expands and contracts, pressure signals are radiated within the body of the fish—making their way to the ear in the form of particle motion (Popper et al. 2021). These species can typically detect a broader range of acoustic frequencies (up to 3–4 kilohertz [kHz]) (Wiernicki et al. 2020) and are therefore considered to be more sensitive to underwater sound than those only detecting particle motion. Hearing sensitivity in fishes is generally considered to fall along a spectrum: the least-sensitive (sometimes called "hearing generalists") are those that do not possess a swim bladder and cannot detect sound above 1 kHz, while the most sensitive ("hearing specialists") possess specialized structures enabling pressure detection (Popper et al. 2021). A few species in the herring family can detect ultrasonic (>20 kHz) sounds (Mann et al. 2001), but this is considered to be very rare among the bony fishes. Another important distinction for species that do possess swim bladders is whether they are "open" or "closed": species with open swim bladders can release pressure via a connection to the gut, while those with closed swim bladders can only release pressure very slowly, making them more prone to injury when experiencing rapid changes in pressure (Popper et al. 2019). It should also be noted that hearing sensitivity can change with age; in some species like black sea bass, the closer proximity between the ear and the swim bladder in smaller fish can mean that younger individuals are more sensitive to sound than older fish (Stanley et al. 2020). In other species, hearing sensitivity seems to improve with age (Kenyon 1996).

Like elasmobranchs, marine invertebrates lack a gas-filled bladder and are thus unable to detect the pressure changes associated with sound waves. However, all cephalopods as well as some bivalves, echinoderms, and crustaceans have a sac-like structure that develops during the larval stage called a statocyst, which includes a mineralized mass (statolith) and associated sensory hairs (e.g., crustaceans in Edmonds et al. 2016). Statocysts, which are similar to fish ears, act like accelerometers: a dense statolith sits within a body of hair cells, and when the animal is moved by particle motion, it results in a shearing force on the hair cells (Budelmann 1992; Mooney et al. 2010). In addition to statocysts, some invertebrates have epidermal hair cells which help them to detect particle motion in their immediate vicinity (Budelmann 1992; Kaifu et al. 2008), comparable to lateral lines in fish (McCormick 2011). Similarly, decapods have sensory setae on their body (Popper et al. 2001), including on their antennae, which may be used to detect low-frequency vibrations (Montgomery 2006). The research thus far shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2021).

Potential Impacts of Underwater Sound

As with marine mammals, fishes and invertebrates may experience a range of impacts from underwater sound depending on physical qualities of the sound source and the environment, as well as the physiological characteristics and the behavioral context of the species of interest (see Section 3.5.6.1). Examination of the short- and long-term effects of low frequency sound on marine fish and invertebrates is critical for understanding the broad range of impacts, especially on important biological processes such as reproduction, larval development, and recruitment (Carroll et al. 2017). It is important to note that unlike mammals, whose hair cells do not regenerate, fishes are able to regrow hair cells that die or become damaged (Corwin 1981), making it less likely that they could experience Permanent Threshold Shift (PTS); therefore, there are no thresholds focused explicitly on auditory injury. However, fishes do experience TTS, and when very close to impulsive sound sources or explosions they could experience barotrauma, a term that refers to a class of injuries ranging from recoverable bruises to organ damage (which could ultimately lead to death) (Popper et al. 2014; Stephenson et al. 2010). When the air-filled swim bladder inside the body of the fish quickly expands and contracts due to a rapid change in pressure, it can cause internal injuries to the nearby tissues (Halvorsen et al. 2012a). The greater the difference between the static pressure at the site of the fish and the positive/negative pressures associated with the sound source, the greater the risk of barotrauma. This means that impulsive sounds like those generated by impact pile-driving may present a risk of injury due to the rapid changes in acoustic pressure (Hamernik and Hsueh 1991).

For marine invertebrates, exposure to near-field high amplitude sound may cause anatomical damage and behavioral responses, although research outside of seismic air gun sources is limited (Carroll et al. 2017). A review by Cones et al. (2023) shows that data from comparable studies of similar sound types and characterizations provide evidence that acoustic impacts on bivalves tend to be more severe with increasing received levels. Jézéquel et al. (2023a) identified significant differences between the auditory thresholds of juvenile and subadult giant scallops, with juveniles being more sensitive, suggesting ontogenetic differences in hearing sensitivity. Giant scallop auditory thresholds were quantified using particle acceleration, and behavioral responses were obtained for lower frequencies below 500 hertz (Hz), with best sensitivity at 100 Hz (Jézéquel et al. 2023a). Giant scallops showed intensity- and frequency-dependent responses to sounds, with higher valve closures to lower frequencies and higher sound levels (Jézéquel et al. 2023a). Damage to invertebrate statocysts has been observed as a result of sound exposure, but it is unclear whether the hair cells can regenerate, like they do in fishes (Solé et al. 2013; Solé et al. 2017). Furthermore, most studies to date have focused on low frequency sound; however, a playback study using high-frequency stimuli (100–200 kHz sweeps) was reported to elicit a noise-induced physiological stress response in black sea urchins (Vazzana et al. 2020). As with marine mammals, continuous, lower-level sources (e.g., vessel noise) are unlikely to result in auditory injury but could induce changes in behavior or acoustic masking.

Hearing Groups

While there is a wide variety in hearing anatomy and sensitivity among fishes and invertebrates, the scientific community has generally landed on three categories to describe fish hearing (Table 3.5.5-2).

Table 3.5.5-2. Fish and invertebrate groupings based on hearing anatomy[1]

Group	Hearing Anatomy	Example Species	Sensitivity to Underwater Sound
1	Fishes with no swim bladder or other gas chamber, invertebrates, eggs and larvae	Flatfish, Atlantic mackerel, sharks, rays, cephalopods, crustaceans, bivalves	Detect particle motion but not acoustic pressure, sensitive to sound over relatively small spatial scales, not susceptible to barotrauma. Generally capable of detecting sounds up to 1 kHz.
2 [2]	Fishes with swim bladders in which hearing does not involve the swim bladder or other gas volume	Bluefish, snapper, some tunas, Atlantic salmon, European seabass, lake sturgeon, drum, black sea bass	Detect particle motion but not acoustic pressure. May be susceptible to barotrauma due to the presence of a swim bladder. May be sensitive to sounds up to ~3 kHz.

Group	Hearing Anatomy	Example Species	Sensitivity to Underwater Sound
3 [2]	Fishes in which hearing involves a swim bladder or other gas volume	Cod, European eel, squirrelfish, croaker, Atlantic herring, goldfish	Detect particle motion and acoustic pressure. May be susceptible to barotrauma. Sounds can be detected over larger spatial scales and are generally considered to be the most sensitive to impacts from anthropogenic sound. May be able to detect sounds up to 5 kHz, and in some rare cases (e.g., herring) >20 kHz.

[1] Nomenclature based on classification in Popper et al. (2014). Example species and frequency ranges from Wiernicki et al. (2020).

[2] There is no distinction within Groups 2 and 3 between fishes with open vs. closed swim bladders, though some evidence suggests that this distinction could be important when considering susceptibility to barotrauma (Popper et al. 2019). Wiernicki et al. (2020) further divide Group 3 into two subgroups: (1) fishes with anterior projections of the swim bladder, which bring it in closer proximity to the ear and enhances hearing; and (2) fishes with Weberian ossicles (special bones that connect the swim bladder to the ear) representing the most sensitive of all fishes.

Regulation of Underwater Sound for Fishes and Invertebrates

Thresholds for Non-Auditory Injury

During construction of the Bay Bridge in California, researchers observed dead fish near pile-driving operations, suggesting that fish could be killed when in very close proximity (< 33 feet [<10 meters]) to the pile (Caltrans 2004). Further work around this construction project led to the formation of dual interim criteria by the Fisheries Hydroacoustic Working Group (2008), which were later adopted by NMFS. With these interim criteria, the maximum permitted Lpk for a single pile-driving strike is 206 decibel (dB) re 1 µPa, and the maximum accumulated SEL is 187 dB re 1µPa2s for fishes greater than 2 grams, and 183 dB re 1µPa2s for fishes less than 2 grams (Table 3.5.5-3). These criteria are still being used by NMFS, but given the new information obtained since 2008, the appropriateness of these thresholds is being reconsidered (Popper et al. 2019).

These early findings prompted a suite of laboratory experiments in which a special testing apparatus was used to simulate signals from pile-driving that a fish would encounter around 10 meters from a pile (Casper et al. 2013a, 2012, 2013b; Halvorsen et al. 2012a, 2011, 2012b). An important component of this work was the ability to simulate both the pressure and particle motion components of the sound field, which is rarely done in laboratory experiments. These studies showed that effects are greater in fishes with swim bladders than those without, and that species with closed swim bladders experienced greater damage than those with open swim bladders. Evidence of barotrauma was observed starting at peak pressures of 207 dB re 1 micropascal (µPa) (Halvorsen et al. 2012a). Larger animals seem to have a higher susceptibility to injury than smaller animals (Casper et al. 2013a). The researchers found that most of the species tested showed recovery from injury within 10 days of exposure, but they note that injured animals may be more vulnerable to predation while they are recovering, and these secondary effects have not been studied. The authors also conclude that SEL alone is not enough to predict potential impacts on fishes; the energy in a given strike and the total number of strikes are also important factors. These studies formed the foundation of the Guidelines for Fish and Sea Turtles by

Popper et al. (2014a), which became American National Standards Institute (ANSI) standard (#ASA S3/SC1.4 TR-2014) and have become widely accepted hearing thresholds for fishes and turtles.

No studies have directly measured TTS in fishes as a result of exposure to pile-driving noise. Popper et al. (2005) exposed caged fish to sounds of seismic airguns (an impulsive signal which can serve as a proxy), and tested their hearing sensitivity afterwards. Three species with differing hearing capabilities were exposed to 5 pulses at a mean received Lpk of 207 dB re 1 µPa (186 dB re 1 µPa2s SEL). None of the fish showed evidence of barotrauma or tissue damage, nor was there damage to the hearing structures (Song et al. 2008). The species with the least-sensitive hearing - the broad whitefish - showed no evidence of TTS. The northern pike and lake chub, species with more sensitive hearing, did exhibit TTS after exposure to seismic pulses, but showed recovery after 18 hours. The findings suggest that there is a relationship between hearing sensitivity and level of impact, and that species without a connection between the swim bladder and ear are unlikely to experience TTS. Nonetheless, Popper et al. (2014a) propose 186 dB re 1 µPa2s SEL as a conservative TTS threshold for all fishes exposed to either seismic airguns or pile-driving, regardless of hearing anatomy. They acknowledge that research is needed on potential TTS due to exposure to pile-driving noise, and that future work should measure particle motion as the relevant cue.

A handful of studies have directly investigated the effects of impulsive sounds on eggs and larvae of marine fishes and invertebrates, and most have taken place in the laboratory. Bolle et al. (2012) used a device similar to Halvorsen et al. (2012a) to simulate pile-driving sounds, and found no damage to larvae of common sole (which has a swim bladder during the larval phase) from an SEL of 206 dB re 1 µPa2s, which the authors surmise is equivalent to the received level at approximately 100 meters from pile-driving a 4 meter diameter pile. Further work by Bolle et al. (2014) tested larvae of seabass and herring (both species have swim bladders). Several different life stages were tested, but none of the species showed a difference in mortality between control and exposed animals. The seabass were exposed to SELs up to 216 dB re 1 µPa2s and maximum Lpk of 217 dB re 1 µPa, while herring were exposed to SELs up to 212 dB re 1 µPa2s and maximum Lpk of 207 dB re 1 µPa. Together, the tested larvae represent the entire range of swim bladder shape types described by Popper et al. (2014a). There was no difference in impacts experienced by species with and without a swim bladder, or between those with open or closed swim bladders. Based on this work, Popper et al. (2014a) use 210 dB re 1 µPa2s SEL as a threshold for mortality after exposure to both pile-driving and seismic airguns.

Popper et al. (2014a) provide thresholds for non-recoverable injury, recoverable injury (i.e., mild forms of barotrauma), and TTS for the three hearing groups described in Table 3.5.5-2 plus an additional category for eggs and larvae (Table 3.5.5-3). Unlike with marine mammals, Popper et al. (2014a) do not distinguish between impulsive and non-impulsive sounds; instead they provide thresholds for each sound type (explosions, pile-driving, seismic airguns, sonars, and continuous sounds). That said, studies focused on pile-driving are sometimes used to draw conclusions about impacts from seismic airguns, and vice versa. This is simply due to a lack of comprehensive data for each source type. The thresholds are all given in terms sound pressure, not particle motion, though many have acknowledged that these would be more appropriate (Popper and Hawkins 2018). Currently, there are no underwater noise thresholds for invertebrates, but the effect ranges are expected to be similar to those predicted for fishes in Group 1.

Table 3.5.5-3. Acoustic thresholds for fishes for exposure to pile-driving sound

Fish Hearing Group	Mortality and Non-Recoverable injury		Recoverable Injury		TTS
	L_{pk}	SEL	L_{pk}	SEL	SEL
Fish without swim bladder (Group 1)[1]	>213	>219	>213	>216	>>186
Fish with swim bladder not involved in hearing (Group 2)[1]	>207	210	>207	203	>186
Fish with swim bladder involved in hearing (Group 3)[1]	>207	207	>207	203	186
Eggs and Larvae[1]	>207	>210	--	--	--
Fish ≥ 2 g[2]			206	187	
Fish < 2 g[2]			206	183	

[1] Popper et al. (2014a) Sound Exposure Guidelines. Note that Popper et al. (2014) use the notation "SELcum," but SEL without a subscript is the preferred nomenclature, used here to describe the energy that would be accumulated over an entire pile-driving event (i.e., installation of a pile). See the Section J.2.1, *Units of Measurement*, in Appendix J for further detail.
[2] Fisheries Hydroacoustic Working Group (2008)

Popper et al. (2014a) present criteria for mortality and non-recoverable injury as a result of exposure to detonations. They note that it is difficult to disentangle the effects of the compressive forces of the shock wave (very close to the explosion) from the decompressive effect (area of negative pressure, further from the explosion), but either can lead to barotrauma or mortality in fishes. Several studies (e.g., Goertner 1978; Yelverton 1975) have worked with different species, with different charge sizes and water depths – all of which are important factors in predicting the effects of explosives. Yet Popper et al. (2014a) derive their thresholds using data from an older study which represents the lowest amplitude that caused consistent mortality across species (Hubbs and Rechnitzer 1952). Therefore, for all fishes, regardless of hearing anatomy, the Lpk threshold for mortality and non-recoverable injury is given as a range: 229-234 dB re 1 µPa by Popper et al. (2014a), but in practice, 229 dB is generally used.

Thresholds for Behavioral Disturbance

NOAA Fisheries currently uses a sound pressure level (SPL) criterion of 150 dB re 1 µPa for the onset of behavioral effects in fishes (GARFO 2020). The scientific rationale for this criterion is not well supported by the data (Hastings 2008), and there has been criticism about its use (Popper et al. 2019). Most notably, the differences in hearing anatomy among fishes suggest the use of a single criterion may be too simplistic. Furthermore, a wide range of behavioral responses have been observed in the empirical studies thus far (ranging from startle responses to changes in schooling behavior), and it is difficult to ascertain which, if any, of those responses may lead to significant biological consequences. Interestingly, several recent studies on free-ranging fishes (Hawkins et al. 2014; Roberts et al. 2016; see detail in Section 3.5.5.3.3) have observed the onset of different behavioral responses at similar received levels (Lpk-pk of 152-167 dB re 1 µPa), and Popper et al. (2019) suggest that a received level of 163 dB re 1 µPa Lpk-pk might be more appropriate than the current SPL criterion of 150 re 1 µPa. Finally, given that most species are more sensitive to particle motion and not acoustic pressure, the criteria should, at least in part, be expressed in terms of particle motion. However, until there is further empirical evidence to support a different criterion, the 150 dB re 1 µPa SPL threshold remains in place as the interim metric that regulatory agencies have agreed upon.

3.5.5.1.4 Essential Fish Habitat

The Magnuson-Stevens Fisheries Conservation and Management Act requires fishery management councils to:

1. Describe and identify EFH for managed species (and their prey) in their respective regions;
2. Specify actions to conserve and enhance EFH; and
3. Minimize the adverse effects of fishing on EFH.

The Magnuson-Stevens Fisheries Conservation and Management Act requires federal agencies to consult on activities that may negatively affect EFH identified in Fishery Management Plans (FMPs). In the NY Bight area, fishery species and EFH are managed by the Mid-Atlantic Fishery Management Council (MAFMC), New England Fishery Management Council (NEFMC), and the Office of Highly Migratory Species (HMS). The Atlantic States Marine Fisheries Commission (ASMFC) manages some species and habitat at the state level. Table 3.5.5-4 provides a summary of the Regional Fishery Management Plan Species including life stages within the NY Bight lease areas.

Table 3.5.5-4. Fishery Management Plans and species including life stage within the NY Bight lease areas

New England Fishery Management Plan Species	Mid-Atlantic Fishery Management Plan Species	Atlantic Highly Migratory Species Fishery Management Plan Species
Atlantic Cod; E, L, A	Atlantic Butterfish; E, L, J	Atlantic Albacore Tuna; J
Atlantic Herring; L, J, A	Atlantic Mackerel; E, L, J, A	Atlantic Bluefin Tuna; J, A
Atlantic Sea Scallop; E, L, J, A	Atlantic Surfclam; J, A	Atlantic Skipjack Tuna; J, A
Haddock; L, J	Black Sea Bass; L, J, A	Atlantic Yellowfin Tuna; J
Little Skate; J, A	Bluefish; E, L, J, A	Blue Shark; L, J, A
Monkfish; E, L, J, A	Longfin Inshore Squid; E, J, A	Common Thresher Shark; L, J, A
Ocean Pout; E, J, A	Ocean Quahog; J, A	Dusky Shark; L, J, A
Pollock; L	Scup; J, A	Sand Tiger Shark; L, J
Red Hake; E, L, J, A	Spiny Dogfish; J, A	Sandbar Shark; L, J, A
Silver Hake; E, L, J	Summer Flounder; E, L, J, A	Shortfin Mako Shark; L, J, A
Windowpane Flounder; E, L, J, A	--	Smooth Dogfish; L, J, A
Winter Flounder; L, J, A	--	Tiger Shark; J, A
Winter Skate; J, A	--	White Shark; L, J, A
Witch Flounder; E, L, A	--	--
Yellowtail Flounder; E, L, J, A	--	--

A=adult, E=egg, F=females, J=juvenile, L=larvae, SF=sub-females.

Three basic marine habitat types occur in the region: pelagic (water column), benthic softbottom, and benthic hardbottom. Within inshore waters, additional biogenic habitats such as emergent vegetation, SAV, and oyster reefs are important. Various managed species use these inshore habitats for shelter, feeding, growth, and reproduction. NY Bight area pelagic habitats support longfin inshore squids, coastal pelagic fishes (Atlantic mackerel [*Scomber scombrus*], Atlantic herring [*Clupea harengus*], Atlantic butterfish [*Peprilus triacanthus*], bluefish [*Pomatomus saltatrix*], spiny dogfish [*Squalus acanthias*]), and oceanic pelagic fishes (tunas [*Thunnus* spp.] and sharks [Carcharhinidae, Lamnidae, Squalidae]). Members of the oceanic pelagic group (HMS) can span the entire NY Bight area through migratory, feeding, and reproductive activity (NMFS 2006, 2017).

Managed softbottom demersal invertebrate species include Atlantic surfclam, Atlantic sea scallop, and ocean quahog, and softbottom fishes include summer flounder (*Paralichthys dentatus*), scup (*Stenotomus chrysops*), and spiny dogfish. Black seabass (*Centropristis striata*) is an example of a hardbottom species with EFH in the NY Bight lease areas. Inshore habitats provide shelter for early life stages of summer flounder, striped bass (*Morone saxatilis*), bluefish, weakfish (*Cynoscion regalis*), black seabass, and scup. All major NY Bight habitats produce prey such as benthic invertebrates, anchovies (Engraulidae), silversides (Atherinidae), herrings (Clupeidae), and sand lances (Ammodytidae), which are important to many managed species (Kritzer et al. 2016).

The fishery management councils also identify EFH habitat areas of particular concern (HAPC). HAPCs are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. No designated HAPCs are located within the NY Bight lease areas; however, summer flounder and sandbar shark HAPCs (Figure 3.5.5-2) may overlap with potential NY Bight offshore export cable corridors and vessel routes to the identified representative ports (see Chapter 2, *Alternatives*). Summer flounder HAPC has not been spatially defined by NOAA but includes native species of macroalgae, seagrasses, and freshwater and tidal macrophytes (i.e., SAV) in any size bed, as well as loose aggregations, within summer flounder EFH.

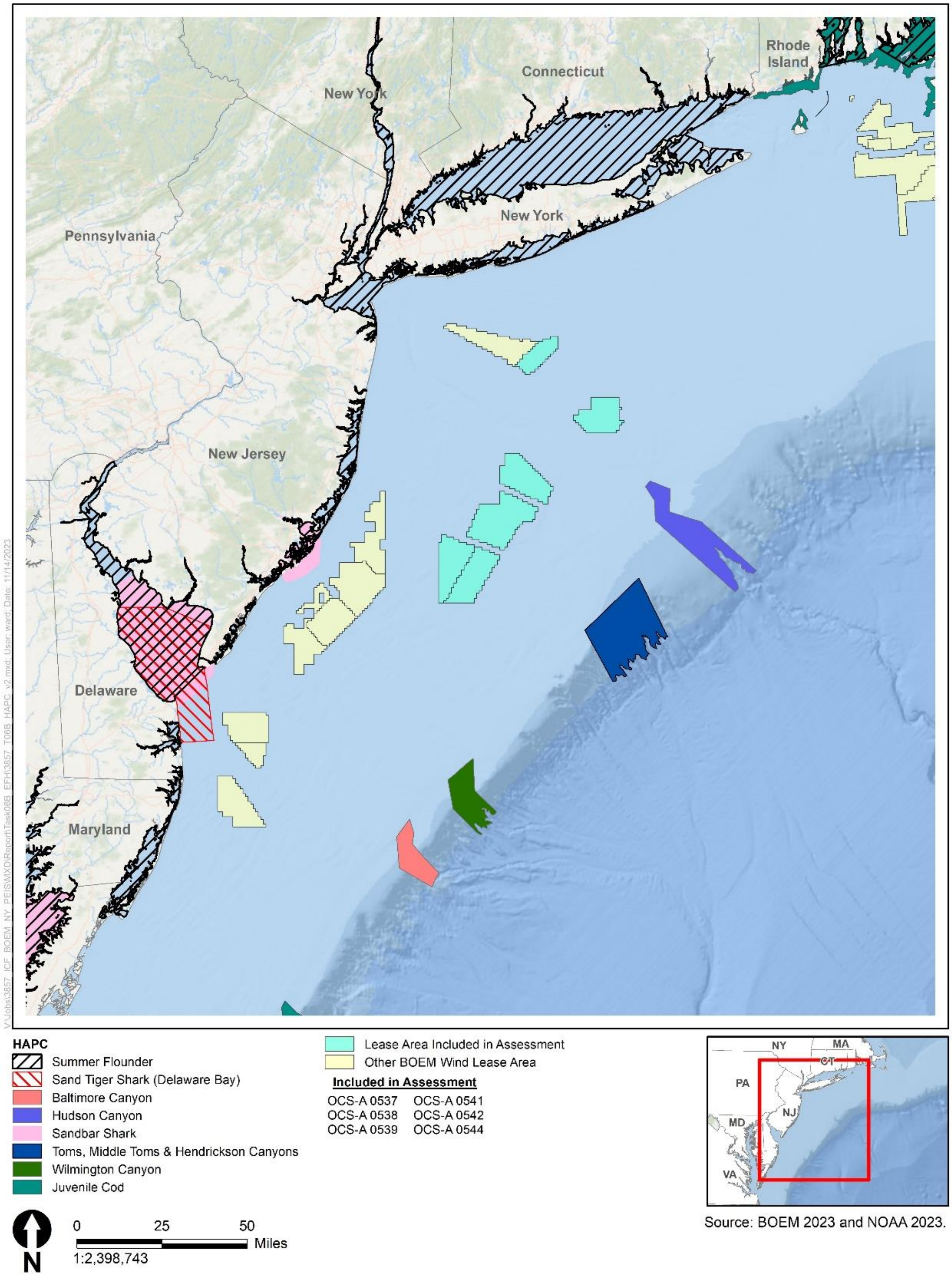


Figure 3.5.5-2. HAPCs within the NY Bight from Cape Cod, Massachusetts, to Cape Henlopen, Delaware

It is important to note that in addition to SAV being an EFH HAPC, it is also a Special Aquatic Site under the CWA. SAV is an important inshore habitat component for many marine species. Once affected, SAV can be difficult to replace, and such efforts are often deemed unsuccessful (Lefcheck et al. 2019).

3.5.5.2 Impact Level Definitions for Finfish, Invertebrates, and Essential Fish Habitat

Definitions of potential impact levels are provided in Table 3.5.5-5. Beneficial impacts on finfish, invertebrates, and essential fish habitat are described using the definitions described in Section 3.3.2 (see Table 3.3-1).

Table 3.5.5-5. Adverse impact level definitions for finfish, invertebrates, and EFH

Impact Level	Definition
Negligible	Regardless of the duration of the effects from IPFs, there would be no measurable impacts on species or habitat, or impacts would be so small that they would be extremely difficult or impossible to discern or measure.
Minor	The duration of effects from IPFs may be short to long term in nature. Most impacts on species are expected to be avoided; if impacts occur, they may result in the loss of a few individuals but there would be no regional or population-level impacts. Impacts on sensitive habitats are avoided; impacts on other habitats are short term in nature.
Moderate	The duration of effects from IPFs may be short term, long term, or permanent in nature. Impacts on species may include the loss of individuals and regional impacts 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 impacts on sensitive habitats at a regional level or population-level effects on species that rely on these habitats.
Major	The duration of effects from IPFs may be short term, long term, or permanent in nature. Impacts would affect the viability of the population and would not be fully recoverable over the life of the project or beyond. Impacts on habitats would be long term to permanent or are expected to result in regional-level or population-level impacts on habitats or species that rely on those habitats.

Accidental releases, anchoring, cable emplacement and maintenance, discharge/intakes, electric and magnetic fields and cable heat, land disturbance, survey gear utilization, lighting, noise, port utilization, and presence of structures are contributing IPFs to finfish, invertebrates, and EFH. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.5.5-6.

Table 3.5.5-6. Issues and indicators to assess impacts on finfish, invertebrates, and EFH

Issue	Impact Indicator
Underwater noise and vibration	Finfish: Extent, frequency, and duration of noise above established effects thresholds, and other quantifiable effects as noted in Section 2.5 (Tables 1-4) in the COP Modeling Guidelines.[1] Invertebrates: Qualitative estimate of potential disturbance, injury, or mortality on invertebrates based on extent, frequency, and duration of noise or vibration.
Crushing, deposition, and entrainment	Estimated extent of potential disturbance, injury, and mortality-level effects on fish and invertebrates (including eggs and larvae) from crushing or burial by construction equipment and materials placement; entrainment by construction equipment; and burial from suspended sediment deposition.

Issue	Impact Indicator
Seabed profile and water column alteration	Short-term and long-term effects on water column and benthic habitats by habitat displacement by monopiles; habitat modification by placement of scour protection and concrete mattresses; short-term alteration of softbottom benthic habitat function; and long-term alteration of complex benthic habitat function.
Water quality impacts	Duration and intensity of suspended sediment impacts. Accidental spills, releases of trash and debris.
Artificial light	Extent and duration of artificial light effects.
Power transmission	Exposure above ambient EMF levels based on extent, duration, and proximity of contact with or exposure to infrastructure; species sensitivity. [2]

[1] https://www.boem.gov/renewable-energy/boemoffshorewindpiledrivingsoundmodelingguidance.
[2] EMF sensitivity varies widely; no effect threshold guidance has been established. The minimum EMF levels needed to produce behavioral responses observed in available research are one or more orders of magnitude larger than the anticipated EMF effects likely to result from the NY Bight projects. Electrosensitive fish can detect low-frequency bioelectric fields at very weak levels but are unable to detect higher frequency fields >20 Hz (Bedore and Kajiura 2013).

3.5.5.3 Impacts of Alternative A – No Action – Finfish, Invertebrates, and Essential Fish Habitat

When analyzing the impacts of the No Action Alternative on finfish, invertebrates, and EFH, BOEM considered the impacts of ongoing activities, including ongoing non-offshore-wind and offshore wind activities, on the baseline conditions for these resources. 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 D, *Planned Activities Scenario*.

3.5.5.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for finfish, invertebrates, and EFH described in Section 3.5.5.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH are generally associated with commercial harvesting and fishing activities, fisheries bycatch, water quality degradation and pollution, dredging (e.g., for navigation, port development, marine minerals extraction), accidental fuel leaks or spills, and climate change. See Appendix D, Table D1-10 for a summary of potential impacts associated with ongoing non-offshore-wind activities by IPF for finfish, invertebrates, and EFH. The effects on these resources from these ongoing non-offshore-wind activities will continue and result in similar impacts regardless of offshore wind energy development. The rate and continuation of these activities is uncertain but their effects on finfish, invertebrates, and EFH would be detectable from changes in various metrics including habitat structure, species abundance, diversity, and composition.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH are listed in Table 3.5.5-7. Ongoing O&M of Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 (OCS-A 0501), South Fork Wind (OCS-A 0517), Ocean Wind 1 (OCS-A 0498), Revolution Wind (OCS-A 0486), Sunrise Wind (OCS-A 0487), Empire Wind 1 and 2 (OCS-A 0512), New England Wind Phase 1 and 2 (OCS-A 0534), and CVOW-C (OCS-A 0483) projects would affect finfish, invertebrates, and EFH through the primary IPFs of noise, presence of structures, and seabed disturbance from cable emplacement.

Some mobile invertebrates can migrate long distances and encounter a wide range of stressors over broad geographical scales (e.g., longfin and shortfin squid). Their mobility and broad range of habitat requirements may also indicate that limited disturbance may not have measurable effects on their stocks (populations). This would apply to finfish, where populations are composed largely of long-range migratory species; it would be expected that their mobility and broad ranges would preclude many temporary and short-term impacts associated with ongoing offshore impacts throughout the geographic analysis area. Invertebrates with more restricted geographical ranges, sessile invertebrates, or life stages can be subject to the above stressors over time and can be more sensitive (Guida et al. 2017).

Seafloor habitat is routinely disturbed through anchoring, submarine cable installation, dredging (e.g., navigation, marine minerals extraction, military purposes), and commercial fishing use of bottom trawls and dredge fishing methods. Abandoned or lost fishing gear remains in the aquatic environment for extended time periods, often entangling or trapping mobile invertebrate and fish species. Based on data from NOAA, bycatch affects many species throughout the geographic analysis area—most notably, windowpane flounder, blueback herring, shark species, and hake species; the majority of bycatch is a result of open area scallop trawls, large-mesh otter trawls, conch pots, and fish traps (NOAA 2019). Water quality impacts from ongoing onshore and offshore activities affect nearshore habitats, and accidental spills can occur from pipeline or marine shipping. Invasive species can be accidentally released in the discharge of ballast water and bilge water from marine vessels. The resulting impacts on invertebrates and finfish depend on many factors but can be widespread and permanent, especially if the invasive species becomes established and outcompetes native species.

Global climate change has the potential to affect the distribution and abundance of invertebrates and their food sources, primarily through increased water temperatures but also through changes to ocean currents and increased acidity. Finfish and invertebrate migration patterns can be influenced by warmer waters, as can the frequency or magnitude of disease (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold may affect the recovery of the American lobster fishery off the East Coast of the United States (Rheuban et al. 2017). Ocean acidification driven by climate change is contributing to reduced growth, and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016).

Based on a recent study, marine, estuarine, and riverine habitat types were found to be moderately to highly vulnerable to stressors resulting from climate change (Farr et al. 2021). In general, rocky and mud bottom, intertidal, special areas of conservation, kelp, coral, and sponge habitats were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Similarly, estuarine habitats considered most vulnerable to climate change include intertidal mud and rocky bottom, shellfish, kelp, SAV, and native wetland habitats. Riverine habitats found to be most vulnerable to climate change include native wetland, sandy bottom, water column, and SAV habitats. As invertebrate habitat, finfish habitat, and EFH may overlap with these habitat types, the environmental study conducted by Farr et al. (2021) suggests that marine life and habitats could experience dramatic changes and decline over time as impacts from climate change continue.

3.5.5.3.2 Impacts of Alternative A – No Action on ESA-Listed Species

As noted in Section 3.5.5.1, *Description of the Affected Environment and Future Baseline Conditions*, five ESA-listed fish species may occur in the NY Bight area (Atlantic salmon, giant manta ray, oceanic whitetip shark, Atlantic sturgeon, shortnose sturgeon); however, only two are most likely to be present and have the potential to be impacted, the Atlantic sturgeon and the giant manta ray.

The primary IPFs from ongoing non-offshore-wind and offshore wind activities that could impact the Atlantic sturgeon and the giant manta ray are survey gear utilization from trawl and gillnet fisheries surveys and noise impacts from pile-driving.

Trawl and gillnet surveys for fisheries monitoring could include the capture of Atlantic sturgeon in trawl gear, which has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). Capture of sturgeon in trawl gear could result in injury or death; however, the use of trawl gear has been used as a safe and reliable method to capture sturgeon if tow time is limited. Trawl surveys conducted as part of fisheries monitoring would be limited to small sampling nets, short tow times, and slow tow speeds, which would reduce the risk of capture. Any captured sturgeon is expected to be released alive and without significant injury, though injury can occur. Given the short tow times for trawl surveys, fisheries and habitat surveys are not expected to result in large numbers of Atlantic sturgeon mortality, but a few could occur without affecting the overall population; therefore, impacts would be minor.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on finfish, invertebrates, and EFH are listed in Table 3.5.5-7. The ongoing construction of the Vineyard Wind 1 (OCS-A 0501), South Fork Wind (OCS-A 0517), Ocean Wind 1 (OCS-A 0498), Revolution Wind (OCS-A 0486), Sunrise Wind (OCS-A 0487), Empire Wind 1 and 2 (OCS-A 0512), New England Wind Phase 1 and 2 (OCS-A 0534), and CVOW-C (OCS-A 0483) projects would include pile-driving. Both the Atlantic sturgeon and giant manta rays are hearing generalists that are relatively insensitive to sound when compared to fish species that are hearing specialists. These species also have different hearing sensitivities based on physiological differences in the structure of their hearing organs. Atlantic sturgeon may experience behavioral disturbance from pile-driving noise but are expected to be able to avoid exposure to noise above the levels that could result in exposure to the cumulative injury threshold. Given anticipated avoidance of disturbing levels of sound, exposure to these sound levels is expected to be temporary, as fish are expected to resume normal behaviors following the completion of pile-driving (Krebs et al. 2016; Shelledy et al. 2018). Based on the small scale of anticipated effects, the effects of underwater noise associated with impact pile-driving leading to injury or behavioral disturbance to ESA-listed species would likely be negligible.

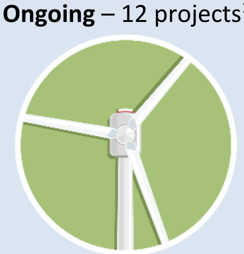
3.5.5.3.3 *Cumulative Impacts of the No Action Alternative*

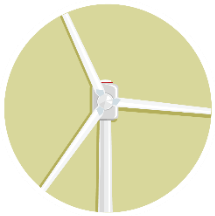
The cumulative impact analysis for the No Action Alternative considers the impact of the No Action Alternative in combination with other planned non-offshore-wind and offshore wind activities (without the NY Bight projects). Planned non-offshore-wind activities that may affect finfish, invertebrates, and EFH include new submarine cables, transmission systems (e.g., PBI), and pipelines, tidal energy projects, marine minerals extraction, dredging, military use, marine transportation, and oil and gas activities (see Appendix D for a description of planned activities). Impacts from planned non-offshore-wind activities would be similar to those from ongoing activities and may include temporary and permanent impacts on finfish, invertebrates, and EFH from disturbance, injury, mortality, habitat degradation, and habitat conversion. While these impacts would have localized effects on finfish, invertebrates, and EFH, population-level effects would not be expected.

Other cumulative impacts include changes in species distribution due to climate change (i.e., increased sea temperatures, changes in ocean circulation patterns, etc.), from the time of this assessment until construction and operation of wind projects in the NY Bight is finalized. Multiple species have shifted their distribution >100 miles (160 kilometers) northwards in the last five decades (e.g., black seabass, American lobster, red hake) (Kleisner et al. 2017; USEPA 2023). The resulting changes in species distribution (latitude and depth) may also impact commercial and for-hire fishing activities.

Ongoing and planned offshore wind activities within the geographic analysis area that contribute to impacts to finfish, invertebrates, and EFH are listed in Table 3.5.5-7.

Table 3.5.5-7. Ongoing and planned offshore wind in the geographic analysis area for finfish, invertebrates, and EFH

Ongoing/Planned	Projects by Region
Ongoing – 12 projects[1] 	**MA/RI** • Block Island (State waters) • Vineyard Wind 1 (OCS-A 0501) • South Fork Wind (OCS-A 0517) • Revolution Wind (OCS-A 0486) • Sunrise Wind (OCS-A 0487) • New England Wind (OCS-A 0534) Phase 1 • New England Wind (OCS-A 0534) Phase 2 **NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512) **VA/NC** • CVOW-Pilot (OCS-A 0497) • CVOW-Commercial (OCS-A 0483)

Ongoing/Planned	Projects by Region
Planned – 16 projects[2] 	**MA/RI** • SouthCoast Wind (OCS-A 0521) • Beacon Wind 1 (OCS-A 0520) • Beacon Wind 2 (OCS-A 0520) • Bay State Wind (OCS-A 0500) • OCS-A 0500 remainder • OCS-A 0487 remainder • Vineyard Wind Northeast (OCS-A 0522) **NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499) **DE/MD** • Skipjack (OCS-A 0519) • US Wind/Maryland Offshore Wind (OCS-A 0490) • GSOE I (OCS-A 0482) • OCS-A 0519 remainder **VA/NC** • Kitty Hawk North (OCS-A 0508) • Kitty Hawk South (OCS-A 0508)

CVOW = Coastal Virginia Offshore Wind; DE = Delaware; GSOE = Garden State Offshore Energy; MA = Massachusetts; MD = Maryland; NC = North Carolina; NJ = New Jersey; NY = New York; RI = Rhode Island; VA = Virginia

[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.

[2] Status as of September 20, 2024.

Accidental releases: Using the assumptions in Appendix D, there would be a low risk of a release of hydrocarbon products from any of the more than 2,331 WTGs and 64 OSSs comprising the offshore wind projects in the geographic analysis area, with a total of approximately 26,798,248 gallons (101,442,404 liters) of fuel/fluids/hazardous materials contained in all offshore wind facilities. From 2000 to 2009, the average spill size for vessels other than tanker ships and tanker barges was 88 gallons (333 liters) (USCG 2011). Should a spill from a vessel associated with the offshore wind activities occur, BOEM anticipates that the volume would be similar. According to BOEM modeling (Bejarano et al. 2013), a release of 128,000 gallons (484,533 liters) is likely to occur no more often than once per 1,000 years, and a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years. The probability of an accidental discharge or spill occurring simultaneously from multiple WTGs is extremely low. An oil weathering model used by NOAA predicted that a spill of 105,000 gallons (397,468 liters) would dissipate rapidly, and depending on the ambient conditions, would reach a concentration of 0.05 percent between 0.5 and 2.5 days (Tetra Tech Inc. 2015). The volume tested was 1,931 times the average volume recorded by the USCG, suggesting that 88 gallons would dissipate much faster and affect a much smaller area. Therefore, along with the low likelihood of a large release and the rapid dissipation, impacts on finfish, invertebrates and EFH are extremely unlikely. As described in Section 2.3, *Non-Routine Activities and Events*, accidental releases of chemicals, gases, or man-made debris may occur as a result of a structural failure and could result in impacts on finfish, invertebrates, and essential fish habitat.

Marine invasive species have been accidentally introduced into habitats along the U.S. Atlantic seaboard in multiple instances. Pederson et al. (2005) list the numerous vectors that transport invasive organisms and inoculate new areas. Ballast water exchange/discharge and biofouling are the two main vectors for invasive species introduction (Carlton et al. 1995; Drake 2015). Some of the dominant vectors are shipping and hull fouling, aquaculture, marine recreational activities, commercial and recreational fishing, and ornamental trades. Still, use of canals by various vessels, offshore drilling, hull cleaning activities, habitat restoration, research, and floating marine debris (particularly plastics) may also facilitate the transfer of invasive organisms (Pederson et al. 2005). The offshore wind industry would increase the risk of accidental releases of invasive species due to increased maritime traffic. Vessels required for the importation of components of the WTGs, OSSs, and submarine power cables and the specialized construction vessels from international ports could potentially represent transport vectors. The impacts related to the release and establishment of invasive species on finfish, invertebrates, and EFH are multifaceted. Invasive species such as the Asian shore crab (*Hemigrapsus sanguineus*) have spread throughout most of the Mid-Atlantic Bight and northern areas of the South Atlantic Bight. The Asian shore crab was first collected in the Delaware Bay area in 1988 and has subsequently extended its distribution north to Maine and south to North Carolina (Epifanio 2013). The impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent. The introduction and impact of the Asian shore crab in the geographic analysis area is a prime example of a species that became established and has out-competed native fauna and adversely modified the coastal habitat. The increase in this risk related to the offshore wind industry would be slight compared to the risk from ongoing activities. The potential for introducing an invasive species through ballast water releases or biofouling from installation activities is estimated to be short term and localized and to result in limited changes to finfish, invertebrates, and EFH. As such, accidental releases from offshore wind development would not be expected to contribute appreciably to the cumulative impacts on finfish, invertebrates, and EFH; impacts on these resources would be considered negligible.

Anchoring: Vessel anchoring related to ongoing, commercial, and recreational activities continues to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Spud barges, jack-up vessels, or DP vessels may be required for other offshore wind projects; only spud barges and jack-up vessels will affect the seafloor during emplacement and removal. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hardbottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish). Impacts from anchoring would occur during construction and installation activities related to the placement of WTGs and their scour protection, placement of OSSs, and installation of the submarine power cable arrays, depending upon the vessels used. Impacts resulting from anchoring or bottom contact would include increased turbidity levels and potential for contact causing mortality of demersal species and, possibly, degradation of sensitive habitats. All impacts would be localized, and turbidity would be temporary; therefore, impacts from anchor contact (or spud can or leg emplacement) are expected to be short term. Degradation of sensitive habitats such as certain types of hardbottom or eelgrass could result in long-term to permanent impacts. The footprint of each anchor would be relatively small and of short duration and would represent a minor cumulative impact on the finfish and invertebrate community.

Cable emplacement and maintenance: The ongoing and planned offshore wind activities would require cable installation and maintenance activities that would disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local and limited to the cable corridor. Ongoing and planned non-offshore wind activities, such as the construction of HDD exit pits and conduits for transmission systems, may also disturb the seafloor and cause temporary increases in suspended sediment. Cable installation and maintenance would use ground disturbance (grapnel runs), jetting, jet plowing, or dredging equipment to install and support cable burial maintenance operations. Cable installation and burial maintenance activities have the potential to disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations, depending on the benthic habitat type. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur.

The process of cable installation can cause localized short-term impacts (habitat alteration, change in complexity) through seabed profile alterations as well as through sediment mobilization and redeposition. Assuming the extent of such impacts is proportional to the length of cable installed, such impacts from offshore wind activities could be extensive within the proposed interarray and offshore export cable corridor construction paths. Dredging would most likely occur in sand wave areas where typical jet plowing is insufficient to meet cable burial target depths. Sand waves that are dredged would likely be redeposited in areas containing similar sediments. 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, although full recovery of faunal assemblage may require several years (Boyd et al. 2005). Therefore, seabed profile alterations, while locally intense, are expected to have minor cumulative impacts on finfish, invertebrates, and EFH on a regional scale.

Cable emplacement methods may include dredging equipment, including mechanical dredging or hydraulic dredging. Entrainment and impingement of organisms (mobile finfish and invertebrates, eggs, and larvae) could occur at intakes for cable-laying equipment. Impacts from entrainment and impingement of finfish and invertebrates associated with cable emplacement would be mostly confined to cable centerlines and would be short term and minor. Water jetting would entrain and possibly injure or kill small organisms, but this impact would be relatively small and localized.

Cable installation and burial activities supporting the ongoing and planned offshore wind development projects will be the primary cause for sediment deposition and burial impacts within the geographic analysis area. Cable installation activities in certain regions of the geographic analysis area would use jet-plowing and dredging installation methodologies to install and bury the interarray and offshore export cables associated for each project. Generally, permit requirements for these operations will mandate mitigation activities to reduce the temporal and spatial impacts related to both dredging and jet-plow activities. Even with stringent adherence to mitigation procedures, sediment dispersion and redisposition could have negative impacts on eggs and larvae of finfish and invertebrates. This is particularly critical for 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 (BOEM 2021a). Impacts related to sediment deposition and burial may vary based on season, or time of year and regional conditions within each planned project area. The impacts of sediment deposition and burial on finfish, invertebrates, and their EFH from ongoing and planned offshore wind development projects would likely be minor.

Discharges/intakes: Entrainment and impingement of finfish, invertebrates, and planktonic larvae could occur at cooling water intakes for HVDC converter OSSs (Middleton and Barnhart 2022). Section 316(b) of the CWA requires NPDES permits to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available to minimize adverse environmental impact from impingement and entrainment of aquatic organisms. Impacts of entrainment and impingement on finfish and invertebrates at HVDC converter intakes would be limited to the immediate area of the OSSs and to intake volumes. Impacts on finfish, invertebrates, and EFH from entrainment and impingement at intakes are expected to be short term and minor.

Electric and magnetic fields and cable heat: EMFs emanate continuously from installed electrical power transmission cables. Biologically notable 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 as negligible for some benthic species (North Sea prawn, round crab, glacial relict isopod, blue mussel, and young flounder) and minor for others (skates and lobster) present near operating DC cables (Taormina et al. 2020; Hutchison et al. 2018). Additionally, electromagnetic-sensitive species (e.g., sharks, skates, and rays) have been shown to respond to HVAC, but adverse consequences have not been established (Gill et al. 2012). Buried submarine cables can warm the surrounding sediment in contact with the cables up to tens of centimeters but impacts on bottom-dwelling organisms are expected to be insignificant (Taormina et al. 2018) and would be limited to a small area around the cable. Studies have shown that EMFs would likely not interfere with movement or migration of marine species (Kavet et al. 2016). However, although there are research gaps, EMF emissions from subsea power cables can have a measurable impact on the early life history and consequently the population dynamics of some crustaceans if the exposure levels are high enough (Harsanyi et al. 2022; Hutchinson et al. 2020). EMF exposure levels in the cable corridor environment are not expected to reach high enough energy levels to impact populations and there is no evidence to indicate that EMFs from undersea AC or DC power cables negatively affect commercially and recreationally important fish species (CSA Ocean Sciences Inc. and Exponent 2019; Gill and Desender 2020; NYSERDA 2017; SEER 2022; Taormina et al. 2018); however, low-intensity EMFs from AC cables are biologically relevant as they may attract fish by mimicking prey bioelectric fields, and EMFs from DC cables have been associated with increased exploratory activity in lobsters and skates (Hutchinson et al. 2020). Therefore, cumulative impacts of EMFs on finfish, invertebrates, and EFH from ongoing and planned actions would likely range from negligible to minor.

Survey gear utilization: Survey gear utilization refers to fisheries monitoring survey gear, site characterization equipment, and commercial fishing gear. Post-ROD preconstruction, construction, and post-construction fisheries monitoring surveys for ongoing and planned projects would continue to harvest finfish and macroinvertebrates. These surveys could include trawl surveys (impacting finfish and squid) and clam dredge surveys (ocean quahog and surfclam).

Trawl and gillnet surveys for fisheries monitoring would likely result in direct impacts on finfish, invertebrates, and EFH and has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). Trawl surveys conducted as part of fisheries monitoring would be limited to small sampling nets, short tow times, and slow tow speeds, which would reduce the risk of capture. Given the short tow times for trawl surveys, impacts from fisheries and habitat surveys would likely be negligible.

Post-ROD survey HRG equipment that would be used for offshore wind projects at a minimum would use side-scan sonar, sub-bottom profiler, magnetometer, and multibeam echosounder. Following the HRG surveys, geotechnical surveys using vibracores, sediment grabs, and cone penetration tests would likely occur as well. Some of this gear would come in contact with benthic resources, which can disrupt the habitat and cause mortality by crushing if under the gear. Other gear would add short-term sound inputs, which may temporarily disturb finfish and invertebrates as well as impact EFH. Impacts from these surveys are expected to be negligible due to the short duration and scale of spatial impact.

Multiple fishing grounds are located within the NY Bight area, including Cholera Bank, Middle Ground Bank, and Angler Bank, and a variety of regulated gear types and fishing techniques are currently used (NYSERDA 2017). Menhaden (*Brevoortia tyrannus*), mackerel, butterfish, and summer flounder all provide high commercial fishing revenue in New York, New Jersey, and Rhode Island (BOEM 2021). See Section 3.6.1 for more information. Several managed invertebrate species occur in the NY Bight area, including longfin inshore squid, Atlantic sea scallops, Atlantic surfclams, ocean quahogs, horseshoe crabs, blue crabs, and American lobsters (BOEM 2021). Stock assessment accuracy may be minimized because current fisheries survey designs and sampling methods that support these assessments will not be sustainable within wind farm areas due to operational safety considerations and the incompatibility of survey methods (Gill et al. 2020). The gear used would continue to affect finfish (including Atlantic sturgeon), invertebrates, and EFH, especially those that disturb the seafloor (trawls, dredges). Scallop and clam dredgers as well as bottom trawlers are ranked second and third for the highest landings within the NY Bight lease areas. See Section 3.6.1 for more details. Dredging and trawling are methods used to land clams, scallops, and other benthic species. Disturbance of benthic invertebrate communities by commercial fishing activities can adversely affect community structure and diversity and limit recovery from offshore wind farms (Avanti Corporation and Industrial Economics 2019), although this impact is less notable in sandy areas that are strongly influenced by tidal currents and waves (Nilsson and Rosenberg 2003; Sciberras et al. 2016). This repetitive impact of regulated bottom-tending fishing gear would be moderate.

Overall, the cumulative impacts from ongoing and planned activities would range from negligible (for fisheries monitoring and site characterization) to moderate (for commercial fishing activities).

Lighting: 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. 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 impacts from vessels can be mitigated through application of BOEM's Guidelines for

Lighting and Marking of Structures Supporting Renewable Energy Development (BOEM 2021). Light sources from offshore structures would occur during their operational phase, and these would be gradually added to the geographic analysis area over time. Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM guidance. The impacts from lighting related to the ongoing and planned offshore wind activities are highly localized and spatially restricted in comparison to planned non-offshore-wind activities. The impacts of light on finfish, invertebrates, and EFH from offshore wind activities would likely be short term, limited to highly localized attraction, and include some potential disruption of spawning cycles. Light impacts on finfish and invertebrates would likely be considered negligible.

Noise: Anthropogenic noises on the OCS associated with offshore wind development include noise from G&G surveys, UXO detonations, pile-driving activities, vessel traffic, cable-laying activities, aircraft, WTG operations, and conceptual decommissioning. These noises have the potential to cause temporary effects on some finfish and invertebrate species and their EFH resources by displacing them and, potentially, changing their temporal feeding and migratory behavior. BOEM anticipates that these impacts would be localized and temporary. Potential impacts could be greater if avoidance and displacement of finfish and invertebrates occurs during seasonal spawning or migration periods.

Geophysical and Geotechnical Surveys

Of the sources that may be used in geophysical surveys for offshore wind, only a handful (e.g., boomers, sparkers, bubble guns, and some sub-bottom profilers [SBPs]) emit sounds at frequencies that are within the hearing range of most fishes and invertebrates (see Appendix J for more detail on these sources [Crocker and Fratantonio 2016; Ruppel et al. 2022]). This means that side-scan sonars, multibeam echosounders, and some SBPs would not be audible, and thus would not affect them. For the sources that are audible, it is important to consider other factors such as source level, beamwidth, and duty cycle (Ruppel et al. 2022). Boomers, sparkers, hull-mounted SBPs, and bubble guns have source levels close to the threshold for injury for pressure-sensitive fishes, so unless a fish was within a few meters of the source, injury is highly unlikely (Crocker and Fratantonio 2016; Popper et al. 2014). Behavioral impacts could occur over slightly larger spatial scales. For example, if one assumes an SPL threshold of 150 dB re 1 µPa for behavioral disturbance (GARFO 2020) and spherical spreading loss, sounds with source levels of 190 dB re µPa-m would fall below this threshold approximately 328 feet (100 meters) from the source (assuming cylindrical spreading, this would be approximately 0.6 mile [1 kilometer]). This means that the lowest-powered sparkers, boomers, and bubble guns would not result in behavioral disturbance beyond approximately 328 feet (100 meters) in a deep water oceanic environment (Crocker and Fratantonio 2016). Towed SBPs are generally lower in power than hull-mounted systems, so behavioral impacts are likely to occur over even smaller scales. It should be noted that these numbers are reported in terms of acoustic pressure because there are currently no behavioral disturbance thresholds for particle motion. It is expected that behavioral impact ranges would be even smaller for particle motion-sensitive species, including invertebrates. Because most HRG sources are typically “on” for short periods with silence in between, only a few “pings” emitted from a moving vessel towing an active acoustic source would reach fish or invertebrates below, so behavioral effects would be intermittent and temporary. The Biological Assessment for Data Collection and Site Survey Activities for

Renewable Energy on the Atlantic OCS (Baker and Howson 2021) concluded that no ESA-listed fish species are likely to be adversely affected or experience long-term impacts from survey activity. Overall, the level of disturbance from G&G surveys is expected to be negligible for fishes and invertebrates due to the frequency range, the small spatial extent of sound propagation, and the short duration of exposure.

Unexploded Ordnance Detonations

The detonation of explosives creates both a shock wave and a rapid oscillation in pressure. As described in Section 3.5.5.1.3, *Importance of Sound to Fish and Invertebrates,* barotrauma occurs when there is a rapid contraction and overextension of the swim bladder, which can occur when a fish is close to a detonation. The distance at which barotrauma may occur is generally expected to be smaller than that at which hearing effects could occur, although there is no data on TTS related to explosions. Jenkins et al. (2022) and Smith et al. (2022) exposed Pacific mackerel to explosives *in situ* at distances ranging from 102 to 2,648 feet (31 to 807 meters) and examined potential damage to auditory tissues (Smith et al. 2022) and non-auditory tissues (Jenkins et al. 2022). Compared to controls, there were increases in mortality observed at distances up to 515 feet (157 meters) from the explosion, and other non-auditory injuries (e.g., damage to swim bladder and kidneys) occurred up to 1,093 feet (333 meters) from the source at received peak pressures (L_{pk}) of 226 dB re 1 µPa (Jenkins et al. 2022). At greater distances and lower received L_{pk} levels (1,312 feet [400 meters]; 220 dB re 1 µPa), there was evidence of hair cell damage, suggesting that hearing would likely be impaired at this distance, although no hearing tests were conducted (Smith et al. 2022). Interestingly, a similarly designed study with sardines (Dahl et al. 2020) showed the greatest physical effects (burst capillaries, swim bladder rupture, and kidney rupture) occurring at the closest distances (<165 feet [50 m]), but then a secondary peak of effects 410 to 492 feet (125 to 150 meters) from the explosion. This secondary peak was likely explained by propagation pathways—reflections off the seafloor and sea surface may have converged at this distance and created a particularly rapid decrease in acoustic pressure. Larval forms of fishes with closed swim bladders are also likely to experience injury or mortality at close distances, as demonstrated in a field study by Govoni et al. (2008).

Fish and invertebrates that lack swim bladders are more resistant to underwater blasts (Goertner et al. 1994) because it is typically the rapid expansion and contraction of gas-filled spaces that results in the greatest physiological injury. Modeling work by Goertner (1978) predicted that the range at which effects could occur in a non-swim bladder fish was 100 times smaller than that of a fish with a swim bladder. Keevin and Hempen (1997) report on several studies in which various invertebrate species were exposed to charges of different sizes. Overall, despite some studies lacking adequate controls and sample sizes, they conclude that invertebrates are resilient to pressure-related damage from underwater explosions.

UXO detonations are expected to occur infrequently, but may have severe effects within several hundred meters for fish with swim bladders, but this would likely only affect a few individuals or a few fish schools. Given the extremely short duration of explosions, any behavioral effects are expected to be short term, making them of lesser concern than potential injury (Popper et al. 2014). Therefore, the impacts on fish and invertebrates associated with the detonation of UXOs are expected to be minor.

Impact and Vibratory Pile-Driving

The greatest potential impacts of underwater sound from ongoing and planned offshore wind-related activities would occur during the construction phase. Impact or vibratory pile-driving is used to secure foundations into the seabed; for information on the physical characteristics of pile-driving see Appendix J. Impact pile-driving is considered to be an impulsive sound, which means that it could cause injury and mortality of fish and invertebrates in the vicinity of each pile, and could cause short-term stress, behavioral changes, and masking over greater distances. Vibratory pile-driving—a continuous noise source—could lead to masking or behavioral effects, similar to those expected from vessel noise (see *Vessels* IPF). Overall, impacts of impact pile-driving noise on fishes and invertebrates are expected to be moderate, while impacts on eggs and larvae are expected to be negligible. Detail for each taxonomic group is provided below.

Fishes: Early observations of dead fish near a bridge construction project (Caltrans 2004) suggested that fish could be killed when very close to pile-driving operations (<33 feet [10 meters] from the pile). Only one field study since then has measured potential mortality of fishes near pile-driving operations, and found no increase in mortality of juvenile European seabass (a species with a closed swim bladder) at received peak pressures of 210 to 211 dB re 1 µPa, within 148 feet (45 meters) of the pile (Debusschere et al. 2014). As little empirical work has examined the potential for non-recoverable injury (i.e., injuries that would lead to mortality), acoustic modeling can be combined with the given acoustic thresholds to predict potential effects.

For example, Ainslie et al. (2020) used a damped cylindrical spreading model informed by empirical measurements from the North Sea (pile diameter ranging from 11–23 feet [3.35-7.0 meters]) to derive effect ranges based on the Popper et al. (2014) Sound Exposure Guidelines. They estimated that when using 7,000 strikes to drive a 20-foot (6-meter) diameter pile in water depths of 125 feet (28 meters) (assuming 10 dB of noise abatement at the source), fish without a swim bladder could experience mortal injury up to 128 feet (39 meters) away, and recoverable injuries up to 253 feet (77 meters) from the pile. These effect ranges are larger for fish that have a swim bladder involved in hearing: mortal injury could occur within 1,748 feet (533 meters) from the pile, and recoverable injury could occur up to 0.75 mile (1.2 kilometers) away. In similar water depths of the Western Atlantic, modeling predictions for installing a 36-foot (11-meter) diameter monopile (assuming 2202 strikes), using a 4,000 kJ hammer with 10 dB of attenuation yielded similar exposure ranges. Fish without a swim bladder could experience recoverable injury at 722 feet (220 meters), while fish with a swim bladder involved in hearing could experience recoverable injury up to 0.94 mile (1.52 kilometers) away (Ocean Wind 2022). It is generally safe to assume that fishes without a swim bladder, as well as invertebrates, could experience recoverable injury on the order of tens to hundreds of meters, while fishes with swim bladders involved in hearing may experience effects on the order of 0.6–1.2 miles (1–2 kilometers); these distances assume 10 dB of attenuation at the source.

These estimates are based on acoustic modeling and are described in terms of acoustic pressure, which is relevant for fishes with swim bladders, but for other species, particle motion is the more appropriate cue. Field work by Amaral et al. (2018) measured particle acceleration during impact pile-driving of jacket foundations with 4.3-foot (1.3-meter) diameter piles. At 1,640 feet (500 meters) distance from the pile, in-water particle acceleration ranged from 30 to 65 dB re 1 $\mu m/s^2$ in the 10 to 1000 Hz range, but closer to the seabed it was significantly higher, at 50 to 80 dB re 1 $\mu m/s^2$. When comparing these received levels to the published hearing thresholds of several fish species, the authors surmised that in-water particle acceleration would be barely audible at this distance, while levels near the seabed would indeed be detectable (Amaral et al. 2018). These field measurements of particle motion are critical for putting other experimental research into context; most of the studies described below have focused on acoustic pressure, which is relevant for only a sub-set of fishes. It also underscores the fact that species that lack hearing specializations are unlikely to experience significant effects from impact pile-driving beyond a few hundred meters from the source, for similar-size piles and water depths.

A suite of empirical studies has examined other behavioral and physiological effects in fishes—beyond injury—and are described briefly here. Most of this work has focused on commercially important species like the European seabass, which lacks hearing specializations and has a closed swim bladder. Adult seabass generally dive deeper and increase swimming speed and group cohesion when exposed to intermittent and impulsive sounds like pile-driving (Neo et al. 2018; Neo et al. 2014), but juveniles become less cohesive (Herbert-Read et al. (2017) and generally seem to be more sensitive to pile-driving noise than adults (Kastelein et al. 2017). There is also some evidence that respiration rates may be affected by pile-driving noise (Spiga et al. 2017). Importantly, a number of studies have shown that European seabass are likely to habituate to pile-driving sounds over repeated exposure (e.g., Bruintjes et al. (2016); Neo et al. (2016); Radford et al. (2016)). Together, this research suggests that European seabass, and probably other species with similar hearing anatomy, are likely to exhibit short-term startle or physiological responses, but would recover quickly once pile-driving is complete.

Finally, it is worth mentioning the results from field studies, as they can better represent the acoustic conditions that fish would experience near real pile-driving operations. Mueller-Blenkle et al. (2010) showed that free-swimming cod and sole both exhibited changes in swimming behavior in response to pile-driving sounds. Hawkins et al. (2014) found that schools of sprat were more likely to disperse, while mackerel were more likely to change water depth, and that both species—despite different hearing anatomy—responded at a similar received level (50 percent of the time they responded at 163 dB re 1 µPa L_{pk-pk}, which could be expected tens of kilometers from the source). Iafrate et al. (2016) did not observe significant displacement in tagged grey snapper (a species with high site fidelity) residing within hundreds of meters of real pile-driving operations, while Krebs et al. (2016) saw that Atlantic sturgeon seemed to avoid certain areas when pile-driving was taking place, suggesting that they would not remain in the area long enough to experience detrimental physiological effects. These field studies indicate that fishes may be startled, temporarily displaced, or change their schooling behaviors during pile-driving noise, but that when the sound is over, they are likely to resume normal behaviors relatively quickly.

Overall, the research thus far indicates that fishes will exhibit short-term behavioral or physiological responses to impulsive sounds like impact pile-driving. Species with more sensitive hearing would be more susceptible to TTS and behavioral disturbance—and at greater distances—than those with less sensitive hearing. Aside from hearing anatomy, impacts are likely to differ between species based on other contextual factors, such as time of year or time of day. For example, impacts from noise would be greater if it occurs during spawning periods or within spawning habitat, particularly for species that are known to aggregate in specific locations to spawn, use sound to communicate, or spawn only once in their lifetime. Fish that avoid an area during pile-driving are likely to return following completion of pile-driving activity. Therefore, impacts on finfish are anticipated to be localized, temporary, and intermittent, during periods when pile-driving is actively occurring.

Invertebrates: Because marine invertebrates detect sound via particle motion and not acoustic pressure, they are not likely to experience barotrauma from pile-driving. Very few studies have examined the effects of substrate vibrations from pile-driving, yet many have recently acknowledged that this is a field of urgently needed research (Hawkins et al. 2021; Popper et al. 2022; Wale et al. 2021). Most of the research thus far has focused on water-borne particle motion, or even acoustic pressure, and is discussed briefly below.

Sessile marine invertebrates like bivalves are sensitive to substrate-borne vibrations and may be affected by pile-driving noise (Day et al. 2017; Roberts et al. 2015; Spiga et al. 2016). A recent study by Jézéquel et al. (2021) exposed scallops to a real pile-driving event at distances of 26 and 164 feet (8 and 50 meters) from the pile. Measured peak particle acceleration was 110 dB re 1 $\mu m/s^2$ at the close site and 87 dB re 1 $\mu m/s^2$ at the farther site. None of the scallops exhibited swimming behavior, an energetically expensive escape response. At the close site only, scallops increased valve closures during pile-driving noise, and did not show any acclimatization to repeated sound exposure. However, they returned to their pre-exposure behaviors within 15 minutes after exposure. Increased time spent with closed valves could reduce feeding opportunities and thus have energetic consequences, though the biological consequences of this effect have not been studied.

Cephalopods can detect low-frequency sounds by sensing particle motion with their statocysts (Mooney et al. 2010), which, similar to the fish ear, act like three-dimensional accelerometers and could be injured from high sound exposures. Indeed, damage to cephalopod statocysts has been observed in several tank-based studies (André et al. 2011; Sole et al. 2022). Jones et al. (2020) observed that exposure to pile-driving noise (at median peak particle velocities of -40 dB re 1 m/s within a tank) elicited alarm responses such as inking and jetting in the longfin squid. While their initial responses diminished quickly, after 24 hours, the squid were re-sensitized to the noise. A follow-up field study with small-scale pile-driving looked at the behavior of the same species held in cages at different distances (26 and 164 feet [8 and 50 meters]) and found similar results: alarm behaviors occurred with the first acoustic stimulus, but diminished quickly (within ~4 seconds). Responses were only observed in squid at the near site, suggesting that at greater distances from pile-driving there is unlikely to be any alarm response (Cones et al. 2022). A similar field study was conducted by Jézéquel et al. (2023b) that focused on behavioral responses of both squid individuals and shoals to repeated pile-driving sound exposure. Pile-driving induced short-term alarm responses and rapid habituation of squid at sound levels (in zero-peak) of 112–123 dB re 1 µm/s^2 that were similar to those measured at a distance of 0.6 mile (1 kilometer) from offshore windfarm construction (Jézéquel et al. 2023b). Jézéquel and Mooney (In press) quantified potential TTS in longfin squid exposed to repeated, real-time impact pile-driving sound following the same field-based design used in their previous studies (Cones et al. 2022; Jézéquel et al. 2023b). The authors reported no statistical evidence of TTS in any squid exposed to impulsive pile driving sound (i.e., one and five repeated 15-minute-long pile-driving sound sequences), corresponding to cumulated sound exposure levels of 104 and 111 dB re 1 µm/s^2 respectively (Jézéquel and Mooney, In press). Another tank experiment examined predatory feeding behavior of longfin squid (Jones et al. 2021). Within the tank, peak particle acceleration during the playbacks were 130 to 150 dB re 1 µm/s^2 (160 to 180 dB re 1 µPa L_{pk}), which the authors surmise is similar to field conditions within 1,640 feet (500 meters) from a 4.3-foot (1.3-meter) diameter steel pile. In the presence of pile-driving noise, there was a reduction in squid feeding success, and the introduction of pile-driving noise caused the squid to abandon predation attempts. Interestingly, additional work showed that interactions between males, and reproductive behaviors between males and females were unaffected by pile-driving noise, suggesting that the motivation to mate exceeds the potential stress that noise may introduce (Stanley et al. 2023; Jones et al. 2023). This work underscores that squid (and likely all cephalopods) are sensitive to low-frequency sound but may recover quickly. When pile-driving noise co-occurs with feeding periods, it could negatively affect feeding, but is unlikely to affect reproductive success.

Like other marine invertebrates, crustaceans are capable of sensing low-frequency sound through particle motion in the water or in the substrate (Popper et al. 2001; Roberts and Breithaupt 2016). Some research on seismic airguns and crustaceans has not demonstrated widespread mortality or major physiological harm (e.g., American lobsters: Payne et al. 2007; rock lobsters: Day et al. 2016a; snow crabs: Christian et al. 2003; Cote et al. 2020; Morris et al. 2020), though some sub-lethal effects on hemolymph biochemistry have been observed, and the biological consequences of these effects have not been well-studied. Recent work by Day et al. (2019, 2022) investigated the impact of seismic surveys on the righting reflex and statocyst morphology of the palinurid rock lobster, using field-based exposure to seismic air gun signals. Following exposure equivalent to a full-scale commercial assay passing within 300 to 1,640 feet (100 to 500 meters), lobsters showed impaired righting and significant damage to the sensory hairs of the statocyst. Reflex impairment and statocyst damage persisted over the course of the experiments—up to 365 days post-exposure—and did not improve following moulting. These results indicate that exposure to air gun signals at close ranges caused morphological damage to the statocyst of juvenile and adult rock lobsters, which can in turn impair complex reflexes (Day et al. 2019, 2022). Pile-driving sounds have been shown to affect certain behaviors in crustaceans, such as reducing locomotor activity (Norway lobster: Solan et al. 2016), decreasing feeding activity (crabs: Corbett 2018), or inhibiting attraction to chemical cues (hermit crabs: Roberts and Laidre 2019). The research thus far indicates that marine crustaceans may alter their natural behaviors in response to pile-driving sounds, but further work is required to understand the biological significance of these changes, and whether substrate-borne or water-borne particle motion has a greater influence on their behavior. Disentangling these effects is important for understanding the spatial scale at which they may be affected by pile-driving noise.

Eggs and larvae: A handful of studies have directly investigated the effects of impulsive sounds on eggs and larvae of marine fishes. Laboratory work by Bolle et al. (2014, 2012)—using a device similar to Halvorsen et al. (2012a)—showed that larvae of sole, seabass, and herring were relatively resilient to mortality even at high received levels (exceeding SELs of 206 dB re 1 $\mu Pa^2 s$), which the authors surmise is equivalent to the received level at approximately 328 feet (100 meters) from a 13-foot (4-meter) diameter pile. This work suggests that fish larvae—regardless of differing hearing anatomy—may be relatively resilient to pile-driving noise, which is generally consistent with the early literature on seismic airguns (e.g., Booman et al. 1996; Holliday et al. 1987; Kostyuchenko 1973; Saetre and Ona 1996). Research on invertebrate larvae is even more limited and has yielded mixed results. Two studies found little effect of exposure to seismic airguns on the embryonic or larval stages of spiny lobster (received SEL: 185 dB re 1 $\mu Pa^2 s$; Day et al. 2016b) or crab (received SPL: 231 dB re 1 µPa; Pearson et al. 1994). While Aguilar de Soto et al. (2013) did show that scallop larvae exposed to sounds of seismic airguns showed body abnormalities and developmental delays, the larvae were held 2–4 inches (5–10 centimeters) away from the speaker for 90 hours of playbacks, which does not represent real-world conditions. Sole et al. (2022) examined hatching and survival of cuttlefish eggs and larvae after exposure to 16 hours of pile-driving sound in the same chamber as in Bolle et al. (2012). They found lower hatching success in exposed eggs, but the received particle motion levels at which this occurred were not reported. Without better understanding of the sound field, it is difficult to extrapolate these findings to real-world conditions.

The research suggests that fish larvae may be more resilient to pile-driving sounds than invertebrate larvae. Impacts would be limited to areas in very close proximity to pile-driving, and effects are likely to be species-specific. Given naturally high rates of mortality in marine larvae, it is unlikely to have significant population-level effects.

Vessels

Noise from large commercial ships, as well as smaller fishing and recreational vessels, is likely to be present and persistent in the geographic analysis area. During both the construction and operational phases of offshore wind development, several types of vessels will be used to transport crew and supplies, and during construction, dynamic positioning systems may be used to keep the pile-driving vessel in place. A description of the physical qualities of vessel noise can be found in the Appendix J. Note that the specific effects of dynamic positioning noise on fishes and invertebrates have not been studied but are expected to be similar to that of transiting vessels as described below.

Avoidance of vessels and vessel noise has been observed in several pelagic, schooling fishes, including Atlantic herring (Vabo et al. 2002), Atlantic cod (Handegard 2003) and others (reviewed in De Robertis and Handegard 2013). Fish may dive toward the seafloor, move horizontally out of the vessel's path, or disperse from their school (De Robertis and Handegard 2013). These types of changes in schooling behavior could render individual fish more vulnerable to predation but are unlikely to have population-level effects. A body of recent work has documented other, more subtle behaviors in response to vessel noise, but has focused mainly on tropical reef-dwelling fish. For example, damselfish antipredator responses (Ferrari et al. 2018; Simpson et al. 2016) and boldness (Holmes et al. 2017) seem to decrease in the presence of vessel noise, while nest-guarding behaviors seem to increase (Nedelec et al. 2017). There is some evidence of habituation, though: Nedelec et al. (2016) found that domino damselfish increased hiding and ventilation rates after 2 days of vessel sound playbacks, but responses diminished after 1 to 2 weeks, indicating habituation over longer durations. Subtle changes to social behaviors and communication, rather than dramatic effects such as injury or mortality, are important to evaluating sublethal impacts of noise on reproductive success and species survival. During reproductive and aggressive encounters, African cichlid data from a playback study using pure tones of 100 Hz to 2 kHz indicate that noise may impact all three components of social communication: signal production, signal reception, and the signal itself, and highlights a possible cross-modal impact of noise on visual signaling (Bulter and Maruska 2020).

It is possible that vessel noise could induce physiological stress or lead to acoustic masking in fishes. Several studies have shown an increase in cortisol, a stress hormone, after playbacks of vessel noise (Celi et al. 2016; Nichols et al. 2015; Wysocki et al. 2006), but other work has shown that the handling stress of the experiment itself may induce a greater stress response than an acoustic stimulus (Harding et al. 2020; Staaterman et al. 2020). The cavitation of vessel propellors produces low-frequency, nearly continuous sound that is audible by most fishes and invertebrates and could mask important auditory cues, including conspecific communication (Haver et al. 2021; Parsons et al. 2021). Stanley et al. (2017) demonstrated that the communication range of both haddock and cod (species with swim bladders but lacking connections to the ear) would be significantly reduced in the presence of vessel noise, which is frequent in their habitat in Cape Cod Bay. Vieira et al. (2021) found a reduction in meagre fish chorus energy during ferryboat passages and a reduction of approximately 20 dB on the ability to discriminate conspecific calls when exposed to boat noise. These results point to a significant masking effect of vessel noise, which may impact spawning behavior (Vieira et al. 2021). Generally speaking, species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion (see Section 3.5.5.1.3 for an explanation of fish hearing). Rogers et al. (2021) and Stanley et al. (2017) theorize that fish may be able to use the directional nature of particle motion to extract meaning from short range cues (e.g., other fish vocalizations) even in the presence of distant noise from vessels.

The limited research on invertebrates' response to vessel noise has yielded inconsistent findings thus far. Some crustaceans seem to increase oxygen consumption (crabs: Wale et al. 2013) or show increases in some hemolymph (an invertebrate analog to blood) biomarkers like glucose and heat-shock proteins, which are indicators of stress (spiny lobsters: Filiciotto et al. 2014). Other species (American lobsters and blue crabs) showed no difference in hemolymph parameters but spent less time handling food, defending food, and initiating fights with competitors (Hudson et al. 2022). While there does seem to be some evidence that certain behaviors and stress biomarkers in invertebrates could be negatively affected by vessel noise, it is difficult to draw conclusions from this work as it has been limited to the laboratory, and in most cases, did not measure particle motion as the relevant cue.

The planktonic larvae of fishes and invertebrates may experience acoustic masking from continuous sound sources like vessels. Several studies have shown that larvae are sensitive to acoustic cues and may use these signals to navigate towards suitable settlement habitat (Montgomery 2006; Simpson et al. 2005), metamorphosize into their juvenile forms (Stanley et al. 2012), or even to maintain group cohesion during their pelagic journey (Staaterman et al. 2014). However, given the short range of such biologically relevant signals for particle motion-sensitive animals (Kaplan and Mooney 2016), the spatial scale at which these cues are relevant is rather small. If vessel transit areas overlap with settlement habitat, it is possible that vessel noise could mask some biologically relevant sounds (e.g., Holles et al. 2013), but these effects are expected to be short term and would occur over a small spatial area.

Simply due to its physical nature (Appendix J), vessel noise may lead to changes in natural behaviors, could induce a stress response, or may cause acoustic masking in fishes, invertebrates, and larvae, but these effects will be species- and context-specific. Generally speaking, impacts are expected to occur over a relatively small area, especially for particle motion-sensitive species. Some species may become habituated to persistent vessel noise. Vessel noise associated with non-offshore-wind activities has been persistent over many years in the geographic area, and therefore vessel noise added from ongoing and planned offshore wind is likely to have a negligible impact on fishes and invertebrates.

Dredging, Trenching, and Cable-Laying

Given the physical qualities of noise associated with dredging, trenching, and cable-laying (see Appendix J), injury and auditory impairment are unlikely, but fishes and invertebrates could experience behavioral disturbance or masking close to the emplacement corridor. No research has specifically looked at responses to these noise sources, but the impacts are likely to be similar, but less intense, than those observed with vessel noise, because these activities are not as widespread or frequent as vessel transits. Therefore, the impacts of noise from dredging, trenching, and cable-laying are expected to be negligible.

Aircraft

Offshore wind projects may require use of aircraft for crew transport during construction and maintenance. The penetration of noise from aircraft into the water is limited because much of the noise is reflected off of the water's surface (see Appendix J); due to the air-water interface, an animal needs to be close to the sea surface to be affected. Given that most fish and invertebrates do not spend significant time near the sea surface, impacts on finfish and invertebrates from aircraft use are expected to be negligible.

Turbine Operations

The operation of turbines on nearby windfarms may introduce low-level, continuous sound into the marine environment. A description of the physical qualities of turbine operational noise can be found in Appendix J. Elliot et al. (2019) compared field measurements during offshore wind operations from the Block Island Wind Farm to the published audiograms of a few fish species. They found that, even at 164 feet (50 meters) from an operating turbine, particle acceleration levels were below the hearing thresholds of several fish species, meaning that it would not be audible at this distance. Pressure-sensitive species may be able to detect operational noise at greater distances, though this will depend on other characteristics of the acoustic environment (e.g., sea state). Nonetheless, it is unlikely that operational noise will be audible to animals beyond those that live in close vicinity to the pile (i.e., those that have settled there due to the structure it provides), and even if it is audible, it may not be bothersome. Therefore, impacts from operational noise to finfish and invertebrates are expected to be negligible.

Conceptual Decommissioning

A physical description of underwater explosives and mechanical cutting, two potential methods that could be used for conceptual decommissioning, can be found in Appendix J. If explosives are used, impacts would be minor, similar to those expected from UXO detonations. If cutting is used, impacts would be negligible, given the relatively low sound levels generated by mechanical cutting operations.

Summary Statement for Sound

The impacts of pile-driving noise on fishes and invertebrates are expected to be moderate given the potential for barotrauma and TTS at close distances, and behavioral effects or masking at greater distances, especially for pressure-sensitive species. Although UXO detonations may cause mortality within a few hundred meters for fish with swim bladders, these will occur infrequently and will only affect a few individuals, so overall effects are expected to be minor. Vessel noise may lead to behavioral changes, increased stress, or acoustic masking for all fishes and invertebrates, but these impacts will be intermittent and occur within a relatively small range around vessel transit areas, so overall effects will be negligible. Many HRG sources are inaudible to fishes and invertebrates, but for those sources that are audible, effects would be negligible due to their short duration and limited spatial scale. Operational noise is not expected to be audible, let alone bothersome, beyond a few hundred meters from each turbine, so impacts would be negligible, even for pressure-sensitive species. Finally, the impacts of conceptual decommissioning (if cutting is used); aircraft; and dredging, trenching, and cable-laying is expected to be negligible.

Port utilization: The major ports in the United States are seeing increased numbers of vessel visits, and vessel size has increased. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 35 years. Multiple ports along the Atlantic seaboard are investing in expanding and modifying port facilities to accommodate supporting offshore wind energy projects as described in Appendix D. These development expansion activities are in part directly associated with the ongoing and planned offshore wind developments within the geographic analysis area. Port expansion could include dredging, deepening, and new berths resulting in localized short-term impacts on some fish and invertebrate species as well as increased sediment deposition that could have adverse impacts on eggs and larvae. Progressive increases in port utilization due to offshore wind energy development would lead to increased vessel traffic through 2030. 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, life stages, or both may lead to impacts on finfish and invertebrates beyond the vicinity of the port. Based on the expected level of port utilization and potential port expansion activities (e.g., dredging), cumulative impacts on finfish, invertebrates, and EFH would be expected to be negligible. Specific ports and expansions will be further discussed in project-specific COPs and NEPA documents.

Presence of structures: The addition of structures to an open sand-bottom seascape can produce the potential for multiple impacts on species of finfish and invertebrates and their associated EFHs within the geographic analysis area. The impacts can include direct displacement and possible mortality of some slow-moving and benthic invertebrate species. Other impacts will include attraction to these artificial substrates by both finfish and invertebrates and the loss of commercial and recreational fishing gear that is fouled with these structures. The risks of impact are proportional to the amount of structure present. Offshore wind projects are estimated to add up to 2,395 WTGs, OSSs, met towers, and buoys, with each potentially requiring scour protection to be emplaced around its foundation (see Appendix D, Table D2-2). This would result in permanent impacts on benthic and demersal finfish, invertebrates, and their respective EFHs by approximately 4,643 acres (1,879 hectares) of habitat within the geographic analysis area, resulting in a minor impact due to the smaller affected area compared to the larger total EFH area in the NY Bight.

Impacts related to commercial and recreational gear loss are localized but can affect finfish and motile invertebrate assemblages and other marine vertebrates (e.g., marine mammals, sea turtles) through entanglement issues. This risk of entanglement and harm to individuals from fouled commercial and recreational gear on any offshore structure would increase with the addition of hard substrate. Fouled gear would result in highly localized, periodic, short-term impacts on finfish, invertebrates, and EFH. The occurrence of gear losses specifically related to WTGs is generally rare, and the impacts on finfish and invertebrates from ongoing and planned offshore wind projects would likely be negligible.

Human-made structures, especially tall vertical structures that extend from the seafloor to the surface such as foundations for towers, continuously alter local water flow at a fine scale. Although water flow typically returns to background levels within a relatively short distance from a structure and impacts on finfish, invertebrates, and EFH are typically undetectable (Johnson et al. 2021), the cumulative effects of the presence of multiple structures on local or regional-scale hydrodynamic processes are not currently well understood. A recent study completed by BOEM assessed the mesoscale effects of offshore wind energy facilities on coastal and oceanic environmental conditions and habitat by examining how oceanic responses will change after turbines are installed, particularly with regards to turbulent mixing, bed shear stress, and larval transport (Johnson et al. 2021). This study focused on the Massachusetts-Rhode Island wind energy areas. The modeling study assessed four post-installation scenarios. Two species of finfish (silver hake and summer flounder) and one invertebrate (Atlantic sea scallop) were selected as focal species. The results of this modeling effort indicate that, at a regional fisheries management level, these shifts are not considered overly relevant with regards to larval settlement. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are also not well understood. Overall, BOEM anticipates that ongoing and planned offshore wind activities (exclusive of the NY Bight development) would cause a negligible impact on finfish, invertebrates, and EFH through presence of structures based on currently available information.

New structures will continue to be installed within the geographic analysis area and may attract finfish and invertebrates that approach the structures during routine movement or during migration. Such attraction could alter or slow migratory movements. However, temperature is expected to be a bigger driver for habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014;

Secor et al. 2019). Migratory fish and invertebrates have exhibited an ability to move away from structures unimpeded. In the context of reasonably foreseeable environmental trends, the presence of many distinct structures from ongoing and planned actions, exclusive of the NY Bight development, could increase the time required for migrations, resulting in a moderate impact.

Wind energy structures, including WTG foundations and the scour protection around the foundations, create uncommon relief in areas that are predominately flat sandy seascapes. Structure-oriented fishes are attracted to these hard substrate installations. Impacts on the soft sediment habitats from structure presence are local and can be short term to permanent for the life of each wind energy project, potentially for as long as each structure remains in place. Fish aggregations found in association with seafloor structures can provide localized, short-term to permanent beneficial impacts on some fish species due to increased prey species availability. Initial recruitment to these hard substrates may result in the increased abundance of certain fish and epifaunal invertebrate species (Claisse et al. 2014; Smith et al. 2016; BOEM 2021a); such recruitment may result in the development of diverse demersal fish and invertebrate assemblages. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). Further, colonization by non-indigenous biota (e.g., invasive or nuisance species) may alter localized benthic or epipelagic communities (Glasby et al. 2007).

Installation of offshore structures would result in the displacement of softbottom benthic species resulting from habitat conversion to hardbottom from the structures and associated scour protection. Softbottom is the dominant habitat type in the region. Species that rely on this habitat would be adversely affected and may be outcompeted as a result of habitat conversion, but they are not likely to experience population-level impacts (Guida et al. 2017). Softbottom species would also not likely experience the beneficial impacts from the added hard surfaces as would be experienced by benthic species dependent on hardbottom habitat. Considering the above information, BOEM anticipates that the cumulative impacts of the presence of structures on finfish, invertebrates, and EFH would be moderate and include minor beneficial impacts. All impacts would be permanent as long as the structures remain but would be temporary if the structures were removed during conceptual decommissioning.

3.5.5.3.4 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, finfish, invertebrates, and EFH would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continued temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on these resources. These effects are primarily driven by ongoing offshore construction impacts (i.e., noise and seabed disturbance) and presence of structures. Alternative A would likely result in **negligible** to **moderate** impacts on finfish, invertebrates, and EFH.

Cumulative Impacts of the No Action Alternative. Ongoing and planned activities would have temporary and permanent impacts (i.e., disturbance, displacement, injury, mortality, habitat degradation, habitat conversion) on finfish, invertebrates, and associated EFH primarily through resource exploitation, dredging, bottom trawling, bycatch, anthropogenic noise, new cable emplacement, and the presence of structures. BOEM anticipates that cumulative impacts of the No Action Alternative would likely be **negligible** to **moderate** for finfish, invertebrates, and EFH.

3.5.5.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Finfish, Invertebrates, and Essential Fish Habitat

3.5.5.4.1 Impacts of One Project

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, and monitor those impacts.

Accidental releases: Vessels associated with a single NY Bight project may potentially generate waste, including bilge and ballast water, sanitary and domestic wastes, and trash and debris. All vessels associated with one NY Bight project would be required to comply with USCG requirements for the prevention and control of oil and fuel spills. Proper vessel regulations and operating procedures would minimize effects on finfish, invertebrates, and their respective EFHs resulting from the release of debris, fuel, hazardous materials, or waste (BOEM 2012). The NY Bight lease area operators will prepare project specific SPCCs and OSRPs prior to construction that are followed throughout the life of the project and monitor for/report any environmental releases or fish kills to the appropriate authorities/agencies. Likewise, utilizing BMPs for ballast or bilge water releases specifically from vessels transiting from foreign ports would reduce the likelihood of accidental release of invasive species. These releases, if any, would occur infrequently at discrete locations and vary widely in space and time. BOEM assumes all vessels would comply with these laws and regulations to minimize releases. Impacts on finfish, invertebrates, and EFH would be expected to be localized and temporary due to the likely limited extent and duration of a release and result in negligible impacts.

Anchoring: Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., SAV, eelgrass, hardbottom) and sessile or slow-moving species (e.g., corals, sponges, sedentary shellfish). Impacts from anchoring relative to a single NY Bight project occur during all phases. The use of DP vessels would preclude the use of anchors, while utilization of jack-up vessels or spud barges would directly affect the benthos. These impacts would include increased turbidity levels and contact would cause mortality of benthic species and, possibly, degradation of sensitive habitats. All impacts would be localized and turbidity would be temporary; impacts from anchor, spud can, or leg contact are expected to be short term. Impacts on sensitive habitats (e.g., SAV, eelgrass, hardbottom) would be higher than would be associated with EFH mobile resources. Degradation of EFH and other sensitive habitats such as SAV or hardbottom habitats, if it occurs, could be long term to permanent and would result in moderate impacts. The footprint of each anchor, spud can, or leg placement would be relatively small in area, with affected habitats likely to fully recover. Minor impacts on the demersal portions of the finfish and invertebrate community (outside of sensitive habitats) would be expected.

Cable emplacement and maintenance: Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance and pre-grapnel runs. A pre-grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the path of construction. Additionally, pre-sweeping may be required in areas of the submarine export cable corridor with sand waves. Pre-sweeping involves smoothing the seafloor by removing ridges and edges using a controlled flow excavator from a construction vessel to remove the excess sediment. While the possibility exists that some seabed leveling, pre-trenching, or boulder removal may be required, it is not currently expected based on the sandy substrate.

Cable emplacement methods that include hydraulic dredging could entrain immobile or slow-moving demersal species and various life stages of finfish and invertebrates resulting in injury or mortality. Atlantic sturgeon have not been observed to avoid dredging activities, potentially placing them in direct interaction with dredging equipment (Balazik et al. 2012). Sturgeon would be most vulnerable to injury, mortality, reduced fecundity, and delayed or aborted spawning migration from impacts due to cable emplacement and associated dredging activities during their spring-summer spawning migration periods. Impacts from entrainment and impingement of finfish and invertebrates associated with cable emplacement would be mostly confined to cable centerlines, and would be short term and localized.

One NY Bight project would result in the seafloor being temporarily disturbed by cable installation. The resultant impacts include turbidity effects that have the potential to displace finfish and motile invertebrates and cause the mortality of sessile benthic invertebrates within the cable corridor during emplacement. A sediment transport model conducted for BOEM (2022) which can be representative for the NY Bight lease areas indicated that displacement of sediments would be low, with suspended sediments remaining for a short period of time (4 hours), and typically dissipating to background levels in relative proximity to the disturbance. Therefore, these impacts would be temporary and localized.

Some benthic invertebrate species such as Atlantic surfclam, ocean quahogs, and Atlantic sea scallops could be displaced, or mortality may result from cable emplacement due to potential direct burial impacts. More broadly, impacts on benthic invertebrate populations and communities are expected to be temporary and localized to the emplacement corridor. However, recovery of these benthic invertebrate assemblages would be expected to occur within months after cable emplacement. This would result in minor impacts, if any, on the benthic assemblages or populations given the localized and temporary nature of the impacts. Suspended sediment concentrations during activities other than cable emplacement would be within the range of natural variability for this location.

Long-term to permanent impacts on the seabed profile include foundation placement, scour protection installation, trenching for cable installation, if needed, and cable protection. Sand ripples and waves disturbed by offshore export and interarray cable installation would naturally reform within days to weeks under the influence of the same tidal and wind-forced bottom currents that formed them initially (Kraus and Carter 2018). Therefore, impacts on finfish, invertebrates, and EFH from seabed profile alterations under one NY Bight project would be minor.

A single NY Bight project would cause sediment deposition from the construction activities and natural marine deposition during O&M; however, sediment deposition impacts on finfish, invertebrates, and EFH would be expected to range between negligible and minor. Sediment deposition and burial under one NY Bight project could cause impacts on sensitive life stages, such as demersal eggs.

Discharges/intakes: If the NY Bight lessees use HVDC converter OSSs with open loop cooling systems, the intake of seawater for cooling water will entrain plankton. If the intake velocity is low, it should allow most strong-swimming juvenile fishes and smaller adults to escape entrainment or impingement. However, drifting plankton would not be able to escape entrainment except for a few fast-swimming larvae of certain taxonomic groups. Those organisms entrained may be stressed or killed, primarily through changes in water temperature during the route from cooling intake structure to discharge structure and mechanical damage (turbulence in pumps and condensers). Placement of the intake pipe opening depth and velocity of the pump system can mitigate effects on finfish and invertebrate species (Middleton and Barnhart 2022). Project-specific siting, design, and modeling are variables that could increase or decrease impact levels; however, based on the limited area scope and intake volumes, long-term impacts from entrainment and impingement of finfish and invertebrates associated with OSS structure presence and cable emplacement would be mostly confined to the immediate area of the OSS intake and cable centerlines and would likely be localized, and negligible, although long-term.

Electric and magnetic fields and cable heat: Under a single NY Bight project, a network of cables will need to be installed to transmit power to onshore infrastructure. Once these cables begin to transmit power, the effects from EMFs and cable heat would initiate. EMFs emanate continuously from installed electrical power transmission cables. The impacts of EMFs on benthic habitats are an emerging field of study; as a result, there is a high degree of uncertainty regarding the nature and magnitude of effects on all potential receptors (Hogan et al. 2023). Impacts of EMFs and cable heat are minimized by proper electrical shielding and cable burial depth (Normandeau et al. 2011). EMFs and cable heat will be present throughout the majority of the life cycle of one NY Bight project.

Biologically notable 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 from EMFs are localized and affect the animals only while they are within relatively close proximity to the EMF source. Although the EMFs would exist as long as a cable was in operation, previous studies indicate that the EMFs from AC cables are not expected to affect commercial and recreational fisheries (CSA Ocean Sciences Inc. and Exponent 2019; Thomsen et al. 2015). Sensitivity ranges, likely encounter rates, and the varying potential effects based on life stages remain gaps in our knowledge (Hogan et al. 2023). Impacts of EMFs and cable heat can be minimized by proper electrical shielding and cable burial depth (Normandeau et al. 2011), when practicable. Therefore, impacts on pelagic finfish species would be expected to be negligible, and impacts on bottom-dwelling finfish and motile invertebrate species would be expected to be minor.

Survey gear utilization: There would be an increase in the amount and types of gear used as a result of one NY Bight project. The presence of structures, cables, etc. increases the risk of loss of survey gear.

The lost gear, moved by currents, could disturb, injure, or kill bottom-dwelling fish and invertebrate species, as well as impact EFH. A common method for retrieving lost equipment is using grapnel lines, which are dragged along the bottom until the lost gear is caught and can be retrieved. In addition to dragging grapnel line along the bottom, after the line catches the lost equipment, it will drag all the components along the seafloor until recovery, resulting in additional impacts. The geographic distribution, temporal spacing, and fast recovery (Brooks et al. 2006; Dernie et al. 2003) of these intermittent impacts at any one location would likely be unmeasurable. As described in Section 3.5.5.3.3, fisheries monitoring for one NY Bight project would harvest finfish and macroinvertebrates and could include trawl surveys (impacting finfish and squid) and clam dredge surveys (ocean quahog and surfclam). Trawl and gillnet surveys for fisheries monitoring would likely result in direct impacts on fish, invertebrates, and EFH and has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). Trawl surveys conducted as part of fisheries monitoring would be limited to small sampling nets, short tow times, and slow tow speeds, which would reduce the risk of capture. Given the intermittent impacts at any one location and short tow times for trawl surveys, impacts on finfish, invertebrate, and EFH would likely be negligible.

Lighting: Additional lights will be needed for the infrastructure associated with one NY Bight project. Impacts from light will be greatest during the operational phase from up to 280 WTGs and 5 OSSs, which would all be lit with navigational and FAA hazard lighting. Per BOEM guidance (BOEM 2021b), each WTG would be lit in accordance with USCG, FAA, and BOEM requirements and only a small fraction of the emitted light would enter the water. Therefore, light resulting from a single NY Bight project would be minimal and would be expected to lead to a negligible impact, if any, on finfish, invertebrates, and EFH.

Noise: Activities associated with one NY Bight project that could cause underwater noise effects on finfish, invertebrates, and EFH are impact and vibratory pile-driving (installation of WTG and OSS foundations), geophysical surveys (HRG surveys), vessel traffic, aircraft, cable laying or trenching and dredging, and potential drilling during construction. Additional information on noise is provided in Section 3.5.5.1.3, Section 3.5.5.3.3, and Appendix J. The effects of noise produced by HRG surveys, aircrafts, cable laying or trenching and dredging, and potential drilling during construction are not expected to differ from that described for Alternative A in Section 3.5.5.3.3, except the temporal and spatial scale of these activities would be smaller for one NY Bight project compared to ongoing and planned offshore wind and non-offshore-wind projects in the geographic analysis area.

Construction activities from one NY Bight project from the installation of up to 280 WTGs and 5 OSSs would generate underwater noise that may result in auditory injury and behavioral disturbances in finfish and invertebrates. Installation of other foundation types (e.g., suction bucket) would emit the least amount of noise, as most other foundation types (including monopile and jacket) would require pile-driving and would produce the most substantial noise within the project area (ICF 2021). Impact pile-driving would be used to drive foundations to the target seabed penetration depths. Noise from impact pile-driving would occur intermittently during the installation of offshore structures. The predominant impact expected during impact pile-driving on finfish and invertebrates is behavioral responses such as startle responses or avoidance of the ensonified area during construction

(Section 3.5.5.3.3). However, the recommended conservative threshold (see *Regulation of Underwater Sound for Fishes and Invertebrates,* in Section 3.5.5.1.3) for the onset of behavioral disturbances is based on observations of fish in captivity and may not accurately capture behavioral responses of free-swimming fish, and also does not capture differences in hearing sensitivity among fish species due to the presence of a swim bladder or other gas-filled organs that could detect underwater sound (Popper et al. 2014). Glauconite sands may be present in the NY Bight lease areas. Depending on the classification of the glauconite sands present, there can be challenges associated with potential offshore wind development in these areas. Specifically, some areas of glauconite sand deposits can form sandstone layers, which result in difficult, or even impossible layers to drill through and cause high friction and increased noise during pile-driving. This temporary increase in noise could have potential impacts on finfish, invertebrates, and EFH resources.

Research indicates the effects of vessel noise, including dynamic positioning vessel noise, will not cause mortality or injuries in adult fish (Hawkins et al. 2014) given the low source levels and non-impulsive nature of the source. The potential for exposures above physiological injury thresholds is extremely unlikely for any fish or invertebrate species. Additionally, as discussed in Section 3.5.5.3.3, evidence suggests fish will return to normal baseline behavior faster following exposure to continuous sources such as vessel noise versus intermittent noise such as pile-driving (Neo et al. 2014). Therefore, while vessel noise would be present within the NY Bight project area throughout the life of one NY Bight project, behavioral disturbances would only be expected within a few meters of the vessel and would dissipate once the vessel has moved away. In addition, fish and invertebrate species are thought to be more sensitive to particle motion than sound pressure (Popper and Hawkins 2018; Mickle and Higgs 2021). Given the nature of non-impulsive sources, such as vessel noise, particle motion levels sufficient to result in behavioral disturbances would not occur more than a few meters from the source, and any effects on this brief exposure would be so small that they could not be measured, detected, or meaningfully evaluated.

Overall, given the limited area of effect over which impacts from most of the noise IPFs are anticipated to occur, and the short duration of activities like impact pile-driving, which would occur over approximately 4 to 6 hours per day, impacts from this IPF would be detectable and measurable, but there would be no regional- or population-level impacts. Impacts on finfish, invertebrates, and EFH from noise would therefore be minor.

Port utilization: Port utilization for one NY Bight project would impact finfish, invertebrates and EFH in nearshore environments. The Brooklyn Navy Yard, South Brooklyn Marine Terminal, Howland Hook Marine Terminal-Port Ivory, Arthur Kill Terminal, Paulsboro Marine Terminal, New Jersey Wind Port, Port of Albany, and Port of Coeymans have been identified for analysis within the PEIS, although not all representative ports are likely to be used at the same time. If port expansions or modifications were necessary for one NY Bight project they would be completed in accordance with state and federal regulations and permits and would be completed in collaboration with multiple entities (e.g., port owners, governmental agencies, states, other offshore wind developers). Port expansion could include dredging, deepening, and new berths. These maintenance dredging as well as port expansion activities would cause mortality of any organisms that come into direct contact with machinery, increase turbidity for a short duration, and increase deposition, which may smother some organisms at varying life stages. The increase in vessel activity during the construction and installation stage would be small and would decrease during operations and conceptual decommissioning stages. In addition, multiple authorities regulate impacts from port activities including port expansions. Impacts on finfish, invertebrates and EFH are expected be negligible.

Presence of structures: A primary impact on finfish, invertebrates, and EFH from one NY Bight project would be the construction and placement of up to 280 WTGs and 5 OSSs in the project area. These structures would displace and cause mortality among the softbottom non-motile infauna and demersal softbottom fauna that use this habitat. WTGs and OSSs would be mounted on one or a combination of the following foundation types: monopile, piled jacket, suction mono-bucket, suction bucket jacket, tri-suction pile caisson, or gravity-based foundations. Monopiles or piled jackets are the most likely foundation types, per the RPDE. Maximum water depth and the geological conditions of the proposed WTG locations will help to inform the foundation type (ICF 2021). Installation of any of the foundations will disturb the seafloor and benthic communities; however, potential impacts are expected to vary based on the foundation types selected. For example, relatively little suspended sediment is expected to occur from the installation of suction bucket foundations compared to gravity-based foundations or monopiles, which would require more extensive seabed preparation (ICF 2021). Foundation scour protection could consist of rock placement, mattress protection, sandbags, stone bags, and nature-inclusive materials. If required, the amount of scour protection would vary based on the type of foundation. The scour protection also increases the footprint of benthic disturbance. Gravity-based or suction bucket foundations would be expected to have large scour effects compared to monopiles (ICF 2021). Each WTG would require from 0.24 acre (0.10 hectare) (monopile) to 2.88 acres (1.7 hectares) (jacket foundation), most of which is related to the scour protection apron. If suction bucket or gravity-based foundations are used, the footprint of these structures would likely be larger than monopile or piled jacket. Each of the OSSs would be installed, dependent on foundation type, with an area of disturbance estimated from 0.51 to 8.05 acres (0.21 to 3.26 hectares). The seafloor habitat would be permanently affected by the construction and installation of the WTGs and OSSs. Species such as the summer flounder, Atlantic surfclam, Atlantic sea scallops, calico scallops, and longfin squid would have their available habitat resources reduced, resulting in a minor to moderate impact, since they would remain for the full project life cycle. A minor impact rating is noted due to the potential small total impact area compared to the total available habitat.

Once in place, impacts of these structures include entanglement and gear loss or damage, hydrodynamic disturbance, fish aggregation resulting in increased predation on benthic invertebrates, and habitat conversion. Any lost gear, moved by currents, could catch on the cabling, foundation, turbine, and or substation infrastructure, resulting in increased seafloor disturbance. Entangled species may attract predators who would therefore also be at greater risk of entanglement. The impacts at any one location would likely be localized and short term, as entangled nets and gear could be removed during routine maintenance activities.

The presence of tall vertical structures such as WTGs and OSSs within the water column could cause a variety of hydrodynamic effects, including reducing the wind-driven mixing of surface water, increasing vertical mixing as the water flows around the structure, introducing turbulence, and influencing local current speed and direction. As stated in more detail in Section 3.5.2, *Benthic Resources*, a few studies have used European models to anticipate the potential oceanographic changes in the water column. As of now, findings have shown that modeled changes are indistinguishable from the interannual variability. Even fewer studies have evaluated how modeled oceanographic changes could impact primary productivity. Recent modeling of taller WTGs in the Mid-Atlantic Bight illustrated a cooling of the surface could occur, which would reduce the stratification expected (Golbazi et al. 2022; Horwitz et al. 2023).

Notably, the wake effect would also vary based on the type of foundation used. Jacket foundations would be expected to have a smaller wake effect compared to monopiles. The scour effects would also be expected to vary, with monopiles creating the least scour and therefore requiring the least amount of scour protection (ICF 2021). On a local scale, changes in nutrient upwelling and related primary productivity were observed in Van Berkel et al. (2020).

The placement of each WTG would additionally attract structure-oriented species that would benefit from the creation of hard substrate (Claisse et al. 2014; Smith et al. 2016). The reef effect can differ based on the type of foundation and scour used. For example, jacket foundations could have a larger reef effect compared to monopiles due to the lattice structure (ICF 2021). The addition of new hardbottom substrate in a predominantly softbottom environment will enhance local biodiversity (Pohle and Thomas 2001; Fautin et al. 2010; Degraer et al. 2020). This indicates that marine structures would generate some beneficial impacts on local ecosystems even though some impacts, such as the loss of softbottom habitat, may be adverse. Soft bottom is the dominant habitat type in the region; the species that rely on this habitat are not likely to experience population-level impacts (Greene et al. 2010; Guida et al. 2017). The diversity of these structure-associated assemblages may decline over time as early colonizers are replaced by successional communities (Degraer et al. 2018). A successional sequence of impacts on structure-oriented species (finfish, motile, and sessile invertebrates) by the presence of artificial hard substrates cannot be foreseeably defined due to a current lack of knowledge, particularly on long-term changes and large-scale effects (Dannheim et al. 2020).

The impacts of invasive species that might settle on the introduced hard structure on finfish, invertebrates, and EFH depend on many factors but could be widespread and permanent. Releases of invasive species may or may not lead to the establishment and persistence of invasive species. Invasive species becoming established as a result of the additional habitat provided by the structures is possible. As documented in observations of colonial sea squirt (*Didemnum vexillum*) at the Block Island Wind Farm (HDR 2020), the impacts of invasive species on finfish, invertebrates, and EFH could be strongly adverse, widespread, and permanent if the species were to become established and outcompete native fauna or modify habitat. Gravity-based foundations would have a slightly higher risk of spreading invasives, compared to other fixed foundation types, as they are typically towed from the port (ICF 2021). The increase in this risk related to a single NY Bight project would be small in comparison to the risk from ongoing activities. For example, the colonial sea squirt is already an established species in New England with documented occurrence in subtidal areas, including on Georges Bank, where numerous sites within a 56,834-acre (23,000-hectare) area are 50 to 90 percent covered by colonial sea squirt

(Bullard et al. 2007). The placement of the structures for one NY Bight would be expected to result in habitat alteration from softbottom to hardbottom habitat. The addition of hard structures into the ecosystem has the potential to expand the geographic range of established non-native species. Minor beneficial impacts would occur on species preferring hardbottom habitat (i.e., Atlantic cod, American lobster) as they would gain habitat (see Section 3.5.5.3.3), while softbottom species (summer flounder, Atlantic surf clam) would see habitat locally reduced. This would result in short-term to permanent impacts on softbottom habitat within the project area and would impart minor to moderate impacts on finfish, invertebrates, and EFH, though localized impacts would likely be greater.

3.5.5.4.2 Impacts of Six Projects

The same IPFs described under one NY Bight project (accidental releases, anchoring, cable emplacement and maintenance, discharges/intakes, electric and magnetic fields and cable heat, survey gear utilization, lighting, noise, port utilization, and presence of structures) apply to six NY Bight projects with a greater potential for impacts due to the greater amount of offshore development of six NY Bight projects. If multiple projects are being constructed within the same timeframe, the impacts would be greater than those identified under one NY Bight project.

Impacts from accidental releases are still expected to remain negligible due to their infrequent occurrence, vessels complying with applicable regulations, and the localized nature of spill-related impacts. Impacts from anchoring are still expected to remain minor because impacts would be localized and short term, and the anchor footprint would be relatively small in area with finfish, invertebrates, and EFH likely to fully recover.

Impacts from cable emplacement and maintenance under six NY Bight projects would be minor to moderate, an increase from minor impacts under one NY Bight project. The increased impacts would be due to multiple areas of cable installation occurring simultaneously, substantially increasing the potential for finfish and motile invertebrate displacement, the mortality of benthic invertebrates within the respective corridors, and sediment deposition/burial impacting sensitive life stages.

Impacts from discharges/intakes would likely remain short term and negligible due to the limited area scope and intake volumes and confined to the immediate area of the OSS intake and cable centerlines.

Impacts from EMFs and cable heat would likely remain negligible for pelagic finfish and minor for bottom-dwelling finfish and motile invertebrate species under six NY Bight projects due to the localized nature of these impacts, affecting the animals only while they are within relative proximity to the EMF source.

Impacts from survey gear utilization would likely remain negligible for pelagic finfish but could increase to minor for bottom-dwelling finfish and motile invertebrate species under six NY Bight projects due to increased areas impacted.

Impacts from lighting mainly occur during the operational phase and would likely remain negligible, even though the number of structures will significantly increase, due to the limited emitted light entering the water column.

The same activities and mechanisms described for impact pile-driving associated with one NY Bight project applies for construction of six NY Bight projects. However, the potential risk on fishes and invertebrates from construction of six projects compared to one project would be largely driven by the timing of construction. If project construction is staggered for all six projects such that only one is being constructed at any given time within the NY Bight area, then the total sound produced would be the same as described for one project. However, if there is overlap in construction for all six projects such that multiple projects are being constructed simultaneously, then the area within which fish and invertebrates could be exposed to noise above thresholds could be greatly increased. However, given the distance between the lease areas in the NY Bight area (Figure 1-1) it is not expected that the area of ensonification for noise that could result in injury would overlap such that a larger area of effect is realized. Additionally, it is not expected that fish (except for highly migratory species) would travel far enough between lease areas to experience impact pile-driving noise from multiple projects undergoing concurrent construction. Therefore, based on the expected level of exposure, fish and invertebrates within the NY Bight area would likely experience noise comparable to that described for one NY Bight project rather than noise levels increased by a factor of six for the six NY Bight projects. For all other noise stressors, the area of effect would be limited to a relatively small area around the activity, so the full build out of up to six projects is not expected to result in an increase in noise levels for individuals within the NY Bight area, and the impacts of six NY Bight projects would remain the same as those described for one NY Bight project.

Although vessel activity will increase under six NY Bight projects (compared to one NY Bight project), impacts from port utilization are expected to remain negligible due to the unmeasurable nature of the impact and the applicable vessel regulations in place.

Impacts from the presence of structures would increase from minor to moderate (for one NY Bight project) to minor to major (for six NY Bight projects). The increased impact would be due to the installations of six NY Bight projects occurring concurrently or consecutively in close proximity to each other, reducing the habitat availability with the permanent structures and not allowing time for the resource to recover. The increased number of structures would create an artificial reef effect, whereby more sessile and benthic organisms would likely colonize these structures over time (e.g., sponges, algae, mussels, shellfish, sea anemones). Higher densities of invertebrate colonizers would provide a food source and habitat to other invertebrates such as mobile crustaceans. The addition of scour and cable protection would have similar effects. Overall, minor to moderate beneficial impacts would occur on species preferring hardbottom habitat (i.e., Atlantic cod, American lobster) as they would gain habitat, while softbottom species (summer flounder, Atlantic surf clam) would see habitat locally reduced.

The potential hydrodynamic effects from the presence of vertical structures in the water column related to six NY Bight projects could affect nutrient cycling and may influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020). Turbulence resulting from multiple wind farms could lead to localized changes in circulation and thermal stratification patterns, with potential implications for localized primary and secondary productivity and fish and invertebrate distributions. Changes to the thermal distribution could hinder the Mid-Atlantic Bight Cold Pool circulatory dynamics, potentially resulting in changes in habitat suitability for fish and invertebrates EFH species, but the extent and significance of these potential effects are unknown. In summary, the waters surrounding offshore wind farms are characterized by strong seasonal stratification, which is expected to limit measurable hydrodynamic effects to within 600 to 1,300 feet (183 to 396 meters) down current of each monopile (Johnson et al. 2021). Assuming monopiles are used for the WTGs, localized turbulence and upwelling effects around the structures are likely to transport nutrients into the surface layer, potentially increasing primary and secondary productivity. That increased productivity could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations. However, because the monopiles would be spaced at minimum of 0.6 nautical mile (1.1 kilometers) apart, it is expected that there could be a nominal areal blockage, but the net effect over the spatial scale of the six NY Bight projects would likely be negligible.

3.5.5.4.3 Impacts of Alternative B on ESA-Listed Species

The Atlantic sturgeon and the giant manta ray are the only federally listed species that are demersal and may occur within the NY Bight project areas during construction and installation, O&M, and conceptual decommissioning. The giant manta ray would only be present within the NY Bight during migratory movements. General impacts of one and six NY Bight projects on finfish were described in the previous subsection and apply to ESA-listed species. The primary IPFs from one or six NY Bight projects that could impact the Atlantic sturgeon and giant manta ray are survey gear utilization from trawl and gillnet fisheries surveys (Atlantic sturgeon), EMF, cable heat, and noise from pile-driving.

Survey gear utilization: Trawl and gillnet surveys for fisheries monitoring could include the capture of Atlantic sturgeon in trawl gear, which has the potential to result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Moser and Ross 1995; Collins et al. 2000; Moser et al. 2000). Capture of sturgeon in trawl gear could result in injury or death; however, trawl gear has been used as a safe and reliable method to capture sturgeon if tow time is limited. Trawl surveys conducted as part of fisheries monitoring would be limited to small sampling nets, short tow times, and slow tow speeds, which would reduce the risk of capture. Any captured sturgeon is expected to be released alive and without significant injury. Given the short tow times for trawl surveys, fisheries and habitat surveys are not expected to result in large numbers of Atlantic sturgeon mortality but a few could occur without affecting the overall population; therefore, impacts would be minor.

Noise: Both the Atlantic sturgeon and giant manta rays are hearing generalists that are relatively insensitive to sound when compared to fish species that are hearing specialists. These species also have different hearing sensitivities based on physiological differences in the structure of their hearing organs. It is expected that any Atlantic sturgeon exposed to pile-driving noise will be able to avoid exposure to noise above the levels that could result in exposure to the cumulative injury threshold. Based on this analysis, it is extremely unlikely that any Atlantic sturgeon will be exposed to noise that will result in injury. Therefore, any impact on Atlantic sturgeon would likely be minor.

3.5.5.4.4 Cumulative Impacts of Alternative B

The construction and installation, O&M, and conceptual decommissioning for ongoing and planned offshore wind activities across the geographic analysis area would contribute to the primary IPFs analyzed under Alternative A. Cumulatively, Alternative B (six NY Bight projects) would contribute to moderate impacts due to cable emplacement and would contribute to minor impacts due to electric and magnetic fields and cable heat and noise. Impacts from accidental releases, anchoring, lighting, and port utilization are expected to remain negligible to minor in the geographic analysis area with contributions from Alternative B (six NY Bight projects). The presence of structures (monopiles) could present a nominal areal blockage, with the net effect over the spatial scale of the six NY Bight projects (Alternative B); however, with the proposed spacing between WTGs, this is expected to be a negligible impact within the geographic analysis area. Cumulative impacts of Alternative B would increase over the No Action Alternative associated with the presence of structures IPF. Major cumulative impacts could result due to the increased number of structures from the six NY Bight projects plus ongoing and planned offshore wind projects that would be installed and remain for the life of the projects.

In context of reasonably foreseeable environmental trends and planned actions, the cumulative impacts of Alternative B (six NY Bight projects), when combined with ongoing and planned activities, would range from negligible to major with a minor to moderate beneficial impact due to the large number of structures and artificial reef effect. If construction of six NY Bight projects were staggered this could minimize the impacts.

3.5.5.4.5 Conclusions

Impacts of Alternative B. Construction and installation, O&M, and conceptual decommissioning of one or six NY Bight projects under Alternative B would affect finfish, invertebrates, and EFH to varying degrees. This is dependent on the location, timing, and species affected by an activity and would introduce noise, lighting, EMFs, and new structures to the geographic analysis area as well as result in habitat conversion. Impacts associated with Alternative B would be specific to the life stage and habitat requirements of a species as well. Impacts from O&M would occur, although at lower levels than those produced during construction and conceptual decommissioning. Offshore structures would also result in long-term effects on pelagic habitat. BOEM anticipates the impacts resulting from Alternative B for one NY Bight project would likely range from **negligible** to **moderate** depending on the IPF, including the presence of structures, which may result in **minor beneficial** impacts. BOEM anticipates the impacts for six NY Bight projects for construction and installation, O&M, and conceptual decommissioning would range from **negligible** to **major** depending on the IPF, with **minor** to **moderate beneficial** impacts for finfish, invertebrates, and EFH. If six NY Bight projects were staggered in construction, the impact ratings have the potential to be reduced because the resources would have more time to recover between each project.

Cumulative Impacts of Alternative B. Impacts of individual IPFs resulting from ongoing and planned actions, including six NY Bight projects, would likely range from **negligible** to **major** and **minor** to **moderate beneficial** impacts. Six NY Bight projects would contribute to the overall impact rating primarily through the simultaneous disturbance within the geographical analysis area of new cable emplacement and WTGs/OSSs and the permanent impacts from the presence of structures (cable protection measures and foundations). In the context of other reasonably foreseeable environmental trends, the impacts contributed by Alternative B to the cumulative impacts on finfish, invertebrates, and EFH would be appreciable. If construction of the six NY Bight projects and other planned offshore wind projects were staggered, then the impact rating could decrease as the resource would have more time to recover from each project.

3.5.5.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Finfish, Invertebrates, and Essential Fish Habitat

Alternative C, the Proposed Action, considers the potential impacts of future and offshore wind development for the NY Bight area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives – Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.5.5.5.1 Sub-Alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS and related consultations (Table 3.5.5-8).

Table 3.5.5-8. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for finfish, invertebrates, and EFH

Measure ID	Measure Summary
BEN-1	This measure proposes avoidance of boulders greater than 1.6 feet (0.5 meter) in diameter within the lease area and along the export cable corridor if practicable and minimization of relocation distance if avoidance is not possible. If boulders need to be relocated, the lessee must submit a *Boulder Identification and Relocation Plan* for review and concurrence.
MUL-1	This measure proposes requiring training, recovery, prevention, and reporting to reduce and eliminate trash and debris in order to reduce impacts from entanglement, ingestion, smothering of benthic species, and pollutants in the water column.
MUL-2	This measure proposes submittal and implementation of an anchoring plan to avoid or minimize impacts from turbidity and anchor placement on sensitive habitats, including hardbottom and structurally complex habitats, as well as any known or potential cultural resources.
MUL-3	This measure proposes that if there are bathymetric changes in berm height greater than 3.3 feet (1 meter) above grade, lessees must develop and implement a *Berm Remediation Plan* to restore created berms to match adjacent natural bathymetric contours (isobaths), as feasible.

Measure ID	Measure Summary
MUL-4	This measure proposes the use of specific cable protection measures (e.g., natural or engineered stone, bioactive concrete, nature-inclusive designs for cable and scour protection) within complex hardbottom habitat to reduce impacts on finfish, invertebrates, and EFH from cable emplacement.
MUL-8	This measure proposes requiring that all trap/pot gear used in fishery surveys would be uniquely marked to distinguish it from commercial or recreational gear and to facilitate identification of gear on any entangled marine mammals, sea turtles, or ESA-listed fish.
MUL-9	This measure proposes requiring recovery and reporting of any lost fishery and benthic monitoring survey gear to reduce entanglement impacts on marine mammals, sea turtles, and ESA-listed fish.
MUL-10a	This measure restricts vessel anchoring and benthic sampling in areas with corals and live bottom habitats (e.g., corals, sponges, eelgrass, bivalve beds), and must maintain an anchoring/sampling buffer of 492 feet (150 meters) from any known locations of threatened or endangered corals.
MUL-13	This measure proposes use of trained observers onboard trawl and trap surveys to mitigate impacts on protected species, including ensuring identification, disentanglement, safe handling, and genetic sampling of Atlantic sturgeon.
MUL-14a	This measure proposes developing and implementing standard protocols for addressing UXOs. Avoidance to the maximum extent practicable is required; a plan must be submitted if avoidance is not possible.
MUL-16	This measure proposes development and implementation of a plan for post-storm event monitoring of facility infrastructure, foundation scour protection, and cables. BSEE reserves the right to require post-storm mitigations to address conditions that could result in safety risks and/or impacts to the environment.
MUL-19	This measure proposes requiring monitoring of the cables after installation to determine location, burial, and conditions of the cable and surrounding areas to determine if burial conditions have changed and whether remedial action is warranted.
MUL-20	This measure proposes requiring implementation of soft-start techniques during impact pile-driving to reduce noise impacts on marine mammals, sea turtles, and finfish.
MUL-29	This measure proposes requiring pile-driving sound field verification, a written plan to inform the size of the isopleths for potential injury and harassment, and reporting requirements.
MUL-31	This measure proposes that all fisheries sampling gear is hauled out every 30 days and between seasons to minimize entanglement risk.
MUL-32	This measure outlines PSO reporting requirements (including foundation pile-driving).
MUL-33	This measure proposes requiring communication of protected species sightings and detections amongst all project vessels.
MUL-34	This measure proposes requiring reporting of any observations or collections of injured or dead protected species. Reports of Atlantic sturgeon take include a statement as to whether a fin clip sample for genetic sampling was taken.
MUL-41	This measure proposes inspecting scour protection performance in accordance with an inspection plan subject to agency review.
STF-2	This measure proposes identification, data collection, handling, and resuscitation measures for sea turtles and Atlantic sturgeon caught or retrieved in fisheries survey gear.
STF-4	This measure proposes requiring reporting of any potential takes of any sea turtles and Atlantic sturgeon during fisheries surveys.

Impacts of One Project

As compared to Alternative B, identification of AMMM measures under Sub-alternative C1 would reduce impacts on benthic resources from some IPFs, including accidental releases, anchoring, cable emplacement and maintenance, survey gear utilization, electric and magnetic fields and cable heat, noise, and presence of structures. Impacts for other IPFs would remain the same as described under Alternative B.

Previously applied AMMM measures BEN-1, MUL-4, and MUL-10a would be some of the most effective to minimize impacts on sensitive live-bottom habitat and EFH resources by avoidance of boulders and boulder relocation (BEN-1) and avoidance of all sensitive live-bottom habitats (MUL-10a), and the utilization of nature-inclusive design (MUL-4) scour protection materials. The ecological services that are lost due to the conversion of softbottom habitat could be replaced with a viable artificial hardbottom with epifaunal and motile invertebrate and finfish assemblages. There are no previously applied AMMM measures for discharges and intakes, lighting, and port utilization that would reduce impacts on finfish, invertebrates, or EFH, and impacts would remain as described under Alternative B.

Accidental releases: MUL-1 would require vessel operators, employees, and contractors to be briefed on marine trash and debris awareness elimination per BOEM guidelines for marine trash and debris prevention. This training and awareness of BMPs proposed for waste management and mitigation of marine debris would be required of project personnel, reducing the likelihood of occurrence to a very low risk. Additionally, MUL-9, which requires the recovery of lost survey gear, would reduce the amount of marine debris that is in the water because of project activities and infrastructure. Overall water quality would be of greatest impact on filter feeding planktonic larvae, and juveniles. These AMMM measures would reduce the likelihood of an accidental release and reduce the impacts on finfish, invertebrates, and EFH, thus impacts would remain negligible, as in Alternative B, for a single NY Bight project.

Anchoring: The implementation of AMMM measure BEN-1 would protect the benthic resources associated with boulder habitats. The implementation of AMMM measure MUL-2 would require detailed anchoring plans outlining the avoidance of sensitive benthic habitats. MUL-10a would restrict all vessel anchoring in areas with sensitive live bottom habitats such as eelgrass, corals, and sponges. These AMMM measures would reduce the impacts on sensitive benthic resources such as hardbottom habitats in offshore areas and seagrass, oyster reef, or blue mussel beds in coastal and estuarine habitats. Anchoring impacts would be reduced from minor in Alternative B to negligible for finfish, invertebrates, and EFH with previously applied AMMM measures.

Cable emplacement and maintenance: Potential impacts on finfish, invertebrates, and EFH from cable emplacement and maintenance would likely decrease under Sub-alternative C1. AMMM measure BEN-1 will ensure boulder avoidance along the export cable corridor, where practicable. If relocation is needed, a *Boulder Identification and Relocation Plan* would be required, which helps to minimize disturbance of the seafloor, including unique boulder habitat.

Once the cable is installed, AMMM measure MUL-4 proposes natural or engineered stone and nature-inclusive design elements in cable and scour protection (e.g., using nature-based scour protection such as oyster beds or other artificial reef materials) to provide suitable substrate for increasing the probability of recolonization and recruitment of epifaunal, motile managed species of invertebrates, and finfish. These materials foster the creation of the "reef effect," thereby providing beneficial impacts for structure-oriented finfish and invertebrates.

AMMM measure MUL-3 proposes that any bathymetric changes in berm height greater than 3.3 feet (1 meter) above grade after the second post-installation survey would be restored as technically and/or economically practical or feasible. The lessee must develop and implement a *Berm Remediation Plan* to restore created berms to match adjacent natural bathymetric contours. AMMM measure MUL-16 requires a plan to BSEE for post-storm event condition monitoring of facility infrastructure, foundation scour protection, and cables. While monitoring would not directly reduce impacts, a monitoring plan would provide information about impacts on environmental conditions from storm events, and BSEE would retain the ability to require post-storm mitigation to address environmental impacts caused by the storm event. While the implementation of AMMM measures analyzed above would reduce impacts from cable emplacement and maintenance, the impact level would remain minor as in Alternative B due to the spatial extent of impacts on finfish, invertebrates, and EFH.

Electric and magnetic fields and cable heat: AMMM measure MUL-19 would require periodic cable inspection to ensure proper cable burial depth and integrity. Although EMFs and cable heat are considered negligible, exposed export cables may inadvertently expose organisms to higher EMFs or cause avoidance behaviors, and MUL-19 would minimize these risks. While this measure would reduce impacts, the level would remain minor for bottom-dwelling finfish and motile invertebrates and negligible for pelagic finfish, as in Alternative B.

Survey gear utilization: The restrictions in MUL-10a also apply to seafloor sampling gear and activities. Sensitive bottom habitats would be avoided as practicable, and vessels in coastal waters should operate in a manner to minimize propeller wash, which disturbs the seafloor communities. All seafloor sampling must occur at least 492 feet (150 meters) away from threatened or endangered coral species. MUL-8 and MUL-9 would require unique markings on all trap/pot gear used in fishery surveys and reporting and recovery of any lost gear to reduce the possibility of entanglement, as well as facilitate gear identification should it occur. MUL-31 prohibits wet storage of trap/pot gear to reduce gear loss and potential entanglement. Impact levels on finfish, invertebrates, and EFH from gear would likely be negligible, as in Alternative B.

Noise: AMMM measure MUL-20 includes soft-start techniques at the beginning of each day's monopile installation, and at any time following a cessation of impact pile driving of 30 minutes or longer. This would allow fish, and motile invertebrates, a chance to retreat from the noise before it reaches the maximum intensity. AMMM measure MUL-14a includes UXO avoidance and implementation of standards for detonations, which would reduce noise impacts from a detonation if UXO(s) could not be avoided. While these measures would reduce the amount of noise, the impact level would remain minor as in Alternative B.

Presence of structures: If AMMM measure MUL-4 is implemented, the impacts from conversion and loss of benthic habitat by the installation of scour protection may be reduced, or a beneficial impact may be created. Nature-in-design materials would enhance the ecological services that the scour protection structures may support as artificial hardbottom habitat. Further, AMMM measure MUL-41 requires that the WTGs and OSS platforms' scour protection features be monitored to ensure scour protection performance, which would minimize the potential disturbance to benthic communities from scour. BOEM would require a monitoring plan be developed for post-storm events (MUL-16). While monitoring would not directly reduce effects on benthic communities, a monitoring plan would provide information about impacts on seabed conditions from storm events, and BSEE would retain the ability to require post-storm mitigation to address environmental impacts caused by the storm event. Under Sub-alternative C1, impacts are expected to be minor compared to minor to moderate impacts in Alternative B; minor beneficial impacts are also expected, as in Alternative B.

Impacts of Six Projects

The same IPF impact types and mechanisms described under a single NY Bight project also apply to six NY Bight projects. There would be more potential for impacts for these IPFs due to the greater amount of offshore and onshore development under six NY Bight projects. The reduction in impacts and increase in beneficial impacts would be similar for six NY Bight projects as described for one NY Bight project under Sub-alternative C1. The AMMM measures for the six NY Bight projects would affect a larger geographic area and more offshore wind construction and O&M activities, and would generally reduce expected impacts on finfish, invertebrates, and EFH. This level of impact reduction is dependent on the amount of complex habitat avoided and the reduction in benthic disturbance. The temporal and spatial separation of the six NY Bight projects would also affect the level of impact on finfish, invertebrates, and EFH.

For the presence of structures IPF, which could introduce scour protection, there is the potential for an increase of beneficial and adverse impacts from the amount of bottom conversion due to the scour protection for six NY Bight projects. Species preferring hardbottom habitat (i.e., Atlantic cod, American lobster) would gain habitat, while softbottom species (i.e., summer flounder, Atlantic surf clam) would see habitat locally lost. This would result in localized, short-term to permanent impacts on softbottom habitat within the project area and would impart minor to moderate adverse and beneficial impacts on finfish, invertebrates, and EFH, which is an increase from the minor impacts expected from one NY Bight project under Sub-alternative C1.

Impacts of Sub-Alternative C1 (Preferred Alternative) on ESA-Listed Species

As previously stated, the Atlantic sturgeon and the giant manta ray are the only ESA-listed species that are likely to be present within the NY Bight lease areas. The previously applied AMMM measures identified for finfish, invertebrates, and EFH in Section 3.5.5.5.1, *Impacts of One Project,* would be applicable to ESA-listed fish species and would reduce impacts from survey gear utilization and noise from pile-driving.

Atlantic sturgeon are vulnerable to vessel collisions within restricted riverine habitats resulting in potential mortality (Balazik et al. 2012). However, there are no reports of vessel strikes on sturgeon in the open marine environment. Additionally, vessel strikes of elasmobranch species such as the giant manta ray are extremely rare. AMMM measures MUL-32, MUL-33, and MUL-34 would require protected species observers (PSOs) and vessel crew to monitor and report any protected species seen and report these sightings in near real-time to other vessels. Additionally, the AMMM measures require routine reporting to help track, prevent, and mitigate vessel interactions with ESA-listed species.

Survey gear utilization: The measures related to survey gear utilization were developed primarily for ESA-listed fish species, specifically Atlantic sturgeon. AMMM measures MUL-8, MUL-9, and MUL-31 apply to fisheries survey gear and require specific marking of gear and haul out of gear every 30 days, reporting, and recovery of any lost gear, which would reduce risk of entanglement of ESA-listed species (Atlantic sturgeon), although that risk is already low.

AMMM measure MUL-13 would implement a requirement that at least one survey staff onboard trawl and ventless trap surveys are trained in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). The lessee must ensure any live, uninjured animals are returned to the water as quickly as possible after completing the required handling and documentation. Any unresponsive Atlantic sturgeon caught and retrieved in gear used in fisheries surveys must be handled and resuscitated according to established protocols. For Atlantic sturgeon that are caught in fisheries survey gear, proper documentation (identification, resuscitation, and take reporting methods) would be required by AMMM measures STF-2 and STF-4. While these measures could reduce impacts and risk of mortality and would collect additional information on Atlantic sturgeon through genetic sampling and tagging, the impact level would remain minor, as in Alternative B for ESA-listed species.

Noise: AMMM measures MUL-14a and MUL-20 address reductions in the noise in waters inhabited by ESA-listed species, including the Atlantic sturgeon and the giant manta ray. Implementation of best available technology to minimize exposure of protected species and sensitive habitats is required when avoidance of UXOs is not possible. This includes consultation with state and federal agencies about seasonal restriction windows, or other precautions (MUL-14a). Soft-start techniques during impact-pile driving, required by MUL-20 will also benefit ESA-listed species.

While it is possible that the other previously applied AMMM measures provided in Sub-alternative C1 could further benefit ESA-listed species such as the Atlantic sturgeon or the giant manta ray, impacts would remain minor.

Cumulative Impacts of Sub-Alternative C1 (Preferred Alternative)

Similar to Alternative B, under Sub-alternative C1, the same ongoing and planned non-offshore-wind and offshore wind activities would continue to contribute to the primary IPFs analyzed above. Impacts on finfish, invertebrates, and EFH are anticipated to be similar as described under Alternative B but with greater beneficial impacts due to the AMMM measures for the six NY Bight projects. In context of reasonably foreseeable environmental trends and planned actions, the cumulative impacts of Sub-alternative C1 (six NY Bight projects), when combined with ongoing and planned activities, would range from negligible to major due to the large number of structures, with an additional minor to moderate beneficial impact from the artificial reef effect.

3.5.5.5.2 Sub-Alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied (Table 3.5.5-9).

Table 3.5.5-9. Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for finfish, invertebrates, and EFH

Measure ID	Measure
MUL-22	This measure proposes a received sound level limit minimizing sound levels during impact pile-driving activity to reduce impacts from noise.
STF-5	This measure proposes that, if a trailing suction hopper dredge is used, dredge pumps must be disengaged when not actively dredging to prevent impingement or entrainment of ESA-listed fish species.

Impacts of One Project

Implementing not previously applied AMMM measures in addition to previously applied measures under Sub-alternative C2 would potentially reduce impact levels compared to those under Sub-alternative C1 for the IPFs of cable emplacement and maintenance and noise. Impacts from other IPFs would remain the same as described under Sub-alternative C1 because previously applied AMMM measures have not been identified that could reduce impacts from those IPFs.

Cable emplacement and maintenance: AMMM measure STF-5 proposes that trailing suction hopper dredge pumps must be disengaged when lowering dragheads to the bottom to start dredging, turning, or lifting dragheads off the bottom, and at the completion of dredging. Operators must disengage dredge pumps when the dragheads are not actively dredging to prevent impingement or entrainment of fish larvae and juveniles, which would minimize effects from dredging but would not change impact levels from Sub-alternative C1, thus remaining minor.

Noise: AMMM measure MUL-22, while designed for baleen whales, also has the potential to reduce the exposure to noise for all species by setting a physical distance limit to injurious sound levels to baleen whales. MUL-22 could also minimize noise impacts if developers discover glauconite sands during construction and installation, which may result in increased noise levels as developers determine if the glauconite is passable. With the implementation of MUL-22, developers will be required to remain under a certain received sound limit. This would apply if glauconite sands are discovered as well. Therefore, the developers would need to use different methodology, technology, or infrastructure, or apply quieting techniques to reduce their received sound limit if glauconite sands are discovered. This received sound limit would help prevent any temporary increases in noise from pile-driving through glauconite soils and subsequent impacts on fish. The acoustic assessment in Appendix J can be referred to for more details. This measure would reduce noise effects on finfish, invertebrates, and EFH but would not change overall impact levels from Sub-alternative C1, thus remaining minor.

Impacts of Six Projects

The same IPF impact types and mechanisms described under a single NY Bight project also apply to six NY Bight projects. However, there would be more potential for impacts for these IPFs due to the greater amount of offshore and onshore development under six NY Bight projects. However, some of these impacts (cable emplacement and maintenance and noise) would also be reduced to a greater extent with the AMMM measures under Sub-alternative C2.

Impacts of Sub-Alternative C2 on ESA-Listed Species

Cable emplacement and maintenance: AMMM measure STF-5 proposes that operators must disengage dredge pumps when the dragheads are not actively dredging and therefore working to keep the draghead firmly on the bottom in order to prevent impingement or entrainment of ESA-listed fish (and sea turtle species). While a reduction in impingement and entrainment would benefit ESA-listed fish species, it would not change impact levels.

Cumulative Impacts of Sub-Alternative C2

Similar to Alternative B, under Sub-alternative C2, the same ongoing and planned non-offshore-wind and offshore wind activities would continue to contribute to the primary IPFs. Potential impacts on finfish, invertebrates, and EFH are anticipated to be similar as described under Alternative B. However, with the AMMM measures for the six NY Bight projects, there would be greater reduction in adverse impacts and potentially greater beneficial impacts on finfish, invertebrates, and EFH. In context of reasonably foreseeable environmental trends and planned actions, the cumulative impacts of Sub-alternative C2 (six NY Bight projects), when combined with ongoing and planned activities, would range from negligible to major due to the large number of structures, with minor to moderate beneficial impacts from the artificial reef effect.

3.5.5.6 Conclusions

Impacts of Alternative C. AMMM measures under Sub-alternatives C1 and C2 would not change the impacts substantially between one NY Bight project and six NY Bight projects. While impacts are expected to be reduced from AMMM measures for some IPFs when compared to Alternative B, they would not be reduced sufficiently to alter the overall impact determinations. Therefore, impacts are expected to range from **negligible** to **minor** with potentially **minor beneficial** impacts for one NY Bight project and **negligible** to **moderate** with potentially **minor** to **moderate beneficial** impacts for six NY Bight projects, depending on the IPF.

Cumulative Impacts of Alternative C. BOEM anticipates that the cumulative impacts on finfish, invertebrates, and EFH in the geographic analysis area would likely be **negligible** to **major** with a potential for **minor** to **moderate beneficial** impacts under both Sub-alternatives C1 and C2. In the context of other reasonably foreseeable environmental trends, the impacts contributed by Sub-alternatives C1 and C2 (six NY Bight projects with AMMM measures) to the cumulative impacts on finfish, invertebrates, and EFH would be appreciable. BOEM expects individual impacts ranging from negligible to major, because while the impacts of accidental releases, anchoring, electric and magnetic field and cable heat, survey gear utilization, lighting, and port utilization would likely be negligible to minor, the presence of structures for the life of the project would likely result in major impacts with minor to moderate beneficial impacts and would remain so as long as the structures are in place.

3.5.5.7 Recommended Practices for Consideration at the Project-Specific Stage

BOEM is recommending that lessees consider analyzing the RPs in Table 3.5.5-10 to further reduce potential finfish, invertebrates, and EFH impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.5.5-10. Recommended Practices for finfish, invertebrates, and essential fish habitat impacts and related benefits

Recommended Practice	Potential Benefit
MUL-5: Use equipment, technology, and best practices to produce the least amount of noise possible and reduce noise impacts.	Depending on the methods implemented, this RP could reduce impacts on finfish and invertebrates, but project-specific information is required before the effectiveness can be fully evaluated.
MUL-6: Use low noise practices or quieting technology to install foundations, when possible, to limit noise impacts.	The consideration of non-pile-driving foundation types (e.g., suction buckets, gravity-based foundations) first, and the use of the best available quieting technology should be applied to reach the received sound level limit (MUL-22). Noise reduction would benefit finfish and invertebrates within the area.
MUL-7: Use the most current International Maritime Organization's (IMO) Guidelines for the reduction of underwater radiated noise, including propulsion noise, machinery noise, and dynamic positioning systems for project vessels.	Vessel noise reduction would benefit finfish and invertebrates within the area, as well as help to protect EFH.
MUL-10b: Prohibits geotechnical or bottom-disturbing activities from April through July, during the sturgeon spawning/rearing season, within freshwater reaches of the Hudson and Delaware Rivers.	Impacts on spawning sturgeon may be reduced by this RP, and because benthic invertebrate spawning has been shown to be strongly associated with water temperatures, imposing time-of-year restrictions on benthic surveys as a result of this measure could likely benefit invertebrate spawning and development.
MUL-10c: Minimize survey vessel interactions with protected species during the use of a moon pool .	Protected species monitoring would benefit the sturgeon that are caught within the moon pool. Early detection would provide guidance on mitigation measures should they be needed and inclusion in the daily report to collect more data on the occurrence rates.
MUL-12: Incorporate ecological design elements where practicable.	Incorporating ecological designs for cables protection and scour protection would provide suitable habitats and benefit benthic communities. The newly established reef effect would also provide foraging grounds and shelter for fish.
MUL-14b: Follow MEC Avoidance Best Practices.	If MEC avoidance is not possible, UXO/MEC avoidance plans should follow the U.S. Committee on the Marine Transportation System best practices. Any reduction in noise or habitat disturbance is beneficial for finfish, invertebrates, and EFH.

Recommended Practice	Potential Benefit
MUL-18: Coordinate transmission infrastructure among projects such as by using shared intra- and interregional connections, meshed infrastructure, or parallel routing.	Using a shared infrastructure would consolidate the extent of transmission cables, which could reduce the geographic extent of impacts from 1) cable emplacement and maintenance and 2) EMF and cable heat. This RP may minimize potential impacts from offshore export cables on finfish, invertebrates, and essential fish habitat.
MUL-21: Use the best available technology, including new and emerging technology, when possible.	A closed-loop subsea cooling system is an emerging technology that, if applied, would eliminate entrainment risks to finfish and invertebrate larvae and juveniles, and may minimize localized hydrodynamic and thermal plume impacts because intake and discharge of seawater would not occur. This measure could also decrease the impacts of presence of structures on demersal fish, benthic invertebrates, and EFH by using best available technology (e.g., jet plows, trenchless technologies) where practicable.
MUL-23: Avoid or reduce potential impacts on important environmental resources by adjusting project design.	Depending on the project design elements implemented, MUL-23 could reduce impacts on finfish, invertebrates, and EFH associated with cable installation by utilizing shared cable crossing locations to reduce overall seabed footprint, using HDD to avoid sensitive resources such as SAV, and avoiding routing through estuaries and embayments to reduce impacts on numerous sensitive habitats and vulnerable life stages of marine species. Avoidance of these habitats, which would not likely recover quickly from disturbance, leaves complex habitats and their associated finfish, invertebrates, and EFH communities undisturbed. MUL-23 could reduce impacts from presence of structures by adjusting project design, which could include adjusting WTG layouts to avoid sensitive habitats, such as the mid-shelf scarp, an important bathymetric feature that overlaps portions of Lease Areas OCS-A 0538 and OCS-A 0539.
MUL-26: Coordinate regional monitoring and survey efforts to standardize approaches, understand potential impacts to resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. Develop monitoring and survey plans that meet regional data requirements and standards.	Coordinating regional monitoring and survey efforts would maximize the monitoring efficiency. The data gathered would be evaluated and considered for future mitigation and monitoring needs, which will serve to reduce impacts.
MUL-27: Employ methods to minimize sediment disturbance from anchoring.	Using mid-line buoys to minimize cable sweep and reduce sediment disturbance would reduce effects on finfish, invertebrates, and EFH.
MUL-28: Develop an Inadvertent Returns Plan that details preferred drilling solutions and methods.	This RP reduces accidental releases by proposing the recirculation of drilling fluids used during HDD construction activity and the use of biodegradable drilling solutions. Development and implementation of an Inadvertent Returns Plan would address prevention, control, and cleanup of the potential

Recommended Practice	Potential Benefit
	inadvertent return during HDD activity, ensuring fewer impacts on water quality near the site of HDD operations near shore. Water quality is important for benthic filter feeding planktonic larvae and juveniles.
MUL-39: Use of electrical shielding on underwater cables.	Using cables that have electrical shielding would mitigate the intensity of EMF. Exposed export cables may inadvertently expose finfish, invertebrates, and the EFH of manages species to higher EMFs or cause avoidance behaviors.
STF-1: Monitor tagged sea turtles and highly migratory fish using technology strategically placed on WTGs.	Incorporating technologies for detecting tagged, highly migratory fish to monitor the effect of increases in habitat use and residency around WTG foundations would provide additional information about impacts on fish and could lead to additional mitigation.

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3.5 Biological Resources

3.5.6 Marine Mammals

This section discusses potential impacts on marine mammals from the Proposed Action, alternatives, and ongoing and planned activities in the marine mammal geographic analysis area. The marine mammal geographic analysis area, as shown on Figure 3.5.6-1, includes the U.S. Southeast Continental Shelf, Northeast Continental Shelf, and Canadian Scotian Shelf LMEs to capture most of the movement range for marine mammal species that could be affected by the NY Bight projects. Due to the size of the geographic analysis area, the analysis of IPFs focuses on marine mammals that would likely occur near the offshore project area (i.e., the area that includes WTGs and their foundations, OSSs and their foundations, scour protection for foundations, interarray cables, offshore export cables, and project vessel transit routes) and have the potential to be affected by the NY Bight projects, depicted on Figure 3.5.6-1.

The marine mammals impact analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

3.5.6.1 Description of the Affected Environment and Future Baseline Conditions

Marine mammals are highly mobile animals that use the North Atlantic OCS for a variety of biologically necessary functions, including resting, foraging, reproduction, calf-rearing, and migrating. Some marine mammal species are highly migratory, traveling long distances between foraging and nursery areas, whereas other species move on a local to regional scale. Species occurrence in the offshore project area is not uniform as some species are pelagic and occur farther offshore, some are coastal and are found nearshore, and others occur in both near and offshore areas. Seasonal migrations between foraging and nursery areas and local movement patterns are generally determined by prey abundance and availability, which can be highly dependent on oceanographic properties and processes. Therefore, impacts on prey items must also be considered when assessing impacts on marine mammals. Section 3.5.5 of the PEIS summarizes the effects on finfish, invertebrates, and EFH.

Forty species of marine mammals are known to occur or could occur in waters of the offshore project area and vicinity, which is within the Northeast Shelf LME and is where almost all activities from the NY Bight projects would occur (Table 3.5.6-1). This includes six mysticete whales (baleen whales), 29 odontocete whales and dolphins (toothed whales, dolphins, and porpoises), four pinnipeds (i.e., seals), and one sirenian (manatee) species. Seventeen of those species have the potential to interact with the NY Bight projects, as they are likely to have regular, common, or uncommon occurrences in the offshore project area. No additional species are expected to occur in the Southeast Shelf LME, which project vessels would transit through on their way to and from ports in the Gulf of

Mexico. Three additional species occur in the Gulf of Mexico that are not expected to occur in the Canadian Scotian Shelf, Northeast Shelf, or Southeast Shelf LMEs.[1]

Current species or NMFS management stock abundance estimates can be found in annual NMFS marine mammal stock assessment reports (Waring et al. 2015; Hayes et al. 2019, 2020, 2021, 2022, 2023; NMFS 2024a). For these reports, data collection, analysis, and interpretation are conducted through marine mammal research programs at NOAA Fisheries Science Centers and by other researchers. Additional population information for the North Atlantic right whale, or NARW (*Eubalaena glacialis*), is understood using the North Atlantic Right Whale Consortium's Annual Report Card (Pettis et al. 2022) and Pace's 2021 population modeling report.

The best available information on marine occurrence and distribution in the offshore project area is provided by a combination of visual sighting data from aerial and vessel surveys, which are routinely conducted near the offshore project area, as well as other available data, including passive acoustic monitoring (PAM) data, habitat-based modeling efforts that utilize multiple years of visual survey data, technical reports, and academic publications, including the following:

- Baseline environmental studies conducted for NJDEP, NYSERDA, and NYSDEC provide wildlife information specific to the NY Bight lease areas off the coasts of New Jersey and New York using aerial and boat-based surveys (APEM and Normandeau 2018; Geo-Marine 2010; Robinson Willmot et al. 2021; Tetra Tech and LGL 2020; NYSDEC's NY Bight Whale Monitoring Program accessible from https://dec.ny.gov/nature/waterbodies/oceans-estuaries/bight-whale-monitoring-program; NYSERDA's Aerial Digital Surveys accessible from https://remote.normandeau.com/nys_aer_overview.php). The environmental and natural resources technical appendix to the New Jersey Offshore Wind Strategic Plan (Ramboll 2020) provides a broad technical assessment of a variety of resources (including marine mammals) in the greater NY Bight region. Other regional data, scientific literature, and technical reports were also used to assess marine mammal distribution patterns in the region (CETAP 1981; Davis et al. 2017, 2020, 2023; Ecology and Environment Engineering 2017; Estabrook et al. 2019; Muirhead et al. 2018; Stone et al. 2017; Van Parijs et al. 2023; Westell et al. 2024; Whitt et al. 2013, 2015; Zoidis et al. 2021).
- The Atlantic Marine Assessment Program for Protected Species (AMAPPS) coordinates data collection and analysis to assess the abundance, distribution, ecology, and behavior of marine mammals in the U.S. Atlantic. These include both ship and aerial surveys conducted from 2010

[1] Additional species that may occur in the Gulf of Mexico include the ESA-listed Rice's whale (*B. ricei*), melon-headed whale (*Peponocephala electra*), and Fraser's dolphin (*Lagenodelphis hosei*). As some project vessels are expected to transit to and from the Gulf of Mexico area during construction and installation, there is the potential for vessel-related impacts on these species. However, only 20 round trips from the Gulf of Mexico are estimated for one NY Bight project. Accidental releases from project vessels are unlikely (Section 3.5.6.4, *Impacts of Alternative B*). Vessel noise would be temporary and localized, and noise effects of a minimal number of round trips would be insignificant. The increased risk of a vessel strike associated with the few round trips would be discountable. Therefore, project impacts in the Gulf of Mexico are unlikely and species unique to the Gulf of Mexico are not considered further in this Final PEIS.

and are currently ongoing. Although the majority of AMAPPS survey efforts have been focused on offshore areas outside the offshore project area, the broad area surveyed encompasses and, therefore, is relevant to the assessment of the NY Bight projects (Palka et al. 2017, 2021). The Regional Wildlife Science Collaborative (RWSC) for Offshore Wind has also collaborated with the NOAA Passive Acoustic Research Group to maintain an understanding of marine mammal presence using PAM devices deployed along the U.S. Atlantic. Maps showing the most current deployment of these devices are periodically updated in the Northeast Ocean Data Portal[2] and the Mid-Atlantic Ocean Data Portal.[3]

- A habitat-based cetacean density model for the U.S. Exclusive Economic Zone (EEZ) of the East Coast (eastern U.S.) and Gulf of Mexico was also developed by the Duke University Marine Geospatial Ecology Lab in 2016 (Roberts et al. 2016). These models have been subsequently updated to include more recently available data in 2017, 2018, 2019, 2020, 2022, and 2023 (Roberts et al. 2017, 2018, 2020, 2023; Curtice et al. 2019; Roberts 2022). Collectively, these estimates are considered the best information currently available for marine mammal densities in the U.S. Atlantic. Abundance and density data maps for individual species are accessible from Duke University's Marine Geospatial Ecology Lab online mapper.[4]

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[2] https://www.northeastoceandata.org/data-explorer/

[3] https://portal.midatlanticocean.org/visualize/#x=-73.68&y=39.76&z=7&logo=true&controls=true&dls%5B%5D=true&dls%5B%5D=0.8&dls%5B%5D=5188&basemap=ocean&themes%5Bids%5D%5B%5D=2&tab=data&legends=false&layers=true

[4] https://seamap.env.duke.edu/models/Duke/EC/

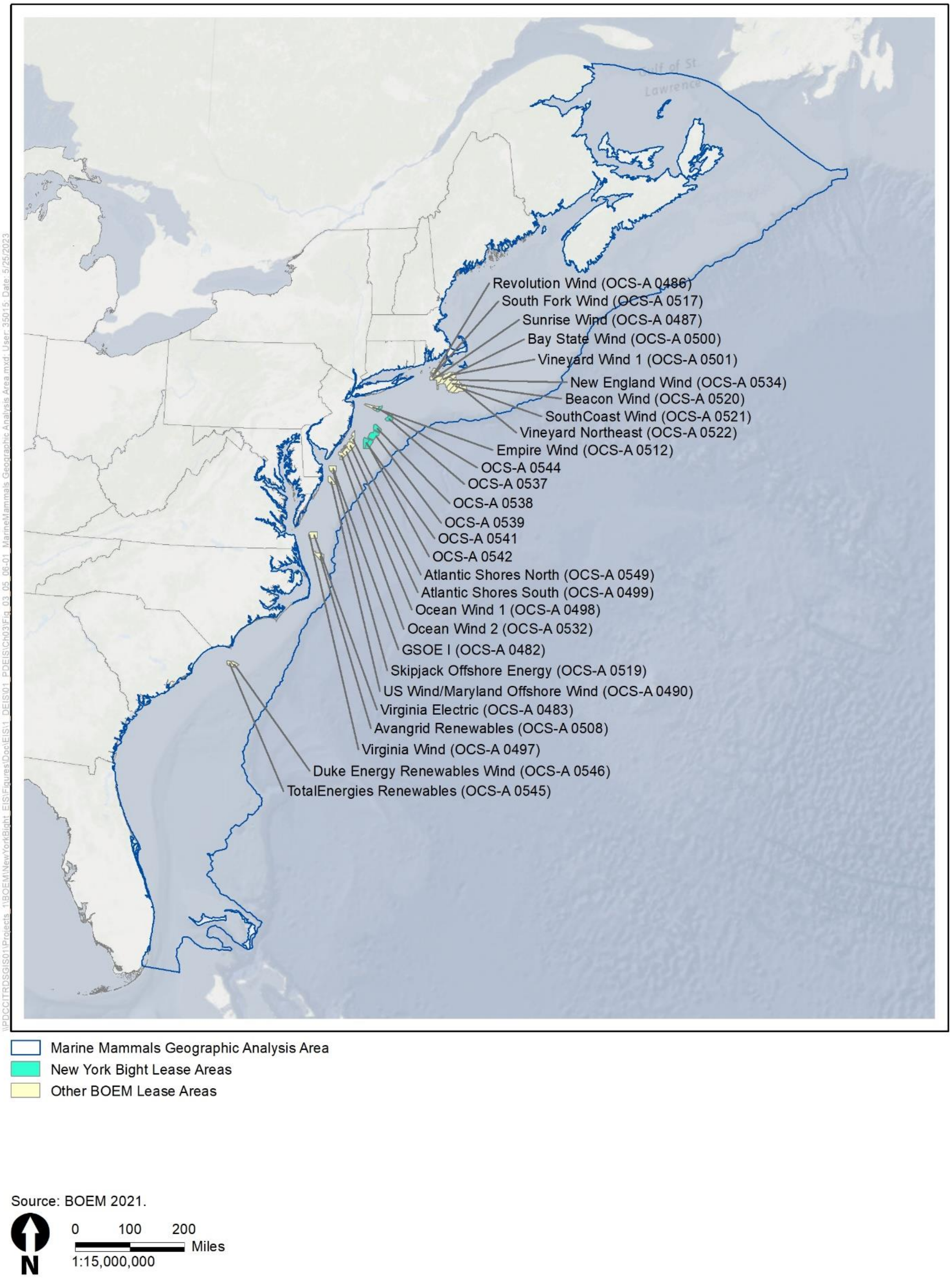

Figure 3.5.6-1. Marine mammals geographic analysis area

Table 3.5.6-1. Marine mammal species and NMFS management stocks with geographic ranges that include the offshore project area

Common Name	Scientific Name	ESA/MMPA Status[1]	Relative Occurrence in the Offshore Project Area[2]	Seasonal Occurrence in the Offshore Project Area[3]	Critical Habitat in Area of Direct Effects	Stock (NMFS)	Population (Abundance) Estimate[4]	Population Trend[5]	Total Annual Human-Caused Mortality/ Serious Injury (M/SI)[6]	Reference
Mysticetes										
Blue whale	*Balaenoptera musculus*	E/D	Uncommon	Fall, winter	N/A	Western North Atlantic	402[7]	Unknown	Unknown	Hayes et al. (2020)
Fin whale	*Balaenoptera physalus*	E/D	Common	Year-round (peak in summer)	N/A	Western North Atlantic	6,802	Unknown	2.05	NMFS (2024a)
Humpback whale	*Megaptera novaeangliae*	None/N	Common	Year-round (peak in winter)	N/A	Gulf of Maine	1,396	+2.8% per year (2000 through 2016)	12.15	Hayes et al. (2020)
Minke whale	*Balaenoptera acutorostrata*	None/N	Regular	Year-round (peak in spring, summer)	N/A	Canadian East Coast	21,968	Unknown	9.4	NMFS (2024a)
North Atlantic right whale	*Eubalaena glacialis*	E/D	Common	Year-round (peak in winter, spring)	No[8]	Western North Atlantic	340	–29.3% overall (2011 through 2020)	27.2[9]	NMFS (2024a)
Sei whale	*Balaenoptera borealis*	E/D	Uncommon	Spring	N/A	Nova Scotia	6,292	Unknown	0.60	NMFS (2024a)
Odontocetes										
Atlantic spotted dolphin	*Stenella frontalis*	None/N	Rare	Rare	N/A	Western North Atlantic	31,506	Decreasing	Presumed 0	NMFS (2024a)
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	None/N	Uncommon	Fall, Winter, Spring	N/A	Western North Atlantic	93,233	Unknown	28	NMFS (2024a)
Blainville's beaked whale	*Mesoplodon densirostris*	None/N	Rare	Rare	N/A	Western North Atlantic	2,936	Unknown	0.2	NMFS (2024a)
Clymene dolphin	*Stenella clymene*	None/N	Rare	Rare	N/A	Western North Atlantic	21,778	Unknown	Presumed 0	NMFS (2024a)
Common bottlenose dolphin (coastal)	*Tursiops truncatus*	None/D	Common	Year-round (peak in summer)	N/A	Western North Atlantic, Northern Migratory Coastal	6,639	Decreasing[10]	12.2–21.5	Hayes et al. (2021)
		None/D	Rare	Year-round (peak in summer)	N/A	Western North Atlantic, Southern Migratory Coastal	3,751	Decreasing[10]	0–18.3	Hayes et al. (2021)
Common bottlenose dolphin (offshore)	*Tursiops truncatus*	None/N	Common	Year-round (peak in summer)	N/A	Western North Atlantic, Offshore	64,587	Unknown	28	NMFS (2024a)
Common dolphin	*Delphinius delphis*	None/N	Common	Year-round (peak in winter)	N/A	Western North Atlantic	93,100	Unknown	414	NMFS (2024a)
Cuvier's beaked whale	*Ziphius cavirostris*	None/N	Rare	Rare	N/A	Western North Atlantic	2,936	Unknown	0.2	NMFS (2024a)
Dwarf sperm whale	*Kogia sima*	None/N	Rare	Rare	N/A	Western North Atlantic	9,474[11]	Unknown	Unknown[12]	NMFS (2024a)
False killer whale	*Pseudorca crassidens*	None/N	Rare	Rare	N/A	Western North Atlantic	1,298	Unknown	Presumed 0	NMFS (2024a)
Fraser's dolphin	*Lagenodelphis hosei*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	NMFS (2024a)
Gervais' beaked whale	*Mesoplodon europaeus*	None/N	Rare	Rare	N/A	Western North Atlantic	8,595	Unknown	0	NMFS (2024a)
Harbor porpoise	*Phocoena phocoena*	None/N	Regular	Year-round (peak in winter, spring)	N/A	Gulf of Maine, Bay of Fundy	85,765	Unknown	145	NMFS (2024a)
Killer whale	*Orcinus orca*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Unknown	Waring et al. (2015)
Long-finned pilot whale	*Globicephala melas*	None/N	Regular	Year-round (peak in summer, fall)	N/A	Western North Atlantic	39,215	Unknown	5.7	NMFS (2024a)
Melon headed whale	*Peponocephala electra*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	NMFS (2024a)

Common Name	Scientific Name	ESA/MMPA Status[1]	Relative Occurrence in the Offshore Project Area[2]	Seasonal Occurrence in the Offshore Project Area[3]	Critical Habitat in Area of Direct Effects	Stock (NMFS)	Population (Abundance) Estimate[4]	Population Trend[5]	Total Annual Human-Caused Mortality/ Serious Injury (M/SI)[6]	Reference
Northern bottlenose whale	*Hyperodon ampullatus*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	Waring et al. (2015)
Pantropical spotted dolphin	*Stenella attenuata*	None/N	Rare	Rare	N/A	Western North Atlantic	2,757	Unknown	Presumed 0	NMFS (2024a)
Pygmy killer whale	*Feresa attenuata*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	Presumed 0	NMFS (2024a)
Pygmy sperm whale	*Kogia breviceps*	None/N	Rare	Rare	N/A	Western North Atlantic	9,474[11]	Unknown	Unknown[12]	Hayes et al. (2020)
Risso's dolphin	*Grampus griseus*	None/N	Regular	Year-round (Spring, summer, fall)	N/A	Western North Atlantic	44,067	Unknown	18	NMFS (2024a)
Rough-toothed dolphin	*Steno bredanensis*	None/N	Rare	Rare	N/A	Western North Atlantic	Unknown	Unknown	0	NMFS (2024a)
Short-finned pilot whale	*Globicephala macrorhynchus*	None/N	Uncommon	Year-round	N/A	Western North Atlantic	18,726	Unknown	218	NMFS (2024a)
Sowerby's beaked whale	*Mesoplodon bidens*	None/N	Rare	Rare	N/A	Western North Atlantic	492	Unknown	0	NMFS (2024a)
Sperm whale	*Physeter macrocephalus*	E/D	Regular	Summer	N/A	North Atlantic	5,895	Unknown	0.2	NMFS (2024a)
Spinner dolphin	*Stenella longirostris*	None/N	Rare	Rare	N/A	Western North Atlantic	3,181	Unknown	Presumed 0	NMFS (2024a)
Striped dolphin	*Stenella coeruleoalba*	None/N	Rare	Rare	N/A	Western North Atlantic	48,274	Unknown	0	NMFS (2024a)
True's beaked whale	*Mesoplodon mirus*	None/N	Rare	Rare	N/A	Western North Atlantic	4,480	Unknown	0	NMFS (2024a)
White-beaked dolphin	*Lagenorhynchus albirostris*	None/N	Rare	Rare	N/A	Western North Atlantic	536,016	Unknown	0	Hayes et al. (2020)
Pinnipeds										
Gray seal	*Halichoerus grypus*	None/N	Common	Fall, winter, spring	N/A	Western North Atlantic	27,911	Increasing	4,570	NMFS (2024a)
Harbor seal	*Phoca vitulina*	None/N	Common	Fall, winter, spring	N/A	Western North Atlantic	61,336	Unknown	339	Hayes et al. (2022)
Harp seal	*Pagophilus groenlandicus*	None/N	Regular	Winter, spring	N/A	Western North Atlantic	Unknown[13]	Increasing	178,573	Hayes et al. (2022)
Hooded seal	*Cystophora cristata*	None/N	Rare	Summer, fall	N/A	Western North Atlantic	593,500	Increasing	1,680	Hayes et al. (2019)
Sirenians										
West Indian manatee	*Trichechus manatus*	T/D	Rare	Rare	No[14]	Florida	8,810[15]	Increasing or stable	98.6[16]	USFWS (2014, 2023)

D = depleted (strategic); E = endangered; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; N = non-strategic; N/A = not applicable; NMFS = National Marine Fisheries Service; T = threatened

[1] This denotes the highest federal regulatory classification (16 USC 1531 et seq. and 16 USC 1361 et seq.). A strategic stock is defined as any marine mammal stock:

a. for which the level of direct human-caused mortality exceeds the potential biological removal (PBR) level;
b. that is declining and likely to be listed as threatened under the ESA; or
c. that is listed as threatened or endangered under the ESA or as depleted under the MMPA.

[2] Relative occurrence in the offshore project area is defined as:

Common: occurring consistently in moderate to large numbers
Regular: occurring in low to moderate numbers on a regular basis or seasonally
Uncommon: occurring in low numbers or on an irregular basis
Rare: limited records exist for some years

[3] Seasonal occurrence, when available, was derived from abundance estimates using density models (Roberts 2022; Roberts et al. 2016, 2023) and NMFS Stock Assessment Reports (Waring et al. 2015; Hayes et al. 2019, 2020, 2021, 2022, 2023; NMFS 2024a). Seasons are depicted as follows: spring (March–May); summer (June–August); fall (September–November); winter (December–February).

[4] Unless otherwise noted, best available abundance estimates (N_{best}) are from NMFS stock assessment reports (Waring et al. 2015; Hayes et al. 2019, 2020, 2021, 2022, 2023; NMFS 2024a).

[5] Increasing = beneficial trend, not quantified; Decreasing = adverse trend, not quantified; Unknown = there are insufficient data to determine a statistically significant population trend (Waring et al. 2015; Hayes et al. 2019, 2020, 2021, 2022, 2023; NMFS 2024a).

[6] The total annual estimated average human-caused mortality and serious injury (M/SI), if known, is the sum of detected mortalities/serious injuries resulting from incidental fisheries interactions and vessel collisions within the U.S. EEZ. The value (number of individuals per year) represents a minimum estimate of human-caused mortality/serious injury only (Waring et al. 2015; Hayes et al. 2019, 2020, 2021, 2022, 2023; NMFS 2024a).

[7] No best population estimate exists for the blue whale; the minimum population estimate is presented in this table (Hayes et al. 2020).

[8] Critical habitat for NARW is established for its foraging area in the Gulf of Maine, approximately 170 miles northeast of the offshore project area, and calving area off the Southeast U.S., approximately 440 miles southwest of the offshore project area (81 *Federal Register* 4837).

[9] The human-caused mortality and serious injury estimate for NARW is based on a hierarchical Bayesian, state-space model (the same used to estimate the abundance for this population from Pace et al. [2017]) for adults and juveniles for the period from 2016 to 2020. In comparison, the total number of observed mortalities and serious injuries for NARW was 7.1 individuals per year for the period from 2017 and 2021 (NMFS 2024a).

[10] No statistically significant population trend is available for this stock. A decreasing trend is based on an analysis of coast-wide (New Jersey to Florida) trends in abundance for common bottlenose dolphin (Hayes et al. 2021).

[11] Estimated abundance is for *Kogia spp*. (dwarf and pygmy sperm whales) (Hayes et al. 2020).

[12] The total estimated human-caused mortality and serious injury for both the dwarf and pygmy sperm whales is unknown because the estimate of fishery-related mortality and serious injury includes both species and does not include any estimate of dwarf or pygmy sperm whales alone (NMFS 2024a).

[13] Hayes et al. (2022) report insufficient data to estimate the population size of harp seals in U.S. waters; the best estimate for the whole population (range-wide) is 7.6 million.

[14] Critical habitat for the West Indian manatee is limited to Florida and located approximately 745 miles southeast of the offshore project area (42 *Federal Register* 47840).

[15] A best population estimate is provided for the West Indian manatee, Florida subspecies (USFWS 2023). The current range-wide population estimate for the West Indian manatee (all subspecies) is 13,000 (USFWS 2019).

[16] Total annual average of human-caused morality only, from 2008 through 2012 (USFWS 2014).

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This Final PEIS assesses 17 species of marine mammals (comprising 18 stocks) that have been documented or are considered likely to occur in the offshore project area and that would likely overlap with activities associated with construction and installation, O&M, and conceptual decommissioning of the NY Bight projects. Occurrence, seasonality, habitat use, and relative densities of the 17 marine mammal species were assessed based on the most current available aerial and vessel survey data, which are routinely collected near the offshore project area. The 17 species considered likely to occur in the offshore project area include:

- Five ESA-listed whale species: blue whale, fin whale, NARW, sei whale, and sperm whale;
- Two non-ESA-listed whale species: humpback and minke whale;
- Seven species (comprising eight stocks) of dolphins, porpoises, and small whales: Atlantic white-sided dolphin, bottlenose dolphin (both the Western North Atlantic, Northern Migratory Coastal and Offshore stocks), common dolphin, harbor porpoise, long- and short-finned pilot whales, and Risso's dolphin; and
- Three pinniped species: gray, harp, and harbor seals.

3.5.6.1.1 Threatened and Endangered Marine Mammals

The ESA (16 USC 1531 et seq.) classifies certain species as threatened or endangered based on their overall population status and health. Five marine mammal species that are known to occur in the offshore project area are currently classified as endangered: blue whale, fin whale, NARW, sei whale, and sperm whale (Hayes et al. 2020, 2022, 2023; NMFS 2024a). The threatened West Indian manatee (*T. manatus*) has the potential to occur in the project area but is considered only a rare and infrequent visitor to the region, and is therefore not considered further in this analysis.

Van Parijs et al. (2023) and Westell et al. (2024) conducted acoustic surveys in the Rhode Island-Massachusetts WEA. These surveys indicated that sperm whales were occasionally present between May and November, with most detections between May and August. NARW were present September through May with sporadic presence in June through August. Sei whale presence was greatest February through June and July through August. Fin whales were present between August and April with sporadic presence from May to July. Finally, blue whales were rarely present with detections on only a few days in January and February. Davis et al. (2023) specifically assessed the presence of NARW upcalls in the Rhode Island-Massachusetts WEA and found that these calls were acoustically present at least one day every month but the highest occurrence was between November and April, and lowest between May and October. Additionally, on average, upcalls were detected from 7 to 12 days in a row or less with reoccurrence of the calls 95 percent of the time within 9 to 31 days following the first day of detection at a given recorder (Davis et al. 2023). Data from the Rhode Island-Massachusetts WEA are applicable to the NY Bight given the sperm whale is slope associated for feeding and has been seen within the NY Bight lease areas during numerous NMFS surveys.

Blue whale: Blue whales in the North Atlantic appear to target high-latitude feeding areas, primarily in the summer, and may also utilize deep-ocean features at or beyond the shelf break outside the summer feeding season (Pike et al. 2009; Lesage et al. 2017, 2018). In the NY Bight specifically, blue whales have been predominantly observed in fall and winter (Zoidis et al. 2021). Given their reported occurrence and habitat preferences, their presence in the project area is considered rare, although they could be encountered by vessels transiting to the lease areas from overseas ports.

Fin whale: Fin whales are common in continental shelf waters of the geographic analysis area north of Cape Hatteras, North Carolina and can occur year-round in the vicinity of the project area, although seasonal densities are highest in the summer, followed by spring (Tetra Tech and LGL 2020; Zoidis et al. 2021). Fin whales have also been reported in waters offshore the Fire Island National Seashore in New York (National Park Service 2015). A Biologically Important Area (BIA) for fin whale feeding has been identified for the area east of Montauk Point, New York, to the west boundary of the Rhode Island-Massachusetts lease areas between the 49-foot and 164-foot depth contour from March to October (LaBrecque et al. 2015).

NARW: Visual surveys in the NY Bight area indicate that NARW are present primarily from January to April (Tetra Tech and LGL 2020; Robinson Wilmot et al. 2021) while a year-round presence, with a peak in abundance during the late winter and early spring, is supported by acoustic studies (Davis et al. 2017). Highest densities occur in the shelf zone (Zoidis et al. 2021) in water depths ranging from 98 to 131 feet (30 to 40 meters) (Ramboll 2020). The offshore waters of New Jersey and New York, including waters in and near the project area, are considered a BIA for NARW migrations between feeding grounds off the Northeast United States and calving grounds off the Southeast United States (LaBrecque et al. 2015). Additionally, the seasonal cold pool in the NY Bight contains nutrient-rich waters that support primary productivity benefitting NARW by contributing to higher presence of their primary prey *Calanus* spp. (Zoidis et al. 2021). (Stone et al. 1988; Kann and Wishner 1995; Woodley and Gaskin 1996). NARW have also been reported in waters offshore the Fire Island National Seashore in New York (National Park Service 2015).

There have been elevated numbers of NARW mortalities and injuries reported since 2017, which prompted NMFS to designate an Unusual Mortality Event (UME) for NARW (NMFS 2024b). These elevated mortalities and injuries have continued into 2024, with a total of 139 reported mortalities, serious injuries, or morbidities (i.e., serious injury or illness) in U.S. and Canadian waters as of 13 June 2024 (NMFS 2024b). This includes 40 confirmed mortalities, 34 live free-swimming whales with serious injuries due to entanglement or vessel strike, and 65 individuals observed with sublethal injuries or illness documented (NMFS 2024b). Human interactions (e.g., fishery-related entanglements and vessel strikes) are the leading cause of this UME. Despite the recent optimistic number of births, the species continues to be in severe decline, which prompted the International Union for Conservation of Nature (IUCN) to update the species' red list status in July 2020 from endangered to critically endangered, noting its high risk for global extinction (Cooke 2020). Data show the NARW population declined in abundance from 2011 to 2020. Recruitment of new individuals from births remains low, with mortalities exceeding births by 3:2 during the 2017 to 2020 time frame (Pettis et al. 2021, 2022). Though births in 2021 (20 calves) were higher than in 2020 (10 calves), fewer births were recorded in 2022 (15 calves), 2023 (12 calves), and 2024 (17 calves as of 1 May 2024) (NMFS 2024c). In addition, mortalities continue to exceed the species' calculated potential biological removal (PBR) (NMFS 2024a; Pettis et al. 2021, 2022).[5] The current PBR for NARW is 0.7 individuals, whereas the total annual observed human-caused mortality and serious injury (M/SI) is 7.1 individuals (NMFS 2024a). Not all mortalities are detected (NMFS 2024a), and overall mortality rate is likely higher than the estimated value (Pace 2021). As such, modeling suggests the mortality rate could be as high as 27.2 animals per year (NMFS 2024a). Most recent data continue to indicate substantial population decline, up to 29.3 percent between 2011 and 2021 (NMFS 2024a). The current population estimate for NARW is at its lowest point in nearly 20 years, with a best-estimated 340 individuals remaining (NMFS 2024a; Pettis et al. 2023). Additional information about the current population status for NARW is provided in the most recent draft Stock Assessment Report (NMFS 2024a). When coupled with the species' low fecundity and small population size, all human-caused mortalities could affect their population status. The species' high mortality rate is driven primarily by fishing gear entanglement and vessel strike (NMFS 2024a).

Sei whale: Sei whales are also considered rare in the offshore project area, but are regular visitors to the areas near the continental slope where they have been observed predominantly in the spring, with possible year-round occurrence (Zoidis et al. 2021). Sei whales typically express irregular movement patterns that appear to be associated with oceanic fronts, sea surface temperatures, and specific bathymetric features (Olsen et al. 2009; Hayes et al. 2022). Sei whales are also often sighted foraging in conjunction with NARW during the spring when they target the same zooplankton prey species (Davis et al. 2020). A BIA for sei whale feeding has been identified from the 82-foot depth contour off coastal Maine and Massachusetts west to the 656-foot depth contour in the central Gulf of Maine, including the northern shelf break area of Georges Bank (LaBrecque et al. 2015).

Sperm whale: Sperm whales are more commonly observed near the continental shelf edge, continental slope, and mid-ocean regions in association with bathymetric features, though they also occur on the continental shelf in some regions, including in the vicinity of the offshore project area (Hayes et al. 2020; Zoidis et al. 2021). The species was detected in the NY Bight area during visual surveys year-round, with a peak in abundance during the summer, though it is considered relatively uncommon (Tetra Tech and LGL 2020). Most of these endangered whale species have also been reported in nearshore waters feeding along the coast in NY Bight (National Park Service 2014).

Critical habitat: Of the marine mammal species listed under the ESA, critical habitat has only been designated for NARW and West Indian manatee. Critical habitat for NARW within the marine mammal geographic analysis area comprises the Gulf of Maine feeding areas in Cape Cod Bay, Stellwagen Bank, and the Great South Channel, as well as the nearshore calving grounds that stretch from Cape Canaveral, Florida to Cape Fear, North Carolina (50 CFR 226). These critical habitat areas do not overlap with the offshore project area; however, the general region and, more broadly, the North Atlantic OCS, is an important migratory corridor for NARW and other ESA-listed large whales (Hayes et al. 2020, 2022, 2023; NMFS 2024a). The closest designated NARW critical habitat area is approximately 170 miles (274

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[5] The calculated PBR is the maximum number of animals, not including in natural mortalities, which may disappear annually from a marine mammal stock while allowing that stock to reach or maintain its optimal sustainable population level.

kilometers) northeast of the offshore project area. Critical habitat established for the West Indian manatee (42 *Federal Register* 47840) is located approximately 745 miles (1,199 kilometers) southeast of the offshore project area; the extent of this species' designated critical habitat is limited to Florida and does not overlap with the project area.

3.5.6.1.2 Non-ESA-listed Marine Mammals

All marine mammals are protected pursuant to the MMPA (16 USC 1361 et seq.), and their populations are monitored by NOAA (except for the West Indian manatee, which is managed by USFWS). Mysticetes that are not ESA-listed and commonly or regularly occur in the offshore project area include the humpback whale and minke whale. Humpback and minke whales are also observed feeding in nearshore coastal waters within the NY Bight (National Park Service 2014). Odontocete whales and dolphin species expected to occur near the offshore project area include the Atlantic spotted dolphin, Atlantic white-sided dolphin, bottlenose dolphin, common dolphin, long-finned and short-finned pilot whales, and Risso's dolphin. Acoustic studies of delphinids indicate they are continuously present year-round in the Rhode Island-Massachusetts WEA (Van Parijs et al. 2023) and visual surveys have verified these acoustic detections in the NY Bight (Palka et al. 2017, 2021). The National Park Service (2014, 2015) further indicates that dolphins have been reported in waters offshore the Fire Island National Seashore in New York and have been reported in nearshore coastal waters within the NY Bight.

Humpback whale: Humpback whales are observed in the NY Bight area year-round with peak abundances occurring during the summer, followed by the fall (Tetra Tech and LGL 2020; Van Parijs et al. 2023). Humpback whales have also been reported in waters offshore the Fire Island National Seashore in New York (National Park Service 2015). The humpback whale was previously federally listed as endangered. However, based on the revised listing completed by NOAA in 2016, the DPS of humpback whales that occurs along the East Coast of the United States (West Indies DPS) is no longer considered endangered or threatened (Hayes et al. 2020, 2021). This stock continues to experience a positive trend in abundance (Hayes et al. 2020). However, in January 2016, a UME was declared for this species. Since then, 75 humpback whales have stranded in New Jersey and New York contributing to a total of 224 strandings along the Atlantic coast from Maine to Florida as of 13 June 2024 (NMFS 2024d). A potential leading cause of the ongoing UME is vessel strikes. A recent uptick in large whale strandings during late 2022 and early 2023 along the New Jersey and New York coastlines, primarily of humpback whales, is currently being evaluated by NMFS. However, there is no causal connection between recent offshore wind development and large whale mortality, and such assumption is contrary to the scientific consensus. The overwhelming scientific consensus is that offshore wind activity is not a cause of these marine mammal mortalities. Instead, the scientific community has determined the UME for humpback whales is primarily caused by non-offshore-wind vessel strikes and fishing gear entanglements. NOAA, the Marine Mammal Commission, academic institutions (e.g., Rutgers University, University of Rhode Island, Yale), environmental organizations (e.g., Sierra Club, Natural Resources Defense Council), BOEM, and DOE have all issued official statements that no marine mammal mortality has been attributed to offshore wind activities. Additionally, Thorne and Wiley (2024) assessed large whale strandings and found no evidence that offshore wind development contributed to strandings or mortalities.

Minke whale: The minke whale is present year-round in the offshore project area, with highest abundances recorded in the spring months (Ecology and Environment Engineering 2017; Risch et al. 2014; Van Parijs et al. 2023). A BIA for minke whale feeding has been identified in waters less than 656 feet in the southern and southwestern section of the Gulf of Maine, including Georges Bank, the Great South Channel, Cape Cod Bay, Massachusetts Bay, Stellwagen Bank, Cape Anne, and Jeffreys Ledge (LaBrecque et al. 2015). A UME was declared for the minke whale in January 2017 (NMFS 2024e). A total of 166 individuals stranded from Maine to South Carolina as of 1 May 2024, with 39 occurring in New Jersey and New York. Preliminary results of necropsy examinations indicate evidence of human interactions or infectious disease; however, these results are not conclusive (NMFS 2024e).

Odontocete whales and dolphins: The bottlenose dolphin is commonly observed in the NY Bight area with a peak abundance in the summer (Tetra Tech and LGL 2020). Two distinct stocks of Western North Atlantic bottlenose dolphins are likely to occur within the offshore project area: the northern migratory coastal and offshore stocks (Hayes et al. 2020, 2021). Although they can be difficult to differentiate during surveys, the coastal and offshore stocks represent different ecotypes with morphological and genetic differences. During warmer months, the migratory coastal stock, consisting of distinct northern and southern stocks, is found from the coastline out to the 20-meter isobath between Assateague, Virginia, and Long Island, New York; in the colder months this stock has been found to occupy coastal waters from Cape Lookout, North Carolina to the North Carolina/Virginia border (Hayes et al. 2021). The southern extent of the northern migratory coastal stock overlaps with that of the southern migratory coastal stock around the Virginia/Maryland border; given these defined stock management ranges, the southern migratory coastal stock is not expected to occur regularly within the project area (Hayes et al. 2021). Because the current stock assessment relies heavily on survey data for abundance and distribution information, the northern migratory coastal and offshore bottlenose dolphin stocks are referred to collectively as a single group.

Common dolphins occur year-round in the project area; strong seasonal changes in abundance are evident and the highest densities are recorded during the winter (Tetra Tech and LGL 2020). The species is the second-most observed odontocete in the NY Bight area (Tetra Tech and LGL 2020). Atlantic white-sided dolphins are relatively uncommon in the NY Bight area, with a highest likelihood of occurrence in seasons other than summer when the vast majority of the population is located in waters north of the offshore project area (Hayes et al. 2022; Tetra Tech and LGL 2020). Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale (*G. melas*) and the short-finned pilot whale (*G. macrorhynchus*). Short-finned pilot whales are less likely to occur in the project area compared to their long-finned counterpart. Pilot whales and Risso's dolphins are typically observed further offshore and in association with unique bathymetric features such as the shelf edge (Hayes et al. 2022). Both pilot whales and Risso's dolphins are regularly encountered during survey efforts and can occur year-round in the NY Bight area, with highest densities in deeper waters offshore in the NY Bight during the spring and summer for pilot whales and spring, summer, and fall for Risso's dolphins (Palka et al. 2021; Tetra Tech and LGL 2020). Harbor porpoises prefer coastal waters shallower than 492 feet (150 meters) but can also be found farther offshore. The species is relatively uncommon in the NY Bight area, though they can occur year-round with a seasonal peak in the winter and spring (Tetra Tech and LGL 2020; Van Parijs et al. 2023).

Pinnipeds: The only pinniped species expected to commonly occur in the project area are harbor seals and gray seals, with the former being the most dominant. Although they can occur year-round, both species are typically present seasonally in the nearshore waters of the NY Bight area, with highest densities during the winter and spring (Robinson Willmot et al. 2021). Additionally, they have been reported as regular winter visitors to National Park Service recreational areas in Sandy Hook, Great Kills Park, Hoffman Island, Swinburne Island, and Jamaica Bay (National Park Service 2014). Gray and harbor seals may also occur in offshore waters, including the NY Bight lease areas (Robinson Willmot et al. 2021). Since July 2018, increased numbers of gray seal and harbor seal mortalities have been recorded across Maine, New Hampshire, and Massachusetts, with strandings as far south as Virginia (NMFS 2022a). This event was declared a UME by NMFS and encompasses 3,152 seal strandings, with 273 reported in New Jersey and New York as of 13 June 2024 (NMFS 2024f). The pathogen phocine distemper virus was found in most deceased seals and has been identified as the cause of the UME. This UME is no longer active and pending closure by NMFS (NMFS 2022a). Additionally, another UME was declared for harbor and gray seals along the coast of Maine between 20 June and 20 July 2022, which was determined to be attributed to spillover events of the highly pathogenic avian influenza H5N1 virus from infected birds. The Maine pinniped UME resulted in a total of 181 seal strandings throughout coastal Maine (NMFS 2024f).

3.5.6.1.3 The Importance of Sound to Marine Mammals

Marine mammals rely heavily on acoustic cues for extracting information from their environment (National Research Council 1994). Sound travels faster and farther in water (approximately 1,500 meters per second) than it does in air (approximately 350 meters per second), making it a reliable mode of information transfer across large distances and in dark environments where visual cues are limited. Acoustic communication is used in a variety of contexts, such as attracting mates, communicating to young, or conveying other relevant information (Bradbury and Vehrencamp 2011). Marine mammals can also glean information about their environment by listening to acoustic cues, like ambient sounds from a reef, the sound of an approaching storm, or the call from a nearby predator. Finally, toothed whales produce and listen to echolocation clicks to locate food and to navigate (Madsen and Surlykke 2013).

Hearing Anatomy

Like terrestrial mammals, the auditory anatomy of marine mammals generally includes the inner, middle, and outer ear (Ketten 1994). Not all marine mammals have an outer ear, but if it is present, it funnels sound into the auditory pathway, capturing the sound. The middle ear acts as a transformer, filtering and amplifying the sound. The inner ear is where auditory reception takes place. The key structure in the inner ear responsible for auditory perception is the cochlea, a spiral-shaped structure containing the basilar membrane, which is lined with auditory hair cells. Specific areas of the basilar membrane vibrate in response to the frequency content of the acoustic stimulus, causing hair cells mapped to specific frequencies to be differentially stimulated and send signals to the brain (Ketten 1994). While the cochlea and basilar membrane are well conserved structures across all mammalian taxa, there are some key differences in the auditory anatomy of terrestrial vs. marine mammals that require explanation. Marine mammals have the unique need to hear in aqueous environments. Amphibious marine mammals (including seals, sea otters, and sea lions) have evolved to hear in both air and under water, and all except phocid pinnipeds have external ear appendages. Cetaceans do not have external ears, do not have air-filled external canals, and the bony portions of the ear are much denser than those of terrestrial mammals (Ketten 1994).

All marine mammals have binaural hearing and can extract directional information from sound. The pathway that sound takes into the inner ear is not well understood for all cetaceans and may not be the same for all species. For example, in baleen whales (i.e., mysticetes), bone conduction through the lower jaw may play a role in hearing (Cranford and Krysl 2015), while odontocetes have a fat-filled portion of the lower jaw which is thought to funnel sound toward the ear (Mooney et al. 2012). Hearing tests have been conducted on several species of odontocetes, but there has yet to be a hearing test on a baleen whale, so most of our understanding comes from examining the ears from deceased whales (Erbe et al. 2016; Houser et al. 2017).

Many marine mammal species produce sounds through vibrations in their larynx (Frankel 2002). In baleen whales, for example, air in the lungs and laryngeal sac expands and contracts, producing vibrations and sounds within the larynx (Frankel 2002). Baleen whales produce low frequency sounds that can be used to communicate with other animals over great distances (Clark and Gagnon 2002). Differences in sound production among marine mammals varies, in part, with their use of the marine acoustic environment. Toothed whales hunt for their prey using high-frequency echolocation signals. To produce these signals, they have a specialized structure called the "melon" in the top of their head that is used for sound production. When air passes through the phonic lips, a vibration is produced, and the melon helps transmit the vibration from the phonic lips to the environment as a directed beam of sound (Frankel 2002). It is generally believed that if an animal produces and uses a sound at a certain frequency, its hearing sensitivity will at least overlap those particular frequencies. An animal's hearing range is likely much broader than this, as they rely heavily on acoustic information—beyond the signals they produce themselves—to understand their environment.

Functional Hearing Groups

Marine mammal species have been classified into functional hearing groups based on similar anatomical auditory structures and frequency-specific hearing sensitivity obtained from hearing tests on a subset of species (Finneran 2015; NMFS 2018; Southall et al. 2019). For those species for which empirical measurements have not been made, the grouping of phylogenetic and ecologically similar species is used for categorization. This concept of marine mammal functional hearing groups was first described in 2007 by Southall et al. and included five groups: low-, mid-, and high-frequency cetaceans, pinnipeds in water, and pinnipeds in air.

These functional hearing groups were further modified by the NMFS in their underwater acoustic guidance document (NMFS 2018), mainly to separate phocid pinnipeds from otariid pinnipeds, and updated again by Southall et al. in 2019. The science (Southall et al. 2019) now supports the need for at least eight functional hearing groups, i.e., low-frequency cetaceans, high-frequency cetaceans, very high frequency cetaceans, sirenians, phocids in air, phocids in water, other marine carnivores in air, and other marine carnivores in water, described in Southall et al. 2019.

Table 3.5.6-2. Marine mammal functional hearing groups[1]

Hearing Group	Generalized Hearing Range[2]
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, Lagenorhynchus cruciger and L. australis)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

[1] From NMFS 2018 technical guidance showing the most current marine mammal hearing groups used in the regulatory process in the United States.

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

Potential Impacts of Underwater Sound

Depending on the level of exposure, the context, and the type of sound, potential impacts of underwater sound on marine mammals may include non-auditory injury, permanent or temporary hearing loss, behavioral changes, acoustic masking, or increases in physiological stress (OSPAR Commission 2009). Each of these impacts is discussed below.

Non-auditory Injury: Non-auditory physiological impacts are possible for very intense sounds or blasts, such as explosions. This kind of impact is not expected for most of the activities associated with offshore wind development; it is only possible during detonation of UXOs or if explosives are used in conceptual decommissioning. Although many marine mammals can adapt to changes in pressure during their deep foraging dives, the shock waves produced by explosives expose the animal to rapid changes in pressure, which in turn causes a rapid expansion of air-filled cavities (e.g., the lungs, gastrointestinal [G.I.] tract). This forces the surrounding tissue or bone to move beyond its limits which may lead to tears, breaks, or hemorrhaging. The extent and severity to which such injury will occur depends on several factors including the size of these air-filled cavities, ambient pressure, how close an animal is to the blast, and how large the blast is (Department of Navy 2017). In extreme cases, this can lead to severe lung damage which can directly kill the animal; a less severe lung injury may indirectly lead to death due to an increased vulnerability to predation or the inability to complete foraging dives. Exposure to underwater explosions can also result in G.I. injuries (Department of Navy 2017).

Permanent or Temporary Hearing Loss: An animal's auditory sensitivity to a sound depends on the spectral, temporal, and amplitude characteristics of the sound (National Research Council 1994; Richardson et al. 1995). When exposed to sounds of significant duration and amplitude (typically within close range of a source), marine mammals may experience noise-induced threshold shifts. PTS is an irreversible loss of hearing due to hair cell loss or other structural damage to auditory tissues (Henderson et al. 2008; Saunders et al. 1985). TTS is a relatively short-term (e.g., within several hours or days), reversible loss of hearing following noise exposure (Finneran 2015; Southall et al. 2007), often resulting from hair cell fatigue (Saunders et al. 1985; Yost 2000). While experiencing TTS, the hearing threshold rises, meaning that a sound must be louder in order to be detected. Prolonged or repeated exposure to sounds at levels that are sufficient to induce TTS without adequate recovery time can lead to PTS (Finneran 2015; Southall et al. 2007).

Behavioral Disturbance: Farther away from a source and at lower received levels, marine mammals show varying levels of disturbance to underwater noise sources, ranging from no observable response to overt behavioral changes. Individuals may flee from an area to avoid the noise source; may exhibit changes in vocal activity, foraging patterns, or change their typical dive behavior; and may experience increases in physiological stress or reduced breeding opportunities, among other responses (National Research Council 1994, 2000, 2003). When exposed to the same sound repeatedly, it is possible that marine mammals may become either habituated (show a reduced response) or sensitized (show an increased response) (National Research Council 1994; Bejder et al. 2009). Several contextual factors play a role in whether an animal exhibits a response to a sound source, including those intrinsic to the animal and those related to the sound source. Some of these factors include: (1) the exposure context (e.g., behavioral state of the animal, habitat characteristics), (2) the biological relevance of the signal (e.g., whether the signal is audible, whether the signal sounds like a predator), (3) the life stage of the animal (e.g., juvenile, mother and calf), (4) prior experience of the animal (e.g., is it a novel sound source), (5) sound properties (e.g., duration of sound exposure, sound pressure level, sound type, mobility/directionality of the source), and (6) acoustic properties of the medium (e.g., bathymetry, temperature, salinity) (Southall et al. 2021a). Because of these many factors, behavioral disturbances are challenging to both predict and measure, and remains an ongoing field of study within the field of marine mammal bioacoustics. Furthermore, the implications of behavioral disturbances can range from temporary displacement of an individual to long-term consequences on a population if there is a demonstrable reduction in fitness (e.g., due to a reduction in foraging success).

Auditory Masking: Auditory masking may occur over larger spatial scales than noise-induced threshold shift or behavioral disturbance. Masking occurs when a noise source overlaps in time, space, and frequency as a signal that the animal is either producing or trying to extract from its environment (Richardson et al. 1995, Clark et al. 2009). Masking can reduce an individual's "communication space," (the range at which it can effectively transmit and receive acoustic cues from conspecifics) or "listening space" (the range at which it can detect relevant acoustic cues from the environment). A growing body of research is focused on the risk of masking from anthropogenic sources, the ecological significance of masking, and what anti-masking strategies may be used by marine animals. This understanding is essential before masking can be properly incorporated into regulation or mitigation approaches (Erbe et al. 2016). As a result, most assessments only consider the overlap in frequency between the sound source and the hearing range of marine mammals.

Physiological stress: The presence of anthropogenic noise, even at low levels, can increase physiological stress in a range of taxa, including humans (Kight and Swaddle 2011; Wright et al. 2007). This is extremely difficult to measure in wild animals, but several methods have recently emerged that may allow for reliable measurements in marine mammals. Baleen plates store both adrenal steroids (stress biomarkers, e.g., cortisol) and reproductive hormones and, at least in bowhead whales, can be reliably analyzed to determine the retrospective record of prior reproductive cycles (Hunt et al. 2014). Waxy earplugs from baleen whales can be extracted from museum specimens and assayed for cortisol levels; one study demonstrated a potential link between historical whaling levels and stress (Trumble et al. 2018). These retrospective methods are helpful for answering certain questions, while the collection of fecal samples is a promising method for addressing questions about more recent stressors (Rolland et al 2005).

The effects of anthropogenic sound on marine life have been studied for more than half a century. In that time, it has become clear that this is a complex subject with many interacting factors and extreme variability in response from one sound source to another and from species to species. But some general trends have emerged from this body of work. First, the louder and more impulsive (Appendix J, *Introduction to Sound and Acoustic Assessment*) the received sound is, the higher the likelihood that there will be an adverse physiological effect, such as PTS or TTS. These impacts generally occur at relatively close distances to a source, in comparison to behavioral effects, masking, or increases in stress, which can occur wherever the sound can be heard. Secondly, the hearing sensitivity of an animal plays a major role in whether it will be affected by a sound or not, and there is a wide range of hearing sensitivities among marine mammal species. Regulation to protect marine life from anthropogenic sound has formed around these general concepts. More information about the regulatory process associated with noise impacts can be found in Appendix J.

Regulation of Underwater Sound for Marine Mammals

The MMPA prohibits the "take" of marine mammals, defined as the harassment, hunting, capturing, killing, or an attempt of any of those actions on a marine mammal. This act requires that an incidental take authorization be obtained for the incidental take of marine mammals as a result of anthropogenic activities. MMPA regulators divide the effects on marine mammals that could result in a take into Level A and Level B, defined as follows:

- Level A: Any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild.
- Level B: Any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but that does not have the potential to injure a marine mammal or marine mammal stock in the wild (16 USC 1362).

With respect to anthropogenic sounds, Level A takes generally include injurious impacts like PTS, whereas Level B takes include behavioral effects as well as TTS. The current regulatory framework used by NMFS for evaluating an acoustic take of a marine mammal involves assessing whether the animal's received sound level exceeds a given threshold. For Level A, this threshold differs by functional hearing group, but for Level B, the same threshold is used across all marine mammals.

Thresholds for Auditory Injury

The current NMFS (2018) injury (Level A) thresholds consist of dual criteria of Lpk and 24 hour-cumulative SEL thresholds (Table 3.5.6-3). These criteria are used to predict the potential range from the source within which injury may occur. The criterion that results in the larger physical impact range is generally used, to be most conservative. The SEL thresholds are frequency-weighted, which means that the sound is essentially filtered based on the animal's frequency-specific hearing sensitivity, de-emphasizing the frequencies at which the animal is less sensitive (see the Table 3.5.6-2 for the frequency range of hearing for each group). The frequency weighting functions are described in detail in Finneran (2016).

Table 3.5.6-3. The acoustic thresholds for onset of PTS and TTS for marine mammals for both impulsive and non-impulsive sound sources

Marine Mammal Functional Hearing Group	Effect	Impulsive Source		Non-Impulsive Source
		L_{pk} (dB re 1 µPa)	Weighted SEL_{24h} (dB re 1 µPa²s)	Weighted SEL_{24h} (dB re 1 µPa²s)
Low-frequency cetaceans	PTS	219	183	199
	TTS	213	168	179
Mid-frequency cetaceans	PTS	230	185	198
	TTS	224	170	178
High-frequency cetaceans	PTS	202	155	173
	TTS	196	140	153
Phocid pinnipeds underwater	PTS	218	185	201
	TTS	212	170	181
Otariid pinnipeds underwater	PTS	232	203	199
	TTS	226	188	199

Source: NMFS (2018).

Lpk values are unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 kHz): Values presented for SEL use a 24-hour accumulation period unless stated otherwise, and are weighted based on the relevant marine mammal functional hearing group (Finneran 2016). dB re 1 µPa = decibels relative to 1 micropascal; dB re 1 µPa2s = decibels relative to 1 micropascal squared second. Note: non-impulsive sources can also be compared to the Lpk criteria if there is a chance of exceedance.

Auditory Injury from Explosives: The supersonic shock wave from an explosion transitions to a normal pressure wave at a range determined by the weight and type of the explosive used. The range to the TTS and PTS threshold are outside of these radii, and the normal impulsive TTS and PTS thresholds (Table 3.5.6-3) are applicable for determining auditory injury impacts (NMFS 2018).

Thresholds for Behavioral Disturbance

NMFS currently uses a threshold for behavioral disturbance (Level B) of 160 dB re 1 µPa SPL for non-explosive impulsive sounds (e.g., airguns and impact pile-driving) and intermittent sound sources (e.g., scientific and non-tactical sonar), and 120 dB re 1 µPa SPL for continuous sounds (e.g., vibratory pile-driving, drilling, etc.) (NMFS 2022c). This is an "unweighted" criterion that is applicable for all marine mammal species. In-air behavioral thresholds exist for harbor seals and non-harbor seal pinnipeds at 90 dB re 20 µPa SPL and 100 dB re 20 µPa SPL, respectively (NMFS 2022c). Unlike with sound exposure level-based thresholds, the accumulation of acoustic energy over time is not relevant for this criterion – meaning that a Level B take can occur even if an animal experiences a received SPL of 160 dB re 1 µPa very briefly in one instance.

While the Level B criterion is generally applied in a binary fashion, as alluded to previously, there are numerous factors that determine whether an individual will be affected by a sound, resulting in substantial variability even in similar exposure scenarios. In particular, it is recognized that the context in which a sound is received affects the nature and extent of responses to a stimulus (Ellison et al. 2012; Southall et al. 2007). Therefore, a "step function" concept for Level B harassment was introduced by Wood et al. (2012) whereby proportions of exposed individuals experience behavioral disturbance at different received levels, centered at an SPL of 160 dB re 1 µPa. These probabilistic thresholds reflect the higher sensitivity that has been observed in beaked whales and migrating mysticete whales (Table 3.5.6-4). At the moment, this step function provides additional insight to calculating Level B takes for certain species groups. The M-weighting functions, described by Southall et al. (2007) and used for the Wood et al. (2012) probabilistic disturbance step thresholds, are different from the weighting functions by Finneran (2016), previously mentioned. The M-weighting was specifically developed for interpreting the likelihood of audibility, whereas the Finneran weighting functions were developed to predict the likelihood of auditory injury.

Table 3.5.6-4. Probabilistic disturbance SPL thresholds (M-weighted) used to predict a behavioral response[1]

	Probabilistic disturbance SPL thresholds (M-weighted) dB re 1 µPa			
Marine Mammal Group	**120**	**140**	**160**	**180**
Porpoises/beaked whales	50%	90%		
Migrating mysticete whales	10%	50%	90%	
All other species/behaviors		10%	50%	90%

Source: Wood et al. (2012).

[1] Probabilities are not additive and reflect single points on a theoretical response curve.

SPL = root-mean-square sound pressure level.

Behavioral Disturbance from Explosives: Single blast events within a 24-hour period are not presently considered by NMFS to produce behavioral effects if exposures are below the onset of TTS thresholds for frequency-weighted SEL and peak pressure level. Only short-term startle responses are expected as far as behavioral responses. For multiple detonations, the threshold applied for behavioral effects is that same TTS threshold minus 5 dB (see Table 3.5.6-4 for TTS threshold values).

Thresholds for Non-Auditory Injury

Shock waves associated with underwater detonations can induce non-auditory physiological effects, including mortality and direct tissue damage (i.e., severe lung injury, slight lung injury, and G.I. tract injury). The magnitude of the acoustic impulse, measured in Pascal-seconds, is the integral of the positive-pressure shock pulse over time and serves as the threshold to predict non-auditory lung injury and mortality. Because lung capacity or size is generally directly related to the size of an animal, body mass is one parameter used to predict the likelihood of lung injury. Additionally, the depth of the animal is used, as this represents the ambient pressure conditions of the animal, as a scaling parameter for lung volume. G.I. tract injury potential is identified using the peak sound pressure level and is considered to occur beginning at levels of 237 dB re 1 µPa. The U.S. Navy established thresholds to assess the potential for mortality and slight lung injury from explosive sources based on a modified Goertner Equation (Department of Navy 2017). This model is recommended by NMFS for predicting injury impacts to marine mammals from explosives. Table 3.5.6-5 provides an estimate of mass of the different marine mammal species covered in this assessment. Table 3.5.6-6 and Table 3.5.6-7 list the equations used to calculate thresholds based on effects observed in 50 percent and 1 percent of animals, respectively.

Table 3.5.6-5. Representative calf/pup and adult mass estimates used for assessing impulse-based onset of lung injury and mortality threshold exceedance distances

Impulse Animal Group	Representative Species	Calf/Pup Mass (kilograms)	Adult Mass (kilograms)
Baleen whales and Sperm whale	Sei whale (*Balaenoptera borealis*), Sperm whale (*Physeter macrocephalus*)	650	16,000
Pilot and Minke whales	Minke whale (*Balaenoptera acutorostrata*)	200	4,000
Beaked whales	Gervais' beaked whale (*Mesoplodon europaeus*)	49	366
Dolphins, Kogia, Pinnipeds, and Sea Turtles	Harbor seal (*Phoca vitulina*)	8	60
Porpoises	Harbor porpoise (*Phocoena phocoena*)	5	40

Table 3.5.6-6. U.S. Navy impulse and peak pressure threshold equations for estimating numbers of marine mammals and sea turtles that may experience mortality or injury due to explosives

Impact Assessment Criterion	Threshold
Mortality – Impulse	$144M^{1/3}(1+ D/10.1)^{1/6}$ Pa-s
Injury – Impulse	$65.8M^{1/3}(1+ D/10.1)^{1/6}$ Pa-s
Injury – Peak Pressure	Lpk of 243 dB re 1 µPa

Source: Department of Navy 2017.
Where M is animal mass (kg) and D is animal depth (m).

Table 3.5.6-7. U.S. Navy impulse and peak pressure threshold equations for estimating distances to onset of potential effect for marine mammal and sea turtle mortality and slight lung injury due to explosives

Impact Assessment Criterion	Threshold
Onset Mortality - Impulse	$103M^{1/3}(1+ D/10.1)^{1/6}$ Pa-s
Onset Injury (Non-auditory) - Impulse	$47.5M^{1/3}(1+ D/10.1)^{1/6}$ Pa-s
Onset Injury (Non-auditory – Peak Pressure	Lpk of 237 dB re 1 µPa

Source: Department of Navy 2017.
[1] These thresholds are relevant for mitigation planning.
Where M is animal mass (kg) and D is animal depth (m).

General Approach to Acoustic Exposure Modeling

In order to predict the number of individuals of a given species that may be exposed to harmful levels of sound from a specific activity, a series of modeling exercises are conducted. First, the sound field of a sound-generating activity is modeled based on characteristics of the source and the physical environment. From the sound field, the range to the U.S. regulatory acoustic threshold isopleths can be predicted. This approach is referred to as acoustic modeling. By overlaying the marine mammal density information for a certain species or population in the geographical area of the activity, the number of animals exposed within the acoustic threshold isopleths is then predicted. This is called exposure modeling. Some models further incorporate animal movement to make more realistic predictions of exposure numbers. Animal movement models may incorporate behavioral parameters including swim speeds, dive depths, course changes, or reactions to certain sound types, among other factors. Exposure modeling may be conducted for a range of scenarios including different seasons, energy (e.g., pile-driving hammers), mitigation strategies (e.g., 6 dB versus 10 dB of attenuation), and levels of effort (e.g., number of piles per day). Acoustic exposure modeling is conducted based on project-specific information detailed in a developer's COP as related to noise-generating construction activities. Because this assessment is programmatic, project-specific details are not available and therefore no acoustic exposure modeling has been conducted.

3.5.6.2 Impact Level Definitions for Marine Mammals

Definitions of potential impact levels are provided in Table 3.5.6-8. Beneficial impacts on marine mammals are described using the definitions described in Section 3.3.2 (see Table 3.3-1).

Table 3.5.6-8. Adverse impact level definitions for marine mammals

Impact Level	Definition
Negligible	The impacts on individual marine mammals and their habitat, if any, would be at the lowest levels of detection and barely measurable, with no perceptible consequences to individuals or the population.
Minor	Impacts on individual marine mammals and their habitat would be detectable and measurable; however, they would be of low intensity, short term, and localized. Impacts on individuals and their habitat would not lead to population-level effects.
Moderate	Impacts on individual marine mammals and their habitat would be detectable and measurable; they would be of medium intensity, can be short term or long term, and can be localized or extensive. Impacts on individuals and their habitat could have population-level effects, but the population can sufficiently recover from the impacts or enough habitat remains functional to maintain the viability of the species both locally and throughout their range.
Major	Impacts on individual marine mammals and their habitat would be detectable and measurable; they would be of severe intensity, can be long-lasting or permanent, and would be extensive. Impacts on individuals and their habitat would have severe population-level effects and compromise the viability of the species.

These significance criteria are intended to serve NEPA purposes only, and they are not intended to incorporate similar terms of art used in other statutory or regulatory reviews. For example, the term "negligible" will be used for NEPA purposes as defined here and is not necessarily intended to indicate a negligible impact or effect under the MMPA. Similarly, the use of "detectable" or "measurable" in the NEPA significance criteria is not necessarily intended to indicate whether an effect is "insignificant" or "adverse" for purposes of ESA Section 7 consultation. For ESA Section 7 consultation, "insignificant effects" relate to the size of the impact and should never reach the scale where take occurs. Based on best judgment, a person would not be able to meaningfully measure, detect, or evaluate insignificant effects.

Accidental releases, cable emplacement and maintenance, discharges/intakes, electric and magnetic fields and cable heat, survey gear utilization, lighting, noise, port utilization, presence of structures, and traffic are contributing IPFs to impacts on marine mammals. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.5.6-9.

Table 3.5.6-9. Issues and indicators to assess impacts on marine mammals

Issue	Impact Indicator
Seabed and water column alteration	Water column volume and acres of seabed disturbance, loss, or conversion by structure presence.
Habitat alteration and hydrodynamic effects	Extent of habitat conversion (e.g., foraging habitat, open water to hard vertical habitat) or changes to prey aggregations due to hydrodynamic impacts from the presence of offshore structures.
Underwater noise from construction, operations, and conceptual decommissioning	Extent, frequency, and duration of impacts resulting from noise above established effects thresholds as noted in Section 2.5 (Tables 3 and 4) in the Construction and Operations Plan Modeling Guidelines.[1]
Vessel collision	Qualitative estimate of potential collision risk.
Water quality impacts	Quantitative estimate of intensity and duration of suspended sediment effects. Qualitative analysis of impacts from potential discharges (fuel spills, trash, and debris) relative to baseline.
Artificial light	Intensity, frequency, and duration of impacts relative to baseline conditions.
Power transmission	Theoretical extent of detectable electric and magnetic effects.
Prey impacts	Extent, frequency, and duration of impacts resulting from activities associated with offshore wind development on prey species for marine mammals.
Entanglement risk from gear/wind equipment	Qualitative estimate of potential entanglement risk.

[1] Source: https://www.boem.gov/renewable-energy/boemoffshorewindpiledrivingsoundmodelingguidance.

3.5.6.3 Impacts of Alternative A – No Action – Marine Mammals

When analyzing the impacts of the No Action Alternative on marine mammals, BOEM considered the impacts of ongoing activities, including ongoing non-offshore-wind and ongoing offshore wind activities, on the baseline conditions for marine mammals. 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, which are described in Appendix D, *Planned Activities Scenario*.

3.5.6.3.1 Impacts of the No Action Alternative

Under Alternative A, baseline conditions for marine mammals described in Section 3.5.6.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends, and respond to project-related IPFs introduced by other ongoing non-offshore-wind and offshore wind activities. Ongoing activities other than offshore wind within the geographic analysis area that contribute to impacts on marine mammals include 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 (i.e., sonar); marine transportation; fisheries use and management; NMFS research initiatives; oil and gas activities; installation of new structures on the U.S. Continental Shelf; onshore development activities; and global climate change (see Appendix D for a description of ongoing and planned activities). These activities contribute to numerous IPFs, detailed in Table 3.5.6-10. The main known contributors to mortality events include collisions with vessels (ship strikes) and entanglement with fishing gear, including fisheries bycatch. Many marine mammal migrations cover long distances, and these factors can have impacts on individuals over broad geographic and temporal scales.

Table 3.5.6-10. General description of potential impacts for ongoing non-offshore-wind and offshore wind activities' IPFs

IPF	Potential Overall Effect on Marine Mammals
Accidental releases	Physiological effects on marine mammals
Discharges/intakes	Entrainment of prey
EMF	Behavioral changes in marine mammals
Cable emplacement & maintenance	Disturbance of benthic habitats and effects on water quality
Lighting	Effects on aggregations of prey
Noise	Physiological and behavioral effects on marine mammals
Survey gear utilization	Increased risk of entanglement
Port utilization	Disturbance benthic habitats and effects on water quality
Presence of structures	Behavioral changes in marine mammals; effects on prey species, which can affect prey availability for, and distribution of, marine mammals; and increased risk of interactions with derelict fishing gear
Vessel traffic	Behavioral changes in marine mammals and increased risk of vessel strike

NMFS lists the long-term changes in climate change as a threat for almost all marine mammal species (Hayes et al. 2020, 2021, 2022, 2023; NMFS 2024a). Climate change is known to increase temperatures, increase ocean acidity, change ocean circulation patterns, raise sea levels, alter precipitation patterns, increase the frequency and intensity of storms, and increase freshwater runoff, erosion, and sediment deposition. Increased water temperatures can alter habitat, modify species' use of existing habitats, change precipitation patterns, and increase storm intensity (USEPA 2022; NASA 2023; Love et al. 2013). Increased ocean acidity has numerous effects on ecosystems, including reducing available carbon that organisms use to build shells and causing a shift in food webs offshore (Love et al. 2013; USEPA 2022; NASA 2023). Climate change also has the potential to affect the distribution and abundance of marine mammal prey. For example, between 1982 and 2018, the average center of biomass for 140 marine fish and invertebrate species along U.S. coasts shifted approximately 20 miles (32 kilometers) north. These species also migrated an average of 21 feet (6.4 meters) deeper (USEPA 2022). Shifts in abundance of their zooplankton prey will affect baleen whales who travel over large distances to feed (Hayes et al. 2020). The extent of climate change impacts is unknown; however, it is likely that marine mammal populations already stressed by other factors (e.g., NARW) will likely be the most affected.

Impacts associated with climate change have the potential to reduce long-term foraging and reproductive success, increase individual mortality and disease occurrence, and affect the distribution and abundance of prey resources for marine mammals (Love et al. 2013; USEPA 2022; NASA 2023; Gulland et al. 2022). Increased storm severity or frequency may result in increased energetic costs, particularly for young life stages, and reduced individual fitness (Evans and Bjørge 2013; Wingfield 2013). Altered habitat/ecology associated with warming has resulted in northward distribution shifts for some prey species, and some marine mammals are altering their behavior and distribution in response (Davis et al. 2017, 2020; Hayes et al. 2020, 2021, 2022; NMFS 2024a). Warming is expected to influence the frequency of marine mammal diseases, particularly for pinnipeds (Burek et al. 2008; Burge et al. 2014). Additionally, ocean acidification may affect some marine mammals through negative effects on zooplankton (PMEL 2020). Over time, climate change and coastal development may alter existing habitats, rendering some areas unsuitable for certain species and their prey, and more suitable for others. The factors discussed above are susceptible—both individually and in combination—to climate change. These changes can influence individual survivorship and fecundity over broad geographical and temporal scales. For example, shifts in NARW distribution patterns are likely in response to changes in prey densities driven in part by climate change (O'Brien et al. 2022; Reygondeau and Beaugrand 2011; Meyer-Gutbrod et al. 2015, 2021). These changes in distribution could result in increased energetic costs associated with altered migration routes, reduction of suitable breeding, foraging habitat, or both, and reduced individual fitness. Therefore, global climate change and its associated consequences could lead to long-term, serious impacts on marine mammals.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals are listed in Table 3.5.6-11. The effects of approved projects have been evaluated through previous NEPA review and are incorporated by reference. Ongoing O&M of the Block Island and CVOW-Pilot (OCS-A 0497) projects and the construction of the Vineyard Wind 1 (OCS-A 0501), South Fork Wind (OCS-A 0517), Ocean Wind 1 (OCS-A 0498), Revolution Wind (OCS-A 0486), Sunrise Wind (OCS-A 0487), Empire Wind 1 and 2 (OCS-A 0512), New England Wind Phase 1 and 2 (OCS-A 0534), and CVOW-C (OCS-A 0483) projects could affect marine mammals through the primary IPFs of noise, presence of structures, and traffic. Additional contributing IPFs on marine mammals include accidental releases, discharges/intakes, cable emplacement and maintenance, electromagnetic fields and cable heat, survey gear utilization, lighting, and port utilization. Ongoing offshore wind activities will have similar impacts on marine mammals from these IPFs as those expected for the planned offshore wind projects and activities to be conducted in the geographic analysis area (Appendix D) described in Section 3.5.6.3.3, *Cumulative Impacts of the No Action Alternative.* However, impacts from ongoing offshore wind activities would be of lower intensity because the number of ongoing projects is smaller than the number of planned projects.

3.5.6.3.2 Impacts of Alternative A – No Action on ESA-Listed Marine Mammals

As noted in Section 3.5.6.1, two ESA-listed marine mammal species are expected to occur regularly in the offshore project area: fin whale and NARW. General impacts of Alternative A on marine mammals are described in Sections 3.5.6.3.1 and 3.5.6.3.3. This subsection addresses specific impacts of the No Action Alternative on ESA-listed species.

Noise: Noise effects associated with aircraft, G&G surveys, WTGs, pile-driving, and cable laying are not expected to differ between ESA-listed marine mammals and other marine mammals. Impacts associated with vessel noise could be greater for fin whales and NARW compared to some other marine mammal species.

The low frequencies produced by vessel noise and the relatively large propagation distances associated with sound at these frequencies put low-frequency cetaceans, including fin whales and NARW, at a greater risk of impacts associated with vessel noise than other marine mammal species. Stress responses to vessel noise may be of particular significance to the critically endangered NARW. In this species, vessel noise is known to increase stress hormone levels, which may contribute to suppressed immunity and reduced reproductive rates and fecundity (Hatch et al. 2012; Rolland et al. 2012). Auditory masking may also be a significant issue for this species, as modeling results indicate that vessel noise has the potential to substantially reduce communication distances for NARW (Hatch et al. 2012).

Presence of structures: Many effects associated with the presence of structures, including hydrodynamic changes, habitat conversion, prey aggregation, avoidance or displacement, and behavioral disruption are not expected to differ between ESA-listed marine mammals and other marine mammal species. Impacts associated with increased entanglement risk could be greater for fin whales and NARW compared to other marine mammal species.

The presence of structures may result in an increase in recreational fishing activity, displacement of commercial fishing activity, and a shift in gear types. An increase in fishing activity or an overall shift to fixed gear types would increase the risk of marine mammal entanglement. Entanglement is a significant threat for NARW. As noted in Section 3.5.6.1, NARW has been experiencing a UME since 2017 attributed to vessel strikes and entanglement in fisheries gear (NMFS 2024b); over 80 percent of NARW show evidence of past entanglements (King et al. 2021; Knowlton et al. 2012; Johnson et al. 2005); and entanglement in fishing gear is a leading cause of death for this species and may be limiting population recovery (Knowlton et al. 2012). An annual average of 5.7 NARW incidental fishery interactions from 2016 to 2020 and 1.5 fin whale incidental fishery interactions from 2015 to 2019 have been recorded (Hayes et al. 2023; Hayes et al. 2022). The increased risk of entanglement associated with the presence of structures could have demographic consequences for NARW.

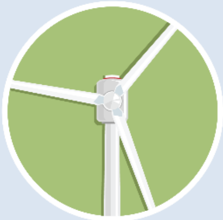
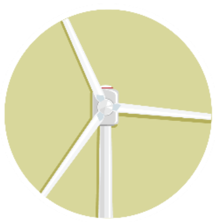
Traffic: Vessel strikes are a significant concern for mysticetes, including fin whales and NARW. NARW are particularly vulnerable to vessel strikes due to their slow swim speeds and the relatively high amount of time spent at or near the surface; vessel strikes are a primary cause of death for this species (Kite-Powell et al. 2007; Hayes et al. 2022). As noted in Section 3.5.6.1, NARW has been experiencing a UME since 2017 attributed to vessel strikes and entanglement in fisheries gear (NMFS 2024b). An annual average of 2.4 NARW vessel strikes from 2016 to 2020 and 0.4 fin whale vessel strikes from 2015 to 2019 have been recorded (Hayes et al. 2023; Hayes et al. 2022), though this is likely an underestimate of total vessel strikes per year. NARW are at the highest risk for vessel strike when vessels travel in excess of 10 knots (Vanderlaan and Taggart 2007). Average vessel speeds in the geographic analysis area may exceed 10 knots, indicating that vessel traffic associated with the No Action Alternative may pose a collision risk for

NARW. Vessel strikes may be particularly significant for this species given their relatively high risk and their low population numbers.

3.5.6.3.3 Cumulative Impacts of Alternative A – 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 NY Bight projects). Planned non-offshore-wind activities that may affect marine mammals include new submarine cables, transmission systems (e.g., PBI), and pipelines, tidal energy projects, oil and gas activities, dredging and port improvement, marine minerals extraction, military use (i.e., sonar, munitions training), marine transportation, research initiatives, and installation of new structures (e.g., artificial reefs) on the U.S. Continental Shelf (see Appendix D for a description of planned activities). These activities could result in displacement and injury to or mortality of individual marine mammals from traffic (vessel strikes), survey gear utilization, noise, accidental releases and discharges, and EMF. Ongoing and planned offshore wind activities within the geographic analysis area that contribute to impacts on marine mammals are listed in Table 3.5.6-11.

Table 3.5.6-11. Ongoing and planned offshore wind in the geographic analysis area for marine mammals

Ongoing/Planned	Projects by Region
Ongoing – 12 projects[1] 	**MA/RI** • Block Island (State waters) • Vineyard Wind 1 (OCS-A 0501) • South Fork Wind (OCS-A 0517) • Revolution Wind (OCS-A 0486) • Sunrise Wind (OCS-A 0487) • New England Wind (OCS-A 0534) Phase 1 • New England Wind (OCS-A 0534) Phase 2 **NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512) **VA/NC** • CVOW-Pilot (OCS-A 0497) • CVOW-Commercial (OCS-A 0483)
Planned – 18 projects[2] 	**MA/RI** • SouthCoast Wind (OCS-A 0521) • Beacon Wind 1 (OCS-A 0520) • Beacon Wind 2 (OCS-A 0520) • Bay State Wind (OCS-A 0500) • OCS-A 0500 remainder • OCS-A 0487 remainder • Vineyard Wind Northeast (OCS-A 0522) **NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499) **DE/MD** • Skipjack (OCS-A 0519) • US Wind/Maryland Offshore Wind (OCS-A 0490) • GSOE I (OCS-A 0482) • OCS-A 0519 remainder **VA/NC** • Kitty Hawk North (OCS-A 0508) • Kitty Hawk South (OCS-A 0508) **SC** • Duke Energy Renewables Wind (OCS-A 0546) • TotalEnergies Renewables (OCS-A 0545)

CVOW = Coastal Virginia Offshore Wind; DE = Delaware; GSOE = Garden State Offshore Energy; MA = Massachusetts; MD = Maryland; NC = North Carolina; NJ = New Jersey; NY = New York; RI = Rhode Island; SC = South Carolina; VA = Virginia

[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.

[2] Status as of September 20, 2024.

Impacts of ongoing activities on marine mammal prey items are assessed in Section 3.5.5.3 of the PEIS, which summarizes the effects on fish, invertebrates, and EFH. BOEM expects ongoing and planned offshore wind activities to affect marine mammals through the following IPFs:

Accidental releases: Marine mammals are particularly susceptible to the effects of contaminants from pollution and discharges as they accumulate through the food chain or are ingested with garbage. PCBs and chlorinated pesticides (e.g., DDT, DDE, dieldrin) are of most concern and can cause long-term chronic impacts. These contaminants can lead to issues in reproduction and survivorship, and other health concerns (e.g., Pierce et al. 2008; Jepson et al. 2016, Hall et al. 2018; Murphy et al. 2018); however, the population-level effects of these and other contaminants are unknown. Research on contaminant levels for many marine mammal species is lacking. Some information has been gathered from necropsies conducted from bycatch and therefore focused on smaller whale species and seals. Moderate levels of these contaminants have been found in pilot whale blubber (Taruski et al. 1975; Muir et al. 1988; Weisbrod et al. 2000). Weisbrod et al. (2000) examined PCBs and chlorinated pesticide concentrations in bycaught and stranded pilot whales in the western North Atlantic. Contaminant levels were similar to or lower than levels found in other toothed whales in the western North Atlantic, perhaps because they are feeding farther offshore than other species (Weisbrod et al. 2000). Dam and Bloch (2000) found very high PCB levels in long-finned pilot whales in the Faroe Islands (a group of islands in the North Atlantic Ocean between Iceland and the Shetland Islands). Also, high levels of toxic metals (e.g., mercury, lead, cadmium) and selenium were measured in pilot whales harvested in the Faroe Islands drive fishery (Nielsen et al. 2000).

Accidental releases of fuel, fluids, hazardous materials, trash, and debris may increase as a result of offshore wind activities. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present, but are also possible during operations and conceptual decommissioning of offshore wind facilities. Refueling of primary construction vessels at sea is proposed for Ocean Wind 1 (OCS-A 0498) (Ocean Wind 2022) as well as Atlantic Shores South (OCS-A 0499) (Atlantic Shores 2022) and is likely for other offshore wind projects. As described in Section 2.3, *Non-Routine Activities and Events*, accidental releases of chemicals, gases, or man-made debris may occur as a result of a structural failure and could result in impacts on marine mammals.

In the planned activities scenario (see Appendix D, Table D2-3), there would be a low risk of a leak of fuel, fluids, or hazardous materials from any one of approximately 2,525 WTGs and OSSs installed in the geographic analysis area, which would store a total of 10,368,997 gallons (39,250,923 liters) of oils and lubricants in the WTGs; 7,493,000 gallons (28,364,090 liters) of oils and lubricants in the OSSs; 1,437,208 gallons (5,440,424 liters) of diesel fuel in the WTGs; and 1,519,420 gallons (5,751,630 liters) of diesel fuel in the OSSs. According to BOEM's modeling (Bejarano et al. 2013), a release of 2,000 gallons (7,571 liters) or less is likely to occur every 5 to 20 years, and a release of 128,000 gallons (484,532.7 liters), which represents all available oils and fluids from 130 WTGs and an OSS, is likely to occur no more often than once per 1,000 years. The likelihood of a spill occurring from multiple WTGs and OSSs at the same time is very low and, therefore, the potential impacts from a spill larger than 2,000 gallons (7,571 liters) are largely discountable. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on individual fitness, including adrenal effects, hematological effects, liver effects, lung disease, poor body condition, skin lesions, and several other health effects 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). Based on the volumes potentially involved, the likely amount of additional accidental releases associated with ongoing and planned offshore wind development would fall within the range of accidental releases that already occur on an ongoing basis from non-offshore-wind activities. Although exposure to accidental releases from ongoing non-offshore-wind activities could result in more severe impacts, current regulations and requirements imposed on federally approved activities prohibit vessels from dumping potentially harmful debris, require measures to avoid and minimize spills of toxic materials, and provide mechanisms for spill reporting and response. These measures would reduce the likelihood, and the extent of potential impacts would be localized to the area around each activity.

Trash and debris may be released by vessels during construction, operations, and conceptual decommissioning of offshore wind facilities. Operators would be required to comply with federal and international requirements to minimize releases. In the unlikely event of a trash or debris release, it would be accidental and localized in the vicinity of the offshore wind lease areas. Worldwide, 62 of 123 (about 50 percent) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). The global stranding data indicates potential debris-induced mortality rates of 0 to 22 percent. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive tract, disease, entanglement, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects on individuals to population-level impacts (Browne et al. 2015). While precautions to prevent accidental releases will be employed by vessels and port operations associated with offshore wind development, it is likely that some debris could be lost overboard during construction, maintenance, and routine vessel activities. However, the amount would likely be miniscule compared to other inputs already occurring. If a release were to occur, it would be an accidental, low-probability event in the vicinity of offshore wind lease areas or the ports used by vessels traveling to those areas.

Impacts from accidental releases from ongoing and planned non-offshore-wind (see Appendix D, Table D1-12) and offshore wind activities would likely be minor for mysticetes (including NARW), odontocetes, and pinnipeds and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable.

Cable emplacement and maintenance: Ongoing and planned offshore wind projects could disturb up to 493,938 acres (1,999 square kilometers) of seabed through installation of undersea cables, causing an increase in suspended sediment (see Appendix D, Table D2-2). The effects would be similar to those observed during construction of the Block Island Wind Farm (Elliot et al. 2017). While suspended sediment impacts would vary in extent and intensity depending on project- and site-specific conditions, measurable impacts are likely to be on the order of 500 milligrams per liter or lower; short term, lasting for minutes to hours; and limited in extent to within a few feet vertically and a few hundred feet horizontally from the point of disturbance.

Data are not available regarding whales' avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that because marine mammals often live in turbid waters, significant impacts from turbidity are not likely. If elevated turbidity caused any behavioral responses, such as avoiding the turbidity zone or changes in foraging behavior, they would be temporary, and any negative impacts would be short term. Increased turbidity effects could affect the distribution of prey species of marine mammals, both in offshore and inshore environments. Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of mg/L before an acute reaction is expected (Wilber and Clark 2001). However, as mentioned previously, sedimentation effects would be temporary and localized and would return to previous levels soon after the activity.

Impacts from cable emplacement and maintenance from ongoing and planned non-offshore-wind (see Appendix D, Table D1-12) and offshore wind activities would likely be minor for mysticetes (including NARW), odontocetes, and pinnipeds and are likely to result in short-term, localized consequences to individuals that are detectable and measurable but do not lead to population-level effects.

Discharges/intakes: Ongoing and planned offshore wind projects in the geographic analysis area may use HVDC substations that would convert AC to DC before transmission to onshore project components. As described in a recent BOEM white paper (Middleton and Barnhart 2022), these HVDC systems are cooled by an open loop system that intakes cool sea water and discharges warmer water back into the ocean. Potential effects resulting from intake and discharge use include altered micro-climates of warm water surrounding outfalls, altered hydrodynamics around intakes/discharges, prey entrainment, and association with (attraction to) intakes if prey are aggregated on intake screens from which marine mammals scavenge. The warm water discharged is generally considered to have a minimal effect as it will be absorbed by the surrounding water and returned to ambient temperatures. Entrainment of potential prey resources would be minimal given the small number of OSSs proposed per project. Entrainment of marine mammals that may depredate on entrained prey is discounted due to physical impedance by intake safety screens. Effects of discharges and intakes on zooplankton prey species are discussed in detail in Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat,* of this PEIS, but generally the effects would be limited to the immediate areas of the OSSs. This could present a small risk of effect on zooplankton prey species for NARW for other wind farm projects near Nantucket Shoals given the importance of this foraging habitat and the proposed 12-mile (20-kilometer) conservation buffer extending out from the 98-foot (30-meter) isobath identified by Hayes et al. (2022). However, this buffer only overlaps with portions of Lease Areas OCS-A 0500, 0501, 0520, 0521, and 0522. None of the ongoing projects occurring in the lease areas from Table 3.5.6-11 have proposed use of HVDC substations. Although it is currently unknown what type of substation the planned projects from Table 3.5.6-11 may use, they may not all use HVDC substations that introduce this intake risk, and effects on NARW prey would only be expected if projects install these substations in the buffer region identified by Hayes et al. (2022).

A potential impact related to vessels and vessel traffic is ballast water and bilge water discharges from marine vessels. Vessels are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR § 151.2025) and USEPA NPDES Vessel General Permit standards, both of which regulate discharge of ballast or bilge water and effectively avoid the likelihood of non-native species invasions through discharges. Adherence to these regulations is the responsibility of the vessel operators.

Impacts from discharges and intakes from ongoing and planned non-offshore-wind (see Appendix D, Table D1-12) and offshore wind activities would therefore be long-term, low in intensity, localized, and negligible for mysticetes (including NARW), odontocetes, and pinnipeds; measurable effects are not anticipated.

Electric and magnetic fields and cable heat: In the planned activities scenario, up to 8,291 miles (13,343 kilometers) of new offshore export cable, and 6,855 miles (11,032 kilometers) of new interarray cable would be added in the marine mammal geographic analysis area, producing EMF in the immediate vicinity of each cable during operations (Table D2-1 in Appendix D). Studies documented electric or magnetic sensitivity up to 0.05 microTesla for Earth's magnetic field for fin whale, humpback whale, sperm whale, bottlenose dolphin, common dolphin, long-fin pilot whale, Atlantic white-sided dolphin, striped dolphin (*Stenella coeruleoalba*), Atlantic spotted dolphin (*S. frontalis*), Risso's dolphin, and harbor porpoise (Normandeau Associates Inc and Exponent Inc 2011). However, evidence used to make the determinations was only observed behaviorally/physiologically for bottlenose dolphins and the remaining species were concluded based on theory or anatomical details.

Recent reviews by Bilinski (2021) on the effects of EMF on marine organisms concluded that measurable, though minimal, effects can occur for some species, but not at the relatively low EMF intensities representative of offshore renewable energy projects. Electrical telecommunications cables are likely to induce a weak EMF on the order of 1 to 6.3 microvolts per meter within 3.3 feet (1 meter) of the cable path (Gill et al. 2005). Fiber-optic communications cables with optical repeaters would not produce EMF effects. Under the No Action Alternative, export cables would be added in other BOEM offshore wind lease areas and are presumed to include at least one identified cable route, which will produce EMF in the immediate vicinity of each cable during operations. Transmission cables using HVAC emit 10 times less magnetic field than HVDC (Taormina et al. 2018); therefore, HVAC cables are likely to have less EMF impacts on marine mammals. It is estimated that the induced magnetic field generated by HVAC cables may range from 4 to 207 milligausses (0.4 to 20.7 microteslas), with the observed variation attributed to variations in burial depth along the cable route (Hutchison et al. 2018). Taormina et al. (2018) found that, although EMF from HVDC cables is higher than that from HVAC cables, there were no significant differences in resettlement of benthic species over the cable a few years after installation compared to baseline regions, so marine mammals foraging on benthic prey species would not be expected to experience long-term changes in prey availability. Hutchison et al. (2018) found notable behavioral responses of American lobster and little skate in response to EMF from HVDC cables, but it did not constitute a barrier to movement across the cable for either species, also indicating that long-term changes to marine mammal prey distribution are unlikely to occur.

Exponent Engineering, P.C. (2018) modeled EMF levels that could be generated by the South Fork Wind Farm (OCS-A 0517) HVAC export and interarray cables. The model estimated induced magnetic field levels ranging from 13.7 to 76.6 milligausses (1.37 to 7.66 microteslas) on the bed surface above the buried and exposed South Fork Wind Farm export cable and 9.1 to 65.3 milligausses (0.91 to 6.53 microteslas) above the interarray cable, respectively. Induced field strength would decrease effectively to 0 milligauss (0 microtesla) within 25 feet (7.6 meters) of each cable. By comparison, Earth's natural magnetic field produces more than five times the maximum potential EMF effect from typical offshore wind projects (BOEM 2021a Appendix F, Figure F-8). Background magnetic field conditions would fluctuate by 1 to 10 milligauss (0.1 to 1 microtesla) from the natural field effects produced by waves and currents. The maximum induced electrical field experienced by any organism close to the exposed cable would be no greater than 0.48 millivolt per meter (Exponent Engineering, P.C. 2018). BOEM performed literature reviews and analyses of potential EMF effects from offshore renewable energy projects (CSA Ocean Sciences Inc. and Exponent 2019; Inspire Environmental 2019; Normandeau Associates Inc and Exponent Inc 2011). These and other available reviews and studies (Gill et al. 2005; Kilfoyle et al. 2018) suggest that most marine species cannot sense low-intensity EMF generated by the HVAC power transmission cables commonly used in offshore wind energy projects. Marine mammal species that are more likely to forage near the seafloor, such as certain delphinids, have more potential to experience EMF above baseline levels (Normandeau Associates Inc and Exponent Inc 2011). Normandeau Associates Inc and Exponent Inc (2011) concluded that marine mammals are unlikely to detect magnetic field intensities below 50 milligausses (5.0 microteslas), suggesting that these species would be insensitive to EMF effects from the renewable energy projects. EMF levels above 50 milligausses (5.0 microteslas) would result primarily from exposed cable, which is not expected for offshore wind projects, and would occur close to (i.e., within 25 feet [7.6 meters] of) the cable. HVDC cables can produce higher EMF levels, up to 207 milligausses (20.7 microteslas); however, this level was associated with shallower cable burial depths, and cables buried deeper under the seafloor would produce EMF closer to 4 milligausses (0.4 microteslas) (Hutchison et al. 2018). Additionally, the 50 milligauss (5.0 microtesla) threshold reported by Normandeau Associates Inc and Exponent Inc (2011) is a minimum sensitivity level, meaning marine mammals are expected to be able to detect EMF at or above this level; it does not directly equate to a biologically significant response. Although HVDC cables can emit relatively higher EMF, impacts on marine mammal behavior would be limited to the seafloor and in close proximity to the cable. However, only certain marine mammal species spend time near the seafloor to forage, therefore limiting their potential for long-term exposure.

EMF effects on marine mammals from these ongoing and planned offshore wind projects would vary in extent and magnitude depending on overall cable length, the proportion of buried versus exposed cable segments, and project-specific transmission design (e.g., HVAC or HVDC, transmission voltage). However, measurable EMF effects are generally limited to within tens of feet of cable corridors. Submarine power cables would have appropriate shielding and would be buried or covered, which would minimize potential EMF effects from cable operation.

Heat transfer into surrounding sediment associated with buried submarine high-voltage cables is possible (Emeana et al. 2016). However, heat transfer is not expected to extend to any appreciable effect into the water column due to the use of thermal shielding, the cable's burial depth, and additional cable protection such as scour protection or concrete mattresses for cables unable to achieve adequate burial depth. As a result, heat from submarine high-voltage cables is not expected to affect marine mammals.

Impacts from EMF from ongoing and planned non-offshore-wind (see Appendix D, Table D1-12) and offshore wind activities would likely be negligible for mysticetes (including NARW), odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Survey gear utilization: Ongoing and planned offshore wind projects are likely to include plans that monitor biological resources in and nearby associated project areas throughout various stages of development. These could include acoustic, trawl, and trap surveys, as well as other methods of sampling the biota in the area. Additionally, ongoing and planned scientific biological and fisheries monitoring surveys occur within the geographic analysis area and may utilize the same gear types. The presence of monitoring gear could affect marine mammals by entrapment or entanglement. Ongoing non-offshore-wind activities include commercial and recreational fishing activity using similar gear types that can also affect marine mammals. A detailed description of commercial and recreational fishing in the offshore project area is provided in Section 3.6.1 of this PEIS. Fishing activities generally include harvesting a variety of finfish and shellfish species such as clams, groundfish, herring, lobster, squid, scallops, and skates. These species are harvested with a variety of fishing gear, including mobile gear (e.g., bottom trawl, midwater trawl, dredge) and fixed gear (e.g., demersal gillnet, lobster trap, crab trap, pots).

Theoretically, any line in the water column, including a line resting on or floating above the seafloor set in areas where whales occur, could entangle a marine mammal (Hamilton et al. 2019; Johnson et al. 2005). Entanglements may involve any part of the body such as the head, flippers, or fluke or a combination of multiple parts of the body; effects range from no apparent injury to death.

Large whales are most vulnerable to entanglement in stationary vertical and ground lines associated with trap/pot gear. The Final Environmental Impact Statement, Regulatory Impact Review, and Final Regulatory Flexibility Analysis for Amending the Atlantic Large Whale Take Reduction Plan (ALWTRP): Risk Reduction Rule (NOAA 2021) provides an analysis of data that shows entanglement in commercial fisheries gear represents the highest proportion of all documented serious and non-serious incidents reported for humpback, NARW, fin, and minke whales. Entanglement was the leading cause of serious injury and mortality for NARW, humpback, fin, and minke whales from 2010 to 2018 for cases where the cause of death could be identified (NOAA 2021).

NMFS' opinion on the Continued Prosecution of Fisheries and Ecosystem Research Conducted and Funded by the Northeast Fisheries Science Center and the Issuance of a LOA under the Marine Mammal Protection Act for the Incidental Take of Marine Mammals pursuant to those Research Activities (dated June 23, 2016), concluded that impacts on NARW, humpback, fin, sei, and blue whales, if any, as a result of trawl gear use would be expected to be extremely unlikely to occur. Observations during mobile gear use have shown that entanglement or capture of large whale species is extremely rare (NMFS 2016).

Biological monitoring using conventional fishing methods has the potential to result in the take of protected species. Ongoing and planned offshore wind fisheries monitoring plans would follow BOEM's guidance for fisheries surveys provided in *Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585* (BOEM 2023a), including recommendations to reduce the number of vertical lines, such as use of ropeless gear technologies, buoy line weak links, and other risk reduction measures consistent with

NMFS recommendations.[6] While impacts from gear utilization associated with biological resource monitoring on individual marine mammals could occur, monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts so as to not result in population-level effects.

Non-offshore wind fisheries interactions are likely to have demographic impacts on some marine mammal species(Read et al. 2006; Reeves et al. 2013). In the U.S. Atlantic, bycatch occurs in various gillnet and trawl fisheries in New England and the Mid-Atlantic Coast, with bycatch hotspots driven by marine mammal density and fishing intensity (Benaka et al. 2019; Lewison et al. 2014). Several commercial fisheries have documented bycatch. Those that most commonly report bycatch are pelagic longline, bottom trawl, and sink gillnet (Hayes et al. 2020, 2021). Purse seine fisheries, Atlantic blue crab trap/pot, North Carolina roe mullet stop net, and hook and line (rod and reel) have also noted instances of marine mammal bycatch (Hayes et al. 2020, 2021).

Entanglement in fishing gear, including abandoned or lost fishing gear, is listed as a threat to NARW, humpback whales, blue whales, fin whales, sei whales, minke whales, bottlenose dolphins, and gray seals (Hayes et al. 2020, 2021, 2023; NMFS 2024a). While entanglement data for blue, fin, sei, and minke whales are limited, evidence of fishery interactions causing injury or mortality has been documented for each of these species in the Greater Atlantic Regional Fisheries Office (GARFO)/NMFS entanglement/stranding database (Hayes et al. 2021). Limited information is available for sperm whale entanglement mortalities, with few records of fishery-related mortality or serious injury to this stock from 1993 through 2010 (Waring et al. 2015) and none from 2013 through 2021 (Hayes et al. 2020; NMFS 2024a). Of available information, there are considerable data on the potential for entanglement for humpback whales and NARW.

A study of 134 individual humpback whales in the Gulf of Maine suggested that between 48 and 65 percent of the whales experienced entanglements (Robbins and Mattila 2001) and that 12 to 16 percent encounter gear annually (Robbins and Mattila 2001). Entanglement, in conjunction with other factors (i.e., vessel collisions), could be limiting the recovery of humpback whale (Hayes et al. 2020). Similarly, entanglement is a leading cause of mortality for NARW and is likely limiting population recovery (NMFS 2024a). NMFS estimates that over 85 percent of NARW have been entangled in fishing gear at least once (Hayes et al. 2023) and 60 percent of individuals show evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021; Knowlton et al. 2012). Of documented NARW entanglements in which gear was recovered, 80 percent was attributed to non-mobile fishing gear (i.e., lobster and gillnet gear) (Knowlton et al. 2012). Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021).

Small odontocetes and pinnipeds are at most risk of being caught as bycatch, mainly in trawl, gillnet, and longline gear types (Hayes et al. 2019, 2021; NMFS 2024a). Of the species considered in this assessment, Risso’s dolphins, long- and short-finned pilot whales, bottlenose dolphins, short-beaked common

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[6] https://www.fisheries.noaa.gov/s3/2023-06/NOAAFisheriesGreaterAtlanticRegionProtectedSpeciesBestManagementPracticesandRiskReductionMeasuresforOffshoreWindFisherySurveys20Jun2023.pdf

dolphins, white-sided dolphins, harbor porpoises, harbor seals, gray seals, and harp seals have been documented in several fisheries' bycatch data (Hayes et al. 2019, 2021; NMFS 2024a). These include pelagic longline, bottom trawl, midwater trawl, gillnet, purse seine, and trap/pot fisheries (Hayes et al. 2019, 2021; NMFS 2024a). Drowning or asphyxiation in gear, chronic secondary complications of injuries, and feeding impairment are all associated with entanglement mortalities in seals (Moore et al. 2013). Results of a 2014 unoccupied aerial system survey of large populations of gray and harbor seals at haul-out sites in the North Atlantic indicated 0.83 to 3.70 percent of the seals observed showed signs of entanglement (Waring et al. 2015). A more recent study from Martins et al. (2019) estimated the mean prevalence of live entangled gray seals at haul-out sites in Massachusetts and Isle of Shoals to be between 1 and 4 percent, similar to the numbers estimated from Waring et al. (2015). However, these estimates likely underestimated overall rate of entanglement for these species because they only focused on live animals observed at these haul-out sites and did not account for animals that had been rescued and released or animals that were already dead when the entanglement was reported. The most recent stock assessment reports for both species indicate an annual estimated number of mortalities and serious injuries attributed to U.S. fisheries interactions using observer data and stranding data was 1,372 gray seals for the period from 2017 to 2021 (NMFS 2024a) and 334 harbor seals for the period from 2015 to 2019 (Hayes et al. 2022).

Stranding data indicate that other marine mammal species may be affected by entanglements or bycatch; however, the contribution of fishery-related mortalities and serious injuries to these strandings is often difficult to determine. This is because not all of the marine mammals that die or are seriously injured wash ashore, and not all will show signs of entanglement or other fishery interaction (Hayes et al. 2020, 2021; NMFS 2024a). As a result, the contribution of fisheries interactions to the annual mortality and injury of marine animal species in the geographic analysis area and beyond is likely underestimated (Hayes et al. 2020, 2021; NMFS 2024a).

In summary, the presence of monitoring gear associated with ongoing and planned offshore wind activities could affect marine mammals by entrapment or entanglement. Biological monitoring using conventional fishing methods has the potential to result in the take of protected species. Ongoing and planned offshore wind fisheries monitoring plans would follow BOEM's guidance for fisheries surveys provided in Guidelines for Providing Information on Fisheries for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585 (BOEM 2023a), including recommendations to reduce the number of vertical lines, such as use of ropeless gear technologies, buoy line weak links, and other risk reduction measures consistent with NMFS recommendations.[7] While impacts from gear utilization associated with biological resource monitoring on individual marine mammals could occur, monitoring plans will have sufficient mitigation procedures in place to reduce potential impacts so as to not result in population-level effects. Therefore, the impacts of survey gear utilization from ongoing and planned offshore wind activities on mysticetes (including NARW), odontocetes, and pinnipeds from ongoing and planned offshore wind activities would be negligible, with no detectable or measurable

[7] https://www.fisheries.noaa.gov/s3/2023-06/NOAAFisheriesGreaterAtlanticRegionProtectedSpeciesBestManagementPracticesandRiskReductionMeasuresforOffshoreWindFisherySurveys20Jun2023.pdf

consequences to individuals or populations. However, it should be noted that the potential extent and number of animals potentially exposed cannot be determined without project-specific information; should future developers not develop mitigation plans that avoid entanglement and entrapment, such an outcome could lead to injury, serious injury, or mortality of a marine mammal.

Conversely, ongoing and planned non-offshore-wind activities would utilize different fisheries survey methodologies and would not follow the same mitigation requirements as offshore wind projects. Stock assessment reports identify serious injuries and mortalities due to commercial fisheries interactions for marine mammals, so the effects from these activities cannot be considered negligible. Therefore, impacts from anchoring and gear utilization for ongoing non-offshore-wind activities are expected to be moderate for mysticetes (except NARW) due to entanglement and bycatch associated with ongoing commercial and recreational fishing. Impacts from ongoing non-offshore-wind fisheries interactions would be detectable and measurable, and long term. For NARW, impacts would be major because entanglements in fishing gear from ongoing commercial and recreational fishing has been identified as a leading cause for mortality and, given the vulnerability of this population, the loss of even one individual would compromise the viability of this species. For odontocetes and pinnipeds, impacts from entanglement and bycatch associated with ongoing commercial and recreational fishing would be minor, as the impacts are detectable and measurable, but because the documented risk of this IPF on these species is lower, the risk of injury is also lower, and no population-level effects are expected.

Lighting: Shoreline development is the predominant existing artificial lighting source in the nearshore component of the geographic analysis area, while vessels are the predominant source of artificial lighting offshore. The addition of over 2,596 WTGs and OSSs in the geographic analysis area with long-term hazard and aviation lighting, as well as lighting associated with construction vessels, would increase artificial lighting. Artificial lighting may disrupt the diel migration (vertical distribution) of some prey species, including zooplankton, which may secondarily influence marine mammal distribution patterns (Orr et al. 2013). Observations at offshore oil rigs showed dolphin species foraging near the surface and staying for longer periods of time around platforms that were lit (Cremer et al. 2009). However, any effects due to artificial lighting would be localized and limited to the area exposed to the lights.

Given the highly localized extent of artificial lighting, impacts from ongoing and planned non-offshore-wind and offshore wind activities would likely be negligible for mysticetes (including NARW), odontocetes, and pinnipeds, of the lowest level of detection, and barely measurable, with no perceptible consequences to individuals or the population.

Noise: In the geographic analysis area, ongoing and planned offshore wind activities that could cause underwater noise are impact pile-driving (installation of WTGs and OSSs), vibratory pile-driving (installation and removal of cofferdams), G&G surveys (HRG surveys and geotechnical drilling activities), detonations of UXOs, vessel traffic, aircraft, cable laying or trenching, and dredging during construction and turbine operation. Conceptual decommissioning activities related to noise are likely similar to those outlined for construction activities.

The siting, construction and installation, O&M, and conceptual decommissioning of other offshore wind farms is expected to introduce several types of underwater sound into the marine environment. Physical descriptions of sounds associated with these activities can be found in Appendix J. The expected impacts of each of these sources on marine mammals is discussed below.

Geophysical and Geotechnical Surveys

For the purposes of offshore wind projects, G&G surveys use active acoustic sources to evaluate the feasibility of turbine installation and to identify potential hazards. A description of the physical qualities of geophysical sound sources can be found in Appendix J. Recently, BOEM and USGS characterized underwater sounds produced by high-resolution geophysical sources and their potential to affect marine mammals (Ruppel et al. 2022). Although some geophysical sources can be detected by marine mammals, given several key physical characteristics of the sound sources—including source level, frequency range, duty cycle, and beamwidth—most HRG sources, even without mitigation, are unlikely to result in substantial behavioral disturbances of marine mammals (Ruppel et al. 2022). Of the few empirical studies assessing the effect of HRG sources on marine mammals, Vires (2011) found no change in Blainville's beaked whale click durations before, during, and after a scientific survey with a 38 kilohertz (kHz) EK-60 scientific echosounder, Quick et al. (2017) found that short-finned pilot whales did not change foraging behavior but did increase their heading variance during use of an EK-60, and Cholewiak et al. (2017) found a decrease in beaked whale echolocation click detections during use of an EK-60. Kates Varghese et al. (2020) found no change in three of four beaked whale foraging behavior metrics (i.e., number of foraging clicks, foraging event duration, click rate) during two deep-water mapping surveys using a 12 kHz multibeam echosounder. There was an increase in the number of foraging events during one of the mapping surveys, but this trend continued after the survey ended, suggesting that the change was more likely in response to another factor, such as the prey field of the beaked whales, than to the mapping survey. During both multibeam mapping surveys, foraging continued in the survey area and the animals did not leave the area (Kates Varghese et al. 2021; Kates Varghese et al. 2020). Given their low source levels, short signal durations, and intermittent use, most geophysical sources are unlikely to result in behavioral disturbance or acoustic masking. For some of the higher-amplitude sources such as bubble guns, some boomers, and the highest-power sparkers, behavioral disturbance is possible, but unlikely if mitigation measures such as clearance zones and shutdowns are applied.

Geotechnical surveys may introduce low-level, intermittent, broadband noise into the marine environment. These sounds could result in acoustic masking in low- or mid-frequency cetaceans but are unlikely to result in behavioral disturbance given their low source levels, intermittent use, and small ranges to the threshold.

No PTS (i.e., Level A harassment) is anticipated from G&G surveys, but, as described above, behavioral disturbance could occur. Mitigation measures designed to protect marine mammals during HRG surveys (e.g., PSOs, clearance zones, shutdowns) would further minimize exposure risk. Additionally, NMFS requires mitigation measures that minimize the risk of TTS and behavioral disturbance (i.e., Level B harassment). Considering the empirical evidence together, the likelihood of G&G survey noise from ongoing and planned offshore wind projects to affect mysticetes (including NARW), odontocetes, and pinnipeds is de minimis in most instances and would be a minor impact. Minor impacts such as limited behavioral disturbance or short-term masking may occur in species with a hearing range that directly overlaps the sound sources, which will differ depending on the sound source used (e.g., sparker sources may overlap with low-frequency cetacean hearing range, and compressed high intensity radar pulse systems may overlap with mid- and high-frequency cetacean hearing ranges).

UXO Detonation

UXOs on the seabed may be encountered in offshore wind lease areas or along export cable routes. If found, the UXO may be left alone, moved, or removed by controlled explosive detonation or low-order deflagration. Further information on UXO detonations can be found in Appendix J. Underwater explosions of this type generate shock waves, or a nearly instantaneous wave characterized by extreme changes in pressure, both positive and negative. This shock wave can cause injury and mortality to a marine mammal, depending on how close an animal is to the blast. The physical range at which injury or mortality could occur will vary based on the amount of explosive material in the UXO, size of the animal, and the location of the animal relative to the explosive. Injuries may include hemorrhages or damage to the lungs, liver, brain, or ears, as well as auditory impairment such as PTS and TTS (Ketten 2004). Smaller animals are generally at a higher risk of blast injuries.

Blast injuries have been documented in close association with explosive detonations, including after 42 British ground mines (MK 1-7) were cleared in the Baltic Sea in 2019 (Siebert et al. 2022). Within a week and in the 2 months following, a total of 24 harbor porpoises were found dead in the general area, eight of which had clear signs of blast injury as the primary cause of death, i.e., dislocated ear bones, bleeding in the acoustic fat and melon, and several more had blast injury in addition to other signs of potential mortal stressors (e.g., found as bycatch, blunt force trauma). As the precise timing of the injuries were not known, it is not clear whether the observed injuries were due to this blast event or an unrelated event. In 2011, an underwater detonation (8.75 pounds [3.97 kilograms]) at the Silver Strand Training Complex in San Diego, California resulted in blast injury and death to at least three long-beaked common dolphins that had entered the 2,100 feet (640 meter) mitigation zone minutes before the detonation (Danil and Ledger 2011).

To predict the potential impacts of UXOs on marine species, several models have been developed. Goertner (1982) developed a model for physical injuries to cetaceans at a range of depths, and a modified version of this model is recommended by NMFS for predicting injury impacts on marine mammals (NMFS 2022b). Von Benda-Beckman et al. (2015) modeled PTS effect distances for charge masses ranging from 2.2 to 2,205 pounds (1 to 1,000 kilograms) at depths up to 98 feet (30 meters) deep based on recordings from several UXO detonations in the North Sea and predicted PTS effect ranges for harbor porpoises from 100s of feet to 9.3 miles (100s of meters to 15 kilometers), and the effect range generally increased with increasing charge mass and depth. In 2022, Hannay and Zykov focused on auditory injury rather than physical injury. They modeled the distance to NMFS auditory exceedance thresholds (see Appendix J for further detail) for five species groups (low-, mid-, and high-frequency cetaceans; phocid pinnipeds; otariid pinnipeds/sea turtles) exposed to UXO detonations of various charge masses at four sites in the Revolution Wind Project area (OCS-A 0486). While exposure ranges will vary among lease areas based on environmental conditions and other factors, their results provide an example of predicted exposure ranges in U.S. waters. The largest effect ranges were predicted for high-frequency cetaceans exposed to a 1,000-pound (454-kg) detonation (the largest charge mass modeled) at 9.9 miles (16 kilometers) (peak sound pressure level [Lpk]) and 7.0 miles (11.3 kilometers) (sound exposure level over 24 hours [SEL_{24h}]) for PTS, and 12.6 miles (20.2 kilometers) for TTS (SEL_{24h}; used by NMFS for the behavioral threshold for a single detonation) (Hannay and Zykov 2022). The distances to auditory injury were always greater than the predicted ranges for non-auditory injury associated with the blast impulse. It is worth noting that when UXOs are detonated they do not always fully detonate, meaning the explosion may not be as large as predicted by the charge mass. The modeling studies presented previously are based on the assumption that the charge fully detonates.

Behavioral effects are also possible out to further ranges, but because the explosion is nearly instantaneous, behavioral effects are expected to be short term, challenging to observe, and of less concern compared to potential injury and mortality effects. Todd et al. (1996) observed humpback whales near underwater explosions and did not note any overt behavioral changes (e.g., changing course, abrupt dive behavior) within 1.14 miles (1.83 kilometers) from the blast, with received Lpk of 123 dB re 1 µPa. They saw no overall trend in humpback whale movements during the course of the month when intermittent blasting was taking place.

The number, charge mass, and location of UXOs that may need controlled detonation for other projects are relatively unknown until a site assessment is performed. However, not all offshore wind projects will require controlled detonations, and, in some cases, non-explosive methods of disposing with UXOs will be effective. Therefore, it is difficult to predict the potential likelihood and frequency of effects of UXO detonation from other projects in the geographic analysis area. However, while the likelihood of encountering this stressor is unknown, the effects are well documented. At close ranges, UXO detonations can be injurious or lethal. Standard permitting requirements under the MMPA would require mitigative measures for handling UXOs to decrease the chance that any marine mammal will be severely injured or killed from an explosion. For example, seasonal and time of day restrictions can be put in place to avoid times when marine mammals may be present, noise mitigation devices (e.g., double bubble curtain) can be applied to reduce noise beyond a certain radius of the detonation, and visual and PAM monitoring of clearance zones can be used to reduce the number of marine mammals present within the predicted distance from a UXO that could cause injury or death. In addition, lower-order detonation methods, such as deflagration, are in development and could substantially decrease the energy released into the environment, therefore decreasing the effect ranges (Robinson et al. 2020). The likelihood of explosive UXO detonation associated with ongoing and planned offshore wind projects is unknown but expected to be low.

The impulsive nature of an explosive UXO detonation is expected to result in similar auditory effects for all marine mammal groups (including NARW), with severe non-auditory impacts more likely for smaller animals. However, with mitigative measures in place, the intensity and impact severity of this IPF can be reduced. Therefore, moderate impacts are expected for all marine mammals, including NARW. While impacts regarded as major for NARW could result from UXO detonations if unmitigated, BOEM assumes that standard permitting requirements under the MMPA would require elimination of injury and mortality impacts on NARW. Due to the small population size of NARW, UXO detonations are expected to have a greater impact on NARW compared to other ESA-listed species that may be better able to recover if individual animals are injured. With standard mitigation implemented, and the low likelihood of explosive detonations, the overall impact for NARW is expected to be moderate. The variability of impacts will be project-specific and will depend on the intensity of the IPF and the mitigation applied.

Impact and Vibratory Pile-Driving

In the planned activities scenario (Appendix D), the construction of up to 3,680 WTG, OSS, and Met Tower foundations associated with planned offshore wind projects in the geographic analysis area is expected to occur intermittently through 2030. During the installation of WTG foundations, underwater sound related to pile-driving would likely occur for 2 to 4 hours per day. The sound generated during pile-driving will vary depending on the piling method (impact or vibratory), pile material, size, hammer energy, water depth, and substrate type. A description of the physical qualities of pile-driving noise can be found in Appendix J. These sounds may affect marine mammal species in the area. The impacts would vary in extent and intensity based on the scale and design of each project, as well as the schedule of project activities.

Potential construction scenarios may include concurrent or non-concurrent pile-driving events over one or more years. Concurrent pile-driving scenarios would increase the geographical extent of noise that is introduced into the marine environment, but would decrease the total number of days that the environment is ensonified (assuming that the project can be completed faster). Results from Southall et al. (2021a) showed that concurrent construction of multiple windfarms—if scheduled to avoid critical periods when NARW are present in higher densities, for example—minimizes the overall risk to this species. More broadly, this determination is likely applicable to multiple marine mammal species. However, it could increase risk for permanent or TTS for species that *are* present during the construction period. Under a non-concurrent exposure scenario, individual marine mammals could be exposed to pile-driving noise on different days within the same year. This would increase the total number of exposure days. Given the migratory movements and seasonal abundances of marine mammals throughout the offshore wind energy areas, it is likely that some individuals would be exposed to multiple days of construction noise within the same year, but these would likely occur intermittently over the geographic range that an individual may be traveling.

Pile-driving activities from ongoing and planned offshore wind development projects have the potential to affect all marine mammal functional hearing groups within a certain radius around each project site. Depending on the hearing sensitivity of the species, exceedance of PTS thresholds may occur on the scale of several kilometers, whereas exceedance of TTS thresholds and behavioral effects may occur on the order of tens of kilometers from the center of pile-driving activity. However, based on the mobility of most marine mammals and the likelihood that they will avoid the area to a certain extent (e.g., Schakner and Blumstein 2013), certain marine mammal species (mid-frequency cetaceans, high-frequency cetaceans, and pinnipeds) may not be exposed to underwater sound for sufficient duration to cause PTS or TTS. In addition, if mitigations are applied (e.g., bubble curtains, shutdown zones) all of these effects and exposure ranges can be reduced. Using quieting technology (e.g., bubble curtains, noise attenuation systems [NAS)) reduces the risk of noise impacts on marine mammals by reducing the sound levels that propagate from the pile source. Available studies suggest that when a single or combined NAS is applied to monopile installation, noise reductions ranging from 3 to 17 dB can be achieved depending on the NAS combination, with some frequency-dependent reductions of >20 dB (Bellmann et al. 2020).

The most commonly reported behavioral effect of impact and vibratory pile-driving on marine mammals has been short-term avoidance or displacement from the pile-driving site. This has been well-documented for harbor porpoises, a species of high concern in European waters. Given that species like harbor porpoise produce echolocation clicks nearly constantly (Osiecka et al. 2020), strategically placed passive acoustic instruments can allow researchers to derive insights about the animals' presence and behavior around wind farms by listening for their clicks. A 2011 study of harbor porpoise acoustic activity in the North Sea at the Horns Rev II wind farm revealed that porpoise vocal activity was reduced as distant as 11.1 miles (17.8 kilometers) from the construction site during pile-driving. At the closest measured distance of 1.6 miles (2.5 kilometers), vocal activity completely ceased at the start of pile-driving and did not recommence for up to one hour after pile-driving ended, and remained below average levels for 24 to 72 hours (Brandt et al. 2011). Dahne et al. (2013) visually and acoustically monitored harbor porpoises during construction of the Alpha Ventus wind farm in German waters and found a decline in porpoise detections at distances up to 6.7 miles (10.8 kilometers) from pile-driving, while an increase in porpoise detections occurred at points 15.5 and 31.1 miles (25 and 50 kilometers) away, suggesting displacement away from the pile-driving activity. During several construction phases of two Scottish wind farms, an 8 to 17 percent decline in porpoise acoustic presence was seen in the 15.5 miles by 15.5 miles (25 kilometers by 25 kilometers) block containing pile-driving activity in comparison to a control block. Displacement within the pile-driving monitored area was seen up to 7.5 miles (12 kilometers) away (Benhemma-Le Gall et al. 2021).

A more recent analysis in the North Sea looked at harbor porpoise density and acoustic occurrence relative to the timing and location of pile-driving activity, as well as the sound levels generated during the development of eight wind farms (Brandt et al. 2016). Using data from PAM pooled across all projects, changes in porpoise detections across space and time were modeled. Compared to the 25 to 48-hour pre-piling baseline period, porpoise detections during construction declined by about 25 percent at SEL_{24h} between 145 to 150 dB re 1 μPa^2 s and 90 percent at SEL_{24h} above 170 dB re 1 μPa^2 s. Across the eight projects, a graded decline in porpoise detections was observed at different distances from pile-driving activities. The results revealed a 68 percent decline in detections within 3.1 miles (5 kilometers) of the noise source during construction, 33 percent decline 3.1 to 6.2 miles (5 to 10 kilometers) away, 26 percent decline 6.2 to 9.3 miles (10 to 15 kilometers) away, and a decline of less than 20 percent at greater distances, up to the 37.3 miles (60 kilometers) range modeled (Note: the authors used a 20 percent decline to indicate an adverse effect had occurred). However, within 20 to 31 hours after pile-driving, porpoise detections increased in the 0 to 3.1 miles (0 to 5 kilometers) range, suggesting no long-term displacement of the animals. Little to no habituation was found, i.e., over the course of installation, porpoises stayed away from pile-driving activities. It is worth noting that there was substantial inter-project variability in the reactions of porpoises that were not all explained by differences in noise level. The authors hypothesized that the varying qualities of prey available across the sites may have led to a difference in motivation for the animals to remain in an area. Temporal patterns were observed as well: porpoise abundance was significantly reduced in advance of construction up to 6.2 miles (10 kilometers) around the wind farm area, likely due to the increase in vessel traffic activity. This study showed that although harbor porpoises actively avoid pile-driving activities during the construction phase, these short-term effects did not lead to population-level declines over the five-year study period (Brandt et al. 2016).

A study conducted during wind farm construction in Cromarty Firth, Scotland compared the effect of impact and vibratory pile-driving on the vocal presence of both bottlenose dolphins and harbor porpoises in and outside the Cromarty Firth area (Graham et al. 2017). The researchers found a similar level of response of both species to both impact and vibratory piling, likely due to the similarly low, received SEL_{24h} from the two approaches (129 dB re 1 μPa^2 s (vibratory) and 133 dB re 1 μPa^2 s (impact), both at 812 meters from the pile). There were no statistically significant responses attributable to either type of pile-driving activity in the three metrics considered: daily presence/absence of a species, number of hours in which a species was detected, or duration of daytime (between 06:00 and 18:00) encounters of a species. The only exception was seen in bottlenose dolphins on days with impact pile-driving. The duration of bottlenose dolphin acoustic encounters decreased by an average of approximately four minutes at sites within the Cromarty Firth (closest to pile-driving activity) in comparison to areas outside the Cromarty Firth. The authors hypothesized that the lack of a strong response was because the received levels were very low in this particularly shallow environment, despite similar size piles and hammer energy to other studies. This study underscores the important influence of environmental conditions on the propagation of sound and its subsequent impacts on marine mammals.

In addition to avoidance behavior, several studies have observed other behavioral responses in marine mammals. A playback study on two harbor porpoises revealed that high-amplitude sounds, like pile-driving, may adversely affect foraging behavior in this species by decreasing catch success rate (Kastelein et al. 2019). In another playback study, trained dolphins were asked to perform a target detection exercise during increasing levels of vibratory pile driver playback sounds (up to 140 dB re 1 μPa) (Branstetter et al. 2018). Three of the five dolphins exhibited either a decrease in their ability to detect targets in the water, or a near complete secession of echolocation activity, suggesting the animals became distracted from the task by the vibratory pile-driving sound.

The effects of pile-driving have been studied on a limited set of additional species. Würsig et al. (2000) studied the response of Indo-Pacific humpback dolphins (*Sousa chinensis*) to impact pile-driving in the seabed in water depths of 6 to 8 meters. No overt behavioral changes were observed in response to the pile-driving activities, but the animals' speed of travel increased, and some dolphins remained in the vicinity while others temporarily abandoned the area. Once pile-driving ceased, dolphin abundance and behavioral activities returned to pre-pile-driving levels. A study using historical telemetry data collected before and during the construction and operation of a British wind farm showed that harbor seals may temporarily leave an area affected by pile-driving sound beginning at estimated received peak to peak pressure levels between 166 and 178 dB re 1 μPa (Russell et al. 2016). Seal abundance was reduced by

19 to 83 percent during individual piling events (i.e., the installation of a single pile) within 15.5 miles (25 kilometers) of the center of the pile. Displacement lasted no longer than 2 hours after the cessation of pile-driving activities, and the study found no significant displacement during construction as a whole. Interestingly, the study also showed that seal usage in the wind farm area increased during the operational phase of the wind farm, although this may have been due to another factor, as seal density increased outside the wind farm area as well.

Since there are no studies that have directly examined the behavioral responses of baleen whales (e.g., NARW) to pile-driving, studies using other impulsive sound sources such as seismic airguns serve as the best available proxies. With seismic airguns, the distance at which responses occur depends on many factors, including the volume of the airgun (and consequently source level), as well as the hearing sensitivity, behavioral state, and even life stage of the animal (Southall et al. 2021b). In a 1986 study, researchers observed the responses of feeding gray whales to a 100 in^3 airgun and found that there was a 50 percent probability that the whales would stop feeding and move away from the area when the received SPL reached 173 dB re 1 µPa (Malme et al. 1986). Other studies have documented baleen whales initiating avoidance behaviors to full-scale seismic surveys at distances as short as 1.9 miles (3 kilometers) away (McCauley et al. 1998, Johnson 2002, Richardson et al. 1986) and as far away as 12.4 miles (20 kilometers) (Richardson et al. 1999). Bowhead whales have exhibited other behavioral changes, including reduced surface intervals and dive durations, at received SPL between 125 to 133 dB re 1 µPa (Malme et al. 1988). A more recent study by Dunlop et al. (2017) compared the migratory behavior of humpback whales exposed to a 3,130 in^3 airgun array with those that were not. There was no gross change in behavior observed (including respiration rates), although whales exposed to the seismic survey made a slower progression southward along their migratory route compared to the control group. This was largely seen in female-calf groups, suggesting there may be differences in vulnerability to underwater sound based on life-stage (Dunlop et al. 2017). The researchers produced a dose-response model which suggested behavioral change was most likely to occur within 2.5 miles (4 kilometers) of the ship at SEL_{24h} over 135 dB re 1 μPa^2 s (Dunlop et al. 2017).

Acoustic masking can occur if the frequencies of the sound source overlap with the frequencies of sound used by marine species. Given that most of the acoustic energy from pile-driving is below 1 kilohertz, low-frequency cetaceans and pinnipeds are more likely to experience acoustic masking from pile-driving than mid- or high-frequency cetaceans. In addition, low-frequency sound can propagate greater distances than higher frequencies, meaning masking may occur over larger distances than masking related to higher-frequency noise. There is evidence that some marine mammals can avoid acoustic masking by changing their vocalization rates (e.g., bowhead whale [*Balaena mysticetus*; Blackwell et al. 2013], blue whale [Di Iorio and Clark 2010], humpback whale [Cerchio et al. 2014]), increasing call amplitude (e.g., beluga whale [*Delphinapterus leucas*; Scheifele et al. 2004], killer whales [*Orcinus orca*; Holt et al. 2009]), or shifting dominant frequencies (Lesage et al. 1999; Parks et al. 2007). When masking cannot be avoided, increasing noise could affect the ability to locate and communicate with other individuals. Given that impact pile-driving occurs intermittently, with some quiet periods between pile-strikes, it is unlikely that complete masking would occur with impact pile-driving. For vibratory pile-driving, sound levels are lower, but noise is generated nearly continuously. This means that the distance at which masking could occur from vibratory pile-driving is smaller than that of impact pile-driving, but the period of time for which masking might occur would be greater.

Overall, it is reasonable to assume that there would be greater impacts on low-frequency cetaceans (i.e., baleen whales) than other species groups, even though direct research on pile-driving noise on baleen whales is limited. As discussed above, there is evidence suggesting that baleen whales may avoid or change their behavior when exposed to impulsive sounds like impact pile-driving, or continuous sounds like vibratory pile-driving. Secondly, their primary frequency range for listening to their environment and communicating with others overlaps with the dominant frequency of impact and vibratory pile-driving noise. Finally, since baleen whales have specific feeding and breeding grounds (unlike toothed whales who can perform these life functions over broader spatial scales), disturbance by anthropogenic noise occurring in one of these key geographic areas may come at an increased cost to these species. Considering the number and extent of projects planned in the geographic analysis area, moderate impacts, such as some individual level fitness effects, are expected on mysticetes (including NARW), odontocetes, and pinnipeds from impact pile-driving activities, and minor impacts, such as short-term, localized behavioral responses and masking, are expected for all marine mammals from vibratory pile-driving. Because of the implementation of project-specific mitigation measures for other ongoing and planned activities included under Alternative A, PTS would not be expected to occur for NARW, so only short-term, localized impacts of medium intensity would occur for this species. For example, noise abatement devices, such as double-bubble curtains, can be used to reduce the overall acoustic energy that is introduced and decrease the geographic extent of noise-related impacts. The implementation of shut-down zones and seasonal restrictions based on species presence in an area can reduce the intensity and likelihood of effects to minor for all marine mammals by only allowing activity when animals are not present. Many of these are requirements as conditions of compliance with the ESA, MMPA, and other federal regulations. These measures would reduce the potential for PTS and TTS effects from pile-driving on all marine mammals. The likelihood of behavioral avoidance and masking effects are still high, especially for baleen whales, so mitigation would be less effective at reducing the risk of this effect for both impact and vibratory pile-driving.

Vessels

Noise from large commercial ships, as well as smaller fishing and recreational vessels, is likely to be present and persistent in the geographic analysis area. A description of the physical qualities of vessel noise can be found in Appendix J. Note that the specific effects of dynamic positioning noise on marine mammals have not been studied but are expected to be similar to that of transiting vessels as described below.

A comprehensive review of the literature (Richardson et al. 1995; Erbe et al. 2019) revealed that most of the reported adverse effects of vessel noise and presence are changes in behavior, though the specific behavioral changes vary widely across species. Physical behavioral responses include changes to flee responses at long ranges and dive patterns (e.g., longer, deeper dives in beluga whales [Finley et al. 1990; Martin et al. 2023]), disruption to resting behavior (harbor seals [Mikkelsen et al. 2019]), increases in swim velocities (belugas [Finley et al. 1990]; humpback whales [Sprogis et al. 2020]; narwhals

[*Monodon monoceros*; Williams et al. 2022]), and changes in respiration patterns (longer inter-breath intervals in bottlenose dolphins [Nowacek et al. 2006]; increased breathing synchrony in bottlenose dolphin pods [Hastie et al. 2006]; increased respiration rates in humpback whales [Sprogis et al. 2020]). A playback study of humpback whale mother-calf pairs exposed to varying levels of vessel noise revealed that the mother's respiration rates doubled and swim speeds increased by 37 percent in the high noise conditions (low-frequency weighted received root-mean-square sound pressure level [SPL] at 100 meters was 133 dB re 1 µPa) compared to control and low-noise conditions (SPL of 104 dB re 1 µPa and 112 dB re 1 µPa respectively [Sprogis et al. 2020]). Changes to foraging behavior, which can have a direct effect on an animal's fitness, have been observed in porpoises (Wisniewska et al. 2018) and killer whales (Holt et al. 2021) in response to vessel noise. Thus far, one study has demonstrated a potential correlation between low-frequency anthropogenic noise and physiological stress in baleen whales. Rolland et al. (2012) showed that fecal cortisol levels in NARW decreased following the 9/11 terrorist attacks, when vessel activity was significantly reduced. Interestingly, NARW do not seem to avoid vessel noise nor vessel presence (Nowacek et al. 2004), yet they may incur physiological effects as demonstrated by Rolland et al. (2012). An additional study documented a physiological stress response in narwhal where a significant increase in cortisol (i.e., stress response hormone) was found in blubber samples during a period with increased vessel traffic related to an iron-ore mine's shipping operations (Watt et al. 2021). This lack of observable responses, despite physiological responses, make it challenging to assess the biological consequences of exposure. In addition, there is evidence that individuals of the same species may have differing responses if the animal has been previously exposed to the sound versus if it is completely novel interaction (Finley et al. 1990). Reactions may also be correlated with other contextual features, such as the number of vessels present, their proximity, speed, direction or pattern of transit, or vessel type. As an example, Croll et al. (2001) examined the behavioral responses to a low-frequency (<1,000 Hz) naval sonar source and found that the whales continued foraging, even when received noise levels exceeded SPL of 140 dB re 1 µPa, and hypothesized that changes in foraging behavior seemed to be more closely linked to change in prey abundance and oceanographic conditions than the low-frequency noise. For a more detailed and comprehensive review of the effects of vessel noise on specific marine mammal groups the reader is referred to Erbe et al. (2019).

Some marine mammals may change their acoustic behaviors in response to vessel noise, either due to a sense of alarm or in an attempt to avoid masking. For example, fin whales (Castellote et al. 2012) and belugas (Lesage et al. 1999) have altered frequency characteristics of their calls in the presence of vessel noise. When vessels are present, bottlenose dolphins have increased the number of whistles (Buckstaff 2006; Guerra et al. 2014), while sperm whales decrease the number of clicks (Azzara et al. 2013), and humpbacks and belugas have been seen to completely stop vocal activity (Tsujii et al. 2018; Finley et al. 1990). Some species may change the duration of vocalizations (fin whales shortened their calls [Castellote et al. 2012]) or increase call amplitude (killer whales [Holt et al. 2009]) to avoid acoustic masking from vessel noise.

Understanding the scope of acoustic masking is difficult to observe directly, but several studies have modeled the potential decrease in "communication space" when vessels are present (Clark et al. 2009;

Erbe et al. 2016; Putland et al. 2017). For example, Putland et al. (2017) showed that during the closest point of approach (<10 kilometers) of a large commercial vessel, the potential communication space of Bryde's whale (*Balaenoptera edeni*) was reduced by 99 percent compared to ambient conditions.

Although there have been many documented behavioral changes in response to vessel noise (Erbe et al. 2019), it is necessary to consider what the biological consequences of those changes may be. One of the first attempts to understand the energetic cost of a change in vocal behavior found that metabolic rates in bottlenose dolphins increased by 20 to 50 percent in comparison to resting metabolic rates (Holt et al. 2015). Although this study was not tied directly to exposure to vessel noise, it provides insight about the potential energetic cost of this type of behavioral change documented in other works (i.e., increases in vocal effort such as louder, longer, or increased number of calls). Modeled whale movements, through constricted navigation channels largely ensonified by vessel noise, predicted the effects of low-frequency noise on migration routes (Johnston and Painter 2024). The mathematical model indicated that minke whale migration routes were likely to be altered due to a reduction in communication space, avoidance responses, and loss of acoustic cue information. The study concluded that there would be an energetic cost to migrating through environments represented by the "current" soundscape containing wind and vessel noise when compared to "pristine" soundscape conditions defined as wind noise only, a condition that, globally, is not a practical assumption (Johnston and Painter 2024). In another study, the energetic cost of high-speed escape responses in dolphins was modeled, and the researchers found that the cost per swimming stroke was doubled during such a flight response (Williams et al. 2017a). When this sort of behavioral response was also coupled with reduced glide time for beaked whales, the researchers estimated that metabolic rates would increase by 30.5 percent (Williams et al. 2017a). Differences in response have been reported both within and among species groups (Finley et al. 1990; Tsujii et al. 2018). Furthermore, flee responses in narwhal after being released from a net entanglement displayed a paradoxical physiological response where extreme bradycardia with heart rates ≤ 4 beats per minute occurred simultaneously with exercise up-regulation (fluke stroke frequency >25 strokes per minute and energetic costs three to six times the resting rate of energy expenditure) that rapidly depleted onboard oxygen stores (Williams et al. 2017b). Despite demonstrable examples of biological consequences to individuals, there is still a lack of understanding about the strength of the relationship between many of these acute responses and the potential for long-term or population-level effects.

Vessel noise associated with non-offshore-wind activities is likely to be present throughout the marine mammal geographic analysis area at a nearly continuous rate due to the prevalence of commercial shipping, fishing, and recreational boating activities which are ongoing and would be expected to continue in the geographic analysis area.

During both the construction and operational phases of offshore wind projects, several types of vessels will be used to transport crew and supplies, and during construction, dynamic positioning systems may be used to keep the pile-driving vessel in place.

Vessel noise associated with ongoing and planned offshore wind projects will be present throughout the geographic analysis area. Vessel noise during construction is expected to be nearly continuous and have broad geographical extent given the size of the vessels, and may therefore have minor impacts on mysticetes (including NARW), odontocetes, and pinnipeds. During the operational phase of offshore wind projects, vessel noise is expected to be infrequent (occurring mostly for maintenance work) and should be localized in extent because smaller vessels would be used, and thus is expected to have negligible impacts on mysticetes (including NARW), odontocetes, and pinnipeds. The required vessel slow-downs to reduce strike risk are expected to reduce the amount of noise that is emitted into the environment (Joy et al. 2019). In addition, helicopters may be used to transport crew from land to the construction site, which would further reduce noise transmitted into the water.

Site Preparation

Prior to offshore wind project foundation and export cable installation, boulder clearance and pre-lay grapnel runs may be conducted to clear the area of obstructions. This may involve several types of equipment, including dredgers; for a physical description of this noise source, see Appendix J.

Given the low source levels and transitory nature of these sources, exceedance of PTS and TTS levels are not likely for harbor porpoise and seals, according to measurements and subsequent modeling by Heinis et al. (2013). For other marine mammals, PTS is not likely, but if dredging occurs in one area for relatively long periods, TTS and behavioral thresholds could be exceeded (Todd et al. 2015).

Behavioral reactions and masking of low-frequency calls in baleen whales and seals are considered more likely to occur due to the low-frequency spectrum over which the sounds occur. Of the few studies that have examined behavioral responses from dredging noise, most have involved other industrial activities, making it difficult to attribute responses specifically to dredging noise (e.g., Bryant et al. 1984). Some found no observable response (beluga whales [Hoffman 2012]), while others showed avoidance behavior (bowhead whales in a playback study of drillship and dredge noise in Richardson et al. 1999). Diederichs et al. (2010) found short-term avoidance of dredging activities by harbor porpoises near breeding and calving areas in the North Sea. Pirotta et al. (2013) found that, despite a documented tolerance of high vessel presence, as well as high availability of food, bottlenose dolphins spent less time in the area during periods of dredging. The study also showed that with increasing intensity in the activity, bottlenose dolphins avoided the area for longer durations (with one instance being as long as 5 weeks) (Pirotta et al. 2013). Brief behavioral effects or acoustic masking over small spatial scales may occur for baleen whales (including NARW) due to the low-frequency nature of these sound sources.

While behavioral responses may occur from site preparation activities, they are expected to be short term and of low intensity. Masking and behavioral reactions from dredging may be more likely for baleen whales and pinnipeds due to the low-frequency spectrum over which the sounds occur and the overlap with their best hearing sensitivity. Therefore, site preparation activities are expected to have negligible impacts on mysticetes (including NARW), odontocetes, and pinnipeds.

Trenching and Cable-Laying

Preparing a lease area for turbine installation and cable-laying may require jetting, plowing, or removal of soft sediments. Cable installation vessels are likely to use dynamic positioning systems while laying the cables. The sound associated with dynamic positioning generally dominates other sound sources present especially in the situation of cable-laying. A description of the physical qualities of these sound sources can be found in Appendix J. Due to the low intensity and localized nature of the sound source, minor impacts, such as brief behavioral effects or acoustic masking over small spatial scales, may occur for mysticetes (including NARW) due to the low-frequency nature of these sound sources.

Aircraft

Ongoing and planned offshore wind activities may employ helicopters and fixed-wing aircraft for transporting construction or maintenance crew, or monitoring during construction activities, which emit sound that could affect marine mammals. A description of the physical qualities of aircraft noise can be found in Appendix J. In general, marine mammal behavioral responses to aircraft have most commonly been observed at altitudes of less than 93 feet (150 meters) from the aircraft (Patenaude et al. 2002; Smultea et al. 2008). Aircraft operations have resulted in temporary behavioral responses including short surface durations (bowhead and belugas [Patenaude et al. 2002]; transient sperm whales [Richter et al. 2006]), abrupt dives (sperm whales [Smultea et al. 2008]), and percussive behaviors (i.e., breaching and tail slapping [Patenaude et al. 2002]). Responses appear to be heavily dependent on the behavioral state of the animal, with the strongest reactions seen in resting individuals (Würsig et al. 1998). BOEM requires all aircraft operations to comply with current approach regulations for NARW or unidentified large whales (50 CFR 222.32). These include the prohibition of aircraft from approaching within 1,500 feet (457 meters), which would minimize the potential responses of marine mammals to aircraft noise.

In addition, based on the physics of sound propagation across different media (e.g., air and water), only a small portion of the acoustic energy from aircraft operations couples into the water. With the implementation of BMPs, noise impacts from aircraft are expected to be negligible to mysticetes (including NARW), odontocetes, and pinnipeds.

WTG Operations

The operation of turbines during ongoing and planned offshore wind farms may result in long-term, low-level, continuous sound in the offshore environment. A description of the physical qualities of turbine operational noise can be found in Appendix J.

Based on the currently available sound field data for turbines smaller than 6.2 MW (Tougaard et al. 2020) and comparisons to acoustic impact thresholds (NMFS 2018), underwater sound from offshore wind turbine operations is not likely to cause PTS or TTS in marine mammals but may have the potential to cause behavioral and masking effects at close distances. Tougaard et al. (2020) aggregated the existing sound field measurements from 17 operating wind farms and modeled the received sound levels as a function of recording distance, wind speed, and turbine size. Based on their model, the mean of all the data normalized to a measurement made at 328 feet (100 meters), for a turbine 1 MW in size operating at a wind speed of 10 meters per second was a received SPL of 109 dB re 1 µPa (with a standard error of 1.7 dB). Based on the model, the noise from a single, 1 MW turbine dropped below ambient conditions within 400 meters of the foundation or a few kilometers for an array of 81 turbines. For high ambient noise conditions, the distance at which the turbine can be heard above ambient noise was even less. It is important to note that just because a sound is audible, that does not mean that it would be disturbing or be at a sufficient level to mask important acoustic cues. There are many natural sources of underwater sound which vary over space and time and would affect an animal's ability to hear turbine operational noise over ambient conditions. More recently, Betke and Bellmann (2023) conducted standardized underwater sound measurements from 25 German offshore wind farms that included turbines up to 8 MW. The trend analysis in the Betke and Bellmann (2023) study showed that there was no statistical increase in radiated noise with increasing turbine power size.

Lucke et al. (2007) explored the potential for acoustic masking from operational noise by conducting hearing tests on trained harbor porpoises while they were exposed to sounds resembling operational wind turbines (i.e., <1 kHz). Of the two masking conditions (i.e., high: SPL of 128 dB re 1 µPa, and moderate: 115 dB re 1 µPa), designed based on noise measurements from operational turbines of sizes less than 5 MW, Lucke et al. (2007) saw masking effects at a received level of 128 dB re 1 µPa at frequencies of 700 Hz, 1 kHz, and 2 kHz, but found no masking at SPLs of 115 dB re 1 µPa. At this broadband received level, the noise at 700 Hz, 1 kHz, and 2 kHz was 6.8 dB, 7.3 dB, and 4.8 dB over unmasked conditions, respectively. Based on these results, the Lucke et al. (2007) concluded that masking may occur within 66 feet (20 meters) of an operating turbine. Lucke et al. (2007) considered the contemporaneous size turbines (i.e., <5 MW, and the noise they make during operation). Larger turbines are being considered now (up to 18 GW) for which no empirical measurements of noise produced during operation are available. While sound levels may increase with increasing turbine size, the use of direct-drive technology in newer turbine models, compared to the gear technology used in the models previously studied, is expected to substantially reduce sound levels. Empirical measurements of operational noise will be needed to predict potential masking effects associated with larger turbine operations.

Very few empirical studies have looked at the effect of operational wind turbine noise on wild marine mammals. Some have shown an increase in acoustic occurrences of marine mammals during the operational phase of wind farms (harbor seals [Russell et al. 2016], harbor porpoise [Scheidat et al. 2011]), while another study showed a decrease in the abundance of porpoises one year after operation began in comparison with the preconstruction period (Tougaard et al. 2005). However, no change in acoustic behavior was detected in the animals that were present (Tougaard et al. 2005). In these field monitoring studies, it is unclear if the behavioral responses result from operational noise, or merely the presences of turbine structures. Regardless, these findings suggests that turbine operational noise did not have any gross adverse effect on the acoustic behavior of the animals.

Due to their low sound levels, behavioral and masking effects associated with turbine operational noise are not expected to have significant impacts on individual survival, population viability, distribution, or behavior, and are not expected to occur outside a very small radius around a given turbine. In addition, the audibility of turbine operational noise may be further limited by the ambient noise conditions of the environment (Jansen and de Jong 2016, as an example). Therefore, turbine operational noise is expected to have a negligible to minor impact on mysticetes (including NARW), odontocetes, and pinnipeds. Minor impacts, such as masking in low ambient noise conditions, may be more likely for mysticetes (including NARW), due to the low-frequency nature of operational noise and this group's hearing sensitivity (note: pinnipeds also have low frequency hearing but their threshold of underwater hearing is higher). As larger turbines with differing technologies (e.g., direct-dive) come online, more acoustic measurements are necessary to characterize the relationship between foundation size, type, and the sound levels associated with operation of a single or an array of WTGs, as this may affect the physical distance in which potential behavioral or masking impacts may be possible (Thomsen and Stober 2022).

Decommissioning

A physical description of underwater explosives and mechanical cutting, two potential methods that could be used for conceptual decommissioning, can be found in Appendix J. The impacts from noise generated during conceptual decommissioning activities are likely be similar to those outlined for construction activities.

Summary

These findings are consistent with the best available information regarding impacts of underwater sound on marine mammals, which predicts a range of effects depending on the duration and intensity of exposure, as well as species and behavioral state of the animal (e.g., migrating, foraging).

Considering the extent of offshore wind projects in the geographic analysis area, it is likely that underwater noise could cause adverse effects to marine mammals. Sound generated from other offshore wind activities include impulsive (e.g., impact pile-driving, UXO detonations, some geophysical sources) and non-impulsive sources (e.g., vibratory pile-driving, some geophysical sources, vessels, aircraft, cable-laying, dredging, WTG operations). Of those activities, only impact pile-driving and UXO detonations, could present a reasonable potential for auditory injury in mysticetes (including NARW), odontocetes, and pinnipeds. UXO detonation may also cause non-auditory injury or even mortality at close range. All sound sources have the potential to cause masking and behavioral-level effects, and some may also cause TTS in certain species at certain ranges. All other ongoing and planned offshore wind projects considered under Alternative A are expected to comply with mitigation measures (e.g., shutdown zones, PSOs, sound abatement), which would minimize underwater sound impacts on marine mammals.

The intensity of the noise IPF is considered minor to moderate for UXO detonations as mortality thresholds could be exceeded, but mitigation would be expected to eliminate the risk of mortality occurring; moderate for impact pile-driving, as PTS thresholds could be exceeded; and negligible to minor for all of the other noise-producing activities in which behavioral thresholds could be exceeded, or in which auditory masking may occur. The predicted effect would be long term in the case of PTS effects and non-auditory injury, and short term with respect to TTS, behavioral effects, and masking. The geographic extent is considered localized for PTS effects and extensive for behavioral disturbance effects, as sound could exceed behavioral thresholds >6.2 miles (>10 kilometers) away depending on the activity. The frequency of the activity causing the effect is considered infrequent for UXO detonations, aircraft, and dredging sound; frequent for impact pile-driving, vibratory pile-driving, cable laying, and HRG survey sound; and continuous for WTG operation sound. Based on the source levels available in the literature (Appendix J), some PTS, TTS, behavioral disturbance, and masking effects on low-frequency cetaceans, mid-frequency cetaceans, high-frequency cetaceans, and pinnipeds are considered likely but would vary by species and population. Due to the overlap between their hearing range and the dominant frequency of many sound sources associated with offshore wind (Appendix J), mysticetes may be more susceptible to behavioral disturbance and masking effects compared to other functional hearing groups. Based on the available information regarding ongoing and planned offshore wind activities in the geographic analysis area, the overall impact of underwater noise is considered to be moderate for mysticetes (including NARW), odontocetes, and pinnipeds.

Port utilization: The development of an offshore wind industry in the marine mammal geographic analysis area may incentivize the expansion or improvement of regional ports to support planned projects. Three main activities surrounding port utilization have the potential to affect marine mammals: port expansion/construction, increased vessel traffic, and increased dredging. The State of New Jersey is planning to build an offshore wind port on the eastern shore of the Delaware River in Lower Alloways Creek (Appendix D). The Atlantic Shores South (OCS-A 0499) project would construct an O&M facility in Atlantic City, New Jersey on a shoreside parcel that was formerly used for vessel docking and other port activities. At larger ports such as Charleston and Norfolk, offshore wind-related activities would make up a small portion of the total activities at the port; therefore, offshore wind activities are likely to have a negligible impact on marine mammals through increased port utilization at these ports. However, for smaller ports within the geographic analysis area, such as Paulsboro and Hope Creek, port expansion may be necessary to accommodate the increased activity, resulting in more significant increases to vessel traffic and shoreline construction and could include dredging, deepening, and new berths. USACE performed maintenance dredging of portions of the Newark Bay, a New Jersey federal navigation channel, including the removal of material from the Port Elizabeth Channel, that occurred between July 2021 and February 2022 (USACE 2021). Additionally, in 2017 USACE Charleston District awarded contracts as part of the Charleston Harbor Deepening Project, which will create a 52-foot (16-meter) depth at the entrance channel to Charleston Harbor in South Carolina. Port improvements could lead to an increase in vessel traffic (see *Traffic* IPF) and underwater noise (pile-driving and dredging; see *Noise* IPF) during construction and installation, O&M, and conceptual decommissioning. The realized impacts on marine mammals in the geographic analysis area from the activities described above include potential increased vessel interaction, exposure to noise, and disturbance of benthic habitat. Specific ports and expansions will be further discussed in project-specific COPs and NEPA documents.

Impacts from port utilization from ongoing and planned non-offshore-wind and offshore wind activities on mysticetes (including NARW), odontocetes, and pinnipeds would likely be minor, with effects that would be detectable and measurable but not lead to population-level impacts. However, any future port expansion and associated increase in vessel traffic would be subject to independent NEPA analysis and regulatory approvals requiring full consideration of potential effects on marine mammals regionwide.

Presence of structures: The presence of up to 3,680 WTG, OSS, and Met Tower foundations in the geographic analysis area can lead to impacts, both beneficial and adverse, on marine mammals through localized changes resulting from hydrodynamic effects, prey aggregation and associated increase in foraging opportunities, entanglement and gear loss/damage, migration disturbances, and displacement. Project-specific effects would vary, recognizing that larger and contiguous projects could have more significant hydrodynamic effects and broader scales. This could in turn lead to more significant effects on prey and forage resources, but the extent and significance of these effects cannot be predicted based on currently available information.

Long-term habitat alterations during wind farm operations through the placement of WTG and OSS foundations, scour protection, and cable protection could lead to potential changes in foraging habitat for some marine mammal species. Though the installation of wind farm infrastructure is expected to result in the loss of soft-bottom habitat, it would also result in the conversion of open-water habitat to hard, vertical habitat, which can, through a series of successional changes, aggregate prey species, including forage fish (Causon and Gill 2018; Taormina et al. 2018). This so-called "reef effect" could attract marine mammals seeking foraging opportunities within the wind farms. Seals, for example, have been documented foraging around wind farm structures in Europe (Russell et al. 2016). Due to the increase in prey availability, the reef effect may be considered a beneficial impact for fish-eating odontocetes and pinnipeds, though no noticeable impact on mysticetes or sperm whales is anticipated. However, there is currently no example of an operational, large-scale offshore renewable energy project within the geographic analysis area for marine mammals, so effects on marine mammals due to the reef effect remain largely uncertain.

The widespread development of offshore renewable energy facilities may facilitate climate change adaptation for certain marine mammal prey and forage species. Hayes et al. (2022) note that marine mammals are following shifts in the spatial distribution and abundance of their primary prey resources driven by increased water temperatures and other climate-related impacts. These range shifts are primarily oriented northward and toward deeper waters. The artificial reef effect created by these structures forms biological hotspots that could support species range shifts and expansions and changes in biological community structure resulting from a changing climate (Degraer et al. 2020; Methratta and Dardick 2019; Raoux et al. 2017), though it is unknown how marine mammals may ultimately respond to this.

The presence of vertical structures in the water column could cause a variety of hydrodynamic effects. The general understanding of offshore wind-related impacts on hydrodynamics is derived primarily from European based studies. A synthesis of European studies by van Berkel et al. (2020) summarized the potential effects of wind turbines on hydrodynamics, the wind field, and fisheries. Local to a wind facility, the range of potential impacts include increased turbulence downstream, remobilization of sediments, reduced flow inside wind farms, downstream changes in stratification, redistribution of water temperature, and changes in nutrient upwelling and primary productivity.

Human-made structures, such as bottom-founded foundations and operational WTGs associated with offshore wind projects, alter local water flow at a fine scale by potentially reducing wind-driven mixing of surface waters or increasing vertical mixing as water flows around the structure (Carpenter et al. 2016; Cazenave et al. 2016; Segtnan and Christakos 2015). When water flows around the structure, turbulence is introduced that influences local current speed and direction. Turbulent wakes have been observed and modeled at the kilometer scale (Cazenave et al. 2016; Vanhellemont and Ruddick 2014). While impacts on current speed and direction decrease rapidly around monopiles and are mainly driven by interactions at the air-sea surface interface, there is also the potential for tidal current wakes out to a kilometer from a monopile (Li et al. 2014). Laboratory measurements demonstrate that water flows are reduced immediately downstream of foundations but would return to ambient levels within relatively short distances (i.e., a few feet) or up to 3,281 feet (1,000 meters) depending on local conditions (Miles et al. 2017; Schultze et al. 2020; Johnson et al. 2021). Direct observations of the influence of a monopile extending to at least 984 feet (300 meters), however, was indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,280 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis. The downstream area affected by reduced flows is dependent on pile diameter and on environmental and oceanographic conditions. Hub height and oceanographic conditions (e.g., currents, stratification, depth) also influence hydrodynamic impacts of foundations.

The presence of vertical structures in the water column could also cause a variety of long-term hydrodynamic effects, which could impact marine mammal prey species. Atmospheric wakes, characterized by reduced downstream mean wind speed and turbulence along with wind speed deficit, are documented with the presence of vertical structures. The magnitude of atmospheric wakes can change relative to instantaneous velocity anomalies. In general, lower impacts of atmospheric wakes are observed in areas of low wind speeds. Several hydrodynamic processes have been identified to exhibit changes from vertical structures:

- Advection and Ekman transport are directly correlated with shear wind stress at the sea surface boundary. Vertical profiles from Christiansen et al. (2022) exhibit reduced mixing rates over the entire water column. As for the horizontal velocity, the deficits in mixing are more pronounced in deep waters than in well-mixed, shallow waters, which is likely favored by the influence of the bottom mixed layer in shallow depths. In both cases, the strongest deficits occur near the pycnocline depth.

- Additional mixing downstream has been documented from Kármán vortices and turbulent wakes due to the pile structures of wind turbines (Carpenter et al. 2016; Grashorn and Stanev 2016; Schultze et al. 2020; Dorrell et al. 2022).

- Upwelling and downwelling dipoles under contact of constant wind directions affecting average surface elevation of waters have been documented as the result of offshore wind farms (Brostörm 2008; Paskyabi and Fer 2012; Ludewig 2015; Floeter et al. 2022). Mean surface variability is between 1 and 10 percent.

- With sufficient salinity stratification, vertical flow of colder/saltier water to the surface occurs in lower sea surface level dipoles and warmer/less saline water travels to deeper waters in elevated sea surface heights (Ludewig 2015; Christiansen et al. 2022; Floeter et al. 2022). This observation also suggested impacts on seasonal stratification, as documented in Christiansen et al. (2022), as well as potential impacts on heat storage and atmospheric CO_2 uptake, as discussed in Dorrell et al. (2022). However, severity of this impact in the U.S. Atlantic is still largely unknown, and the magnitude of salinity and temperature changes with respect to vertical structures is small compared to the long-term and interannual variability of temperature and salinity.

The potential hydrodynamic effects identified above from the presence of vertical structures in the water column therefore affect nutrient cycling and could influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020). Turbulence resulting from vertical structures in the water column could lead to localized changes in circulation and stratification patterns, with potential implications for localized primary and secondary productivity and fish distribution. Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Changes in cold pool dynamics resulting from future activities, should they occur, could conceivably result in changes in habitat suitability and fish community structure, but the extent and significance of these potential effects are unknown.

Several modeling studies have assessed the potential effects of structures on productivity. Daewel et al. (2022) modeled the effects of offshore wind farm projects in the North Sea on primary productivity and found that there were areas with both increased and decreased productivity within and around the wind farms. There was a decrease in productivity in the center of large wind farm clusters but an increase around these clusters in the shallow, near-coastal areas of the inner German Bight and Dogger Bank (Daewel et al. 2022). However, the authors noted that when integrated over a larger area, the local decreases and increases averaged to a nominal (0.2 percent) change. Although their modeling effort focused on upwelling in California waters, Raghukumar et al. (2023) concluded that presence of wind farm structures can alter the cross-shore structure of wind stress, which can change the pattern of the Ekman transport inshore of the wind farm. Results of the modeling for Northern California (around 35°N) indicated a decrease in upwelling observed inshore of the wind farm and increase in upwelling offshore of the wind farm (Raghukumar et al. 2023). The underlying effects from the wind stress gradient also affect along-shore currents, eddy kinetic energy, and net primary productivity such that a stable or even increasing nutrient supply may occur despite periods of upwelling variation (Raghukumar et al. 2023).

Alterations in primary productivity due to hydrodynamic effects associated with the presence of structures may alter typical distributions of fish and invertebrates on the OCS, which are normally driven by primary productivity associated with cold pool upwelling (Chen et al. 2018; Lentz 2017; Matte and Waldhauer 1984). These localized and regional alterations to primary productivity could have impacts on prey species for marine mammals. The vertical structures in the water column associated with WTG and OSS foundations may increase vertical mixing driven by currents flowing around the foundations (Christiansen et al. 2022; Carpenter et al. 2016; Schultze et al. 2020). This mixing could fundamentally change shelf sea systems, particularly in seasonally stratified seas, although enhanced mixing may positively affect some marine ecosystems (Dorrell et al. 2022). During times of stratification (i.e., summer), increased mixing due to the presence of structures could potentially result in increased pelagic primary productivity (English et al. 2017; Degraer et al. 2020). However, increased primary productivity may not lead to increases in marine mammal prey species, as the increased productivity may be consumed by filter feeders colonizing the structures (Maar et al. 2009; Slavik et al. 2019). This filter feeder colonization may lead to biological changes in the demersal community within up to 164 feet (50 meters) of the foundation due to increased local fecal pellet excretions (Maar et al. 2009).

Impacts from the presence of structures, mainly resulting from the extraction of kinetic wind energy by turbine operations and reduction in wind stress at the air-sea interface, can lead to changes in horizontal and vertical water column mixing patterns (Miles et al. 2021). These effects are likely to occur over a range of temporal and spatial scales. Dorrell et al. (2022) concluded that the presence of structures could diffuse local thermoclines and the subsequent changes in surface water characteristics may affect heat storage, atmosphere CO_2 uptake, and benthic resupply of oxygen. However, the scale of these responses will be dependent on local site conditions and project infrastructure, and, at the regional scale, the water column stratification should reform (Dorrell et al. 2022). Individual foundations may increase vertical mixing and deepen the thermocline, potentially increasing pelagic productivity locally (English et al. 2017; Kellison and Sedberry 1998). Eddies may also form as a result of water flowing around WTG and OSS foundations (Chen et al. 2016), which could increase local retention of plankton, although this is hypothesized based on modeling of conditions present during storm activities and not in-situ observations. A recent modeling study found that offshore wind structures could deepen the thermocline in the wind farm area by 3.3 to 6.6 feet (1 to 2 meters) and lead to a greater retention of cooler water in the wind farm area during the summer (Johnson et al. 2021). However, other studies report direct observations of the influence of a monopile extending to at least 984 feet (300 meters). Ultimately, the hydrodynamic influence was indistinguishable from natural variability in a subsequent year (Schultze et al. 2020).

The change in stratification and vertical mixing would influence lower tropic level prey species and would therefore be most relevant to marine mammals. Localized turbulence and upwelling effects around the monopiles are likely to transport nutrients into the surface layer, potentially increasing primary and secondary productivity. That increased productivity could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations. While the net impacts of these interactions are difficult to predict, they are not likely to result in more than localized effects on the abundance of zooplankton. Turbulent mixing would be increased locally within the flow divergence and in the wake, which would enhance local dispersion and dissipation of flow energy. However, because the monopiles would be spaced approximately 1 nm (1.9 kilometers) apart, there would be less than 1 percent areal blockage and the net effect over the spatial scale of the project would be negligible. When considered relative to the broader oceanographic factors that determine primary and secondary productivity in the region, localized impacts on zooplankton abundance and distribution are not likely to measurably affect the availability of prey resources for marine mammals.

In contrast, broadscale hydrodynamic impacts could alter zooplankton distribution and abundance, with impacts that may extend to tens of kilometers from structure foundations (Christiansen et al. 2022; van Berkel et al. 2020). This possible effect is primarily relevant to NARW, as their planktonic prey (e.g., calanoid copepods) are the only listed species' prey in the region whose aggregations are primarily driven by hydrodynamic processes. As aggregations of plankton, which provide a dense food source for NARW to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities. Potential effects of hydrodynamic changes in prey aggregations are specific to listed species that feed on plankton, whose movement is largely controlled by water flow, as opposed to other listed species that eat fish, cephalopods, crustaceans, and marine vegetation, which are either more stationary on the seafloor or are more able to move independent of typical ocean currents (NMFS 2021). Chen et al. (2020) modeled sea scallop larval transport as influenced by the presence of WTG foundations (Vineyard Wind 1 offshore Massachusetts) and found that the presence of structures altered the local vertical mixing, horizontal advections, and dispersal of larvae. Specifically, the change in local hydrodynamics shifted larval dispersal to new locations that could affect sea scallop abundance in the region (Chen et al. 2021). Johnson et al. (2021) modeled the effects from the full build-out of all the southern New England offshore wind lease areas on larval transport. In the modeling results, the changes to depth-averaged currents varied from an 8-percent decrease to an 11-percent increase; the greatest changes in currents occurred in the regions north and south of the offshore wind lease areas (Johnson et al. 2021). Changes in currents east of the offshore wind lease areas, in the Nantucket Shoals region, were minor. Johnson et al. (2021) also showed a relative deepening in the thermocline of approximately 3 to 7 feet (1 to 2 meters) and a retention of colder water inside the wind farm areas through the summer months compared to the baseline scenario where WTGs were not present. This result is somewhat contrary to some of the results from European studies (theoretical, observational, and modeled) that suggest a loss of stratification due to the introduction of turbulence by wind wakes (van Berkel et al. 2020). Chen et al. (2016) assessed how WTGs would affect oceanographic processes during storm events. The results showed that there would not be a significant influence on southward larval transport from Georges Bank and Nantucket Shoals to the Mid-Atlantic Bight due to the presence of WTGs, although it could cause increased cross-shelf larval dispersion. Broadscale atmospheric and hydrodynamic impacts could alter planktonic larval distribution and abundance, with impacts that may extend to tens of kilometers from structure foundations (Christiansen et al. 2022; Dorrel et al. 2022; van Berkel et al. 2020).

As evidenced in the literature, much of which is based upon modeling, there is uncertainty as to what effects will occur from the presence of offshore wind structures, how the potential broader ecological changes may affect marine mammals in the future, and how those changes will interact with other human-caused impacts. Given this, BOEM asked the National Academies of Sciences, Engineering, and Medicine (NASEM) to further evaluate this issue, with particular emphasis on assessing potential impacts on NARW prey availability. The NASEM (2023) report included the following two conclusions:

- The paucity of observations and uncertainty of the modeled hydrodynamic effects of wind energy development at the turbine, wind farm, and regional scales make potential ecological impacts of turbines difficult to predict and/or detect.
- The hydrodynamic impacts from offshore wind development in the Nantucket Shoals region on zooplankton will be difficult to isolate from the much larger magnitude of variability introduced by natural and other anthropogenic sources (including climate change) in this dynamic and evolving oceanographic and ecological system.

Therefore, based on available data, the impact of the increased presence of structures on marine mammals and their habitats is uncertain, its significance is unknown, and it likely varies by species and location. However, BOEM is committed to further studying the impacts of offshore wind operations on NARW prey (BOEM 2024).

The long-term presence of WTG structures could displace marine mammals from preferred habitats or alter movement patterns. The evidence for long-term displacement is unclear and varies by species. For example, Long (2017) studied marine mammal habitat use around two commercial wind farm facilities before and after construction and found that habitat use appeared to return to normal after construction. In contrast, Teilmann and Carstensen (2012) observed clear long-term (greater than 10 years) displacement of harbor porpoise from commercial wind farm areas in Denmark. Displacement effects remain a focus of ongoing study (Kraus et al. 2019). Other studies have documented apparent increases in marine mammal density around wind energy facilities. Russel. et al. (2014) found clear evidence that seals were attracted to a European wind farm, apparently attracted by the abundant concentrations of prey created by the artificial reef effect.

Displacement or altered movement patterns due to the presence of structures could lead to a heightened exposure to commercial and recreational fishing activity, thereby leading to an increased risk of interaction with fishing gear, potentially resulting in entanglement leading to injury or death. Offshore structures and the anticipated reef effect have the potential to lead to increased recreational fishing within the lease areas and result in moderate exposure and high-intensity risk of interactions with fishing gear that may lead to entanglement, ingestion, injury, and death (Moore and van der Hoop 2012). The reef effect may result in drawing in recreational fishing effort from inshore areas, and overall interaction between marine mammals and fisheries could increase if marine mammals are also drawn to the offshore structures due to increased prey abundance. Gray seals are susceptible to entrapment in gillnet fisheries, as well as trawl fisheries to a lesser degree (Orphanides 2020; Lyssikatos 2015). If commercial trawling were to occur near wind farms, increased interactions and resulting mortality of gray seals could potentially occur. Additionally, commercial and recreational fishing vessels may be displaced outside of offshore wind farms. IPFs under Alternative A would impact all fisheries and all gear types. Bottom tending mobile gear is more likely to be displaced to areas outside of the offshore wind farms than fixed gear. Ongoing and planned offshore wind projects would be more likely to displace larger fishing vessels with small mesh bottom-trawl gear and mid-water trawl gear, compared to smaller fishing vessels with similar gear types that may be easier to maneuver. In addition, some potential exists for a shift in gear types from fixed to mobile, or from mobile to fixed gear, due to displacement from the offshore wind farms. The potential impact on marine mammals from these changes is uncertain. However, if a shift from mobile gear to fixed gear occurs due to inability of the fishermen to maneuver mobile gear, there would be a potential increase in the number of vertical buoy lines, resulting in an increased risk of marine mammal interactions with fishing gear. These fisheries interactions may result in demographic impacts on marine mammal species.

All marine mammal species are vulnerable to entanglement to varying degrees (Read 2008; Stelfox et al. 2016). Entanglement in fishing gear has been identified as one of the leading causes of mortality in NARW and may be a limiting factor in the species recovery (Knowlton et al. 2012). Current estimates indicate that 83 percent of NARW show evidence of at least one past entanglement and 60 percent with evidence of multiple fishing gear entanglements, with rates increasing over the past 30 years (King et al. 2021; Knowlton et al. 2012). Of documented NARW entanglements in which gear was recovered, 80 percent was attributed to non-mobile fishing gear (i.e., lobster and gillnet gear) (Knowlton et al. 2012). Additionally, recent literature indicates that the proportion of NARW mortality attributed to fishing gear entanglement is likely higher than previously estimated from recovered carcasses (Pace 2021). Entanglement may also be responsible for high mortality rates in other large whale species, most notably humpback, minke, and fin whales (Henry et al. 2020; Read et al. 2006).

Abandoned or lost fishing gear, including that associated with pre- and post-construction fisheries monitoring surveys and gear that is completely unrelated to any offshore wind activities, may get ensnared with foundations, posing a secondary entanglement risk to marine mammals in the vicinity of these foundations. Although currently, no data exist for this risk associated with U.S. offshore wind structures, the National Academy of Sciences (1975) estimated that around 1,000 metric tons of commercial fishing gear is lost in the world's ocean annually. A study conducted by the Scottish Natural Heritage Commission (Benjamins et al. 2014) to assess the entanglement risk of megafauna in renewable energy structures concluded that facilities, including offshore wind, pose a relatively modest risk for marine megafauna when compared to entanglement risk posed directly by fisheries. Further, based on the conditions set forth in COP approval letters for ongoing offshore wind projects, BOEM requires that lessees monitor for lost fishing gear at WTG foundations, though removal is not required. Therefore, although the risk of secondary entanglement from derelict gear on offshore structures is currently not quantifiable, it remains a potential impact risk for marine mammals. These potential long-term and intermittent impacts would persist until conceptual decommissioning is complete and structures are removed.

Although spacing between the WTG and OSS structures would be sufficient to allow marine mammals to use habitat between and around structures, information about large whale responses to offshore wind structures is lacking. Some level of displacement of marine mammals during construction of ongoing and planned offshore wind development may result in animals moving into areas with a higher potential for interactions with ships or fishing gear. Additionally, some marine mammals may avoid the area during all stages (construction, operations, and conceptual decommissioning) of the ongoing and planned offshore wind development. Therefore, while disruption of normal behaviors could occur due to the presence of offshore structures, the magnitude and implications of this, if realized, remains unknown.

Impacts from the presence of structures from ongoing and planned offshore wind activities would likely be minor for non-NARW mysticetes, odontocetes, and pinnipeds, primarily as a result of increased interaction with active or abandoned fishing gear; although impacts on individuals would be detectable and measurable, they would not lead to population-level effects for most species. Impacts on NARW are considered moderate due to the heightened risk for entanglement in any fishing gear, with detectable and measurable long-term effects possible. It is important to note, however, that the likelihood of any entanglement is unclear because it is not known how much derelict fishing gear may accumulate on offshore foundations, if the presence of structures would displace marine mammals, or if displacement would lead to increased fishing gear exposure. Additionally, relevant to all marine mammals, there is uncertainty as to how the increased presence of structures and related hydrodynamic impacts will affect marine mammals, their habitat, and their prey resources. Minor beneficial impacts due to the reef effect are possible for non-ESA-listed odontocetes and pinnipeds. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Traffic: Studies indicate that maritime activities can have adverse effects on marine mammals due to vessel presence, noise (see *Noise* IPF), and vessel strikes (Laist et al. 2001; Moore and Clarke 2002). Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world, including large container ships, ferries, cruise ships, military vessels, recreational vessels, commercial fishing boats, whale-watch vessels, research vessels, and even jet-skis (Dolman et al. 2006). Research into vessel strikes and marine mammals has focused largely on baleen whales given their higher susceptibility to a strike because of their larger size, slower maneuverability, larger proportion of time spent at the surface foraging, and inability to actively detect vessels using sound (i.e., echolocation). Focused research on vessel strikes on toothed whales is lacking. Factors that affect the probability of a marine mammal vessel strike and its severity include number, species, age, size, speed, health, and behavior of the animal(s) (Martin et al. 2016; Vanderlaan and Taggart 2007); number, speed, and size of the vessel(s) (Martin et al. 2016; Vanderlaan and Taggart 2007); habitat type characteristics (Gerstein et al. 2006; Vanderlaan and Taggart 2007); operator's ability to avoid collisions (Martin et al. 2016); vessel path (Martin et al. 2016; Vanderlaan and Taggart 2007); and the ability of a marine mammal to detect and locate the sound of an approaching vessel.

Vessel speed and size are important factors for determining the probability and severity of vessel strikes. The size and bulk of large vessels inhibit the ability for crew to detect and react to marine mammals along the vessel's transit route. Vessel strikes have been preliminarily determined as a leading cause of death for humpback whales during the current UME (NMFS 2024c). Two vessel types that carry AIS transponders were thought to be of the highest threat to humpback whales in the NY Bight area: tug/tow vessels due to their ability to traverse shallower waters outside shipping channels where humpbacks are frequently found, and passenger vessels due to their high rate of speed (Brown et al. 2019). In 93 percent of marine mammal collisions with large vessels reported in Laist et al. (2001), whales were either not seen beforehand or were seen too late to be avoided. Laist et al. 2001 reported that most lethal or severe injuries are caused by ships 262 feet (80 meters) or longer traveling at speeds greater than 13 knots. A more recent analysis conducted by Conn and Silber (2013), which built upon collision data collected by Vanderlaan and Taggart (2007) and Pace and Silber (2005), included new observations of serious injury to marine mammals as a result of vessel strikes at lower speeds (e.g., 2 and 5.5 knots). The relationship between lethality and strike speed was still evident; however, the speed at which 50 percent probability of lethality occurred was approximately 9 knots. Vanderlaan and Taggart (2007) reported that the probability of whale mortality increased with vessel speed, with greatest increases occurring between 8.6 and 15 knots, and that the probability of death declined by 50 percent at speeds less than 11.8 knots. As a result of these findings, NMFS implemented a seasonal, mandatory vessel speed rule in certain areas along the U.S. East Coast in 2008 to reduce the risk of vessel collisions with NARW (50 CFR 224.105), hereinafter referred to as the NMFS NARW vessel speed rule. These Seasonal Management Areas (SMAs), Dynamic Management Areas (DMAs), and Slow Zones require vessels greater than or equal to 65 feet in length to maintain speeds of 10 knots or less when operating within the bounds of an SMA, DMA, or Slow Zone and to avoid the areas when possible. In 2017, vessel strikes were thought to be a leading cause of a UME for NARW (NMFS 2024b). From 2017 to 2022, a total of 34 individuals died. Pace et al. (2021) estimated that between 1990 and 2017, only 36 percent of right whale deaths were detected, suggesting the actual number of deaths could be much higher. Effectiveness of the SMA program was reviewed by NMFS in 2020. Results indicated that while it was not possible to determine a direct causal link, the mortality and serious injury incidents on a per-capita basis suggest a downward trend in recent years (NMFS 2020). NARW vessel strike mortalities decreased from 10 prior to the implementation of SMAs to three, while serious injuries (defined as a 50-percent probability of leading to mortality) increased from two to four, and injuries increased from eight to 14 (potentially due to increased monitoring levels). Laist et al. 2014 assessed the effectiveness of SMAs five years after their initiation by comparing the number of NARW and humpback whale carcasses attributed to ship strikes since 1990 to proximity to the SMAs. Prior to implementation of SMAs, they found that 87 percent of NARW and 46 percent of humpback whale ship-strike deaths were found either inside SMAs or within 52 miles (83 kilometers, 43 nm), and that no ship-struck carcasses were found within the same proximity during the first 5 years of SMAs.

NMFS also recognized that NARW foraging aggregations take place outside of established SMAs; therefore, temporal voluntary DMAs are established when a group of three or more NARW are sighted within close proximity. Mariners are encouraged to avoid the DMAs or reduce speed to less than 10 knots when transiting through the area. NMFS establishes a DMA boundary around the whales for 15 days and alerts mariners through radio and local notices. Adhering to reduced speed limits within DMAs is voluntary and cooperation has been modest and not at the same levels as achieved with SMAs; however, cooperation does increase during active DMA periods (NMFS 2020). A Proposed Rule was published on August 1, 2022, to amend the NARW vessel speed regulations (87 *Federal Register* 46921). This Proposed Rule would expand the 10-knot speed restriction to most vessels greater than or equal to 35 feet (10.7 meters) in length and expand the spatial and temporal boundaries of the current SMAs.

Smaller vessels have also been involved in marine mammal collisions. Minke whales, humpback whales, fin whales, and NARW have been killed or fatally wounded by whale-watching vessels around the world (Jensen et al. 2003; Pfleger et al. 2021). Strikes have occurred when whale-watching boats were actively watching whales as well as when they were transiting through an area (Laist et al. 2001; Jensen et al. 2003). Small vessels other than whale watching vessels are also potential sources of large whale vessel strikes; however, many go unreported and are a source of cryptic mortality (Pace et al. 2021). Vessels more than 263 feet (80 meters) in length or longer, and therefore those more likely to cause lethal or severe injury to large whales (Laist et al. 2001), in the area accounted for up to 38.7 percent of vessel traffic.

In general, large baleen whales are more susceptible to a vessel strike than smaller cetaceans and pinnipeds. While there are rare reports of toothed whales being struck by ships (Van Waerebeek et al. 2007; Wells and Scott 1997), these animals are at relatively low risk due to their speed and agility (Richardson et al. 1995). Pinnipeds are also fast and maneuverable in the water and have sensitive underwater hearing, potentially enabling them to avoid being struck by approaching vessels (Olson et al.

2021). Of the 3,633 stranded harbor seals in the Salish Sea (Canada/United States) from 2002–2019, 28 exhibited injuries consistent with propeller strike (Olson et al. 2021). There are very few documented cases of seal mortalities as a result of a vessel strikes in the literature (Richardson et al. 1995). Large whales are more susceptible to vessel strikes than other marine mammals due to their large size, slower travel and maneuvering speeds, lower avoidance capability, and increased proportion of time they spend near the surface (Laist et al. 2001; Vanderlaan and Taggart 2007). In the marine mammal geographic analysis area, whales at risk of collision include NARW, humpback whales, blue whales, fin whales, sei whales, sperm whales, and, to a lesser extent, minke whales due to their smaller size (Hayes et al. 2020, 2021, 2022). Although the duration of increased vessel traffic for ongoing and planned non-offshore-wind activities is long term, the frequency of an individual vessel in any one location throughout the geographic analysis area is short term and localized. Because vessel strikes can result in severe injury to and mortality of individual marine mammals, their intensity can be medium for non-listed species or severe for listed species.

Vessel traffic in the NY Bight area is relatively high, with a range of vessel classes composed of deep draft (cargo/carrier, tanker, etc.), commercial fishing, recreational/pleasure, tug and tow, passenger, military/restricted, and other vessels (Empire 2022; Ramboll 2020). Deep draft vessels mainly follow the designated Traffic Separation Scheme (TSS) and designated shipping lanes when entering and leaving New York Harbor, which pass through the NY Bight area (Ramboll 2020).

Based on the vessel traffic expected to be generated by nearby wind development areas, it is assumed that construction of each individual offshore wind project would generate approximately 18 to 65 construction vessels operating in the geographic analysis area for marine mammals at any given time (Empire 2022; Ocean Wind 2022). Ongoing and planned offshore wind projects on the OCS would be constructed between 2023 and 2030, contributing to increases in vessel traffic within the marine mammal geographic analysis area. Additional information regarding the expected increase in vessel traffic is provided in Section 3.6.7, *Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)* and Section 3.6.6, *Navigation and Vessel Traffic*. Due to the large number of vessels required for ongoing and planned offshore wind development, vessel noise could potentially result in impacts on individual marine mammals (see *Noise* IPF above).

Once projects are operational, they would be serviced by crew transfer vessels making routine trips between the wind farms and port-based O&M facilities several times per week. Increased vessel traffic presents a potential increase in collision-related risks to marine mammals. Unplanned maintenance activities would require the periodic use of larger vessels of the same class used for project construction. Unplanned maintenance would occur infrequently, dictated by equipment failures, accidents, or other events. The number and size of crew transfer vessels and number of trips per week required for unplanned maintenance would vary by project based on the number of WTGs. Vessel requirements for unplanned maintenance would also likely vary based on overall project size. Additionally, vessels required to complete monitoring programs at various stages of project development will add to the number of vessel trips undertaken by other projects. These planned activities would pose the same type of vessel-related collision risks to marine mammals as discussed for ongoing activities, but the extent and number of animals potentially exposed cannot be determined without project-specific information.

Standard vessel strike mitigation measures, including establishing a Vessel Strike Avoidance Plan and requiring minimum separation distances, vessel speed restrictions, and trained observer or PSO requirements, are generally included in lease and ROD issuance for offshore wind activities. These measures, which would be implemented throughout all construction and installation, O&M, and decommissioning activities, are considered in this assessment for vessel strike risk related to ongoing and planned offshore wind activities. Effective implementation of required vessel strike mitigation measures are expected to reduce the encounter rate for vessels and animals, which would therefore reduce overall strike risk for all marine mammals from vessel activity related to offshore wind.

The likelihood of an offshore wind vessel striking a marine mammal is considered very low. BOEM concluded that vessel strikes associated with ongoing offshore wind projects were unlikely to occur because of the relatively low number of vessel trips and the monitoring and mitigation activities to avoid vessel strikes (BOEM 2021a, 2021b, 2023b, 2023c, 2023d, 2023e). Therefore, ongoing offshore-wind activities are anticipated to have no effect on marine mammals via the vessel traffic IPF, as vessel strikes from this industry are not likely to occur.

For non-offshore-wind vessel traffic, the impact of vessel strikes on mysticetes, with the exception of NARW, is moderate because it is likely to result in long-term consequences (i.e., injuries or mortalities) to individuals or populations that are detectable and measurable; population-level effects may occur, particularly for those populations listed under the ESA, but populations should sufficiently recover. Not all populations (e.g., minke whales, humpback whales) are currently experiencing population-level consequences from vessel strikes; however, vessel strikes are a threat for all whales. The impact of vessel strikes on NARW from ongoing vessel activities would be major because vessel strikes continue to have population-level effects that compromise the viability of the species. Odontocetes (other than sperm whales) and pinnipeds are less susceptible to vessel strikes, but they do occur. The impact of vessel strikes on odontocetes and pinnipeds from ongoing vessel activities would be moderate because, while population-level effects are unlikely, consequences to individuals would be detectable, measurable, and potentially long term if the strike results in an injury or mortality.

3.5.6.3.4 Conclusions

Impacts of the No Action Alternative. Under Alternative A (i.e., the No Action Alternative), no development would occur on any of the six NY Bight lease areas. As such, stressors from construction and installation, O&M, and conceptual decommissioning would not occur. Baseline conditions of the existing environment would remain unchanged. Therefore, no development in the NY Bight lease areas would have no effect on marine mammals. However, under Alternative A, marine mammals would continue to be affected by existing environmental trends and ongoing activities. Climate change would continue to affect marine mammal foraging and reproduction through changes to the distribution and abundance of marine mammal prey. Vessel activity (vessel collisions) and survey gear utilization associated with ongoing non-offshore-wind activities would continue to cause long-term detectable and measurable injury and mortality to individual marine mammals. Underwater noise from pile-driving during construction of ongoing offshore wind projects would also result in detectable short- to long-term impacts on marine mammals, including possible disturbance, displacement, or auditory injury.

BOEM anticipates that the impacts of Alternative A would be **negligible** to **moderate** for mysticetes (except NARW), odontocetes, and pinnipeds. For non-NARW mysticetes, this determination is due to the high intensity and long-term effects from vessel strike and PTS resulting from exposure to anthropogenic noise (e.g., pile-driving, UXO detonations). The adverse impacts that could result in moderate effects on odontocetes and pinnipeds are mainly due to pile-driving noise and UXO detonation resulting in PTS for some species of odontocetes and the risk of entanglement to odontocetes and pinnipeds. In all cases, impacts would be detectable and measurable, with no population-level effects expected for these species' groups. Additionally, the presence of structures could include **minor beneficial** impacts for some species (e.g., non-ESA-listed odontocetes and pinnipeds) that benefit from increased prey availability, which may be offset by the potential risks associated with entanglement from fishing gear.

BOEM anticipates that the impacts of Alternative A would be **negligible** to **major** for NARW. For NARW, impacts from non-offshore-wind vessel strikes and non-offshore-wind-related commercial fisheries gear are expected to be major due to the current stock status for which serious injury or loss of an individual could result in population-level impacts that threaten the viability of the species. This, combined with the continued stressor of climate change, would reduce the health and resilience of the population. Impacts from underwater noise activities (e.g., pile-driving, UXO detonation) are expected to be moderate for NARW due to the application of standard mitigative practices that eliminate injury and mortality on NARW. Impacts from the presence of structures are expected to be moderate for NARW, mainly driven by an increased risk of entanglement. Ongoing offshore wind construction, operation, and maintenance activities would be conducted with applicant-proposed and agency-required mitigation measures developed to further avoid and minimize impacts on NARW, so impacts from offshore wind activities are not anticipated to substantially contribute to the ongoing, non-offshore-wind-related, impacts for this species.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue in addition to impacts from planned offshore wind activities. Marine mammals would continue to be affected by natural and human-caused IPFs. Planned non-offshore-wind activities would also contribute to impacts on marine mammals. Planned non-offshore-wind activities include increasing vessel traffic; new submarine cable and pipeline installation and maintenance; marine surveys; commercial and recreational fishing activities; marine minerals extraction; port expansion; channel-deepening activities; military readiness activities; and the installation of new towers, buoys, and piers.

BOEM expects the cumulative impacts of the No Action Alternative, in combination with other ongoing and planned offshore wind activities, would likely range from **negligible** to **major** for NARW and **negligible** to **moderate** for non-NARW mysticetes, odontocetes, and pinnipeds, depending on the IPF; and potentially **minor beneficial** for non-ESA-listed odontocetes and pinnipeds due to the artificial reef effect from the presence of structures. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Moderate impacts on mysticetes (except NARW), odontocetes, and pinnipeds are primarily driven by ongoing underwater noise impacts, vessel activity (vessel collisions), entanglement, and habitat alteration (presence of structures). Moderate impacts on mysticetes (except NARW), odontocetes, and pinnipeds are expected because the anticipated impact would be notable and measurable, but populations are expected to recover completely when IPF stressors are removed and remedial or mitigating actions are taken.

For NARW, impacts from ongoing and planned activities are magnified in severity to major impacts due to the species' low population numbers and the potential to compromise the viability of the species from the loss of a single individual (given its low PBR value). Offshore wind construction, operation, and maintenance activities would be conducted with applicant proposed and agency-required mitigation measures developed to minimize impacts on NARW, so impacts from offshore wind activities are not anticipated to substantially contribute to the major impacts. The main IPFs contributing to the major impact rating for this species is non-offshore-wind vessel traffic and commercial fisheries gear.

3.5.6.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Marine Mammals

3.5.6.4.1 Impacts of One Project

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts.

Accidental releases: Accidental releases of fuel, fluids, hazardous materials, and trash and debris may increase as a result of a single NY Bight project. The risk of any type of accidental release would be increased primarily during construction when additional vessels are present and during the potential refueling of primary construction vessels at sea. BOEM prohibits the discharge or disposal of solid debris into offshore waters during any activity associated with construction and operation of offshore energy facilities (30 CFR 250.300). USCG also prohibits dumping of trash or debris capable of posing entanglement or ingestion risk (International Convention for the Prevention of Pollution from Ships, Annex V, Public Law 100–200 [101 Stat. 1458]). One NY Bight project would be required to comply with federal and international requirements to minimize releases. The impact of one NY Bight project from accidental releases of hazardous materials and trash/debris would, therefore, not increase the risk beyond that described under Alternative A. In the unlikely event of an accidental oil spill, impacts would be sublethal due to quick dispersion, evaporation, and weathering, all of which would limit the amount and duration of exposure of marine mammals to hydrocarbons. The combined regulatory requirements would effectively avoid accidental debris releases and avoid and minimize the impacts from accidental spills such that effects on marine mammals are unlikely to occur. The impact from accidental releases as a result of one NY Bight project would likely be minor for mysticetes (including NARW), odontocetes, and pinnipeds and are unlikely to result in population-level effects, although consequences to individuals would be detectable and measurable.

The impacts of one NY Bight project during O&M from accidental releases of hazardous materials and trash/debris would be the same, though slightly reduced, as that described above for construction and installation. During O&M, at-sea refueling for construction vessels would not likely occur, thereby reducing overall risk for an accidental spill. All other impacts of accidental releases during O&M would be the same as during construction and installation and would therefore remain minor for mysticetes (including NARW), odontocetes, and pinnipeds.

Cable emplacement and maintenance: A single NY Bight project would include seafloor disturbance by cable installation, which would result in turbidity effects with the potential to have temporary impacts on some marine mammal prey species (see Section 3.5.5*, Finfish, Invertebrates, and Essential Fish Habitat*). Jack-up vessels and vessel anchoring will include additional seafloor disturbance. These effects would be increased primarily during construction and installation activities as cable installation for the offshore export cables and interarray cables is gradually added. In general, plumes generated during trenching of offshore areas would be limited to directly above the seabed and not extend into the water column. Suspended sediments due to jet plowing are expected to remain localized to the area of disturbance and settle quickly to the seafloor. Suspended sediment concentrations are predicted to be less than 500 mg/L, short term lasting for minutes to hours, and limited in extent to within a few feet vertically and a few hundred feet horizontally during trenching for the offshore export cables and the interarray cables. All sediment plumes are expected to settle out of the water column entirely within 24 hours after the completion of jetting operations. The jet plow embedment process for cable installation will, therefore, result in short-term and localized heightened turbidity. Trenching with a jet plow in areas of shallower water depths could cause plumes to nearly reach the surface of the water, and alternate cable emplacement methods may be required for some areas, such as dredging to install cable along sand waves.

BOEM anticipates localized, short term, and undetectable impacts from cable installation on mysticetes, odontocetes, and pinnipeds due to increased turbidity. Suspended sediment concentrations during activities other than dredging are expected to be within the range of natural variability for this location. Any dredging necessary prior to cable installation could generate additional impacts. However, individual marine mammals, if present, would be expected to successfully forage in nearby areas not affected by increased sedimentation, and only non-measurable, negligible impacts, if any, on individuals would be expected given the localized and temporary nature of the potential impacts.

Only intermittent, localized cable maintenance is predicted during the O&M phase of one NY Bight project. In case of insufficient burial or cable exposure, whether attributable to natural or human-caused issues, appropriate remedial measures will be taken including reburial or placement of additional protective measures. If a cable failure occurs, an appropriate cable repair spread will be mobilized. During these remedial activities, if they occur, sediment plumes would be limited to directly above the seabed and not extend into the water column. Suspended sediments due to jet plowing are expected to remain localized to the area of disturbance and settle quickly to the seafloor. Elevated turbidity levels would be short term, highly localized, and temporary. Therefore, the effects of one NY Bight project to marine mammals would be similar to that described for the construction and installation phase and impacts would be non-measurable and negligible for mysticetes (including NARW), odontocetes, and pinnipeds.

Survey gear utilization: Pre- and post-construction biological/fisheries monitoring surveys for a single NY Bight project would result in an increase in the amount of fishing gear in the water. However, specific monitoring plans are not known at this time, and, therefore, effects would need to be assessed once individual project plans are known. At this time, it is expected that fisheries monitoring surveys conducted for one NY Bight project will be of limited frequency and duration, though any sampling that utilizes in-water gear may pose an entanglement or capture risk to marine mammals. As discussed in the *Presence of structures* IPF section, all marine mammal species could potentially be entangled in fishing gear, though the impact is particularly pronounced for NARW.

Survey gear utilization for one NY Bight project without AMMM measures would pose a heightened entanglement risk to marine mammals. If entanglement or entrapment occurs, the impacts of survey gear utilization on non-NARW mysticetes, odontocetes, and pinnipeds would be minor; impacts on individuals would be detectible and measurable, but would not lead to population-level effects given the expected limited extent and duration of monitoring surveys for one NY Bight project. Survey gear utilization could result in major impacts for NARW because, if an entanglement were to occur, it could result in long-term impacts with the potential for population-level effects that compromise the viability of the species. However, the likelihood of NARW entanglement in biological monitoring gear is considered very low given the expected limited extent and duration of monitoring surveys for one NY Bight project; therefore, impacts would be minor in those cases. At this time, the extent and number of animals potentially at risk of entanglement cannot be determined without project-specific information.

Lighting: A single NY Bight project would introduce stationary light sources in the form of navigation, safety, and work lighting, which would increase artificial lighting in the marine environment. Though vessel-related lighting impacts would be localized and temporary, such lighting could attract potential prey species to construction zones, potentially aggregating some marine mammal species (primarily odontocetes), exposing them to greater harm from other IPFs associated with construction, including an increased risk of collision with vessels. Lighting associated with offshore structures (i.e., WTGs and OSSs) would also introduce additional lighting, though only a limited area around the structures would be lit relative to the surrounding unlit open ocean areas. Given the highly localized nature of artificial lighting associated with one NY Bight project, BOEM anticipates that lighting effects on mysticetes (including NARW), odontocetes, and pinnipeds would be negligible, as impacts, if any, would result in no perceptible consequences to individuals or populations.

Discharges/intakes: The use of HVDC cables is possible for one NY Bight project, which would require HVDC converter intakes on up to five OSSs. Therefore, intakes and discharges related to cooling offshore wind converter stations are possible for one NY Bight project. Potential effects resulting from intake and discharge use include altered micro-climates of warm water surrounding outfalls, altered hydrodynamics around intakes/discharges, prey entrainment, and association with intakes if prey are aggregated on intake screens from which marine mammals scavenge. As discussed in Section 3.5.6.3.3, these impacts on marine mammals are largely discountable given the small number of OSSs, and, because none of the six NY Bight projects are within the recommended 20-kilometer buffer zone extending from the 30-meter isobath around Nantucket Shoals identified by Hayes et al. (2022), no substantial effects on NARW prey availability are expected. Therefore, impacts from discharges and intakes, though long term, would be low in intensity, highly localized, non-measurable, and negligible for mysticetes (including NARW), odontocetes, and pinnipeds.

Electric and magnetic fields and cable heat: As discussed in Section 3.5.6.3.3, marine mammals are unlikely to detect magnetic field intensities below 50 milligausses (5.0 microteslas). EMFs for one NY Bight project are likely below the threshold detectable to marine mammals and, therefore, indistinguishable from natural variability in the area. As a result, marine mammals are likely insensitive to EMF effects from one NY Bight project electrical cables. Export and interarray cables may be either HVAC or HVDC; potential effects to marine mammals from HVAC cables are considerably reduced than for HVDC cables. Areas where cable lie exposed on the seafloor could potentially result in EMFs that are detectable by marine mammals. However, the area of potentially detectable EMFs would be small, extending only a few feet from the cable, and only marine mammal species that routinely forage near the seafloor would be expected to occur within this range. Export and interarray cables would be buried at a depth ranging from 3 to 19.6 feet (0.9 to 6 meters) and 3 to 9.8 feet (0.9 to 3 meters), respectively, and installed with appropriate cable shielding and scour protection (where needed). These factors will effectively limit marine mammal exposure to both EMF and heat originating from the one NY Bight project cables.

These factors indicate that the likelihood of marine mammals encountering detectable EMF and heat effects is low, and any exposure would be below levels associated with measurable biological effects. Therefore, one NY Bight project EMF effects on mysticetes (including NARW), odontocetes, and pinnipeds would be negligible.

Noise: Activities associated with one NY Bight project that could cause underwater noise effects on marine mammals are UXO detonations, impact and vibratory pile-driving (installation of WTG and OSS foundations), geophysical (i.e., HRG) and geotechnical surveys, vessel traffic, aircraft, cable laying or trenching and dredging, and potential drilling during construction. Project construction activities could generate underwater noise and result in auditory injury (i.e., PTS), behavioral disturbance, and masking effects on marine mammals. Some noise impacts may have a greater effect on NARW given their relatively small population sizes and endangered status and, therefore, would result in a higher impact determination for NARW when compared to other mysticetes.

UXO Detonation

There is the potential to encounter munitions and explosives of concern (MEC) that are the result of military testing and training within the NY Bight area. MEC is inclusive of UXOs and discarded military munitions of constituents that could pose an explosive hazard. Five specific UXO locations and two larger UXO areas are located within the NY Bight geographic analysis area for Other Uses (refer to Section 3.6.7, *Other Uses*) (MAOPD 2022). While non-explosive methods may be employed to lift and move these objects, deflagration or removal by explosive detonation may also be needed. Underwater explosions of this type generate high pressure levels that could cause disturbance and injury to marine mammals. Injuries may include hemorrhage or damage to the lungs, liver, brain, or ears, as well as auditory impairment such as PTS and TTS (Ketten 2004). Smaller animals are generally at a higher risk of blast injuries. The distance to auditory injury (PTS) thresholds following a UXO detonation may exceed

52,493 feet (16,000 meters) for high-frequency cetaceans; 8,038 feet (2,450 meters) for low-frequency cetaceans; 2,460 feet (750 meters) for mid-frequency cetaceans; and 9,022 feet (2,750 meters) for pinnipeds in water, based on unmitigated acoustic modeling off the U.S. East Coast for a U.S. Navy bin E12 charge size (1,000 pound [454 kilogram] equivalent weight) (Hannay and Zykov 2022). UXO detonation may also cause non-auditory injury or even mortality at close range. Auditory injury thresholds (i.e., PTS PK or SEL noise metrics) were larger than modeled distances to mortality and non-auditory injury criteria for UXOs (See Appendix J). Maximum mortality and non-auditory injury ranges, based on worst case scenario modeling (i.e., charge category U.S. Navy bin E12; 1,000 pound [454 kilogram] equivalent weight), was estimated for porpoise pup/calf mortality at 2,848 feet (868 meters); for non-auditory injury (lung injury) at 4,980 feet (1,518 meters) for porpoises pup/calf; and for G.I. injury at 1,178 feet (359 meters) for all marine mammal species (Hannay and Zykov 2022). However, the physical range at which injury or mortality could occur will vary based on the amount of explosive material in the UXO, size of the animal, and the location of the animal relative to the explosive. Although acoustic modeling was not conducted for one NY Bight project, the ranges presented above from Hannay and Zykov (2022) are used to approximate risk in this PEIS. UXO detonation is anticipated to be infrequent, localized, and temporary. However, given the large ranges to auditory and non-auditory injury, the risk for mortality, and the severity of consequences to an exposed individual, impacts due to an unmitigated UXO detonation would be major for NARW and moderate for all other mysticetes, odontocetes, and pinnipeds. For species other than NARW, the risk of auditory and non-auditory injury and mortality would primarily have long-term effects on individuals that could rise to the population level but they would be expected to sufficiently recover and maintain the viability of their populations given their current status. For NARW, long-term effects that rise to the population level would compromise the viability of the species given their current status and low population numbers that contributed to their ESA listing.

Impact and Vibratory Pile-Driving

Noise from impact and vibratory pile-driving for the installation of WTG and OSS foundations would occur intermittently during the installation of offshore structures. Impact pile-driving is anticipated to be used for monopiles and piled jacket foundations; vibratory pile-driving would likely only be used for piled jacket foundations. Maximum hammer energy for impact pile-driving is assumed to be less than 5,000 kJ with an estimated duration of up to four hours per day. Vibratory pile-driving is predicted to occur over a one-hour period. A single NY Bight project includes installation of up to 280 WTGs and up to 5 OSSs, which would equate to up to 285 days of impact pile-driving (assuming one monopile installation per day). If suction bucket or gravity-based foundations are used, no pile-driving would be required, and therefore no impact or vibratory pile-driving noise impacts would occur.

Glauconite sands may be present in the NY Bight lease areas. Depending on the classification of the glauconite sands present, there can be challenges associated with potential offshore wind development in these areas. Specifically, some glauconite sands are difficult, or even impossible, to drill through and cause high friction and increased noise during pile-driving (Bruggeman et al. 2023). If developers discover glauconite sands during construction and installation, noise levels will likely increase temporarily as they determine if the glauconite is passable.

Noise produced by both impact pile-driving during installation of WTG and OSS foundations have the potential to result in PTS for some species, mainly low-frequency cetaceans, and behavioral disturbances for all species. Given that this programmatic analysis precedes the submittal of COPs for the NY Bight projects, acoustic modeling is not available for any activities of one NY Bight project. In order to provide the reader with context for potential ranges to PTS and behavioral thresholds during pile-driving activities, this analysis categorized the sizes of potential impact ranges as follows:

- Very large: >3 miles (>5 kilometers);
- Moderately large: 1.5 to 3 miles (2.5 kilometers to 5 kilometers);
- Moderate: 1,640 feet to 1.5 miles (500 meters to 2.5 kilometers);
- Small: 328 to 1,640 feet (100 to 500 meters); and
- Nominal: <1,640 feet (<100 meters).

These categories were generalized and take into account the sizes of the sound envelopes produced by the offshore wind installations that were modeled or measured for other projects off the U.S. East Coast (i.e., Empire Wind (OCS-A 0512) [Empire 2022]; Ocean Wind 1 (OCS-A 0498) [Ocean Wind 2022]), along with U.S. offshore wind sound measurement reports (Water Proof 2020). It is important to note that actual threshold ranges are highly site- and project-specific and therefore should not be interpreted as explicit for one NY Bight project. The summarized and categorical ranges to marine mammal effects are provided below.

Based on the categories defined above, the horizontal distance within which the PTS thresholds are exceeded for impact pile-driving of one monopile per day without mitigation is expected to be moderately large in size for low-frequency cetaceans, and moderate in size for mid-frequency cetaceans, high-frequency cetaceans, and pinnipeds. Therefore, based on expected pile-driving activities and the magnitude of ranges to auditory injury thresholds, there is risk of PTS for all marine mammals (including NARW). Low-frequency cetacean species such as NARW, fin, humpback, sei, and minke whales are likely to be present within the project area during construction and would face the risk of exposure to noise above the PTS threshold during impact pile-driving.

The horizontal distance within which PTS thresholds are exceeded for vibratory pile-driving of one monopile per day without mitigation is expected to be small to moderate in size for all marine mammal hearing groups. Therefore, considering the threshold ranges, vibratory pile-driving is not likely to result in PTS for any species.

The ranges to the behavioral disturbance thresholds for all marine mammal species during impact and vibratory pile-driving of unmitigated piles are expected to be very large in size. Masking effects may be experienced by some species groups at similar ranges as behavioral thresholds. Therefore, behavioral and masking effects are considered likely during impact and vibratory pile-driving given their very large threshold ranges.

Low-frequency cetacean species are at highest risk of disturbance and masking from impact and vibratory pile-driving noise because their primary hearing frequency range overlaps with the dominant frequencies produced by pile-driving. Behavioral disturbance thresholds only distinguish between impulsive sources and non-impulsive, continuous sources, but otherwise apply to all marine mammal species (i.e., not frequency weighted for hearing groups like the PTS thresholds are); therefore, there is no distinction in the modeled behavioral disturbance ranges for different marine mammal species that may result from both impact and vibratory pile-driving activities. However, behavioral disturbances may not equally affect all species or even all individuals. Disturbances that affect biologically important behaviors or ESA-listed species will have a greater impact than disturbances that result in minor reactions. Because pile-driving activities under the maximum case scenario could occur up to 285 days, behavioral changes or temporary displacement from the project area may occur.

Therefore, impacts from unmitigated impact pile-driving are expected to be major for NARW but moderate for all other mysticetes, odontocetes, and pinnipeds due to the likelihood of PTS and variability in effects on the population. Impacts may occur on mysticetes, including NARW, resulting from the large PTS ranges for low-frequency cetaceans produced by impact pile-driving, which increases the risk of PTS in low-frequency cetacean species. The potential for PTS in odontocete and pinniped species during impact pile-driving is slightly less due to the smaller ranges, driven largely by the lower overlap in the frequencies of this sound source and the hearing sensitivity of these species, expected for mid-frequency cetaceans, high-frequency cetaceans, and pinnipeds. Given the risk of PTS in non-NARW marine mammals, impacts would be detectable and of medium intensity, but localized, and while individuals would be affected, potential impacts would not have population consequences that threaten the viability of the population. For NARW, impacts from unmitigated impact pile-driving are expected to be major due to the risk of PTS for this species; and, given the current population status, the loss or injury of any individuals would have long-term population-level effects that would compromise the viability of the species.

Impacts from unmitigated vibratory pile-driving are expected to be minor for all mysticetes (including NARW), odontocetes, and pinnipeds. Given the non-impulsive nature of this source (Appendix J), the risk of PTS is low and not likely to occur, but the continuous nature of this source results in a high likelihood of behavioral exposures or masking that would be detectable and measurable. However, behavioral exposures or masking that do occur would be low-intensity, short term, and not expected to result in any population-level consequences.

Geophysical and Geotechnical Surveys

G&G surveys may occur prior to and during project construction to identify any potential obstructions that would affect installation of the WTG and OSS foundations and interarray cables. As discussed in Section 3.5.6.3.3, G&G survey noise would be unlikely to result in any PTS impacts on marine mammals, and the likelihood of biologically notable behavioral disturbances is low (Ruppel et al. 2022). Geotechnical surveys may introduce low-level, intermittent noise into the marine environment. These sounds could result in acoustic masking in low- or mid-frequency cetaceans in low ambient sound conditions, but are unlikely to result in behavioral disturbance given their low source levels and intermittent use. Impacts, therefore, on all mysticetes (including NARW), odontocetes, and pinnipeds are expected to be minor.

G&G surveys may occur irregularly throughout the O&M phase of one NY Bight project to check the integrity of the scour protection around the foundations and ensure the interarray and export cables have not become exposed. The scope of these surveys during O&M would be similar to that described for project construction and impacts on all mysticetes (including NARW), odontocetes, and pinnipeds would similarly be minor.

Vessels

Vessels that may be used during construction of one NY Bight project include vessel classes ranging from utility boats and offshore supply vessels to general cargo and jack-up crane vessels. As discussed in Section 3.5.6.3.3, vessel noise is not likely to elicit PTS for any marine mammal species, though behavioral disturbances are possible. Under one NY Bight project, construction vessels would only be present for a relatively short period, and larger vessels would adhere to the NMFS NARW speed rule, which is aimed to reduce the risk of vessel strike (discussed further below under *Traffic*) but will also reduce the noise level associated with these vessels (ZoBell et al. 2021). Additionally, the extent of one NY Bight project vessel traffic would result in an increase in vessels compared to the existing traffic, though the exact extent of this increase is currently unknown. Vessels utilizing dynamic positioning may be employed during construction. BOEM anticipates impacts on marine mammals from one NY Bight project construction vessel noise to be minor for mysticetes (including NARW), odontocetes, and pinnipeds as effects of vessel noise on individual marine mammals are expected to be temporary and localized. Effects are expected to be greatest for low-frequency cetaceans due to the low frequency of vessel noise and the relatively large propagation distances of low-frequency sounds. No stock or population-level impacts are expected for any marine mammal species.

Vessel traffic during the O&M phase of a single NY Bight project is expected to be infrequent and limited to the use of smaller vessels which would limit the level of noise produced during the maintenance trips and G&G surveys. Accommodation vessels, if used, could stay onsite for extended periods of time; these vessels may utilize dynamic positioning. Given the lower volume of vessel traffic expected during O&M and the smaller size of the vessels expected, impacts on mysticetes (including NARW) are expected to be minor, while impacts on odontocetes and pinnipeds are expected to be negligible given their estimated hearing ranges, which limit the risk of auditory masking for these species.

Aircraft

Under one NY Bight project, rotary-winged aircraft (helicopters) may be used for crew changes or supply runs. However, these are anticipated to be intermittent trips occurring irregularly throughout the construction period. As described in Section 3.5.6.3.3, aircraft noise, though audible to most marine mammals, would only result in temporary behavioral responses such as shortened surface durations or abrupt dives (Patenaude et al. 2002; Richter et al. 2006; Smultea et al. 2008). However, based on the physics of sound propagation across different media (e.g., air and water), only a small portion of the acoustic energy from aircraft operations couples into the water. With the implementation of regulatory requirements such as approach regulations for NARW (50 CFR 222.32), and the irregular occurrence of project aircraft traffic, impacts on all mysticetes (including NARW), odontocetes, and pinnipeds would be negligible.

Cable Laying or Trenching

During project construction, jetting, plowing, or removal of soft sediments may be required prior to installation of the WTG and OSS foundations, and installation of the interarray cable and export cable. As described in Section 3.5.6.3.3, these activities may result in behavioral disturbances for some marine mammals, though these are expected to be low-intensity and localized (Hoffman 2012; Pirotta et al. 2013). Low-frequency cetacean species may face a nominally higher risk of behavioral effects or masking given the overlap between their hearing and the frequency of cable-laying noise; however, activities associated with one NY Bight project are expected to be short term and localized and impacts on all mysticetes (including NARW), odontocetes, and pinnipeds from dredging or trenching activities during cable-laying would therefore be negligible.

Drilling

Drilling activities may be used during installation of the WTG foundations in the unlikely event that pile refusal occurs prior to meeting the target embedment depth for the piles (e.g., if the pile cannot be driven deep enough into the seabed). Drilling would be used for the removal of soils, boulders, or other obstructions from the pile to ensure the foundation is safely and securely installed in the seabed.

See Appendix J for a description of drilling-related noise. Research suggests that the sensitivity of marine mammals to drilling noise varies between and within species and is likely context-dependent (Richardson et al. 1990). For example, ringed seals and harbor porpoises may be relatively tolerant to drilling activities (Moulton et al. 2003; Todd et al. 2009). In fact, Todd et al. (2020) measured drilling noise from jack-up platforms and concluded that harbor porpoises can only detect drilling noise out to a distance of approximately 230 feet (70 meters) from the source at the study site and concluded that the noise is unlikely to interfere with or mask echolocation clicks. In terms of behavioral disturbance, drilling activities may exceed the continuous noise threshold of 120 dB re 1 µPa tens of kilometers from the source (Appendix J), and given the low-frequency nature of drilling sounds, baleen whales may be more vulnerable to disturbance. The majority of studies on baleen whale behavioral responses to drilling noise have been conducted on arctic species in the context of oil and gas extraction, and these studies currently serve as the best available proxies. Bowhead whales have been reported to avoid a radius of ~6.2 miles (~10 kilometers) around an operating drillship, with some individuals avoiding the site up to 12.4 miles (20 kilometers) away (Richardson et al. 1995). Richardson et al. (1990) performed playback experiments of drilling and dredging noises and observed bowhead whale responses. Behavioral reactions were observed for most of the animals, such as orienting away from the sound, cessation of feeding, and altered surfacing, respiration, and diving cycles (Richardson et al. 1990). Roughly half of the bowhead whales responded to the drilling noise playback at a received level of 115 dB re 1 µPa (20–1000 Hz band) (Richardson et al. 1990). Blackwell et al. (2017) reported that bowhead whale calling rates were correlated with increasing levels of drilling noise, where calling rates initially increased, peaked, and then decreased. While such behavioral responses may result from offshore drilling, they are expected to be short term and intermittent.

Drilling activities may produce SPL of 140 dB re μPa at 1,000 meters (Austin et al. 2018). This would exceed the continuous noise behavioral disturbance threshold of 120 dB re 1 μPa beyond 1,000 meters, but these events are expected to be short term, which limits the marine mammals potentially present during construction. While behavioral responses may occur from drilling, they are expected to be short term and of low intensity. Impacts from potential drilling activities on all mysticetes (including NARW), odontocetes, and pinnipeds would therefore be negligible.

WTG Operations

As discussed in Section 3.5.6.3.3, operations of the WTG would result in long-term, low-level, continuous noise in the project area which could result in behavioral disturbances and auditory masking at close distances (Lucke et al. 2007; Tougaard et al. 2005, 2020; Thomsen and Stober 2022). Noise produced by operational WTGs is within the auditory hearing range for all marine mammals, but the potential for impacts is not likely to occur outside a relatively small radius surrounding the project foundations; impacts would range from negligible to minor. Minor impacts, such as masking in low ambient noise conditions, would be more likely to occur in mysticetes (including NARW) due to the low-frequency and localized nature of operational noise and this group's hearing sensitivity as impacts on individuals would not lead to population-level effects. Negligible impacts are expected for odontocetes and pinnipeds as masking is less likely and impacts, if any, would not lead to long-term adverse consequences.

Port utilization: Potential use of the port facilities located in New York and New Jersey would increase vessel traffic in the area and potentially require expansion or increased maintenance of port facilities within the marine mammal geographic analysis area. If port expansions or modifications were necessary for a single NY Bight project they would be completed in accordance with state and federal regulations and permits and would be completed in collaboration with multiple entities (e.g., port owners, governmental agencies, states, other offshore wind developers). Port expansion could include dredging, deepening, and new berths. Expansion could result in adverse effects on coastal and estuarine habitats from shoreline noise during construction and disturbance or loss of habitat for prey species. Existing representative ports in New York that may be utilized for one NY Bight project include the Port of Albany, Port of Coeymans, Brooklyn Navy Yard, South Brooklyn Marine Terminal, Howland Hook/Port Ivory, and Arthur Kill Terminal. Potential ports in New Jersey that may be utilized for one NY Bight project include the Paulsboro Marine Terminal and New Jersey Wind Port.

Increased maintenance such as dredging could expose marine mammals to increased levels of underwater noise (see *Noise* IPF) and increased turbidity (see *Cable Emplacement and Maintenance* IPF), affecting individual marine mammals or their prey. Increased port expansion and port maintenance would likely be intermittent but long term. Increased vessel traffic associated with the above specified ports is also expected (see *Traffic* IPF).

Port activities beyond routine maintenance of the facilities are not predicted at this time. Therefore, port utilization during the construction and O&M phase of one NY Bight project is likely to have negligible impacts on mysticetes (including NARW), odontocetes, and pinnipeds as there would be no perceptible consequences to individuals or populations. Vessel traffic in and out of the ports is considered in the *Traffic* IPF.

Presence of structures: The WTG and OSS structures of one NY Bight project would be placed in a grid-like pattern with approximate spacing of 0.6 by 0.6 nm (1.1 by 1.1 kilometers) between structures. Based on documented lengths (Wynne and Schwartz 1999), the largest NARW (59 feet [18 meters]), fin whale (79 feet [24 meters]), sei whale (59 feet [18 meters]), and sperm whale (59 feet [18 meters]) would fit end to end between two foundations spaced at 0.6 nm (1.1 kilometers) about 50 times over. This simple assessment of spacing relative to animal size indicates that the physical presence of the monopile foundations is unlikely to pose a barrier to the movement of large marine mammals, and even less likely to impede the movement of smaller marine mammals. On this basis, this PEIS concludes that the presence of one NY Bight project's WTG foundations would pose little risk of physical displacement effects on marine mammals, though altered movement patterns to avoid developed areas cannot be ruled out; the likelihood and impact of this remains unknown for marine mammals. Localized displacement may result in higher encounter rates with fishing gear (see the entanglement discussion below) and vessel traffic (see *Traffic* IPF).

The long-term reef effect resulting from one NY Bight project during O&M could result in minor beneficial effects on non-ESA-listed odontocetes and pinnipeds that may benefit from increased prey abundance around the structures, though no noticeable impact is anticipated for mysticetes or sperm whales. Attraction to the wind farm area due to the aggregation of prey species may, however, result in higher encounter rates with fishing gear (see the entanglement discussion that follows) and vessel traffic (see *Traffic* IPF).

Both localized and broadscale hydrodynamic impacts may occur as a result of one NY Bight project. However, effects on marine mammals and their habitats resulting from the disruption in hydrodynamics due to the increased presence of structures is uncertain, their significance unknown, and they likely vary by species and location. Refer to the discussion of hydrodynamic impacts in Section 3.5.6.3.3.

Long-term impacts could occur as a result of increased interaction with active or abandoned fishing gear. All marine mammal species are vulnerable to entanglement to varying degrees (Read 2008; Stelfox et al. 2016). Entanglement is an especially significant threat for NARW, which has been experiencing a UME since 2017 attributed to vessel strikes and entanglement in fisheries gear. A majority of NARW show evidence of past entanglements (Johnson et al. 2005), and entanglement in fishing gear is a leading cause of death for this species and may be limiting population recovery (Knowlton et al. 2012). Therefore, the increased risk of entanglement is more significant for this species.

Impacts from the presence of structures for one NY Bight project would likely be minor for mysticetes (except NARW), odontocetes, and pinnipeds, primarily due to the increased risk for entanglement; although impacts on individuals would be detectable and measurable, they would not lead to population-level effects for most species, with the exception of NARW. Due to the heightened risk for entanglement in fishing gear and because a single NARW death could have population-level consequences, impacts on NARW are considered major. Minor beneficial impacts due to the reef effect are possible for non-ESA-listed odontocetes and pinnipeds. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures.

Traffic: A number of vessels will be required to support activities carried out during the construction and installation, O&M, and conceptual decommissioning phases of one NY Bight project. Specific vessels are required for surveying activities, foundation installation, OSS installation, cable installation, WTG installation, and support activities. The majority of the vessels are expected to have conventional propeller- or thruster-based propulsion systems. Smaller vessels designed primarily for crew transfer applications are expected to employ conventional propeller-propulsion systems and water jet-drive based systems.

Based on the estimated number of vessels planned to operate during construction of other regional offshore wind projects (Empire Wind [OCS-A 0512], Ocean Wind 1 [OCS-A 0498], and Atlantic Shores South [OCS-A 0499]), construction of one NY Bight project is estimated to generate up to 51 vessels operating in the one NY Bight project area or over the offshore export cable route(s) at any given time. Various vessel types (installation, cable-laying, support, transport/feeder, and crew vessels) would be deployed throughout the NY Bight project area during the construction and installation phase. It is estimated that a single NY Bight project would generate approximately 3,285 vessel roundtrips during the construction and installation phase and approximately the same number of vessel trips per year during conceptual decommissioning as during construction and installation; this would equate to up to approximately 12 vessel roundtrips per day.

After a single NY Bight project is constructed, related vessel activity would decrease. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. Based on the estimated number of vessels planned to operate during O&M from other regional offshore wind projects (Empire Wind [OCS-A 0512], Ocean Wind 1 [OCS-A 0498], and Atlantic Shores South [OCS-A 0499]), O&M of one NY Bight project is estimated to generate approximately 8 vessel roundtrips per day throughout the operating period, which BOEM anticipates being approximately 35 years. This would equate to approximately 2,902 vessel roundtrips annually. Crew transfer vessels would account for a majority of vessel types used during O&M followed by crew vessels, supply vessels, and jack-up vessels. One NY Bight project would comply with the NMFS NARW speed rule as established.

If a vessel strike does occur, the impact on marine mammals would range from minor to major, depending on the species and severity of the strike. The potential effect of a vessel strike on marine mammal populations is considered severe in intensity because potential receptors include listed species (e.g., NARW) and other large baleen whales (e.g., fin and humpback whales), which have a higher susceptibility to vessel strikes compared to certain odontocetes (excluding sperm whales) and pinnipeds (see Section 3.5.6.3.3). As project vessels would operate throughout the construction and installation, O&M, and conceptual decommissioning phases, the potential for a vessel to strike a marine mammal is considered continuous (for the life of the project). Effects from vessel strikes range from short term in duration for minor injuries to permanent in the case of death of an animal. Most odontocetes and pinnipeds are considered to be at low risk for vessel strikes due to their swimming speed and agility in the water.

The area around the offshore project area is used by a number of different vessels including large, deep-draft vessels, fishing vessels, recreational vessels, and tugboats operating to and from ports in Maryland, Delaware, New Jersey, New York, New England, and abroad. The contribution of one NY Bight project would be relatively small when compared to the number of vessel trips associated with ongoing and planned non-offshore activities and ongoing offshore wind activities throughout the marine mammal geographic analysis area and would represent only a small portion of the overall annual increases in vessel traffic in the region. This impact is considered minor for pinnipeds and odontocetes because population-level effects are unlikely although consequences to individuals would be detectable and measurable. Impacts on mysticetes other than NARW would be moderate because vessel strike would result in long-term consequences to individuals or populations that are detectable and measurable, though populations are expected to sufficiently recover. As the death of a single NARW could lead to severe population-level consequences that compromises the viability of the species, this impact is considered major for the species.

3.5.6.4.2 Impacts of Six Projects

The same IPF impact types and mechanisms described under one NY Bight project apply to six NY Bight projects. Under six NY Bight projects, up to 1,103 foundation locations for WTGs and OSSs may be installed within the NY Bight area over the course of 35 years. There would be a greater likelihood for impacts for all IPFs due to the greater amount of offshore and onshore development under six NY Bight projects. However, impacts for accidental releases, cable emplacement/maintenance, discharges/intakes, EMF and cable heat, survey gear utilization, lighting, and port utilization for six NY Bight projects would be expected to remain minor as discussed for one NY Bight project. The resulting effects of the listed IPFs would be highly localized with a low likelihood of impacts for those IPFs. Though the additional consideration of all six NY Bight projects would increase the anticipated volume of potential accidental releases, the value is based on a maximum case scenario and, regardless of the number of projects considered, such releases are still unexpected events with a very low likelihood of occurrence that would result in the same determination for one or six projects. Therefore, effects on mysticetes (including NARW), odontocetes, and pinnipeds remain so low as to be discountable regardless of the number of NY Bight projects considered. IPFs that will have a greater potential for impact under six NY Bight projects include noise, presence of structures, and traffic.

Noise: Under six NY Bight projects, noise generated from pile-driving will increase due to the substantial increase in the number of foundations to be installed in the NY Bight area. If project construction is staggered for all six NY Bight projects such that only one is being constructed at any given time, then the total sound produced would be the same as in the one NY Bight project scenario for a given time. However, if there is overlap in construction for all six NY Bight projects such that multiple projects are being constructed simultaneously within a proximal geographic area, then the total sound produced could greatly increase the ensonified region within which marine mammals must forage, travel, and communicate.

The impact of unmitigated pile-driving noise on marine mammals would remain major for NARW as there is a reasonable likelihood that auditory injury would occur, and, therefore, population-level impacts affecting the viability of the species cannot be ruled out. Impacts remain moderate for all other mysticetes, odontocetes, and pinnipeds as auditory injury could result in population-level effects for some species, but the long-term viability of populations would not be affected. These impacts are expected to result from impact pile-driving, whereas vibratory pile-driving would result in only minor impacts on all marine mammals including NARW.

The risk of impacts on marine mammals from unmitigated UXO detonations will increase under six NY Bight projects because more UXO detonations could occur; however, the impact determination will remain the same as for one NY Bight project and is expected to be major for NARW given the high-consequence of this IPF and the status of the population. UXO detonations would be moderate for all other mysticetes, odontocetes, and pinnipeds for six NY Bight projects as there could be population-level effects, but the long-term viability of the populations would not be affected.

During construction, impacts on marine mammals from elevated vessel noise would remain minor for odontocetes and pinnipeds but would increase from minor to moderate for mysticetes (including NARW) due to the expected substantial increase in vessels operating under six NY Bight projects (see the *Traffic* IPF). Increased vessel traffic would result in effects that are detectable, measurable, and extensive for mysticetes during construction assuming a full buildout of six NY Bight projects. During O&M, effects would be minor for mysticetes, odontocetes, and pinnipeds, with effects that are of lower intensity and less extensive than during construction.

The impact on marine mammals from WTG operations under six NY Bight projects would remain minor for mysticetes (including NARW) due to the risk for long-term but localized masking in low ambient noise conditions. Impacts from WTG operations under six NY Bight projects would remain negligible for odontocetes and pinnipeds as masking is less likely and impacts, if any, would not lead to adverse consequences.

The impact of six NY Bight projects from all other noise sources (G&G surveys, aircraft, cable laying/trenching, and drilling) on all marine mammals (including NARW) would remain negligible because the intensity and extent of the ensonified area during these activities is not expected to increase significantly under six NY Bight projects versus one project. Even concurrent, adjacent projects engaging in these activities would have a geographical separation sufficient to pose localized, negligible impacts only.

Within a concurrent exposure scenario of multiple wind farms under construction, an individual marine mammal in the area has the potential to be exposed to the sounds from more than one pile-driving event per day, repeated over a period of days if traveling through more than one lease area. Results from Southall et al. (2021a) showed that concurrent construction of multiple wind farms, if scheduled to avoid critical periods when NARW are present in higher densities, minimizes the overall risk to the species. However, under Alternative B (no identification of AMMM measures at the programmatic stage), seasonal restrictions would not be in place and therefore would contribute to the major impact rating for pile-driving for all marine mammals, particularly NARW.

Presence of structures: Under six NY Bight projects, the number of structures in the NY Bight area will be substantially higher than that for one NY Bight project. As a result, the presence of structures IPF has the potential to be more impactful to marine mammals under six NY Bight projects, mainly due to the increased risk of secondary entanglement associated with structures in the water column (see *Presence of Structures* IPF). The risk is greatest for NARW, for which the removal of a single individual through death or serious injury can lead to population-level consequences for the species. The impact rating for NARW for one NY Bight project is major, and thus will remain major under six NY Bight projects. Other mysticetes would likewise be at increased risk of entanglement and may experience long-term consequences; impacts would be moderate as effects would be long term, detectable, and measurable, though the viability of the species is likely to remain functional or is able to fully recover. The impact of six NY Bight projects on odontocetes and pinnipeds will remain minor as effects on individuals could be detectable, but no population consequences are expected. Minor beneficial impacts will likely result for non-ESA-listed odontocetes and pinnipeds due to the reef effect and potential increase in foraging opportunity. Beneficial effects, however, may be offset given the increased risk of secondary entanglement due to derelict fishing gear on the structures.

Both localized and broadscale hydrodynamic impacts may occur as a result of six NY Bight projects. However, there is considerable uncertainty as to how the increased presence of structures will affect marine mammals and their habitat.

Traffic: The construction of six NY Bight projects will substantially increase the number of vessels operating in the NY Bight area throughout all project phases. This increase in vessel traffic may increase the impact on all mysticetes; however, impacts are expected to remain moderate for one NY Bight project and six NY Bight projects for non-NARW mysticetes because, although consequences could be severe and long term, population viability is not expected to be threatened by injury or loss of individuals. As discussed in the *Traffic* IPF section, the risk is greatest to NARW, and impacts will remain major under six NY Bight projects. Though vessel strike risk to individuals could increase under six NY Bight projects, population-level impacts are not anticipated for pinnipeds and odontocetes, and therefore would remain minor, the same as for one NY Bight project.

3.5.6.4.3 Impacts of Alternative B on ESA-Listed Species

General impacts of six NY Bight projects on marine mammals were described in the previous subsection. This subsection addresses specific impacts of the Alternative B (six NY Bight projects) on ESA-listed species for those impacts with species-specific information.

Noise: As noted for the No Action Alternative, noise effects associated with aircraft, G&G surveys, cable laying, drilling, vessel noise, and WTG operations for six NY Bight projects are not expected to differ between ESA-listed marine mammals and non-ESA-listed marine mammal species.

UXO detonations may result in auditory and non-auditory injury, mortality, and behavioral effects on ESA-listed and non-listed marine mammals, but would have more severe consequences for ESA-listed species compared to non-ESA-listed species as the listed populations are not as resilient to the injury or loss of individuals given their low reproduction rates and population numbers. NARW in particular would suffer effects on the viability of their population due to the injury or loss of an individual given their current status. The concurrent exposure scenario described in Section 3.5.6.4.2, *Impacts of Six Projects,* would also contribute to impacts on ESA-listed species, particularly NARW because Alternative B could ensonify large areas of acoustic space during key NARW activities within adjacent regions (e.g., foraging, migrating, cow-calf communication).

Presence of structures: As noted for the No Action Alternative, many effects associated with the presence of structures, including hydrodynamic changes, habitat conversion and prey aggregation, avoidance or displacement, and behavioral disruption are not expected to differ substantially between ESA-listed marine mammals and other marine mammal species, but any impacts may have a greater effect on NARW given their small population size and endangered status. Impacts associated with increased entanglement risk could be greater for NARW and fin whales compared to other marine mammal species. The presence of structures may result in increased risk of marine mammal entanglement due to increased fishing activity or a shift to fixed gear types. Entanglement is a significant threat for NARW and may be limiting population recovery (King et al. 2021; Knowlton et al. 2012; Johnson et al. 2005). Therefore, the increased risk of entanglement and hydrodynamic changes is more significant for this species and other ESA-listed mysticetes than for other non-listed marine mammals.

Traffic: As described in Section 3.5.6.4.2, *Impacts of Six Projects,* vessel strikes are a significant concern for ESA-listed and non-listed mysticetes. NARW are particularly vulnerable to vessel strikes, and vessel strikes are a primary cause of death for this species (Hayes et al. 2022; Kite-Powell et al. 2007). As noted for the *Presence of Structures* IPF, NARW has been experiencing a UME since 2017 attributed to vessel strikes and entanglement in fishing gear; humpback whales have been experiencing a UME since 2016, with the primary cause indicated as vessel strikes (NMFS 2024b). Vessel strikes may be particularly significant for NARW given their relatively high risk and their low population numbers. Under six NY Bight projects, impacts resulting from vessel traffic on ESA-listed species is expected to be greater than other marine mammals due to the lower population size of the ESA-listed species; however, non-listed mysticetes are at equal or greater risk to vessel strike as ESA-listed species.

3.5.6.4.4 Cumulative Impacts of Alternative B

The construction and installation, O&M, and conceptual decommissioning of infrastructure for offshore wind activities across the geographic analysis area would contribute to the primary IPFs of accidental releases, cable emplacement and maintenance, discharges/intakes, electric and magnetic fields and cable heat, survey gear utilization, lighting, noise, port utilization, presence of structures, and traffic.

Accidental releases: In the context of ongoing and planned non-offshore-wind and offshore wind activities, the impact contributed by accidental releases and discharges from six NY Bight projects would be undetectable. Impacts, therefore, are expected to be temporary and highly localized due to the likely limited extent and duration of a release, resulting in minor impacts for mysticetes (including NARW), odontocetes, and pinnipeds.

Cable emplacement and maintenance: In the context of reasonably foreseeable environmental trends, the contributions of six NY Bight projects to the combined cable emplacement impacts associated with ongoing and planned non-offshore-wind and offshore wind activities would be undetectable on mysticetes (including NARW), odontocetes, and pinnipeds. These impacts are expected to be minor, with short-term, localized consequences to individuals that are detectable and measurable but do not lead to population-level effects.

Discharges/intakes: In the context of reasonably foreseeable environmental trends, the contributions of six NY Bight projects to the combined discharge and intake impacts associated with ongoing and planned non-offshore-wind and offshore wind activities would be undetectable. Impacts, therefore, are expected to be low in intensity, highly localized, and non-measurable due to the small number of OSSs, resulting in negligible impacts for mysticetes (including NARW), odontocetes, and pinnipeds.

Electric and magnetic fields and cable heat: In the context of reasonably foreseeable environmental trends, the impact contributed by six NY Bight projects would result in an undetectable increase in EMFs in the geographic analysis area beyond that described under the No Action Alternative. The combined impacts from EMF and cable heat on mysticetes (including NARW), odontocetes, and pinnipeds would likely still be negligible, localized, and long term though with no perceptible consequences to individuals or populations.

Survey gear utilization: In the context of ongoing and planned non-offshore-wind and offshore wind activities, the impact contributed by six NY Bight projects would be a noticeable addition to the impacts of survey gear utilization. The impacts of survey gear utilization on mysticetes (except NARW) would be moderate, and on odontocetes, and pinnipeds would be minor; impacts on individuals would be detectable and measurable but would not lead to population-level effects. Gear utilization could result in major long-term impacts for NARW; if an entanglement were to occur, impacts could lead to severe population-level effects that compromise the viability of the species.

Lighting: In the context of reasonably foreseeable environmental trends, the contributions of six NY Bight projects to the combined lighting impacts associated with ongoing and planned non-offshore-wind and offshore wind activities would contribute an undetectable amount. Impacts are expected to be low in intensity and non-measurable due to the highly localized nature of lighting effects, resulting in negligible impacts for mysticetes (including NARW), odontocetes, and pinnipeds.

Noise: In the context of reasonably foreseeable environmental trends, the contributions of six NY Bight projects to the combined noise impacts associated with ongoing and planned non-offshore-wind and offshore wind activities would be noticeable to appreciable. Cumulative impacts on marine mammals would range from negligible to major given the magnitude of ongoing and planned activities and the status of the specific affected. The most significant sources of noise are expected to be pile-driving, UXO detonation, and vessels.

Effects from impact pile-driving and UXO detonation would be major for NARW due to the potential for severe-intensity and population-level effects that would impact the viability of the species. Moderate impacts are expected for all other mysticetes, odontocetes, and pinnipeds as population-level effects could still occur but the viability of these populations would not be threatened. Impacts from vibratory pile-driving and G&G surveys are expected to be minor for all marine mammals.

Impacts from G&G surveys, aircraft, cable laying and trenching, and drilling would be negligible for all marine mammals (including NARW) as impacts on individuals would not be measurable or perceptible, and would be short term and highly localized.

Impacts from vessel noise would be moderate for mysticetes (including NARW) as the risk of auditory masking would result in impacts that are detectable, measurable, and of medium intensity with no long-term population-level effects. Impacts from vessel noise would be minor for odontocetes and pinnipeds as the lower risk of masking makes the intensity of this impact lower for these species.

Impacts from WTG operations are expected to range from negligible to minor; minor impacts, such as potential masking in low ambient noise conditions, may be more likely for mysticetes (including NARW) due to the low-frequency nature of operational noise and the hearing sensitivity of these species, though population-level impacts are not expected. Negligible impacts on pinnipeds and odontocetes are predicted given effects on these groups are anticipated to be of low intensity and not likely to result in measurable consequences.

Port utilization: In the context of ongoing and planned non-offshore-wind and offshore wind activities, the impact contributed by six NY Bight projects would result in a noticeable increase in port utilization in the geographic analysis area beyond those described under the No Action Alternative. These impacts would likely be minor, as impacts on marine mammals would be detectable, but highly localized and intermittent; population-level impacts would not be expected for mysticetes (including NARW), odontocetes, and pinnipeds.

Presence of structures: In context of other ongoing and planned non-offshore-wind and offshore wind activities, the impact contributed by six NY Bight projects would result in a noticeable increase in the presence of structures in the geographic analysis area beyond that described under the No Action Alternative. However, the combined impacts from the presence of structures would likely still be moderate for mysticetes (except NARW), driven mainly by the elevated entanglement risk, as impacts would be detectable and measurable, but all populations would be expected to sufficiently recover from the impacts. Impacts on NARW would remain major due to the potential for increased risk for secondary entanglement in derelict fishing gear that could result in population-level consequences. Impacts on odontocetes and pinnipeds would be minor because impacts on individuals would be detectible and measurable, but would not lead to a population-level effect. Minor beneficial impacts may result for non-ESA-listed odontocetes and pinnipeds due to the reef effect and potential increase in foraging opportunity. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. Additionally, both localized and broadscale hydrodynamic impacts may occur, though there is considerable uncertainty as to how the increased presence of structures will affect marine mammals and their habitat.

Traffic: In context of other ongoing and planned non-offshore-wind and offshore wind activities, the impact contributed by six NY Bight projects would result in a noticeable increase in vessel traffic in the geographic analysis area; the subsequent increase in the risk of impacts on marine mammals would therefore also be noticeable and appreciable. Cumulative impacts would be minor for pinnipeds and odontocetes as consequences to individuals would be detectable and measurable, but population-level effects are unlikely. Because the death of a single NARW could lead to severe population-level consequences that compromises the viability of the species, this impact is considered major for NARW in the absence of mitigating or remedial actions. The cumulative impact on other mysticetes would be moderate as consequences of a vessel strike would be long term and severe, and could have population-level impacts; however, it would be unlikely to affect the viability of the species.

3.5.6.4.5 Conclusions

Impacts of Alternative B. The impact of Alternative B when compared to the No Action Alternative is summarized here. Project construction and installation, O&M, and conceptual decommissioning of Alternative B, whether one or six NY Bight projects, would result in habitat disturbance (presence of structures and new cable emplacement), habitat conversion (presence of structures), noise, vessel traffic (strikes and noise), and potential discharges/spills and trash.

For one or six NY Bight projects, BOEM expects overall impacts to be **negligible** to **major** for NARW. Major impacts result from noise produced during unmitigated pile-driving, UXO detonations, secondary entanglement in derelict gear around project structures, and vessel strikes. For NARW, injury or loss of individuals in these populations would be a permanent impact of severe intensity that could lead to population-level effects that would compromise the viability of the species given their current population status. For all other IPFs, impacts on NARW would be **negligible** to **minor**.

For one or six NY Bight projects, BOEM expects vessel traffic impacts to be moderate for non-NARW mysticetes and minor for odontocetes and pinnipeds. For one or six NY Bight projects, BOEM expects impacts to be moderate for all non-NARW species resulting from unmitigated pile-driving noise, and UXO detonation. For one NY Bight project, BOEM expects impacts to non-NARW mysticetes to be minor for secondary entanglement in derelict gear around project structures and moderate for six NY Bight projects. Impacts from these IPFs would be detectable and measurable and of sufficient intensity to result in population-level effects, but impacts would not compromise the viability of these species. For all other IPFs, for one or six NY Bight projects, BOEM expects impacts to range from negligible to minor for mysticetes, odontocetes, and pinnipeds.

For one or six NY Bight projects, BOEM expects overall impacts on non-NARW mysticetes, odontocetes, and pinnipeds to be **negligible** to **moderate**, with moderate impacts largely resulting from unmitigated pile-driving noise and UXO detonations. BOEM further expects, for one or six NY Bight projects, **minor beneficial** impacts on non-ESA-listed odontocetes and pinnipeds due to the presence of structures are possible, though such impacts may be offset by the increased risk of entanglement due to derelict fishing gear on the structures.

Cumulative Impacts of Alternative B. The cumulative impacts of Alternative B considered the impacts of Alternative B in combination with other ongoing and planned offshore wind activities described for Alternative A in Section 3.5.6.3. BOEM anticipates that the cumulative impacts on marine mammals in the geographic analysis area resulting from individual IPFs under six NY Bight projects would likely range from **negligible** to **major** for NARW; **negligible** to **moderate** for non-NARW mysticetes, odontocetes, and pinnipeds, depending on the IPF; and potentially **minor beneficial** for non-ESA-listed odontocetes and pinnipeds due to the artificial reef effect from the presence of structures.

Overall, the main drivers for these impacts are pile-driving and UXO detonation, risk of vessel strikes due to non-offshore-wind vessel traffic described under Alternative A, risks associated with gear entanglement from non-offshore-wind fishing gear, and ongoing climate change. Based on the current status of NARW, impacts on NARW resulting from all IPFs combined from ongoing and planned actions, including Alternative B, are expected to be major because serious injury or loss of an individual would result in population-level impacts that threaten the viability of the species if a vessel strike or entanglement were to occur. Impacts on non-NARW mysticetes, odontocetes, and pinnipeds could have population-level effects, but populations are expected to sufficiently recover such that the viability of the species is maintained; therefore, overall impacts would be **moderate**.

In context of other reasonably foreseeable environmental trends, impacts contributed by six NY Bight projects to the cumulative impacts on marine mammals would range from undetectable to appreciable. Six NY Bight projects would contribute to the cumulative impacts primarily through unmitigated pile-driving, UXO detonation, vessel traffic, and the presence of structures as related to secondary entanglement in derelict fishing gear.

3.5.6.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Marine Mammals

Alternative C, the Proposed Action, considers the potential impacts of offshore wind development in the six NY Bight lease areas with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives: Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.5.6.5.1 Sub-Alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS (Table 3.5.6-12).

Table 3.5.6-12. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for marine mammals

Measure ID	Measure Summary
MM-1	This measure proposes requiring reporting of all NARW detections to gather data that could be used to evaluate impacts and potentially lead to additional mitigation measures.
MM-3	This measure proposes requiring long-term PAM monitoring to inform future predictions of potential impacts on marine mammals.
MM-5	This measure proposes requiring a maximum 10-knot vessel speed limit for vessel transits in an SMA unless a Marine Mammal Vessel Strike Management Plan is submitted to and approved by BOEM, BSEE, and NMFS. The 10-knot requirement will reduce potential for vessel strikes by allowing more time for the vessel and animal to detect one another and take evasive action; and it will reduce the severity of any injury in the event of a strike. The Marine Mammal Vessel Strike Management Plan will reduce potential vessel strikes for vessels traveling over 10 knots by identifying transit corridors, monitoring with PAM and visual observations, and setting protocols for reducing speed in the presence of NARW.
MMST-1	This measure proposes requiring submittal and approval of Reduced Visibility Monitoring (RVMP)/Nighttime Pile Driving Monitoring Plan to ensure visual monitoring can be achieved.
MMST-2	This measure proposes requiring the submittal and approval of a final pile-driving Marine Mammal and Sea Turtle Monitoring Plan with PAM and PSO requirements.
MMST-3	This measure proposes adjusting pile-driving clearance zones, shutdown zones, and monitoring and mitigation measures for pile driving based on sound field verification measurements.
MMST-4	This measure proposes requiring time of day restrictions, PSO, clearance, and shutdown zones for pile-driving activities to reduce impacts from noise.
MMST-5	This measure proposes requiring additional PSO coverage to reliably monitor expanded pile driving clearance or shutdown zones to reduce noise impacts on marine mammals.
MMST-6	This measure proposes requiring that PSOs have clear conditions for visual monitoring during pile-driving to ensure visual detection of marine mammals.
MMST-7	This measure proposes requiring that PSO coverage and training requirements for pile-driving are sufficient to detect protected species.
MMST-9	This measure proposes requiring vessel crew and PSO training for protected species identification to reduce vessel strike risk.
MMST-10	This measure proposes requiring PSO reporting of all protected species in the shutdown zone during active pile driving.
MMST-12	This measure proposes requiring clearance and shutdown zones and related mitigations for marine mammals and sea turtles during geophysical surveys.
MMST-14	This measure proposes requiring that vessel operators and crews maintain a watch for protected species and take mitigative action if sighted to reduce vessel strike risk.
MUL-1	This measure proposes requiring training, recovery, prevention, and reporting to reduce and eliminate trash and debris in order to reduce impacts from entanglement, ingestion, smothering of benthic species, and pollutants in the water column. This measure also proposes requiring surveys to monitor and adaptively mitigate for lost fishing gear accumulated at WTG foundations.
MUL-8	This measure proposes requiring that all trap/pot gear used in fishery surveys would be uniquely marked to distinguish it from commercial or recreational gear and to facilitate identification of gear on any entangled marine mammals, sea turtles, or ESA-listed fish.
MUL-9	This measure proposes requiring recovery and reporting of any lost fishery and benthic monitoring survey gear to reduce entanglement impacts on marine mammals, sea turtles, and ESA-listed fish.
MUL-10d	This measure proposes requiring qualified third-party PSOs to observe Clearance and Shutdown Zones and implement mitigation measures during data collection and site survey activities.

Measure ID	Measure Summary
MUL-10e	This measure proposes PSO reporting requirements during site characterization and site assessment/data collection activities.
MUL-13	This measure proposes requiring use of trained observers onboard trawl and trap surveys to mitigate impacts on ESA-listed species.
MUL-14a	This measure proposes developing and implementing standard protocols for addressing UXOs. Avoidance to the maximum extent practicable is required; a plan must be submitted if avoidance is not possible.
MUL-16	This measure proposes development and implementation of a plan for post-storm event monitoring of facility infrastructure, foundation scour protection, and cables. BSEE reserves the right to require post-storm mitigations to address conditions that could result in safety risks and/or impacts on the environment.
MUL-19	This measure proposes requiring monitoring of the cables after installation to determine location, burial, and conditions of the cable and surrounding areas to determine if burial conditions have changed and whether remedial action is warranted.
MUL-20	This measure proposes requiring implementation of soft start techniques during impact pile-driving to reduce noise impacts on marine mammals, sea turtles, and finfish.
MUL-29	This measure proposes requiring pile-driving sound field verification, a written plan to inform the size of the isopleths for potential injury and harassment, and reporting requirements.
MUL-31	This measure proposes that all fisheries sampling gear is hauled out every 30 days and between seasons to minimize entanglement risk.
MUL-32	This measure outlines PSO reporting requirements (including foundation pile-driving).
MUL-33	This measure proposes requiring communication of protected species sightings and detections amongst all project vessels.
MUL-34	This measure proposes requiring reporting of any observations or collections of injured or dead protected species.
MUL-37	This measure proposes requiring use of an FAA-approved vendor for the ADLS, which will activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility.

Impacts of One Project

As compared to Alternative B, AMMM measures under Sub-alternative C1 would reduce impacts on marine mammals for several IPFs, including accidental releases, cable emplacement and maintenance, EMF and cable heat, survey gear utilization, lighting, noise, presence of structures, and traffic. Impacts for other IPFs would remain the same as described under Alternative B.

Under Sub-alternative C1, AMMM measures could potentially reduce impacts on marine mammals compared to Alternative B. BOEM-proposed mitigation, monitoring, and reporting measures derived from BOEM's *Data Collection and Site Survey Activities for Renewable Energy on the Atlantic OCS* Biological Assessment (BOEM 2021c) and presented in BOEM's *Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection* notice (last revised on November 22, 2021), are required under lease issuance, and are therefore considered standard for preconstruction activities. These measures are primarily related to reducing impacts on marine mammals from G&G surveys and vessel traffic during site assessment. Additionally, measures that are required by federal law, such as USCG discharge rules and the NMFS NARW speed rule, are requirements for all vessel operators and not limited to offshore wind or project-specific activities; these measures are accounted for in both Alternative B and Sub-alternative C1 analyses.

AMMM measures that are limited to required reporting procedures (i.e., MMST-10; MUL 10-e, MUL-32, and MUL-34,) do not directly reduce impacts on marine mammals; however, the information gathered could be evaluated for efficacy and potentially lead to changes in or additions to existing mitigation measures.

Accidental releases: AMMM measure MUL-1 would require standardized marine debris awareness training for one NY Bight project personnel, proper marking and storage of all materials, equipment, tools and containers, and recovery for all discarded or lost items to the extent practicable. Additionally, MUL-9 requires the recovery of lost survey gear. The combination of MUL-1 and MUL-9 contributes to reducing and tracking the amount of marine debris that is in the water as a result of project activities and infrastructure. Implementation of these waste management and mitigation measures, as well as marine debris awareness training, would reduce the likelihood of any impacts on marine mammals due to accidental release. The impact of accidental releases and discharges under Sub-alternative C1, therefore, would be reduced to negligible for mysticetes (including NARW), odontocetes, and pinnipeds due to the previously applied AMMM measures. Impacts would be low intensity, short term, and localized, and would not lead to population-level consequences.

Cable emplacement and maintenance: AMMM measure MUL-19 would require periodic post-installation cable monitoring, although potential impacts on marine mammals from cable emplacement and maintenance activities, primarily through increased turbidity in the water column, are not expected to differ under Sub-alternative C1 compared to Alternative B. Therefore, MUL-19 is not anticipated to reduce the level of impact of this IPF on marine mammals compared to Alternative B. The G&G survey efforts and vessel traffic needed to satisfy this AMMM measure could increase risk to marine mammals through both noise and traffic IPFs. However, this potential increase in risk is not anticipated to increase any IPF impact rating. Potential impacts on marine mammals from cable emplacement and maintenance are not expected to differ under Sub-alternative C1 compared to Alternative B and would remain negligible for all mysticetes (including NARW), odontocetes, and pinnipeds. Impacts would be low intensity, short term, and localized, and would not lead to population-level consequences.

Electric and magnetic fields and cable heat: MUL-19 would require periodic post-installation cable monitoring. This measure is intended to identify areas where project cables are exposed on the seabed at particular intervals and following major storm events. Remedial actions would be required if burial conditions have deteriorated or changed significantly, which would ensure that exposed transmission cables are minimized, thereby minimizing the resulting EMF levels. The G&G survey efforts and vessel traffic needed to satisfy this AMMM measure could increase risk to marine mammals through both noise and traffic IPFs. However, this potential increase in risk is not anticipated to increase any IPF impact rating. Potential impacts on marine mammals from EMF and cable heat are not expected to differ under Sub-alternative C1 compared to Alternative B and would remain negligible for all mysticetes (including NARW), odontocetes, and pinnipeds.

Survey gear utilization: The AMMM measures would help to reduce entanglement or capture risk for all marine mammal species in project-related fisheries and monitoring surveys. MUL-31 requires all trap/pot sampling gear to be hauled at least once every 30 days and to be removed from the water between sampling seasons. This measure would reduce overall entanglement risk for ESA-listed species by ensuring gear is monitored while in use and not left unattended for extended periods of time. However, given the standard soak time for commercial fishing gear is closer to 10 days, the magnitude of risk reduction as a result of this measure is likely limited. MUL-9 would require that all reasonable efforts are undertaken to recover any survey gear that is lost during any phase of one NY Bight project, including G&G surveys, biological monitoring surveys, and fisheries monitoring surveys. Fast recovery of the lost gear would benefit marine mammals by reducing the amount of time lost gear is in the water, thereby reducing the likelihood of entanglement. While required gear marking (MUL-8) would not reduce entanglement risk directly, it will facilitate understanding of which sampling gear is highest risk to ESA-listed species if multiple entanglements were to occur, which could be used to inform future deployments, ideally with minimized risk. AMMM measure MUL-13 would implement a requirement that at least one survey staff onboard trawl and ventless trap surveys be trained in protected species identification and safe handling and that disentanglement procedures would be available onboard. These measures serve to reduce overall risk of entanglement or entrapment to marine mammals by minimizing the risk of gear being caught in the project structures. Potential impacts on marine mammals from survey gear utilization associated with one NY Bight project under Sub-alternative C1 compared to Alternative B would therefore be reduced, particularly for ESA-listed species. Given the limited extent and duration of monitoring surveys, and with the implementation of the above-described AMMM measures, impacts from survey gear utilization under one NY Bight project would be negligible for mysticetes (including NARW), odontocetes, and pinnipeds as risk for entanglement or entrapment would be so low as to be barely detectable.

Lighting: MUL-37 will require the use of an ADLS to turn aviation obstruction lights on and off in response to detection of nearby aircraft; an ADLS system would significantly reduce the amount of time lights on WTGs would be illuminated. This measure in particular will serve to reduce impacts on marine mammals by reducing the amount of artificial light introduced to the environment. However, potential impacts on marine mammals from lighting are not expected to differ under Sub-alternative C1 compared to Alternative B and would remain negligible for all mysticetes (including NARW), odontocetes, and pinnipeds.

Noise: Unmitigated noise has the potential to be highly impactful to marine mammals, especially noise from impact pile-driving. A BOEM-funded acoustic assessment (contained in Appendix J, Section J.4) was conducted to assess the AMMM measures being considered under the Proposed Action that may serve to lessen the extent of acoustic disturbance on marine mammals, primarily associated with pile-driving. This assessment identified several key results relevant to one NY Bight project:

- The lowest exposure risk associated with pile-driving coincided with times of lowest animal abundance.

- Mitigated pile-driving reduced the overall exposure indices in comparison to unmitigated pile-driving.
- The relative noise exposure risk of offshore wind development on marine mammals is higher for low-frequency cetaceans than mid- and high-frequency cetaceans due to the low frequency nature of the noises most-commonly generated during offshore wind development (i.e., pile-driving and vessel noise).

The assessment further identified the following mitigative principles that, when implemented via applicable AMMM measures, may reduce the impact of noise on marine mammals under one NY Bight project:

- A reduction in noise at the source would reduce the spatial extent of potential exposure to all species.
- Focusing activity (pile-driving or vessel activity) to times when animals are not present or are in very low abundance in the area could decrease the risk to marine mammals. As no time exists when no animals are predicted to be present, the specific trade-offs to certain species would have to be weighed against conservation needs and priorities.
- Increased monitoring, including the use of alternative monitoring technologies, could lead to increased opportunities to further mitigate effects on marine mammals.

The identified AMMM measures fall into several main themes:

- Modifications in construction activity schedules that limit temporal exposure to noise (e.g., MMST-1, MMST-4).
- Measures that limit the spatial extent of noise (e.g., MMST-2, MMST-5, MUL-20).
- Use of real-time and near-real time monitoring to inform adaptive mitigation measures (e.g., MMST-2, MMST-3, MMST-4, MMST-5, MMST-6, MMST-12, MUL-29).
- Collection of baseline information to better anticipate potential impacts and further mitigate effects on marine mammals in the future (e.g., MM-3 MUL-29).

As discussed in the following paragraphs and in Appendix J, Section J.4, the AMMM measures identified in the analysis serve key functions in reducing noise impacts. The AMMM measures focused on reducing the spatio-temporal overlap of noise with marine life may have the greatest potential to reduce impacts. However, these AMMM measures are built on a foundation of knowledge that would not be possible without continued environmental monitoring to understand where and when animals are present and to characterize the sound fields associated with noise-generating activities. Therefore, the monitoring AMMM measures are also critical in ensuring that the spatio-temporal AMMM measures are most effective and are based on the best available and current information.

NARW is a species of great concern due to the status and vulnerability of its population compared to other whales in the region. Therefore, many AMMM measures are designed specifically in consideration of NARW and, in certain circumstances, may increase risk to other species that do not overlap temporally with NARW. In other instances, AMMM measures provide similar benefits to other species. For the full description of each AMMM measure, see Appendix G. Note that there are other noise-related AMMM measures that are not discussed further as they neither directly (e.g., reporting requirements) nor indirectly reduce acoustic impacts to marine mammals. The complete acoustic assessment can be found in Appendix J, Section J.4.

PSO training, visual monitoring coverage, shutdown procedures, PAM coverage, and monitoring equipment effectiveness, procedures, and protocols are critical to monitoring the defined clearance and shutdown zones during noise-generating activities (included in AMMM measures MMST-2, MMST-4, MMST-5, MMST-6, MMST-7, MMST-12, and MUL-10e). Using qualified PSOs and PAM operators would minimize the potential for adverse effects of noise on marine mammals from pile-driving noise by increasing knowledge and effectiveness of mitigation and monitoring personnel. Standardized reporting allows review of PSO activities and mitigation actions such that revisions in methods can be made during activities to ensure adequate mitigation. These measures, namely, to establish clearance and shutdown zones and effectively monitor them by trained PSOs, will reduce the overall impact on marine mammals by reducing exposure to sound levels that can cause PTS. Time of day and time of year restrictions (MMST-4) are designed to avoid pile-driving activities during the period when NARW abundance in the project area is likely to be greatest. Although this measure is specifically designed to reduce impacts on NARW, it will also be protective toward other marine mammals that would be present during the restricted season. The seasonal restrictions will therefore further reduce marine mammal exposure to pile-driving noise.

AMMM measure MMST-1 would require the submittal of Reduced Visibility Monitoring Plan (RVMP)/ Nighttime Pile Driving Monitoring Plan that details both Low-Visibility Pile-Driving Monitoring and Nighttime Pile-Driving Monitoring; nighttime pile-driving activities may be considered with the submittal and approval of the Nighttime Pile Driving Monitoring Plan. The RVMP would demonstrate the effective use of technologies that can meet the visual monitoring criteria, which would include criteria and equipment necessary to ensure effective monitoring of the required clearance and shut down zones. Only use of specific devices that are demonstrated to meet the visual monitoring criteria would be considered in the plan as approved by NMFS and BOEM. The measure would reduce impacts on marine mammals by improving visibility requirements (through the use of effective monitoring devices) during nighttime conditions, allowing for better detection and thus better mitigation responses during pile-driving activities. Alternative monitoring technologies during periods of poor visibility are also stipulated under MMST-1 and MMST-6.

AMMM measures MMST-3 and MUL-29 require sound field measurements and verification to confirm clearance and shutdown zones, adjust these zones or implement additional sound attenuation, and to monitor the effectiveness of sound attenuation methods. The clearance and shutdown zones will be based on the modeled threshold ranges, particularly PTS threshold ranges, to ensure the risk of PTS is significantly minimized, if not eliminated altogether. If the initial field measurements indicate that the isopleths of concern are larger than those considered in the Proposed Action for the COP NEPA analysis, in coordination with applicable federal permitting agencies, the lessee would be required to implement additional sound attenuation measures before driving any additional piles under MMST-3 and conduct Thorough Sound Field Verification (MUL-29) on the next three piles to verify that noise levels do not exceed modeled thresholds. If they do, the same steps would be required, i.e., implementation of additional sound attenuation measures and Thorough Sound Field Verification. This would minimize noise impacts on marine mammals by reducing sound propagation in the surrounding water.

Soft-start procedures (MUL-20) for impact pile-driving can also be an effective mechanism to reduce the potential for PTS exposures in certain species by deterring individuals from the area before the maximum hammer energy, and therefore the maximum sound levels, are reached. They are considered highly effective in deterring high-frequency cetaceans (i.e., harbor porpoises) from the area but not as effective in deterring pinnipeds, as described in Southall et al. (2021b). The efficacy of deterring other marine mammal species such as mysticetes through pile-driving soft-start procedures is unknown; however, this measure would also allow time for animals to move farther from noise that could potentially result in auditory injury or behavioral disturbance.

AMMM measure MMST-12 proposes clearance and shutdown zones, pre-start clearance protocols, ramp up protocols, and shutdown protocols to be implemented during G&G surveys using equipment operating below 180 kHz. The measure reduces impacts on marine mammals and sea turtles by requiring mitigation measures for sound sources that operate within the species' hearing frequencies. The mitigation measures will reduce impacts on marine mammals and sea turtles by ensuring animals are outside any auditory impact ranges before sources are started, allowing animals to move out of the highest ensonified areas by using ramp up protocols, and stopping sound source operations if an animal enters into a zone that may result in behavioral disturbance. The measure also requires proven technologies for detecting animals at night so that the mitigation measures are equally effective at night as they are during the day.

AMMM measure MUL-14a would require the development and implementation of standard protocols for addressing UXOs, including implementation of best available technology to avoid or minimize exposure of marine mammals. Avoidance to the maximum extent practicable would be preferred; a plan must be submitted if avoidance is not possible. Where detonation is demonstrated to be necessary for the project, the lessee would consult with state and federal agencies regarding seasonal restriction windows or other precautions. This measure serves to minimize impacts on marine mammals from UXO detonation or deflagration.

AMMM measure MM-3 requires long-term PAM monitoring before and throughout the lifetime of the lease to inform future predictions of potential impacts on marine mammals and could potentially lead to additional mitigation measures. The primary impacts of long-term PAM monitoring (MM-3) include bottom disturbance, marine debris in the case of sacrificial weights, and an increased risk of vessel noise or vessel strike each time the hydrophones are refurbished, which is typically two to three times a year.

AMMM measure MUL-33 will require communication of marine mammal sightings and detections between all operating project vessels. This measure will be most beneficial to NARW and other mysticetes as project personnel would be alerted to their regional presence, thereby increasing situational awareness for the project crew potentially leading to reduced noise exposure for mysticetes.

Some AMMM measures, and NARW reporting procedures (MM-1), are expected to reduce potential impacts of noise on all marine mammals, with additional protections specifically for NARW. AMMM measures MUL-10e and MUL-32 establish specific reporting requirements as related to pile-driving activities; data gathered through these reporting procedures could be used to evaluate impacts and potentially lead to additional or improved mitigation measures. However, these measures would not directly reduce impacts on marine mammals.

The AMMM measures under Sub-alternative C1 will reduce noise-related impacts compared to impacts from Alternative B by avoiding peak density periods, implementing well-monitored mitigation zones, and monitoring sound levels to confirm that predicted sound propagation distances are not exceeded and therefore not introducing larger sound exposure areas around the piling activities.

The identified AMMM measures outlined for impact pile-driving of WTG foundations are expected to substantially reduce the likelihood of PTS-level exposures and reduce the potential to disrupt important behaviors for NARW. Under Sub-alternative C1, the impacts are reduced from major (Section 3.5.6.4.1) to minor, as the effects would be short term, localized, and of low intensity. Low-intensity effects are considered effects that would not result in exposure to PTS thresholds, not result in severe injury or mortality, not result in a regular disruption of critical activities (e.g., foraging, breeding), and not cause damage to critical habitat. No PTS exposures, no disruption of critical function or population consequences, and no damage to critical habitat for NARW are anticipated from impact pile-driving activities for WTG foundations using the AMMM measures under Sub-alternative C1. Behavioral disturbances, should they occur, would be brief and primarily outside of peak seasonal occupancy (MMST-4).

Although the risk of PTS is expected to be lessened for other marine mammal species through the Sub-alternative C1 AMMM measures, the risk of PTS and disruption of critical behaviors would not be sufficiently reduced for non-NARW marine mammals to reduce the impact determination level to minor. Population-level impacts are not anticipated for any marine mammal species during impact pile-driving under Sub-alternative C1, but, due to the risk of PTS-level noise exposures and the potential for critical behavior disruption in non-NARW marine mammal species, impacts would be considered medium intensity and, therefore, would remain moderate as described under Alternative B (Section 3.5.6.4.1).

Impacts due to vibratory pile-driving are unlikely to differ substantially from Alternative B and would therefore remain minor for all marine mammals, including NARW, for one project under Sub-alternative C1.

With the planning, minimization, and monitoring requirements described in the AMMM measures, the impact of UXO detonation would be reduced to minor for all marine mammals. The risk of auditory injury, mortality, or PTS in marine mammal species (including NARW) would be unlikely with AMMM measures under Sub-alternative C1. Any impacts realized by marine mammals are anticipated to be infrequent, short term, and highly localized, and, therefore, would not lead to population-level effects for any species.

The AMMM measures discussed under the Noise IPF above are not directed at reducing impacts from vessel noise; therefore, the impacts from vessel noise under Sub-alternative C1 are unlikely to differ substantially from those under Alternative B and would remain minor. Similarly, BOEM anticipates the noise impact of aircraft, cable laying or trenching, and drilling to remain negligible, the same as Alternative B. Impacts from WTG operations and G&G surveys are unlikely to differ substantially from Alternative B and would therefore remain minor for mysticetes and negligible for odontocetes and pinnipeds.

Presence of structures: The primary impact on marine mammals associated with the presence of structures is due to entanglement risk resulting from an increased interaction with active or abandoned fishing gear. AMMM measure MUL-1 addresses this risk by monitoring and adaptively mitigating recreational and commercial fishing gear that may accumulate at or near WTG foundations. Monitoring and removing lost or derelict fishing gear will reduce exposure to such gear, therefore reducing the risk of entanglement to marine mammals. Additionally, MUL-31 requires all trap/pot sampling gear to be hauled at least once every 30 days and is removed from the water between sampling seasons. This measure would reduce entanglement risk for marine mammals by ensuring gear is monitored while in use and not left unattended for extended periods of time. However, given that the standard soak time for fishing gear is closer to 10 days, the magnitude of risk reduction as a result of this measure is likely limited. MUL-9 requires the recovery of lost project-related survey gear. These measures are expected to reduce entanglement risk to marine mammals by minimizing exposure to and monitoring all survey gear periodically. While required gear marking (MUL-8) would not reduce entanglement risk directly, it will facilitate understanding of which sampling gear is highest risk to marine mammals if multiple entanglements were to occur, which could be used to inform future deployments, ideally with minimized risk. BOEM would also require a monitoring plan be developed for post-storm events (MUL-16). While monitoring of cables (and cable protection) and WTG/OSS scour protection would not directly reduce effects on marine mammals, a monitoring plan would provide information about conditions that pose increased entanglement hazards from fishing gear (e.g., unburied cables), and BSEE would retain the ability to require post-storm mitigation to address safety risks and environmental impacts caused by the storm event.

Based on these previously applied AMMM measures, the impact from the presence of structures due to entanglement risk would be reduced to minor for mysticetes (including NARW), odontocetes, and pinnipeds as impacts would be detectable and measurable but not expected to lead to population-level effects. Minor beneficial impacts would still result for non-ESA-listed odontocetes and pinnipeds due to the reef effect and potential increase in foraging opportunity. Beneficial effects, however, may be offset given the increased risk of entanglement due to derelict fishing gear on the structures. In the case of NARW, the potential for increased exposure to entanglement could pose a significant risk as injury or mortality that removes even one juvenile or reproductive age individual from the population would constitute an effect that compromises the viability of the species. However, BOEM anticipates that the above-described AMMM measures would reduce the risk and likelihood of an entanglement occurring to NARW.

Traffic: As discussed in Section 3.5.6.3.3, vessel strike is a significant concern for all marine mammals, and especially NARW. AMMM measures MM-5 (vessel speed restrictions and Marine Mammal Vessel Strike Management Plan), MMST-9 (vessel crew and PSO training requirements), MUL-10d (PSO requirements during data collection and site survey activities), and MMST-14 (vessel strike mitigation measures and visual watch requirements) would require the use of trained observers, reduced vessel speeds, minimum separation distances, project-specific training for all vessel crew, and vessel strike minimization protocols. Fundamental to the effective implementation of these measures is MMST-14, which requires visual vessel strike monitoring of protected species for any construction, operations, or decommissioning vessel transits associated with a NY Bight project. Implementation of these measures would allow whales to avoid vessels, vessels to avoid whales, or both to take evasive actions, thereby reducing the risk of vessel strike to marine mammals.

AMMM measure MM-5 requires all project vessels to travel at 10 knots or less while transiting within an SMA. Additionally, the measure requires a Marine Mammal Vessel Strike Management Plan that details how the required vessel or aerial-based surveys, PAM, and other detection methodologies will be conducted to clear the vessel routes of NARW presence in order for crew transfer or other related vessels to travel greater than 10 knots. This measure would reduce impacts on large whales, and in particular NARW, by slowing vessel speeds and requiring routes taken by vessels that will travel faster than 10 knots to be clear of NARW. Vessel speed is a known factor in the ability to detect an animal within a strike risk zone and a factor in the severity of injury if an animal is struck; slower speeds allow observers more time to detect an animal at risk and implement evasive actions, and slower speeds reduce the severity of injury or potential for mortality if a strike occurs.

MUL-33 will require communication of marine mammal detections between all operating project vessels. These measures will be beneficial to NARW and other mysticetes as vessel operators and PSOs would be alerted to their regional presence, thereby increasing situational awareness for the vessel crew.

MM-3 requires long-term PAM monitoring before and throughout the lifetime of the lease to inform future predictions of potential impacts on marine mammals. Long-term PAM monitoring (MM-3) could result in an increased risk of vessel noise or vessel strike each time the hydrophones are refurbished, which is typically two to three times a year. However, while this measure does not directly reduce impacts on marine mammals, archived data can inform future predictions of marine mammal distribution and activity that could be considered for future mitigation and monitoring needs, which will serve to reduce impacts.

Overall, these AMMM measures, along with requiring compliance with NARW reporting procedures (MM-1), may reduce overall vessel strike risk for all marine mammals, with additional protections specifically for NARW. MUL-34 establishes reporting procedures for any takes, strikes, or dead/injured protected species caused by project vessels; although this measure could be used to evaluate impacts and potentially lead to additional mitigation measures, it would not directly reduce impact on marine mammals. With the effective implementation of these AMMM measures, encounters that have a high risk of resulting in collision or injury would be minimized by reducing both the encounter potential and severity potential.

The identified mitigation measures are expected to reduce the risk of vessel strike on mysticetes and are considered effective at minimizing collision risk and avoiding vessel strikes on marine mammals. Therefore, with implementation of these known and highly effective measures, BOEM concludes that vessel strikes are unlikely to occur. As a result, there is no anticipated effect on marine mammals; vessel traffic impacts due to one NY Bight project would therefore be negligible for mysticetes (including NARW), odontocetes, and pinnipeds.

Impacts of Six Projects

The same IPF impact types and mechanisms described under one NY Bight project apply to six NY Bight projects. There is a greater likelihood for impacts for these IPFs due to the increased amount of offshore and onshore development under six NY Bight projects. However, with standard BMPs (BOEM 2021c) and the AMMM measures described in Section 3.5.6.5.1, *Impacts of One Project,* and Appendix G, impacts under six NY Bight projects are not expected to differ substantially from one NY Bight project, except for noise resulting from impact pile-driving of WTG foundations. Therefore, impacts from accidental releases, cable emplacement and maintenance, EMF and cable heat, survey gear utilization, lighting, noise (excluding impact pile-driving), presence of structures, and vessel traffic are expected to be the same as that discussed in Section 3.5.6.5.1 for one NY Bight project.

Noise: With a concurrent installation scenario in which multiple NY Bight lease areas are under construction at the same time, an individual marine mammal moving through the area could be exposed to the sounds from more than one pile-driving event per day, repeated over a period of weeks and potentially months. Under a non-concurrent exposure scenario, individual marine mammals could be exposed to pile-driving noise on different days and/or months, but these periodic exposures would occur over a longer duration, potentially on the scale of multiple years. Impacts on all marine mammals from impact pile-driving under six NY Bight projects for Sub-alternative C1 for both concurrent and non-concurrent exposure scenarios would be moderate. Effects on NARW could include accumulation of acoustic exposures that, while not expected to result in PTS, cannot be eliminated. Likewise, repeated disruption of important behaviors could result in multiple exposure scenarios across the geographic analysis area. Effects on all other marine mammals, including potential PTS and critical behavioral disturbances, would result in impacts of medium intensity and cover a larger geographic area than for a single NY Bight project. Although individuals and populations would be expected to sufficiently recover from the stressor, the impact determination would remain moderate. See the acoustic narrative in Appendix J, Section J.4 for further discussion on the build out of six NY Bight projects under Sub-alternative C1.

Impacts of Sub-Alternative C1 (Preferred Alternative) on ESA-Listed Species

As discussed in Section 3.5.6.4.3, ESA-listed marine mammal populations, most notably NARW, are more vulnerable to impacts from noise, the presence of structures, and vessel traffic because IPFs that may result in long-term effects or population-level consequences have a higher likelihood of negatively affecting small, vulnerable populations or stocks. Many of the previously applied AMMM measures are designed specifically to reduce the intensity, duration, and spatial extent of impacts on NARW given their population status, life history traits, and heightened risk to anthropogenic disturbances. Many of the same AMMM measure benefits extend to other listed marine mammals, resulting in a reduction of potential impact from some IPFs, including noise, presence of structures, and vessel traffic. Implementation of AMMM measures can differentially affect marine mammal species and species groups; a description of how impacts on ESA-listed species deviate from that for other marine mammals are described for each IPF in Section 3.5.6.5.1.

Cumulative Impacts of Sub-Alternative C1 (Preferred Alternative)

The cumulative impacts of Sub-alternative C1 consider the impacts of Sub-alternative C1 in combination with other ongoing and planned non-offshore-wind and offshore wind activities described for Alternative A in Section 3.5.6.3. BOEM anticipates that the cumulative impacts of Sub-alternative C1 for individual IPFs would range from negligible to major for NARW and negligible to moderate for non-NARW mysticetes, odontocetes, and pinnipeds, depending on the IPF. Minor beneficial impacts for non-ESA-listed odontocetes and pinnipeds are also possible due to the reef effect from the presence of structures. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. Major cumulative impacts are anticipated for NARW, as population-level impacts may occur, primarily due to non-offshore-wind vessel traffic and entanglement risk associated with non-offshore-wind fishing gear utilization.

3.5.6.5.2 Sub-Alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus AMMM measures that have not been previously applied (Table 3.5.6-13).

Table 3.5.6-13. Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for marine mammals

Measure ID	Measure Summary
MUL-22	This measure would reduce noise impacts on marine mammals, sea turtles, and finfish by establishing Received Sound Level Limits (RSLL) that will require non-exceedance of an acoustic threshold at 3,280 feet (1,000 meters) or 4,921 feet (1,500 meters) depending on the year of pile installation.

Impacts of One Project

The AMMM measures under Sub-alternative C2 will reduce noise-related impacts compared to impacts from Alternative B. Further, implementing those not previously applied AMMM measures plus previously applied measures would potentially reduce impacts on some marine mammals from moderate to minor compared to those under Sub-alternative C1 for the noise IPF. Impacts from other IPFs would remain the same as described under Sub-alternative C1 because no previously applied AMMM measures are identified to reduce impacts from those IPFs.

Noise: AMMM measure MUL-22 would establish a Received Sound Level Limit (RSLL) such that sound fields generated during impact pile-driving would not exceed NOAA Fisheries' Level A PTS limits for low-frequency cetaceans at a specified distance of less than 1,500 meters. This measure reduces the spatial extent of potential PTS effects for all marine mammal species by relying on low-frequency cetacean PTS thresholds as a target for the RSLL because low-frequency cetacean thresholds represent the greatest PTS potential. Minimizing the PTS ranges, in turn, would reduce the range to TTS and other behavioral disturbance thresholds. Reduction in the size of the PTS ranges in turn reduces the size of clearance and shutdown zones, which improves the ability for PSOs or other monitoring technologies to successfully detect marine mammals in and near those zones. MUL-22 could also minimize noise impacts if developers discover glauconite sands during construction and installation, which may result in increased noise levels as developers determine if the glauconite is passable. Developers would need to use different methodology, technology, or infrastructure, or apply other quieting techniques to reduce their received sound limit if glauconite sands are discovered. The implementation of this AMMM measure is expected to benefit all marine mammal species; however noise from pile-driving would still have a reasonable potential to result in some behavioral disturbance to any marine mammals, including NARW. These disturbances would be short term, low intensity, and localized. Therefore, when compared to Sub-Alternative C1, impact levels for NARW would remain minor with AMMM measures under Sub-alternative C2, but would be reduced from moderate to minor under Sub-alternative C2 for all other non-NARW mysticetes, odontocetes, and pinnipeds.

Impacts of Six Projects

The same IPF impact types and mechanisms described under a single NY Bight project also apply to six NY Bight projects. Although AMMM measure MUL-22 may reduce the potential impacts of noise on marine mammals, the risk of accumulated acoustic energy over the spatial and temporal scales of installation of six projects would pose more than a minor risk of TTS, PTS, and disruption of important behaviors. Therefore, the impacts would be long term, extensive, and moderate for all marine mammals, including NARW.

Impacts of Sub-Alternative C2 on ESA-Listed Species

As discussed in Section 3.5.6.4.3, ESA-listed marine mammal populations are more vulnerable to impacts from noise, the presence of structures, and vessel traffic because these IPFs, which may result in long-term effects or population-level consequences, have a higher likelihood of negatively affecting small, vulnerable populations or stocks. The AMMM measures under Sub-alternative C2 are more broadly applicable to mysticetes and, by default, other marine mammals, rather than just NARW. The not previously applied AMMM measures benefit ESA-listed marine mammals by reducing the intensity of the noise (leading to a discountable risk of PTS) and extent of noise exceeding acoustic thresholds (smaller more manageable mitigation zones), resulting in a reduction of potential impacts from the noise IPF.

Cumulative Impacts of Sub-Alternative C2

The cumulative impacts of Sub-alternative C2 consider the impacts of Sub-alternative C2 in combination with other ongoing and planned non-offshore-wind and offshore wind activities described for Alternative A in Section 3.5.6.3. BOEM anticipates that the cumulative impacts of individual IPFs would range from negligible to major for NARW and negligible to moderate for non-NARW mysticetes, odontocetes, and pinnipeds, depending on the IPF. Minor beneficial impacts for non-ESA-listed odontocetes and pinnipeds are also possible due to the artificial reef effect from the presence of structures. Beneficial effects, however, may be offset by increased interactions with fishing gear associated with the presence of structures. Major cumulative impacts are anticipated for NARW, as population-level impacts may occur, primarily due to non-offshore-wind vessel traffic and entanglement risk associated with non-offshore-wind fishing gear utilization.

3.5.6.5.3 Conclusions

Impacts of Alternatives C. Project construction and installation, O&M, and conceptual decommissioning, whether one or six NY Bight projects under Sub-alternatives C1 and C2, would result in habitat disturbance (presence of structures and new cable emplacement), habitat conversion (presence of structures), underwater and airborne noise, vessel traffic (strikes and noise), and potential discharges/spills and trash. AMMM measures under Sub-alternative C1 or C2 would reduce some impacts, including from noise, secondary entanglement from presence of structures, and vessel strike risk, compared to Alternative B. The only AMMM measure applied under Sub-alternative C2 that was not previously applied under Sub-alternative C1 is MUL-22, the RSLL, which would reduce noise impacts during impact pile-driving. Impacts from all other IPFs would remain the same for Sub-alternatives C1 and C2.

For one NY Bight project, BOEM expects impacts of Sub-alternative C1 for individual IPFs to range from negligible to moderate for mysticetes (except NARW), odontocetes, and pinnipeds, depending on the IPF. Moderate impact levels would mainly result from impact pile-driving noise because impacts would be noticeable and measurable and could result in population-level effects for some species (not including NARW); however, impacts would not risk the viability of any species' population. BOEM expects impacts of Sub-alternative C1 for individual IPFs to range from negligible to minor for NARW. For six NY Bight projects, BOEM expects BOEM expects impacts of Sub-alternative C1 for individual IPFs to range from negligible to moderate for all marine mammals (including NARW).

The additional AMMM measure applied under Sub-alternative C2 would reduce impacts of pile-driving noise on mysticetes (except NARW) compared to Sub-alternative C1. For one project, impacts resulting from pile-driving would remain minor for NARW with the additional AMMM measure under Sub-alternative C2, but would be reduced from moderate to minor under Sub-alternative C2 compared to Sub-alternative C1 for non-NARW mysticetes, odontocetes, and pinnipeds due to the AMMM measure. For six projects, impacts from pile-driving noise would remain the same, moderate, under both Sub-alternatives C1 and C2 for all marine mammals (including NARW). While AMMM measures may reduce the potential impacts of noise on marine mammals, the risk of accumulated acoustic energy over the spatial and temporal scales of installation of six projects would pose more than a minor risk of TTS, PTS, and disruption of important behaviors. Therefore, the effects would be long term, extensive, and of medium intensity for all marine mammals, including NARW.

Impacts from UXO detonations for one or six NY Bight projects would be minor under both Sub-alternatives C1 and C2. Impacts resulting from UXO detonation could lead to long-term consequences for NARW; however, AMMM measures are likely to provide a significant reduction in the intensity and likelihood of noise impacts and therefore would result in a lower impact level compared to Alternative B for all marine mammal species.

With the effective implementation of the AMMM measures, BOEM concludes that vessel strikes are unlikely to occur as a result of project vessel activities associated with any of the six NY Bight projects. As a result, there is no anticipated effect on marine mammals, and collision effects due to one or six NY Bight projects would therefore be negligible for all marine mammals.

For both one or six NY Bight projects, BOEM expects impacts to be minor for all marine mammals due to the presence of structures.

Overall, for Sub-alternative C1 for one NY Bight project, BOEM expects impacts to be **negligible** to **moderate** for all for all marine mammals except NARW and **negligible** to **minor** for NARW. When considering all IPFs and AMMM measures for Sub-alternative C1 for six NY Bight projects, BOEM expects impacts to be **negligible** to **moderate** for all marine mammals (including NARW). For Sub-alternative C2 for one NY Bight Project, BOEM expects impacts to be **negligible** to **minor** for all marine mammals (Including NARW). For Sub-alternative C2 for six NY Bight projects, BOEM expects impacts to be **negligible** to **moderate** for all marine mammals (including NARW). One or six NY Bight projects for both Sub-alternatives C1 and C2 would also include **minor beneficial** impacts for non-ESA-listed odontocetes and pinnipeds resulting from the presence of structures, though these beneficial impacts may be offset by increased interactions with fishing gear associated with the presence of structures.

Cumulative Impacts of Alternative C. The cumulative impacts of Sub-alternatives C1 and C2 consider the impacts described above in combination with other ongoing and planned non-offshore-wind and offshore wind activities described for Alternative A in Section 3.5.6.3. BOEM anticipates that the cumulative impacts on marine mammals in the geographic analysis area under six NY Bight projects for individual IPFs would range from **negligible** to **major** for NARW; **negligible** to **moderate** for non-NARW mysticetes, odontocetes, and pinnipeds; and would be potentially **minor beneficial** for non-ESA-listed odontocetes and pinnipeds.

Overall, the main drivers for these impacts are pile-driving and UXO detonation, risk of vessel strikes due to non-offshore-wind vessel traffic described under Alternative A, risks associated with gear entanglement from non-offshore-wind fishing gear, and ongoing climate change. Based on the current status of NARW, impacts on NARW resulting from all IPFs combined from ongoing and planned actions, including Sub-alternatives C1 and C2, are expected to be major because serious injury or loss of an individual would result in population-level impacts that threaten the viability of the species if a vessel strike or entanglement were to occur. Impacts on non-NARW mysticetes, odontocetes, and pinnipeds could have population-level effects, but populations are expected to sufficiently recover such that the viability of the species is maintained; therefore, overall impacts would be moderate.

In context of other reasonably foreseeable environmental trends, the impacts contributed by Sub-alternatives C1 and C2 to the cumulative impact on marine mammals would range from undetectable to appreciable. Sub-alternatives C1 and C2 would contribute to the cumulative impacts primarily through pile-driving noise. AMMM measures that would have otherwise not been implemented under Alternative B would reduce impact levels on marine mammals for some IPFs.

3.5.6.6 Recommended Practices for Consideration at the Project-Specific Stage

In addition to the AMMM measures identified under Alternative C, BOEM is recommending lessees consider analyzing the RPs in Table 3.5.6to further reduce potential marine mammals impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.5.6-14. Recommended Practices for marine mammal impacts and related benefits

Recommended Practice	Potential Benefit
COMFIS-5: Follow BOEM Fisheries Survey Guidelines with regards to pre-, during- and post-construction fisheries monitoring survey plan design.	The Fisheries Guidelines provide guidance for standardizing survey plan design and aim to reduce the risk of interactions between protected species and sampling gear by minimizing the amount of gear fished (i.e., set or towed), the gear soak or tow duration, and the spatial and temporal overlap with protected species.
MM-2: Use near real-time PAM system to detect baleen whales and provide awareness to mariners involved in offshore wind activities.	Using a real-time PAM system with an alert sent to mariners and construction operators regarding the regional distribution of detection events within the greater NY Bight area would reduce the risk of impacts on baleen whales, including NARW, by increasing situational awareness. The network of PAM monitoring may be particularly useful between leases where the placement of other near-real-time PAM systems is not already directed, or near transit or cable-laying corridors, or other locations where near-real-time alerting of marine mammal presence would be beneficial to offshore wind-related activities occurring in one or more lease areas. Archived data could inform future predictions of baleen whale distribution and activity that can be considered for future mitigation and monitoring needs.
MM-7: Implement the project's schedule to reduce vessel density during the times of year when NARW are most likely to occur in lease areas and along vessel routes. Coordinate across different offshore wind development projects to reduce cumulative vessel density within the region to the extent practicable.	Reducing vessel density during time periods of highest risk (foraging migration, breeding behavior, etc.) would reduce overall risks of vessel strike with NARW.

Recommended Practice	Potential Benefit
MM-8: Include effectiveness criteria in vessel strike avoidance plans.	Including effectiveness criteria in vessel strike avoidance plans would encourage effective marine mammal vessel strike avoidance measures.
MUL-5: Use equipment, technology, and best practices to produce the least amount of noise possible to reduce noise impacts.	Using noise-reduction measures to produce the least amount of noise practicable would likely minimize disturbance/displacement impacts on marine mammals.
MUL-6: Use low noise practices or quieting technology to install foundations when possible.	The consideration of non-pile-driving foundation types (e.g., suction buckets, gravity-based foundations) first, and the use of the best available quieting technology should be applied to reach the received sound level limit (MUL-22). Using quieting technology (e.g., noise attenuation system [NAS]) reduces the risk of noise impacts on marine mammals by reducing the sound levels that propagate from the pile source. Available studies suggest that when a single or combined NAS is applied to monopile installation, noise reductions ranging from 3 to 17 dB can be achieved depending on the NAS combination, with some frequency-dependent reductions of >20 dB (Bellmann et al. 2020).
MUL-7: Use the most current International Maritime Organization's (IMO) Guidelines for the reduction of underwater radiated noise, including propulsion noise, machinery noise, and dynamic positioning systems for project vessels.	Adherence to IMO Guidelines would reduce underwater vessel noise as much as possible and reduce acoustic impacts from vessels on marine mammals.
MUL-10c: Follow BMPs during utilization of moon pool.	Following protocols for moon pool use and monitoring for protected species would minimize vessel interactions with protected species.
MUL-12: Incorporate ecological design elements where practicable.	Nature-inclusive design products are an alternative to traditional concrete that enhances or encourages the growth of flora or fauna when placed in a marine environment. This measure may contribute to maintaining biodiversity on project infrastructure that could enhance the reef effect, which is associated with a beneficial impact for some marine mammal species.
MUL-14b: When MEC avoidance is not possible, submitted UXO/MEC avoidance plans should follow, when finalized, the U.S. Committee on the Marine Transportation System general guidance on MEC.	Following the U.S. Committee on the Marine Transportation System general guidance on MEC would minimize effects from MEC detonation on marine mammals.
MUL-18: Coordinate transmission infrastructure among projects by using shared intra- and interregional connections, meshed infrastructure, or parallel routing.	Using a shared infrastructure would consolidate the extent of transmission cables, which could reduce the geographic extent of impacts from 1) cable emplacement and maintenance and 2) EMF and cable heat. This RP may minimize potential impacts from offshore export cables on marine mammals.

Recommended Practice	Potential Benefit
MUL-21: Use the best available technology, including new and emerging technology, when possible and consider upgrading or retrofitting equipment. Best available technology may include jet plows, closed-loop cooling systems and new foundations designs that do not rely on pile driving.	The use of jet plows would minimize the extent of turbidity plumes associated with cable emplacement as compared to other installation methods. As described in Section 3.4.2, *Water Quality*, a closed-loop subsea cooler system is an emerging technology, that, if applied, would eliminate entrainment risks to marine mammal prey resources and may minimize localized hydrodynamic and thermal plume impacts because intake and discharge of seawater would not occur. Using foundation designs that do not rely on pile-driving would, if employed, reduce noise exposure to marine mammals.
MUL-23: Avoid or reduce potential impacts on important environmental resources by adjusting project design.	Adjusting the project(s) design by utilizing cable installation methods that would avoid or reduce impacts on benthic habitats, or adjusting turbine layout to avoid certain sensitive habitat regions could reduce potential impacts from the presence of structures on marine mammals and their prey resources. Furthermore, the use of BOEM's risk assessment tool to model potential encounter rates between large whales and vessel traffic from offshore wind energy development (i.e., the "vessel strike model") will serve to identify potential encounter rates between ESA-listed marine mammal species and project vessels. Speed and routing variables can be incorporated into this tool to assess when and where high strike risk may occur and identify where additional mitigation measures should be focused.
MUL-26: Coordinate regional monitoring and survey efforts to standardize approaches, understand potential impacts to resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. Develop monitoring and survey plans that meet regional data requirements and standards.	Coordinating regional monitoring and survey efforts would maximize the monitoring efficiency. The data gathered would be evaluated and considered for future mitigation and monitoring needs, which will serve to reduce impacts.
MUL-39: Use of standard underwater cables designs that mitigate the intensity of electromagnetic fields (EMF) at the seafloor	Using cables that have electrical shielding could mitigate the intensity of EMFs, cable heat, and exposure to marine mammals.

3.5 Biological Resources

3.5.7 Sea Turtles

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on sea turtles from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.5 Biological Resources

3.5.8 Wetlands

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on wetlands from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.1 Commercial Fisheries and For-Hire Recreational Fishing

This section discusses potential impacts on commercial and for-hire recreational fisheries resources from the Proposed Action, alternatives, and ongoing and planned activities in the geographic analysis area. The commercial and for-hire recreational fisheries geographic analysis area, as shown on Figure 3.6.1-1, includes the waters within the Greater Atlantic Region managed by the NEFMC and MAFMC for federal fisheries in the U.S. Exclusive Economic Zone (from 3 to 200 nautical miles [5.6 to 370.4 kilometers] from the coastline), plus the state waters (out to 3 nautical miles [5.6 kilometers] from the coastline) from Maine to Cape Hatteras, North Carolina. The boundaries for the geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and U.S. Exclusive Economic Zone waters surrounding the NY Bight projects. Due to the size of the geographic analysis area, the analysis for this PEIS focuses on the commercial fisheries and for-hire recreational fishing within waters in the vicinity of the NY Bight lease areas, while providing context within the larger geographic analysis area. Private recreational fishing from shore or personal vessel is discussed in Section 3.6.8, *Recreation and Tourism*.

The commercial fisheries and for-hire recreational fishing impact analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

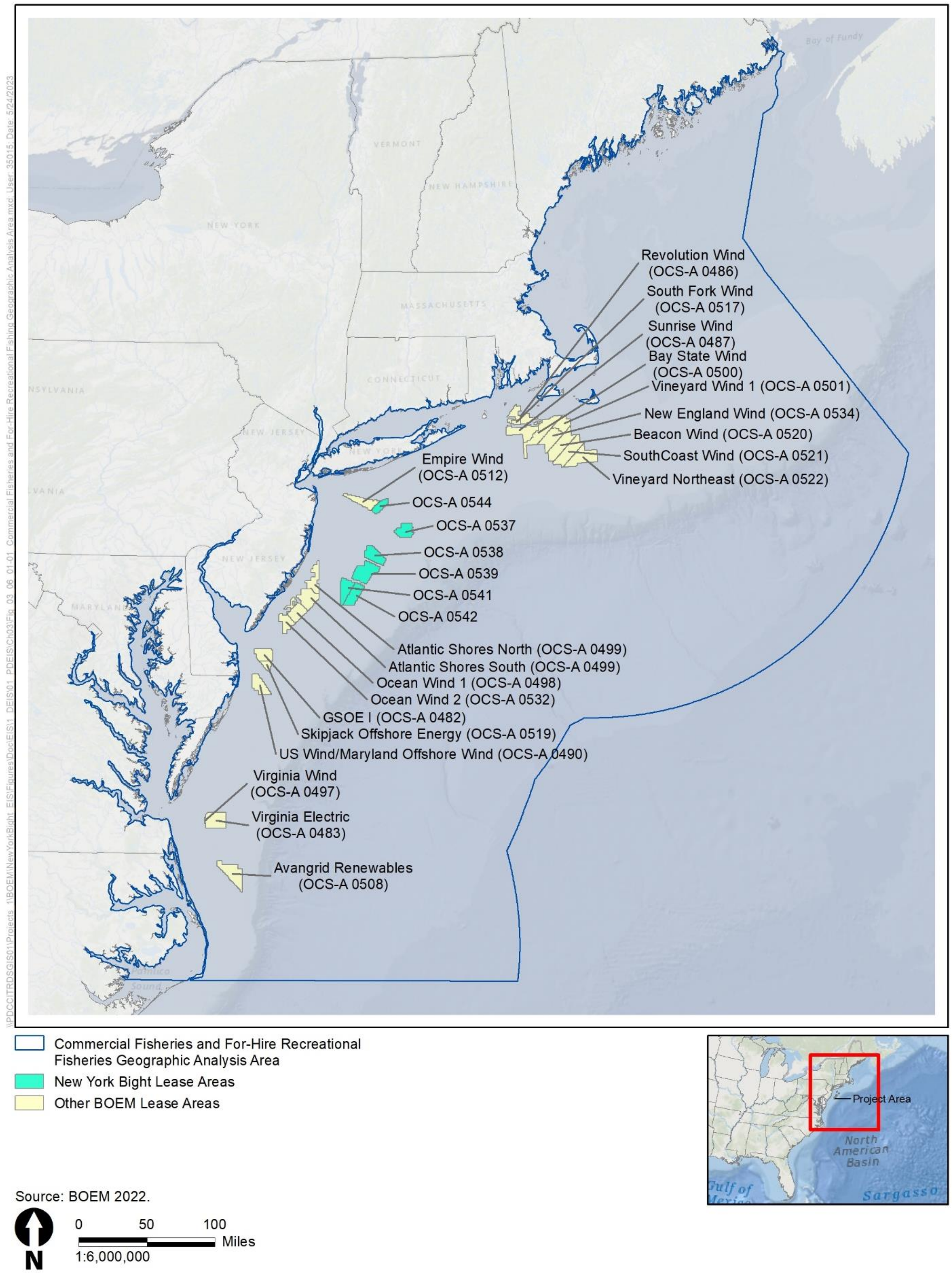


Figure 3.6.1-1. Commercial fisheries and for-hire recreational fishing geographic analysis area

3.6.1.1 Description of the Affected Environment and Future Baseline Conditions

At the federal level, there are three councils for the NY Bight geographic analysis area designated by the Magnuson Fishery Conservation and Management Act of 1976 (later renamed the Magnuson-Stevens Fishery Conservation and Management Act): the NEFMC for Connecticut, Massachusetts, Maine, New Hampshire, and Rhode Island; the MAFMC for Delaware, Maryland, North Carolina, New Jersey, New York, Pennsylvania, and Virginia; and the South Atlantic Fishery Management Council (SAFMC) for North Carolina (partially included in the geographic analysis area) as well as South Carolina, Georgia, and Florida (not included in the geographic analysis area).

Most fisheries resources in federal waters of the New England and Mid-Atlantic regions are managed under the Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 et seq.) through two Regional Fishery Management Councils, NEFMC and MAFMC. The Regional Fishery Management Councils develop species-specific FMP that establish fishing quotas, seasons, and closure areas, as well as establishing protections for EFH. The Regional Fishery Management Councils work with NMFS to assess and predict the status of fish stocks, set catch limits, promote compliance with fisheries regulations, and reduce bycatch.

Within the New Jersey and New York state waters near the NY Bight lease areas, commercial and for-hire recreational fisheries are further managed by state regulatory agencies under various ocean management plans developed at the state level (New York, New Jersey), or at the regional level (MAFMC) and by the ASMFC. The ASMFC is a deliberative body of the Atlantic coastal states that coordinates the conservation and management of 27 nearshore, migratory fish species. Each coastal state has its own structure of agencies and plans that govern fisheries resources. In New York, NYSDEC's Division of Marine Resources administers all laws relating to marine fisheries (New York Codes, Rules and Regulations part 6:1, subchapter C – Fishing) and is responsible for the development and enforcement of regulations pertaining to marine fish and fisheries in New York state waters. The Division of Marine Resources is divided into three bureaus: Marine Fisheries, Shellfisheries, and Marine Habitat. In New Jersey, the Marine Resources Administration is divided into two bureaus: the Bureau of Marine Fisheries and the Bureau of Marine Habitat and Shellfish. The NJDEP'S Bureau of Marine Fisheries administers all laws relating to marine fisheries (part 7:25, subchapter 18 – Marine Fisheries) and is responsible for the development and enforcement of state and federal regulations pertaining to marine fish and fisheries in New Jersey state waters, including the management of diadromous species (e.g., American eel, striped bass, river herring, sturgeon).

3.6.1.1.1 Regional Setting

Commercial fisheries in federal waters of the New England and Mid-Atlantic regions harvest a variety of finfish and shellfish species, including clams, groundfish, herring, lobster, squid, scallops, and skates. These species are harvested with a variety of fishing gear, including mobile gear (e.g., bottom trawl, midwater trawl, dredge) and fixed gear (e.g., demersal gillnet, lobster trap, crab trap, pots). The fishery resources are managed under numerous FMPs, including the Atlantic Herring FMP, Monkfish FMP, Northeast Multispecies (large- and small-mesh) FMP,[1] Red Crab FMP, Sea Scallop FMP, and Skate FMP (NEFMC 2022); Bluefish FMP, Mackerel/Squid/Butterfish FMP, Spiny Dogfish FMP, Summer Flounder/Scup/Black Sea Bass FMP, Surfclam/Ocean Quahog FMP, and Tilefish FMP (MAFMC 2022); Highly Migratory Species FMP (NMFS 2023a); and Atlantic Menhaden FMP, Lobster FMP, and Jonah Crab FMP (ASMFC 2022). NMFS prepared planning-level assessments that include descriptions of selected fishery landings, estimates of commercial revenue, and a small business analysis from each of the NY Bight lease areas (NMFS 2023b, 2023c, 2023d, 2023e, 2023f).

A summary of managed species and their respective managing agencies is presented in Table 3.6.1-1. These species represent many of the prominent commercial and for-hire recreational fisheries in the geographic analysis area, but they do not represent a comprehensive list of all managed fisheries in the Atlantic region.

Table 3.6.1-1. Summary of managed species and managing agencies

Managed Species	Species Group, Waters of Interest, or Managing Agency					ASMFC
	HMS	Regional/ State Waters	NEFMC	MAFMC	SAFMC	
Acadian redfish (*Sebastes fasciatus*)			X			
American lobster (*Homarus americanus*)		X				X
American plaice (*Hippoglossoides platessoides*)			X			
Atlantic cod (*Gadus morhua*)			X			
Atlantic menhaden (*Brevoortia tyrannus*)						X
Atlantic halibut (*Hippoglossus hippoglossus*)			X			
Atlantic mackerel (*Scomber scombrus*)				X		
Atlantic pollock (*Pollachius virens*)			X			
Atlantic salmon (*Salmo salar*)			X			
Atlantic striped bass (*Morone saxatilis*)		X				X
Atlantic wolffish (*Anarhichas lupus*)			X			
Black drum (*Pogonias cromis*)		X				X
Black seabass (*Centropristis striata*)				X		X
Blue crab (*Callinectes sapidus*)		X				
Bluefish (*Pomatomus saltatrix*)				X		X
Butterfish (*Peprilus triacanthus*)				X		
Cobia (*Rachycentron canadum*)					X	X
Dolphinfish (*Coryphaena hippurus*)					X	
Groundfish (flounders, Atlantic cod [*Gadus morhua*])			X			
Haddock (*Melanogrammus aeglefinus*)			X			
Herring (*Clupea harengus*)			X			

[1] The Northeast Multispecies (large-mesh) FMP includes Acadian redfish, American plaice, Atlantic cod, Atlantic haddock, Atlantic halibut, Atlantic wolffish, ocean pout, pollock, white hake, witch flounder, windowpane flounder, winter flounder, and yellowtail flounder. The Northeast Multispecies small-mesh FMP includes offshore hake, red hake, and silver hake.

Managed Species	Species Group, Waters of Interest, or Managing Agency					ASMFC
	HMS	Regional/ State Waters	NEFMC	MAFMC	SAFMC	
Jonah crab (*Cancer Borealis*)						X
Monkfish (*Lophius americanus*)				X		
Ocean pout (*Zoarces americanus*)			X			
Ocean quahog (*Arctica islandica*)				X		
Red crab (*Chaceon quinquedens*)			X			
Red drum (*Sciaenops ocellatus*)		X				X
Red hake (*Urophycis chuss*)			X			
Scup (*Stenotomus chrysops*)				X		X
Sea scallop (*Placopecten magellanicus*)			X			
Silver hake (*Merluccius bilinearis*)			X			
Skates (Rajidae)			X			
Spiny dogfish (*Squalus acanthias*)			X	X		X
Shortfin squid (*Illex* spp.)				X		
Longfin squid (*Doryteuthis pealeii*)				X		
Summer flounder (*Paralichthys dentatus*)				X		X
Surf clam (*Spisula solidissima*)				X		
Tautog (*Tautoga onitis*)		X				X
Tilefish (Malacanthidae)			X		X	
Wahoo (*Acanthocybium solandri*)					X	
Weakfish (*Cynoscion regalis*)		X				X
White hake (*Urophycis tenuis*)			X			
Whiting (*Merlangius merlangus*)			X			
Windowpane flounder (*Scophthalmus aquosus*)			X			
Witch flounder (*Glyptocephalus cynoglossus*)			X			
Winter flounder (*Pseudopleuronectes americanus*)			X			X
Yellowtail flounder (*Limanda ferruginea*)			X			
Tunas (Thunnini)*	X					
Sharks (Selachimorpha)*	X					
Swordfish (*Xiphias gladius*)*	X					
Billfish (Istiophoridae)*	X					

*NOAA has management authority for certain tunas (Thunnini), sharks (Selachimorpha), swordfish (*Xiphias gladius*), and billfish (Istiophoridae).

HMS = highly migratory species; MAFMC = Mid-Atlantic Fishery Management Council; NEFMC = New England Fishery Management Council; SAFMC = South Atlantic Fishery Management Council; ASMFC = Atlantic States Marine Fisheries Commission

3.6.1.1.2 Regional Fisheries Economic Value and Landings

NOAA maintains landings data for commercial and for-hire recreational fisheries based on year, state, and species. The top species landed by weight in 2022 (the most recent year for which data are available) from commercial fisheries operating in coastal bays and offshore New Jersey and New York include menhaden (*Brevoortia* spp.), Atlantic surf clam (*Spisula solidissima*), scup (*Stenotomus chrysops*), longfin squid (*Loligo pealeii*), and blue crab (*Callinectes sapidus*). Substantial commercial harvests were also reported for sea scallops (*Placopecten magellanicus*), summer flounder (*Paralichthys dentatus*), spiny dogfish (*Squalus acanthias*), Jonah crab (*Cancer borealis*), and other species (NMFS 2021a).

Commercial fisheries provide economic benefits to the coastal communities of New England and the Mid-Atlantic region by contributing to the income of vessel crews and owners and by creating demand for dockside services. These fisheries also contribute to the overall economy in the region through direct employment, income, and gross revenues, as well as through products and services to maintain and operate vessels, seafood processors, wholesalers/distributors, and retailers. Four ports in the geographic analysis area ranked in the top 20 U.S. ports for commercial landings by weight (Reedville, Virginia; New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; and Gloucester, Massachusetts), and five ports ranked in the top 20 U.S. ports in commercial landings value (New Bedford, Massachusetts; Cape May-Wildwood, New Jersey; Gloucester, Massachusetts; Stonington, Maine; and Point Judith, Rhode Island) in 2021 (NMFS 2021b). Domestic landings in New Jersey and New York were approximately 62,822 and 8,716 metric tons in 2022, respectively, representing an approximate cumulative value of $180.7 million dollars (NMFS 2021c). Revenue in each state may be impacted by the fact that vessels may land commercial catch in any state they have a landing permit in, which can result in products being cross-docked and trucked to the vessel's home port or state.

The value of commercial landings in New England and Mid-Atlantic NMFS regions has been generally increasing since 2000, ranging from $986 million in 2001 to $1.9 billion in 2022 (NMFS 2021c). Commercial landings in the Mid-Atlantic are dominated by menhaden, a high-volume, low value fishery that typically accounts for 50 to 65 percent of the region's landings by weight, but less than 10 percent by value. An analysis of the landings of economically important species in the Mid-Atlantic other than menhaden showed a marked decline in landed weight, but an increase in ex-vessel landed value between 2002 and 2015 (King 2017). Table 3.6.1-2 and Table 3.6.1-3 show commercial fishing landings and revenue, respectively, by state for the New England, Mid-Atlantic, and South Atlantic (North Carolina only) regions for 2012 to 2022. While most of the revenue is derived from areas outside of the NY Bight lease areas, it is important to note that the geographic analysis area does include areas under jurisdiction of the NEFMC, MAFMC, SAFMC, and ASMFC. Table 3.6.1-4 shows commercial fishing landings and revenue for the top 10 species by landings for the states in the geographic analysis area for 2022. American lobster and sea scallops were the largest sources of revenue, with revenues of approximately $518.4 million and $75.5 million, respectively, while menhaden had the highest landings (176,783 metric tons) (Table 3.6.1-4). Appendix B, *Supplemental Information and Additional Figures and Tables,* Section B.8.2 provides an analysis of the percentage of each permit's total commercial fishing revenue attributed to catch from NMFS 2023h, 2023i, 2023j, 2023k, 2023l, 2023m.

Table 3.6.1-2. Landings (metric tons) for states in the geographic analysis area for years 2012 through 2022

State	2012 Landings	2013 Landings	2014 Landings	2015 Landings	2016 Landings	2017 Landings	2018 Landings	2019 Landings	2020 Landings	2021 Landings	2022 Landings
Maine	131,498	121,161	126,123	114,525	125,598	104,879	114,411	82,382	75,009	92,598	75,029
New Hampshire	5,511	3,745	4,140	5,032	3,600	4,899	4,591	5,999	5,142	5,784	5,266
Massachusetts	133,834	118,651	123,960	117,849	110,995	110,162	109,658	106,231	103,401	92,830	78,250
Rhode Island	38,662	40,756	41,632	34,351	37,508	38,010	36,788	35,744	33,349	33,068	26,910
Connecticut	4,055	3,609	3,406	4,259	5,510	4,613	5,204	4,169	3,161	3,036	3,211
New York	16,678	15,412	12,490	13,675	13,697	11,400	10,361	10,692	10,503	10,549	8,396
New Jersey	81,866	54,379	56,694	67,376	60,014	89,626	85,997	79,538	78,922	72,923	54,771
Pennsylvania	17	11	16	47	31	29	33	--	--	--	--
Delaware	2,558	1,836	1,690	1,601	2,578	2,304	2,396	2,719	2,393	2,627	2,338
Maryland	35,047	21,417	22,786	24,494	26,835	23,262	22,288	21,566	15,927	13,164	13,783
Virginia	209,766	173,082	176,524	185,139	164,187	153,594	164,562	177,937	145,995	158,875	156,038
North Carolina	25,716	22,769	27,725	29,649	27,525	24,196	20,314	23,590	19,035	18,662	15,390

-- = No data available.

Source: Developed using data from NMFS 2021c. Data current as of September 15, 2023.

Table 3.6.1-3. Revenue ($1,000s) for states in the geographic analysis area for years 2012 through 2022

State	2012 Revenue	2013 Revenue	2014 Revenue	2015 Revenue	2016 Revenue	2017 Revenue	2018 Revenue	2019 Revenue	2020 Revenue	2021 Revenue	2022 Revenue
Maine	530,634	478,938	595,715	628,922	735,666	577,504	645,970	658,761	518,648	953,788	575,268
New Hampshire	23,241	20,192	24,294	27,794	33,479	35,691	39,118	39,550	30,368	48,702*	37,246
Massachusetts	615,377	562,596	522,568	523,538	551,052	605,242	647,813	681,044	562,603	840,032	670,448
Rhode Island	81,136	86,063	86,432	82,080	94,899	101,962	105,122	109,306	78,435	109,875	107,101
Connecticut	21,128	14,629	14,089	15,782	15,006	13,808	16,540	16,601	20,288	15,603*	15,269
New York	55,063	57,322	56,800	69,171	52,582	46,788	46,864	42,176	34,299	40,609	37,420
New Jersey	187,697	131,492	149,354	166,267	191,027	184,611	169,845	181,728	216,985	220,533	124,727
Pennsylvania	123	84	117	125	231	215	251	--	--	--	--
Delaware	8,464	7,305	7,220	6,843	11,495	9,807	10,557	11,831	10,146	16,293	15,077
Maryland	84,390	81,137	92,262	88,394	91,040	81,717	72,178	78,273	68,024	68,893	70,769
Virginia	174,524	163,020	172,833	197,531	204,703	188,004	178,655	184,269	214,431	222,029	176,761
North Carolina	72,978	79,127	93,895	105,203	97,326	97,307	78,303	87,673	78,285	90,623	69,585

-- = No data available.

Source: Developed using data from NMFS 2021c. All data current as of September 15, 2023, except *, which is data current as of April 24, 2024.

Table 3.6.1-4. Top 10 species by landings weight from states in the geographic analysis area in 2022

Species	2022 Landings (metric tons)	2022 Revenue
Menhaden	176,783	$75,529,278
American lobster	54,569	$518,444,905
Species confidential	29,852	$126,325,515
Atlantic surf clam	23,398	$50,720,723
Blue crab	22,750	$99,601,973
Longfin squid	18,418	$60,625,928
Sea scallop	14,413	$479,642,041
Ocean quahog	13,714	$26,258,141
Goosefish	6,660	$12,943,510
Jonah crab	5,961	$21,920,442

Source: Developed using data from NMFS 2021c. Data current as of April 26, 2024.

Mobile and fixed gear types that are commonly used in the region of the six NY Bight lease areas are summarized from data sources and fisheries stakeholder engagement (data are associated with Lease Area OCS-A 0512) (Tetra Tech 2022). Mobile gear commonly used in the region includes otter trawls, mid-water trawls, purse seines, dredges, and rod and reel trolling. Fixed gear commonly includes lobster, whelk and crab pots, fish pots (primarily for black sea bass), and demersal gillnets. Table 3.6.1-5 summarizes commercial gear types that are commonly used in the region. There are seven Lobster Management Areas (LMA) in the region with varying fishing restrictions for trap limits, minimum/maximum sizes, gear requirements, and closed seasons. Any vessel with a federal lobster permit can fish in LMAs 1, 2, 3, 4, 5, and Outer Cape with gear other than traps but in order to trap fish in these LMAs, fishing vessels must have a permit based on historical fishing in that area (NMFS 2016a). In addition to LMAs there are four restricted areas that are alternatively closed to either trap or mobile gear on a seasonal basis. These areas were agreed upon by the mobile gear and trap fishers to reduce gear conflicts and run west to east along the 50 fathom contours, south of Rhode Island (NMFS 2014).

Table 3.6.1-5. Fishing gear types and seasons for the region of the NY Bight lease areas

Gear Type	Season(s)
Mobile Gear	
Otter trawl	Year-round
Mid-water trawl	Year-round
Pair trawl	Year-round
Scallop dredge	Year-round, first Monday in November through March 31 in New York state waters
Hydraulic clam dredge	Year-round
Rod and reel	Year-round, intensity increases April through November
Green stick	Year-round, intensity increases July through September for tuna
Fixed Gear	
Demersal gillnet	Year-round
Lobster pot	Year-round, June 1 to April 29 in New York state waters
Crab pot	Year-round
Fish/Whelk pot	Year-round

Source: Adapted from Tetra Tech (2022).

3.6.1.1.3 Commercial Fisheries in the NY Bight Lease Areas

This section summarizes NY Bight lease area-specific commercial fish landings and associated revenue by FMP fishery, gear type, and port of landing based on NMFS-prepared planning-level assessments, which describe selected fishery landings and estimates of commercial revenue from each of the NY Bight lease areas (NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g). These reports modeled results using Vessel Trip Report (VTR) and vessel logbook data to estimate catch and landings based on the percentage of a trip that overlapped with each lease area. It should be noted, however, that not all vessels are required to provide federal VTRs, including, for example, federal lobster vessels with only lobster permits or Atlantic HMS permitted vessels (NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g).

NMFS (2023b, 2023c, 2023d, 2023e, 2023f, 2023g) described the most impacted FMPs from each lease area, with "most impacted" meaning the FMP that provided the most revenue during the 14-year period from 2008 to 2021. The top five impacted FMPs for each of the NY Bight lease areas are listed in Table 3.6.1-6 by landings (pounds) and in Table 3.6.1-7 by revenue (data are only available through 2021). Sea scallops were the top revenue-producing species for all six NY Bight lease areas between 2008 and 2021, and the top species by landings for two of the six lease NY Bight lease areas (OCS-A 0544 and OCS-A 0538). The surf clam and ocean quahog were the top species by landings weight for the remaining four lease areas (Table 3.6.1-6). Other impacted FMPs include Atlantic Herring, Bluefish, Highly Migratory Species, Northeast Multispecies, Southeast Regional FMP, Atlantic States Marine Fisheries Commission FMP, Skates, Small-Mesh Multispecies, Spiny Dogfish, Tilefish, and the No Federal FMPs, which contain a variety of species that are not federally regulated (e.g., lobster, Jonah crab, smooth and chain dogfish, whelk, menhaden; NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g).

Table 3.6.1-6. Highest total landings by weight (in pounds) from 2008 to 2021 for the six NY Bight lease areas

Fishery Management Plan	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Sea Scallop	2,094,000	3,485,000	5,826,000	4,131,000	2,468,000	4,029,000
Mackerel, Squid, and Butterfish	1,668,000	2,935,000	3,215,000	1,780,000	504,000	875,000
Monkfish	259,000	--	307,000	71,000	72,000	56,000
Surfclam, Ocean Quahog	663,000	5,042,000	2,313,000	16,479,000	6,363,000	6,242,000
Summer Flounder, Scup, Black Sea Bass	264,000	1,154,000	662,000	584,000	194,000	287,000
Other impacted FMPs	2,702,000	3,055,000	3,039,000	1,436,000	576,000	568,000
All Others*	--	6,415,000	--	--	--	--
Total	**7,650,000**	**22,086,000**	**15,362,000**	**24,481,000**	**10,177,000**	**12,057,000**
Grand Total	**91,813,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g.

Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

-- = No data available. *Grouped confidential information.

Table 3.6.1-7. Highest total revenue from 2008 to 2021 for the six NY Bight lease areas

Fishery Management Plan	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Sea Scallop	$24,338,000	$39,624,000	$61,925,000	$43,425,000	$25,227,000	$41,731,000
Mackerel, Squid, and Butterfish	$587,000	$1,362,000	$1,250,000	$1,015,000	$375,000	$614,000
Monkfish	$515,000	--	$626,000	$194,000	$156,000	$141,000
Surfclam, Ocean Quahog	$715,000	$3,858,000	$1,838,000	$12,408,000	$5,096,000	$4,994,000
Summer Flounder, Scup, Black Sea Bass	$542,000	$2,075,000	$1,320,000	$1,217,000	$382,000	$567,000
Other impacted FMPs	$871,000	$1,154,000	$1,197,000	$563,000	$177,000	$193,000
All Others*	--	$5,381,000	--	--	--	--
Total	**$27,568,000**	**$53,454,000**	**$68,156,000**	**$58,822,000**	**$31,440,000**	**$48,240,000**
Grand Total	**$287,680,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

All revenue values have been deflated to 2021 dollars. Numbers are rounded to the nearest thousand.

-- = No data available.

*Grouped confidential information.

NMFS (2023b, 2023c, 2023d, 2023e, 2023f, 2023g) further analyzed the most impacted species in each of the NY Bight lease areas and separated them from combined FMPs. Table 3.6.1-8 and Table 3.6.1-9 present cumulative landings and revenue, respectively, for the most impacted species by lease area from 2008 to 2021. The highest landings varied somewhat by lease area, but were typically observed in catches of Atlantic herring, sea scallops, or surf clams. Revenue, however, was highest for sea scallop landings for all lease areas for the analyzed period, ranging from approximately $24.3 million for Lease Area OCS-A 0544 to approximately $61.9 million for Lease Area OCS-A 0538.

Table 3.6.1-8. Highest landings (pounds) by species from 2008 to 2021 for the six NY Bight lease areas

Species	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Sea scallop	2,094,000	3,485,000	5,826,000	4,131,000	2,468,000	4,029,000
Atlantic herring	2,045,000	2,536,000	2,536,000	--	--	--
Atlantic mackerel	1,440,000	2,277,000	2,692,000	1,022,000	--	--
Monkfish	259,000	117,000	307,000	71,000	72,000	56,000
Longfin squid	163,000	578,000	388,000	431,000	148,000	231,000
Scup	132,000	638,000	--	--	67,000	108,000
Summer flounder	81,000	329,000	251,000	229,000	82,000	112,000
Black sea bass	52,000	187,000	134,000	152,000	46,000	67,000
American lobster	--	--	86,000	--	--	--
Ocean quahog	--	734,000	--	674,000	936,000	1,576,000
Surf clam	98,000	--	1,434,000	15,469,000	4,931,000	3,654,000
Ilex squid	--	--	--	304,000	229,000	442,000
All others*	1,032,000	10,786,000	669,000	502,000	640,000	1,194,000

Species	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Total	**7,395,000**	**21,666,000**	**14,323,000**	**22,984,000**	**9,618,000**	**11,467,000**
Grand Total	**87,453,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

Numbers are rounded to the nearest thousand.

-- = No data available.

*Grouped confidential information.

Table 3.6.1-9. Revenue from the most impacted species from 2008 to 2021 for the six NY Bight lease areas

Species	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Sea scallop	$24,338,000	$39,624,000	$61,925,000	$43,425,000	$25,227,000	$41,731,000
Atlantic herring	$283,000	$339,000	$335,000	--	--	--
Atlantic mackerel	$315,000	$515,000	$625,000	$239,000	--	--
Monkfish	$515,000	$274,000	$626,000	$194,000	$156,000	$141,000
Longfin squid	$225,000	$788,000	$536,000	$585,000	$195,000	$308,000
Scup	$117,000	$519,000	--	--	$41,000	$69,000
Summer flounder	$246,000	$937,000	$676,000	$599,000	$203,000	$274,000
Black sea bass	$178,000	$618,000	$436,000	$480,000	$138,000	$224,000
American lobster	--	--	$463,000	--	--	--
Ocean quahog	--	$491,000	--	$592,000	$800,000	$1,407,000
Surf clam	$80,000	--	$1,074,000	$11,509,000	$3,832,000	$2,644,000
Ilex squid	--	--	--	$175,000	$141,000	$254,000
All others*	$1,026,000	$8,800,000	$595,000	$403,000	$541,000	$1,038,000
Total	**$27,323,000**	**$52,908,000**	**$67,291,000**	**$58,201,000**	**$31,274,000**	**$48,090,000**
Grand Total	**$285,087,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

All revenue values have been deflated to 2021 dollars. Numbers are rounded to the nearest thousand.

-- = No data available.

*Grouped confidential information.

For landings from fishing done within the six NY Bight lease areas, NMFS (2023b, 2023c, 2023d, 2023e, 2023f, 2023g) estimated the highest 14-year (2008 to 2021) landings (Table 3.6.1-10) and revenues (Table 3.6.1-11) by port. New Bedford, Massachusetts, had the highest revenue for the four northernmost lease areas in the NY Bight lease areas (OCS-A 0544, OCS-A 0537, OCS-A 0538, and OCS-A 0539), while Cape May, New Jersey, had the highest revenue for the two southernmost lease areas (OCS-A 0541 and OCS-A 0542). Overall, 14-year revenue for the NY Bight lease areas ranged from $25.6 million to $64 million, with a cumulative revenue of approximately $273.5 million.

Table 3.6.1-10. Total landings (pounds) by port from 2008 to 2021 for the six NY Bight lease areas

Port	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
New Bedford, MA	2,287,000	2,773,000	3,532,000	2,071,000	424,000	799,000
Point Pleasant, NJ	1,048,000	8,453,000	732,000	588,000	80,000	129,000
Cape May, NJ	1,286,000	1,234,000	3,582,000	1,849,000	1,200,000	1,827,000
Barnegat, NJ	430,000	473,000	1,277,000	893,000	362,000	310,000
Newport News, VA	164,000	199,000	508,000	496,000	414,000	818,000
Point Judith, RI	135,000	625,000	--	310,000	--	--
Point Lookout, NY	54,000	--	--	--	--	--
Atlantic City, NJ	335,000	3,780,000	2,268,000	16,248,000	6,535,000	6,297,000
Stonington, CT	38,000	133,000		--	--	--
Hampton, VA	--	176,000	257,000	215,000	166,000	204,000
Long Beach, NJ	--	--	119,000	81,000	62,000	37,000
Wildwood, NJ	--	--	73,000	--	45,000	43,000
All Others*	650,000	251,000	573,000	645,000	393,000	678,000
Total	**6,427,000**	**18,097,000**	**12,921,000**	**23,396,000**	**9,681,000**	**11,142,000**
Grand Total	**81,664,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

-- = No data available.

*Grouped confidential information.

Table 3.6.1-11. Total revenue by port from 2008 to 2021 for the six NY Bight lease areas

Port	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
New Bedford, MA	$9,610,000	$18,034,000	$19,536,000	$12,522,000	$3,272,000	$6,789,000
Total MA	**$9,610,000**	**$18,034,000**	**$19,536,000**	**$12,522,000**	**$3,272,000**	**$6,789,000**
Point Judith, RI	$396,000	$1,442,000	--	$519,000	--	--
Total RI	**$396,000**	**$1,442,000**	**--**	**$519,000**	**--**	**--**
Stonington, CT	$340,000	$1,148,000	--	--	--	--
Total CT	**$340,000**	**$1,148,000**	**--**	**--**	**--**	**--**
Point Lookout, NY	$337,000	--	--	--	--	--
Total NY	**$337,000**	**--**	**--**	**--**	**--**	**--**
Point Pleasant, NJ	$4,863,000	$9,896,000	$3,254,000	$2,123,000	$418,000	$580,000
Cape May, NJ	$4,329,000	$6,433,000	$11,805,000	$8,922,000	$7,713,000	$13,420,000
Barnegat, NJ	$3,079,000	$4,843,000	$13,086,000	$8,837,000	$3,211,000	$3,551,000
Point Judith, RI	$396,000	$1,442,000	--	$519,000	--	--
Point Lookout, NY	$337,000	--	--	--	--	--
Atlantic City, NJ	$362,000	$3,135,000	$2,106,000	$13,017,000	$7,610,000	$7,310,000
Stonington, CT	$340,000	$1,148,000	--	--	--	--
Long Beach, NJ	--	--	$1,213,000	$925,000	$626,000	$432,000
Wildwood, NJ	--	--	$765,000	--	$508,000	$474,000
Total NJ	**$12,633,000**	**$24,307,000**	**$32,229,000**	**$33,824,000**	**$20,086,000**	**$25,767,000**
Hampton, VA	--	$732,000	$2,044,000	$1,510,000	$1,266,000	$1,523,000
Newport News, VA	$1,683,000	$1,784,000	$4,811,000	$4,455,000	$3,429,000	$7,070,000
Total VA	**$1,683,000**	**$2,516,000**	**$6,855,000**	**$5,965,000**	**$4,695,000**	**$8,593,000**
All Others*	$637,000	$2,186,000	$5,458,000	$3,770,000	$2,637,000	$5,721,000

Port	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Total	$25,639,000	$49,633,000	$64,078,000	$56,600,000	$30,690,000	$46,870,000
Grand Total	**$274,510,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

All revenue values have been deflated to 2021 dollars. Numbers are rounded to the nearest thousand.

-- = No data available.

*Grouped confidential information.

3.6.2.1.3 Commercial Fishing Gear Types

NMFS also presented data on fishing gear types and their associated revenues used in the NY Bight lease areas between 2008 and 2021. Fishing gear types by landings weight in all six NY Bight lease areas were dominated by various trawls and dredges (Table 3.6.1-12). By revenue, scallop dredge was by far the type of gear that yielded the largest revenue in each of the NY Bight lease areas, ranging from a total of approximately $23.6 million to $61.7 million over 14 years (Table 3.6.1-13).

Table 3.6.1-12. Landings (pounds) by fishing gear type from 2008 to 2021 for the six NY Bight lease areas

Fishing Gear Type	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Trawl-Midwater	3,186,000	4,261,000	4,672,000	1,664,000	141,000	303,000
Dredge-Scallop	2,049,000	3,471,000	5,877,000	4,157,000	2,479,000	4,052,000
Dredge-Clam	1,100,000	11,481,000	2,325,000	16,555,000	6,392,000	6,263,000
Trawl-Bottom	955,000	2,590,000	1,903,000	1,727,000	721,000	1,176,000
Gillnet-Sink	251,000	77,000	289,000	33,000	12,000	1,000
Pot-Other	50,000	50,000	44,000	98,000	47,000	26,000
Pot-Lobster	15,000	95,000	180,000	69,000	5,000	7,000
Seine-Purse	--	--	--	--	--	---
Longline-Bottom	--	12,000	4,000	2,000	--	<500
Handline	--	1,000	3,000	--	--	--
Gillnet – Other	--	--	1,000	--	--	--
All Other*	43,000	49,000	64,000	175,000	379,000	228,000
Total	**7,651,000**	**22,087,000**	**15,361,000**	**24,480,000**	**10,177,000**	**12,057,000**
Grand Total	**91,810,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

Numbers are rounded to the nearest thousand.

-- = No data available.

*Grouped confidential information.

Table 3.6.1-13. Total revenue by fishing gear type from 2008 to 2021 for the six NY Bight lease areas

Fishing Gear Type	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
Trawl-Midwater	$508,000	$612,000	$734,000	$265,000	$20,000	$40,000
Dredge-Scallop	$23,616,000	$39,039,000	$61,792,000	$43,108,000	$25,017,000	$41,536,000
Dredge-Clam	$1,114,000	$9,451,000	$1,941,000	$12,732,000	$5,351,000	$5,182,000
Trawl-Bottom	$1,746,000	$3,808,000	$2,472,000	$2,323,000	$842,000	$1,346,000
Gillnet-Sink	$411,000	$136,000	$455,000	$33,000	$14,000	$1,000
Pot-Other	$75,000	$82,000	$122,000	$101,000	$45,000	$29,000
Pot-Lobster	$61,000	$217,000	$568,000	$170,000	$21,000	$22,000
Seine-Purse	--	--	--	--	--	--
Longline-Bottom	--	$45,000	$15,000	$10,000	--	$2,000
Handline	--	$5,000	$16,000	--	--	--
Gillnet – Other	--	--	$1,000	--	--	--
All Other*	$37,000	$57,000	$40,000	$81,000	$102,000	$81,000
Total	**$27,568,000**	**$53,453,000**	**$68,157,000**	**$58,822,000**	**$31,412,000**	**$48,240,000**
Grand Total	**$287,652,000**					

Source: Adapted from NMFS 2023b, 2023c, 2023d, 2023e, 2023f, 2023g. Data are for vessels issued federal fishing permits by the NMFS Greater Atlantic Region.

All revenue values have been deflated to 2021 dollars. Numbers are rounded to the nearest thousand.

-- = No data available.

*Grouped confidential information.

Commercial fishing regulations include requirements for vessel monitoring systems (VMS). A VMS is a satellite surveillance system that monitors the location and movement of commercial fishing vessels; therefore, it is a good data source for understanding the spatial distribution of fishing vessels engaged in FMP fisheries in the Northeast (Greater Atlantic) region. However, VMS coverage is not universal for all fisheries, with some fisheries (summer flounder, scup, black sea bass, bluefish, American lobster, spiny dogfish, skate, whiting, and tilefish) not covered at all by VMS. For activity histograms of non-VMS[2] fishery vessels, see Appendix B, *Supplemental Information and Additional Figures and Tables,* Section B.8.1.

Using VMS data conveyed in individual position reports (pings) from January 2014 to December 2021, BOEM compiled information about fishing activities within the NY Bight lease areas (NMFS 2021d). From the VMS data, it is interpreted that vessels with speeds less than 5 knots (9.3 kilometers per hour) are actively engaged in fishing, although vessels may also be using slower speeds to transit or be engaged in other activities such as processing at sea. Vessels traveling faster than 5 knots (9.3 kilometers per hour) are generally interpreted to be transiting. BOEM developed polar histograms using the VMS data that show the directionality of VMS-enabled vessels operating in the six NY Bight lease areas (Figure 3.6.1-2 through Figure 3.6.1-19). The larger bars in the polar histograms represent a greater number of position

[2] VMS coverage is not universal for all fisheries. Non-VMS data have declared as out of fishery, meaning they have declared out of a fishery managed by days-at-sea effort controls (i.e., scallops, Northeast multispecies, and monkfish).

reports showing fishing vessels moving in a certain direction within the project area. The polar histograms differ with respect to their scales.

Figure 3.6.1-2 through Figure 3.6.1-7 show all VMS activities (i.e., transiting and fishing combined), by course (i.e., north, south, east, west) for the Herring; Monkfish; Northeast Multispecies; Surfclam and Ocean Quahog; Squid, Mackerel, and Butterfish; and Atlantic Sea Scallop FMP fisheries for each lease area. The course varies by lease area and fishery.

A total of 534 vessels in the six fisheries used Lease Area OCS-0537 for transiting and/or active fishing in the 7-year period (2014–2021)[3]. In Lease Area OCS-0538 there were a total of 514 vessels in the six fisheries that used the area for transiting and/or active fishing in same period. A total of 480 vessels used Lease Area OCS-0539 for transiting and/or active fishing, while Lease Area OCS-0541 had 497 vessels transiting and/or actively fishing. Lease Areas OCS-0542 and OCS-0544 had 467 and 442 vessels using the areas, respectively.

Vessels transiting through the lease areas (Figure 3.6.1-8 through Figure 3.6.1-13) operated in all directions with the most prevalent directional pattern being east-west. Vessels actively fishing in the lease areas (Figure 3.6.1-14 through Figure 3.6.1-19) generally operated in an east-west direction with a secondary pattern of northeast-southwest direction, the exception being Lease Area OCS-0538 where a northwest-southwest direction was also used for active fishing. The scallop fishery was the fishery with the greatest number of unique vessels transiting and actively fishing in all of the lease areas, generally transiting east-west and actively fishing in an east-west and northeast-southwest pattern.

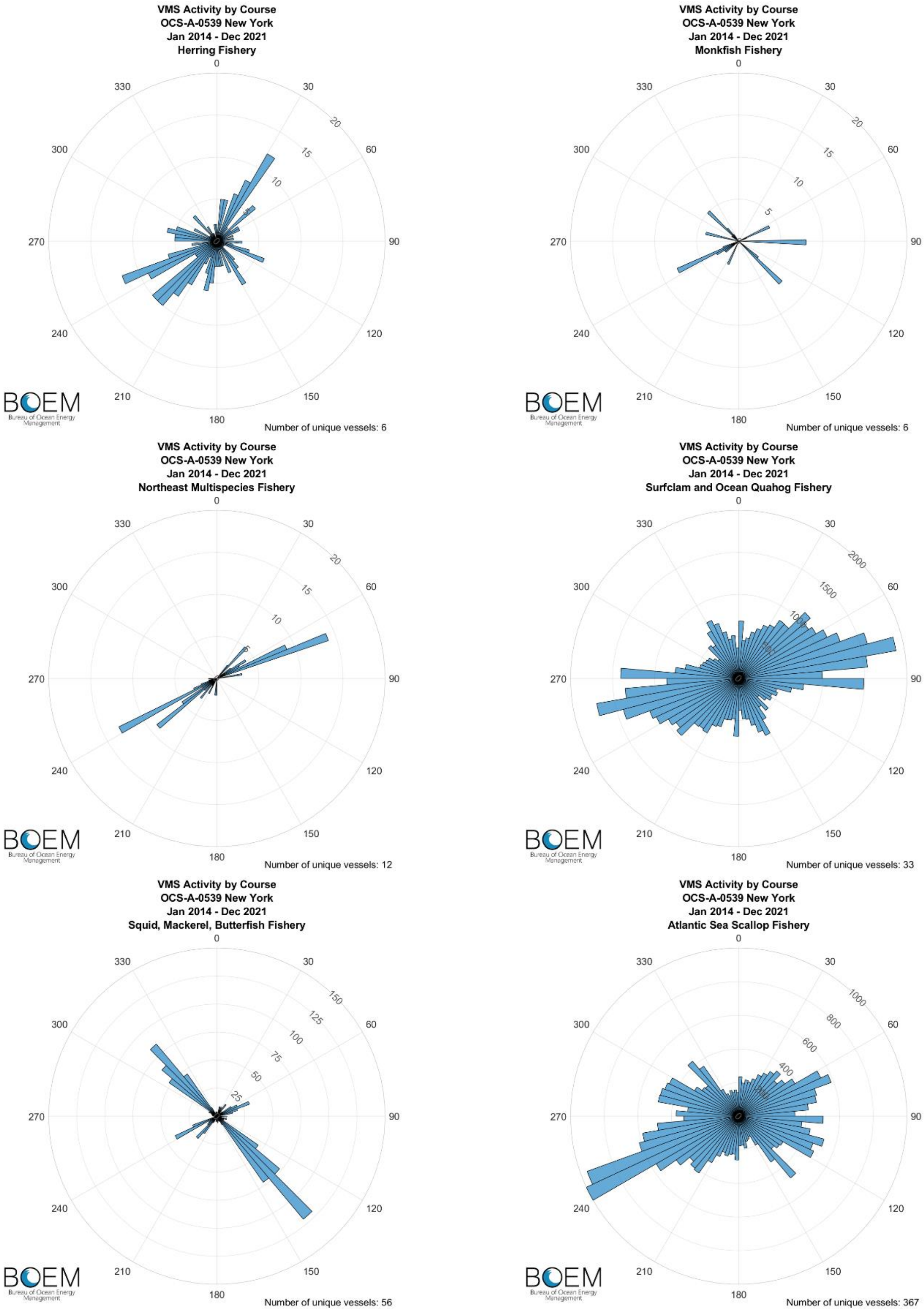
[3] During the processing of the raw VMS data, issues were discovered with the inaccurate coding of the vessel registration numbers within the relevant field(s). These fields either contained no information or information in clearly incorrect formats. These data were excluded/omitted from the vessel count analysis; therefore, the results do not fully capture the number of total vessels. Accordingly, there should be deliberative use of the vessel count values as they are only representative of the vessels operating in the lease area. Any use of this information should clearly caveat such as part of its findings.

Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-2. VMS bearings for VMS activity in Lease Area OCS-A 0537, January 2014–December 2021

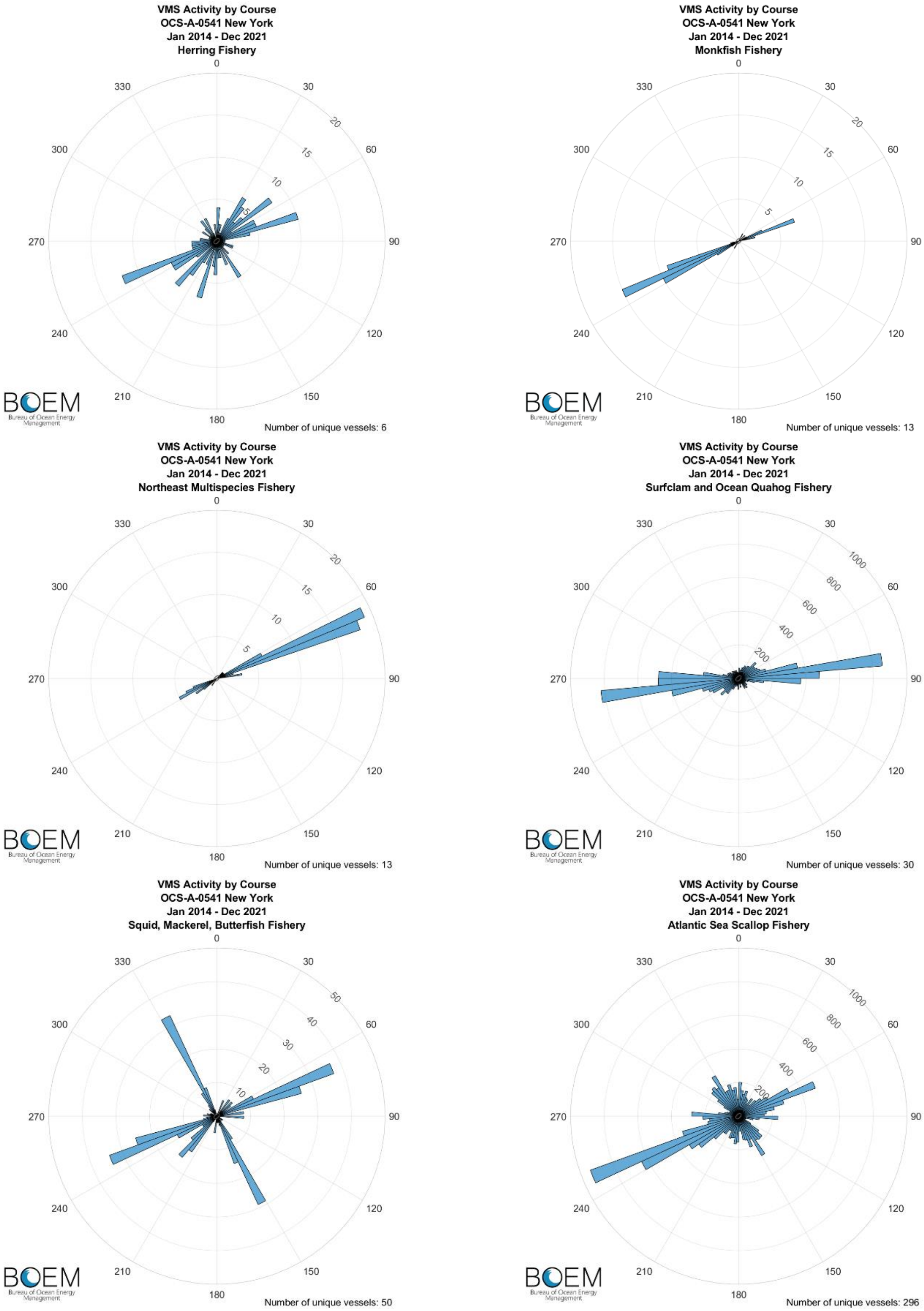
Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-3. VMS bearings for VMS activity in Lease Area OCS-A 0538, January 2014–December 2021



Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-4. VMS bearings for VMS activity in Lease Area OCS-A 0539, January 2014–December 2021



Source: Developed by BOEM using VMS data provided by NMFS (2021d).

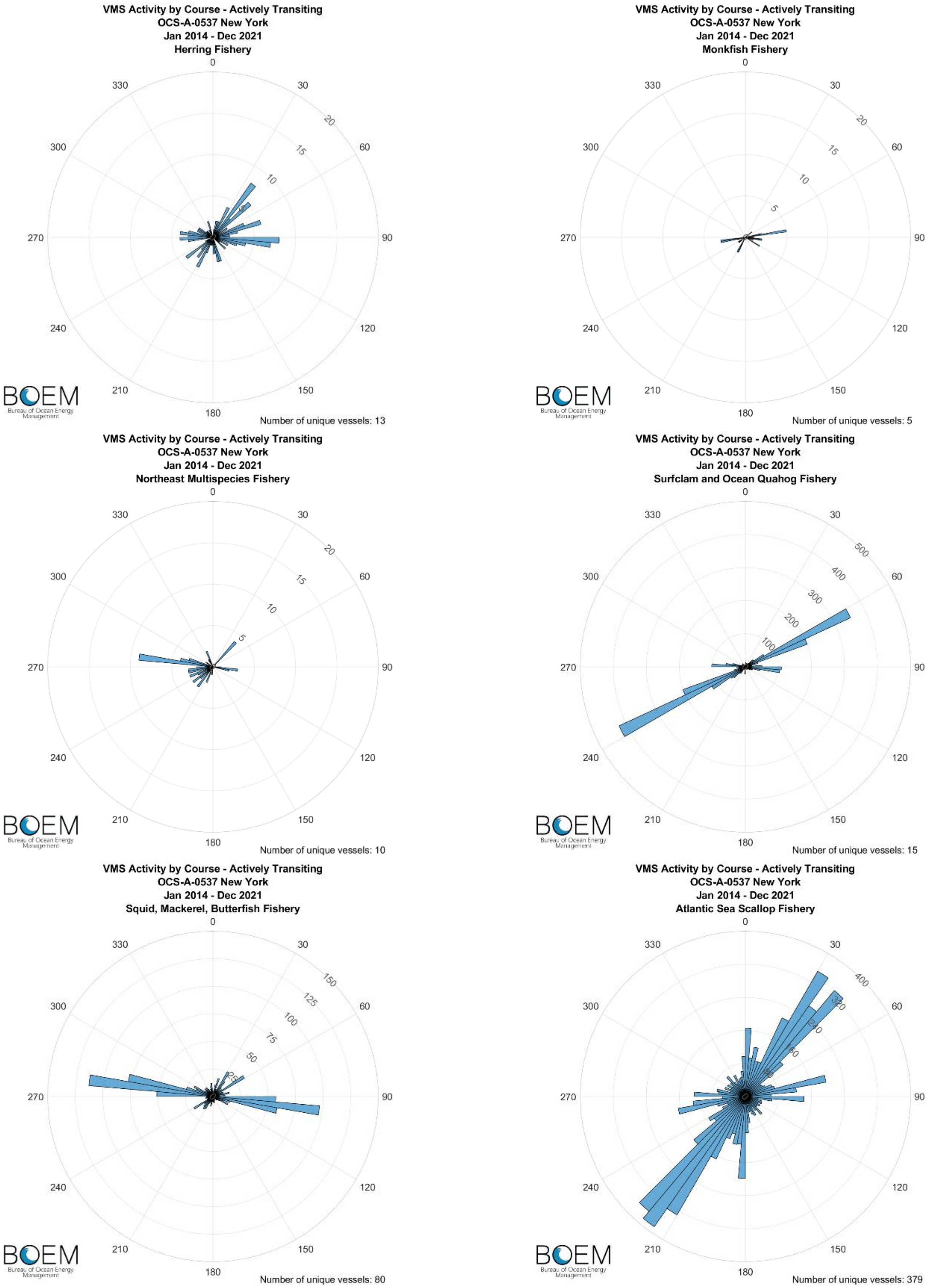
Figure 3.6.1-5. VMS bearings for VMS activity in Lease Area OCS-A 0541, January 2014–December 2021

Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-6. VMS bearings for VMS activity in Lease Area OCS-A 0542, January 2014–December 2021

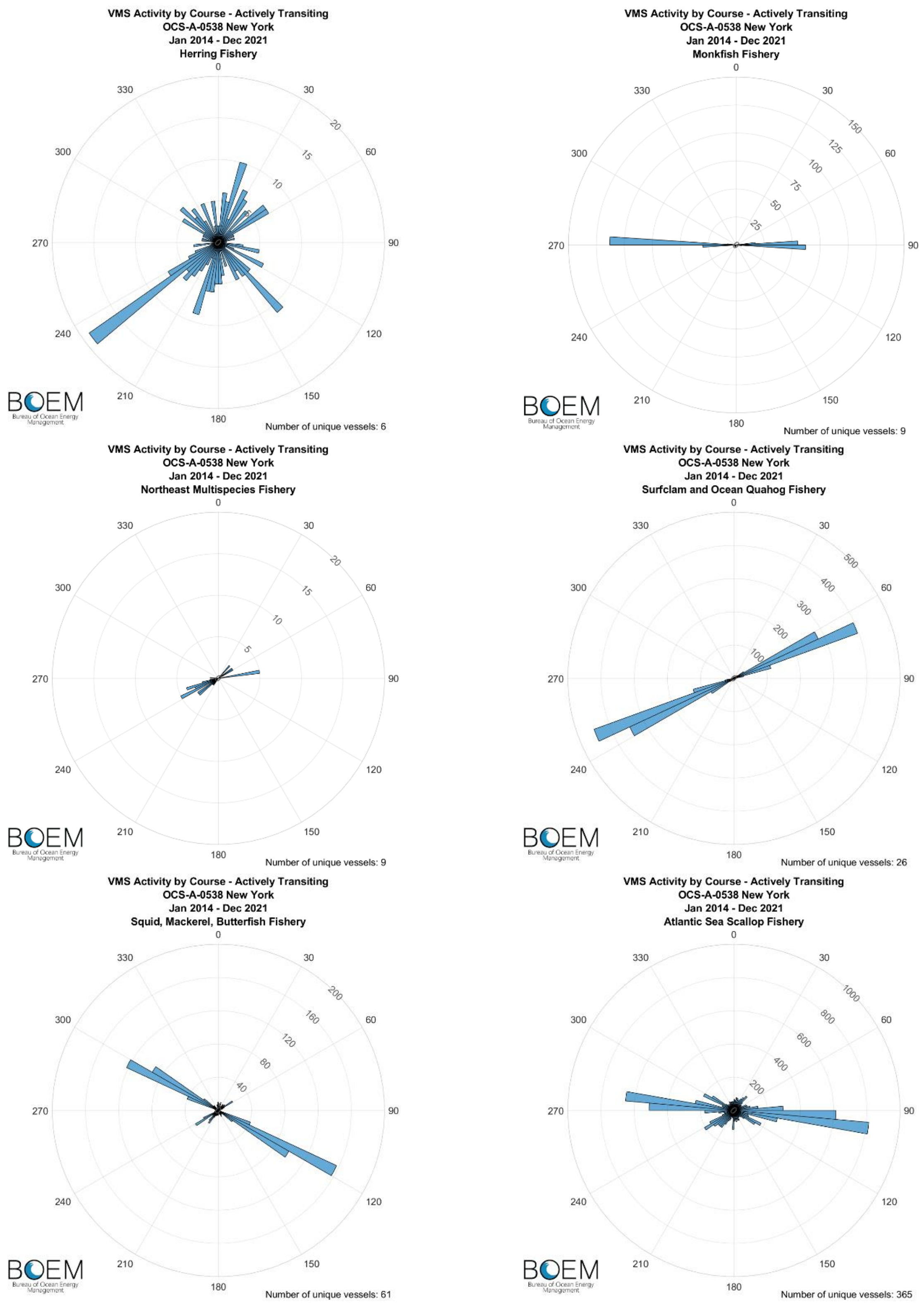
Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-7. VMS bearings for VMS activity in Lease Area OCS-A 0544, January 2014–December 2021



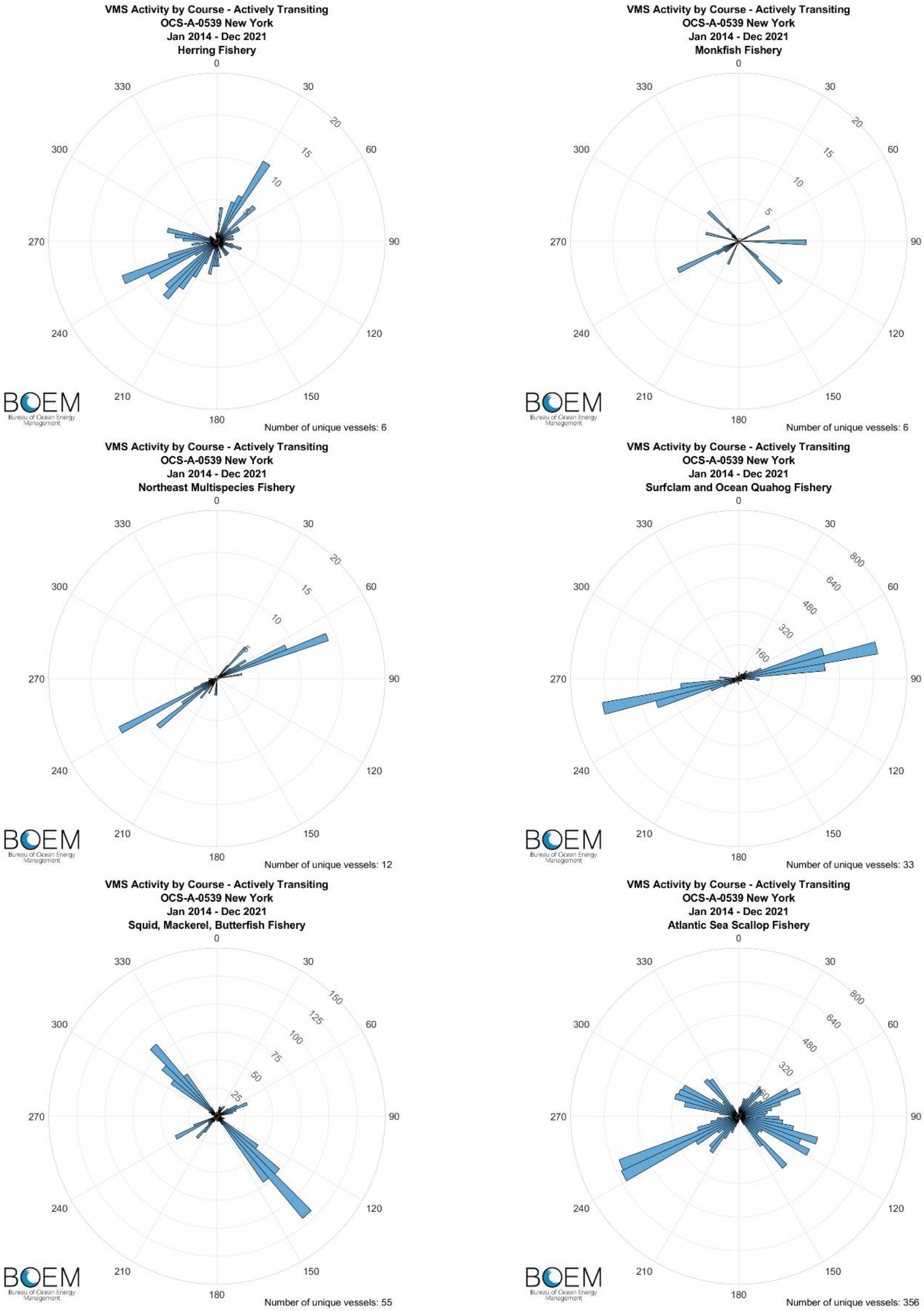
Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-8. VMS bearings for transiting VMS in Lease Area OCS-A 0537, January 2014–December 2021



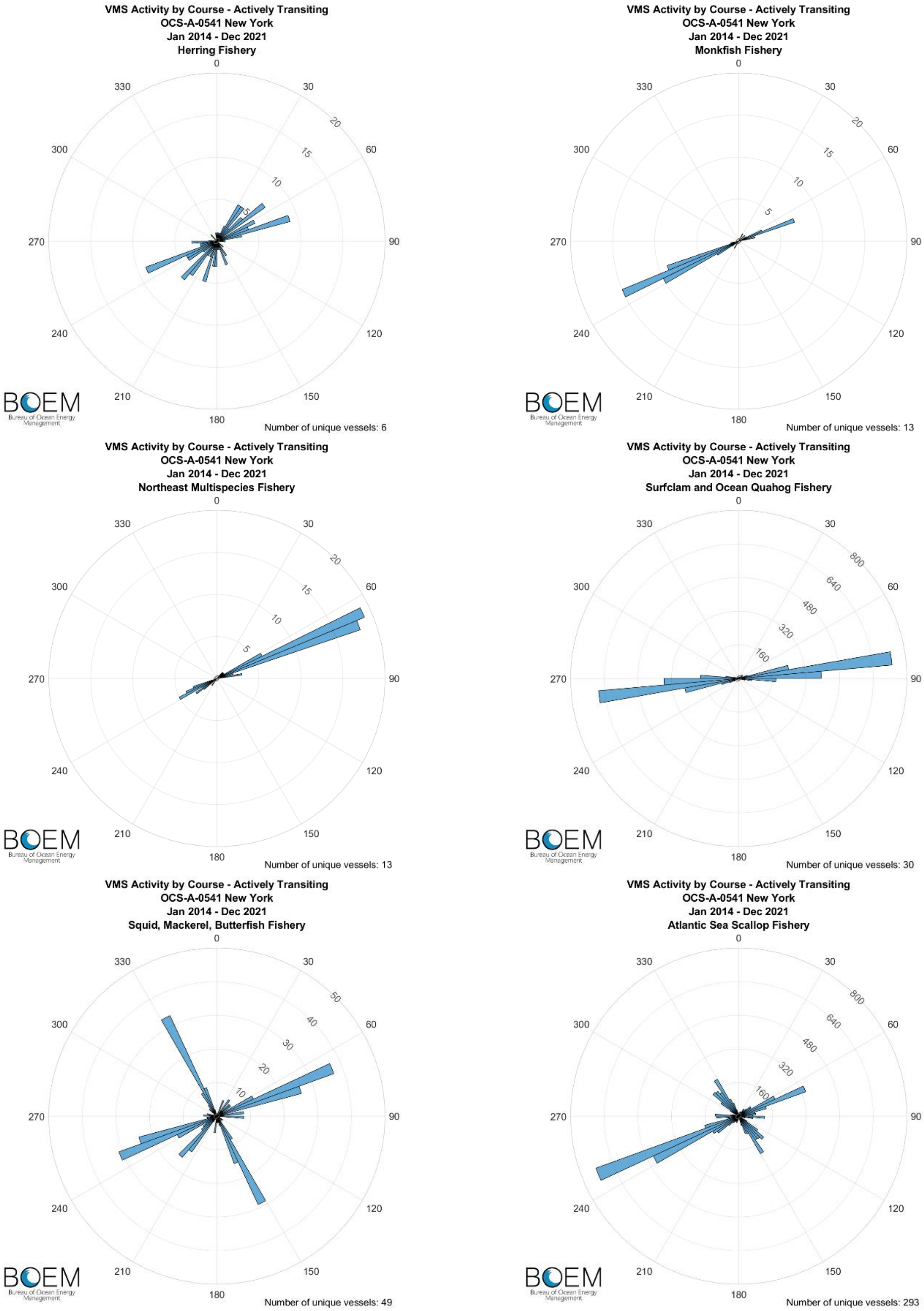
Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-9. VMS bearings for transiting VMS in Lease Area OCS-A 0538, January 2014–December 2021



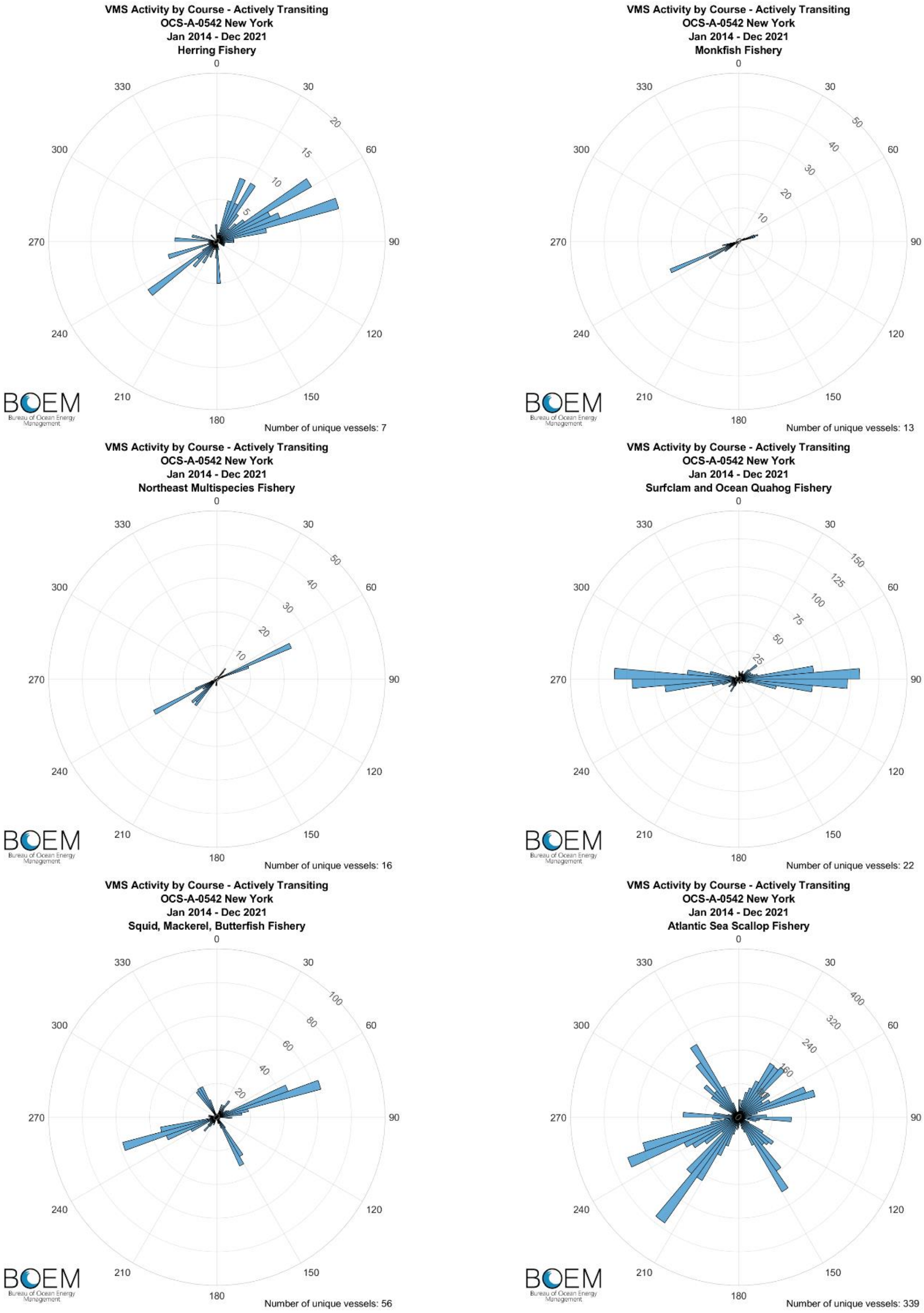
Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-10. VMS bearings for transiting VMS in Lease Area OCS-A 0539, January 2014–December 2021



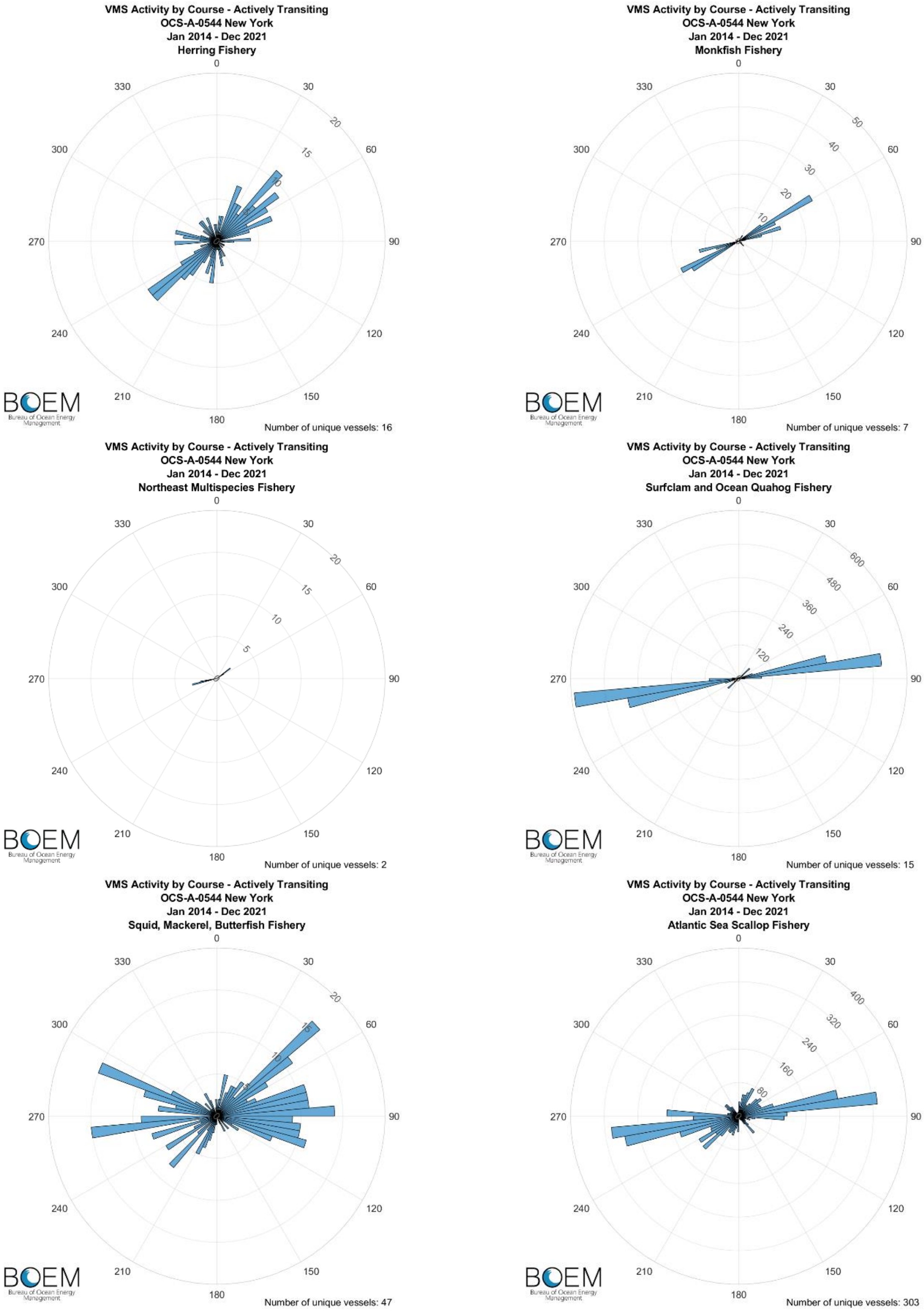
Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-11. VMS bearings for transiting VMS in Lease Area OCS-A 0541, January 2014–December 2021



Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-12. VMS bearings for transiting VMS in Lease Area OCS-A 0542, January 2014–December 2021



Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-13. VMS bearings for transiting VMS in Lease Area OCS-A 0544, January 2014–December 2021

Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-14. VMS bearings for fishing VMS in Lease Area OCS-A 0537, January 2014–December 2021

Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-15. VMS bearings for fishing VMS in Lease Area OCS-A 0538, January 2014–December 2021

Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-16. VMS bearings for fishing VMS in Lease Area OCS-A 0539, January 2014–December 2021

Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-17. VMS bearings for fishing VMS in Lease Area OCS-A 0541, January 2014–December 2021

Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-18. VMS bearings for fishing VMS in Lease Area OCS-A 0542, January 2014–December 2021

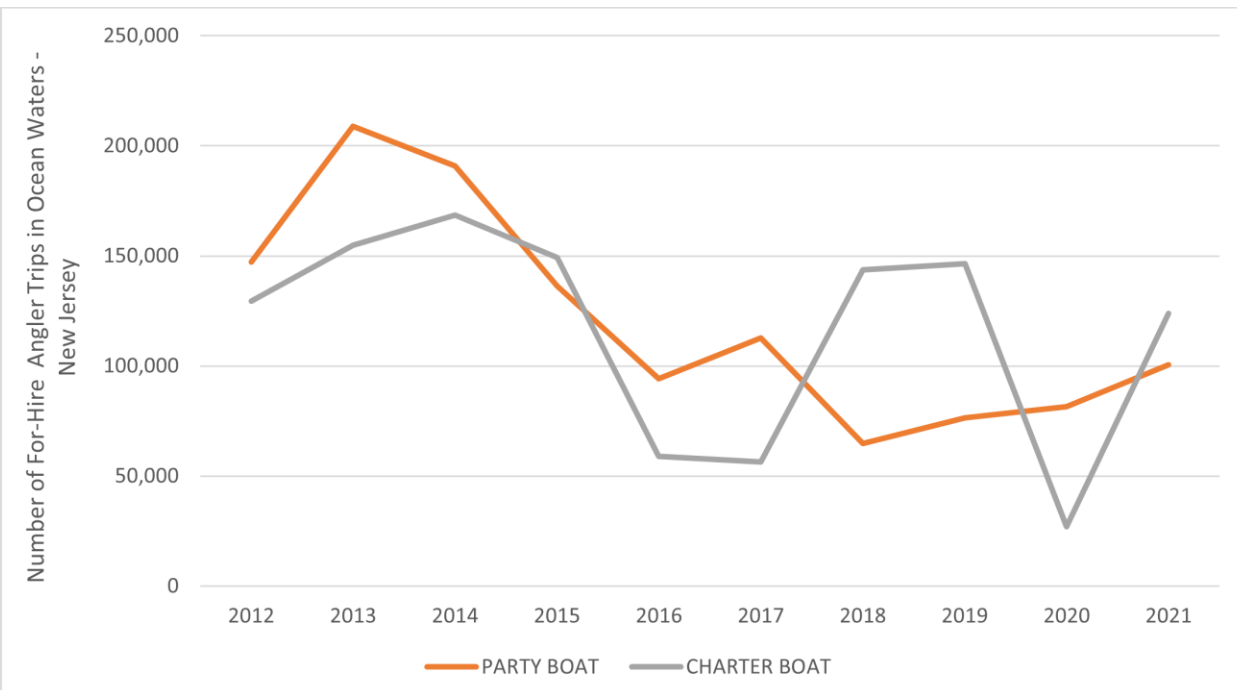
Source: Developed by BOEM using VMS data provided by NMFS (2021d).

Figure 3.6.1-19. VMS bearings for fishing VMS in Lease Area OCS-A 0544, January 2014–December 2021

3.6.1.1.4 For-Hire Recreational Fishing

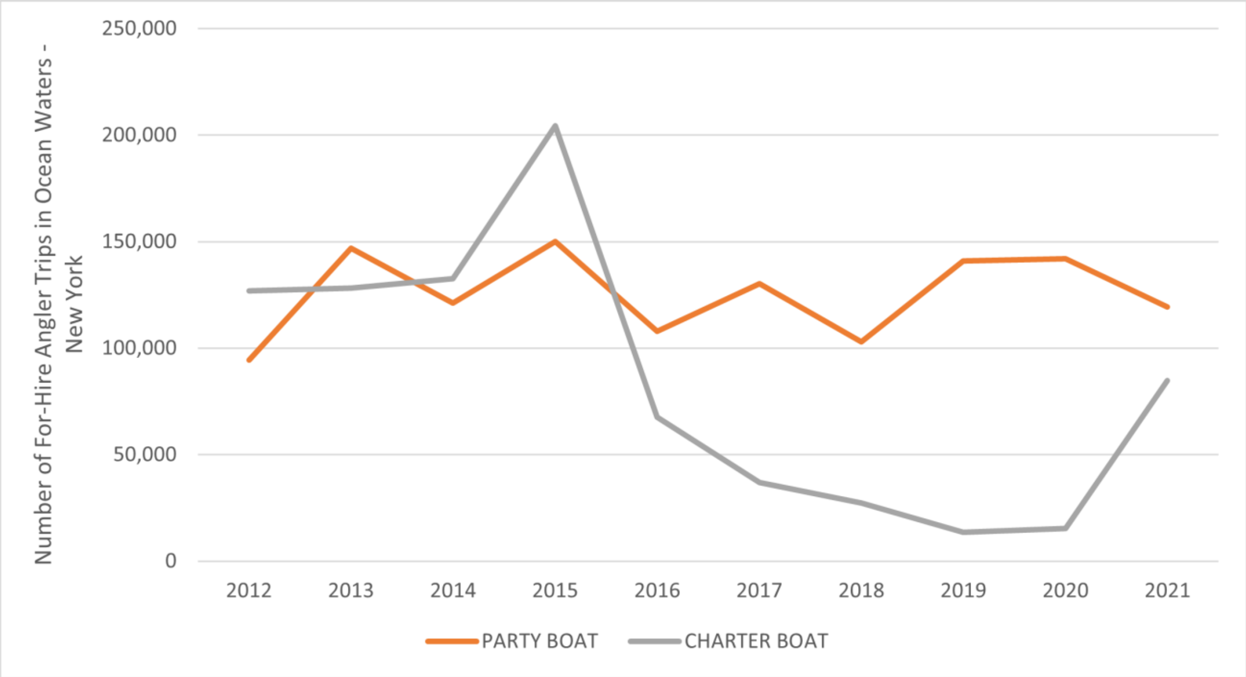
For-hire recreational fishing boats are operated by licensed captains for businesses that sell recreational fishing trips to anglers. These boats include both party (head) boats, defined as boats on which fishing space and privileges are provided for a fee, and charter boats, defined as boats operating under charter for a price, time, etc. and the participants are part of a preformed group of anglers. Private recreational fishing from shore or personal vessel is discussed in Section 3.6.8. For-hire recreational fishing in and around the NY Bight lease areas may occur year-round, but the majority of trips likely occur in the spring, summer, and fall seasons. The for-hire recreational fishing industry in New Jersey and New York is primarily made up of small- to medium-sized (i.e., 25- to 50-foot [8- to 15-meter]) vessels that are chartered for half-day or full-day trips. The majority of chartered fishing vessels that may utilize the NY Bight project area likely originate from the coast of New Jersey and various ports on the south coast of Long Island. Therefore, for the purposes of this PEIS, the affected environment for for-hire recreational fishing will focus on New Jersey and New York.

In the most recent year with available data (2021), there were approximately 100,000 party boat trips and approximately 124,000 charter boat trips in New Jersey. In New York, there were approximately 119,000 party boat trips and approximately 85,000 charter boat trips in 2021 (NMFS 2022a; Figure 3.6.1-20 and Figure 3.6.1-21).



Data source: NMFS 2022a. Data current as of November 21, 2022.

Figure 3.6.1-20. Number of for-hire recreational angler trips in New Jersey from 2012 to 2021



Data source: NMFS 2022a. Data current as of November 21, 2022.

Figure 3.6.1-21. Number of for-hire recreational angler trips in New York from 2012 to 2021

Target species for for-hire recreational anglers vary by location and fishing type, but include scup, summer flounder, sea robins, striped bass, tautog, bluefish, and others. Table 3.6.1-14 presents the top species by landings weight from for-hire recreational fishing trips in ocean waters for New Jersey and New York for 2021. Black sea bass and other sharks were the top species in New Jersey (approximately 362,000 and 328,000 pounds, respectively), while black sea bass and scup were the top species in New York (approximately 353,000 and 309,000 pounds, respectively) (NMFS 2022b). NMFS (2022c, 2022d, 2022e, 2022f, 2022g, 2022h) presents a planning-level assessment of recreational and charter vessel revenues, including a small business analysis for each of the six NY Bight lease areas. These data are incorporated by reference.

Table 3.6.1-14. For-hire recreational fish catch (pounds) from New Jersey and New York in 2021

New Jersey		New York	
Species	**2021 Total Catch (Pounds)**	**Species**	**2021 Total Catch (Pounds)**
Black sea bass	361,299	Black sea bass	352,828
Other sharks	327,754	Scup	309,243
Other tunas/mackerels	287,119	Striped bass	215,761
Summer flounder	226,367	Other tunas/mackerels	202,888
Striped bass	131,023	Summer flounder	135,484
Bluefish	129,802	Tautog	118,253
Red hake	55,156	Bluefish	59,910
Dolphin	40,585	Atlantic cod	19,018
Tautog	31,187	Red hake	18,446
Triggerfishes/filefishes	13,575	Dogfish	6,583
All other species	33,301	All other species	17,590

Data source: NMFS 2022b.

Data current as of February 15, 2023.

The total fish count kept by management category for for-hire and recreational fishing in the NY Bight lease areas varies between the lease areas (Table 3.6.1-15). The most impacted FMPs are the Summer Flounder, Scup, Black Sea Bass FMP; Highly Migratory Species FMP; Cod; Northeast Multispecies FMP; and the ASMFC Interstate FMP. The category "All Others" refers to categories with less than three permits impacted to protect data confidentiality. The ASMFC Interstate FMP includes species managed exclusively under an ASMFC Interstate FMP (American lobster, Atlantic croaker, cobia, red drum, black drum Spanish mackerel, spot, striped bass, spotted sea trout, tautog, weakfish, and coastal sharks). The Atlantic HMS FMP includes Atlantic billfish, Atlantic tunas, swordfish, and sharks (NMFS 2006, 2017). The Northeast Multispecies FMP includes bluefish, mackerel, squid, butterfish, and bolden and blueline tilefish. At the species level, the most impacted species includes cod in OCS-A 0544 (NMFS 2023h) and bluefin tuna, red hake, and black seabass in OCS-A 0538 (NMFS 2023j).

Table 3.6.1-15. Fish count of the most impacted species caught in for-hire and recreational fishing in the six NY Bight lease areas from 2008–2021

Management Category	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
All Others*	195	9,404	16,028	1,479	456	1,105
ASMFC Interstate FMP	--	9	--	--	--	--
Cod	68	--	--	--	--	--
Highly Migratory Species FMP	--	34	53	--	--	--
Northeast Multispecies FMP	--	--	28	--	--	--
Summer Flounder, Scup, Black Sea Bass, FMP	--	--	130	--	--	--
Total	**263**	**9,447**	**16,239**	**1,479**	**456**	**1,105**
Grand Total	**28,989**					

Source: Adapted from NMFS 2023h, 2023i, 2023j, 2023k, 2023l, 2023m. Data are vessel trip reports (VTR) for vessels issued a party/charter permit by the NMFS Greater Atlantic Region, and from marine angler expenditure surveys.

-- = No data available.

*Grouped confidential information.

NMFS conducted a small business analysis to characterize the amount of for-hire and recreational fishing revenue from a lease area that is generated by small businesses. A small business is independently owned and operated, is not dominant in its field of operation (including its affiliates), and has combined annual receipts not in excess of $8 million for all its affiliated operations worldwide. Small Business Administration principles of affiliation are used to define a business entity, meaning the following analysis is conducted upon unique business interests, which can represent multiple vessel permits (NMFS 2023h, 2023i, 2023j, 2023k, 2023l, 2023m). The number of small businesses engaged in for-hire and recreational fishing and the revenue of those businesses from 2019 through 2021 for the six NY Bight lease areas are summarized in Table 3.6.1-16. In 2019 and 2020, the small business revenue from within Lease Areas OCS-A 0537 and OCS-A 0538 contributed a substantial amount of the total revenue from small businesses active within the lease areas.

Table 3.6.1-16. Small business revenue as a proportion of the total revenue across all business entities inside the NY Bight lease areas

Year	OCS-A 0544	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542
2019	$1,437,000	--	$1,831,000	--	--	--
2020	--	--	$8,000	--	--	--
2021	--	$40,000	<$500	--	--	--

Source: Adapted from NMFS 2023h, 2023i, 2023j, 2023k, 2023l, 2023m. Data are vessel trip reports (VTR) for vessels issued a party/charter permit by the NMFS Greater Atlantic Region, and from marine angler expenditure surveys.

The information reported for 2020 should be interpreted with caution due to the generalized impacts the COVID-19 pandemic had on passenger demand for party/charter trips across many fisheries in the Greater Atlantic Region resulting in an unusually low number of angler trips, hence reduced revenues from passenger fees for affected party/charter entities.

-- = No data available.

All revenue values have been deflated to 2019 dollars.

Artificial reefs are often key locations for anglers during tournaments, as well as during regular non-tournament charter trips. While there are no known artificial reefs in any of the NY Bight lease areas, New Jersey has designated 17 artificial reefs and New York has designated 12 (Figure 3.6.1-22). The composition of the artificial reefs varies, but include, for example, sunken ships and vehicles, dredge rock, subway cars and concrete structures. The reefs are known havens for a variety of fish species, including bluefish, scup, cunner, gray triggerfish, black sea bass, summer flounder, and tautog (NJDEP 2019). Eight of the 12 artificial reefs in New York are located in the Atlantic Ocean on the south side of Long Island, while two are located in Great South Bay and two are located in Long Island Sound (NYSDEC 2022). Figure 3.6.1-22 presents the location of the New Jersey and New York artificial reefs relative to the NY Bight lease areas and popular charter fishing areas based on NMFS (2016b) VTR data from 2011 to 2015 (NMFS 2016b). Based on NMFS (2016b) data, there is no substantial for-hire recreational fishing activity in any of the six NY Bight lease areas, with activity instead focused in nearshore areas off the coast of central New Jersey, near artificial reefs, and along the southern coast of Long Island, New York (Figure 3.6.1-22). However, for-hire recreational fishing trips do target HMS (tunas, sharks, swordfish, and billfish) as far as the continental shelf break and Gulf Stream. Most for-hire recreational fishing in the NY Bight area involves rod and reel fishing. Rod and reel fishing techniques include bait fishing, bottom jigging, casting lures, fly fishing, and trolling.

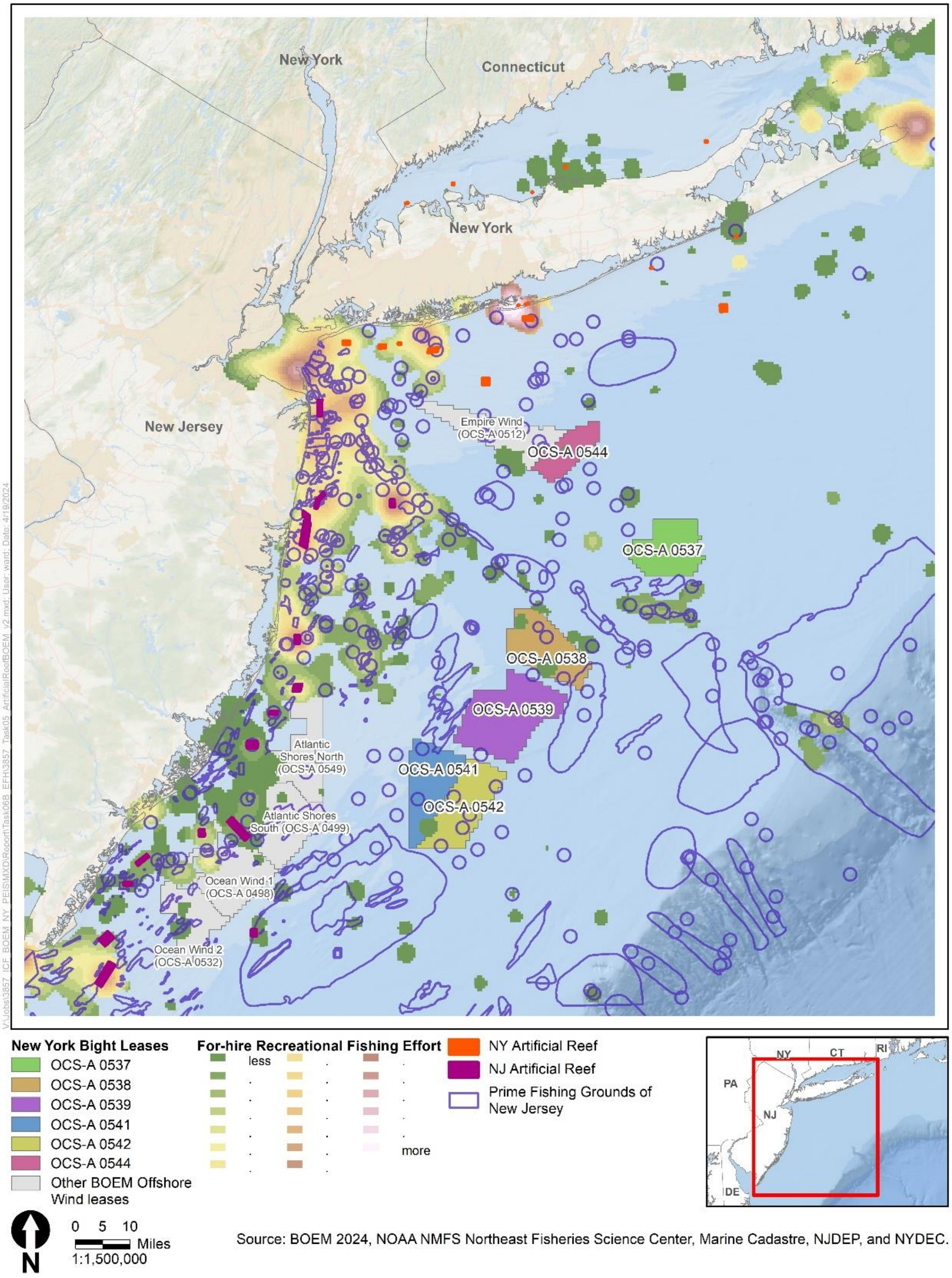


Figure 3.6.1-22. Location of artificial reefs and for-hire recreational fishing areas offshore New Jersey and New York relative to the six NY Bight lease areas

3.6.1.2 Impact Level Definitions for Commercial Fisheries and For-Hire Recreational Fishing

Definitions of adverse impact levels are provided in Table 3.6.1-17. Beneficial impacts on commercial fisheries and for-hire recreational fishing are described using the definitions described in Section 3.3.2 (see Table 3.3-1).

Table 3.6.1-17. Adverse impact level definitions for commercial fisheries and for-hire recreational fishing

Impact Level	Definition
Negligible	There would be no measurable impacts, or impacts would be so small that they would be extremely difficult or impossible to discern or measure.
Minor	Adverse impacts would not disrupt the normal or routine functions of the affected activity or community. Once the impacting agent is eliminated, the affected activity or community would return to a condition with no measurable effects.
Moderate	The affected activity or community would have to adjust somewhat to account for disruptions due to impacts of the project. Once the impacting agent is eliminated, the affected activity or community would return to a condition with no measurable effects if proper remedial mitigation is taken.
Major	The affected activity or community would experience substantial disruptions. Once the impacting agent is eliminated, the affected activity or community could continue to experience measurable effects indefinitely, even if remedial action is taken.

Anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and vessel traffic are contributing IPFs to impacts on commercial fisheries and for-hire recreational fishing. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.6.1-18.

Table 3.6.1-18. Issues and indicators to assess impacts on commercial fisheries and for-hire recreational fishing

Issue	Impact Indicator
Port access	Vessel traffic congestion and reduced access to high-demand port services, which could result in higher costs for such services; displacement to other primary or landing ports.
Fishing access	Increased operating costs (e.g., additional fuel to arrive at more distant locations; additional crew/observer compensation and higher monitoring costs due to more days at sea; inefficient use of days-at-sea effort controls; increased search times due to reduced familiarity of accessible fishing grounds); lower revenue (e.g., less-productive area, less-valuable species, lower catch rates, lower product quality); increased conflict among fishermen; avoidance of area by fishermen because of safety concerns or noise; decreased permit value due to limited access and reduced fishery landings revenue potential; loss of fishing are due to protection measures; temporary displacement due to surveys, construction, maintenance, and decommissioning.
Loss of or damage to fishing gear	Costs of gear repair or replacement; lost fishing revenue while gear is being repaired or replaced.
Change in distribution and subsequent catch of target species	Change in revenue due to change in abundance, distribution, and mortality of target species resulting from habitat alteration, changes to oceanographic processes (flow, temperature, nutrient/prey mixing), presence of structures (reef effect), predator/prey interactions, construction and operational noise above established behavioral effects and mortality thresholds, or other quantifiable effects as noted in Section 2.5 (Tables 1-4) in the Construction and Operations Plan Modeling Guidelines.[1]

Issue	Impact Indicator
Social and cultural impacts	Assessment of impacts on the well-being of fishing communities (place-based and activity level communities, families, individuals); community dependence; increased stakeholder pressure; social stratification and change in ownership patterns; fisheries participation and employment structure; access to social capital; impacts on identity and livelihoods.
Shoreside business impacts	Impacts on shoreside support businesses (e.g., revenue, employees, displacement).

[1] https://www.boem.gov/renewable-energy/boemoffshorewindpiledrivingsoundmodelingguidance.

3.6.1.3 Impacts of Alternative A – No Action – Commercial Fisheries and For-Hire Recreational Fishing

When analyzing the impacts of the No Action Alternative on commercial fisheries and for-hire recreational fishing, BOEM considered the impacts of ongoing activities, including ongoing non-offshore-wind and ongoing offshore wind activities on the baseline conditions for commercial fisheries and for-hire recreational fishing. 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, which are described in Appendix D, *Planned Activities Scenario*.

3.6.1.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for commercial fisheries and for-hire recreational fishing described in Section 3.6.1.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and management, 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 commercial fisheries and for-hire recreational fishing are generally associated with activities that limit the areal extent of where fishing can occur. This includes tidal energy projects, military use, dredge material disposal, and sand borrowing operations; increased vessel congestion that can pose a risk for collisions or allisions; dredging and port improvements, marine transportation, and oil and gas activities; or activities that pose a risk for gear entanglement such as undersea transmission lines, gas pipelines, and other submarine cables. Existing undersea transmission lines, gas pipelines, and other submarine cables are generally indicated on nautical charts and may also cause commercial fishermen to avoid the areas to prevent the risk of gear entanglement. Some of these activities may also result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality, resulting in a less-productive fishery or causing some vessel operators to seek alternate fishing grounds, target a different species, or switch gear types. If these risks result in a decrease in catch or increase in fishing costs, the profitability of businesses engaged in commercial fisheries and for-hire recreational fishing would be adversely affected.

Activities of NMFS and regional fishery management councils could affect commercial and for-hire recreational fisheries through stock assessments (and potential setting of quotas) and implementing fishery management plans to ensure the continued existence of species at levels that will allow commercial and for-hire recreational fisheries to occur. Ongoing commercial and recreational regulations for finfish and shellfish implemented and enforced by state, regional, or federal agencies may affect commercial fisheries and for-hire recreational fishing by modifying the nature, distribution, and intensity of fishing-related impacts.

Commercial and for-hire recreational fisheries would also be affected by climate change primarily through ocean acidification, ocean warming, sea level rise, and increases in both the frequency and magnitude of storms, which could lead to altered habitats, altered fish migration patterns, changes in species abundance and distribution, increases in disease frequency, and safety issues for conducting fishing operations.

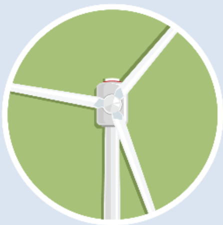
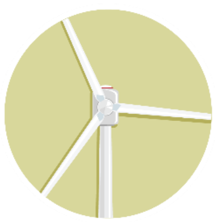
Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on commercial and for-hire recreational fisheries are listed in Table 3.6.1-19. Ongoing O&M of the Block Island and Coastal Virginia Offshore Wind Pilot projects and ongoing construction of the Vineyard Wind 1 (OCS-A 0501), South Fork Wind (OCS-A 0517), Ocean Wind 1 (OCS-A 0498), Revolution Wind (OCS-A 0486), Sunrise Wind (OCS-A 0487), Empire Wind 1 and 2 (OCS-A 0512), New England Wind Phase 1 and 2 (OCS-A 0534), and CVOW-C (OCS-A 0483) projects would affect commercial fishing and for-hire recreational fishing through the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures (resulting in loss of fishing grounds via exclusion), and traffic. Ongoing offshore wind activities would have the same types of impacts that are described in detail in Section 3.6.1.3.2, *Cumulative Impacts of the No Action Alternative,* but the impacts would be of lower intensity.

3.6.1.3.2 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 NY Bight projects). Other planned non-offshore-wind activities that may affect commercial fisheries and for-hire recreational fishing include tidal energy projects, military use, dredge material disposal, and sand borrowing operations; increased vessel congestion that can pose a risk for collisions or allisions; dredging and port improvements, marine transportation, and oil and gas activities; or activities that pose a risk for gear entanglement such as undersea transmission lines, gas pipelines, and other submarine cables. See Appendix D for a description of planned activities. These activities may result in bottom disturbance or habitat conversion that may alter the distribution of fishery-targeted species and increase individual mortality, resulting in a less-productive fishery.

Table 3.6.1-19 lists the ongoing and planned offshore wind activities in the geographic analysis area for commercial fisheries and for-hire recreational fishing.

Table 3.6.1-19. Ongoing and planned offshore wind in the geographic analysis area for commercial fisheries and for-hire recreational fishing

Ongoing/Planned	Projects by Region
Ongoing – 12 projects[1] 	**MA/RI** • Block Island (State waters) • Vineyard Wind 1 (OCS-A 0501) • South Fork Wind (OCS-A 0517) • Revolution Wind (OCS-A 0486) • Sunrise Wind (OCS-A 0487) • New England Wind (OCS-A 0534) Phase 1 • New England Wind (OCS-A 0534) Phase 2 **NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512) **VA/NC** • CVOW-Pilot (OCS-A 0497) • CVOW-Commercial (OCS-A 0483)
Planned – 16 projects[2] 	**MA/RI** • SouthCoast Wind (OCS-A 0521) • Beacon Wind 1 (OCS-A 0520) • Beacon Wind 2 (OCS-A 0520) • Bay State Wind (OCS-A 0500) • OCS-A 0500 remainder • OCS-A 0487 remainder • Vineyard Wind Northeast (OCS-A 0522) **NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499) **DE/MD** • Skipjack (OCS-A 0519) • US Wind/Maryland Offshore Wind (OCS-A 0490) • GSOW I (OCS-A 0482) • OCS-A 0519 remainder **VA/NC** • Kitty Hawk North (OCS-A 0508) • Kitty Hawk South (OCS-A 0508)

CVOW = Coastal Virginia Offshore Wind; DE = Delaware; GSOE = Garden State Offshore Energy; MA = Massachusetts; MD = Maryland; NC = North Carolina; NJ = New Jersey; NY = New York; RI = Rhode Island; VA = Virginia

[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.

[2] Status as of September 20, 2024.

BOEM expects ongoing and planned non-offshore-wind and offshore wind activities to affect commercial fisheries and for-hire recreational fishing through the following primary IPFs.

Anchoring: Anchoring could pose a localized (within a few hundred feet of anchored vessels), temporary (hours to days) navigational hazard to fishing vessels. There would be an increase in vessel anchoring during survey activities and during the construction and installation of offshore components as a result of future offshore wind activities. Spud barges and jack-up vessels could have short-term impacts on the seafloor. Bathymetric surveys one year after construction activities of the Block Island Wind Farm indicated that 46 percent of the seafloor area that was disturbed (e.g., spuds, anchor drag) recovered to the point that it was no longer discernable from baseline surveys (HDR 2018). However, the location and level of these impacts would depend on specific locations and duration of activity; the use of vessels equipped with dynamic positioning would lessen this impact. There could be increased anchoring associated with the installation of met towers or buoys that would have the potential to affect commercial fisheries or for-hire recreational fishing charters. The footprint of each anchoring would be relatively small and of short duration and would represent a negligible cumulative impact for commercial fisheries and for-hire recreational fishing.

Cable emplacement and maintenance: This IPF could cause localized, short-term impacts including disrupting fishing activities during active installation and maintenance or periods during which the cable is exposed on the seabed prior to burial (if simultaneous lay and burial techniques are not used). Although the offshore wind projects listed in Appendix D are currently at various stages in the process, BOEM does anticipate some simultaneous emplacement activities. This will result in a disturbed footprint that will vary in scale and location over the course of the development of the offshore wind projects. Prior to cable installation, seabed preparation activities—including boulder and sand wave clearance, UXO clearance, and pre-lay grapnel runs—may be required. Details about these activities will be provided at the project-specific NEPA stage. Fishing vessels may not have access to affected areas, in whole or in part, over various durations during the installation and operation period, which could lead to reduced revenue, displacement, or increased conflict over other fishing grounds. Because most construction activities would likely take place in more favorable conditions (i.e., late spring through early fall), fisheries and fishery resources most active during that period would likely be affected more than those in the winter (e.g., the longfin squid fishery). The localized commercial and for-hire recreational fishing industries proximal to the offshore export cable corridor landing sites would also be disproportionately affected by emplacement activities. Therefore, impacts from cable emplacement and maintenance, while locally intense, are expected to have minor cumulative impacts on commercial fisheries and for-hire recreational fishing.

Noise: Noise from construction, site assessment and monitoring G&G survey activities, O&M, pile-driving, trenching, and vessels could cause temporary impacts on commercial fisheries and for-hire recreational fishing through direct effects on species (Popper and Hastings 2009). The most impactful noise on commercial fisheries and for-hire recreational fishing is expected to result from pile-driving, which can cause behavioral changes, injury, and mortality (Popper et al. 2014). Noise from impact pile-driving is transmitted through the water column to the seafloor and could cause short-term stress and behavioral changes to individuals near the pile-driving activity. The extent depends on pile size, hammer energy, and local acoustic conditions. Most impacts would be short term and behavioral in nature, with most finfish species avoiding the noise-affected areas. Invertebrates may exhibit stress and behavioral changes, such as discontinuation of feeding activities. For example, scallops showed intensity and frequency-dependent responses to pile-driving sounds, with higher valve closures to lower frequencies and higher sound levels, and particularly stronger responses for juveniles (Jézéquel et al. 2022, 2023). However, the exposure to sound levels from pile-driving is expected to be temporary, as fish are expected to resume normal behaviors following the completion of pile-driving (Krebs et al. 2016; Shelledy et al. 2018). Noise impacts are also anticipated from operational WTGs; however, these are anticipated to occur at relatively short distances from the WTG foundations. Research has documented that fishes exposed to sustained anthropogenic noise respond in their own species-specific manner, potentially producing disruption in social interactions, hearing loss, increase in the calling amplitude (Holt and Johnston 2014), and a rise in noise-induced stress (Debusschere et al. 2016; Popper and Hastings 2009). Fishes with strong social cohesion are likely to be particularly vulnerable to loud and sustained anthropogenic noise (Popper and Hastings 2009; Sueur and Farina 2015). In particular, vocalizations of sound-producing fish species that produce well-organized chorusing patterns in the low-frequency range (50–5000 Hz) could be masked by the noise produced by operational turbines. Although there is little available information to suggest that such noise would negatively affect fishery resources on a broad scale (English et al. 2017), the combined cumulative impacts from underwater noise from wind turbines could result in fishery-level impacts. Additional information on potential impacts from various noise sources on finfish is presented in Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat.* Impacts on commercial fisheries and for-hire recreational fishing from noise related to ongoing and planned non-offshore-wind and offshore wind activities are expected to be negligible to minor.

Port utilization: Ports are largely privately owned or managed businesses that are expected to compete against each other for offshore wind business. Various ports along the east coast of the United States could be used to support offshore wind energy construction and operations for ongoing and planned offshore wind activities. Port expansion and modification could include dredging, deepening, and new berths and could have localized, temporary impacts on commercial and for-hire recreational fishing vessels in ports used for both fishing and offshore wind and other projects. Some displacement of available dockage may occur. Based on the expected level of port utilization and related activities (e.g., dredging), cumulative impacts on commercial fisheries and for-hire recreational fishing from ongoing and planned non-offshore and offshore wind activities would be expected to be minor. Specific ports and expansions will be further discussed in project-specific COPs and COP-level NEPA analyses.

Presence of structures: The presence of structures can lead to impacts on commercial fisheries and for-hire recreational fishing through fish aggregation, habitat conversion, allisions, displacement of certain vessels/gear types, entanglement or gear loss/damage, navigation hazards (including transmission cable infrastructure), alterations on fisheries management mechanisms, space use conflicts, and safety-related issues (e.g., hindering search and rescue). These impacts may arise from buoys, met towers, WTG foundations, OSSs, scour/cable protection, and transmission cable infrastructure.

The addition of vertical structures and their foundations in the NY Bight lease areas could result in hydrodynamic effects that influence primary and secondary productivity, transport, and the distribution and abundance of fish and invertebrate species within and near project footprints. This could in turn lead to localized effects on food web productivity and the distribution of pelagic eggs and larvae (Chen

2021). Pelagic juveniles and adults in the water column habitat could experience the effects of the wakes caused by the presence of vertical structures. These effects may be limited to decreased current speeds but could also include minor changes to seasonal stratification and could affect larger oceanographic patterns such as the Mid-Atlantic Bight Cold Pool. While impacts on current speed and direction decrease rapidly around monopiles and are mainly driven by interactions at the air-sea surface interface, there is also the potential for tidal current wakes out to a kilometer from a monopile (Li et al. 2014). Laboratory measurements demonstrate that water flows are reduced immediately downstream of foundations but would return to ambient levels within relatively short distances (i.e., a few feet) or up to 3,281 feet (1,000 meters), depending on local conditions (Miles et al. 2017; Schultze et al. 2020; Johnson et al. 2021). Direct observations of the influence of a monopile extending to at least 984 feet (300 meters), however, were indistinguishable from natural variability in a subsequent year (Schultze et al. 2020). The range of observed changes in current speed and direction 984 to 3,280 feet (300 to 1,000 meters) from a monopile is likely related to local conditions, wind farm scale, and sensitivity of the analysis. The downstream area affected by reduced flows is dependent on pile diameter and on environmental and oceanographic conditions. Hub height and oceanographic conditions (e.g., currents, stratification, depth) also influence hydrodynamic impacts of foundations.

Structures may alter the availability of targeted fish species in the immediate vicinity of the structures for commercial and for-hire recreational fishers. Structure-oriented fish such as black sea bass, striped bass, lobster, and cod may increase in areas where there was no previous structure (natural or artificial) (Claisse et al. 2014; Linley et al. 2007; Smith et al. 2016; Stevens et al. 2019). Highly migratory species may also be attracted to the wind turbine foundations (Fayram et al. 2007). Flatfish, clams, and squid species are likely to remain in open soft-bottom sandy areas, although offshore wind structures may act as substrate for larval settlement. Species dependent on hardbottom habitat could benefit from an increase in hard surfaces and increase benthic diversity. However, such high initial diversity levels may decline over time as early colonizers are replaced by successional communities, or predators are attracted to the area (Langhammer 2012). Softbottom is the dominant substrate in the region. Species that rely on this habitat would be adversely affected and may be outcompeted as a result of habitat conversion, but they are not likely to experience population-level impacts (Guida et al. 2017). Softbottom species would also not likely experience the beneficial impacts from the added hard surfaces as would be experienced by benthic species dependent on hardbottom habitat. These effects are not anticipated to result in stock-level impacts that would affect commercial and for-hire recreational fisheries.

The presence of structures (including transmission cable infrastructure) would have long-term impacts on commercial fisheries and for-hire recreational fishing by increasing the risk of allisions, entanglement or gear loss/damage, and navigational hazards. Although portions of cable infrastructure achieving burial depths (3 to 3.3 feet [1 to 1.2 meters] below stable seabed elevation) would not likely pose a risk to vessels using mobile bottom-tending gear (Eigaard et al. 2016), cables may become unburied, due to the dynamic sand systems in the area, and hence pose a larger risk for bottom-tending fishing gear entanglement. Furthermore, the conversion of soft sediment to hardbottom via protective cover could negatively affect vessels fishing with bottom-tending mobile gear (e.g., dredges and trawls) by increasing the risk of snagging structure and the resultant vessel instability. The need to change vessel transit routes may also affect commercial and for-hire recreational fisheries by affecting travel time, fuel consumption, and overall trip costs. Certain sectors of the commercial fishing industry will likely be at higher risk operating within an offshore wind farm (e.g., mobile gear such as trawls and dredges) due to maneuverability and entanglement hazards.

Space use conflicts could cause a temporary or permanent reduction in fishing activities and fishing revenue, as some displaced fishing vessels may not opt to, or may not be able to, fish in alternative fishing grounds. Potential increases in structure-affiliated species (e.g., black sea bass) may result in an increase in for-hire recreational vessel trips in and around turbine structures. This may result in increased gear or space use conflicts as commercial fisheries and for-hire recreational fishing compete for space between turbines. Commercial fishing vessels, particularly those using mobile gear, that typically fish in offshore wind farm areas may be displaced. This relocation of fishing activity outside of offshore wind lease areas could increase conflict among commercial fishing interests as other areas are encroached. The competition is expected to be higher for less-mobile species such as lobster, crab, surfclam/ocean quahog, and sea scallop. Additionally, alternative fishing areas may be farther away and less productive than traditional fishing grounds, leading to potential increased travel costs for fishermen and decreased revenue.

Vessel traffic: Increased vessel traffic associated with offshore wind development could increase congestion, delays at ports, and the risk for collisions with fishing vessels. Ongoing and planned non-offshore-wind and offshore wind projects would result in a small increase in vessel traffic, with a peak during surveys and construction, particularly when offshore wind project construction activities overlap. The presence of construction vessels could restrict harvesting or other fishing activities in offshore wind lease areas and along cable routes during installation and maintenance activities. The cumulative impacts from vessel traffic on commercial and for-hire recreational fishing from offshore wind activities is expected to be minor.

3.6.1.3.3 Conclusions

Impacts of the No Action Alternative: Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to follow current regional trends and management, and respond to current and future environmental trends and societal activities. Although development of the NY Bight lease areas would not occur under the No Action Alternative, BOEM expects ongoing offshore wind and non-offshore-wind activities to have continuing temporary to long-term impacts (displacement, space use conflicts, navigational and fishing hazards, changes in target species abundance and distribution) on commercial fisheries and for-hire recreational fishing, primarily through new cable emplacement, noise, port expansion, presence of structures, and vessel traffic. The extent of impacts on commercial fisheries and for-hire recreational fishing would vary by fishery due to different target species, gear type, and location of activity.

BOEM anticipates **negligible** to **major** impacts on commercial fisheries and for-hire recreational fisheries as a result of ongoing non-offshore-wind and ongoing offshore wind activities. This is largely driven by the effects of climate change and the ability for fisheries management agencies to readily adapt to changing distributions and other climate-related effects. BOEM also anticipates there would also be **minor beneficial** impacts on for-hire recreational fishing from fish aggregation effects as a result of ongoing offshore wind activities that may bolster populations of epipelagic fish species such as tunas, dolphins, billfishes, and jacks that are commonly attracted to fixed and drifting surface structures (Holland 1990; Higashi 1994; Reliini et al. 1994).

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, commercial fisheries and for-hire recreational fishing would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to the impacts on commercial fisheries and for-hire recreational fishing, particularly from increased vessel traffic and climate change. BOEM anticipates **negligible** to **major** impacts on commercial and for-hire recreational fisheries from planned non-offshore-wind activities and planned offshore wind activities (dependent largely on the ability for fisheries' managers to adapt to climate change). The impact rating has a wide range as the extent of adverse impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. In the context of reasonably foreseeable trends (e.g., environmental, infrastructure) BOEM anticipates cumulative impacts of the No Action Alternative to result in **negligible** to **major** impacts on commercial and for-hire recreational fisheries. The presence of structures may also induce a **minor beneficial** impact, particularly on the for-hire recreational fishing.

3.6.1.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Commercial Fisheries and For-Hire Recreational Fishing

3.6.1.4.1 Impacts of One Project

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts.

Anchoring: Vessel stabilization during construction and possibly during conceptual decommissioning is assumed to be primarily done using either spud barges, jack-up vessels, or vessels equipped with dynamic positioning; therefore, only minimal anchoring would occur. However, vessel anchoring could occur in shallow waters or where other non-anchoring alternatives are not feasible. Vessel anchoring would cause temporary impacts on fishing vessels and fishing activities. Anchoring vessels used during one NY Bight project would pose a navigational hazard to fishing vessels and disturb seafloor habitats. All impacts would be localized, and potential navigation hazards would be temporary (hours to days). The anticipated impacts from anchoring on commercial fisheries and for-hire recreational fishing in the geographic analysis area for one NY Bight project would be negligible.

Cable emplacement and maintenance: The development of one NY Bight project would result in seafloor disturbance due to the installation of interarray and export cables. Prior to cable installation, survey campaigns would be completed, including boulder and sand wave clearance, UXO clearance, and pre-lay grapnel runs. A pre-lay grapnel run may be completed to remove seabed debris, such as abandoned fishing gear and wires, from the path of construction. Additionally, pre-sweeping may be required in areas of the submarine export cable and interarray cable corridors with sand waves. Cable emplacement could prevent deployment of fixed and mobile fishing gear in limited parts of the project area from one day up to several months (if simultaneous lay and burial techniques are not used), which may result in the loss of revenue if alternative fishing locations are not available. Activities from cable emplacement would require communications with fixed-gear fisheries stakeholders to ensure no gear is deployed along the installation route. Though many of the impacts from cable installation are temporary, some of the offshore export cable would require cable protection and therefore the seafloor would be permanently impacted. Additionally, small areas along the cable routes could be temporarily closed throughout the duration of the project due to routine or emergency maintenance. If cable repairs are needed, support vessels would temporarily impact commercially important fish and invertebrate species as well as exclude fishing vessels, but only in a localized area immediately adjacent to the repair location. Commercial and recreational fishing vessels would also be excluded from small areas during routine cable surveys, which would likely occur throughout the duration of the project's lifetime. Overall, cable emplacement and maintenance would not restrict large areas, and navigational impacts on commercial or for-hire recreational fishing vessels would be on the scale of hours to days. Cable emplacement and maintenance as a result of one NY Bight project would result in localized and permanent minor impacts on commercial fisheries and for-hire recreational fishing.

Noise: Noise from G&G surveys, construction, trenching, pile-driving, operations, and maintenance may occur. Noise can temporarily disturb fish and invertebrates in the immediate vicinity of the source, causing a temporary behavior change, including leaving the area affected by the sound source. Although UXO detonations are expected to occur infrequently, they may have severe effects within several hundred meters for fish with swim bladders. However, this would likely only affect a few individuals or a few fish schools. Given the extremely short duration of explosions, any behavioral effects are expected to be short term and minor. Impacts on commercial fisheries and for-hire recreational fishing would depend on the duration of the noise-producing activity and corresponding impacts on managed fish species and are anticipated to be negligible to minor from one NY Bight project alone.

Port utilization: A list of representative ports has been identified that may be utilized during construction and operations of one NY Bight project, including New Jersey Wind Port, Paulsboro Marine Terminal, Arthur Kill Terminal, and Howland Hook/Port Ivory in New Jersey, and South Brooklyn Marine Terminal, Brooklyn Navy Yard, Port of Coeymans, and Port of Albany in New York. However, other ports may be identified based on the location of the project and port/equipment availability at the time. Port usage as a result of one NY Bight project may result in a decrease in available dockage for commercial or recreational fishing vessels. While one NY Bight project is not anticipated to require port upgrades, some ports have planned improvements to accommodate offshore wind activities across the region; these improvements are described in Appendix D. The additional vessels due to the project could cause delays or reduced access to port services such as fueling and provisioning, potentially causing fishing vessels to use alternative ports. Therefore, it is expected that one NY Bight project would generate minor impacts on commercial fisheries and for-hire recreational fishing associated with port utilization.

Presence of structures: The installation of components, as well as the presence of construction vessels and permanent structures, could restrict harvesting and fishing activities in the project area. The various types of impacts on commercial fisheries and for-hire recreational fishing that could result from the presence of structures, including fish aggregation, habitat conversion, allisions, displacement of certain vessels/gear types, entanglement or gear loss/damage, navigation hazards (including transmission cable infrastructure), alterations on fisheries management mechanisms, space use conflicts, and safety-related issues (e.g., hindering search and rescue), are described in Section 3.6.1.3.2, *Cumulative Impacts of the No Action Alternative*. The structures, and related impacts, associated with one NY Bight project would remain at least until conceptual decommissioning of the project is complete and could pose long-term effects on commercial fisheries and for-hire recreational fishing.

The exact location of the proposed infrastructure within the project area could affect transit corridors and access to preferred or traditional fishing locations. Transiting through the project area could also create challenges associated with using navigational radar when there are many radar targets that may obscure smaller vessels and where radar returns may be duplicated under certain meteorological conditions like heavy fog. Larger vessels may find it necessary to travel around the project area to avoid maneuvering among the WTGs.

The addition of new WTG and OSS foundations in the NY Bight lease areas could result in hydrodynamic effects that influence primary and secondary productivity and the distribution and abundance of fish and invertebrate species within and near project footprints. This could in turn lead to more significant effects on prey and forage resources for commercially or recreationally targeted fish species, but the extent and significance of these effects cannot be predicted based on currently available information.

The potential hydrodynamic effects from the presence of vertical structures in the water column therefore affect nutrient cycling and could influence the distribution and abundance of fish and planktonic prey resources (van Berkel et al. 2020) and larvae (Chen 2021). Turbulence resulting from vertical structures in the water column could lead to localized changes in circulation and stratification patterns, with potential implications for localized primary and secondary productivity and fish distribution. Structures may reduce wind-forced mixing of surface waters, whereas water flowing around the foundations may increase vertical mixing (Carpenter et al. 2016). During summer, when water is more stratified, increased mixing could increase pelagic primary productivity near the structure, increasing the algal food source for zooplankton and filter feeders. Increased mixing may also result in warmer bottom temperatures, increasing stress on some shellfish and fish at the southern or inshore extent of the range of suitable temperatures. Changes in cold pool dynamics resulting from future activities, should they occur, could result in changes in habitat suitability and fish community structure, but the extent and significance of these potential effects are unknown. In summary, the waters surrounding offshore wind farms are characterized by strong seasonal stratification, which is expected to limit measurable hydrodynamic effects to within 600 to 1,300 feet (183 to 396 meters) down current of each monopile. Localized turbulence and upwelling effects around the monopiles are likely to transport nutrients into the surface layer, potentially increasing primary and secondary productivity. That increased productivity could be partially offset by the formation of abundant colonies of filter feeders on the monopile foundations.

The net impacts of these interactions on commercially or recreationally targeted fish species and subsequently on commercial fisheries or for-hire recreational fishing are difficult to predict. Turbulent mixing would be increased locally within the flow divergence and in the wake, which would enhance local dispersion and dissipation of flow energy. However, because the monopiles would be spaced at minimum of 0.6 nautical mile (1.1 kilometers) apart, it is expected that there could be a nominal areal blockage and the net effect over the spatial scale of the NY Bight projects would likely be negligible.

Overall, the impacts from the presence of structures associated with one NY Bight project on commercial fisheries and for-hire recreational fishing are anticipated to range from negligible to major and would not increase the impacts across entire fisheries beyond those of the No Action Alternative. However, impacts on local commercial fisheries and for-hire recreational fishing would be greater than under the No Action Alternative. The magnitude of impact would also vary depending on individual fishery or fishing grounds, distance from the project area, vessel size, and type of gear used (e.g., large mobile-gear vessels would be affected more than smaller fixed-gear vessels). There would also be minor beneficial impacts on for-hire recreational fishing from fish aggregation effects that may bolster populations of recreationally targeted epipelagic fish species—such as tunas, dolphins, billfishes, and jacks—that are commonly attracted to fixed and drifting surface structures (Holland 1990; Higashi 1994; Reliini et al. 1994).

Vessel traffic: A single project in the NY Bight lease areas would generate a small increase in vessel traffic compared to the No Action Alternative, with a peak during project construction. Offshore construction and installation of one NY Bight project would temporarily restrict access to the project area (offshore export cables and Wind Farm Area) during construction. Construction support vessels, including vessels carrying assembled WTGs or WTG and OSS components, would be present in the waterways between the project area and the ports used during construction and installation and during conceptual decommissioning.

Nearly all vessels that travel through NY Bight lease areas where no structures currently exist would need to navigate with greater caution to avoid WTGs and OSSs; however, BOEM does not anticipate any restrictions on use or navigation in the lease areas. Fishing vessels transiting in proximity to the project area or ports being utilized by construction and installation vessels would be required to avoid project vessels and restricted safety zones though routine adjustments to navigation. Although fishing vessels may experience increased transit times in some situations, these situations would be spatially and temporally limited. O&M activities would require a much more limited number of vessels than construction activities and would only periodically be present in the project area. Overall, BOEM expects vessel activities in the open waters between the project area and ports and along the offshore export cable corridor to have minor impacts on commercial fisheries and for-hire recreational fishing.

3.6.1.4.2 Impacts of Six Projects

The same impact types and mechanisms described under one NY Bight project apply to six NY Bight projects for cable emplacement and maintenance, noise, port utilization, presence of structures, and vessel traffic. However, there would be a greater potential for impacts due to the larger number of projects affecting a larger geographic area.

Impacts from anchoring are still expected to remain negligible because anchoring is not expected to substantially affect or disrupt commercial fisheries or for-hire recreational fishing. Impacts from noise would be minor under six NY Bight projects because the combined impacts from underwater noise from six NY Bight projects could result in temporary impacts associated with high-noise activities such as G&G activities or pile-driving.

Impacts from cable emplacement and maintenance under six NY Bight projects would be minor to moderate, an increase from minor impacts under one NY Bight project. The increased impacts would be due to multiple areas of cable installation potentially occurring simultaneously, substantially increasing the area from which commercial or recreational fishing vessels would be excluded during installation, and substantially increasing the probability of occurrence of cable breaks and subsequent vessel exclusion during repair activities. However, the area used by installation vessels would still be small relative to the size of available fishing grounds for commercial and for-hire recreational fishermen, and it is unlikely that all six NY Bight projects would be installed simultaneously.

Impacts from port use would increase from minor to moderate under six NY Bight projects. If the components under six NY Bight projects were constructed, the number of required project vessels would substantially increase, resulting in a subsequent increase in demand for port dockage and other services. This increase in demand could cause commercial or for-hire recreational fishing vessels to make substantial alterations to their normal port usage.

Impacts from presence of structures would increase to minor to major under six NY Bight projects as compared with negligible to major under one NY Bight project. Similar to during one NY Bight project, exact impacts would depend on project-specific timing, location, and spacing of project-related structures. However, given the substantial increase in structures (for vessels, turbines, and OSSs) that would occur under six NY Bight projects, BOEM expects impacts to be minor, at a minimum. BOEM expects that beneficial impacts would increase to moderate on for-hire recreational fishing from fish aggregation effects due to the substantial increase in structures under six NY Bight projects.

Impacts from vessel traffic would increase from minor to moderate under six NY Bight projects due to the substantially higher number of vessels that would be required as compared to one NY Bight project during construction and installation, O&M, and conceptual decommissioning. The number of vessels would increase the likelihood of commercial fishing or for-hire recreational fishing vessels to change their travel routes, times, or other routines that could negatively impact their catch or result in increased expenses.

3.6.1.4.3 Cumulative Impacts of Alternative B

The construction and installation, O&M, and conceptual decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and vessel traffic. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater. Remedial action during conceptual decommissioning may reduce long-term impacts.

In context of reasonably foreseeable environmental trends and planned actions, the impacts of six NY Bight projects would range from negligible to major with moderate beneficial impacts to for-hire recreational fishing. If the construction of the six NY Bight projects is staggered, this could further minimize the impacts. BOEM anticipates that the cumulative impacts associated with six NY Bight projects, when combined with planned non-offshore-wind and planned offshore wind activities, would not alter the overall state of commercial fisheries and for-hire recreational fishing. Six NY Bight projects would contribute to, but would not change, the overall impact ratings, as discussed in Section 3.6.1.4.2, *Impacts of Six Projects*.

3.6.1.4.4 Conclusions

Impacts of Alternative B: In summary, activities associated with the construction and installation, O&M, and conceptual decommissioning of either one NY Bight project or six NY Bight projects under Alternative B, would affect commercial fisheries and for-hire recreational fishing to varying degrees. Impacts on commercial fisheries and for-hire recreational fishing are expected to be negligible or minor for most IPFs. The main impact would be from the presence of structures, which could range from negligible to major for commercial fisheries and moderate for for-hire recreational fishing. Overall, impacts on commercial fisheries and for-hire recreational fishing are expected to range from **negligible** to **major**. **Minor beneficial** impacts on for-hire recreational fishing may also occur based on the potential bolstering of for-hire recreational fishing opportunities due to fish aggregation around structures. Localized impacts on commercial fisheries and for-hire recreational fishing would likely be greater. Impacts of six NY Bight projects for some IPFs would be slightly greater than for one NY Bight project, but overall impacts would still range from **negligible** to **major** with **moderate beneficial** impacts for for-hire recreational fishing.

Cumulative Impacts of Alternative B: BOEM anticipates that the cumulative impacts on commercial fisheries and for-hire recreational fishing in the geographic analysis area would likely be **negligible** to **major** under six NY Bight projects. In context of reasonably foreseeable environmental trends, the impacts contributed by Alternative B to the cumulative impacts on commercial fisheries and for-hire recreational fishing would be undetectable and would not alter the overall state of commercial fisheries and for-hire recreational fishing. The impact rating has a wide range as the extent of adverse impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The presence of structures is also expected to yield a **moderate beneficial** impact on for-hire recreational fishing. Considering all the IPFs together, BOEM anticipates that the impacts from ongoing and planned actions including six NY Bight projects would likely result in **negligible** to **major** impacts on commercial fisheries and for-hire recreational fishing in the geographic analysis area, driven largely by the presence of structures.

3.6.1.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Commercial Fisheries and For-Hire Recreational Fishing

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight Area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives – Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.6.1.5.1 Sub-Alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations (Table 3.6.1-20).

Table 3.6.1-20. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for commercial fisheries and for-hire recreational fishing

Measure ID	Measure Summary
BEN-1	This measure proposes avoidance of boulders greater than 1.6 feet (0.5 meters) in diameter within the lease area and along the export cable corridor if practicable and minimization of relocation distance if avoidance is not possible. If boulders need to be relocated, the lessee must submit a Boulder Identification and Relocation Plan for review and concurrence.
COMFIS-2	This measure proposes that the lessee must prepare a Scour and Cable Protection Plan(s) that includes descriptions and specifications for all scour and cable protection materials. The measure would ensure that all materials used for scour and cable protection measures consist of natural or engineered stone that provides three-dimensional complexity in height and in interstitial spaces, as practicable and feasible. The measure would also ensure that the lessee avoid the use of engineered stone or concrete mattresses in complex habitat, use tapered edges for trawled areas, use materials that do not inhibit epibenthic growth, and submit the plan for review and approval.
COMFIS-3	This measure proposes that lessees develop a Fisheries and Benthic Monitoring Plan that should include shellfish, such as surfclam and scallop.
COMFIS-6	This measure proposes establishing compensation programs to compensate commercial and for-hire recreational fishermen for loss of gear associated with uncharted obstructions resulting from the proposed project and loss of income due to unrecovered economic activity resulting from displacement from fishing grounds due to project construction and operations. These programs would also compensate shoreside businesses for losses indirectly related to the expected development.
MUL-2	This measure proposes submittal and implementation of an anchoring plan to avoid or minimize impacts from turbidity and anchor placement on sensitive habitats, including hardbottom and structurally complex habitats, as well as any known potential or cultural resources.

Measure ID	Measure Summary
MUL-14a	This measure proposes developing and implementing standard protocols for addressing UXOs. Avoidance to the maximum extent practicable is required; a plan must be submitted if avoidance is not possible.
MUL-16	This measure proposes development and implementation of a plan for post-storm event monitoring of facility infrastructure, foundation scour protection, and cables. BSEE reserves the right to require post-storm mitigations to address conditions that could result in safety risks and/or impacts on the environment.
MUL-19	This measure proposes monitoring of the cables after installation to determine location, burial, and conditions of the cable and surrounding areas to determine if burial conditions have changed and whether remedial action is warranted.
MUL-40	This measure proposes the lessee provides USCG and NOAA with a comprehensive list and shapefile of positions and areas to which boulders larger than 6.6 feet (2 meters) will be relocated (latitude, longitude) at least 60 days prior to boulder relocation activities.

Impacts of One Project

Implementation of previously applied AMMM measures would reduce impacts on commercial fisheries and for-hire recreational fishing from all IPFs analyzed in Alternative B, including anchoring, cable emplacement and maintenance, noise, and presence of structures. Impacts for other IPFs would remain the same as described under Alternative B.

Anchoring: Potential impacts on commercial fisheries and for-hire recreational fishing from anchoring under Sub-alternative C1 would largely be the same as Alternative B. The application of MUL-2 would require detailed anchoring plans outlining the avoidance of sensitive benthic habitats, which could provide a small reduction in impacts on habitats used by certain commercially important fish.

Cable emplacement and maintenance: AMMM measure COMFIS-6 would establish compensation/mitigation funds to compensate commercial and for-hire recreational fishermen for loss of income due to unrecovered economic activity resulting from displacement from fishing grounds due to project construction and operations. COMFIS-6 would also compensate shoreside businesses for losses indirectly related to offshore wind development, which could offset some of the negative impacts borne by shoreside businesses that support the fishing industry. Additionally, COMFIS-6 would reduce negative impacts by providing monetary compensation to account for gear lost to seabed obstructions.

The scour and cable protection plan required by COMFIS-2 includes cable design elements intended to reduce the risk of fishery gear snags. COMFIS-2 proposes that scour and cable protection methods are technologically or economically feasible and are designed to reflect the pre-existing seafloor conditions. Further, COMFIS-2 includes avoidance of methods that raise the profile of the seabed. AMMM measure BEN-1 would require the avoidance of boulders and minimization of relocation distance, which could minimize disturbance to commercially important species that prefer boulder habitats. MUL-19 proposes monitoring programs for the interarray and export cables to gather data that could be used to determine if burial conditions have changed and whether remedial action is warranted. While this information may be beneficial to commercial and for-hire recreational fisheries, the implementation of this measure would not reduce the impacts from one NY Bight project. Post-storm event monitoring plan (MUL-16) requires post-storm surveys of facility infrastructure, including cables. While monitoring of offshore infrastructure would not directly reduce effects on commercial fisheries, a monitoring plan would provide information about conditions that pose a hazard to fishing activities from storm events.

MUL-40 would require the NY Bight lessee to report the locations of boulders moved during cable installation activities. This would allow fishing vessels to adapt their fishing activity to the relocated boulders.

Noise: MUL-14a requires lessees to develop and implement standard protocols for addressing UXO risks, including implementation of best available technology to avoid or minimize exposure of protected species and sensitive habitats. Application of these standards would reduce noise impacts from a detonation if UXO could not be avoided.

Presence of structures: AMMM measure COMFIS-2 may reduce impacts from the presence of structures through several methods, including compensatory reimbursement, reducing the risks of fishery gear snags, and analyzing turbine layout and spacing to reduce impacts. BOEM would also require a monitoring plan to be developed for post-storm events (MUL-16). While monitoring of offshore infrastructure, including foundation scour protection at WTGs/OSSs, would not directly reduce effects on commercial fisheries, a monitoring plan would provide information about conditions that pose a hazard to fishing activities from storm events, and BSEE would retain the ability to require post-storm mitigation to address safety risks and environmental impacts caused by the storm event.

Other measures: COMFIS-3 proposes the development of a Fisheries and Benthic Monitoring Plan that includes shellfish, such as surfclam and scallops, compatible with other regional data collection methods. This measure would increase data and knowledge about the surfclam and scallop fishery, which may result in the future development of other mitigation measures that may benefit the fisheries or other commercial or for-hire recreational fisheries.

The fisheries compensatory mitigation fund required under COMFIS-6 would compensate commercial and for-hire recreational fishermen for loss of income due to unrecovered economic activity resulting from displacement from fishing grounds due to project construction and operations. Details of this plan can be found in Table G-1 in Appendix G.

Combined, these AMMM measures would have the effect of reducing the overall impact range of one NY Bight project on commercial fisheries and for-hire recreational fishing of negligible to major to the new range of negligible to moderate. This is driven largely by compensatory mitigation that would mitigate "indefinite" impacts to a level where the fishing community would have to adjust somewhat to account for disruptions due to impacts, but income losses would be mitigated.

Impacts of Six Projects

The same IPF impact types and mechanisms described under one NY Bight project also apply to six NY Bight projects. There would be an increased potential for impacts for these IPFs due to the greater amount of offshore and onshore development under six NY Bight projects. Impacts from anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and vessel traffic and potential benefits from previously applied AMMMs are expected to be the same as discussed for one NY Bight project, though over the broader geographic and temporal scale covered by the six NY Bight projects.

Cumulative Impacts of Sub-Alternative C1 (Preferred Alternative)

Similar to Alternative B, under Sub-alternative C1, the same ongoing and planned non-offshore-wind and offshore wind activities would continue to contribute to the primary IPFs of anchoring, cable emplacement and maintenance, noise, port utilization, presence of structures, and vessel traffic. BOEM anticipates that the cumulative impacts on commercial fisheries and for-hire recreational fishing associated with six NY Bight projects when combined with impacts from ongoing and planned activities including offshore wind would be unchanged (negligible to major) because some commercial and for-hire recreational fisheries and fishing operations could experience substantial disruptions indefinitely, even with these project-specific mitigation measures.

3.6.1.5.2 Sub-Alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied. However, BOEM has not identified any AMMM measures that have not been previously applied for commercial fisheries and for-hire recreational fishing; therefore, the impacts on commercial fisheries and for-hire recreational fishing under Sub-alternative C2 are the same as under Sub-alternative C1 and Alternative B.

3.6.1.6 Conclusions

Impacts of Alternative C. Previously applied AMMM measures would reduce the impact rating under Alternative B on commercial fisheries and for-hire recreational fishing for either one or six NY Bight projects from negligible to major to **negligible** to **moderate,** depending on the IPF, and **minor** (one project) to **moderate** (six projects) **beneficial** impacts on for-hire recreational fishing. There are not any not previously applied AMMM measures identified under Sub-alternative C2, so the impact levels under Sub-alternative C2 would be the same as under Sub-alternative C1.

Cumulative Impacts of Alternative C. BOEM anticipates that the cumulative impacts on commercial fisheries and for-hire recreational fishing in the geographic analysis area would likely be **negligible** to **major** for six NY Bight projects because some commercial and for-hire recreational fisheries and fishing operations could experience substantial disruptions indefinitely, even with application of AMMM measures. The impact rating has a wide range as the extent of adverse impacts would vary by fishery and fishing operation because of differences in target species, gear type, and predominant location of fishing activity. The presence of structures is also expected to yield a **moderate beneficial** impact, particularly on for-hire recreational fishing. In context of reasonably foreseeable environmental trends, the impacts contributed by Sub-alternative C1 and Sub-alternative C2 to the cumulative impacts on commercial fisheries and for-hire recreational fishing would be undetectable and would not alter the overall state of commercial fisheries and for-hire recreational fishing.

3.6.1.7 Recommended Practices for Consideration at the Project-Specific Stage

BOEM is recommending lessees consider analyzing the RPs in Table 3.6.1-21 to further reduce potential commercial fisheries and for-hire recreational fishing impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.6.1-21. Recommended Practices for commercial fisheries and for-hire recreational fishing impacts and related benefits

Recommended Practice	Potential Benefit
COMFIS-4: Follow fisheries mitigation recommended practices for static cable design elements, project design, and safety, including minimum cable burial of 3 feet (1 meter), avoidance of methods that raise the profile of the seabed, and use of protection measures that reflect the pre-existing conditions. Elements should be planned in coordination with fisheries.	This RP would reduce snag hazards by ensuring the minimal burial depth, which would minimize space use conflicts with fisheries.
COMFIS-5: Follow the Fisheries Survey Guidelines issued by BOEM with regards to pre-, during, and post-construction fisheries monitoring survey plan design.	This RP would increase data and knowledge about potentially affected fisheries, which may result in the future development of other mitigation measures.
COMFIS-7: Contract with a neutral third-party to manage the Fisheries Compensation Fund.	Contracting a neutral third-party, such as a regional fund administrator, to process claims, manage funds, disburse funds, and handle appeals would ensure equal treatment across the fisheries.
MUL-5: Use equipment, technology, and best practices to produce the least amount of noise possible to reduce noise impacts.	This RP would benefit commercial and recreational species through overall noise reduction.
MUL-12: Incorporate ecological design elements where practicable.	This RP would serve to increase the amount of available foraging habitat for species targeted by commercial or for-hire recreational fisheries.
MUL-14b: When MEC avoidance is not possible, submitted UXO/MEC avoidance plans should follow, when finalized, the U.S. Committee on the Marine Transportation System general guidance on MEC.	If avoidance is not possible, any reduction in noise or habitat disturbance is beneficial to the species and habitat in the area, which is beneficial for commercial and recreational fish and invertebrate species.
MUL-18: Coordinate transmission infrastructure among projects by using shared intra- and interregional connections, meshed infrastructure, or parallel routing.	Implementation of this RP could result in a reduction of the seafloor disturbance, snag hazards, and the overall amount of cable placed on the seafloor. A subsequent reduction of impacts on commercial fisheries and for-hire recreational fishing from cable emplacement and maintenance would also occur.
MUL-21: Use the best available technology, including new and emerging technology, when possible, and consider upgrading or retrofitting equipment.	This RP would ensure the best available, safest technologies are used to reduce impacts. Examples include but are not limited to the use of jet plows, closed loop cooling systems, trenchless technology, gravity-based structures, and foundation designs that do not rely on pile-driving.

Recommended Practice	Potential Benefit
MUL-23: Adjust project design to avoid or reduce potential impacts on important environmental resources.	This RP recommends avoiding habitats such as estuaries for export cable routes, adjusting turbine layout, and encouraging micrositing to reduce impacts on vulnerable life stages of many commercially and recreationally fished species.
MUL-25: Use consistent turbine grid layouts, markings, and lighting in lease areas to minimize navigational hazards and facilitate other ocean uses. Turbines should have one of the two lines of orientation spaced at least 1 nautical mile (1.9 kilometers) apart.	This RP would employ consistent turbine grid layouts, spacing, markings, and lighting among lease areas to minimize navigational hazards. The 1-nautical mile (1.9-kilometer) spacing would support navigation safety and search and rescue, facilitate fishing and recreational activities, and preserve structure-free areas.
MUL-26: Coordinate regional monitoring and survey efforts to standardize approaches, understand potential impacts to resources at a regional scale, and maximize efficiencies in monitoring and survey efforts. Develop monitoring and survey plans that meet regional data requirements and standards.	Coordinating regional monitoring and survey efforts would maximize the monitoring efficiency. The data gathered would be evaluated and considered for future mitigation and monitoring needs, which will serve to reduce impacts.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.2 Cultural Resources

Federal, state, and local regulations recognize Tribal Nations' significant cultural ties to, and the public's interest in, cultural resources. Many of these regulations, including NEPA and the National Historic Preservation Act (NHPA), require the consideration of potential impacts on cultural resources and historic properties. This section discusses the identification of cultural resource types in the cultural resources geographic analysis area; potential types of impacts on cultural resources from the alternatives and ongoing and planned activities in the cultural resources geographic analysis area; analysis of applying potential AMMM measures for avoiding or reducing adverse impacts on cultural resources; and will assist in fulfilling BOEM's obligations under Sections 106 and 110 of the NHPA. The cultural resources geographic analysis area (Figure 3.6.2-1) comprises knowable or hypothetical areas where cultural resources would be subject to potential impacts from the alternatives.

The cultural resources analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

The cultural resources geographic analysis area encompasses the NY Bight programmatic area of potential effects (Programmatic APE) which BOEM has developed to fulfill its obligations to Section 106 of the NHPA in accordance with implementing regulations at 36 CFR part 800 (Protection of Historic Properties) and Stipulation I of the *Programmatic Agreement Among The U.S. Department of the Interior, Bureau of Ocean Energy Management, The State Historic Preservation Officers of New Jersey and New York, The Shinnecock Indian Nation, and The Advisory Council on Historic Preservation Regarding Review of Outer Continental Shelf Renewable Energy Activities Offshore New Jersey and New York Under Section 106 of the National Historic Preservation Act* (NJ-NY PA). In 36 CFR 800.16(d), the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist." BOEM (2020) further defines the APE as the following:

- The depth and breadth of the seabed potentially impacted by any bottom-disturbing activities.
- The depth and breadth of terrestrial areas potentially impacted by any ground-disturbing activities.
- The viewshed from which renewable energy structures, whether located offshore or onshore, would be visible.
- Any temporary or permanent construction or staging areas, both onshore and offshore.

Per Section 106 of the NHPA, BOEM has formed the Programmatic APE to facilitate the preliminary discussion of cultural resource types subject to potential effects from planned offshore wind development in the NY Bight area. BOEM will include Tribal Nations; the ACHP; New York State Historic Preservation Officer (SHPO); New Jersey SHPO; other involved federal, state, and local agencies; and consulting parties in review and assessment of historic properties related reports. The marine portion of the Programmatic APE (Programmatic Marine APE) includes the six NY Bight lease areas potentially affected by seabed-disturbing activities. The visual portion of the Programmatic APE (Programmatic Visual APE) includes the maximum viewshed from which hypothetical offshore renewable energy structures constructed within the six NY Bight lease areas per the RPDE would be visible and areas of intervisibility where hypothetical NY Bight offshore wind structures and ongoing and planned offshore wind structures would be visible simultaneously (see Figure 3.6.2-1).

Specific information, such as cable routes, landfall locations, and onshore transmission routes are not available at this time. Based on general information obtained from the lessees and other consulting parties, BOEM has defined a conservative Programmatic APE meant to encapsulate future COP-specific APEs when that information becomes available. Areas associated with anticipated NY Bight offshore wind project development but excluded from delineation of the NY Bight Final PEIS cultural resources geographic analysis area and Programmatic APE are:

- Any other offshore areas, aside from the six NY Bight lease areas, potentially physically affected by seabed-disturbing activities (i.e., other marine areas in which temporary or permanent construction or staging areas are proposed to occur, such as offshore export cable route corridors and HDD locations, which may have physical impacts on cultural resources).
- All onshore areas potentially physically affected by ground-disturbing activities (i.e., terrestrial areas in which temporary or permanent construction or staging areas are proposed to occur, such as onshore export cable route corridors, substations, or HDD locations, which may have physical impacts on cultural resources).
- Any other areas within the viewshed of offshore renewable energy structures measuring greater than 1,312 feet (400 meters) in height.
- Any other onshore areas potentially visually affected by the presence of onshore renewable energy structures (e.g., the viewshed from which onshore structures would be visible, such as onshore export cable routes, substations, or switching stations, and which may have visual impacts on cultural resources).

BOEM expects each lessee to complete the requisite cultural resource technical studies per BOEM (2020) historic property identification guidelines including, but not limited to, the delineation of a preliminary APE (PAPE) per the COP PDE, completion of associated cultural resource and historic property identification efforts that comply with federal and state requirements, assessment of potential effects, and development of potential AMMM measures for identified historic properties. BOEM will then delineate the COP APE and assess the specific impacts on historic properties in the APE in COP-specific NEPA and NHPA reviews and consultations. BOEM also acknowledges that Tribal Nations have traditional knowledge regarding cultural, religious, archaeological, and other resources that may be adversely affected by a project and therefore requires consideration under the NHPA and NEPA reviews.

BOEM is conducting a programmatic review of the NY Bight leases under Section 106 in coordination with the NEPA review pursuant to 36 CFR 800.8(a). The primary objective of the programmatic Section 106 review is to provide an opportunity for Section 106 consulting parties to identify historic properties early in project planning that could be avoided and/or minimized from project impacts and consult on and identify a consistent Section 106 consultation process that will allow Tribal Nations and consulting parties to consult as early as possible for each of the six project-level reviews. BOEM is memorializing these concepts in a Programmatic Agreement for NY Bight (NY Bight PA). The NY Bight PA will afford greater consistency across the six lease areas while reducing the consultation burden for consulting Tribes, SHPOs, ACHP, and other parties. Additional information on the NHPA processes for the PEIS and future COP NEPA analyses can be found in Appendix I, *NHPA Section 106 Summary*.

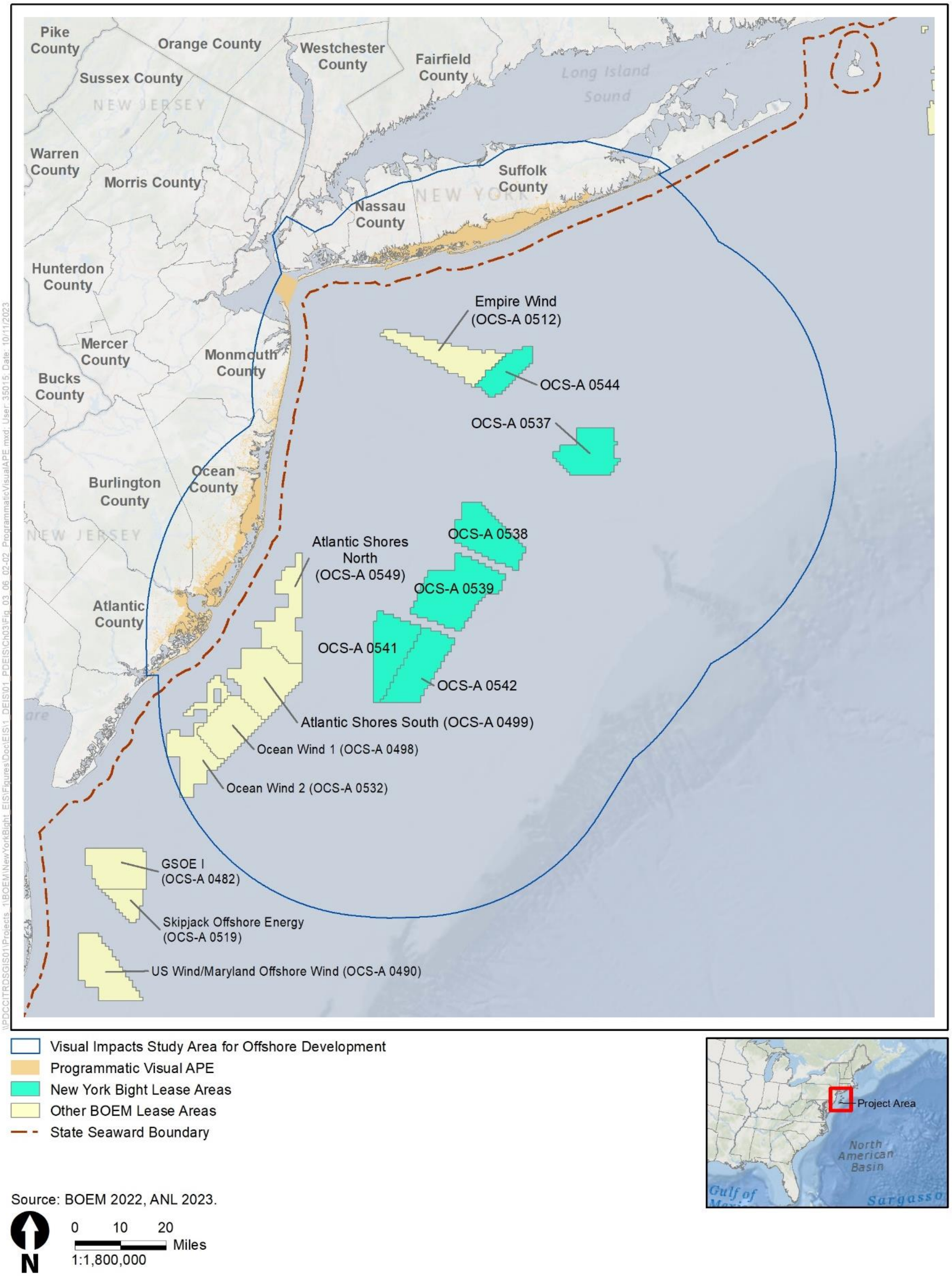


Figure 3.6.2-1. Cultural resources geographic analysis area and programmatic visual APE

3.6.2.1 Description of the Affected Environment and Future Baseline Conditions

This section discusses baseline conditions in the geographic analysis area for cultural resources. Table 3.6.2-1 presents a summary of the cultural context of the cultural resources geographic analysis area encompassing the Programmatic APE in New Jersey and New York (BOEM 2021).

Table 3.6.2-1. Cultural context for the NY Bight cultural resources geographic analysis area

Period	Description
Paleoindian (>14,500–11,500 BP)	Semi-nomadic hunting and gathering populations. Use of broad spectrum of plants and animals for subsistence. Characteristic fluted projectile points used to hunt now-extinct large megafauna (mammoth and mastodon). Landscape of spruce forest. Sea levels about 330 feet (100 meters) below present-day levels. Sea level rise occurred with episodes of melting of the North American ice sheet. Deeply incised drainages along the OCS would have been estuarine environments utilized as a source of food and fresh water and habitation by Paleoindian populations. Flooding of these drainages allowed for sediment flows to bury possible Paleoindian sites.
Archaic Period (11,500–3200 BP)	Period subdivided into Early (10,000–8,000 BP), Middle (8,000–6,000 BP), and Late (6,000–3,000 BP) phases. Gradual shift to modern environmental conditions with overall warmer temperatures and less precipitation relative to previous period. Spruce and pine forests gradually transition to mixed deciduous forest (hickory, oak, chestnut). Sea level had risen to about 75 feet (23 meters) below present-day levels by the Early Archaic and stabilized around 1.5–6.5 feet (0.5–2 meters) below present-day levels by the Late Archaic. Mobility of hunting and gathering populations decreased as environmental conditions stabilized. Population density increased and seasonal settlements were common with introduction of a broad range of seasonal food sources, including shellfish and other riverine and marine resources. Diverse types of stone tools used including ground stone vessels.
Woodland Period (3200 BP–European Contact)	Period subdivided into Early (3,000–2,000 BP), Middle (2,000–1,000 BP), and Late (1,000–400 BP) phases. Cooler and wetter climate in Early Woodland, then warming and drying trend begins in Middle Woodland. Mixed deciduous forests persist. Terrestrial foraging and intensive exploitation of marine food sources. Increasing sedentism with use of agriculture. Use of ceramic pots for cooking and storage. Triangular projectile points with introduction of bow and arrow by Late Woodland.
Contact and Colonization (1500–1699)	Native Americans settle in sedentary villages supported by agriculture and seasonal camps targeting large and small game, plants, riverine, and marine resources. Similar technologies to Late Woodland but increasing use of European trade goods. Interactions occur among Native Americans, European colonists, and enslaved peoples. Dutch, Swedish, English colonies established. New Amsterdam colony established on Island Manhattan (Manhattan Island) in 1625. Sweden colony established in what is now referred to as New Jersey in 1638. English colonists control the region by 1664.
Contact and Colonization (18th Century)	Shipbuilding and fish, tobacco, and fur trade industries thrive. First lighthouses on the Atlantic Seaboard are completed, including Sandy Hook in 1764. Ongoing conflicts between English and French colonists and Native Americans continue. During the American Revolutionary War, many engagements between British and Continental forces took place in New Jersey and New York. Statehood granted to New Jersey in 1787 and to New York in 1788.
American Expansion (19th Century)	Manufacturing drives the economy during the Industrial Revolution. Cities grow as electricity is introduced and transportation improved through growth of public roadways, railroads, and canals. Iron and zinc mines become leading industries in New Jersey. New York City is a financial center during the American Civil War and remains a

Period	Description
	major ocean port and immigration hub. African American populations increase due to the slave trade and post-Civil War northward migrations. Ellis Island opened 1892.
Urban Expansion and Rural Decline (20th Century)	African American populations continue to increase with post-Civil War northward migrations. New Jersey and New York shipyards, factories, and refineries support military efforts in World War I and World War II. Many forts and training camps are active, and Port of New York used for troop deployments. Rail connections with larger urban areas and later improved roadways for automobiles led to growth of seaside communities. Urban decay in 1950s resulting from suburban growth.

Source: BOEM 2012, 2021.
AD = Anno Domini; BP = before present.

To facilitate analysis in this PEIS, BOEM conducted background research to identify cultural resource types in the Programmatic APE (see Appendix I for more details). As discussed in the introduction to Section 3.6.2, BOEM does not have enough information available about the NY Bight projects to fully delineate either a cultural resources geographic analysis area or Programmatic APE that encompasses all areas that may be subject to potential effects from NY Bight offshore wind project development. As a result, the totality of cultural resources and historic properties in the Programmatic APE is not knowable at this time. For the purposes of the discussion that follows, cultural resources are divided into several types and subtypes as defined in Table 3.6.2-2.

Table 3.6.2-2. Definitions of cultural resource types used in the analysis

Term	Definition
Ancient submerged landform feature	*ASLFs* are landforms that have the potential to contain Native American archaeological resources inundated and buried as sea levels rose at the end of the last Ice Age. Additionally, Native American Tribes in the region may consider ASLFs to be independent or contributing elements to previously subaerial TCPs representing places where their ancestors once lived.
Cultural landscape	The National Park Service (2006) defines a *cultural landscape* as a "geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values." In this analysis, cultural landscapes are considered a type of historic aboveground resource.
Cultural resource	The phrase *cultural resource* refers to a physical resource valued by a group of people such as an archaeological resource, building, structure, object, district, landscape, or TCP. Cultural resources can date to the pre-Contact or post-Contact periods (i.e., respectively, the time prior to the arrival of Europeans in North America and thereafter) and may be listed on national, state, or local historic registers or be identified as important to a particular group during consultation, including any of those with cultural or religious significance to Native American Tribes. Cultural resources in this analysis are divided into several types and subtypes: marine cultural resources, terrestrial archaeological resources, historic aboveground resources, and TCPs.
Marine archaeological resource	*Marine archaeological resources* are the physical remnants of past human activity that occurred at least 50 years ago and are submerged underwater. They may date to the pre-Contact period (e.g., those inundated and buried as sea levels rose at the end of the last Ice Age) or post-Contact period (e.g., shipwrecks, downed aircraft, and related debris fields).

Term	Definition
	Some of these marine cultural resources are likely to be sunken military craft, which are afforded protection against unauthorized disturbance under the Sunken Military Craft Act of 2004 (H.R. 4200 108th Congress: Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005).
Historic aboveground resource	*Historic aboveground resources* are subaerial features or structures of cultural significance at least 50 years in age and include those that date to the pre-Contact or post-Contact periods. Example types that are or may have historic aboveground components include standing buildings, bridges, dams, historic districts, cultural landscapes, and TCPs.
Historic district	A *historic district* is an area composed of a collection of either or both archaeological and aboveground cultural resources.
Historic property	As defined in 36 CFR 800.16(l)(1), the phrase *historic property* refers to any “prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the [NRHP] maintained by the Secretary of the Interior. The term includes artifacts, records, and remains that are related to and located within such properties.” *Historic property* also includes NHLs as well as properties of religious and cultural significance to Native American Tribal Nations that meet NRHP criteria. The NRHP recognizes historic properties that are significant at the national, state, and local levels that possess integrity of location, design, setting, materials, workmanship, feeling, and association and that meet any of Criterion A through D. Criterion A covers a historic property that is associated with events that are significant to the broad patterns of our history. Criterion B covers a historic property associated with the lives of persons significant to our past. Criterion C covers a historic property that embodies distinctive characteristics of a type, period, or method of construction; represents the work of a master or possesses high artistic values; or represents a significant and distinguishable entity whose components may lack individual distinction. Criterion D covers a historic property that yields, or may be likely to yield, information important to prehistory or history.
Terrestrial archaeological resource	*Terrestrial archaeological resources* are the physical remnants of past human activity that occurred at least 50 years ago and are located on or within lands not submerged underwater. They may date to the pre-Contact period (i.e., have associations with Native American populations dating to before European colonization of the Americas) or post-Contact period (i.e., have associations with African American, European American, or Native American populations dating to after European colonization of the Americas).
Traditional cultural property	National Register Bulletin 38 (Parker and King 1990, revised 1992 and 1998) defines a *traditional cultural property* (TCP) as a “[historic property] that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community’s history, and (b) are important in maintaining the continuing cultural identity of the community.” TCPs may be locations, places, or cultural landscapes and have either or both archaeological and aboveground elements.

ASLF = ancient submerged landform features; NHL = National Historic Landmark; TCP = traditional cultural property.

Marine cultural resources in the region include pre- and post-Contact marine archaeological resources and ancient submerged landform features (ASLFs) on the OCS (BOEM 2012). Based on known historic and recent maritime activity in the region, the NY Bight lease areas, composing the knowable

Programmatic Marine APE, have a high probability for containing shipwrecks, downed aircraft, and related debris fields that may be subject to potential impacts by seabed-disturbing activities from offshore wind development in the NY Bight area (BOEM 2012, 2013). ASLFs also have a high probability of occurrence on the OCS (BOEM 2012). However, as mentioned above, the totality of cultural resources and historic properties in the Programmatic Marine APE is not knowable at this time, and, therefore, while the cultural context and general sensitivity for marine cultural resources may be described, at this stage BOEM does not have information about specific marine archaeological resources or ASLFs that may be present in the Programmatic Marine APE. BOEM will require each NY Bight lessee to conduct identification efforts for marine archaeological resources and ASLFs and present findings in a Marine Archaeological Resources Assessment (MARA) report prepared in partial fulfillment of a sufficient COP. These efforts will be required to include areas of potential impacts by seabed-disturbing activities in the inter-tidal zone closer to the existing shoreline that may include Indigenous resources, including habitation sites, procurement and quarry sites, submerged canoes, etc. BOEM will fully analyze impacts on marine cultural, inter-tidal archaeological, and ASLF resources in COP-specific NEPA and NHPA reviews and consultations.

As evidenced by the extent of known human occupation in the region (see Table 3.6.2-1), onshore areas potentially subject to ground-disturbing activities from NY Bight offshore wind project development are likely to contain terrestrial archaeological resources dating from the pre- and post-Contact periods. As discussed in the previous section, BOEM does not have enough information available from the lessees and their COPs at this time to delineate a terrestrial portion of the Programmatic APE. Subsequently, BOEM is unable to identify specific terrestrial archaeological or other cultural resources that may be subject to impacts from ground-disturbing activities during NY Bight offshore wind project development. Therefore, impacts on terrestrial archaeological resources and any other types of cultural resources potentially affected by any ground-disturbing activities from the anticipated development of the NY Bight lease areas are only generally discussed in this section. BOEM will require each NY Bight lessee to conduct identification efforts for terrestrial archaeological resources and present findings in a Terrestrial Archaeological Resources Assessment (TARA) report prepared in partial fulfillment of a sufficient COP. BOEM will fully analyze impacts on such resources in COP-specific NEPA and NHPA reviews and consultations.

The viewshed of hypothetical offshore renewable energy structures constructed within the six NY Bight lease areas per the RPDE encompasses historically developed and densely occupied coastal areas of New Jersey and New York. As such, a large number of historic aboveground resources are anticipated to be located in the Programmatic Visual APE, of which a proportion are anticipated to be historic properties or potential historic properties listed or eligible for listing in the National Register of Historic Places (NRHP). These aboveground historic properties may include buildings, historic districts, cultural landscapes, and traditional cultural properties (TCPs). BOEM will require each NY Bight lessee to conduct identification efforts for historic aboveground resources and present findings in a Historic Resource Visual Effects Assessment (HRVEA) report prepared in partial fulfillment of a sufficient COP. BOEM will fully analyze impacts on such resources in COP-specific NEPA and NHPA reviews and consultations.

Additional information on the NEPA and NHPA processes for the PEIS and future COP NEPA analyses can be found in Appendix I.

3.6.2.2 Impact Level Definitions for Cultural Resources

Impacts on cultural resources are discussed in general terms (e.g., alteration, disturbance, diminishment, destruction) with more specific scenarios described for each IPF. The impact levels for cultural resources are defined by the degree to which the resource's historical integrity would be impaired if the project would alter any of the characteristics that qualify it for listing in the NRHP. For aboveground historic resources, this may be related to physical harm to the materials, design, or workmanship of a building or structure or the introduction of project components that change the historical character of a resource's setting or feeling. For archaeological resources, this may be related to physical disturbance of cultural materials that diminishes or destroys the information of scientific or cultural value embodied in that resource. It is important to note that temporary activities may result in permanent impacts on cultural resources. For example, disturbance of an archaeological site resulting in the loss of irreplaceable information would constitute a permanent impact regardless of whether the disturbance is caused by an isolated, temporary, or short-term activity.

Definitions of potential impacts on cultural resources (including historic properties per Section 106 of the NHPA) are provided in Table 3.6.2-3.

Table 3.6.2-3. Adverse impact level definitions for cultural resources by type

Impact Level	Definition for Historic Properties under Section 106 of the NHPA	Definition for Archaeological Resources and Ancient Submerged Landform Features	Definition for Historic Aboveground Resources
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(1).	A. No cultural resources subject to potential impacts from ground- or seabed-disturbing activities; or B. All disturbances to cultural resources are fully avoided, resulting in no damage to or loss of scientific or cultural value from the resources.	A. No measurable impacts; or B. No physical impacts and no change to the integrity of resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or C. All physical impacts and disruptions are fully avoided.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b). This can include avoidance measures.	A. Some damage to cultural resources from ground- or seabed-disturbing activities, but there is no loss of scientific or cultural value from the resources; or B. Disturbances to cultural resources are avoided or limited to areas lacking scientific or cultural value.	A. No physical impacts (i.e., alteration or demolition of resources) and some limited visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to historic or aesthetic settings are short-term and expected to return to an original or comparable condition (e.g., temporary vegetation

Impact Level	Definition for Historic Properties under Section 106 of the NHPA	Definition for Archaeological Resources and Ancient Submerged Landform Features	Definition for Historic Aboveground Resources
			clearing and construction vessel lighting).
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be altered in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association, but the adversely affected property would remain eligible for the NRHP.	As compared to Minor Impacts: A. Greater extent of damage to cultural resources from ground- or seabed-disturbing activities, including some loss of scientific or cultural data; or B. Disturbances to cultural resources are minimized or mitigated to a lesser extent, resulting in some damage to and loss of scientific or cultural value from the resources.	As compared to Minor Impacts: A. No or limited physical impacts and greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance; or B. Disruptions to settings are minimized or mitigated; or C. Historic or aesthetic settings may experience some long-term or permanent impacts.
Major	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur. Characteristics of historic properties would be affected in a way that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association to the extent that the property is no longer eligible for listing in the NRHP.	As compared to Moderate Impacts: A. Destruction of or greater extent of damage to cultural resources from ground- or seabed-disturbing activities; or B. Disturbances are minimized or mitigated but do not reduce or avoid the destruction or loss of scientific or cultural value from the cultural resources; or C. Disturbances are not minimized or mitigated resulting in the destruction or loss of scientific or cultural value from the resources.	As compared to Moderate Impacts: A. Physical impacts on cultural resources (for example, demolition of a cultural resource onshore); or B. Greater extent of changes to the integrity of cultural resources or visual disruptions to the historic or aesthetic settings from which resources derive their significance, including long-term or permanent impacts; or C. Disruptions to settings are not minimized or mitigated.

Contributing IPFs to impacts on cultural resources include accidental releases, anchoring, cable emplacement and maintenance, survey gear utilization, land disturbance, lighting, and presence of structures. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.6.2-4.

Table 3.6.2-4. Issues and indicators to assess impacts on cultural resources

Issue	Impact Indicator
Offshore seabed disturbance: potential physical destruction of, damage to, or entanglement with marine cultural resources	Qualitative analysis of impacts on pre- and post-Contact marine archaeological resources and ASLFs subject to physical impacts from activities occurring in offshore areas

Issue	Impact Indicator
Onshore ground disturbance: potential physical destruction of or damage to terrestrial archaeological and other cultural resources	Qualitative discussion of potential for impacts on terrestrial archaeological resources or any other resources subject to physical impacts from activities occurring in onshore areas
Viewshed disturbance: potential visual impact on identified aboveground historic properties	Qualitative assessment of maritime settings/ocean views of aboveground historic properties subject to visual impacts from components constructed or activities occurring offshore Qualitative assessment of settings/views of aboveground historic properties subject to visual impacts from components constructed or activities occurring onshore
Nighttime lighting: potential impact on identified historic properties	Qualitative assessment of dark nighttime settings of aboveground historic properties subject to visual lighting impacts from components constructed or activities occurring offshore or onshore

3.6.2.3 Impacts of Alternative A – No Action – Cultural Resources

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

3.6.2.3.1 Impacts of the No Action Alternative

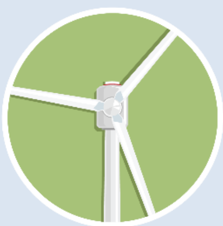
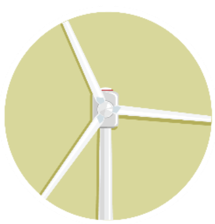
Under the No Action Alternative, baseline conditions for cultural resources described in Section 3.6.2.1, *Description of the Affected Environment and Future Baseline Conditions*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore-wind and offshore wind activities. Ongoing activities in the geographic analysis area that contribute to impacts on cultural resources include those with seabed disturbance or that introduce intrusive visual elements offshore. While such affected areas are not explicitly defined in the cultural resources geographic analysis area for this PEIS, ongoing activities may also include those with ground disturbance or that introduce intrusive visual elements onshore that would contribute to impacts on cultural resources. Ongoing offshore wind activities in the geographic analysis area that would contribute to impacts on cultural resources include ongoing construction of Ocean Wind 1 (OCS-A 0498) and Empire Wind 1 and 2 (OCS-A 0512). Ongoing construction of Ocean Wind 1 and Empire Wind 1 and 2 would have the same type of impacts on cultural resources that are described in Section 3.6.2.3.2, *Cumulative Impacts of the No Action Alternative,* for all ongoing and planned offshore wind activities in the geographic analysis area. Onshore and offshore construction activities and associated impacts are expected to continue at current trends and would have the potential to result in a range of minor to major impacts on cultural resources.

3.6.2.3.2 *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 development of the NY Bight lease areas). Other planned non-offshore-wind activities that may have impacts on cultural resources include undersea transmission lines and transmission systems, gas pipelines, and other submarine cables; dredging and port improvement projects; marine minerals use and ocean dredged material disposal; marine transportation; oil and gas activities; and other onshore development activities (see Appendix D, Section D.2, for descriptions of these activities).

Ongoing and planned offshore wind projects considered in this cumulative impact analysis (Table 3.6.2-5) are those with areas of intervisibility in which hypothetical NY Bight offshore wind structures and the planned project's offshore wind structures would be visible simultaneously (see Appendix D, Table D2-1 for more details on these projects).

Table 3.6.2-5. Ongoing and planned offshore wind projects excluding the NY Bight lease areas in the geographic analysis area

Ongoing/Planned	Projects by Region
Ongoing – 3 projects[1] 	**NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512)
Planned – 3 projects[2] 	**NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499)

NJ = New Jersey; NY = New York
[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.
[2] Status as of September 20, 2024.

The following sections summarize the potential impacts of ongoing and planned offshore wind activities on cultural resources during construction and installation, O&M, and conceptual decommissioning of the projects. Impacts on cultural resources are expected through the following primary IPFs.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, may potentially impact cultural resources. The majority of impacts associated with accidental releases would be considered negligible and would be caused by cleanup activities that require the removal of contaminated soils. In the planned activities scenario, accidental leaks of fuel, fluids, or hazardous materials are unanticipated from any of the WTGs or substations in the offshore NY Bight area. The potential for accidental releases, volume of released material, and associated need for cleanup activities from offshore wind projects in the geographic analysis area would be limited due to the low probability of occurrence, low volumes of material released in individual incidents, low persistence time, standard BMPs to prevent releases, and localized nature of such events (refer to Section 3.4.2, *Water Quality*). As such, most accidental releases from offshore wind development would not be expected to result in measurable impacts on cultural resources and would be considered negligible impacts. As described in Section 2.3, *Non-Routine Activities and Events*, accidental releases of chemicals, gases, or man-made debris may occur as a result of a structural failure and could result in impacts on cultural resources.

Although most 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. Although considered unlikely, a large-scale accidental release and associated cleanup could result in major impacts on cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials, resulting in damage to or complete removal of coastal and marine cultural resources during the removal of contaminated terrestrial soil or marine sediment; temporary or permanent impacts on the setting of coastal historic aboveground resources and TCPs; and damage to or removal of nearshore submerged marine cultural resources during contaminated soil/sediment removal. In addition, the accidentally released materials in deep-water settings could settle on marine cultural resources. In the case of marine archaeological resources, such as shipwrecks, downed aircraft, and debris fields, this may accelerate their decomposition or cover them and make them inaccessible or unrecognizable to researchers, resulting in a significant loss of historic information. Therefore, the potential major impacts of large-scale accidental releases would be permanent and geographically extensive.

Anchoring: Anchoring associated with ongoing commercial and recreational activities and the development of offshore wind projects has the potential to cause permanent, adverse impacts on marine cultural resources. These activities would increase during the construction and installation, O&M, and conceptual decommissioning of offshore wind energy facilities. Construction of offshore wind projects could result in impacts on cultural resources on the seafloor caused by anchoring. The placement and relocation of anchors and other seafloor gear such as wire ropes, cables, and anchor chains may affect the seafloor through sweeping, dragging, or emplacement and could potentially disturb, damage, or destroy marine cultural resources on or just below the seafloor surface. The damage or destruction of marine archaeological resources or ASLFs from these activities would likely result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts.

The scale of impacts on cultural resources due to anchoring would depend on the number of marine archaeological resources and ASLFs within offshore wind lease areas and offshore export cable corridors. Physical impacts that may damage or disturb marine archaeological resources due to anchoring can typically be avoided through the implementation of avoidance buffers or exclusion zones in project design. The number, extent, orientation, and dispersed character of the ASLFs make avoidance difficult, while the depth of these resources makes mitigative measures difficult and expensive. It is unlikely that offshore wind projects would be able to avoid all these resources. Existing federal and state requirements to identify and avoid maritime cultural resources may mitigate the potential for impacts. These existing requirements include the New York State Environmental Quality Review Act (SEQR) (2018), the New Jersey Register of Historic Places Act (1970), the NHPA (1966, as amended), the Archaeological and Historic Preservation Act (1974), and NEPA (1969). Some of these marine cultural resources are likely to be sunken military craft, which are afforded protection against unauthorized disturbance under the Sunken Military Craft Act of 2004 (H.R. 4200 108th Congress: Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005). Each of these state and federal requirements require project authorities to consider impacts on cultural or environmental resources in project planning and set forth specific measures to protect identified cultural or environmental resources from project impacts to the greatest extent possible. Specifically, as part of its compliance with the NHPA, BOEM requires offshore wind developers to conduct geophysical remote sensing surveys of proposed development areas to identify cultural resources and implement plans to avoid, minimize, or mitigate impacts on these resources. As a result, impacts on marine cultural resources from anchoring from ongoing and planned activities would be localized and permanent, and range from negligible to major on a case-by-case basis, depending on the ability of offshore wind projects to avoid, minimize, or mitigate impacts. In cases where the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction, moderate to major impacts could occur.

Cable emplacement and maintenance: Construction of ongoing and planned offshore wind infrastructure could have geographically extensive and permanent impacts on cultural resources, such as disturbance or destruction of marine cultural resources on or just below the seafloor surface. The damage to marine cultural resources from these activities would likely result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts. Ongoing and planned offshore wind projects would likely result in seabed disturbance from the installation of interarray and offshore export cables and associated installation activities that may occur within cable corridors. Construction and installation, O&M, and conceptual decommissioning of these cables may necessitate additional geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. Ongoing and planned offshore wind development projects that are expected to lay cable in the geographic analysis area, aside from projects in the NY Bight lease areas, include those listed in Table 3.6.2-5. There is the potential that other projects near the NY Bight area that do not yet have published COPs may propose cable routes that also intersect the geographic analysis area. A prior study of the OCS (BOEM 2012) suggests that the offshore wind lease areas and export cable corridors of offshore wind projects likely contain marine archaeological resources, which could be subject to impacts from offshore construction activities.

As part of compliance with the NHPA, BOEM and SHPOs will require planned offshore wind project applicants to conduct extensive geophysical surveys of offshore wind lease areas and export cable corridors to identify marine archaeological resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of cable emplacement and maintenance on marine archaeological resources would be infrequent and isolated, and in cases where conditions are imposed to avoid such resources, impacts would be negligible.

However, if marine archaeological resources are present and cannot be avoided, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts, unless these resources can be avoided. As such, across potential circumstances, the magnitude of impacts would range from negligible to major.

If present in a project area, the number, extent, orientation, and dispersed character of ASLFs make avoidance impossible in many situations and make extensive archaeological investigations of formerly terrestrial archaeological resources in these features logistically challenging and prohibitively expensive. Due to the submerged and buried nature of ASLFs, HRG surveys can roughly delineate the features; the surveys cannot delineate specific archaeological resources within those features. Additionally, coring would be needed to properly characterize the paleoenvironment to understand whether the area would have been attractive to habitation or resource utilization by past peoples. Such analysis may also provide insights into whether human habitation may have occurred in a particular area. Coring itself is a form of impact on the environment, and the impacts would need to be considered in context of the potential information to be gained. As a result, offshore construction related to cable emplacement and maintenance could result in geographically widespread and permanent adverse impacts on portions of these resources, such as disturbance or destruction of ASLFs on or just below the seafloor surface resulting in the permanent and irreversible loss of scientific information or cultural value. For ASLFs that cannot be avoided, mitigation would likely be considered under the NHPA review process, including studies to document the nature of the paleoenvironment during the time these now-submerged landscapes could have been occupied and provide Native American Tribes with the opportunity to include their history in these studies. However, the magnitude of these impacts would remain moderate to major, due to their permanent, irreversible nature.

Survey gear utilization: Construction and installation, O&M, and conceptual decommissioning of offshore wind activities may necessitate additional monitoring or geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in adverse impacts. Examples of impacts may include disturbance, dislodging, damage, or destruction of marine archaeological resources through contact with survey gear. Offshore wind projects in the geographic analysis area as listed in Table 3.6.2-5 have the potential to conduct these additional surveys. A BOEM study (BOEM 2012) suggests that the offshore wind lease areas and offshore export cable corridors of offshore wind projects likely contain marine archaeological resources that could be subject to impacts from survey gear utilization.

As part of compliance with the NHPA, BOEM and SHPOs will require offshore wind project applicants to conduct extensive geophysical surveys of offshore wind lease areas and offshore export cable corridors to identify submerged marine cultural resources. These geophysical surveys are typically designed to avoid entanglement with marine cultural resources, but infrequent and isolated occurrences of survey instruments making physical contact with marine cultural resources are possible and could potentially result in minor impacts on cultural resources. Due to the federal and state requirements to avoid, minimize, or mitigate these resources when identified, the adverse impacts of survey gear utilization from subsequent survey activities on marine cultural resources would be infrequent and isolated, and in cases where conditions are imposed to avoid marine cultural resources, impacts would be negligible.

However, if survey gear utilization activities were to occur prior to the identification of marine cultural resources, impacts on previously unidentified resources could occur, and the magnitude of these impacts could be moderate to major in the case of an entanglement, due to the permanent, irreversible nature of the impacts, unless these marine cultural resources can be avoided.

Land disturbance: The construction of onshore components associated with offshore wind projects, such as electrical export cables and onshore substations, could result in adverse physical impacts on known and undiscovered cultural resources. The construction of planned transmission infrastructure, such as PBI, could also result in adverse physical impacts on known and undiscovered cultural resources. Such ground-disturbing construction activities could disturb or destroy undiscovered archaeological resources and TCPs, if present, by grading or excavating in areas without having conducted prior comprehensive archaeological surveys, or without implementing appropriate avoidance buffers for known archaeological resources. The number of cultural resources subject to impacts and the scale, extent, and severity of impacts would depend on the location of specific project components relative to recorded and undiscovered cultural resources and the proportion of the resource subject to impacts. State and federal requirements to identify cultural resources, assess project impacts, and develop treatment plans to avoid, minimize, or mitigate adverse impacts would limit the extent, scale, and magnitude of impacts on individual cultural resources; as a result, if adverse impacts from this IPF occur, they would likely be permanent but localized, and range from negligible to major. Less substantial impacts of negligible-to-minor intensity could occur if activities utilize areas where prior ground disturbance has occurred, such as for existing infrastructure, rather than undeveloped or undisturbed areas, whereas more substantial impacts of moderate-to-major intensity could occur if designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting: Development of ongoing and planned offshore wind projects would increase the amount of offshore anthropogenic light from vessels, the amount of area lighting during construction and conceptual decommissioning of projects (to the degree that construction occurs at night), and the use of aircraft and vessel hazard/warning lighting on WTGs and OSSs during operation. Ongoing and planned offshore wind development includes up to 697 WTGs with a maximum blade tip height of approximately 1,049 feet (320 meters) AMSL that could impact cultural resources.

Construction and conceptual decommissioning lighting would be most noticeable if construction activities occur at night. Up to six lease areas in the geographic analysis area (excluding the NY Bight lease areas) could be constructed from 2023 through 2030 and beyond (see Appendix D, Table D-2). Some of the offshore wind projects could require nighttime construction lighting, and all would require nighttime hazard lighting during operations. Construction lighting from any project would be temporary, lasting only during nighttime construction, and could be visible from shorelines and elevated locations, although such light sources would be limited to individual WTGs or OSSs and nearby vessels rather than the entirety of the lease areas in the geographic analysis area. Aircraft and vessel hazard lighting systems installed on the tower and on the nacelle of each WTG would be in use for the entire operational phase of each offshore wind project, resulting in long-duration impacts. The intensity of these impacts would be relatively low and considered minor, as the lighting would consist of small, intermittently flashing lights at a significant distance from the resources.

The impacts of construction and operational lighting would be limited to cultural resources subject to visual impacts and for which a dark nighttime sky is a contributing element to historical integrity. The intensity of lighting impacts would be limited by the distance between resources and the nearest lighting sources. The intensity of lighting impacts would be further reduced by atmospheric and environmental conditions such as clouds, fog, and waves that could partially or completely obscure or diffuse sources of light. As a result, nighttime construction and conceptual decommissioning lighting would have localized, temporary, and intermittent impacts on a limited number of cultural resources. Operational lighting would have localized, long-term, and continuous impacts on a limited number of cultural resources. Operational lighting impacts would be reduced if ADLS is used to meet FAA aircraft hazard lighting requirements. ADLS would activate the aviation lighting on WTGs and OSSs only when an aircraft is within a predefined distance of the structures. The reduced time of FAA hazard lighting resulting from an ADLS, if implemented, would likely reduce the duration of the potential impacts of nighttime aviation lighting compared with the normal operating time that would occur without using ADLS. The use of ADLS or related systems on offshore wind projects would likely result in similar limits on the frequency of WTG and OSS aviation warning lighting use. This technology, if used, would reduce the impacts of lighting on cultural resources, resulting in localized, negligible to moderate impacts; however, without it, widespread, major impacts from ongoing and planned offshore wind activities are possible.

Onshore structure lighting would be required for ongoing and planned offshore wind projects and could impact cultural resources. The magnitude of impact would depend on the height of the buildings or towers and the intensity of the lighting fixtures. The impacts on cultural resources from these lights would be minimized by the distance between the facilities and cultural resources, and the presence of vegetation, buildings, or other visual buffers that may diffuse or obscure the light. Therefore, lighting associated with onshore components from ongoing and planned offshore wind activities could have long-term, continuous, negligible to moderate impacts on cultural resources.

Presence of structures: The development of ongoing and planned offshore wind projects would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources along the coasts of the NY Bight area. Up to 729 WTGs, OSSs, and meteorological towers would be added in the geographic analysis area for cultural resources, with maximum WTG blade tip height of approximately 1,049-feet (320 meters) AMSL.

Visual impacts on cultural resources from the presence of structures would be limited to those cultural resources from which ongoing and planned offshore wind projects would be visible, which would typically be limited to historic aboveground resources such as buildings, structures, objects, and districts, and could include significant cultural landscapes relatively close to shorelines and on elevated landforms near the coast. The magnitude of impacts from the presence of structures would be greatest for cultural resources for which a maritime view, free of modern visual elements, is an integral part of their historic integrity and that contributes to their eligibility for listing in the NRHP. Due to the distance between the ongoing and planned wind development projects and the nearest historic aboveground resources, WTGs of individual projects would appear relatively small on the horizon, and the visibility of individual structures would be further affected by environmental and atmospheric conditions such as vegetation, clouds, fog, sea spray, haze, and wave action (for a detailed explanation, see Section 3.6.9, *Scenic and Visual Resources*). While environmental and atmospheric factors would intermittently limit the intensity of impacts, the presence of visible WTGs from offshore wind activities could have widespread, long-term, continuous, major impacts on cultural resources.

Additionally, the presence of onshore components associated with offshore wind projects, including substations, converter or switching stations, transmission lines, O&M facilities, and other components, would introduce new, modern, and intrusive visual elements to the viewsheds of cultural resources located within sight of these components in New Jersey and New York. The magnitude of impacts from the presence of structures would be greatest for historic aboveground resources for which a setting free of modern visual elements is an integral part of their historic integrity and contributes to historic properties' eligibility for listing in the NRHP. Factors such as distance and visual buffers, including vegetation and buildings, would also affect the intensity of these impacts. While these factors would limit the intensity of impacts, the presence of onshore components associated with ongoing and planned offshore wind projects would have localized, long-term, continuous, negligible to major impacts on cultural resources.

Ongoing and planned offshore wind projects could also result in seabed disturbance from construction and installation of structure foundations and scour protection for WTGs and OSSs, which could have geographically extensive and permanent impacts on cultural resources, such as damage or destruction of marine archaeological resources or ASLFs on or just below the seafloor surface. The damage to cultural resources from these activities would likely result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts. A prior study of the OCS (BOEM 2012) suggests that the offshore wind lease areas likely contain cultural resources, which could be subject to such impacts from offshore construction activities.

As part of compliance with the NHPA, BOEM and SHPOs will require offshore wind project applicants to conduct extensive geophysical surveys of offshore wind lease areas to identify cultural resources and avoid, minimize, or mitigate these resources when identified. Due to these federal and state requirements, the adverse impacts of offshore construction of structure foundations on marine archaeological resources or ASLFs would be infrequent and isolated, and in cases where conditions are imposed to avoid such resources, impacts would be negligible. However, if resources are present and cannot be avoided, the magnitude of these impacts would remain moderate to major, due to the permanent, irreversible nature of the impacts. In circumstances where cultural resources cannot be avoided, reducing the size of scour protection installed around structure foundations can minimize disturbance or destruction of the resources. As such, across potential circumstances, the magnitude of impacts would range from negligible to major.

As described under the anchoring and cable emplacement and maintenance IPFs, avoidance of ASLFs may be impossible in many situations, and mitigation would likely be considered under the NHPA review process. The magnitude of impacts on ASLFs would be moderate to major, due to their permanent, irreversible nature.

3.6.2.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, cultural resources would continue to be subject to impacts from existing environmental trends and ongoing activities. Ongoing activities are expected to have continued short-term, long-term, and permanent impacts on cultural resources. These impacts are primarily driven by offshore construction activities and the presence of structures and to a lesser extent onshore construction impacts. The primary sources of onshore impacts from ongoing activities include ground-disturbing activities and the introduction of intrusive visual elements, while the primary sources of offshore impacts include activities that may disturb the seafloor or otherwise physically damage or destroy marine cultural resources, such as ongoing dredging and cable emplacement. Other ongoing activities that may potentially disturb the seafloor or submerged marine cultural resources include accidental release and associated cleanup of contaminated soils, and physical entanglements due to vessel anchoring. Given the extent of known cultural resources in the region and the extent of ongoing development on the OCS, ongoing activities would noticeably contribute to impacts on cultural resources. While long-term and permanent impacts may occur as a result of offshore wind development, impacts would be reduced through the NHPA Section 106 consultation process to resolve adverse effects on historic properties. The No Action Alternative would likely result in **minor** to **major** impacts on cultural resources.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and cultural resources would continue to be subject to impacts by natural processes and human-caused IPFs. Planned activities would contribute to impacts on cultural resources due to disturbance, damage, disruption, and destruction of individual cultural resources located onshore and offshore. BOEM anticipates that the cumulative impacts of the No Action Alternative would likely be **major** due to the extent of known cultural resources in the region subject to impacts.

3.6.2.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Cultural Resources

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Table 3.6.2-6 provides key statistics about the NY Bight lease areas as relevant to the analysis of one NY Bight project and six NY Bight projects that follow in this section.

Table 3.6.2-6. NY Bight lease area descriptive statistics

Statistic		One Project (by NY Bight Lease Area [OCS-A])						Six Projects
		0537	0538	0539	0541	0542	0544	
Estimated WTG Count		50–280						1,103
Lease Area Size (acres)		71,522	84,332	125,964	79,351	83,976	43,056	488,201
Distance to Shore (nautical miles)	To New York	38*	47	56	65	69	20*	38
	To New Jersey	53	36*	32*	27*	35*	36	27*

Source: BOEM n.d.

* Denotes nearest distance to the shoreline.

As discussed in the introduction to Section 3.6.2, BOEM has defined a conservative Programmatic APE meant to encapsulate future COP-specific APEs when that information becomes available. BOEM is therefore analyzing potential impacts on cultural resource types that may be present in the Programmatic APE. However, other cultural resources and cultural resource types subject to potential impacts and not identified in BOEM's analysis are possible; these are discussed generally throughout this section.

It is commonly understood that there is no comprehensive or sufficient existing survey of cultural resources and historic properties covering the totality of the cultural resources geographic analysis area and Programmatic APE; thus, there may be cultural resources that could be affected by development in the NY Bight region that have not yet been identified. As part of compliance with federal and state requirements, offshore wind project applicants are required to conduct cultural resource and historic property identification studies and commit to measures for avoiding, minimizing, or mitigating identified resources. These are considered standard processes for preconstruction activities. In general, due to the types, extent, and specificity of measures necessary to avoid, minimize, or mitigate impacts on cultural resources and effects on historic properties per Sections 106 and 110 of the NHPA, COP-specific NEPA and NHPA review and consultations would still be required beyond this PEIS.

3.6.2.4.1 Impacts of One Project

While development of a single NY Bight project within the RPDE is not intended to be associated with any particular lease area and is instead intended to be representative of development that could occur in any of the six NY Bight lease areas (see Chapter 2, Section 2.1.2.1, *One Project*), the programmatic analysis of impacts on cultural resources from one NY Bight project benefits from delineating the specific location within which the RPDE would be developed to the extent possible (see Section 3.6.2.1 for a description of the knowable extent of the cultural resources geographic analysis area and Programmatic APE). As such, the analysis in this section includes a comparison of impacts on cultural resources by the location of one NY Bight project where differences are anticipated by NY Bight lease area.

Overall, IPFs from the development of one NY Bight project under Alternative B would impact cultural resources in the same manner as those described for the corresponding IPFs in Section 3.6.2.3.2, *Cumulative Impacts of the No Action Alternative*. Accordingly, the discussion does not repeat the analyses supplied in Section 3.6.2.3.2 but describes any differences in impact types, severity factors and assessments, and conclusions.

Accidental releases: Accidental release of fuel, fluids, hazardous materials, trash, or debris, if any, may potentially impact cultural resources. Development of offshore components of one NY Bight project under the RPDE would include storage for a variety of potential chemicals such as coolants, oils, lubricants, and diesel fuel (see Appendix D, Table D2-3) and use of several types of machinery, vehicles, and ocean-going vessels (see Chapter 2, Table 2-2) from which there may be unanticipated release or spills of substances into receiving waters or onto land. A NY Bight project developed in a location containing a greater number of cultural resources would have greater likelihood for impacts on such resources than a location with a lesser amount due to the localized nature of accidental releases anticipated for the majority of cases. However, a single, large-scale accidental release such as an oil spill could have more geographically extensive impacts beyond the location of the one NY Bight project. Overall, BOEM anticipates impacts on cultural resources from accidental releases from one NY Bight project under Alternative B, if any, would be localized, short-term, and negligible in the majority of cases but could be geographically extensive, permanent, and major depending on the number and scale of accidental releases.

Anchoring: Anchoring associated with offshore activities of one NY Bight project could have physical impacts on marine cultural resources, the severity of which would depend on the location (e.g., which specific NY Bight lease area, routes of offshore export cable corridor[s]), and number of impacted marine archaeological resources and ASLFs. One NY Bight project developed in a location containing a greater number of resources would have greater likelihood for impacts on such resources than a location with a lesser amount due to the localized nature of anchoring impacts. Specific locations of offshore export cable corridor(s) or any other offshore seabed-disturbing activities in the RPDE are unknown. Additionally, one NY Bight project developed in a larger or closer-to-shore offshore area may have a greater likelihood for unanticipated discovery of and impacts on marine archaeological resources (for the sizes of and distances to shore from the NY Bight lease areas see Table 3.6.2-6; BOEM 2012). Overall, BOEM anticipates impacts on cultural resources from anchoring from one NY Bight project under Alternative B would be localized and permanent, and they would range from negligible to major depending on the types and quantity of resources present. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Cable emplacement and maintenance: The installation of interarray cables and offshore export cables for one NY Bight project constructed within the RPDE could include site preparation activities (e.g., dredging, trenching) and cable installation via jet trenching, plowing/jet plowing, or mechanical trenching, which could have physical impacts on cultural resources. The cultural resource types subject to potential impacts and potential range of severity and extent of impacts on cultural resources under this IPF are the same as those described under the *Anchoring* IPF for one NY Bight project under Alternative B. Overall, BOEM anticipates impacts on cultural resources from cable emplacement and maintenance from one NY Bight project under Alternative B would be localized and permanent, and would range from negligible to major depending on the types and quantity of resources present. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Survey gear utilization: Construction and installation, O&M, and conceptual decommissioning of one NY Bight project may necessitate additional monitoring or geophysical surveys, from which gear utilization could cause entanglements with marine archaeological resources, resulting in physical impacts. The adverse impacts of survey gear utilization on marine archaeological resources would be infrequent and isolated, and in cases where conditions are imposed to avoid resources, impacts would be negligible. However, the magnitude of these impacts would remain moderate to major in the case of an entanglement, due to the permanent, irreversible nature of the impacts, unless these marine archaeological resources can be avoided. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Land disturbance: While specific locations of onshore components of one NY Bight project are undefined, land disturbance associated with the construction of such components could have physical impacts on cultural resources. Ground-disturbing activities associated with construction (e.g., site clearing, grading, excavation, and filling) could have physical impacts on cultural resources, including terrestrial archaeological resources. The number of resources subject to impacts would depend on the location of specific NY Bight project components relative to known and undiscovered cultural resources, and the severity of impacts would depend on the horizontal and vertical extent of disturbance relative to the size of the resources subject to impacts. As a result, for terrestrial archaeological resources and any other cultural resource type subject to physical impacts, physical impacts of land disturbance would have negligible to major impacts.

Components of onshore facilities that would be buried underground may involve visual impacts on historic aboveground resources during construction (e.g., presence of construction equipment). However, these would be temporary, short-term impacts, and the underground components would not have any long-term visual impacts once built and operational. As a result, for historic aboveground resources, visual impacts of land disturbance would have negligible to minor impacts.

Overall, BOEM anticipates impacts on cultural resources from land disturbance from a single NY Bight project under Alternative B would be localized, range from temporary to permanent, and range from negligible to major. Less substantial impacts of negligible-to-minor intensity could occur if activities utilize areas where prior ground disturbance has occurred, such as for existing infrastructure, rather than undeveloped or undisturbed areas, whereas more substantial impacts of moderate-to-major intensity could occur if the design cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting: Use of lighting onshore and offshore during the construction and installation, O&M, and conceptual decommissioning of one NY Bight project could have visual impacts on cultural resources by introducing new sources of light into historic contexts. While specific locations of onshore components of one NY Bight project are undefined, onshore construction and conceptual decommissioning area lighting and operational lighting on substations and converter stations could cause temporary to long-term impacts. However, due to the extent of existing development in New Jersey and New York where potential locations of onshore components are likely, lighting from onshore components of one NY Bight project is not expected to contribute significantly to the sky glow and is unlikely to have measurable impacts on historic aboveground resources.

Offshore construction and conceptual decommissioning area lighting and operational lighting on WTGs and OSSs of one NY Bight project could also cause impacts, the severity of which could vary based on the number and proximity to shore of WTGs and OSSs. In general, one NY Bight project developed with fewer WTGs and OSSs and farther from shore would likely result in fewer impacts on historic aboveground resources as compared to one NY Bight project developed with a greater number of WTGs and OSSs and closer to shore (see Table 3.6.2-6 for RPDE parameters for one NY Bight project as developed in each NY Bight lease area). Overall, BOEM anticipates impacts on cultural resources from lighting from one NY Bight project under Alternative B would range from localized to widespread and from temporary to long-term, resulting in negligible to major impacts depending on the locations and types of lighting sources and their proximity to historic aboveground resources.

Presence of structures: The presence of onshore and offshore structures of one NY Bight project could have visual impacts on cultural resources along the coasts of New Jersey and New York by introducing new modern infrastructure within a setting that historically consisted of unimpeded maritime views. The cultural resource types and known aboveground historic properties subject to potential impacts, potential range of and factors in determining impact severity, and extent of impacts on cultural resources under this IPF are the same as those described under the *Lighting* IPF for one NY Bight project under Alternative B. As with the lighting IPF, the severity of impacts from the presence of structures could vary based on the number and proximity to shore of WTGs and OSSs, as illustrated by the visual simulations of ocean views from two different historic properties (refer to Appendix I for additional information about the visual simulations prepared for the NY Bight lease areas). The visual simulation of KOP 03 Stafford Beach shows that the WTGs located more than 40 miles away appear small and indistinguishable, while the visual simulation of KOP 32 Fire Island Lighthouse shows that the WTGs that are closer to shore relative to the KOP disrupt the visual experience of the maritime setting of this resource.

Overall, BOEM anticipates visual impacts on cultural resources from the presence of structures from one NY Bight project under Alternative B would range from localized to widespread and from temporary to long-term, resulting in negligible to major impacts depending on the locations and heights of WTGs and their proximity to historic aboveground resources and their significant historic contexts.

Offshore construction of foundations for WTGs and OSSs for one NY Bight project could also result in physical disturbance of the seabed, which could have geographically extensive and permanent impacts on cultural resources, such as damage or destruction of cultural resources on or just below the seafloor surface. The damage to cultural resources from these activities would likely result in the permanent and irreversible loss of scientific or cultural value and would be considered major impacts. The cultural resource types subject to potential impacts and potential range of severity and extent of impacts on cultural resources under this IPF are the same as those described under the *Anchoring* IPF for one NY Bight project under Alternative B. Overall, BOEM anticipates offshore physical impacts on cultural resources from the presence of structures from one NY Bight project under Alternative B would range from localized to widespread and from temporary to permanent, resulting in negligible to major impacts depending on the location, number, and orientation of cultural resources and ASLFs within the lease areas. More substantial impacts could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

3.6.2.4.2 Impacts of Six Projects

Overall, IPFs from the development of six NY Bight projects under Alternative B would impact cultural resources in the same manner as those described for the corresponding IPFs for one NY Bight project under Alternative B but would be of greater likelihood, intensity, or extent (Section 3.6.2.4.1). Accordingly, the discussion below does not repeat the analyses supplied in Section 3.6.2.4.1 but describes any differences in impact types, severity assessments, severity factors, and conclusions as compared to the development of one NY Bight project.

Accidental releases: The development of six NY Bight projects compared to one NY Bight project would have a greater likelihood of accidental releases that could potentially impact cultural resources due to the increased storage of potential chemicals and use of machinery, vehicles, and ocean-going vessels from which there may be unanticipated release or spills of substances into receiving waters or onto land. Additionally, a greater number of cultural resources could be subject to potential localized impacts. Overall, BOEM anticipates impacts on cultural resources from accidental releases from six NY Bight projects under Alternative B, if any, would still be localized, short-term, and negligible in the majority of cases but could be geographically extensive, permanent, and major depending on the number and scale of accidental releases.

Anchoring: Anchoring associated with offshore activities of six NY Bight projects would have greater overall impacts on cultural resources due to the greater number of marine cultural resources subject to potential impacts and greater geographic area within which unanticipated discovery of and impacts on marine archaeological resources could occur. Overall, BOEM anticipates impacts on cultural resources from anchoring from six NY Bight projects under Alternative B would still be localized and permanent, and would range from negligible to major. Impacts of a greater magnitude could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Cable emplacement and maintenance: The circumstances of impacts on cultural resources under this IPF are the same as those described under the *Anchoring* IPF for six NY Bight projects under Alternative B. Overall, BOEM anticipates impacts on cultural resources from cable emplacement and maintenance from six NY Bight projects under Alternative B would be localized and permanent, and range from negligible to major. Impacts of a greater magnitude could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Survey gear utilization: The circumstances of impacts on cultural resources under this IPF are the same as those described under the *Survey gear utilization* IPF for one NY Bight project under Alternative B. The adverse impacts of survey gear utilization on marine archaeological resources would be infrequent and isolated, and in cases where conditions are imposed to avoid resources, impacts would be negligible. However, the magnitude of these impacts would remain moderate to major in the case of an entanglement, due to the permanent, irreversible nature of the impacts, unless these marine archaeological resources can be avoided. Impacts of a greater magnitude could occur if the final project designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Land disturbance: While specific locations of onshore components of six NY Bight projects are undefined, land disturbance associated with the development of six NY Bight projects would have greater overall impacts due to the greater geographic area within which physical and visual impacts on cultural resources and unanticipated discovery of and physical impacts on terrestrial archaeological resources could occur. Overall, BOEM anticipates impacts on cultural resources from land disturbance from six NY Bight projects under Alternative B would still be localized, range from temporary to permanent, and range from negligible to major. Less substantial impacts could occur if the final project designs utilize areas where prior ground disturbance has occurred, such as for existing infrastructure, rather than undeveloped or undisturbed areas, and more substantial impacts could occur if designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting: Use of lighting onshore and offshore during the construction and installation, O&M, and conceptual decommissioning of six NY Bight projects would have greater overall visual impacts on cultural resources by introducing new sources of light into a greater number of historic contexts. Overall, BOEM anticipates impacts on cultural resources from lighting from six NY Bight projects under Alternative B would be widespread, range from temporary to long-term, and range from negligible to major depending on the locations and types of lighting sources, their proximity to historic aboveground resources and their significant historic contexts.

Presence of structures: The presence of onshore and offshore structures of six NY Bight projects would have greater overall visual impacts on cultural resources due to being more geographically visible along the coasts of New Jersey and New York. The circumstances of impacts on cultural resources under this IPF are the same as those described under the *Lighting* IPF for six NY Bight projects under Alternative B. Overall, BOEM anticipates visual impacts on cultural resources from the presence of structures from six NY Bight projects under Alternative B would be widespread, range from temporary to long-term, and range from negligible to major depending on the locations and types of lighting sources, their proximity to historic aboveground resources and their significant historic contexts.

Offshore construction of foundations for WTGs and OSSs for six NY Bight projects would also have greater overall physical impacts on cultural resources due to the increased area of disturbance of the seabed. The circumstances of impacts on cultural resources under this IPF are the same as those described under the *Anchoring* IPF for six NY Bight projects under Alternative B. Overall, BOEM anticipates offshore physical impacts on cultural resources from the presence of structures from six NY Bight projects under Alternative B would range from localized to widespread, from temporary to permanent, and from negligible to major depending on the location, number, and orientation of cultural resources and ASLFs within the lease areas.

3.6.2.4.3 Cumulative Impacts of Alternative B

The analysis of cumulative impacts considers the potential impacts of six NY Bight projects in combination with other ongoing and planned non-offshore-wind and offshore wind activities. Overall, potential cumulative impacts on cultural resources under Alternative B would occur in the same manner as those described for cumulative impacts under Alternative A (Section 3.6.2.3.2). However, the additive impacts of six NY Bight projects, as analyzed in Section 3.6.2.4.2, would increase the overall likelihood, intensity, or extent of impacts on cultural resources. Accordingly, the discussion below does not repeat the analyses supplied in Sections 3.6.2.3.2 or 3.6.2.4.2 but summarizes any differences in impact types, severity factors and assessments, and conclusions.

Accidental releases: The cumulative impacts of accidental releases on cultural resources under Alternative B would be the same as or similar to those under Alternative A. While development of the six NY Bight projects would increase the number of vessels and facilities containing fuel, fluids, hazardous materials, trash, or debris in the region, and therefore increase the likelihood of an accidental release occurring that could potentially impact marine archaeological resources, the majority of potential impacts, if any, would be negligible on cultural resources in most cases, except for rare cases of large-scale accidental release that represent major impacts.

Anchoring: The cumulative impacts of anchoring on cultural resources under Alternative B would be increased compared to those under Alternative A. Development of the six NY Bight projects would increase the extent of anchoring activities in the region and therefore increase the number of marine cultural resources subject to potential anchoring impacts.

Cable emplacement and maintenance: The cumulative impacts of cable emplacement and maintenance on cultural resources under Alternative B would be increased compared to those under Alternative A. Development of the six NY Bight projects would increase the extent of cabling activities in the region and therefore increase the number of marine cultural resources subject to potential anchoring impacts.

Survey gear utilization: The cumulative impacts of survey gear utilization on cultural resources under Alternative B would be the same as or similar to those under Alternative A. While development of the six NY Bight projects would increase the extent of survey gear utilization activities in the region, and therefore increase the likelihood of survey gear utilization causing entanglements with marine archaeological resources resulting in moderate to major impacts, the majority of potential impacts on cultural resources, if any, would be infrequent, isolated, and negligible.

Land disturbance: The cumulative impacts of land disturbance on cultural resources under Alternative B would be similar or increased compared to those under Alternative A. Similar impacts could occur if the final project designs utilize areas where prior ground disturbance has occurred, such as for existing infrastructure, rather than undeveloped or undisturbed areas, and more substantial impacts could occur if designs cannot avoid known resources or if previously undiscovered resources are discovered during construction.

Lighting: The cumulative impacts of lighting on cultural resources under Alternative B would be increased compared to those under Alternative A. Development of the six NY Bight projects would increase the number of lighting sources in the region and therefore increase the number of historic aboveground resources and contexts subject to potential visual impacts.

Presence of structures: The cumulative impacts of presence of structures on cultural resources under Alternative B would be increased compared to those under Alternative A. Development of the six NY Bight projects would increase the number of structures in the region and therefore increase the number of historic aboveground resources and contexts subject to potential visual impacts, as well as the number of marine cultural resources and contexts subject to potential physical impacts resulting from construction of structure foundations.

3.6.2.4.4 Conclusions

Impacts of Alternative B. The construction and installation, O&M, and conceptual decommissioning of one NY Bight project, depending on the NY Bight lease area subject to development, would likely result in **moderate** to **major** impacts overall. The development of a NY Bight lease area closer to the shoreline or entailing ground or seabed disturbances to a larger area would likely have greater impacts on cultural resources than development of a lease area farther from the shoreline or entailing ground or seabed disturbances to a smaller area. Six NY Bight projects would likely have **major** impacts overall on cultural resources. Impacts of one or six NY Bight projects would be due to the extent of onshore and offshore development that could introduce physical and visual impacts on cultural resources.

Cumulative Impacts of Alternative B. BOEM anticipates cumulative impacts on cultural resources from six NY Bight projects in combination with other ongoing and planned non-offshore-wind and offshore wind activities would likely be **major** due to the extent of onshore and offshore development and extent of known cultural resources in the region subject to impacts. In the context of other reasonably foreseeable environmental trends, the impacts contributed by Alternative B to the cumulative impacts on cultural resources would be noticeable.

3.6.2.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Cultural Resources

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight Area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives – Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from those impacts discussed in Sub-alternative C1.

Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.6.2.5.1 Sub-alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations (Table 3.6.2-7).

Table 3.6.2-7. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for cultural resources

Measure ID	Measure Summary
CUL-2	This measure proposes that BOEM establish and lessees comply with requirements for all avoidance buffers recommended by BOEM for each marine cultural resource (i.e., archaeological resource and ASLFs) based on the size and dimension of the resource. If an adverse effect cannot be avoided, the lessee will be required to conduct further investigations to minimize or resolve effects on these historic properties. If avoidance of an unevaluated resource is infeasible, additional investigations must be conducted for the purpose of determining eligibility for listing in the NRHP.
CUL-3	This measure proposes that BOEM establish and lessees comply with monitoring and post-review discovery plans outlining processes to document and review impacts of construction or any seabed-disturbing activities on marine cultural resources.
CUL-4	BOEM will establish avoidance criteria for any identified terrestrial archaeological historic property or any unevaluated terrestrial archaeological resource. This measure proposes lessees avoid impacts on identified terrestrial archaeological historic properties or unevaluated resources. If avoidance is infeasible, the lessee must develop a plan to be submitted to BOEM that addresses the adverse effect on the terrestrial archaeological resource. If avoidance of an unevaluated resource is infeasible, additional investigations must be conducted for the purpose of determining eligibility for listing in the NRHP.
CUL-5	This measure proposes that BOEM establish and lessees comply with monitoring and post-review discovery plans outlining processes to document and review impacts of construction or any ground-disturbing activities on terrestrial archaeological resources. A monitoring plan may be required for certain areas, identified through consultation, to ensure impacts on resources are avoided or minimized. A post-review discovery plan will be required for the purposes of establishing a protocol in the event of an unanticipated discovery and/or inadvertent impact of a terrestrial archaeological resource.
MUL-2	This measure proposes submittal and implementation of an anchoring plan to reduce impacts from turbidity and avoid anchor placement that would result in impacts on archaeological resources.
MUL-37	This measure proposes the use of ADLS and adherence to FAA regulations regarding lighting of offshore structures to minimize light pollution and species impacts while ensuring the structures are visible to aircraft.

Impacts of One Project

Overall, the IPFs and impacts of one NY Bight project on cultural resources under Sub-alternative C1 would be the same or similar to those for one NY Bight project under Alternative B. The Programmatic Agreement currently under development for all NY Bight projects (NY Bight PA) would enable a more consistent process allowing the future COP-specific NEPA and NHPA reviews, consultations, and plans to be focused on the project-specific impacts. The NY Bight PA may enable greater assurances that impacts on cultural resources could be avoided, reduced, or resolved through measures agreed upon by federally recognized Tribes, ACHP, SHPOs, lessees, and other consulting parties.

As part of compliance with federal and state requirements and the conditions of the leases, offshore wind project applicants are required to conduct requisite cultural resource and historic property identification studies and commit to measures for avoiding, minimizing, or mitigating identified resources. These are considered standard processes for preconstruction activities.

In general, due to the types, extent, and specificity of measures necessary to avoid, minimize, or mitigate impacts on cultural resources and effects on historic properties per Sections 106 and 110 of the NHPA, the effectiveness of the AMMM measures cannot be fully known until BOEM conducts the COP-specific NEPA and NHPA reviews and consultations. These COP reviews would fully determine the extent to which measures listed in Table 3.6.2-7 are able to address resource-specific impacts on cultural resources identified during the cultural resource and historic property identification studies prepared by the lessees. However, if applied, the AMMM measures may change the level of impact from several IPFs on cultural resources in the following ways:

Accidental releases: The impacts of accidental releases on cultural resources under Sub-alternative C1 would be the same as or similar to those under Alternative B. The majority of potential impacts, if any, would be negligible on cultural resources in most cases, except for rare cases of large-scale accidental release that represent major impacts. AMMM measures for cultural resources listed in Table 3.6.2-7 are not likely to change this level of impact.

Anchoring, cable emplacement and maintenance, and **survey gear utilization**: The impacts of these IPFs on marine archaeological resources and ASLFs from the development of any one of the six NY Bight lease areas would be decreased compared to those under Alternative B. Sufficient development and implementation of COP-specific avoidance measures per CUL-2 and MUL-2 would likely result in negligible impacts. CUL-3, which would establish detailed, location-specific protocols for handling unanticipated discovery of marine archaeological resources, would allow for negligible to minor impacts that could otherwise be moderate to major with only the general protocols outlined in the lease agreements.

Land disturbance: The impacts of land disturbance on terrestrial archaeological resources and historic aboveground resources from the development of any one of the six NY Bight lease areas under Sub-alternative C1 would be decreased compared to those under Alternative B. Sufficient development and implementation of COP-specific avoidance measures per CUL-4 would likely result in negligible impacts on terrestrial archaeological resources. CUL-5, which would establish a protocol for handling an unanticipated discovery of a terrestrial archaeological resource, would allow for negligible to minor impacts on the resource that could otherwise be moderate to major without a protocol in place. Despite avoidance of physical impacts on cultural resources, moderate to major visual impacts on historic aboveground resources may still be possible.

Lighting: The impacts of lighting on historic aboveground resources from the development of any one of the six NY Bight lease areas under Sub-alternative C1 would be decreased compared to those under Alternative B. Implementation of ADLS per MUL-37 would reduce the already low-level impacts of lighting on cultural resources, resulting in localized, negligible to moderate impacts. ADLS would be most effective at reducing impacts on cultural resources from one NY Bight project developed in a lease area closer to the shoreline, where lighting sources on offshore structures would be more visible than those on structures located in a NY Bight lease area farther from the shoreline.

Presence of structures: The visual impacts of presence of structures on historic aboveground resources from the development of any one of the six NY Bight lease areas under Sub-alternative C1 would be the same as or similar to those under Alternative B. Moderate to major visual impacts on historic aboveground resources may still be possible.

The physical impacts of structure foundations on marine cultural resources from the development of any one of the six NY Bight lease areas under Sub-alternative C1 would be decreased compared to those under Alternative B. Sufficient development and implementation of COP-specific avoidance measures per CUL-2 would likely result in negligible impacts on marine cultural resources. CUL-3, which would establish a protocol for handling an unanticipated discovery of a marine archaeological resource, would allow for negligible to minor impacts on the resource that could otherwise be moderate to major without a protocol in place.

Impacts of Six Projects

Overall, the IPFs and impacts of six NY Bight projects on cultural resources under Sub-alternative C1 would be the same or similar to those for six NY Bight projects under Alternative B. The extent to which measures listed in Table 3.6.2-7 would, or are able to, reduce impacts of six NY Bight projects on cultural resources is the same as described for one NY Bight project.

Cumulative Impacts of Sub-alternative C1 (Preferred Alternative)

Overall, the cumulative impacts of six NY Bight projects in combination with other ongoing and planned non-offshore-wind and offshore wind activities on cultural resources under Sub-alternative C1 would be the same or similar to the cumulative impacts described under Alternative B. The extent to which measures listed in Table 3.6.2-7 would, or are able to, reduce cumulative impacts on cultural resources is the same as described for one NY Bight project.

3.6.2.5.2 Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied. However, BOEM does not identify any AMMM measures that have not been previously applied for cultural resources; therefore, the impacts on cultural resources under Sub-alternative C2 are the same as under Sub-alternative C1.

3.6.2.5.3 Conclusions

Impacts of Alternative C. Under Sub-alternatives C1 and C2, the construction and installation, O&M, and conceptual decommissioning of one NY Bight project, depending on the NY Bight lease area subject to development, would likely result in **moderate** to **major** impacts overall. The development of a NY Bight lease area closer to the shoreline or entailing ground or seabed disturbances to a larger area would likely have greater impacts on cultural resources than development of a lease area farther from the shoreline or entailing ground or seabed disturbances within a smaller area. Six NY Bight projects would likely have **major** impacts overall on cultural resources. Impacts of one or six NY Bight projects would be due to the extent of onshore and offshore development that could introduce physical and visual impacts on cultural resources. Implementation of AMMM measures has the potential to reduce or avoid impacts on cultural resources. However, review of these AMMM measures during the COP-specific NEPA and NHPA reviews and consultations is necessary to address project- or site-specific impacts. In addition, the NY Bight PA will enable a more consistent process allowing the future COP-specific NEPA and NHPA reviews, consultations, and plans to be focused on the project-specific impacts not considered in the PEIS, or those impacts that warrant further consideration, and may enable greater assurances that impacts on cultural resources could be avoided, reduced, or resolved through measures agreed to by federally recognized Tribes, ACHP, SHPOs, lessees, and other consulting parties.

Cumulative Impacts of Alternative C. Under Sub-alternatives C1 and C2, BOEM anticipates cumulative impacts on cultural resources from six NY Bight projects in combination with other ongoing and planned non-offshore-wind and offshore wind activities would likely be **major** due to the extent of onshore and offshore development and extent of known cultural resources in the region subject to impacts. Implementation of AMMM measures has the potential to reduce or avoid impacts on cultural resources. However, review of these AMMM measures during the COP-specific NEPA and NHPA reviews and consultations is necessary to address project- or site-specific impacts. In the context of other reasonably foreseeable environmental trends, the impacts contributed by Sub-alternatives C1 and C2 to the cumulative impacts on cultural resources would be noticeable.

3.6.2.6 Recommended Practices for Consideration at the Project-Specific Stage

In addition to the AMMM measures identified under Alternative C, BOEM is recommending lessees consider analyzing the RPs in Table 3.6.2-8 to further reduce potential cultural resources impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.6.2-8. Recommended Practices for cultural resources impacts and related benefits

Recommended Practice	Potential Benefit
CUL-7: Financially contribute to a third-party managed compensatory mitigation fund to address visual impacts on aboveground historic properties related to OCS offshore wind activities.	CUL-7 would allow for visual adverse effects on aboveground resources to be resolved via COP-specific NHPA review and consultation through contribution to a third-party managed compensatory mitigation fund in the event that moderate to major impacts on individual cultural resources that are historic properties cannot be avoided.
MUL-18: Coordinate transmission infrastructure among projects such as by using shared intra- and interregional connections, meshed infrastructure, or parallel routing, which may minimize potential impacts from offshore export cables on cultural resources.	MUL-18 could further reduce impacts on cultural resources by having lessees use shared transmission infrastructure or follow parallel routing with existing and proposed infrastructure, where practicable. This would result in the consolidation of export cables from the six NY Bight projects into a reduced number of cable corridors. Impacts from the *Anchoring, Cable Emplacement and Maintenance, Survey Gear Utilization,* and *Land Disturbance* IPFs would be most pronounced if cables from the six NY Bight projects all follow different corridors to different landfalls, requiring seabed disturbance within multiple different cable routes and affecting a larger geographic area. Coordinated offshore transmission infrastructure and cable corridors among six NY Bight projects may reduce the area of seabed disturbance required for cable emplacement, and any related trenching, vessel anchoring, and survey activities would be conducted in more localized area. Anchoring, cable emplacement and maintenance, and survey gear utilization activities would therefore potentially result in impacts on fewer marine cultural resources. Consolidation of transmission infrastructure and cable corridors among six NY Bight projects may also reduce the number of landfalls, therefore decreasing potential onshore land disturbance impacts on cultural resources.

3.6 Socioeconomic Conditions and Cultural Resources

3.6.3 Demographics, Employment, and Economics

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on demographics, employment, and economics from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.4 Environmental Justice

This section discusses environmental justice impacts from the Proposed Action, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area for environmental justice, as shown on the Figure 3.6.4-1, includes the counties where onshore infrastructure may be located, the counties with representative ports that may be used by the NY Bight projects, as well as the counties closest to the NY Bight lease areas that may be affected by construction and installation, O&M, and conceptual decommissioning of the NY Bight projects.

The environmental justice impact analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Because the locations of onshore components and ports used for the NY Bight projects are not known at this time, the analysis of environmental justice impacts onshore and at ports is dependent on a hypothetical project analysis, and impact conclusions consider a maximum-case scenario. Additional detailed site-specific analysis will be required for individual COPs. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

3.6.4.1 Description of the Affected Environment and Future Baseline Conditions

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations” (Subsection 1-101). EO 14096, Revitalizing Our Nation’s Commitment to Environmental Justice for All, maintains that agencies must make achieving environmental justice part of their mission (Section 3), and further defines environmental justice as “the just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability, in agency decision-making and other Federal activities that affect human health and the environment so that people:

(i) are fully protected from disproportionate and adverse human health and environmental effects (including risks) and hazards, including those related to climate change, the cumulative impacts of environmental and other burdens, and the legacy of racism or other structural or systemic barriers; and

(ii) have equitable access to a healthy, sustainable, and resilient environment in which to live, play, work, learn, grow, worship, and engage in cultural and subsistence practices” (Section 2b).

When determining whether human health and environmental effects are disproportionate and adverse, agencies are to consider whether there is or will be a cumulative impact on the natural or physical environment that adversely affects a population on the basis of income, race, color, national origin, Tribal affiliation, or disability, including ecological, cultural, human health, economic, or social impacts; and whether the effects appreciably exceed those on the general population or other appropriate comparison group (CEQ 1997), (EO 14096 Section 2b). This section identifies potential beneficial effects on populations with environmental justice concerns, where appropriate. This PEIS uses “populations” in the description of the affected environment as BOEM is not identifying specific communities at the programmatic stage.

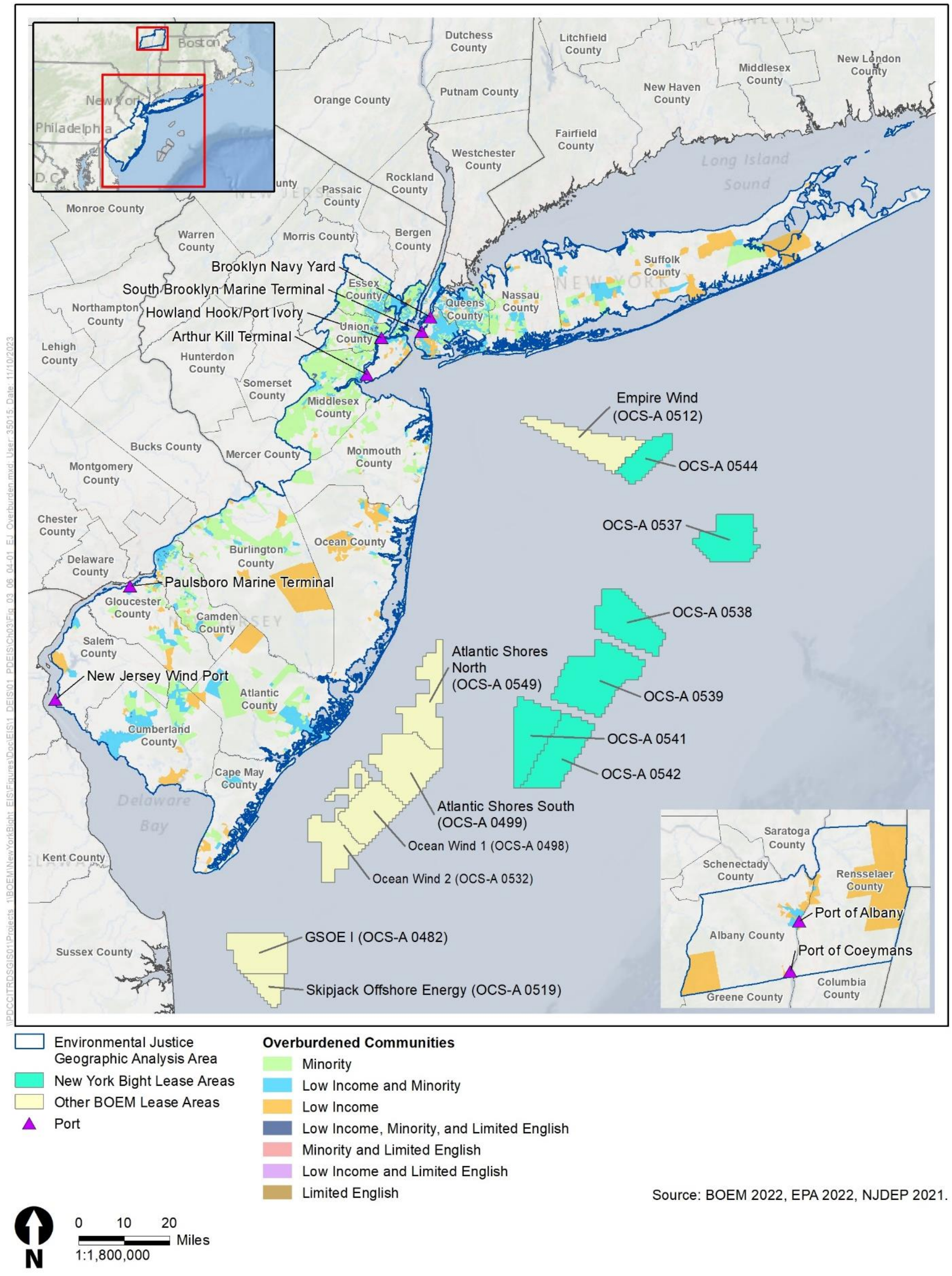

Figure 3.6.4-1. Populations with environmental justice concerns in the geographic analysis area

EO 14096 directs federal agencies to actively scrutinize the following issues with respect to environmental justice as part of the NEPA process:

- Characteristics of potentially affected communities related to income, race, color, national origin, Tribal affiliation, or disability;
- Pre-existing environmental stressors and pollution burden of potentially affected communities;
- Historical inequities, systemic barriers, or actions related to any Federal regulation, policy, or practice that impair the ability of communities with environmental justice concerns to achieve or maintain a healthy and sustainable environment;
- Health-related issues that may amplify project effects to minority or low-income individuals; and
- Meaningful public engagement strategies, including community or tribal participation in the NEPA process, that ensure access to individuals with limited English proficiency and disabilities.

3.6.4.1.1 USEPA Environmental Justice Community Definition

According to USEPA guidance, environmental justice analyses must address disproportionate and adverse impacts on minority populations (i.e., residents who are non-white, or who are white and of Hispanic descent) when minority populations comprise over 50 percent of an affected area. Environmental justice analyses must also address affected areas where minority or low-income populations are "meaningfully greater" than the minority percentage in the "reference population"—defined as the population of a larger area in which the affected population resides (i.e., a county, state, or region depending on the geographic extent of the analysis area). Low-income populations are those that fall within the annual statistical poverty thresholds from the U.S. Department of Commerce, Bureau of the Census Population Reports, Series P-60 on Income and Poverty (USEPA 2016). CEQ and USEPA guidance do not define *meaningfully greater* in terms of a specific percentage or other quantitative measure. For the purposes of this analysis, a population with environmental justice concerns is identified if it is so defined under either federal- or, if available, state-specific criteria.

Both New York and New Jersey have identified populations with environmental justice concerns at the U.S. Census block-level using criteria, as described in Section 3.6.4.1.2, *New York State Environmental Justice Community Definition*, and Section 3.6.4.1.3, *State of New Jersey Environmental Justice Community Definition*, and shown on Figure 3.6.4-2 and Figure 3.6.4-3. This PEIS uses county-level data to provide a first-order approximation of where populations with environmental justice concerns are located. This approach of using county-level data to identify populations with environmental justice concerns for analysis was considered appropriate for the PEIS because of the lack of site-specific information about where onshore impacts would occur. At the COP-level NEPA analysis, where cable landfalls, support facilities, and ports are identified, census block-level analyses, including cumulative impact analyses, are more appropriate.

3.6.4.1.2 New York State Environmental Justice Definitions

The State of New York identifies populations with environmental justice concerns as U.S. Census block groups that meet or exceed one or more of the following criteria from the New York Codes, Rules, and Regulations (NYCRR) Title 6 Section 487.3:

- At least 51.1 percent of the population in an urban area reported themselves to be members of minority groups; or
- At least 33.8 percent of the population in a rural area reported themselves to be members of minority groups; or
- At least 23.59 percent of the population in an urban or rural area had household incomes below the federal poverty level.

Populations with environmental justice concerns within the State of New York are present within the geographic analysis area, including areas in the vicinity of several of the ports that may support the offshore wind industry or in areas potentially affected by traffic, noise, and lights from vessel traffic related to port activities.

Populations with environmental justice concerns in the geographic analysis area are clustered around larger cities and towns. Populations potentially affected by port activity in the State of New York are adjacent to Howland Hook/Port Ivory, Port of Albany, Port of Coeymans, South Brooklyn Marine Terminal, Brooklyn Navy Yard, and Arthur Kill Terminal (Figure 3.6.4-1).

3.6.4.1.3 State of New Jersey Environmental Justice Definitions

New Jersey, following New Jersey Statutes Annotated (N.J.S.A.) 13:1D-157, identifies a community with environmental justice concerns (referred to as “overburdened communities” in the New Jersey statute) as a U.S. Census block group that meets one or more of the following criteria (NJDEP 2021):

- At least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the U.S. Census Bureau);
- At least 40 percent of the residents identify as minority or as members of a state-recognized tribal community; or
- At least 40 percent of the households have limited English proficiency (without an adult that speaks English “very well” according to the U.S. Census Bureau). For the purposes of this analysis, limited English proficiency is defined as meeting the U.S. Census criteria for “linguistic isolation,” specifically households where no one over the age of 14 speaks only English or English very well (NJDEP 2023).

Based on these criteria and the data on overburdened communities provided through the State of New Jersey’s environmental justice mapping tool EJMAP, populations with environmental justice concerns in the New Jersey portion of the geographic analysis area are clustered around larger cities and towns.

Populations potentially affected by port activity in New Jersey are adjacent to New Jersey Wind Port and Paulsboro Marine Terminal (Figure 3.6.4-1).

3.6.4.1.4 Populations with Environmental Justice Concerns

Table 3.6.4-1 provides trends for low-income populations (i.e., percentage of residents with household incomes below the federally defined poverty line) and minority populations in the counties studied in the geographic analysis area. There currently are seven counties that exceed thresholds for environmental justice in New Jersey—Atlantic County, Camden County, Cumberland County, Essex County, Hudson County, Middlesex County, and Union County—and three counties that exceed thresholds for environmental justice in the State of New York—Kings County, New York County, and Queens County. These exceedances are based on their minority populations.

In addition, as shown in Figure 3.6.4-2 and Figure 3.6.4-3, there are individual populations within the counties of the geographic analysis area in the States of both New Jersey and New York that exceed either racial or poverty environmental justice thresholds. Environmental justice assessments are strongly place-based analyses. The level of project-specific detail needed for community-level determinations of disproportionate and adverse impacts is unavailable at this stage (e.g., the actual, planned project locations of the cable landfall(s), staging area(s), substation(s), or the ports that will be used). This Final PEIS presents analyses at the county level with several individual coastal communities presented as illustrations of the conditions of populations with environmental justice concerns. In future NEPA analyses of individual COPs, more specific information about populations with environmental justice concerns will be identified and evaluated at a project- and site-specific level. Appendix B, *Supplemental Information and Additional Figures and Tables,* Section B.5, *Environmental Justice*, describes demographic, economic, and social characteristics for each of the counties of concern identified in Table 3.6.4-1 as exceeding thresholds for environmental justice.

Table 3.6.4-1. Low-income and minority populations in the geographic analysis area

Jurisdiction	Percentage of Population Below the Federal Poverty Line		Minority Population Percentage[1]	
	2010	2020	2010	2020
State of New Jersey	**10.3**	**10.2**	**27.9**	**33.9**
Atlantic County	14.3	13.5	**41.4**	**45.0**
Burlington County	5.1	5.9	29.4	36.2
Camden County	12.4	12.3	39.7	**46.7**
Cape May County	10.5	9.9	13.1	16.0
Cumberland County	16.9	16	49.7	**57.3**
Essex County	16.7	15.3	**66.8**	**72.8**
Gloucester County	6.3	7.0	18.9	25.5
Hudson County	16.5	14.2	**69.2**	**71.5**
Middlesex County	7.7	8.7	**50.8**	**61.4**
Monmouth County	6.6	6.5	23.3	28.4
Ocean County	11.2	9.9	14.1	18.3
Salem County	11.3	13.8	23.2	30.2
Union County	11.1	8.8	**54.6**	**63.3**
State of New York	**14.9**	**13.9**	**29.2**	**34.8**
Albany County	13.7	12.1	24.0	33.0
Kings County	23.0	19.2	**64.3**	**64.6**
Nassau County	5.9	5.4	34.5	44.2
New York County	16.4	15.6	**52.0**	**53.2**
Queens County	15	11.6	**72.4**	**77.2**
Rensselaer County	14.5	10.8	14.3	22.7
Suffolk County	6.2	6.5	28.4	36.6
Richmond County	11.8	10.8	36.0	43.9

Sources: U.S. Census Bureau 2010, 2020.

[1] The definition used for minority includes persons who are Black or African American, Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, Other, and Hispanic or Latino.

Bolding indicates counties with percentages above the thresholds for the federal or state definitions of communities with environmental justice concerns.

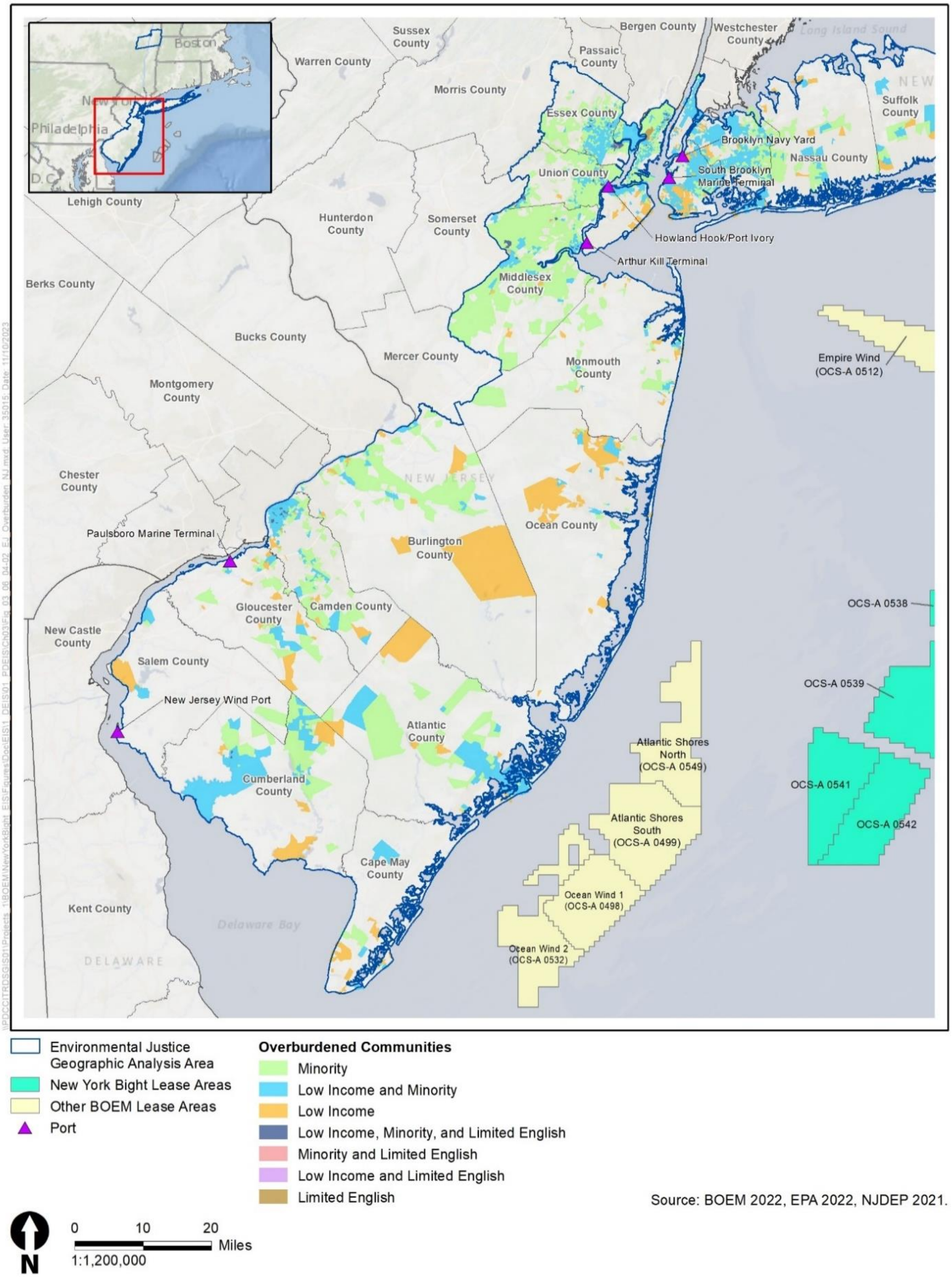

Figure 3.6.4-2. Populations with environmental justice concerns in the New Jersey geographic analysis area

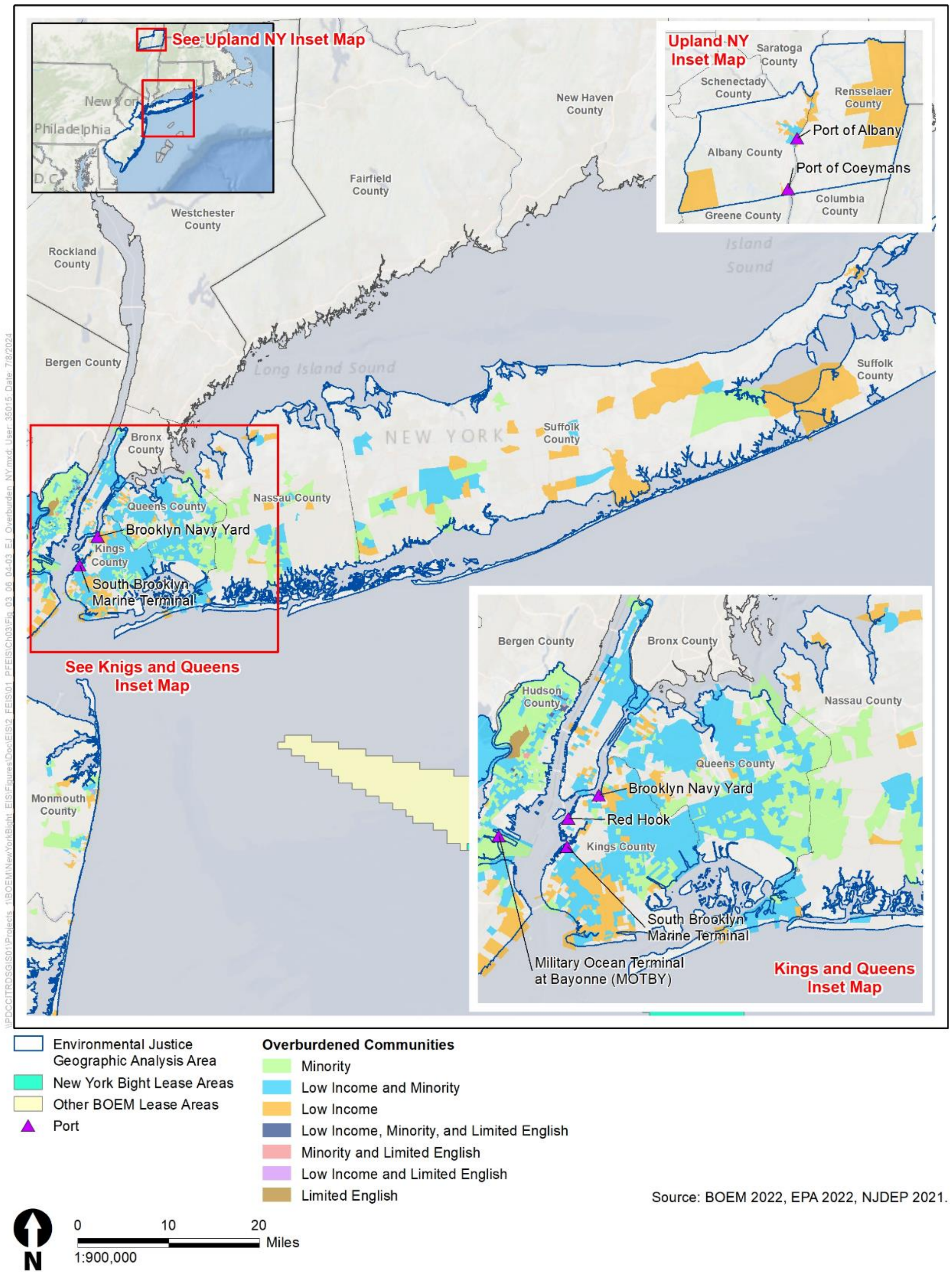

Figure 3.6.4-3. Populations with environmental justice concerns in the New York geographic analysis area

Ocean Economy Considerations

NOAA provides a tool that identifies stressors on coastal communities that may be affected by offshore activities, which supplements consideration of impacts on populations with environmental justice concerns. For example, in populations with environmental justice concerns with high poverty, low-income workers may rely disproportionately on recreational fishing to augment their food supply. They may also be employed by the commercial fishing and supporting industries that provide employment in marine trades, vessel and port maintenance, and marine industries such as marinas or boat yards, boat builders, and marine equipment suppliers and retailers. Due to the lack of subsistence fishing reliance indicators, this analysis uses recreational fishing reliance, as defined by the NOAA social indicator, as a proxy for subsistence fishing reliance.

As noted previously, although the Final PEIS can supply county-level analyses, the community-level analyses needed for a disproportionate and adverse impact assessment must rely on the detailed information found in a COP. NOAA's social indicator index tool identifies communities with environmental justice concerns in coastal areas (NOAA 2019). The social indicator mapping uses two metrics to find low-income or minority communities within the geographic analysis area that have a high level of recreational or commercial fishing engagement or recreational or commercial fishing reliance, with a higher rank indicating a higher engagement or reliance:

- Commercial fishing engagement measures the presence of commercial fishing through fishing activity as shown through permits, fish dealers, and vessel landings.
- Commercial fishing reliance measures the presence of commercial fishing in relation to the population size of a community through fishing activity.
- Recreational fishing engagement measures the presence of recreational fishing through fishing activity estimates.
- Recreational fishing reliance measures the presence of recreational fishing in relation to the population size of a community.

NOAA's social indicator mapping also provides community stressor data related to labor force, housing issues, and gentrification pressures (NOAA 2019). *Gentrification* is the process of changing the character of a neighborhood from a low value to a high value area. Gentrification occurs when there is an influx of more affluent residents and businesses that leads to increasing prices for housing, goods, and services. This often results in a demographic displacement of less affluent, existing residents who leave the neighborhood when they can no longer afford the increased cost of living and are replaced by more affluent, incoming residents. For this environmental justice analysis, these data provide additional characteristics of communities and are valuable for assessing potential impacts on onshore populations with environmental justice concerns. The data on the indicator mapping tool include the following:

- Labor force structure pressure index includes the percent of the total population and the number of females that are in the labor force, the percent of those who may be retired, and those who are self-employed. These variables characterize the strength and stability of the labor force, with a higher rank indicating higher levels of vulnerability.

- The housing characteristics pressure index measures the average rent and mortgages and median number of rooms. The percentage of mobile homes within a community adds to that characterization as an indication of either temporary or seasonal housing and an indication of socio-economic status. A high rank indicates more vulnerability.

The gentrification pressure indicators measure factors that, over time, may indicate a threat to the viability of a commercial or recreational working waterfront, including infrastructure. Gentrification pressure indicators measure factors that are related to housing disruption, retiree migration, and urban sprawl:

- Housing disruption represents factors that indicate a fluctuating housing market where some displacement may occur due to rising home values and rents including change in mortgage value. A high rank means more vulnerability for those in need of affordable housing and a population more vulnerable to gentrification.

- Retiree migration characterizes communities with a higher concentration of retirees and elderly people in the population including households with inhabitants over 65 years, individuals receiving social security or retirement income, and level of participation in the work force. A high rank indicates a population more vulnerable to gentrification as retirees seek out the amenities of coastal living.

- Urban sprawl describes areas experiencing gentrification through increasing population density, proximity to urban centers, home values, and the cost of living. A high rank indicates a population more vulnerable to gentrification.

The NOAA tool also assesses community vulnerability to sea level rise and storm surge. These community stressors are a burden on community planning budgets, property values, and potentially recovery from storm events.

Where communities experience environmental justice concerns, reliance on offshore fishing industries may be an additional economic concern if affected by offshore wind activities. As shown on Figure 3.6.4-4 and Figure 3.6.4-5, multiple communities in the States of New Jersey and New York are highly engaged in commercial fishing, but only Cape May, located at the southernmost tip of New Jersey at the mouth of the Delaware Bay, and Barnegat Light, located on New Jersey's barrier islands, have high levels of commercial fishing reliance. Portions of Cape May County meet environmental justice thresholds based on low income and minority populations. Barnegat Light does not meet environmental justice thresholds but is experiencing stressors as defined by the NOAA tool. As also shown on Figure 3.6.4-4 and Figure 3.6.4-5, numerous coastal communities in New Jersey and New York are highly engaged in recreational fishing but only Barnegat Light, New Jersey, is highly reliant on recreational fishing.

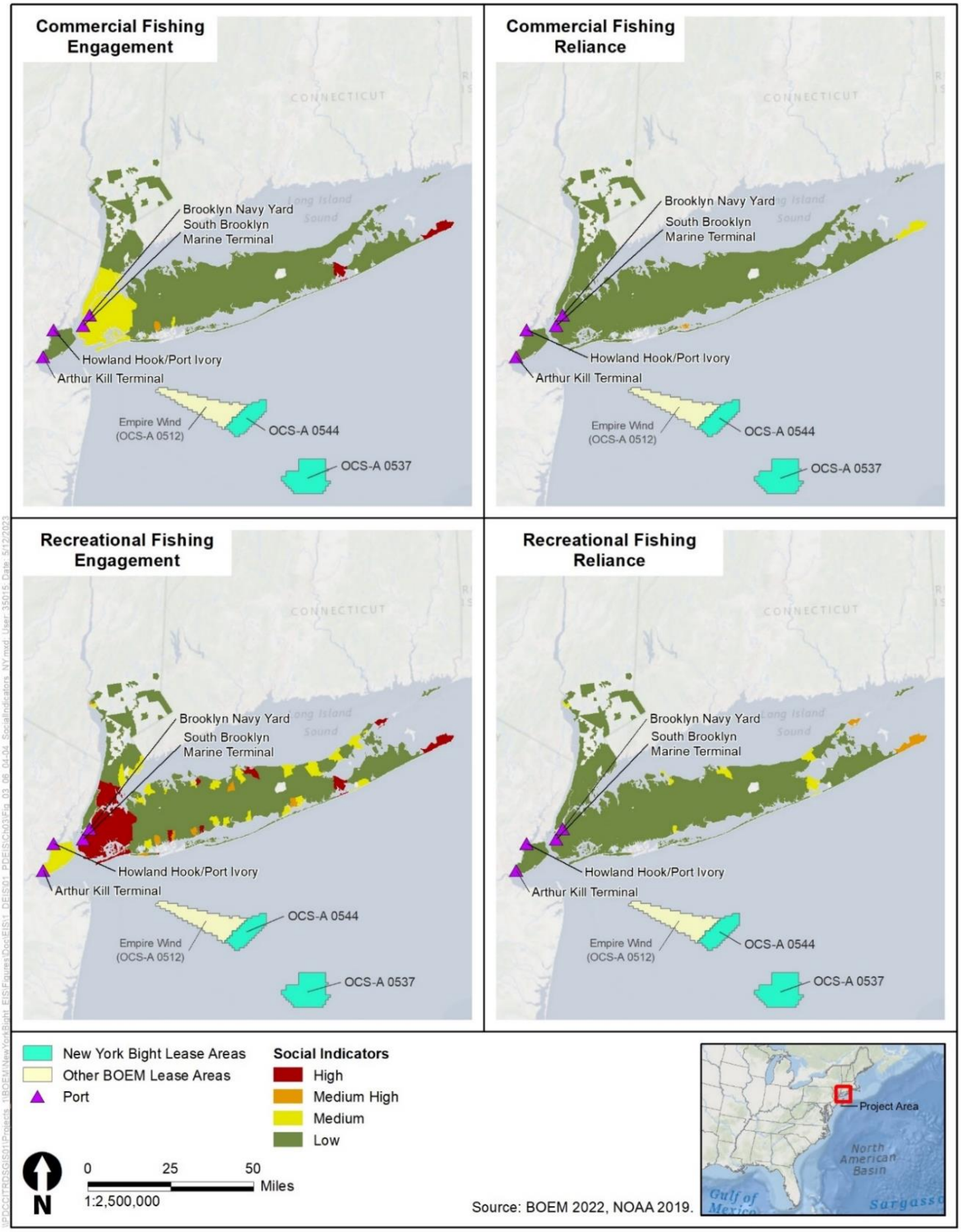

Figure 3.6.4-4. Commercial and recreational fishing engagement or reliance of coastal communities in New York

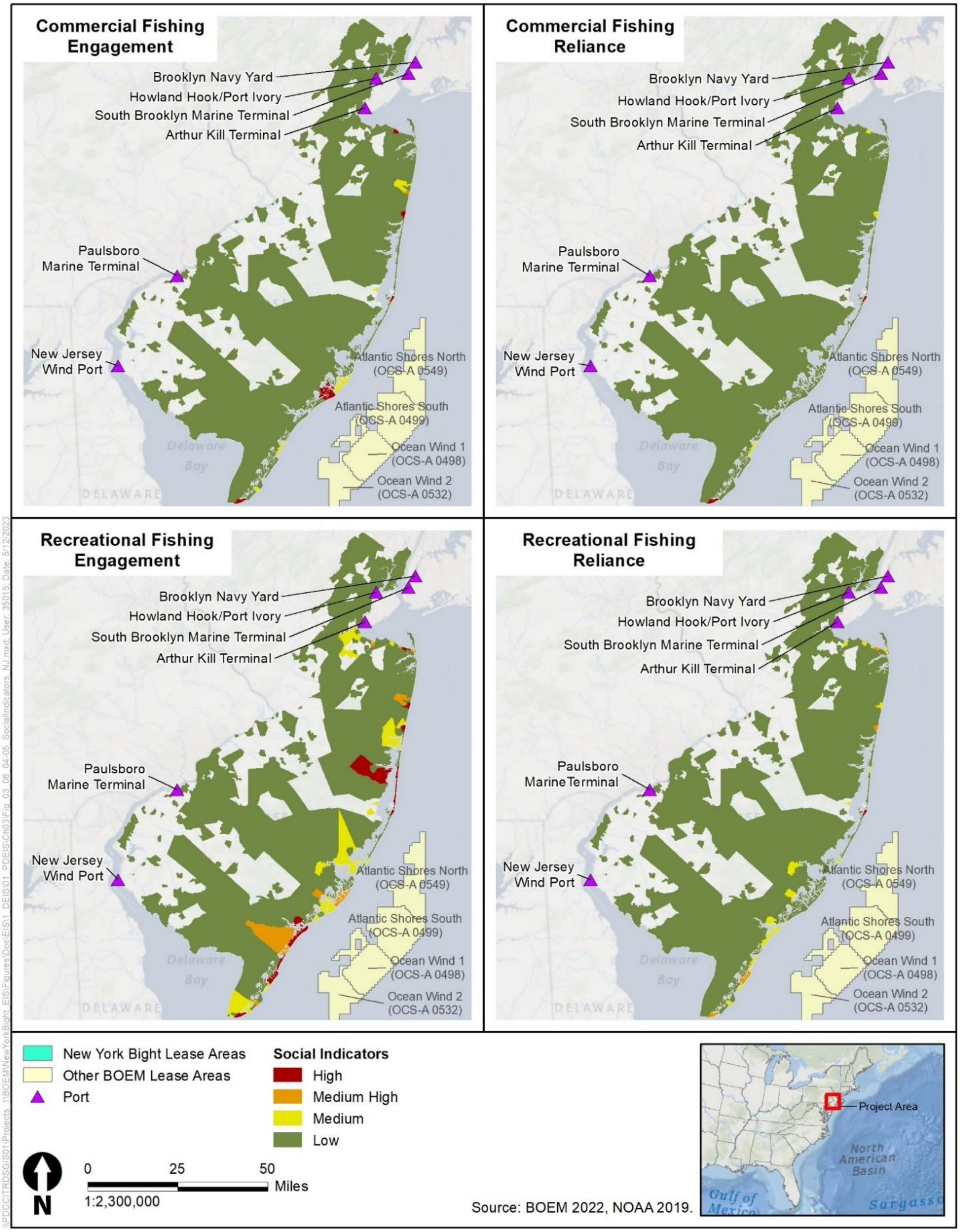

Figure 3.6.4-5. Commercial and recreational fishing engagement or reliance of coastal communities in New Jersey

Counties in the geographic analysis area that may not meet federal and state definitions of populations with environmental justice concerns may still have census tracts within their borders that do meet the criteria (Figure 3.6.4-2 and Figure 3.6.4-3). These communities also may be affected by the environmental and social stressors included in NOAA's analysis. Based on 2019 data, (NOAA 2019) these include the following:

- **Atlantic City, New Jersey**. The community has significant low income and minority populations in addition to high personal disruption, sea level rise, and storm surge risk; medium-high housing availability and disruption risk; and medium labor force risk.
- **Jersey City, New Jersey**. The community has significant low income and minority populations, and the area is subject to high housing disruption and urban sprawl; medium-high storm surge risk; and medium personal disruption and sea level rise risk.
- **Brooklyn/Sheepshead Bay, New York**. The community has significant low income and minority populations, and the area is subject to high storm surge risk, housing disruption, and urban sprawl; medium-high personal disruption risk; and medium sea level rise risk.
- **Queens, New York**. The community has significant low income and minority populations, and the area is subject to high storm surge risk, housing disruption, and urban sprawl; medium-high sea level rise risk; and medium personal disruption risk.

3.6.4.1.5 Tribal Communities

Environmental justice analyses must also address impacts on Native American Tribes and indigenous people. Federal agencies should evaluate "interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed agency action," and "recognize that the impacts within…Indian Tribes may be different from impacts on the general population due to a community's distinct cultural practices" (CEQ 1997). Factors that could lead to a finding of disproportionate and adverse impacts on populations with environmental justice concerns include loss of significant cultural or historical resources and the impact's relation to other cumulatively significant impacts (USEPA 2016).

Federally recognized Tribes invited to participate in Government-to-Government consultation and in consultation under Section 106 of the NHPA with BOEM are identified in Appendix A, *Consultation and Coordination*. The Shinnecock Indian Nation and Unkechaug Nation are in Suffolk County, Long Island, State of New York, within the geographic analysis area. No federally recognized Tribes currently reside on the land within the geographic analysis area in New Jersey. With respect to Tribal and Indigenous peoples, New Jersey formally recognizes the Nanticoke Lenni-Lenape Indians, Powhatan Renape Indians, Ramapough Lenape Indian Nation, and Inter-Tribal People.[1] The Nanticoke Lenni-Lenape Indians, originally two distinct Tribes, the Lenape and Nanticoke, are from Southern New Jersey and Delmarva Peninsula, with the Tribal headquarters located in Cumberland County (Norwood). The Ramapough Lenape Indian Nation, or Ramapo Munsee Lenape Nation, lived in their homelands from Western Connecticut to Eastern Pennsylvania and the Northern Bank of the Raritan River to Albany, New York. They now live primarily in the Ramapo foothills, on the border between New York and New Jersey (Ramapo Munsee Lenape Nation).

3.6.4.1.6 Environmental Justice Engagement

BOEM recognizes that meaningful engagement with populations with environmental justice concerns is essential to fully identifying and addressing environmental justice issues, as expressed in EO 14098, CEQ's Environmental Justice Guidance Under NEPA (CEQ 1997), and the Federal Interagency Working Group on Environmental Justice and NEPA Committee's guidance (EJ IWG 2016). For the NY Bight PEIS, BOEM convened a roundtable to bring together federal and state agency partners, federally recognized Tribes, indigenous populations, and representatives of community-based organizations that work on environmental justice whom BOEM identified through prior engagement and research. BOEM used feedback from this roundtable to inform how to design engagement throughout the development of the NY Bight PEIS. Based on the feedback from roundtable participants, BOEM convened a series of quarterly environmental justice forums (EJ Forums) to offer a recurring space for participants to discuss topics related to environmental justice and offshore wind in the New York and New Jersey area, much of which was relevant to the development of the Final PEIS. Topics of the EJ Forums included discussion of potential impacts on environmental justice and underserved communities from offshore wind development, exploration of potential AMMM measures for environmental justice, discussions of approaches to improve the engagement process, and other topic areas identified by EJ Forum participants. Potential impacts discussed by EJ Forum participants included air quality and vessel and vehicle traffic concerns, particularly around ports; jobs from offshore wind development and equitable access to opportunities for populations with environmental justice concerns; other potential benefits for communities; impacts on Tribes; impacts on fishing communities; and other topics. EJ Forum participants also described a need and interest in BOEM continuing to conduct engagement activities specifically designed for environmental justice topics during the development of project-specific NEPA documents, and with lessees throughout the life of the project. BOEM plans to use participant input from EJ Forums when considering the potential for engagement beyond the NY Bight PEIS. BOEM continues to consider how to meaningfully address recurring themes heard in the EJ Forums, including capacity-building, barrier reduction, engagement fatigue, accountability, transparency, relationship-building, and others.

[1] Inter-Tribal People refers to American Indian people who reside in New Jersey but are members of federally or state-recognized Tribes in other states.

Additional information on the EJ Forum series, including summaries of each forum, is available on BOEM's website: https://www.boem.gov/renewable-energy/state-activities/new-york-new-jersey-offshore-wind-environmental-justice-forums. Input-Status Reports are also published on this webpage; these were developed after each EJ Forum and provide details on how BOEM used input received from EJ Forum participants, including which questions or information directly informed the Final PEIS. Members of populations with environmental justice concerns also had opportunities to provide input through the public scoping process (Appendix O, *Scoping Report*) and the public comment process (Appendix P, *Response to Comments*).

Additionally, federally recognized Tribes were invited to participate in Government-to-Government consultation and in consultation under Section 106 of the NHPA with BOEM, as summarized in Appendix A, *Consultation and Coordination*).

3.6.4.2 Scope of the Environmental Justice Analysis

To define the scope of the environmental justice analysis, BOEM reviewed the impact conclusions for each resource analyzed in Sections 3.4.1 through 3.6.9 to assess whether the alternatives would result in impacts that have the potential to lead to a "disproportionate and adverse impact" determination given the geographic extent of the impact relative to the locations of populations with environmental justice concerns. The PEIS resource sections that were determined to be applicable and were subsequently examined were *Air Quality and Greenhouse Gas Emissions*; *Commercial Fisheries and For-Hire Recreational Fishing*; *Cultural Resources*; *Demographics, Employment, and Economics*; *Land Use and Coastal Infrastructure*; *Recreation and Tourism*; and *Scenic and Visual Resources.* Based on the impact level definitions used throughout this Final PEIS, major, moderate, and minor impacts are considered to have the potential to be disproportionate and adverse for populations with environmental justice concerns; negligible impacts are considered unlikely to have the potential to be disproportionate and adverse. While the PEIS identifies impacts that have the potential to be disproportionate and adverse, final determinations of disproportionate and adverse impacts would need to be based on project-level information, ideally with input from potentially impacted communities, as practicable, during the project-specific NEPA review stages.

Onshore project infrastructure could be located in areas where populations with environmental justice concerns have been identified and could thus affect populations with environmental justice concerns. The specific resources and IPFs that are carried forward for analysis of disproportionate and adverse effects in an environmental justice analysis will require project- and site-specific information beyond the scope of the environmental justice assessment in this Final PEIS. When such detailed information is available, including other planned offshore wind projects, determinations as to whether impacts on populations with environmental justice concerns would be disproportionate and adverse will be made.

Offshore activities result nearly exclusively in indirect impacts on populations with environmental justice concerns, which should be analyzed in the project-specific NEPA stage, as advised by EO 14096. Cable emplacement and maintenance and construction noise could also contribute to impacts on commercial and recreational fishing. The long-term presence of offshore structures would also have impacts on commercial and recreational fishing and tourism that could affect populations with environmental justice concerns. Therefore, impacts of offshore project components are carried forward for analysis under IPFs that include the presence of structures, cable emplacement and maintenance, and noise. Similar to onshore impacts, the analysis of disproportionate and adverse effects from offshore activities requires project- and site-specific information beyond the scope of the environmental justice assessment in this Final PEIS.

Other resource impacts that were concluded to have less-than-minor impacts for the alternatives or were unlikely to affect populations with environmental justice concerns were excluded from further analysis of environmental justice impacts. This includes impacts related to bats; benthic resources; birds; coastal habitat and fauna; commercial fisheries and for-hire recreational fishing; finfish, invertebrates, and EFH; marine mammals; demographics, employment, and economics; recreation and tourism; sea turtles; water quality; scenic and visual resources; and wetlands. Future analyses may require site- or project-specific analyses of these resources based on project location, size, and schedule, and based on project-specific input gathered during engagement with populations with environmental justice concerns.

3.6.4.3 Impact Level Definitions for Environmental Justice

Definitions of adverse impact levels are provided in Table 3.6.4-2. Beneficial impacts on populations with environmental justice concerns are described using the definitions described in Section 3.3.2 (see Table 3.3-1).

Table 3.6.4-2. Impact level definitions for environmental justice

Impact Level	Definition
Negligible	There would be no adverse impacts on communities with environmental justice concerns, or impacts would be so small that they would be extremely difficult or impossible to discern or measure.
Minor	Adverse impacts on communities with environmental justice concerns would be detectable but not measurable. Once the impacting agent is eliminated, the affected communities with environmental justice concerns would return to a condition with no detectable effects without need for remedial action.
Moderate	Adverse impacts on communities with environmental justice concerns are perceptible and can be measured. Once the impacting agent is eliminated, the affected communities with environmental justice concerns would return to a condition with no perceptible effects if proper remedial action is taken.
Major	The affected community with environmental justice concerns would experience measurable adverse impacts. Once the impacting agent is eliminated, the affected communities with environmental justice concerns could continue to experience measurable effects indefinitely, even if remedial action is taken.

Air emissions, cable emplacement and maintenance, land disturbance, lighting, noise, port utilization, and presence of structures are contributing IPFs to impacts on communities with environmental justice concerns[2]. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.6.4-3.

Table 3.6.4-3. Issues and indicators to assess impacts on environmental justice

Issue	Indicator
Potential public health and safety impacts (e.g., toxicity of dredged materials, emissions, dust, noise, lighting)	Assessment of impacts on minority and low-income populations from project impacts that could affect public health and safety, including air quality, water quality, noise, and land use impacts
Changes in the economy (e.g., property values, affordable housing availability, or tax revenues)	Assessment of impacts on minority and low-income populations from project impacts that could affect the economy
Potential job and income losses due to disruption of ocean and coastal areas (e.g., commercial fisheries, for-hire recreational fishing, recreational fishing/tourism) or cultural disruption (subsistence fishing and tribal fishing)	Assessment of economic impacts on minority and low-income populations due to project impacts on ocean and coastal areas (e.g., commercial fisheries and for-hire recreational fishing, recreation and tourism)
Access to public spaces and the enjoyment of nature	Assessment of impacts on minority and low-income populations from project impacts that could affect access to public spaces or the enjoyment of nature
Impacts on culture and identity (e.g., sense of place)[1]	Assessment of impacts on minority and low-income populations from project impacts that could affect sense of place

[1] Sense of place refers to cognitive, affective, functional, and social relationships with and reactions to a spatial setting. It can both evoke and be inspired by place-based concepts of place identity, place attachment, and place dependence (Jorgensen and Stedman 2001).

3.6.4.4 Impacts of Alternative A – No Action – Environmental Justice

When analyzing the impacts of the No Action Alternative on environmental justice, BOEM considered the impacts of ongoing activities, including ongoing non-offshore-wind and ongoing offshore wind activities, on the baseline conditions for environmental justice. 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 D, *Planned Activities Scenario*.

3.6.4.4.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for environmental justice would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore-wind activities that have the potential to affect communities with environmental justice concerns. Ongoing non-offshore-wind activities in the geographic analysis area that contribute to impacts on communities with environmental justice concerns include growth in onshore development; ongoing installation of

[2] The PEIS refers to populations with environmental justice concerns as "communities" in the impact analysis as BOEM is discussing the types of potential impacts to communities.

submarine cables and pipelines; ongoing commercial shipping; continued port use, upgrades, and maintenance; and ongoing effects from climate change (e.g., damage to property and coastal infrastructure) (see Appendix D for a description of ongoing activities). These ongoing activities contribute to numerous IPFs including cable emplacement and maintenance, which could disrupt fishing; land disturbance, which includes potential adverse impacts on public health and safety, enjoyment of nature, changes in the economy, and sense of place, in addition to potential beneficial effects that support employment and economies; lighting and noise, which can affect local populations; port utilization, which can affect air quality, jobs, populations, and economies; presence of structures, which can affect fishing, navigation, and coastal views; and marine traffic, which can affect commercial fishing/shipping and recreation and tourism economies. These activities currently contribute periodic disruptions to communities with environmental justice concerns and are typical occurrences in these coastal communities. Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on communities with environmental justice concerns include ongoing construction of Ocean Wind 1 (OCS-A 0498) and Empire Wind 1 and 2 (OCS-A 0512) (Table 3.6.4-4). Ongoing construction of Ocean Wind 1 and Empire Wind 1 and 2 would have the same type of impacts on communities with environmental justice concerns that are described in Section 3.6.4.4.2, *Cumulative Impacts of the No Action Alternative*, for all ongoing and planned offshore wind activities in the geographic analysis area, but would be of lower intensity.

Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increases in precipitation, and warmer ocean temperatures resulting from climate change. Sea level rise and increased storm frequency and severity could result in property or infrastructure damage, increase insurance costs, and reduce the economic viability of coastal communities. Impacts on marine life due to ocean acidification, altered habitats and migration patterns, and disease frequency would affect industries that rely on these species. The impacts of climate change are likely to, over time, worsen problems that coastal areas already face. Communities with environmental justice concerns are likely to be disproportionately affected by climate change and also more likely not to have adequate resources to adapt to climate change impacts.

USEPA (2021) examined the degree to which socially vulnerable populations—based on income, educational attainment, race and ethnicity, and age—may be more exposed to the highest impacts of climate in six categories: Air Quality and Health; Extreme Temperature and Health; Extreme Temperature and Labor; Coastal Flooding and Traffic; Coastal Flooding and Property; and Inland Flooding and Property. The report found that minority populations are more likely (compared to non-minority populations) to live in areas that are projected to experience the highest levels of climate change impacts, including increased mortality due to extreme temperatures, childhood asthma diagnoses due to climate-driven changes in particulate air pollution, labor hour losses in weather-exposed industries due to high-temperature days, and increases in traffic delays from climate-driven changes in high-tide flooding. Those with low income or no high school diploma are approximately 25 percent more likely than non-low-income individuals and those with a high school diploma to currently live in areas with the highest projected losses of labor hours due to increases in high-temperature days.

The socioeconomic impact of ongoing activities varies depending on each activity. Activities that generate economic activity, such as port maintenance and channel dredging, would generally benefit a local economy by providing job opportunities and generating indirect economic activity from suppliers and other businesses that support activity along coastal areas. Conversely, ongoing conditions that disrupt economic activity, such as climate change, may adversely affect businesses, resulting in impacts on employment and wages. Coastal development that leads to gentrification of coastal communities may displace low-income households and reduce access to coastal areas and working waterfronts that communities rely on for recreation, employment, and commercial, recreational, or subsistence fishing. Gentrification also can lead to increased tourism and recreational boating and fishing that provide employment opportunities in recreation and tourism. As described in Section 3.6.4.1, *Description of the Affected Environment and Future Baseline Conditions*, social indicator mapping shows a high level of potential housing disruption related to gentrification in coastal communities, such as Jersey City and Atlantic City in New Jersey, and Brooklyn/Sheepshead Bay in New York State. Housing disruption caused by rising home values and rents can displace affordable housing, with disproportionate effects for low-income populations.

3.6.4.4.2 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 NY Bight projects). Other planned non-offshore-wind activities that may affect communities with environmental justice concerns include the introduction or continuation of industrial activities or gentrification of coastal communities and working waterfronts. Ongoing and planned offshore wind activities that may contribute to impacts on environmental justice in the geographic analysis area are listed in Table 3.6.4-4.

Table 3.6.4-4. Ongoing and planned offshore wind activities that may contribute to impacts on environmental justice

Ongoing/Planned	Projects by Region
Ongoing – 3 projects[1]	**NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512)
Planned – 3 projects[2]	**NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499)

NJ = New Jersey; NY = New York

[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.
[2] Status as of September 20, 2024.

BOEM expects ongoing non-offshore-wind activities and ongoing and planned offshore wind activities to affect communities with environmental justice concerns through the following primary IPFs.

Air emissions: Ongoing and planned offshore wind activities could contribute to air emissions, which would primarily occur during construction and could have the potential to affect public health. These projects would have overlapping construction periods beginning in 2024 and continuing through 2030. Construction activity would occur at different locations and could overlap temporally with activities at other locations, including operational activities. As stated in Section 3.4.1, *Air Quality and Greenhouse Gas Emissions*, the total emissions of criteria pollutants and O_3 precursors from construction of ongoing and planned offshore wind projects (without the NY Bight projects) within the air quality geographic analysis area,[3] summed over all construction years, are estimated to be 11,582 tons of CO, 47,127 tons of NO_X, 1,501 tons of PM_{10}, 1,361 tons of $PM_{2.5}$, 635 tons of SO_2, 1,811 tons of VOCs, and 3,043,329 tons of CO_2 (Appendix D, Table D2-4). The geographic analysis area for air quality is larger than the environmental justice geographic analysis area; a large portion of the emissions would be generated along the vessel transit routes and at the offshore work areas. Most emissions would occur from diesel-fueled construction equipment, vessels, and commercial vehicles. Emissions would vary spatially and temporally during construction phases and could affect communities with environmental justice concerns adjacent or close to onshore construction areas or ports. Because a large portion of the total air emissions from offshore wind projects would be generated offshore, BOEM expects that air emissions during construction would have small and variable impacts on communities with environmental justice concerns that may be near onshore construction areas and ports. Localized air quality impacts have the potential to disproportionately affect communities with environmental justice concerns if the emissions from ongoing industrial activities occur in communities with environmental justice concerns. Air quality impacts would be minor, shifting spatially and temporally across the air quality geographic analysis area but could be greater if multiple offshore wind projects use the same onshore constructions areas or ports.

As discussed in Section 3.4.1, emissions from operation of the ongoing and planned offshore wind projects would generate an estimated 228–697 tons per year of CO, 479–1,963 tons per year of NO_X, 13–60 tons per year of PM_{10}, 12–55 tons per year of $PM_{2.5}$, 7–17 tons per year of SO_2, 21–59 tons per year of VOCs, and 45,918–159,045 tons per year of CO_2 (Appendix D, Table D2-4). Emissions would largely be due to vessel traffic related to O&M and the operation of emergency diesel generators. Operational emissions would be intermittent and widely dispersed throughout the vessel routes between onshore O&M facilities and the offshore wind lease areas and would generally contribute to

[3] The air quality geographic analysis area includes the airshed within 25 miles (40 kilometers) of the NY Bight lease areas and the airshed within 15.5 miles (25 kilometers) of onshore construction areas and representative ports that may be used for the NY Bight projects.

negligible air quality impacts. Only the portion of those emissions resulting from ship engines at ports or port-based equipment has the potential to affect communities with environmental justice concerns near ports. Therefore, during operations of offshore wind projects, the air emissions volumes resulting from port activities are not anticipated to be large enough to have impacts on the health of communities with environmental justice concerns.

A 2019 study found that exposure to fine particulate matter from fossil fuel electricity generation varied nationally by income and by race, with average exposures highest for Black individuals, followed by non-Latino white individuals. For remaining groups (e.g., Asians, Native Americans, Latinos), exposures were somewhat lower. These racial or ethnic disparities held after accounting for income (Thind et al. 2019). A 2016 study in New Jersey found a higher percentage increase in mortality associated with fine particulate matter in census tracts with more Black individuals, lower home values, or lower median incomes (Wang et al. 2016). As described in Section 3.4.1, the power generation capacity of offshore wind development could potentially lead to lower regional air emissions provided that fossil fuel power-generating capacity is displaced within or near the geographic analysis area.

Exposure to air pollution is linked to health impacts, including respiratory illness, increased health care costs, and mortality. Communities with environmental justice concerns tend to have disproportionately high exposure to air pollutants, likely leading to disproportionate and adverse health consequences. A 2022 study found that concentrations of total fine particulate matter are two times higher in racially segregated communities in the United States and, further, concentrations of metals from anthropogenic sources are nearly 10 times higher in those areas (Kodros et al. 2022). The study also found that these disproportionate exposures may be reduced through targeted regulatory action (e.g., regulations on sulfur content of marine fuel oil). Maternal exposure to fine and ultrafine particulate matter has been found to have lasting effects on children's health, including low birth weight, respiratory issues, and immune system problems (Johnson 2021).

Offshore wind generation analyzed under the No Action Alternative could result in short-term, spatially shifting, negligible to minor increases in emissions during construction or ongoing industrial activities resulting in potential health and safety concerns if air quality deteriorates significantly in communities with environmental justice concerns. Offshore wind generation also may result in long-term potential benefits for communities with environmental justice concerns through reduction or avoidance of air emissions and an associated reduction or avoidance of adverse health impacts if a local and regional reduction in fossil fuel usage as an energy source occurs. Furthermore, as described in Section 3.4.1, 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 and associated effects of climate change on communities with environmental justice concerns. Emissions from ongoing and planned offshore wind activities are not likely to affect the other environmental justice issues or indicators listed in Table 3.6.4-3.

Cable emplacement/maintenance: Cable emplacement and maintenance for offshore wind projects would result in seafloor disturbance and temporary increases in turbidity and could temporarily displace other marine activities within cable installation areas. As described in Section 3.6.1, *Commercial*

Fisheries and For-Hire Recreational Fishing, cable emplacement and maintenance would have localized, temporary, short-term impacts on the revenue and operating costs of commercial fisheries and for-hire recreational fishing businesses. Commercial fishing operations may temporarily be less productive during cable installation or repair, resulting in reduced income or leading to short-term reductions in business volumes for seafood processing and wholesaling businesses that depend upon the commercial fishing industry. Although commercial and for-hire fishing businesses could temporarily adjust their operating locations to avoid revenue loss, impacts would be greater if multiple cable installations or repair projects are underway offshore at the same time. Business impacts could affect communities with environmental justice concerns due to the potential loss of income or jobs by low-income or minority workers in the commercial fishing industry. In addition, cable installation and maintenance could temporarily disrupt tribal or subsistence fishing, resulting in short-term, localized impacts on tribal or low-income residents who rely on subsistence fishing as a food source.

Cable emplacement could temporarily affect the environmental justice issues and indicators listed in Table 3.6.4-3 due to disruptions to public access to shore locations if cable landfall were to occur near recreation areas. Construction activities also may create temporary job or income losses caused by disruptions to commercial or recreational fishing industries. The jobs created by the construction and maintenance of cables may be a benefit to local communities in the form of job creation. These disruptions or benefits may be temporary, likely occurring only during construction phases, but temporary loss of income may be more than negligible to a low-income worker in the fishing or recreation industries.

Land disturbance: Offshore wind development projects and planned transmission projects would require onshore cable installation, substation construction or expansion, and possibly expansion of shore-based port facilities. Construction related to these projects is anticipated to occur from 2024 to 2030. Land disturbance for construction, expansion, and conceptual decommissioning of onshore infrastructure would involve clearing and grading, trenching, excavation, and stockpiling of excavated material, among other land-disturbing activities. Depending on siting, land disturbance could result in temporary, localized, variable disturbances of neighborhoods and businesses near cable routes and construction sites due to typical construction impacts such as increased noise, dust, vibration, and vehicle traffic that could cause travel delays along roads used by construction vehicles or equipment. Effects of increased dust can have long-term health impacts, and impacts from dust due to land disturbance are similar to those discussed in the air emissions impact discussion.

Recreational and subsistence fishing near onshore construction areas and in proximity to inland water crossings could be temporarily disrupted if construction activities occur in proximity to public fishing sites. Potential variable impacts on communities with environmental justice concerns could result from land disturbance, depending on the location of onshore construction for each offshore wind project. BOEM expects onshore construction for offshore wind would have small and measurable impacts on communities with environmental justice concerns but would not disrupt the normal or routine functions of the affected population. People who rely on subsistence fishing would likely need to travel to alternative locations while construction occurs. They could return to affected sites after construction is completed assuming the habitat and water quality have not been degraded.

Land disturbances could affect the environmental justice issues and indicators listed in Table 3.6.4-3 due to the noise, dust, vibrations, and other disturbances associated with construction activities that may cause health issues. These activities also may create temporary jobs that could be a benefit to local communities. If construction is significant, there is the potential to change communities, which could affect a population's sense of place, which could be an environmental justice concern. Most construction is likely to occur in port or industrial areas. However, land disturbance due to construction could also disrupt recreation and tourism jobs and income if it occurs in coastal areas that are reliant on the tourism industry.

Lighting: Offshore WTGs require aviation warning lighting that could have economic impacts in certain locations. Visitors may alter their plans because of visible lights on offshore wind energy structures, and lighting that detracts coastal visitors could affect tourism businesses that employ individuals from communities with environmental justice concerns. As described in Section 3.6.8, *Recreation and Tourism*, the impact from offshore lighting in the geographic analysis area is likely to be limited to individual decisions by visitors to the New York and New Jersey coastline and elevated areas, with less impact on the recreation and tourism industry as a whole. Additionally, lighting impacts are expected to be widely dispersed across the geographic analysis area, and further analysis would need to be conducted to determine if a community with environmental justice concerns may experience disproportionate impacts. This analysis should consider potentially changing recreation and tourism trends that communities with environmental justice concerns may depend on for income.

Nighttime lighting for transit or construction could occur and would be visible from coastal residences and businesses, especially near the ports that support offshore wind operations. However, the change anticipated to current port activity levels from offshore wind projects will be negligible to minor given the current and expected level of activity and result in a similar level of impact on communities with environmental justice concerns near ports. Any increased lighting associated with offshore wind activity is not likely to affect the environmental justice issues and indicators listed in Table 3.6.4-3.

Noise: Under the No Action Alternative, noise from site assessment G&G survey activities, pile-driving, trenching, and vessels associated with offshore wind projects in areas outside the geographic analysis area is likely to result in temporary disruption and potential revenue reductions for commercial fishing and marine recreational businesses. This disruption and potential revenue loss could affect communities with environmental justice concerns if the affected businesses operate out of or employ a large number of individuals from such communities. Construction noise, especially site assessment G&G surveys and pile-driving, would affect fish and marine mammal populations, with impacts on commercial and for-hire fishing and marine sightseeing businesses. The severity of impacts would depend on the proximity and temporal overlap of offshore wind survey and construction activities (currently estimated to occur from 2024–2030), and the location of noise-generating activities in relation to preferred locations for commercial/for-hire fishing and marine tours. Noise impacts during surveying and construction would be more widespread when multiple offshore wind projects are under construction at the same time. Impacts of offshore noise on marine businesses would be short-term and localized, occurring during surveying and construction, with no noticeable impacts during operations and only periodic, short-term impacts during maintenance.

The impacts of offshore noise would have short-term, localized impacts on low-income business owners and workers in marine-dependent businesses, as well as recreational fishing if finding replacement areas for visitor services would require additional expenses such as those caused by longer travel times. The localized impacts of noise associated with offshore wind activities on fishing could also have an impact on subsistence fishing by low-income residents. Based on the NOAA social indicator, used as a proxy for subsistence fishing reliance, there are no communities with environmental justice concerns located in the geographic analysis area that have high levels of recreational fishing reliance. However, recent BOEM consultation with affected Tribes for adjacent lease areas to the project have expressed concern that expected offshore wind development would diminish their subsistence rights (BOEM 2020).

Onshore construction noise would temporarily inconvenience visitors, workers, and residents near sites where onshore cables, substations, or port improvements are installed to support offshore wind. Construction noise has been associated with cardiovascular disease, cognitive impairment, sleep disturbance, and tinnitus (WHO 2011). Impacts would depend upon the location of onshore construction in relation to businesses or communities with environmental justice concerns. Noise generated by onshore construction of infrastructure would result in temporary increases in sound levels near the activity, and equipment could periodically be audible from offsite locations. General construction noise levels would not be expected to create a noise nuisance condition, as they would be similar in character to existing daytime sound levels. Additionally, BOEM assumes onshore construction for offshore wind projects would meet applicable local or municipal noise requirements, including procedures of approval for any exceedances. Impacts on communities with environmental justice concerns could be short-term and intermittent during the projected 2024–2030 construction period and may not be distinguishable from existing onshore utility construction activities.

Noise generated by offshore wind staging operations at ports would potentially have impacts on communities with environmental justice concerns if the port is located near such communities. Several of the ports being analyzed for the NY Bight projects would also be used for ongoing and planned offshore wind projects in the geographic analysis area, such as the Port of Paulsboro in New Jersey (Ocean Wind 1 OCS-A 0498) and the South Brooklyn Marine Terminal in New York State (Empire Wind OCS-A 0512), which have nearby communities with environmental justice concerns. The noise impacts under the No Action Alternative from offshore wind projects from increased port utilization would be short-term and variable, decrease after the construction period, and would increase if a port or adjacent ports are used for multiple offshore wind projects during the same time period.

Noise impacts related to the environmental justice issues and indicators listed in Table 3.6.4-3 may include health and safety concerns. However, onshore construction activities are expected to be conducted in compliance with noise ordinances. Offshore noise has the potential to disrupt local economies if fishing or marine sightseeing operations are disrupted. Construction noise also can disrupt a community’s ability to enjoy public spaces and nature during active construction operations. The impact of this disruption would be localized and temporary and would cease when construction is completed.

Port utilization: Offshore wind project construction would require port facilities for berthing, staging, and loadout. Air emissions, noise, and vessel and vehicle traffic generated at ports could potentially affect communities with environmental justice concerns near ports and depend on the number and location of the selected ports. Ports also may require upgrades to accommodate offshore wind development. Utilization of ports for activities related to manufacturing, staging, and loadout of WTG components could have moderate impacts on surrounding communities due to disruptions and notable adverse impacts associated with port operations (resulting from air emissions, noise, lighting, and vessel and vehicle traffic). Ports that would be utilized are typically sited in industrial areas or are in high-density developed areas with ambient levels of air emissions, noise, lighting, and traffic that are typical of high-density urban areas.

Port use and expansion could have beneficial impacts on employment, which may benefit communities with environmental justice concerns where underemployment is a factor. Offshore wind projects would contribute to minor increases in employment at certain major ports. Beneficial impacts would also result from port utilization during offshore wind operations, but these impacts would be of lower magnitude. For more information on potential employment benefits see Section 3.6.3.3, *Impacts of Alternative A – No Action – Demographics, Employment, and Economics*.

Port utilization impacts related to the environmental justice issues and indicators listed in Table 3.6.4-3 are related to the effects described in this section for air emissions, noise, and light. States and communities have expressed their desire for the offshore wind industry to ensure job training and employment in communities with environmental justice concerns affected by the offshore wind industry. This would ensure benefits to the communities affected by the increased port activity.

Presence of structures: The No Action Alternative would result in establishment of offshore structures that may have both adverse and beneficial impacts on low-income marine business owners and workers supporting commercial fisheries and for-hire recreational fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for tour boats and for-hire recreational fishing businesses. Adverse impacts would result from navigational complexity within the lease areas leading to possible equipment loss and limiting certain commercial fishing methods. If these disruptions negatively affect businesses that rely on fishing or fishing excursions, impacts on low-income communities that rely on these industries would occur. Presence of structures may have an impact on culture and identity by affecting sense of place.

Views of offshore WTGs could also have impacts on individual locations and businesses serving the recreation and tourism industry, based on visitor decisions to select or avoid certain locations. Because the service industries that support tourism are a source of employment and income for low-income workers, impacts on tourism would also result in impacts on communities with environmental justice concerns. Within the geographic analysis area, the projects with the closest WTGs to shore are Atlantic Shores North (OCS-A 0549), Atlantic Shores South (OCS-A 0499), and Ocean Wind 2 (OCS-A 0532). The closest edge of each of these lease areas to shore is 8 to 9 miles (13 to 15 kilometers). As described in Section 3.6.8, based on currently available studies and the distance of ongoing and planned offshore wind projects from shore, BOEM anticipates that the WTGs associated with ongoing and planned offshore wind projects in the geographic analysis area could have a minor adverse impact on recreation and tourism but would be unlikely to affect shore-based or marine recreation and tourism. The studies do not indicate whether these potential impacts are disproportionate.

Therefore, related to the environmental justice issues and indicators listed in Table 3.6.4-3, the presence of offshore WTGs are expected to have lighting impacts that are widely dispersed across the geographic analysis area, and further analysis would need to be conducted to determine if a community with environmental justice concerns may experience disproportionate impacts. This analysis should consider potentially changing recreation and tourism trends that a community with environmental justice concerns depends on for income.

3.6.4.4.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, communities with environmental justice concerns would continue to be affected by existing environmental trends and ongoing activities. BOEM anticipates that the impacts of ongoing non-offshore-wind 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 communities with environmental justice concerns in the geographic analysis area. These are typical, current activities occurring along the New York and New Jersey State coastlines and would not substantially alter currently felt impacts. Ongoing offshore wind activities increase impacts to moderate, primarily associated with port utilization, noise, and cable emplacement.

Overall, BOEM anticipates **negligible** to **moderate** impacts on communities with environmental justice concerns, largely driven by the effects of climate change and the ability for coastal communities to readily adapt to population migration (housing disruptions), sea level rise, and storm surge threats.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and communities with environmental justice concerns would continue to be affected by the primary IPFs of emissions, cable emplacement and maintenance, land disturbance, lighting, noise, port utilization, and presence of structures, in addition to existing environmental stressors and legacy pollution. Planned offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being port utilization, noise, and cable emplacement during construction and the presence of offshore structures during operations. The primary IPFs listed above result from activities that may ultimately provide employment and revenue that could benefit communities with environmental justice concerns. Beneficial economic impacts (e.g., direct, indirect, and induced employment or increased demand for supplies and services) are diffused throughout the economy and could provide income and employment for individuals in communities with environmental justice concerns. These topics will be assessed in more detail at the project-specific NEPA stage. Additionally, measures can be taken by lessees to increase equitable distribution of these benefits through purchasing and hiring practices.

Related to the environmental justice issues and indicators listed in Figure 3.6.4-3, health concerns due to increased emissions may cause moderate impacts if port activities for multiple projects are concentrated near communities with environmental justice concerns over the period anticipated for ongoing and planned offshore wind construction activity (2024–2030). Localized, temporary impacts on communities reliant on recreation and tourism industries also may occur during times of construction due to noise, dust, and general disturbances. Similarly, potential negative effects on access to public spaces and the culture and identity of communities with environmental justice concerns during construction disturbances are not expected to be lasting. Job and income losses may occur due to disruptions to tourism industries. However, these are expected to be short-term and temporary. Job and income benefits may occur in communities with environmental justice concerns where construction, transportation, and other support industry jobs are created as a result of the planned activities.

In the context of reasonably foreseeable trends, BOEM anticipates cumulative impacts of the No Action Alternative to likely result in **negligible** to **moderate** impacts on communities with environmental justice concerns. BOEM also anticipates that the ongoing and planned offshore wind activities in the analysis area would likely result in **minor beneficial** impacts due to direct, indirect, and induced employment and economic benefits associated with offshore wind activities, increased port utilization, and potential air quality improvements as a result of the reduced reliance on fossil fuels for energy in the area, provided that fossil fuel power-generating capacity is displaced within or near the geographic analysis area.

3.6.4.5 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Environmental Justice

3.6.4.5.1 Impacts of One Project

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts.

Air emissions: Emissions at offshore locations would have regional impacts, with no potentially disproportionate impacts on communities with environmental justice concerns. However, communities with environmental justice concerns near onshore construction areas and ports used for construction, operation, and conceptual decommissioning of one NY Bight project could experience adverse effects from air emissions. The total estimated construction emissions associated with one NY Bight project would be 5,555 tons CO, 26,104 tons NO_x, 527 tons PM_{10}, 504 tons $PM_{2.5}$, 1,014 tons SO_2, 755 tons VOCs, and 1,533,965 tons CO_2 (Table 3.4.1-5). Most emissions would occur temporarily during construction, offshore in the lease area, onshore at the landfall sites, along the offshore and onshore export cable routes, at the onshore substation/converter station, and at construction staging areas. These emissions would be distributed across areas with and without communities with environmental justice concerns. Permitting authorities, including USEPA and states, are responsible for ensuring regulated pollutants do not exceed standards in place to protect human health.

A single NY Bight project would provide beneficial impacts on the air quality over time to the extent that energy produced by the project could displace energy produced by fossil-fuel power plants. As explained in Section 3.4.1, once operational, a single NY Bight project would result in annual avoided emissions of 1,818 tons of NO_X, 268 tons of $PM_{2.5}$, 999 tons of SO_2, and 5,414,326 metric tons of CO_2. Estimates of annual avoided health effects would range from 131 to 337 million dollars in monetized health benefits and 13 to 30 avoided mortality cases per year (Table 3.4.1-7). Communities with environmental justice concerns are disproportionately affected by emissions from fossil-fuel powered plants nationwide and by higher levels of air pollutants. As part of the EJ Forums, community-based organizations that work with communities located near ports indicated that the short-term increase in emissions should not be borne by them without also realizing the potential long-term benefits of reduced fossil-fuel power plant emissions. To achieve this, the fossil fuel power-generating capacity that is displaced would need to be within or near communities with environmental justice concerns, particularly those near port locations.

Cable emplacement and maintenance: Impacts from offshore cable emplacement and maintenance for one NY Bight project would be localized and short-term primarily affecting commercial fishing and recreational fishing in the geographic analysis area. Recreational or subsistence fishing could be locally and temporarily disrupted in nearshore areas, which may cause minor impacts on low-income individuals who rely on subsistence fishing. Disruptions to businesses or workers in commercial and offshore recreational fishing would be affected by loss of business during times of cable emplacement. Impacts on communities with environmental justice concerns from cable emplacement and maintenance for one NY Bight project would be short-term and minor, occurring during cable emplacement.

Land disturbance: Land disturbance could result in adverse disturbances of communities near cable routes, cable landfall, and onshore construction sites due to typical construction impacts (e.g., traffic, dust, road disturbances). Recreational/subsistence fishing near onshore construction areas and in proximity to inland water crossings could be temporarily disrupted if construction activities occur close to public fishing sites. BOEM expects that impacts of land disturbance on communities with environmental justice concerns from a single NY Bight project would be minor to moderate by disrupting the normal or routine functions of the affected population only for the period of construction. Impacts of land disturbance on communities with environmental justice concerns would be measurable during construction. Although not currently expected, potential impacts of dust should be assessed in more detail when site-specific information is available due to its potential for longer-term health effects, which could potentially raise the impact level determination.

Lighting: Visible nighttime lighting for transit or construction vessels could occur and disrupt communities with environmental justice concerns, especially near the ports or along transit routes for vessels accessing those ports. However, due to the minimal increase in vessel traffic for one NY Bight project, the impacts of increased lighting from passing vessel traffic would result in negligible impacts on communities with environmental justice concerns along transit routes for the port used. Active lighting in ports would remain unchanged.

Offshore WTGs require aviation warning lighting that would be visible from beaches and coastlines at nighttime. Nighttime lighting could have long-term impacts on recreation and tourism businesses that employ communities with environmental justice concerns if the lighting influences visitor decisions in selecting coastal locations to visit. Because of the distance from shore (the NY Bight lease area nearest to shore is 20 nautical miles [37 kilometers] offshore), lighting on the WTGs and OSSs is not anticipated to have a substantial effect on views. As described in Section 3.6.8, the addition of a single project in the NY Bight area would result in long-term, minor impacts on recreation and tourism.

Noise: Noise from vessel traffic during maintenance and construction and from pile-driving for a single NY Bight project could drive away or adversely affect individuals or populations of species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities. In turn, this could affect employment and economic activity for members of communities with environmental justice concerns that rely on fishing, tourism, and recreation. Impacts would be localized, with potential for more dispersed impacts depending on where members of communities with environmental justice concerns who work in fishing and tourism reside. Impacts would be temporary, mainly occurring during construction with negligible impacts during O&M. Onshore construction noise could temporarily affect residents, possibly also resulting in a short-term reduction of economic activity for businesses near construction sites. The magnitude of onshore noise impacts from one NY Bight project would be localized, but impacts on communities with environmental justice concerns would be similar to those of other onshore utility construction activities and would be intermittent, short-term, and negligible to minor.

Port utilization: Offshore wind development for a single NY Bight project would support the use and expansion of ports and ancillary industries in the States of New York and New Jersey, bolstering investment, employment, and revenue at ports and supporting industries. Communities with environmental justice concerns reside close to, and have the potential to be affected by, activities at the following ports: Howland Hook/Port Ivory, Military Ocean Terminal at Bayonne, Brooklyn Navy Yard, and South Brooklyn Marine Terminal. In the O&M phase, port activity would be lower than during construction but more consistent. Overall, however, port utilization from offshore wind is anticipated to result in beneficial impacts on local economies both from the short-term creation of new construction jobs and long-term job creation during the O&M phase. One NY Bight project could have long-term, moderate beneficial impacts on communities with environmental justice concerns if workforce development and employment initiatives are implemented for local communities.

As discussed for the air emissions IPF above and in Section 3.4.1, increased onshore emissions near ports during construction, and to a lesser extent during the O&M phase are expected to be small relative to larger emission sources such as fossil-fuel power plants. A project will have to demonstrate compliance with the NAAQS and must demonstrate no adverse impact on air quality–related values as part of their air permitting process.

Presence of structures: Commercial fishing operators, marine recreational businesses, and shore-based supporting services in communities with environmental justice concerns could experience both short-term impacts during construction and long-term impacts from the presence of structures that could result in adverse economic impacts. The presence of structures could eventually produce a beneficial impact from their fish-aggregation characteristic. Businesses that would benefit from fish-aggregation and reef effects as a result of one NY Bight project—such as those that cater to highly migratory species and offshore fishing recreationists—may increase business and catch. The presence of structures from a single NY Bight project may result in minor adverse impacts for communities with environmental justice concerns reliant on commercial fishing due to navigational complexities and negligible to minor beneficial impacts on those who participate in or who are reliant on recreational/subsistence fishing.

BOEM anticipates there would be no meaningful visual impact on communities with environmental justice concerns from the presence of structures for one NY Bight project. However, presence of structures may result in impacts on culture and identity by affecting sense of place. As described in Section 3.6.8, based on currently available studies and the distance of a single NY Bight project from shore (the NY Bight lease area nearest to shore is 20 nautical miles [37 kilometers] offshore), BOEM anticipates that one NY Bight project would be unlikely to affect shore-based or marine recreation and tourism businesses that are a source of employment for communities with environmental justice concerns. Potential impacts from the presence of structures for one project are not anticipated to differ substantially from those described for the No Action Alternative.

Overall, the beneficial impacts of one project are expected to be minor to moderate.

3.6.4.5.2 Impacts of Six Projects

The same types of IPFs, impacts, and mechanisms that affect the communities with environmental justice concerns in the NY Bight geographic analysis area as described for one NY Bight project would apply to six NY Bight projects. There would be the potential for greater impacts from these IPFs due to the greater level of activity under six NY Bight projects. If multiple projects are being constructed at the same time, temporary impacts associated with construction could be greater than those identified for one NY Bight project. If projects are staggered, some impacts may be less intense but last over a longer period.

Air emissions: With six NY Bight projects, the estimated air emissions generated by construction, operation, and conceptual decommissioning of onshore infrastructure and offshore structures estimated for a single NY Bight project would be increased. Emissions impacts on communities with environmental justice concerns would depend on the proximity and timing/overlap of project schedules for the six NY Bight projects. Nevertheless, BOEM anticipates that air quality impacts from construction, operation, and conceptual decommissioning of six NY Bight projects would be minor (i.e., less than the NAAQS) and may have negligible to minor impacts on communities with environmental justice concerns. The air permit applications required for each NY Bight project must demonstrate to USEPA's satisfaction that there would be no exceedances of the applicable standards and thresholds that are designed to protect all communities from emissions on federal waters. States hold air quality permitting authority for emissions onshore and in state waters. As projects are permitted, subsequent projects would have an additive effect. Permitting authorities, including USEPA and states, are responsible for ensuring regulated pollutants do not exceed standards in place to protect human health, even in the cases of such additive effects.

With six NY Bight projects, the potential health benefits associated with displacement of energy produced by fossil-fuel power plants could be greater than those anticipated under one NY Bight project. Six NY Bight projects would have beneficial effects on the health of communities with environmental justice concerns, provided that fossil fuel power-generating capacity is displaced within or near communities with environmental justice concerns. While the adverse impacts from air emissions would primarily occur during construction, the beneficial impacts on air quality from reduced reliance on fossil fuel power plants would be long-lasting.

Cable emplacement and maintenance: Consistent with one NY Bight project, cable emplacement and maintenance from six NY Bight projects could have short-term and minor adverse impacts on commercial and recreational/subsistence fishing due to temporary displacement during construction. The number of communities with environmental justice concerns affected by six NY Bight projects and the magnitude of impacts depends on cable placement locations relative to active fishing grounds, how many projects occur simultaneously or consecutively (thus, having a longer impact), and the extent of reliance of communities on those fishing grounds.

Land disturbance: Land disturbance impacts from construction of onshore infrastructure, port expansions, and cable landfalls for six NY Bight projects would be increased compared to a single NY Bight project. Most of the land-disturbing activities for the six projects would likely be dispersed throughout the geographic analysis area. For example, BOEM assumes onshore substations and onshore export cable routes would not overlap for the six projects but could occur throughout the area, depending on project-specific siting decisions. Some land-disturbing activities, such as port modifications or cable landfalls may potentially be shared by multiple projects and would result in a concentration of land disturbance in specific locations. Overall, the effect on communities with environmental justice concerns would still be a minor to moderate adverse impact from disruption of communities and business operations temporarily affected during the period of onshore construction. Potential impacts from the presence of dust should be reassessed in the project-specific NEPA documents; increased dust can contribute to longer-term health effects, which could potentially raise the level of the impact determination.

There may be a direct beneficial impact on communities with environmental justice concerns from the creation of construction jobs.

Lighting: The amount of nighttime lighting that would be visible from WTGs and OSSs would increase with six NY Bight projects. However, because of the distance from shore from any of the NY Bight leases (the closest lease area is 20 nautical miles [37 kilometers] offshore) and the pervasive light sources already present along the New York and New Jersey coastline, impacts on recreation and tourism businesses that may employ communities with environmental justice concerns are anticipated to be minor. Lighting from six projects could potentially affect sleep, therefore affecting health; long-term health effects should be reexamined at the project-specific NEPA stage.

Noise: Noise impacts from six NY Bight projects on communities with environmental justice concerns would be somewhat similar to cable emplacement and land disturbance. The effect would be an adverse indirect impact from impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities during the offshore installation phase. However, determining the increased impact of six NY Bight projects is dependent on the relationship between project locations and fish/marine mammal distributions. Further, tourism and recreation are huge drivers of the New Jersey and New York region's economy, and communities with environmental justice concerns dependent on fishing and marine sightseeing activities could be temporarily affected if noise impacts interfere with their businesses or employment due to disruption to tourism. Refer to Section 3.6.8 for a more detailed discussion of the temporary and minor determination for impacts of noise on recreation and tourism. Onshore construction noise could temporarily affect residents, possibly also resulting in a short-term reduction of economic activity for businesses near construction sites. Onshore noise impacts would be site specific, but impacts on communities with environmental justice concerns from six NY Bight projects are anticipated to be similar to those of other onshore utility construction activities and could be negligible to minor. Noise from six projects could potentially affect sleep, therefore affecting health; long-term health effects should be reexamined at the project-specific NEPA stage.

Port utilization: The communities affected by port utilization would be highly dependent on the specific ports under consideration for the six NY Bight projects. Port expansion and upgrade activities have the potential to affect communities with environmental justice concerns, and the extent of impacts may depend on whether multiple offshore wind developers use the same port. Ports that may be utilized are typically sited in industrial areas that are either set back from surrounding residential areas or are in high-density developed areas with ambient levels of air emissions, noise, lighting, and traffic that are typical of high-density urban areas. During engagement efforts for the Final PEIS, BOEM heard from community-based organizations that work on environmental justice issues. They identified traffic impacts near ports as a concern. If all six NY Bight projects were constructed utilizing the same or adjacent ports, there could be measurable increases in vehicle and vessel traffic, resulting in congestion and delays for communities with environmental justice concerns working at or living near ports, and air emissions near those ports that could result in health impacts on communities with environmental justice concerns. Given the context of surrounding land uses, BOEM expects that port utilization would not have adverse effects on communities with environmental justice concerns. However, the incidence and level of impact would be highly dependent on port selection and the specific location of communities with environmental justice concerns near port areas. Port expansion and upgrade activities could prolong these impacts for communities with environmental justice concerns. Six NY Bight projects could have long-term, moderate beneficial impacts on communities with environmental justice concerns if workforce development and employment initiatives are implemented for local communities.

Presence of structures: The installation of offshore structures would result in both adverse and beneficial impacts on marine businesses supporting commercial fisheries and for-hire recreational fishing. Beneficial impacts would be generated by the reef effect of offshore structures, providing additional opportunity for tour boats and for-hire recreational fishing businesses. Adverse impacts would result from navigational complexity within the lease areas, disturbance of customary routes and fishing locations, and the presence of scour protection and cable hardcover, leading to possible equipment loss and limiting certain commercial fishing methods. In terms of commercial fishing and for-hire recreational fishing, six NY Bight projects would have a greater impact on communities that have a high level of commercial or recreational fishing engagement or reliance. The effect on communities with environmental justice concerns would be indirect impacts from adversely affected commercial fishing operators (particularly for ground fish species), marine recreational businesses, and shore-based supporting services during the installation phase due to exclusion zones. The increase in the disruption from construction of six NY Bight projects may result in additional time of disruption, but it would be geographically dispersed and may not be sequential. BOEM expects that impacts of six NY Bight projects on commercial fisheries and for-hire recreational fishing would range from minor to major due to disruption of these businesses. Impacts would depend on project-specific timing, location, and spacing of structures relative to fishery and fishing operations and would not likely have widespread impacts on entire communities with environmental justice concerns, only on those businesses and residents who rely on these fishing industries. For those members of communities with environmental justice concerns who rely on fishing and related industries, impacts would range from minor to major depending on the level of disruption of their businesses. Because of the distance of the WTGs/OSSs from shore (the NY Bight lease area nearest to shore is 20 nautical miles [37 kilometers] offshore), visual impacts on communities with environmental justice concerns are not anticipated. However, presence of structures may result in impacts on culture and identity by affecting sense of place.

3.6.4.5.3 Cumulative Impacts of Alternative B

The construction and installation, O&M, and conceptual decommissioning of both onshore and offshore infrastructure for offshore wind activities across the geographic analysis area would also contribute to the primary IPFs of air emissions, cable emplacement and maintenance, land disturbance, lighting, noise, port utilization, and presence of structures. Existing stressors and legacy waste could be compounded by industrial activities and will be considered in the project-specific NEPA documents to examine the potential for disproportionate and adverse impacts for people living in communities with environmental justice concerns. In the context of reasonably foreseeable environmental trends and planned actions, the cumulative impacts of six NY Bight projects could range from negligible to major. The magnitude and extent of impacts would largely depend on whether the projects are staggered or concurrent. For example, if all six NY Bight projects and multiple other planned offshore wind projects use the same or adjacent ports, there would be increases in vessel and vehicle traffic near ports. Depending on emissions permits not under BOEM's jurisdiction, concurrent projects could affect communities with environmental justice concerns who live near, or work at, the ports, and result in increases in air emissions, which could result in health impacts. If the projects are staggered, or if multiple ports are used, these same impacts on traffic and air emissions may not be detectable. The economic viability of some coastal communities with environmental justice concerns is dependent on tourism, recreation, and fishing industries.

3.6.4.5.4 Conclusions

Impacts of Alternative B. Construction and installation, O&M, and conceptual decommissioning of either a single NY Bight project or six NY Bight projects under Alternative B would likely have negligible to major impacts on communities with environmental justice concerns, depending on the port locations, the timing of construction (whether the six NY Bight projects are concurrent or staggered), and their proximity to fishing or recreation/tourism areas that might impact local economies. It should be noted that all identified impacts have the potential to be disproportionate and adverse and should therefore be considered at the project-specific NEPA review stage. Noise impacts would be temporary, primarily during the construction phase, and negligible to minor. Land disturbance impacts would also occur primarily during construction and would be localized, temporary, and minor to moderate. Potential long-term health effects from the impacts of noise, lighting, and dust that occur during onshore construction will be re-examined in the project-specific NEPA documents. Emissions impacts are expected to be temporary and negligible to minor during construction but long-term negligible to minor beneficial from replacement of fossil fuel energy generation emissions, provided that fossil fuel power-generating capacity is displaced within or near communities with environmental justice concerns in the geographic analysis area.

The presence of structures may have negligible to major impacts on communities with environmental justice concerns who rely on fishing industry jobs and revenues, depending on the timing of construction and siting of structures and their potential to disrupt recreational and commercial fishing operations. Any long-term impacts on jobs and revenues would remain for as long as the structures are present.

The communities with environmental justice concerns that may be affected by NY Bight projects are dynamic and diversified. In the context of the region's ongoing levels of economic and employment activity, BOEM expects negligible to slight changes, with mostly temporary and largely indirect adverse impacts affecting the region's communities with environmental justice concerns. BOEM also expects there may be opportunities for moderate beneficial impacts from port expansion and utilization for communities with environmental justice concerns resulting from positive contributions to employment and revenue from offshore wind energy development activities.

In addition, the potential health benefits associated with displacement of energy produced by fossil-fuel power plants would have beneficial effects on the health of communities with environmental justice concerns provided that fossil fuel power-generating capacity is displaced within or near communities with environmental justice concerns in the geographic analysis area.

Overall, the adverse impacts of either a single NY Bight project or six NY Bight projects under Alternative B have the potential to be **negligible** to **major** with **minor** to **moderate** beneficial impacts.

Cumulative Impacts of Alternative B. BOEM anticipates that the cumulative adverse impacts on communities with environmental justice concerns in the geographic analysis area would likely be **negligible** to **major** under six NY Bight projects. All identified cumulative impacts have the potential to be disproportionate and adverse and should therefore be considered at the project-specific NEPA review stage. In context of reasonably foreseeable environmental trends, the impacts contributed by six

NY Bight projects to the cumulative impacts on communities with environmental justice concerns would likely be noticeable.

BOEM does not anticipate any significant demographic changes to the region's communities with environmental justice concerns and expects minor to moderate beneficial impacts on regional or ocean industry-related employment, unemployment, or persons living below the poverty level in the geographic analysis area (Section 3.6.3, *Demographics, Employment, and Economics*). The potential long-term minor to moderate benefits for communities with environmental justice concerns depend on states, local governments, and the offshore wind industry targeting the workforce development and jobs for the benefit of residents from communities with environmental justice concerns. The affected New York and New Jersey coastal counties would continue to rely economically on marine transportation and tourism and recreation, more so than the inland counties in the geographic analysis area that have more diversified economic bases. Communities with environmental justice concerns may indirectly experience temporary increased economic activity through industries peripheral to the offshore wind development (e.g., housing, transportation, and restaurants for temporary workers) during the construction and installation phases and a lower level of increased economic activity over the long-term O&M phase of offshore wind energy production.

3.6.4.6 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Environmental Justice

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives—Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from those impacts discussed under Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.6.4.6.1 Sub-alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations. However, BOEM has not identified any previously applied AMMM measures for environmental justice; therefore, the impacts on environmental justice under Sub-alternative C1 are the same as under Alternative B. Although there are no previously applied measures specifically targeted toward addressing impacts on communities with environmental justice concerns, these communities may experience reduced impacts through application of previously applied AMMM measures for other resources. For example, the highest impact conclusion described in Alternative B is related to impacts on communities with environmental justice concerns relying on commercial fisheries and for-hire recreational fishing, and COMFIS-6, a previously applied AMMM measure, reduces impacts on those fishing industries. There are other previously applied AMMM measures for other resources that may reduce potential impacts on communities with environmental justice concerns; however, COMFIS-6 is the most relevant to the environmental justice analysis. While COMFIS-6 is not specifically designed to reduce impacts on communities with environmental justice concerns, they may still benefit from it.

3.6.4.6.2 Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied (Table 3.6.4-5). EJ-specific AMMM measures analyzed in Sub-alternative C2 are intended to help specifically target the inclusion of communities with environmental justice concerns and further reduce barriers they may face.

Table 3.6.4-5. Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for environmental justice

Measure ID	Measure Summary
EJ-1a	This measure proposes requiring a lessee to create an Environmental Justice Communications Plan that will guide a lessee throughout the project life on meaningful engagement and will propose a process for what, how, and to whom the lessee plans to communicate during activities described in the COP that may affect populations with environmental justice concerns, including construction, operations, and decommissioning. The Environmental Justice Communications Plan must be specifically designed for populations with environmental justice concerns and be created in coordination with, at minimum, organizations that serve these populations. Residents of these populations should be involved in the creation of the plan and will have the opportunity to review the plan and provide feedback.
EJ-3	This measure proposes requiring a lessee to report their activities under AMMM measure EJ-1a. This measure allows the lessee to adaptively address communications and mitigation resource needs, in addition to reported impacts, over the life of the project. Lessees should respond to recommendations made by populations with environmental justice concerns or BSEE in order to improve the plans over time.

Impacts of One Project

The implementation of AMMM measures could potentially reduce impacts on communities with environmental justice concerns compared to those described under Alternative B for the IPFs of air emissions, cable emplacement, land disturbance, lighting, noise, port utilization, and presence of structures.

AMMM measure EJ-1a could lessen impacts on communities by requiring each lessee to develop an Environmental Justice Communications Plan that would set forth how the lessee proposes to perform engagement with communities with environmental justice concerns and to document that engagement throughout the life of the project. Among other elements, the plan would require advanced notification to communities with environmental justice concerns of construction and installation, O&M, and conceptual decommissioning activities, to respond to concerns raised by these communities, and to ensure these communities are made aware of employment and training opportunities. This would reduce impacts to communities with environmental justice concerns by allowing community members time to adjust to upcoming construction and other project activities, would ensure community concerns are being heard, documented by lessees, and responded to, and could increase awareness of employment opportunities for these communities in the offshore wind industry.

Under AMMM measure EJ-3, communities with environmental justice concerns would have enhanced transparency about continued engagement during project activities through access to summaries of lessees' actions undertaken under AMMM measure EJ-1a and the opportunity to submit recommendations to improve the plans to which lessees need to respond. This AMMM measure could improve accountability and ensure that the Environmental Justice Communications Plan is being implemented and is adaptable over time.

Overall, the AMMM measures under Sub-alternative C2, combined with the previously applied AMMM measures for other resources, could reduce the negligible to major adverse impacts associated with Alternative B on communities with environmental justice concerns in the NY Bight geographic analysis area to negligible to moderate; minor to moderate beneficial impacts would remain unchanged. Previously applied AMMM measures for other resources alone may not reach communities with environmental justice concerns, and therefore may not reduce the impacts. However, combined with the EJ AMMM measures, the impacts are more likely to be reduced.

Impacts of Six Projects

The inclusion of not previously applied AMMM measures in Sub-alternative C2 for six NY Bight projects would likely reduce the impacts associated with Alternative B on the communities with environmental justice concerns. Impacts would be reduced to negligible to moderate as described for one NY Bight project, except it would apply to six projects and may affect more communities with environmental justice concerns. **Minor** to **moderate beneficial** impacts would remain unchanged.

Cumulative Impacts of Sub-alternative C2

The inclusion of AMMM measures in Sub-alternative C2 could reduce the negligible to major adverse cumulative impacts associated with Alternative B on the communities with environmental justice concerns of the NY Bight geographic analysis area to **negligible** to **moderate**. Existing stressors and legacy waste could be compounded by the impacts of industrial activities and will be considered in the project-specific NEPA documents. **Minor** to **moderate** beneficial impacts would remain unchanged.

3.6.4.6.3 Conclusions

Impacts of Alternative C. BOEM has not identified any previously applied AMMM measures specifically for communities with environmental justice concerns; therefore, the impacts under Sub-alternative C1 are the same as under Alternative B for either one or six NY Bight projects: **negligible** to **major**. Previously applied AMMM measures for other resources would likely address some of the potential impacts on communities with environmental justice concerns referenced in this section. BOEM expects the impacts on communities with environmental justice concerns, whether for one NY Bight project or six NY Bight projects, to be **negligible** to **moderate** under Sub-alternative C2. This reduction in impacts from those in Alternative B would be due to AMMM measures for this resource (i.e., EJ-1a) as well as those for other resources. BOEM expects the same direct **minor** to **moderate beneficial** impacts on communities with environmental justice concerns from offshore wind energy development under Sub-alternative C2.

Cumulative Impacts of Alternative C. BOEM has not identified any previously applied AMMM measures for communities with environmental justice concerns; therefore, the cumulative impacts on communities with environmental justice concerns under Sub-alternative C1 are the same as under Alternative B. Under Sub-alternative C2, BOEM anticipates that the cumulative impacts on communities with environmental justice concerns in the geographic analysis area would likely be reduced to **negligible** to **moderate** with **minor** to **moderate beneficial** impacts. The AMMM measures would reduce impacts on communities with environmental justice concerns in the NY Bight geographic analysis area by implementing an environmental justice communications plan for the six NY Bight projects. In the context of reasonably foreseeable environmental trends, the impacts contributed by Sub-alternative C2 to cumulative impacts on environmental justice would likely be noticeable.

3.6.4.7 Recommended Practices for Consideration at the Project-Specific Stage

In addition to the AMMM measures identified under Alternative C, BOEM is recommending lessees consider analyzing the RPs in Table 3.6.4-6 to further reduce potential environmental justice impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.6.4-6. Recommended Practices for environmental justice impacts and related benefits

Recommended Practice	Potential Benefit
EJ-1b: Develop a Draft Environmental Justice Communications Plan early in the project planning process. This plan can be submitted to BOEM for feedback prior to the publication of the Draft COP NEPA document.	This RP provides sufficient time for engagement with populations with environmental justice concerns during the development of an Environmental Justice Communications Plan, allowing the lessee to develop a more effective plan that integrates relevant concerns of the community earlier in the process and build relationships with the community, contributing to overall project success.
EJ-2: Create and submit an Environmental Justice Impact Mitigation Plan for populations with environmental justice concerns potentially affected by onshore construction activities prior to the publication of the Draft COP NEPA document. Submission of the Final Environmental Justice Impact Mitigation Plan is recommended before construction begins.	This RP integrates community concerns and priorities and allows the lessee to effectively identify what mitigation resources are necessary to reduce adverse impacts. This RP has the potential to facilitate important relationships between the lessee and the potentially affected community.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.5 Land Use and Coastal Infrastructure

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on land use and coastal infrastructure from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.6 Navigation and Vessel Traffic

This section discusses navigation and vessel traffic characteristics and potential impacts on waterways and water approaches from the Proposed Action, alternatives, and ongoing activities. The navigation and vessel traffic geographic analysis area, as shown on Figure 3.6.6-1, includes:

- Coastal and marine waters within a 10-mile (16.1-kilometer) buffer of the six NY Bight lease areas
- Adjacent Lease Area OCS-A 0512 (Empire Wind)
- Waterways leading to the representative ports that may be used by the NY Bight projects

The geographic analysis area encompasses locations where BOEM anticipates direct and indirect impacts on navigation and vessel traffic associated with construction and installation, O&M, and conceptual decommissioning of the NY Bight projects. Information presented in this section is based on anticipated navigation considerations and estimated vessel traffic required to support the RPDE parameters for the NY Bight projects. This programmatic analysis precedes the submittal of COPs for the NY Bight projects; therefore, this section draws upon existing Navigation Safety Risk Assessments (NSRAs) prepared for other offshore wind projects in the region: the Atlantic Shores South NSRA[1] (COP Appendix II-S; Atlantic Shores 2022), the Empire Wind NSRA (COP Appendix DD; Empire Wind 2022), and the Ocean Wind 1 NSRA (COP Appendix M; Ocean Wind 2022). This analysis assumes that the NY Bight projects would conform to the guidelines in USCG Navigation and Vessel Inspection Circular 02-23 (USCG 2023c) or the latest guidance, and Commandant Instruction 16003.2B (USCG 2016a). The lessees will be required to prepare an NSRA in consultation with USCG as part of the lessees' COP submission.

The navigation and vessel traffic impact analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

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[1] The NSRA for Empire Wind analyzed vessel traffic that navigated within or near the Empire Wind project areas (Figure 3.6.6-1) based on 12 months of AIS data (2017–2018) and the NSRA for Atlantic Shores South analyzed vessel traffic that navigated within or near the Atlantic Shores South project area based on 3 years of AIS data (2017–2019). The NSRA for Ocean Wind 1 analyzed vessel traffic that navigated in and within 40 nautical miles (74 kilometers) in any direction from the lease area based on 1 year of AIS data (January–December 2020). The analysis included studies of vessel traffic patterns, density, and numbers as well as anticipated changes in traffic from the project.

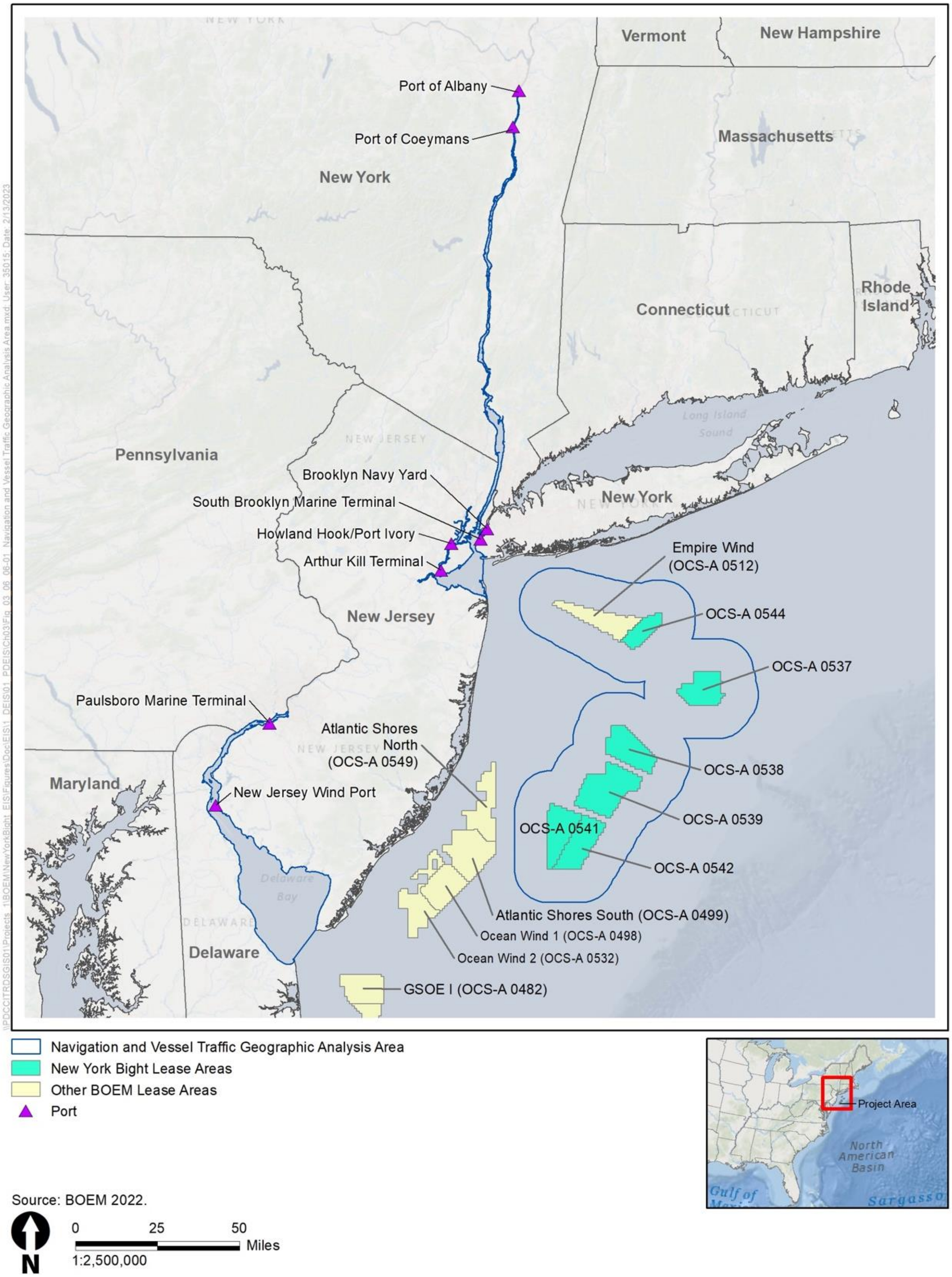

Figure 3.6.6-1. Navigation and vessel traffic geographic analysis area

3.6.6.1 Description of the Affected Environment and Future Baseline Conditions

3.6.6.1.1 Regional Setting

Within the NY Bight area, there is a large volume of commercial, private, and government vessel traffic to and from U.S. or international ports. The NOAA Coast Pilot, Volume 2 (NOAA 2023:163), notes that the Cape Cod to Sandy Hook mariner must contend with "a great volume of waterborne traffic that moves through the area to and from the Port of New York." The regional setting is dominated by this commerce hub that consists of the Port of New York and New Jersey with facilities along the shores of Staten Island, Brooklyn, Manhattan, Hudson County, and Newark.[2] The Hudson River gives access to and from the NY Bight from the Port of Albany, Port of Coeymans (Ravena), Kingston, and Yonkers, New York, among numerous other commercial and small craft marina and port facilities. In the southern portion of the geographic analysis area, vessel traffic patterns are influenced by the ports in the Delaware Bay and commercial fishing ports along the coast of New Jersey, including Long Beach-Barnegat, Atlantic City, and Cape May-Wildwood. The coastal NY Bight waters are also a favorite area for commercial fisheries and recreational uses further described in Section 3.6.1, *Commercial Fisheries and For-Hire Recreational Fishing*, and Section 3.6.8, *Recreation and Tourism.*

Dominating the approach to the Port of New York and New Jersey and its navigation channels are three of the four "Off New York" TSS (33 CFR 167.152–167.155) which are maritime traffic-management route-systems governed by the IMO with Separation Zones between each unidirectional traffic lane, all of which converge on a central and circular Precautionary Area (33 CFR 167.151). The three TSS as shown on Figure 3.6.6-2 are:

- Nantucket to Ambrose and Ambrose to Nantucket traffic lanes
- Hudson Canyon to Ambrose and Ambrose to Hudson Canyon traffic lanes
- Barnegat to Ambrose and Ambrose to Barnegat traffic lanes

The TSS, Separation Zones, and Precautionary Area are IMO routing measures to improve vessel safety at sea by establishing separated, one-way traffic lanes and demarcation areas requiring particular caution for navigation.[3] The Nantucket to Ambrose and Ambrose to Nantucket traffic lanes are connected to the fourth "Off New York" TSS, described as the "Eastern approach, off Nantucket" (33 CFR 167.152), by shipping safety fairways (defined in 33 CFR 166.105). The "Off New York" TSS is outside of the NY Bight lease areas. These shipping safety fairways were established by USCG in a 1987 Final Rule

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[2] According to the *Port Master Plan 2050* (Port Authority of New York and New Jersey 2019), the Port District comprises an area in both states of New York and New Jersey roughly within a 25-mile (40-kilometer) radius of the Statue of Liberty, centered on New York Harbor.

[3] IMO is the only recognized international body for developing guidelines, criteria, and regulations on an international level concerning certain routing measures and areas to be avoided by ships. USCG submits and obtains approval for routing measures within U.S. navigable waters to IMO (USCG 2016a).

(*Federal Register* Vol. 52, No. 172) to "control the erection of structures therein to provide safe vessel routes along the Atlantic Coast."

On June 19, 2020, USCG issued an Advance Notice of Proposed Rulemaking (85 *Federal Register* 37034-37040) (ANPRM) seeking comments regarding the possible establishment of additional shipping safety fairways along the Atlantic Coast based on the navigation safety corridors identified in the *Atlantic Coast Port Access Route Study* (ACPARS) (USCG 2016b). On September 9, 2022, USCG published the Consolidated Port Approaches Port Access Route Studies (CPAPARS) to announce the conclusion of the studies supplemental to the ACPARS. On March 10, 2023, USCG released an update to the CPAPARS (USCG 2023a). This report summarizes the findings of four regional PARS (the Northern New York Bight; Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware; Approaches to the Chesapeake Bay, Virginia; and the Seacoast of North Carolina Including Approaches to the Cape Fear River and Beaufort Inlet, North Carolina), dialogue with the maritime industry, and comments received on the ANPRM for establishing shipping safety fairways along the Atlantic Coastline. The report provides recommendations for a system of shipping safety fairways and routing measures along the Atlantic Coast, which would be included in any subsequent rulemaking proposal. Figure 3.6.6-2 shows the proposed fairways in the vicinity of the NY Bight lease areas. None of the proposed fairways intersect with the NY Bight lease areas.

As summarized in the CPAPARS, USCG published the *Seacoast of New Jersey Including Offshore Approaches to the Delaware Bay, Delaware Port Access Route Study: Draft Report* (USCG 2021a). Using 3 years (January 1, 2017, to December 31, 2019) of traffic data, that analysis offers an in-depth look at the traffic patterns and traffic composition along the New Jersey seacoast from year to year. Along with the New Jersey PARS, the *Northern New York Bight Port Access Route Study: Final Report* (USCG 2021b) supplements and builds upon the ACPARS. The Northern New York Bight PARS specifically analyzed an area that includes the approaches to the Port of New York and New Jersey and, based on Marine Planning Guidelines, recommended that multiple shipping fairways and one federal anchorage be established within the PARS area. As noted above, USCG is pursuing a rulemaking effort to establish the shipping safety fairways throughout the Atlantic, and both the Northern NY Bight PARS and the New Jersey PARS final reports will be considered during that process. The USCG-proposed fairways and anchorage area are shown on Figure 3.6.6-2.

Vessel traffic within the existing Precautionary Area shown on Figure 3.6.6-2 (circular area at the entrance to the Port of New York and New Jersey) transitions between the Ambrose or Sandy Hook channels (federally maintained channels into and out of the Port of New York and New Jersey) and the traffic lanes, and mariners are advised to exercise extreme caution within the area (NOAA 2018; 355–359, note C on NOAA chart 12326). A North Atlantic right whale seasonal management area exists around the Port of New York and New Jersey between November 1 and April 30. The seasonal management area requires that all vessels greater than or equal to 65 feet (19.8 meters) in overall length must travel at a speed of 10 knots or less during the time frame noted (50 CFR 224.105).

USCG Vessel Traffic Service New York coordinates vessel traffic movements in the Port of New York and New Jersey. Also supporting the vessel traffic management system within the Port of New York and New

Jersey are pilots working within three pilot organizations (Sandy Hook, Hudson River Pilots Association, and Northeast Marine Pilots) supported by 14 ocean-going pilot vessels (Board of Commissioners of Pilots of the State of New York 2020a, 2020b). Pilotage is compulsory (required by New York State navigation law) within the Port of New York and New Jersey.

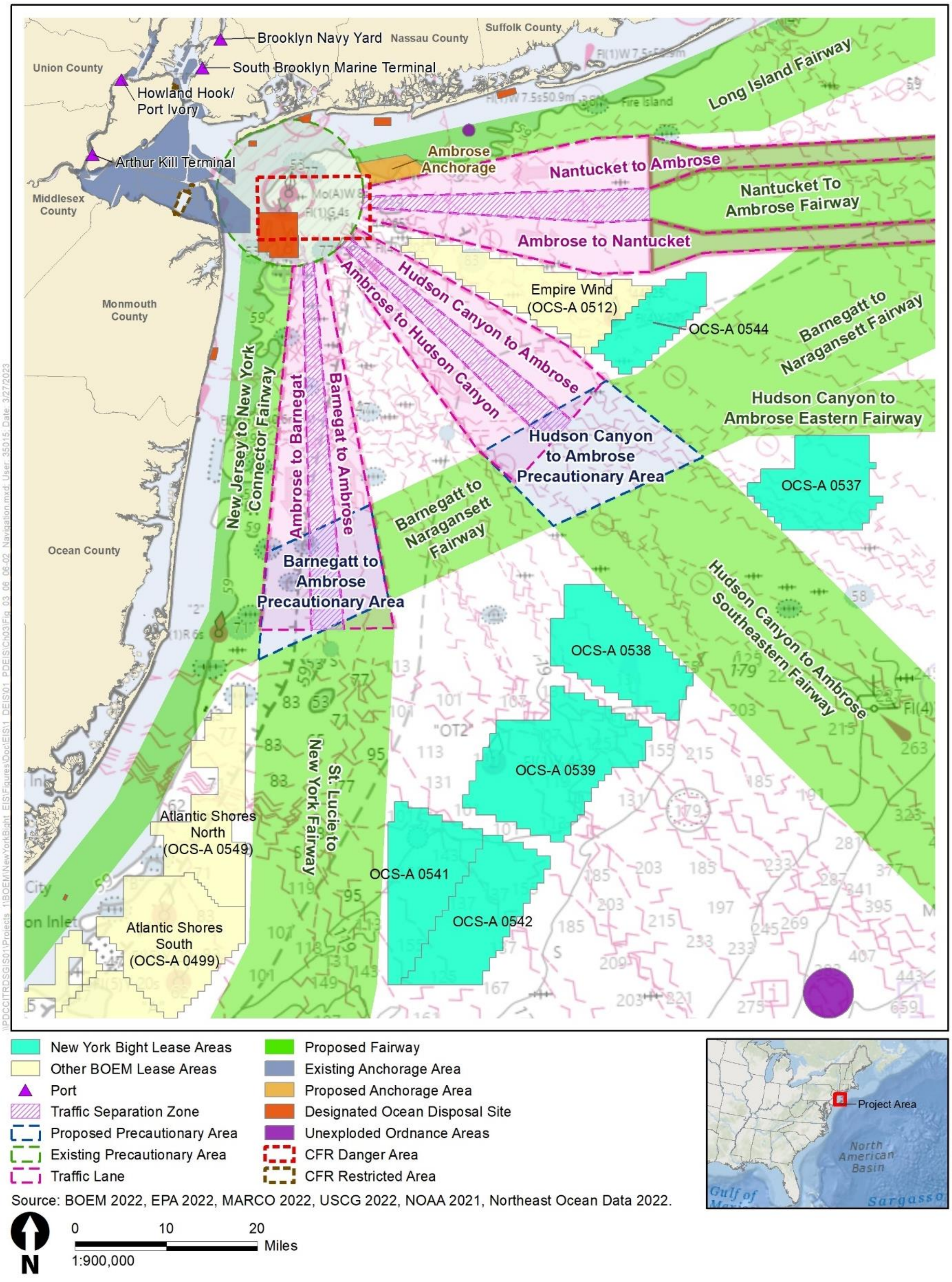

Figure 3.6.6-2. TSS, separation zones, precautionary areas, and USCG proposed fairways, anchorages, and precautionary areas in the geographic analysis area

3.6.6.1.2 Lease Areas

The NY Bight lease areas are in the vicinity of the six traffic lanes guiding large vessel traffic into and from the Port of New York and New Jersey, as described in Section 3.6.6.1.1, *Regional Setting*. Figure 3.6.6-2 shows the TSS, Separation Zones, and Precautionary Area in the vicinity of the NY Bight lease areas.

Figure 3.6.6-2 also shows the active dredge material dumping sites (ocean disposal) to the west of the NY Bight lease areas. A NOAA charted Danger Area exists within the Precautionary Area. The Danger Area is open to unrestricted surface navigation, but all vessels are cautioned not to anchor, dredge, trawl, or lay cables because of residual danger from mines on the ocean bottom (NOAA 2018: note B on chart 12326). An Area to be Avoided is also within the "CFR Danger Area," depicted by the orange dotted line on Figure 3.6.6-2. All vessels carrying petroleum or dangerous or toxic cargoes or any vessel exceeding 1,000 tons should avoid this area (NOAA 2018: note E on chart 12326).

A Regulated Navigation Area (RNA) is established from the territorial sea limit to the south of Long Island, and security and safety zones within the USCG Long Island Sound Marine Inspection and Captain of the Port Zone establish necessary security measures (68 *Federal Register* 48798) as needed. RNAs are water areas within a defined boundary for which regulations for vessels navigating within the area have been established. Vessel traffic is prohibited within the security and safety zones unless authorized by USCG. The RNA and the safety and security zones do not extend into the NY Bight lease areas, but they influence vessel traffic in the vicinity. Additional details about the RNA and these safety and security zones are available in 33 CFR 165.153 and 165.154. A safety zone is also established around UXO in Gravesend Bay, approximately 70 yards (64 meters) southeast of the Verrazano Bridge Brooklyn tower (33 CFR 165.172).

Ports, Harbors, and Navigation Channels

The Ambrose Channel is the closest deep-draft vessel channel to the northern NY Bight lease areas and provides primary access to port and harbor facilities within the Port of New York and New Jersey. The Ambrose Channel extends from the sea to deep water in Lower Bay where it continues as an Anchorage Channel through the Upper Bay to The Battery (previously Battery Park). The Hudson River Channel continues northward from The Battery. Sandy Hook channel is the southern entrance point to New York Harbor. Adjoining channels provide access to Sandy Hook Bay and Raritan Bay.

The closest ports to the southern NY Bight lease areas are the New Jersey Wind Port, the Paulsboro Marine Terminal, and the Port of Wilmington, Delaware, within Delaware Bay and River. These are ports of call for large commercial deep-draft ships and tug/barge units as well as smaller commercial and non-commercial shallower-draft vessels. The NSRAs developed for other regional projects considered commercial cargo vessels, military vessels, towing, fishing, and recreation. Most of the traffic in the vicinity of the NY Bight lease areas consists of transits of fishing and pleasure vessels to or from three major New Jersey commercial fishing ports: Long Beach-Barnegat, Atlantic City, and Cape May-Wildwood. North of the NY Bight lease areas is the outer portion of the approach to New York Harbor, Ambrose Channel, where the AIS data shows a large distribution of deep-draft ships. Deep-draft traffic within the NY Bight lease areas is predominately along a north-northeast to south-southwest course, and density increases towards the east on the approach to the port areas.

Several representative port facilities in New Jersey and New York have been identified for analysis in this PEIS (Table 3.6.6-1). These representative ports may be used for major construction staging activities, fabricating and assembling components for the NY Bight projects, and other offshore wind projects. Other ports along the Atlantic seaboard, U.S. Gulf Coast, or international ports may also be used by the NY Bight projects but are not analyzed in this PEIS. In addition to construction staging, ports may be used for limited, basic activities associated with marine construction, including refueling (although some limited refueling is expected to occur offshore), restocking supplies, and sourcing parts for repairs.

Table 3.6.6-1. Representative ports that may be used during construction of the NY Bight projects

Port	Location
New Jersey Wind Port	Lower Alloways Creek, New Jersey
Port of Paulsboro	Paulsboro, New Jersey
Port of Albany	Albany, New York
Port of Coeymans	Coeymans, New York
Brooklyn Navy Yard	Brooklyn, New York
South Brooklyn Marine Terminal	Brooklyn, New York
Port Ivory / Howland Hook Marine Terminal (GCT New York)	Staten Island, New York
Arthur Kill Terminal	Staten Island, New York

Vessel Traffic

Three years (2017–2019) of AIS vessel traffic were reviewed for this PEIS analysis, as shown in Table 3.6.6-2 and Figure 3.6.6-3. An AIS transponder is only required on certain commercial vessels, including self-propelled vessels of 65 feet (19.8 meters) or longer, towing vessels longer than 26 feet (7.9 meters) and more than 600 horsepower, self-propelled passenger vessels that carry more than 150 passengers, self-propelled dredge vessels that operate in or near commercial channels or shipping fairways, and self-propelled vessels that move Certain Dangerous Cargo or flammable/combustible liquid cargo in bulk. Additional information on AIS carriage requirements can be found at 33 CFR Section 146.46. Although some smaller recreational and fishing vessels may be required or choose to have one, this category of vessels is likely to be underreported. “Other” vessels consist of commercial vessels not covered by other categories, including dredgers, cable-laying, and survey vessels.

Table 3.6.6-2. AIS vessel traffic data for 2017–2019

Vessel Type	OCS-A 0537			OCS-A 0538			OCS-A 0539			OCS-A 0541			OCS-A 0542			OCS-A 0544			Totals
	2017	2018	2019	2017	2018	2019	2017	2018	2019	2017	2018	2019	2017	2018	2019	2017	2018	2019	
Cargo	261	297	293	273	430	352	283	410	266	319	403	301	237	329	292	26	30	45	4,847
Fishing	1,773	1,015	697	1,009	1,002	1,039	1,251	1,679	1,448	807	952	1,141	542	827	1,121	618	457	402	17,780
N/A (Unspecified AIS type)	1	85	149	1	80	135	0	40	95	0	71	66	0	50	88	1	18	44	924
Other	26	21	47	58	50	64	49	53	78	46	47	61	43	48	76	22	119	31	939
Passenger	23	7	12	156	98	134	84	58	75	55	80	55	45	40	37	21	19	10	1,009
Recreational Vessels	149	158	118	213	371	373	229	457	446	202	439	344	176	319	30	159	202	181	4,837
Tankers	202	238	216	165	195	209	153	137	151	106	86	87	125	90	90	33	38	38	2,359
Tug-barge	20	10	21	42	16	32	22	11	25	35	15	32	4	19	21	21	14	33	403
Total	2,455	1,831	1,553	1,917	2,242	2,338	2,071	2,845	2,584	1,570	2,093	2,087	1,182	1,722	2,026	901	897	784	33,098
2017–2019 Total	**5,839**			**6,497**			**7,500**			**5,750**			**4,930**			**2,582**			**33,098**

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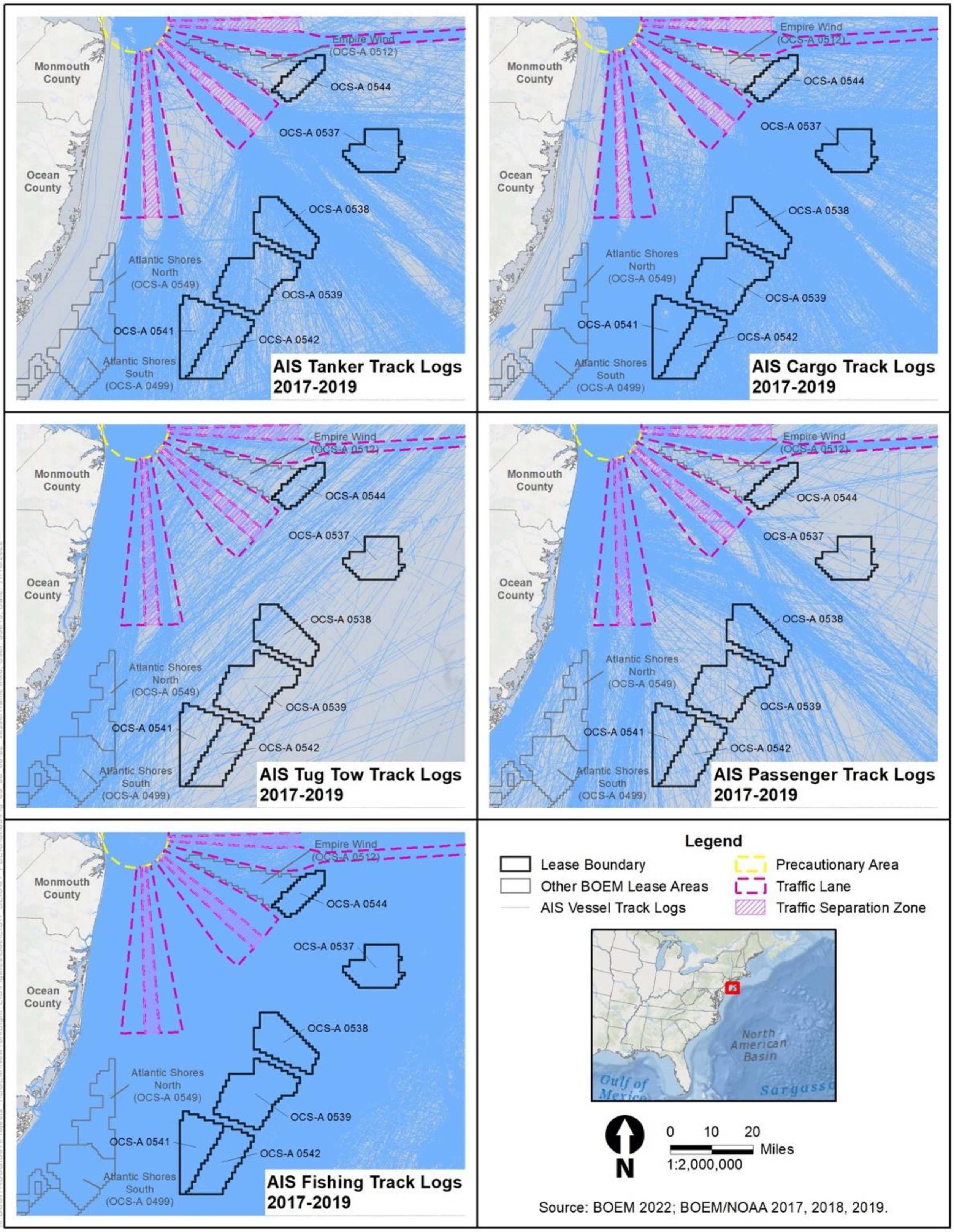


Figure 3.6.6-3. AIS track logs by vessel type in relation to NY Bight lease areas

Most of the AIS-identified, regular-routed vessel traffic transiting within the NY Bight utilizes the TSS and pre-established IMO routing measures in the NY Bight area, which are outside of the lease areas. Once the vessels have cleared the regional routing measures, some will traverse the lease areas. As shown in Table 3.6.6-2, the highest number of vessel types with AIS track lines through the NY Bight lease areas were fishing vessels (53.7 percent). Recreational vessels were the next highest and accounted for approximately 14.6 percent of the AIS track lines recorded.

BOEM reviewed pollution data from 2002–2021 and SAR data for the geographic analysis area from the USCG for 2011–2020 (USCG 2023b). The data indicate that there were 22 pollution incidents and 1 vessel incident within the NY Bight lease areas or buffer zone (10 nm [18.52 kilometers] around the lease areas). As shown in Table 3.6.6-3 and Figure 3.6.6-4, during the study period a total of 128 SAR-related missions were found to have occurred within the NY Bight lease areas and buffer zone. These incidents occurred during all seasons, during daylight hours and after dark, and varied among type.

Table 3.6.6-3. SAR incident data in the geographic analysis area (2011–2020)

Lease Area (Buffer[1])	SAR	Medevac	SAR/Medevac	Miscellaneous[2]	Total
OCS-A 0541	1 (3)	1 (0)	2 (0)	0 (3)	10
OCS-A 0542	3 (3)	0 (0)	0 (1)	0 (1)	8
OCS-A 0539	0 (6)	0 (1)	0 (3)	3 (2)	15
OCS-A 0538	2 (30)	0 (1)	2 (3)	0 (4)	42
OCS-A 0537	1 (10)	0 (1)	0 (2)	0 (1)	15
OCS-A 0544	7 (17)	0 (0)	0 (2)	2 (10)	38
Total	**14 (69)**	**1 (3)**	**4 (11)**	**5 (21)**	**128**

Source: USCG 2023b.
[1] The number in parentheses represents the number of incidents that occurred in the buffer area that encompasses an area 10 nm (18.52 kilometers) around the lease areas, consistent with the geographic analysis area.
[2] Miscellaneous refers to uncorresponded flares or other reports, adrift personal crafts, or other unusual incidents.

Accident frequencies in the vicinity of several regional offshore wind project lease areas Empire Wind (OCS-A 0512), Ocean Wind 1 (OCS-A 0498), and Atlantic Shores South (OCS-A 0499) were collected and modeled in each project's respective NSRA for future-case traffic levels, including the additional risk once the wind turbines are in place. Overall, for future-case traffic levels that are estimated at 10 percent vessel traffic increase (this is the standard approach taken with the majority of United Kingdom offshore wind developments), the projected increase in the likelihood for a vessel to be involved in a collision or allision within the three regional offshore wind project lease areas is 6 percent or below, as shown in Table 3.6.6-4. This can be applied to the NY Bight lease areas due to their proximity.

Table 3.6.6-4. Percent change in accident frequencies within three regional offshore wind project lease areas

Incident Type	Empire Wind	Ocean Wind 1	Atlantic Shores South	Average % Change
Collision	0%	2.7%	10%	+4.2%
Powered Allision	0.113%	6.6%	0.28%	+2.3%
Drifting Allision	0.015%	1.9%	0.013%	+0.64%
Total % Change	0.128%	6.627%	10.2%	**+5.65%**

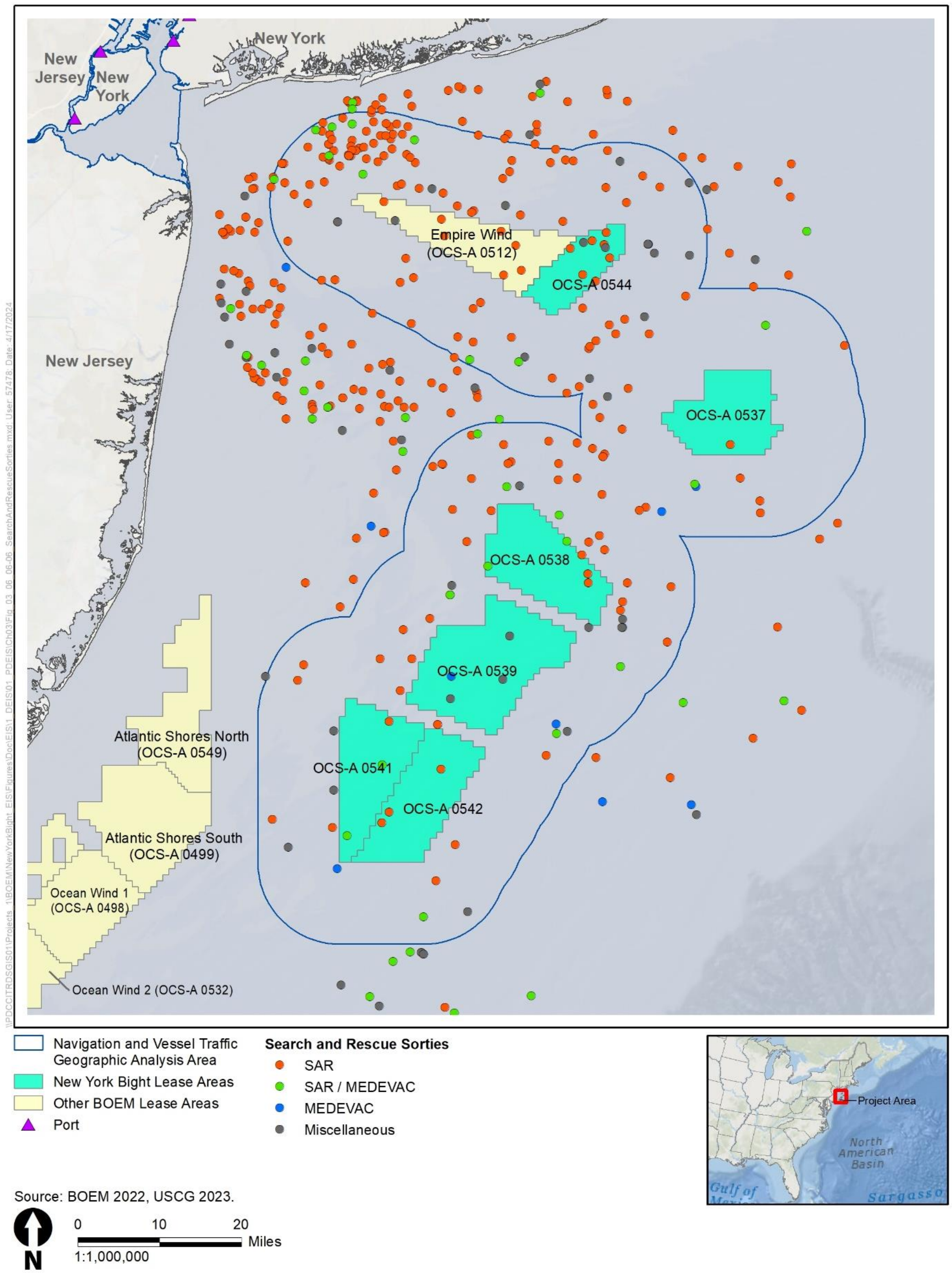


Figure 3.6.6-4. SAR missions near the NY Bight lease areas

Aids to Navigation

The majority of the navigational buoys near the six NY Bight lease areas are close to the shoreline, within the Precautionary Area, and directly to the north, marking the entrance to the East Rockaway Inlet. There are both PATON and Federal Aids to Navigation (ATON) in areas that may be utilized for offshore export cable routes for one or more of the NY Bight lease areas, as shown on Figure 3.6.6-5. ATONs are developed, established, operated, and maintained or regulated by the USCG to assist mariners in determining their position and identifying safe courses, and to warn of dangers and obstructions. ATONs and PATONs will need to be considered, and coordination with the USCG will be necessary, during the planning and installation of the offshore export cables. There are two private aids within the buffer zone of 10 nautical miles (18.5 kilometers) and two private aids within two of the NY Bight lease areas (see Figure 3.6.6-5) that will need to be considered during planning and construction within these lease areas.

There are radar transponders in the vicinity of the NY Bight lease areas but not within them. These consist of lights, sound horns, buoys, and onshore lighthouses and are intended to serve as references to support safe maritime navigation.

Anchorages

The federal anchorage regulations for the Port of New York are prescribed in 33 CFR 110.1, 110.60, and 110.155. Anchorage grounds (33 CFR 109.05) as identified in 33 CFR 110.155 are established and enforced by USCG for vessels (generally deep-draft and commercial vessels) in navigable waters of the United States whenever it is apparent that these are required by the maritime or commercial interests of the United States for safe navigation. The latest revision to the Port of New York anchorage ground regulations was in January 2015 to establish new Anchorage Ground No. 18 and modify existing anchorage grounds to support port demands and enhance navigation safety (80 *Federal Register* 10, page 2011). Anchorage grounds in New York Harbor are shown in Figure 3.6.6-2.

According to the Coast Pilot, Volume 2, the Harbor Safety, Operations and Navigation Committee of the Port of New York and New Jersey has issued recommendations regarding designated anchorage usage to “minimize vessel delays and allow efficient use of current anchorage areas” (NOAA 2023:351). One of these recommendations is that “ships awaiting berths will use the offshore anchorages at Ambrose.” This area is not a prescribed anchorage ground/area; however, USCG is currently evaluating the potential establishment of an anchorage ground in this area (86 *Federal Register* 17090). The proposed “Ambrose” anchorage is northeast of the NY Bight lease areas (Figure 3.6.6-2). It is 3 nautical miles (5.6 kilometers) south of Long Beach, New York, and just north of the Nantucket to Ambrose traffic lane. As an existing informal anchorage area, this is currently the closest deep-draft anchorage to the NY Bight lease areas.

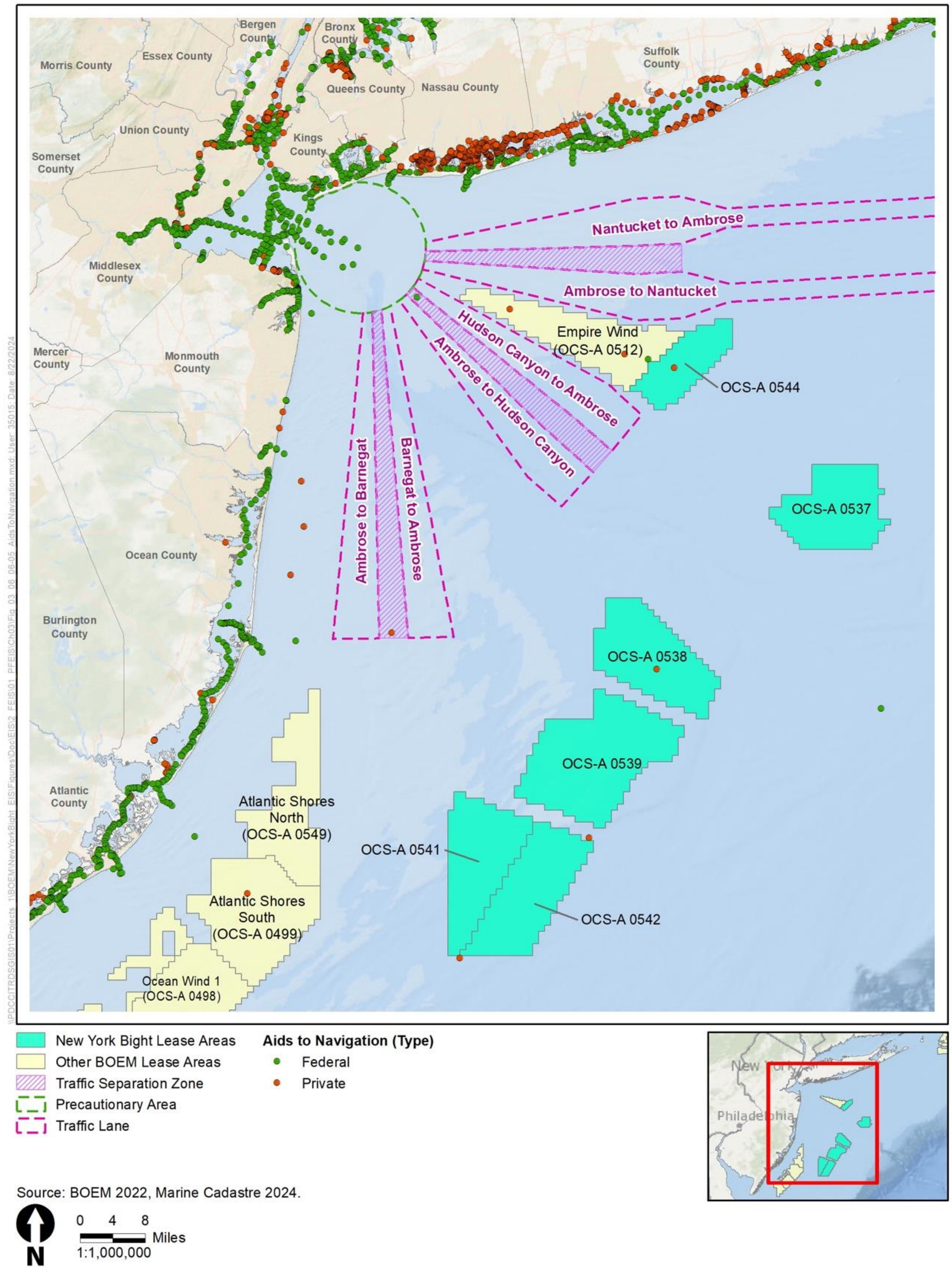


Figure 3.6.6-5. Aids to Navigation near the NY Bight lease areas

3.6.6.2 Impact Level Definitions for Navigation and Vessel Traffic

Definitions of adverse impact levels are provided in Table 3.6.6-5. Beneficial impacts on navigation and vessel traffic are described using the definitions described in Section 3.3.2 (Table 3.3-1).

Table 3.6.6-5. Adverse impact level definitions for navigation and vessel traffic

Impact Level	Definition
Negligible	There would be no measurable impacts, or impacts would be so small that they would be extremely difficult or impossible to discern or measure.
Minor	Impacts on vessels and turbines could be avoided. Impacts would not disrupt the normal or routine functions or navigation of the vessel or turbine.
Moderate	Impacts are unavoidable, although impacts could be reduced during the life of the project(s) through careful planning and communication. The vessel would have to adjust somewhat to account for disruptions due to impacts of the project(s).
Major	Vessel traffic would experience unavoidable disruptions to a degree beyond what is normally acceptable, including potential loss of vessels and life.

Anchoring, cable emplacement and maintenance, port utilization, presence of structures, and traffic are contributing IPFs to impacts on navigation and vessel traffic. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.6.6-6.

Table 3.6.6-6. Issues and indicators to assess impacts on navigation and vessel traffic

Issue	Impact Indicator
Vessel or structural damage due to incident	Increased frequency of strikes/allisions, collisions, and groundings due to restricted vessel movement
Navigation Risk	Changes to navigational patterns and increased risk of navigational hazards
Port Expansion	Changes to port accessibility depending on port construction or maintenance
Port Congestion	Increased delays for vessels to get berthing or services
Increased Vessel Traffic	Increased frequency of vessel incidents, delays in berthing and services.

3.6.6.3 Impacts of Alternative A – No Action – Navigation and Vessel Traffic

When analyzing the impacts of the No Action Alternative on navigation and vessel traffic, BOEM considered the impacts of ongoing activities, including ongoing non-offshore-wind and ongoing offshore wind activities on the baseline conditions for navigation and vessel traffic. The cumulative impacts of the No Action Alternative considered the impacts of the No Action Alternative in combination with other non-offshore-wind activities and offshore wind activities, which are described in Appendix D, *Planned Activities Scenario*.

3.6.6.3.1 Impacts of the No Action Alternative

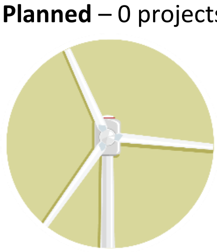
Under the No Action Alternative, baseline conditions for navigation and vessel traffic described in Section 3.6.6.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore-wind activities. Ongoing non-offshore-wind activities that affect navigation and vessel traffic in the geographic analysis area include marine transportation, military use, NMFS activities and scientific research, and fisheries use and management. These activities would increase vessel traffic in the area, adding to congestion in waterways and increasing the potential for maritime accidents. Empire Wind 1 and 2 (OCS-A 0512) are the only ongoing offshore wind projects in the geographic analysis area. Impacts on navigation and vessel traffic from ongoing construction of the Empire Wind 1 and 2 projects are described in Section 3.6.6.3.2, *Cumulative Impacts of the No Action Alternative*.

3.6.6.3.2 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 non-offshore-wind activities and offshore wind activities (without the NY Bight projects). Other non-offshore-wind activities that affect navigation and vessel traffic in the geographic analysis area include dredging and port improvement projects, military use, future marine transportation and fisheries use, and offshore cable emplacement and maintenance (see Appendix D for a description of activities). These activities may result in a moderate increase in port maintenance activities, port upgrades to accommodate larger deep-draft vessels, and temporary increases in vessel traffic for offshore cable emplacement and maintenance.

Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on navigation and vessel traffic are listed in Table 3.6.6-7.

Table 3.6.6-7. Ongoing offshore wind in the geographic analysis area for navigation and vessel traffic

Ongoing/Planned	Projects by Region
Ongoing – 2 projects[1] 	**NY/NJ** • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512)
Planned – 0 projects 	None within the geographic analysis area

NJ = New Jersey; NY = New York
[1] Refer to footnote 10 in PEIS Chapter 1 for additional information on the status of Empire Wind 1 and 2.

The following summarizes the potential impacts of offshore wind activities in the geographic analysis area on navigation and vessel traffic from construction and installation, O&M, and conceptual decommissioning.

Anchoring: Offshore wind lessees are expected to coordinate with the maritime community and USCG to avoid laying export cables through any traditional or designated lightering/anchorage areas, meaning that any risk of impacts for deep-draft vessels would come from anchoring in an emergency scenario. Generally, larger vessels accidently dropping anchor on top of an export cable (buried or otherwise protected) to prevent drifting in the event of vessel power failure could result in damage to the export cable, risks associated with an anchor contacting an electrified cable, and impacts on the vessel operator's liability and insurance. Impacts on navigation and vessel traffic would likely be minor, short term, and localized, and navigation and vessel traffic would be expected to fully recover following the incident.

Smaller commercial or recreational vessels anchoring in the ongoing offshore wind lease area may have issues with anchors failing to hold near foundations and any scour protection. Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of a moderate increase commensurate with any increase in tankers visiting ports. Deep-draft visits to major ports are expected to increase as well, increasing the potential for an emergency need to anchor, and thereby creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely remain largely the same related to this IPF.

Port utilization: Ongoing offshore wind development would support future expansions and modifications at ports in the geographic analysis area for navigation and vessel traffic, such as Paulsboro Marine Terminal in New Jersey and Arthur Kill Terminal in New York (refer to Appendix D, Section D.2). Construction or conceptual decommissioning (and, to a lesser degree, operation) activities for projects outside the geographic analysis area may also use these and other nearby ports, which could stress port capacity and resources and could concentrate vessel traffic in port areas. Such concentrated activities could lead to increased risk of allision, collision, and vessel delay. The Empire Wind projects (OCS-A 0512) would generate vessel traffic during construction and subsequent O&M activities, the majority of which is anticipated to originate from various facilities within the Port of New York and New Jersey and from ports farther north on the Hudson River (Port of Albany and Port of Coeymans, New York) (Empire Wind 2022). The increase in port utilization due to this vessel activity would vary across the specific facilities supporting ongoing offshore wind activities. During peak construction activity, impacts on port utilization would be temporary at the ports and within the maritime approaches. O&M impacts on port utilization would be long term and intermittent depending upon the activity schedule.

Presence of structures: Construction of Empire Wind's 138 WTGs and two OSS structures in the geographic analysis area would pose navigational hazards to vessels transiting within and around the Empire Wind lease area (OCS-A 0512). The offshore wind project would increase navigational complexity and ocean space use conflicts, including the presence of WTG and OSS structures in areas where no such structures currently exist, potential compression of vessel traffic both outside and within the offshore wind lease area, and potential difficulty seeing other vessels due to a cluttered view field. Another potential impact of offshore wind structures is interference with marine vessel radars. USCG noted in its final *Areas Offshore of Massachusetts and Rhode Island Port Access Route Study* (USCG 2020) that various factors play a role in potential marine radar interference by offshore wind infrastructure, stating that "the potential for interference with marine radar is site specific and depends on many factors including, but not limited to, turbine size, array layouts, number of turbines, construction material(s), and the vessel types." In the event of radar interference, other navigational tools are available to ship captains. For more information on this topic, see the BOEM-sponsored National Academies of Sciences, Engineering, and Medicine (2022) study.

The fish aggregation and reef effects of offshore wind structures would also provide new opportunities for recreational fishing. The additional recreational vessel activity focused on aggregation and reef effects would gradually increase vessel congestion and the risk of allision, collision, and spills near WTGs and OSSs. The impacts of this IPF on navigation and vessel traffic would be long term.

Cable emplacement and maintenance: The 138 WTGs and two OSSs proposed for development in the Empire Wind lease area (OCS-A 0512) would require about 375 miles (603 kilometers) of interarray cables (299 miles) and offshore export cables (76 miles). Emplacement and maintenance of cables for the Empire Wind offshore wind project would generate vessel traffic and would specifically add slower-moving vessel traffic above cable routes during the construction period of 2023 to 2027. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes during installation and maintenance activities. The impacts of cable maintenance would be long term but intermittent.

Traffic: Ongoing offshore wind activities would generate vessel traffic during construction, operation, and conceptual decommissioning within the navigation and vessel traffic geographic analysis area. Other vessel traffic in the region (e.g., from commercial fishing, for-hire and individual recreational use, shipping activities, military uses) would overlap with offshore wind-related vessel activity in the open ocean and near ports supporting the ongoing offshore wind projects.

The Empire Wind projects (OCS-A 0512) would add approximately 36 vessels for construction of the wind farm between 2023 and 2027 (COP Volume 1, page 3-37 and Table 3.4-1; Empire 2022). The presence of offshore wind project construction vessels would add to the existing NY Bight vessel traffic levels during development of the Empire Wind projects (OCS-A 0512), leading to increased congestion and navigational complexity, which could result in crew fatigue, damage to vessels, injuries to crews, engagement of USCG SAR, and vessel fuel spills. Increased offshore wind-related vessel traffic during construction would have temporary impacts on overall (wind and non-wind) vessel traffic and navigation in the geographic analysis area and vicinity.

After the ongoing offshore wind project is constructed, related vessel activity would decrease. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. During operations, project-related vessel traffic would have long-term but intermittent impacts on overall vessel traffic and navigation. Vessel activity would increase again during conceptual decommissioning at the end of the operating period, which BOEM anticipates being approximately 35 years, with magnitudes and impacts similar to those described for construction.

3.6.6.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, navigation and vessel traffic would continue to be affected by existing environmental trends and ongoing activities. BOEM expects ongoing activities to have continuing short- and long-term impacts on navigation and vessel traffic, primarily through the IPFs of anchoring, port utilization, presence of structures, cable emplacement and maintenance, and traffic. BOEM anticipates that the impacts of ongoing activities, especially port utilization and vessel traffic, would likely be **moderate**.

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and navigation and vessel traffic would continue to be affected by the primary IPFs of anchoring, port utilization, presence of structures, cable emplacement, and traffic. Ongoing non-offshore-wind activities, including port expansion, new cable emplacement and maintenance, and SAR operations, would also contribute to impacts on navigation and vessel traffic. Ongoing offshore wind activities would increase vessel activity, which could lead to congestion at affected ports, the possible need for port upgrades beyond those currently envisioned, and an increased likelihood of collisions and allisions, with resultant increased risk of accidental releases. In addition, the ongoing construction and operation of the Empire Wind projects (OCS-A 0512), which shares a boundary with one of the NY Bight lease areas, would add an estimated 138 WTGs and 2 OSSs where no structures currently exist, also increasing the risk for collisions, allisions, and resultant accidental releases and threats to human health and safety. BOEM anticipates that the cumulative impact of Alternative A would likely be **moderate** because the overall effect would be notable, but vessels would be able to adjust to account for disruptions.

3.6.6.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Navigation and Vessel Traffic

3.6.6.4.1 Impacts of One Project

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts.

Anchoring: There are no anchorages in the NY Bight lease areas, but several anchorages are located near the approaches to New York Harbor (Figure 3.6.6-2). High levels of anchoring (an average of seven unique vessels per day according to the 2017–2018 AIS data) near the NY Bight lease areas were recorded to the north of the Nantucket to Ambrose TSS, which corresponds to the USCG proposed “Ambrose” Anchorage (86 *Federal Register* 17090) (Empire 2022, COP Appendix DD, page 102). Depending on the locations of the offshore export cable routes for the NY Bight projects, cable emplacement activities could potentially affect anchorages within the proposed “Ambrose” anchorage as well as other anchorages in the NY Bight area. Any disruptions during cable installation would be minor, localized, and temporary.

During the O&M phase, cable maintenance for one NY Bight project could displace routine vessel anchorage operations within affected anchorage areas. Cable crossings of federally designated anchorages would require USACE review and approval to ensure the cables could be buried to an appropriate depth so as not to interfere with anchoring activities. In addition, lessees would be required to conduct a Cable Burial Risk Assessment to determine appropriate cable depths and measures for minimizing impacts if the cables cross anchorage areas. If cables could not be buried to an appropriate depth, they could affect long-term use of the affected anchorage. Outside of anchorage areas, deviations from “normal” anchorage activities, such as vessels anchoring in an emergency scenario, would likewise pose a potential hazard related to subsea cables. Depending upon the anchor weight, vessels with a tonnage greater than 10,000 deadweight tonnage would be the most likely to carry anchors that could penetrate to cable burial depth if anchoring in the vicinity of the export cable corridor (Sharples 2011). For comparison, average passenger or pleasure vessels are typically less than 1,000 deadweight tonnage. Interarray and export cables for one NY Bight project would be buried to a target depth of 6 feet (1.8 meters). Due to variable conditions expected in the lease areas and along the offshore export cable routes, the anticipated burial depth ranges from 3 to 9.8 feet (0.9 to 3 meters) for interarray cables and from 3 to 19.6 feet (0.9 to 6 meters) for offshore export cables; where cables cross federal navigation projects, including designated anchorages, depths would be required to be on the deeper end of that range. A cable burial depth targeted at 5 to 6 feet (1.5 to 1.8 meters) has resulted in cable interactions approaching zero incidents, based on observations in the U.S. telecommunications industry since 2000 (North American Submarine Cable Association 2019).

If sufficient burial depth cannot be achieved, armoring or other cable protection would be used to protect cables from external damage. Cable protection methods may include rock placement, concrete mattresses, frond mattresses, rock bags, and seabed spacers. In the event an anchor does make contact with a buried export cable, impacts could include damage to the export cable and potential damage to the vessel anchor or anchor chain. Depending on the extent of the damage to the export cable the risks associated with an anchor contacting an electrified cable can pose issues to equipment for one NY Bight project (an overload and shut-down of converter or transformer stations) but is not going to cause electrical shock to the ship involved since seawater is a good conductor of electricity (Sharples 2011). If the export cable is damaged to the point of requiring repair, there could be impacts associated with additional vessel activity to conduct damage assessment and repair. Secondary impacts on navigation could include repercussions on the vessel operator’s liability and insurance. Combined with the low likelihood that any anchoring would occur in an emergency scenario within the geographic analysis area, impacts on navigation and vessel traffic would be minor, localized, and temporary to short term.

Smaller commercial or recreational vessels anchoring in any of the NY Bight lease areas may have issues with anchors failing to hold near foundations and any scour protection. Any potential impacts from smaller vessels anchoring within a NY Bight lease area would primarily occur during the O&M phase. These impacts would be minor, localized, and temporary. It is unlikely that a larger vessel would anchor within any of the NY Bight lease areas given current routes for commercial deep-draft vessel traffic.

Port utilization: One NY Bight project would generate vessel traffic within and in the waterways approaching ports utilized by the NY Bight projects (which may include Howland Hook/Port Ivory, Port of

Albany, Port of Coeymans, South Brooklyn Marine Terminal, Brooklyn Navy Yard, Arthur Kill Terminal in New York, and New Jersey Wind Port and Paulsboro Marine Terminal in New Jersey) during construction and O&M. The construction phase would generate trips by various vessels needed for construction activity, such as jack-up vessels to provide a stable platform on site and support vessels, including crew transport vessels, hotel vessels, tugs, and miscellaneous vessels (such as for security). Vessels would transport components from ports to the NY Bight project area.

The presence of these vessels could cause port and waterway congestion and delays for vessels not associated with the NY Bight project. It could also cause some fishing or recreational vessel operators to change routes or use an alternate port. These impacts would be especially pronounced in the Hudson River, which serves the Port of Albany and the Port of Coeymans, where slow-moving construction traffic (feedering/transport) would add to congestion within the narrow Hudson River waterway, potentially leading to vessel delay and increased potential for collisions. However, based on an assessment of future offshore wind vessel traffic to/from ports in the New York region prepared by NYSERDA, the increase in vessel trips associated with offshore wind, which would include the NY Bight projects, would be small relative to existing vessel traffic levels (BTMI Engineering (COWI) 2022). The impacts of one NY Bight project on vessel traffic due to port utilization would be long term through construction and installation, O&M, and conceptual decommissioning.

Presence of structures: One NY Bight project would include up to 280 WTGs and five OSSs, operating for approximately 35 years within any of the six NY Bight lease areas, where no such structures currently exist. Presently there are no formal routing measures within the geographic analysis area that would be altered by the presence of the structures for one NY Bight project. Vessel types such as cargo, passenger, tankers, and tugs would continue to follow the main vessel traffic routes in the vicinity of any of the NY Bight lease areas. Enclosure 2 (Marine Planning Guidelines - *Recommended Navigational Safe Distances*) of the ACPARS (USCG 2016b) recommends a 2-nautical mile (3.7-kilometer) buffer from the parallel outer or seaward boundary of a traffic lane and a 5-nautical mile (9.3-kilometer) buffer from the entry/exit of a TSS. Except for OCS-A 0544, the NY Bight lease areas are at least 10 nautical miles from the nearest established traffic lane and would comply with this recommendation. OCS-A 0544 is located 1 nautical mile from the Hudson Canyon to Ambrose traffic lane and 1.2 nautical miles from the Ambrose to Nantucket traffic lane (Figure 3.6.6-2) and, therefore, could result in the placement of structures closer to traffic lanes than recommended in the ACPARS Enclosure 2 (Marine Planning Guidelines – *Recommended Navigational Safe Distances*). As shown in Figure 3.6.6-2, none of the NY Bight lease areas would intersect the USCG-proposed fairways and therefore none would affect implementation of these fairways or traffic within the fairways if they are formally established.

Structures associated with one NY Bight project would increase the risk of allision either from smaller vessels transiting within the array or from passing commercial vessels. The average increase in powered allision risk related to the presence of structures for one NY Bight project is estimated to be 2.3 percent per year based on AIS data for other regional offshore wind projects (Table 3.6.6-4). Based on the same analysis, the average drift allision risk for vessels and a structure within the any of the NY Bight lease areas would increase by an estimated 0.64 percent per year. The increased risk of allisions would, in turn, increase the risk of spills (refer to Section 3.4.2, *Water Quality*, for a discussion of the likelihood of spills), vessel foundering, engagement of USCG SAR activities, injuries, and loss of life.

Nearly all vessels that travel through NY Bight lease areas where no structures currently exist would need to navigate with greater caution to avoid WTGs and OSSs; however, BOEM does not anticipate any restrictions on use or navigation in the lease areas. The anticipated minimum spacing of the structures in the NY Bight lease areas is 0.6 nautical mile by 0.6 nautical mile. Smaller vessels, such as recreational or fishing vessels, may continue to be able to navigate through the lease areas between the WTGs and OSSs, although the minimum structure spacing of 0.6 nautical mile would result in greater challenges to navigating through the wind farm than if wider spacing (e.g., 1 nautical mile) was used as there would be less room to maneuver. BOEM expects that larger vessels would not transit through the turbine arrays and instead would navigate around the lease area. If WTGs and OSSs are not properly lighted or marked (such as in accordance with BOEM's *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* [BOEM 2021]), they would pose increased hazards for vessels traveling at night or in adverse weather conditions. Smaller static and mobile gear fishing vessels, like all vessels, would not be prohibited from transiting or fishing within the array; however, vessel operators would need to take the WTGs and OSSs into account as they set their courses through the lease area and would need to take care when fishing near the WTGs and OSSs to avoid snagging fishing equipment on underwater WTG components. Smaller vessels that continue to navigate within a NY Bight lease area would still need to navigate with more caution than is currently necessary to avoid WTGs and OSSs, as well as other vessel traffic, especially during inclement weather. Increased navigational awareness while navigating through WTGs could lead to increased crew fatigue, which could also increase the risk of allision or collision and resultant injury or loss of life. The potential for this impact is more pronounced for one NY Bight project because structure spacing of 0.6 nautical mile (as opposed to wider spacing) provides limited space for vessels to navigate safely.

Vessels would be at greatest risk of alliding with WTG blades at highest astronomical tide (HAT) and would need to navigate around or navigate with caution through a NY Bight lease area to avoid the WTGs, although vessels of this size are unlikely to transit close enough to the WTGs to be affected by the blade sweep.

Marine vessel radars are not optimized to operate in a WTG environment due to a combination of factors ranging from the slow adoption of solid-state technology to the electromagnetic characteristics of WTGs (National Academies of Sciences, Engineering, and Medicine 2022). Therefore, marine radar on vessels near or within a NY Bight lease area would likely be affected during the O&M period (although other navigational tools are available to ship captains). BOEM expects the maritime industry to adopt both technological and non-technology-based measures to reduce impacts on marine radar, including greater use of AIS and electronic charting systems, new technologies like LiDAR, employing more watchstanders, and simply avoiding wind farms altogether.

The navigational complexity of transiting through a NY Bight lease area, including the potential effects of WTGs and OSSs on marine radars, would increase risk of collision with other vessels, especially because 0.6-nautical-mile structure spacing leaves limited room for vessels to maneuver safely. Based on the average of collision risks from the NSRAs of other projects in the region, BOEM anticipates there could be a 4.2 percent increase in collision frequency from one NY Bight project (Table 3.6.6-4). Furthermore, the presence of the WTGs could complicate offshore SAR operations or surveillance missions within a NY Bight lease area. This would have localized, long-term, and major impacts on navigation and vessel traffic.

Cable emplacement and maintenance: One NY Bight project would require the installation of offshore export cables and interarray cables. The presence of slow-moving (or stationary) installation or maintenance vessels would increase the risk of collisions with other vessels and spills. Offshore export cable installation activities would include site preparation, such as sand wave and boulder clearance. In areas where sand waves are present, multiple passes may be required. Vessels engaged in cable emplacement are, by definition, restricted in their ability to maneuver and other power-driven vessels must give way.[4] Cable-laying vessels would display lights at nighttime, or day shapes during the daytime to communicate with other vessels that they are restricted in their ability to maneuver. Vessels not involved in cable emplacement or maintenance would need to take additional care when crossing cable routes or would need to avoid installation or maintenance areas entirely during installation and maintenance activities. The presence of installation or maintenance vessels would have localized, short-term, minor impacts on navigation and vessel traffic. Cable corridors that cross navigational features, such as federal navigation channels, traffic lanes, anchorage areas, or ATONs, would increase the potential for impacts on vessel traffic and navigation. In instances where cables are not able to maintain their proposed burial depths, the presence of additional cable protection measures (e.g., rock, mattresses), would effectively reduce available navigable depths, affect the ability of deeper draft vessels to safely navigate in that area, and have localized but long-term, major impacts on navigation and vessel traffic.

Traffic: Impacts from one NY Bight project would include increased vessel traffic in and near the one NY Bight project area, on the approach to ports used by one NY Bight project, and within the ports. Based on the estimated number of vessels needed during construction of other regional ongoing offshore wind projects (Empire Wind [OCS-A 0512], Ocean Wind 1 [OCS-A 0498], and Atlantic Shores South [OCS-A 0499]), construction of one NY Bight project is estimated to generate up to 51 vessels operating in the one NY Bight project area or over the offshore export cable route(s) at any given time. Various vessel types (installation, cable-laying, support, transport/feeder, and crew vessels) would be deployed throughout the NY Bight project area during the construction and installation phase, increasing the risk of allisions and collisions. Additional construction vessels, especially those used in transport/feedering activities, would add congestion to already busy waterways, such as the Hudson River and New York Harbor. During offshore export cable route construction, smaller vessels not associated with the NY Bight project may be required to travel a more restricted (narrow) lane and could potentially experience greater delays waiting for cable-laying vessels to pass. Vessels not associated with the NY Bight project transiting between ports and a NY Bight lease area would be able to avoid NY Bight project

[4] International Regulations for Preventing Collisions at Sea, 1972 (72 COLREGS), rules 3, 18, and 27.

vessels, components, and any safety zones (where USCG is authorized and elects to establish such zones)[5] through routine adjustments to navigation.

After a single NY Bight project is constructed, related vessel activity would decrease. Vessel activity related to the operation of offshore wind facilities would consist of scheduled inspection and maintenance activities with corrective maintenance as needed. Based on the estimated number of vessels planned to operate during O&M from other regional offshore wind projects (Empire Wind [OCS-A 0512], Ocean Wind 1 [OCS-A 0498], and Atlantic Shores South [OCS-A 0499]), O&M of one NY Bight project is estimated to generate approximately 8 vessel trips per day. During operations, vessel traffic for one NY Bight project would have long-term impacts on overall vessel traffic and navigation. Vessel activity would increase again during conceptual decommissioning at the end of the operating period, which BOEM anticipates being in approximately 35 years, with intensity and impacts similar to those described for construction.

Impacts on navigation and vessel traffic in the vicinity of a NY Bight lease area would be specific to the waterway users. Commercial vessels (dry bulk, wet bulk, vehicle carriers, containerized cargo vessels, passenger vessels, marine aggregate dredgers, and tug/tows) generally use the pre-established TSS lanes. As discussed under presence of structures, impacts on vessel traffic would likely be the greatest associated with OCS-A 0544 because it is closest to established traffic lanes and the Precautionary Area on the approach to the Port of New York and New Jersey. Vessels for one NY Bight project transiting from the TSS and the Precautionary Area toward or away from the lease area would increase overall congestion. Most likely the greatest disruption to established commercial vessel traffic would be during cable emplacement activities within or near established routing measures, federally maintained channels, and anchorage areas in and around New York Harbor. Because of their distance from the TSSs and Precautionary Area, the southernmost NY Bight lease areas (OCS-A 0539, OCS-A 0541, and OCS-A 0542) would have the least impact on commercial vessel traffic.

Recreational vessels and commercial fishing vessels could potentially experience deviations from planned routes during construction activities. While some vessels not associated with one NY Bight project may navigate through a lease area, many vessels would most likely choose not to pass through the area during construction (due to the presence of construction-related activities and the emergence of fixed structures), operations (due to the presence of fixed structures), and during conceptual decommissioning. The construction and installation vessel traffic for one NY Bight project would have moderate localized and temporary impacts on overall navigation and vessel traffic in open waters and near the Port of New York and New Jersey. O&M vessel traffic for one NY Bight project would have moderate intermittent, long-term impacts on overall navigation and vessel traffic in open waters and near the Port of New York and New Jersey.

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[5] Under the current captain of the Port Authority, USCG does not regulate the safety and security risks associated with the construction and operation of Offshore Renewable Energy Installations beyond 12 nautical miles (USCG 2021b).

3.6.6.4.2 Impacts of Six Projects

Anchoring: Under six NY Bight projects, there would be an increase in offshore wind–related traffic that could experience a need for emergency anchoring and additional offshore cable routes that would increase the risk of anchors coming into contact with buried cables. However, as described for one NY Bight project, the overall risk related to anchoring is low and impacts from anchoring from six NY Bight projects would remain minor.

Port utilization: The impacts on port utilization from increased vessel traffic in developing one NY Bight project would be amplified should all six NY Bight projects be developed. The impacts on port utilization could be greater if there is simultaneous construction of six NY Bight projects. There are a limited number of port facilities that are equipped for the larger equipment and support vessels required to support offshore wind development, which could concentrate vessel activity at the port locations capable of supporting such activity. Slow-moving construction vessel traffic (feedering/transport) would add congestion to ports used by the NY Bight projects, especially for ports on the Hudson River where vessel traffic is constrained within the confines of the river, although the amount of traffic would be relatively small compared to existing vessel traffic levels. The presence of these vessels could cause delays for vessels not associated with the NY Bight project vessels and could cause some fishing or recreational vessel operators to change routes or use an alternative port. However, there is also a limited number of equipment and vessels suitable for offshore wind development, which may ultimately assist with a port's ability to manage the required number of vessels. Six NY Bight projects would cause moderate, long-term impacts on port users during construction and installation, O&M, and conceptual decommissioning.

Presence of structures: Six NY Bight projects would add additional WTGs and OSSs within the six NY Bight lease areas where no such structures currently exist. While the navigational complexity for a vessel transiting through any one of the six NY Bight lease areas at any given time would be the same as described for one NY Bight project, the combined effect from installation of structures from six NY Bight projects would increase the overall navigational complexity in the NY Bight area, as a significant portion of the NY Bight area would be occupied with project structures. Impacts would include greater potential for marine radar interference, increased risk of allisions with structures and collision with other vessels, and a larger geographic area with structures that could complicate offshore SAR operations and research or surveillance missions.

Impacts would be greater if NY Bight lease areas do not follow uniform spacing and alignment. Each lease area should be organized in a grid pattern (straight rows and columns), consisting of two lines of orientation. One corridor width should be at least 1.0 nautical mile to allow for the SAR operations and/or fishing operations; one corridor should be 0.6–0.8 nautical mile for vessels. When adjacent offshore wind projects share borders, in accordance with USCG recommendations, BOEM requires a common WTG spacing and layout across the projects to provide consistent straight-line routes for mariners through the adjoining areas. In the absence of a common spacing and orientation between adjacent wind projects, the lease agreements stipulate setbacks from the shared border to create a separation between projects. Lease areas that share a border with other lease areas include OCS-A 0541 and OCS-A 0542, which share a common border, and Lease Area OCS-A 0544, which shares a border with Empire Wind (OCS-A 0512). Lease stipulations for OCS-A 0544 requires a 2-nautical-mile setback from Empire Wind (OCS-A 0512) if common lines of orientation between lease areas are not used while lease stipulations for OCS-A 0541 and OCS-A 0542 require a 1-nautical-mile setback if common lines of orientation between lease areas are not used. If these three lease areas propose different spacing and layout than their adjacent lease area, the ability of vessels to navigate safely through the lease areas would be adversely affected. Overall, BOEM anticipates the presence of structures from six NY Bight projects would have long-term, major impacts on navigation and vessel traffic.

Cable emplacement and maintenance: The installation of offshore export cables and interarray cables for all six NY Bight projects would increase the presence of slow-moving (or stationary) installation or maintenance vessels and thereby increase the risk of collisions with other vessels and spills. Impacts would be greater if two or more of the six NY Bight projects are constructed simultaneously than if cable-laying of the six NY Bight projects is staggered and impacts are spread out over time. The presence of installation or maintenance vessels would have localized, short-term, moderate impacts on navigation and vessel traffic.

If cables from the six NY Bight projects all follow different corridors to different landfall locations, this would increase the potential for navigation impacts, than if the cables were installed in one or more shared cable corridors, especially if the cables cross traffic lanes, navigation channels, or anchorages where impacts on navigation would be most pronounced. In instances where cables are not able to maintain their proposed burial depths, the presence of additional cable protection measures (e.g., rock, mattresses) would effectively reduce available depths, affect the ability of deeper draft vessels to safely navigate in that area, and have localized but long-term, major impacts on navigation and vessel traffic.

Traffic: Development of six NY Bight projects would increase slow moving construction vessel traffic in and near the geographic analysis area during construction and installation, O&M, and conceptual decommissioning. By multiplying the number of vessel trips from one NY Bight project by six, BOEM estimates that six NY Bight projects would collectively generate up to 306 vessels operating daily during construction and 48 vessel trips per day during O&M. Impacts would be greatest if construction of all six NY Bight projects overlapped, resulting in the potential for all 306 vessels to be operating in the lease areas or over offshore export cable routes at any given time. The increased congestion from more vessels operating simultaneously would result in increased potential for collision and delays for ships transiting areas used by the NY Bight project vessels, especially if the same ports are used for construction staging by multiple projects. If construction is staggered, construction vessel trips would be spread out over time and impacts would be less. Impacts from increased vessel traffic would be similar to those from one NY Bight project but of a greater intensity, resulting in a moderate, long-term impact.

3.6.6.4.3 Cumulative Impacts of Alternative B

The combined impacts of six NY Bight projects and other ongoing offshore wind activities on navigation and vessel traffic from anchoring would be short term and minor due to the small size of the offshore wind lease areas compared to the remaining area of open ocean, as well as the low likelihood that any anchoring risk would occur in an emergency scenario.

Other ongoing offshore wind development would generate comparable types and volumes of vessel traffic in New York and New Jersey ports and would require similar types of port facilities as each of the six NY Bight projects. The increase in port utilization due to other offshore wind project vessel activity would begin during construction and installation of the six NY Bight projects and continue during the operations phase of the six NY Bight projects. There could be delays for vessels using facilities within or accessible from ports in New York and New Jersey if two or more projects are under construction at the same time. Ongoing activities, including the six NY Bight projects, would have long-term and moderate impacts on navigation and vessel traffic due to increased port utilization.

The presence of structures from ongoing offshore wind projects in the geographic analysis area would result in impacts similar to those of six NY Bight projects. Construction of six NY Bight projects in combination with the Empire Wind projects (OCS-A 0512) would add an estimated 1,265 WTGs and OSSs (Appendix D) to the geographic analysis area for navigation and vessel traffic. The presence of structures associated with offshore wind activities would increase navigational complexity in the geographic analysis area, resulting in an increased risk of collisions and allisions, which could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. The presence of structures associated with offshore wind activities could also affect demand for and resources associated with USCG SAR operations by changing vessel traffic patterns and densities.

Cable installation and maintenance for other offshore wind activities would generate comparable types of impacts to those of six NY Bight projects for each offshore export cable route and interarray and interconnector cable system. Simultaneous construction of export and interarray cables from the Empire Wind projects (OCS-A 0512) and the six NY Bight projects would have an additive effect, although it is assumed that installation vessels would only be present above a portion of a project’s cable system at any given time. Substantial areas of open ocean are likely to separate simultaneous offshore export and interarray cable installation activities for other offshore wind projects. Where cables are not able to maintain their proposed burial depths, the presence of additional cable protection measures will affect the ability of deeper draft vessels to safely navigate in that area. Impacts from ongoing activities, including six NY Bight projects, on navigation and vessel traffic from cable installation and maintenance would be localized. There are short-term and long-term impacts; therefore, the combined impacts would be moderate.

Construction and installation, O&M, and conceptual decommissioning of offshore wind projects in the NY Bight area (both within and outside the geographic analysis area) are estimated to generate vessel traffic comparable to that of each of the six NY Bight projects. In the event that the six NY Bight projects and offshore wind projects with vessel activity in the NY Bight area (Empire Wind OCS-A 0512) are under construction at the same time, construction vessel traffic from all projects could be operating at the same time. In context of reasonably foreseeable environmental trends, the six NY Bight projects would result in an increase in vessel traffic that would be additive to the baseline vessel traffic in the geographic analysis area and vessel traffic associated with other ongoing activities.

A 2022 study completed by BTMI Engineering (COWI) for the NYSERDA conducted vessel traffic modeling of yearly increases in vessel traffic with and without offshore wind traffic in the New York region (BTMI Engineering (COWI) 2022). The study compared vessel density changes at select locations in New York where offshore wind traffic could be introduced. Table 3.6.6-8 is the study's estimation of the number of vessel round trips per year for construction of known and projected offshore wind projects in New York waters. Projects 2029, 2031, 2033, and 2035 in the table correspond to future projects offshore of New York, which would include development associated with the NY Bight projects analyzed in this PEIS. Table 3.6.6-9 contains the estimation of the number of vessel round trips per year for O&M of known and projected offshore wind projects in New York waters. The report found that the relative increase in vessel traffic resulting from offshore wind projects in the region is small compared with the total volume of vessel traffic anticipated over time (0 to 4 percent increase over baseline depending on the port) (BTMI Engineering (COWI) 2022).

Table 3.6.6-8. Estimated number of vessel round trips per year within New York State waters for construction of offshore wind projects offshore of New York

Project	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Grand Total
South Fork Wind	10	22	16	4	-	-	-	-	-	-	-	-	-	-	-	-	52
Sunrise Wind	-	47	106	76	17	-	-	-	-	-	-	-	-	-	-	-	246
Empire Wind	-	29	66	48	11	-	-	-	-	-	-	-	-	-	-	-	154
Empire Wind 2	-	-	-	-	44	100	72	16	-	-	-	-	-	-	-	-	232
Beacon Wind	-	-	-	-	-	35	81	59	13	-	-	-	-	-	-	-	188
Project 2029*	-	-	-	-	-	-	35	84	63	14	-	-	-	-	-	-	196
Project 2031*	-	-	-	-	-	-	-	-	35	84	63	14	-	-	-	-	196
Project 2033*	-	-	-	-	-	-	-	-	-	-	35	84	63	14	-	-	196
Project 2035*	-	-	-	-	-	-	-	-	-	-	-	-	33	78	12	-	182
Grand Total	10	98	188	128	72	135	188	159	111	98	98	98	96	92	58	13	1,642

Source: BTMI Engineering (COWI) 2022.

*Project is included for purposes of analysis only. This information is subject to change as the projects come on line.

Table 3.6.6-9. Estimated number of vessel round trips per year within New York State waters for O&M of offshore wind projects offshore of New York

Project	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
South Fork Wind	-	-	-	50	50	50	50	50	50	50	50	50	50	50	50	50
Empire Wind	-	-	-	-	20	20	20	20	20	20	20	20	20	20	20	20
Sunrise Wind	-	-	-	-	33	33	33	33	33	33	33	33	33	33	33	33
Empire Wind 2	-	-	-	-	-	-	-	31	31	31	31	31	31	31	31	31
Beacon Wind	-	-	-	-	-	-	-	-	24	24	24	24	24	24	24	24
Project 2029*	-	-	-	-	-	-	-	-	-	25	25	25	25	25	25	25
Project 2031*	-	-	-	-	-	-	-	-	-	-	-	25	25	25	25	25
Project 2033*	-	-	-	-	-	-	-	-	-	-	-	-	-	25	25	25
Project 2035*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25

Source: BTMI Engineering (COWI) 2022

* Project is included for purposes of analysis only. This information is subject to change as the projects come on line.

3.6.1.5.4 Conclusions

Impacts of Alternative B. The impacts of Alternative B on navigation and vessel traffic for either one or six NY Bight projects would likely be **major**. The primary driver of the major impact determination is the presence of structures, which would affect vessels not associated with the NY Bight projects through changes in navigation routes, degraded communication and radar signals, and increased difficulty of offshore SAR or surveillance missions within the NY Bight lease areas, all of which would increase navigational safety risks. Some commercial fishing, recreational, and other vessels would choose to avoid the lease areas altogether, leading to some potential funneling of vessel traffic along the lease area borders. In addition, the increased potential for marine accidents, which may result in injury, loss of life, and property damage, could produce disruptions for ocean users in the geographic analysis area.

Cumulative Impacts of Alternative B. BOEM anticipates that cumulative impacts of six NY Bight projects under Alternative B would likely be **major**. Alternative B in combination with the ongoing Empire Wind projects (OCS-A 0512) and other ongoing non-offshore-wind activities would increase the risk of allision and navigational complexity in the geographic analysis area, resulting in an increased risk of collisions and allisions that could result in personal injury or loss of life from a marine casualty, damage to boats or turbines, and oil spills. In context of reasonably foreseeable environmental trends, the impacts contributed by Alternative B to cumulative impacts on navigation and vessel traffic would be noticeable.

3.6.6.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Navigation and Vessel Traffic

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight Area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives – Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from those impacts discussed in Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.6.6.5.1 Sub-alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations (Table 3.6.6-10).

Table 3.6.6-10. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for navigation and vessel traffic

Measure ID	Measure Summary
MUL-40 (Previously NAV-1)	This measure proposes that the locations of any boulder greater than 6.6 feet (2 meters) be reported at least 60 days prior to boulder-relocation activity.

Impacts of One Project

Sub-alternative C1 would reduce impacts on navigation and vessel traffic associated with cable emplacement. Impacts for other IPFs would remain the same as described under Alternative B.

Cable emplacement and maintenance: MUL-40 would require the NY Bight lessee to report the locations of boulders greater than 6.6 feet (2 meters) moved during construction activity, which would ensure fishing vessels, dredging operations, and other mariners are aware of the boulders' locations, reducing the risk of allisions.

Impacts of Six Projects

MUL-40 for six NY Bight projects would similarly reduce impacts on navigation and vessel traffic as described for one NY Bight project, but the benefits would apply to more projects and cover a large geographic extent.

Cumulative Impacts of Sub-alternative C1 (Preferred Alternative)

Under Sub-alternative C1, the same ongoing activities (including offshore wind) as those under Alternative B would contribute to impacts on navigation and vessel traffic. The construction and installation, O&M, and conceptual decommissioning for six NY Bight projects with the AMMM measure would still cumulatively affect navigation and vessel traffic across the geographic analysis area, although at a reduced level.

3.6.6.5.2 Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus AMMM measures that have not been previously applied (Table 3.6.6-11).

Table 3.6.6-11. Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for navigation and vessel traffic

Measure ID	Measure Summary
NAV-3	This measure proposes avoiding cable placement in ATONs, PATONs, anchorage areas (including Ambrose Anchorage), TSSs, fairways, and other unfavorable areas.

Impacts of One Project

The implementation of AMMM measures under Sub-alternative C2 could potentially reduce impacts on navigation and vessel traffic associated with cable emplacement compared to those under Sub-alternative C1. Impacts for other IPFs would remain the same as described under Sub-alternative C1.

Cable emplacement and maintenance: By avoiding unfavorable placement of offshore cables that would conflict with existing ATONs, PATONs, TSS, fairways, and anchorage areas, NAV-3 could avoid impacts on these navigational features. This would include reducing the level of interruption the installation and maintenance of cables would have on navigation activities, as well as minimize the potential for conflicts with future dredging or other maintenance activities in these areas.

Impacts of Six Projects

NAV-3 for six NY Bight projects would similarly reduce impacts on navigation and vessel traffic as described for one NY Bight project, but the benefits would apply to more projects and cover a large geographic extent.

Cumulative Impacts of Sub-alternative C2

Under Sub-alternative C2, the same ongoing activities (including offshore wind) as those under Sub-alternative C1 would contribute to impacts on navigation and vessel traffic. The construction and installation, O&M, and conceptual decommissioning for six NY Bight projects with the AMMM measure would still cumulatively affect navigation and vessel traffic across the geographic analysis area, although at a reduced level.

3.6.6.5.3 Conclusions

Impacts of Alternative C. The construction, installation, and conceptual decommissioning of one NY Bight project and six NY Bight projects would likely have the same **major** impacts on navigation and vessel traffic as Alternative B under Sub-alternative C1 and Sub-alternative C2. The AMMM measures would slightly reduce impacts associated with cable emplacement but would not reduce overall impact levels.

Cumulative Impacts of Alternative C. BOEM anticipates that the cumulative impacts on navigation and vessel traffic in the geographic analysis area from six NY Bight projects combined with ongoing activities would likely be **major**. The AMMM measures would have a slight reduction in impacts associated with cable emplacement but would not reduce overall impacts. In context of reasonably foreseeable environmental trends, the impacts contributed by the six NY Bight Projects in Alternative C to cumulative impacts on navigation and vessel traffic would be noticeable.

3.6.6.6 Recommended Practices for Consideration at the Project-Specific Stage

In addition to the AMMM measures identified under Alternative C, BOEM is recommending lessees consider analyzing the RPs in Table 3.6.6-12 to further reduce potential navigation and vessel traffic impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.6.6-12. Recommended Practices for navigation and vessel traffic impacts and related benefits

Recommended Practice	Potential Benefit
MUL-18: Coordinate transmission infrastructure among projects such as by using shared intra- and interregional connections, meshed infrastructure, or parallel routing, which would reduce hazards to navigation.	Using shared transmission infrastructure or following parallel routing with existing and proposed infrastructure could result in a reduced number of cable corridors and reduce effects on navigation and vessel traffic from cable installation and maintenance. Impacts from cable installation on navigation would be most pronounced if cables from the six NY Bight projects all follow different corridors to different landfalls, requiring cable-laying vessels to be spread out over multiple different cable routes and affecting a larger geographic area. Consolidating cables into a shared transmission system could reduce these impacts, which would also reduce the risk of collisions with other vessels and spills, especially where the cables cross traffic lanes, navigation channels, or anchorages where impacts on navigation would be most pronounced. Transmission configurations that could be adopted by NY Bight lessees to optimize and share the use of offshore transmission equipment under MUL-18 include shared line (platform), backbone, and meshed grid topologies, which are described in Section 2.1.2.1.1, *Transmission Interconnection Configurations.* Configurations that effectively reduce the amount of cable installed and number of OSSs would benefit navigation and vessel traffic.
MUL-25: Use consistent turbine grid layouts, markings, and lighting in lease areas to minimize navigational hazards and facilitate other ocean uses. Turbines should have one of two lines of orientation spaced at least 1 nautical mile apart.	Increasing the spacing of the turbines from 0.6 to 1 nautical mile for one line of orientation could reduce navigational and safety impacts of NY Bight projects by providing more spacing in the lease areas for vessels and SAR operations to maneuver. Larger commercial vessels would still likely avoid the lease area altogether, but operators of smaller recreational or fishing vessels may be more likely to navigate through the lease areas with more space between structures, reducing ocean space use conflicts. Increased spacing could also reduce the risk of allision for vessels navigating through the turbine arrays and could minimize the difficulty of conducting SAR missions in the lease areas. Lease areas OCS-A 0541 and OCS-A 0542 would need to agree on a common turbine layout or adhere to a 1-nautical-mile setback in

Recommended Practice	Potential Benefit
	accordance with lease stipulations. For OCS-A 0544, the lessee would need to agree to a common turbine layout with Empire Wind (OCS-A 0512) or adhere to a 2-nautical-mile setback pursuant to lease stipulations. In this case, adhering to the common turbine layout as specified in the lease stipulation, rather than a 1-nautical-mile spacing as suggested by MUL-25, would better minimize impacts on navigation and vessel traffic. MUL-25 would also require lessees to appropriately light and mark structures in accordance with BOEM lighting and marking guidelines, which would ensure that wind farm structures are marked in a manner that is most effective to minimize safety risks. WTGs with lighting and marking could serve as additional aids to navigation and minimize navigational safety risks.
NAV-4: Where possible, adhere to the recommendations for mitigation to marine radar interference from the National Academy of Science: *Wind Turbine Generator Impacts to Marine Vessel Radar* (2022).	Following recommendations for mitigating impacts on marine radar interference, such as selecting material for blades and towers to mitigate clutter, would minimize the potential adverse effects on marine vessel radar.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.7 Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research, and Surveys)

This section discusses potential impacts on other uses not addressed in other portions of this Final PEIS, including marine minerals, national security and military use, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys that would result from the Proposed Action, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis areas for these topics are described in the following list and shown on Figure 3.6.7-1 and Figure 3.6.7-2.

- Marine minerals: All six NY Bight lease areas and extending to the shoreline of New Jersey and New York to account for the potential locations of offshore export cables that could affect marine minerals extraction (Figure 3.6.7-1).
- Aviation and air traffic, military and national security, and radar systems: Areas within 10 miles (16.1 kilometers) of the NY Bight lease areas, as well as the following airports: Cape May County Airport, Woodbine Municipal Airport, Ocean City Municipal Airport, Atlantic City International Airport, Warren Grove Range Airport, Monmouth Executive Airport, Newark Liberty International Airport, Teterboro Airport, LaGuardia Airport, John F Kennedy International Airport, Republic Airport, Long Island MacArthur Airport, Francis S. Gabreski Airport, and East Hampton Airport (Figure 3.6.7-1).
- Cables and pipelines: All six NY Bight lease areas and extending to the shoreline of New Jersey and New York to account for the potential locations of offshore export cables, and associated substations, that could affect future siting or operation of cables and pipelines (Figure 3.6.7-1).
- Scientific research and surveys: Same analysis area as the Section 3.5.5, *Finfish, Invertebrates, and Essential Fish Habitat*, geographic analysis area, which extends from the Gulf of Maine to Cape Hatteras, North Carolina. The geographic analysis area is shown on Figure 3.6.7-2.

These areas encompass locations where BOEM anticipates direct and indirect impacts associated with construction and installation, O&M, and conceptual decommissioning.

The other uses impact analysis in this PEIS is intended for incorporation by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

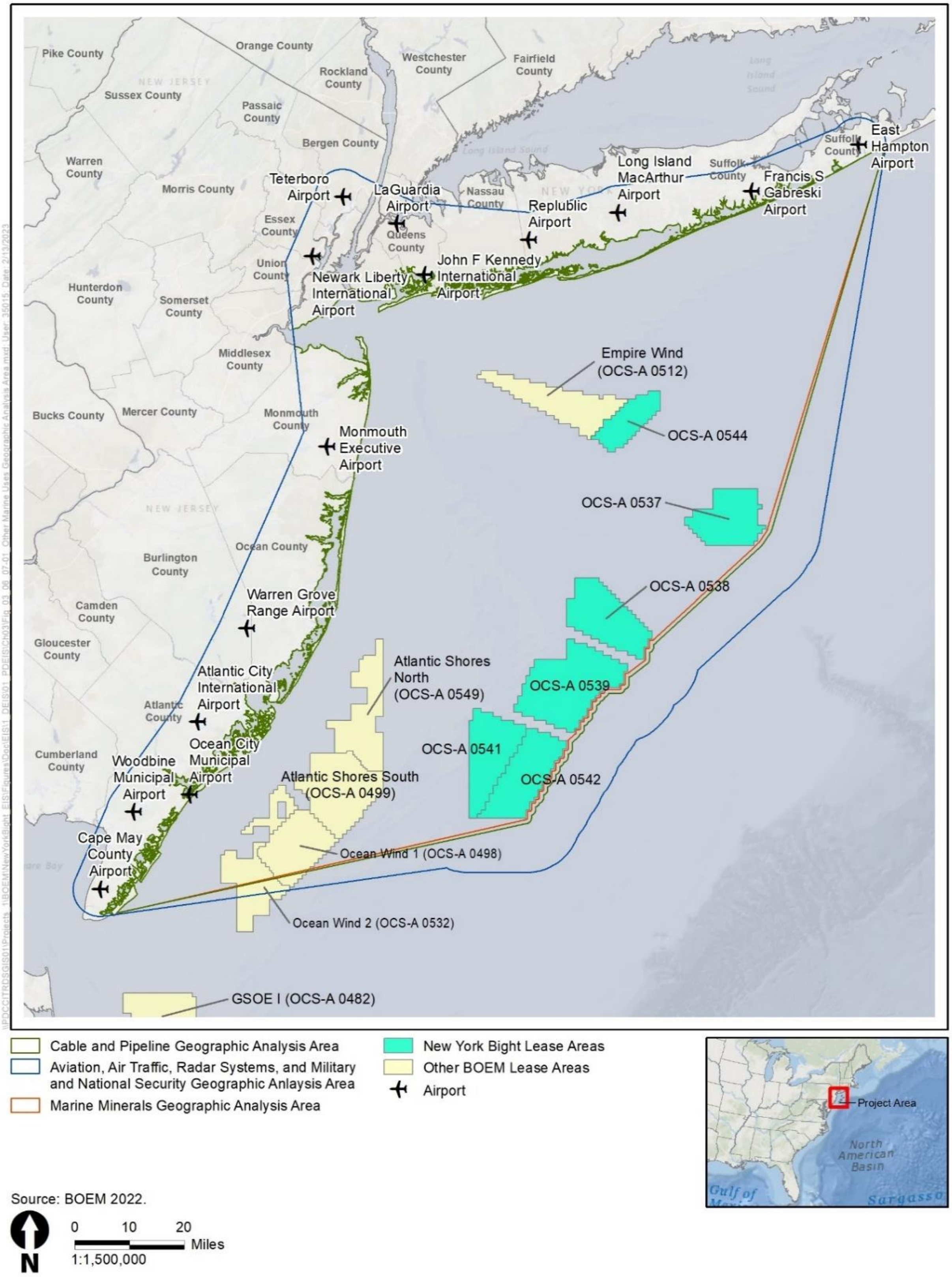


Figure 3.6.7-1. Marine minerals, aviation and air traffic, military and national security, radar systems, cables, and pipelines geographic analysis area

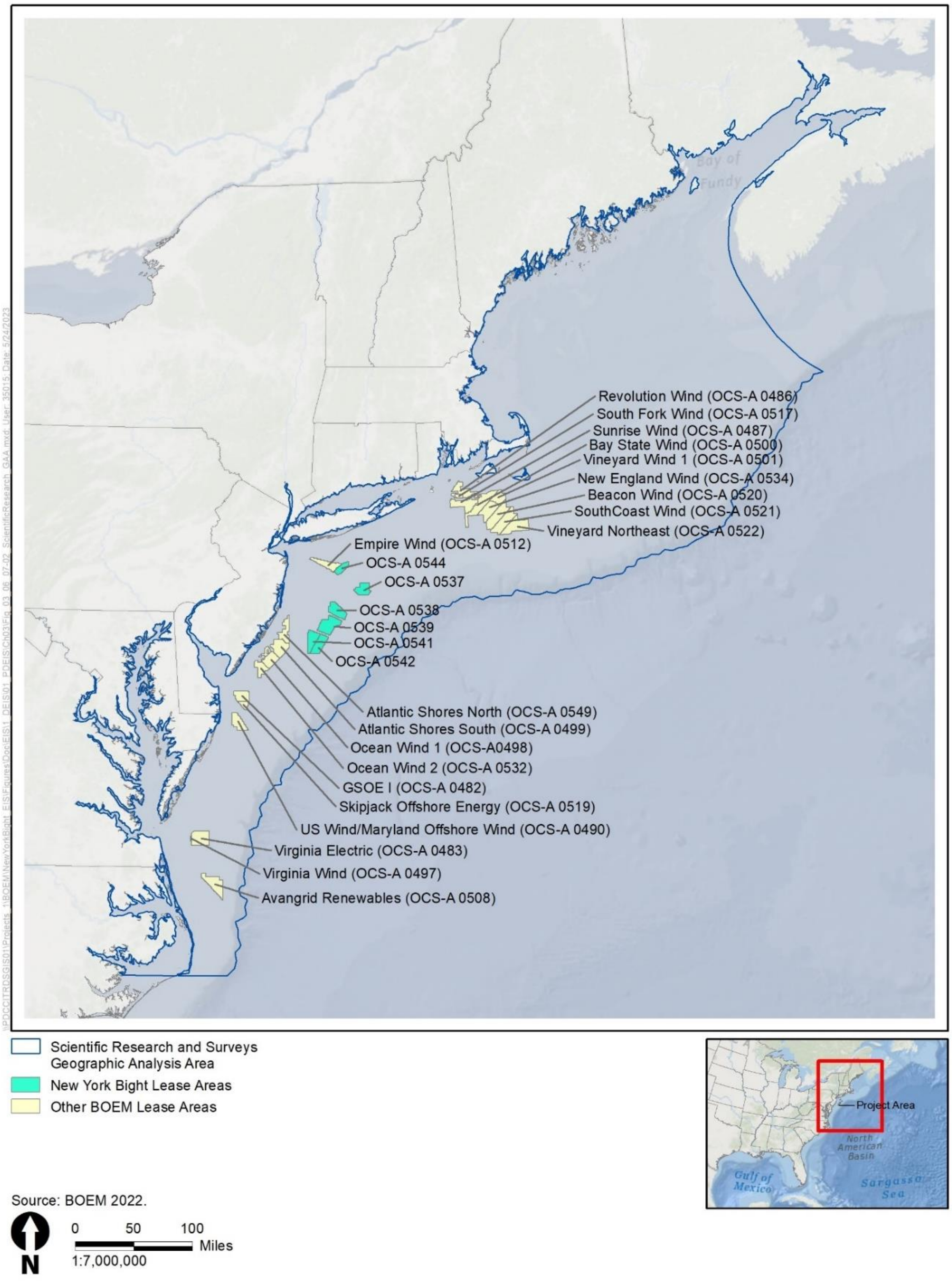


Figure 3.6.7-2. Scientific research and surveys geographic analysis area

3.6.7.1 Description of the Affected Environment and Future Baseline Conditions

3.6.7.1.1 Marine Minerals Extraction

BOEM's Marine Minerals Program manages non-energy minerals (primarily sand and gravel) in federal waters of the OCS and leases access to these resources to target shoreline erosion, beach nourishment, and restoration projects. The Marine Minerals Program identifies sand resource areas and partners with USACE, states, and localities on winnowing down these larger areas into sand borrow areas, based on need for beach renourishment. USACE also identifies borrow areas within state waters for beach renourishment. BOEM's Marine Minerals Program has identified multiple proven, potential, and unverified sand and gravel resources, and aliquots with sand resources along the coast of New York and New Jersey. Figure 3.6.7-3 shows the locations of marine mineral resources identified by BOEM's Marine Minerals Program in the geographic analysis area (BOEM 2022).

The demand for sand resources suitable for beach replenishment efforts along the Atlantic Coast has increased due to shoreline erosion, damage from coastal storms, and climate change-induced sea level rise. BOEM funded offshore surveys from 2015 to 2017 as part of the Atlantic Sand Assessment Project to identify sources of sand in federal waters to help coastal communities recover from storms and coastal erosion (BOEM undated). More than $1.5 billion has been invested in New Jersey across more than 35 coastal resilience projects, translating to almost 300 nourishment events and 200 million cubic yards placed since the mid-1930s (Elko et al. 2021). New Jersey has exhausted most of its state sand sources and is expected to rely on offshore resource areas to protect and maintain its coastline, which relies heavily on regular renourishment cycles and may be needed by the state for future hurricane relief. Since 1923, New York has placed almost 200 million cubic yards of total beach nourishment across 147 nourishment events (Elko et al. 2021; ASBPA 2023). At present, there are 15 USACE beach renourishment projects in the USACE North Atlantic Division, which includes the New York and Philadelphia Districts, that may target OCS sand resources (NJDEP pers. comm. 2023). The New York District projects include Sandy Hook to Barnegat Inlet in addition to the Raritan Bay Flood Control Projects of Keansburg, Port Monmouth, Union Beach and Highlands. The Philadelphia District projects include Manasquan Inlet to Barnegat Inlet, Barnegat Inlet to Little Egg Inlet, Brigantine Inlet to Great Egg Inlet (Brigantine), Brigantine Inlet to Great Egg Inlet (Absecon Island), Great Egg Inlet to Pecks Beach, Great Egg Inlet to Townsends Inlet, Townsends Inlet to Cape May Inlet, Hereford Inlet to Cape May Inlet, Cape May Inlet to Lower Township, and Lower Township to Cape May Point. In addition to the OCS sand resource needs for these projects, USACE has additional beach renourishment projects currently targeting sand resources in state waters/inlets. Figure 3.6.7-3 provides the locations of marine mineral resources in the NY Bight geographic analysis area.

Offshore sand and gravel resources are managed by federal and state agencies and used for coastal protection and restoration, beach nourishment, and habitat reconstruction purposes. Within or adjacent to the geographic analysis area, BOEM, USACE, New York Department of State Office of Planning and Development, NJDEP, and New Jersey Geological and Water Survey coordinate the management of areas of potential and confirmed sand resources for these coastal management and restoration activities.

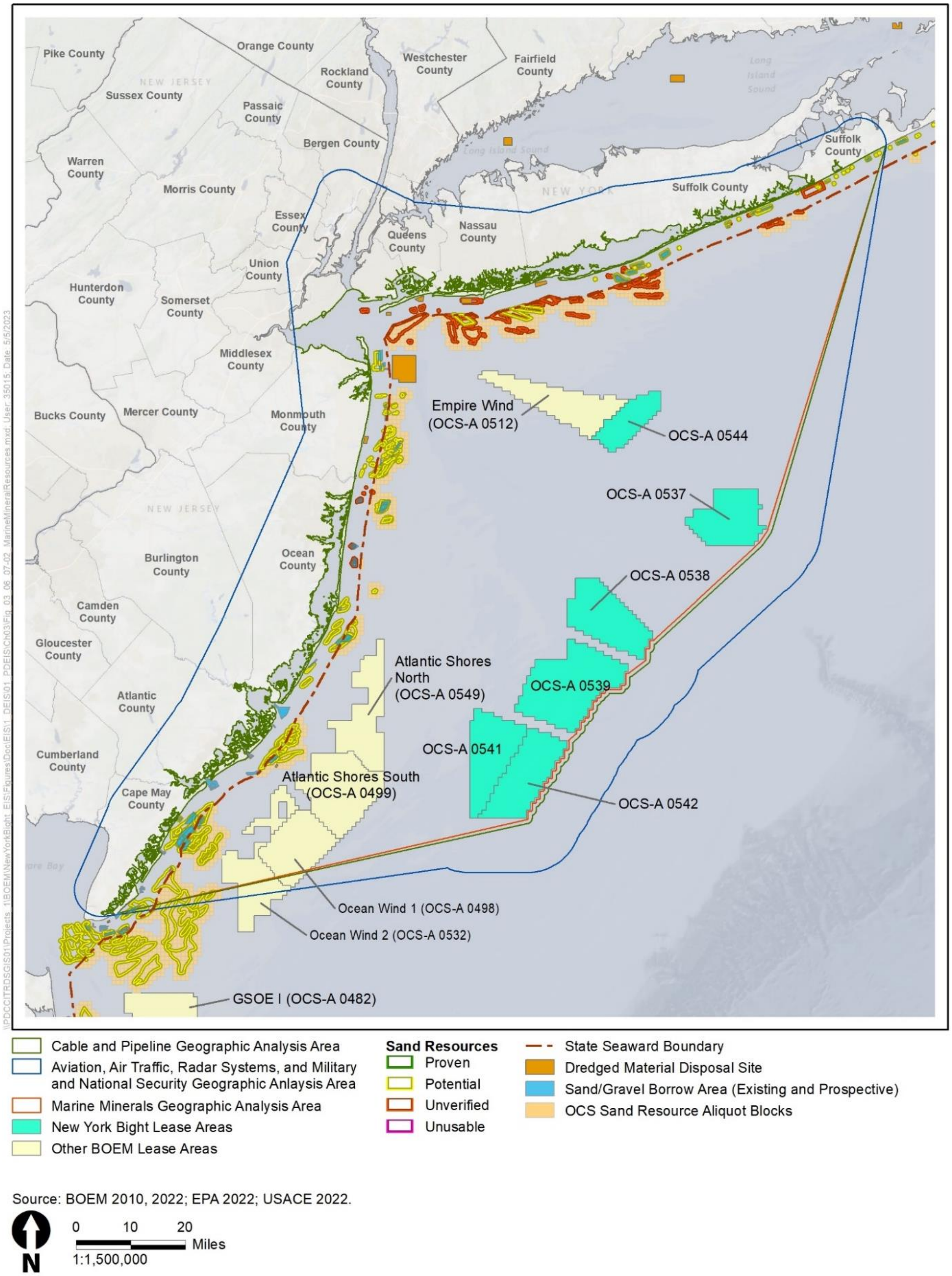


Figure 3.6.7-3. Marine mineral resources

3.6.7.1.2 National Security and Military Use

The United States Armed Forces, with installations and operations in the vicinity of the NY Bight, the USCG, and the U.S. Navy have a significant presence in and around the NY Bight geographic analysis area, as shown in Figure 3.6.7-4.

Existing onshore regional military facilities include Naval Weapons Station Earle, Joint Base McGuire-Dix-Lakehurst, Manasquan Inlet USCG station, USCG Air Station Atlantic City, and the Sea Girt National Guard Training Center. Naval Weapons Station Earle in Colts Neck, New Jersey, provides all the ordnance for the Atlantic Fleet Carrier and Expeditionary Strike Groups and supports strategic ordnance requirements. Joint Base McGuire-Dix-Lakehurst is a military installation approximately 18 miles (29 kilometers) south of Trenton, New Jersey. The base includes units from all six armed forces branches. The USCG Manasquan Inlet Station is approximately 60 miles (97 kilometers) north of Oyster Creek in Point Pleasant Beach, New Jersey. Military activities at the Manasquan Inlet Station could include various vessel training exercises, submarine and antisubmarine training, and U.S. Air Force exercises. The USCG Air Station Atlantic City, located at the Atlantic City International Airport in Egg Harbor, New Jersey, supports a range of USCG operations, including SAR, port security, and marine environmental protection services. The Sea Girt National Guard Training Center (NGTC) is a training facility for New Jersey Citizen Soldiers, Airmen, and law enforcement professionals. The facilities include classrooms and offices, a firing point range, the New Jersey State Police Academy, Department of Corrections Academy, Division of Criminal Justice Academy, and the Juvenile Justice Academy. Several National Guard units have support facilities located at the NGTC. The Department of Defense (DoD) also operates the North American Aerospace Defense Command national defense radar in the vicinity.

The Offshore Narragansett Bay Range Complex, controlled by the U.S. Navy Fleet Area Control and Surveillance Facility, is in the eastern vicinity of the geographic analysis area. As part of the range complex, the Narragansett Bay Operating Area extends into the NY Bight lease areas. Airspace warning areas W105A, W105B, W106A, W106B, W106C, and W106D are present within the geographic analysis area. The Narragansett Bay Warning Areas are actively used for U.S. Navy subsurface and surface training and testing activities and are designated for aircraft activity that may be hazardous for nonparticipating aircraft (Empire 2022). The Atlantic City Complex is located within waters adjacent to the coasts of New Jersey and New York. The complex includes the Atlantic City Operating Area, extending from Seaside Heights to Sea Isle City, and is composed of warning areas W107A, W107B, and W107C. This range complex is used for U.S. Atlantic Fleet training and testing exercise and supports training and testing by other services, primarily the U.S. Air Force. The AEGIS Combat Systems Center conducts operations in this area. It is controlled by the Fleet Area Control and Surveillance Facility Virginia Capes, located in Norfolk, Virginia. The Atlantic City special use airspace (SUA), within the OPAREA, is used for surface-to-air gunnery exercises and is, therefore, designated as Warning Area 107 for nonparticipating pilots.

Within the NY Bight geographic analysis area, there is the potential to encounter munitions and explosives of concern (MEC) that are the result of military testing and training. MEC is inclusive of UXO and discarded military munitions of constituents that could pose an explosive hazard. Five UXO locations and two UXO areas are located within the NY Bight geographic analysis area (MAOPD 2022). UXO locations are shown on Figure 3.6.7-6. Two site-specific studies were commissioned by Atlantic Shores for the Atlantic Shores Offshore Wind South Project (OCS-A 0499) to determine the risk of potential MECs found within the Atlantic Shores South geographic analysis area (Atlantic Shores 2022). The reports determined that the Atlantic Shores offshore project area, located within the NY Bight geographic analysis area, is within low hazard zones for MECs and that the likelihood of encountering buried items that constitute a notable safety risk are below the industry standard of As Low as Reasonably Practicable. The U.S. Committee on the Marine Transportation System is developing the *National Guidance for Industry on Responding to Munitions and Explosives of Concern in U.S. Federal Waters* to identify and coordinate federal statutory and regulatory authorities that approve, permit, and regulate the detonation, removal, or mitigation of MECs on the outer continental shelf. The public comment period ended on September 25, 2023. As of August 21, 2024, the final guidance document has not been issued.

The Naval Undersea Warfare Center Testing Range is located along the northeastern edge of the geographic analysis area. The area provides underwater testing ranges for the Naval Undersea Warfare Center, located in Newport, Rhode Island, for research, development, testing, and evaluation activities for submarine systems and subsystems (NAVSEA 2022).

Four Danger Zones/Restricted Areas, where general use by the U.S. government may limit public access, are located in the geographic analysis area. The largest area is at the mouth of New York Harbor, and is open to unrestricted surface navigation, but vessels are cautioned to not anchor, dredge, trawl, lay cables, bottom, or conduct any other similar type of operation (NOD 2022). The second area is the Naval Weapons Station Earle in Sandy Hook Bay, where ammunition from warships is loaded and unloaded (NOD 2022). The third area is within New York Harbor, adjacent to the Stapleton Naval Station off the coast of Staten Island, New York. The final area is the Coast Guard Rifle Range, off the coast of Cape May, New Jersey. Danger Zone/Restricted Areas are shown in Figure 3.6.7-4. Military activities are anticipated to continue to use onshore and offshore areas in the vicinity of the geographic analysis area into the future and may involve routine and non-routine activities.

3.6.7.1.3 Aviation and Air Traffic

Multiple public and private-use airports serve the region within the geographic analysis area, as shown in Figure 3.6.7-4. Air traffic is expected to continue at current levels in and around the geographic analysis area.

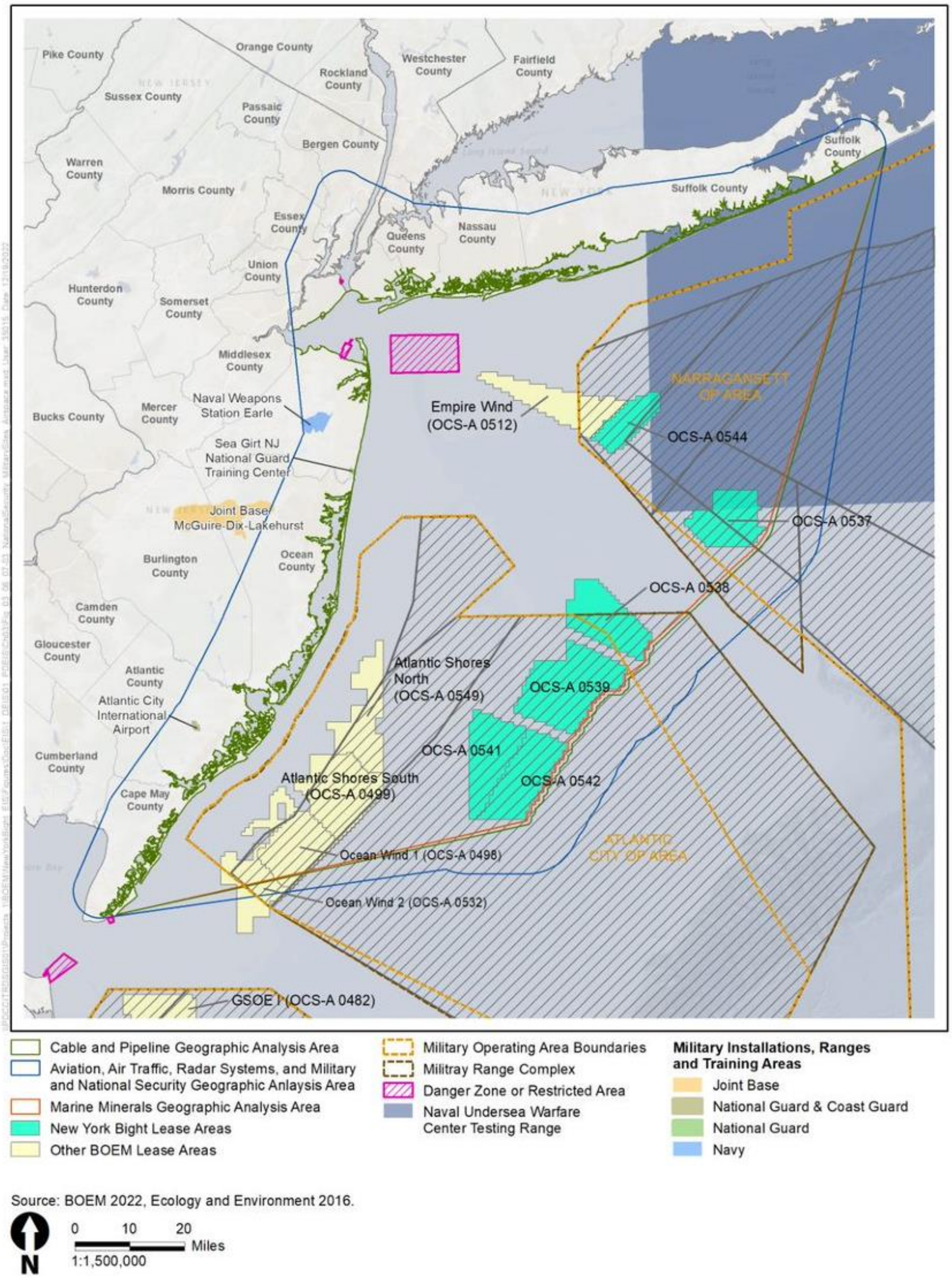


Figure 3.6.7-4. National security, military sites, and airspace

3.6.7.1.4 Cables and Pipelines

There are 27 cables (18 active and 9 out of service) offshore within the NY Bight geographic analysis area (Figure 3.6.7-5) (NASCA 2020). The potential for overlap of submarine cables in the geographic analysis area will be evaluated during the future COP NEPA stage.

The NYSERDA developed an Offshore Wind Cable Corridor Constraints Assessment to identify the constraints of developing future offshore wind cables in New York State Waters, at landfall, and along overland routes to existing POIs (NYSERDA 2023). NYSERDA identified POIs for offshore wind projects to interconnect to the existing New York State transmission grid. Table 3.6.7-1 lists the potential POIs in New York identified in the Offshore Wind Cable Corridor Constraints Assessment. No comparable study has been conducted by the State of New Jersey.

Table 3.6.7-1. Onshore POIs

Substations Representing Potential POIs		
Academy	Glenwood	Port Jefferson
Astoria	Goethals	Rainey
Barret	Gowanus	Ruland Road
Brookhaven	Mott Haven	Shoreham
East Garden City	Newbridge Road	Shore Road
Farragut	Northport	Syosset
Freshkills	Pilgrim	West 49th Street

In 2020, the State of New York released the New York State Offshore Wind Master Plan (NYSERDA 2020). The Master Plan was developed to inform a pathway toward reaching the State's goals to develop 2,400 MW of offshore wind power by 2030. The Master Plan included two studies regarding the development of cables, pipelines, and infrastructure within the NY Bight area. The Cable Landfall Permitting Study identified existing offshore and onshore resources and identified potential routes and constraints to the development of future cable landfall sites (NYSERDA 2017a). The Cables, Pipelines, and Other Infrastructure Study provided the locations of submarine cables, gas pipelines, and other infrastructure within the NY Bight area (NYSERDA 2017b). There are six in-service pipelines within the vicinity of the NY Bight lease areas. The Williams Transco pipeline, which supplies a significant amount of natural gas to New York, is located in the nearshore waters between New Jersey and New York (NYSERDA 2017b). A gas pipeline is buried in the northern New York Harbor utility corridor, two gas pipelines and one petroleum product pipeline are buried in the southern New York Harbor utility corridor, and the deeply tunneled replacement Brooklyn-Staten Island water siphon is in the New Jersey Harbor.

The locations of known cables and pipelines are shown in Figure 3.6.7-5. BOEM has not identified any additional publicly noticed plans for planned submarine cables or pipelines in the geographic analysis area.

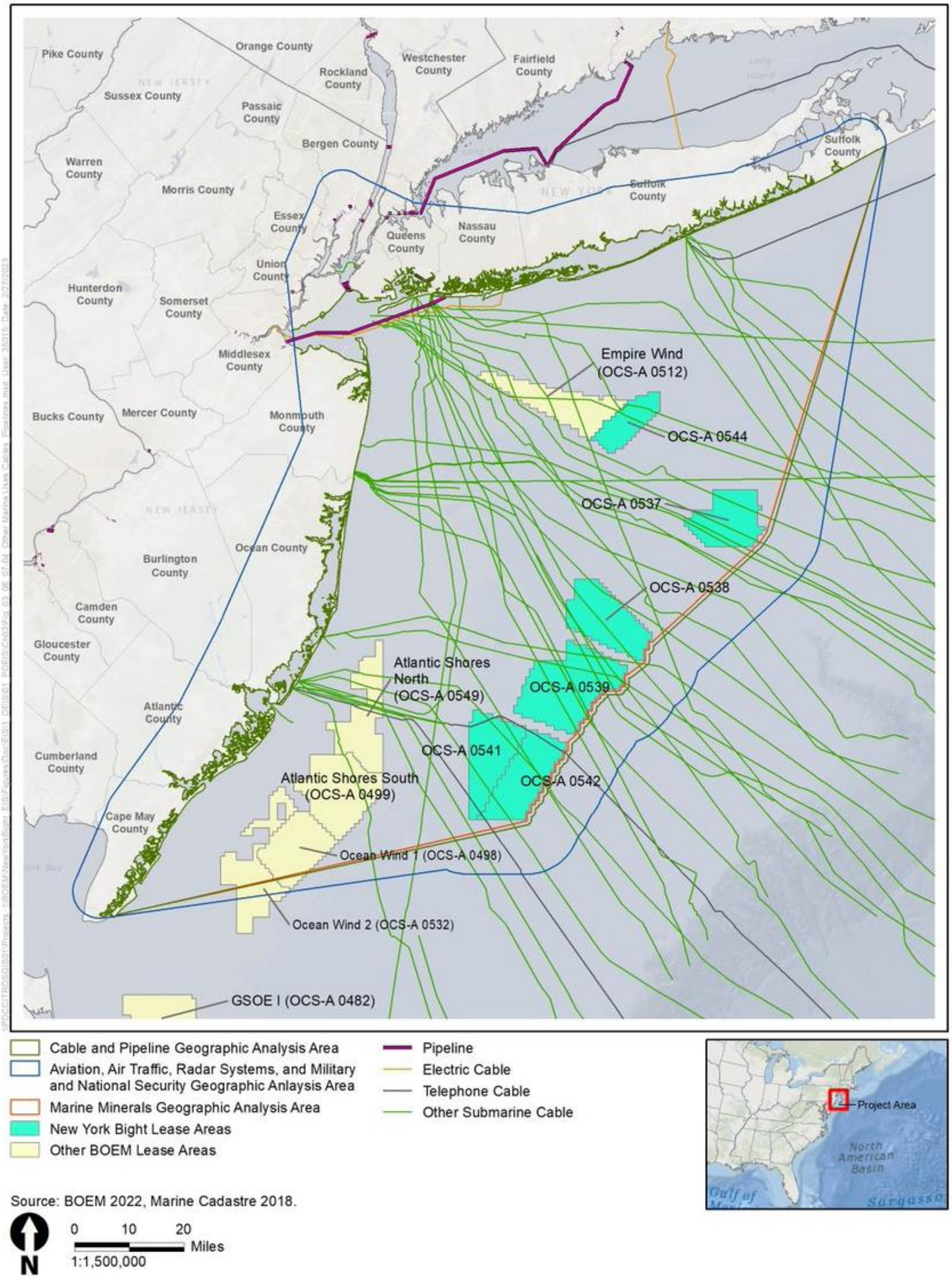


Figure 3.6.7-5. Cables and pipelines

3.6.7.1.5 Radar Systems

Commercial air traffic control, national defense, and weather radar systems currently operate in the region. Radar facilities that overlap with the geographic analysis area include those that support air traffic control, military surveillance, high frequency coastal radars, and weather monitoring. See Figure 3.6.7-6 for locations of radars within the geographic analysis area.

The following radar sites are within the geographic analysis area for air traffic control and weather radar systems:

- Gibbsboro Air Route Surveillance Radar (ARSR-4)
- Islip Airport Surveillance Radar-9 (ASR-9)
- New York ASR-9
- Newark ASR-9
- Riverhead ARSR-4
- White Plains ASR-9
- Atlantic City Airport ASR-9
- Dover Air Force Base Digital Airport Surveillance Radar (DASR)
- McGuire Air Force Base Digital Airport Surveillance Radar
- Floyd Bennet Field Terminal Doppler Weather Radar (TDWR)
- Woodbridge TDWR
- Naval Air Station Willow Grove Airport Surveillance Radar model-11 (ASR-11)

In addition to onshore facilities, several oceanographic high-frequency radar stations are in the geographic analysis area as part of regional and local high-frequency networks. The oceanographic high-frequency radars are used by the NOAA Integrated Ocean Observing System (IOOS) as part of its Surface Currents Program. Data collected are used by USCG's Search and Rescue Optimal Planning System, a decision-support tool that uses ocean observations to narrow search areas. Figure 3.6.7-6 shows the locations of oceanographic high frequency radar sites within the geographic analysis area.

Existing radar systems will continue to provide weather, navigational, and national security support to the region. The number of radars and their coverage areas are anticipated to remain at current levels for the foreseeable future.

Located adjacent to NY Bight Lease Area OCS-A 0544, Weather Buoy 44025 is operated by the NOAA National Data Bouy Center. While not a radar system, the buoy gathers observations used in marine forecasts.

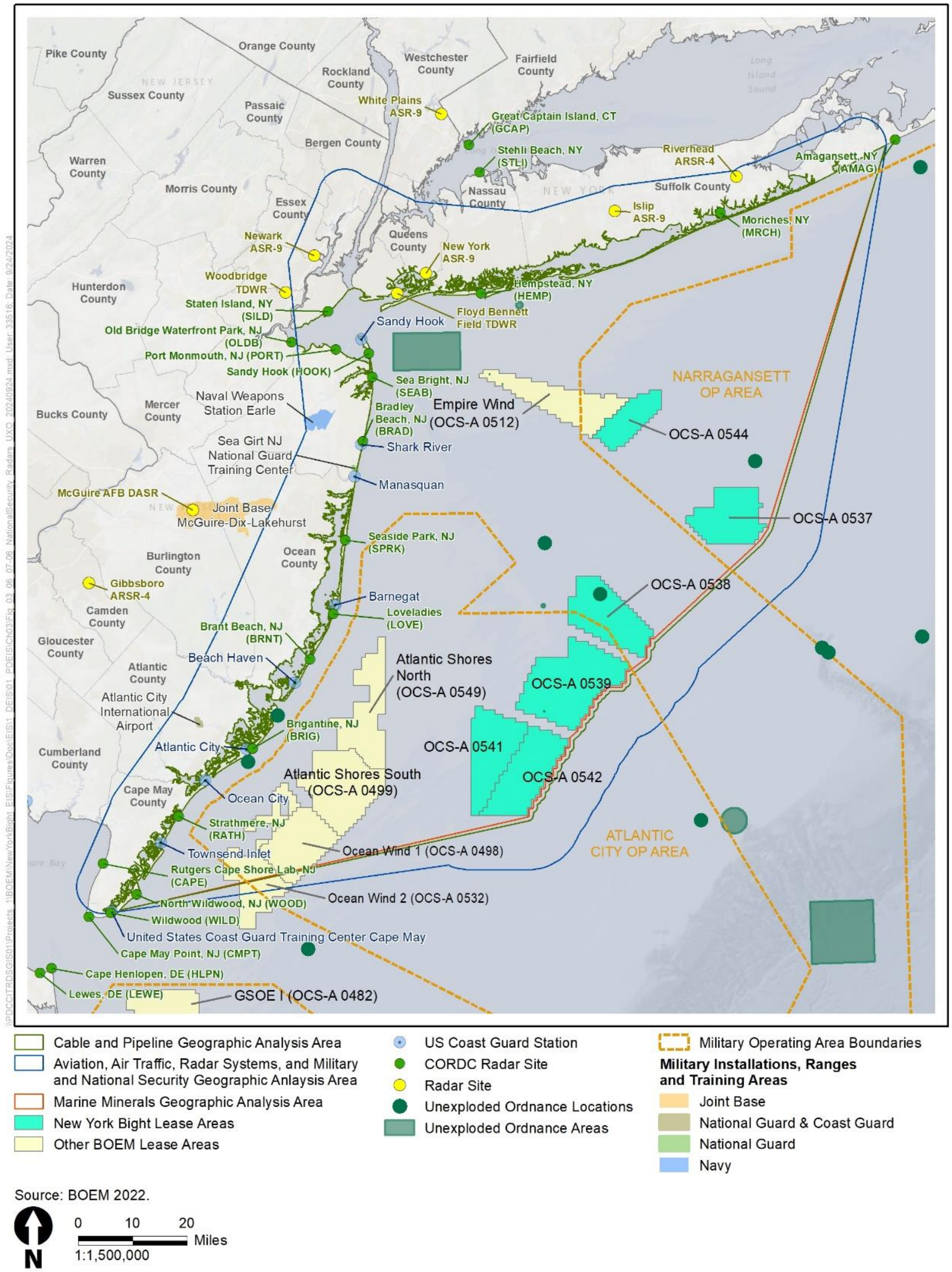


Figure 3.6.7-6. National security, radars, and unexploded ordnances

3.6.7.1.6 Scientific Research and Surveys

Research in the geographic analysis area includes oceanographic, biological, geophysical, and archeological surveys focused on the OCS and nearshore environments, and resources that may be affected by offshore wind development. Federal and state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing offshore research in the surrounding waters, including aerial and ship-based scientific surveys. Figure 3.6.7-2 shows the geographic analysis area for scientific research and surveys.

NYSERDA conducts several studies covering the NY Bight area in support of offshore wind development, including pre-development, environmental, economic, infrastructure, social, and regulatory studies (NYSERDA 2023). NOAA and USACE conduct extensive studies along the Northwest Atlantic Outer Continental Shelf from Massachusetts to North Carolina, including seafloor substrate mapping and fisheries studies, using ship-based survey methods (Battista et al. 2019; Guida et al. 2017).

Current fisheries management and ecosystem monitoring surveys would overlap with offshore wind lease areas in the geographic analysis area. Agency-sponsored surveys are conducted by the NEFSC, NJDEP, and the Northeast Area Monitoring and Assessment Program (NEAMAP) led by the Virginia Institute of Marine Sciences. NEFSC 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; (4) the NEFSC Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units; (5) NOAA's Atlantic Marine Assessment Program for Protected Species aerial and shipboard survey; (6) North Atlantic Right Whale Sighting Advisory System aerial survey; and (7) the large coastal shark long-line survey (BOEM 2021; Hare et al. 2022). These surveys support management of more than 40 fisheries, 30 marine mammal species, and 14 threatened and endangered species, as well as numerous other science products produced by NMFS, including ecosystem and climate assessments (Hare et al. 2022). NJDEP has conducted the New Jersey Ocean Trawl Program annually for over 30 years to document the occurrence, distribution, and relative abundance of marine recreational and non-recreational fish species in New Jersey coastal waters. Nearshore survey activities associated with NEAMAP overlap the NY Bight geographic analysis area. NOAA conducts seal abundance monitoring surveys to determine the abundance of harbor and grey seals and conducts marine turtle ecology and assessment research within the offshore wind lease areas in the geographic analysis area.

In addition to in-water surveys, NOAA conducts aerial surveys from Maine to the Florida Keys as part of the AMAPPS to measure the abundance of marine mammals and sea turtles. NOAA conducts these surveys within the geographic analysis area utilizing aircraft that fly 600 feet (183 meters) above the water surface at 110 knots (200 kilometers per hour) (NEFSC 2020). Further information on scientific research and surveys can be found in Section 3.5.5.

As planned offshore wind development continues, alternative platforms, sampling designs, and sampling methodologies are needed to maintain the surveys conducted in or near the lease areas.

3.6.7.2 Impact Level Definitions for Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Definitions of potential impact levels are provided in Table 3.6.7-2. There are no beneficial impacts on other uses.

Table 3.6.7-2. Adverse impact level definitions for other uses

Impact Level	Definition
Negligible	There would be no measurable impacts, or impacts would be so small that they would be extremely difficult or impossible to discern or measure.
Minor	Impacts on the affected activity could be avoided, and impacts would not disrupt the normal or routine functions of the affected activity. Once the project is decommissioned, the affected activity would return to a condition with no measurable effects.
Moderate	Impacts on the affected activity are unavoidable, but impacts could be reduced through strategic space-use planning during the life of the project. The affected activity would have to adjust to account for disruptions due to impacts of the project, or, once the project is decommissioned, the affected activity could return to a condition with no measurable effects if proper remedial action is taken.
Major	The affected activity would experience unavoidable disruptions to a degree beyond what is normally acceptable, and, once the project is decommissioned, the affected activity could continue to experience measurable effects indefinitely, even if remedial action is taken.

Presence of structures and traffic are contributing IPFs to impacts on other uses. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.6.7-3.

Table 3.6.7-3. Issues and indicators to assess impacts on other uses

Issue	Impact Indicator
Military and National Security Uses (land, sea, air): Reduction in the military's ability to access and use the site due to construction vessel traffic and WTG installation; reduction in air surveillance and national defense operations	Level of interruption to military exercises and national security operations
Reduced availability of offshore energy (oil/gas) production at the site	Acreage of oil and gas activities excluded due to WTGs or offshore export cables or postponed due to increased traffic
Marine Minerals: Reduced access to sand and minerals on the OCS	Acreage of mineral extraction area excluded due to WTGs or offshore export cables or postponed due to increased traffic
Aviation and Air Traffic: Risk to aviation traffic	Qualitative assessment of impacts from risk to flight vectors to regional airports
Radar Systems: Impacts on land-based radar (air traffic control, air space surveillance, weather, high-frequency ocean observation radar)	Qualitative assessment of system-specific impacts from potential wind turbine radar interference

Issue	Impact Indicator
Impacts on other renewable energy projects, particularly if there is overlap in ports to be used; transit lane orientation	Qualitative assessment of impacts from potential exclusions of other renewable energy projects
Cables and Pipelines: Impacts on any proposed/approved pipelines; electricity/telecom transmission lines	Qualitative assessment of impacts from potential exclusions of or damage to other undersea cables
Scientific Research and Surveys: Impacts on scientific research and surveys	Quantitative assessment of impacts from interactions of offshore wind development (both project-level and cumulative effects) on NMFS fisheries independent surveys, ecosystem surveys, and protected species surveys; assessment of impacts for each project should be conducted in consultation with NMFS fisheries and protected species survey leads or other points of contact
Impact on dredged material ocean disposal sites	Impacts resulting from project overlap with ocean disposal sites

3.6.7.3 Impacts of Alternative A – No Action – Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

When analyzing the impacts of the No Action Alternative on other uses, BOEM considered the impacts of ongoing activities, including ongoing non-offshore-wind and ongoing offshore wind activities on the baseline conditions for other uses. 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, which are described in Appendix D, *Planned Activities Scenario.*

3.6.7.3.1 Impacts of the No Action Alternative

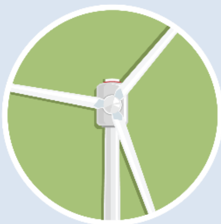
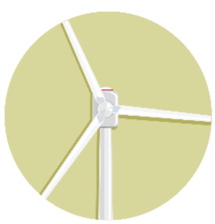
Under the No Action Alternative, marine minerals extraction, military and national security uses, aviation and air traffic, offshore cables and pipelines, radar systems, and scientific research and surveys described in Section 3.6.7.1, *Description of the Affected Environment and Future Baseline Conditions,* 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 would contribute to impacts on other uses would generally be associated with dredging and ocean disposal, which could affect access to marine minerals, and climate change impacts. Ongoing offshore wind activities within the geographic analysis area for scientific research and surveys are listed in Table 3.6.7-4. Ongoing offshore wind activities within the geographic analysis area for marine minerals extraction, military and national security uses, aviation and air traffic, cables and pipelines, or radar systems are listed in Table 3.6.7-5. Impacts on the marine environment associated with ongoing offshore wind activity have the potential to affect ongoing scientific research and surveys, marine minerals extraction, military and national security uses, aviation and air traffic, cables and pipelines, or radar systems as described for cumulative impacts of the No Action Alternative in Section 3.6.7.3.2.

3.6.7.3.2 *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 NY Bight projects). No planned non-offshore-wind developments, such as the installation of new structures on the OCS outside of planned offshore wind projects, were identified in the geographic analysis area. Ongoing and planned offshore wind projects in the geographic analysis area are listed in Table 3.6.7-4 for scientific research and surveys and in Table 3.6.7-5 for marine minerals extraction, national security and military use, aviation and air traffic, cables and pipelines, and radar systems.

Table 3.6.7-4. Ongoing and planned offshore wind in the geographic analysis area for scientific research and surveys

Ongoing/Planned	Projects by Region
Ongoing – 12 projects[1] 	**MA/RI** • Block Island (State waters) • Vineyard Wind 1 (OCS-A 0501) • South Fork Wind (OCS-A 0517) • Revolution Wind (OCS-A 0486) • Sunrise Wind (OCS-A 0487) • New England Wind (OCS-A 0534) Phase 1 • New England Wind (OCS-A 0534) Phase 2 **NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512) **VA/NC** • CVOW-Pilot (OCS-A 0497) • CVOW-Commercial (OCS-A 0483)
Planned – 16 projects[2] 	**MA/RI** • SouthCoast Wind (OCS-A 0521) • Beacon Wind 1 (OCS-A 0520) • Beacon Wind 2 (OCS-A 0520) • Bay State Wind (OCS-A 0500) • OCS-A 0500 remainder • OCS-A 0487 remainder • Vineyard Wind Northeast (OCS-A 0522) **NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499) **DE/MD** • Skipjack (OCS-A 0519) • US Wind/Maryland Offshore Wind (OCS-A 0490) • GSOE I (OCS-A 0482) • OCS-A 0519 remainder **VA/NC**

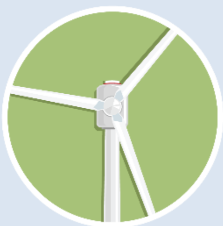
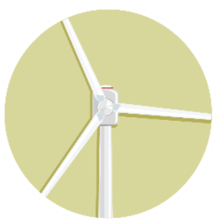
Ongoing/Planned	Projects by Region
	• Kitty Hawk North (OCS-A 0508) • Kitty Hawk South (OCS-A 0508)

CVOW = Coastal Virginia Offshore Wind; DE = Delaware; GSOE = Garden State Offshore Energy; MA = Massachusetts; MD = Maryland; NC = North Carolina; NJ = New Jersey; NY = New York; RI = Rhode Island; VA = Virginia

[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.

[2] Status as of September 20, 2024.

Table 3.6.7-5. Ongoing and planned offshore wind in the geographic analysis area for marine minerals extraction, national security and military use, aviation and air traffic, cables and pipelines, and radar systems

Ongoing/Planned	Projects by Region
Ongoing – 3 projects[1] 	**NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512)
Planned – 3 projects[2] 	**NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499)

NJ = New Jersey; NY = New York

[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.

[2] Status as of September 20, 2024.

The following summarizes the potential impacts of ongoing and planned offshore wind activities in the geographic analysis area on other uses. Ongoing and planned offshore activities have the potential to have continuing impacts on military and national security uses, aviation and air traffic, cables and pipelines, radar systems, and scientific research and surveys primarily through presence of structures and vessel traffic that introduce navigational complexities, and radar interference.

Marine Minerals Extraction

Presence of structures: Demand for marine minerals is expected to grow with increasing trends in coastal erosion, storm events, and sea level rise. Within the geographic analysis area, there are many sand resource areas and several planned USACE borrow areas. Offshore wind project infrastructure, including WTGs and transmission cables, could prevent future marine minerals extraction activities where project footprints overlap the extraction area. Marine minerals extraction typically occurs within 8 miles (13 kilometers) of the shoreline, limiting adverse impacts on offshore export cable routes. Additionally, it may be possible for other offshore wind projects to avoid existing and prospective borrow areas through consultation with the BOEM Marine Minerals Program, USACE, and relevant state agencies before an offshore wind cable route is approved. However, with the number of existing leases offshore New York and New Jersey, and the expected number of cable corridors to result from lease development, BOEM expects that impacts on sand resources would likely occur. The impacts on marine minerals extraction are expected to be moderate.

National Security and Military Uses

The NY Bight lease area geographic boundaries were developed through coordination with stakeholders to address concerns surrounding overlapping military and security uses. BOEM continues to coordinate with stakeholders to minimize these concerns, as needed.

Presence of structures: Existing stationary facilities within the geographic analysis area are limited to meteorological buoys operated for offshore wind farm site assessment. Dock facilities and other structures are concentrated along the coastline. Installation of 697 WTGs (see Appendix D, Table D2-1) as part of other ongoing and planned offshore wind projects would likely affect military and national security, including USCG SAR operations, primarily through increased risk of allision with foundations and other stationary structures. Generally, deep-draft military vessels are not anticipated to transit outside of navigation channels unless necessary for SAR operations or other non-typical activities. Smaller-draft vessels moving within or near the wind installation have a higher risk of allision with offshore wind structures. Wind energy facility structures would be lighted according to USCG, FAA, and BOEM requirements at sea level to decrease allision risk. Allision risk would be further mitigated through coordination with stakeholders on WTG layouts to allow for safe navigation through the offshore wind farms in the geographic analysis area.

The construction of offshore wind projects in the geographic analysis area would gradually change navigational patterns and would increase navigational complexity for vessels and military aircraft operating in the region. Military and national security aircraft would be affected by the presence of tall equipment necessary for offshore wind facility construction, such as stationary lift vessels and cranes. Additionally, military and security operations conducted within all Warning Areas would be affected during the construction and operation periods of offshore wind activities. Refer to Section 3.6.6, *Navigation and Vessel Traffic*, for additional discussion of navigation impacts in the geographic analysis area. The installation of WTGs within the geographic analysis area could create an artificial reef effect that attracts species of interest for recreational fishing and sightseeing, resulting in more recreational vessel traffic farther offshore than typically occurs (e.g., from recreational activities). An increase in vessels in and around offshore wind projects could increase the risk of vessel collisions with military and national security vessels and may lead to an increased demand for USCG SAR operations.

Navigational hazards would be eliminated as structures are removed during decommissioning. Due to anticipated coordination with agencies the overall impacts on military and national security uses from offshore wind energy, activities are anticipated to be minor to moderate**.**

Traffic: Impacts on military operations from increased vessel traffic during construction and operation of offshore wind activities in the NY Bight area are expected to be short term and localized. Military and national security vessels may experience congestion and delays in ports due to an increase in offshore wind facility vessels. Any interruptions to military operations would be mitigated with the corresponding agency. The cumulative impacts on military and national security uses from ongoing and planned offshore wind energy activities are anticipated to be minor.

Aviation and Air Traffic

Presence of structures: The addition of WTGs from offshore wind development would gradually alter aircraft navigational patterns and complexity. These changes could compress lower-altitude aviation activity into more limited airspace in these areas, leading to airspace conflicts or congestion and increased collision risk for low-flying aircraft. Navigational hazards and collision risk in transit routes would likely be reduced as construction is completed and would be gradually eliminated during decommissioning as offshore WTGs are removed.

All stationary structures would have aviation and navigational marking and lighting in accordance with FAA, USCG, and BOEM requirements and guidelines to minimize and mitigate impacts on air traffic. BOEM assumes that ongoing and planned offshore wind projects would coordinate with aviation interests through the planning, construction, operations, and decommissioning processes to avoid or minimize impacts on aviation activities and air traffic. For this reason, the adverse impacts on aviation and airports are anticipated to be minor.

Cables and Pipelines

Presence of structures: Existing cables and pipelines may be affected by the development of offshore wind projects. Installed WTGs and OSSs, and the stationary lift vessels used during construction of offshore wind energy project infrastructure, may pose allision/collision risks and navigational hazards to vessels conducting maintenance activities on these existing cables and pipelines. Risk to cable maintenance vessels during construction and operations of nearby offshore wind projects would be limited due to the infrequent submarine cable maintenance required at any single location along existing cable routes. Allision risks would likely be mitigated by navigational hazard markings per FAA, BOEM, and USCG requirements and guidelines, and risk of allision by cable maintenance vessels would likely decrease to zero after decommissioning as structures are removed.

Additional submarine cables are expected to be installed for Ocean Wind 1 (OCS-A 0498), Ocean Wind 2 (OCS-A 0532), Atlantic Shores South (OCS-A 0499), Atlantic Shores North (OCS-A 0549), and Empire Wind projects (OCS-A 0512). The installation of WTGs and OSSs could preclude future submarine cable placement within the foundation footprint, which would cause future cables to route around these areas. However, the presence of existing submarine cables would not likely prohibit the placement of additional cables and pipelines. Following standard industry procedures, cables and pipelines can be crossed without adverse impact. Impacts on submarine cables would likely be eliminated during decommissioning of offshore wind farms when foundations are removed and if the export and interarray cables associated with those projects are removed. Minor adverse impacts on existing cables and pipelines due to offshore wind projects are expected.

Radar Systems

Presence of structures: WTGs that are near to or in the direct line of sight or over the horizon coverage area of land-based radar systems can interfere with the radar signal, causing shadows or clutter in the received signal. Construction of offshore wind energy projects could lead to localized, long-term, moderate impacts on radar systems. Development of offshore wind projects could gradually decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars. Most offshore wind structures would be sited at such a distance from existing and proposed land-based radar systems to minimize interference to most radar systems, but some impacts are anticipated. Moderate adverse impacts on existing radar systems due to ongoing and planned offshore wind projects are expected.

BOEM assumes that project proponents would conduct an independent radar analysis and coordinate with the federal agency that manages the radar system (e.g., FAA, DoD, NOAA) to identify potential impacts and any mitigation measures specific to aeronautical, military, and weather radar systems. Refer to Section 3.6.6, *Navigation and Vessel Traffic,* for discussion of impacts on marine vessel radar.

Scientific Research and Surveys

Presence of structures: Ongoing and planned offshore wind energy projects within the geographic analysis area would add up to 2,331 WTGs, up to 64 OSSs, associated cable systems, and associated vessel activity that would present additional navigational obstructions for sea- and air-based scientific studies. Collectively, these developments would prevent NOAA from continuing scientific research surveys or protected species surveys under current vessel capacities, could conflict with state and nearshore surveys, would affect monitoring protocols, and could reduce opportunities for other scientific research studies in the geographic analysis area.

This PEIS incorporates by reference the detailed summary of and potential impacts on NOAA's scientific research provided in the *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement* (Vineyard Wind 1 Final EIS) in Section 3.12.2.5, *Scientific Research and Surveys* (BOEM 2021). In summary, offshore wind facilities would impact scientific surveys by precluding NOAA survey vessels and aircraft from sampling in survey strata; impact the random-stratified statistical design that is the basis for assessments, advice, and analysis; alter benthic and pelagic habitats and airspace in and around the wind energy development, which would require new designs and methods to sample new habitats; and reduce sampling productivity through navigation impacts of wind energy infrastructure on aerial and vessel surveys. NOAA has determined that survey activities within offshore wind facilities are outside of safety and operational limits. Survey vessels would be required to navigate around offshore wind projects to access survey locations, leading to a decrease in survey precision and operational efficiency. The height of turbines would affect aerial survey design and protocols, requiring flight altitudes and transects to change. Scientific survey and protected species survey operations would therefore be reduced or eliminated as offshore wind facilities are constructed. If stock or population changes, biomass estimates, or other environmental parameters differ within the offshore wind lease areas but cannot be observed as part of surveys, resulting survey indices could be biased and unsuitable for monitoring stock status. Offshore wind facilities would disrupt survey sampling statistical designs, such as random stratified sampling. Impacts on the statistical design of region-wide surveys violate the assumptions of probabilistic sampling methods. Development of new survey technologies, changes in survey methodologies, and required calibrations could help to mitigate losses in accuracy and precision of current practices caused by the impacts of wind development on survey strata.

Offshore wind projects could also require implementation of mitigation and monitoring measures identified in records of decision. Identification and analysis of specific measures are speculative at this time; however, these measures could further affect NOAA's ongoing scientific research surveys or protected species surveys because of increased vessel activity or in-water structures from these other projects.

NMFS and BOEM have prepared a *Federal Survey Mitigation Implementation Strategy for the Northeast U.S. Region* (Hare et al. 2022) describing impacts on fishery participants and on the conservation and recovery of protected species. This implementation strategy defines stakeholders, partners, and other ocean uses that will be engaged throughout the implementation process and identifies potential resources for successful implementation throughout the duration of wind energy in the Northeast U.S. region. BOEM is committed to working with NOAA toward a long-term regional solution to account for changes in survey methodologies as a result of offshore wind facilities.

Overall, ongoing and reasonably foreseeable planned offshore wind energy projects in the geographic analysis area would likely have major effects on NOAA's scientific research and protected species surveys, potentially leading to impacts on fishery participants and communities; as well as potential major impacts on monitoring and assessment activities associated with recovery and conservation programs for protected species.

3.6.7.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, other uses would continue to be affected by existing environmental trends and activities. Existing operations on the OCS could increase vessel traffic, navigational complexity, and radar interference.

BOEM anticipates that the impacts of ongoing activities on other uses would likely be **negligible** for marine minerals extraction, military and national security uses, aviation and air traffic, cables and pipelines, and radar systems. Military and national security use, aviation and air traffic, vessel traffic, and scientific research and surveys are expected to continue in the geographic analysis area. Impacts of ongoing activities on scientific research and surveys are anticipated to be **major** due to the impacts from ongoing offshore wind activity (e.g., Block Island Wind Farm).

Cumulative Impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue and the impacts of planned activities would continue to contribute to impacts on other uses. Planned activities expected to occur in the geographic analysis area include increasing vessel traffic; continued residential, commercial, and industrial development onshore and along the shoreline; planned offshore wind development; and possible continued development of FAA-regulated structures such as communication towers. No planned non-offshore-wind stationary structures or cables and pipeline development were identified within the offshore portion of the geographic analysis area. Any issues with aviation routes or radar systems would be resolved through coordination with FAA, DoD, or NOAA, as well as through implementation of navigational marking of structures according to FAA, USCG, and BOEM requirements.

Cumulative impacts of the No Action Alternative would likely be **moderate** for marine minerals extraction, **minor** for aviation and air traffic, cables and pipelines, and most national security and military uses; **moderate** for USCG SAR operations; **moderate** for radar systems due to potential interference; and **major** for scientific research and surveys. The presence of structures associated with ongoing and planned wind energy projects could adversely impact continued NOAA scientific research surveys using current vessel capacities and monitoring protocols or reduce opportunities for other NOAA scientific research studies in the area. Coordinators of large-vessel survey operations or operations deploying mobile survey gear have determined that activities within offshore wind facilities would not be within current safety and operations limits. In addition, changes in required flight altitudes due to the proposed WTG height would affect aerial survey design and protocols.

3.6.7.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring,* that could avoid, minimize, mitigate, and monitor those impacts.

3.6.7.4.1 Impacts of One Project

Marine Minerals Extraction

Presence of structures: Within the geographic analysis area, there are dozens of sand resource areas and several USACE borrow areas that may be targeted for use over the next 50+ years. Development of the lease area for one NY Bight project has the potential to prevent future marine minerals extraction activities through cable emplacement within or adjacent to sand resources and increasing vessel traffic and navigational complexity for activities in the NY Bight.

The need for federal sand resources is expected to increase over time due to increased storm activity, coastal erosion, and sea level rise. These offshore sand resources are used to protect coastal infrastructure and economic viability of the localities in need. During construction, installation of the submarine export cables may result in installation vessels being present within sand resources, borrow areas, and dredge disposal sites, with temporarily restricted access to those resources as vessel safety zones are applied to ensure maritime safety. Cables that cross federal beachfill projects (including borrow areas) would require a USACE Section 408 permit review to determine if the proposed alterations to the beachfill project would be injurious to the public interest or would impair the usefulness of the project. During cable installation, extraction of sand resources or dumping would be temporarily restricted.

A single NY Bight project would install up to 550 miles (885 kilometers) of additional array cables and up to 929 miles (1,495kilometers) of additional export cables. Submarine export cables should be routed to avoid active sand borrow and disposal sites. However, with the number of existing leases in the NY Bight area and the expected number of cable corridors associated with each of these leases, BOEM expects that impacts on sand resources would likely occur. Lessees would work with BOEM, and the other appropriate federal and state agencies, to identify opportunities to minimize impacts on sand resources prior to the placement of an offshore export cable. Impacts of one NY Bight project on marine minerals use is expected to be long term, localized, and moderate because the placement of offshore export cables through sand resources could lead to limited sand availability for coastal renourishment efforts. Or, once the project is decommissioned, the affected activity could return to a condition with no measurable effects if proper remedial action is taken.

National Security and Military Uses

Presence of structures: The addition of up to 280 WTGs would increase the risk of allisions for national security and military vessels during operations, particularly in bad weather or low visibility. The presence of structures could also change navigational patterns and add to the navigational complexity for military vessels and aircraft operating in the NY Bight area during construction and operation of one NY Bight project. Project structures would be marked as a navigational hazard per FAA, BOEM, and USCG regulations and guidelines, and WTGs would be visible on military and national security vessel and aircraft radar, minimizing the potential for allision and increased navigational complexity. Additional navigational complexity would increase the risk of collision and allisions for military and national security vessels or aircraft within the NY Bight area.

The presence of offshore wind infrastructure has the potential to hinder USCG SAR activities due to increased navigational complexity within the geographic analysis area and safety concerns of operating among the WTGs. Changing navigational patterns could also concentrate vessels within and around the outside of the geographic analysis area, potentially causing space use conflicts in these locations or reducing the efficiency of SAR operations. USCG may need to adjust its SAR planning and search patterns to accommodate the WTG layout, leading to a potentially less optimized search pattern and a lower probability of success. This could lead to increased loss of life due to maritime incidents.

Construction of up to 280 WTGs and 5 OSSs could create an artificial reef effect, attracting species of interest to recreational fishing or sightseeing, which would attract additional recreational vessels in addition to existing vessel traffic in the area. The presence of additional recreational vessels would add to the space use conflict and collision risks for military and national security vessels.

Traffic: Vessel traffic related to a single NY Bight project is expected to be minimal in relation to existing vessel traffic. Increased vessel traffic in the NY Bight area during construction, operations, and decommissioning could result in an increased risk of vessel collisions with military and national security vessels, cause military and national security vessels to change routes, and could result in congestion and delays in ports. Impacts are anticipated to be minor to moderate and would be greatest during construction when vessel traffic is greatest and would be reduced during operations. Vessel traffic and navigation impacts are summarized in Section 3.6.6, *Navigation and Vessel Traffic*.

Aviation and Air Traffic

Presence of structures: One NY Bight project would install up to 280 WTGs with a total turbine height of up to 1,312 feet (400 meters) AMSL. The addition of these structures would increase navigational complexity and change aircraft navigational patterns around the NY Bight area.

WTGs and OSSs would comply with lighting and marking regulations and would be marked per FAA and USCG rules to minimize and mitigate impacts on air traffic. Due to their size, WTGs and OSSs would also be visible on aircraft radars. In addition to the long-term presence of the fixed structures, there is also the potential for temporary impacts on regulated airspace from cranes used to install and repair or replace wind turbine components within the geographic analysis area. Navigational hazards and collision risks in transit routes would be reduced as construction is completed and be gradually eliminated during decommissioning as WTGs are removed. Adverse impacts on air traffic are anticipated to be localized, long term, and minor.

Cables and Pipelines

Presence of structures: One NY Bight project would install up to 550 miles (885 kilometers) of additional interarray cables and up to 929 miles (1,495 kilometers) of additional export cables in the NY Bight project area.

Specific crossing methodologies would be developed where cable or pipeline crossings along the submarine export cable routes are necessary. Cable crossings and in-service pipeline crossings would require a physical separation, such as a concrete mattress or an exterior protection product installed on the export cable. Impacts on submarine cables and pipelines would be eliminated during decommissioning of WTGs and OSSs as the foundations and export and interarray cables are removed.

Project structures, including WTGs and OSSs, and the stationary lift vessels used during construction and installation, may pose allision risks and navigational hazards to vessels conducting maintenance activities on existing submarine telecommunication cables. However, FAA, USCG, and BOEM navigational hazard markings as well as the relative infrequency of cable maintenance activities would minimize the risk of allision. The risk of vessel collision between cable maintenance vessels and vessels associated with one NY Bight project would be limited to the construction and installation phase and during planned maintenance activities during the operational phase. Adverse impacts on cables and pipelines are anticipated to be localized, long term, and minor.

Radar Systems

Presence of structures: Air traffic control, national defense, weather, and oceanographic radar within the line of sight of the offshore infrastructure associated with a single NY Bight project may be affected by the O&M phase of the NY Bight project. Potential impacts for radar operations over and in the immediate vicinity of the NY Bight project include unwanted radar returns (i.e., clutter) resulting in a partial loss of primary target detection and several false primary targets, a loss of ocean surface current data and wave measurements in an area extending within and substantially beyond the NY Bight area, and a partial loss of weather detection including false weather indications.

Studies have been conducted to evaluate concerns that the WTGs may affect some shipborne radar systems, potentially creating false targets on the radar display or causing vessels navigating within the NY Bight area to become "hidden" on radar systems due to shadowing created by the WTGs. The effectiveness of radar systems and any effects from WTGs will vary from vessel to vessel based on several factors, including radar equipment type, settings, and installation (including location of placement on the vessel). One NY Bight project would affect radar systems primarily due to the presence of WTGs within the line of sight, causing interference with radar systems. Therefore, impacts would be moderate, localized and long term.

Construction of WTGs and OSSs could also adversely affect the operation of Weather Bouy 44025 operated by the National Data Bouy Center, which is adjacent to OCS-A 0544. The presence of structures could affect the accuracy of marine observations collected by the buoy, which in turn could affect the quality of marine forecasts in the area, resulting in moderate, localized, and long-term impacts.

Scientific Research and Surveys

Presence of structures: Scientific research and surveys, particularly NOAA surveys supporting commercial fisheries and protected species research programs, could be affected during the construction and operations of one NY Bight project; however, research activities may continue within the one NY Bight project area as permissible by survey operators. One NY Bight project would affect survey operations by excluding certain portions of the lease area occupied by offshore structures (WTGs and OSSs) from sampling, affecting the statistical design of surveys, and reducing survey efficiency. One NY Bight project could also cause habitat alteration within the geographic analysis area that could not be monitored by NOAA surveys. Additionally, NOAA's Office of Marine and Aviation Operations has determined that the NOAA Ship Fleet would not conduct survey operations within facilities with 1-nautical mile (1.9-kilometer) or less separation between turbine foundations. As analyzed in this PEIS, WTGs for one NY Bight project would have a minimum spacing of 0.6 nautical mile (1.1 kilometers) between WTGs, which would mean survey operations in the lease area would likely be curtailed.

One NY Bight project would install WTGs with a total turbine height of up to 1,312 feet (400 meters) AMSL. Aerial survey track lines for cetacean and sea turtle abundance surveys could not continue at the current altitude (600 feet [183 meters] AMSL) within the lease area because the planned maximum-case scenario for WTG turbine height would exceed the survey altitude. The increased altitude necessary for safe survey operations could result in lower chances of detecting marine mammals and sea turtles, especially smaller species. Agencies would need to expend resources to update scientific survey methodologies due to construction and operation of one NY Bight project, as well as to evaluate these changes on stock assessments and fisheries management, resulting in major impacts for scientific research and surveys.

3.6.7.4.2 Impacts of Six Projects

The same IPFs (presence of structures and traffic) as described under the impacts of one NY Bight project would apply to the impacts of six NY Bight projects. The potential for impacts from these IPFs could be higher under the development of six NY Bight projects due to the increased amount of project activity in the geographic analysis area. The impacts of the development of six NY Bight projects would likely be greater than those identified under a single NY Bight project as occurrence of conflicts with other uses' activities would be widespread and long term. The presence of structures and increased traffic of six NY Bight projects would increase interference with national security and military uses, aviation and air traffic, cables and pipelines, radar systems, marine minerals extraction, and scientific research and surveys, as multiple projects would affect larger areas within the NY Bight geographic analysis area. Installation of export cables for six NY Bight projects would increase the potential to conflict with sand resources, borrow areas, and dredge disposal sites. Impacts from the presence of structures and traffic under six NY Bight projects would range from minor to major. Should the installations of six NY Bight projects occur at the same time, the impacts would be greater as consistent interference with existing operations would be widespread and long term. Staggered installation of six NY Bight projects would reduce the impacts, as construction would result in more localized impacts. Overall, BOEM anticipates six NY Bight projects would likely contribute to greater impacts on all other uses.

3.6.7.4.3 Cumulative Impacts of Alternative B

Marine Minerals Extraction

The cumulative impacts consider the impacts of Alternative B in combination with the other ongoing and planned non-offshore-wind activities and other ongoing and planned offshore wind activities. The contribution of Alternative B to the impacts on marine minerals extraction from ongoing and planned activities, including offshore wind, would likely be moderate. BOEM anticipates that the other offshore wind projects may be designed to avoid existing and proposed marine minerals extraction areas through consultation with USACE, BOEM, and relevant state and local agencies. However, the coexistence of sand resources and multiple offshore export cables in the geographic analysis area would make this task challenging, and there is the likelihood for impacts on sand resources from placement of offshore export cables.

National Security and Military Uses

Alternative B would contribute to the combined impacts on military use from ongoing and planned activities, including offshore wind, through the construction and operation of offshore structures. While potential impacts on most military and national security uses are anticipated to be minor, installation of WTGs throughout the geographic analysis area would hinder USCG SAR operations across a larger area, resulting in moderate impacts and potentially leading to increased loss of life. Alternative B and ongoing and planned activities would contribute to localized, temporary, and minor to moderate impacts on military and national security related traffic, which are most likely to occur during the construction and decommissioning timeframes.

Aviation and Air Traffic

While open airspace in the geographic analysis area would still exist after all foreseeable planned offshore wind energy projects are built, the WTGs for Alternative B and other planned offshore wind projects would contribute to the increased navigational complexity for aviation and air traffic, resulting in minor impacts. BOEM assumes that offshore wind project operators would coordinate with aviation interests throughout the planning, construction, operations, and decommissioning processes to avoid or minimize impacts on aviation activities and air traffic.

Cables and Pipelines

The contribution of Alternative B to the impacts on cables and pipelines from ongoing and planned activities could result in some localized and long-term impacts. However, these impacts would likely be minor because they can be reduced by standard protection techniques.

Radar Systems

Alternative B would contribute to the impacts on radar systems from ongoing and planned activities, primarily due to the presence of WTGs in the line of sight causing interference with radar systems. Development of offshore wind projects could decrease the effectiveness of individual radar systems if the field of WTGs expands within the radar system's coverage area. In addition, large areas of installed WTGs could create a large geographic area of degraded radar coverage that could affect multiple radars, resulting in moderate impacts.

Scientific Research and Surveys

The cumulative impacts of Alternative B and ongoing and planned activities, including ongoing and planned offshore wind, would result in long-term, major impacts on scientific research and surveys, particularly for NOAA surveys that support commercial fisheries and protected species research programs. The entities conducting scientific research and surveys would have to make significant investments to change methodologies to account for areas occupied by offshore energy components, such as WTGs and cable routes, that are no longer able to be sampled, resulting in major impacts.

The construction, installation, operations and maintenance, and decommissioning of turbines would increase traffic and interference in the NY Bight, resulting in impacts on other uses. The cumulative impacts would likely be minor for aviation and air traffic, cables and pipelines, and national security and military use, except for USCG SAR operations, where impacts would likely be moderate. Impacts would likely be moderate for marine minerals extraction and radar systems, and major for scientific research and surveys.

3.6.7.4.4 Conclusions

Impacts of Alternative B. The construction and installation, O&M, and decommissioning of Alternative B, whether one NY Bight project or six NY Bight projects, would likely have **minor** to **major** impacts on other uses.

- Marine minerals extraction: NY Bight projects may be designed to avoid existing and proposed marine minerals extraction areas through consultation with USACE, BOEM, and relevant state and local agencies. However, the coexistence of sand resources and multiple offshore export cables in the geographic analysis area would make this task challenging, and there is the likelihood for impacts on sand resources from placement of offshore export cables. Therefore, the impacts would likely be **moderate** for one NY Bight project and six NY Bight projects.

- Military and national security uses: The installation of WTGs for one NY Bight project and six NY Bight projects would likely result in increased navigational complexity and increased allision risk, creating potential **moderate** adverse impacts on USCG SAR operations and potential **minor** impacts on all other military and national security uses.

- Aviation and air traffic: Potential **minor** impacts on low-level flights would likely occur for one NY Bight project and six NY Bight projects, primarily due to the installation of WTGs and changes in navigation patterns.

- Cables and pipelines: Potential impacts on cables and pipelines would likely be **minor** for one NY Bight project and six NY Bight projects due to the use of standard protection techniques to reduce impacts.

- Radar: Potential **moderate** adverse impacts on radar systems for one NY Bight project and six NY Bight projects would primarily be caused by the presence of WTGs in the line of sight causing interference with radar systems.

- Scientific research and surveys: Potential impacts on scientific research and surveys would likely be **major** for one NY Bight project and six NY Bight projects, particularly for NOAA surveys supporting commercial fisheries and protected-species research programs. The presence of structures would exclude certain areas occupied by offshore project components (e.g., WTG foundations, cable routes) from potential vessel and aerial sampling, and could affect survey gear performance, efficiency, and availability.

Cumulative Impacts of Alternative B. In context of other reasonably foreseeable environmental trends, the impacts contributed by six NY Bight projects to the overall impacts on other uses would be noticeable. BOEM anticipates that the cumulative impacts on other uses in the geographic analysis area would likely be **minor** to **major**. Considering all the IPFs together, BOEM anticipates that the cumulative impacts associated with Alternative B when combined with ongoing and planned activities would likely be **minor** for aviation and air traffic, cables and pipelines, and most military and national security uses; **moderate** for marine minerals extraction, radar systems and USCG SAR operations; and **major** for NOAA's scientific research and surveys. Impacts on NOAA scientific research and surveys would qualify as **major** because entities conducting surveys and scientific research would have to make significant investments to change methodologies to account for unsampleable areas. The six NY Bight projects would result in potential long-term and irreversible impacts on protected species research as well as on the commercial fisheries community. BOEM would implement and contribute to survey mitigation measures as outlined in the *Federal Survey Mitigation Implementation Strategy for the Northeast U.S. Region* (Hare et al. 2022). Six NY Bight projects would contribute to overall impact ratings through impacts on sand resources, increased navigational complexity, vessel traffic, national security and military training interruptions, and radar interference.

3.6.7.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Other Uses (Marine Minerals, Military Use, Aviation, Scientific Research and Surveys)

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight Area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives: Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from those impacts discussed in Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.6.7.5.1 Sub-alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations (Table 3.6.7-6).

Table 3.6.7-6. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for other uses (marine minerals, military use, aviation, scientific research, and surveys)

Measure ID	Measure Summary
OU-1	This measure proposes lessees coordinate with the radar operators and the Surface Currents Program of NOAA IOOS Office to assess if the project causes interference with oceanographic high-frequency radar. Options to mitigate these effects include data sharing, wind farm curtailment/curtailment agreements, and other modifications.
OU-3	This measure requires the lessee to coordinate with ARSR-4 and ASR-8/9 radar operators, including the FAA and DoD Clearinghouse, to assess if the project causes radar interference to the degree that radar performance is no longer within the specified radar system's operation parameters or fails to meet mission objectives. If interference is determined, operational mitigation measures would be applied.
OU-7	Consistent with NMFS and BOEM survey mitigation strategy actions 1.3.1, 1.3.2, 2.1.1, and 2.1.2 in the *NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy - Northeast US Region*, this measure proposes that the lessee must submit to BOEM a survey mitigation agreement between NMFS and the lessee. If the lessee and NMFS fail to reach a survey mitigation agreement, then the lessee must submit a survey mitigation plan subject to BOEM and NMFS approval.

Impacts of One Project

The implementation of AMMM measures could potentially reduce impacts on other uses compared to those under Alternative B for the presence of structures. Impacts associated with the traffic IPF would remain the same as described under Alternative B.

Presence of structures: AMMM measures OU-1 and OU-3 could decrease interference to radars from WTGs in the geographic analysis area. AMMM measure OU-1 could result in the reduction of impacts for oceanographic radar systems as data sharing (i.e., turbine orientation and rate, nacelle bearing angles, and other information about the operational state of each turbine) between turbine and radar operators would allow for the turbine information to be included in the radar signal processing system, leading to more accurate radar readings. Modifying existing oceanographic radars systems with signal processing enhancements and antennae modifications would increase the accuracy of radar readings for ocean current data gathering (Colburn et al. 2020). Wind farm curtailment agreements identified under AMMM measure OU-1 require wind farms to cease operations during emergency circumstances, which would further reduce radar interference. OU-1 would require a high-frequency data interference mitigation agreement between the NY Bight lessee and the Surface Currents Program of NOAA's IOOS Office. The lessee would be responsible for determining if a project would cause radar interference to a degree to which radar performance is no longer within the specific radar systems' operational parameters or fails to meet NOAA IOOS's objectives. The mitigation agreement would allow for NOAA IOOS to ensure that any impacts on NOAA IOOS's radar systems are adequately mitigated, thereby reducing impacts on these radar systems.

AMMM measure OU-3 includes both operational mitigation and modification of existing ARSR-4 and ASR-8/9 radars in the NY Bight area. Operational measures, such as adjusting aircraft altitude to account for WTGs near airport activities, would likely decrease the impacts on ASR-8/9 radars, as the aircraft would fly outside of the range of the WTGs to be picked up on radar. Other potential operational mitigation measures include passive aircraft tracking, sensitivity time control, range azimuth gating, velocity editing, and plot amplitude thresholding. These operational mitigation measures would clear clutter and interference from the radar system, leading to more accurate radar readings (Colburn et al. 2020). Modification of existing radars, such as utilizing dual beams of the radar and adding in-fill radars, would allow for additional information to be gathered by the radars, thus decreasing uncertainties due to information gaps created by additional radar clutter (Colburn et al. 2020). Relevant operations and modification measures will be determined at the COP NEPA stage, with BOEM and other federal and state agencies.

AMMM measures OU-1 and OU-3 would likely result in decreased impacts on radars in the NY Bight geographic analysis area, changing the anticipated level of impact from moderate to minor.

AMMM measure OU-7 may reduce some of the impacts of one NY Bight project on NOAA research and survey activities and may allow NOAA to continue to meet its mission objectives. Survey-specific mitigation agreements or plans have the potential to allow survey activities to continue in some capacity; however, individual survey mitigation plans would not be required until COP approval. While

OU-7 may reduce some impacts on scientific research and surveys, the presence of structures would continue to limit the ability of surveys to be conducted in the NY Bight lease areas and impacts would remain major.

Impacts of Six Projects

The same AMMM measures for one NY Bight project would be implemented for six NY Bight projects and would have similar reductions in impacts. AMMM measures OU-1 and OU-3 could reduce radar impacts for all six NY Bight projects as described for one NY Bight project, but the number of radar systems for which impacts would be minimized is anticipated to be greater because of the increased geographic scope of the mitigation measures (applying to six lease areas instead of just one). Similar to one NY Bight project, BOEM anticipates that implementing these mitigation measures for six NY Bight projects would decrease the anticipated level of impact on radars from moderate to minor. OU-7 would similarly result in a reduced impact on NOAA research and survey activities as described for one NY Bight project, but the area of reduced impact would be larger; the overall impact would remain major.

Cumulative Impacts of Sub-alternative C1 (Preferred Alternative)

Similar to Alternative B, under Sub-alternative C1 the same ongoing and planned activities (including offshore wind) would continue to contribute to the primary IPFs of presence of structures and traffic on other uses. The cumulative impacts on other uses under Sub-alternative C1 would decrease compared to Alternative B, with impacts on radar systems decreasing from moderate to minor with the AMMM measures. Cumulative impacts on research and surveys would remain major.

3.6.7.5.2 Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied. Under this Sub-alternative, these AMMM measures are analyzed in addition to the AMMM measures applied under Sub-alternative C1; therefore, the analysis is presented as the change in impacts from those impacts discussed under Sub-alternative C1 (Table 3.6.7-7).

Table 3.6.7-7. Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for other uses (marine minerals, military use, aviation, scientific research, and surveys)

Measure ID	Measure Summary
OU-2	BOEM would require that the lessee coordinate with NEXRAD radar operators, through the Department of Commerce's National Information Telecommunications Administration (NTIA), to assess if the project causes radar interference to the degree that radar performance is no longer within the specified radar system’s operation parameters or fails to meet mission objectives. If interference is determined, operational mitigation measures would be applied.
OU-4	Infrastructure emplaced in marine minerals resource areas must be removed from the marine mineral resource area during decommissioning. In addition, any request to decommission in place in such areas through a departure request must demonstrate no significant impacts on marine minerals resources.

Impacts of One Project

Presence of Structures: Under AMMM measure OU-2, operational mitigation for NEXRAD weather radar systems may also include windfarm curtailment agreements during emergency circumstances. The circumstances upon which windfarm curtailment agreements would occur would be agreed upon at the COP NEPA stage and may include periods of severe storms or in the event of a hazardous spill within the OCS (Colburn et al. 2020).

AMMM measure OU-4 could decrease long-term impacts on marine minerals extraction by requiring infrastructure within marine mineral resource areas to be removed during decommissioning, which would likely decrease permanent impacts by resuming access to marine minerals for uses identified in Section 3.6.7.1.1. AMMM measure OU-4 would likely lower the anticipated impact level from moderate to minor.

Impacts of Six Projects

As for one NY Bight project, AMMM measure OU-4 could decrease long-term impacts on marine minerals. However, because the mitigation measures do not ensure avoidance of sand resources and there are more infrastructure and cable corridors that could affect marine mineral extraction from six NY Bight projects as compared to one NY Bight project, impacts would remain similar to those for Alternative B. Impacts from six NY Bight projects on marine minerals under Sub-alternative C2 would remain moderate. Impacts on radar would be the same as for Sub-alternative C1.

Cumulative Impacts of Sub-alternative C2

Similar to Sub-alternative C1, under Sub-alternative C2, the same ongoing and planned activities (including offshore wind) would continue to contribute to the primary IPFs of presence of structures and traffic on other uses. The cumulative impacts on radar systems would remain minor, and the cumulative impacts on marine minerals would remain moderate with the additional AMMM measures.

3.6.7.5.3 Conclusions

Impacts of Alternative C. The construction and installation, O&M, and decommissioning for either one NY Bight project or six NY Bight projects would likely have **minor** to **major** impacts on other uses under Sub-alternative C1 and Sub-alternative C2. While impacts may be reduced with AMMM measures, most of the other uses covered in this section would have the same impact conclusion as Alternative B, except for marine mineral extraction and radar systems.

- Marine minerals extraction: Sub-alternative C1 does not include previously applied AMMM measures, and impacts would remain **moderate** for one and six NY Bight projects. The not previously applied AMMM measures under Sub-alternative C2 would reduce impacts on marine mineral extraction to **minor** for one NY Bight project, but impacts would remain **moderate** for six NY Bight projects.

- Military and national security uses: Potential impacts would likely remain **minor** for most military and national security uses and **moderate** for USCG SAR operations as no AMMM measures specific to all military and national security uses are identified under Sub-Alternative C1 and Sub-Alternative C2.

- Aviation and air traffic: Potential impacts would likely remain **minor** as no AMMM measures specific to aviation and air traffic are identified under Sub-Alternative C1 and Sub-Alternative C2.

- Cables and pipelines: Potential impacts would likely remain **minor** as no AMMM measures specific to cables and pipelines are identified under Sub-Alternative C1 and Sub-Alternative C2.

- Radar: The previously applied AMMM measures under Sub-alternative C1 and Sub-Alternative C2 would reduce impacts on radar systems from moderate to **minor** compared to Alternative B.

- Scientific research and surveys: Potential impacts would likely remain major under Sub-Alternative C1 and Sub-Alternative C2. While a previously applied AMMM measure is identified in Sub-Alternative C1, the presence of structures would continue to limit the ability of surveys to be conducted in the NY Bight lease areas.

Cumulative Impacts of Alternative C. BOEM anticipates that the cumulative impacts on other uses in the geographic analysis area would likely be **minor** to **major** under both Sub-alternative C1 and Sub-alternative C2. Cumulative impacts would likely be **minor** for radar systems, aviation and air traffic, cables and pipelines, and most military and national security uses; **moderate** for USCG SAR operations and marine mineral extraction; and **major** for NOAA's scientific research and surveys. In context of reasonably foreseeable environmental trends, the impacts contributed by six NY Bight projects under Sub-alternative C1 and Sub-alternative C2 to cumulative impacts on other uses would be noticeable. Implementation of AMMM measures that would not have been implemented under Alternative B would reduce the impact level for radar systems and marine minerals extraction.

3.6.7.6 Recommended Practices for Consideration at the Project-Specific Stage

BOEM is recommending that lessees consider analyzing the RPs in Table 3.6.7-8 to further reduce potential other uses (marine minerals, military use, aviation, scientific research and surveys) impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.6.7-8. Recommended Practices for other uses (marine minerals, military use, aviation, scientific research, and surveys) impacts and related benefits

Recommended Practice	Potential Benefit
OU-8: Avoid marine mineral resource areas from bottom-disturbing activities and respond to requests from agencies to show good faith efforts to avoid resource areas.	RP OU-8 could decrease impacts on marine mineral resources through avoidance to the maximum extent practicable, allowing for continued use of marine mineral resources.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.8 Recreation and Tourism

The reader is referred to Appendix F, *Assessment of Resources with Moderate (or Lower) Impacts*, for a discussion of current conditions and potential impacts on recreation and tourism from implementation of the No Action Alternative, the Proposed Action, and other action alternatives.

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3.6 Socioeconomic Conditions and Cultural Resources

3.6.9 Scenic and Visual Resources

This section discusses potential impacts on open ocean, seascape, and landscape character and viewers from the Proposed Action, alternatives, and ongoing and planned activities in the scenic and visual resources geographic analysis area, as advised in the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Developments on the Outer Continental Shelf of the United States* (BOEM 2021) and the *Guidelines for Landscape and Visual Impact Assessmen*t (3rd Edition) (Landscape Institute and Institute of Environmental Management and Assessment 2016). In accordance with those guidance documents, Argonne National Laboratory (Argonne) and BOEM conducted an in-depth study of the six NY Bight lease areas as presented in *Ocean, Seascape, Landscape, and Visual Impact Assessment of the New York Bight Offshore Wind Lease Areas* (Argonne 2024). The scenic and visual resources analysis in this Final PEIS largely relies on that impact assessment.

The scenic and visual resources geographic analysis area, shown on Figure 3.6.9-1 and Figure 3.6.9-2, extends 47.4 miles (76.3 kilometers) offshore and 50 miles (80.5 kilometers) onshore to capture potential views of the NY Bight projects and includes the coastlines from Atlantic City, New Jersey, to the Shinnecock Indian Nation in Long Island, New York, as well as elevated viewpoints of national significance (e.g., Empire State Building) (Argonne 2024). Appendix H, *Seascape, Landscape, and Visual Impact Assessment*, contains additional analysis of the open ocean, seascape, and landscape character areas and viewer experiences that would be affected by the NY Bight projects. Visual simulations of the NY Bight projects alone and in combination with other ongoing and planned offshore wind projects were used to inform the analysis and are available on BOEM's NY Bight website: https://www.boem.gov/renewable-energy/state-activities/new-york-bight.

In accordance with BOEM (2001) guidance, the analysis in this section contains two separate but linked parts: the open ocean, seascape, and landscape impact assessment (SLIA) and the visual impact analysis (VIA). The SLIA analyzes and evaluates the *sensitivity* of the receptor and the *magnitude of change* in consideration of impacts on both the physical elements and features that make up a landscape, seascape, or open ocean. The VIA analyzes and evaluates the impacts on people from adding the proposed development to views from selected viewpoints.

The impacts on open ocean, seascape, and landscape character and viewers are assessed based on two WTG heights corresponding to the maximum and minimum heights in the RPDE: 1,312 feet (400 meters) and 853 feet (260 meters). By evaluating both heights, this analysis discloses the maximum and minimum impacts that may occur as a result of development in the NY Bight.

The cumulative impact analysis in this section assesses how other ongoing and planned offshore wind projects in the geographic analysis area may combine with the NY Bight projects to produce cumulative visual effects. The area of potential cumulative effects was determined by overlaying the NY Bight geographic analysis area with the visibility buffers of planned offshore wind projects along the New York to New Jersey coast. The visibility buffers constitute the maximum theoretical distance a WTG could be visible and were developed using earth curvature-calculated distances based on WTG heights of each project. Figure 3.6.9-1 shows the buffer for each ongoing and planned lease area and the geographic analysis area, and Figure 3.6.9-2 shows the buffer for each lease area clipped to the geographic analysis area of the six NY Bight projects. In this way, Figure 3.6.9-2 demonstrates what could theoretically be seen from various points within the NY Bight projects geographic analysis area.

The scenic and visual resources impact analysis in this PEIS is intended to be incorporated by reference into the project-specific environmental analyses for individual COPs expected for each of the NY Bight lease areas. Refer to Appendix C, *Tiering Guidance*, which identifies additional analyses anticipated to be required for the project-specific environmental analysis of individual COPs.

3.6.9.1 Description of the Affected Environment and Future Baseline Conditions

This section summarizes the open ocean, seascape, landscape, and viewer baseline conditions as described in Argonne (2024). The demarcation line between seascape and open ocean is the U.S. state jurisdictional boundary, 3 nautical miles (3.45 statute miles) (5.5 kilometers) seaward from the coastline (U.S. Congress Submerged Lands Act, 1953). This line coincides with the area of sea visible from the shoreline. The line defining the separation of seascape and landscape is based on the juxtaposition of apparent seacoast and landward landscape elements, including topography, water (bays and estuaries), vegetation, and structures.

3.6.9.1.1 SLIA Affected Environment

The geographic analysis area is classified by specific open ocean, seascape, and landscape character. These characters are based on major features and elements in the characteristic landscape that define the physical character, “feel,” and “experiential qualities” of the geographic analysis area and include open ocean, shoreline, coast, marsh, bay, and inland areas. Open ocean, seascape, and landscape character is further broken down into character types, which include two types specific to seascape character (bayside and oceanside), and into character areas, which is the most discrete level of character and includes 28 distinctive areas. Open ocean, seascape, and landscape character areas provide a framework to analyze potential visual effects throughout the geographic analysis area. The open ocean, seascape, and landscape characters and types used in this analysis are shown in Figure 3.6.9-3. Detailed maps of character areas are included in Appendix H.

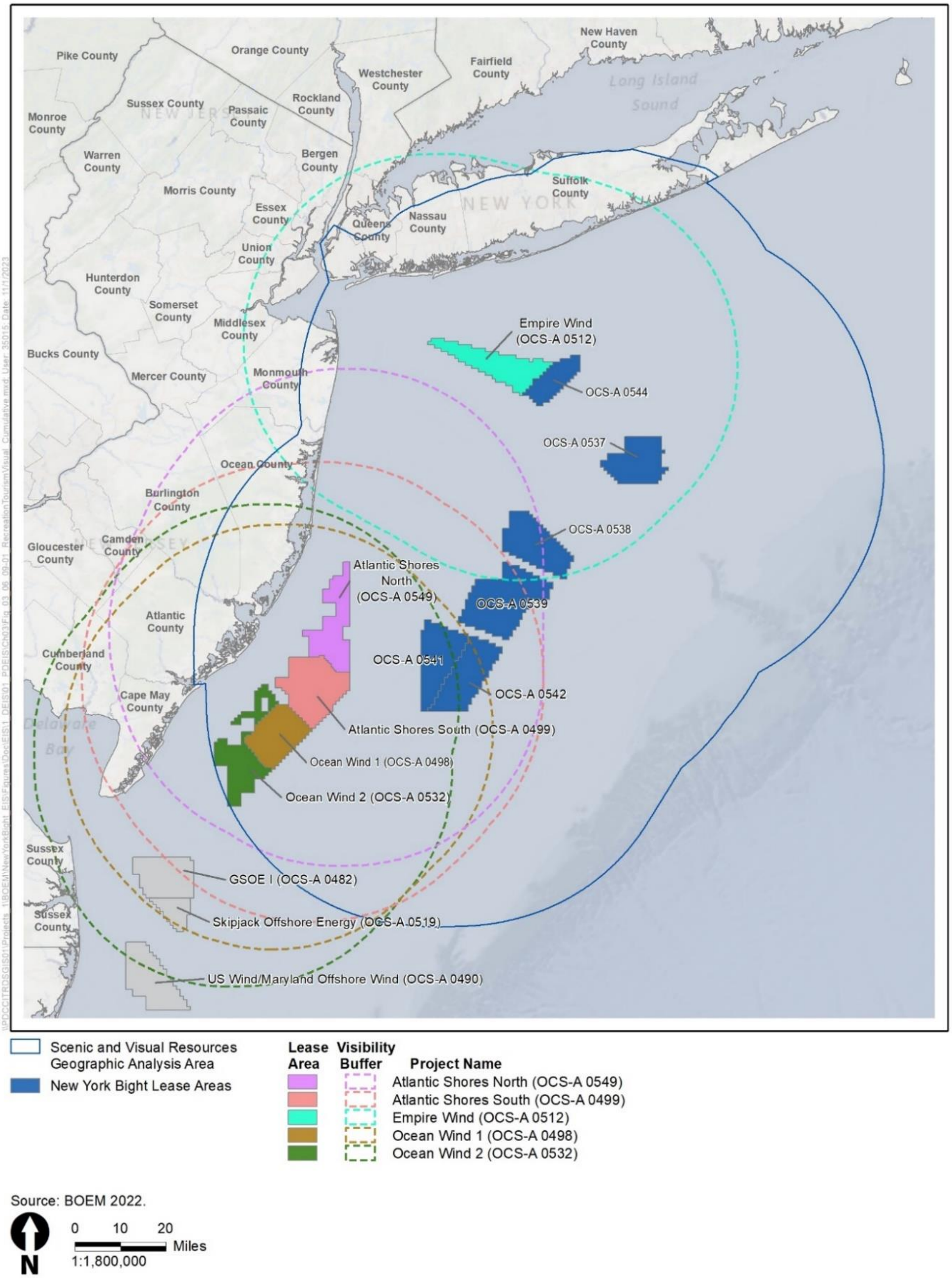


Figure 3.6.9-1. Scenic and visual resources geographic analysis area and lease visibility buffers

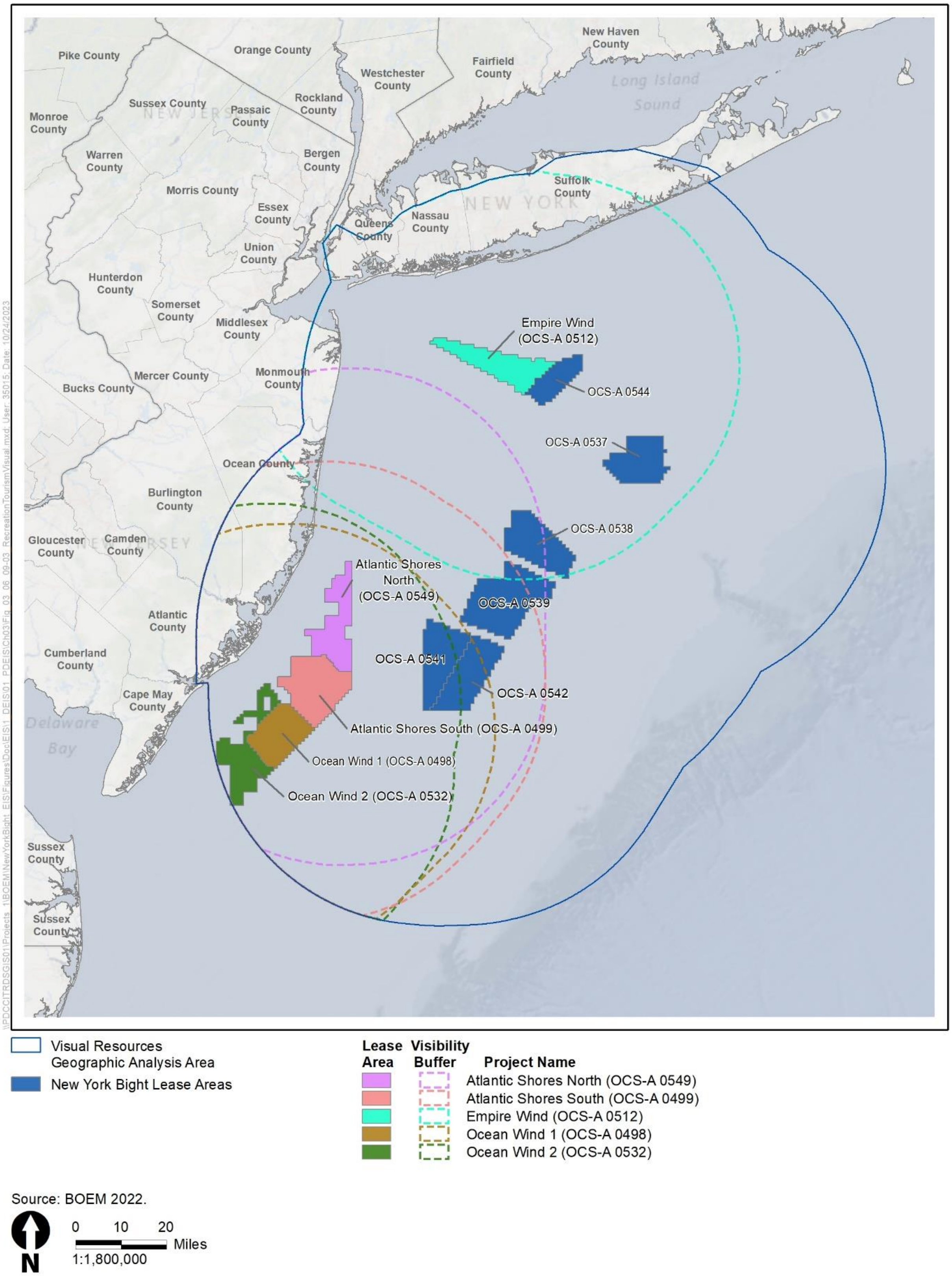


Figure 3.6.9-2. Scenic and visual resources geographic analysis area and cumulative impacts analysis area

Figure 3.6.9-3 provides an overview of seascape and landscape in the geographic analysis area, including the key observation point (KOP) locations. Figure 3.6.9-4 shows the extent of visibility of the NY Bight project's WTGs. More detailed maps of the character areas, KOPs, and other scenic resources are contained in Appendix H and Argonne (2024). The geographic analysis area's landforms, water, vegetation, and built environment structures contain common and distinctive landscape features as outlined in Table 3.6.9-1.

Table 3.6.9-1. Landform, water, vegetation, and structures

Category	Landscape Features
Landform	Flat shorelines to gently sloping beaches, dunes, islands, and inland topography.
Water	Ocean, bay, estuary, tidal river, river and stream water patterns.
Vegetation	Tidal salt marshes and estuarine biomes, beach grass, meadows, and maritime forests. Vegetation community indicator species: choke berry (*Prunus maritime*), sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*Vaccinium corymbosum*), poison ivy (*Toxicodendron radicans*), sour gum (*Nyssa sylvatica*), swamp magnolia (*Magnolia virginiana*), red cedar (*Juniperus virginiana*), red maple (*Acer rubrum*), and pine-oak woodlands.
Structures	Buildings, plazas, signage, walks, parking, roads, trails, seawalls, jetties, and infrastructure.

The visual characteristics of the open ocean, seascape, and landscape conditions in the geographic analysis area contain both locally common and regionally distinctive physical features, characters, and experiential views (Table 3.6.9-2). The onshore infrastructure locations of the NY Bight projects are currently unknown and therefore will need to be analyzed in the COP-specific NEPA analysis. It is anticipated there will be multiple cable landfall locations, new or expanded onshore substations and converter stations, and new or expanded onshore powerline corridors as part of the NY Bight projects.

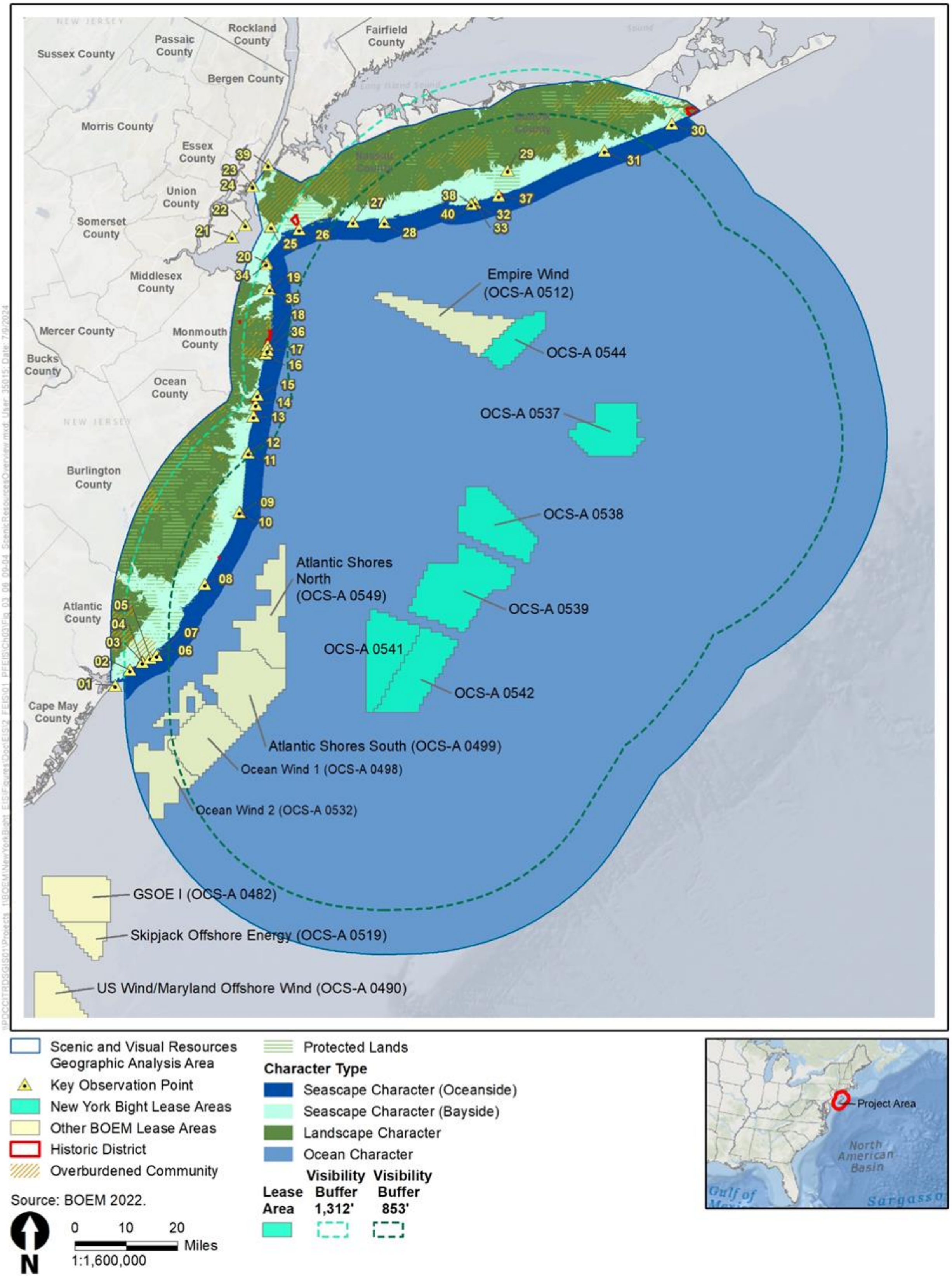


Figure 3.6.9-3. Scenic resources overview map

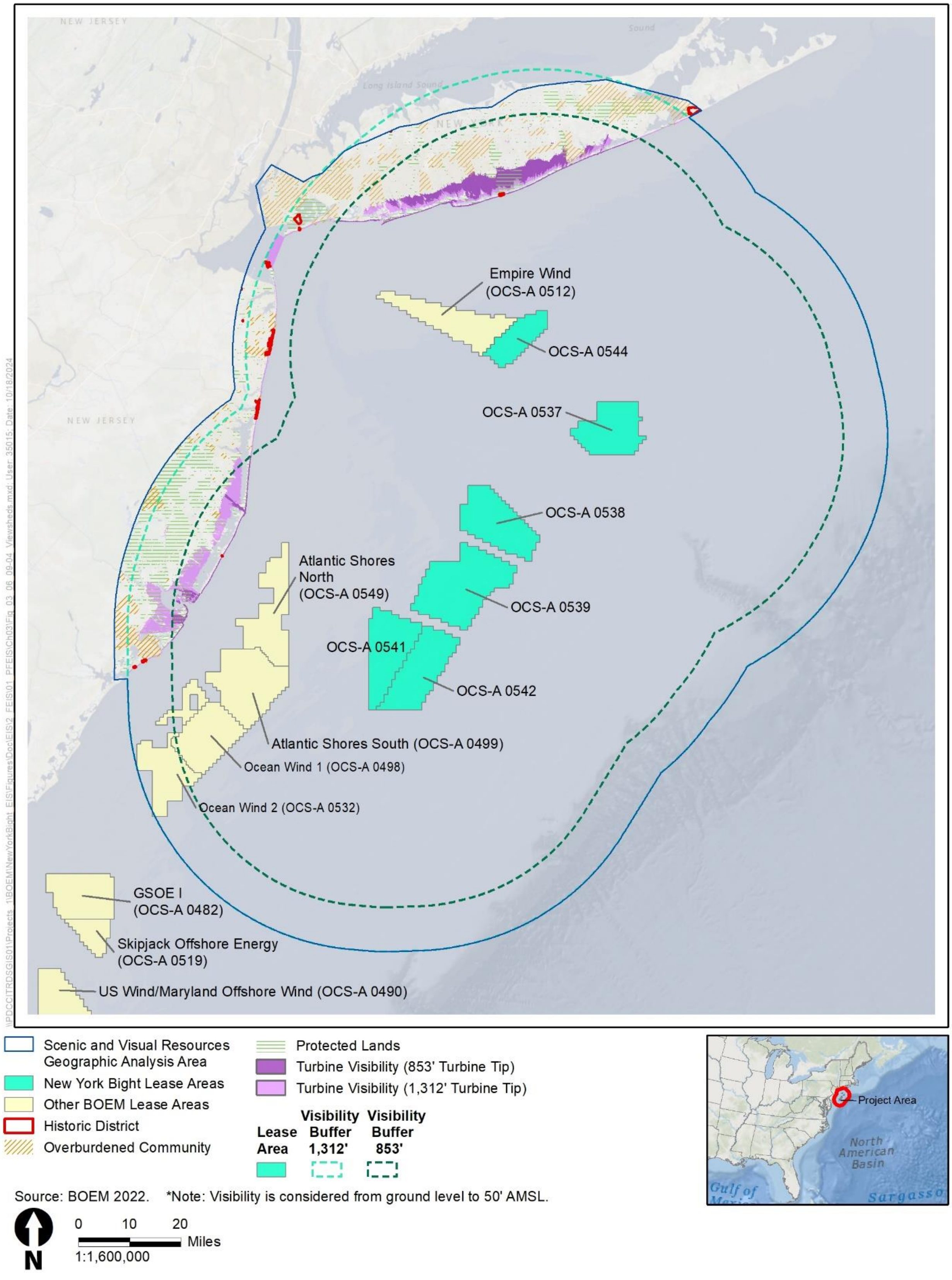


Figure 3.6.9-4. Offshore facility viewsheds of six NY Bight projects

Table 3.6.9-2. Open ocean, seascape, and landscape conditions

Category	Seascape, Open Ocean, and Landscape
Seascape	Inter-visibility within coastal and adjacent marine areas within the geographic analysis area by pedestrians and boaters.
Seascape Features	Physical features range from built elements, landscape, dunes, and beaches to flat water and ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Seascape Character	Experiential characteristics stem and range from built and natural landscape forms, lines, colors, and textures to the foreground water's tranquil, mirrored, and flat; active, rolling, and angular; vibrant, churning, and precipitous. Forms range from horizontal planar to vertical structures', landscapes', and water's slopes; lines range from continuous to fragmented and angular; colors of structures, landscape, and the water's foam, and spray reflect the changing colors of the daytime and nighttime, built environment, land cover, sky, clouds, fog, and haze; and textures range from mirrored smooth to disjointed coarse.
Open Ocean	Inter-visibility from seagoing vessels within the open ocean within the 47.4-mile (76.3-kilometer) offshore geographic analysis area, including recreational cruising and fishing boats, commercial "cruise ship" routes, commercial fishing activities, tankers and cargo vessels; and air traffic over and near the WTG array and cable routes.
Open Ocean Features	Physical features range from flat water to ripples, waves, swells, surf, foam, chop, whitecaps, and breakers.
Open Ocean Character	Experiential characteristics range from tranquil, mirrored, and flat; to active, rolling, and angular; to vibrant, churning, and precipitous. Forms range from horizontal planar to vertical slopes; lines range from continuous and horizontal to fragmented and angular; colors of water, foam, and spray reflect the changing colors of sky, clouds, fog, haze, and the daytime and nighttime textures range from mirrored smooth to disjointed coarse.
Landscape	Inter-visibility within the adjacent inland areas, seascape, and open ocean; nighttime views diminished by ambient light levels of shorefront development; open, modulated, and closed views of water, landscape, and built environment; and pedestrian, bike, and vehicular traffic throughout the region within the onshore geographic analysis area.
Landscape Features	Natural elements: landward areas of barrier islands, bays, marshlands, shorelines, vegetation, tidal rivers, flat topography, and natural areas. Built elements: boardwalks, bridges, buildings, gardens, jetties, landscapes, life-saving stations, umbrellas, lighthouses, parks, piers, roads, seawalls, skylines, trails, single-family residences, commercial corridors, village centers, mid-rise motels, and moderate to high-density residences.
Landscape Character	Tranquil and pristine natural, to vibrant and ordered, to chaotic and disordered.
Designated National, State, and Local Parks, Preserves, and Parkways	Alfred E. Smith/Sunken Meadow State Park; Allaire State Park; Angelo Valenzano Park; Arboretum Park; Argyle Lake Park; Arthur Mackey Park; Atlantic City Boulevard; Atlantic Highlands Harbor Park; Ave J Park; Babylon Northport Expressway; Baldwin Harbor Park; Barnegat Branch Trail; Barnegat Lighthouse State Park; Bass River State Forest; Bay Parkway; Bayport Commons Park; Bayshore Park; Beaver Dam Park; Belleplain State Forest; Belmont Lake State Park; Belt Parkway; Bethpage State Park; Birchwood Park; Breezy Point Beach Club[1]; Breezy Point Tip[1]; Caleb Smith Park Preserve; Calverton Pine Barrens State Forest; Cantiague County Park; Captree State Park; Cedar Drive Preserve; Cedarhurst Park; Cheesequake State Park; Clark Memorial Garden; Connetquot River State Park Preserve; Corson's Inlet State Park; Crook Horn Creek; Cow Meadow Park & Preserve; Cupsoque Beach County Park; David A. Dahrouge Park; Edwin B. Forsythe National Wildlife Refuge; Elberon Park: Emil Palmer Park; Empire State Building; Enos Pond County Park; Fire Island Lighthouse; Fire Island National Seashore; Flatbush Avenue; Floyd Bennet Field[1]; Forest Park; Forked River State Marina; Forked River Mountain WMA; Fort Tilden[1]; Fort Wadsworth[1]; Fresh Creek Park;

Category	Seascape, Open Ocean, and Landscape
	Garden State Parkway; Gateway National Recreation Area; Gerritsen Avenue Park; Gilgo State Park; Gillian's Wonderland Pier; Great Kills Park; Gleason Drive Park; Great Egg Harbor Bay; Green Belt Park; Green-Wood Cemetery; Indian Hill Park; Harding Bird Sanctuary; Hartshorne Woods Park; Heckscher State Park; Hempstead Lake State Park; Henry Hudson Trail; Hewlett Point Park; Highland Park; Holmdel Park; Holtsville Park; Huber Woods County Park; I-195; Indian Island County Park; Island Beach State Park; Islip County Preserve; Jacob Riis State Park; James A. Caples Memorial Park; Joe Palaia Park; John J. Randall Park; Jones Beach State Park; Leonardo State Marina; Leon B. Smock Jr. Park; Lido Boulevard; Longwood State Forest; Loop Parkway; Lt. Johns Neck Tidal Wetlands Area; Joseph Petrosino Park; Manasquan River WMA; Manson Park; Marina Park; Meadowbrook Park; Meadowbrook State Parkway; Merrick Road Park; Miller Field[1]; Monmouth Battlefield State Park; Montauk Highway; Mount Mitchell Scenic Overlook; Nassau Expressway; Nassau Shores Bayfront Park; National Natural Landmark Manahawkin Bottomland Hardwood Forest; Nehemiah Park; Norman J Levy Park and Preserve; North Beach[1]; Ocean Breeze Park; Ocean City Boardwalk; Ocean City Park; Oceanside Park; Ocean State Parkway; Otis Pike Fire Island High Dune Wilderness; Otis Pike Preserve; Overlook Park; Parker Sickles Park; Peck Bay; Piping Rock Park; Planting Fields Arboretum State Historic Park; Point O'Woods; Quogue Historic District; Quogue Village Park; Raynor Park; Robert Morse State Park; Robert Morse State Parkway; Rocky Point Pine Barrens Preserve; Roosevelt South Preserve; Ruth Wales Dupont Sanctuary; Sandy Hook[1]; Sandy Hook Light[1]; Shark River Park; Shorefront Park; Smith Point County Park; Shinnecock East County Park; Shinnecock West County Park; Shirley Chisholm State Park[1]; Shore Road Park; Silver Gull Beach Club[1]; Skinner Park; Smith Point County Park; Southern Pinelands Natural Heritage Trail; Southern Stainton Wildlife Refuge; State Parkway; Statue of Liberty National Monument; Stone Harbor Bird Sanctuary; Sunken Forest; Sunrise Highway; Tanner Park; Terrell River County Park; The Common Ground at Rotary Park; Tuckahoe WMA; Upper Barnegat Bay WMA; Vale Park; Van Court Park; Verrazzano-Narrows Bridge; Vincent Klune Park; Wanamassa Firemen's Memorial Field; Wantagh State Parkway; Wantagh Park; Weltz Park; Wertheim National Wildlife Refuge; West Hills Park; Wharton State Forest; William Floyd Estate; and Wolf Hill Park.

[1] Location within the Gateway National Recreation Area, a unit of the National Park System
WMA – Wildlife Management Area

The geographic analysis area's seascape character areas, open ocean character area, and landscape character areas are based on major features and elements in the characteristic landscape that define the physical character, "feel," and "experiential qualities" of the geographic analysis area and include open ocean, shoreline, coast, marsh and bay, and inland areas. Open ocean, seascape, and landscape character areas provide specific spatial locations and description of the existing area and provide a framework to systematically analyze potential visual effects throughout the geographic analysis area (Argonne 2024). The extents of seascape character areas, open ocean character area, and landscape character areas for all six NY Bight projects used in this analysis are summarized in Table 3.6.9-3 and Table 3.6.9-4 for both WTG heights. Table H-13 and Table H-14 in Appendix H show the extents of open ocean character area, seascape character areas, and landscape character areas for each individual NY Bight lease area for the 1,312-foot and 853-foot WTGs respectively.

Table 3.6.9-3. Area of ocean, seascape, and landscape areas in the zone of potential visual influence for 1,312-foot wind turbines for all six NY Bight projects

Ocean, Seascape, and Landscape Character Areas	Area within Geographic Analysis Area		Area of in the Zone of Potential Visual Influence		
	Square Miles	Square Kilometers	Square Miles	Square Kilometers	Percent of Area Affected
Ocean					
Open Ocean	15,569.90	40,325.86	15,569.90	40,325.86	100.00%
Seascape					
Bayside					
Bayside Commercial Park	0.44	1.15	0.00	0.00	0.32%
Bayside Industrial	5.74	14.87	0.05	0.12	0.82%
Bayside Industrial Resource	0.42	1.09	0.12	0.30	27.31%
Bayside Military Site	0.58	1.49	0.04	0.10	6.91%
Bayside Natural Upland	13.81	35.76	0.44	1.14	3.19%
Bayside Natural Wetland	154.00	398.85	65.99	170.92	42.85%
Bayside Recreation	13.98	36.22	0.92	2.39	6.61%
Bayside Residential	71.73	185.78	1.85	4.79	2.58%
Bayside Urban	12.06	31.22	0.12	0.32	1.01%
Bayside Waterbodies	419.31	1,086.01	184.22	477.12	43.93%
Oceanside					
Nearshore Ocean	636.12	1,647.54	635.91	1,646.99	99.97%
Oceanside Beach	12.87	33.32	7.81	20.22	60.68%
Oceanside Recreation	6.97	18.05	3.27	8.46	46.86%
Oceanside Residential/Commercial	20.12	52.10	6.19	16.04	30.79%
Oceanside Urban	4.94	12.80	1.48	3.84	30.00%
Seascape Residential	9.04	23.42	0.05	0.12	0.51%
Seascape Urban	1.39	3.61	0.00	0.00	0.06%
Landscape					
Inland Agriculture	21.27	55.09	0.01	0.04	0.07%
Inland Commercial Park	38.16	8.84	0.04	0.11	0.11%
Inland Industrial	30.08	77.92	0.24	0.63	0.81%
Inland Industrial Resource	18.55	48.04	0.28	0.71	1.49%
Inland Military Site	20.39	52.82	0.24	0.63	1.20%
Inland Natural Area	455.94	1,180.89	0.47	1.22	0.10%
Inland Recreation	29.30	75.88	0.08	0.21	0.28%
Inland Rural	25.60	66.30	0.11	0.29	0.44%
Inland Suburban/Exurban Residential	691.95	1,792.14	0.60	1.54	0.09%
Inland Urban	157.39	407.65	0.203	0.525	0.13%

Table 3.6.9-4. Area of ocean, seascape, and landscape areas in the zone of potential visual influence for 853-foot wind turbines for all six NY Bight projects

Ocean, Seascape, and Landscape Character Areas	Area within Geographic Analysis Area		Area of in the Zone of Potential Visual Influence		
	Square Miles	Square Kilometers	Square Miles	Square Kilometers	Percent of Area Affected
Ocean					
Open Ocean	15,569.90	40,325.86	12,962.88	33,573.71	83.26%
Seascape					
Bayside					
Bayside Commercial Park	0.44	1.15	0.00	0.00	0.15%
Bayside Industrial	5.74	14.87	0.04	0.11	0.74%
Bayside Industrial Resource	0.42	1.09	0.11	0.27	25.12%
Bayside Military Site	0.58	1.49	0.00	0.01	0.74%
Bayside Natural Upland	13.81	35.76	0.19	0.48	1.36%
Bayside Natural Wetland	154.00	398.85	12.95	33.55	8.41%
Bayside Recreation	13.98	36.22	0.66	1.71	4.72%
Bayside Residential	71.73	185.78	0.99	2.58	1.39%
Bayside Urban	12.06	31.22	0.06	0.15	0.49%
Bayside Waterbodies	419.31	1,086.01	87.47	226.55	20.86%
Oceanside					
Nearshore Ocean	636.12	1,647.54	388.34	1,005.80	61.05%
Oceanside Beach	12.87	33.32	6.06	15.70	47.11%
Oceanside Recreation	6.97	18.05	2.66	6.88	38.12%
Oceanside Residential/Commercial	20.12	52.10	3.90	10.09	19.36%
Oceanside Urban	4.94	12.80	0.98	2.54	19.81%
Seascape Residential	9.04	23.42	0.03	0.07	0.28%
Seascape Urban	1.39	3.61	0.00	0.00	0.05%
Landscape					
Inland Agriculture	21.27	55.09	0.00	0.00	0.01%
Inland Commercial Park	38.16	98.84	0.02	0.05	0.05%
Inland Industrial	30.08	77.92	0.05	0.12	0.16%
Inland Industrial Resource	18.55	48.04	0.21	0.55	1.15%
Inland Military Site	20.39	52.82	0.00	0.01	0.02%
Inland Natural Area	455.94	1,180.89	0.09	0.23	0.02%
Inland Recreation	29.30	75.88	0.02	0.06	0.08%
Inland Rural	25.60	66.30	0.04	0.09	0.14%
Inland Suburban/Exurban Residential	691.95	1,792.14	0.31	0.80	0.04%
Inland Urban	157.39	407.65	0.14	0.36	0.09%

Scenic resource susceptibility, value, and sensitivity analyses document the region’s scenic views, nature, culture, and history. The NY Bight projects’ affected character area extents are calculated through geographic information system (GIS) visibility studies and calculate the projects’ affected resources’ extents, verified and augmented by expert onsite analysis (Argonne 2024).

Susceptibility is informed by the overall character of a particular seascape or landscape area, or by an individual element or feature, or by a particular aesthetic, experiential, and perceptual aspect that contributes to the character of the area. Open ocean, seascape, and landscape susceptibility rating criteria are listed in Table 3.6.9-5.

Table 3.6.9-5. Susceptibility definitions for rating criteria of open ocean, seascape, and landscape

Region	High	Medium	Low
Open ocean is defined by the susceptibility to impacts from an NY Bight project.	Highly vulnerable to the type of change proposed.	Reasonably resilient to the type of change proposed.	Unlikely to be affected by the type of change proposed.
Seascape character is defined by the susceptibility to impacts from an NY Bight project.	Highly vulnerable to the type of change proposed.	Reasonably resilient to the type of change proposed.	Unlikely to be affected by the type of change proposed.
Landscape character is defined by the vulnerability to impacts from an NY Bight project.	Highly vulnerable to the type of change proposed.	Reasonably resilient to the type of change proposed.	Unlikely to be affected by the type of change proposed.

Value stems from the distinctive nature of a seascape or landscape and where scenic quality, wildness or tranquility, and natural or cultural heritage features contribute to the seascape or landscape. The relative value can be based on special designations (i.e., national parks or monuments, state parks, and local protections). It also considers other key characteristics and qualities of social values such as tourism, local meanings, and cultural and historic values. When examining the perceptual, experiential, and aesthetic qualities of the potentially affected ocean, seascapes, and landscapes, special consideration is given to key components that contribute to distinctive character. Open ocean, seascape, and landscape value rating criteria are listed in Table 3.6.9-6.

Table 3.6.9-6. Value definitions for rating criteria of open ocean, seascape, and landscape

Region	High	Medium	Low
Open ocean is defined by its visual resources' scenic and social value.	Highly distinctive and highly valued by residents and visitors.	Moderately distinctive and moderately valued by residents and visitors.	Common and unimportant to residents and visitors, or with minimal scenic value.
Seascape character is defined by its visual resources' scenic and social value.	Highly distinctive and highly valued by residents and visitors.	Moderately distinctive and moderately valued by residents and visitors.	Common and unimportant to residents and visitors, or with minimal scenic value.
Landscape character is defined by the visual resources' scenic and social value.	Distinctive and highly valued by residents and visitors, or within a designated scenic or historic landscape.	Moderately distinctive or within a landscape of locally valued scenic quality.	Common and unimportant to residents and visitors, or within a landscape of minimal scenic value.

Sensitivity results from consideration of both susceptibility and value. A higher rating prevails over a lower rating. Sensitivity rating criteria is listed in the following Table 3.6.9-7.

Table 3.6.9-7. Sensitivity definitions for rating criteria of open ocean, seascape, and landscape

Region	High	Medium	Low
Open ocean is defined by both the susceptibility to impacts from an offshore wind project and its visual resources' scenic and social value.	Pristine, highly distinctive, and highly valued by residents and visitors.	Moderately distinctive and moderately valued by residents and visitors.	Common or with minimal scenic value.
Seascape character is defined by both the susceptibility to impacts from an offshore wind project and its visual resources' scenic and social value.	Distinctive and highly valued by residents and visitors.	Moderately distinctive and moderately valued by residents and visitors.	Common and unimportant to residents and visitors.
Landscape character is defined by both the vulnerability to impacts from an offshore wind project, and the visual resources' scenic and social value.	Highly distinctive, highly valued by residents and visitors, or within a designated scenic or historic landscape.	Moderately distinctive and moderately valued by residents and visitors.	Common or within a landscape of minimal scenic value.

Cultural and historic resources are considered in the SLIA affected environment analysis, because these resources may contribute in important ways to seascape and landscape character. Section 3.6.2, *Cultural Resources*, describes the cultural contexts and associated resources that may occur in the affected environment. Cultural and historic properties and landscapes may occur within the seascape and landscape character types and contribute to the region's historical landscape character (see Section 3.6.2, *Cultural Resources*).

Night skies and natural darkness are also components of seascape and landscape character. The numeric Bortle scale measures the night sky's brightness/darkness. Class 1 represents the darkest skies available on Earth, whereas Class 9 is an urban brilliantly lit sky. Dark sky areas along the coast of New England are uncommon because of the dense urban development and associated light domes. However, Fire Island is recognized as being good star-gazing location by the National Park Service, with a Class 4 Bortle rating for "bright suburban" allowing the central galaxy to appear visible only at the zenith and light pollution up to 35°, according to the U.S. Light Pollution Map (lightpollutionmap.info 2024). Although Fire Island has decent stargazing as compared to Long Island and New York City, residents need to travel 100 miles to the Catskills to experience Class 3 rating and nearly 200 miles to the Adirondacks to experience Class 2 average dark sky. Morristown National Historical Park is the nearest location where the National Park Service is collecting data on night skies brightness, and Cape Cod National Seashore is the nearest collection point with high-quality night sky viewing (National Park Service 2023). Although the probability is low, if aircraft warning lighting on WTGs is visible from any Wilderness Areas or Wilderness Study Areas, this could result in impacts on the night sky and, therefore, the wilderness character.

The sensitivity of the geographic analysis area's open ocean, seascape, and landscape character is defined by both the susceptibility to impact from the NY Bight projects and its visual resources' scenic and social value. Each character area is defined and described based on the context in which the character area is distributed throughout the geographic analysis area as well as their typical defining features and activities observed (see Appendix H and Argonne 2024). Sensitivity (in terms of value and susceptibility) of each character area is included in the SLIA Affected Environment for context; however, sensitivity is part of the impacts analysis on Character Areas. Based on the existing natural, undeveloped, highly valued open ocean character, and the type of change proposed by the NY Bight projects, the open ocean is rated high sensitivity. The NY Bight lease areas would be an unavoidably dominant, strongly pervasive to clearly visible feature in the view from open water and would change its highly valued character (Appendix H).

Table 3.6.9-8 lists the susceptibility, value, and sensitivity ratings for the open ocean, seascape, and landscape character. A summary of character descriptions and analysis can be found in Appendix H, and detailed descriptions and photographs can be found in Argonne (2024).

Table 3.6.9-8. Open ocean, seascape, and landscape sensitivity

Open Ocean, Seascape, and Landscape Character Area	Susceptibility	Value	Sensitivity
Ocean			
Open Ocean	High	High	**High**
Seascape – Bayside Seascape			
Bayside Commercial Park	Low	Low	**Low**
Bayside Industrial	Low	Low	**Low**
Bayside Industrial Resource	Low	Low	**Low**
Bayside Military Site	Low	Medium	**Low**
Bayside Natural Upland	High	High	**High**
Bayside Natural Wetland	High	High	**High**
Bayside Recreation	High	High	**High**
Bayside Residential	High	High	**High**
Bayside Urban	Low	High	**Medium**
Bayside Waterbodies	High	High	**High**
Seascape Residential	High	High	**High**
Seascape Urban	Low	High	**Medium**
Seascape – Oceanside Seascape			
Nearshore Ocean	High	High	**High**
Oceanside Beach	High	High	**High**
Oceanside Recreation	High	High	**High**
Oceanside Residential/Commercial	High	High	**High**
Oceanside Urban	Medium	High	**High**
Landscape			
Inland Agriculture	Medium	High	**High**
Inland Commercial Park	Low	Low	**Low**
Inland Industrial	Low	Low	**Low**
Inland Industrial Resource	Medium	Low	**Low**
Inland Military Site	Medium	Medium	**Medium**
Inland Natural Area	High	High	**High**
Inland Recreation	High	High	**High**
Inland Rural	High	Medium	**High**
Inland Suburban/Exurban Residential	High	Medium	**High**
Inland Urban	Low	Medium	**Low**

3.6.9.1.2 VIA Affected Environment

The VIA affected environment describes the physical environment in which the project is sited, the visual properties of the project area, and its scenic quality. This is described below through jurisdictions with ocean views, context of the KOPs, and the sensitivity of view receptors. Table 3.6.9-9 lists the jurisdictions with ocean beach views and ocean views from an inland landscape, bay, estuary, marsh, pond, or river.

Table 3.6.9-9. Jurisdictions with ocean views

Ocean View	Jurisdiction
Ocean view from a seascape	Atlantic Beach, Allenhurst Borough, Ashbury Park, Avon-by-the-Sea Borough, Babylon, Bay Head Borough, Belmar Borough, Bradley Beach Borough, Brick Township, Brookhaven, Deal Borough, Hempstead, Islip, Interlaken Borough, Lavallette Borough, Loch Arbour Village, Long Beach, Long Branch Borough, Manasquan Borough, Mantoloking Borough, Middletown Township, Monmouth Beach Borough, Neptune Township, New York, Ocean Beach, Oyster Bay, Point Pleasant Beach Borough, Quogue, Sea Bright Borough, Sea Girt Borough, Spring Lake Borough, Seaside Heights Borough, Spring Lake Borough, Seaside Park Borough, Saltaire, Southampton, Tomes River Township, West Hampton Dunes, and Westhampton Beach Borough.
Ocean view from a landscape bay, estuary, or inland	Amityville, Atlantic Highlands Borough, Bellport, Brightwaters, Brielle Borough, Highlands Borough, Ocean Township, Old Westbury, Farmingdale, Freeport, Huntington, Islandia, Lawrence, Lindenhurst, Massapequa Park, Muttontown, North Hempstead, North Hills, Patchogue, Riverhead, Roslyn Estates, Rumson Borough, Shinnecock Nation; Smithtown, Tinton Falls Borough, Wall Township, and Woodsburgh.

Typical views in the geographic analysis area are represented by the photographs shown in Figure 3.6.9-5 and Figure 3.6.9-6. Each photograph occupies 27° vertical by 39.6° horizontal extents of view, typical of a single-lens reflex camera lens with a 50-millimeter focal length.

Figure 3.6.9-5. Long Beach, New Jersey

Figure 3.6.9-6. Atlantique Beach, New York

KOPs are locations from where proposed project components may be seen by individuals or groups of people that could be potentially affected by changes in views and visual amenity. Based on higher viewer sensitivity, viewer exposure, and context photography, 40 designated KOPs (Table 3.6.9-10) provide the locational basis for detailed analyses of the geographic analysis area's open ocean, seascape, landscape, and viewer experiences, as shown on Figure 3.6.9-3 (Argonne 2024). Visual simulations were prepared for 17 of the KOPs (simulations are available on BOEM's NY Bight website: https://www.boem.gov/renewable-energy/state-activities/new-york-bight). For the KOPs without simulations, BOEM used a simulated KOP with similar distance, horizontal view, and viewer elevation as a reference for the analysis combined with GIS predicted visibility (see Appendix H, Table H-35). Refer to Appendix H, Section H.3.2.2 for additional information on the methodology for determining magnitude. Two open ocean KOPs are representative and not place-based, to capture viewer experiences from recreational fishing, pleasure, and tour boats and shipping and cruise ship lanes. These are KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area and KOP-B Representative Commercial and Cruise Ship Shipping Lanes.

Table 3.6.9-10. Representative offshore analysis area view receptor contexts and key observation points

Context	Key Observation Points [1]
Vantage Point	KOP-02 Lucy the Elephant KOP-04 John Stafford Hall-Beach Entrance KOP-05 Jim Whelan Hall-Balcony KOP-07 Atlantic City Boardwalk-Top of Ocean Casino [2] KOP-10 Barnegat Lighthouse KOP-11 US Life Saving Station #14 KOP-19 Navesink Twin Lights [2] KOP-29 Rudolph Oyster House [2] KOP-32 Fire Island Lighthouse-Upper Deck KOP-33 Fire Island Lighthouse-Bottom [2] KOP-35 Twin Lights Lighthouse KOP-36 Asbury Park Hall-Top KOP-39 Empire State Building
Linear Receptor	KOP-03 John Stafford Hall-Boardwalk [2] KOP-06 Atlantic City Boardwalk-Ocean Casino Boardwalk View KOP-B Representative Commercial and Cruise Ship Shipping Lanes
Scenic Area	KOP-02 Lucy the Elephant KOP-03 John Stafford Hall-Boardwalk [2] KOP-04 John Stafford Hall-Beach Entrance KOP-05 Jim Whelan Hall-Balcony KOP-06 Atlantic City Boardwalk-Ocean Casino Boardwalk View [2] KOP-07 Atlantic City Boardwalk-Top of Ocean Casino [2] KOP-08A/B Beach Haven - daytime and nighttime KOP-09 Barnegat Jetty [2] KOP-10 Barnegat Lighthouse KOP-11 US Life Saving Station #14 [2] KOP-12 Seaside Park Beach [2] KOP-13 Mantoloking KOP-14 Bayhead [2]

Context	Key Observation Points [1]
	KOP-15 Point Pleasant [2] KOP-16 Ocean Grove [2] KOP-17 Asbury Park Beach [2] KOP-18 Allenhurst Residential Historic District KOP-19 Navesink Twin Lights [2] KOP-26 Fort Tilden KOP-27 Magnolia Beach [2] KOP-28 Jones Beach KOP-29 Rudolph Oyster House [2] KOP-30 Shinnecock Inlet KOP-31 Westhampton Beach KOP-32 Fire Island Lighthouse-Upper Deck KOP-33 Fire Island Lighthouse-Bottom [2] KOP-35 Twin Lights Lighthouse KOP-36 Asbury Park Hall-Top KOP-37 Point O' Woods KOP-38 Robert Moses Field 5 [2] KOP-39 Empire State Building KOP-40 Robert Moses Field 5 - nighttime KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area KOP-B Representative Commercial and Cruise Ship Shipping Lanes

[1] Eight additional KOPs were identified but with analysis were found to be outside of the affected viewshed and have been removed from the impact analysis. These were: KOP-01 Ocean City Music Hall, KOP-20 Sandy Hook Beach, KOP-21 Great Kills, KOP-22 Roosevelt Pier, KOP-23 Statue of Liberty – Upper Deck, KOP-24 Statue of Liberty – Base, KOP-25 Coney Island Boardwalk, and KOP-34 Sandy Hook Observatory.
[2] Reference simulation used for analysis.

The range of sensitivity of view receptors and people viewing the NY Bight projects is determined by their engagement and view expectations. Table 3.6.9-11 lists the sensitivity issues identified for the open ocean, seascape, landscape, and visual impact assessment and the indicators and criteria used to assess impacts for the Final PEIS.

Table 3.6.9-11. View receptor sensitivity ranking criteria

Sensitivity	Sensitivity Criteria
High	Residents with views of the NY Bight projects from their homes; people with a strong cultural, historic, religious, or spiritual connection to landscape or seascape views; people engaged in outdoor recreation whose attention or interest is focused on the open ocean, seascape, and landscape, and on particular views; visitors to historic or culturally important sites, where views of the surroundings are an important contributor to the experience; visitors to National Park System sites, where visitors expect a visual and sensory experience emphasizing a unique nature experience, protected views, dark night skies, and in some locations a wilderness experience; people who regard the visual environment as an important asset to their community, churches, schools, cemeteries, public buildings, and parks; and people traveling on scenic highways and roads, or walking on beaches and trails, specifically for enjoyment of views. Dark sky environment is documented as high quality on the Bortle scale (Bortle 1-2).

Sensitivity	Sensitivity Criteria
Medium	People engaged in outdoor recreation whose attention or interest is unlikely to be focused on the landscape and on particular views because of the type of activity but where views and the aesthetic environment create a more desirable and enjoyable experience; people at their places of livelihood, commerce, and personal needs (inside or outside) whose attention is generally focused on that engagement, not on scenery, but where the seascape and landscape setting adds value to the quality of their activity; and, generally, those commuters and other travelers traversing routes that are not dominated by scenic developments, but the overall visual setting adds value to the experience. Dark sky environment is documented as moderate quality on the Bortle scale (Bortle 3-4).
Low	People engaged in outdoor activities whose attention or interest is not focused on the landscape or on particular views because of the type of activity. The setting is inconsequential and adds little or no value to the viewer experience.

The sensitivity of KOP viewers is determined with reference to view location and activity: (1) review of relevant designations and the level of policy importance that they signify (such as landscapes designated at national, state, or local levels); and (2) application of criteria that indicate value (such as scenic quality, rarity, recreational value, representativeness, conservation interests, perceptual aspects, and artistic associations). Judgments regarding seascape, landscape, and KOP sensitivity are informed by the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States* (BOEM 2021). Table 3.6.9-12 lists KOP viewer sensitivity ratings.

Table 3.6.9-12. Key observation point viewer sensitivity ratings

Rating	Key Observation Points[1]
High	KOP-02 Lucy the Elephant KOP-03 John Stafford Hall-Boardwalk [2] KOP-04 John Stafford Hall-Beach Entrance KOP-05 Jim Whelan Hall-Balcony KOP-06 Atlantic City Boardwalk-Ocean Casino Boardwalk View [2] KOP-07 Atlantic City Boardwalk-Top of Ocean Casino [2] KOP-08A/B Beach Haven - daytime and nighttime KOP-09 Barnegat Jetty [2] KOP-10 Barnegat Lighthouse KOP-11 US Life Saving Station #14 [2] KOP-12 Seaside Park Beach [2] KOP-13 Mantoloking KOP-14 Bayhead [2] KOP-15 Point Pleasant [2] KOP-16 Ocean Grove [2] KOP-17 Asbury Park Beach [2] KOP-18 Allenhurst Residential Historic District KOP-19 Navesink Twin Lights [2] KOP-26 Fort Tilden KOP-27 Magnolia Beach [2] KOP-28 Jones Beach KOP-29 Rudolph Oyster House [2] KOP-30 Shinnecock Inlet KOP-31 Westhampton Beach

Rating	Key Observation Points[1]
	KOP-32 Fire Island Lighthouse-Upper Deck KOP-33 Fire Island Lighthouse-Bottom [2] KOP-35 Twin Lights Lighthouse KOP-36 Asbury Park Hall-Top KOP-37 Point O' Woods KOP-38 Robert Moses Field 5 [2] KOP-39 Empire State Building KOP-40 Robert Moses Field 5 - nighttime KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area KOP-B Representative Commercial and Cruise Ship Shipping Lanes
Medium	None
Low	None

[1] Eight additional KOPs were identified but with analysis were found to be outside of the affected viewshed and have been removed from the impact analysis. These are: KOP-01 Ocean City Music Hall, KOP-20 Sandy Hook Beach, KOP-21 Great Kills, KOP-22 Roosevelt Pier, KOP-23 Statue of Liberty – Upper Deck, KOP-24 Statue of Liberty – Base, KOP-25 Coney Island Boardwalk, and KOP-34 Sandy Hook Observatory.
[2] Reference simulation used for analysis.

While not designated as representative KOPs, daytime and nighttime scenic aerial tour viewers arriving and departing Atlantic City International Airport, JFK International Airport, LaGuardia International Airport, Newark Liberty International Airport, Republic Airport, and Ocean City Municipal Airport, and enroute airport flights traversing the coast, range from foreground to background viewing situations. Aircraft viewers are more frequently affected by view-limiting atmospheric conditions than are land and ocean receptors.

The nearest proposed WTG offshore of New Jersey is located in Lease Area OCS-A 0541, at 26.7 nautical miles (30.7 miles [49.4 kilometers]) from Long Beach. The nearest proposed WTG offshore of New York is located in Lease Area OCS-A 0544, at 20.2 nautical miles (23.6 miles [38.0 kilometers]) from Atlantique Beach.

Views from nearer the shoreline are more limited by atmospheric conditions than views from interior areas. Larger numbers of viewers, particularly recreational users, are more likely to be present on beaches on sunny days, when viewing conditions are better than on rainy, hazy, or foggy days. However, atmospheric conditions due to different temperatures in air, ground, and sea temperatures can create an offshore haze that limits visibility during the summer months. Conversely, late fall and winter months can have exceptional visibility, but the number of viewers is greatly reduced. The affected environment and visual impact assessments of the NY Bight projects are based on clear-day and clear-night visibility to evaluate the most impactful scenario and not necessarily the largest number of viewers. Several of the visual simulations of the NY Bight projects (simulations are available here: https://www.boem.gov/renewable-energy/state-activities/new-york-bight) depict both maximum visibility and predicted visibility based on the atmospheric conditions the day the photograph was taken. Elevated walks afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from beaches may be diminished by ambient light levels and glare of developments.

Ocean receptors include the people on recreational and fishing boats, pleasure craft, tour boats, and commercial fishing boats with visibility of NY Bight project WTGs out to 47.4 miles (76.3 kilometers), and cruise ships with elevated 63-foot (19.2-meter) visibility out to 54.1 miles (87.1 kilometers).

Environmental Justice in minority populations and low-income populations is considered in the VIA affected environment. Communities with environmental justice concerns within the states of New York and New Jersey are present within the geographic analysis area. In both states, these neighborhoods are clustered around larger cities and towns and, within the viewshed, are found mostly along the coastline. Section 3.6.4, *Environmental Justice*, describes the affected environment and impacts of the NY Bight projects on these communities. The Argonne SLVIA has detailed tables and figures illustrating low income, minority, and low income and minority combined neighborhoods for both the geographic analysis area and the viewshed for both WTG heights (Argonne 2024).

3.6.9.2 Impact Level Definitions for Scenic Resources and Viewer Experience

Definitions of adverse impact levels are provided in Table 3.6.9-13. There are no beneficial impacts on scenic and visual resources.

Table 3.6.9-13. Adverse impact level definitions for scenic and visual resources

Impact Level	Definition for Seascape, Landscape, Ocean Impact Assessment (SLIA)	Definition for Visual Impact Assessment (VIA)
Negligible	Very little or no effect on seascape/landscape area character, features, elements, or key qualities either because unit lacks distinctive character, features, elements, or key qualities; values for these are low; or project visibility would be minimal.	Very little or no effect on viewers' visual experience because view value is low, viewers are relatively insensitive to view changes, or project visibility would be minimal.
Minor	NY Bight projects would introduce features that may have low to medium levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The NY Bight projects' features may introduce a visual character that is slightly inconsistent with the character of the unit, which may have minor to medium negative effects on the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value.	The visibility of the NY Bight projects would introduce a small but noticeable to medium level of change to the view's character; have a low to medium level of visual prominence that attracts but may or may not hold the viewer's attention; and have a small to medium effect on the viewer's experience. The viewer receptor sensitivity/susceptibility/value is low. If the value, susceptibility, and viewer concern for change is medium or high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified. For instance, a KOP with a low magnitude of change, but that has a high level of viewer concern (combination of susceptibility/value), may justify adjusting to a moderate level of impact.
Moderate	The NY Bight projects would introduce features that would have medium to large levels of visual	The visibility of the NY Bight projects would introduce a moderate to large level of change to the view's character; may have a moderate to

Impact Level	Definition for Seascape, Landscape, Ocean Impact Assessment (SLIA)	Definition for Visual Impact Assessment (VIA)
	prominence within the geographic area of an ocean/seascape/ landscape character unit. The NY Bight projects would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect on the unit's features, elements, or the key qualities. In areas affected by large magnitudes of change, the unit's features, elements, or key qualities have low susceptibility or value.	large level of visual prominence that attracts and holds, but may or may not dominate the viewer's attention; and has a moderate effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/value is medium to low. Moderate impacts are typically associated with medium viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has medium levels of change, or low viewer receptor sensitivity (combination of susceptibility/value) in areas where the view's character has large changes to the character. If the value, susceptibility, and viewer concern for change is high, then evaluate the nature of the sensitivity to determine if elevating the impact to the next level is justified.
Major	The NY Bight projects would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/ landscape character unit. The NY Bight projects would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect on the unit's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the character unit is high.	The visibility of the NY Bight projects would introduce a major level of character change to the view; will attract, hold, and dominate the viewer's attention; and have a moderate to major effect on the viewer's visual experience. The viewer receptor sensitivity/susceptibility/ value is medium to high. If the magnitude of change to the view's character is medium, but the susceptibility or value at the KOP is high, then evaluate the nature of the sensitivity to determine if elevating the impact to major is justified. If the sensitivity (combination of susceptibility/value) at the KOP is low in an area where the magnitude of change is large, then evaluate the nature of the sensitivity to determine if lowering the impact to moderate is justified.

Accidental releases, land disturbance, lighting, presence of structures, and vessel traffic are contributing IPFs to impacts on scenic and visual resources. However, these IPFs may not necessarily contribute to each individual issue outlined in Table 3.6.9-14.

Table 3.6.9-14. Issues and indicators to assess impacts on scenic and visual resources

Issue	Impact Indicator
Change in scenic quality of the ocean, seascape, and landscape character.	Visual contrast and dominance of NY Bight project component structures and activities onshore and offshore visible in the viewshed.
Impacts on the physical elements and features that make up an ocean, seascape, or landscape and the aesthetic, perceptual, and experiential aspects of the ocean, seascape, or landscape that contribute to its distinctive character.	Public sensitivity for the settings and tolerance for change: susceptibility to impact, and perceived social value.

Issue	Impact Indicator
Impacts on the "feel," "character," or "sense of place" of an area of ocean, seascape or landscape.	
Changes to the view from adding wind energy project components into the viewshed as seen from a particular key viewing location and how the change affects people who are likely to be at the viewpoint.	Magnitude of change: the combination of visual contrast, size and scale of the change to existing conditions caused by the project, the geographic extent of the area subject to the project's effects, and the effects' duration and reversibility.
Changes to the view from adding wind energy project lighting into the viewshed.	Sensitivity to luminance and illuminance from NY Bight project component lighting sources onshore and offshore visible in the viewshed related to frequency, color, timing, brightness, etc.

3.6.9.3 Impacts of Alternative A – No Action – Scenic and Visual Resources

When analyzing the impacts of the No Action Alternative on scenic and visual resources, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities on the baseline conditions for scenic and visual resources. 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 D, *Planned Activities Scenario*.

3.6.9.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for open ocean, seascape, landscape, and viewers described in Section 3.6.9.1, *Description of the Affected Environment and Future Baseline Conditions,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing activities. Ongoing activities that contribute to impacts on scenic and visual resources in the geographic analysis area primarily involve onshore development and construction activities and offshore vessel traffic. These activities have the potential to contribute to new structures, traffic congestion, and nighttime light impacts. Ongoing offshore wind activities within the geographic analysis area that contribute to impacts on scenic and visual resources include ongoing construction of Ocean Wind 1 (OCS-A 0498) and Empire Wind 1 and 2 (OCS-A 0512). Ongoing construction of Ocean Wind 1 and Empire Wind 1 and 2 would have the same type of impacts on scenic and visual resources that are described in Section 3.6.9.3.2, *Cumulative Impacts of the No Action Alternative*, for all ongoing and planned offshore wind activities in the geographic analysis area.

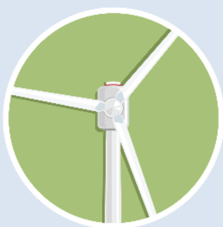
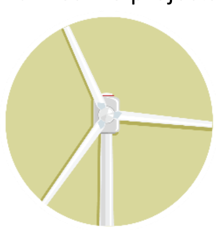
3.6.9.3.2 Cumulative Impacts of the No Action Alternative

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 six NY Bight projects). Planned non-offshore-wind activities in the geographic analysis area that contribute to impacts on open ocean, seascape, landscape, and viewers include activities related to development of undersea transmission lines, gas pipelines, and submarine cables; dredging and port improvements; marine minerals extraction; military use; marine transportation; and onshore development activities (see Appendix D for a description of activities in the geographic analysis area). Planned activities have the potential to affect seascape character, open ocean character, landscape character, and viewer experience through the introduction of structures, light, land disturbance, traffic, air emissions, and accidental releases to the landscape or seascape.

Table H-51 to Table H-54 in Appendix H consider effects on open ocean, seascape, landscape, and viewers of offshore wind development without the NY Bight projects and in combination with the NY Bight projects.

The discussion that follows summarizes the potential impacts of ongoing and planned offshore wind activities on scenic and visual resources during construction and installation, O&M, and conceptual decommissioning of the projects. Ongoing and planned offshore wind projects in the geographic analysis area that would contribute to cumulative impacts on scenic and visual resources are listed in Table 3.6.9-15. These projects are estimated to collectively install 697 WTGs in the geographic analysis area between 2023 and 2030 (Appendix D, Table D2-1).

Table 3.6.9-15. Ongoing and planned offshore wind projects in the geographic analysis area for scenic and visual resources

Ongoing/Planned	Projects by Region
Ongoing – 3 projects[1] 	**NY/NJ** • Ocean Wind 1 (OCS-A 0498) • Empire Wind 1 (OCS-A 0512) • Empire Wind 2 (OCS-A 0512)
Planned – 3 projects[2] 	**NY/NJ** • Ocean Wind 2 (OCS-A 0532) • Atlantic Shores North (OCS-A 0549) • Atlantic Shores South (OCS-A 0499)

NJ = New Jersey; NY = New York
[1] Refer to footnotes 9 and 10 in PEIS Chapter 1 for additional information on the status of Ocean Wind 1, Empire Wind 1, and Empire Wind 2.
[2] Status as of September 20, 2024.

BOEM expects ongoing and planned offshore wind activities to affect scenic and visual resources through the following primary IPFs.

Accidental releases: Accidental releases during construction and installation, O&M, and conceptual decommissioning of offshore wind projects could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean area, and landscapes. The potential for accidental releases would be greatest during construction and installation and conceptual decommissioning of offshore wind projects and would be lower but continuous during O&M. Accidental releases would cause short-term negligible to minor impacts. As described in Section 2.3, *Non-Routine Activities and Events*, accidental releases of chemicals, gases, or man-made debris may occur as a result of a structural failure and could result in impacts on scenic and visual resources.

Land disturbance: Offshore wind development would require installation of onshore export cables, onshore substations or converter stations, and transmission infrastructure to connect to the electric grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and installation and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of project infrastructure for ongoing and planned offshore wind energy projects; however, BOEM anticipates these projects would generally have localized, short-term, negligible to minor impacts on scenic and visual resources during construction and installation, O&M, or conceptual decommissioning due to land disturbance.

Lighting: Construction-related nighttime vessel lighting would be used if offshore wind development projects include nighttime, dusk, or early morning construction or material transport. In a maximum-case scenario, lights could be active throughout nighttime hours for up to 697 WTGs within the geographic analysis area. Depending on the distance between the viewer and an ongoing or planned project, minor to major impacts at night may occur during construction because of artificial nighttime lighting required to illuminate the construction zone for safe construction activity. The impact of vessel lighting on scenic and visual resources during construction and installation would be localized and short term. Visual impacts of nighttime lighting on vessels would continue during O&M of ongoing and planned offshore wind facilities, and the impact on seascape character, open ocean character, nighttime viewer experience, and valued scenery from vessel lighting would be intermittent and long term.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines in the geographic analysis area and would have major impacts on scenic and visual resources. During construction, FAA warning lighting systems would be affixed to the wind turbines as they rise over 200 feet above sea level to provide for safe nighttime aviation. Once affixed, the aviation warning lights would remain in the on position throughout the construction period and for the duration of O&M. FAA warning lighting systems would be in use for the duration of O&M. The cumulative effect of these WTGs and associated synchronized flashing strobe lights affixed with a minimum of three red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle in 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 warning lighting from sensitive viewing locations. The location of the WTGs at the horizon and their associated red colored aviation warning lighting will generally not be in the direction of stargazing and will not create a skyglow effect like those created by urban area lighting.

The implementation of ADLS would activate the warning 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 open ocean, seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night compared to the standard continuous, medium-intensity red strobe FAA warning system due to the reduced duration of activation. For example, the Atlantic Shores South (OCS-A 0499) ADLS-controlled obstruction lights would be activated for 9 hours over a 1-year period, 1 percent of the normal operating time that would occur without ADLS. However, ADLS cannot be initiated until construction is completed and the ADLS is installed, tested, and approved for operation. Although the probability is low, if aircraft warning lighting on WTGs is visible from any Wilderness Areas or Wilderness Study Areas, this could potentially impact the night sky and therefore, the wilderness character.

Presence of structures: The placement of 697 WTGs from ongoing and planned offshore wind projects in the geographic analysis area would contribute to adverse impacts on scenic and visual resources. In the geographic analysis area, lease areas of ongoing and planned projects would have the potential to be seen within the same viewshed as the NY Bight projects from ground-level coastal KOPs and elevated viewpoints. The total number of WTGs that would be visible from any single KOP would be less than the 697 WTGs that would be constructed in the geographic analysis area. For example, a total of 548 WTGs from ongoing and planned offshore wind projects would be theoretically visible from KOP-8 Beach Haven and a total of 216 WTGs would be theoretically visible from KOP-36 Ashbury Park Hall - Top.

The presence of structures associated with offshore wind development would affect open ocean character, seascape character, and landscape character. The seascape character and open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character by approximately 2030 and would result in major impacts.

Traffic (vessel): The Port of New York and New Jersey handled an annual ship traffic volume of 14,981 vessels in 2020, approximately 41 vessels per day (Statista 2024). The vessels included dry bulk barges and carriers, container ships, and freight ships. Other offshore wind project construction and installation, conceptual decommissioning, and, to a lesser extent, O&M would generate increased vessel traffic that could contribute to adverse moderate to major impacts on scenic and visual resources in the geographic analysis area. The impacts would occur primarily during construction and installation along routes between ports and the offshore wind construction areas. Assuming vessel traffic of other projects is similar to that of a single NY Bight project, each project would generate up to 51 vessels operating in a lease area or over the offshore export cable route at any given time during the construction and installation phase (Section 3.6.6, *Navigation and Vessel Traffic)*. This would more than double existing ship traffic during construction, although each project maybe using a different port and construction timing may not overlap. Stationary and moving construction vessels would change the daytime and nighttime seascape and open ocean character from open ocean to active waterway.

Onshore and offshore visual impacts would continue from visible vessel activity related to O&M of offshore wind facilities. Each offshore wind project in the geographic analysis area would generate approximately eight vessel trips per day (Section 3.6.6), a 20 percent increase, assuming vessel traffic of other projects is similar to one NY Bight project. During O&M of ongoing and planned offshore wind projects, vessel traffic would result in long-term, intermittent contrasts to seascape and open ocean character and in the viewer experience of valued scenery. Vessel activity would increase again during conceptual decommissioning at the end of the assumed operating period of each project, with impacts similar to those described for construction and installation.

3.6.9.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, current regional trends and activities would continue, and scenic and visual resources would continue to be affected by natural and human-caused IPFs. Ongoing offshore wind and non-offshore-wind activities would have continuing short- and long-term impacts on open ocean, seascape, and landscape character areas and viewer experience, primarily through the daytime and nighttime presence of structures, lighting, and vessel traffic. The character of the coastal landscape would change in the short term and long term through natural processes and ongoing activities that would continue to shape onshore features, character, and viewer experience. Ongoing activities in the geographic analysis area that contribute to visual impacts include construction activities and vessel traffic, which lead to increased nighttime lighting, visible congestion, and the introduction of new structures. The No Action Alternative would result in **negligible** to **major** impacts on scenic and visual resources from ongoing activities.

Cumulative Impacts of the No Action Alternative. Planned activities in the geographic analysis area other than offshore wind include new cable emplacement and maintenance, dredging and port improvements, marine minerals extraction, military use, marine transportation, and onshore development activities. Construction of WTGs associated with planned offshore wind would change the surrounding marine environment from undeveloped ocean to a wind farm environment. The seascape character and open ocean character would reach the maximum level of change to their features and characters from a formerly undeveloped ocean to one with a visually dominant wind farm character by approximately 2030. The No Action Alternative combined with all other planned activities (including offshore wind activities) would result in **negligible** to **major** impacts on scenic and visual resources within the geographic analysis area due to the addition of new structures, nighttime lighting, offshore construction, and increased vessel traffic.

3.6.9.4 Impacts of Alternative B – No Identification of AMMM Measures at the Programmatic Stage – Scenic and Visual Resources

Alternative B considers the potential impacts of future offshore wind development for the NY Bight area without the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. This section addresses the impacts associated with construction and installation, O&M, and conceptual decommissioning of the NY Bight projects on seascape character, open ocean character, landscape character, and viewer experience in the geographic analysis area. The impact level is judged with reference to the sensitivity of the view receptor and the magnitude of change, which considers the noticeable WTG/OSS features; distance and field of view (FOV) effects; view framing and intervening foregrounds; the form, line, color, and texture contrasts; scale of change; and prominence in the characteristic open ocean, seascape, and landscape.

The degree of adverse effects is determined through application of the following criteria for both the SLIA and the VIA.

- The NY Bight project's magnitude of impact measured from characteristics, contrasts, scale of change, prominence, and spatial interactions with the special qualities and extents of the baseline open ocean, SLIA.
- The sensitivities and magnitude of change of the ocean, SLIA.
- Intervisibility between viewer locations and the NY Bight project's features (VIA).
- The sensitivities of viewers (VIA).

Viewers or visual receptors in the NY Bight project's zone of theoretical visibility include the following.

- Residents living in coastal communities or individual residences.
- Tourists visiting, staying in, or traveling through the area.
- Recreational users of the seascape, including those using ocean beaches and tidal areas.
- Recreational users of the open ocean, including those involved in yachting, fishing, boating, and passage on ships and ferries.
- Recreational users of the landscape, including those using landward beaches, golf courses, ballfields, playgrounds, cycle routes, and footpaths.
- Tourists, workers, visitors, or local people using transport routes.
- People working in the countryside, commerce, or dwellings.
- People working in the marine environment, such as those on fishing vessels and in crews of ships.

Visual simulations of the NY Bight projects alone and in combination with other ongoing and planned offshore wind projects used to inform this analysis are available on BOEM's NY Bight website: https://www.boem.gov/renewable-energy/state-activities/new-york-bight.

3.6.9.4.1 Impacts of One Project

In this section, each of the NY Bight lease areas is evaluated based on its individual impact. Based on the RPDE, up to 280 WTGs and 5 OSSs could be installed within one NY Bight project lease area, with resulting impacts on scenic and visual resources. Onshore to offshore view distances to the lease areas range from 23.6 miles (38.0 kilometers) to 47.4 miles (76.3 kilometers). Table 3.6.9-16 provides a summary of the magnitude of visibility for each lease area based on the nearest beach or shoreline view from New Jersey and New York. The table provides a range for onshore to offshore view distances and horizontal and vertical FOV. The horizontal FOV is based on the percentage the project would occupy of the typical human's 124° horizontal FOV. The percent vertical FOV is based on the typical human's 55°

vertical FOV as measured from eye level at 5.9 feet (1.8 meters) above HAT. This vertical measure also indicates the perceived proportional size and relative height of a wind farm.

Some distances are constant for each lease area. The 1,312-foot (400-meter) WTG's rotor blade tips will be visible out to 47.4 miles (76.3 kilometers) at 5.9 feet (1.8 meters) eye level above the HAT. The 853-foot (260-meter) WTG's rotor blade tips will be visible out to 38.7 miles (62.3 kilometers) from 5.9 feet (1.8 meters) above the HAT.

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Table 3.6.9-16. Magnitude of view summary for all NY Bight lease areas to nearest onshore viewpoint for 1,312-foot and 853-foot WTGs

Lease Area and Nearest Viewpoint by State	Lease Area to Nearest Viewpoint in Miles (Kilometers)	1,312-foot WTG Visibility				853-foot WTG Visibility			
		Rotor Blade Tip Visibility in Miles (Kilometers)	Visibility Range in Miles (Kilometers)	Horizontal FOV Range Near to Far in Miles (Kilometers) (% of 124)	Vertical FOV Range Near to Far (% of 55)	Rotor Blade Tip Visibility in Miles (Kilometers)	Visibility Range in Miles (Kilometers)	Horizontal FOV Range Near to Far (% of 124)	Vertical FOV Range Near to Far (% of 55)
OCS-A 0537									
NJ – Bay Head Beach	61.3 (98.7)	47.4 (76.3)	Not visible	Not visible	Not visible	38.7 (62.3)	Not visible	Not visible	Not visible
NY – Cherry Grove Beach	44.4 (71.5)	47.4 (76.3)	44.4 (71.5) – 47.4 (76.3)	14.7 (23.6) wide 17° (14%) – 15° (12%)	0.3° (0.5%) – 0.2° (0.3%)	38.7 (62.3)	Not visible	Not visible	Not visible
OCS-A 0538									
NJ – Barnegat Beach and Barnegat Lighthouse	42.0 (67.6)	47.4 (76.3)	42.0 (67.6) – 47.4 (76.3)	14.1 (21.2) wide 17° (14%) – 15° (12%)	0.2° (0.3 %) – 0.2° (0.3%)	Barnegat Lighthouse 42.6 (68.6)	42.0 (67.6) – 42.6 (68.6)	14.1 (21.2) wide 16° (13%) – 15° (12%)	0.2° (0.3%) – 0.2° (0.3%)
NY – Robert Moses Beach	54.8 (88.2)	47.4 (76.3)	Not visible	Not visible	Not visible	38.7 (62.3)	Not visible	Not visible	Not visible
OCS-A 0539									
NJ – High Point Beach	37.1 (59.7)	47.4 (76.3)	37.1 (59.7) – 47.4 (76.3)	16.5 (26.6) wide 21° (17%) – 15° (12%)	0.4° (0.7%) – 0.2° (0.3%)	38.7 (62.3)	37.1 (59.7) – 38.7 (59.7)	16.5 (26.6) wide 24° (19%) – 23° (18.5%)	0.25° (0.45%) – 0.2° (0.3%)
NY – Tobay Beach	65.4 (105.3)	47.4 (76.3)	Not visible	Not visible	Not visible	38.7 (62.3)	Not visible	Not visible	Not visible
OCS-A 0541									
NJ – Long Beach	30.7 (49.4)	47.4 (76.3)	30.7 (49.4) – 47.4 (76.3)	20 (32.2) wide 26.6° (21 %) – 22° (40%)	0.5° (0.9 %) – 0.3° (0.5 %)	38.7 (62.3)	30.7 (49.4) – 38.7 (62.3)	15.5 (24.9) wide 26.8° (21.6%) – 28° (22.5%)	0.3 (0.5%) – 0.2 (0.3%)
NY – Jones Beach	75.1 (120.9)	47.4 (76.3)	Not visible	Not visible	Not visible	38.7 (62.3)	Not visible	Not visible	Not visible
OCS-A 0542									
NJ – North Beach	40.6 (65.3)	47.4 (76.3)	40.6 (65.3) – 47.4 (76.3)	18.7 (30.1) wide 25° (20%) – 15° (12%)	0.4° (0.7%) – 0.2° (0.3%)	38.7 (62.3)	Not visible	Not visible	Not visible
NY – Jones Beach	80.3 (129.3)	47.4 (76.3)	Not visible	Not visible	Not visible	38.7 (62.3)	Not visible	Not visible	Not visible
OCS-A 0544									
NJ – Elberton Beach	41.2 (66.3)	47.4 (76.3)	41.2 (66.3) – 47.4 (76.3)	9.7 (15.6) wide 13° (10.5%) – 12° (10%)	0.35° (0.6%) – 0.3° (0.5%)	38.7 (62.3)	Not visible	Not visible	Not visible
NY – Atlantique Beach	23.6 (38.0)	47.4 (76.3)	23.6 (38.0) – 47.4 (76.3)	15.1 (24.3) wide 32° (26%) – 18° (14%)	0.6° (1%) – 0.2° (0.3%)	38.7 (62.3)	23.6 (38.0) – 38.7 (62.3)	15.1 (24.3) wide 32° (26%) – 21° (17%)	0.4° (0.7%) – 0.2° (0.3%)

NJ = New Jersey; NY = New York

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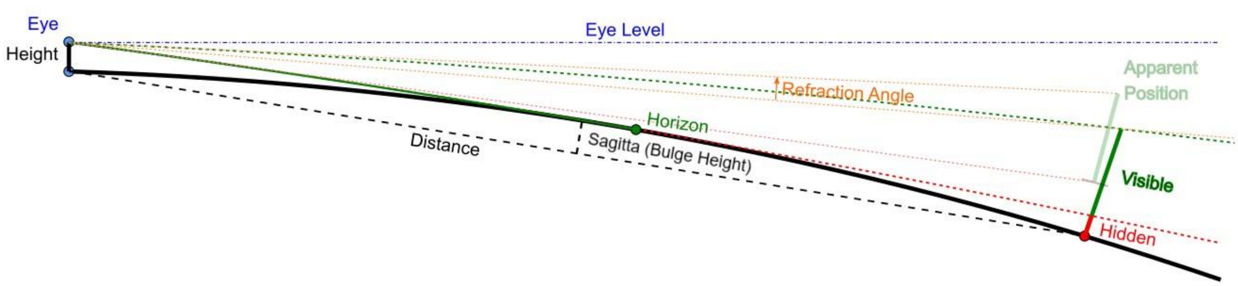
WTG and OSS visibility would be variable throughout the day depending on specific factors. View angle, sun angle, atmospheric conditions, and distance would affect the visibility and noticeability. Visual contrast of WTGs and OSSs would vary throughout daylight hours depending on whether the WTGs and OSSs are backlit, side-lit, or front-lit and based on the visual character of the horizon's backdrop. These variations through the course of the day could result in periods of major visual impacts, while at other times of day would have moderate, minor, or negligible impacts.

Atmospheric refraction of light rays causes fluctuations in the extents and appearances of offshore and onshore facilities. It results from the bending of light rays between viewers and objects due to current air temperature, water vapor, and barometric pressure (Bislins 2022). Atmospheric refraction can increase the visibility of objects, making them look larger or taller, depending on conditions. Figure 3.6.9-7 illustrates the effect of both earth curvature and atmospheric refraction. Atmospheric refraction would increase visibility of the 1,312-foot (400-meter) WTG by as much as 55 to 208 feet (16.8 to 63.4 meters) and of the 853-foot (260-meter) WTG by as much as 55 to 143 feet (16.8 to 43.6 meters) depending on lease area. Table H-7 in Appendix H provides a summary of increased visibility ranges for the nearest beach viewers for each lease area and both turbine sizes based on the average sea level refraction calculation coefficient of 0.17 (Bislins 2022) applied to the turbine blade tip viewshed distances. Daytime and nighttime atmospheric refraction-based visibility varies with sea level's continuous increases and decreases in temperature, water vapor, and barometric pressure. In addition, the atmospheric influences that increase the refraction phenomena are the same influences that may inhibit longer range views due to atmospheric haze. These variations in atmospheric refraction could result in periods of major visual impacts, while at other times would have moderate, minor, or negligible impacts.



Source: Bislins 2022

Figure 3.6.9-7. The effect of earth curvature and atmospheric refraction on visibility of a distant object

Considerations of atmospheric visibility conditions between potential shoreline viewing receptors and NY Bight lease area WTGs include (Argonne 2024):

- Onshore to offshore view conditions vary both daily and monthly.

- Averaged meteorological and atmospheric conditions for New York indicates overcast conditions of the NY Bight lease areas from seascape and landscape areas on 60 percent of daylight hours (3 of every 5 days) and provide clear visibility on 17 percent of daylight hours (about 1 of every 5 days).
- Averaged meteorological and atmospheric conditions for New Jersey indicates reduced visibility of the NY Bight lease areas from seascape and landscape areas on 60 percent of daylight hours (3 of every 5 days) and average visibility over the ocean in July and August ranges from 5 to 12 miles.
- Yearly, monthly, and summer average visibility each share a trend of increasing visibility from morning to the late afternoon, which is consistent with warmer temperatures during the day lowering the relative humidity and causing higher visibility.

Variations in atmospheric conditions throughout the day and year could result in periods of major, moderate, minor, or negligible impacts visual impacts.

Accidental releases: Accidental releases during construction and installation, O&M, and conceptual decommissioning of a NY Bight project could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Nearshore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction, installation, and conceptual decommissioning and would be lower but continuous during O&M, resulting in overall negligible to minor impacts.

Land disturbance: A NY Bight project would require installation of onshore export cables, construction of onshore substations or converter stations, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and installation and continue until restoration of disturbed areas. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. Impacts from a NY Bight project related to land disturbance are expected to be negligible to minor, but the impacts will need to be fully evaluated in the COP NEPA documents.

Lighting (offshore): Nighttime vessel lighting could result from construction and installation, O&M, and conceptual decommissioning of a NY Bight project if these activities are undertaken during nighttime, evening, or early morning hours. Vessel lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore and offshore viewing locations based on viewer distance and atmospheric conditions. The impact of vessel lighting on scenic and visual resources during construction and installation and conceptual decommissioning would be moderate to major, localized, and short term (5 years or less). Visual impacts of nighttime lighting on vessels would continue during O&M, but long-term impacts would be less due to the lower number of forecast vessel trips. Nighttime vessel lighting for a NY Bight project would affect seascape character, open ocean character, nighttime viewer experience, and valued scenery. This impact would be localized and short term during construction and installation and conceptual decommissioning, and intermittent and long term during O&M.

Permanent aviation warning lighting on the 280 WTGs would be visible from beaches, coastlines, and elevated observation points in the geographic analysis area and would have impacts on scenic and visual resources. Field observations associated with visibility of FAA aviation warning lighting under clear-sky conditions indicate that FAA warning lighting may be visible at a distance of 40 miles (64.4 kilometers) or more from the viewer (Sullivan et al. 2013). Darker-sky conditions may increase this distance due to increased potential for moments of contrast created by the red light radiating from aviation warning lights that are positioned above the WTG nacelles reflecting off the ocean water surface and/or low-level cloud cover. Aviation warning lights would be affixed to the wind turbines during construction to provide for safe nighttime aviation, as the turbine towers rise over 200 feet above sea level. Once affixed, the aviation warning lights would remain on throughout the construction period and O&M. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of aviation warning lighting from viewing locations. The location of the WTGs at the horizon and their associated, red-colored aviation warning lighting would generally not be in the direction of stargazing and would not create a skyglow effect like those created by urban area lighting. Impacts from lighting on WTGs would be long term and would range from minor to major depending on atmospheric variables, distance, and viewer position and orientation to the project. Although the probability is low, if aircraft warning lighting on WTGs is visible from any Wilderness Areas or Wilderness Study Areas, this could result in impacts on the night sky and, therefore, the wilderness character.

The OSSs would be lit and marked in accordance with Occupational Safety and Health Administration (OSHA) lighting standards to provide safe working conditions when O&M personnel are present. For purposes of the scenic and visual resources analysis, BOEM has assumed an OSS height of 295.3 feet (90.0 meters) above sea level for the NY Bight projects. Due to earth curvature, from eye levels of 5.9 feet (1.8 meters), the lights on the OSSs would become invisible above the ocean surface beyond approximately 23.8 miles (38.3 kilometers). Lights of the OSS, when lit for maintenance, potentially would be visible from beaches and adjoining areas during hours of darkness. Reflection of aviation warning lights could create contrasting moments of luminance cast from low level cloud cover that could possibly be seen from distances beyond the 50-mile (80.5-kilometer) onshore geographic analysis area, depending on variable cloud, and atmospheric reflectivity.

Lighting (onshore): Nighttime facility lighting would result from construction and installation, O&M, and conceptual decommissioning of a NY Bight project. Facility lighting, depending on the quantity, intensity, and location, could be visible from unobstructed sensitive onshore viewing locations. The impact of lighting on scenic and visual resources during construction and installation and conceptual decommissioning would be moderate to major, localized, and short term. Visual impacts of nighttime facility lighting would continue during O&M. This impact would be localized and short term during construction and installation and conceptual decommissioning, and long term during O&M.

Presence of structures: One NY Bight project would install up to 280 WTGs at a height of 1,312 feet (400-meter) or 853 feet (260-meter) and up to 5 OSSs at a height of 295.3 feet (90.0 meters) above

MLLW, for a maximum of 285 offshore structures within a NY Bight lease area. The WTGs would be painted white or light gray, no lighter than RAL 9010 Pure White and no darker than RAL 7035 Light Grey. RAL 7035 Light Grey would help reduce potential visibility against the horizon. The presence of structures would affect open ocean character, seascape character, landscape character, and viewer experience. The magnitude of WTG and OSS impact is defined by the contrast, scale of the change, prominence, FOV, viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. The visual simulations of the NY Bight projects considered in this analysis are available on BOEM's NY Bight website: https://www.boem.gov/renewable-energy/state-activities/new-york-bight.

The analysis considered clear-day and clear-night simulations of similar distance, variability of viewer location within the KOP vicinity, variability of sun angles throughout the day, and nighttime variability of cloud cover, ocean reflections, and moonlight. Appendix H provides an assessment of each NY Bight project's 1,312-foot (400-meter) and 853-foot (260-meter) WTGs. Open ocean character area, seascape character areas, and landscape character areas would be affected by each NY Bight project's WTG height, applicable distances, and noticeable WTG elements (Appendix H, Tables H-15 through H-18) and form, line, color, and texture contrasts, scale of change, and prominence in the characteristic open ocean, seascape, and landscape (Appendix H, Tables H-19 through H-32). WTG options' distances, noticeable elements, FOV, KOP foreground elements and influence on viewer experience at each KOP can be found in Appendix H, Tables H-34 through H-43. Higher impact significance stems from unique, extensive, and long-term appearance of strongly contrasting vertical structures in the otherwise horizontal open ocean environment, larger scale of change, and higher prominence, where structures are an unexpected element and viewer experience includes formerly open views of high-sensitivity open ocean, seascape, and landscape, and from high-sensitivity view receptors. Table 3.6.9-17 (1,312-foot [400-meter] WTG option) and Table 3.6.9-18 (853-foot [260-meter] WTG option) considers the totality of each NY Bight lease area's level of impact by open ocean character area, seascape character area, and landscape character area. All lease areas would result in major impacts on open ocean character regardless of WTG height. For the 853-foot (260-meter) WTGs, lease areas would result in negligible to minor impacts on SLIA seascape and landscape character types, except for Lease Area OCS-A 0544, which would have moderate and major impacts for some nearshore ocean, oceanside seascape, and bayside seascape character areas for the Fire Island region of New York. Similarly, views from KOPs located along Fire Island, New York, would have visibility of 853-foot WTG rotors, hubs, and aviation warning lights when high-visibility atmospheric conditions occur. For the 1,312-foot (400-meter) WTGs, Lease Areas OCS-A 0537, OCS-A 0538, OCS-A 0539, and OCS-A 0542 would result in negligible or minor impacts on seascape and landscape character due to their distance from shore. Lease Area OCS-A 0541 would result in moderate impacts on certain seascape and landscape character units along the New Jersey shore. The greatest impacts would result from OCS-A 0544, which is the closest lease area to shore, and specifically to the Fire Island region of New York from Democrat Point to approximately Watch Hill where mid-tower lights of the 1,312-foot WTGs would be visible. Lease Area OCS-A 0544 would result in moderate to major impacts to both SLIA character areas and VIA visual receptors.

Table 3.6.9-17. 1,312-foot WTG NY Bight lease areas impact on open ocean, seascape, and landscape character

Open Ocean, Seascape, and Landscape	1,312-Foot WTG Impact Level					
	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542	OCS-A 0544
Open Ocean						
Open Ocean	Major	Major	Major	Major	Major	Major
Bayside Seascape						
Bayside Commercial Park	--	Minor	--	--	--	Negligible
Bayside Industrial	--	--	--	--	--	Minor
Bayside Industrial Resource	--	--	--	--	Minor	Minor
Bayside Military Site	--	Minor	Minor	Minor	--	--
Bayside Natural Upland	--	Minor	--	Minor	Minor	Minor
Bayside Natural Wetland	Minor	Minor	Minor	Moderate	Minor	Moderate
Bayside Recreation	--	Minor	Minor	Minor	Minor	Minor
Bayside Residential	--	Minor	Minor	Minor	Minor	Moderate
Bayside Urban	--	Minor	--	Minor	Minor	Minor
Bayside Waterbodies	Minor	Minor	Minor	Moderate	Minor	Moderate
Seascape Residential	--	Minor	Minor	Minor	Minor	Minor
Seascape Urban	--	Minor	Minor	--	Minor	--
Oceanside Seascape						
Nearshore Ocean	Minor	Minor	Minor	Major	Minor	Major
Oceanside Beach	Minor	Minor	Minor	Moderate	Minor	Major
Oceanside Recreation	Minor	Minor	Minor	Minor	Minor	Moderate
Oceanside Residential/Commercial	Minor	Minor	Minor	Moderate	Minor	Moderate
Oceanside Urban	--	Minor	Minor	Moderate	Minor	Moderate
Landscape						
Inland Agriculture	--	--	--	Minor	--	--
Inland Commercial Park	--	--	--	Minor	Minor	Minor
Inland Industrial	--	--	--	--	Minor	Minor
Inland Industrial Resource	--	--	--	Minor	Minor	Minor
Inland Military Site	--	--	--	Minor	--	N/A
Inland Natural Area	--	--	--	Minor	Minor	Minor
Inland Recreation	--	--	--	Minor	--	Minor
Inland Rural	--	--	--	Minor	--	Minor
Inland Suburban/Exurban Residential	--	Minor	Minor	Minor	Minor	Minor
Inland Urban	--	--	--	Minor	--	Minor

Note: Dashed spaces indicate negligible impact.

Table 3.6.9-18. 853-foot WTG NY Bight lease areas impact on open ocean, seascape, and landscape character

Open Ocean, Seascape, and Landscape	853-Foot WTG Impact Level					
	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542	OCS-A 0544
Open Ocean						
Open Ocean	Major	Major	Major	Major	Major	Major
Bayside Seascape						
Bayside Commercial Park	--	--	--	--	--	--
Bayside Industrial	--	--	--	--	--	Minor
Bayside Industrial Resource	--	--	--	--	--	Minor
Bayside Military Site	--	--	--	--	--	--
Bayside Natural Upland	--	--	--	--	--	Minor
Bayside Natural Wetland	--	--	Minor	Minor	--	Moderate
Bayside Recreation	--	--	--	Minor	--	Minor
Bayside Residential	--	--	--	Minor	--	Minor
Bayside Urban	--	--	--	Minor	--	Minor
Bayside Waterbodies	--	--	Minor	Minor	--	Moderate
Seascape Residential	--	Minor	--	Minor	--	Minor
Seascape Urban	--	--	--	--	--	--
Oceanside Seascape						
Nearshore Ocean	--	--	Minor	Moderate	--	Major
Oceanside Beach	--	--	Minor	Moderate	--	Moderate
Oceanside Recreation	--	--	--	--	--	Moderate
Oceanside Residential/Commercial	--	--	Minor	Minor	--	Moderate
Oceanside Urban	--	--	Minor	Minor	--	Minor
Landscape						
Inland Agriculture	--	--	--	--	--	--
Inland Commercial Park	--	--	--	--	--	--
Inland Industrial	--	--	--	--	--	Minor
Inland Industrial Resource	--	--	--	--	--	Minor
Inland Military Site	--	--	--	--	--	--
Inland Natural Area	--	--	--	Minor	--	Minor
Inland Recreation	--	--	--	--	--	Minor
Inland Rural	--	--	--	--	--	Minor
Inland Suburban/Exurban Residential	--	--	--	Minor	--	Minor
Inland Urban	--	--	--	--	--	Minor

Note: Dashed spaces indicate Negligible impact.

Table 3.6.9-19 describes the magnitude of change criteria for determining viewer impact levels at onshore and offshore KOPs. Negligible impacts are based on very little to no effect on viewer experiences because the project is not visible or barely visible. Table 3.6.9-20 considers the totality of the 1,312-foot-tall (400-meter-tall) WTGs level of impact (the Sensitivity Level and Magnitude of Change; BOEM 2021) on KOPs. Table 3.6.9-21 considers the totality of the 853-foot-tall (260-meter-tall) WTGs level of impact on KOPs. All KOPs are rated high sensitivity (Argonne 2024). Appendix H, Tables H-36 through H-43 list the applicable impact level for each KOP based on specific measures of distance, occupied field of view, noticeable facility elements, visual contrasts, scale of change, and prominence.

Table 3.6.9-19. Criteria for measuring magnitude of change impacts

Impact Measure	Major	Moderate	Minor
Distance	Lease area facilities located from 0.0 mile (0.0 kilometer) to 16 miles (25.75 kilometers) of the KOP's viewers.	Lease area facilities located between 16 miles (25.75 kilometers) and the visible distance of the aviation lights, 36.1 miles (58.1 kilometers) for the 1,312-foot (400-meter) and 30.8 miles (49.6 kilometers) for the 853-foot (260-meter) WTGs, of the KOP's viewers.	For 1,312-foot (400-meter) WTGs, lease area facilities located between 36.1 miles (58.1 kilometers) and 47.4 miles (76.3 kilometers) of the KOP's viewers. For 853-foot (260-meter) WTGs, lease area facilities located between 30.8 miles (49.6 kilometers) and 38.7 miles (62.3 kilometers) of the KOP's viewers.
Field of View	Extensive FOV occupied by the facilities, horizon is dominated to mostly filled (>60%) by WTGs.	Moderate FOV occupied by the facilities, roughly 30–50% of horizontal FOV, and viewing is at the periphery.	Minor FOV occupied by the facilities, viewing is an oblique angle so that <30% horizontal FOV is filled.
Noticeability	Greater extents of noticeable facility elements in the view. Long view duration.	Moderate extents of noticeable facility elements in the view. Moderate view duration.	Minor extents of noticeable facility elements in the view. View duration is a glimpse.
Visual Contrast	Strong-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, textures, and motion.	Moderate-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, textures, and motion.	Weak-rated visual contrasts between facilities' forms, lines, colors, and textures and the existing viewing condition's forms, lines, colors, textures, and motion.
Scale of Change	Large-rated scale of change by facilities.	Medium-rated scale of change by facilities.	Small-rated scale of change by facilities.
Prominence[1]	6- or 5-rated prominence in the view.	4- or 3-rated prominence in the view.	2- or 1-rated prominence in the view.
Duration/ Reversibility	Permanent Not reversible	Long term Partially reversible	Short term Fully reversible

[1] WTGs and OSS prominence: 0 = Not visible. 1 = Visible only after extended study; otherwise not visible. 2 = Visible when viewing in general direction of the wind farm; otherwise, likely to be missed by casual observer. 3 = Visible after brief glance in general direction of the wind farm; unlikely to be missed by casual observer. 4 = Plainly visible; could not be missed by casual observer but does not strongly attract visual attention or dominate view. 5 = Strongly attracts viewers' attention to the wind farm; moderate to strong contrasts in form, line, color, or texture, luminance, or motion. 6 = Dominates view; strong contrasts in form, line, color, texture, luminance, or motion fill most of the horizontal FOV or vertical FOV (Sullivan et al 2013).

Table 3.6.9-20. Impact levels on the viewer experience (sensitivity level and magnitude of change) for the 1,312-foot WTGs

Offshore and Onshore Key Observation Points[1]	1,312-Foot WTG Impact by Lease Area					
	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542	OCS-A 0544
KOP-02 Lucy the Elephant	--	--	--	--	--	--
KOP-03 John Stafford Hall-Boardwalk[2]	--	--	--	--	--	--
KOP-04 John Stafford Hall-Beach Entrance	--	--	--	--	--	--
KOP-05 Jim Whelan Hall-Balcony	--	--	--	--	--	--
KOP-06 Atlantic City Boardwalk-Ocean Casino Boardwalk View[2]	--	--	--	--	--	--
KOP-07 Atlantic City Boardwalk-Top of Ocean Casino[2]	--	--	--	--	--	--
KOP-08A Beach Haven - Daytime	--	--	--	Minor	Minor	--
KOP-08B Beach Haven - Nighttime	-	--	--	Minor	--	--
KOP-09 Barnegat Jetty[2]	--	Minor	Minor	Minor	Minor	--
KOP-10 Barnegat Lighthouse	--	Minor	Moderate	Minor	Minor	--
KOP-11 US Life Saving Station #14[2]	--	Minor	Minor	--	--	--
KOP-12 Seaside Park Beach[2]	--	Minor	Minor	--	--	--
KOP-13 Mantoloking	--	Minor	Minor	--	--	--
KOP-14 Bayhead[2]	--	Minor	Minor	--	--	--
KOP-15 Point Pleasant[2]	--	Minor	Minor	--	--	--
KOP-16 Ocean Grove[2]	--	--	--	--	--	Minor
KOP-17 Asbury Park Beach[2]	--	--	--	--	--	Minor
KOP-18 Allenhurst Residential Historic District	--	--	--	--	--	Minor
KOP-19 Navesink Twin Lights[2]	--	--	--	--	--	--
KOP-26 Fort Tilden (nighttime)	--	--	--	--	--	--
KOP-27 Magnolia Beach[2]	--	--	--	--	--	Minor
KOP-28 Jones Beach	--	--	--	--	--	Minor
KOP-29 Rudolph Oyster House[2]	--	--	--	--	--	--
KOP-30 Shinnecock Inlet	--	--	--	--	--	--
KOP-31 Westhampton Beach	--	--	--	--	--	Minor
KOP-32 Fire Island Lighthouse-Upper Deck	Minor	Minor	--	--	--	Moderate
KOP-33 Fire Island Lighthouse-Base[2]	Minor	--	--	--	--	Moderate
KOP-35 Twin Lights Lighthouse	--	--	--	--	--	Minor
KOP-36 Asbury Park Hall-Top	--	--	--	--	--	--

Offshore and Onshore Key Observation Points[1]	1,312-Foot WTG Impact by Lease Area					
	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542	OCS-A 0544
KOP-37 Point O' Woods	Minor	--	--	--	--	Moderate
KOP-38 Robert Moses Field 5[2]	Minor	--	--	--	--	Moderate
KOP-39 Empire State Building Observation Deck	--	--	--	--	--	Minor
KOP-40 Robert Moses Field 5 - nighttime	--	--	--	--	--	Moderate
KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area	Major	Major	Major	Major	Major	Major
KOP-B Representative Commercial and Cruise Ship Shipping Lanes	Major	Major	Major	Major	Major	Major

[1] Eight additional KOPs were identified but with analysis were found to be outside of the affected viewshed and have been removed from the impact analysis. These are: KOP-01 Ocean City Music Hall, KOP-20 Sandy Hook Beach, KOP-21 Great Kills, KOP-22 Roosevelt Pier, KOP-23 Statue of Liberty – Upper Deck, KOP-24 Statue of Liberty – Base, KOP-25 Coney Island Boardwalk, and KOP-34 Sandy Hook Observatory.
[2] KOPs evaluated based on GIS data and simulations of representative KOPs (see Table H-35 in Appendix H).
Note: Dashed spaces indicate Negligible impact.

Table 3.6.9-21. Impact levels on the viewer experience (sensitivity level and magnitude of change) for the 853-foot WTGs

Offshore and Onshore Key Observation Points[1]	853-Foot WTG Impact by Lease Area					
	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542	OCS-A 0544
KOP-02 Lucy the Elephant	--	--	--	--	--	--
KOP-03 John Stafford Hall-Boardwalk[2]	--	--	--	--	--	--
KOP-04 John Stafford Hall-Beach Entrance	--	--	--	--	--	--
KOP-05 Jim Whelan Hall-Balcony	--	--	--	--	--	--
KOP-06 Atlantic City Boardwalk-Ocean Casino Boardwalk View[2]	--	--	--	--	--	--
KOP-07 Atlantic City Boardwalk-Top of Ocean Casino[2]	--	--	--	--	--	--
KOP-08A Beach Haven	--	--	--	--	--	--
KOP-08B Beach Haven - Nighttime	--	--	--	Minor	--	--
KOP-09 Barnegat Jetty[2]	--	--	--	Minor	--	--
KOP-10 Barnegat Lighthouse	--	Minor	Minor	Minor	--	--
KOP-11 US Life Saving Station #14[2]	--	--	--	--	--	--
KOP-12 Seaside Park Beach[2]	--	--	--	--	--	--
KOP-13 Mantoloking	--	--	--	--	--	--
KOP-14 Bayhead[2]	--	--	--	--	--	--

Offshore and Onshore Key Observation Points[1]	853-Foot WTG Impact by Lease Area					
	OCS-A 0537	OCS-A 0538	OCS-A 0539	OCS-A 0541	OCS-A 0542	OCS-A 0544
KOP-15 Point Pleasant[2]	--	--	--	--	--	--
KOP-16 Ocean Grove[2]	--	--	--	--	--	--
KOP-17 Asbury Park Beach[2]	--	--	--	--	--	--
KOP-18 Allenhurst Residential Historic District	--	--	--	--	--	--
KOP-19 Navesink Twin Lights[2]	--	--	--	--	--	--
KOP-26 Fort Tilden	--	--	--	--	--	--
KOP-27 Magnolia Beach[2]	--	--	--	--	--	--
KOP-28 Jones Beach	--	--	--	--	--	Minor
KOP-29 Rudolph Oyster House[2]	--	--	--	--	--	--
KOP-30 Shinnecock Inlet	--	--	--	--	--	--
KOP-31 Westhampton Beach	--	--	--	--	--	--
KOP-32 Fire Island Lighthouse-Upper Deck	--	--	--	--	--	Moderate
KOP-33 Fire Island Lighthouse-Base[2]	--	--	--	--	--	Minor
KOP-35 Twin Lights Lighthouse	--	--	--	--	--	Minor
KOP-36 Asbury Park Hall-Top	--	--	--	--	--	--
KOP-37 Point O' Woods	--	--	--	--	--	Moderate
KOP-38 Robert Moses Field 5[2]	--	--	--	--	--	Minor
KOP-39 Empire State Building	--	--	--	--	--	--
KOP-40 Robert Moses Field 5 - nighttime	--	--	--	--	--	Moderate
KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area	Major	Major	Major	Major	Major	Major
KOP-B Representative Commercial and Cruise Ship Shipping Lanes	Major	Major	Major	Major	Major	Major

1 Eight additional KOPs were identified but with analysis were found to be outside of the affected viewshed and have been removed from the impact analysis. These are: KOP-01 Ocean City Music Hall, KOP-20 Sandy Hook Beach, KOP-21 Great Kills, KOP-22 Roosevelt Pier, KOP-23 Statue of Liberty – Upper Deck, KOP-24 Statue of Liberty – Base, KOP-25 Coney Island Boardwalk, and KOP-34 Sandy Hook Observatory.
2 KOPs evaluated based on GIS data and simulations of representative KOPs (see Table H-35 in Appendix H).
Note: Dashed spaces indicate Negligible impact.

Traffic (vessel): Construction, O&M, and decommissioning of one NY Bight project would generate increased vessel traffic that could contribute to minor to moderate adverse impacts on scenic and visual resources within the geographic analysis area. The impacts would occur primarily during construction along routes between ports and the planned offshore wind construction areas. One NY Bight project is projected to generate an average of up to 51 vessels at any given time during construction, and up to 8 vessel trips per day during operations.

3.6.9.4.2 Impacts of Six Projects

The analysis of six NY Bight projects considers the combined impact of all six NY Bight projects, which would include the construction, O&M, and decommissioning of up to 1,103 WTGs and 22 OSSs across all six lease areas. The same impact types and mechanisms described for a single NY Bight project apply to six NY Bight projects for accidental releases, land disturbance, lighting, presence of structures, and vessel traffic, but the magnitude of impacts would be greater from more offshore and onshore development. With the exception of lighting and presence of structures, impacts could be slightly greater from six projects than described for one project, especially if multiple projects are constructed at the same time, but because the onshore and offshore development activity would be dispersed geographically within different lease areas, cable corridors, and onshore locations and the generally low level of impacts on scenic and visual resources anticipated from these IPFs (negligible to minor for accidental releases and land disturbance, and minor to moderate for traffic), it is not anticipated that there would be a change in impact levels. For lighting, the impact from vessel lighting during construction would be major (an increase from moderate to major for one project) if multiple projects are constructed simultaneously as there would be substantially more lighted vessels contributing to nighttime impacts. Permanent aviation lighting on the up to 1,103 WTGs and 22 OSSs associated with six NY Bight projects would result in long-term major impacts (same impact level as one NY Bight project) as these structures would add new permanent sources of nighttime lighting where none existed.

The remainder of this section describes the impacts associated with the presence of structures. The extent and magnitude of visual impacts associated with the presence of WTGs and OSSs would increase from one project to six projects. Table 3.6.9-22 and Table 3.6.9-23 provide a summary of the magnitude of visibility for the six lease areas based on the nearest beach or shoreline view from New Jersey and New York for the 1,312-foot (400-meter) and 853-foot (260-meter) WTGs, respectively. Compared to one project, the horizontal FOV would be substantially wider because, depending on viewer location, a viewer would have the potential to see portions of more than one of the six lease areas. This would be most pronounced in Long Beach, New Jersey (the closest onshore shoreline location in New Jersey to the six NY Bight lease areas), where the visible portions of the six NY Bight projects with 1,312-foot (400-meter) WTGs would occupy 57° (46 percent) of the typical human's 124° horizontal FOV, meaning that just under half of the viewer's horizontal FOV would be occupied by wind turbine arrays from the NY Bight projects.

Table 3.6.9-22. Magnitude of view summary for the six NY Bight lease areas to nearest onshore viewpoint for 1,312-foot WTG

Nearest Viewpoint by State	Distance to Nearest Viewpoint in Miles (Kilometers)	1,312-Foot WTG Visibility			
		Width[1] of Wind Turbine Array in Miles (Kilometers)	Horizontal FOV (% of 124)	Height Above Horizon[2] Feet (Meters)	Vertical FOV (% of 55)
New Jersey – Long Beach	30.7 (49.4)	46.7 (75.1)	57° (46 %)	799.4 (311.5)	0.28° (0.5 %)
New York – Atlantique Beach	23.6 (38.0)	28.9 (46.5)	50° (40 %)	1,036.5 (311.5)	0.48° (0.8%)

[1] Maximum extent of the visible wind turbine array.
[2] Height of rotor blade tip, based on intervening earth curvature, clear-day, and clear-night conditions.

Table 3.6.9-23. Magnitude of view summary for the six NY Bight lease areas to nearest onshore viewpoint for 853-foot WTG

Nearest Viewpoint by State	Distance to Nearest Viewpoint in Miles (Kilometers)	853-Foot WTG Visibility			
		Width[1] of Wind Turbine Array in Miles (Kilometers)	Horizontal FOV (% of 124)	Height Above Horizon[2] Feet (Meters)	Vertical FOV (% of 55)
New Jersey – Long Beach	30.7 (49.4)	23.9 (38.5)	38° (31 %)	340.4 (103.7)	0.12° (0.2 %)
New York – Atlantique Beach	23.6 (38.0)	19.0 (30.6)	39° (31 %)	577.5 (176.0)	0.27° (0.4 %)

[1] Maximum extent of the visible wind turbine array.
[2] Height of rotor blade tip, based on intervening earth curvature, clear-day, and clear-night conditions.

Table 3.6.9-24 (1,312-foot [400-meter] WTG option) and Table 3.6.9-25 (853-foot [260-meter] WTG option) consider the totality of the level of impact upon open ocean character area, seascape character area, and landscape character area from the six NY Bight projects.

Table 3.6.9-24. 1,312-foot WTG impact on open ocean character, seascape character, and landscape character from six NY Bight projects

Open Ocean, Seascape, and Landscape	1,312-Foot Wind Turbine Impact Level for Six NY Bight Projects
Open Ocean	Major
Bayside Seascape	
Bayside Commercial Park	Minor
Bayside Industrial	Minor
Bayside Industrial Resource	Minor
Bayside Military Site	Minor
Bayside Natural Upland	Minor
Bayside Natural Wetland	Moderate
Bayside Recreation	Minor
Bayside Residential	Moderate
Bayside Urban	Minor

Open Ocean, Seascape, and Landscape	1,312-Foot Wind Turbine Impact Level for Six NY Bight Projects
Bayside Waterbodies	Moderate
Seascape Residential	Minor
Seascape Urban	Minor
Oceanside Seascape	
Nearshore Ocean	Major
Oceanside Beach	Moderate
Oceanside Recreation	Moderate
Oceanside Residential/Commercial	Moderate
Oceanside Urban	Moderate
Landscape	
Inland Agriculture	Minor
Inland Commercial Park	Minor
Inland Industrial	Minor
Inland Industrial Resource	Minor
Inland Military Site	Minor
Inland Natural Area	Minor
Inland Recreation	Minor
Inland Rural	Minor
Inland Suburban/Exurban Residential	Minor
Inland Urban	Minor

Table 3.6.9-25. 853-foot WTG impact on open ocean character, seascape character, and landscape character from six NY Bight projects

Open Ocean, Seascape, and Landscape	853-Foot Wind Turbine Impact Level for Six NY Bight Projects
Open Ocean	Major
Bayside Seascape	
Bayside Commercial Park	Negligible
Bayside Industrial	Minor
Bayside Industrial Resource	Minor
Bayside Military Site	Negligible
Bayside Natural Upland	Minor
Bayside Natural Wetland	Moderate
Bayside Recreation	Minor
Bayside Residential	Minor
Bayside Urban	Minor
Bayside Waterbodies	Moderate
Seascape Residential	Minor
Seascape Urban	Negligible
Oceanside Seascape	
Nearshore Ocean	Major
Oceanside Beach	Moderate
Oceanside Recreation	Moderate

Open Ocean, Seascape, and Landscape	853-Foot Wind Turbine Impact Level for Six NY Bight Projects
Oceanside Residential/Commercial	Moderate
Oceanside Urban	Minor
Landscape	
Inland Agriculture	Negligible
Inland Commercial Park	Minor
Inland Industrial	Minor
Inland Industrial Resource	Minor
Inland Military Site	Negligible
Inland Natural Area	Minor
Inland Recreation	Minor
Inland Rural	Minor
Inland Suburban/Exurban Residential	Minor
Inland Urban	Minor

Table 3.6.9-26 considers the totality of the 1,312-foot-tall (400-meter-tall) and 853-foot-tall (260-meter-tall) WTGs level of impact on offshore KOPs from the six NY Bight projects (the magnitude of change criteria are the same as described for one project in Table 3.6.9-19). Appendix H, Table H-36 through Table H-43 list the applicable impact level for each KOP based on specific measures of distance, occupied field of view, noticeable facility elements, visual contrasts, scale of change, and prominence, for the 1,312-foot (400-meter) and 853-foot (260-meter) WTG project options, respectively.

Table 3.6.9-26. Impact levels on the viewer experience for WTGs from six NY Bight projects

Level of Impact	Offshore and Onshore Key Observation Points [1]	
	1,312-Foot WTGs	853-Foot WTGs
Major	KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area KOP-B Representative Commercial and Cruise Ship Shipping Lanes	KOP-A Representative Recreational Fishing, Pleasure, and Tour Boat Area KOP-B Representative Commercial and Cruise Ship Shipping Lanes
Moderate	KOP-10 Barnegat Lighthouse (OCS-A 0538, 0539, 0541, 0542) KOP-09 Barnegat Jetty [2] KOP-32 Fire Island Lighthouse-Upper Deck (OCS-A 0537, 0544) KOP-33 Fire Island Lighthouse-Base [2] KOP-37 Point O' Woods (OCS-A 0537, 0544) KOP-38 Robert Moses Field 5 [2] KOP-40 Robert Moses Field 5 – nighttime (OCS-A 0544)	KOP-32 Fire Island Lighthouse-Upper Deck (OCS-A 0537, 0544) KOP-40 Robert Moses Field 5 - nighttime (OCS-A 0544)
Minor	KOP-08A Beach Haven – daytime (OCS-A 0539, 0542) KOP-08B Beach Haven – nighttime (OCS-A 0541) KOP-09 Barnegat Jetty [2] KOP-11 US Life Saving Station #14 [2] KOP-12 Seaside Park Beach [2] KOP-13 Mantoloking (OCS-A 0538, 0539, 0541, 0544) KOP-14 Bayhead [2] KOP-15 Point Pleasant [2] KOP-16 Ocean Grove [2] KOP-17 Asbury Park Beach [2] KOP-18 Allenhurst Residential Historic District (OCS-A 0544) KOP-27 Magnolia Beach [2] KOP-28 Jones Beach (OCS-A 0544) KOP-31 Westhampton Beach (OCS-A 0544) KOP-35 Twin Lights Lighthouse (OCS-A 0544) KOP-39 Empire State Building (OCS-A 0538, 0544)	KOP-08A Beach Haven - daytime (OCS-A 0541) KOP-09 Barnegat Jetty [2] KOP-10 Barnegat Lighthouse (OCS-A 0538, 0539, 0541, 0542) KOP-27 Magnolia Beach [2] KOP-28 Jones Beach (OCS-A 0544) KOP-33 Fire Island Lighthouse-Base [2] KOP-37 Point O' Woods (OCS-A 0544) KOP-38 Robert Moses Field 5 [2]
Negligible	KOP-02 Lucy the Elephant KOP-03 John Stafford Hall-Boardwalk [2] KOP-04 John Stafford Hall-Beach Entrance KOP-05 Jim Whelan Hall-Balcony KOP-06 Atlantic City Boardwalk-Ocean Casino Boardwalk View [2] KOP-07 Atlantic City Boardwalk-Top of Ocean Casino [2] KOP-19 Navesink Twin Lights [2] KOP-26 Fort Tilden	KOP-02 Lucy the Elephant KOP-03 John Stafford Hall-Boardwalk [2] KOP-04 John Stafford Hall-Beach Entrance KOP-05 Jim Whelan Hall-Balcony KOP-06 Atlantic City Boardwalk-Ocean Casino Boardwalk View [2] KOP-07 Atlantic City Boardwalk-Top of Ocean Casino [2] KOP-08B Beach Haven – nighttime KOP-11 US Life Saving Station #14 [2]

Level of Impact	Offshore and Onshore Key Observation Points [1]	
	1,312-Foot WTGs	853-Foot WTGs
	KOP-29 Rudolph Oyster House [2] KOP-30 Shinnecock Inlet KOP-36 Asbury Park Hall-Top	KOP-12 Seaside Park Beach [2] KOP-13 Mantoloking KOP-14 Bayhead [2] KOP-15 Point Pleasant [2] KOP-16 Ocean Grove [2] KOP-17 Asbury Park Beach [2] KOP-18 Allenhurst Residential Historic District KOP-19 Navesink Twin Lights [2] KOP-26 Fort Tilden KOP-29 Rudolph Oyster House [2] KOP-30 Shinnecock Inlet KOP-31 Westhampton Beach (OCS-A 0544) KOP-35 Twin Lights Lighthouse KOP-36 Asbury Park Hall-Top KOP-39 Empire State Building

[1] Eight additional KOPs were identified but with analysis were found to be outside of the affected viewshed and have been removed from the impact analysis. These are: KOP-01 Ocean City Music Hall, KOP-20 Sandy Hook Beach, KOP-21 Great Kills, KOP-22 Roosevelt Pier, KOP-23 Statue of Liberty – Upper Deck, KOP-24 Statue of Liberty – Base, KOP-25 Coney Island Boardwalk, and KOP-34 Sandy Hook Observatory.
[2] KOPs evaluated based on GIS data and simulations of representative KOPs (see Table H-35 in Appendix H).

3.6.9.4.3 Cumulative Impacts of Alternative B

The cumulative impacts of Alternative B considered the impacts of the six NY Bight projects in combination with other ongoing and planned activities.

Accidental releases: Accidental releases during construction and installation, O&M, and conceptual decommissioning of ongoing and planned offshore wind projects including the six NY Bight projects could affect nearby seascape character, open ocean character, landscape character, and viewers through the accidental release of fuel, trash, debris, or suspended sediments. Near-shore accidental releases could cause temporary closure of beaches, which would limit the opportunity for viewer experience of affected seascapes, open ocean, and landscapes. The potential for accidental releases would be greatest during construction and installation and conceptual decommissioning of offshore wind projects, and would be lower but continuous during O&M. The combined accidental release impacts from the NY Bight projects and other ongoing and planned activities would be negligible to minor.

Land disturbance: Ongoing and planned offshore wind development including the six NY Bight projects would require installation of onshore export cables, onshore substations, and transmission infrastructure to connect to the electrical grid, which would result in localized, temporary visual impacts near construction sites due to land disturbance for vegetation clearing, site grading or trenching, and construction staging. These impacts would last through construction and installation and continue until disturbed areas are restored. Intermittent land disturbance may also be required to maintain onshore infrastructure during O&M. The exact extent of impacts would depend on the locations of project infrastructure for the NY Bight projects and other ongoing and planned offshore wind energy projects; however, the six NY Bight projects in combination with other planned offshore wind development are expected to generally have localized, short-term, negligible to minor cumulative impacts on scenic and visual resources during construction and installation and O&M due to land disturbance.

Lighting: Lighting from the six NY Bight projects in combination with other offshore wind projects would have minor to major, long-term cumulative impacts on scenic and visual resources. This range in impacts from lighting is due to variable distances from visually sensitive viewing locations and potential use of ADLS for ongoing and planned offshore wind projects. The recreational and commercial fishing, pleasure, and tour boating community would experience major adverse effects in foreground views.

Presence of structures: The six NY Bight projects would contribute up to 1,103 WTGs of a combined total of 1,800 WTGs that would be installed by all projects in the geographic analysis area, which accounts for approximately 61 percent of offshore wind development planned for the geographic analysis area. While 1,103 WTGs represent the maximum number of WTGs that BOEM anticipates could be installed by the six NY Bight projects based on the RPDE (see Section 2.1.2.2, *Six Projects*, in Chapter 2), the visual simulations used to support the visual analysis assessed WTGs at potential offshore structure positions in the six NY Bight lease areas based on grid spacing of 0.6 by 0.6 nm (1.1 by 1.1 kilometer) for purposes of a maximum case analysis, which exceeds the 1,103 WTGs in the RPDE.

Therefore, the potential number of WTGs visible from any KOP as reported in this analysis likely overestimates impacts.

The total number of WTGs that would be visible from any single viewpoint would be substantially fewer than the 1,800 WTGs considered under the planned activities scenario in combination with the six NY Bight projects. For example, BOEM estimates that 1,206 WTGs would be theoretically visible from KOP-8 Beach Haven and 523 WTGs would be theoretically visible from KOP-35 Twin Lights Lighthouse from all ongoing and planned offshore wind projects and the six NY Bight projects with 1,312-foot-tall (400-meter-tall) WTGs. BOEM estimates that 744 WTGs would be theoretically visible from KOP-8 Beach Haven and 337 WTGs would be theoretically visible from KOP-35 Twin Lights Lighthouse from all ongoing and planned offshore wind projects and the six NY Bight projects with 853-foot-tall (260-meter-tall) WTGs. The presence of structures associated with offshore wind development in combination with the NY Bight project would have major seascape character, open ocean character, landscape character, and viewer experience impacts, as simulated from sensitive onshore receptors (Appendix H).

Atmospheric refraction (refer to Section H.2.3 in Appendix H for a description of refraction) creates variability in WTG visibility and could increase the number of visible WTGs by as much as 14 percent. However, when WTGs are farther offshore, as in the case of the NY Bight projects, the atmospheric conditions for high refraction coincide with conditions for high atmospheric haze at the ocean horizon, which would limit visibility. Therefore, it is expected these two atmospheric phenomena would largely cancel each other and are not expected to increase WTG visibility and associated visual impact.

The open ocean character would reach the maximum level of change to its features and characters from formerly undeveloped ocean to dominant wind farm character once all projects are constructed and result in major impacts. The 1,312-foot-tall (400-meter-tall) WTG option’s contribution to cumulative impacts would range from 265 of 831 total WTGs visible from KOP-2 Lucy the Elephant (32 percent of the total), to 1,159 of 1,706 total WTGs visible from KOP-10 Barnegat Lighthouse (67 percent of the total). The 853-foot-tall (260-meter-tall) WTG option’s contribution to cumulative impacts would range from 196 of 744 total WTGs visible from KOP-8 Beach Haven (26 percent of the total), to 1,009 of 1,556 total WTGs visible from KOP-10 Barnegat Lighthouse (65 percent of the total). The open ocean, seascape, and landscape are highly valued scenery and rated high susceptibility.

The NY Bight projects’ contribution to cumulative impacts of theoretically visible WTGs at selected KOPs based on clear sky and earth curvature for the 1,312-foot (400-meter) and 853-foot (260-meter) WTGs are described in Table 3.6.9-27 and Table 3.6.9-28, respectively. The tables also show the additive changes in the number of WTGs visible as each planned offshore lease area is constructed based on anticipated construction schedules. For example, for KOP-02, 98 WTGs would be visible once Ocean Wind 1 is constructed (98 total), followed by an additional 200 WTGs for Atlantic Shores South (298 total), with more WTGs added over time until all projects are constructed in 2030 or later for a total of 831 visible WTGs. This analysis does not include refraction (refraction coefficient is 0). The actual number of WTGs visible would vary based on atmospheric conditions.

Table 3.6.9-27. Cumulative and additive impacts within the NY Bight geographic analysis area for the 1,312-foot WTGs

KOP	Visibility [2]	Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact						
		EW1-2 [1] 2023–2027	OW1 [1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (1,312-Foot) 2030	Total Cumulative Visibility
KOP-2 Lucy the Elephant	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	Not visible	16.0 (25.8) 38.6° (31%) 98 98 Moderate	14.4 (23.2) 38.9° (31%) 200 200 Major	22.1 (35.6) 38.5° (31%) 157 157 Moderate	10.8 (17.3) 71.9° (58%) 111 111 Major	46.3 (74.4) 23.1° (19%) 265 -- Negligible	127.6° (103%) **Major**
Additive Changes	Visible WTGs		98	298	455	566	831	831
KOP-4 John Stafford Hall-Beach Entrance	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	Not visible	15.6 (25.1) 40.5° (33%) 98 98 Moderate	14.4 (23.2) 41.0° (33%) 200 200 Major	19.3 (31.0) 42.5° (34%) 157 157 Moderate	9.6 (15.5) 67.3° (54%) 111 111 Major	43.8 (70.5) 24.4° (20%) 223 -- Negligible	135.6° (109%) **Major**
Additive Changes	Visible WTGs		98	298	455	566	789	789
KOP-5 Jim Whelan Hall-Balcony	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	Not visible	15.4 (24.8) 40.9° (33%) 98 98 Moderate	11.5 (18.4) 42.4° (34%) 200 200 Major	17.6 (28.4) 45.1° (36%) 157 157 Moderate	9.2 (14.7) 62.8° (51%) 111 111 Major	42.3 (68.1) 25.2° (20%) 369 -- Negligible	140.2° (113%) **Major**
Additive Changes	Visible WTGs[3]		98	298	455	566	935	935

		Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact						
KOP	**Visibility [2]**	**EW1-2 [1] 2023–2027**	**OW1 [1] 2024–2025**	**ASOW South [1] 2025-2027**	**ASOW North [1] 2026–2030**	**OW2 [1] 2026–2030**	**NY Bight Projects (1,312-Foot) 2030**	**Total Cumulative Visibility**
KOP-8 A Beach Haven – Day	Nearest WTG	Not visible	24.5 (39.4)	13.5 (21.7)	9.8 (15.8)	20.2 (32.6)	32.6 (52.5)	
	Horizontal FOV		26.3° (21%)	44.8° (36%)	87.0° (70%)	20.3° (16%)	42.7° (34%)	139.7° (113%)
	Visible Rotor		98	200	157	93	658	
	Visible Hub		61	200	157	25	85	
	Impact		Minor	Major	Major	Moderate	Minor	**Major**
Additive Changes	Visible WTGs		98	298	455	548	1,206	1,206
KOP-8 B Beach Haven – Nighttime	Nearest WTG	Not visible	24.5 (39.4)	13.5 (21.7)	9.8 (15.8)	20.2 (32.6)	32.6 (52.5)	
	Horizontal FOV		26.3° (21%)	44.8° (36%)	87.0° (70%)	20.3° (16%)	42.7° (34%)	139.7° (113%)
	Visible Rotor		98	200	157	93	658	
	Visible Hub		61	200	157	25	85	
	Impact		Minor	Major	Major	Moderate	Moderate	**Major**
Additive Changes	Visible WTGs		98	298	455	548	1,206	1,206
KOP-10 Barnegat Lighthouse	Nearest WTG	50.2 (80.8)	38.6 (62.2)	27.3 (44.0)	10.1 (16.2)	35.4 (57.0)	32.3 (52.0)	
	Horizontal FOV	15.6° (13%)	17.3° (14%)	28.6° (23%)	58.1° (47%)	13.9° (11%)	91° (73%)	169.6° (138%)
	Visible Rotor	34	58	200	157	58	1,159	
	Visible Hub	--	25	200	157	22	789	
	Impact	Negligible	Minor	Moderate	Major	Minor	Moderate	**Major**
Additive Changes	Visible WTGs	34	92	292	449	507	1,666	1,666
KOP-13 Mantoloking	Nearest WTG	34.1 (54.9)	Not visible	Not visible	25.8 (41.5)	Not visible	44.1 (71.0)	
	Horizontal FOV	22.6° (18%)			19.4° (16%)		80.5° (65%)	138.1° (111%)
	Visible Rotor	74			128		275	
	Visible Hub	--			43		--	
	Impact	Minor			Moderate		Minor	**Moderate**
Additive Changes	Visible WTGs	74			202		477	477

KOP	Visibility [2]	Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact						
		EW1-2 [1] 2023–2027	OW1 [1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (1,312-Foot) 2030	Total Cumulative Visibility
KOP-18 Allenhurst Residential Historic District	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	24.4 (39.3) 25.7° (21%) 157 54 Moderate	Not visible	Not visible	39.0 (62.8) 8.0° (6.5%) 30 -- Minor	Not visible	42.5 (68.4) 48.4° (39%) 111 -- Minor	116.2° (94%) **Moderate**
Additive Changes	Visible WTGs	157			187		298	298
KOP-26 Fort Tilden	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	21.2 (33.9) 15.7° (13%) 154 53 Moderate	Not visible	Not visible	Not visible	Not visible	43.7 (70.3) 15° (12%) 85 -- Negligible	20.0° (16%) **Moderate**
Additive Changes	Visible WTGs	154					239	239
KOP-28 Jones Beach	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	14.2 (22.9) 52.4° (42%) 174 170 Major	Not visible	Not visible	Not visible	Not visible	31.4 (50.5) 23.1° (19%) 110 88 Minor	60.5° (49%) **Major**
Additive Changes	Visible WTGs	174					284	284
KOP-31 Westhampton Beach	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	37.9 (61.0) 12.9° (10%) 43 -- Minor	Not visible	Not visible	Not visible	Not visible	33.9 (54.5) 11.5° (9%) 110 23 Minor	22.3° (18%) **Minor**
Additive Changes	Visible WTGs	43					153	153

KOP	Visibility [2]	Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact EW1-2 [1] 2023–2027	OW1 [1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (1,312-Foot) 2030	Total Cumulative Visibility
KOP-32 Fire Island Lighthouse-Upper Deck	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	21.7 (35.0) 61.7° (50%) 174 174 Major	Not visible	Not visible	Not visible	Not visible	24.2 (39.0) 41.1° (33%) 400 123 Moderate	82.8° (67%) **Major**
Additive Changes	Visible WTGs	174					574	574
KOP-35 Twin Lights Lighthouse	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	22.4 (36.1) 14.2° (11.5%) 174 174 Major	Not visible	Not visible	50.0 (80.5) 6.3° (5%) 48 -- Minor	Not visible	44.1 (70.9) 57.8° (47%) 301 99 Minor	89.5° (72%) **Major**
Additive Changes	Visible WTGs	174			222		523	523
KOP-36 Asbury Park Hall-Top	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	24.9 (40.0) 26.1° (21%) 168 74 Moderate	Not visible	Not visible	38.1 (61.4) 8.2° (6.6) 48 2 Minor	Not visible	42.6 (68.6) 61.9° (50%) 188 -- Negligible	117.8° (95%) **Moderate**
Additive Changes	Visible WTGs[3]	168			216		404	404
KOP-37 Point O' Woods	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	23.9 (38.5) 55.2° (44.5%) 174 174 Moderate	Not visible	Not visible	Not visible	Not visible	24.1 (38.7) 38.2° (31%) 227 110 Moderate	82.3° (66%) **Major**
Additive Changes	Visible WTGs	174					401	401

KOP	Visibility [2]	Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact						
		EW1-2 [1] 2023–2027	OW1 [1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (1,312-Foot) 2030	Total Cumulative Visibility
KOP-39 Empire State Building Observation Deck	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	34.1 (54.9) 16.7° (13.5%) 174 174 Moderate	Not visible	Not visible	74.2 (119.5) 4.3° (3.5%) 43 -- Negligible	Not visible	55.8 (89.8) 42.4° (34%) 623 125 Minor	63.4° (51%) **Moderate**
Additive Changes	Visible WTGs	174			217		840	840
KOP-40 Robert Moses Field 5 – Nighttime	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	21.3 (34.2) 62.9° (51%) 174 174 Major	Not visible	Not visible	Not visible	Not visible	24.2 (39.0) 31.5° (25%) 141 110 Moderate	80.4° (65%) **Major**
Additive Changes	Visible WTGs	174					315	315

[1] Atlantic Shores (ASOW) leases – WTG blade tip height is 1,049 feet (319.7 meters), Empire Wind (EW) leases – WTG blade tip height is 951 feet (290 meters), Ocean Wind (OW) leases - WTG blade tip height is 906 feet (276 meters).
[2] Theoretically visible base on clear sky, earth curvature, and no refraction.

Table 3.6.9-28. Cumulative and additive impacts within the NY Bight geographic analysis area for the 853-foot WTGs

KOP	Visibility [2]	Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact						
		EW1-2 [1] 2023–2027	OW1[1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (853-Foot) 2030	Total Cumulative Visibility
KOP-2 Lucy the Elephant	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	Not visible	16.0 (25.8) 38.6° (31%) 98 98 Moderate	14.4 (23.2) 38.9° (31%) 200 200 Major	22.1 (35.6) 38.5° (31%) 157 157 Moderate	10.8 (17.3) 71.9° (58%) 111 111 Major	Not visible	127.6° (102%) **Major**
Additive Changes	Visible WTGs		98	298	455	566		566
KOP-4 John Stafford Hall-Beach Entrance	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	Not visible	15.6 (25.1) 40.5° (3%) 98 98 Moderate	14.4 (23.2) 41.0° (33%) 200 200 Major	19.3 (31.0) 42.5° (34%) 157 157 Moderate	9.6 (15.5) 67.3° (54%) 111 111 Major	Not visible	135.6° (109%) **Major**
Additive Changes	Visible WTGs		98	298	455	566		566
KOP-5 Jim Whelan Hall-Balcony	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	Not visible	15.4 (24.8) 40.9° (33%) 98 98 Moderate	11.5 (18.4) 42.4° (34%) 200 200 Major	17.6 (28.4) 45.1° (36%) 157 157 Moderate	9.2 (14.7) 62.8° (51%) 111 111 Major	42.3 (68.1) 21.4° (17%) 38 -- Negligible	140.2° (113%) **Major**
Additive Changes	Visible WTGs		98	298	455	566	604	604
KOP-8 Beach Haven	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	Not visible	24.5 (39.4) 26.3° (21%) 98 61 Minor	13.5 (21.7) 44.8° (36%) 200 200 Major	9.8 (15.8) 87.0° (70%) 157 157 Major	20.2 (32.6) 20.3° (16%) 93 25 Moderate	32.6 (52.5) 27.2° (22%) 196 -- Minor	139.7° (113%) **Major**
Additive Changes	Visible WTGs		98	298	455	548	744	744

KOP	Visibility [2]	Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact						
		EW1-2 [1] 2023–2027	OW1[1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (853-Foot) 2030	Total Cumulative Visibility
KOP-10 Barnegat Lighthouse	Nearest WTG	50.2 (80.8)	38.6 (62.2)	27.3 (44.0)	10.1 (16.2)	35.4 (57.0)	32.3 (52.0)	
	Horizontal FOV	15.6° (13%)	17.3° (14%)	28.6° (23%)	58.1° (47%)	13.9° (11%)	63° (51%)	169.6° (137%)
	Visible Rotor	34	58	200	157	58	1,009	
	Visible Hub	--	25	200	157	22	111	
	Impact	Negligible	Minor	Moderate	Major	Minor	Minor	**Major**
Additive Changes	Visible WTGs	34	92	292	449	507	1,516	1,516
KOP-13 Mantoloking	Nearest WTG	34.1 (54.9)	Not visible	Not visible	25.8 (41.5)	Not visible	Not visible	
	Horizontal FOV	22.6° (18%)			19.4° (16%)			138.1° (111%)
	Visible Rotor	74			128			
	Visible Hub	--			43			
	Impact	Minor			Moderate			**Moderate**
Additive Changes	Visible WTGs	74			202			202
KOP-18 Allenhurst Residential Historic District	Nearest WTG	24.4 (39.3)	Not visible	Not visible	39.0 (62.8)	Not visible	Not visible	
	Horizontal FOV	25.7° (21%)			8.0° (6.5%)			116.2° (94%)
	Visible Rotor	157			30			
	Visible Hub	54			--			
	Impact	Moderate			Minor			**Moderate**
Additive Changes	Visible WTGs	157			187			187
KOP-26 Fort Tilden	Nearest WTG	21.2 (33.9)	Not visible	Not visible	Not visible	Not visible	Not visible	
	Horizontal FOV	15.7° (13%)						15.7° (13%)
	Visible Rotor	154						
	Visible Hub	53						
	Impact	Moderate						**Moderate**
Additive Changes	Visible WTGs	154						154

KOP	Visibility [2]	Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact EW1-2 [1] 2023–2027	OW1[1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (853-Foot) 2030	Total Cumulative Visibility
KOP-28 Jones Beach	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	14.2 (22.9) 52.4° (42%) 174 170 Major	Not visible	Not visible	Not visible	Not visible	31.4 (50.5) 23.1° (19%) 110 -- Minor	60.5° (49%) **Major**
Additive Changes	Visible WTGs	174					284	284
KOP-31 Westhampton Beach	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	37.9 (61.0) 12.9° (10%) 43 -- Minor	Not visible	Not visible	Not visible	Not visible	33.9 (54.5) 8.9° (7%) 52 -- Negligible	22.3° (18%) **Minor**
Additive Changes	Visible WTGs	43					95	95
KOP-32 Fire Island Lighthouse-Upper Deck	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	21.7 (35.0) 61.7° (50%) 174 174 Major	Not visible	Not visible	Not visible	Not visible	24.2 (39.0) 34.7° (28%) 212 110 Moderate	82.8° (67%) **Major**
Additive Changes	Visible WTGs	174					386	386
KOP-35 Twin Lights Lighthouse	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	22.4 (36.1) 14.2° (11.5%) 174 174 Major	Not visible	Not visible	50.0 (80.5) 6.3° (5%) 48 -- Negligible	Not visible	44.1 (70.9) 41.1° (33%) 115 -- Minor	89.5° (72%) **Major**
Additive Changes	Visible WTGs	174			222		337	337

KOP	Visibility [2]	EW1-2 [1] 2023–2027	OW1[1] 2024–2025	ASOW South [1] 2025-2027	ASOW North [1] 2026–2030	OW2 [1] 2026–2030	NY Bight Projects (853-Foot) 2030	Total Cumulative Visibility
		Distance in Miles (Kilometers), FOV Degrees (% of 124°), and Impact						
KOP-36 Asbury Park Hall-Top	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	24.9 (40.0) 26.1° (21%) 168 74 Moderate	Not visible	Not visible	38.1 (61.4) 8.2° (6.6) 48 2 Minor	Not visible	42.6 (68.6) 6.1° (5%) 11 -- Negligible	**Moderate**
Additive Changes	Visible WTG	168			216		227	227
KOP-37 Point O' Woods	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	23.9 (38.5) 55.2° (44.5%) 174 174 Moderate	Not visible	Not visible	Not visible	Not visible	24.1 (38.7) 25.7° (21%) 110 73 Minor	**Moderate**
Additive Changes	Visible WTGs	174					284	284
KOP-39 Empire State Building Observation Deck	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	34.1 (54.9) 16.7° (13.5%) 174 174 Moderate	Not visible	Not visible	74.2 (119.5) 4.3° (3.5%) 43 -- Negligible	Not visible	55.8 (89.8) 33.5° (27%) 186 110 Negligible	**Moderate**
Additive Changes	Visible WTGs	174			217		403	403
KOP-40 Robert Moses Field 5 – nighttime	Nearest WTG Horizontal FOV Visible Rotor Visible Hub Impact	21.3 (34.2) 62.9° (51%) 174 174 Major	Not visible	Not visible	Not visible	Not visible	24.2 (39.0) 28.3° (23%) 110 50 Moderate	**Major**
Additive Changes	Visible WTGs	174					284	284

[1] Atlantic Shores (ASOW) leases – WTG blade tip height is 1,049 feet (319.7 meters), Empire Wind (EW) leases – WTG blade tip height is 951 feet (290 meters), Ocean Wind (OW) leases - WTG blade tip height is 906 feet (276 meters).
[2] Theoretically visible base on clear sky, earth curvature, and no refraction.

Traffic (vessel): Development of six NY Bight projects would increase construction vessel traffic in and near the geographic analysis area during construction, O&M, and conceptual decommissioning. BOEM estimates the NY Bight projects would collectively generate up to 306 vessels per day during construction and 58 vessel trips per day during O&M (see Section 3.6.6, *Navigation and Vessel Traffic*). Impacts would be greatest if all six NY Bight projects overlapped, resulting in the potential for all vessels to be operating in the lease areas or over export cable routes at any given time. This would potentially increase daily ship traffic in and around the ports of New York and New Jersey more than seven-fold during construction and slightly more than double (117-percent increase) during O&M. Planned offshore wind project construction and installation, O&M, and conceptual decommissioning would further increase vessel traffic in the geographic analysis area beyond what the NY Bight projects would generate in isolation. Stationary and moving vessels would change the daytime and nighttime seascape and open ocean characters from open ocean to active waterway. Increases in these vessel movements would be noticeable to onshore and offshore viewers and would have moderate to major, long-term effect.

3.6.9.4.4 Conclusions

Impacts of Alternative B. Impacts on high- and moderate-sensitivity open ocean, seascape, and landscape character units from one NY Bight project and six NY Bight projects would be **negligible** to **major**, due to view distances; minor to moderate FOVs; strong, moderate, and weak visual contrasts; clear-day conditions; and nighttime lighting. The open ocean, seascape, and landscape character units and viewer experience would be affected during construction and installation, O&M, and conceptual decommissioning by the project's features, applicable distances, horizontal and vertical FOV extents, view framing or intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence. These assessments are documented in Appendix H. Project conceptual decommissioning impacts would be similar to construction and installation impacts. Due to distance, extensive FOVs, strong contrasts, large scale of change, and level of prominence, as well as previously undeveloped ocean views, the NY Bight projects would have **moderate** to **major** impacts (the magnitude of change per BOEM 2021) on the open ocean character unit and viewer boating and cruise ship experiences. The daytime presence of offshore WTGs and OSSs, as well as their nighttime lighting, would change perception of ocean scenes from natural and undeveloped to a developed wind energy environment characterized by WTGs and OSSs. In clear weather, the WTGs and OSSs would be a noticeable presence in views from elevated viewpoints and select areas of the coastline, with **minor** to **major** impacts on seascape character and **negligible** to **minor** impacts on landscape character, and **major** impacts on open ocean character. Impacts on viewers at elevated KOPs would be **minor** to **major** for the 1,312-foot WTGs and **negligible** to **major** for the 853-foot WTGs.

Onshore, temporary impacts would occur during construction and installation and conceptual decommissioning of the landfalls and onshore export cables. Impacts during O&M activities would likely involve temporary vehicular and personnel presence. Onshore visual impacts will be determined through project-specific NEPA evaluations of individual COPs.

Cumulative Impacts of Alternative B. The impacts contributed by six NY Bight projects to the cumulative impacts on scenic and visual resources would be appreciable. BOEM anticipates that the impacts associated with six NY Bight projects when combined with the impacts from ongoing and planned activities including other offshore wind development would range from **negligible** to **major**. Impacts to character types would range from **major** impacts to open ocean, **moderate** to **major** impacts to seascape, and **minor** to **major** impacts to landscape character types due to industrialization of the open ocean environment. The main drivers for this impact rating are the major visual impacts associated with the presence of structures, lighting, and vessel traffic.

3.6.9.5 Impacts of Alternative C (Proposed Action) – Identification of AMMM Measures at the Programmatic Stage – Scenic and Visual Resources

Alternative C, the Proposed Action, considers the potential impacts of future offshore wind development for the NY Bight Area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, that could avoid, minimize, mitigate, and monitor those impacts. Alternative C consists of two sub-alternatives—Sub-alternative C1: Previously Applied AMMM Measures, and Sub-alternative C2: Previously Applied and Not Previously Applied AMMM Measures. The analysis for Sub-alternative C1 is presented as the change in impacts from those impacts discussed under Alternative B, and the analysis for Sub-alternative C2 is presented as the change from those impacts discussed in Sub-alternative C1. Refer to Table G-1 in Appendix G, *Mitigation and Monitoring*, for a complete description of AMMM measures that make up the Proposed Action.

3.6.9.5.1 Sub-alternative C1 (Preferred Alternative): Previously Applied AMMM Measures

Sub-alternative C1 analyzes the AMMM measures that BOEM has required as conditions of approval for previous activities proposed by lessees in COPs submitted for the Atlantic OCS or through related consultations (Table 3.6.9-29).

Table 3.6.9-29. Summary of previously applied avoidance, minimization, mitigation, and monitoring measures for scenic and visual resources

Measure ID	Measure Summary
MUL-37	This measure would require lessees use ADLS, which will activate the FAA warning lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night.

Impacts of One Project

The identification of AMMM measures under Sub-alternative C1 could potentially reduce impacts on scenic and visual resources compared to those under Alternative B for the lighting IPF. Impacts for other IPFs would remain the same as described under Alternative B.

Lighting: With MUL-37, a single NY Bight project would be required to use ADLS, which activates the aviation warning lighting system in response to detection of nearby aircraft. The synchronized flashing of the aviation lights would occur only when aircraft are present, resulting in shorter-duration night sky impacts on the SLIA open ocean, seascape, and landscape character areas and reducing impacts to people with views of the seascape and open ocean from areas of New York and New Jersey within 36 miles of leases (the typical distance from which the aviation warning lights are visible on the 1,312-foot WTGs from non-elevated viewpoints). This measure would also reduce impacts on the natural, undeveloped, solitude, and other characteristics of Wilderness Areas or Wilderness Study Areas. Based on 2018–2019 air traffic over the nearby Atlantic Shores South (OCS-A 0499) and Empire Wind (OCS-A 0512) lease areas and hours of sunlight and darkness: (1) the Atlantic Shores South (OCS-A 0499) ADLS-controlled obstruction lights would be activated for 9 hours over a 1-year period, 1 percent of the normal operating time that would occur without ADLS (Atlantic Shores 2022); and (2) the Empire Wind (OCS-A 0512) ADLS-controlled obstruction lights would be activated for 357 hours, 46 minutes, and 45 seconds over a 1-year period, 7.5 percent of the normal operating time that would occur without ADLS (Equinor 2022). A single NY Bight project is estimated to have similar or fewer shorter-duration synchronized flashing of ADLS, as compared to the standard continuous, medium-intensity red strobe FAA warning system. The ADLS aviation warning lighting would be in use for the duration of O&M of any of the NY Bight projects.

Impacts of Six Projects

For six NY Bight projects, the AMMM measures would be the same as described for one NY Bight project, but they would reduce impacts on scenic and visual resources associated with a larger number of turbines across a larger geographic area, and therefore would affect more land and ocean receptors. Most significantly, MUL-37 would reduce nighttime lighting impacts by requiring ADLS on all six NY Bight projects.

Cumulative Impacts of Sub-alternative C1 (Preferred Alternative)

Under Sub-alternative C1, the same ongoing and planned activities (including offshore wind) as those under Alternative B would contribute to impacts on scenic and visual resources. The construction, installation, O&M, and conceptual decommissioning for six NY Bight projects with AMMM measures would still cumulatively affect scenic and visual resources across the geographic analysis area, although at a slightly reduced level.

3.6.9.5.2 Sub-Alternative C2: Previously Applied and Not Previously Applied AMMM Measures

Sub-alternative C2 analyzes the AMMM measures under Sub-alternative C1 plus the AMMM measures that have not been previously applied (Table 3.6.9-31).

Table 3.6.9-30. Summary of not previously applied avoidance, minimization, mitigation, and monitoring measures for scenic and visual resources

Measure ID	Measure Summary
VIS-7	This measure proposes lessees prepare and implement a scenic and visual resource monitoring plan that would compare the visual effects of a wind farm during construction and O&M to the findings in the COP VIA and verify the accuracy of the visual simulations. The plan would also include monitoring of ADLS.

Impacts of One Project

Presence of structures: AMMM measure VIS-7 would require lessees to monitor the visual effects of the offshore wind facilities. This measure would improve accountability and provide a means to verify that impacts on scenic and visual resources during construction and O&M are consistent with the impacts disclosed in the COP VIA. While application of this measure would improve accountability, it would not alter the impact determination.

Impacts of Six Projects

AMMM measure VIS-7 would provide valuable monitoring data for all six NY Bight projects across the geographic analysis area, which would provide information about the real scale of impacts during O&M but would not reduce the impact levels.

Cumulative Impacts of Sub-alternative C2

Under Sub-alternative C2, the same ongoing and planned activities (including offshore wind) as those under Alternative B would contribute to impacts on scenic and visual resources. The construction, installation, O&M, and conceptual decommissioning for six NY Bight projects with previously applied and not previously applied AMMM measures would still cumulatively affect scenic and visual resources across the geographic analysis area, the same as under Sub-alternative C1.

3.6.9.5.3 Conclusions

Impacts of Alternative C. The impact of one NY Bight project and six NY Bight projects under Sub-alternative C1 and Sub-alternative C2 on open ocean character, seascape character, landscape character, and viewer experience would be similar to the impacts of Alternative B during daytime hours. Sub-alternative C1 and Sub-alternative C2 would have **moderate** to **major** impacts on the seascape and open ocean unit character and viewer boating and cruise ship experiences. Due to view distances, moderate FOVs, moderate and weak visual contrasts, clear-day conditions, and nighttime ADLS activation, impacts of Sub-alternative C1 and Sub-alternative C2 on high- and moderate-sensitivity landscape character units would be **negligible** to **major**. The AMMM measures under Sub-alternative C1 would reduce nighttime visual impacts from implementation of ADLS. The not previously applied AMMM measures in Sub-alternative C2 would improve accountability but would not alter the impact determination. The overall impact of both one and six NY Bight projects under Sub-alternative C1 and Sub-alternative C2 would result in **negligible** to **major** impacts on scenic resources and viewer experience within the geographic analysis area due to the addition of new structures, facility lighting, onshore construction, and increased vessel traffic.

Cumulative Impacts of Alternative C. The impact of six NY Bight projects under Sub-alternative C1 and Sub-alternative C2 combined with all other planned activities (including other offshore wind activities) would result in **negligible** to **major** impacts on scenic resources and viewer experience within the geographic analysis area due to the addition of new structures, facility lighting, onshore construction, and increased vessel traffic.

3.6.9.6 Recommended Practices for Consideration at the Project-Specific Stage

In addition to the AMMM measures identified under Alternative C, BOEM is recommending lessees consider analyzing the RPs in Table 3.6.9-31 to further reduce potential scenic and visual resources impacts. Refer to Table G-2 in Appendix G for a complete description of the RPs.

Table 3.6.9-31. Recommended Practices for scenic and visual resources impacts and related benefits

Recommended Practice	Potential Benefit
VIS-1: Select an onshore transmission tower type that has the least amount of visual contrast within the surrounding setting and the extended landscape within view of the transmission line. The transmission towers should be color-treated or powder-coated to reduce visual contrast.	This RP would minimize visual contrast impacts associated with onshore transmission towers by selecting transmission towers that minimize visual contrast and color-treating towers to reduce visual contrast. This RP would reduce impacts on SLIA character areas and VIA viewer experiences from future KOPs (determined in the COP VIA) in the vicinity of future onshore infrastructure.
VIS-2: Color-treat substation facilities to minimize visual contrast with the surrounding setting and extended landscape within view.	This RP would minimize visual contrast impacts associated with substations/converter stations by color-treating facilities to blend with the surrounding setting and extended landscape within view. This RP would reduce impacts on SLIA character areas and VIA viewer experiences from future KOPs (determined in the COP VIA) in the vicinity of future onshore infrastructure.
VIS-3: Use non-specular conductors for overhead transmission powerlines to avoid glare commonly associated with untreated conductors.	This RP would minimize visual impacts by selecting non-specular conductors for overhead transmission powerlines to minimize contrast and avoid glare. This RP would reduce impacts on SLIA character areas and VIA viewer experiences from future KOPs (determined in the COP VIA) in the vicinity of future onshore infrastructure.
VIS-4: Use polymer insulators to minimize glare commonly associated with glass insulators. Polymer insulators should be of a color that minimizes visual contrast with the surrounding setting and the extended landscape that is within view.	This RP would involve selecting polymer insulators to minimize visual contrast and avoid glare. This RP would reduce impacts on SLIA character areas and VIA viewer experiences from future KOPs (determined in the COP VIA) in the vicinity of future onshore infrastructure.
VIS-5: Treat security fencing to eliminate glare and minimize visual contrast with the surrounding setting and the extended landscape that is within view.	This RP would involve treating security fencing to minimize visual contrast and avoid glare. This RP would reduce impacts on SLIA character areas and VIA viewer experiences from future KOPs (determined in the COP VIA) in the vicinity of future onshore infrastructure.
VIS-6: Ensure lighting at onshore and offshore facilities follows night lighting principles and artificial lighting BMPs to avoid light pollution.	This RP would minimize onshore and offshore lighting impacts through adherence to night lighting principles to avoid light pollution and artificial lighting BMPs for facilities. This RP would reduce impacts on SLIA character areas and VIA viewer experiences from future KOPs (determined in the COP VIA) in the vicinity of future infrastructure.

Recommended Practice	Potential Benefit
VIS-8: Prepare a methodology for using and integrating BOEM's 2021 SLVIA guidance into the COP SLVIA and submit it to BOEM for review and comment before initiating the impact assessment.	This RP would ensure a streamlined but thorough approach to analyzing visual impacts and measure effectiveness of visual RPs 1 through 6 (VIS-1–VIS-6) if they are not incorporated into project design.

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Chapter 4

Other Required Impact Analyses

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4.1 Unavoidable Adverse Impacts of the Proposed Action

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(2)) require that NEPA analyses evaluate the potential unavoidable adverse impacts associated with a Proposed Action. The Proposed Action (Sub-alternative C1 [Preferred Alternative] and Sub-alternative C2) considers the potential impacts of future offshore wind development for the NY Bight area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, at the programmatic stage that could avoid, minimize, mitigate, and monitor those impacts. However, even with AMMM measures, development would still result in unavoidable adverse impacts. This PEIS does not approve any activities, so these unavoidable impacts would occur if and when COPs are approved and after COP-specific NEPA analysis is completed. Table 4.1-1 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, *Affected Environment and Environmental Consequences,* 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 PEIS, regardless of whether COPs for NY Bight leases are approved at the subsequent NEPA stage.

Table 4.1-1. Potential unavoidable adverse impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Physical Resources	
Air Quality and Greenhouse Gas Emissions	• Air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation
Water Quality	• Increase in erosion, turbidity, and suspended sediments due to seafloor disturbance, and inadvertent spills during construction and installation, O&M, and conceptual decommissioning
Biological Resources	
Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs
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 or alteration, equipment activity and noise, and vessel traffic • Individual mortality due to construction activities
Birds	• Displacement and avoidance behavior due to habitat loss or alteration, equipment noise, and vessel traffic • Individual mortality due to collisions with operating WTGs

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
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 collisions with vehicles or equipment during clearing and grading activities, particularly species with limited mobility
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 • Entrainment/impingement due to HVDC converter OSSs and use of construction equipment • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat
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, vessel traffic, aircraft, WTG operation, and dredging during construction and operations • Presence of structures resulting in hydrodynamic effects that influence primary and secondary productivity and availability of prey and forage resources • Increased risk of individual injury and mortality due to vessel strikes • Increased risk of individual injury and mortality associated with fisheries gear
Sea Turtles	• Increased risk for individual injury and mortality due to vessel strikes during construction and installation, O&M, and conceptual decommissioning • Increased risk of individual injury and mortality associated with fisheries gear • Disturbance, displacement, and avoidance behavior due to habitat disturbance and underwater noise during construction
Wetlands	• Wetland and surface water alterations, including increased sedimentation and removal of vegetation
Socioeconomic Conditions and Cultural Resources	
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption of access or temporary restriction in harvesting activities due to construction • Disruption of harvesting activities during operations of offshore wind facilities • 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 marine and terrestrial archaeological resources • Physical impacts on ancient submerged landforms
Demographics, Employment, and Economics	• Disruption of onshore and marine recreational businesses during onshore and offshore construction and cable installation • Potential changes to ocean economy sectors due to the long-term presence of offshore wind facilities, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses

Resource Area	Potential Unavoidable Adverse Impacts of the Proposed Action
Environmental Justice	• Compounded health issues of local environmental justice communities near ports as a result of air quality impacts from engine emissions 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 subsistence fishing due to offshore construction and operation of the offshore wind facilities
Land Use and Coastal Infrastructure	• Land use disturbance due to construction as well as effects due to noise and travel delays • Potential for accidental releases during construction
Navigation and Vessel Traffic	• Congestion in port channels • Increased navigational complexity, vessel congestion, and allision and collision risk within the NY Bight lease areas, along potential export cable corridors, and along vessel routes to/from ports • Potential for disruption to marine radar on smaller vessels operating within or in the vicinity of the NY Bight lease areas, increasing navigational complexity • Hindrances to USGS SAR missions within the NY Bight lease areas
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 NY Bight lease areas • Changes to aviation and air traffic navigational patterns
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 to, or temporary restriction of, in-water recreational activities from offshore construction • 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
Scenic and Visual Resources	• Alterations to the ocean, seascape, landscape character units' character, and effects on viewer experience by the wind farm, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations, converter stations or both, and electrical connections with the power grid

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4.2 Irreversible and Irretrievable Commitment of Resources

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(4)) require that NEPA analyses 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.

If chosen by BOEM, the Proposed Action (Sub-alternative C1 [Preferred Alternative] and Sub-alternative C2) discussed in this Final PEIS considers the potential impacts of future offshore wind development for the NY Bight area with the AMMM measures identified in Appendix G, *Mitigation and Monitoring*, at the programmatic stage that could avoid, minimize, mitigate, and monitor those impacts. Additional mitigation measures would then be considered throughout the development of the COP, project-specific NEPA documents, and for project-specific consultations, as summarized below.

- As required under 30 CFR 585, NY Bight lessees are expected to submit a COP, which typically includes, as part of the Proposed Action, measures to which the lessees commit to reduce impacts.
- BOEM, in consultation with cooperating agencies, participating agencies, and Cooperating Tribal Governments, will propose mitigation measures in the development of the project-specific NEPA document. These will be published in the Draft NEPA document for public review and comment.
- The completion of project-specific consultations under the MMPA, ESA Section 7, the Magnuson-Stevens Fishery Conservation and Management Act, and Section 106 of the NHPA may result in additional measures or changes to the measures.

Table 4.2-1 provides a listing of potential irreversible and irretrievable impacts by resource area. Chapter 3 provides additional information on the impacts summarized below.

Table 4.2-1. Irreversible and irretrievable commitment of resources by resource area for the Proposed Action

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Physical Resources			
Air Quality and Greenhouse Gas Emissions	No	No	BOEM expects air pollutant emissions to comply with permits regulating compliance with air quality standards. Emissions would be temporary during construction activities. During O&M, emissions would be limited to the lifetime of each NY Bight project. To the extent that the NY Bight projects

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
			displace fossil-fuel energy generation, overall improvement of air quality would be expected.
Water Quality	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies or wetlands. Turbidity and other water quality impacts in marine and coastal environments would be short term.
Biological Resources			
Bats	No	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. Tree clearing for onshore components would result in habitat loss for bat species. Decommissioning of the NY Bight projects would reverse some of the impacts of bat displacement and allow foraging habitat to recover.
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	No	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 NY Bight 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 onshore facilities is 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.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality of finfish and invertebrates, and habitat alteration and temporary loss of submerged aquatic vegetation 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

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
			invertebrates would recover following decommissioning activities.
Marine Mammals	No	Yes	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 behavioral effects with severe consequences or be injured or killed would be reduced or eliminated. No irreversible high-severity behavioral effects from NY Bight project activities are anticipated; however, due to the uncertainties from lack of information that are outlined in Appendix E, *Analysis of Incomplete and Unavailable Information*, 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 NY Bight lease areas.
Sea Turtles	No	Yes	The implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for impacts on ESA-listed species, and irreversible impacts on sea turtles are not expected. 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 caught on the structures, or due to displacement from the NY Bight lease areas.
Wetlands	No	No	BOEM expects most NY Bight projects would avoid activities that would cause loss of, or major impacts on, wetlands to the extent feasible.
Socioeconomic Conditions and Cultural Resources			
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and installation and O&M activities, BOEM does not anticipate irreversible impacts on commercial fisheries and for-hire recreational fishing. The NY Bight projects could alter habitat during construction and installation and O&M activities, limit access to fishing areas during construction and installation, or reduce vessel maneuverability during O&M. However, the decommissioning of the NY Bight projects would reverse those impacts. Irretrievable impacts (lost revenue) could occur due to the loss of use of fishing areas at an individual level.
Cultural Resources	Yes	Yes	Although unlikely, unanticipated removal or disturbance of cultural resources onshore and

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
			offshore could result in irreversible and irretrievable impacts.
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 decommissioning of the NY Bight projects or by other employment, but income lost during O&M would be irretrievable.
Land Use and Coastal Infrastructure	Yes	Yes	Land use for construction and operation could result in irretrievable and irreversible impacts due to the temporary or long-term loss of use of the land. Onshore facilities may or may not be decommissioned. Depending largely on future consultations with state and municipal agencies, onshore facilities (e.g., onshore substations and converter stations and buried duct banks) would either be retired in place or reused for other purposes.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and installation and O&M activities, BOEM does not anticipate impacts on vessel traffic to result in irreversible impacts. Irretrievable impacts could occur due to changes in transit routes, which could be less efficient during the life of the NY Bight projects.
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during construction and installation, O&M, and decommissioning activities. Placement of offshore cables may result in irretrievable impacts on marine mineral extraction if cables restrict access to mineral resources, but access to these resources would return following decommissioning. Irretrievable impacts would also occur for radar systems as a result of interference caused by the presence of WTGs, which would last until decommissioning. Irreversible and irretrievable impacts are not expected for military use, aviation, and cables and pipelines.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Recreation and Tourism	No	No	Construction and installation activities near the shore could result in a temporary loss of use of the land for recreation and tourism purposes.
Scenic and Visual Resources	No	Yes	Until post-decommissioning, the following irretrievable impacts could occur: 1) long-term impacts on seascape units, open ocean units, and landscape units' character alterations; and 2) effects on viewer experience due to the wind farms, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations or converter stations (or both), and electrical connections to the power grid.

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4.3 Relationship Between the Short-term Use of the Human Environment and the Maintenance and Enhancement of Long-term Productivity

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(3)) require that NEPA analyses 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 Chapter 3, BOEM anticipates that the majority of the potential adverse effects associated with the NY Bight projects 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 NY Bight projects, which include:

- Promotion of clean and safe development of domestic energy sources, and creation of clean energy jobs;
- 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 New York and New Jersey energy grid to contribute to the states' renewable energy requirements; and
- Generation of new offshore wind energy resources to advance the Administration's goal of 30 GW of offshore wind energy capacity by 2030 and consistency with Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad."

As it relates specifically to the Proposed Action, long-term benefits include:

- Identification of AMMM measures that BOEM may require as conditions of approval for activities proposed by lessees in COPs submitted for the NY Bight lease areas that could reduce impacts from construction and installation, O&M, and conceptual decommissioning of the NY Bight projects.

Based on the anticipated potential impacts evaluated in this document that could occur during construction and installation, O&M, and conceptual decommissioning of the NY Bight projects, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the NY Bight projects would not result in impacts that would significantly narrow the range of future uses of the environment. Removal or disturbance of habitat associated with onshore activities could create long-term irreversible impacts. For purposes of this analysis, BOEM assumes that the irreversible impacts presented in Table 4.2-1 would be long term. After completion of the O&M and decommissioning phases of the NY Bight projects, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.