OCS EIS
BOEM 2023-052

Docket Number: BOEM-2023-0047

Volume 2

Coastal Virginia Offshore Wind Commercial Project Final Environmental Impact Statement

September 2023

Estimated Lead Agency Total Costs to Prepare the Draft and Final EIS: $1,850,000

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

BOEM
Bureau of Ocean Energy Management

OCS EIS
BOEM
2023-052

Coastal Virginia Offshore Wind Commercial Project Final Environmental Impact Statement

Volume 2

Docket Number: BOEM-2023-0047

September 2023

Author:

Bureau of Ocean Energy Management
Office of Renewable Energy Programs

Published by:

U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

Appendix A. Required Environmental Permits and Consultations

A.1. Required Environmental Permits

Table A-1 includes a summary of federal, state, and local permits or approvals that are required for Project implementation.

Table A-1 Required Environmental Permits for the Proposed Project

Agency/Regulatory Authority	Permit/Approval	Status
Federal (Portions of the Project within Federal Jurisdiction)		
BOEM	COP Approval	COP filed with BOEM on December 17, 2020. Updates to the COP were submitted on June 29, 2021, October 29, 2021, December 3, 2021, May 6, 2022, February 28, 2023, and July 31, 2023. BOEM's decision to approve, approve with modifications, or disapprove the COP is anticipated by January 29, 2024.
BSEE	Oil Spill Response Plan	Planned.
BSEE	Safety Management System	Planned.
BSEE	Facility Design Report and Fabrication and Installation Report non-objection	Planned.
FAA	FAA Form 7460-1, Notice of Proposed Construction or Alteration (for Hazard to Air Navigation Determination)	Submitted on April 5, 2022, and determinations received on May 10, 2022.
NMFS	MMPA Section 101(a)(5) Letter of Authorization	Dominion Energy submitted a Letter of Authorization application to NMFS on February 16, 2022. The application was reviewed and considered complete on August 12, 2022. NMFS published a Notice of Receipt in the *Federal Register* on September 15, 2022. NMFS published the proposed Incidental Take Regulations in the *Federal Register* on May 4, 2023. Issuance of the Letter of Authorization is anticipated by February 5, 2024.
USACE - Norfolk District	CWA Section 404 Permit and RHA Section 10 Permit	The initial RHA Section 10 and CWA Section 404 application was submitted on May 17, 2022. The complete application was received on August 31, 2022 and USACE published a Public Notice on September 15, 2022. Issuance of the permit decision is anticipated by January 29, 2024.

Agency/Regulatory Authority	Permit/Approval	Status
USACE - Norfolk District	CWA Section 408 Permit	The initial application was submitted on May 17, 2022. A revised application was submitted on July 15, 2022 and USACE determined it was complete on August 1, 2022. Issuance of the permit decision is anticipated by January 29, 2024.
USCG	PATON authorization	Planned.
USCG	Local Notice to Mariners per Ports and Waterways Safety Act	Planned.
USEPA	CAA OCS Air Permit	The initial air permit application was submitted on January 12, 2023. The air permit application was determined to be complete on February 7, 2023. Issuance of the permit decision is anticipated by February 7, 2024.
State (Portions of the Project within State Jurisdiction)		
VMRC	Submerged Land Permit	Planned.
SCC	Certificate of Public Convenience and Necessity	Application submitted on November 5, 2021 and approved on August 5, 2022.
VDEQ, NCDEQ	CZMA Section 307 Consistency Certification	VDEQ review was started December 12, 2021. A decision is anticipated on July 16, 2023 (four stays agreed upon from March 24, 2022, to May 1, 2023).
VDEQ	Virginia Water Protection Individual Permit	Planned.
VDEQ	CWA Section 401 Water Quality Certification	Planned.
VDEQ	Conformity Determination	Formal determination of applicability will result from further discussion with USEPA and VDEQ.
VDEQ	Emergency Generator General Permit	Planned.
VDEQ	Construction Stormwater General Permit Authorization	Planned.
VDEQ	Stormwater Pollution Prevention Plan	Planned.
VDEQ	Erosion and Sediment Control Plan	Planned.
VDCR	Virginia Scenic Rivers and invasive species consultation; invasive species management plan	Planned.
VDWR	Natural heritage/protected species consultation	Planned.
VDHR	Historic properties consultation	Planned.
VDMA-VaARNG	Consultation for SMR activities	Planned.
VDACS	Consultation	Planned.
VDOF	Consultation	Planned.

Agency/Regulatory Authority	Permit/Approval	Status
Local (Portions of the Project within Local Jurisdiction)		
City of Virginia Beach	Floodplain Development Permit	Planned.
City of Virginia Beach	Land Disturbance Permit	Planned.
City of Virginia Beach	Conditional Use Permit/Site Plan Review	Planned.
Chesapeake	Floodplain Development Permit	Planned.
Chesapeake	Conditional Use Permit/Site Plan Review	Planned.
Local Wetlands Board Virginia Beach	Local Wetlands Approvals	Planned.
Various Virginia Counties / Municipalities, and Virginia Department of Transportation	Transportation permits (use of wide load and similar vehicles on public roads)	Planned.

BOEM = Bureau of Energy Management; BSEE = Bureau of Safety and Environmental Enforcement; COP = Construction and Operations Plan; FAA = Federal Aviation Administration; MMPA = Marine Mammal Protection Act; CWA = Clean Water Act; NCDEQ = North Carolina Department of Environmental Quality; Q = quarter; RHA = Rivers and Harbors Act; SCC = State Corporation Commission; SMR = State Military Reservation; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; USEPA = U.S. Environmental Protection Agency; VCADS = Virginia Department of Agriculture and Consumer Services; VDEQ = Virginia Department of Environmental Quality; VDHR = Virginia Department of Historic Resources; VDMA-VaARNG = Virginia Department of Military Affairs-Virginia Army National Guard; VDOF = Virginia Department of Forestry; VDOR = Virginia Department of Forestry; VMRC = Virginia Marine Resources Commission

A.2. Consultation and Coordination

A.2.1 Introduction

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

A.2.2 Consultations

The following sections provide summaries and status of each consultation. BSEE is a co-action agency for the ESA and EFH consultations.

A.2.2.1 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) requires that any applicant for a required federal license or permit to conduct an activity, within the coastal zone or within the geographic location descriptions (i.e., areas outside the coastal zone in which an activity would have reasonably foreseeable coastal effects), affecting any land or water use or natural resource of the coastal zone be consistent with the enforceable policies of a state's federally approved coastal management program. The Virginia Coastal Zone Management Program (CZMP) was established in 1986 and is administered by VDEQ, which serves as the lead agency for the network of Virginia state agencies and local governments that administer the CZMP. The North Carolina CZMP was established in 1978 and is administered by the North Carolina Division of Coastal Management, which serves as the lead agency for the network of North Carolina state agencies and local governments that administer the CZMP. Dominion Energy submitted a Coastal Zone consistency certification in the Coastal Virginia Offshore Wind Project (CVOW-C) COP. Appendix P (Dominion Energy 2023) provides the data and information necessary to certify that the construction, operations and maintenance (O&M), and decommissioning of the Project will be consistent with the CZMP, in accordance with CZMA § 307(c)(3)(A) and 15 Code of Federal Regulations (CFR) § 930, subpart D. VDEQ and the North Carolina DCM will review the reasonably foreseeable effects of the Project on coastal use or resources for consistency with the enforceable policies of the Virginia and North Carolina CZMPs. The state's concurrence is required before BOEM may approve or approve with conditions the CVOW-C COP per 30 CFR 585.628(f) and 15 CFR 930.130(1).

A.2.2.2 Endangered Species Act

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 United States Code [U.S.C.] 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either the National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (USFWS), depending upon the jurisdiction. Pursuant to 50 CFR 402.07, BOEM has accepted designation as the lead federal agency for the purposes of fulfilling interagency consultation under Section 7 of the ESA for listed species under the jurisdiction of NMFS and USFWS. BOEM is consulting on the proposed activities considered in this Final EIS with both NMFS and USFWS and has prepared biological assessments for listed species under their respective jurisdictions. BOEM transmitted the draft biological assessment to NMFS on September 21, 2022, and NMFS received the complete consultation package and initiated consultation on April 4, 2023. BOEM transmitted the draft biological assessment to FWS on August 31, 2022, and USFWS received the complete consultation package and initiated the consultation on March 31, 2023. NMFS's and USFWS's biological opinions were issued on September 1, 2023.

A.2.2.3 Government-to-Government Tribal Consultation

Executive Order 13175 commits federal agencies to engage in government-to-government consultation with tribes when federal actions have tribal implications. A June 29, 2018, memorandum outlines BOEM's current tribal consultation policy (BOEM 2018). This memorandum states that "consultation is a deliberative process that aims to create effective collaboration and informed federal decision-making" and is in keeping with the spirit and intent of Executive Order 13175 (BOEM 2018). BOEM implements tribal consultation policies through formal government-to-government consultation, informal dialogue, collaboration, and other engagement.

BOEM hosted a government-to-government consultation meeting with the Rappahannock Indian Tribe, Pamunkey Indian Tribe, Nansemond Indian Nation, Chickahominy Indian Tribe, Upper Mattaponi Indian

Tribe, Monacan Indian Nation, Delaware Nation, Delaware Tribe of Indians, Mashpee Wampanoag Tribe, Eastern Band Cherokee Indians, Passamaquoddy Tribe, Mashantucket (Western) Pequot Tribal Nation, and Cultural Heritage Partners (who represent several tribes) on September 27, 2021. During the meeting, BOEM presented information about both the CVOW-C and Kitty Hawk Wind projects and discuss scoping comments received from federally recognized tribes for both projects.

BOEM presented on the Project at the USEPA's Region 3 Regional Tribal Operations Committee meeting on January 10, 2023. Representatives from Nansemond Indian Nation, Chickahominy Indian Tribe, Chickahominy Indian Tribe - Eastern Division, Monacan Indian Nation, Rappahannock Tribe, Pamunkey Indian Tribe, and Upper Mattaponi Indian Tribe were in attendance.

BOEM hosted a government-to-government meeting on January 30, 2023, with representatives from Delaware Tribe of Indians, Nansemond Indian Nation, Chickahominy Indian Tribe, Chickahominy Indian Tribe - Eastern Division, Monacan Indian Nation, Rappahannock Tribe, and Upper Mattaponi Indian Tribe. Multiple tribal representatives expressed concerns related to potential Project impacts on fish, including types of sturgeon, shad, and herring. Multiple tribal representatives wanted more information regarding impacts on historic properties, and requested a complete terrestrial archaeological report and more information on visual impacts.

In response to feedback in the January 30 meeting, BOEM hosted an informal meeting for tribal representatives to discuss potential Project impacts on fisheries on April 10, 2023 (see Table A-2 for a list of attendees). At the meeting, BOEM presented on shortnose and Atlantic sturgeon in the CVOW-C Project area, including results of recent studies on sturgeon populations and habitat use, as well as anticipated types of impacts; all information presented was incorporated into the Final EIS and the NMFS ESA Section 7 Biological Assessment (BOEM 2022). BOEM also presented on other anadromous fish, mollusks, eels, and fish habitat in the CVOW-C Project area; information on potential impacts on these species, as well as shad, river herring, and sea bass, were incorporated into the Final EIS and NMFS ESA Section 7 Biological Assessment. Following the meeting, BOEM provided attendees with the briefing materials used by BOEM and a link to the draft NMFS Section 7 Biological Assessment on BOEM's website.

Table A-2 Tribal Fisheries Meeting Attendees

Name	Role	Organization
Leigh Mitchell	Natural Resources & Environmental Protection Coordinator	Upper Mattaponi Indian Tribe
Reggie Tupponce	Tribal Administrator	Upper Mattaponi Indian Tribe
Kyle McLemore	Environmental Technician	Upper Mattaponi Indian Tribe
Susan Bachor	Deputy Tribal Historic Preservation Officer	Delaware Tribe of Indians
William Cook	Partner	Cultural Heritage Partners
Olga Symeonoglou	Attorney at Law	Cultural Heritage Partners
Jessica Phillips	Environmental Director	Chickahominy Indian Tribe, Eastern Division
Jack Ryan	Environmental Director	Rappahannock Tribe
Bonnie Houghton	NEPA Coordinator	BOEM
Laura (LK) Schnitzer	Archaeologist	BOEM
Brian Hooker	Lead Biologist	BOEM
Brandon Jensen	Fish Biologist	BOEM
Liz Oliver	Renewable Energy Tribal Liaison	BOEM

Name	Role	Organization
Greg Fulling	Marine Biologist	BOEM
Bettina Washington	Tribal Historic Preservation Officer	Wampanoag Tribe of Gayhead (Aquinnah)
Judith Shapiro	*Attending on behalf of*:	Shinnecock Nation
Quinn Buchwald	Policy Lead	National Congress of American Indians
Cultural Heritage Partners, PLLC	*Attending on behalf of:*	Nansemond Indian Nation, Chickahominy Indian Tribe, Chickahominy Indian Tribe-Eastern Division, Monacan Indian Nation, Rappahannock Tribe, and Upper Mattaponi Indian Tribe

A.2.2.4 National Historic Preservation Act

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

The Section 106 regulations at 36 CFR 800.8 provide for use of the NEPA substitution process to fulfill a federal agency's NHPA Section 106 review obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6. This process is commonly known as "NEPA substitution for Section 106", and BOEM is using this process and documentation required for the preparation of this EIS and the Record of Decision (ROD) to comply with Section 106. Appendix O, *Finding of Adverse Effect for the Coastal Virginia Offshore Wind Commercial Construction and Operations Plan*, of this Final EIS contains BOEM's Finding of Adverse Effect, which includes a description and summary of BOEM's consultation. BOEM has consulted with the Virginia State Historic Preservation Office (SHPO), North Carolina SHPO, Advisory Council on Historic Preservation (ACHP), federally recognized tribes, and consulting parties regarding the identification of historic properties, assessment of effects, and avoidance, minimization, and mitigation measures to resolve of adverse effects. BOEM has conducted Section 106 consultation meetings on the Project, the results of historic property identification, the Finding of Adverse Effect, and resolution of adverse effects. Consistent with use of the NEPA substitution process to fulfill Section 106 requirements, BOEM has codified the resolution of adverse effects through a Memorandum of Agreement (MOA) pursuant to 36 CFR 800.6(c). See Appendix O, Attachment A for the MOA.

BOEM fulfilled public involvement requirements for Section 106 of the NHPA through the NEPA public scoping and public meetings process, pursuant to 36 CFR 800.2(d)(3). The Scoping Summary Report (BOEM 2021), available on BOEM's Project-specific website, summarizes comments related to cultural, historical, and archaeological resources. On June 28, 2021, BOEM contacted ACHP, Virginia SHPO, and North Carolina SHPO to provide Project information, notify of BOEM's intention to use the NEPA process to fulfill Section 106 obligations in lieu of the procedures set forth in 36 CFR 800.3 through 800.6, and invite these organizations to be consulting parties.

On June 28, 2021, BOEM corresponded with 59 points of contact from governments, non-governmental and preservation organizations, and non-federally recognized tribes by mail and email. The correspondence included information about the Project, an invitation to be a consulting party to the NHPA Section 106 review of the COP, and the Notice of Intent to prepare an EIS. BOEM also used this correspondence to notify of its intention to use the NEPA process for Section 106 purposes, as described in 36 CFR 800.8(c), during its review. To aid those consulting parties not familiar with the NEPA substitution process, BOEM developed a *National Environmental Policy Act (NEPA) Substitution for Section 106 Consulting Party Guide* (available at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/NEPA-Substitution-Consulting-Party-Guide.pdf).

On July 2, 2021, BOEM contacted the following federally recognized tribes by email and mail with information about the Project, an invitation to be a consulting party to the NHPA Section 106 review of the COP, and the Notice of Intent to prepare an EIS: the Eastern Shawnee Tribe of Oklahoma, Shawnee Tribe, Cherokee Nation, Eastern Band of Cherokee Indians, United Keetoowah Band of Cherokee Indians in Oklahoma, Absentee-Shawnee Tribe of Indians of Oklahoma, Delaware Nation, Delaware Tribe of Indians, Shinnecock Indian Nation, Narragansett Indian Tribe, Pamunkey Indian Tribe, Chickahominy Indian Tribe, Chickahominy Indian Tribe – Eastern Division, Upper Mattaponi Indian Tribe, Rappahannock Tribe, Nansemond Indian Nation, Tuscarora Nation, and Monacan Indian Nation. BOEM also used this correspondence to notify of its intention to use the NEPA process for Section 106 purposes, as described in 36 CFR 800.8(c), during its review.

BOEM held NHPA Section 106 consultation meetings with consulting parties on September 9, 2022; December 15, 2022; April 13, 2023; and June 12, 2023; and August 28, 2023. Additional details on the subject of these meetings as well as other milestones in BOEM's consultation on the Project are summarized in Appendix O, Section O.2.2, *NHPA Section 106 Consultations*.

Participants that have accepted consulting party status for the NHPA Section 106 Consultation are listed in Table A-3. BOEM considers federally recognized tribes to be consulting parties until they request in writing to not consult on the Project. The Absentee-Shawnee Tribe of Indians of Oklahoma and Shawnee Tribe informed BOEM that the Project is outside their respective areas of interest. The Mashantucket (Western) Pequot Tribal Nation informed BOEM they only wish to consult on projects off the coast of New England.

Table A-3 NHPA Section 106 Consulting Parties

Participants in the Section 106 Process	Participating Consulting Parties
SHPOs and state agencies	North Carolina State Historic Preservation Office Virginia Department of Historic Resources
Federal agencies or facilities	Advisory Council on Historic Preservation Bureau of Safety and Environmental Enforcement Colonial National Historic Park NASA Wallops Flight Facility Naval History and Heritage Command (Underwater Archaeology Branch) U.S. Army Corps of Engineers, Eastern Virginia Regulatory Section U.S. Coast Guard U.S. Fish and Wildlife Service U.S. Fleet Forces Command U.S. National Park Service U.S. Navy Region Mid-Atlantic Virginia Army National Guard

Participants in the Section 106 Process	Participating Consulting Parties
Federally recognized tribes	Chickahominy Indian Tribe (represented by Cultural Heritage Partners) Chickahominy Indian Tribe – Eastern Division (represented by Cultural Heritage Partners) Delaware Tribe of Indians Monacan Indian Nation (represented by Cultural Heritage Partners) Nansemond Indian Nation (represented by Cultural Heritage Partners) Pamunkey Indian Tribe Rappahannock Indian Tribe (represented by Cultural Heritage Partners) The Delaware Nation Upper Mattaponi Indian Tribe (represented by Cultural Heritage Partners)
Non-federally recognized tribes	Lumbee Tribe of North Carolina Nottoway Indian Tribe of Virginia Patawomeck Indian Tribe of Virginia The Coharie Tribe
Local governments	Accomack County City of Norfolk City of Virginia Beach Town of Chincoteague Town of Eastville
Nongovernmental organizations or groups	Atlantic Wildfowl Heritage Museum Cavalier Associates, LLC Chesapeake Bay Bridge and Tunnel District Council of Virginia Archaeologists Eastern Shore of Virginia Historical Society Nansemond River Preservation Alliance Outer Banks Conservationists Preservation Virginia Property Owner for House at 4910 Ocean Front Avenue Ruffin 86, LLC Sandbridge Beach Civic League Sandswept, LLC The Historic Cavalier Shores Civic League Virginia African American Cultural Center
Lessee	Dominion Energy

A.2.2.5 Magnuson-Stevens Fishery Conservation and Management Act

Pursuant to Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), federal agencies are required to consult with NMFS on any action that may result in adverse effects on Essential Fish Habitat (EFH). NMFS regulations implementing the EFH provisions of the MSA can be found at 50 CFR 600. As provided for in 50 CFR 600.920(b), BOEM has accepted designation as the lead agency for the purposes of fulfilling EFH consultation obligations under Section 305(b) of the MSA. Certain OCS activities authorized by BOEM may result in adverse effects on EFH and, therefore, require consultation with NMFS. BOEM developed an EFH Assessment concurrent with the Draft EIS and transmitted the EFH Assessment to NMFS on August 31, 2022. NMFS received the complete EFH Assessment from BOEM and initiated the EFH consultation on April 10, 2023. NMFS issued EFH conservation recommendations on July 21, 2023. BOEM will respond to NMFS on how it will proceed with the Action, and relevant terms and conditions will be incorporated into the ROD.

A.2.2.6 Marine Mammal Protection Act

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

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

Dominion Energy submitted a Letter of Authorization application to NMFS on February 16, 2022. The application was reviewed and considered complete on August 12, 2022. NMFS published a Notice of Receipt in the *Federal Register* on September 15, 2022. NMFS published the proposed Incidental Take Regulations in the *Federal Register* on May 4, 2023. NMFS plans to publish the final Incidental Take Authorization Regulations in the *Federal Register* by January 5, 2024, and to render the Incidental Take Authorization decision by February 5, 2024.

A.2.3 Development of the Final Environmental Impact Statement

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

A.2.3.1 Scoping

On July 2, 2021, BOEM issued a Notice of Intent (NOI) to prepare an EIS consistent with NEPA regulations (42 U.S.C. 4321 et seq.) to assess the potential impacts of the Proposed Action and alternatives (83 *Federal Register* 13777). The NOI commenced a public scoping process for identifying issues and potential alternatives for consideration in the EIS. The formal scoping period was from July 2, 2021 through August 2, 2021. BOEM held three virtual public scoping meetings to solicit feedback and identify issues and potential alternatives for consideration in the EIS. Throughout this timeframe, federal agencies, state and local governments, and the general public had the opportunity to help BOEM identify potential significant resources and issues, impact producing factors (IPFs), reasonable alternatives (e.g., size, geographic, seasonal, or other restrictions on construction and siting of facilities and activities), and potential mitigation measures to analyze in the EIS, as well as provide additional information. BOEM also used the NEPA scoping process to initiate the Section 106 consultation process under the NHPA (54 U.S.C. 300101 et seq.), as permitted by 36 CFR 800.2(d)(3), which requires federal agencies to assess the effects of projects on historic properties. Additionally, BOEM informed its Section 106 consultation by seeking public comment and input through the NOI regarding the identification of historic properties or potential effects on historic properties from activities associated with approval of the COP (Dominion Energy 2023). The NOI requested comments from the public in written form, delivered by hand or by mail, or through the http://regulations.gov web portal.

BOEM held three virtual scoping meetings on July 12, 14, and 20, 2021. BOEM reviewed and considered all scoping comments in the development of the Draft EIS and used the comments to identify alternatives for analysis. A Scoping Summary Report (BOEM 2021) summarizing the submissions received and the methods for analyzing them is available on BOEM's website at https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/20211116_Final_Scoping_Report_CVOW.pdf. In addition, all public scoping submissions received can be viewed online at http://www.regulations.gov by typing "BOEM-2021-0040" in the search field. As detailed in the Scoping Summary Report, the resource areas or NEPA topics most referenced in the scoping comments include the NEPA/public involvement process; recreation and tourism; mitigation and monitoring; commercial fisheries and for-hire recreational fishing; birds; demographics, employment and economics; and others.

A.2.3.2 Cooperating Agencies

BOEM invited other federal agencies and state, tribal, and local governments to consider becoming cooperating agencies in the preparation of the Final EIS. According to Council on Environmental Quality (CEQ) guidelines, qualified agencies and governments are those with "jurisdiction by law or special expertise" (CEQ 1981). BOEM asked potential cooperating agencies to consider their authority and capacity to assume the responsibilities of a cooperating agency, and to be aware that an agency's role in the environmental analysis neither enlarges nor diminishes the final decision-making authority of any other agency involved in the NEPA process. BOEM also asked agencies to consider the "Factors for Determining Cooperating Agency Status" in Attachment 1 to CEQ's January 30, 2002 Memorandum for the Heads of Federal Agencies (CEQ 2002). BOEM held interagency meetings on August 19, 2021, October 18, 2021, and December 17, 2021, to discuss the environmental review process, schedule, responsibilities, consultation, and potential alternatives.

The following federal agencies and state, tribal, and local governments have supported preparation of the Final EIS as cooperating agencies:

- NMFS
- USACE
- Bureau of Safety and Environmental Enforcement (BSEE)
- USEPA
- USCG
- USFWS
- U.S. Department of Defense (DOD)
- Virginia Mines Minerals & Energy Department (VA DMME)

In response to BOEM's invitation to be a cooperating agency, the National Park Service and the US Navy requested to support the environmental review as a participating agency instead.

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

USACE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. As applicable, permits and authorizations are issued pursuant to Sections 10 and 14 of the RHA and Section 404 of the CWA. As an offshore wind energy project, the Project needs to be situated offshore in the water. Consequently, the fill activities associated with the Project—which consist of the inter-array cables, armoring at the base of the WTG foundations, protective cable armoring for the export cables, and temporary cofferdams—are water dependent. Issuance of Section 10 or Section 404 permits requires NEPA compliance, which will be met via adoption of BOEM’s EIS and issuance of the ROD.

BSEE is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect marine resources under its jurisdiction by law and special expertise. The reorganization of the Renewable Energy rules (30 CFR Parts 285, 585, and 586) enacted on January 31, 2023) reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to BSEE.

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

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

USFWS is serving as a cooperating agency pursuant to 40 CFR 1501.8 because the scope of the Proposed Action and alternatives involves activities that could affect resources under its jurisdiction by law and special expertise. USFWS also serves as the Consulting Agency under Section 7 of the ESA for federal agencies proposing actions that may affect terrestrial resources listed as threatened or endangered.

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

VA DMME is serving as a cooperating agency pursuant to 40 CFR 1501.8 because it has special expertise with respect to potential impacts that may occur as a result of the Proposed Action.

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

On December 16, 2022, BOEM published a Notice of Availability for the Draft EIS. The Draft EIS was made available in electronic format for public viewing at https://www.boem.gov/renewable-energy/state-activities/CVOW-C. Notification was provided as indicated in Appendix K, *List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent,* of the Draft EIS. Hard copies and digital copies of the Draft EIS were delivered to entities as requested. The Notice of Availability commenced the 60-day public review and comment period of the Draft EIS. BOEM held three virtual public hearings to solicit feedback and identify issues for consideration in preparing the Final EIS. Throughout the public review and comment period, government agencies, members of the public, and interested stakeholders had the opportunity to provide comments on the Draft EIS in various ways, including the following:

- In hard copy form, delivered by mail, enclosed in an envelope labeled "CVOW-C EIS" and addressed to Program Manager, Office of Renewable Energy, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166.
- Through the regulations.gov web portal by navigating to https://www.regulations.gov/, searching for docket number "BOEM-2022-0069," and submitting a comment.
- By attending one of the virtual public hearings held on Wednesday, January 25, 2023; Tuesday, January 31, 2023; and Thursday, February 2, 2023, and providing written or verbal comments.

BOEM reviewed and considered all comment submissions in the development of the Final EIS, except those from anonymous sources. BOEM's evaluation of public submissions focused on those comments in the submissions that were identified as substantive. EIS Appendix N describes the public comment processing methodology and includes comment responses. All public comment submissions received on the Draft EIS can be viewed online at https://www.regulations.gov/ by typing "BOEM-2022-0069" in the search field.

A.2.3.4 Distribution of the Final Environmental Impact Statement

The EIS is available in electronic form for public viewing at https://www.boem.gov/renewable-energy/state-activities/CVOW-C. Hard copies and digital copies of the Final EIS can be requested by contacting the Program Manager, Office of Renewable Energy Programs in Sterling, Virginia. Publication of the Final EIS initiates a minimum 30-day mandatory waiting period, during which BOEM is required to pause before issuing a ROD. The ROD will state clearly whether BOEM intends to approve, approve with conditions, or disapprove the COP for construction, operation, and eventual decommissioning of the Project. Notification will be provided as indicated in Appendix K of the Final EIS.

A.3. References Cited

Bureau of Ocean Energy Management (BOEM). 2018. *Tribal Consultation Guidance*. June 29, 2018. Available: https://www.boem.gov/sites/default/files/about-boem/Public-Engagement/Tribal-Communities/BOEM-Tribal-Consultation-Guidance-with-Memo.pdf.

Bureau of Ocean Energy Management (BOEM). 2021. *Coastal Virginia Offshore Wind Commercial Project Construction and Operations Plan Scoping Report.* Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/20211116_Final_Scoping_Report_CVOW.pdf.

Bureau of Ocean Energy Management (BOEM). 2022. *Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment*. September 2022. 147 pp.

Council on Environmental Quality (CEQ). 1981. *Memorandum to Agencies: Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulation*. Amended 1986. Available: https://www.energy.gov/nepa/downloads/forty-most-asked-questions-concerning-ceqs-national-environmental-policy-act. Accessed: August 2021.

Council on Environmental Quality (CEQ). 2002. *Memorandum for the Heads of Federal Agencies: Cooperating Agencies in Implementing the Procedural Requirements of the National Environmental Policy Act*. Available: https://www.energy.gov/sites/prod/files/nepapub/nepa_documents/RedDont/G-CEQ-CoopAgenciesImplem.pdf. Accessed: September 11, 2020.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Appendix B. List of Preparers and Reviewers

Table B-1 Bureau of Ocean Energy Management Contributors

Name	Role/Resource Area
NEPA Coordinator	
Houghton, Bonnie	Environmental Protection Specialist
Resource Scientists and Contributors	
Baker, Kyle	Marine Mammals; Sea Turtles
Bigger, David	Birds; Bats; Coastal Habitat and Fauna
Brune, Genevieve	Land Use and Coastal Infrastructure
Denes, Sam	Marine Acoustician
Dobbs, Kerby	Other Uses – Marine Minerals
Draher, Jennifer	Water Quality
Draher, Jennifer	Oceanographer; Technical Design Elements
Fulling, Gregory	Marine Mammals; Sea Turtles
Heinze, Martin	Demographics, Employment, and Economics
Hildreth, Emily	Policy, Environmental Planning
Horrell, Chris	Marine Archaeologist
Houghton; Bonnie	Other Uses – Military, Aviation
Jensen, Brandon	Benthic Resources: Commercial Fisheries and For-Hire Recreational Fishing; Finfish, Invertebrates, and Essential Fish Habitat
Jensen, Mark	Demographics, Employment, Economics; Recreation and Tourism
Krevor, Brian	CZMA, NEPA Team Lead
MacDuffee, Dave	Chief, Projects, and Coordination Branch
McCarty, John	Visual Resources
Moshier, Marissa	Historian
Oliver, Elizabeth	Tribal Liaison
Ololade, Ajilore	Navigation and Vessel Traffic
Schnitzer, Laura K	Archaeologist, Section 106 Coordinator
Stokely, Sarah	Cultural Resources Team Lead
Wolf, Jacob	Air Quality

NEPA = National Environmental Policy Act; CZMA = Coastal Zone Management Act

Table B-2 USACE Support Staff to BOEM Contributors

Name	Role/Resource Area
NEPA Coordinators	
McCormick, John	Project Manager
Woodward, Justine	NEPA Coordinator
Resource Scientists and Contributors	
Colvin, Brandon	Scenic and Visual Resources
Martin, Zach	Marine Mammals; Sea Turtles
Perdue, Kathy	Coastal Habitat and Fauna; Wetlands

Name	Role/Resource Area
Schulte, Dave	Benthic Resources; Coastal Habitat and Fauna; Commercial Fisheries and For-Hire Recreational Fishing
Woodward, Justine	Birds; Bats; Other Uses

Table B-3 Reviewers

Name	Title	Agency
Andersen, Troy	Supervisory Fish & Wildlife Biologist, Virginia Field Office	USFWS
Argo, Emily	Biologist	USFWS, Virginia Field Office
Brown, William Y.	Chief Environmental Officer	BOEM
Christopher, Al	Director, Energy Team	VA DOE
Creelman, Matthew	District 5 Secondary Point of Contact District	USCG
Davis, Jamie	NEPA Reviewer	USEPA
Giordano, Juliette	Environmental Compliance Program Point of Contact	BSEE
Krueger, Mary	Energy Specialist	NPS Interior Region 1, North Atlantic - Appalachian
Ledwin, Jane	Infrastructure Streamlining Coordinator	USFWS
McCulloch, Tom	Assistant Director, Federal Property Management Section, Office of Federal Agency Programs	ACHP
Miller, Martin	Ecological Services	USFWS
Monroe, Lori	Solicitor	DOI
Morin, Michelle	Chief, Environment Branch for Renewable Energy	BOEM
Nevshehirlian, Stepan	Chief, Environmental Assessment Branch (NEPA)	USEPA
Sample, Steven	Executive Director, DOD Siting Clearinghouse	DOD
Schulz, Cindy	Field Office Supervisor, Virginia Field Office	USFWS
Supplee, Gwendolyn	Air Permitting Contact, Permits Branch	USEPA
Traver, Carrie	Lead NEPA Reviewer	USEPA
Tuxbury, Sue	Fishery Biologist/Wind Coordinator, Greater Atlantic Regional Fisheries Office Habitat and Ecosystems Services Division	NMFS
Vail-Muse, Stephanie	Regional Energy Coordinator	USFWS
Vorkoper, Stephen	Solicitor	DOI
Waller, Blake	NAS Oceana Environmental Program Director	US Navy
Woodward, Justine	Biologist	USACE
Woodward, Nicole	Environmental Scientist, Project Manager-Southern Virginia Regulatory Section	USACE

USFWS = U.S. Fish and Wildlife Service BOEM = Bureau of Ocean Energy Management; VA DOE = Virginia Department of Energy; USCG = U.S. Coast Guard; USEPA = U.S. Environmental Protection Act; BSEE = Bureau of Safety and Environmental Enforcement; NPS = National Park Service; ACHP = Advisory Council on Historic Preservation; DOI = U.S. Department of the Interior; DOD = U.S Department of Defense; NMFS = National Marine Fisheries Service; USACE = U.S. Army Corps of Engineers

Table B-4 Consultants

Name	Company	Role/Resource Area
Baer, Sarah	ICF	Demographics, Employment, and Economics; Environmental Justice
Bartlett, Alex	ICF	Deputy Project Manager; Water Quality; Wetlands
Barkaszi, Mary Jo	CSA	Marine Mammals; Sea Turtles
Brown, Sheri	ICF	Scenic and Visual Resources
Byram, Saadia	ICF	Editor
Cady, Robert	CSA	Bats; Birds
Cherry, Jesse	ICF	Publications Specialist
Cherry, Ken	ICF	Editor
Clermont, Jason	CSA	Commercial Fisheries and For-Hire Recreational Fishing
Cox, Deneisha	ICF	Administrative Record
Cwalinski, Emma	ICF	Public Engagement
Diller, Elizabeth	ICF	Project Director
Dodillet, Grace	CSA	Coastal Habitat and Fauna
Erickson, Robert	CSA	Coastal Habitat and Fauna
Ernst, David	ICF	Air Quality/Climate
Fownes, Jennifer	ICF	Project Coordinator; Other Uses (Marine Minerals, Military Use, Aviation); Planned Activities Scenario
Gleaton, Soniya	ICF	Comment Processing
Graham, Bruce	CSA	Benthic Resources
Ha, Anthony	ICF	Publications Specialist
Hartigan, Kayla	CSA	Marine Mammals; Sea Turtles
Hatfield, Teresa	ICF	Navigation and Vessel Traffic; Environmental and Physical Setting
Irvin, Elizabeth	ICF	Editor
Jablon, Rebecca	ICF	Demographics, Employment, and Economics; Environmental Justice
Johnson, David	ICF	Water Quality; Wetlands
Johnson, Lissa	ICF	Geographic Information Systems
Jost, Rebecca	ICF	Recreation and Tourism
Lanza, Robert, P.E.	ICF	Planned Activities Scenario; QA/QC
Lassell, Susan	ICF	Cultural Resources and Section 106 Lead
Le, Alyssa	ICF	Land Use and Coastal Infrastructure
Lundstrom, Kristen	ICF	Editor
Martin, Tony	CSA	Finfish, Invertebrates, and EFH
McCoy, Maureen	ICF	Section 106 Support, Architectural History
McMahon, Adrianna	CSA	Benthic Resources; Finfish, Invertebrates, and EFH
Mendoza, Tiffany	ICF	Public Involvement
Munaretto, Claire	ICF	Demographics, Employment, and Economics; Environmental Justice
Muntz, Alice	ICF	Section 106 Support, Terrestrial and Marine Archaeology
Olsen, Kim	CSA	CSA Project Manager

Name	Company	Role/Resource Area
Paulson, Merlyn	ICF	Scenic and Visual Resources
Piggott, Jennifer	ICF	Public Involvement
Read, Brent	ICF	Geographic Information Systems
Schanel, Pam	ICF	Project Manager
Stevens, Tara	CSA	Marine Mammals; Sea Turtles
Stutts, Ben	ICF	Recreation and Tourism
Tiggelaar, John	CSA	Commercial Fisheries and For-Hire Recreational Fishing
Unyi, Stephen	ICF	Publications Specialist

QA/QC = quality assurance/quality control

Appendix C. References Cited and Glossary

C.1. References Cited

Executive Summary

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

C.1.1 Chapter 1, Purpose and Need

Bureau of Ocean Energy Management (BOEM). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf. Final Environmental Impact Statement.* October. OCS EIS/EA MMS 2007-046. Available: https://www.boem.gov/renewable-energy/guide-ocs-alternative-energy-final-programmatic-environmental-impact-statement-eis.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment.* January. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Mid-Atlantic_Final_EA_012012.pdf.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

C.1.2 Chapter 2, Alternatives Including the Proposed Action

Bureau of Ocean Energy Management (BOEM). 2022. *Process for Identifying Alternatives for Environmental Reviews of Offshore Wind Construction and Operations Plans Pursuant to the National Environmental Policy Act (NEPA).* Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEM%20COP%20EIS%20Alternatives-2022-06-22.pdf. Accessed: September 10, 2022.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Jabs, Mitchell M. Manager, Environmental, Dominion Energy Services, Inc. March 16, 2023— Email to Bonnie Houghton, NEPA Coordinator, BOEM, regarding onshore cable bundling engineering details.

C.1.3 Chapter 3, Affected Environment and Environmental Consequences

C.1.3.1. Section 3.1, Impact-Producing Factors

Bureau of Ocean Energy Management (BOEM). 2017. *Evaluating Benefits of Offshore Wind Energy Projects in NEPA*. July. BOEM 2017-048. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/Final-Version-Offshore-Benefits-White-Paper.pdf.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf.* May. OCS Study BOEM 2019-036. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf.

C.1.3.2. Section 3.2, Mitigation Identified for Analysis in the Environmental Impact Statement

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

C.1.3.3. Section 3.3, Definition of Impact Levels

No references cited.

C.1.3.4. Section 3.4, Air Quality

Barthelmie, R.J., and S.C. Pryor. 2021. Climate Change Mitigation Potential of Wind Energy. *Climate* 9(9):136.

Buonocore, J.J., P. Luckow, J. Fisher, W. Kempton, and J.I. Levy. 2016. Health and Climate Benefits of Offshore Wind Facilities in the Mid-Atlantic United States. *Environmental Research Letters* 11 (2016) 074019. DOI:10.1088/1748-9326/11/7/074019.

Council on Environmental Quality (CEQ). 2023. *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change*. Available: https://www.federalregister.gov/d/2023-00158. Accessed: March 2023.

Dolan, S.L., and G.A. Heath. 2012. Life Cycle Greenhouse Gas Emissions of Utility-Scale Wind Power. *Journal of Industrial Ecology* 16(S1):S136–54.

Dominion Energy, Inc. (Dominion Energy). 2020. *Virginia Electric and Power Company's Report of Its Integrated Resource Plan*. Available: https://www.dominionenergy.com/-/media/pdfs/global/2020-va-integrated-resource-plan.pdf?la=en&rev=fca793dd8eae4ebea4ee42f5642c9509. Accessed: March 1, 2022.

Dominion Energy, Inc. (Dominion Energy). 2023a. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dominion Energy, Inc. (Dominion Energy). 2023b. *Outer Continental Shelf Air Permit Application, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. January.

Federal Land Managers' Air Quality Related Values Work Group (FLAG). 2010. Phase I Report—Revised. Natural Resource Report NPS/NRPC/NRR—2010/232. Available: https://www.fws.gov/guidance/sites/guidance/files/documents/FLAG Air Quality Phase 1 report.pdf. Accessed: June 28, 2023.

Ferraz de Paula, L., and B.S. Carmo. 2022. Environmental Impact Assessment and Life Cycle Assessment for a DeepWater Floating OffshoreWind Turbine on the Brazilian Continental Shelf. *Wind* (2):495–512. DOI:10.3390/wind2030027.

Interagency Working Group on Social Cost of Greenhouse Gases (IWG). 2021. *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide – Interim Estimates under Executive Order 13990*. Available: https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf. Accessed: November 2, 2022.

Katzenstein, W., and J. Apt. 2009. Air Emissions Due to Wind and Solar Power. *Environmental Science and Technology* 43(2):253–258. DOI:10.1021/es801437t.

Kempton, W., J. Firestone, J. Lilley, T. Rouleau, and P. Whitaker. 2005. The Offshore Wind Power Debate: Views from Cape Cod. *Coastal Management Journal* 33(2):119–149. DOI:10.1080/08920750590917530.

Kitty Hawk Wind North. 2021. *Kitty Hawk Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Kitty Hawk Wind South. 2022. *Kitty Hawk South Offshore Wind Project Construction and Operations Plan.* Prepared by Tetra Tech, Inc. April.

Monitoring Analytics. 2021. *2020 State of the Market Report for PJM*. Available: https://www.pjm.com/-/media/committees-groups/committees/mc/2021/20210329-special/20210329-state-of-the-market-report-for-pjm-2020.ashx. Accessed: November 8, 2021.

National Oceanographic and Atmospheric Administration (NOAA). 2006. *Small Diesel Spills (500–5000 gallons)*. Available: https://dec.alaska.gov/spar/ppr/response/sum_fy10/100111201/NOAAFactsheet_Diesel.pdf. Accessed: November 2, 2021.

National Renewable Energy Laboratory (NREL). 2021. *Life Cycle Assessment Harmonization*. Available: https://www.nrel.gov/analysis/life-cycle-assessment.html. Accessed: January 31, 2023.

O'Donoughue, P.R., G.A. Heath, S.L. Dolan, and M. Vorum. 2014. Life Cycle Greenhouse Gas Emissions of Electricity Generated from Conventionally Produced Natural Gas: Systematic Review and Harmonization. *Journal of Industrial Ecology* 18(1):125–144. DOI:10.1111/jiec.12084.

Rueda-Bayona, J.G., J.J. Cabello Eras, and T.R. Chaparro. 2022. Impacts generated by the materials used in offshore wind technology on Human Health, Natural Environment and Resources. *Energy* 261 (Part A):125223. DOI:10.1016/j.energy.2022.125223.

Shoaib, Nawal. 2022. A Study on Wind Farms in New Jersey : Life Cycle Assessment and Acceptance of Wind Farms by the Tourists. *Theses, Dissertations and Culminating Projects* 1114. Available: https://digitalcommons.montclair.edu/etd/1114.

U.S. Energy Information Administration. 2014. *Oil Tanker Sizes Range from General Purpose to Ultra-Large Crude Carriers on AFRA Scale*. September 16, 2014. Available: https://www.eia.gov/todayinenergy/detail.php?id=17991. Accessed: September 12, 2021.

U.S. Environmental Protection Agency (USEPA). 1980. *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals*. EPA-450/2-81-078. Available: https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=9100ZHNW.PDF. Accessed: June 28, 2023.

U.S. Environmental Protection Agency (USEPA). 2020a. *Greenhouse Gases Equivalencies Calculator—Calculations and References*. Available: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references#vehicles. Accessed: September 16, 2021.

U.S. Environmental Protection Agency (USEPA). 2020b. CO-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool. Available: https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool. Accessed: September 16, 2021.

U.S. Environmental Protection Agency (USEPA). 2021a. *Nonattainment Areas for Criteria Pollutants (Green Book).* Available: https://www.epa.gov/green-book. Accessed: September 13, 2021.

U.S. Environmental Protection Agency (USEPA). 2021b. *Avoided Emissions and Generation Tool (AVERT)*, Web Edition. Available: https://www.epa.gov/avert/avert-web-edition. Accessed: November 23, 2021.

U.S. Environmental Protection Agency (USEPA). 2021c. *User's Manual for the CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA)*. Available: https://www.epa.gov/system/files/documents/2021-11/cobra-user-manual-nov-2021_4.1_0.pdf. Accessed: March 3, 2022.

U.S. Global Change Research Program. 2018. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*. Volume II, Chapter 19: Southeast. Available: https://nca2018.globalchange.gov/chapter/southeast. Accessed: March 1, 2022.

C.1.3.5. Section 3.5, Bats

Baerwald, E.F., and R.M.R. Barclay. 2009. Geographic Variation in Activity and Fatality of Migratory Bats at Wind Energy Facilities. *Journal of Mammalogy* 90:1341–1349.

Barclay, R.M.R., E.F. Baerwald, and J.C. Gruver. 2007. Variation in Bat and Bird Fatalities at Wind Energy Facilities: Assessing the Effects of Rotor Size and Tower Height. *Canadian Journal of Zoology* 85:381–387.

Brabant, R., Y. Laurent, B. Jonge Poerink, and S. Degraer. 2021. The Relation Between Migratory Activity of Pipistrellus Bats at Sea and Weather Conditions Offers Possibilities to Reduce Offshore Wind Farm Effects. *Animals*. 11:3457.

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment*. OCS EIS/EA BOEM 2015-031. 239 pp.

Bureau of Ocean Energy Management (BOEM). 2020. Information Guidelines for a Renewable Energy Construction and Operations Plan (COP). August. Available: https://www.boem.gov/sites/default/files/documents/about-boem/COP%20Guidelines_Technical_Corrections.pdf.

Bureau of Ocean Energy Management (BOEM). 2022. *Coastal Virginia Offshore Wind Commercial Biological Assessment for the United States Fish and Wildlife Service*. December. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C%20USFWS%20BA.pdf.

Bureau of Ocean Energy Management (BOEM). 2023. *Addendum to the Coastal Virginia Offshore Wind Commercial Biological Assessment for the United States Fish and Wildlife Service*. June.

Cheng, T.L., J.D. Reichard, J.T.H. Coleman, T.J. Weller, W.E. Thogmartin, B.E. Reichert, A.B. Bennett, H.G. Broders, J. Campbell, K. Etchison, D.J. Feller, R. Geboy, T. Hemberger, C. Herzog, A.C. Hicks, S. Houghton, J. Humber, J.A. Kath, R.A. King, S.C. Loeb, A. Massé, K.M. Morris, H. Niederriter, G. Nordquist, R.W. Perry, R.J. Reynolds, D.B. Sasse, M.R. Scafini, R.C. Stark, C.W. Stihler, S.C. Thomas, G.G. Turner, S. Webb, B.J. Westrich, and W.F. Frick. 2021. The Scope and Severity of White-Nose Syndrome on Hibernating Bats in North America. *The Society for Conservation Biology* 35:1586–1597.

Choi, D.Y., T.W. Wittig, and B.M. Kluever. 2020. An Evaluation of Bird and Bat Mortality at Wind Turbines in the Northeastern United States. *PLoS One*. 15(8):e0238034.

Cryan, P.M. 2003. Seasonal Distribution of Migratory Tree Bats (*Lasiurus and Lasionycteris*) in North America. *Journal of Mammalogy* 84:579–593.

Cryan, P.M., and R.M.R. Barclay. 2009. Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. *Journal of Mammalogy* 90:1330–1340.

Cryan P.M., M. Gorresen, C.D. Hein, M.R. Schirmacher, R.H. Diehld, M.M. Husoe, D.T.S. Hayman, P.D. Fricker, F.J. Bonaccorso, D.H. Johnson, K. Heist, and D.C. Dalton. 2014. Behavior of Bats at Wind Turbine. *Proceedings of the National Academy of Sciences* 11(42):15126–15131.

De La Cruz, J.L. 2020. *Occupancy and Roost Ecology of the Northern Long-Eared Bat and Indiana Bat on the Coastal Plain of Virginia and North Carolina.* Virginia Department of Game and Inland Fisheries Project EP2858740.

Deepwater Wind Block Island, LLC (Deepwater Wind). 2020. *Avian and Bat Acoustic Survey Final Post-Construction Monitoring Report, 2017–2020.* November. Prepared by Stantec Consulting Services, Inc.

Dominion Energy. 2022. *CVOW Pilot Project Post Construction Monitoring, February 2022 Monthly Report.* RAPR 4.3.3.1. 8 pp.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dowling, Z. P.R. Sievert, E. Baldwin, L. Johnson, S. von Oettingen, and J. Reichard. 2017. *Flight Activity and Offshore Movements of Nano-Tagged Bats on Martha's Vineyard, MA*. OCS Study BOEM 2017-054. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, Virginia. 39 pp.

Fiedler, J.K. 2004. *Assessment of Bat Mortality and Activity at Buffalo Mountain Windfarm, Eastern Tennessee.* Masters Thesis, University of Tennessee. Available: https://trace.tennessee.edu/utk_gradthes/2137.

Georgiakakis, P., E. Kret, B. Carcamo, B. Doutau, A. Kafkaletou-Diez, D. Vasilakis, and E. Papadatou. 2012. Bat Fatalities at Wind Farms in North-Eastern Greece. *Acta Chiropterologica* 14(2):459–468.

Gilardi, E., and ISLI Engineering. 2022. Bat Acoustic and Mistnetting Survey Report: Naval Air Station Oceana Dam Neck Annex. Biodiversity Research Institute. Prepared for Naval Facilities Engineering Systems Command (NAVFAC). November 2022. 84 pp.

Hamilton, R.M. 2012. *Spatial and Temporal Activity of Migratory Bats at Landscape Features*. Electronic Thesis and Dissertation Repository. 886. 90 pp.

Hann, Z.A., M.J. Hosler, and P.R. Moosman. 2017. Roosting Habits of Two *Lasiurus borealis* (eastern red bat) in the Blue Ridge Mountains of Virginia. *Northeastern Naturalist* 24(2).

Hatch S.K., E.E. Connelly, T.J. Divoll, I.J. Stenhouse, and K.A. Williams. 2013. Offshore Observations of Eastern Red Bats (*Lasiurus borealis*) in the Mid-Atlantic United States Using Multiple Survey Methods. *PLoS One*. 8:e83803.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R.P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. Ecological Impacts of Wind Energy Development on Bats: Questions, Research Needs, and Hypotheses. *Frontiers in Ecology and the Environment* 5:315–324.

Maslo, B., and K. Leu. 2013. *The Facts about Bats in New Jersey*. Rutgers New Jersey Agricultural Experiment Station. Available: https://njaes.rutgers.edu/fs1207/. Accessed: November 12, 2021.

Pelletier, S.K., K.S. Omland, K.S. Watrous, and T.S. Peterson. 2013. *Information Synthesis on the Potential for Bat Interactions with Offshore Wind Facilities: Final Repor*t. U.S. Dept of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM 2013-01163. 119 pp.

Petersen, T.S. 2016. *Long-Term Bat Monitoring on Islands, Offshore Structures, and Coastal Sites in the Gulf Of Maine, Mid-Atlantic, and Great Lakes.* Final Report. Report by Stantec Consulting Services Inc. to U.S. Department of Energy. 171 pp.

Reynolds, R. 2021. *Mixed News for Virginia's Bats After 10 Years of White-Nose Syndrome*. Virginia Department of Wildlife Resources blog. Available: https://dwr.virginia.gov/blog/mixed-news-for-virginias-bats-after-10-years-of-white-nose-syndrome/. Accessed: November 15, 2021.

Schaub, A., J. Ostwald, and B.M. Siemers. 2008. Foraging Bats Avoid Noise. *Journal of Experimental Biology* 211:3174–80. Erratum in: *J Exp Biol.* 2009. 212:3036.

Silvis, A., S.E. Sweeten, and A.B. Kniowski. 2017. *Distribution of Indiana Bats (Myotis odalist) and Northern Long-Eared Bats (*M. septentrionalis*) in Virginia.* Virginia Polytechnic Institute and State University and USGS Virginia Cooperative Fish and Wildlife Research Unit.

Simmons, A.M., K.N. Hom, M. Warnecke, and J.A. Simmons. 2016. Broadband Noise Exposure Does Not Affect Hearing Sensitivity in Big Brown Bats (*Eptesicus fuscus*). *Journal of Exploratory Biology* 219:1031–40.

Sjollema, A.L., J.E. Gates, R.H. Hilderbrand, and J. Sherwell. 2014. Offshore Activity of Bats Along the Mid-Atlantic Coast. *Northeastern Naturalist* 21(2):154–163.

Smallwood, K.S. 2020. USA Wind Energy-Caused Bat Fatalities Increase with Shorter Fatality Search Intervals. *Diversity* 12(3):98.

Smith, A.D., and S.R. McWilliams. 2016. Bat Activity During Autumn Relates to Atmospheric Conditions: Implications for Coastal Wind Energy Development. *Journal of Mammalogy* 97(6):1565–1577.

Solick, D.I., and C.M. Newman. 2021. Oceanic Records of North American Bats and Implications for Offshore Wind Energy Development in the United States. *Ecology and Evolution*. 11:14433–14447.

St. Germain, M.J., A.B. Kniowski, A. Silvis, and W.M. Ford. 2017. Who Knew? First *Myotis odalist* (Indiana bat) Maternity Colony in the Coastal Plain of Virginia. *Northeastern Naturalist* 24(1):N5–N10.

Stantec Consulting Services, Inc. (Stantec). 2016. *Long-term Bat Monitoring on Islands, Offshore Structures, and Coastal Sites in the Gulf of Maine, mid-Atlantic, and Great Lakes*. Final report to US Department of Energy.

Stantec Consulting Services Inc. (Stantec). 2018. *2017 Acoustic Monitoring Block Island Wind Farm, Rhode Island.* Prepared for Deepwater Wind Block Island, LLC. Stantec Consulting Services Inc., Topsham, ME.

Stantec Consulting Services (Stantec). 2020. *Avian and Bat Acoustic Survey Final Post-Construction Monitoring Report, 2017–2020; Block Island Wind Farm, Rhode Island*. November 25.

Tetra Tech, Inc. (Tetra Tech). 2019. *Northern Long-eared Bat Survey Report. Naval Air Station Oceana Dam Neck Annex Virginia Beach, Virgini*a. NAVFAC Atlantic Biological Resource Services.

Timpone, J., K.E. Francl, D. Sparks, V. Brack, and J. Beverly. 2011. Bats of the Cumberland Plateau and Ridge and Valley Provinces, Virginia. *Southeastern Naturalist* 10(3):515–528.

True, M.C., R.J. Reynolds, and W.M. Ford. 2021. Monitoring and Modeling Tree Bat (Genera: *Lasiurus, Lasionycteris*) Occurrence Using Acoustics on Structures Off the Mid-Atlantic Coast- Implications for Offshore Wind Development. *Animals* 11:3146.

Udell, B.J., B.R. Straw, T. Cheng, K.D. Enns, F. Winfred, B.S. Gotthold, K.M. Irvine, C. Lausen, S. Loeb, J. Reichard, T. Rodhouse, D.A. Smith, C. Stratton, W.E. Thogmartin, A.M. Wiens, B.E. Reichert. 2022. *Status and Trends of North American Bats Summer Occupancy Analysis 2010-2019* Data Release: U.S. Geological Survey data release. DOI:10.5066/P92JGACB.

Virginia Department of Wildlife Resources (VDWR). 2021. *Threatened and Endangered Faunal Species*. Virginia Department of Wildlife Resources, Special Status Faunal Species in Virginia. 24 pp. Available: https://dwr.virginia.gov/wp-content/uploads/media/virginia-threatened-endangered-species.pdf.

Whitaker, J.O. Jr., 1998. Life History and Roost Switching in Six Summer Colonies of Eastern Pipistrelles in Buildings. *Journal of Mammalogy* 79:651–659.

C.1.3.6. Section 3.6, Benthic Resources

Albert, L., O. Maire, F. Olivier, C. Lambert, A. Romero-Ramirez, A. Jolivet, L. Chauvaud, and S. Chauvaud. 2022. Can Artificial Magnetic Fields Alter the Functional Role of the Blue Mussel, *Mytilus edulis*? *Marine Biology* 169:75. DOI:10.1007/s00227-022-04065-4.

Anderson, C.M., M. Mayes, and R.P. LaBelle. 2012. Update of Occurrence Rates for Offshore Oil Spills. Bureau of Ocean Energy Management OCS Report 2012-069. Herndon, VA: Bureau of Ocean Energy Management. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Environmental_Stewardship/Environmental_Assessment/Oil_Spill_Modeling/AndersonMayesLabelle2012.pdf.

Avanti Corporation and Industrial Economics Inc. 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf.* Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. Report No. OCS Study BOEM 2019-036. 201 pp.

Bakker, P., A. Schmittner, and J.T.M. Lenaerts. 2016. Fate of the Atlantic Meridional Overturning Circulation: Strong Decline Under Continued Warming and Greenland Melting. *Geophysical Research Letters* 43:12252–12260.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment*. January. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Mid-Atlantic_Final_EA_012012.pdf. Accessed: November 15, 2021.

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment*. OCS EIS/EA BOEM 2015-031. 239 pp.

Bureau of Ocean Energy Management (BOEM). 2019. *Guidelines for Providing Benthic Habitat Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585*. Available: https://www.boem.gov/sites/default/files/renewable-energy-program/Regulatory-Information/BOEM-Renewable-Benthic-Habitat-Guidelines.pdf. Accessed: November 22, 2021.

Bureau of Ocean Energy Management (BOEM). 2020. *Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585.* Office of Renewable Energy Program. May 27, 2020. Available: https://www.boem.gov/sites/default/files/documents/about-boem/GG-Guidelines.pdf. Accessed: March 17, 2023.

Bureau of Ocean Energy Management (BOEM). 2021. *South Fork Wind Farm and South Fork Export Cable: Essential Fish Habitat Assessment with NOAA Trust Resources*. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/SFWF-EFH-AssessmentNMFS.pdf. Accessed: March 17, 2023.

Bureau of Ocean Energy Management (BOEM). 2023a. *Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. March 2022. 147 pp. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C-NMFS-BA.pdf.

Bureau of Ocean Energy Management (BOEM). 2023b. *Addendum to the Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. May.

Boyd, S.E., D.S. Limpenny, H.L. Rees, and K.M. Cooper. 2005. The Effects of Marine Sand and Gravel Extraction on the Macrobenthos at a Commercial Dredging Site (Results 6 Years Post-Dredging). *ICES Journal of Marine Science* 62:145–162.

Brooks, R.A., C.N. Purdy, S.S. Bell, and K.J. Sulak. 2006. The Benthic Community of the Eastern US Continental Shelf: A Literature Synopsis of Benthic Faunal Resources. *Continental Shelf Research* 26(6):804–818.

Brothers, C.J., J. Harianto, J.B. McClintock, and M. Byrne. 2016. Sea Urchins in a High-CO_2 World: The Influence of Acclimation on the Immune Response to Ocean Warming and Acidification. *Proceeding of the Royal Society* B 283: 20161501. DOI:10.1098/rspb.2016.1501.

Callender, G., D. Ellis, K.F. Goddard, J.K. Dix, J.A. Pilgrim, and M. Erdmann. 2021. Low Computational Cost Model for Convective Heat Transfer From Submarine Cables. *IEEE Transactions on Power Delivery* 36(2):760–768.

Carroll, A.G., R. Przeslawski, A. Duncan, M. Gunning, and B. Bruce. 2016. A Critical Review of the Potential Impacts of Marine Seismic Surveys on Fish & Invertebrates. *Marine Pollution Bulletin* 114(1) 9:24. DOI:10.1016/j.marpolbul.2016.11.038.

Causon, P.D., and A.B. Gill. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. *Environmental Science and Policy* 89:340–347.

Christiansen, N., U. Daewel, B. Djath, and C. Schrum. 2022. Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes. *Fronters in Marine Science* 9(818501).

Coates, D.A., Y. Deschutter, M. Vincx, and J. Vanaverbeke. 2014. Enrichment and Shifts in Macrobenthic Assemblages in an Offshore Wind Farm Area in the Belgian Part of the North Sea. *Marine Environmental Research* 95:1–12.

Colden, A.M., and R.N. Lipcius. 2015. Lethal and Sublethal Effects of Sediment Burial on the Eastern Oyster *Crassostrea virginica*. *Marine Ecology Progress Series* 527:105–117. Available: https://www.int-res.com/articles/meps_oa/m527p105.pdf. Accessed: January 25, 2020.

Copping, A., N. Sather, L. Hanna, J. Whiting, G. Zydlewski, G. Staines, A, Gill, I. Hutchison, A. O'Hagan, T. Simas, J. Bald, C. Sparling, J. Wood, and E. Masden. 2016. *Annex IV 2016 State of the Science Report: Environmental Effects of Marine Renewable Energy Development Around the World.* Available: https://tethys.pnnl.gov/sites/default/files/publications/Annex-IV-2016-State-of-the-Science-Report_LR.pdf. Accessed: December 3, 2021.

CSA International Inc., Applied Coastal Research and Enginnering, Inc. Barry A. Vittor & Associates, Inc., C.F. Bean LLC, and Florida Institute of Technology. 2009. Analysis of Potential Biological and Physical Impacts of Dredging on Offshore Ridge and Shoal Features. Leasing Division, Marine Minerals Branch, Herndon, VA. 160 p. OCS Study MMS 2010-010 160 pp.

CSA Ocean Sciences Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England.* U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049. 59 pp.

Cutter, G., and R. Diaz. 1998. Part I: Benthic Habitats and Biological Resources Off the Virginia Coast 1996 and 1997. In *Environmental Studies Relative to Potential Sand Mining in the Vicinity of the City of Virginia Beach, Virginia.* Virginia Institute of Marine Science, College of William and Mary. Available: http://dx.doi.org/doi:10.21220/m2-mx15-9c77.. Accessed: September 22, 2022.

Daewel, U., N. Akhtar, N. Christiansen, and C. Schrum. 2022. Offshore Wind Farms Are Projected to Impact Primary Production and Bottom Water Deoxygenation in the North Sea. *Communications Earth & Environment* 3.

Dannheim J., L. Bergström, S.N.R. Birchenough, R. Brzana, A.R. Boon, J.W.P. Coolen, J. Dauvin, I. De Mesel, J. Derweduwen, A.B. Gill, Z.L. Hutchison, A.C. Jackson, U. Janas, G. Martin, A. Raoux, J. Reubens, L. Rostin, J. Vanaverbeke, T.A. Wilding, D. Wilhelmsson, and S. Degraer. 2020. Benthic Effects of Offshore Renewables: Identification of Knowledge Gaps and Urgently Needed Research. *ICES Journal of Marine Science* 77(3):1092–1108.

De Mesel, I., F. Kerckhof, A. Norro, B. Rumes, and S. Degraer. 2015. Succession and Seasonal Dynamics of the Epifauna Community on Offshore Wind Farm Foundations and Their Role as Stepping Stones for Non-Indigenous Species. *Hydrobiologia* 756. DOI:10.1007/s10750-014-2157-1.

DeAlteris, J. T., L. G. Skrobe, and K. M. Castro. 2000. Effects of Mobile Bottom Fishing Gear on Biodiversity in Offshore New England Waters. *Northeastern Naturalist* 7(4):379–394.

Degrear, S., D.A. Carey, J.W.P. Coolen, Z.L. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis. *Oceanography* 33(4):48–57. DOI:10.5670/oceanog.2020.405.

Dernie, K.M., M.J. Kaiser, and R.M. Warwick. 2003. Recovery Rates of Benthic Communities Following Physical Disturbance. *Journal of Animal Ecology* (72):1043–1056.

Diaz, R., G. Cutter, and K. Able. 2003. The Importance of Physical and Biogenic Structure to Juvenile Fishes on the Shallow Inner Continental Shelf. *Estuaries* 26:12–20.

Dima, M., D. Nichita, G. Lohmann, M. Ionita, and M. Voiculescu. 2021. Early-Onset of Atlantic Meridional Overturning Circulation Weakening in Response to Atmospheric CO_2 Concentration. *npj | Climate and Atmospheric Science* 4.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dorrell, R., C. Lloyd, B. Lincoln, T. Rippeth, J. Taylor, C.-c. Caulfield, J. Sharples, J. Polton, B. Scannell, D. Greaves, R.A. Hall, and J.H. Simpson. 2021. Anthropogenic Mixing of Seasonally Stratified Shelf Seas by Offshore Wind Farm Infrastructure. *Frontiers in Marine Science* 9. Available: https://www.frontiersin.org/articles/10.3389/fmars.2022.830927.

Dunkley, F., and J.-L. Solandt. 2022. Windfarms, Fishing and Benthic Recovery: Overlaps, Risks and Opportunities. *Marine Policy* 145:105262.

Edmonds, N., C. Firmin, D. Goldsmith, R. Faulkner, and D. Wood. 2016. A Review of Crustacean Sensitivity to High Amplitude Underwater Noise: Data Needs for Effective Risk Assessment in Relation to UK Commercial Species. *Marine Pollution Bulletin* 108.

English, P.A., T.I. Mason, J.T. Backstrom, B.J. Tibbles, A.A. Mackay, M.J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-026.

Essink, K. 1999. Ecological Effects of Dumping of Dredged Sediments; Options for Management. *Journal of Coastal Conservation* 5:69–80.

Fautin, D., P. Dalton, L.S. Incze, J.-A.C. Leong, C. Pautzke, A. Rosenberg, P. Sandifer, G. Sedberry, J.W. Tunnell, Jr., I. Abbott, R.E. Brainard, M. Brodeur, L.G. Eldredge, M. Feldman, F. Moretzsohn, P.S. Vroom, M. Wainstein, and N. Wolff. 2010. An Overview of Marine Biodiversity in United States Waters. *PLoS One* 5(8): e11914. Doi:10.1371/journal.pone.0011914.

Floeter, J., T. Pohlmann, A. Harmer, and C. Möllmann. 2022. Chasing the Offshore Wind Farm Wind-Wake-Induced Upwelling/Downwelling Dipole. *Frontiers in Marine Science* 9:884943.

Friedland, K., T. Miles, A. Goode, E. Powell, and D. Brady. 2022. The Middle Atlantic Bight Cold Pool Is Warming and Shrinking: Indices from in situ Autumn Seafloor Temperatures. *Fisheries Oceanography* 31(2):2147–223.

Gill, A.B., and M. Desender. 2020. *Risk to Animals from Electromagnetic Fields Emitted by Electric Cables and Marine Renewable Energy Devices*. Available: https://www.osti.gov/servlets/purl/1633088. Accessed: April 18, 2023.

Good, P., J. Bamber, K. Halladay, A.B, Harper, L.C. Jackson, G. Kay, B. Kruijt, J.A. Lowe, O.L. Phillips, J. Ridley, M. Srokosz, C. Turley, and P. Williamson. 2018. Recent Progress in Understanding Climate Thresholds: Ice Sheets, the Atlantic Meridional Overturning Circulation, Tropical Forests and Responses to Ocean Acidification. *Progress in Physical Geography: Earth and Environment*. 2018;42(1):24–60.

Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg, eds. 2010. *The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One.* The Nature Conservancy, Eastern U.S. Division, Boston, MA.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas.* U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088.

Hager, C., and K. Breault. 2023—Personal communications to G. Fulling regarding Preliminary Conclusions of the BOEM report, Spatiotemporal Distributions of Species Detected within Virginia's Offshore Lease Areas, The Virginia Wind Energy Lease Area A-0483.

Hale, S.S., H.W. Buffum, J.A. Kiddon, M.M. Hughes. 2017. Subtidal Benthic Invertebrates Shifting Northward Along the US Atlantic Coast. *Estuaries and Coasts* (40):1744–1756.

Harsanyi, P., K. Scott, B.A.A. Easton, G. de la Cruz Ortiz, E.C.N. Chapman, A.J.R. Piper, C.M.V. Rochas, and A.R. Lyndon. 2022. The Effects of Anthropogenic Electromagnetic Fields (EMF) on the Early Development of Two Commercially Important Crustaceans, European Lobster, Homarus gammarus (L.) and Edible Crab, Cancer pagurus (L.). *J. Mar. Sci. Eng.* 10:564. DOI:10.1007/s00227-022-04065-4.

Hawkins, A.D., and A.N. Popper. 2014. Assessing the Impact of Underwater Sounds on Fishes and Other Forms of Marine Life. *Acoustics Today* (Spring 2014):30–41.

HDR 2020. *Seafloor Disturbance and Recovery Monitoring at the Block Island Wind Farm, Rhode Island – Summary Report*. OCS Study BOEM 2020-019. Final report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. Available: https://espis.boem.gov/final%20reports/BOEM_2020-019.pdf. Accessed: December 3, 2021.

Hendrick, V.J., Z.L. Hutchison, and K.S. Last. 2016. Sediment Burial Intolerance of Marine Macroinvertebrates. *PLoS One* 11(2):e0149114. Available: https://doi.org/10.1371/journal.pone.0149114. Accessed: January 25, 2022.

Hoegh-Guldberg, O., and J.F. Bruno. 2010. The Impact of Climate Change on the World's Marine Ecosystems. *Science* 328(5985):1523–1528. DOI:10.1126/science.1189930.

Hogan F., B. Hooker, B. Jensen, L. Johnston, A. Lipsky, E. Methratta, A. Silva, and A. Hawkins. 2023. Fisheries and Offshore Wind Interactions: Synthesis of Science. Woods Hole, MA. NOAA Technical Memorandum NMFS-NE-291. 388 p.

Hutchison, Z.L., P. Sigray, H. He, A.B. Gill, J. King, and C. Gibson, 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables*. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-003.

Hutchison, Z.L., A.B. Gill, P. Sigray, H. He, and J.W. King. 2021. A Modelling Evaluation of Electromagnetic Fields Emitted by Buried Subsea Power Cables and Encountered by Marine Animals: Considerations for Marine Renewable Energy Development. *Renewable Energy* 177:72–81.

ICF. 2021. *Comparison of Environmental Effects from Different Offshore Wind Turbine Foundations*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2021-053. 48 pp.

Jakubowska-Lehrmann, M., M. Białowąs, Z. Otremba, A. Hallmann, S. Śliwińska-Wilczewska, and B. Urban-Malinga. 2022. Do Magnetic Fields Related to Submarine Power Cables Affect the Functioning of a Common Bivalve? *Marine Environmental Research* 179:105700.

Johnson, T.L., J.J. v. Berkel, L.O. Mortensen, M.A. Bell, I. Tiong, B. Hernandez, D.B. Snyder, F. Thomsen, and O.S. Peterson. 2021. *Hydrodynamic Modeling, Particle Tracking and Agent-Based Modeling of Larvae in the U.S. Mid-Atlantic Bight.* Report No. OCS Study BOEM 2021-049.

Jones, I., J. Stanley, and A. Mooney. 2020. Impulsive Pile Driving Noise Elicits Alarm Responses in Squid (*Doryteuthis pealeii*). *Marine Pollution Bulletin* 150:110792.

Jones, I., J. Peyla, H. Clark, Z. Song, J. Stanley, and A. Mooney. 2021. Changes in Feeding Behavior of Longfin Squid (*Doryteuthis pealeii*) during Laboratory Exposure to Pile Driving Noise. *Marine Environmental Research* 165:105250.

Jumars, P.A., K.M. Dorgan, and S.M. Lindsay. 2015. An Update of Polychaete Feeding Guilds. *Annual Review of Marine Science* 7:497–520.

Kerckhof, F., B. Rumes, and S. Degraer. 2019. About “Mytilisation” and “Slimeification”: A Decade of Succession of the Fouling Assemblages on Wind Turbines off the Belgian Coast. Chapter 7, pages 73–84 in S. Degraer, R. Brabant, B. Rumes, and L. Vigin (eds.), *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Marking a Decade of Monitoring, Research and Innovation*. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management.

Kraus, C., and L. Carter. 2018. Seabed Recovery Following Protective Burial of Subsea Cables – Observations from the Continental Margin. *Ocean Engineering* 4:251–261.

Lentz, S. 2017. Seasonal Warming of the Middle Atlantic Bight Cold Pool. *Journal of Geophysical Research: Oceans* 122.

Lucy, J. 1983. *Development of Virginia's Artificial Fishing Reefs: A Historical Outline (1959–1977)*. Sea Grant Marine Advisory Service, Virginia Institute of Marine Science Marine Resource Report No. 83-6. Available: https://www.vims.edu/GreyLit/VIMS/mrr83-6ocr.pdfdf. Accessed: November 22, 2021.

Mardiana, R. 2011. *Parameters Affecting the Ampacity of HVDC Submarine Power Cables*. In 2011 2nd International Conference on Electric Power and Energy Conversion Systems (EPECS); 11/01.

Mavraki, N., S. Degraer, and J. Vanaverbeke. 2021. Offshore Wind Farms and the Attraction–Production Hypothesis: Insights from a Combination of Stomach Content and Stable Isotope Analyses. *Hydrobiologia* (2021) 848:1639–1657.

McCormick, M., T. Manley, D. Beletsky, A. Foley III, and G. Fahnenstiel. 2008. *Tracking the Surface Flow in Lake Champlain.* Available: http://www.glerl.noaa.gov/pubs/fulltext/2008/20080053.pdf.. Accessed: December 4, 2021.

Mid-Atlantic Regional Council on the Ocean (MARCO). n.d. Mid-Atlantic Ocean Data Portal. Available: http://portal.midatlanticocean.org.. Accessed: March 8, 2022.

Miles T., S. Murphy, J. Kohut, S. Borsetti, and D. Munroe. 2021. Offshore Wind Energy and the Mid-Atlantic Cold Pool: A Review of Potential Interactions. *Marine Technology Society Journal* 55:72–87.

National Oceanic and Atmospheric Administration (NOAA). 2021. *National Centers for Environmental Information: Bathymetric Data Viewer.* Available: https://www.ncei.noaa.gov/maps/bathymetry/. Accessed: June 8, 2022.

National Oceanic and Atmospheric Administration (NOAA) Fisheries Office of Science and Technology. 2022. DisMAP Data Records. Available: https://apps-st.fisheries.noaa.gov/dismap/DisMAP.html Accessed: May 24, 2022.

Nairn R., M. Dibajnia, G. Wikel, R. Amato. 2011. An Analysis of Morphological Parameters For Shoals Of The Mid-Atlantic Bight, USA. In: p. 1007-1020. DOI:10.1142/9789814355537_0076.

Nilsson, H., and R. Rosenberg. 2003. Effects on Marine Sedimentary Habitats of Experimental Trawling Analysed by Sediment Profile Imagery. *Journal of Experimental Marine Biology and Ecology* 285–286:453–463.

Pacific Marine Environmental Laboratory (PMEL). 2020. *Ocean Acidification: The Other Carbon Dioxide Problem*. Available: https://www.pmel.noaa.gov/co2/story/Ocean+Acidification. Accessed: February 11, 2020.

Payne, J.F., C.A. Andrews, L.L. Fancey, A.L. Cook, and J.R. Christian. 2007. *Pilot Study on the Effects of Seismic Air Gun Noise on Lobster (*Homarus Americanus*)*. Fisheries and Oceans Canada. Science Branch.

Pohle, G.W., and M.L.H. Thomas. 2001. *Marine Biodiversity Monitoring. Monitoring Protocol for Marine Benthos: Intertidal and Subtidal Macrofauna.* A Report by the Marine Biodiversity Monitoring Committee (Atlantic Maritime Ecological Science Cooperative, Huntsman Marine Science Centre) to the Ecological Monitoring and Assessment Network of Environment Canada.

Popper A., and A. Hawkins. 2018. The Importance of Particle Motion to Fishes and Invertebrates. *The Journal of the Acoustical Society of America* 143:470–488.

Powell, E.N., A.M. Ewing, and K.M. Kuykendall. 2020. Ocean Quahogs (*Arctica islandica*) and Atlantic Surfclams (*Spisula solidissima*) on the Mid-Atlantic Bight Continental Shelf and Georges Bank: The Death Assemblage as a Recorder of Climate Change and the Reorganization of the Continental Shelf Benthos. *Palaeogeography, Palaeoclimatology, Palaeoecology* 537. DOI:10.1016/j.palaeo.2019.05.027.

Ramsay K., M.J. Kaiser, R.N. Hughes. 1998. Responses of benthic scavengers to fishing disturbance by towed gears in different habitats. *Journal of Experimental Marine Biology and Ecology* 224(1):73–89.

Raoux, A., S. Tecchio, J.P. Pezy, G. Lassalle, S. Degraer, D. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangeré, F. Le Loc'h, J.C. Dauvin, and N. Niquil. 2017. Benthic and Fish Aggregation Inside an Offshore Wind Farm: Which Effects on the Trophic Web Functioning? *Ecological Indicators* 72:33–46.

Rutecki, D., T. Dellapenna, E. Nestler, F. Scharf, J. Rooker, C. Glass, and A. Pembroke. 2014. *Understanding the Habitat Value and Function of Shoals and Shoal Complexes to Fish and Fisheries on the Atlantic and Gulf of Mexico Outer Continental Shelf.* Literature Synthesis and Gap Analysis. Prepared for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M12PS00009. BOEM 2015-012. 176 pp.

Schmittner, A. 2005. Decline of the Marine Ecosystem Caused by a Reduction in the Atlantic Overturning Circulation. *Nature* 434: 628–633. DOI:10.1038/nature03476.

Sciberras, M., R. Parker, C. Powell, C. Robertson, S. Kröger, S. Bolam, and J. Geert Hiddink. 2016. Impacts of Bottom Fishing on the Sediment Infaunal Community and Biogeochemistry of Cohesive and Non-Cohesive Sediments. *Limnology and Oceanography* 61(6):2076–2089.

Slacum, H.W., W.H. Burton, E.T. Methratte, E.D. Weber, R.J. Llanso, and J. Drew-Baxter. 2010. *Assemblage Structure in Shoal and Flat-Bottom Habitats on the Inner Continental Shelf of the Middle Atlantic Bight, USA*. U.S. Minerals Management Services. Ecological Sciences and Applications. Grant Number: MMS 1435-01-00-CT-85060. January 9, 2011. Available: https://doi.org/10.1577/C09-012.1.

Smit, M.G.D., R.G. Jak, H. Rye, T.K. Frost, I. Singsaas, and C.C. Karman. 2008. Assessment of Environmental Risks from Toxic and Nontoxic Stressors; A Proposed Concept for a Risk-Based Management Tool for Offshore Drilling Discharges. *Integrated Environmental Assessment Management* 4:177–183. Available: https://doi.org/10.1897/IEAM_2007-036.1.

Stenberg C., J. G. Støttrup, M. Deurs, C.W. Berg, G. Dinesen, H. Mosegaard, T. Grome, and S. Leonhard. 2015. Long-term Effects of an Offshore Wind Farm in the North Sea on Fish Communities. *Marine Ecology Progress Series* 528:257–265.

Stevenson, D., L. Chiarella, D. Stephan, R. Reid, K. Wilhelm, J. McCarthy, and M. Pentony. 2004. *Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast US Shelf, and an Evaluation of the Potential Effects of Fishing on Essential Fish Habitat*. NOAA Technical Memorandum NMFS-NE-181.

Tetra Tech (Tetra Tech, Inc.). 2013. *Draft Marine Site Characterization Survey Report*. Virginia Offshore Wind Technology Advancement Project (VOWTAP). Prepared for Dominion Resources, Inc. 51 pp.

Tetra Tech. 2014. Benthic Survey Report, Virginia Offshore Wind Technology Advancement Project (VOWTAP). Prepared for Dominion Energy. Submitted December 2013, Revised February 2014. 154 pp.

Thieler, E.R., D.S. Foster, E.A. Himlestoss, and D.J. Mallinson. 2014. Geologic Framework of the Northern North Carolina, USA Inner Continental Shelf and its Influence on Coastal Evolution. *Marine Geology* 348:113–130. DOI:10.1016/j.margeo.2013.11.011.

Thomsen, F., A.B. Gill, M. Kosecka, M. Andersson, M. André, S. Degraer, T. Folegot, J. Gabriel, A. Judd, T. Neumann, A. Norro, D. Risch, P. Sigray, D. Wood, and B. Wilson, 2016. MaRVEN – Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy. 10.2777/272281.

Tougaard, J., L. Hermannsen, and P.T. Madsen. 2020. How Loud is the Underwater Noise from Operating Offshore Wind Turbines? *The Journal of the Acoustical Society of America* 148(5):2885. DOI:10.1121/10.0002453.

Trannum, H.C., H.C. Nilsson, M.T. Schaanning, and S. Øxnevad. 2010. Effects of Sedimentation from Water-Based Drill Cuttings and Natural Sediment on Benthic Macrofaunal Community Structure and Ecosystem Processes. *Journal of Experimental Marine Biology and Ecology* 383:111–121.

U.S. Army Corps of Engineers (USACE). 2020. *South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States.*

United States Coast Guard. 2021. *Part Access Route Study (PARS): Approaches to the Chesapeake Bay, VA.* Draft Report. USCG-2019-0862. Available: https://www.regulations.gov/document/USCG-2019-0862-0019.

U.S. Environmental Protection Agency (USEPA). 2009. *Site Management and Monitoring Plan for the Dam Neck Ocean Disposal Site (DNODS).* Available: https://www.epa.gov/sites/default/files/2015-10/documents/r3_dam_neck_smmp_final_signed.pdf. Accessed: December 2, 2021.

U.S. Environmental Protection Agency (USEPA). 2019. *A Site Management and Monitoring Plan (SMMP) for the Dam Neck Ocean disposal Site, VA*. Available: https://www.epa.gov/sites/default/files/2019-09/documents/2019_dam_neck_ocean_disposal_site_smmp.pdf. Accessed: November 8, 2022.

U.S. Geological Survey (USGS). n.d. East-Coast Sediment Texture Database. Available: http://woodshole.er.usgs.gov/project-pages/sediment/.. Accessed: March 8, 2022.

Virginia Marine Resources Commission (VMRC). 2020. *Artificial Reefs Map*. Available: https://www.mrc.virginia.gov/vsrfdf/reef.shtm. Accessed: November 22, 2021.

Wilding, T.A. 2014. Effects of Man-Made Structures on Sedimentary Oxygenation: Extent, Seasonality and Implications for Offshore Renewables. *Marine Environmental Research* 97:39–47.

Zhang, Z., C. Capinha, D.N. Karger, X. Turon, H.J. MacIsaac, and A. Zhan. 2020. Impacts of Climate Change on Geographical Distributions of Invasive Ascidians. *Marine Environmental Research* 159:104993.

C.1.3.7. Section 3.7, Birds

Ainley, D.G., E. Porzig, D. Zajanc, and L.B. Spear. 2015. Seabird Flight Behavior and Height in Response to Altered Wind Strength and Direction. *Marine Ornithology* 43:25–36.

Amélineau, F., B. Merkel, A. Tarroux, S. Descamps, T. Anker-Nilssen, O. Bjørnstad, V.S. Bråthen, O. Chastel, S. Christensen-Dalsgaard, J. Danielsen, F. Daunt, N. Dehnhard, M. Ekker, K.E. Erikstad, A. Ezhov, P. Fauchald, M. Gavrilo, G.T. Hallgrimsson, E.S. Hansen, M.P. Harris, M. Helberg, H.H. Helgason, M.K. Johansen, J.E. Jónsson, Y. Kolbeinsson, Y. Krasnov, M. Langset, S.H. Lorentsen, E. Lorentzen, M.V. Melnikov, B. Moe, M.A. Newell, B. Olsen, T. Reiertsen, G.H. Systad, P. Thompson, T.L. Thórarinsson, E. Tolmacheva, S. Wanless, K. Wojczulanis-Jakubas, J. Åström, H. Strøm. 2021. Six Pelagic Seabird Species of the North Atlantic Engage in a Fly-and-Forage Strategy During Their Migratory Movements. *Marine Ecology Progress Series* 676:127–144.

Andersen D.E., J.R. Orrin, and R.M. William. 1986. The Behavioral Response of a Red-Tailed Hawk to Military Training Activity. *Raptor Research* 20(2):65–68.

Andres, B.A, P.A. Smith, R.I. Guy Morrison, C.L. Gratto-Trevor, S.C. Brown, and C.A. Friis. 2012. Population Estimates of North American Shorebirds, 2012. *Wader Study Group Bulletin* 19(3):178–194.

Barclay R.M.R., E.F. Baerwalk, and J.C. Gruver. 2007. Variation in Bat and Bird Fatalities at Wind Energy Facilities: Assessing the Effects of Rotor Size and Tower Height. *Canadian Journal of Zoology* 85:381–387.

Bayne, E.M., L. Habib, and S. Boutin. 2008. Impacts of Chronic Anthropogenic Noise from Energy-Sector Activity on Abundance of Songbirds in the Boreal Forest. *Conservation Biology* 22(5):1186–1193.

Black B., M.W. Collopy, H.F. Percival, A.A Tiller, and P.G. Bohall. 1984. *Effects of Low Level Military Training Flights on Wading Bird Colonies in Florida.* Florida Coop. Fish and Wild1. Res. Unit, Sch. For. Res. and Conserv., Univ. of Florida. Tech. Rept. No.7.

Briggs K.T., M.E. Gershwin, and D.W. Anderson. 1997. Consequences of Petrochemical Ingestion and Stress on the Immune System of Seabirds. *ICES Journal of Marine Science* 54:718–725.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia, Final Environmental Assessment*. OCS EIS/EA BOEMRE 2012-003. 366 pp.

Bureau of Ocean Energy Management (BOEM). 2014. *Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Final Programmatic Environmental Impact Statement*. Volumes I, II, and III; http://www.boem.gov/Atlantic-G-G-PEIS/#Final.

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia Revised Environmental Assessment.* OCS EIS/EA BOEM 2015-031. 239 pp.

Bureau of Ocean Energy Management (BOEM). 2021a. *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development.* 9 pp.

Bureau of Ocean Energy Management (BOEM). 2021b. *South Fork Wind Farm and South Fork Export Cable Project Final Environmental Impact Statement.* 1317 pp. Report No.: OCS EIS/EA BOEM 2020-057.

Bureau of Ocean Energy Management (BOEM). 2021c. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. 4 vols. 2,422 pp. Report No.: OCS EIS/EA BOEM 2021-0012.

Bureau of Ocean Energy Management (BOEM). 2022. *Coastal Virginia Offshore Wind Commercial Biological Assessment for the United States Fish and Wildlife Service*. December. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C%20USFWS%20BA.pdf.

Bureau of Ocean Energy Management (BOEM). 2023. *Addendum to the Coastal Virginia Offshore Wind Commercial Biological Assessment for the United States Fish and Wildlife Service*. June.

Causon, P.D., and A.B. Gill. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. *Environmental Science and Policy* 89:340–347.

Choi, D.Y., T.W. Wittig, and B.M. Kluever. 2020. An Evaluation of Bird and Bat Mortality at Wind Turbines in the Northeastern United States. *PLoS One*. 15(8):e0238034.

Conomy J.T., J.A. Dubovsky, J.A. Collazo, and W.J. Fleming. 1998. Do Black Ducks and Wood Ducks Habituate to Aircraft Disturbance? *Journal of Wildlife Management* 62(3):1135–1142.

Cook A.S.C.P., and N.H.K. Burton. 2010. *A Review of the Potential Impacts of Marine Aggregate Extraction on Seabirds.* Marine Environment Protection Fund (MEPF) Project 09/P130. 114 pp.

Cook A.S.C.P., E.M. Humphreys, F. Bennet, E.A. Masden, N.H.K. Burton. 2018. Quantifying Avian Avoidance of Offshore Wind Turbines: Current Evidence and Key Knowledge Gaps. *Marine Environmental Research* 140:278–288.

Degraer, S., D. Carey, J. Coolen, Z. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis. *Oceanography* 33(4):48–57.

Dierschke, V., R.W. Furness, and S. Garthe. 2016. Seabirds and Offshore Wind Farms in European Waters: Avoidance and Attraction. *Biological Conservation* 202:59–68.

Dolbeer R.A., M.J. Begier, P.R. Miller, J.R. Weller, and A.L. Anderson. 2021. W*ildlife Strikes to Civil Aircraft in the United States, 1990- 2020.* Federal Aviation Administration, National Wildlife Strike Database, Serial Report Number 27. 141 pp.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dooling R.J., and A.N. Popper. 2007. *The Effects of Highway Noise on Birds*. Available: https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/bio-effects-hwy-noise-birds-100707-a11y.pdf.

Dooling, R.J., D. Buehler, M.R. Leek, and A.N. Popper. 2019. The Impact of Urban and Traffic Noise on Birds. *Acoustical Society of America* 15(3):19–27.

Dorrell, R. M., C.J. Lloyd, B.J. Lincoln, T.P. Rippeth, J.R. Taylor, C.C.P. Caulfield, J. Sharples, J.A. Polton, B.D. Scannell, D.M. Greaves, R.A. Hall, and J.H. Simpson. 2022. Anthropogenic Mixing in Seasonally Stratified Shelf Seas by Offshore Wind Farm Infrastructure. *Front. Mar. Sci*. 9:830927.

Drewitt A.L., and R.H.W. Langston. 2006. Assessing the Impacts of Wind Farms on Birds. *International Journal of Avian Science* 148(s1):29–42.

Dunn, E.H. 1993. Bird Mortality from Striking Residential Windows in Winter. *Journal of Field Ornithology* 64(3):302–309.

English, P.A., T.I. Mason, J.T. Backstrom, B.J. Tibbles, A.A. Mackay, M.J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. OCS Study BOEM 2017-026. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs.

Erickson W.P., G.D. Johnson, and D.P. Young, Jr. 2005. A Summary and Comparison of Bird Mortality from Anthropogenic Causes with an Emphasis on Collisions. Pages 1029–1042 in C. John Ralph, and T.D. Rich (eds.), *Bird Conservation Implementation and Integration in the Americas: Proceedings of the Third International Partners in Flight Conference*. 2002 March 20-24; Asilomar, California, Volume 2 Gen. Tech. Rep. PSW-GTR-191. Albany, CA: U.S. Dept. of Agriculture, Forest Service, Pacific Southwest Research Station.

Fox A.D., and I.B.K. Petersen. 2019. Offshore Wind Farms and Their Effects on Birds. *Journal of the Danish Ornithological Society* 113:86–101.

Fox A.D., M. Desholm, J. Kahlert, T.K. Christensen, and I.B.K. Petersen. 2006. Information Needs to Support Environmental Impact Assessment of the Effects of European Marine Offshore Wind Farms on Birds. *Ibis* 148:129–144.

Galparsoro, I., I. Menchaca, J.M. Garmendia, A. Borja, A.D. Maldonado, G. Iglesias, and J. Bald. 2022. Reviewing the Ecological Impacts of Offshore Wind Farms. *npj Ocean Sustainability* 1(1). DOI:10.1038/s44183-022-00003-5.

González-Solís J., A. Felicísimo, J.W. Fox, V. Afanasyev, Y. Kolbeinsson, and J. Muñoz. 2009. Influence of Sea Surface Winds on Shearwater Migration Detours. *Marine Ecology Progress Series* 391(221).

Goodale, M., and A. Millman. 2016. Cumulative Adverse Effects of Offshore Wind Energy Development on Wildlife. *Journal of Environmental Planning and Management* 59(1):1–29.

Goodwin, S.E., and W.G. Shriver. 2010. Effects of Traffic Noise on Occupancy Patterns of Forest Birds. *Conservation Biology* 25(2):406–411.

Haney J.C., P.G.R. Jodice, W.A. Montevecchi, and D.C Evers. 2017. Challenges to Oil Spill Assessment for Seabirds in the Deep Ocean. *Archives of Environmental Contamination and Toxicology* 73(1):33–39.

Hatch, J.M. 2018. Comprehensive Estimates of Seabird-Fishery Interactions for the US Northeast and Mid-Atlantic. *Aquatic Conservation: Marine and Freshwater Ecosystems* 28:182–193.

Hüppop O., J. Dierschke, K.M. Exo, E. Fredrich, and R. Hill. 2006. Bird Migration Studies and Potential Collision Risk with Offshore Wind Turbines. *Ibis* 148:90–109.

Huso, M., T. Conkling, D. Dalthorp, M. Davis, H. Smith, A. Fesnock, and T. Ktzner. 2021. Relative Energy Production Determines Effect of Repowering on Wildlife Mortality at Wind Energy Facilities. *Journal of Applied Ecology* 58(6):1284–1290.

Johnston, A., A.S.C.P. Cook, L.J. Wright, E.M. Humphreys, and N.H.K. Burton. 2014. Modeling Flight Heights of Marine Birds to More Accurately Assess Collision Risk with Offshore Wind Turbines. *Journal of Applied Ecology* 51:31–41.

Kerlinger P., J.L. Gehring, W.P. Erickson, R. Curry, A. Jain, and J. Guarnaccia. 2010. Night Migrant Fatalities and Obstruction Lighting at Wind Turbines in North America. *The Wilson Journal of Ornithology* 122(4):744–754.

Klem D., Jr. 1989. Bird-Window Collisions. *The Wilson Bulletin* 101(4):606–620.

Klem, D., Jr. 1990. Collisions Between Birds and Windows: Mortality and Prevention. *Journal of Field Ornithology* 61(1):120–128.

Longcore T., C. Rich, P. Mineau, B. MacDonald, D.G. Bert, L.M. Sullivan, E. Mutrie, S.A. Gauthreaux, Jr., M.L. Avery, R.L. Crawford, A.M. Manville II, E.R. Travis, and D. Drake. 2013. *Avian Mortality at Communication Towers in the United States and Canada: Which Species, How Many, and Where?* USDA National Wildlife Research Center - Staff Publications. Paper 1162. 12 pp.

Loss S.R., T. Will, and P.P. Marra. 2013a. Estimates of Bird Collision Mortality at Wind Facilities in the Contiguous United States. *Biological Conservation* 168:201–209.

Loss S.R., T. Will, and P.P. Marra. 2013b. The Impact of free-Ranging Domestic Cats on Wildlife of the United States. *Nature Communications* 4:1396.

Loss S.R., T. Will, and P.P. Marra. 2015. Direct Mortality of Birds from Anthropogenic Causes. *Annual Review of Ecology, Evolution, and Systematics* 46:99–120.

Madsen, A.M., R. Reeve, M. Desholm, A. D. Fox, R.W. Furness, and D.T. Haydon. 2012. Assessing the Impact of Marine Wind Farms on Birds Through Movement Modelling. *J. R. Soc. Interface* 9:2120–2130.

Maggini I., L.V. Kennedy, A. Macmillan, K.H. Elliott, K. Dean, and C.G. Guglielmo. 2017. Light Oiling of Feathers Increases Flight Energy Expenditure in a Migratory Shorebird. *Journal of Explanatory Biology* 220:2372–2379.

McGrew, K.A., S.E. Crowell, J.L. Finey, A.M. Berlin, G.H. Olse, J. James, H. Hopkins, and C.K. Williams. 2022. Underwater Hearing in Sea Ducks with Applications for Reducing Gillnet Bycatch through Acoustic Deterrence. *J Exp Biol* 225(20):jeb243953.

McLaughlin, K.E., and H.P. Kunc. 2013. Experimentally Increased Noise Levels Change Spatial and Singing Behavior. *Biology Letters* 9:20120771.

Minerals Management Service (MMS) and U.S. Fish and Wildlife Service (USFWS). 2009. *Memorandum of Understanding Between the Department of the Interior U.S. Minerals Management Service and the Department of the Interior U.S. Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds."* 17 pp.

Mizrahi, D., R. Fogg, T. Magarian, V. Elia, P. Hodgetts, and D. La Puma. 2010. *Radar Monitoring of Bird and Bat Movement Patterns on Block Island and its Coastal Waters*. Final Report. Submitted to University of Rhode Island. Prepared by New Jersey Audubon. 53 pp.

Mizrahi, D.S., A. Leppold, R. Fogg, and T. Magarian. 2013. *Radar Monitoring of Bird and Bat Movement Patterns on Monhegan Island, Maine and its Coastal Waters*. Final Report. Submitted to University of Maine DeepC Wind Consortium. New Jersey Audubon Society. 219 pp.

National Audubon Society. 2019. *Survival by Degrees: 389 Bird Species on the Brink*. Virginia. 20 pp.

New Jersey Department of Environmental Quality (NJDEP). 2010. Ocean/Wind Power Ecological Baseline Studies Final Report, January 2008–December 2009. New Jersey Department of Environmental Protection, Office of Science, Trenton, NJ. 259 pp.

Newton, I. 2007. Weather-Related Mass-Mortality Events in Migrants. *Ibis* 149:453-467.

Nisbet, I.C.T., R.R. Veit, S.A. Auer, and T.P. White. 2013. *Marine Birds of the Eastern United States and the Bay of Fundy: Distribution, Numbers, Trends, Threats, and Management*. Nuttall Ornithological Monographs No. 29. Nuttall Ornithological Club, Cambridge, MA.

Normandeau Associates, Inc. 2014. *Acoustic Monitoring of Temporal and Spatial Abundance of Birds Near Outer Continental Shelf Structures: Synthesis Report*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Herndon, VA. BOEM 2014-004. 172 pp.

North American Bird Conservation Initiative (NABCI). 2016. *The State of North America's Birds 2016.* Environment and Climate Change Canada: Ottawa, Ontario. 8pp.

North American Bird Conservation Initiative (NABCI). 2019. *The State of the Birds 2019 United States of America, America's Birds in Crisis But Conservation Works.* 5pp.

Northeast Regional Ocean Council. 2021. *Northeast Ocean Data: Birds, Total Abundance*. Available: https://www.northeast oceandata.org/data-explorer/?birds|stressor-groups. Accessed: November 14, 2021.

Orr, T., S. Herz, and D. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-0116. 429 pp.

Paleczny, M., E. Hammill, V. Karpouzi, and D. Pauly. 2015. Population Trend of the World's Monitored Seabirds, 1950–2010. *PLoS One* 10(6):e0129342.

Panuccio, M., G. Dell'Omo, G. Bogliani, C. Catoni, and N. Sapir. 2019. Migrating Birds Avoid Flying through Fog and Low Clouds. *International Journal Biometeorology* 63:231–239.

Paruk, J.D., E.M. Adams, H. Uher-Koch, K.A. Kovach, and D. Long. 4th, Perkins C., Schoch N., Evers D.C. 2016. Polycyclic Aromatic Hydrocarbons in Blood Related to Lower Body Mass in Common Loons. *Science of the Total Environment* 565:360-–368.

Paton, P., K. Winiarski, C. Trocki, and S. McWilliams. 2010. *Spatial Distribution, Abundance, and Flight Ecology of Birds in Nearshore and Offshore Waters of Rhode Island*. Interim technical report for the Rhode Island Ocean Special Area Management Plan 2010. University of Rhode Island, technical report #11. 239 pp.

Petersen, I.K., T.K. Christensen, J. Kahlert, M. Denholme, and A.D. Fox. 2006. *Final Results of Bird Studies at the Offshore Wind Farms at Nysted and Horns Reef, Denmark*. Commissioned report to Elsam Engineering and Energy E2 (DONG Energy). 166 pp.

Pezy, J. P., A. Raoux, J. C. Dauvin, and Steven Degraer. 2018. An Ecosystem Approach for Studying the Impact of Offshore Wind Farms: A French Case Study. *ICES Journal of Marine Science*, fsy125, September 12, 2018.

Plonczikier, P., and I.C. Simms. 2012. Radar Monitoring of Migrating Pink-Footed Geese: Behavioral Responses to Offshore Wind Farm Development. *Journal of Applied Ecology* 49:1187–1194.

Raoux, A., S. Tecchio, J.P. Pezy, G. Lassalle, S. Degraer, S. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangere, F. Le Loc'h, J.C. Dauvin, and N. Niquil. 2017. Benthic and Fish Aggregation Inside an Offshore Wind Farm: Which Effects on the Trophic Web Functioning? *Ecological Indicators* 72:33–46.

Regular P., W. Montevecchi, A. Hedd, G. Robertson, and S. Wilhelm. 2013. Canadian Fishery Closures Provide a Large-Scale Test of the Impact of Gillnet Bycatch on Seabird Populations. *Biology Letter* 9(4):20130088.

Research Activities Plan (RAP). 2015. *Virginia Offshore Wind Technology Advancement Project*. Prepared by Tetra Tech. Submitted December 2013. Revised February and October 2014, and April 2015. Available: http://www.boem.gov/Research-Activities-Plan/ Accessed: November 14, 2021.

Roberts A.J. 2021. *Atlantic Flyway Harvest and Population Survey Data Book*. U.S. Fish and Wildlife Service, Laurel, MD. 37 pp.

Robinson Willmott, J., G. Forcey, and A. Kent. 2013. *The Relative Vulnerability of Migratory Bird Species to Offshore Wind Energy Projects on the Atlantic Outer Continental Shelf: An Assessment Method Database*. Final report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2013-207.

Roman L., B.D. Hardesty, M.A. Hindell, and C. Wilcox. 2019. A Quantitative Analysis Linking Seabird Mortality and Marine Debris Ingestion. *Scientific Reports* 9:3202.

Rosenberg K.V., A.M. Dokter, P.J. Blancher, J.R. Sauer, A.C. Smith, P.A. Smith, J.C. Stanton, A. Panjabi, L. Helft, M. Parr, and P.P. Marra. 2019. Decline of the North American Avifauna. *Science* 366:120–124.

Sigourney D.B., C.D. Orphanides, and J.M. Hatch. 2019. *Estimates of Seabird Bycatch in Commercial Fisheries Off the East Coast of the United States from 2015 to 2016*. NOAA Technical Memorandum NMFS-NE-252. 30 pp.

Skov, H., S. Heinanen, T. Norman, R.M. Ward, S. Mendez-Roldan, and I. Ellis. 2018. *ORJIP Bird Collision and Avoidance Study. Final Report.* The Carbon Trust. United Kingdom. April 2018. 248 pp.

Slavik, K., C. Lemmen, W. Zhang, O. Kerimoglu, K. Klingbeil, and K.W. Wirtz. 2019. The Large-Scale Impact of Offshore Wind Farm Structures on Pelagic Primary Productivity in the Southern North Sea. *Hydrobiologia* 845:35–53.

Steinkamp M. 2008. New England/Mid-Atlantic Coast Bird Conservation Region (BCR 30) Implementation Plan. 251 pp.

Tetra Tech, Inc. 2012. *Appendix O: Pre-construction Avian and Bat Assessment: 2009-2011*. Block Island Wind Farm, Rhode Island State Waters. Prepared for Deepwater Wind, LLC. Providence, RI.

Thaxter C.B., G.M. Buchanan, J. Carr, S.H.M. Butchart, T. Newbold, R.E. Green, J.A. Tobias, W.B. Foden, S. O’Brien, and J.W. Pearce-Higgins. 2017. Bird and Bat Species’ Global Vulnerability to Collision Mortality at Wind Farms Revealed Through a Trait-Based Assessment. *Proceeds of the Royal Society B: Biological Sciences* 284: 20170829.

Turnpenny A.W.H., and J.R. Nedwell. 1994. *The Effects on Marine Fish, Diving Mammals and Birds of Underwater Sound Generated by Seismic Surveys*. Fawley Aquatic Research laboratories Ltd. FCR 089/94. October 1994. 40 pp.

Vattenfall. 2023. AOWFL-Resolving Key Uncertainties of Seabird Flight and Avoidance Behaviours at Offshore Wind Farms. Final report for the study period 2020-2021. Prepared by RPS. February 20.

Wang, J., X. Zou, W. Yu, D. Zhang, and T. Wang. 2019. Effects of Established Offshore Wind Farms on Energy Flow of Coastal Ecosystems: A Case Study of the Rudong Offshore Wind Farms in China. *Ocean & Coastal Management* 171:111–118.

Watts, B.D. 2010. *Wind and Waterbirds: Establishing Sustainable Mortality Limits Within the Atlantic Flyway.* Center for Conservation Biology Technical Report Series, CCBTR-10-05. College of William and Mary/Virginia Commonwealth University, Williamsburg, VA. 43 pp.

Watts, B.D., C. Hines, L. Duval, and A.L. Wilke. 2022. Exposure of Whimbrels to Offshore Wind Leases During Departure from and Arrival to a Major Mid-Atlantic Staging Site. *Avian Conservation and Ecology* 17(2):31.

Welcker J., and G. Nehls. 2016. Displacement of Seabirds by an Offshore Wind Farm in the North Sea. *Marine Ecology Progress Series* 554:173–182.

Williams K.A., E.E. Connelly, S.M. Johnson, and I.J. Stenhouse. 2015. Wildlife Densities and Habitat Use Across Temporal and Spatial Scales on the Mid-Atlantic Outer Continental Shelf: Final Report to the Department of Energy EERE Wind & Water Power Technologies Office. Award Number: DE-EE0005362. Report BRI 2015-11. Biodiversity Research Institute, Portland, Maine. 814 pp.

Winship A.J., B.P. Kinlan, T.P. White, J.B. Leirness, and J. Christensen. 2018. *Modeling At-Sea Density of Marine Birds to Support Atlantic Marine Renewable Energy Planning: Final Report.* U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study BOEM 2018-010. x+67 pp. and Appendices.

C.1.3.8. Section 3.8, Coastal Habitat and Fauna

Avangrid Renewables. 2021. Kitty Hawk Offshore Wind North COP Chapter 3, Description of Proposed Activity. September. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/KTH%20Chapter%203%20Project%20Description_rev7_clean.pdf.

Bayne, E.M., L. Habib, and S. Boutin. 2008. Impacts of Chronic Anthropogenic Noise from Energy-Sector Activity on Abundance of Songbirds in the Boreal Forest. *Conservation Biology* 22(5):1186–1193.

Bayraktarov, E., Saunders, M.I., Abdullah, S., Mills, M., Beher, J., Possingham, H.P., Mumby, P.J. and Lovelock, C.E. 2016. The Cost and Feasibility of Marine Coastal Restoration. *Ecol Appl* 26: 1055–1074. DOI:10.1890/15-1077.

Bilkovic, D.M., M.M. Mitchell, K.J. Havens, and C.H. Hershner. 2019. Chesapeake Bay. Pages 379–404 in *World Seas: An Environmental Evaluation, Volume I: Europe, The Americas and West Africa*, Second Edition. Academic Press, Elsevier Limited.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia: Final Environmental Assessment.* OCS EIS/EA BOEM 2012-003.

Bureau of Ocean Energy Management (BOEM). 2022. *Coastal Virginia Offshore Wind Commercial Biological Assessment for the United States Fish and Wildlife Service*. December. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C%20USFWS%20BA.pdf.

Bureau of Ocean Energy Management (BOEM). 2023. *Addendum to the Coastal Virginia Offshore Wind Commercial Biological Assessment for the United States Fish and Wildlife Service*. June.

Bureau of Ocean Energy Management (BOEM) and Dominion Energy. 2022. Revised Project Design Information Submitted to BOEM.

Cassotta, S., Derkesen, C., Ekaykin, A., Hollowed, A., Kofinas, G., Mackintosh, A., Melbourne-Thomas, J., Muelbert, M.M.C., Ottersen, G., Pritchard, H., and Schuur, E.A.G. 2019. Polar Regions. Chapter 3 in H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, and N. Weyer (eds.), *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. Available: https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/SROCC_FinalDraft_Chapter3.pdf.

Cech, R., and Tudor, G. 2005. Butterflies of the East Coast: An Observer's Guide. Princeton University Press. Princeton, New Jersey. 345 pp.

Chesapeake Bay Program. 2020. *Climate Change | Chesapeake Bay Program*. Available: https://www.chesapeakebay.net/issues/climate_change#:~:text=How%20rapidly%20is%20sea%20level,through%20a%20process%20called%20subsidence. Accessed: March 4, 2022.

CSA Ocean Sciences Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England.* U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049. 59 pp.

Dernie, K.M., M.J. Kaiser, and R.M. Warwick. 2003. Recovery Rates of Benthic Communities Following Physical Disturbance. *Journal of Animal Ecology* (72):1043–1056.

Dominion Energy, Inc. (Dominion Energy). 2023a. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dominion Energy, Inc. (Dominion Energy). 2023b. Dominion Energy's Response to CVOW Request for Information (RFI) #12. July 25, 2023.

Dominion Energy, Inc. (Dominion Energy). 2023c. Dominion Energy's Response to CVOW Request for Information (RFI) #10. May 31, 2023.

Dooling, R.J., D. Buehler, M.R. Leek, A.N. Popper. 2019. The Impact of Urban and Traffic Noise on Birds. *Acoustical Society of America* 15(3):19–27.

Erbe, C., and C. McPherson. 2017. Underwater Noise from Geotechnical Drilling and Standard Penetration Testing. *The Journal of the Acoustical Society of America* 142:EL281–EL285. DOI:10.1121/1.5003328.

Glassberg, J. 1999. Butterflies through binoculars: A field guide to the butterflies of eastern North America. Oxford University Press. New York, NY. 242 pp.

Glick, P, Staudt, A, Nunley, B. 2008. *Sea-Level Rise and Coastal Habitats of the Chesapeake Bay: A Summary*. National Wildlife Federation. 11pp.

Goodwin, S.E., and W.G. Shriver. 2010. Effects of Traffic Noise on Occupancy Patterns of Forest Birds. *Conservation Biology* 25(2):406–411.

Hobbs, C.H., D.E. Krantz, and G.L. Wikel. 2008. Coastal Processes and Offshore Geology. Pages 1–44 in C. Bailey (ed.), *The Geology of Virginia.* College of William and Mary.

Kitty Hawk Wind North. 2021. *Kitty Hawk Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Kitty Hawk Wind South. 2022. *Kitty Hawk South Offshore Wind Project Construction and Operations Plan.* Prepared by Tetra Tech, Inc. April.

McCormick, M., T. Manley, D. Beletsky, A. Foley III, and G. Fahnenstiel. 2008. *Tracking the Surface Flow in Lake Champlain*. Available: http://www.glerl.noaa.gov/pubs/fulltext/2008/20080053.pdf. Accessed: December 4, 2021.

McLaughlin, K.E., and H.P. Kunc. 2013. Experimentally Increased Noise Levels Change Spatial and Singing Behavior. *Biology Letters 9*: 20120771.

Mineral Management Service. 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternative Use of Facilities on the Outer Continental Shelf. Final Environmental Impact Statement.* October 2007. Volume II: Chapter 5. OCS EIS/EA, MMS 2007-046. 342 pp.

Parker, S. 2020. *Loggerhead Sea Turtles Are Nesting in Virginia Beach*. Available: https://www.pilotonline.com/life/wildlife-nature/vp-nw-sea-turle-nest-0709-20200709-apv3xoqlbnd6ppvtd5h27hu53q-story.html. Accessed: December 1, 2021.

Roberts, C., M. Palmer, and D. McNeall. 2015. Quantifying the Likelihood of a Continued Hiatus in Global Warming. *Nature Climate Change* 5:337–342. Available: https://www.nature.com/articles/nclimate2531.

Sacatelli, R., R. Lathrop, and M.B. Kaplan. 2020. *Impacts of Climate Change on Coastal Forests in the Northeast US*. Rutgers University. Available: https://doi.org/10.7282/t3-n4tn-ah53.

Sivle, L.D., P.H. Kvadsheim and M.A. Ainslie. 2014. Potential for Population-Level Disturbance by Active Sonar in Herring. *ICES Journal of Marine Science*. DOI:10.1093/icesjms/fsu154.

Steimle, F., and C. Zetlin. 2000. Reef Habitats in the Middle Atlantic Bight: Abundance, Distribution, Associated Biological Communities, and Fishery Resource Use. *Marine Fisheries Review* 62:24–42.

U.S. Environmental Protection Agency (USEPA). 2009. *U.S. Climate Change Science Program; Final Report, Synthesis and Assessment Product 4.1. Coastal Sensitivity to Sea Level Rise: A Focus on the Mid-Atlantic Region*. A report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research (Synthesis and Assessment Product 4.1). Available: http://downloads.globalchange.gov/sap/sap4-1/sap4-1-final-report-all.pdf.. Accessed: November 22, 2021.

Virginia Department of Conservation and Recreation, Division of Natural Heritage (VDCR-DNH) and Virginia Department of Game and Inland Fisheries (VDGIF). 2013. Atlas of Rare Butterflies, Skippers, Moths, Dragonflies, and Damselflies of Virginia. Available: www.vararespecies.org. Accessed: March 20, 2023.

Virginia Department of Conservation and Recreation, Division of Natural Heritage (VDCR-DNH). 2018a. *Virginia Natural Landscape Assessment*. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Available: https://www.dcr.virginia.gov/naturalheritage/vaconvisvnla#ref. Accessed: October 13, 2020.

Virginia Department of Conservation and Recreation, Division of Natural Heritage (VDCR-DNH). 2018b. *Element Occurrences of Virginia*. Available: https://www.dcr.virginia.gov/natural-heritage/document/summapeos17.pdf. Accessed: October 8, 2020.

Wilber, D.H., and D.G. Clarke. 2007. *Defining and Assessing Benthic Recovery Following Dredging and Dredged Material Disposal.* Presentation from the 2007 WODCON XVIII Conference in Lake Buena Vista, FL.

C.1.3.9. Section 3.9, Commercial Fisheries and For-Hire Recreational Fishing

Atlantic States Marine Fisheries Commission (ASMFC). No Date. *Fisheries Resource Surveys*. Available: http://www.asmfc.org/fisheries-science/surveys.. Accessed: January 4, 2022.

Bureau of Ocean Energy Management (BOEM). 2021a. *Final Environmental Impact Statement: Vineyard Wind 1 Offshore Wind Energy Project*. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-1-FEIS-Volume-1.pdf. Accessed: November 16, 2021.

Bureau of Ocean Energy Management (BOEM). 2021b. *Final Environmental Impact Statement: South Fork Wind Farm and South Fork Export Cable Project.* Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/SFWF%20FEIS.pdf. Accessed: November 16, 2021.

Claisse, J.T., D.J. Pondella, M. Love, L.A. Zahn, C.M. Williams, J.P. Williams, and A.S. Bull. 2014. Oil Platforms Off California Are Among the Most Productive Marine Fish Habitats Globally. *Proceedings of the National Academy of Sciences* 111(43):15462–15467.

Colburn, L.L., M. Jepson, C. Weng, T. Seara, J. Weiss, and J.A. Hare, J.A., 2016. Indicators of Climate Change and Social Vulnerability in Fishing Dependent Communities Along the Eastern and Gulf Coasts of the United States. *Marine Policy* 74:323–333.

Dominion Energy, Inc. (Dominion Energy). 2023a. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dominion Energy, Inc. (Dominion Energy). 2023b. *CVOW-C American Eel Analysis (Developed in support of BOEM)*. Memorandum dated April 6, 2023.

Dominion Energy, Inc. (Dominion Energy). 2023c. CVOC-C Striped Bass Analysis, Developed in support of BOEM.

Eigaard, O.R., F. Bastardie, M. Breen, G.E. Dinesen, N.T. Hintzen, P. Laffargue, L.O. Mortensen, J.R. Nielsen, H.C. Nilsson, F.G. O'Neill, and H. Polet. 2016. Estimating Seabed Pressure from Demersal Trawls, Seines, and Dredges Based on Gear Design and Dimensions. *ICES Journal of Marine Science* 73(suppl_1):i27–i43.

Elliot J., A.A. Khan, Y.T. Lin, T. Mason, J.H. Miller, A.E. Newhall, G.R. Potty, and K. Vigness-Raposa. 2019. *Field Observations During Wind Turbine Operations at the Block Island Wind Farm, Rhode Island.* Sterling (VA): 281 p. Report No.: OCS Study 2019-028.

English, P.A., T.I. Mason, J.T. Backstrom, B.J. Tibbles, A.A. Mackay, M.J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling. OCS Study BOEM 2017-026. Available: https://tethys.pnnl.gov/sites/default/files/publications/English-et-al-2017-BOEM.pdf.

Fabrizio, M.C., J.P. Manderson, and J.P. Pessutti. 2014. Home Range and Seasonal Movements of Black Sea Bass (*Centropristis striata*) during Their Inshore Residency at a Reef in the Mid-Atlantic Bight. *Fishery Bulletin* 112:82–97. DOI:10.7755/FB.112.1.5.

Fayram, A.H., and A. De Risi. 2007. The Potential Compatibility of Offshore Wind Power and Fisheries: An Example Using Bluefin Tuna in the Adriatic Sea. *Ocean and Coastal Management* 50(8):597–605.

Grabowski, J., and S. Scyphers. 2020. *Impacts to New England's Commercial Fisheries. COVID-19 Special Investigation Report.* GRI Whitepaper Series 2020-9. Available: https://globalresilience.northeastern.edu/publications-whitepaperseries-covid-19-special-i6vestigation-report-2020-9/.

Hare, J.A., W.E. Morrison, M.W. Nelson, M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, and A.S. Chute. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast US Continental Shelf. *PLoS One* 11(2):e0146756.

Hawkins, A.D., L. Roberts, and S. Cheesman S. 2014. Responses of Free-Living Coastal Pelagic Fish to Impulsive Sounds. *The Journal of the Acoustical Society of America* 135(5):3101–3116. DOI:10.1121/1.4870697

Herbert-Read J.E., L. Kremer, R. Bruintjes, A.N. Radford, and C.C. Ioannou. 2017. Anthropogenic Noise Pollution from Pile-Driving Disrupts the Structure and Dynamics of Fish Shoals. *Proceedings of the Royal Society B: Biological Sciences* 284(1863). DOI:10.1098/rspb.2017.1627.

Hopkins T.E., and J.J. Cech. 2003. The Influence of Environmental Variables on the Distribution and Abundance of Three Elasmobranchs in Tomales Bay, California. *Environmental Biology of Fishes* 66(3):279–291.

Hutt, C. and G. Silva. 2019. *Economic Contributions of Atlantic Highly Migratory Species Anglers and Tournaments, 2016*. NOAA Technical Memorandum NMFS-OSF-8. Available: https://repository.library.noaa.gov/view/noaa/22420. Accessed: September 16, 2020.

Keppel, E.A., R.A. Scrosati, and S.C. Courtenay. 2012. Ocean Acidification Decreases Growth and Development in American lobster (*Homarus americanus*) Larvae. *Journal of Northwest Atlantic Fishery Science* 44:61–66.

King, D.M. 2017. *Economics of Mid-Atlantic Fisheries in the Year 2030* (Discussion Paper). Available: https://www.monmouth.edu/uci/documents/2019/11/economics-of-mid-atlantic-fisheries-in-the-year-2030.pdf/.

Kirkpatrick, J. 2014. *Who Fishes There? Establishing a Baseline of Spatial Fishing Revenue Along the Atlantic Coast.* Available: http://www.mafmc.org/briefing/april-2014.. Accessed: October 12, 2020.

Kuriyama, P.T., D.S. Holland, L.A. Barnett, T.A. Branch, R.L. Hicks, and K.E. Schnie. 2019. Catch Shares Drive Fleet Consolidation and Increased Targeting But Not Spatial Effort Concentration Nor Changes in Location Choice in a Multispecies Trawl Fishery. *Canadian Journal of Fisheries and Aquatic Sciences* 76(12):2377–2389.

Langhamer, O. 2012. Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art. *The Scientific World Journal 2012*.

Linley, E.A.S., T.A. Wilding, K. Black, A.J.S. Hawkins, and S. Mangi. 2007. *Review of the Reef Effects of Offshore Wind Farm Structures and Their Potential for Enhancement and Mitigation.* Report PML Applications Ltd. and Scottish Association for Marine Science to BERR. Available: https://tethys.pnnl.gov/sites/default/files/publications/Potential_for_Enhancement_and_Mitigation.pdf.

McCreary, S., and B. Brooks. 2019. *Atlantic Large Whale Take Reduction Team Meeting: Key Outcomes Meeting. April 23–26, 2019.*

Mueller-Blenkle, C, P.K. McGregor, A.B. Gill, M.H. Andersson, J. Metcalfe, B. Bendall, P. Sigray, D. Wood D, Thomsen F. 2010. *Effects of Pile-Driving Noise on the Behaviour of Marine Fish.* Lowestoft (UK): Cefas Lowestoft Laboratory. 62 p. Report No.: Cefas Ref: C3371.

National Marine Fisheries Service (NMFS). 2019. Vessel Activity by Vessel Speed and VMS Activity by Course, OCS-A-0498, Ocean Wind, January 2014 to August 2019.

National Marine Fisheries Service (NMFS). 2021a. *Fisheries of the United States, 2019*. U.S. Department of Commerce, NOAA Current Fishery Statistics No. 2019. Available: https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-united-states.

National Marine Fisheries Service (NMFS). 2021b. *Descriptions of Selected Fishery Landings and Estimates of Vessel Revenue from Areas: A Planning Level Assessment*. Available: https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/WIND_AREA_REPORTS/Dominion_Wind.html.

National Marine Fisheries Service (NMFS). 2021c. *Fisheries Economics of the United States, 2018.* U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-225, 246 pp.

National Marine Fisheries Service (NMFS). 2021d. *Landing and Revenue Data for Wind Energy Areas, 2008–2019*. Available: https://www.greateratlantic.fisheries.noaa.gov/ro/fso/reports/WIND/ALL_WEA_BY_AREA_DATA.html.

National Marine Fisheries Service (NMFS). 2022. *NOAA Fisheries DisMAP Data Records*. Available: https://apps-st.fisheries.noaa.gov/dismap/DisMAP.html. Accessed: May 24, 2022.

National Marine Fisheries Service (NMFS). 2023a. *Description of Selected Fishery Landings and Estimates of Vessel Revenue from Areas: A Planning-level Assessment*. March 1, 2023. Available: EconReport_Com_auto.knit (noaa.gov). Accessed: September 7, 2023.

National Marine Fisheries Service (NMFS). 2023b. Descriptions of Selected Fishery Landings and Estimates of Recreational Party and Charter Vessel Revenues from Areas: A Planning-level Assessment. March 1, 2023. Available: EconReport_Rec_auto.knit (noaa.gov). Accessed: September 7, 2023.

National Oceanic and Atmospheric Administration (NOAA). 2021a. *Commercial Fisheries Statistics*. Available: https://www.fisheries.noaa.gov/foss/f?p=215:200:7354399263191::NO:RP. Accessed: November 15, 2021.

National Oceanic and Atmospheric Administration (NOAA). 2021b. *Covid-19 Impact Assessment*. Available: https://media.fisheries.noaa.gov/2021-02/Updated-COVID-19-Impact-Assessment-webready.pdf. Accessed: November 15, 2021.

National Oceanic and Atmospheric Administration (NOAA) Fisheries Office of Science and Technology. 2022. *DisMAP Data Records*. Available: https://apps-st.fisheries.noaa.gov/dismap/DisMAP.html. Accessed: May 24, 2022.

Neo Y.Y., J. Hubert, L.J. Bolle, H.V. Winter, and H. Slabbekoorn. 2018. European Seabass Respond More Strongly to Noise Exposure at Night and Habituate Over Repeated Trials of Sound Exposure. *Environmental Pollution* 239:367–374. DOI:10.1016/j.envpol.2018.04.018.

Neo Y.Y., J. Seitz, R.A. Kastelein, H.V. Winter, C. ten Cate, and H. Slabbekoorn H. 2014. Temporal Structure of Sound Affects Behavioural Recovery from Noise Impact in European Seabass. *Biological Conservation* 178:65–73. DOI:10.1016/j.biocon.2014.07.012.

Ocean Wind. 2022. Ocean Wind Offshore Wind Farm Construction and Operations Plan, Appendix R Noise Supplementary Material. August. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OCW01-COP-Volume-III-Appendix-R_0.pdf.

Popper, A., A. Hawkins, R. Fay, D. Mann, and D. Bartol. 2014. Sound Exposure Guidelines. Pages 33–51 in *Sound Exposure Guidelines for Fish and Sea Turtles: A Technical Report.* Prepared by ANSI Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC14 TR-2014.

Popper, A.N., and M.C. Hastings. 2009. The Effects of Human-Generated Sound on Fish. *Integrative Zoology* 4(1):43–52.

Rogers, L.A., R. Griffin, T. Young, E. Fuller, K.S. Martin, and M.L. Pinsk. 2019. Shifting Habitats Expose Fishing Communities to Risk Under Climate Change. *Nature Climate Change* 9(7):512–516.

Secor, D.H., F. Zhang, M.H.P. O'Brien, and M. Li. 2018. Ocean Destratification and Fish Evacuation Caused by a Mid-Atlantic Tropical Storm. *ICES Journal of Marine Science* 76(2):573–584. DOI:10.1093/icesjms/fsx241.

Sims, D.W., M.J. Genner, A.J. Southward, and S.J. Hawkins, 2001. Timing of Squid Migration Reflects North Atlantic Climate Variability. *Proceedings of the Royal Society of London. Series B: Biological Sciences* 268(1485):2607–2611.

Smith J., M. Lowry, C. Champion, and I. Suthers. 2016. A Designed Artificial Reef is Among the Most Productive Marine Fish Habitats: New Metrics to Address 'Production Versus Attraction.' *Marine Biology* 163(18). DOI:10.1007/s00227-016-2967-y.

Stevens, B.G., C. Schweitzer, and A. Price. 2019. *Hab in the MAB: Characterizing Black Sea Bass Habitat in the Mid-Atlantic Bight*. Available: https://tethys.pnnl.gov/sites/default/files/publications/Potential_for_Enhancement_and_Mitigation.pdf.

Talmage, S.C., and C.J. Gobler. 2010. Effects of Past, Present, and Future Ocean Carbon Dioxide Concentrations on the Growth and Survival of Larval Shellfish. *Proceedings of the National Academy of Sciences* 107(40):17246–17251.

Virginia Marine Resources Commission (VMRC). No Date. *Virginia Saltwater Anglers Guide*. Available: https://mrc.virginia.gov/vswft/angler_guide/angler_web.pdf. Accessed: November 11, 2021.

Young W. No Date. *Virginia Triangle Reef: Tarav's Square Triangle*. Available: https://fishtalkmag.com/blog/virginia-triangle-reef-taravs-square-triangle. Accessed: November 22, 2021.

C.1.3.10. Section 3.10, Cultural Resources

Bureau of Ocean Energy Management (BOEM). 2012. *Inventory and Analysis of Archaeological Site Occurrence on the Atlantic Outer Continental Shelf*. Prepared by TRC Environmental Corporation for the U.S. Dept. of the Interior, Bureau of Ocean Energy, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEM 2012-008. 324 pp.

Bureau of Ocean and Energy Management (BOEM). 2020. *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585*. May 27. Available: https://www.boem.gov/sites/default/files/documents/about-boem/Archaeology%20and%20Historic%20Property%20Guidelines.pdf. Accessed: November 7, 2021.

Bureau of Ocean Energy Management (BOEM). 2022. Cumulative Historic Resources Visual Effects Assessment (CHRVEA). November. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C_CHRVEA_11.08.2022_WithAttachments_Reduced.pdf.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Kitty Hawk Wind North. 2021. *Kitty Hawk Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Kitty Hawk Wind South. 2022. *Kitty Hawk South Offshore Wind Project Construction and Operations Plan.* Prepared by Tetra Tech, Inc. April.

C.1.3.11. Section 3.11, Demographics, Employment, and Economics

American Wind Energy Association (AWEA). 2020. *U.S. Offshore Wind Power Economic Impact Assessment*. Available: https://supportoffshorewind.org/wp-content/uploads/sites/6/2020/03/AWEA_Offshore-Wind-Economic-ImpactsV3.pdf. Accessed: September 30, 2021.

Bureau of Ocean Energy Management (BOEM). 2021a. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind. Accessed: August 2021.

BVG Associates Limited. 2017. *U.S. Job Creation in Offshore Wind: A Report for the Roadmap Project for Multi-State Cooperation on Offshore Wind*. Final Report. Report No. 17-22. Report for New York State Energy Research and Development Authority (NYSERDA). Available: https://tethys.pnnl.gov/sites/default/files/publications/NYSERDA-Report-2017-OSW-Jobs.pdf. Accessed: October 7, 2021.

City of Virginia Beach. 2017.*VB Geofacts & Information.* Available: https://www.vbgov.com/government/departments/communications-info-tech/maps/pages/vb-geo-facts-and-information.aspx. Accessed: December 1, 2021.

Dominion Energy, Inc. (Dominion Energy). 2023a. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dominion Energy, Inc. (Dominion Energy). 2023b. Dominion Energy's Response to CVOW Request for Information (RFI) #8. February 28, 2023.

E2. 2018. *Offshore Wind: Generating Economic Benefits on the East Coast*. Prepared by BW Research. August. Available: https://www.e2.org/wp-content/uploads/2018/08/E2-OCS-Report-Final-8.30.18.pdf.

Georgetown Economic Services, LLC. 2020. *Potential Employment Impact from Offshore Wind in the United States: The Mid-Atlantic and New England Region*. July 27, 2020.

Gould, R., and E. Cresswell. 2017. *New York State and the Jobs of Offshore Wind Energy.* Workforce Development Institute. Available: https://wdiny.org/Portals/0/New%20York%20State%20and%20The%20Jobs%20Of%20Offshore%20Wind%20Energy_%20WDI2017.pdf?ver=2017-05-03-150746-023. Accessed: May 16, 2022.

National Oceanic and Atmospheric Administration (NOAA). 2021. *Quick Report Tool of Socioeconomic Data: Ocean Economy (Employment data)*. Available: https://coast.noaa.gov/quickreport/#/index.html. Accessed: September 14, 2021.

University of Delaware. 2021. *Supply Chain Contracting Forecast for U.S. Offshore Wind Power*. Special Initiative on Offshore Wind. October 2021.

U.S. Bureau of Economic Analysis. 2021. *Current-Dollar Gross Domestic Product (GDP) by State and Region, 2020*. Available: https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1&acrdn=1. Accessed: September 30, 2021.

U.S. Census Bureau. 2021a. Table DP05: *ACS Demographic and Housing Estimates, 2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/all?q=&t=Populations%20and%20People. Accessed: November 19, 2021.

U.S. Census Bureau. 2021b. Table DP05: *ACS Demographic and Housing Estimates, 2010 American Community Survey 5-Year Estimate*s. Available: https://data.census.gov/cedsci/all?q=&t=Populations%20and%20People. Accessed: November 19, 2021.

U.S. Census Bureau. 2021c. Table DP03: A*CS Selected Economic Characteristics. 2015–2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/. Accessed: November 29, 2021.

U.S. Census Bureau. 2021d. 2019 Gazetteer Files, Virginia. Available: https://www2.census.gov/geo/docs/maps-data/data/gazetteer/2019_Gazetteer/2019_gaz_place_51.txt. Accessed: November 29, 2021.

U.S. Census Bureau. 2021e. Table CB1900CBP: All Sectors: County Business Patterns, including ZIP Code Business Patterns, by Legal Form of Organization and Employment Size Class for the U.S., States, and Selected Geographies: 2019. Economic Surveys. Available: https://data.census.gov/cedsci/advanced?text=at-place%20employment&t=Industry. Accessed: November 29, 2021.

U.S. Census Bureau. 2022a. Table DP04: *ACS Selected Housing Characteristics. 2015–2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/. Accessed: May 16, 2022.

U.S. Census Bureau. 2022b. Table B25004: *ACS Vacancy Status. 2015–2019 American Community Survey 5-Year Estimates*. Available: https://data.census.gov/cedsci/. Accessed: May 16, 2022.

C.1.3.12. Section 3.12, Environmental Justice

Buonocore, J.J., P. Luckow, J. Fisher, W. Kempton, and J.L. Levy. 2016. *Health and Climate Benefits of Offshore Wind Facilities in the Mid-Atlantic United States.* Environmental Research Letters 11 074019. July 14, 2016. Available: https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074019/pdf. Accessed: November 2021.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment.* January. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Mid-Atlantic_Final_EA_012012.pdf.

Council on Environmental Quality (CEQ). 1997. *Environmental Justice: Guidance Under the National Environmental Policy Act.* Available: https://www.epa.gov/sites/default/files/2015-02/documents/ej_guidance_nepa_ceq1297.pdf. Accessed: November 17, 2021.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Kitty Hawk Wind North. 2021. *Kitty Hawk Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Kitty Hawk Wind South. 2022. *Kitty Hawk South Offshore Wind Project Construction and Operations Plan.* Prepared by Tetra Tech, Inc. April.

Nansemond Indian Nation. n.d. *Nansemond Indian Nation, History*. Available: https://nansemond.org/history/. Accessed: November 17, 2021.

National Guestworker Alliance. 2016. *Raising the Floor for Supply Chain Workers: Perspective from U.S. Seafood Supply Chains*. New Orleans, LA.

National Oceanic and Atmospheric Administration (NOAA). 2018. *Economics: National Ocean Watch (ENOW)*. Available: https://coast.noaa.gov/digitalcoast/data/enow.html. Accessed: December 27, 2021.

National Oceanic and Atmospheric Administration (NOAA). 2022. *Social Indicators for Coastal Communities.* Available: https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities. Accessed: September 1, 2022.

National Oceanic and Atmospheric Administration (NOAA). 2023. *Marine Recreational Information Program.* Available: https://www.st.nmfs.noaa.gov/msd/html/siteRegister.jsp. Accessed: April 19, 2023.

Secretary of the Commonwealth. n.d. *State Recognized Tribes*. Available: https://www.commonwealth.virginia.gov/virginia-indians/state-recognized-tribes/. Accessed: April 17, 2023.

Thind, M.P.S., C.W. Tessum, I.L. Azevedo, and J.D. Marshall. 2019. Fine Particulate Air Pollution from Electricity Generation in the US: Health Impacts by Race, Income, and Geography. *Environmental Science & Technology*. DOI:10.1021/acs.est.9b02527. Available: https://depts.washington.edu/airqual/Marshall_117.pdf. Accessed: November 7, 2021.

U.S. Census Bureau (USCB). 2000a. *2000 Decennial Census, Summary File 1. Table ID: P004. HISPANIC OR LATINO, AND NOT HISPANIC OR LATINO BY RACE [73]*. Available: https://data.census.gov/cedsci/. Accessed: September 1, 2022.

U.S. Census Bureau (USCB). 2000b. *2000 Decennial Census, Summary File 3*. Available: https://data.census.gov/cedsci/. Accessed: September 1, 2022.

U.S. Census Bureau (USCB). 2010. *Table S1701: POVERTY STATUS IN THE PAST 12 MONTHS. 2010: ACS 1-year Estimates Subject Table.* Available: https://data.census.gov/cedsci/. Accessed: September 1, 2022.

U.S. Census Bureau (USCB). 2019. *Table S1701: POVERTY STATUS IN THE PAST 12 MONTHS. 2019: ACS 5-year Estimates Subject Table*. Available: https://data.census.gov/cedsci/. Accessed: September 1, 2022.

U.S. Environmental Protection Agency (USEPA). 2016. *Promising Practices for EJ Methodologies in NEPA Reviews: Report for the Federal Interagency Working Group on Environmental Justice & NEPA Committee*. Available: https://www.epa.gov/sites/default/files/2016-08/documents/nepa_promising_practices_document_2016.pdf. Accessed: November 17, 2021.

U.S. Environmental Protection Agency (USEPA). 2022. *E.O. 13985 Equity Action Plan*. April. Available: https://www.epa.gov/system/files/documents/2022-04/epa_equityactionplan_april2022_508.pdf.

U.S. Environmental Protection Agency (USEPA). 2023. *EJScreen Environmental Justice Screening and Mapping Tool*. April. Available: https://ejscreen.epa.gov/mapper/.

C.1.3.13. Section 3.13, Finfish, Invertebrates, and Essential Fish Habitat

Aguilar de Soto N, Delorme N, Atkins J, Howard S, Williams J, Johnson M. 2013. Anthropogenic Noise Causes Body Malformations and Delays Development in Marine Larvae. *Scientific Reports*. 3:2831. DOI:10.1038/srep02831.

Ainslie M.A., M.B. Halvorsen, R.A.J. Muller, and T. Lippert. 2020. Application of Damped Cylindrical Spreading to Assess Range to Injury Threshold for Fishes from Impact Pile Driving. *J Acoust Soc Am*. 148(1):108. DOI:10.1121/10.0001443.

Albert L., F. Deschamps A. Jolivet, F. Olivier, L. Chauvaud, and S. Chauvaud. 2020. A Current Synthesis on the Effects of Electric and Magnetic Fields Emitted by Submarine Power Cables on Invertebrates. *Marine Environmental Research.* 159:104958. DOI:10.1016/j.marenvres.2020.104958. Available: https://linkinghub.elsevier.com/retrieve/pii/S0141113619307706. Accessed: March 28, 2023.

Amaral J.L., R.B. Beard, R.J. Barham, A.G. Collett, J. Elliot, A. Frankel, D. Gallien, C. Hager, A.A. Khan, Y.T. Lin, et al. 2018. *Field Observations during Wind Turbine Foundation Installation at the Block Island Wind Farm, Rhode Island.* Englewood (CO): U.S. Department of Interior, Bureau of Ocean Energy Management. 95 p. Report No.: OCS Study 2018-029.

André, M., M. Solé, M. Lenoir, M. Durfort, C. Quero, A. Mas, A. Lombarte, M. van der Schaar, M. López-Bejar, M. Morell, S. Zaugg, and L. Houégnigan. 2011. Low-Frequency Sounds Induce Acoustic Trauma in Cephalopods. *Frontiers in Ecology and the Environment* 9(9):489–493.

Andres, M. 2016. On the Recent Destabilization of the Gulf Stream Path Downstream of Cape Hatteras. *Geophysical Research Letters* 43(18):9836–9842.Available: https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2016GL069966. Accessed: November 22, 2021.

Atlantic States Marine Fisheries Commission (ASMFC). 2012a. *American Eel Stock Assessment for Peer Review.* ASMFC, Stock Assessment. Report No. 12-01, Washington, D.C. 254 p.

Atlantic States Marine Fisheries Commission (ASMFC). 2012b. *River Herring Benchmark Stock Assessment.* ASMFC Stock Assessment Report No. 12, Washington, D.C.

Atlantic States Marine Fisheries Commission (ASMFC). 2017a. *River Herring Stock Assessment Update, Volume I: Coastwide Summary*. ASMFC Stock Assessment Report, Washington, D.C.

Atlantic States Marine Fisheries Commission (ASMFC). 2017b. *River Herring Stock Assessment Update, Volume II: State-Specific Reports*. ASMFC Stock Assessment Report, Washington, D.C.

Atlantic States Marine Fisheries Commission (ASMFC). 2017c. *Atlantic Sturgeon Benchmark Stock Assessment and Peer Review Report*. Raleigh, North Carolina: Prepared by the ASMFC Atlantic Sturgeon Stock Assessment Peer Review Panel. Pursuant to NOAA Award No. NA15NMF4740069. 456 pp.

Atlantic States Marine Fisheries Commission (ASMFC). 2023. *Shad and River Herring*. Available: http://www.asmfc.org/species/shad-river-herring.. Accessed: April 27, 2023.

Baker, K., and U. Howson. 2021. *Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf. Biological Assessment*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. October 2018, Revised February 2021. 152 p.

Balazik M., M. Barber, S. Altman, K. Reine, A. Katzenmeyer, A. Bunch, and G. Garman. 2020. *Dredging Activity and Associated Sound Have Negligible Effects on Adult Atlantic Sturgeon Migration to Spawning Habitat in a Large Coastal River.* Peng Z, editor. *PLoS ONE*. 15(3):e0230029. DOI:10.1371/journal.pone.0230029.

Balazik, M.T., and J.A. Musick. 2015. Dual Annual Spawning Races in Atlantic Sturgeon. *PLoS One* 10(5):e0128234. DOI:10.1371/journal.pone.0128234.

Balazik, M.T., K.J. Reine, A.J. Spells, C.A. Fredrickson, M.L. Fine, G.C. Garman, and S.P. McIninch. 2012. *The Potential for Vessel Interactions with Adult Atlantic Sturgeon in the James River, Virginia.* North American Journal of Fisheries Management. 32(6):1062–1069. DOI:10.1080/02755947.2012.716016.

Bejarano, A., J. Michel, J. Rowe, Z. Li, D. French McCay, and D. Schmidt Etkin. 2013. *Environmental Risks, Fate, and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213. Available: https://espis.boem.gov/final%20reports/5330.pdf. Accessed: November 24, 2021.

Bergström, L., L. Kautsky, T. Malm, R. Rosenberg, M. Wahlberg, N. Åstrand Capetillo, and D. Wilhelmsson. 2014. Effects of Offshore Wind Farms on Marine Wildlife—A Generalized Impact Assessment. *Environ Res Lett*. 9(3):034012. DOI:10.1088/1748-9326/9/3/034012.

Bolle L., C. de Jong, E. Blom, P.W. Wessels, C.J. van Damme, and H.V. Winter. 2014. *Effect of Pile-Driving Sound on the Survival of Fish Larvae.* Den Haag (Netherlands): Institute for Marine Resources & Ecosystem Studies.

Bolle, L.J., C.A. de Jong, S.M. Bierman, P.J. van Beek, O.A. van Keeken, P.W. Wessels, C.J. van Damme, H.V. Winter, D. de Haan, and R.P. Dekeling. 2012. Common Sole Larvae Survive High Levels of Pile-Driving Sound in Controlled Exposure Experiments. *PLoS One*. 7(3):e33052. DOI:10.1371/journal.pone.0033052.

Bonfil, R., S. Clarke, and H. Nakano. 2008. Chapter 11: The Biology and Ecology of the Oceanic Whitetip Shark, *Carcharhinus longimanus*. In: M.D. Camhi, E.K. Pikitch, B.E. A (Eds.), *Sharks of the Open Ocean: Biology, Fisheries and Conservation*. Online: Blackwell Publishing Ltd. Pp. 128-139.

Boyd, S.E., D.S. Limpenny, H.L. Rees, and K.M. Cooper. 2005. The Effects of Marine Sand and Gravel Extraction on the Macrobenthos at a Commercial Dredging Site (Results 6 Years Post-Dredging). *ICES Journal of Marine Science* 62:145–162.

Bruintjes R., J. Purser, K.A. Everley, S. Mangan, S.D. Simpson, and A.N. Radford. 2016. Rapid Recovery Following Short-Term Acoustic Disturbance in Two Fish Species. *Royal Society Open Science* 3(1):150686. DOI:10.1098/rsos.150686.

Budelmann, B.U. 1992. Hearing in crustacea. In: D. B. Webster, A. N. Popper and R. R. Fay (Eds.), The Evolutionary Biology of Hearing. New York, NY: Springer New York. pp. 131–139.

Bullard, S.G., G. Lambert, M.R. Carman, J. Byrnes, R.B. Whitlatch, G. Ruiz, R.J. Miller, L. Harris, P.C. Valentine, J.S. Collie, J. Pederson, D.C. McNaught, A.N. Cohen, R.G. Asch, J. Dijkstra, and K. Heinonen. 2007. The Colonial Ascidian *Didemnum* sp. A: Current Distribution, Basic Biology, and Potential Threat to Marine Communities of the Northeast and West Coasts of North America. *Journal of Experimental Marine Biology and Ecology* 342(1):99–108. DOI:10.1016/j.jembe.2006.10.020..

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia, Final Environmental Assessment.* 366 pp. Report No.: OCS EIS/EA BOEM 2012-003.

Bureau of Ocean Energy Management (BOEM). 2014a. *Programmatic Environmental Impact Statement for Atlantic OCS Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas*. Office of Renewable Energy Programs. OCS EIS/EA BOEM 2014-001.

Bureau of Ocean Energy Management (BOEM). 2014b. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf*. Revised Environmental Assessment. 240 pp. Report No.: OCS EIS/EA BOEM 2015-031.

Bureau of Ocean Energy Management (BOEM). 2021a. *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development*. April 28, 2021. 9 pp.

Bureau of Ocean Energy Management (BOEM). 2021b. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement Volume I*. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-1-FEIS-Volume-1.pdf. Accessed: November 22, 2021.

Bureau of Ocean Energy Management (BOEM). 2022c. Appendix R-2: Underwater Acoustic Modeling of Detonations of Unexploded Ordnance (UXO) for Ørsted Wind Farm Construction, US East Coast. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/OCW01_COP_Volume%20III_Appendix%20R_20220614.pdf. Accessed: March 17, 2023.

Bureau of Ocean Energy Management (BOEM). 2023a. *Draft Coastal Virginia Offshore Wind Commercial Project Essential Fish Habitat Assessment*. May 2022. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C-EFH-Assessment.pdf.

Bureau of Ocean Energy Management (BOEM). 2023b. *Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. March 2022. 147 pp. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C-NMFS-BA.pdf.

Bureau of Ocean Energy Management (BOEM). 2023c. *Addendum to the Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. May.

Bureau of Ocean Energy Management (BOEM). 2023d. Coastal Virginia Offshore Wind Discussion of Tribal Fisheries Concerns: Other Fishes, Habitats, and Updates. April 10.

Burkill, P.H., and C. Reid. 2010. *Plankton Biodiversity of the North Atlantic: Changing Patterns Revealed by the Continuous Plankton Recorder Survey.* December. DOI:10.5270/OceanObs09.pp.09.

California Department of Transportation (Caltrans). 2004. F*isheries and Hydroacoustic Monitoring Program Compliance Report for the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project*. June. Available: https://ocr.org/pdfs/papers/2004_pile_driving_impacts.pdf.

Carlson, J.K., and S. Gulak. 2012. Habitat use and movement patterns of oceanic whitetip, bigeye thresher and dusky sharks based on archival satellite tags. *Collective Volumes of Scientific Papers, ICCAT* 68(5):1922–1932.

Carlton. J., D.M. Reid, and H. van Leeuwen. 1995. *The Role of Shipping in the Introduction of Nonindigenous Aquatic Organisms to the Coastal Waters of the United States (Other than the Great Lakes) and an Analysis of Control Options*. Report to US Coast Guard, Washington DC.

Carpenter, J.R., L. Merchelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. Potential impacts of offshore wind farms on North Sea stratification. *PLoS ONE* 11(8):e0160830.

Casper, B.M., P.S. Lobel, and H.Y. Yan. 2013. Effects of Exposure to Pile Driving Sounds on Fish Inner Ear Tissues. *Comparative Biochemistry and Physiology, Part A* 166 (2013):352–360.

Christian J.R., A. Mathieu, D.H. Thomson, D. White, and R.A. Buchanan. 2003. *Effect of Seismic Energy on Snow Crab (*Chionoecetes opilio*).* Calgary (Alberta): Environmental Studies Research Fund. 106 p. Report No.: CAL-1-00364.

Christiansen M.B., and C.B. Hasager. 2005. Wake Effects of Large Offshore Wind Farms Identified from Satellite SAR. *Remote Sensing of Environment* 98(2–3):251–268. DOI:10.1016/j.rse.2005.07.009.

Christiansen N., U. Daewel, B. Djath, and C. Schrum. 2022. Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes. *Front Mar Sci*. 9:818501. DOI:10.3389/fmars.2022.818501.

Claisse, J.T., D.J. Pondella II, M. Love, L.A. Zahn, C.M. Williams, J.P. Williams, and A.S. Bull. 2014. Oil Platforms Off California are among the Most Productive Marine Fish Habitats Globally. *Proceedings of the National Academy of Sciences of the United States of America* 111 (43):15462–15467. October 28, 2014. First published October 13, 2014. Available: https://www.pnas.org/content/pnas/111/43/15462.full.pdf. Accessed: November, 28, 2021.

Coen, L.D., R.E. Grizzle, J.L. Lowery, and K.T. Paynter Jr. 2007. *The Importance of Habitat Created by Molluscan Shellfish to Managed Species along the Atlantic Coast of the United States*. ASMFC Habitat Management Series #8. Atlantic States Marine Fisheries Commission. 115 pp.

Cones, S., Y. Jézéquel, S. Ferguson, N. Aoki, and T.A. Mooney. 2022. Pile Driving Noise Induces Transient Gait Disruptions in the Longfin Squid (*Doryteuthis pealeii*). *Frontiers in Marine Science* 2556.

Corbett, W.T. 2018. *The Behavioural and Physiological Effects of Pile-Driving Noise on Marine Species*. Exeter (UK): University of Exeter.

Cote, D., C.J. Morris, P.M. Regular, and M.G. Piersiak. 2020. Effects of 2D Seismic on Snow Crab Movement Behavior. *Fisheries Research* 230. DOI:10.1016/j.fishres.2020.105661.

Cresci, A., C.M.F. Durif, T. Larsen, R. Bjelland, A.B. Skiftesvik, and H.I. Browman. 2022a. Magnetic Fields Produced by Subsea High-Voltage Direct Current Cables Reduce Swimming Activity of Haddock Larvae (*Melanogrammus aeglefinus*). Nelson KE, editor. *PNAS Nexus*. 1(4):pgac175. DOI:10.1093/pnasnexus/pgac175.

Cresci, A., P. Perrichon, C.M.F. Durif, E. Sørhus, E. Johnsen, R. Bjelland, T. Larsen, A.B. Skiftesvik, and H.I. Browman. 2022b. Magnetic Fields Generated by the DC Cables of Offshore Wind Farms Have No Effect on Spatial Distribution or Swimming Behavior of Lesser Sandeel Larvae (*Ammodytes marinus*). *Marine Environmental Research*. 176:105609. DOI:10.1016/j.marenvres.2022.105609.

Crocker, S.E., and F.D. Fratantonio. 2016. *Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys*. Naval Undersea Warfare Center Division, Newport, RI. For U.S. Department of the Interior, Bureau of Ocean Energy Management, Environmental Assessment Division and U.S. Geological Survey. OCS Study BOEM 2016-044. NUWC-NPT Technical Report 12,203. March 24, 2016. 266 pp.

Crocker, S.E., F.D. Fratantonio, P.E. Hart, D.S. Foster, T.F. O'Brien, and S. Labak. 2019. Measurements of Sounds Emitted by Certain High-Resolution Geophysical Survey Systems. *IEEE Journal of Oceanic Engineering* 4(3):796–813.

CSA International Inc., Applied Coastal Research and Enginnering, Inc. Barry A. Vittor & Associates, Inc., C. F. Bean L. L. C., and Florida Institute of Technology. 2009. Analysis of Potential Biological and Physical Impacts of Dredging on Offshore Ridge and Shoal Features. Leasing Division, Marine Minerals Branch, Herndon, VA. 160 p. OCS Study MMS 2010-010 160 pp.

CSA Ocean Sciences Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049.

Cutter, G., and R. Diaz. 1998. Part I: Benthic Habitats and Biological Resources Off the Virginia Coast 1996 and 1997. In *Environmental Studies Relative to Potential Sand Mining in the Vicinity of the City of Virginia Beach, Virginia.* Virginia Institute of Marine Science, College of William and Mary. Available: http://dx.doi.org/doi:10.21220/m2-mx15-9c77.. Accessed: September 22, 2022.

Daewel, U., N. Akhtar, N. Christiansen, and C. Schrum. 2022. Offshore wind farms are projected to impact primary production and bottom water deoxygenation in the North Sea. *Commun Earth Environ.* 3(1):292. DOI:10.1038/s43247-022-00625-0.

Day, R.D., R.D. McCauley, Q.P. Fitzgibbon, K. Hartmann, and J.M. Semmens. 2016. *Assessing the Impact of Marine Seismic Surveys on Southeast Australian Scallop and Lobster Fisheries.* Hobart (Australia): Fisheries Research and Development Corporation. FRDC Project No 2012/008.

Debusschere, E., B. De Coensel, A. Bajek, D. Botteldooren, K. Hostens, J. Vanaverbeke, S. Vandendriessche, K. Van Ginderdeuren, M. Vincx, and S. Degraer. 2014. In Situ Mortality Experiments with Juvenile Sea Bass (*Dicentrarchus labrax*) in Relation to Impulsive Sound Levels Caused by Pile Driving of Windmill Foundations. *PLoS One* 9(10):e109280. DOI:10.1371/journal.pone.0109280.

Degraer, S., D. Carey, J. Coolen, Z. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning: A Synthesis. *Oceanography* 33(4):48–57. DOI:10.5670/oceanog.2020.405.

Degraer, S., R. Brabant, B. Rumes, and L. Vigin. 2018. *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea, Assessing and Managing Effect Spheres of Influence.* Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management, 136 pp.

de León, R., K. Vane, P. Bertuol, V. Chamberland, F. Simal, E. Imms, and M. Vermeij. 2013. Effectiveness of lionfish removal efforts in the southern Caribbean. *Endang Species Res*. 22(2):175–182. DOI:10.3354/esr00542.

De Robertis, A., and N.O. Handegard. 2013. Fish Avoidance of Research Vessels and the Efficacy of Noise-Reduced Vessels: A Review. *ICES Journal of Marine Science* 70(1):34–45.

Di Iorio, L., C. Gervaise, V. Jaud, A.A. Robson, and L. Chauvaud. 2012. Hydrophone detects cracking sounds: non-intrusive monitoring of bivalve movement. *Journal of Experimental Marine Biology and Ecology* 432–433:9–16.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dorrell, R.M., C.J. Lloyd, B.J. Lincoln, T.P. Rippeth, J.R. Taylor, C.P. Caulfield, J. Sharples, J.A. Polton, B.D. Scannell, D.M. Greaves, et al. 2022b. Anthropogenic Mixing in Seasonally Stratified Shelf Seas by Offshore Wind Farm Infrastructure. *Front Mar Sci*. 9:830927. DOI:10.3389/fmars.2022.830927.

Drake, L.A. 2015. Review of "Global Maritime Transport and Ballast Water Management" by M. David and S. Gollasch, eds. *Biological Invasions* 17:3063–3065.

Eklund, A.M., and T.E. Targett. 1991. Seasonality of Fish Catch Rates and Species Composition from the Hard Bottom Trap Fishery in the Middle Atlantic Bight (US East Coast). *Fish. Res*. 12:1–22.

Elliot, J., A.A. Khan, Y.T. Lin, T. Mason, J.H. Miller, A.E. Newhall, G.R. Potty, and K. Vigness-Raposa. 2019. *Field Observations during Wind Turbine Operations at the Block Island Wind Farm, Rhode Island.* Sterling (VA): 281 p. Report No.: OCS Study 2019-028.

Epifanio, C.E. 2013. Invasion Biology of the Asian Shore Crab *Hemigrapsus sanguineus*: A Review. *Journal of Experimental Marine Biology and Ecology* 441 (2013):33–49.

Fabrizio, M.C., J.P. Manderson, and J.P. Pessutti. 2014. Home Range and Seasonal Movements of Black Sea Bass (*Centropristis striata*) during Their Inshore Residency at a Reef in the Mid-Atlantic Bight. *Fishery Bulletin* 112:82–97. DOI:10.7755/FB.112.1.5.

Farmer, N.A., L.P. Garrison, C. Horn, M. Miller, T. Gowan, R.D. Kenney, M. Vukovich, J.R. Willmott, J. Pate, D.H. Webb, T.J. Mullican, J.D. Stewart, K. Bassos-Hull, C. Jones, D. Adams, N.A. Pelletier, J. Waldron, and S. Kajiura. 2022. The Distribution of Manta Rays in the Western North Atlantic Ocean off the Eastern United States. *Scientific Reports* 12:6544.

Farr, E.R., M.R. Johnson, M.W. Nelson, J.A. Hare, W.E. Morrison, M.D. Lettrich, B. Vogt, C. Meaney, U.A. Howson, P.J. Auster, F.A. Borsuk, D.C. Brady, M.J. Cashman, P. Colarusso, J.H. Grabowski, J.P. Hawkes, R. Mercaldo-Allen, D.B. Packer, and D.K. Stevenson. 2021. An Assessment of Marine, Estuarine, and Riverine Habitat Vulnerability to Climate Change in the Northeast U.S. *PLoS One* 16(12): e0260654. DOI:10.1371/journal.pone.0260654.

Fay, R.R., and A.N. Popper. 2000. Evolution of hearing in vertebrates: the inner ears and processing. *Hearing Research* 149:1–10.

Fay, R. 2009. Soundscapes and the sense of hearing of fishes. *Integrative Zoology* 4(1):26–32.

Filiciotto, F., M. Vazzana, M. Celi, V. Maccarrone, M. Ceraulo, G. Buffa, V. Di Stefano, Mazzola S, Buscaino G. 2014. Behavioural and Biochemical Stress Responses of *Palinurus Elephas* after Exposure to Boat Noise Pollution in Tank. *Marine Pollution Bulletin*. 84(1-2):104–114.

Fisheries Hydroacoustic Working Group (FHWG). 2008. *Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities*. Memorandum to Applicable Agency Staff. June 12, 2008. 4 pp.

Floeter, J., J.E.E. van Beusekom, D. Auch, U. Callies, J. Carpenter, T. Dudeck, S. Eberle, A. Eckhardt, D. Gloe, K. Hänselmann, et al. 2017. Pelagic Effects of Offshore Wind Farm Foundations in the Stratified North Sea. *Progress in Oceanography* 156:154–173. DOI:10.1016/j.pocean.2017.07.003.

Glarou, M., M. Zrust, and J.C. Svendsen. 2020. Using Artificial-Reef Knowledge to Enhance the Ecological Function of Offshore Wind Turbine Foundations: Implications for Fish Abundance and Diversity. *JMSE.* 8(5):332. DOI:10.3390/jmse8050332.

Glasby, T.M., S.D. Connell, M.G. Holloway, and C.L. Hewitt. 2007. Nonindigenous Biota on Artificial Structures: Could Habitat Creation Facilitate Biological Invasions? *Marine Biology* 151(3):887–895.

Grashorn, S., and E.V. Stanev. 2016. Kármán vortex and turbulent wake generation by wind park piles. *Ocean Dynamics* 66:1543–1557.

Greater Atlantic Region Fisheries Office (GARFO). 2021. *Section 7: Consultation Technical Guidance in the Greater Atlantic Region: List of Resources to Help Action Agencies Draft Their Biological Assessments*. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-consultation-technical-guidance-greater-atlantic. Accessed: December 10, 2021.

Greater Atlantic Region Fisheries Office (GARFO). 2022. *Section 7: Consultation Technical Guidance in the Greater Atlantic Region. NOAA Fisheries.* Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-consultation-technical-guidance-greater-atlantic. Accessed: March 23, 2023.

Grieve, B., E. Curchitser, and R. Rykaczewski. 2016. Range expansion of the invasive lionfish in the Northwest Atlantic with climate change. *Mar Ecol Prog Ser*. 546:225–237. DOI:10.335.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estlea-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas. December 2017.* Sterling, VA: US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. Available: https://espis.boem.gov/final%20reports/5647.pdf. Accessed: November 22, 2021.

Hager, C., and K. Breault. 2023—Personal communications to G. Fulling regarding Preliminary Conclusions of the BOEM report, Spatiotemporal Distributions of Species Detected within Virginia's Offshore Lease Areas, The Virginia Wind Energy Lease Area A-0483.

Hager, C., J. Kahn, C. Watterson, J. Russo, and K. Hartman. 2014. Evidence of Atlantic Sturgeon Spawning in the York River System. *Transactions of the American Fisheries Society* 143:10.1080/00028487.2014.925971.

Handegard, N. 2003. Avoidance Behaviour in Cod (*Gadus morhua*) to a Bottom-Trawling Vessel. *Aquatic Living Resources* 16(3):265–270.

Hare, J.A., W.E. Morrison, M.W. Nelson, M. Stachura, E.J. Teeters, R.B. Griffis, M.A. Alexander, J.D. Scott, L. Alade, R.J. Bell, A.S. Chute, K.L. Curti, T.H. Curtis, D. Kircheis, J.F. Kocik, S.M. Lucey, C.T. McCandless, L.M. Milke, D.E. Richardson, E. Robillard, H.J. Walsh, M.C. McManus, K.E. Marancik, and C.A. Griswold. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast US Continental Shelf. *PLoS One* 11(2):e0146756.

Harris, H.E., A.Q. Fogg, S.R. Gittings, R.N.M. Ahrens, M.S. Allen, and W.F. Patterson III. 2020. Testing the efficacy of lionfish traps in the northern Gulf of Mexico. Tsikliras AC, editor. *PLoS ONE* 15(8):e0230985. DOI:10.1371/journal.pone.0230985.

Harsanyi, P., S.K, Easton BAA, O.G. de la Cruz Ortiz, E.C.N. Chapman, A.J.R. Piper, C.M.V. Rochas, and A.R. Lyndon. 2022. The Effects of Anthropogenic Electromagnetic Fields (EMF) on the Early Development of Two Commercially Important Crustaceans, European Lobster, *Homarus gammarus* (L.) and Edible Crab, *Cancer pagurus* (L.). *JMSE* 10(5):564. DOI:10.3390/jmse10050564.

Haver, S.M., J.D. Adams, L.T. Hatch, S.M. Van Parijs, R.P. Dziak, J. Haxel, S.A. Heppell, M.F. McKenna, D.K. Mellinger, and J. Gedamke. 2021. Large Vessel Activity and Low-Frequency Underwater Sound Benchmarks in United States Waters. *Frontiers in Marine Science* 8. DOI:10.3389/fmars.2021.669528.

Hawkins, A.D., R.A. Hazelwood, A.N. Popper, and P.C. Macey. 2021. Substrate Vibrations and Their Potential Effects upon Fishes and Invertebrates. *J Acoust Soc Am.* 149(4):2782. DOI:10.1121/10.0004773.

Hawkins, A.D., L. Roberts, and S. Cheesman. 2014. Responses of Free-Living Coastal Pelagic Fish to Impulsive Sounds. *The Journal of the Acoustical Society of America* 135(5):3101–3116.

HDR. 2020. *Benthic and Epifaunal Monitoring During Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Project Report*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2020-044. 2 vols. Accessed: 2 November, 2022.Available: https://espis.boem.gov/final%20reports/BOEM_2020-044.pdf.

Herbert-Read JE, Kremer L, Bruintjes R, Radford AN, Ioannou CC. 2017. Anthropogenic Noise Pollution from Pile-Driving Disrupts the Structure and Dynamics of Fish Shoals. *Proceedings of the Royal Society B: Biological Sciences.* 284(1863). DOI:10.1098/rspb.2017.1627.

Holles, S., S.D. Simpson, A.N. Radford, L. Berten, and D. Lecchini. 2013. Boat Noise Disrupts Orientation Behaviour in a Coral Reef Fish. *Marine Ecology Progress Series* 485:295–300.

Hopkins T.E, and J.J. Cech. 2003. The Influence of Environmental Variables on the Distribution and Abundance of Three Elasmobranchs in Tomales Bay, California. *Environmental Biology of Fishes* 66(3):279–291.

Hudson, D.M., J.S. Krumholz, D.L. Pochtar, N.C. Dickenson, G. Dossot, G. Phillips, E.P. Baker, and T.E. Moll. 2022. Potential Impacts from Simulated Vessel Noise and Sonar on Commercially Important Invertebrates. *Peer J.* 10:e12841. DOI:10.7717/peerj.12841.

Hunter, M.E., C.E. Beaver, N.A. Johnson, E.K. Bors, A.A. Mignucci-Giannoni, B.R. Silliman, D. Buddo, L. Searle, and E. Díaz-Ferguson. 2021. Genetic analysis of red lionfish Pterois volitans from Florida, USA, leads to alternative North Atlantic introduction scenarios. Marine Ecology Progress Series, 675, pp.133–151.

Hutchison, Z. L., P. Sigray, H. He, A. B. Gill, J. King, and C. Gibson, 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (Shark, Rays, and Skates) and American Lobster Movement and Migration from Direct Current Cables*. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-003. 254 pp.

Iafrate, J.D., S.L. Watwood, E.A. Reyier, D.M. Scheidt, G.A. Dossot, and S.E. Crocker. 2016. Effects of Pile Driving on the Residency and Movement of Tagged Reef Fish. *PLoS One.* 11(11):e0163638. DOI:10.1371/journal.pone.0163638.

Jakubowska-Lehrmann, M., M. Białowąs, Z. Otremba, A. Hallmann, S. Śliwińska-Wilczewska, and B. Urban-Malinga. 2022. Do Magnetic Fields Related to Submarine Power Cables Affect the Functioning of a Common Bivalve? *Marine Environmental Research.* 179:105700. DOI:10.1016/j.marenvres.2022.105700.

Jézéquel, Y., S. Cones, F.H. Jensen, H. Brewer, J. Collins, and T.A. Mooney. 2022. Pile Driving Repeatedly Impacts the Giant Scallop (*Placopecten magellanicus*). *Scientific Reports* 12(1):15380. DOI:10.1038/s41598-022-19838-6.

Johnson, M.W., F.A. Everest, and R.W. Young. 1947. The Role of Snapping Shrimp (*Crangon* and *Synalpheus*) in the Production of Underwater Noise in the Sea. *The Biological Bulletin* 93(2):122–138.

Johnson, T.L., J.J. van Berkel, L.O. Mortensen, M.A. Bell, I. Tiong, B. Hernandez, D.B. Snyder, F. Thomsen, and O.S. Petersen. 2021. *Hydrodynamic Modeling, Particle Tracking and Agent-Based Modeling of Larvae in the U.S. Mid-Atlantic Bight.* OCS Study BOEM 2021-049. 232 pp.

Jones, I.T., J.F. Peyla, H. Clark, Z. Song, J.A. Stanley, and T.A. Mooney. 2021. Changes in Feeding Behavior of Longfin Squid (*Doryteuthis pealeii*) during Laboratory Exposure to Pile Driving Noise. *Marine Environmental Research* 165:105250. DOI:10.1016/j.marenvres.2020.105250.

Jones, I.T., J.A. Stanley, and T.A. Mooney. 2020. Impulsive Pile Driving Noise Elicits Alarm Responses in Squid (*Doryteuthis pealeii*). *Marine Pollution Bulletin* 150:110792.

Kahn, J. E., C. Hager, J. C. Watterson, N. Mathies, and K. Hartman. 2019. Comparing abundance estimates from closed population mark recapture models of endangered adult Atlantic Sturgeon. *Endangered Species Research* 39:63–76.

Kahn, J.E., J.C. Watterson, C. Hager, N. Mathies, and K.J. Hartman. 2021. Calculating Adult Sex Ratios from Observed Breeding Sex Ratios for Wide-Ranging, Intermittently Breeding Species. *Ecosphere* 12 5):e03504. DOI:10.1002/ecs2.3504

Kahn J.E., C. Hager, J.C. Watterson, N. Mathies, A. Deacy, and K. J. Hartman. 2023. Population and Sex-specific Survival Estimates for Atlantic Sturgeon: Addressing Detection Probability and Tag Loss. *Aquatic Biology* 32:1–12.

Kane, J. 2011. Inter-Decadal Variability of Zooplankton Abundance in the Middle Atlantic Bight. *Journal of Northwest Atlantic Fishery Science* 43:81–92. DOI:10.2960/J.v43.m674.

Kaplan, M.B., and T.A. Mooney. 2016. Coral Reef Soundscapes May Not Be Detectable Far from the Reef. *Scientific Reports* 6:31862. DOI:10.1038/srep31862.

Kastelein, R.A., N. Jennings, A. Kommeren, L. Helder-Hoek, and J. Schop. 2017. Acoustic Dose-Behavioral Response Relationship in Sea Bass (*Dicentrarchus labrax*) Exposed to Playbacks of Pile Driving Sounds. *Marine Environmental Research* 130:315-324. DOI:10.1016/j.marenvres.2017.08.010.

Kenyon, T. 1996. Ontogenetic changes in the auditory sensitivity of damselfishes (Pomacentridae). *Journal of Comparative Physiology* A 179:553–561.

Kimball, M.E., J.M. Miller, P.E. Whitfield, and J.A. Hare. 2004. Thermal Tolerance and Potential Distribution of Invasive Lion Fish (*Pterois volitans/Miles Complex*) on the East Coast of the United States. *Mar Ecol Prog Ser* 283:269−278.

Kohler, N.E., J.G. Casey, and P.A. Turner. 1998. NMFS cooperative shark tagging program, 1962-93: an atlas of shark tag and recapture data. *Marine Fisheries Review* 60(2):1-1.

Kohut, J., and J. Brodie. 2019. *Offshore Wind and the Mid-Atlantic Cold Pool.* Workshop Proceedings and White Paper. Available: https://rucool.marine.rutgers.edu/wp-content/uploads/2020/10/PartnersWorkshop_WhitePaper_Final.pdf. Accessed: March 7, 2022.

Kraus, C., and L. Carter. 2018. Seabed Recovery Following Protective Burial of Subsea Cables-Observations from the Continental Margin. *Ocean Engineering* 157:251–261.

Krebs, J., F. Jacobs, and A.N. Popper. 2016. Avoidance of Pile-Driving Noise by Hudson River Sturgeon during Construction of the New NY Bridge at Tappan Zee. In: *The Effects of Noise on Aquatic Life II; Dublin (Ireland)*. Pp 555–563.

Kritzer, J.P., M. DeLucia, E. Greene, C. Shumway, M.F. Topolski, J. Thomas-Blate, L.A. Chiarella, K.B. Davy, and K. Smith. 2016. The Importance of Benthic Habitats for Coastal Fisheries. *BioScience* 66(4):274–284.

Ladich, F., and A.H. Bass. 2011. Vocal behavioral of fishes. In: A.P. Farrell (Ed.), Encyclopedia of fish physiology: from genome to environment. San Diego (CA): Academic Press.

Loesch, J.G., and W.A. Lund. 1977. A Contribution to the Life History of the Blueback Herring. *Trans. Am Fish, Soc.* 106:583-589.

Malatesta, R.J., and P.J. Auster. 1999. The Importance of Habitat Features in Low-Relief Continental Shelf Environments. *Oceanologica Acta* 22(6):623–626.

Mann, D.A., D.M. Higgs, W.N. Tavolga, M.J. Souza, and A.N. Popper. 2001. Ultrasound detection by clupeiform fishes. *The Journal of the Acoustical Society of America* 109(6):3048–3054.

Marshall, A., R. Barreto, J. Carlson, D. Fernando, S. Fordham, M.P. Francis, D. Derrick, K. Herman, R.W. Jabado, K.M. Liu, C.L. Rigby, and E. Romanov. 2020. *Mobula birostris*. *The IUCN Red List of Threatened Species* 2020:e.T198921A68632946.

Mavraki, N., S. Degraer, T. Moens, and J. Vanaverbeke. 2020. Functional Differences in Trophic Structure of Offshore Wind Farm Communities: A Stable Isotope Study. *Marine Environmental Research* 157:104868. DOI:10.1016/j.marenvres.2019.104868.

McCormick, C.A. 2011. Auditory/lateral line CNS: Anatomy. In: A.P. Farrell (Ed.), Encyclopedia of fish physiology: from genome to environment. San Diego, CA: Academic Press. pp. 283–291.

Messieh, S.N. 1977. Population Structure and Biology of Alewife Alosa Pseudoharengus and Blueback Herring A. Aestivalis in the Saint John River, New Brunswick. *Environmental Biology of Fishes* 2: 195–210.

Mid-Atlantic Regional Council on the Ocean (MARCO). n.d. Mid-Atlantic Ocean Data Portal. Available: http://portal.midatlanticocean.org.. Accessed: March 8, 2022.

Minerals Management Service (MMS). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf, Final Environmental Impact Statement*. Four volumes. Report No.: OCS EIS/EA MMS 2007-046.

Montgomery, J.C. 2006. Sound as an Orientation Cue for the Pelagic Larvae of Reef Fishes and Decapod Crustaceans. *Advances in Marine Biology* 51:143–196.

Mooney, T., R. Hanlon, J. Christensen-Dalsgaard, P. Madsen, D. Ketten, and P. Nachtigall. 2010. Sound Detection by the Longfin Squid (*Loligo pealeii*) Studied with Auditory Evoked Potentials: Sensitivity to Low-Frequency Particle Motion and Not Pressure. *The Journal of Experimental Biology* 213:3748–3759.

Morris, C.J., D. Cote, S.B. Martin, and D. Mullowney. 2020. Effects of 3D Seismic Surveying on Snow Crab Fishery. *Fisheries Research* 232. DOI:10.1016/j.fishres.2020.105719.

Moser, J., and G.R. Shepard. 2009. Seasonal Distribution and Movement of Black Sea Bass (*Centropristis striata*) in the Northwest Atlantic as Determined from a Mark-Recapture Experiment. *J. Northw. Atl. Fish. Sci*. 40:17–28.

Mueller-Blenkle, C., P.K. McGregor, A.B. Gill, M.H. Andersson, J. Metcalfe, V. Bendall, P. Sigray, D. Wood, and F. Thomsen. 2010. Effects of Pile-Driving Noise on the Behaviour of Marine Fish. Lowestoft (UK): Cefas Lowestoft Laboratory. 62 p. Report No.: Cefas Ref: C3371.

Muñoz, R., C. Currin, and P. Whitfield. 2011. Diet of Invasive Lionfish on Hard Bottom Reefs of the Southeast USA: Insights from Stomach Contents and Stable Isotopes. *Mar Ecol Prog Ser*. 432:181–193. DOI:10.3354/meps09154.

National Marine Fisheries Service (NMFS). 2006. *Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan*. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division, Silver Spring, MD. Public Document. 1,600 pp.

National Marine Fisheries Service (NMFS). 2017. *Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat. Silver Spring (MD).* National Marine Fisheries Service, Office of Sustainable Fisheries, Highly Migratory Species Management Division. 442 p. Available: https://www.habitat.noaa.gov/application/efhinventory/docs/a10_hms_efh.pdf. Accessed: June 2, 2022. .

National Marine Fisheries Service (NMFS). 2019. *Status Review Report: Alewife (*Alosa pseudoharengus*) and Blueback Herring (*Alosa aestivalis*).* Final Report to the National Marine Fisheries Service, Office of Protected Resources. 160 pp.

National Marine Fisheries Service (NMFS). 2023a. Giant Manta Ray, Species Directory. Available: https://www.fisheries.noaa.gov/species/giant-manta-ray. Accessed: April 27, 2023.

National Marine Fisheries Service (NMFS). 2023b. Oceanic Whitetip Shark (*Carcharhinus longimanus*) Species Page. Available: https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark. Accessed: March 1, 2023.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2021a. *Status of Stocks 2020.* Annual Report to Congress on the Status of U.S. Fisheries. 11 pp. Available: https://media.fisheries.noaa.gov/2021-05/2020%20Status%20of%20Stocks%20RtC_5-18-21_FINAL.pdf?null. Accessed: December 5, 2021.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2021b. *State of the Ecosystem Mid-Atlantic*. Available: https://apps-nefsc.fisheries.noaa.gov/rcb/publications/soe/SOE_MAFMC_2021_Final-revised.pdf. Accessed: December 5, 2021.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022a. Essential Fish Habitat Mapper. Available: https://www.habitat.noaa.gov/apps/efhmapper/?page=page_3. Accessed: June 7, 2022.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022b. *Species Directory: Atlantic sturgeon*. Available: https://www.fisheries.noaa.gov/species/atlantic-sturgeon. Accessed: September 7, 2023.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022c. *Species Directory: Scalloped Hammerhead Shark*. Available: https://www.fisheries.noaa.gov/species/scalloped-hammerhead-shark. Accessed: October 21, 2022.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2022d. *Species Directory, Oceanic Whitetip Shark* Carcharhinus longimanus. Available: https://www.fisheries.noaa.gov/species/oceanic-whitetip-shark. Accessed: October 21, 2022 .

Neo, Y.Y., J. Hubert, L. Bolle, H.V. Winter, C. Ten Cate, and H. Slabbekoorn. 2016. Sound Exposure Changes European Seabass Behaviour in a Large Outdoor Floating Pen: Effects of Temporal Structure and a Ramp-Up Procedure. *Environmental Pollution* 214:26-34.

Neo, Y.Y., J. Hubert, L.J. Bolle, H.V. Winter, and H. Slabbekoorn. 2018. European Seabass Respond More Strongly to Noise Exposure at Night and Habituate over Repeated Trials of Sound Exposure. *Environ Pollution* 239:367–374. DOI:10.1016/j.envpol.2018.04.018.

Neo, Y.Y., J. Seitz, R.A. Kastelein, H.V. Winter, C. ten Cate, and H. Slabbekoorn. 2014. Temporal Structure of Sound Affects Behavioural Recovery from Noise Impact in European Seabass. *Biological Conservation* 178:6573. DOI:10.1016/j.biocon.2014.07.012.

New England Fishery Management Council (NEFMC). 2017. Omnibus Essential Fish Habitat Amendment 2. Volume 2: EFH and HAPC Designation Alternatives and Environmental Impacts. Newburyport (MA): New England Fishery Management Council National Marine Fisheries Service. 143 p. Available: https://www.habitat.noaa.gov/protection/efh/efhmapper/oa2_efh_hapc.pdf. Accessed: June 24, 2022.

Normandeau Associates, Inc., Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09. Available: https://espis.boem.gov/final%20reports/5115.pdf. Accessed: November 9, 2021.

Osmanbasic, E. 2020. *The Future of Wind Turbines: Comparing Direct Drive and Gearbox. Development effort focuses on two types of wind turbines, is there a dominant choice?* Available at: https://www.engineering.com/story/the-future-of-wind-turbines-comparing-direct-drive-and-gearbox.

Owens, S.J., and P.J. Geer. 2003. Size and Age Structure of American Eels in Tributaries of the Virginia Portion of the Chesapeake Bay. Pages 117-124 in D. A. Dixon (Editor). *Biology, Management and Protection of Catadromous Eels*. American Fisheries Society, Symposium 33, Bethesda, MD, USA.

Pacific Marine Environmental Laboratory (PMEL). 2020. *Strategic Plan 2021-2030.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 33 pp.

Parsons, M.J.G., C. Erbe, M.G. Meekan, and S.K. Parsons. 2021. A Review and Meta-Analysis of Underwater Noise Radiated by Small (<25 m Length) Vessels. *Journal of Marine Science and Engineering* 9(8). DOI:10.3390/jmse9080827.

Patek, S.N. 2002. Squeaking with a sliding joint: mechanics and motor control of sound production in palinurid lobsters. *The Journal of Experimental Biology* 205:2375–2385.

Payne, J.F., C.A. Andrews, L.L. Fancey, A.L. Cook, and J.R. Christian. 2007. Pilot Study on the Effects of Seismic Air Gun Noise on Lobster (*Homarus americanus*). Newfoundland (Canada): National Energy Board for the Minister of Natural Resources Canada. 34 p. Environmental Studies Research Funds Report No. 171.

Pearson, W.H., J.R. Skalski, S.D. Sulkin, and C. Malme. 1994. Effects of Seismic Energy Releases on the Survival and Development of Zoeal Larvae of Dungeness Crab (*Cancer magister*). *Marine Environmental Research* 38:93–113.

Pederson, J. (ed). 2005. *Marine Bioinvasions: First International Conference*. MIT Sea Grant College Program, Cambridge, Massachusetts. Available: https://www.buzzardsbay.org/download/marine_invaders_in_the_northeast_2003.pdf. Accessed: November 24, 2021.

Pinsky, M., B. Worm, M. Fogarty, J. Sarmiento, and S. Levin. 2013. Marine Taxa Track Local Climate Velocities. *Science* 341(6151):1239–1242. DOI:10.1126/science.1239352.

Popper, A.N., and M.C. Hastings. 2009. The Effects of Anthropogenic Sources of Sound on Fishes. *Journal of Fish Biology* 75(3):455–489.

Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Rogers, B.L. Southall, D.G. Zeddies, and W.N. Tavolga. 2014. Sound Exposure Guidelines. Pages 33–51 in *ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered with ANSI*.

Popper A.N., and A.D. Hawkins. 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. *Journal of Fish Biology* 94(5):692–713.

Popper, A.N., A.D. Hawkins, and J.A. Sisneros. 2021. Fish hearing "specialization" - A re-valuation. *Hearing Research* 425:108393.

Popper, A.N., L. Hice-Dunton, E. Jenkins, D.M. Higgs, J. Krebs, A. Mooney, A. Rice, L. Roberts, F. Thomsen, K. Vigness-Raposa, et al. 2022. Offshore Wind Energy Development: Research Priorities for Sound and Vibration Effects on Fishes and Aquatic Invertebrates. *J Acoust Soc Am*. 151(1):205. DOI:10.1121/10.0009237.

Popper, A.N., M. Salmon, and J.W. Horch. 2001. Acoustic Detection and Communication by Decapod Crustaceans. *Journal of Comparative Physiology A*. 187:83–89.

Radford, A.N., L. Lèbre, G. Lecaillon, S.L. Nedelec, and S.D. Simpson. 2016. Repeated Exposure Reduces the Response to Impulsive Noise in European Seabass. *Global Change Biology* 22(10):3349–3360.

Radford, C.A., A.G. Jeffs, C.T. Tindle, and J.C. Montgomery. 2008a. Temporal Patterns in Ambient Noise of Biological Origin from A Shallow Water Temperate Reef. *Oecologia* 156(4):921–929.

Rheuban, J.E., M.T. Kavanaugh, and S.C. Doney. 2017. Implications of Future Northwest Atlantic Bottom Temperatures on the American Lobster (*Homarus americanus*) Fishery. *Journal of Geophysical Research: Oceans* 122:9387–9398. DOI:10.1002/2017JC012949.

Rice, A.N., S.C. Farina, A.J. Makowski, I.M. Kaatz, P.S. Lobel, W.E. Bemis, and A.H. Bass. 2022. Evolutionary Patterns in Sound Production across Fishes. *Ichthyology & Herpetology* 110(1).

Roberts, L., and M.E. Laidre. 2019. Finding a Home in the Noise: Cross-Modal Impact of Anthropogenic Vibration on Animal Search Behaviour. *Biol Open.* 8(7). DOI:10.1242/bio.041988.

Roberts, L. and T. Breithaupt. 2016. Sensitivity of Crustaceans to Substrate-Borne Vibration. *Adv Exp Med Biol*. 875:925-931. DOI:10.1007/978-1-4939-2981-8_114.

Robins, C.R., and G.C. Ray. 1986. *A Field Guide to the Atlantic Coast Fishes. Peterson Field Guide Series.* Houghton Mifflin, New York. 942 pp.

Rogers, P., E. Debusschere, D. de Haan, B. Martin, and H. Slabbekoorn. 2021. North Sea Soundscapes from a Fish Perspective: Directional Patterns in Particle Motion and Masking Potential from Anthropogenic Noise. *The Journal of the Acoustical Society of America* 150(3):2174–2188.

Rothermel, E.R., M.T. Balazik, J.E. Best, M.W. Breece, D.A. Fox, B.I. Gahagan, D.E. Haulsee, A.L. Higgs, M.H.P. O'Brien, M.J. Oliver, et al. 2020. Comparative Migration Ecology of Striped Bass and Atlantic Sturgeon in the US Southern Mid-Atlantic Bight Flyway. Mourier J, editor. *PLoS ONE*. 15(6):e0234442. DOI:10.1371/journal.pone.0234442.

Ruppel, C.D., T.C. Weber, E.R. Staaterman, S.J. Labak, and P.E. Hart. 2022. Categorizing Active Marine Acoustic Sources Based on Their Potential to Affect Marine Animals. *Journal of Marine Science and Engineering* 10(9):1-46.

Rutecki, D., T. Dellapenna, E. Nestler, F. Scharf, J. Rooker, C. Glass, and A. Pembroke. 2014. *Understanding the Habitat Value and Function of Shoals and Shoal Complexes to Fish and Fisheries on the Atlantic and Gulf of Mexico Outer Continental Shelf. Literature Synthesis and Gap Analysis*. Prepared for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M12PS00009. BOEM 2015-012. 176 pp.

Schofield, P. 2010. Update on geographic spread of invasive lionfishes (Pterois volitans [Linnaeus, 1758] and P. miles [Bennett, 1828]) in the Western North Atlantic Ocean, Caribbean Sea and Gulf of Mexico. *Aquatic Invasions 5(Supplement 1)*:S117–S122. DOI:10.3391/ai.2010.5.S1.024.

Sciberras, M., R. Parker, C. Powell, C. Robertson, S. Kröger, S. Bolam, and J. Geert Hiddink. 2016. Impacts of Bottom Fishing on the Sediment Infaunal Community and Biogeochemistry of Cohesive and Non-Cohesive Sediments. *Limnology and Oceanography* 61(6):2076–2089.

Secor, D.H., F. Zhang, M.H.P. O'Brien, and M. Li. 2018. Ocean Destratification and Fish Evacuation Caused by a Mid-Atlantic Tropical Storm. *ICES Journal of Marine Science* 76(2):573–584. DOI:10.1093/icesjms/fsx241.

Simpson, S.D., M.G. Meekan, J.C. Montgomery, R.D. McCauley, and A.G. Jeffs. 2005. Homeward Sound. *Science* 308:221. DOI:10.1126/science.1107406.

Sims, D.W., M.J. Genner, A.J. Southward, and S.J. Hawkins. 2001. Timing of Squid Migration Reflects North Atlantic Climate Variability. *Proceedings of the Royal Society of London. Series B: Biological Sciences* 268(1485):2607–2611.

Slacum, H.W., W.H. Burton, E.T. Methratta, E.D. Weber, R.J. Llansó, and J. Dew-Baxter. 2010. Assemblage Structure in Shoal and Flat-Bottom Habitats on the Inner Continental Shelf of the Middle Atlantic Bight, USA. *Marine and Coastal Fisheries* 2(1):277–298. DOI:10.1577/C09-012.1..

Smith, J.A., M.B. Lowry, C. Champion, and I.M. Suthers. 2016. A Designed Artificial Reef is Among the Most Productive Marine Fish Habitats: New Metrics to Address 'Production Versus Attraction.' *Marine Biology* 163:188.

Solan, M., C. Hauton, J.A. Godbold, C.L. Wood, T.G. Leighton, and P. White. 2016. Anthropogenic sources of underwater sound can modify how sediment-dwelling invertebrates mediate ecosystem properties. *Scientific Reports* 6(1):1–9.

Sole, M., S. De Vreese, J.M. Fortuno, M. van der Schaar, A.M. Sanchez, and M. Andre. 2022. Commercial Cuttlefish Exposed to Noise from Offshore Windmill Construction Show Short-Range Acoustic Trauma. *Environ Pollut.* 312:119853. DOI:10.1016/j.envpol.2022.119853.

South Fork Wind. 2021. *South Fork Wind Farm Construction and Operations Plan*. May.

Spiga, I., N. Aldred, and G.S. Caldwell. 2017. Anthropogenic Noise Compromises the Anti-Predator Behaviour of the European Seabass, *Dicentrarchus labrax* (L.). *Marine Pollution Bulletin* 122(1-2):297–305. DOI:10.1016/j.marpolbul.2017.06.067.

Staaterman, E., C.B. Paris, and A.S. Kough. 2014. First Evidence of Fish Larvae Producing Sounds. *Biology Letters* 10(10):20140643. DOI:10.1098/rsbl.2014.0643.

Staaterman, E.R., C.W. Clark, A.J. Gallagher, M.S. deVries, T. Claverie, and S.N. Patek. 2011. Rumbling in the benthos: acoustic ecology of the California mantis shrimp *Hemisquilla californiensis*. *Aquatic Biology* 13(2):97–105.

Stanley, J.A., P.E. Caiger, B. Phelan, K. Shelledy, T.A. Mooney, and S.M. Van Parijs. 2020. Ontogenetic Variation in the Auditory Sensitivity Of Black Sea Bass (*Centropristis striata*) and the Implications of Anthropogenic Sound on Behavior and Communication. *Journal of Experiment Biology* 223(13):1–11.

Stanley, J.A., C.A. Radford, and A.G. Jeffs. 2012. Location, Location, Location: Finding a Suitable Home Among the Noise. *Proceedings of the Royal Society B: Biological Sciences* 279(1742):3622–3631.

Stanley, J.A., S.M. Van Parijs, and L.T. Hatch. 2017. Underwater Sound from Vessel Traffic Reduces the Effective Communication Range in Atlantic Cod and Haddock. *Scientific Reports* 7(1):14633.

Stein, A.B., K.D. Friedland, and M. Sutherland. 2004. Atlantic Sturgeon Marine Bycatch and Mortality on the Continental Shelf of the Northeast United States. *North American Journal of Fisheries Management* 24(1):171–183. DOI:10.1577/M02-123.

Stevenson, D., L. Chiarella, D. Stepha, R. Reid, K. Wilhelm, J. McCarthy, and M. Pentony. 2004. *Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast US Shelf, and an Evaluation of the Potential Effects of Fishing on Essential Fish Habitat*. NOAA Technical Memorandum NMFS-NE-181. Available: http://roa.midatlanticocean.org/wp-content/uploads/2016/01/stevenson-et-al-2004.pdf.
Tetra.

Tetra Tech, Inc. 2015. *Virginia Offshore Wind Technology Advancement Project (VOWTAP) Research Activities Plan*. Prepared by Tetra Tech for Dominion and Virginia Department of Mines, Minerals, and Energy. Available: https://www.nao.usace.army.mil/Portals/31/docs/regulatory/publicnotices/2014/July/NAO-2013-0418_RAP_FINAL_Rev_2.pdf?ver=guEU6KOo5u1qZHd7DG5i4Q%3D%3D. Accessed: November 22, 2021.

Tetra Tech, Inc. 2022. *Dominion Energy Coastal Virginia Offshore Wind Commercial Project Request for Rule Making and Letter of Authorization (LOA) for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0483 and the Associated Offshore Export Cable Route Corridor: Roberts et al. 2022 Revision Addendum*. Prepared for Dominion Energy by Tetra Tech, Inc. Submitted to NOAA National Marine Fisheries Service September 2022. 88 pp.

Thomsen, F., A.B. Gill, M. Kosecka, M. Andersson, M. André, S. Degraer, T. Folegot, J. Gabriel, A. Judd, T. Neumann, A. Norro, D. Risch, P. Sigray, D. Wood, and B. Wilson. 2015. *MaRVEN—Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy.* Doi:10.2777/272281. Luxembourg: Publications Office of the European Union, 2015. Available: https://www.researchgate.net/publication/301296662_MaRVEN_-_Environmental_Impacts_of_Noise_Vibrations_and_Electromagnetic_Emissions_from_Marine_Renewable_Energy. Accessed: November 24, 2021.

Tolotti, M.T., P. Bach, F. Hazin, P. Travassos, and L. Dagorn. 2015. Vulnerability of the oceanic whitetip shark to pelagic longline fisheries. *PLoS ONE* 10(10):e0141396.

U.S. Geological Survey (USGS). n.d. East-Coast Sediment Texture Database. Available: http://woodshole.er.usgs.gov/project-pages/sediment/.. Accessed: March 8, 2022.

Vabo, R., K. Olsen, and I. Huse. 2002. Vessel Avoidance of Norwegian Spring Spawning Herring. *Fisheries Research* 58(1):2471–2472.

van Berkel, J., H. Burchard, A. Christensen, L. Mortensen, O. Petersen, F. Thomsen. 2020. The Effects of Offshore Wind Farms on Hydrodynamics and Implications for Fishes. *Oceanography* 33(4):108–117. Doi:10.5670/oceanog.2020.410.

Vasslides, J.M., and K.W. Able. 2008. Importance of Shoreface Sand Ridges as Habitat for Fishes Off the Northeast Coast of the United States. *Fishery Bulletin* 106:93–107.

Vaudo, J., B.M. Wetherbee, G. Harvey, and M. Shivji. 2022. Region-specific movements of oceanic whitetip sharks in the western North Atlantic Ocean revealed by long-term satellite tracking. In: 2022 *Graduate Science Research Symposium*, February 24–25, 2022. Oral Presentation.

Wale, M.A., R.A. Briers, and K. Diele. 2021. Marine Invertebrate Anthropogenic Noise Research - Trends in Methods and Future directions. *Marine Pollution Bulletin* 173(Pt A):112958. DOI:10.1016/j.marpolbul.2021.112958.

Wale, M.A., S.D. Simpson, and A.N. Radford. 2013. Size-Dependent Physiological Responses of Shore Crabs to Single and Repeated Playback of Ship Noise. *Biology Letters* 9(2):20121194.

Welch, H., J. McHenry, and V. Kentner. 2018. Habitat Mapping and Assessment of Northeast Wind Energy Areas. 10.13140/RG.2.2.18064.51209.

Whitfield, P., R. Muñoz, C. Buckel, B. Degan, D. Freshwater, and J. Hare. 2014. Native Fish Community Structure and Indo-Pacific Lionfish *Pterois Volitans* Densities along A Depth-Temperature Gradient in Onslow Bay, North Carolina, USA. *Mar Ecol Prog Ser.* 509:241–254. DOI:10.3354/meps10882.

Wiernicki, C.J., D. Liang, H. Bailey, and D.H. Secor. 2020. The effect of swim bladder presence and morphology on sound frequency detection for fishes. Reviews in Fisheries Science & Aquaculture: 1–19.

Wilber, D., L. Brown, M. Griffin, G. DeCelles, and D. Carey. 2022. Offshore Wind Farm Effects on Flounder and Gadid Dietary Habits and Condition on the Northeastern US Coast. *Mar Ecol Prog Ser.* 683:123–138. DOI:10.3354/meps13957.

Young, C.N., and J.K. Carlson. 2020. The biology and conservation status of the oceanic whitetip shark (*Carcharhinus longimanus*) and future directions for recovery. *Reviews in Fish Biology and Fisheries* 30(2):293-312.

C.1.3.14. Section 3.14, Land Use and Coastal Infrastructure

Bureau of Ocean Energy Management (BOEM) and Dominion Energy. 2022. Revised Project Design Information Submitted to BOEM.

City of Virginia Beach. 2008. Zoning Grid Reference Maps in PDF Format. Grid M8 and K7. Available: https://www.vbgov.com/government/departments/planning/maps/Documents/zoning-grid-reference-map.pdf. Accessed: May 27, 2022.

City of Virginia Beach. 2017. *Zoning Districts – General Description and Purpose*. Available: https://www.vbgov.com/government/departments/planning/Documents/zoningdistricts.pdf. GIS data available: https://gisapps.vbgov.com/map/. Accessed: May 27, 2022.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Kitty Hawk Wind North. 2021. *Kitty Hawk Wind Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Kitty Hawk Wind South. 2022. *Kitty Hawk South Offshore Wind Construction and Operations Plan*. Prepared by Tetra Tech, Inc. April.

Parsons, George, and Jeremy Firestone. 2018. *Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism*. U.S. Department of the Interior, Bureau of Ocean Energy Management. Available: https://www.semanticscholar.org/paper/Atlantic-Offshore-Wind-Energy-Development%3A-Values-Parsons-Firestone/91b0ede146b8701cb44d72c58f09b29533df3cdf. Accessed: May 27, 2022.

Virginia Port Authority. 2019. *Virginia Begins First Phase of 55-Foot Dredging Project Ahead of Schedule*. News Release. October 31, 2019. Available: https://www.portofvirginia.com/who-we-are/newsroom/virginias-path-to-55-feet-is-set-first-phase-of-dredging-to-begin-by-january-2020/. Accessed: May 27, 2022.

C.1.3.15. Section 3.15, Marine Mammals

Anderwald, P., A. Brandecker, M. Coleman, C. Collins, H. Denniston, M.D. Haberlin, M.O. Donovan, R. Pinfield, F. Visser, and L. Walshe. 2013. Displacement responses of a mysticete, an odontocete, and a phocid seal to construction-related vessel traffic. *Endangered Species Research* 21(3):231–240.

Azzara, A.J., W.M. von Zharen, and J.J. Newcomb. 2013. Mixed-methods Analytical Approach for Determining Potential Impacts of Vessel Noise on Sperm Whale Click Behavior. *The Journal of the Acoustical Society of America* 134:4566.

Baulch, S., and C. Perry. 2014. Evaluating the Impacts of Marine Debris on Cetaceans. *Marine Pollution Bulletin* 80:210–221.

Benaka L.R., D. Bullock, A.L. Hoover, and N.A. Olsen. 2019. *U.S. National Bycatch Report First Edition Update 3.* Silver Spring (MD): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Report No. NOAA Technical Memorandum NMFS-F/SPO-19. 95 pp.

Benhemma-La Ball, A., I.M. Graham, N.D. Merchant, and P.M. Thompson. 2021. Broad-Scale Responses of Harbor Porpoises to Pile-Driving and Vessel Activities During Offshore Windfarm Construction. Mar. Sci., 02 July 2021. Marine Ecosystem Ecology Volume 8 - 2021.

Betke K., and M.A. Bellmann. 2023. Operational Underwater Noise from Offshore Wind Farms. In: *The Effects of Noise on Aquatic Life*. pp. 1–12.

Bilinski, J. 2021. Review of the impacts to marine fauna from electromagnetic frequencies (EMF) generated by energy transmitted through undersea electric transmission cables. Report by NJDEP – Division of Science and Research. 15 pp.

Blackwell, S.B., J.W. Lawson, and M.T. Williams. 2004. Tolerance by ringed seals (Phoca hispida) to impact pipe-driving and construction sounds at an oil production island. *J Acoust Soc Am* 115: 2346−2357.

Blackwell, S.B., C.S. Nations, T.L. McDonald, C.R. Greene, A.M. Thode, M. Guerra, and A.M. Macrander. 2013. Effects of airgun sounds on bowhead whale calling rates in the Alaskan Beaufort Sea. *Marine Mammal Science* 29(4):E342-E365.

Blackwell, S.B., C.S. Nations, A.M. Thode, M.E. Kauffman, A.S. Conrad, R.G. Norman, and K.H. Kim. 2017. Effects of Tones Associated with Drilling Activities on Bowhead Whale Calling Rates. *PLoS One 12*(11), p.e0188459.

Borggaard, D., J. Lien, and P. Stevick. 1999. Assessing the Effects of Industrial Activity on Large Cetaceans in Trinity Bay, Newfoundland (1992–1995). *Aquatic Mammals* 25(3):149–161.

Brandt, R., F. Barros, C. Noronha, M.J. Tulli, M.J. and T. Kohlsdorf. 2016. Brandt et al. 2016 - Supplementary material 1.

Brandt, M.J., A. Diederichs, K. Betke, R. Matuschek, and G. Nehls. 2011. Responses of harbour porpoises to pile driving at the Horns Rev II offshore wind farm in the Danish North Sea. Marine Ecology Progress Series. 421. 205-216. 10.3354/meps08888.

Branstetter, B.K., V.F. Bowman, D.S. Houser, M. Tormey, P. Banks, J.J. Finneran, and K. Jenkins. 2018. Effects of Vibratory Pile Driver Noise on Echolocation and Vigilance in Bottlenose Dolphins (*Tursiops truncatus*). *The Journal of the Acoustical Society of America* 143(1):429–439.

Broström, G. 2008. On the influence of Large Wind Farms on the Upper Ocean Circulation. *Journal of Marine Systems* 74:585–591.

Brown, D.M., P.L. Sieswerda, and E.C.M. Parsons. 2019. *Potential Encounters between Humpback Whales (Megaptera Novaeangliae) and Vessels in the New York Bight Apex, USA*. Marine Policy. 106:103527.

Browne, M.A., A.J. Underwood, M.G. Chapman, R. Williams, R.C. Thompson, and J.A. van Franeker. 2015. Linking Effects of Anthropogenic Debris to Ecological Impacts. *Proceedings of the Royal Society* B282:20142929.

Buckstaff, K.C. 2006. Effects of watercraft noise on the acoustic behavior of bottlenose dolphins, *Tursiops truncatus* in Sarasota Bay, Florida. *Marine Mammal Science* 20(4):709–725.

Bureau of Ocean Energy Management (BOEM). 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia: Revised Environmental Assessment*. OCS EIS/EA BOEM 2015-031. 239 pp.

Bureau of Ocean Energy Management (BOEM). 2019a. *Guidelines for Providing Information on Marine Mammals and Sea Turtles for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 CFR Part 585.* Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 15 pp.

Bureau of Ocean Energy Management (BOEM). 2019b. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf. Accessed: November 15, 2021.

Bureau of Ocean Energy Management (BOEM). 2023a. *Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. March 2022. 147 pp. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C-NMFS-BA.pdf.

Bureau of Ocean Energy Management (BOEM). 2023b. *Addendum to the Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. May.

Burge, C.A., C. Mark Eakin, C.S. Friedman, B. Froelich, P.K. Hershberger, E.E. Hofmann, L.E. Petes, K.C. Prager, E. Weil, B.L. Willis, and S.E. Ford. 2014. Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society. *Annual Review of Marine Science* 6:249–277.

Carpenter, J.R., L. Merchelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. Potential Impacts of Offshore Wind Farms on North Sea Stratification. *PLoS ONE* 11(8):e0160830.

Castellote, M., C.W. Clark, and M.O. Lammers. 2012. Acoustic and Behavioural Changes by Fin Whales (*Balaenoptera Physalus*) in Response to Shipping and Airgun Noise. *Biological Conservation* 147(1):115–122.

Causon, P.D., and A.B. Gill. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. *Environmental Science and Policy* 89:340–347.

Cazenave, P.W., R. Torres, and J. Icarus Alen. 2016. Unstructured Grid Modelling of Offshore Wind Farm Impacts on Seasonally Stratified Shelf Seas. *Progress in Oceanography* 145(2016) 25–41.

Cerchio S., S. Strindberg, T. Collins, C. Bennett, and H. Rosenbaum. 2014. Seismic surveys negatively affect humpback whale singing activity off northern Angola. *PLoS ONE* 9(3):e86464.

Cholewiak D., A.I. DeAngelis, D. Palka, P.J. Corkeron and S.M. Van Parijs. 2017. Beaked Whales Demonstrate A Marked Acoustic Response to the Use of Shipboard Echosounders. DOI:10.1098/rsos.170940.

Christiansen, N., U. Daewel, B. Djath, and C. Schrum. 2022. Emergence of Large-Scale Hydrodynamic Structures Due to Atmospheric Offshore Wind Farm Wakes. *Frontiers in Marine Science.* 64 pp.

Clark, C.W., W.T. Ellison, B.L. Southall, L. Hatch, S.M. Van Parijs, A.S. Frankel, and D. Ponirakis. 2009. Acoustic Masking in Marine Ecosystems: Intuitions, Analysis, and Implication. *Marine Ecology Progress Series* 395:201–222.

Conn P.B., and G.K. Silber. 2013. Vessel Speed Restrictions Reduce Risk of Collision Mortality for North Atlantic Right Whales. *Ecosphere* 4.4 (2013):1–16.

Cummings, E.W., D.A. Pabst, J.E. Blum, S.G. Barco, S.J. Davis, V.G. Thayer, N. Adimey, and W.A. McLellan. 2014. Spatial and Temporal Patterns of Habitat Use and Mortality of the Florida Manatee (*Trichechus manatus latirostris*) in the Mid-Atlantic States of North Carolina and Virginia from 1991 to 2012. *Aquatic Mammals* 40(2):126.

Daewel, U., N. Akhtar, N. Christiansen, and C. Schrum. 2022. Offshore Wind Farms Are Projected to Impact Primary Production and Bottom Water Deoxygenation in the North Sea. *Communications Earth & Environment* 3.

Dähne, M., A. Giles, K. Lucke, V. Peshko, S. Adler, K. Krügel, J. Sundermeyer, and W. Siebert. 2013. Effects of pile-driving on harbour porpoises (*Phocoena phocoena*) at the first offshore wind farm in Germany. *Environ. Res. Lett.* 8 025002. DOI 10.1088/1748-9326/8/2/025002.

Danil, K. and J.A. St Leger. 2011. Seabird and dolphin mortality associated with underwater detonation exercises. *Marine Technology Society Journal* 45(6):89–95.

Degraer, S., D.A. Carey, J.W. Coolen, Z.L. Hutchison, F. Kerckhof, B. Rumes, and J. Vanaverbeke. 2020. Offshore Wind Farm Artificial Reefs Affect Ecosystem Structure and Functioning. *Oceanography* 33(4):48–57.

Department for Business Enterprise and Regulatory Reform (BERR). 2008. *Review of Cabling Techniques and Environmental Effects Applicable to the Offshore Wind Energy Industry*. Technical Report, January 2008. Available: https://tethys.pnnl.gov/sites/default/files/publications/Cabling_Techniques_and_Environmental_Effects.pdf. Accessed: February 20, 2022.

Di Iorio, L., and C.W. Clark. 2010. Exposure to Seismic Survey Alters Blue Whale Acoustic Communication. *Biology Letters* 6(1):51–54.

Diederichs, A., M. Brandt, and G. Nehls. 2010. Does Sand Extraction near Sylt Affect Harbour Porpoises. *Wadden Sea Ecosystem* 26:199–203.

DNV. 2021. *Ocean Wind Navigation and Safety Risk Assessment*. Document No. 10205448HOU-R-01. 3 February 2021. COP Vol. 3, Appendix M2.

Dolman, S., V. Williams-Grey, R. Asmutis-Silvia, and S. Issac. 2006. *Vessel Collisions and Cetaceans: What Happens When They Don't Miss the Boat.* Whale and Dolphin Conservation Society Science Report. 25 p.

Dorrell, R.M., C.J. Lloyd, B.J. Lincoln, T.P. Rippeth, J.R. Taylor, C.C.P. Caulfield, J. Sharples, J.A. Polton, B.D. Scannell, D.M. Greaves, and R.A. Hall. 2022. Anthropogenic Mixing in Seasonally Stratified Shelf Seas by Offshore Wind Farm Infrastructure. *Frontiers in Marine Science* 9:830927.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dunlop, R.A., M.J. Noad, R.D. McCauley, L. Scott-Hayward, E. Kniest, R. Slade, D. Paton, and D.H. Cato. 2017. Determining the Behavioural Dose-Response Relationship of Marine Mammals to Air Gun Noise and Source Proximity. *Journal of Experiment Biology* 220(16):2878–2886.

Elliott, J., K. Smith, D.R. Gallien, and A. Khan. 2017. Observing Cable Laying and Particle Settlement During the Construction of the Block Island Wind Farm. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-027. 225 pp.

Ellison, W.T., B.L. Southall, C.W. Clark, and A.S. Frankel. 2012. A New Context-Based Approach to Assess Marine Mammal Behavioral Responses to Anthropogenic Sounds. *Conservation Biology* 26(1):21–28.

Engelhaupt, A., J.M. Aschettino, D. Engelhaupt, M. Richlen, and M. Cotter. 2020. *VACAPES Outer Continental Shelf Cetacean Study, Virginia Beach, Virginia: 2019 Annual Progress Report.* Prepared by HDR for Naval Facilities Engineering Systems Command Atlantic. Under Contract No. N62470-15-D-8006, Task Order 18F4082. April 2020. 60 pp.

Engelhaupt, A., J.M. Aschettino, D. Engelhaupt, M. Richlen, and M. Cotter. 2021. *VACAPES Outer Continental Shelf Cetacean Study, Virginia Beach, Virginia: 2020 Annual Progress Report.* Prepared by HDR for Naval Facilities Engineering Systems Command Atlantic. Under Contract No. N62470-15-D-8006, Task Order 19F4068. May 2021. 56 pp.

Environment e. 2008. Albany Iron Ore Project Albany Port Expansion Proposal. Albany Port Authority. 112 p. Report No.: EPA Assessment No. 1594.

Erbe, C., S.A. Marley, R.P. Schoeman, J.N. Smith, L.E. Trigg, C.B. Embling. 2019. The Effects of Ship Noise on Marine Mammals – A Review. *Frontiers in Marine Science* 6(606):1–21.

Erbe, C., C. Reichmuth, K. Cunningham, K. Lucke, and R. Dooling. 2016. Communication Masking in Marine Mammals: A Review and Research Strategy. *Marine Pollution Bulletin* 103:15–38.

Finley, K.J., G.W. Miller, R.A. Davis, and C.R. Greene. 1990. *Reactions of Belugas, Delphinapterus leucas, and Narwhals, Monodon monoceros, to Ice-Breaking Ships in the Canadian high Arctic. In: Advances in research on the Beluga Whale, Delphinapterus leucas.* Smith, T.G., D.J. St. Aubin, and J.R. Geraci (Eds.). *Canadian Bulletin of Fisheries and Aquatic Sciences* 224. 206 pp. Available: Canadian Bulletin of Fisheries and Aquatic Sciences 224 (dfo-mpo.gc.ca) Accessed: January 26, 2023.

Gailey, G., O. Sychenko, T. McDonald, R. Racca, A. Rutenko, and K. Bröker. 2016. Behavioural Responses of Western Gray Whales to A 4-D Seismic Survey Off Northeastern Sakhalin Island, Russia. *Endangered Species Research* 30:53–71.

Gerstein, E.R., J.E. Blue, G.F. Pinto, and S. Barr. 2006. Underwater Noise and Zones of Masking with Respect to Hopper Dredging and Manatees in the St. Johns River in Jacksonville. *Journal of the Acoustical Society of America* 120:3145–3222.

Gill, A.B., I. Gloyne-Phillips, K.J. Neal, and J.A. Kimber. 2005. *The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms—A Review*. Collaborative Offshore Wind Research into the Environment (COWRIE), Ltd, UK.

Gilmartin, W.G. 2002. Responses of monk seals to human disturbance and handling. In: Workshop on the Management of Hawaiian Monk Seals on Beaches in the Main Hawaiian Islands; Kauai (HI). Marine Mammal Commission. p. 4-5.

Goertner, J.F. 1982. *Prediction of Underwater Explosion, Safe Ranges for Sea Mammals*. Naval Surface Weapons Center.

Golbazi, M., C.L. Archer, and S. Alessandrini. 2022. Surface Impacts of Large Offshore Wind Farms. *Environmental Research Letters* 17(2022):064021.

Graham, I.M., E. Pirotta, N.D. Merchant, A. Farcas, T.R. Barton, B. Cheney, G.D. Hastie, and P.M. Thompson. 2017. Responses of Bottlenose Dolphins and Harbor Porpoises to Impact and Vibration Piling Noise During Harbor Construction. *Ecosphere 8*(5):e01793.

Gubbins, C. 2002. Use of Home Ranges by Resident Bottlenose Dolphins (*Tursiops truncatus*) in a South Carolina Estuary. *Journal of Mammalogy* 83(1):178–187.

Guerra, M., S.M. Dawson, T.E. Brough, and W.J. Rayment. 2014. Effects of Boats on the Surface and Acoustic Behaviour of an Endangered Population of Bottlenose Dolphins. *Endangered Species Research* 24:221–236.

Hall, A. J., B.J. McConnell, L.H. Schwacke, G. M. Ylitalo, R. Williams, and T.K. Rowles. 2018. Predicting the Effects of Polychlorinated Biphenyls on Cetacean Populations through Impacts on Immunity and Calf Survival. *Environmental Pollution* 233:407–418.

Hamilton, P.K., A.R. Knowlton, M.N. Hagbloom, K.R. Howe, M.K. Marx, H.M. Pettis, A.M. Warren, M.A. Zani, N.E. Aquarium, H. Milliken, and S. Hayes. 2019. Maintenance of the North Atlantic Right Whale Catalog, Whale Scarring and Visual Health Databases, Anthropogenic Injury Case Studies, and Near Real-Time Matching for Biopsy Efforts, Entangled, Injured, Sick, or Dead Right Whales. *Contract* (1305M2-18).

Hannay, D., and M. Zykov. 2021. Underwater Acoustic Modeling of Detonations of Unexploded Ordnance (UXO) for Orsted Wind Farm Construction, US East Coast. *JASCO Applied Sciences (USA) Inc., Silver Spring, MD*.

Hastie, G.D., B. Wilson, L.H. Tufft, and P.M. Thompson. 2006. Bottlenose dolphins increase breathing synchrony in response to boat traffic. *Marine Mammal Science* 19(1):74–084.

Hayes, S.A. 2022. Letter of Memorandum to the Bureau of Ocean Energy Management regarding North Atlantic right whale effects from Offshore Wind Development in New England. Prepared by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center for Brian R. Hooker, Lead Biologist, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. May 13, 2022. 4 pp.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel (eds.). 2019. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2018.* Woods Hole (MA): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Report No. NOAA Technical Memorandum NMFS-NE-258. 306 pp.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2020. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2019.* Woods Hole (MA): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Report No. NOAA Technical Memorandum NMFS-NE-264. 479 pp.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, and J. Turek. 2021. *US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2020*. Woods Hole (MA): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Report No. NOAA Technical Memorandum NMFS-NE-271. 403 pp.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, and J.E. Wallace. 2022. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports 2021*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. May 2022. 386 p.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, J. McCordic, and J.E. Wallace. 2023. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports 2022*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. June 2023. 262 p.

Heinis, F., C. de Jong, M. Ainslie, W. Borst, T. Vellinga. 2013. Monitoring Programme for the Maasvlakte 2, Part III- the effects of Underwater Sound. *Terra et Aqua* 132:21–32.

Henry, A.G., M. Garron, D. Morin, A. Reid, W. Ledwell, and T.V.N. Cole. 2020. *Serious Injury and Mortality Determinations for Baleen Whale Stocks along the Gulf of Mexico, United States East Coast, and Atlantic Canadian Provinces, 2013-2017*. Woods Hole, MA: U.S. Department of Commerce, Northeast Fisheries Science Center Reference Document 20-06.

Hoffman, C.A. 2012. Mitigating impacts of underwater noise from dredging on beluga whales in Cook Inlet, Alaska. *Advances in Experimental Medicine and Biology* 730(617–619).

Holt, M.M., J.B. Tennessen, M.B. Hanson, C.K. Emmons, D.A. Giles, J.T. Hogan, and M.J. Ford. 2021. Vessels and their Sounds Reduce Prey Capture Effort by Endangered Killer Whales (*Orcinus orca*). *Marine Environmental Research* 170:105429.

Holt, M.M., D.P. Noren, R.C. Dunkin, and T.M. Williams. 2015. Vocal Performance Affects Metabolic Rate in Dolphins: Implications for Animals Communicating in Noisy Environments. *Journal of Experimental Biology* 218(Pt 11):1647–1654.

Holt, M.M., D.P. Noren, V. Veirs, C.K. Emmons, and S. Veirs. 2009. Speaking Up: Killer Whales (*Orcinus orca*) Increase Their Call Amplitude in Response to Vessel Noise. *Journal of the Acoustical Society of America* 125:EL27-EL32.

Jansen, E., and C.D. de Jong. 2014. Underwater noise measurements in the North Sea in and near the Princess Amalia Wind Farm in operation. TNO report: TNO 2013 R11916. The Hague, Netherlands. 55pp.

Jensen, A.S., and G.K. Silber. 2003. Large Whale Ship Strike Database. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-OPR-. 37 p.

Jensen, J.H., L. Bejder, M. Wahlberg, N. Aguilar Solo, M. Johnson, and P.T. Madsen. 2009. Vessel Noise Effects on Delphinid Communication. *Marine Ecology Progress Series* 395:161–175.

Jepson, P.D., R. Deaville, J.L. Barber, À. Aguilar, A. Borrell, S. Murphy, Jon Barry et al. 2016. PCB Pollution Continues to Impact Populations of Orcas and Other Dolphins in European Waters. *Scientific Reports* 6 (1):18573.

Johnson, S.R. 2002. *Marine mammal mitigation and monitoring program for the 2001 Odoptu 3-D seismic survey, Sakhalin Island, Russia: Executive summary*. Report by LGL Limited, Sidney, BC, Canada, for Exxon Neftegas Limited, Yuzhno-Sakhalinsk, Russia. 49 pp.

Johnson, A., G. Salvador, J. Kenney, J. Robbins, S. Kraus, S. Landry, and P. Clapham. 2005. Fishing Gear Involved in Entanglements of Right and Humpback Whales. *Marine Mammal Science* 21(4):635–645.

Kastelein R.A., L.A.E. Huijser, S. Cornelisse, L. Helder-Hoek, N. Jennings, and C.A.F. de Jong. 2019. Effect of Pile-Driving Playback Sound Level on Fish-Catching Efficiency in Harbor Porpoises (*Phocoena phocoena*). *Aquatic Mammals* 45(4):398–410.

Kates Varghese, H., J. Miksis-Olds, N. DiMarzio, K. Lowell, E. Linder, L. Mayer, and D. Moretti. 2020. The Effect of Two 12 Khz Multibeam Mapping Surveys on the Foraging Behavior of Cuvier's Beaked Whales off of Southern California. *The Journal of the Acoustical Society of America* 147:3849.

Kates Varghese, H., K. Lowell, J. Miksis-Olds, N. DiMarzio, D. Moretti, and L. Mayer. 2021. Spatial Analysis of Beaked Whale Foraging during Two 12 Khz Multibeam Echosounder Surveys. *Frontiers in Marine Science* 2021:1139.

Kellar, N.M., T.R. Speakman, C.R. Smith, S.M. Lane, B.C. Balmer, M.L. Trego, K.N. Catelani, M.N. Robbins, C.D. Allen, R.S. Wells, E.S. Zolman, T.K. Rowles, and L.H. Schwacke. 2017. Low Reproductive Success Rates of Common Bottlenose Dolphins *Tursiops truncatus* in the Northern Gulf of Mexico Following the Deepwater Horizon Disaster (2010–2015). *Endangered Species Research* 33:1432–158.

King, K., M. Joblon, K. McNally, L. Clayton, H. Pettis, P. Corkeron, and F. Nutter. 2021. Assessing North Atlantic Right Whale (*Eubalaena glacialis*) Welfare. *J. Zoological and Botanical Garden*s 2:728–739. DOI:10.3390/jzbg2040052.

Knowlton, A.R., P.K. Hamilton, M.K. Marx, H.P. Pettis, and S.D. Kraus. 2012. Monitoring North Atlantic Right Whale *Eubalaena galcialis* Entanglement Rates: A 30-Year Retrospective. *Marine Ecology Progress Series* 466:293–302.

Kraus, S.D., M.W. Brown, H. Caswell, C.W. Clark, M. Fujiwara, P.H. Hamilton, R.D. Kenney, A.R. Knowlton, S. Landry, C.A. Mayo, W.A. McLellan, M.J. Moore, D.P. Nowacek, D.A. Pabst, A.J. Read, and R.M. Rolland. 2005. North Atlantic Right Whales in Crisis. *Science* 309:561–562.

Kraus, S.D., S. Leiter, K. Stone, B. Wikgren, C. Mayo, P. Hughes, R.D. Kenney, C.W. Clark, A.N. Rice, B. Estabrook, and J. Tielens. 2016. *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles*. OCS Study BOEM 2016-054. Final report. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management.

LaBrecque, E., C. Curtice, J. Harrison, S.M. Van Parijs, and P.N. Halpin. 2015. Biologically Important Areas for Cetaceans within US Waters-East Coast Region. *Aquatic Mammals* 41(1):17.

Laist D.W., A.R. Knowlton, and D. Pendleton. 2014. Effectiveness of Mandatory Vessel Speed Limits for Protecting North Atlantic Right Whales. *Endangered Species Research* l(23):133–147.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions between Ships and Whales. *Marine Mammal Science* 17(1):35–75.

Lesage, V., C. Barrette, M.C.S. Kingsley, and B. Sjare. 1999. The Effect of Vessel Noise on the Vocal Behavior of Belugas in the St. Lawrence River Estuary, Canada. *Marine Mammal Science* 15(1):65–84.

Lewison, R.L., L.B. Crowder, B.P. Wallace, J.E. Moore, T. Cox, R. Zydelis, S. McDonald, A. DiMatteo, D.C. Dunn, and C.Y. Kot. 2014. Global Patterns of Marine Mammal, Seabird, and Sea Turtle Bycatch Reveal Taxa-Specific and Cumulative Megafauna Hotspots. *Proceedings of the National Academy of Sciences* 111(14):5271.

Li, X., L. Chi, X. Chen, Y. Ren, and S. Lehner. 2014. SAR Observation and Numerical Modeling of Tidal Current Wakes at the East China Sea Offshore Wind Farm. *Journal of Geophysical Research: Oceans* 119(8):4958–4971.

Ludewig, E. 2015. *On the Effect of Offshore Wind Farms on the Atmosphere and Ocean Dynamics*. Cham: Springer International Publishing. 162 pp. Available: 978-3-319-08641-5.pdf (springer.com).

Lyssikatos, M. 2015. Estimates of Cetacean and Pinniped Bycatch in Northeast and Mid-Atlantic Bottom Trawl Fisheries, 2008–2013.

Madsen, P.T., M. Wahlberg, J. Tougaard, K. Lucke, P. Tyack. 2006. Wind Turbine Underwater Noise and Marine Mammals: Implications of Current Knowledge and Data Needs. *Marine Ecology Progress Series* 309:279–295.

Malme, C.I., B. Wursig, J.E. Bird, and P. Tyack. 1988. Observations of feeding grey whale responses to controlled industrial noise exposure. In: Port and Ocean Engineering Under Arctic Conditions. Vol. II, ed. by W.M. Sackinger, 55-73. Fairbanks, AK, University of Alaska.

Malme, C.I., B. Würsig, J.E. Bird, and P. Tyack. 1986. *Behavioural Responses of Gray Whales to Industrial Noise: Feeding Observations and Predictive Modelling. Final Report.* Outer Continental Shelf Environmental Assessment Program. Research Unit 675. August 1986.Martin, J., Q. Sabatier, T.A. Gowan, C. Giraud, E. Gurarie, C.S. Calleson, J.G. Ortega-Ortiz, C.J. Deutsch, A. Rycyk, and S.M. Koslovsky. 2016. A Quantitative Framework for Investigating Risk of Deadly Collisions between Marine Wildlife and Boats. *Methods in Ecology and Evolution* 7(1):42-50.

Martin J., Sabatier Q., Gowan T.A., Giraud C., Gurarie E,. Calleson C.S., Ortega-Ortiz J.G., Deutsch C.J., Rycyk A., Koslovsky S.M. 2016. A quantitative framework for investigating risk of deadly collisions between marine wildlife and boats. August. Available: https://besjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/2041-210X.12447.

Mazet, J.A.K., I.A. Gardner, D.A. Jessup, and L.J. Lowenstine. 2001. Effects of Petroleum on Mink Applied as a Model for Reproductive Success in Sea Otters. *Journal of Wildlife Diseases* 37(4):686–692.

McCauley, R.D., M.N. Jenner, C. Jenner, K.A. McCabe, and J. Murdoch. 1998. The response of humpback whales (*Megaptera novaenglize*) to offshore seismic survey noise: preliminary results of observations about a working seismic vessel and experimental exposures. *APPEA Journal* 38(1):692–707.

McConnell, B.J., M.A. Fedak, P. Lovell, and P.S. Hammond. 1999. Movements and Foraging Areas of Grey Seals in the North Sea. *Journal of Applied Ecology* 36:573–590.

Methratta, E.T., and W.R. Dardick. 2019. Meta-Analysis of Finfish Abundance at Offshore Wind Farms. *Reviews in Fisheries Science & Aquaculture* 27(2):242–260.

Meyer-Gutbrod, E.L., C.H. Greene, P.J. Sullivan, and A. J. Pershing. 2015. Climate-Associated Changes in Prey Availability Drive Reproductive Dynamics of the North Atlantic Right Whale Population. *Marine Ecology Progress Series* 535:243–258.

Meyer-Gutbrod, E.L., C.H. Greene, K.T. Davies, and D.G. Johns. 2021. Ocean Regime Shift is Driving Collapse of the North Atlantic Right Whale Population. *Oceanography* 34(3):22–31.

Mikkelsen, L., M. Johnson, D.M. Wisniewska, A. van Neer, U. Siebert, P.T. Madsen, and J. Teilmann. 2019. Long-term Sound and Movement Recording Tags to Study Natural Behavior and Reaction to Ship Noise of Seals. *Ecology and Evolution* 9(5):2588–2601.

Miles T., S. Murphy, J. Kohut, S. Borsetti, and D. Munroe. 2021. Offshore Wind Energy and the Mid-Atlantic Cold Pool: A Review of Potential Interactions. *Marine Technology Society Journal* 55:72–87.

Mohr, F.C., B. Lasely, and S. Bursian. 2008. Chronic Oral Exposure to Bunker C Fuel Oil Causes Adrenal Insufficiency in Ranch Mink. *Archive of Environmental Contamination and Toxicology* 54:337–347.

Moore, M.J., and J.M. van der Hoop. 2012. The Painful Side of Trap and Fixed Net Fisheries: Chronic Entanglement of Large Whales. *Journal of Marine Biology* Article 230653:4 pp.

Moore, S. E., and J. T. Clarke. 2002. Potential Impact of Offshore Human Activities on Gray Whales (*Eschrichtius robustus*). *Journal of Cetacean Resource Management* 4(1):19–25.

Moreno, P.T., DeMaster, D.P., Punt, A.E. and J.R. Brandon. 2020. Estimates of human-caused removals of gray seals in the northeastern U.S. Atlantic and adjacent Canadian waters: Preliminary implications for PBR-based management. Independent Advisory Team (IAT) for Marine Mammal Assessments, 32p.

Moulton, V.D., W.J. Richardson, M.T. Williams, and S.B. Blackwell. 2003. Ringed Seal Densities and Noise Near an Icebound Artificial Island with Construction and Drilling. *Acoustics Research Letters Online* 4(4):112–117. 10.1121/1.1605091.

Murphy, S., R.J. Law, R. Deaville, J. Barnett, M.W. Perkins, A. Brownlow, R. Penrose, N.J. Davison, J.L. Barber, and P.D. Jepson. 2018. Organochlorine Contaminants And Reproductive Implication In Cetaceans: A Case Study Of The Common Dolphin. *Marine Mammal Ecotoxicology:*3–38.

National Marine Fisheries Service (NMFS). 2018. *2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-OPR-59. 167 pp.

National Marine Fisheries Service (NMFS). 2020. North Atlantic Right Whale (*Eubalaena glacialis*) Vessel Speed Rule Assessment. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD.

National Marine Fisheries Service (NMFS). 2021. *ESA Section 7 Consultation Biological Opinion for the Construction, Operation, Maintenance, and Decommissioning of the South Fork Offshore Energy Project (Lease OCS-A 0517) GARFO-2021-00353 – [CORRECTED]*. Conducted by NMFS GARFO. October 2021. 523 p.

National Marine Fisheries Service (NMFS). 2023a. *North Atlantic Right Whale Calving Season 2023*. Available: https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-calving-season-2023. Accessed: August 4, 2023.

National Marine Fisheries Service (NMFS). 2023b. 2017–2023 North Atlantic Right Whale Unusual Mortality Event. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2023-north-atlantic-right-whale-unusual-mortality-event. Accessed: August 4, 2023.

National Marine Fisheries Service (NMFS). 2023c. 2016–2023 Humpback Whale Unusual Mortality Event Along the Atlantic Coast. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2023-humpback-whale-unusual-mortality-event-along-atlantic-coast. Accessed: August 4, 2023.

National Marine Fisheries Service (NMFS). 2023d. 2017–2023 Minke Whale Unusual Mortality Event along the Atlantic Coast. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2023-minke-whale-unusual-mortality-event-along-atlantic-coast. Accessed: August 4, 2023.

National Marine Fisheries Service (NMFS). 2023e. Active and Closed unusual Mortality Events. Available: https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events. Accessed: August 4, 2023.

National Marine Fisheries Service (NMFS). 2023f. 2022-2023 Pinniped Unusual Mortality Event along the Maine Coast. Available: https://www.fisheries.noaa.gov/marine-life-distress/2022-2023-pinniped-unusual-mortality-event-along-maine-coast. Accessed: August 4, 2023.

National Marine Fisheries Service (NMFS). 2023g. Species Directory: *North Atlantic Right Whale.* Available: https://www.fisheries.noaa.gov/species/north-atlantic-right-whale. Accessed: July 10, 2023.

National Marine Fisheries Service (NMFS). 2023h. Summary of Marine Mammal Protection Act Acoustic Thresholds. February 2023. Available: https://www.fisheries.noaa.gov/s3/2023-02/MMAcousticThresholds_secureFEB2023_OPR1.pdf. Accessed: August 15, 2023.

National Oceanic and Atmospheric Administration (NOAA). 2020. *Fin whale (*Balaenoptera physalus*) 5-Year Review: Summary and Evaluation*. NMFS Office of Protected Resources, Silver Spring, MD. 23 pp.

National Oceanic and Atmospheric Administration (NOAA). 2020. *North Atlantic Right Whale (*Eubalaena glacialis*) Vessel Speed Rule Assessment.* June. NOAA Fisheries, Office of Protected Resources. Available: https://media.fisheries.noaa.gov/2021-01/FINAL_NARW_Vessel_Speed_Rule_Report_Jun_2020.pdf?null.

National Oceanic and Atmospheric Administration (NOAA). 2021. Final Environmental Impact Statement, Regulatory Impact Review, and Final Regulatory Flexibility Analysis for Amending the Atlantic Large Whale Take Reduction Plan: Risk Reduction Rule. Vol. 1. 433 pp. Available at: https://media.fisheries.noaa.gov/2022-10/2021FEIS_VolumeI-GARFO.pdf.

National Oceanic and Atmospheric Administration (NOAA). n.d. Marine Mammal Protection Act, 1972 (as amended in 1994). Available: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act.

National Science Foundation and U.S. Geological Survey (NSF and USGS). 2011. *Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey.* Prepared for National Science Foundation and U.S. Geological Survey. June 2011. 514 pp.

Navy Marine Species Monitoring. 2018. *Pinniped Tagging and Tracking in Southeast Virginia*. Available: https://www.navymarinespeciesmonitoring.us/reading-room/project-profiles/pinniped-tagging-and-tracking-southeast-virginia/.

Newby, T.C., F.M. Hart, and R.A. Arnold. 1970. Weight and Blindness of Harbor Seals. *Journal of Mammalogy* 51(1):152.

Normandeau Associates, Inc., Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

Nowacek, S.M., R.S. Wells, and A.R. Solow. 2006. Short-term Effects of Boat Traffic on Bottlenose Dolphins, *Tursiops Truncatus,* in Sarasota Bay, Florida. *Marine Mammal Science* 17(4):673–688.

Nowacek, D.P., M.P. Johnson, and P.L. Tyack. 2004. North Atlantic Right Whales (*Eubalaena glacialis*) Ignore Ships but Respond to Alerting Stimuli. *Proceedings of the Royal Society B: Biological Sciences* 271(1536):227–231.

O'Brien, O., D.E. Pendleton, L.C. Ganley, K.R. McKenna, R.D. Kenney, E. Quintana-Rizzo, C.A. Mayo, S.D. Kraus, and J.V. Redfern. 2022. Repatriation of a Historical North Atlantic Right Whale Habitat during an Era of Rapid Climate Change. *Scientific Reports* 12(1):1–10.

Ocean Biodiversity Information System (OBIS). 2020. OBIS 2.0 Database. Available: http://obis.org. Accessed: December 10, 2021.

Olson J.K., D.M. Lambourn, J.L. Huggins, S. Raverty, A.A. Scott, and J.K. Gaydos. 2021. Trends in Propeller Strike-Induced Mortality in Harbor Seals (Phoca vitulina) of the Salish Sea. *Journal of Wildlife Diseases* 57(3):689–693.

Orphanides, C.D. 2020. Estimates of cetacean and pinniped bycatch in the 2017 New England sink and Mid- Atlantic gillnet fisheries. NEFSC Ref Doc 20-03; 16 p. Available: http://www.nefsc.noaa.gov/publications/.
Orr, T., S. Herz, and D. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments*. OCS Study BOEM 2013-0116. Herndon, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs.

Osmanbasic, E. 2020. The Future of Wind Turbines: Comparing Direct Drive and Gearbox. Development Effort Focuses on two Types of Wind Turbines, Is There a Dominant Choice? Available: https://www.engineering.com/story/the-future-of-wind-turbines-comparing-direct-drive-and-gearbox. Accessed: December 28, 2022.

Pace, R.M. 2021. *Revisions and Further Evaluations of the Right Whale Abundance Model: Improvements for Hypothesis Testing.* Woods Hole (MA): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Report No. NOAA Technical Memorandum NMFS-NE-269. 54 pp.

Pace, R.M., and G.K. Silber. 2005. *Simple Analysis of Ship and Large Whale Collisions: Does Speed Kill*? Presentation at the Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, CA, December 2005.

Palka, D., L. Aichinger Dias, E. Broughton, S. Chavez-Rosales, D. Cholewiak, G. Davis, A. DeAngelis, L. Garrison, H. Haas, J. Hatch, M. Jech, E. Josephson, L. Mueller-Brennan, C. Orphanides, N. Pegg, C. Sasso, D. Sigourney, M. Soldevilla, and H. Walsh. 2021. Atlantic Marine Assessment Program for Protected Species: FY15 – FY19. US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-051. 330 p.

Parks, S.E., C.W. Clark, and P.L. Tyack. 2007. Short- and Long-Term Changes in Right Whale Calling Behavior: The Potential Effects of Noise on Acoustic Communication. *The Journal of the Acoustical Society of America* 122(6):3725–3731.

Paskyabi, M.B., and I. Fer. 2012. Upper Ocean Response to Large Wind Farm Effect in the Presence of Surface Gravity Waves. *Energy Procedia* 24:245–254.

Patenaude, N.J., W.J. Richardson, M.A. Smultea, W.R. Koski, and G.W. Miller. 2002. Aircraft Sound and Disturbance to Bowhead and Beluga Whales during Spring Migration in the Alaskan Beaufort Sea. *Marine Mammal Science* 18(2):309–335.

Pettis, H.M., R.M. Pace, III, and P.K. Hamilton. 2021. *North Atlantic Right Whale Consortium 2020 Annual Report Card*. Report to North Atlantic Right Whale Consortium. NARWC, Boston, MA

Pettis, H.M., R.M. Pace, and P.K. Hamilton. 2022. *North Atlantic Right Whale Consortium 2021 Annual Report Card. Report to North Atlantic Right Whale Consortium*. Boston, MA: NARWC. 25 pp. Available: https://www.narwc.org/uploads/1/1/6/6/116623219/2021report_cardfinal.pdf. Accessed: April 4, 2022.

Pfleger, M., P. Mustain, M. Valentine, E. Gee, W. Webber, and B. Fenty. 2021. Vessel Strikes Threaten North Atlantic Right Whales. *Oceana*. DOI:10.5281/zenodo.5120727.

Pierce, G.J., M.B. Santos, S. Murphy, J.A. Learmonth, A.F. Zuur, E. Rogan, P. Bustamante, et al. "Bioaccumulation of persistent organic pollutants in female common dolphins (Delphinus delphis) and harbour porpoises (Phocoena phocoena) from western European seas: Geographical trends, causal factors and effects on reproduction and mortality." *Environmental Pollution* 153(2):401–415.

Pirotta, E., B.E. Laesser, A. Hardaker, N. Riddoch, M. Marcoux, and D. Lusseau. 2013. Dredging Displaces Bottlenose Dolphins from an Urbanised Foraging Patch. *Mar Pollut Bull.* 74(1):396–402.

Precoda, K., and C.D. Orphanides. 2022. Estimates of cetacean and pinniped bycatch in the 2019 New England sink and Mid-Atlantic gillnet fisheries. US Dept Commer, Northeast Fish Sci Cent Ref Doc. 22-05; 21 p.

Putland, R.L., N.D. Merchant, A. Farcas, and C.A. Radford. 2018. Vessel noise cuts down communication space for vocalizing fish and marine mammals. *Global Change Biology* 24(4):1708–1721.

Quick, N., L. Scott-Hayward, D. Sadykova, D. Nowacek, and A. Read. 2017. Effects of a scientific echo sounder on the behavior of short-finned pilot whales (*Globicephala macrorhynchus*). *Canadian Journal of Fisheries and Aquatic Sciences* 74(5):716–726.

Quintana-Rizzo, E., S. Leiter, T.V.N. Cole, M.N. Hagbloom, A.R. Knowlton, P. Nagelkirk, O.O. Brien, C.B. Khan, A.G. Henry, P.A. Duley, and L.M. Crowe. 2021. Residency, Demographics, and Movement Patterns of North Atlantic Right Whales Eubalaena Glacialis in an Offshore Wind Energy Development Area in Southern New England, USA. *Endangered Species Research* 45*:*251–268

Raghukumar, K., C. Chartrand, G. Chang, L. Cheung, and J. Roberts. 2022. Effect of Floating Offshore Wind Turbines on Atmospheric Circulation in California. *Frontiers in Energy Research* 10:1–14.

Raoux, A., S. Tecchio, J.P. Pezy, G. Lassalle, S. Degraer, S. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangeré, F. Le Loc'h, J.C. Dauvin, and N. Niquil. 2017. Benthic and Fish Aggregation Inside an Offshore Wind Farm: Which Effects on the Trophic Web Functioning? *Ecological Indicators* 7233–7246.

Read, A.J., P. Drinker, and S. Northridge. 2006. Bycatch of Marine Mammals in U.S. and Global Fisheries. *Conservation Biology* 20(1):163–169.

Reeves, R.R., K. McClellan, and T.B. Werner. 2013. Marine Mammal Bycatch in Gillnet and Other Entangling Net Fisheries, 1990 to 2011. *Endangered Species Research*. 20(1):71–97.

Reygondeau G, and G. Beaugrand. 2011. Future Climate-Driven Shifts in Distribution of *Calanus finmarchicus*. *Global Change Biology* 17:756−766.

Richardson W.J., B. Würsig, and C.R. Greene Jr. 1990. Reactions of bowhead whales, Balaena mysticetus, to drilling and dredging noise in the Canadian Beaufort Sea. *Marine Environmental Research* 29(2):135–160.

Richardson, W.J., G.W. Miller, and C.R. Green. 1999. Displacement of Migrating Bowhead Whales by Sounds from Seismic Surveys in Shallow Waters of the Beaufort Sea. *The Journal of the Acoustical Society of America* 106(4):2281–2281.

Richardson, W., C. Greene Jr., C. Malme, and D. Thomson. 1995. Marine Mammals and Noise. San Diego, CA: *Academic Press.* 575 pp.

Richardson, W.J., B. Würsig, and C. Greene Jr. 1990. Reactions of Bowhead Whales, *Balaena Mysticetus*, to Drilling and Dredging Noise in the Canadian Beaufort Sea. *Marine Environmental Research* 29(2):26.

Richardson, W.J., B. Wursig, and C.R. Greene. 1986. Reactions of bowhead whales, Balaena mysticetus, to seismic exploration in the Canadian Beaufort Sea. *The Journal of the Acoustical Society of America* 79(4):1117–1128.

Richter, C.F., S.M. Dawson, and E. Slooten. 2006. Impacts of Commercial Whale Watching on Male Sperm Whales at Kaikoura, New Zealand. January. Available: https://www.researchgate.net/publication/230077727_Impacts_of_commercial_whale_watching_on_male_sperm_whales_at_Kaikoura_New_Zealand.

Robbins, J., and D.K. Mattila. 2001. Monitoring entanglements of humpback whales (Megaptera novaeangliae) in the Gulf of Maine on the basis of caudal peduncle scarring. *Unpublished report to the Scientific Committee of the International Whaling Commission: SC/53/NAH25*.

Robbins, J. 2012. Scar-based inference into Gulf of Maine humpback whale entanglement: 2010. Report to the Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, Massachusetts. 28 pp.

Roberts, J.J., L. Mannocci, R.S. Schick, and P.N. Halpin. 2018. *Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2017-2018 (Opt. Year 2)*. Document version 1.0. Report prepared for Naval Facilities Engineering Command, Atlantic, by the Duke University Marine Geospatial Ecology Lab, Durham, NC.

Roberts, J.J., R.S. Schick, and P.N. Halpin. 2020. *Final Project Report: Marine Species Density Data Gap Assessments and Update for the AFTT Study Area, 2018-2020 (Opt. Year 3).* Document version 1.4. Report prepared for Naval Facilities Engineering Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, NC. 142 pp.

Roberts, J., T. Yack, and P. Halpin. 2022. *Habitat-Based Marine Mammal Density Models for the U.S. Atlantic: Latest Versions.* Available: https://seamap.env.duke.edu/models/Duke/EC/. Accessed: October 25, 2022.

Roberts, J.J., T.M. Yack, and P.N. Halpin. 2023. Marine mammal density models for the U.S. *Navy Atlantic Fleet Training and Testing (AFTT) study area for the Phase IV Navy Marine Species Density Database (NMSDD).* Document version 1.3. Report prepared for Naval Facilities Engineering Systems Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, North Carolina. 46 p.

Rockwood, R.C., J. Calambokidis, and J. Jahncke. 2017. High Mortality of Blue, Humpback and Fin Whales from Modeling of Vessel Collisions on the US West Coast Suggests Population Impacts and Insufficient Protection. *PLoS One* 12(8):e0183052.

Rolland, R.M., S.E. Parks, K.E. Hunt, M. Castellote, P.J. Corkeron, D.P. Nowacek, S.K. Wasser, and S.D. Kraus. 2012. Evidence That Ship Noise Increases Stress in Right Whales. *Proceedings of Royal Society B* 279(1737):2363–2368.

Ruppel, C.D., T.C. Weber, E.R. Staaterman, S.J. Labak, and P.E. Hart. 2022. Categorizing Active Marine Acoustic Sources Based on Their Potential to Affect Marine Animals. *Journal of Marine Science and Engineering* 10(9):1–46.

Russell, D.J.F., S.M.J.M. Brasseur, D. Thompson, G.D. Hastie, V.M. Janik, and G. Aarts. 2014. Marine Mammals Trace Anthropogenic Structures at Sea. *Current Biology* 24(14):R638–R639.

Russell, D.J.F., G.D. Hastie, D. Thompson, V.M. Janik, P.S. Hammond, L. Scott-Hayward, J. Matthiopoulos, E.L. Jones and B. McConnell. 2016. "Avoidance of wind farms by harbour seals is limited to pile driving activities." *The Journal of Applied Ecology* 53 (2016):1642–1652.

Salisbury, D.P. ,C.W. Clark, and A.N. Rice. 2016. Right Whale Occurrence in the Coastal Waters of Virginia, USA: Endangered Species Presence in a Rapidly Developing Energy Market. *Marine Mammal Science* 32(2):508–519.

Salisbury, D.P., B.J. Estabrook, H. Klinck, and A.N. Rice. 2018. *Understanding Marine Mammal Presence in the Virginia Offshore Wind Energy Area*. Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2019-007. 103 pp.

Schakner, Z., and D. Blumstein. 2013. Behavioral Biology of Marine Mammal Deterrents: A Review and Prospectus. *Biological Conservation* 167:380–389. 10.1016/j.biocon.2013.08.024.

Scheidat, M., J. Tougaard, S. Brasseur, J. Carstensen, T. van Polanen Petel, J. Teilmann, and P. Reijnders. 2011. Harbour Porpoises (*Phocoena phocoena*) and Wind Farms: A Case Study in the Dutch North Sea. *Environmental Research Letters 6:*025102. DOI:10.1088/1748-9326/6/2/025102.

Scheifele P.M., S. Andrew, R.A. Cooper, M. Darre, F.E. Musiek, and L. Max. 2004. Indication of a Lombard vocal response in the St. Lawrence River beluga. *Journal of the Acoustical Society of America* 17:1486–1492.

Schoeman, R.P., C. Patterson-Abrolat, and S. Plön. 2020. A Global Review of Vessel Collisions with Marine Animals. *Frontiers in Marine Science* 7:292.

Schultze, L., L. Merckelbach, S. Raasch, N. Christiansen, U. Daewel, C. Schrum, and J. Carpenter. 2020. *Turbulence in the Wake of Offshore Wind Farm Foundations and Its Potential Effects on Mixing of Stratified Tidal Shelf Seas* [Presentation]. Presented at Ocean Sciences Meeting 2020, San Diego, CA, USA.

Segtnan, O.H., and K. Christakos. 2015. *Effect of Offshore Wind Farm Design on the Vertical Motion of the Ocean*. 12th Deep Sea Offshore Wind R&D Conference, EERA DeepWind 2015. *Energy Procedia* 80:213–222.

Siebert U., J. Stürznickel, T. Schaffeld, R. Oheim, T. Rolvien, E. Prenger-Berninghoff, et al. 2022. Blast Injury on Harbour Porpoises (*Phocoena Phocoena*) from the Baltic Sea after Explosions of Deposits of World War II Ammunition. *Environ. Int.* 159:107014. DOI:10.1016/j.envint.2021.107014

Smith, C.R., T.K. Rowles, L.B. Hart, F.I. Townsend, R.S. Wells, E.S. Zolman, B.C. Balmer, B. Quigley, M. Ivnacic, W. McKercher, M.C. Tumlin, K.D. Mullin, J.D. Adams, Q. Wu, W. McFee, T.K. Collier, and L.H. Schwacke. 2017. Slow Recovery of Barataria Bay Dolphin Health Following the Deepwater Horizon Oil Spill (2013–2014), with Evidence of Persistent Lung Disease and Impaired Stress Response. *Endangered Species Research* 33:127–142.

Smultea M.A., J.R. Mobley, D. Fertl Jr, and G. Fulling. 2008. An Unusual Reaction and Other Observations of Sperm Whales New Fixed-Wing Aircraft. *Gulf and Caribbean Research* 20(1). DOI:10.18785/gcr.2001.10.

South Fork Wind. 2021. *South Fork Wind Farm Constructions and Operations Plan*. May.

Southall, B.J., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals* 33(44):411–521.

Southall, B.L., J.J. Finneran, C. Reichmuth, P.E. Nachtigall, D.R. Ketten, A.E. Bowles, W.T. Ellison, D.P. Nowacek, and P.L. Tyack. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals* 45(2):125–232.

Southall B., W. Ellison, C. Clark, D. Tollit, and J. Amaral. 2021a. *Marine Mammal Risk Assessment for New England Offshore Wind Farms Construction and Operation Scenarios*. U.S. Department of the Interior, Bureau of Ocean Energy Management Sterling (VA). OCS Study BOEM 2021-080.

Southall, B.L., D.P. Nowacek, A.E. Bowles, V. Senigaglia, L. Bejder, and P.L. Tyack. 2021b. Marine Mammal Noise Exposure Criteria: Assessing Severity of Marine Mammal Behavioral Responses to Human Noise. *Aquatic Mammals* 47(5):421–464.

Sprogis, K.R., S. Videsen, and P.T. Madsen. 2020. Vessel noise levels drive behavioral response of humpback whales with implications for whale-watching. *Ecology* 9:e56760.

Stöber, U., and F. Thomsen. 2021. How Could Operational Underwater Sound from Future Offshore Wind Turbines Impact Marine Life? *The Journal of the Acoustical Society of America* 149:1791. DOI:10.1121/10.0003760.

Sullivan, L., T. Brosnan, T.K. Rowles, L. Schwacke, C. Simeone, and T.K. Collier. 2019. *Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals*. NOAA Tech. Memo. NMFS-OPR-62, 82 pp.

Takeshita, R., L. Sullivan, C. Smith, T. Collier, A. Hall, T. Brosnan, T. Rowles, and L. Schwacke. 2017. The Deepwater Horizon Oil Spill Marine Mammal Injury Assessment. *Endangered Species Research* 33:96–106.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review Of Potential Impacts of Submarine Power Cables on the Marine Environment: Knowledge Gaps, Recommendations and Future Directions. *Renewable and Sustainable Energy Reviews* 96:380–391.

Tetra Tech, Inc. 2022a. *Dominion Energy Coastal Virginia Offshore Wind Commercial Project Request for Rule Making and Letter of Authorization (LOA) for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0483 and the Associated Offshore Export Cable Route Corridor: Roberts et al. 2022 Revision Addendum*. Prepared for Dominion Energy by Tetra Tech, Inc. Submitted to NOAA National Marine Fisheries Service September 2022. 88 pp.

Tetra Tech, Inc. (Tetra Tech). 2022b. Dominion Energy Coastal Virginia Offshore Wind Commercial Project Request for Rulemaking and Letter of Authorization (LOA) for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0483 and the Associated Offshore Export Cable Route Corridor: Roberts and Halpin (2022) Revision Addendum. Prepared for Dominion Energy, Submitted to NOAA National Marine Fisheries Service September 2022, revised December 2022. 31 p.

Thomas, P.O., R.R. Reeves, and R.L. Brownell Jr. 2016. Status of the World's Baleen Whales. *Marine Mammal Science* 32(2):682–734.

Thomsen, F., and U. Stöber. 2022. Operational Underwater Sound From Future Offshore Wind Turbines Can Affect the Behavior of Marine Mammals. *The Journal of the Acoustical Society of America* 151(4):A239–A239.

Todd, S., J. Lien, F. Marques, P. Stevick, and D. Ketten. 1996. Behavioural Effects of Exposure to Underwater Explosions in Humpback Whales (*Megaptera novaeangliae*). *Canadian Journal of Zoology*, 74(9):1661–1672.

Todd, V.L.G., W.D. Pearse, N.C. Tregenza, and I.B. Todd. 2009. Diel Echolocation Activity of Harbour Porpoises (*Phocoena Phocoena*) around North Sea Offshore Gas Installations. *ICES J. Mar. Sci.* 66: 734–745. DOI:10.1093/icesjms/fsp035.

Todd, V.L.G., I.B. Todd, J.C. Gardiner, E.C.N. Morrin, N.A. MacPherson, N.A. DiMarzio, and F. Thomsen. 2015. A Review of Impacts on Marine Dredging Activities on Marine Mammals. *ICES Journal of Marine Science* 72(2):328–340.

Todd, V.L., L. Lazar, L.D. Williamson, I.T. Peters, A.L. Hoover, S.E. Cox, I.B. Todd, P.I. Macreadie, and D.L. McLean. 2020. Underwater Visual Records of Marine Megafauna around Offshore Anthropogenic Structures. *Frontiers in Marine Science* 7:230.

Toth, J.L., A.A. Hohn, K.W. Able, and A.M. Gorgone. 2011. Patterns of Seasonal Occurrence, Distribution, and Site Fidelity of Coastal Bottlenose Dolphins (*Tursiops truncatus*) in Southern New Jersey, USA. *Marine Mammal Science* 27(1):94–110.

Tougaard, J., and O.D. Henriksen. 2009. Underwater Noise from Three Types of Offshore Wind Turbines: Estimation of Impact Zones for Harbor Porpoises and Harbor Seals." *Journal of the Acoustical Society of America* 125(6):3766–3773. DOI:10.1121/1.3117444.

Tougaard, J., L. Hermannsen, and P.T. Madsen. 2020. How Loud is the Underwater Noise from Operating Offshore Wind Turbines? *The Journal of Acoustical Society of America* 145:2885–2893. DOI:10.1121/10.0002453.

Tsujii K., T. Akamatsu, R. Okamoto, K. Mori, Y. Mitani, and N. Umeda. 2018. Change in singing behavior of humpback whales caused by shipping noise. *PLoS One.* DOI:10.1371/journal.pone.0204112.

Tyack, P.L., and E.H. Miller. 2002. Vocal Anatomy, Acoustic Communication and Echolocation. Pages 142–184 in A.R. Hoetzel (ed.), *Marine Mammal Biology: An Evolutionary Approach*. Oxford, UK: Blackwell Science Ltd.

Tyack, P.L. 2008. Implications for Marine Mammals of Large-Scale Changes in the Marine Acoustic Environment. *Journal of Mammalogy* 89(3):549–558.

U.S. Army Corps of Engineers (USACE). 2021. Newark Bay, New Jersey Federal Navigation Project Maintenance Dredging. Public Notice No. Newark Bay, NJ FY21. May.

U.S. Fish and Wildlife Service (USFWS). 2023. Stock Assessment Report (SAR) West Indian Manatee (*Trichechus manatus*) Florida Stock (Florida subspecies, *Trichechus manatus latirostris*). U.S. Fish and Wildlife Service, Florida Ecological Services Office Jacksonville, Florida. 27 pp.

van Berkel, J., H. Burchard, A. Christensen, L.O. Mortensen, O.S. Petersen, and F. Thomsen. 2020. The Effects of Offshore Wind Farms on Hydrodynamics and Implications for Fishes. *Oceanography* 33(4):108–117.

Van Waerebeek, K., A.N. Baker, F. Félix, J. Gedamke, M. Iñiguez, G.P. Sanino, E. Secchi, D. Sutaria, A. van Helden, and Y. Wang. 2007. Vessel Collisions with Small Cetaceans Worldwide and with Large Whales in the Southern Hemisphere, an Initial Assessment. *Latin American Journal of Aquatic Mammals* 6(1):43–69.

Vanderlaan, A.S.M., and C.T. Taggart. 2007. Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed. *Marine Mammal Science* 23(1):144–156.

Vanhellemont, Q., and K. Ruddick. 2014. Turbid Wakes Associated with Offshore Wind Turbines Observed with Landsat 8. *Remote Sensing of Environment* 145:105–115

Vires, G. 2011. Echosounder effects on beaked whales in the Tongue of the Ocean, Bahamas. Masters project proposal for the Master of Environmental Management degree, Duke University. 37 pp. ViresG_MP_2011.pdf (duke.edu) Accessed: January 24, 2023.

Virginia Department of Wildlife Resources (VDWR). *Special Status Faunal Species in Virginia*. Updated July 9, 2020.

Walker, M.M., C.E. Diebel, and J.L. Kirschvink. 2003. Detection and Use of the Earth's Magnetic Field by Aquatic Vertebrates. Pages 53–74 in S.P. Collin and N.J. Marshall (eds.), *Sensory Processing in Aquatic Environments*. Spriner-Verlag, New York.

Waring, G.T., E. Josephson, C.P. Fairfield-Walsh, K. Maze-Foley, D. Belden, T.V.N. Cole, L.P. Garrison, K. Mullin, C. Orphanides, R.M. Pace, D.L. Palka, M.C. Rossman, and F.W. Wenzel. 2007. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2007*. NOAA Technical Memorandum NMFS-NE-205. U.S. Department of Commerce, National Oceanic and Atmospheric Administration.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel (Eds). 2009. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2009*. NOAA Technical Memo NOAA Fisheries NE 213.

Waring, G.T., S.A. Wood, and E. Josephson. 2012. *Literature Search and Data Synthesis for Marine Mammals and Sea Turtles in the U.S. Atlantic from Maine to the Florida Keys*. BOEM, Gulf of Mexico OCS Region, OCS Study BOEM 2012-109.

Waring, G.T., E. Josephson, K. Maze-Foley, and P.E. Rosel, editors. 2013. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2012*. NOAA Technical Memo NMFS NE 223.

Weilgart, L.S. 2007. A Brief Review of Known Effects of Noise on Marine Mammals. *International Journal of Comparative Psychology* 20:159–168.

Wells, R.S., and M.D. Scott. 1997. Seasonal Incidence of Boat Strikes on Bottlenose Dolphins near Sarasota, Florida. *Marine Mammal Science* 3:475–480.

Werner, S., A. Budziak, J. van Franeker, F. Galgani, G. Hanke, T. Maes, M. Matiddi, P. Nilsson, L. Oosterbaan, E. Priestland, R. Thompson, J. Veiga, and T. Vlachogianni. 2016. *Harm Caused by Marine Litter.* MSFD GES TG Marine Litter—Thematic Report; JRC Technical report; EUR 28317 EN. DOI:10.2788/690366.

Williams, T.M., S.B. Blackwell, O. Tervo, E. Garde, M.H.S. Sinding, B. Richter, and M.P. Heide-Jørgensen. 2022. Physiological Responses of Narwhals to Anthropogenic Noise: A Case Study With Seismic Airguns and Vessel Traffic in the Arctic. *Functional Ecology* 36(9):2251–2266.

Williams, T.M., T.L. Kendall, B.P. Richter, C.R. Ribeiro-French, J.S. John, K.L. Odell, B.A. Losch, D.A. Feuerback, and M.A. Stamper. 2017. Swimming and Diving Energetics in Dolphins: A Stroke-By-Stroke Analysis for Predicting the Cost of Flight Responses in Wild Odontocetes. *Journal of Experimental Biology* 15(220):1135–1145.

Wisniewska, D.M., M. Johnson, J. Teilmann, U. Siebert, A. Galatius, R. Dietz, and P.T. Madsen. 2018. High Rates of Vessel Noise Disrupt Foraging in Wild Harbour Porpoises (*Phocoena phocoena*). *Proceedings of the Royal Society B: Biological Sciences* 285(1872):20172314.

Würsig B. K.L. Spencer, T.A. Jefferson, and K. Mullin. 1998. Behavior of Cetaceans in the Northern Gulf of Mexico Relative to Survey Ships and Aircraft. *Aquatic Mammals* 24(1):41–50.

Würsig, B., Greene, C.R., Jefferson, T.A.2000. Development of an air bubble curtain to reduce underwater noise of percussive piling. May. Available: https://www.sciencedirect.com/science/article/abs/pii/S0141113699000501.

Wynne, K., and M. Schwartz. 1999. *Guide to Marine Mammals & Turtles of the U.S. Atlantic & Gulf of Mexico*. Fairbanks: University of Alaska Press.

C.1.3.16. Section 3.16, Navigation and Vessel Traffic

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study 2019-036.

Bureau of Ocean Energy Management (BOEM). 2023a. *Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. March 2022. 147 pp. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C-NMFS-BA.pdf.

Bureau of Ocean Energy Management (BOEM). 2023b. *Addendum to the Draft Coastal Virginia Offshore Wind Commercial Project Biological Assessment for the National Marine Fisheries Service*. May.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Mid-Atlantic Regional Council on the Ocean (MARCO). 2016. Mid-Atlantic Ocean Data Portal. Available: http://portal.midatlanticocean.org.. Accessed: 14 April 2019.

Royal Examiner. 2023. Virginia making progress on 55-ft deep channel and becoming the US East Coast's deepest port. March 1, 2023. Available: https://royalexaminer.com/virginia-making-progress-on-55-ft-deep-channel-and-becoming-the-us-east-coasts-deepest-port/. Accessed: July 14, 2023.

U.S. Army Corps of Engineers (USACE). 2018. *Final Waterborne Commerce Statistics for Calendar Year 2017: Waterborne Commerce National Totals and Selected Inland Waterways for Multiple Years*. Available: https://usace.contentdm.oclc.org/digital/api/collection/p16021coll2/id/3002/page/0/inline/p16021coll2_3002_0. Accessed: December 8, 2020.

U.S. Army Corps of Engineers (USACE). 2019a. *Federal Register* Vol. 84. Washington, D.C.: U.S. Government Publishing Office.

U.S. Army Corps of Engineers (USACE). 2019b. Thimble Shoal Channel slated for dredging after Norfolk District award, By Andria Allmond, U.S. Army Corps of Engineers Norfolk District Public Affairs, Published March 5, 2019. Available: https://www.nao.usace.army.mil/Media/News-Stories/Article/1775378/thimble-shoal-channel-slated-for-dredging-after-norfolk-district-award/.Accessed: July 14, 2023.

U.S. Army Corps of Engineers (USACE). 2022a. Norfolk District U.S. Army Corps of Engineers - Fy23+ Workload Forecast. Michael R. Darrow, P.E., PMP, Deputy District Engineer for Programs and Project Management. October/November 2022. Available: https://www.nao.usace.army.mil/Portals/31/docs/business/NAO_Workload_Forecast_Oct_Nov_2022.pdf?ver=Z83SjY4f40NzXxCtvRHuNw%3D%3D. Accessed: July 14, 2023.

U.S. Army Corps of Engineers (USACE). 2022b. Port of Virginia Unrestricted Navigation, USACE Norfolk District, September 2023. Available: https://media.defense.gov/2022/Sep/23/2003083918/-1/-1/0/220923-A-YZ123-1001.JPG. Accessed: July 14, 2023.

U.S. Coast Guard (USCG). 2016. *Atlantic Coast Port Access Route Study*. USCG-2011-0351. March 14. Available: https://www.federalregister.gov/documents/2016/03/14/2016-05706/port-access-route-study-the-atlantic-coast-from-maine-to-florida.

U.S. Coast Guard (USCG). 2019. *Navigation and Vessel Inspection Circular 01-19*. Available: https://www.mafmc.org/s/190801-Nav-Vess-Insp-Circ-01-19.pdf. Accessed: August 1, 2019.

U.S. Coast Guard (USCG). 2020. *The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study, Final Report.* Docket Number USCG-2019-0131. Available: https://www.navcen.uscg.gov/pdf/PARS/FINAL_REPORT_PARS_May_14_2020.pdf. Accessed: September 21, 2020.

U.S Coast Guard (USCG). 2021. *Search and Rescue Operations Near Offshore Wind Energy Project*s. Fiscal Year 2020 Report to Congress. June 16.

U.S. Coast Guard (USCG). 2023. Consolidated Port Approaches Port Access Route Studies. Available: https://www.navcen.uscg.gov/sites/default/files/pdf/PARS/Consolidated_Port_Approaches_PARS_Updated_Mar2023.pdf. Accessed: March 27, 2023.

Virginia Port Authority. 2021. Portsmouth Marine Terminal. Port of Virginia 2021. Available: https://www.portofvirginia.com/facilities/portsmouth-marine-terminal-pmt/. Accessed: August 11, 2021.

Weeks Marine, Inc. 2021. Norfolk Harbor Navigation Improvements – Thimble Shoal Channel West of Chesapeake Bay Bridge-Tunnel. Weeks Marine, Inc. October 2021. Available: file:///C:/Users/27214/Downloads/9%20%20%20%20Weeks%20Thimble%20Shoals%20PPT.pdf. Accessed: July 14, 2023.

C.1.3.17. Section 3.17, Other Uses (Marine Minerals, Military Use, Aviation)

Bureau of Ocean Energy Management (BOEM). 2015. Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf Offshore Virginia, Revised Environmental Assessment. OCS EIS/EA, BOEM 2015-031. Available: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/VA/VOWTAP-EA.pdf.

Bureau of Ocean Energy Management (BOEM). 2021. *Final Environmental Impact Statement: Vineyard Wind 1 Offshore Wind Energy Project.* Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/Vineyard-Wind-1-FEIS-Volume-1.pdf.

Dominion Energy, Inc. (Dominion Energy). 2018. Amendment to the Coastal Virginia Offshore Wind Project (CVOW, formerly the Virginia Offshore Wind Technology Advancement Project or VOWTAP) Research Activities Plan (RAP) and Response to Comments. May 21. Available: https://www.boem.gov/sites/default/files/renewable-energy-program/State-Activities/VA/CVOW_RAP_Amendment_Memo.pdf.

Dominion Energy, Inc. (Dominion Energy). 2022. Dominion Energy's Response to CVOW Request for Information (RFI) #3. October 3.

Dominion Energy, Inc. (Dominion Energy). 2023a. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Dominion Energy, Inc. (Dominion Energy). 2023b. Dominion Energy's Response to CVOW Request for Information (RFI) #8. February 28, 2023.

Dominion Energy, Inc. (Dominion Energy). 2023c. Dominion Energy's Response to CVOW Request for Information (RFI) #11. July 18, 2023.

Hare, J.A., J.B. Blythe, K.H. Ford, S. Godfrey-McKee, B.R. Hooker, B.M. Jensen, A. Lipsky, C. Nachman, L. Pfeiffer, M. Rasser, and K. Renshaw. 2022. *NOAA Fisheries and BOEM Federal Survey Mitigation Strategy – Northeast U.S. Region.* NOAA Technical Memorandum NMFS-NE-292. Available: https://www.fisheries.noaa.gov/resource/document/federal-survey-mitigation-strategy-northeast-us-region. Accessed: December 13, 2022.

Norfolk Airport Authority. 2021. *ORF Master Plan*. Available: http://orfmasterplan.com/resources/documents/ORF-Executive-Summary-27-op.pdf..

Sample, Steven, J. Executive Director. Military Aviation and Installation Assurance Siting Clearinghouse. April 21, 2023—Letter to David MacDuffee, Chief, Projects and Coordination Branch BOEM, regarding identified impacts on the mission of the NORAD radar, the Department of the Navy, and undetermined impacts on the Department of the Army (USA).

C.1.3.18. Section 3.18, Recreation and Tourism

Accomack County. 2021. *About the County*. Available: https://www.co.accomack.va.us/about-us/about-the-county. Accessed: November 2021.

Bureau of Ocean Energy Management (BOEM). 2012. *Atlantic Region Wind Energy Development: Recreation and Tourism Economic Baseline Development Impacts of Offshore Wind on Tourism and Recreation Economies*. BOEM 2012-085. Available: https://espis.boem.gov/final%20reports/5228.pdf. Accessed: November 2021.

Bureau of Ocean Energy Management (BOEM). 2021. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement*. OCS EIS/EA BOEM 2021-0012. Available: https://www.boem.gov/vineyard-wind. Accessed: August 2021.

Cape Charles Harbor. 2020. *Visit Virginia's Eastern Shore*. Available: https://capecharlesharbor.com/. Accessed: November 2021.

Carr-Harris, A., and C. Lang. 2019. Sustainability and Tourism: The Effect of the United States' First Offshore Wind Farm on the Vacation Rental Market. *Resource and Energy Economics* 57:51–67. DOI:10.1016/j.reseneeco.2019.04.003.

Chincoteague Chamber of Commerce. 2021. *Things To Do In Chincoteague*. Available: https://www.chincoteaguechamber.com/visit/. Accessed: November 2021.

City of Chesapeake. 2021. *History of Chesapeake.* Available: https://www.cityofchesapeake.net/Visitors/history.htm. Accessed: November 2021.

City of Norfolk. 2021. *Facts About Norfolk*. Available: https://www.norfolk.gov/430/Facts-About-Norfolk. Accessed: November 2021.

City of Virginia Beach. 2017. *VB Geofacts & Information*. Available: https://www.vbgov.com/government/departments/communications-info-tech/maps/Pages/VB-Geo-Facts-and-Information.aspx. Accessed: November 2021.

Currituck County. 2021. *Visit Currituck*. Available: https://www.visitcurrituck.com/. Accessed: November 2021.

Currituck County Tourism. 2021. *Currituck County Tourism*. Available: https://www.currituck.com/currituck-county-tourism.html. Accessed: November 2021.

Dare County. 2021. *About Dare County*. Available: https://www.darenc.com/about/. Accessed: November 2021.https://www.darenc.com/about

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Glarou, M., M. Zrust, and J.C. Svendsen. 2020. Using Artificial-Reef Knowledge to Enhance the Ecological Function of Offshore Wind Turbine Foundations: Implications for Fish Abundance and Diversity. *Journal of Marine Science and Engineering* 8(5):332.

Haughton, J., D. Giuffre, and J. Barrett. 2003. *Blowing in the Wind: Offshore Wind and the Cape Cod Economy.* The Beacon Hill Institute at Suffolk University. October 2003.

Kitty Hawk Wind North. 2021. *Kitty Hawk Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Kitty Hawk Wind South. 2022. *Kitty Hawk South Offshore Wind Project Construction and Operations Plan.* Prepared by Tetra Tech, Inc. April.

Kirkpatrick, A.J., S. Benjamin, G S. DePiper, T. Murphy, S. Steinback, and C. Demarest. 2017. *Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic*. Volume I—Report Narrative. U.S Dept. of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region, Washington, D.C. OCS Study BOEM 2017-012. 150 pp. Available: https://espis.boem.gov/final%20reports/5580.pdf. Accessed: November 2021.

Lutzeyer, S., D.J. Phaneuf, and L.O. Taylor. 2017. *The Amenity Costs of Offshore Windfarms: Evidence from a Choice Experiment*. (CEnREP Working Paper No. 17-017). Raleigh, NC: Center for Environmental and Resource Economic Policy. August 2017.

Northampton County. 2019. *Welcome To Northampton County*. Available: https://www.co.northampton.va.us/. Accessed: November 2021.

Orr, T.L., S.M. Herz, and D.L. Oakley. 2013. *Evaluation of Lighting Schemes for Offshore Wind Facilities and Impacts to Local Environments*. Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-0116. Available: https://espis.boem.gov/final%20reports/5298.pdf.

Outer Banks. 2021. *Your Guide to Dare County Tourism*. Available: https://www.outerbanks.org/partners/did-you-know-dare-county-tourism/. Accessed: November 2021.

Parsons, G., and J. Firestone. 2018. *Atlantic Offshore Wind Energy Development: Values and Implications for Recreation and Tourism*. U.S. Department of the Interior, Bureau of Ocean Energy Management. Available: https://www.semanticscholar.org/paper/Atlantic-Offshore-Wind-Energy-Development%3A-Values-Parsons-Firestone/91b0ede146b8701cb44d72c58f09b29533df3cdf. Accessed: November 2021.

Smythe, T., H. Smith, A. Moore, D. Bidwell, and J. McCann. 2018. *Analysis of the Effects of Block Island Wind Farm (BIWF) on Rhode Island Recreation and Tourism Activities*. U.S. Department of the Interior, Bureau of Ocean Energy Management. Sterling, Virginia. OCS Study BOEM 2018-068. Available: https://espis.boem.gov/final%20reports/BOEM_2018-068.pdf. Accessed: November 2021.

U.S. Census Bureau. 2010. *2010 Census: Population and Housing Unit Counts*. Available: https://www.census.gov/library/publications/2012/dec/cph-2.html. Accessed: November 2021.

Visit Chesapeake. 2021. *Chesapeake Parks and Trails*. Available: https://www.visitchesapeake.com/things-to-do/parks-trails/. Accessed: November 2021.

Visit Norfolk. n.d. *Get To Know Norfolk, VA*. Available: https://www.visitnorfolk.com/. Accessed: November 2021.

Visit Virginia Beach. 2021. *You Deserve a Virginia Beach Vacation*. Available: https://www.visitvirginiabeach.com/. Accessed: November 2021.

C.1.3.19. Section 3.19, Sea Turtles

Bailey , H., K.L. Brookes, and P.M. Thompson. 2014. Assessing Environmental Impacts of Offshore Wind Farms: Lessons Learned and Recommendations for the Future. *Aquatic Biosystems* 10(8). DOI:10.1186/2046-9063-10-8.

Baker, K., and U. Howsen. 2021. *Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf.* Biological Assessment. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. October 2018, Revised February 2021.

Barco, S., M. Law, B. Drummond, H. Koopman, C. Trapani, S. Reinheimer, S. Rose, M. Swingle, and A. Williard. 2016. Loggerhead Turtles Killed by Vessel and Fishery Interaction in Virginia, USA, Are Healthy Prior to Death. *Marine Ecology Progress Series* 555:221–234.

Barkaszi M.J., M. Fonseca, T. Foster, A. Malhotra, and K. Olsen. 2021. *Risk Assessment to Model Encounter Rates Between Large Whales and Vessel Traffic from Offshore Wind Energy on the Atlantic OCS*. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-034. 54 p + Appendices.

Barnette, M.C. 2017. *Potential Impacts of Artificial Reef Development on Sea Turtle Conservation in Florida*. National Oceanic and Atmospheric Administration, Technical Memorandum NMFS-SER-5. 36 pp.

Bartol, S.M., and I.K. Bartol. 2012. *Hearing Capabilities of Loggerhead Sea Turtles (Caretta caretta) throughout Ontogeny: An Integrative Approach involving Behavioral and Electrophysiological Techniques*. Final Report E&P & Marine Life Programme. Prepared by Virginia Wesleyan College and Old Dominion University. JIP Grant No. 22 07-14. 37 pp.

Berreiros J.P., and V.S. Raykov. 2014. Lethal Lesions and Amputation Caused by Plastic Debris and Fishing Gear on the Loggerhead Turtle Caretta (Linnaeus, 1758). Three Case Reports from Terceira Island, Azores (NE Atlantic). *Marine Pollution Bulletin* 86:518–522.

Betke K., and M.A. Bellmann. 2023. Operational Underwater Noise from Offshore Wind Farms. In: *The Effects of Noise on Aquatic Life*. pp. 1–12.

Bies, J. 2018. *Rare Delaware Sea Turtle Nest Has DNREC, Marine Biologists Intrigued*. Available: https://www.delawareonline.com/story/news/2018/10/26/rare-delaware-sea-turtle-nest-could-sign-climate-changed/1759869002/. Accessed: November 15, 2021.

Bugoni, L., L. Krause, and M.V. Petry. 2001. Marine Debris and Human Impacts on Sea Turtles in Southern Brazil. *Marine Pollution Bulletin* 42(12):1330–1334.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment*. January. Available: https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Mid-Atlantic_Final_EA_012012.pdf. Accessed: November 15, 2021.

Bureau of Ocean Energy Management (BOEM). 2014. A*tlantic OCS Proposed Geological and Geophysical Activities. Mid-Atlantic and South Atlantic Planning Areas*. Final Programmatic Environmental Impact Statement. OCS EIS/EA BOEM 2014-001. Available: https://www.boem.gov/sites/default/files/oil-and-gas-energy-program/GOMR/BOEM-2014-001-v1.pdf. Accessed: November 15, 2021.

Bureau of Ocean Energy Management (BOEM). 2019. N*ational Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf*. Available: https://www.boem.gov /sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf . Accessed: November 15, 2021.

Bureau of Ocean Energy Management (BOEM). 2021. *South Fork Wind Farm and South Fork Export Cable Biological Assessment. Submitted to the National Marine Fisheries Service*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs.

Caillouet Jr, C.W., and B.J. Gallaway. 2020. Kemp's Ridley Sea Turtle Emigration and Immigration Between The Gulf Of Mexico And North Atlantic Ocean Should Not Be Ignored In Age-Structured Population Modeling. *Marine Turtle Newsletter* (161):9–14.

Carpenter, J.R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. Potential Impacts of Offshore Wind Farms on North Sea Stratification. *PLoS One* 11(8):e0160830. DOI:10.1371/journal.pone.0160830.

Causon, P.D., and A.B. Gill. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. *Environmental Science and Policy* 89:340–347.

Ceriani S.A., P. Casale, M. Brost, E. Leone, B. Witherington. 2019. Conservation Implications of Sea Turtle Nesting Trends: Elusive Recovery of a Globally Important Loggerhead Population. *Ecosphere*. 10(11):e02936.

Charrier, I., L. Jeantet, L. Maucourt, S. Régis, N. Lecerf, A. Benhalilou, and D. Chevallier. 2022. First Evidence of Underwater Vocalizations in Green Sea Turtles Chelonia Mydas. *Endangered Species Research* 48:31–41.

Croatan Civic League. 2021. *Turtles Nesting on Croatan Beach*. Available: https://www.croatanbeach.org/turtles-nesting-on-croatan-beach/. Accessed: November 1, 2022.

Crocker, S.E., and F.D. Fratantonio. 2016. *Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys. Naval Undersea Warfare Center Division, Newport, RI.* For U.S. Department of the Interior, Bureau of Ocean Energy Management, Environmental Assessment Division and U.S. Geological Survey. OCS Study BOEM 2016-044. NUWC-NPT Technical Report 12,203, 24 March 2016. 266 pp.

Crocker, S.E., F.D. Fratantonio, P.E. Hart, D.S. Foster, T.F. O'Brien, and S. Labak. 2019. Measurements of Sounds Emitted by Certain High-Resolution Geophysical Survey Systems. *IEEE Journal of Oceanic Engineering* 4(3):796–813.

CSA Ocean Sciences Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Headquarters, Sterling, VA. OCS Study BOEM 2019-049.

DeRuiter, S., and K.L. Doukara. 2012. Loggerhead Turtles Dive in Response to Airgun Sound Exposure. *Endangered Species Research* 16:55–63.

DiMatteo A., J.J. Roberts, D. Jones, L. Garrison, K.M. Hart, R.D. Kenney, C. Khan, W.A. McLellan, K. Lomac-MacNair, D. Palka, M.E. Rickard, K. Roberts, A.M. Zoidis, and L. Sparks. 2023. Sea turtle density surface models along the United States Atlantic coast. Manuscript in prep. Available: https://seamap.env.duke.edu/models/NUWC/EC/. Accessed: September 7, 2023.

Dodge, K.L., B. Galuardi, T.J. Miller, and M.E. Lutcavage. 2014. Leatherback Turtle Movements, Dive Behavior, and Habitat Characteristics in Ecoregions of the Northwest Atlantic Ocean. *PLoS One* 9(3):e91726.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Duncan E., Z. Botterell, A. Broderick, T. Galloway, P. Lindeque, A. Nuno, and B. Godley. 2017. A Global Review of Marine Turtle Entanglement in Anthropogenic Debris: A Baseline for Further Action. *Endangered Species Research*. 34:431–448.

English, P.A., T.I. Mason, J.T. Backstrom, B.J. Tibbles, A.A. Mackay, M.J. Smith, and T. Mitchell. 2017. *Improving Efficiencies of National Environmental Policy Act Documentation for Offshore Wind Facilities Case Studies Report*. Sterling, Virginia: OCS Study BOEM 2017-026. 217 pp.

Evans, D.R., R.R. Carthy, and S.A. Ceriani. 2019. Migration Routes, Foraging Behavior, and Site Fidelity of Loggerhead Sea Turtles (*Caretta caretta*) Satellite Tracked from A Globally Important Rookery. *Marine Biology* 166(10):134.

Ferrara, C.R., R.C. Vogt, M.R. Harfush, R.S. Sousa-Lima, E. Albavera, and A. Tavera. 2014a. First Evidence of Leatherback Turtle (*Dermochelys coriacea*) Embryos and Hatchlings Emitting Sounds. *Chelonian Conservation and Biology* 13(1):110–114.

Ferrara, C.R., J.A. Mortimer, and R.C. Vogt. 2014b. First Evidence That Hatchlings of Chelonia Mydas Emit Sounds. *Copeia* 2014(2):245–247.

Ferrara, C.R., R.C. Vogt, R.S. Sousa-Lima, A. Lenz, and J.E. Morales-Mávil. 2019. Sound Communication in Embryos and Hatchlings of Lepidochelys Kempii. *Chelonian Conservation and Biology* 18(2):279–283.

Finkbeiner, E. M., B. P. Wallace, J. E. Moore, R. L. Lewison, L. B. Crowder, and A. J. Read. 2011. Cumulative Estimates of Sea Turtle Bycatch and Mortality in USA Fisheries Between 1990 and 2007. *Biological Conservation* 144(11):2719–2727.

Finneran, J.J., E.E. Henderson, D.S. Houser, K. Jenkins, S. Kotecki, and J. Mulsow. 2017. *Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III).* Technical report by Space and Naval Warfare Systems Center Pacific (SSC Pacific). 183 pp.

Florida Fish and Wildlife Commission. 2023. Leatherback Nesting in Florida. Available: https://myfwc.com/research/wildlife/sea-turtles/nesting/leatherback/. Accessed: March 23, 2023.

Foley, A.M., B.A. Stacy, R.F. Hardy, C.P. Shea, K.E. Minch, and B.A. Schroeder. 2019. Characterizing Watercraft-Related Mortality of Sea Turtles in Florida. *The Journal of Wildlife Management* 83(5):1057–1072.

Freitas, C., R. Caldeira, and T. Dellinger. 2019. Surface Behavior of Pelagic Juvenile Loggerhead Sea Turtles in the Eastern North Atlantic. *Journal of Experimental Marine Biology and Ecology* 510:73–80.

Gall, S.C., and R.C. Thompson. 2015. The Impact of Marine Debris on Marine Life. *Marine Pollution Bulletin* 92:170–179.

Gill, A.B., I. Gloyne-Phillips, K.J. Neal, and J.A. Kimber. 2005. *The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms – A Review*. Report No. COWRIE-EM FIELD 2-06-2004. Final report. Prepared for Collaborative Offshore Wind Energy Research Into the Environment. Cranfield University and the Centre for Marine and Coastal Studies Ltd.

Gregory, M.R. 2009. Environmental Implications of Plastic Debris in Marine Settings – Entanglement, Ingestion, Smothering, Hangers-On, Hitch-Hiking, and Alien Invasion. *Philosophical Transactions of the Royal Society B* 364:2013–2025.

Hazel, J., I. Lawler, H. Marsh, and S. Robson. 2007. Vessel Speed Increases Collision Risk for the Green Turtle *Chelonia mydas*. *Endangered Species Research* 3:105–113.

HDR. 2019. *Field Observations During Wind Turbine Operations at the Block Island Wind Farm, Rhode Island*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-028. 281 pp.

Heinis, F., C.H. De Jong, M.I. Ainslie, W. Borst, and T.I. Vellinga. 2013. Monitoring programme for the Maasvlakte 2. Part III: The effects of underwater sound. Terra et Aqua (132) 2013.

Hoarau, L., L. Ainley, C. Jean, and S. Ciccione. 2014. Ingestion and Defecation of Marine Debris by Loggerhead Sea Turtles, from By-Catches in the South-West Indian Ocean. *Marine Pollution Bulletin* 84:90–96.

Illingworth & Rodkin, Inc. 2017. *Pile-Driving Noise Measurements at Atlantic Fleet Naval installations: 28 May 2013 - 28 April 2016*. Prepared for Naval Facilities Engineering Command Atlantic under HDR Environmental, Operations and Construction, Inc. Contract No. N62470-10-D-3011, Task Order CTO33. 152 pp.

Ketten, D.R., and S.M. Bartol. 2006. *Functional Measures of Sea Turtle Hearing*. Woods Hole, Massachusetts: Woods Hole Oceanographic Institution.

Kilfoyle, A.K., R.F. Jermain, M.R. Dhanak, J.P. Huston, and R.E. Speiler. 2018. Effects of EMF Emissions from Undersea Electric Cables on Coral Reef Fish. *Bioelectromagnetics* 39:35–52.

Klimley, A.P., N.F. Putman, B.A. Keller, and D. Noakes. 2021. A Call to Assess the Impacts of Electromagnetic Fields from Subsea Cables on the Movement Ecology of Marine Migrants. *Conservation Science and Practice* 3(7):e436. DOI:10.1111/csp2.436.

Laloë J-O., and G.C. Hays. 2023. Can a Present-Day Thermal Niche Be Preserved in A Warming Climate by A Shift in Phenology? A case study with sea turtles. *R. Soc. Open Sci.* 10:221002. DOI:10.1098/rsos.221002.

Langhamer, O. 2012. Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art. *Scientific World Journal*. Article ID 386713. DOI:10.1100/2012/386713.

Lavender, A.L., S.M. Bartol, and I.K. Bartol. 2014. Ontogenetic Investigation of Underwater Hearing Capabilities in Loggerhead Sea Turtles (*Caretta caretta*) Using a Dual Testing Approach. *The Journal of Experimental Biology* 217(14):2580–2589.

Lenhardt, M.L. 1994. "Seismic and very low frequency sound induced behaviors in captive loggerhead marine turtles (Caretta caretta)" *In* Proceedings of the fourteenth annual symposium on sea turtle biology and conservation, NOAA Tech. Mem. NMFS-SEFSC-351, pp. 238–241.

Lenhardt, M. 2002. Sea Turtle Auditory Behavior. *The Journal of the Acoustical Society of America* 112(5): 2314–2314.

Lindeboom, H.J., H.J. Kouwenhove, M.J.N Bergman, S. Bouma, S. Brasseur, R. Daan, R.C. Fijn, D. de Haan, S. Dirksen, R. van Hal, R. Hille Ris Lambers, R. ter Hofstede, K.L. Krijgsveld, M. Leopold, and M. Scheidat. 2011. Short-Term Ecological Effects of an Offshore Wind Farm in the Dutch Coastal Zone; A Compilation. *Environmental Research Letters* 6(3):035101.

Lohmann, K.J., B.E. Witherington, C.M.F. Lohmann, and M. Salmon. 1997. Orientation, navigation, and natal beach homing in sea turtles. *In* P. L. Lutz and J. A. Musick (eds.), *The biology of sea turtles,* pp. 107–135. CRC Press, Boca Raton.

Lutcavage, M.E., P.T. Plotkin, B. Witherington, P.L. Lutz, and J.A. Musick. 1997. *The Biology of Sea Turtles. Human Impacts on Sea Turtle Survival*. Boca Raton, Florida: CRC Press. 387–409 pp.

Mansfield, K.L., Wyneken, J. and Luo, J., 2021. First Atlantic satellite tracks of 'lost years' green turtles support the importance of the Sargasso Sea as a sea turtle nursery. *Proceedings of the Royal Society B* 288(1950):20210057.

Marine Ventures International, Inc. 2022. Protected Species Observer Technical Report, Kitty Hawk North BOEM Lease OCS-A 0508 (M/V *Deep Helder*). Prepared for MMT Sweden AB, Submitted to Avangrid. February 2022. 78 p. Available: https://media.fisheries.noaa.gov/2022-04/KittyHawkNorth_2021IHA_MonRep.pdf. Accessed: September 7, 2023.

McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine Seismic Surveys - A Study of Environmental Implications. *APPEA Journal* 40(1):692–708.

McKenna, L.N., F.V. Paladino, P.S. Tomillo, and N.J. Robinson. 2019. Do Sea Turtles Vocalize to Synchronize Hatching or Nest Emergence? *Copeia* 107(1):120–123.

Meylan, A. 1995. Sea Turtle Migration: Evidence from Tag Returns. In *Biology and Conservation of Sea Turtles (revised)*, edited by K.A. Bjorndal, pp. 91–100. Washington, D.C.: Smithsonian Institution Press.

Michel, J., A.C. Bejarano, C.H. Peterson, and C. Voss. 2013. *Review of Biological and Biophysical Impacts from Dredging and Handling of Offshore Sand*. OCS Study BOEM 2013-0119. Herndon, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Miller, J.H., and G.R. Potty. 2017. Measurements of Underwater Sound Radiated from an Offshore Wind Turbine. *The Journal of the Acoustical Society of America* 142(4):2699.

Mineral Management Service (MMS). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternative Use of Facilities on the Outer Continental Shelf*. Final Environmental Impact Statement. October 2007. Volume II: Chapter 5. OCS EIS/EA, MMS 2007-046. pp 342.

Moein SE, Musick JA, Keinath JA, Barnard DE, Lenhardt M, George R. 1994. Evaluation of seismic sources for repelling sea turtles from hopper dredges. Report from Virginia Institute of Marine Science, Gloucester Point, VA, to U.S. Army Corps of Engineers.

Monteiro, C.C., H.M. Carmo, A.J. Santos, G. Corso, and R.S. Sousa-Lima. 2019. First Record of Bioacoustic Emission in Embryos and Hatchlings of Hawksbill Sea Turtles (*Eretmochelys imbricata*). *Chelonian Conservation and Biology* 18(2):273–278.

National Marine Fisheries Service (NMFS). 2021. *Sea Turtle Species Directory*. Available: https://www.fisheries.noaa.gov/sea-turtles#by-species. Accessed: November 15, 2021.

National Marine Fisheries Service (NMFS). 2023a. Entanglement of Marine Life: Risks and Response. Available: https://www.fisheries.noaa.gov/insight/entanglement-marine-life-risks-and-response. Accessed: March 21, 2023.

National Marine Fisheries Service (NMFS). 2023b. National Marine Fisheries Service: Summary of Endangered Species Act Acoustic Thresholds (Marine Mammals, Fishes, and Sea Turtles). January 2023. Available: https://www.fisheries.noaa.gov/s3/2023-02/ESA%20all%20species%20threshold%20summary_508_OPR1.pdf. Accessed: March 3, 2023.

National Marine Fisheries Service (NMFS). 2023c. Turtle Excluder Device Regulations. Available: https://www.fisheries.noaa.gov/southeast/bycatch/turtle-excluder-device-regulations. Accessed: March 22, 2023.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2007. *Green Sea Turtle (*Chelonia mydas*) 5-Year Review: Summary and Evaluation*. August.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2013. *Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation*. National Marine Fisheries Service, Office Of Protected Resources, Silver Spring, MD, and U.S. Fish And Wildlife Service, Southeast Region, Jacksonville Ecological Services Office, Jacksonville, FL. November 2013. 93 pp.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2014. Green turtle (Chelonia mydas) Status Review under the U.S. Endangered Species Act. October. Available: https://www.researchgate.net/publication/262262552_Green_turtle_Chelonia_mydas_Status_Review_under_the_US_Endangered_Species_Act.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2015. *Kemp's Ridley Sea Turtle (*Lepidochelys Kempii*) 5-Year Review: Summary and Evaluation*. Silver Spring (MD) and Albuquerque (NM): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Department of the Interior, U.S. Fish and Wildlife Service. 53 pp.

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 2019. *Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*)*. Second revision (2008). Assessment of progress toward recovery. Washington (DC): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Department of the Interior, U.S. Fish and Wildlife Service. 21 pp.

National Ocean Service. 2023. What causes a sea turtle to be born male or female? Available: https://oceanservice.noaa.gov/facts/temperature-dependent.html#:~:text=This%20is%20called%20temperature%2Ddependent,the%20hatchlings%20will%20be%20female. Accessed: March 22, 2023.

National Oceanic and Atmospheric Administration (NOAA). 2021. *Section 7 Effect Analysis: Turbidity in the Greater Atlantic Region*. NOAA Greater Atlantic Regional Fisheries Office. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region. Accessed: December 9, 2021.

National Research Council. 1990. *Decline of the Sea Turtles: Causes and Prevention*. Washington, DC: The National Academies Press. DOI:10.17226/1536.

National Science Foundation (NSF) and U.S. Geological Survey (USGS). 2011. *Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey. Prepared for National Science Foundation and U.S. Geological Survey*. June 2011. 514 pp.

Nelms, S.E., W.E.D. Piniak, C.R. Weir, and B.J. Godley. 2016. Seismic Surveys and Marine Turtles: An Underestimated Global Threat? *Biological Conservation* 193:49–65.

Normandeau Associates Inc. (Normandeau). 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranch and Other Marine Species*. Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region. OCS Study BOEMRE 2011-09.

Northwest Atlantic Leatherback Working Group. 2018. *Northwest Atlantic Leatherback Turtle* (Dermochelys coriacea) *Status Assessment* (Bryan Wallace and Karen Eckert, compilers and editors). Godfrey (IL): Conservation Science Partners and the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). Report No. WIDECAST Technical Report No. 16. 36 pp

Ocean Biodiversity Information System (OBIS). 2021. *OBIS Spatial Ecological Analysis of Megavertebrate Populations (SEAMAP)*. Available: https://seamap.env.duke.edu/. Accessed: November 15, 2021.

Parker, S. 2020. *Loggerhead Sea Turtles Are Nesting in Virginia Beach*. Available: https://www.pilotonline.com/life/wildlife-nature/vp-nw-sea-turtle-nest-0709-20200709-apv3xoqlbnd6ppvtd5h27hu53q-story.html. Accessed: November 15, 2021.

Patel, S.H., M.V. Winton, J.M. Hatch, H.L. Haas, V.S. Saba, G. Fay, and R.J. Smolowitz. 2021. Projected Shifts in Loggerhead Sea Turtle Thermal Habitat in the Northwest Atlantic Ocean Due To Climate Change. *Scientific Reports* 11(1):1–12.

Patrício, A.R., L.A. Hawkes, J.R. Monsinjon, B.J. Godley, and M.M.P.B. Fuentes. 2021. Climate Change and Marine Turtles: Recent Advances and Future Directions. *Endangered Species Research* 44:363–395.

Pezy, J.P., A. Raoux, J.C. Dauvin, and S. Degraer. 2018. An Ecosystem Approach for Studying the Impact of Offshore Wind Farms: A French Case Study. *ICES Journal of Marine Science* 77(3):1238–1246.

Pomeroy, C. 2020. *3 Loggerhead Clutches Hatch on Assateague in Rare Instances of North-of-Virginia Nesting*. Available: https://wjla.com/news/local/third-final-sea-turtle-clutch-hatches-assateague-island. Accessed: November 15, 2021.

Popper, A., A. Hawkins, R. Fay, D. Mann, and D. Bartol. 2014. Sound Exposure Guidelines. Pages 33–51 in *ASA S3/SC14 TR-2014 Sound Exposure Guidelines for Fish and Sea Turtles: A Technical Report prepared by ANSI Accredited Standards Committee S3/SC1 and Registered with ANSI*.

Ramirez, A., C.Y. Kot, Piatkowski, D. 2017. *Review of Sea Turtle Entrainment Risk by Trailing Suction Hopper Dredges in the US Atlantic and Gulf of Mexico and the Development of the ASTER Decision Support Tool.* Sterling (VA): US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-084. 275 pp.

Raoux, A., S. Tecchio, J.P. Pezy, G. Lassalle, S. Degraer, D. Wilhelmsson, M. Cachera, B. Ernande, C. Le Guen, M. Haraldsson, K. Grangeré, F. Le Loc'h, J.C. Dauvin, and N. Niquil. 2017. Benthic and Fish Aggregation Inside an offshore wind farm: Which Effects on the Trophic Web Functioning? *Ecological Indicators* 72:33–46.

RPS. 2021. Dominion Energy Geophysical Survey 2020–2021 *IHA Protected Species Observer Report*. Prepared for Dominion Energy by RPS. November 18, 2021. 802 pp.

Ruppel, C.D., T.C. Weber, E.R. Staaterman, S.J. Labak, and P.E. Hart. 2022. Categorizing Active Marine Acoustic Sources Based on Their Potential to Affect Marine Animals. *Journal of Marine Science and Engineering* 10(9):1–46.

Sapsford, C.W., and M. van der Riet. 1979. Uptake of Solar Radiation by the Sea Turtle, *Caretta caretta,* During Voluntary Surface Basking. *Comparative Biochemistry and Physiology Part A: Physiology* 63(4):471–474.

Schoeman, R.P., C. Patterson-Abrolat, and S. Plön. 2020. A Global Review of Vessel Collisions with Marine Animals. *Frontiers in Marine Science* 7:00292.

Schultze, L., L. Merckelbach, S. Raasch, N. Christiansen, U. Daewel, C. Schrum, and J. Carpenter. 2020. *Turbulence in the Wake of Offshore Wind Farm Foundations and Its Potential Effects on Mixing of Stratified Tidal Shelf Seas*. Presented at Ocean Sciences Meeting 2020, San Diego, CA.

Schuyler, Q.A., C. Wilcox, K. Townsend, B.D. Hardesty, and N.J. Marshall. 2014. Mistaken Identity? Visual Similarities of Marine Debris to Natural Prey Items of Sea Turtles. *BMC Ecology* 14(14). DOI:10.1186/1472-6785-14-14.

Seminoff, J.A., C.D. Allen, G.H. Balazs, P.H. Dutton, T. Eguchi, H. Haas, S.A. Hargrove, M.P. Jensen, D.L. Klemm, and A.M. Lauritsen, et al. 2015. *Status Review of the Green Turtle (*Chelonia mydas*) Under the Endangered Species Act.* La Jolla (CA). Report No. NOAA-TM-NMFS-SWFSC 539. 599 pp.

Shigenaka, G., S. Milton, P. Lutz, R. Hoff, R. Yender, and A. Mearns. 2010. *Oil and Sea Turtles: Biology, Planning, and Response*. Originally published 2003. National Oceanic and Atmospheric Administration Office of Restoration and Response Publication.

Slavik, K., C. Lemmen, W. Zhang, O. Kerimoglu, K. Klingbell, and K.W. Wirtz. 2019. The Large-Scale Impact of Offshore Wind Farm Structures on Pelagic Primary Productivity in the Southern North Sea. *Hydrobiologia* 845:35–53. DOI:10.1007/s10750-018-3653-5.

South Fork Wind. 2021. *South Fork Wind Farm Constructions and Operations Plan*. May.

Stöber, U., and F. Thomsen. 2021. How Could Operational Underwater Sound from Future Offshore Wind Turbines Impact Marine Life? *The Journal of the Acoustical Society of America* 149:1791. DOI:10.1121/10.0003760.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review of Potential Impacts of Submarine Power Cables on the Marine Environment: Knowledge Gaps, Recommendations and Future Directions. *Renewable and Sustainable Energy Reviews* 96:380–391.

Tetra Tech. 2022a. Dominion Coastal Virginia Offshore Wind Commercial Project Request for Rulemaking and Letter of Authorization (LOA) for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0483 and the Associated Offshore Export Cable Route Corridor.

Thomsen, F., A.B. Gill, M. Kosecka, M. Andersson, M. André, S. Degraer, T. Folegot, J. Gabriel, A. Judd, T. Neumann, A. Norro, D. Risch, P. Sigray, D. Wood, and B. Wilson. 2015. *MaRVEN—Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy*. Final study report prepared for the European Commission, Directorate General for Research and Innovation. September 2015. 82 pp.DOI:10.2777/272281.

Tomás, J., R. Guitart, R. Mateo, and J.A. Raga. 2002. Marine Debris Ingestion in Loggerhead Sea Turtles, Caretta, from the Western Mediterranean. *Marine Pollution Bulletin* 44(2002):211–216.

Tougaard, J., O.D. Henriksen, and L.A. Miller. 2009. Underwater Noise from Three Types of Offshore Wind Turbines: Estimation of Impact Zones for Harbor Porpoises and Harbor Seals. *Journal of the Acoustical Society of America* 125(6):3766–3773. DOI:10.1121/1.3117444.

Tougaard, J., L. Hermannsen, and P.T. Madsen. 2020. How Loud is the Underwater Noise from Operating Offshore Wind Turbines? *Journal of the Acoustical Society of America* 148:2885–2892.

Turtle Expert Working Group (TWEG). 2007. *An Assessment of the Leatherback Turtle Population in the Atlantic Ocean.* A report of the Turtle Expert Working Group, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center. April 2007. 124 pp.

U.S. Army Corps of Engineers (USACE). 2020. *South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States*. Available: https://www.fisheries.noaa.gov/content/endangered-species-act-section-7-biological-opinions-southeast. Accessed: November 15, 2021.

U.S. Coast Guard (USCG). 2023. Office of Commercial Vessel Compliance (CG-CVC). Available: https://www.dco.uscg.mil/Our-Organization/Assistant-Commandant-for-Prevention-Policy-CG-5P/Inspections-Compliance-CG-5PC-/Commercial-Vessel-Compliance/Domestic-Compliance-Division/MARPOL/. Accessed: April 27, 2023.

U.S. Department of the Navy. 2018. Final Environmental Impact Statement/Overseas Environmental Impact Statement Atlantic Fleet Training and Testing, Volume I. Prepared for U.S. Department of Commerce, National Marine Fisheries Service by U.S. Department of the Navy, Naval Facilities Engineering Command Atlantic. September 2018. 1020 p.

U.S. Fish and Wildlife Service (USFWS). 2005. Refuge Update. *Newsletter of the National Wildlife Refuge System* 2(6):1–24.

U.S. Fish and Wildlife Service (USFWS). 2012. Sea turtle nests meet Virginia's state record. Available: https://usfwsnortheast.wordpress.com/2012/07/20/sea-turtle-nests-meet-virginias-state-record/. Accessed: April 27, 2023.

U.S. Fish and Wildlife Service (USFWS). 2021. *IPac Information for Planning and Consultation*. Available: https://ecos.fws.gov/ipac/. Accessed: November 15, 2021.

Vegter, A.C., M. Barletta, C. Beck, J. Borrero, H. Burton, M.L. Campbell, M.F. Costa, M. Eriksen, C. Eriksson, A. Estrades, K.V.K. Gilardi, B.D. Hardesty, J.A. Ivar do Sul, J.L. Lavers, B. Lazar, L. Lebreton, W.J. Nichols, C.A. Ribic, P.G. Ryan, Q.A. Schuyler, S.D.A. Smith, H. Takada, K.A. Townsend, C.C.C. Wabnitz, C. Wilcox, L.C. Young, and M. Hamann. 2014. Global Research Priorities to Mitigate Plastic Pollution Impacts on Marine Wildlife. *Endangered Species Research* 25:225–247.

Virginia Department of Conservation and Recreation. 2021. *Department of Conservation and Recreation's Virginia Natural Heritage Data Explorer*. Available: https://www.dcr.virginia.gov/natural-heritage/nhdeinfo. Accessed: November 15, 2021.

Virginia Department of Wildlife Resources. 2021a. *Sea Turtles in Virginia*. Available: https://dwr.virginia.gov/blog/sea-turtles-in-virginia/. Accessed: 15 November 2021.

Virginia Department of Wildlife Resources. 2021b. *Special Status Faunal Species in Virginia*. Available: https://dwr.virginia.gov/wp-content/uploads/media/virginia-threatened-endangered-species.pdf. Accessed: November 15, 2021.

Virginia Institute of Marine Science (VIMS). 2021. *Virginia's Sea Turtles*. Available: https://www.vims.edu/research/units/legacy/sea_turtle/va_sea_turtles/index.php. Accessed: November 15, 2021.

Virginia Institute of Marine Science (VIMS). 2023. Kemp's Ridley Sea Turtle. Available: https://www.vims.edu/research/units/legacy/sea_turtle/va_sea_turtles/kemps_ridley.php. Accessed: March 30, 2023.

Virginia State Parks. 2012. Rare Kemp's Ridley Sea Turtle Nest at False Cape. Available: https://vastateparks.tumblr.com/post/94010576113/rare-kemps-ridley-sea-turtle-nest-at-false-cape/amp. Accessed: April 27, 2023.

Wang, J., Zou, X., Yu, W., Zhang, D., Wang, T. 2019. Effects of established offshore wind farms on energy flow of coastal ecosystems: A case study of the Rudong offshore wind farms in China. April. Available: https://www.sciencedirect.com/science/article/abs/pii/S0964569118306483.

Weir, C.R. 2007. Observations of Marine Turtles in Relation to Seismic Airgun Sound off Angola. *Marine Turtle Newsletter* 116:17.

Wollam, M. 2023. Sea turtle nesting season on Dam Neck Annex. By Petty Officer 2nd Class Megan Wollam Naval Air Station Oceana. Available: https://www.militarynews.com/norfolk-navy-flagship/news/top_stories/sea-turtle-nesting-season-on-dam-neck-annex/article_6217bd30-107a-11ee-b991-438c640daf5b.html. Accessed: July 13, 2023.

Wright, M. 2015. First Kemp's Ridley Sea Turtle Nests at Dam Neck Annex. *Currents* pp. 66–70.

C.1.3.20. Section 3.20, Scenic and Visual Resources

Bureau of Ocean Energy Management (BOEM). 2021. *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States*. OCS Study BOEM 2021-032. April.

Bureau of Ocean Energy Management (BOEM). 2022. *Coastal Virginia Offshore Wind Commercial Biological Assessment for the United States Fish and Wildlife Service*. December. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/CVOW-C%20USFWS%20BA.pdf.

Dominion Energy, Inc. (Dominion Energy). 2022. *Coastal Virginia Offshore Wind Commercial Project Cumulative Visual Effects Simulations*. November.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Landscape Institute and Institute of Environmental Management and Assessment. 2016. *Guidelines for Landscape and Visual Assessment 3rd Edition*. Spon Press.

C.1.3.21. Section 3.21, Water Quality

Bejarano, A.C., J. Michel, J. Rowe, Z. Li, D. French McCay, L. McStay, and D.S. Etkin. 2013. *Environmental Risks, Fate and Effects of Chemicals Associated with Wind Turbines on the Atlantic Outer Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Herndon, VA. OCS Study BOEM 2013-213.

Bureau of Ocean and Energy Management. (BOEM). 2018. *Field Observations During Wind Turbine Foundation Installation at the Block Island Wind Farm, Rhode Island*. Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management (BOEM). 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study BOEM 2019-036. May 2019.

Bureau of Ocean and Energy Management (BOEM). 2021. *Hydrodynamic Modeling, Particle Tracking and Agent-Based Modeling of Larvae in the U.S. Mid-Atlantic Bight*. OCE Study, BOEM 2021-049. Available: https://espis.boem.gov/final%20reports/BOEM_2021-049.pdf.

Bureau of Ocean Energy Management (BOEM) and Dominion Energy. 2022. Revised Project Design Information Submitted to BOEM.

Carpenter, J.R., L. Merckelbach, U. Callies, S. Clark, L. Gaslikova, and B. Baschek. 2016. Potential Impacts of Offshore Wind Farms on North Sea Stratification. *PLoS ONE* 11(8):e0160830.

Castelao, R., S. Glenn, and O. Schofield. 2010. Temperature, Salinity, and Density Variability in the Central Middle Atlantic Bight. *Journal of Geophysical Research* 115:C10005. Available: https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2009JC006082. Accessed: December 8, 2020.

Cazenave, P.W., R. Torres, and J.I. Alen. 2016. Unstructured Grid Modelling of Offshore Wind Farm Impacts on Seasonally Stratified Shelf Seas. *Progress in Oceanography* 145(2016) 25–41.

Center for Coastal Studies (CCS). 2017. *Water Quality Parameters.* Available: http://coastalstudies.org/cape-cod-bay-monitoring-program/monitoring-stations/.. Accessed: June 18, 2018.

City of Chesapeake. 2007. *Map Showing Master Drainage 2005*. November 7. Available: https://www.cityofchesapeake.net/Assets/documents/departments/public_works/watershed/pdf/MasterDrainageMap-11-7-07.pdf. Accessed: December 8, 2020.

City of Virginia Beach. 2018. *Water Resources in the Southern Watershed of Virginia Beach*. VB SeaLevel Wise: A Vibrant Future for Virginia Beach. 127 pp. Available: https://www.vbgov.com/government/departments/public-works/comp-sea-level-rise/Documents/water-resources-south-wshed-4-2-18-a.pdf. Accessed: November 24, 2020

Csanady, G.T., and P. Hamilton. 1988. Circulation of Slopewater. *Continental Shelf Research* 8(5-7):565–624.

Department of Energy (DOE). 2014. *Assessment of Ports for Offshore Wind Development in the United States*. March 2014. 700694-USPO-R-03.

DNV GL. 2016. *Support Structures for Wind Turbines*. DNVGL-ST-0126. April 2016.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Epsilon Associates, Inc. 2018. Draft Construction and Operations Plan Vineyard Wind Farm Appendix Volume III-K Scour Potential Evaluation at Vineyard Wind. Submitted to BOEM. October 22.

Floeter, J., J. E. E. van Beusekom, D. Auch, U. Callies, J. Carpenter, T. Dudeck, et al. 2017. Pelagic Effects of Offshore Wind Farm Foundations in the Stratified North Sea. *Prog. Oceanography* 156:154–173. DOI:10.1016/j.pocean.2017.07.003.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas*. Sterling, VA. US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088. December 2017. Available: https://tethys.pnnl.gov/publications/habitat-mapping-assessment-northeast-wind-energy-areas. Accessed: December 8, 2020.

Harris, J.M., R.J.S. Whitehouse, and J. Sutherland. 2011. *Marine Scour and Offshore Wind – Lessons Learnt and Future Challenges.* In Proceedings of the AMSE 2011 20th International Conference of Ocean, Offshore and Arctic Engineering, OMAE2011, June 19-24, 2011, Rotterdam, The Netherlands.

Kaplan, B. (ed). 2011. *Literature Synthesis for the North and Central Atlantic Ocean*. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study BOEMRE 2011-012. Available: https://www.boem.gov/ESPIS/5/5139.pdf. Accessed: October 30, 2018.

Kirchgeorg, T., I. Weingberg, M. Hornig, R. Baier, M.J. Schmid, and B. Brockmeyer. 2018. Emissions from Corrosion Protection Systems of Offshore Wind Farms: Evaluation of the Potential Impact on the Marine Environment. *Marine Pollution Bulletin* 136:257–268.

Avangrid Renewables. 2021. *Kitty Hawk Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Latham, P., W. Fiore, M. Bauman, and J. Weaver. 2017. *Effects Matrix for Evaluating Potential Impacts of Offshore Wind Energy Development on U.S. Atlantic Coastal Habitats.* Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2017-014. Available: https://www.boem.gov/Effects-Matrix-Evaluating-Potential-Impacts-of-Offshore-Wind-Energy-Development-on-US-Atlantic-Coastal-Habitats/. Accessed: October 30, 2018.

Li, X., L. Chi, X. Chen, Y. Ren, and S. Lehner. 2014. SAR Observation and Numerical Modeling of Tidal Current Wakes at the East China Sea Offshore Wind Farm. *Journal of Geophysical Research: Oceans* 119(8):4958–4971.

National Oceanic and Atmospheric Administration. (NOAA). n.d. *NWA Regional Climatology*. National Oceanic and Atmospheric Administration, National Centers for Environmental Information. Available: https://www.nodc.noaa.gov/OC5/regional_climate/nwa-climate/. Accessed: September 22, 2020.

National Oceanic and Atmospheric Administration (NOAA). 2018. *NOAA Deep Sea Coral Data Portal*. Available: http://deepseacoraldata.noaa.gov.. Accessed: August 2, 2018.

National Water Quality Monitoring Council. (NWQMC). 2020. *Camp Pendleton (VA514504) Site Data in the Water Quality Portal.* Available: https://www.waterqualitydata.us/portal/#siteid=21VABCH-VA514504&mimeType=csv. Accessed: October 2, 2020.

Nielsen, A.W., B.M. Sumer, and T.U. Peterson. 2014. Sinking of Scour Protections at Horns Rev 1 Offshore Wind Farm. *Coastal Engineering Proceedings* 1(34):67. DOI:10.9753/icce.v34.sediment.67.

Peterson, T.U. 2014. *Scour around Offshore Wind Turbine Foundations.* Technical University of Denmark. Department of Mechanical Engineering.

Schultze, L.K.P., L.M. Merckelbach, J. Horstmann, S. Raasch, and J.R. Carpenter. 2020. Increased Mixing and Turbulence in the Wake of Offshore Wind Farm Foundations. *J. Geophys. Res. Oceans* 125:e2019JC015858. DOI:10.1029/2019JC015858.

Segtnan, O.H., and K. Christakos. 2015. *Effect of Offshore Wind Farm Design on the Vertical Motion of the Ocean*. 12th Deep Sea Offshore Wind R&D Conference, EERA DeepWind 2015. Energy Procedia 80 (2015) 213–222.

Siudyla, E.A., A. May, and D. Hawthorne. 1981. *Groundwater Resources of the Four Cities Area, Virginia*. Planning Bulletin 331. Commonwealth of Virginia State Water Control Board Bureau of Water Control Management.

Stevenson D., L. Chiarella, D. Stephan, R. Reid, K. Wilhelm, J. McCarthy, and M. Pentony. 2004. *Characterization of the Fishing Practices and Marine Benthic Ecosystems of the Northeast US Shelf and an Evaluation of the Potential Effects of Fishing on Essential Habitat*. NOAA Tech Memo NMFS NE 181; 179 pp.

Tempel, J., M.B. Zaaijer, and H. Subroto. 2004. *The Effects of Scour on the Design of Offshore Wind Turbines.* Delft University of Technology, The Netherlands.

Tetra Tech, Inc. 2010. *Final Site Inspection for the Battlefield Golf Club Site City of Chesapeake, Virginia.*

Tetra Tech, Inc. 2015a. *Stream and Pond Assessment Surveys for Naval Air Station Oceana (NASO). Final Report.* Prepared for NAVFAC Mid-Atlantic. 102 pp.

Tetra Tech, Inc. 2015b. *Stream Assessment Surveys for Naval Auxiliary Landing Field Fentress (NALFF). Final Report*. Prepared for NAVFAC Mid-Atlantic. 206 pp.

URS Corporation. 2009. *Battlefield Golf Water Project. Water Supply Feasibility Study*.

U.S. Army Corps of Engineers (USACE). 2022. Norfolk District Public Notice for Permit NAO-13-00418; Coastal Virginia Offshore Wind (CVOW) Commercial Project. September 15. Available: https://www.nao.usace.army.mil/Media/News-Stories/Article/3157796/nao-13-00418-coastal-virginia-offshore-wind-cvow-commercial-project/.

U.S. Environmental Protection Agency (USEPA). 2000. *Ambient Aquatic Life Water Quality Criteria for Dissolved Oxygen (Saltwater): Cape Cod to Cape Hatteras*. Office of Water. EPA-822-R-00-012. Available: https://nepis.epa.gov/Exe/ZyPDF.cgi/20003HYA.PDF?Dockey=20003HYA.PDF. Accessed: November 8, 2018.

U.S. Environmental Protection Agency (USEPA). 2012. *National Coastal Condition Report IV. EPA842-R-10-003*. United States Environmental Protection Agency, Washington, D.C. 368 pp. Available: https://www.epa.gov/sites/production/files/2016-01/documents/ncca_2010_technical_report_20160127.pdf. Accessed: December 8, 2020.

U.S. Environmental Protection Agency (USEPA). 2015. *National Coastal Condition Assessment 2010*. Office of Water and Office of Research and Development. EPA 841-R-15-006. Available: https://www.epa.gov/sites/production/files/2016-01/documents/ncca_2010_report.pdf. Accessed: October 30, 2018.

U.S. Environmental Protection Agency (USEPA). 2016. *National Coastal Condition Assessment 2010* (data and metadata files). National Aquatic Resource Surveys. United States Environmental Protection Agency, Washington, D.C. Available: https://www.epa.gov/national-aquatic-resource-surveys/data-national-aquatic-resource-surveys. Accessed: October 6, 2020.

Van Berkel, J., H. Burchard, A. Christensen, L. O. Mortensen, O. S. Petersen, and F. Thomsen. 2020. *The effects of offshore wind farms on hydrodynamics and implications for fishes*. *Oceanography* 33:108–117.

Vanhellemont, Q., and K. Ruddick. 2014. *Turbid Wakes Associated with Offshore Wind Turbines Observed with Landsat 8*. Remote Sensing of Environment 145:105–115

Virginia Department of Environmental Quality (VDEQ). 2020a. *Annual Water Quality Monitoring Plan.* Virginia Department of Environmental Quality. Available: https://www.deq.virginia.gov/programs/water/waterqualityinformationtmdls/waterqualitymonitoring/annualwaterqualitymonitoringplan.aspx. Accessed: October 6, 2020.

Virginia Department of Environmental Quality (VDEQ). 2020b. *Bacteria Criteria for the Protection of Recreational Uses – 2019*. Virginia Department of Environmental Quality Available: https://www.deq.virginia.gov/programs/water/waterqualityinformationtmdls.

Virginia Department of Environmental Quality (VDEQ). 2020c. 2020 305(b)/303(d) *Water Quality Assessment Integrated Report* [also see Appendix 1a of the report for official 303(d) impaired waters list]. Virginia Department of Environmental Quality. Available: https://www.deq.virginia.gov/water/water-quality/assessments/integrated-report. Accessed: October 5, 2021.

Virginia Department of Environmental Quality (VDEQ). 2021. *Rivers, Reservoirs, Estuaries: 2020 Final WQA IR Assessment GIS Data*.

Virginia Department of Health. (VDH). 2020a. *Monitoring and Advisory Data by Year - 2019 Monitoring Data*. Virginia Department of Health. Available: https://www.vdh.virginia.gov/environmental-epidemiology/beach-monitoring/monitoring-and-advisory-data-by-year/. Accessed: October 5, 2020.

Virginia Department of Health. (VDH). 2020b. *Algal Bloom Surveillance Map.* Virginia Department of Health. Available: https://www.vdh.virginia.gov/waterborne-hazards-control/algal-bloom-surveillance-map/.. Accessed: December 8, 2020.

Whitehouse, R.J.S, J.M. Harris, J. Sutherland, and J. Rees. 2011. The Nature of Scour Development and Scour Protection at Offshore Windfarm Foundations. *Marine Pollution Bulletin* 62(1):73–88.

Wilkin, J.L., and E.J. Hunter. 2013. An Assessment of the Skill of Real-Time Models of Mid-Atlantic Bight Continental Shelf Circulation. *Journal of Geophysical Research: Oceans* 118(6):2919–2933.

C.1.3.22. Section 3.22, Wetlands

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Kitty Hawk Wind North. 2021. *Kitty Hawk Offshore Construction and Operations Plan*. Prepared by Tetra Tech, Inc. November.

Kitty Hawk Wind South. 2022. *Kitty Hawk Offshore Construction and Operations Plan.* Prepared by Tetra Tech, Inc. April.

U.S. Fish and Wildlife Service (USFWS). 2021. *National Wetlands Inventory*. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. Updated May 3, 2021. Available: http://www.fws.gov/wetlands/.. Accessed: December 1, 2021.

Virginia Department of Conservation and Recreation (VDCR). 2022. *Rare Species and Natural Communities*. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Available: https://www.dcr.virginia.gov/natural-heritage/rare-species-com. Accessed: March 5, 2022.

C.2. Glossary

Term	Definition
affected environment	Environment as it exists today that could be affected by the proposed Project
algal blooms	Rapid growth of the population of algae, also known as algae bloom
allision	A moving ship running into a stationary ship
anthropogenic	Generated by human activity
Applicant Proposed Measure (APM)	Applicant proposed measures to avoid, minimize, and mitigate potential impacts
archaeological resource	Historical place, site, building, shipwreck, or other archaeological site on the landscape
below grade	Below ground level
benthic	Related to the bottom of a body of water
benthic resources	The seafloor surface, the substrate itself, and the communities of bottom-dwelling organisms that live within these habitats
cable landing location	Location where the offshore export cable transitions to the onshore export cable
Cetacea	Order of aquatic mammals made up of whales, dolphins, porpoises, and related lifeforms
coastal habitat	Coastal areas where flora and fauna live, including salt marshes and aquatic habitats
coastal waters	Waters in nearshore areas where bottom depth is less than 98.4 feet (30 meters)
coastal zone	The lands and waters starting at 3 nautical miles from the land and ending at the first major land transportation route
commercial fisheries	Areas or entities raising and catching fish for commercial profit
commercial-scale wind energy facility	Wind energy facility usually greater than 1 MW that sells the produced electricity
criteria pollutant	One of six common air pollutants for which USEPA sets NAAQS: CO, lead, NO_2, ozone, particulate matter, or SO_2
critical habitat	Geographic area containing features essential to the conservation of threated or endangered species
cultural resource	Historical districts, objects, places, sites, buildings, shipwrecks, and archaeological sites on the American landscape, as well as sites of traditional, religious, or cultural significance to cultural groups, including Native American tribes
culvert	A structure, usually a tunnel, allowing water to flow under an obstruction (e.g., road, trail)
cumulative impacts	Impacts that could result from the incremental impact of a specific action, such as the proposed Project, when combined with other past, present, or reasonably foreseeable future actions or other projects; can occur from individually minor, but collectively significant actions that take place over time
demersal	Living close to the ocean floor
design envelope	The range of proposed Project characteristics defined by the applicant and used by BOEM for purposes of environmental review and permitting

Term	Definition
dredging	Removal of sediments and debris from the bottom of lakes, rivers, harbors, and other waterbodies
duct bank	Underground structure that houses the onshore export cables, which consists of polyvinyl chloride pipes encased in concrete
ecosystem	Community of interacting living organisms and nonliving components (such as air, water, soil)
electromagnetic field	A field of force produced by electrically charged objects and containing both electric and magnetic components
embayment	Recessed part of a shoreline
endangered species	A species that is in danger of extinction in all or a significant portion of its range
Endangered Species Act-listed species	Species listed under the ESA of 1973 (as amended)
environmental protection measure	Measure proposed to avoid or minimize potential impacts
ensonification	The process of filling with sound
environmental consequences	The potential direct, indirect, and cumulative impacts that the construction, O&M, and decommissioning of the proposed Project would have on the environment
environmental justice communities	Minority and low-income populations affected by the proposed Project
epifauna	Fauna that lives on the surface of a seabed (or riverbed), or is attached to underwater objects or aquatic plants or animals
essential fish habitat	Those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (50 CFR 600)
export cables	Cables connecting the wind facility to the onshore electrical grid power
export cable corridor	Area identified for routing the entire length of the onshore and offshore export cables
federal aids to navigation	Visual references operated and maintained by USCG, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation
finfish	Vertebrate and cartilaginous fishery species, not including crustaceans, cephalopods, or other mollusks
for-hire commercial fishing	Commercial fishing on a for-hire vessel (i.e., a vessel on which the passengers make a contribution to a person having an interest in the vessel in exchange for carriage)
for-hire recreational fishing	Fishing from a vessel carrying a passenger for hire who is engaged in recreational fishing
foundation	The bases to which the WTGs and OSS are installed on the seabed. Three types of foundations have been considered and reviewed for the Project: jacket, monopile, or gravity-based structure.
geomagnetic	Relating to the magnetism of Earth
hard-bottom habitat	Benthic habitats composed of hard-bottom (e.g., cobble, rock, and ledge) substrates

Term	Definition
historic property	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource
historical resource	Prehistoric or historic district, site, building, structure, or object that is eligible for or already listed in the NRHP; also includes any artifacts, records, and remains (surface or subsurface) related to and located within such a resource
horizontal directional drilling	Trenchless technique for installing underground cables, pipes, and conduits using a surface-launched drilling rig
hull	Watertight frame or body of a ship
infauna	Fauna living in the sediments of the ocean floor (or river or lake beds)
inter-array cables	Cables connecting the wind turbine generators to the electrical service platforms
interconnection cables	Cables connecting from the switching station to the onshore substation; interconnection cables would be installed as either all overhead or a combination of overhead and underground (hybrid)
inter-link cables	Cables connecting the electrical service platforms to one another
invertebrate	Animal with no backbone
jacket foundation	Latticed steel frame with three or four supporting piles driven into the seabed
jack-up vessel	Mobile and self-elevating platform with buoyant hull
jet excavation	Process of moving or removing soil with a jet
jet plowing	Plowing in which the jet plow, with an adjustable blade, or plow rests on the seafloor and is towed by a surface vessel; the jet plow creates a narrow trench at the designated depth, while water jets fluidize the sediment within the trench; in the case of the proposed Project, the cables would then be feed through the plow and laid into the trench as it moves forward; the fluidized sediments then settle back down into the trench and bury the cable
jointing bay	Provides a clean dry environmental for jointing the offshore and onshore cables and provides protection to the cable jointing during operation
knot	Unit of speed equaling 1 nm per hour
landfall site	The shoreline landing site at which the offshore cable transitions to onshore
Lease Area	Commercial Lease of Submerged Lands for Renewable Energy Development on the OCS Offshore Virginia, Lease number OCS-A-0483 Approximately 112,799 acres. Approximately 27 statute miles (23.75 nautical miles) off Virginia Beach.
marine mammal	Aquatic vertebrate distinguished by the presence of mammary glands, hair, three middle ear bones, and a neocortex (a region of the brain)
marine waters	Waters in offshore areas where bottom depth is more than 98.4 feet (30 meters)
mechanical cutter	Method of submarine cable installation equipment that involves a cutting wheel or excavation chain to cut a narrow trench into the seabed allowing the cable to sink under its own weight or be pushed to the bottom of the trench via a cable depressor

Term	Definition
mechanical plow	Method of submarine cable installation equipment that involves pulling a plow along the cable route to lay and bury the cable. The plow's share cuts into the soil, opening a temporary trench, which is held open by the side walls of the share, while the cable is lowered to the base of the trench via a depressor. Some plows may use additional jets to fluidize the soil in front of the share.
monopile or monopile foundation	A long steel tube driven into the seabed that supports a tower
nautical mile	A unit used to measure sea distances and equivalent to approximately 1.15 miles (1.85 kilometers)
offshore export cable	Cables that transfer electricity from the offshore substations to the cable landing location
offshore infrastructure	Turbines, offshore substations, and inter-array and offshore export cables
offshore Project area	Lease Area and offshore export cable corridors
offshore substation (OSS)	The interconnection point between the WTGs and the export cable; the necessary electrical equipment needed to connect the inter-array cables to the offshore export cables
onshore export cable	Underground cables that transfer electricity from the cable landing location to the onshore substation
onshore Project area	Onshore Project components including cable landing locations, onshore export cable corridors, onshore substation, switching station, and interconnection cables and cable routes
onshore substation	Substation connecting the proposed Project to the existing bulk power grid system
operations and maintenance facilities	Would include offices, control rooms, warehouses, shop space, and pier space
Outer Continental Shelf	All submerged land, subsoil, and seabed belonging to the United States but outside of states' jurisdiction
pile	A type a foundation akin to a pole
pile driving	Installing foundation piles by driving them into the seafloor
pinnipeds	Carnivorous, semiaquatic marine mammals with fins, also known as seals
pin pile	Small-diameter pipe driven into the ground as foundation support
plume	Column of fluid moving through another fluid
private aids to navigation	Visual references on structures positioned in or near navigable waters of the United States, including radar transponders, lights, sound signals, buoys, and lighthouses, that support safe maritime navigation; permits for the aids are administered by USCG
Project area	The combined onshore and offshore area where proposed Project components would be located
Project Design Envelope (PDE)	The PDE identifies a reasonable range of design parameters for proposed components and installation techniques for the Project
protected species	Endangered or threatened species that receive federal protection under the ESA of 1973 (as amended)
SCADA system	Supervisory Control and Data Acquisition system
scour protection	Protection consisting of rock and stone that would be placed around all foundations to stabilize the seabed near the foundations as well as the foundations themselves

Term	Definition
scrublands	Plant community dominated by shrubs and often also including grasses and herbs
sessile	Attached directly by the base
silt substrate	Substrate made of a granular material originating from quartz and feldspar, and whose size is between sand and clay
soft-bottom habitat	Benthic habitats include soft-bottom (i.e., unconsolidated sediments) and hard-bottom (e.g., cobble, rock, ledge) substrates, as well as biogenic habitat (e.g., eelgrass, mussel beds, worm tubes) created by structure-forming species
substrate	Earthy material at the bottom of a marine habitat; the natural environment that an organism lives in
suspended sediments	Very fine soil particles that remain in suspension in water for a considerable period of time without contact with the bottom; such material remains in suspension due to the upward components of turbulence and currents, or by suspension
switching station	Aboveground onshore facility that collects power and converts an underground onshore export cable configuration to an overhead interconnection cable configuration
threatened species	A species that is likely to become endangered within the foreseeable future
tidal energy project	Project related to the conversion of the energy of tides into usable energy, usually electricity
tidal flushing	Replacement of water in an estuary or bay because of tidal flow
trawl	A large fishing net dragged by a vessel at the bottom or in the middle of sea or lake water
turbidity	A measure of water clarity
utility right-of-way	Registered easement on private land that allows utility companies to access the utilities or services located there
vibracore	Technology/technique for collecting core samples of underwater sediments and wetland soils
viewshed	Area visible from a specific location
visual resource	The visible physical features on a landscape, including natural elements such as topography, landforms, water, vegetation, and manmade structures
wetland	Land saturated with water; marshes; swamps
wind energy	Electricity from naturally occurring wind
wind energy area	Areas with significant wind energy potential and defined by BOEM
wind turbine generator (WTG)	Component that puts out electricity in a structure that converts kinetic energy from wind into electricity

Appendix D. Analysis of Incomplete or Unavailable Information

In accordance with Section 1502.21 of the Council on Environmental Quality (CEQ) regulations implementing the National Environmental Policy Act (NEPA), when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an Environmental Impact Statement (EIS) and when information is incomplete or unavailable, the agency shall make clear that such information is lacking. When incomplete or unavailable information was identified, the U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM) considered whether the information was relevant to the assessment of impacts and essential to its analysis of alternatives based upon the resource analyzed. If essential to a reasoned choice among the alternatives, BOEM considered whether it was possible to obtain the information and if the cost of obtaining it was exorbitant. If it could not be obtained or if the cost of obtaining it was exorbitant, BOEM applied acceptable scientific methodologies to inform the analysis in light of this incomplete or unavailable information. For example, conclusive information on many impacts of the offshore wind industry may not be available for years, and certainly not within the contemplated timeframe of this NEPA process. In its place, subject matter experts have used the scientifically credible information available and generally accepted scientific methodologies to evaluate impacts on the resources while this information is unavailable.

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

D.1.1 Air Quality

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

D.1.2 Bats

Habitat use and distribution varies between season and species, and, as a result, there will always be some level of incomplete information on the distribution and habitat use of bats in both the onshore and offshore portions of the analysis area. Additionally, there is some level of uncertainty regarding the potential collision risk to individual bats that may be present within the offshore portions of the analysis area, as the U.S offshore wind is a new industry with only two offshore wind projects having been constructed at the time of this analysis. However, sufficient information on collision risk to bats observed at land-based U.S. wind projects exists, and it was used along with empirical data, including regional bat acoustic studies conducted from coastal, island, vessel, or offshore structure locations and regional telemetry data from recent studies focusing on listed species, to assess the likelihood of offshore occurrence, seasonal patterns, and bat species composition (Construction and Operations Plan [COP], Appendix O; Dominion Energy 2023). Dominion Energy is conducting Acoustic Thermographic Offshore Monitoring of birds and bats as part of the CVOW-Pilot Project adjacent to the commercial lease area to advance the understanding of avian and bat activity offshore. As described in Section 3.5 of the EIS, the likelihood of an individual bat encountering an operating wind turbine generator (WTG) during migration is low; therefore, the differences among action alternatives with respect to bats for the Project are expected to be small. Dominion Energy has consulted with state and federal agencies and conducted presence/absence surveys (mist-net) for bats along portions of the Interconnection Cable Route Alternatives that will require tree removal beginning in May 2022 to better understand bat presence in the Onshore Project Area (COP, Appendix O-3; Dominion Energy 2023). As such, the analysis provided in the Final EIS is sufficient to support sound scientific judgments and informed decision-making related to the distribution and use of the onshore and offshore portions of the analysis area, as well as to the potential for collision risk of bats. Therefore, in light of the data currently being collected and data planned to be collected, BOEM does not believe that there is incomplete or unavailable information on bat resources that is essential to a reasoned choice among alternatives.

D.1.3 Benthic Resources

Although there is uncertainty regarding the spatial and temporal distribution of benthic (faunal) resources and periods during which they might be especially vulnerable to disturbance, Dominion's surveys of benthic resources and BOEM studies (COP, Appendix D, Dominion Energy 2023; BOEM 2012; BOEM 2015) provided a suitable basis for generally predicting the species, abundances, and distributions of benthic resources within the geographic analysis area. Uncertainty also exists regarding the impact of some impact-producing factors (IPFs) on benthic resources. For example, specific stimulus-response related to acoustics and electromagnetic fields (EMFs) is not well studied, although there is some information from benthic monitoring at the Block Island Wind Farm and other studies (Hutchinson et al. 2018; PNNL 2013; Love et al. 2015, 2016) that allows for a broad understanding of the impacts. Similarly, specific secondary impacts, such as changes in diets throughout the food chain resulting from habitat modification and synergistic behavioral impacts from multiple IPFs, are not fully known. Again, results of benthic monitoring at the Block Island Wind Farm provide general knowledge of the overall impacts of these IPFs combined, if not individually. Therefore, the analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making related to the overall impacts. For these reasons, BOEM does not believe that there is incomplete or unavailable information on benthic resources that is essential to a reasoned choice among alternatives.

D.1.4 Birds

There is incomplete information on the exact migratory routes of passerines and shore birds that fly over the Atlantic Outer Continental Shelf (OCS) (including those that fly at night) where some may fly overland or along the coast before crossing the ocean. In addition, there will always be some level of incomplete information on the distribution and habitat use of marine birds in the offshore portions of the analysis area, as habitat use and distribution varies between season, species, and years. However, a risk assessment framework was used to quantitatively evaluate adverse impacts of the Project on bird resources in the geographic analysis area (Section 3.7 of the EIS). The risk assessment utilized a weight-of-evidence approach and combined an assessment of exposure and behavioral vulnerability (including both displacement and collision) within the context of the literature to establish potential risk (COP, Appendix O-1; Dominion Energy 2023). In addition, because U.S. offshore wind is a new industry, as described above for bats, there will be some level of uncertainty regarding the potential for collision risk and avoidance behaviors for some of the bird species that may be present within the offshore portions of the analysis area until information can be gained from operational projects.

Similarly, the U.S. Fish and Wildlife Service (USFWS) Biological Assessment (BA) (BOEM 2022) also provides a qualitative analysis of collision risk for the Project because relatively few individual birds from each of the listed species are likely (if at all) to enter into the proposed wind farm. Further, sufficient information on collision risk and avoidance behaviors observed in related species at European offshore wind projects is available and was used to analyze and corroborate the potential for these impacts as a result of the proposed Project (e.g., Petersen et al. 2006; Skov et al. 2018; COP, Appendix O-1;

Dominion Energy 2023). As such, the analysis provided in the EIS is sufficient to support sound scientific judgments and informed decision-making related to distribution and use of the offshore portions of the analysis area as well as to the potential for collision risk and avoidance behaviors in bird resources. Further, the similarity between the WTG layouts analyzed for the different alternatives does not render any of this incomplete and unavailable information essential to a reasoned choice among alternatives. Therefore, BOEM does not believe that there is incomplete or unavailable information on avian resources that is essential to a reasoned choice among alternatives.

D.1.5 Coastal Habitat and Fauna

Although the preferred habitats of terrestrial and coastal fauna are generally known, specific data on abundances and distributions within the geographic analysis area of various fauna within these habitats are likely to remain unknown without site-specific surveys. However, the species inventories and other general information about the area provide an adequate basis for evaluating the fauna likely to inhabit the onshore geographic analysis area. Additionally, the onshore activities proposed involve only common, industry-standard activities for which impacts are generally understood. Therefore, BOEM believes that the analysis provided in Section 3.8 of the EIS is sufficient to make a reasoned choice among the alternatives.

D.1.6 Commercial Fisheries and For-Hire Recreational Fishing

Fisheries are managed using a number of assumptions due to a partial understanding of fish stock dynamics and effects of environmental factors on fish populations. The commercial fisheries information used in this assessment has additional limitations including, but not limited to, reliance on self-reported fishery-dependent data and lack of economic baseline data. Vessel trip report data only provide an approximation because this information is self-reported and may not account for all trips. Available historical fisheries data lack consistency, making comparisons challenging. However, these data represent the best available data, and, in combination with other fisheries-dependent and independent data, sufficient information exists to support the findings presented in this EIS.

Recent annual revenue exposed for for-hire recreational fishing deriving directly from the Lease Area is also not currently available, although the majority of effort is centered around the triangle reefs area. The economic analysis conducted by BOEM of recreational for-hire boats, as well as for-hire and private-boat angler trips that might be affected by the overall Virginia Wind Energy Area (WEA), including the Lease Area, was conducted for 2007–2012 (Kirkpatrick et al. 2017). Although these data are presented in the COP and used for impact determinations in Section 3.9 of the EIS, updated data for the period of 2013 to the present are not explicitly available for the Lease Area. Using this study, coupled with recreational fishing surveys (e.g., the National Oceanic and Atmospheric Administration's [NOAA] Marine Recreational Information Program), BOEM does not believe that there is incomplete or unavailable information on commercial fisheries and for-hire recreational fishing resources that is essential to a reasoned choice among alternatives.

D.1.7 Cultural Resources

BOEM requires detailed information regarding the nature and location of historic properties that may be affected by an applicant's proposed activity in order to conduct review of the COP under Section 106 of National Historic Preservation Act (NHPA) (54 United States Code 306108; BOEM 2020). The assessment of effects from the proposed Project on historic properties is reliant on the identification and analysis of cultural resources in the geographic area in which these activities are proposed to take place (referred to as the *area of potential effects* [APE]). BOEM has determined there is sufficient information on cultural resources in the geographic analysis area and APE for the proposed Project that allows for the assessment of impacts, analysis and comparison of alternatives, and completion of a determination of effects on historic properties and to support a reasoned choice among alternatives.

D.1.8 Demographics, Employment, and Economics

There is some incomplete information relating to future offshore wind activities in the geographic analysis area, specifically for the number of WTGs and foundations, area of seafloor disturbance, and construction timeline. Best estimates or placeholders have been used for the current analysis; however, this missing information is not related to the Proposed Action. Therefore, BOEM does not believe that there is specific incomplete or unavailable information on demographics, employment, and economics that is essential to a reasoned choice among alternatives.

D.1.9 Environmental Justice

Evaluations of impacts on environmental justice communities rely on the assessment of impacts on other resources. As a result, incomplete or unavailable information related to other resources, such as visual and scenic resources, as described in this document, also affect the completeness of the analysis of impacts on environmental justice communities. For these reasons, BOEM does not believe that there is incomplete or unavailable data for environmental justice that is essential to a reasoned choice among alternatives.

D.1.10 Finfish, Invertebrates, and Essential Fish Habitat

Assessing and predicting the temporal and spatial distribution and abundance of marine motile finfish or invertebrates within an area as large as the proposed CVOW-C Lease Area will lead to some unexplained variability. Using resource survey data collected within the Lease Area (Dominion Energy 2023), BOEM (2012, 2014, and 2015) assessments, and inter-agency broad-scale monitoring studies (Guida et al. 2017) have furnished a sufficient basis to assess and predict the finfish and invertebrate resources within the geographic analysis area. Information outlining the Endangered Species Act (ESA)-listed species, Essential Fish Habitat (EFH), and Habitats Areas of Particular Concern (HAPCs) will support the EIS in the BA and EFH Assessments. The Final EIS and EFH Assessment do not include or provide impact estimates per specific EFH features of concern (e.g., sand waves, megaripples, trough habitat, and isolated mud and gravel). Estimates for these benthic habitat features should be provided in the Final EIS and EFH assessments. Impacts on the ESA and EFH managed species should not be affected in a greater or lesser manner for the finfish or invertebrates discussed in the EIS. Specific impact discussions for the ESA and EFH species are provided in the BA and EFH Assessments (BOEM 2022).

The effects of EMF and noise such as pile driving on invertebrates is not well documented. There are limited studies or data regarding how energy expenditure of EMF sensitive species may be affected by multiple EMF encounters and if cumulative impacts may alter growth and reproduction. However, there are studies regarding EMF impacts on fish and invertebrates. The effects of sound and the thresholds of exposure have not been defined for fish and invertebrate juvenile and larvae stages as they have for adult finfish (Hawkins and Popper 2017; Weilgart 2018). The available studies concerning sound impacts related to pile driving specifically have been performed in test tanks and not in natural conditions, leaving some ambiguity as to the exact effect of noise impacts on the behavior of finfish invertebrate in an in-situ sitting. Other related impacts concerning habitat modification and the concomitant change in community structure and secondary impacts of the offshore food chain are not well studied for the geographic analysis area. The assessment utilized studies within the Mid-Atlantic Bight and European temperate waters that focused on monitoring the invertebrate and finfish assemblage dynamics and food-chain linkages. Using these studies provided a better understanding of how the benthic resources and communities within the proposed Lease Area may change and what impacts these changes may produce. Although these studies supported a better understanding of how these resources may be affected, the National Marine Fisheries Service (NMFS) has identified uncertainties of the scale of the broader geographic resource impacts and made recommendations for designing studies and pre-, during, and post-construction monitoring efforts to be used to identify and assess the potential effects on the finfish, invertebrate, and EFH resources in the geographic analysis area. NMFS has recommended that offshore wind energy projects incorporate and support the Northeast Fisheries Science Center scientific surveys (NMFS surveys), incorporating and developing a programmatic approach to mitigate impacts on these NMFS surveys and develop a broader geographical understanding of habitat modifications made by wind energy project structures.

Overall, the analysis of the IPFs presented in this EIS is sufficient to support sound scientific judgment and informed decision-making related to the impacts discussed and presented. Therefore, BOEM does not believe that there is incomplete or unavailable information on finfish, invertebrate, and EFH resources that is essential to a reasoned choice among alternatives.

D.1.11 Land Use and Coastal Infrastructure

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

D.1.12 Marine Mammals

NMFS has summarized the current information about marine mammal population status, occurrence, and use of the region in its stock assessment reports for the Atlantic OCS and Gulf of Mexico (Hayes et al. 2019, 2020, 2021; NMFS 2021). These studies provided a suitable basis for predicting the species, abundances, and distributions of marine mammals in the geographic analysis area. The *Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment 2021* (NMFS 2021) indicated that there are insufficient data to determine population trends for most marine mammal species found regularly in the coastal and oceanic waters of Virginia, with the exception of the humpback whale (*Megaptera novaeangliae*; increasing population trend) and North Atlantic right whale (*Eubalaena glacialis*; decreasing population trend). As a result, there is uncertainty regarding how Project activities and cumulative effects may affect these populations. In addition to species distribution information, effects of some IPFs on marine mammals are also uncertain or ambiguous, as described below.

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

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

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

To address this uncertainty, the assessment in the EIS used the best available information when considering behavioral effects related to underwater noise. To better characterize these impacts, all potential types of behavioral responses, as well as the context within which these responses may occur, were considered following guidance from applicable studies (Ellison et al. 2012, 2015; Southall et al. 2021) and used in conjunction with the NMFS disturbance threshold, as described in Section 3.15. For the assessment of large baleen whales, studies on other impulsive noises (e.g., seismic sources) were used to inform the potential behavioral reactions to pile-driving noise. Monitoring studies would provide insight into species-specific behavioral reactions to Project-generated underwater noise. Long-term monitoring of concurrent and multiple projects could inform the understanding of long-term effects and subsequent consequences from cumulative underwater noise activities on marine mammal populations.

There is a lack of research regarding the responses of large whale species to extensive networks of new structures due to the novelty of this type of development on the Atlantic OCS. Although over 2,100 new structures are anticipated from multiple offshore wind projects in the geographic analysis area under the planned activities scenario, it is expected that spacing will allow large whales to access areas within and between wind facilities. No physical obstruction of marine mammal migration routes or habitat areas are anticipated, but whether avoidance of offshore wind lease areas will occur due to new structures is unknown. Additionally, while there is some uncertainty regarding how hydrodynamic changes around foundations may affect prey availability, these changes are expected to have limited impacts on the local conditions around WTG foundations. It is anticipated that the presence of structures on the Atlantic OCS will also lead to localized changes in fishing activities and vessel traffic in the vicinity of the WTG foundations. The potential consequences of these impacts on marine mammals of the Atlantic OCS are currently unknown. Monitoring studies would provide insight into species-specific avoidance behaviors and other potential behavioral reactions to Project structures.

At present, this EIS has no basis to conclude that these IPFs would result in significant adverse impacts on most marine mammal populations. The life history and stock status of the North Atlantic right whale combined with ongoing, planned non-wind, and planned wind activities in the Atlantic OCS could result in severe population-level effects that may compromise the viability of the species. However, given the complex interconnectedness of individual IPFs, the exact level and extent of impacts on the North Atlantic right whale is impossible to predict with certainty. To address data gaps identified above, BOEM extrapolated or drew assumptions from known information for similar species and studies, as presented in Section 3.15 of the EIS and in the BA submitted to NMFS (BOEM 2022). The information and methods used to predict potential impacts to marine mammal species represent the best available information. The analysis provided in this EIS is sufficient to support sound scientific judgments and informed decision-making. Therefore, BOEM does not believe that there is incomplete or unavailable information on marine mammal resources that is essential to a reasoned choice among alternatives.

D.1.13 Navigation and Vessel Traffic

The navigation and vessel traffic impact analysis in the EIS is based on one year (January 1, 2019, to December 31, 2019) of Automatic Identification System (AIS) data from vessels required to carry AIS (i.e., those 65 feet [19.8 meters] or greater in length), as well as Vessel Monitoring System (VMS) data to infer commercial fishing and recreational vessel transits. Fishing vessels at least 65 feet (19.8 meters) long were not required to carry AIS until March 2015 (80 *Federal Register* 5282); therefore, AIS data prior to March 2015 are more limited than data available after March 2015. To account for some gaps in the data due to limitations of the AIS carriage requirements, the risk model included VMS data and Vessel Trip Reports required by NOAA to account for both current and future traffic not represented in the data (COP, Section 4, Table 4.4-19; Dominion Energy 2023).

The combination of AIS and VMS data described above with informed assumptions about smaller vessel numbers represents the best available vessel traffic data and is sufficient to enable BOEM to make a reasoned choice among alternatives.

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

D.1.14 Other Uses

The proposed Project lies within the Atlantic Test Range Geographical Area of Concern, with the potential to impact test capabilities of the Advanced Dynamic Aircraft Measurement System at Patuxent River Naval Air Station. The Department of the Navy requests continued coordination on the undersea cable route and cable landing location, and notification of whether there are plans to put monitoring equipment on the undersea cables, and coordination on the use of foreign-owned or controlled vendors in the Project. Discussions with the Department of Defense are ongoing based on the findings of this informal review.

D.1.15 Recreation and Tourism

Evaluations of impacts on recreation and tourism rely on the assessment of impacts on other resources. As a result, incomplete or unavailable information related to visual and scenic resources, navigation and vessel traffic, commercial fisheries, and for-hire recreational fishing, as described in this document, also affect the completeness of the analysis of impacts on recreational tourism. For these reasons, BOEM does not believe that there is incomplete or unavailable information on recreation and tourism that is essential to a reasoned choice among alternatives.

D.1.16 Sea Turtles

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

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

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

Some uncertainty exists regarding the potential for sea turtle responses to Federal Aviation Administration hazard lights and navigation lighting associated with offshore wind development. Dominion Energy would limit lighting on WTGs and OSSs to minimum levels required by regulation for worker safety, navigation, and aviation. Although sea turtles' sensitivity to these minimal light levels is unknown, sea turtles do not appear to be adversely affected by oil and gas platform operations, given their propensity for resting at these structures (Gitschlag and Herczeg 1994; NRC 1994), which produce far more artificial light than offshore wind structures. The placement of new structures would be far from nesting beaches, so no impacts on nesting female or hatchling sea turtles are anticipated.

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

To address data gaps identified above, BOEM extrapolated or drew assumptions from known information for similar species and studies, as presented in Section 3.19, and in the BA submitted to NMFS (BOEM

2022). The information and methods used to predict potential impacts on sea turtle species represent the best available information. Therefore, the analysis provided is sufficient to support sound scientific judgments and informed decision-making about the proposed Project with respect to its impacts on sea turtles. For these reasons, BOEM does not believe that there is incomplete or unavailable information on turtles that is essential to a reasoned choice among alternatives.

D.1.17 Scenic and Visual Resources

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

D.1.18 Water Quality

There is no incomplete or unavailable information related to the analysis of impacts on water quality.

D.1.19 Wetlands

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

D.2. References Cited

Biodiversity Research Institute. 2021. *Assessment of the Potential Effects of Coastal Virginia Offshore Wind (CVOW) Commercial Project on Birds & Bats: Lease Area OCS-A 0483.* Report to Tetra Tech. Biodiversity Research Institute, Portland, ME. 256 pp.

Bureau of Ocean Energy Management (BOEM). 2012. *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia, Final Environmental Assessment.* 366 p. Report No.: OCS EIS/EA BOEM 2012-003.

———. 2014. *Programmatic Environmental Impact Statement for Atlantic OCS Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas. Office of Renewable Energy Programs*. OCS EIS/EA BOEM 2014-001

———. 2015. *Virginia Offshore Wind Technology Advancement Project on the Atlantic Outer Continental Shelf. Revised Environmental Assessment*. 240 p. Report No.: OCS EIS/EA BOEM 2015-031.

———. 2020. *Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585.* May 27. Available: https://www.boem.gov/sites/default/files/documents/about-boem/Archaeology%20and%20Historic%20Property%20Guidelines.pdf. Accessed: November 7, 2021.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. May.

Ellison, W.T., B.L. Southall, C.W. Clark, and A.S. Frankel. 2012. A New Context-Based Approach to Assess Marine Mammal Behavioral Responses to Anthropogenic Sounds. *Conservation Biology* 26(1):21–18.

Ellison, W.T., C.W. Clark, D.A. Mann, B. Southall, and D.J. Tollit. 2015. A Risk Assessment Framework to Assess the Biological Significance of Noise Exposure on Marine Mammals. In *21st Biennial Conference on the Biology of Marine Mammals*. 13–18 December 2016, San Francisco, CA.

Gitschlag, G.R., and B.A. Herczeg. 1994. Sea Turtle Observations at Explosive Removals of Energy Structures. *Marine Fisheries Review* 56(2):1–8.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estlea-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas.* December 2017. Sterling, VA: US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088.

Hawkins, A.D., and A.N. Popper. 2017. A Sound Approach to Assessing the Impact of Underwater Noise on Marine Fishes and Invertebrates. *ICES J.Mar. Sci.* 74(3):635–651.

Hayes, S.A., E. Josephson, K. Maze-Foley, and P.E. Rosel. 2019. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2018.* Woods Hole (MA): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Report No. NOAA Technical Memorandum NMFS-NE-258. 306 p.

Hayes S.A., Josephson E., K. Maze-Foley, and P.E. Rosel. 2020. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2019.* Woods Hole (MA): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Report No. NOAA Technical Memorandum NMFS-NE-264. 479 p

Hayes S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, and J. Turek. 2021. *US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2020.* Woods Hole (MA): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center. Report No. NOAA Technical Memorandum NMFS-NE-271. 403 p.

Hutchison, Z.L., P. Sigray, H. He, A.B. Gill, J. King, and C. Gibson. 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables*. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2018-003.

Kirkpatrick, A. J., S. Benjamin, G. S. DePiper, S. S. T. Murphy, and C. Demarest. 2017. *Socio-Economic Impact of Outer Continental Shelf Wind Energy Development on Fisheries in the U.S. Atlantic*. Vol. II—Appendices. U.S. Department of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region. Washington, D.C.

Love, M.S., M.M. Nishimoto, S. Clark, and A.S. Bull. 2015. Identical Response of Caged Rock Crabs (Genera Metacarcinus and Cancer) to Energized and Unenergized Undersea Power Cables in Southern California, USA. *Bulletin of the Southern California Academy of Sciences* 14(1):11.

Love, M.S., M.M. Nishimoto, S. Clark, and A.S. Bull. 2016. *Renewable Energy in situ Power Cable Observation*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region, Camarillo, CA.

National Marine Fisheries Service (NMFS). 2021. *Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment 2021.* U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Draft published 25 October 2021, 86 FR 58887. 329 p.

National Oceanic and Atmospheric Administration (NOAA). 2020. Section 7 Effect Analysis: Turbidity in the Greater Atlantic Region. NOAA Greater Atlantic Regional Fisheries Office. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region. Accessed November 11, 2021.

National Research Council (NRC). 1996. An Assessment of Techniques for Removing Offshore Structures. *National Academy Press*, Washington, D.C.

Normandeau Associates Inc. (Normandeau). 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranch and Other Marine Species.* Camarillo, CA: U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region. OCS Study BOEMRE 2011-09.

Pacific Northwest National Laboratory (PNNL). 2013. *Effects of Electromagnetic Fields on Fish and Invertebrates: Task 2.1.3: Effects on Aquatic Organisms Fiscal Year 2012 Progress Report*. Prepared for the U.S. Department of Energy. May 2013.

Petersen, I. K., T. K. Christensen, J. Kahlert, M. Desholm, and A. D. Fox. 2006. *Final Results of Bird Studies at the Offshore Wind Farms at Nysted and Horns Rev, Denmark.*

Skov, H., S. Heinanen, T. Norman, R. M. Ward, S. Mendez-Roldan, and I. Ellis. 2018. *ORJIP Bird Collision and Avoidance Study. Final Report – April 2018*.

Southall, B.J., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals* 33(44):411–521.

Southall B.L., D.P. Nowacek, A.E. Bowles, V. Senigaglia, L. Bejder, and P.L. Tyack. 2021. Marine Mammal Noise Exposure Criteria: Assessing the Severity of Marine Mammal Behavioral Responses to Human Noise. *Aquatic Mammals* 47(5):421–464.

Taormina, B., J. Bald, A. Want, G. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review of Potential Impacts of Submarine Power Cables on the Marine Environment: Knowledge Gaps, Recommendations and Future Directions. *Renewable and Sustainable Energy Reviews* 96:380–391.

U.S. Coast Guard (USCG). 2020. The Areas Offshore of Massachusetts and Rhode Island Port Access Route Study, Final Report. Docket Number USCG-2019-0131. Available: https://www.navcen.uscg.gov/pdf/PARS/FINAL_REPORT_PARS_May_14_2020.pdf. Accessed: September 21, 2020

Weilgart, L. 2018. *The Impact of Ocean Noise Pollution on Fish and Invertebrates.* Report by OceanCare.

Appendix E. Project Design Envelope and Maximum-Case Scenario

Dominion Energy would implement a Project Design Envelope (PDE) concept. This concept allows Dominion Energy to define and bracket proposed Project characteristics for environmental review and permitting while maintaining a reasonable degree of flexibility for selection and purchase of Project components, such as wind turbine generators (WTGs), foundations, submarine cables, and offshore substation (OSS).[1]

The Bureau of Ocean Energy Management (BOEM) invited Dominion Energy and other lessees to submit Construction and Operations Plans (COPs) using the PDE concept—providing sufficiently detailed information within a reasonable range of parameters to analyze a "maximum-case scenario" within those parameters for each affected environmental resource. BOEM identified and verified that the maximum-case scenario based on the PDE provided by Dominion Energy and analyzed in this Final Environmental Impact Statement (EIS) could reasonably occur if approved. This approach is intended to provide flexibility for lessees and allow BOEM to analyze environmental impacts in a manner that minimizes the need for subsequent environmental and technical reviews. In addition, the PDE approach may enable BOEM to expedite review by beginning National Environmental Policy Act (NEPA) evaluations of COPs before a lessee has finalized all of its design decisions.

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

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

Table E-1. Summary of PDE Parameters

Project Parameter Details
General (Layout and Project Size)
• 176 to 202 WTGs • Wind farm nameplate capacity ranging from 2,500 to 3,000 MW • Anticipated to begin offshore construction in 2023 (scour protection, offshore cables) and 2025 (WTGs) • Construction of the Project is expected to be complete within approximately 3 years

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

Project Parameter Details
WTGs and Foundations
• Siemens Gamesa Renewable Energy SG 14-222 DD WTG with power boost technology • 14- to 16-MW WTGs characterized as “minimum” and “maximum” capacity • Rotor diameter ranging from 725 to 761 feet (221 to 232 meters) • Hub height from MSL ranging from 446 to 489 feet (136 to 149 meters) • Turbine tip height from MSL ranging from 804 to 869 feet (245 to 265 meters) • Installation of monopiles through pile-driving • Scour protection installed around WTG monopile foundation installation vessels to include jack-up, platform support, crew transfer, tugs, crew transfer, barges, heavy-lift vessels, fall pipe vessels, walk-to-work, and other support vessel types as necessary
Inter-Array Cables
• Up to 66- kV cables buried 3.3 to 9.8 feet (1 to 3 meters) beneath the seabed • Up to 300 miles (484 kilometers) total length of inter-array cables (average inter-array cable length of 5,868 feet [1,789 meters] between turbines) • Installation by jet trenching, chain cutting, trench former, and/or other available technologies • Installation vessels to include deep draft cable lay, walk-to-work, crew transfer, trenching support, burial tool, survey, multipurpose support vessels, and other support vessel types as necessary
Offshore Export Cables
• Up to nine 230-kV export cables buried 3.3 to 16.4 feet (1 to 5 meters) beneath the seabed; with additional cover in some sections, total burial depth may be up to 24.6 feet (7.5 meters) • Nine export cables (in a single corridor), with alternatives • Up to 337.9 miles (543.7 kilometers) total length of offshore export cable • Installation by jet trenching, plowing, chain cutting, trench former, direct steerable pipe thrusting, and/or other available technologies • Installation vessels to include pull-in support barge, tug, multipurpose support, survey, shallow draft cable lay, hydroplow, crew transfer, deep-draft, walk-to-work, trenching support, burial tool vessels, and other support vessel types, as necessary • Cable protection at the cable crossings
Offshore Substations and Foundations
• Three OSSs • OSS installed atop piled jacket foundations • Scour protection installed at all foundation locations • Installation vessels to include barge, tug, transport, heavy lift, anchor handling, jack-up vessels, platform support, and other support vessel types, as necessary
Onshore Facilities
• Landfall of offshore export cable(s) would be completed via Trenchless Installation • Maximum area of temporary disturbance for cable landing location: 2.8 acres (1.1 hectares); maximum temporary workspace at the Nearshore Trenchless Installation Area approximately 0.36 acre [0.15 hectare]). • Construction work area for the Harpers Switching Station: maximum of approximately 46.5 acres (18.4 hectares); construction work area for the Chicory Switching Station: maximum of approximately 35.5 acres (14.4 hectares) • Construction work area for the upgrades at the onshore substation (existing Dominion Energy

Project Parameter Details
Fentress substation): maximum of approximately 15.2 acres (6.2 hectares) • Maximum onshore export cable length of approximately 4.41 miles (7.10 kilometers) • Maximum interconnection cable length of approximately 14.3 miles (22.9 kilometers) • Maximum area of temporary disturbance for onshore export cable route of approximately 26.6 acres (10.8 hectares) [1] • Maximum area of permanent disturbance for onshore export cable route of approximately 1.0 acres (0.4 hectare)[1] • Maximum area of temporary disturbance for Interconnection Cable Route Option 1 of approximately 0 acres (0 hectares) [1] • Maximum area of permanent disturbance for Interconnection Cable Route Option 1 of approximately 1 acre (0.4 hectare) [1] • Maximum area of temporary disturbance for Hybrid Interconnection Cable Route Option 6 of approximately 29.0 acres (11.7 hectares) [1] • Maximum area of permanent disturbance for Hybrid Interconnection Cable Route Option 6 of approximately 4.2 acres (1.7 hectares) [1]

MSL = mean sea level; kV = kilovolt; MW = megawatt; WTG = wind turbine generator; OSS = offshore substation
[1] For the purposes of this analysis, the estimated temporary disturbance for the Onshore Export Cable Route and Interconnection Cable Route is calculated based on areas where actual land disturbance will occur (i.e., locations of permanent structures [permanent disturbance] and surface trenching [temporary disturbance]).

This page intentionally left blank.

Table E-2. Maximum-Case Design Parameters for the Coastal Virginia Offshore Wind Commercial Project (an "X" indicates that the parameter is relevant to an EIS resource analysis)

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
WIND FARM																				
Wind farm nameplate capacity (MW)	3,000	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WIND TURBINES																				
Parameters per Turbine																				
Number of WTGs	202	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
WTG generating capacity (MW)	16	X	X		X								X	X			X	X		
Cut-in wind speed (miles per hour)	11.2		X		X															
Cut-out wind speed (miles per hour)	67.1		X		X															
Turbine tip height from MSL (feet)	869		X		X		X	X				X		X	X	X		X		
Hub height from MSL (feet)	489		X		X		X	X				X		X	X	X		X		
Rotor diameter (feet)	761		X		X		X	X				X		X	X	X		X		
Distance from bottom of turbine tip to HAT (feet)	115		X		X		X	X				X		X	X	X		X		
Parameters per Turbine Foundation (Monopile)																				
Monopile diameter per foundation (feet)	31			X			X	X			X		X	X			X		X	
Base diameter with scour protection (feet)	230			X	X		X				X		X	X			X		X	
Seabed penetration (feet)	197			X			X	X			X		X	X			X		X	
Diameter at HAT (feet)	31			X			X	X			X		X	X			X	X		
Maximum hammer energy (kilojoule)	4,000		X	X	X		X				X		X	X			X		X	
Maximum Total Impacts for Turbine Foundations (Monopile)																				
Number of monopiles	202	X	X	X	X		X	X				X	X	X	X	X	X	X	X	
Number of transition pieces	202		X		X		X	X								X		X		
Platform supply vessel: Bubble curtain installation (noise mitigation) temporary impacts (acres)	148.1			X			X				X		X	X			X			
Noise monitoring buoys temporary impacts (acres)	0.8			X			X				X		X	X			X			
Heavy lift vessel (HLV) monopile construction and installation	0.0																			
Feeder spread – monopile feeder	0.0																			
JUV WTG loading temporary impacts (acres) [1]	9.5			X	X		X				X		X	X	X		X		X	
JUV WTG construction and installation temporary impacts (acres) [1]	38.0			X	X		X				X		X	X	X		X		X	
W2W WTG commissioning temporary impacts (acres)	0.0														X					

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
WTG foundation and scour protection permanent impacts (acres)	191.9			X	X		X				X		X	X			X		X	
OFFSHORE SUBSTATIONS																				
Topside Offshore Substations																				
Number of substations	3	X	X	X	X		X	X			X	X	X	X	X	X	X	X	X	
Width of topside main structure (feet)	203		X	X	X		X	X			X	X	X	X			X	X		
Length of topside main structure (feet)	242		X	X	X		X	X			X	X	X	X			X	X		
Height (feet)	177		X		X		X	X				X		X	X					
Base height above HAT (feet) (air gap)	151		X		X		X	X				X		X	X			X		
Offshore Substation Foundations (Piled Jackets)																				
Number of structures	3	X	X	X	X		X	X			X	X	X	X	X	X	X	X	X	
Number of piles per offshore substation	4		X	X	X		X	X			X		X	X			X		X	
Pile diameter (feet)	9.0			X	X		X	X			X		X	X			X		X	
Base dimensions (feet)	306.8 x 283.8			X			X	X			X		X	X			X		X	
Scour protection diameter per leg (feet)	230			X			X	X			X		X	X			X		X	
Seabed penetration (feet)	269			X			X	X			X		X	X			X		X	
Seabed footprint without scour protection per offshore substation foundation (square feet)	87,070			X			X	X			X		X	X			X		X	
Seabed footprint with scour protection per offshore substation foundation (square feet)	497,092			X			X	X			X		X	X			X		X	
Dimensions at lowest astronomical tide (feet)	98.4 x 131.2			X			X	X			X		X	X			X	X		
Maximum Total Impacts for OSS Foundations																				
Maximum temporary construction footprint per OSS (acres)	3.74			X	X		X	X			X		X	X			X		X	
OSS jacket footprint permanent impact (acres)	1.27			X							X		X	X			X			
Vessels Associated with OSS																				
Fallpipe vessel scour protection temporary impact (acres) [2]	0		X	X	X		X				X		X	X	X		X		X	
Pin pile template temporary impact (acres)	1.9		X	X	X		X				X		X	X	X		X		X	
HLV OSS pre-piling temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
HLV OSS jacket construction and installation temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
Feeder spread OSS jacket supply temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
HLV offshore substation topside construction and installation temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Feeder spread offshore substation topside supply temporary impact (acres) [2]	0		X		X		X				X		X	X	X		X		X	
CTV/JUV offshore substation commissioning temporary impact (acres)	3.6		X	X	X	X	X				X		X	X	X		X		X	
OFFSHORE CABLES																				
Inter-Array Cable Parameters																				
Number of cables	230			X			X	X			X	X	X	X	X		X		X	
Length per cable (feet)	31,804	X		X			X	X			X	X	X	X	X		X		X	
Total length of cable (miles)	300.7	X		X			X	X			X	X	X	X	X		X		X	
Operating voltage (kV)	66			X			X				X	X	X	X			X			
Cable diameter (inches)	7.9			X			X	X			X	X	X	X	X		X		X	
Target burial depth (feet)	9.8			X			X	X			X	X	X	X	X		X		X	
Trench width – temporary (feet)	65.6			X			X	X			X	X	X	X	X		X		X	
Seabed footprint (cable) – temporary (acres)	48			X			X	X			X	X	X	X	X		X		X	
Seabed footprint (per 1 UXO Survey/Removal) – temporary (square feet)	161.5			X			X	X			X	X	X	X	X		X		X	
Temporary impact footprint (acres)	2,405.6			X			X	X			X		X	X			X		X	
Pre-lay grapnel run temporary impact (acres)	2,981.8			X			X	X			X		X	X			X		X	
Offshore Export Cable Parameters																				
Number of cables	9			X			X	X			X		X	X			X		X	
Total length of cable (miles)	337.9	X		X			X	X			X		X	X	X	X	X		X	
Operating voltage (kV)	230			X			X				X		X	X			X		X	
Cable diameter (inches)	11.4			X			X	X			X		X	X			X		X	
Burial depth (feet)	16.4			X			X	X			X		X	X			X		X	
Trench width – temporary (feet)	32.8			X			X	X			X		X	X			X		X	
Total corridor length from the lease area to the cable landing location (miles)	49.01	X		X			X	X			X		X	X	X	X	X		X	
Area of construction corridor (offshore work area to offshore substations) (acres)	2,635.37			X			X	X			X		X	X	X	X	X		X	
Requested operational right-of-way (feet)	2,953			X			X				X		X	X			X			

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
Maximum Total Temporary Impacts for Vessels Associated with Inter-Array Cables and Offshore Export Cables																				
Pontoon - nearshore export cable installation anchor handling (acres)	355																			
Cable lay vessel (cable laying and wet end storage; affects same area as pre-lay grapnel run) (acres)	1,393			X			X	X			X	X	X	X	X	x	X		X	
Cable trenching jetting vessel (multiple burial passes would impact same area and are thus counted a single time) (acres)	2,892.4		X	X	X		X				X		X	X	X		X	X	X	
Cable joining vessel for joining offshore export cable and interarray cable (acres) [2]	3		X		X		X				X		X	X	X		X	X	X	
Cable lay vessel for wet end storage (acres)	0.2		X	X	X		X				X		X	X	X		X	X	X	
Support vessel for pre-lay grapnel run (acres)	1,393		X	X	X		X				X		X	X	X		X	X	X	
ONSHORE COMPONENT CONSTRUCTION IMPACTS																				
Length of onshore trenchless installation work area at cable landing location area (feet)	2,500			X		X			X	X		X			X	X		X	X	X
Maximum area of temporary disturbance for cable landing location offshore trenches installation punch-out (acres)	80	X	X		X	X		X	X			X				X		X	X	X
Construction work area for switching station (acres)	46.5	X	X		X	X		X	X			X						X	X	X
Construction work area existing Fentress onshore substation, existing footprint plus expanded footprint (acres)	26.9	X	X		X	X		X	X			X						X	X	X
Maximum onshore export cable length (miles)	4.41	X	X		X	X		X	X			X						X	X	X
Maximum interconnection cable length (miles)	14.3	X	X		X	X		X	X	X		X			X	X			X	X
Maximum area of temporary disturbance for onshore export cable route (acres)	26.6	X	X		X	X		X	X			X						X	X	X
Maximum area of temporary disturbance for Interconnection Cable Route Option 1 (acres)	0	X	X		X	X		X	X	X		X			X	X			X	X
Maximum area of permanent disturbance for Interconnection Cable Route Option 1 (acres)	1.0	X	X		X	X		X	X	X		X			X	X			X	X
Maximum area of temporary disturbance for Interconnection Cable Route Option 6 (acres)	29.0	X	X		X	X		X	X	X		X			X	X			X	X
Maximum area of permanent disturbance for Interconnection Cable Route Option 6 (acres)	3.85	X	X		X	X		X	X	X		X			X	X			X	X
Duration of onshore export cable installation (months)	24	X	X		X	X		X	X			X				X		X	X	X
Duration of onshore interconnection cable installation (months)	15	X	X		X	X		X	X			X				X		X	X	X
Duration of switching station construction (months)	24	X	X		X	X		X	X			X				X		X	X	X
Duration of onshore substation upgrade construction (months)	24	X	X		X	X		X	X			X				X		X	X	X

Design Parameter	Maximum Design Parameters	3.4 Air Quality	3.5 Bats	3.6 Benthic Resources	3.7 Birds	3.8 Coastal Habitat and Fauna	3.9 Commercial Fisheries and For-Hire Recreational Fishing	3.10 Cultural Resources	3.11 Demographics, Employment, and Economics	3.12 Environmental Justice	3.13 Finfish, Invertebrates, and Essential Fish Habitat	3.14 Land Use and Coastal Infrastructure	3.15 Marine Mammals	3.16 Navigation and Vessel Traffic	3.17 Other Uses (Marine Minerals, Military Use, Aviation)	3.18 Recreation and Tourism	3.19 Sea Turtles	3.20 Scenic and Visual Resources	3.21 Water Quality	3.22 Wetlands
OPERATIONS AND MAINTENANCE																				
Commercial project lifespan (years)	33	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Number of offshore emergency generators	3	X																	X	
Offshore emergency generator capacity (kW)	563 each	X																	X	
Number of onshore switching station emergency generators	3	X	X		X	X		X				X							X	
Onshore switching station emergency generator capacity (kW)	260 each	X	X		X	X		X				X							X	
Number of onshore substation emergency generators	3	X	X		X	X		X				X							X	
Onshore substation emergency generator capacity (kW)	150, 310, and 410	X	X		X	X		X				X							X	
Onshore substation electric switchgear sulfur hexafluoride quantity (pounds)	35,137	X																	X	
Switching station electric switchgear sulfur hexafluoride quantity (pounds)	26,000	X																	X	
Offshore substation sulfur hexafluoride switchgear fugitive emissions (pounds per 1 offshore substation)	13,227	X																	X	

[1] Adjusted for 202 WTG positions. COP Table 3.4-1 (Dominion Energy 2023) provides acreage for 176 WTG positions.
[2] Floating marine spread (COP Table 3.4-3; Dominion Energy 2023).
CVT = Crew Vessel Transfer; HAT = Highest Astronomical Tide; HLV = heavy lift vessel; JUV = jack-up vessel; kV = kilovolt; kW = kilowatt; MW = megawatt; WTG = wind turbine generator; W2W = Multirole Subsea Support Vessel with Walk to Work.

Appendix F. Planned Activities Scenario

This page intentionally left blank.

CONTENTS

Appendix F. Planned Activities Scenario ... F-1
F.1. Ongoing and Planned Activities Scenario ... F-1
F.2. Ongoing and Planned Activities ... F-6
F.2.1 Offshore Wind Energy Development Activities ... F-6
F.2.2 Commercial Fisheries Cumulative Fishery Effects Analysis ... F-7
F.2.3 Incorporation by Reference of Cumulative Impacts Study and the Analyses Therein ... F-12
F.2.4 South Carolina Activities ... F-12
F.2.5 Undersea Transmission Lines, Gas Pipelines, and Other Submarine Cables ... F-12
F.2.6 Dredging and Port Improvement Projects ... F-13
F.2.7 Marine Minerals Use and Ocean-Dredged Material Disposal ... F-13
F.2.8 National Security and Military Use ... F-14
F.2.9 Marine Transportation ... F-15
F.2.10 National Marine Fisheries Service Activities ... F-15
F.2.11 Global Climate Change ... F-17
F.2.12 Oil and Gas Activities ... F-21
F.2.13 Onshore Development Activities ... F-22
F.3. Literature Cited ... F-25

Attachments

Attachment 1 Ongoing and Future Non-Offshore Wind Activity Analysis
Attachment 2 Maximum-Case Scenario Estimates for Offshore Wind Projects

Tables

Table F-1 Resource-Specific Geographic Analysis Areas ... F-1
Table F-2 Site Characterization Survey Assumptions ... F-7
Table F-3 Offshore Wind Project Construction Schedule (dates shown as of June 20, 2023) ... F-9
Table F-4 Other Fishery Management Plans ... F-17
Table F-5 Climate Change Plans and Policies ... F-18
Table F-6 Resiliency Plans and Policies in the Lease Area ... F-19
Table F-7 Liquid Natural Gas Terminals Located in the Northeastern United States ... F-21
Table F-8 Existing, Approved, and Proposed Onshore Development Activities ... F-22

This page intentionally left blank.

F.1. Ongoing and Planned Activities Scenario

This appendix describes the other ongoing or planned activities that could occur within the analysis area for each resource and contribute to baseline conditions and trends for resources considered in this Environmental Impact Statement (EIS). The Coastal Virginia Offshore Wind Commercial Project (CVOW-C or Project) comprises the construction, operation and maintenance (O&M), and conceptual decommissioning of a wind energy project located within the Bureau of Ocean Energy Management's (BOEM) Renewable Energy Lease No. OCS-A-0483, located in federal waters approximately 23.75 nautical miles (nm) (27 statute miles: 44 kilometers) off of the Virginia Beach coastline.

The geographic analysis area varies for each resource as shown below in Table F-1. BOEM anticipates that impacts could occur between the start of Project construction in 2023 and the completion of Project decommissioning in approximately 2047. The geographic analysis area is defined by the impact-producing factor (IPF) with the maximum geographic area of impact, for example sound during pile driving. For the mobile resources—bats, birds, finfish and invertebrates, marine mammals, and sea turtles—the species potentially affected are those that occur within the area of impact of the Proposed Action. The geographic analysis area for these mobile resources is the general range of the species. The purpose is to capture the cumulative impacts on each of those resources that are affected by the Proposed Action as well as the impacts that would still occur under the No Action Alternative.

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

Table F-1 Resource-Specific Geographic Analysis Areas

Resource	Geographic Analysis Area	Rationale
Air quality	The airshed within 25 miles (40 kilometers) of the Wind Turbine Area (WTA) (corresponding to the outer continental shelf permit area) and the airshed within 15.5 miles (25 kilometers) of the Onshore Project area and ports that may be used for the Project (Figure 3.4-1).	The geographic analysis area encompasses the geographic region subject to USEPA review as part of an OCS permit for the Project under the Clean Air Act. The geographic analysis area also considers potential air quality impacts associated with the onshore construction areas and the mustering port(s) outside of the OCS permit area. Given the generally low emissions of the sea vessels and equipment that would be used during proposed construction activities, any potential air quality impacts would likely be within a few miles of the source. BOEM selected the 15.5-mile (25-kilometer) distance to provide a reasonable buffer.

Resource	Geographic Analysis Area	Rationale
Bats	The U.S. coastline from Maine to Florida, extending 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland (Figure 3.5-1). While some historic, anecdotal observations of bats up to 1,212 miles (1,951 kilometers) offshore of North America exist, recent offshore observations of tree bats range from 10.5 to 26 miles (17 to 42 kilometers) (Hatch et al. 2013). As such, the geographic analysis area for bats consists of the U.S. East Coast, from Maine to Florida, to capture migratory species, and extends 100 miles (161 kilometers) offshore.	The geographic analysis area for bats was established to capture most of the movement range for migratory species. The offshore limit was established to capture the migratory movements of most species in this group, while the onshore limit covers onshore habitats used by species that may be affected by onshore and offshore components of the proposed Project. Tree bats are long-distance migrants; their range includes the majority of the Atlantic coast from Florida to Maine. While these species have been documented traversing the open ocean and have the potential to encounter wind turbine generators (WTGs), use of offshore habitat is thought to be limited and generally restricted to spring and fall migration. The onshore limit of the geographic scope is intended to cover a majority of the onshore habitat used by those species that may encounter the Project during the majority of their life cycles.
Benthic resources	A 10-mile (16.1-kilometer) buffer around the Wind Turbine Area and a 330-foot (101-meter) buffer around the Offshore Export Cable Route and Inshore Export Cable Route corridors (Figure 3.6-1).	The geographic analysis area is based upon where the most widespread impact (namely, suspended sediment) from the proposed Project could affect benthic resources. This area would account for some transport of water masses and for benthic invertebrate larval transport due to ocean currents. Although sediment transport beyond 10 miles (16.1 kilometers) is possible, sediment transport related to proposed Project activities would likely to be on a smaller spatial scale than 10 miles (16.1 kilometers).
Birds	The U.S. coastline from Maine to Florida, extending 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland (Figure 3.7-1).	The geographic analysis area for birds was established to capture resident species and migratory species that winter as far south as South America and the Caribbean, and those that breed in the Arctic or along the Atlantic coast that travel through the area. The offshore limit was established to cover the migratory movement of most species in this group. The onshore limit was established to cover onshore habitats used by the species that may be affected by onshore and offshore components of the proposed Project.

Resource	Geographic Analysis Area	Rationale
Coastal habitat and fauna	A 1.0-mile (1.6-kilometer) buffer of the Onshore Project area [1] (Figure 3.8-1).	BOEM expects the resources in this area to have small home ranges. These resources are unlikely to be affected by impacts outside their home ranges.
Commercial fisheries and for-hire recreation fishing	Commercial fisheries: the boundaries of the management areas of the South Atlantic Fishery Management Council (SAFMC) from the South Carolina / Georgia border northward, the Mid-Atlantic Fishery Management Council (MAFMC), and the New England Fishery Management Council (NEFMC) for all federal fisheries within the U.S. Exclusive Economic Zone (EEZ) (from 3 to 200 nautical miles [5.6 to 370 kilometers; 3.5 to 230 miles] from the coastline and all adjacent state waters (from 0 to 3 nautical miles [0 to 5.6 kilometers; 0 to 3.5 miles]) from the coastline (Figure 3.9-1). For-hire recreational fisheries: all areas managed by the NEFMC south of Cape Cod, Massachusetts, the MAFMC and the SAFMC to Cape Hatteras, North Carolina, including all adjacent state waters (from 0 to 3 nautical miles [0 to 5.6 kilometers; 0 to 3.5 miles] from the coastline) (Figure 3.9-2).	The boundaries for the commercial fisheries geographic analysis area were developed to consider impacts on federally permitted vessels operating in all fisheries in state and EEZ waters surrounding the proposed Project, vessels from the Project area that may transit to fishing grounds in other Atlantic regions, as well as potential impacts on federally managed species of commercial importance that have ranges which overlap with the Project area.
Cultural, historical, and archaeological	The Area of Potential Effect (APE) for terrestrial and marine archaeology and analysis of visual effects on historic properties (Figure 3.10-1).	The Area of Potential Effect is a geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.
Demographics, employment, and economic characteristics	The cities closest to the Onshore and Offshore Project areas and the cities where potential port cities are located, including: City of Chesapeake, City of Hampton; City of Newport News; City of Norfolk; City of Portsmouth; and City of Virginia Beach, Virginia (Figure 3.11-1).	These cities are the most likely to experience beneficial or adverse economic impacts from the proposed Project.
Environmental justice	The cities closest to the Onshore and Offshore Project areas and the cities where potential port cities are located, including City of Chesapeake, City of Hampton, City of Newport News, City of Norfolk, City of Portsmouth, and City of Virginia Beach, Virginia. (Figure 3.12-1).	The geographic analysis area would be the same as the demographic, employment, and economic characteristics analysis area, as these cities, and environmental justice communities located within are the most likely to experience impacts from the proposed Project.
Finfish, invertebrates, and essential fish habitat	The Northeast Shelf Large Marine Ecosystem (LME),[2] which extends from the southern edge of the Scotian Shelf (in the Gulf of Maine) to Cape Hatteras,	This area is likely to capture the majority of the movement range for most species in this group.

Resource	Geographic Analysis Area	Rationale
	North Carolina, and Southeast Shelf Large Marine Ecosystem, which extends from Cape Hatteras to Florida. The northern portion of the geographic analysis area includes only U.S. waters (Figure 3.13-1).	
Land use and coastal infrastructure	City of Chesapeake, City of Hampton, City of Newport News, City of Norfolk, City of Portsmouth, and City of Virginia Beach, Virginia, and municipal boundaries surrounding the ports that may be used for the Project (Figure 3.14-1).	These areas encompass locations where BOEM anticipates direct and indirect impacts associated with proposed onshore facilities and ports.
Marine mammals	The Scotian Shelf, Northeast Shelf, and Southeast Shelf Large Marine Ecosystems (Figure 3.15-1).	This area is likely to capture the majority of the movement range for all species in this group.
Navigation and vessel traffic	Coastal and marine waters within 10 miles (16.1 kilometers) of the Offshore Project area, as well as waterways leading to ports that may be used by the Project (Figure 3.16-1).	These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction, operations and maintenance, and conceptual decommissioning.
Other uses	**Aviation and Air Traffic, Military and National Security, and Radar Systems:** Areas within 10 miles (16.1 kilometers) of the Offshore Export Cable Route Corridor, Interconnection Cable Route Corridor, Onshore Export Cable Route Corridor, and Wind Turbine Area and Lease Area, as well as Norfolk International Airport; Newport News/Williamsburg International Airport; U.S. Naval Air Station, Norfolk; Naval Air Station Oceana; Naval Auxiliary Landing Field Fentress; and Dam Neck Annex, Virginia Beach (Figure 3.17-1). **Cables and Pipelines:** Areas within 1 mile (1.6 kilometers) of the Offshore Export Cable Route Corridor, Interconnection Cable Route Corridor, Onshore Cable Route Corridor, Wind Turbine Area, and the Lease Area that could affect future siting or operation of cables and pipelines (Figure 3.17-1). **Scientific Research and Surveys:** Same analysis area as finfish, invertebrates, and essential fish habitat (Figure 3.17-1). **Marine Minerals:** Areas within 0.25 mile (0.4 kilometer) of the offshore corridor and WTA that could affect marine minerals extraction (Figure 3.17-1).	These areas encompass locations where BOEM anticipates direct and indirect impacts associated with Project construction, operations and maintenance, and conceptual decommissioning.

Resource	Geographic Analysis Area	Rationale
Recreation and tourism	The geographic analysis area includes the 40-mile (64.4-kilometer) visual analysis area measured from the borders of the Wind Turbine Area (Figure 3.18-**1**).	This geographic analysis area was selected to coincide with the CVOW-C visual impact assessment visual analysis area corresponding to the theoretical limits of project visibility.
Sea turtles	The Northeast and Southeast Shelf Large Marine Ecosystems (Figure 3.19-1).	This area is likely to capture the majority of the movement range for all species in this group.
Scenic and visual resources	The geographic analysis area includes the 40-mile (64.4-kilometer) visual analysis area measured from the borders of the Wind Turbine Area (Figure 3.20-1).	This geographic analysis area was selected to coincide with the CVOW-C visual impact assessment visual analysis area to address Project visibility from sensitive resources and encompass all locations where BOEM anticipates direct and indirect impacts associated with Project construction, operations and maintenance, and conceptual decommissioning.
Water quality	**Offshore**, the geographic analysis area includes the coastal and marine waters within a 10-mile (16-kilometer) buffer around the Offshore Project area and a 15.5-mile (25-kilometer) buffer around the ports that may be used by the Project. **Onshore,** the geographic analysis area includes any sub-watershed that is intersected by the Onshore Project area (Figure 3.21-1).	The offshore geographic analysis area accounts for some transport of water masses due to ocean currents. The onshore geographic analysis area was chosen to capture the extent of the natural network of waterbodies that could be affected by construction and operation activities of the proposed project.
Wetlands	Subwatersheds that intersect the Onshore Project area (Figure 3.22-1).	This area encompasses all wetlands and surface waters that are most likely to experience impacts from the proposed Project.

[1] Includes landfalls, onshore export cable route corridors, onshore substations, grid interconnections, and O&M facility.

[2] Large Marine Ecosystems are delineated based on ecological criteria including bathymetry, hydrography, productivity, and trophic relationships among populations of marine species, and the National Oceanic and Atmospheric Administration uses them as the basis for ecosystem-based management.

F.2. Ongoing and Planned Activities

This section includes a list and description of ongoing and planned activities that could contribute baseline conditions and trends within the geographic analysis area for each resource topic analyzed in this EIS. Projects or actions that are considered speculative per the definition provided in 43 Code of Federal Regulations (CFR) 46.30[1] are noted in subsequent tables but excluded from the cumulative impact analysis in Chapter 3 of the EIS.

Ongoing and planned activities described in this section consist of 10 types of actions: (1) other offshore wind energy development activities; (2) undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); (3) tidal energy projects; (4) marine minerals use and ocean-dredged material disposal; (5) military use; (6) marine transportation; (7) fisheries use and management; (8) global climate change; (9) oil and gas activities; (10) onshore development activities; and (11) research, monitoring, and survey activities.

BOEM analyzed the possible extent of future other offshore wind energy development activities on the Atlantic Outer Continental Shelf (OCS) to determine reasonably foreseeable cumulative effects measured by installed power capacity. Table F2-1 in Attachment 2 represents the status of projects as of August 1, 2022. The methodology for developing the scenario is the same as for the Vineyard Wind 1 project and details of the scenario development are described in the Vineyard Wind 1 Final EIS (BOEM 2021e).

F.2.1 Offshore Wind Energy Development Activities

F.2.1.1. Site Characterization Studies

A lessee is required to provide the results of site characterization activities with its site assessment plan (SAP) and Construction and Operations Plan (COP). Lessees have up to 5 years to perform site characterization activities before they must submit a COP (30 CFR 585.235(a)(2)). For the purposes of the cumulative effects analysis, BOEM makes the following assumptions for survey and sampling activities:

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

[1] 43 CFR 46.30 – Reasonably foreseeable future actions include those federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision. The federal and non-federal activities that BOEM must take into account in the analysis of cumulative impacts include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified by BOEM. Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite.

Table F-2 describes the typical site characterization surveys, the types of equipment and method used, and which resources the survey information would inform.

Table F-2 Site Characterization Survey Assumptions

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

Source: BOEM (2016).

F.2.1.2. Site Assessment Activities

After SAP approval, a lessee can evaluate the meteorological conditions, such as wind resources, with the approved installation of meteorological towers and buoys. Meteorological buoys have become the preferred meteorological and oceanographic (metocean) data collection platform for developers, and BOEM expects that most future site assessments will use buoys instead of towers (BOEM 2021f). The installation and operation of meteorological buoys involves substantially less activity and a much smaller footprint than the construction and operation of a meteorological tower. Site assessment activities have been approved or are in the process of being approved for multiple lease areas consisting of one to three meteorological buoys per SAP (Table F2-1 in Attachment 2). Site assessment would likely take place starting within 1 to 2 years of lease execution, because preparation of an SAP (and subsequent BOEM review) takes time. The No Action Alternative and cumulative analyses consider these site assessment activities.

F.2.1.3. Construction and Operation of Offshore Wind Facilities

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

F.2.2 Commercial Fisheries Cumulative Fishery Effects Analysis

Table F-3 details the future construction of offshore wind projects from Maine to North Carolina including Atlantic Shores South and Ocean Wind 2 that are proposed offshore New Jersey adjacent to Ocean Wind, and Empire Wind 1 and Empire Wind 2 that are proposed offshore New York. Also included are all of the projects currently in various stages of planning within BOEM's offshore leases from Massachusetts to North Carolina, including the future development of Atlantic Shores North. Projected construction dates for each offshore wind project are listed in Table F2-1 in Attachment 3, and each project will require a National Environmental Policy Act (NEPA) process with an EIS or environmental assessment prior to approval.

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

Note that the Kitty Hawk Offshore Wind and Kitty Hawk South projects are included despite their location in the National Marine Fisheries Service (NMFS) South Atlantic Region. Fishing vessels operating in fisheries managed by the NMFS Greater Atlantic Regional Office regularly harvest in this area. It is also likely that vessels participating in fisheries managed by the NMFS Southeast Regional Office will be affected by the Kitty Hawk Offshore Wind and Kitty Hawk South projects, although revenues from these fisheries have not been included in the Fishery Management Plan Revenue Exposure Analysis (BOEM 2020).

BOEM assumes proposed offshore wind projects will include the same or similar components as the proposed Project: wind turbines, offshore and onshore cable systems, offshore substations (OSSs), onshore O&M facilities, and onshore interconnection facilities. BOEM further assumes that other potential offshore wind projects will employ the same or similar construction, O&M, and conceptual decommissioning activities as the proposed Project. However, future offshore wind projects would be subject to evolving economic, environmental, and regulatory conditions. Lease areas may be split into multiple projects, expanded, or removed, and development within a particular lease area may occur in phases over long periods of time (e.g., Kitty Hawk Offshore Wind and Kitty Hawk South). Research currently being conducted in combination with data gathered regarding physical, biological, socioeconomic, and cultural resources during development of initial offshore wind projects in the United States could affect the design and implementation of future projects, as could advancements in technology. For the cumulative impact analysis, all proposed projects included in Table F2-1 in Attachment 2 are analyzed in Chapter 3 of this EIS. For a list of mitigation measures that were considered in the impact analysis in Chapter 3 of this EIS, please see EIS Appendix H, *Mitigation and Monitoring*.

Table F-3 Offshore Wind Project Construction Schedule (dates shown as of June 20, 2023)

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
NE Aquaventis (Maine state waters)	-	-	-	-	2	-	-	-	-	-	-
Total Other State Waters Projects	-	-	-	-	2	-	-	-	-	-	-
Estimated Other State Waters Construction Total	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**2**	**2**	**2**	**2**
EXISTING AND ONGOING PROJECTS											
Block Island (Rhode Island state waters)	5	-	-	-	-	-	-	-	-	-	-
Vineyard Wind 1, part of OCS-A 0501	-	-	-	63	-	-	-	-	-	-	-
South Fork, OCS-A 0517	-	-	-	13	-	-	-	-	-	-	-
CVOW, OCS-A 0497	2	-	-	-	-	-	-	-	-	-	-
Estimated Existing and Ongoing Project Construction Total	**7**	**0**	**0**	**76**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**7**	**7**	**7**	**83**	**83**	**83**	**83**	**83**	**83**	**83**
PLANNED PROJECTS											
Massachusetts/Rhode Island Region											
Sunrise Wind, OCS-A 0487	-	-	-	-	95	-	-	-	-	-	-
Revolution Wind, part of OCS-A 0486	-	-	-	-	102	-	-	-	-	-	-
New England Wind OCS-A 0534 and portion of OCS-A-501 (Phase 1 [i.e., Park City Wind)	-	-	-	-	64	-	-	-	-	-	-
New England Wind OCS-A 0534 and portion of OCS-A-501 (Phase 2 [i.e., Commonwealth Wind)	-	-	-	-	-	66	-	-	-	-	-
SouthCoast Wind OCS-A 0521	-	-	-	-	149	-	-	-	-	-	-
Beacon Wind 1, part of OCS-A 0520	-	-	-	-	-	-	78	-	-	-	-
Beacon Wind 2, part of OCS-A 0520	-	-	-	-	-	-	-	79	-	-	-
Bay State Wind, part of OCS-A 0500	-	-	-	-	-	-	96	-	-	-	-

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
OCS-A 0500 remainder	-	-	-	-	-	-	119	-	-	-	-
OCS-A 0487 remainder	-	-	-	-	-	-	-	-	-	-	-
Vineyard Wind Northeast [formerly Liberty Wind], OCS-A 0522	-	-	-	-	-	-	160	-	-	-	-
Estimated Massachusetts/Rhode Island Construction Total	**0**	**0**	**0**	**0**	**410**	**66**	**453**	**79**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**0**	**410**	**476**	**929**	**1,008**	**1,008**	**1,008**
New York/New Jersey Region											
Atlantic Shores South, OCS-A 0499	-	-	-	-	-	11	200	-	-	-	-
Atlantic Shores North, OCS-A 0549	-	-	-	-	-	-	165	-	-	-	-
Ocean Wind 1, part of OCS-A 0498	-	-	-	-	101	-	-	-	-	-	-
Ocean Wind 2, part of OCS- A 0532	-	-	-	-	-	-	111	-	-	-	-
Empire Wind 1, part of OCS-A 0512	-	-	-	58	-	-	-	-	-	-	-
Empire Wind 2, part of OCS-A 0512	-	-	-	91	-	-	-	-	-	-	-
OW Ocean Winds East LLC, OCS-A 0537[1]	-	-	-	-	-	-	82	-	-	-	-
Attentive Energy LLC OCS-A 0538[1]	-	-	-	-	-	-	102	-	-	-	-
Bight Wind Holdings, LLC OCS-A 0539[1]	-	-	-	-	-	-	148	-	-	-	-
Atlantic Shores Offshore Wind Bight, LLC OCS-A 0541[1]	-	-	-	-	-	-	95	-	-	-	-
Invenergy Wind Offshore LLC, OCS-A 0542[1]	-	-	-	-	-	-	99	-	-	-	-
Vineyard Mid-Atlantic LLC, OCS-A 0544[1]	-	-	-	-	-	-	104	-	-	-	-
Estimated New York/New Jersey Construction Total	**0**	**0**	**0**	**149**	**101**	**11**	**1,106**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**149**	**250**	**261**	**1,367**	**1,367**	**1,367**	**1,367**

Project/Region	Number of Foundations										
	Before 2021	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030 and Beyond
Delaware/Maryland Region											
Skipjack, part of OCS-A 0519	-	-	-	-	17	-	-	-	-	-	-
US Wind/Maryland Offshore Wind, part of OCS-A 0490	-	-	-	-	125	-	-	-	-	-	-
GSOE I, OCS-A 0482	-	-	-	96	-	-	-	-	-	-	-
OCS-A 0519 remainder	-	-	-		-	-	-	-	-	-	-
Estimated Delaware/Maryland Construction	**0**	**0**	**0**	**96**	**142**	**0**	**0**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**96**	**238**	**238**	**238**	**238**	**238**	**238**
South Atlantic Region											
CVOW-C, OCS-A 0483	-	-	-	205	-	-	-	-	-	-	-
Kitty Hawk North, OCS-A 0508	-	-	-	-	-	-	70	-	-	-	-
Kitty Hawk Wind South, OCS-A 0508 remainder	-	-	-	-	-	-	123	-	-	-	-
TotalEnergies Renewables Wind, OCS-A 0545							65	-	-	-	-
Duke Energy Renewables Wind, OCS-A 0546							65	-	-	-	-
Estimated annual South Atlantic Construction Total	**0**	**0**	**0**	**205**	**0**	**0**	**323**	**0**	**0**	**0**	**0**
Estimated O&M Total	**0**	**0**	**0**	**0**	**205**	**205**	**205**	**528**	**528**	**528**	**528**
Total											
Estimated Total construction	**7**	**0**	**0**	**526**	**655**	**77**	**1,882**	**79**	**0**	**0**	**0**
Estimated O&M Total	**0**	**7**	**7**	**7**	**533**	**1,188**	**1,265**	**3,147**	**3,226**	**3,226**	**3,226**

[1] BOEM recognizes that the estimates presented within this cumulative analysis are likely high, conservative estimates; however, BOEM believes that this analysis appropriately captures the potential cumulative impacts and errs on the side of maximum impacts.
[2] New England Wind Phase I and Phase 2 would collectively have no more than 130 foundations, and the maximum number of foundations for Phase I would be 64.
[3] Beacon Wind 1 and Beacon Wind 2 would collectively have no more than 157 foundations. BOEM made the assumption to split the foundation numbers evenly across both projects.
CVOW = Coastal Virginia Offshore Wind; GSOE = Garden State Offshore Energy

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

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

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

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

F.2.4 South Carolina Activities

BOEM held a Regional Carolina Task Force meeting on July 21, 2021. The meeting focused on:

- Past and present of Carolina Long Bay offshore wind development;
- Approach for possible offshore South Carolina lease sale; and
- Discussion with federal, tribal, state, and local government officials.

The meeting outlined the basic principles and major decision points BOEM is considering for offshore renewable energy leasing in the Carolina Long Bay area of South Carolina. The meeting also provided a forum for discussion and information to ensure BOEM is informed about regional Task Force members' interests and provided opportunities for public input about the topics being considered by the Task Force. BOEM is also conducting environmental studies offshore South Carolina including ecological baseline studies, and has completed other studies of the Mid-Atlantic region including evaluation of visual impacts on cultural resources in the North Atlantic, Mid-Atlantic, and Florida Straits.

BOEM announced a lease sale for two lease areas in the Carolina Long Bay, and on May 11, 2022, BOEM held an offshore wind auction for the two lease areas (BOEM 2022). The lease areas were awarded to Total Energies Renewables USA, LLC (OCS-A 0545) (54,937 acres) and Duke Energy Renewables Wind, LLC (OCS-A 0546) (55,154 acres) (DOI 2022).

F.2.5 Undersea Transmission Lines, Gas Pipelines, and Other Submarine Cables

Anthropogenic hazards, including in-service and abandoned submarine telecommunication cables that may be present in the offshore export cable corridor and in the vicinity of the Lease Area, will be identified through the geophysical and geotechnical (G&G) survey campaigns were conducted in 2020 and 2021, and additional campaigns are scheduled to be conducted for the Lease Area. Based on general knowledge of the Offshore Project area and prior survey efforts associated with the Project and the adjacent CVOW Pilot Project, Dominion Energy anticipates anthropogenic hazards to be present in the Offshore Project area to some capacity. In-depth descriptions of anthropogenic hazards will be provided in the supplemental filing once the future G&G survey campaigns have been completed.

F.2.6 Dredging and Port Improvement Projects

The following dredging projects have been proposed or studied at ports that may be used by the Project in Virginia and South Carolina, and are either in operation or are considered reasonably foreseeable:

- A channel deepening project at the Port of Virginia is currently underway with the U.S. Army Corps of Engineers (USACE) and a private contractor engaged in dredging approximately 1.1 million cubic yards (841,010 cubic meters) of sediment from the federal channel in Norfolk Harbor and Newport News, Virginia (USACE 2019a). The project is anticipated to be completed in 2024, resulting in a channel depth of over 50 feet (15 meters) in the harbor, which will allow it to accommodate two ultra-large container vessels simultaneously (Virginia Port Authority 2021). The Norfolk dredging project is anticipated to be completed by 2024 (Port of Virginia 2022).
- In 2017, the 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. The project also involves widening a turning basin in the port. The project will support and enhance the military readiness of Charleston harbor and joint base Charleston and allow Post-Panamax vessels to call upon the harbor (USACE 2021b). The Port of Charleston dredging project is anticipated to be completed in 2022 (South Carolina Ports 2022).
- The Thimble Shoal Channel Widening and Dredging Project has been ongoing since 2019 (USACE 2019b; Weeks Marine Inc. 2021. The Project includes dredging to a depth of 55 feet (16.7 meters) and widening the channels from 1,000 feet (305 meters) to 1,300–1,400 feet (396–427 meters) (USACE 2022). As of March 2023 Thimble Shoal West Channel deepening work was 99 percent finished with full completion expected in 3Q 2023; Thimble Shoal East Channel dredging was 90 percent complete with full completion expected 1Q 2024 (*Royal Examiner* 2023). Dredge material has been disposed of in the Dam Neck Ocean Disposal Site (DNODS) and Craney Island Dredged Material Management Area (CIDMMA), The DNODS has an area of approximately 9 square nautical miles (17 square kilometers) located in federal waters due east of the Dam Neck/Virginia Beach section of the Virginia coast and approximately 7 nautical miles (12 kilometers) south and east of the Chesapeake Bay. Water depth within the DNODS averages approximately -40 feet (-12 meters) mean lower low water. The CIDMMA is a 2,500-acre (1,012-hectare) upland confined dredged material placement facility located in the City of Portsmouth, Virginia. (USACE 2022a).
- The Atlantic Ocean Channel (Southern Approach) Phase I/Phase II Dredging Project is scheduled to commence in 2023 (USACE 2022c) The Atlantic Ocean Channel is located in the Atlantic Ocean east of the mouth of the Chesapeake Bay. The channel is approximately 10 statute miles (16 kilometers) long and 1,300 feet (427 meters) wide. The Phase I/Phase II Project includes dredging to a depth of 59 feet (18 meters) (USACE 2022a). Dredged material is to be disposed of in the CIDMMA and DNODS disposal areas (USACE 2022b).

F.2.7 Marine Minerals Use and Ocean-Dredged Material Disposal

The closest lease requests in BOEM’s Marine Minerals Program for sand borrow areas for beach replenishment are by the Department of the Army/Corps of Engineers and Maryland Department of Natural Resources for Ocean City Maryland (Weaver Shoal) with a requested volume of 1,300,000 cubic yards (993,921 cubic meters); and by Dare County, North Carolina (Towns of Duck, Southern Shores, Kitty Hawk, and Kill Devil Hills) for a requested volume of 6,600,000 cubic yards (5,046,062 cubic meters) (BOEM 2021c). One project, USACE Norfolk District and City of Virginia Beach, Virginia, for renourishment of beach along the Sandbridge Beach, Virginia Beach, Virginia Shoreline (volume

2,200,000 cubic yards [1,682,020 cubic meters]) has been completed, and an active project in Carteret County, North Carolina (Bogue Banks beaches, including Emerald Isle, Indian Beach, Salter Path, Pine Knoll Shores, and Atlantic Beach), with a volume of 2,000,000 cubic yards (1,529,110 cubic meters), commenced operation in March 2019 and is expected to operate through calendar year 2022.

To help meet the sand resource needs of coastal communities, BOEM-funded reconnaissance, and design-level OCS studies along the East Coast from Rhode Island to Florida have identified potential future sand resources in many areas. Sand resources identified nearest the Project include OCS locations offshore of all of the beaches noted above; many of these potential sand resources are located within 5 miles of the Project Lease Area and associated planned infrastructure (e.g., export cables).

The U.S. Environmental Protection Agency (USEPA) Region 3 (including Delaware, Maryland, Pennsylvania, and Virginia), and USEPA Region 4 (including North Carolina and South Carolina) are responsible for designating and managing ocean disposal sites for materials offshore in the region of the Project. The USACE issues permits for ocean disposal sites; all ocean sites are for the disposal of dredged material permitted or authorized under the Marine Protection, Research, and Sanctuaries Act (16 United States Code [USC] 1431 et seq. and 33 USC 1401 et seq.). There are two active projects along the Virginia Coast with dredge disposal sites located offshore Norfolk, Virginia (Norfolk site) and Virginia Beach, Virginia (Dam Neck site) (USACE 2021).

F.2.8 National Security and Military Use

The Lease Area is within the Virginia Capes Range Complex and the Virginia Capes Operating Area (OPAREA). The Virginia Capes (VACAPES) Range Complex is comprised of the VACAPES OPAREA, which is located offshore of the states of Virginia, North Carolina, Maryland, and Delaware. The VACAPES OPAREA consists of surface and subsurface waters, special use airspace, mobile targets and target control facilities, and instrumentation facilities. The facility is a designated air traffic control facility, and is required to provide air traffic separation consistent with the guidelines used by Federal Aviation Administration controllers. The VACAPES OPAREA extends from the shoreline seaward to approximately 200 miles (322 kilometers) from land at its farthest point; the subsurface portion of the VACAPES OPAREA has the same boundaries as the surface water portion. This Range Complex is used for the U.S. Atlantic Fleet training and testing exercises and supports training and testing by other services, primarily the U.S. Air Force; the AEGIS Combat Systems Center (ACSC) is also located in this area. Instrumented areas within the Range Complex include the Oceana Tactical Aircrew Training System (TACTS) Range; Warning Areas within the Range Complex include Warning Area 50 (W-50) and Warning Area 72 (W-72). The Range Complex is controlled by the Fleet Area Control and Surveillance Facility Virginia Capes, Naval Air Station, Oceana. Subsurface, surface, and surface to air exercises are conducted in the VACAPES OPAREA. Naval operations include Naval Air Station Oceana and Naval Air Station Dam Neck Annex in the City of Virginia Beach and Naval Auxiliary Landing Field Fentress in the City of Chesapeake.

The cable landing location would be adjacent to the existing CVOW-Pilot Project landing location and at a proposed parking lot west of the State Military Reservation (SMR) firing range (formerly known as Camp Pendleton). Dominion Energy is negotiating with the Virginia Department of Military Affairs-Virginia Army National Guard (VDMA-VaARNG) on the easement agreement, which would be determined prior to BOEM’s COP Authorization.

The proposed Harpers Switching Station would be located at the NAS Oceana Parcel, pending Navy approval, which would be determined prior to BOEM’s COP authorization.

F.2.9 Marine Transportation

Marine transportation in the region is diverse and sourced from many ports and private harbors. Commercial vessel traffic in the region includes research, tug/barge, liquid tankers (such as those used for liquid petroleum), cargo, military and search-and-rescue vessels, and commercial fishing vessels. Recreational vessel traffic includes cruise ships, sailboats, and charter boats. A number of federal agencies, state agencies, educational institutions, and environmental non-governmental organizations participate in ongoing research offshore including oceanographic, biological, geophysical, and archaeological surveys. The Mid-Atlantic Regional Planning Body (RPB) (comprising Delaware, Maryland, New Jersey, New York, Pennsylvania, and Virginia as well as federally recognized Tribes) anticipates that regional commercial shipping may increase and navigation routes may change in response to increasing demand for larger ships to transport goods (Mid-Atlantic Regional Planning Body 2016). The Port of Virginia recently completed land-side projects to expand cargo and rail capacity and a dredging project to increase depth of Norfolk Harbor to 55 feet is scheduled for completion in 2024 (Port of Virginia 2020b).

F.2.10 National Marine Fisheries Service Activities

Research and enhancement permits may be issued for marine mammals protected by the Marine Mammal Protection Act (MMPA) and for threatened and endangered species under the Endangered Species Act (ESA). NMFS is anticipated to continue issuing research permits under Section 10(a)(1)(A) of the ESA to allow take of certain ESA-listed species for scientific research. Scientific research permits issued by NMFS currently authorize studies on ESA-listed species in the Atlantic Ocean. Current fisheries management and ecosystem monitoring surveys conducted by or in coordination with the Northeast Fisheries Science Center (NEFSC) could overlap with offshore wind lease areas in the Mid-Atlantic region.

Surveys include (1) the NEFSC Bottom Trawl Survey, a more than 50-year multispecies stock assessment tool using a bottom trawl; (2) the NEFSC Sea Scallop/Integrated Habitat Survey, a sea scallop stock assessment and habitat characterization tool, using a bottom dredge and camera tow; (3) the NEFSC Surfclam/Ocean Quahog Survey, a stock assessment tool for both species using a bottom dredge; and (4) the NEFSC Ecosystem Monitoring Program, a more than 40-year shelf ecosystem monitoring program using plankton tows and conductivity, temperature, and depth units. Given the potential impacts on National Oceanic and Atmospheric Administration (NOAA) Fisheries scientific surveys resulting from offshore wind development, BOEM and NOAA have committed to addressing these impacts through the implementation of a programmatic mitigation approach that is currently under development.

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

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

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

F.2.10.2. Fisheries Use and Management

NMFS implements regulations to manage commercial and recreational fisheries in federal waters, including those within which the Project would be located; the State of Virginia regulates commercial fisheries in state waters (within 3 nautical miles [5.6 kilometers; 3.5 miles] of the coastline). Aquaculture in Virginia is permitted by the Virginia Marine Resources Commission. No shellfish aquaculture leases presently occur in the vicinity of the Virginia Beach onshore interconnection locations and no future leases are anticipated (Virginia Marine Resources Commission 2021).

The Project overlaps NMFS' Mid-Atlantic regional council that manages federal fisheries: Mid-Atlantic Fisheries Management Council (MAFMC) includes New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina ((MARCO 2016). The council manages species with many fishery management plans that are frequently updated, revised, and amended and coordinate with each other to jointly manage species across jurisdictional boundaries (MAFMC 2019). Many of the fisheries managed by the council are fished for in state waters or outside of the Mid-Atlantic region, so the council works with the Atlantic States Marine Fisheries Commission (ASMFC). ASMFC is composed of the 15 Atlantic coast states and coordinates the management of marine and anadromous resources found in the states' marine waters.

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

NMFS also manages highly migratory species (HMS), such as tuna and sharks, that can travel long distances and cross domestic boundaries. Table F-4 summarizes other fishery management plans and actions in the region.

The Maryland Department of Natural Resources (DNR) has developed Fishery Management Plans (FMPs) for Chesapeake Bay species. For coastal migratory species, the MAFMC develops management measures for species mainly found in the Exclusive Economic Zone (EEZ or 3–200 miles [5–321 kilometers] offshore). For species utilizing inshore coastal area (0-3 miles offshore), the ASMFC defines compliance requirements.

The Virginia Maritime Resources Commission – Fisheries Management Division implements state policies affecting recreational and commercial saltwater fisheries in Virginia's tidal waters. Fishery management plans for oyster, blue crab, shad and herring, striped bass, weakfish, bluefish, spotted sea trout, black drum, red drum, spot, and croaker have been completed by the Fisheries Management Division.

Table F-4 Other Fishery Management Plans

Area	Plan and Projects
Atlantic States Marine Fisheries Commission	ASMFC Five-Year Strategic Plan 2019–2023 (ASMFC 2019) ASMFC 2022 Action Plan (ASMFC 2021) Management, Policy and Science Strategies for Adapting Fisheries Management to Changes in Species Abundance and Distribution Resulting from Climate Change (ASMFC 2018)
Maryland	2015 Fishery Management Plans (Legislative Report December 2016) – Chesapeake Bay Fishery Management Plans
Virginia	Virginia Marine Resources Commission – Fisheries Management Division (2021) The Virginia Marine Resources Commission implements current and long-term state policies affecting saltwater fisheries, both recreational and commercial, in Virginia's tidal waters and conservation and enhancement of finfish and shellfish resources
Texas	The Texas Parks and Wildlife Department implements fisheries management programs including operation of hatcheries and development of artificial reefs and habitat projects (TPWD 2021)

F.2.11 Global Climate Change

Climate change results primarily from the increasing concentration of GHGs in the atmosphere, which causes planet-wide physical, chemical, and biological changes, substantially affecting the world's oceans and lands. Changes include increases in global atmospheric and oceanic temperature, shifting weather patterns, rising sea levels, and changes in atmospheric and oceanic chemistry (Blunden and Arndt 2020). Section 7.6.1.4 of the Programmatic EIS for Alternative Energy Development and Production and Alternate Use of Activities on the Outer Continental Shelf (BOEM 2007) describes global climate change with respect to assessing renewable energy development. Climate change is predicted to affect Northeast fishery species differently (Hare et al. 2016), and the NMFS biological opinion discusses in detail the potential impacts of global climate change on protected species that occur within the Proposed Action Area (NMFS 2013).

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

Table F-5 summarizes regional plans and policies that are in place to address climate change, and Table F-6 summarizes regional resiliency plans.

Table F-5 Climate Change Plans and Policies

Plans and Policies	Summary/Goal
Maryland	
The Greenhouse Gas Emissions Reduction Act 2030 GGRA Plan (February 19, 2021)	The Maryland Greenhouse Gas Emissions Reduction Act of 2016 establishes greenhouse gas emission reduction goals. The Act required the State of Maryland to adopt a final plan by 2019 that reduces statewide greenhouse gas emissions by 40% from 2006 levels by 2030. The 2020 GGRA Plan provides an implementation strategy for the 2030 greenhouse gas emissions reduction goal.
Maryland Renewable Energy Portfolio Standard	The Renewable Portfolio Standard (RPS) Program requires electricity suppliers to meet a prescribed minimum portion of their retail electricity sales with various renewable energy sources, which have been classified within the RPS Statute as Tier 1 and Tier 2 renewable sources. The program is implemented through the creation, sale, and transfer of Renewable Energy Credits (RECs).
Virginia	
Virginia Carbon Rule (June 25, 2020)	Under the Virginia Carbon Rule, Virginia is to establish a greenhouse gas cap-and-trade program and is to join the Regional Greenhouse Gas Initiative (RGGI), a regional cap-and trade program that reduces climate pollution from fossil fuel-fired power plants. The Virginia Department of Environmental Quality (DEQ) issued a Draft Report on March 11, 2022, called for by Virginia Executive Order 9 *Protecting Ratepayers from the Rising Cost of Living Due to the Regional Greenhouse Gas Initiative*, January 15, 2022 (DEQ 2022b). The Draft Report includes an attached draft *Process for Addressing EO-9 Emergency Regulation and Repeal CO_2 Emissions Trading Program*. As of July 2022, no action had been taken by VADEQ re: Virginia's participation in the RGGI.
Virginia Clean Economy Act (April 12, 2020)	The Virginia Clean Economy Act establishes an electric power RPS for Virginia electric power companies to become 100% carbon-free by 2050 and requires closure of coal-fired electric power plants, establishes energy efficiency standards, and promotes offshore wind development and solar and distributed generation.
Virginia Department of Environmental Quality Strategic Plan (2021)	The Virginia DEQ Strategic Plan establishes the Objective to support the commonwealth's resilience efforts by encouraging climate change adaptation through programmatic outreach and requirements, and strategies to make climate change adaptation an explicit, expected outcome of appropriate Virginia agency programs and initiatives. The Virginia DEQ Strategic Plan incorporates climate resilience, adaptation, and mitigation.

Plans and Policies	Summary/Goal
North Carolina	
Executive Order 80: North Carolina's Commitment to Address Climate Change and Transition to a Clean Energy Economy (October 29, 2018)	Executive Order 80 establishes climate goal for North Carolina to strive to accomplish by 2025, including: • Reduce statewide greenhouse gas emissions to 40% below 2005 levels. • Increase the number of registered, zero-emission vehicles (ZEVs) to at least 80,000. • Reduce energy consumption per square foot in state-owned buildings by at least 40% from FY 2002–2003 levels.
Executive Order 80	Executive Order 80 established the Climate Change Interagency Council to help North Carolina cabinet agencies work together to achieve goals established by the Executive Order.
Cabinet-level Plans	North Carolina Cabinet agencies have established Cabinet-level climate plans including the Clean Energy Plan, Climate Risk Assessment and Resilience Plan and Energy, Water and Utility Use Conservation Plan (Department of Environmental Quality); North Carolina Zero Emission Vehicle (ZEV) Plan (Department of Transportation); and Motor Fleet ZEV Plan (Department of Administration).

Table F-6 Resiliency Plans and Policies in the Lease Area

Plans and Policies	Summary
Maryland	
Maryland Commission on Climate Change – Adaptation and Resiliency Workgroup.	The Maryland Commission on Climate Change (MCCC), codified by legislation in 2015, is tasked with advising the Governor and General Assembly on ways to mitigate the causes of, prepare for, and adapt to the consequences of climate change, including participation in development of climate action plans. The MCCC is chaired by the Maryland Department of Environment (MDE) Secretary. The Commission is organized into four working groups: Adaptation and Resiliency; Education, Communication, and Outreach; Greenhouse Gas Mitigation; and Science and Technical. The Adaptation and Resiliency Work Group (ARWG) is charged with developing and implementing a comprehensive strategy for reducing Maryland's climate change vulnerability and providing state and local governments with tools to plan for and adapt to climate impacts such as extreme weather and sea level rise.

Plans and Policies	Summary
Virginia	
Virginia CZM Program 2020 Coastal Needs Assessments and FY 2021–2025 Strategies (Section 309)	The Virginia Coastal Zone Management (CZM) Program assesses Virginia's coastal resources and management efforts every 5 years, including coastal hazards and ocean resources. The 5-year grant strategies are applied to result in new enforceable policies to better manage high priority resources or issues; initiatives include responses to results of the Virginia CZM Program Phase I Coastal Hazards Assessment. Climate resiliency was selected by the Coastal Policy Team as a Fiscal Year (FY) 2020–2023 focal area theme to help meet the goals and needs in the statewide resiliency plan.
Virginia Clean Energy and Community Flood Preparedness Act	This Act creates a Virginia Community Flood Preparedness Fund to enhance flood prevention, protection, and coastal resilience.
North Carolina	
North Carolina Climate Risk Assessment and Resilience Plan (June 2020)	This Plan establishes the North Carolina Resilience Strategy, which is a compilation of documents organized into four elements: (1) The North Carolina Science Report, (2) State Agency Resilience Strategies, (3) Statewide Vulnerability Assessment and Resilience Strategies, and (4) the North Carolina Enhanced Hazard Mitigation Plan.
Hazard Mitigation Plan (February 2018)	The Plan identifies hazards that may affect North Carolina, and includes a Planning Process, Risk and Vulnerability Assessment, Mitigation Capability, Mitigation Strategy, and Plan Maintenance, Monitoring, and Implementation.
Texas	
Texas Coastal Resiliency Master Plan (2019)	Texas General Land Office 2019 *Texas Coastal Resiliency Master Plan* is the second installment of a statewide plan to protect and promote a vibrant and resilient Texas coast (GLO 2019). The Resiliency Master Plan identifies eight priority Issues of Concern that encompass risks and threats to the viability of coastal communities, habitats, and industries: • Altered, Degraded or Lost Habitat • Gulf Beach Erosion and Dune Degradation • Bay Shoreline Erosion • Existing and Future Coastal Storm Surge Damage • Coastal Flood Damage • Impact on Water Quality and Quantity • Impact on Coastal Resources • Abandoned or Derelict Vessels, Structures and Debris

F.2.12 Oil and Gas Activities

The proposed Project area is located in the Mid-Atlantic Planning Area of the OCS Oil and Gas Leasing Program (National OCS Program) comprising Delaware, Maryland, Virginia, and North Carolina (BOEM 2021d). There are no active oil and gas leases in the Mid-Atlantic Planning Area. On September 8, 2020, the White House issued a presidential memorandum for the Secretary of the Interior on the withdrawal of certain areas of the United States OCS from leasing disposition for 10 years, including the areas currently designated by BOEM as the South Atlantic and Straits of Florida Planning Areas (The White House 2020a). The South Atlantic Planning Area includes the OCS off South Carolina, Georgia, and northern Florida. On September 25, the White House issued a similar memorandum for the Mid-Atlantic Planning Area that lies south of the northern administrative boundary of North Carolina (The White House 2020b). This withdrawal prevents consideration of these areas for any leasing for purposes of exploration, development, or production during the 10-year period beginning July 1, 2022, and ending June 30, 2032. However, currently, there has been no decision by the Secretary of the Interior regarding future oil and gas leasing in the remainder of the Mid-Atlantic Planning Areas. Existing leases in the withdrawn areas are not affected.

BOEM issues G&G permits to obtain data for hydrocarbon exploration and production; locate and monitor marine mineral resources; aid in locating sites for alternative energy structures and pipelines; identify possible anthropogenic, seafloor, or geological hazards; and locate potential archaeological and benthic resources. G&G surveys are typically classified into categories by equipment type and survey technique. There are currently no such permit applications under review for areas offshore Maryland or North Carolina; there is one permit application for an air gun seismic survey under review for areas offshore Norfolk Virginia (BOEM 2021d).

Several liquefied natural gas (LNG) ports are located on the East Coast of the United States. Table F-7 lists existing, approved, and proposed LNG ports on the East Coast of the United States that provide (or may in the future provide) services such as natural gas export, natural gas supply to the interstate pipeline system or local distribution companies, or storage of LNG for periods of peak demand, or production of LNG for fuel and industrial use (FERC 2018).

Table F-7 Liquid Natural Gas Terminals Located in the Northeastern United States

Terminal Name	Type	Company	Jurisdiction	Distance from Project (approximate)	Status
Everett, Massachusetts	Import terminal	GDF SUEZ—DOMAC	FERC	440 miles northeast	Existing
Offshore Boston, Massachusetts	Import terminal	Neptune LNG	U.S. Department of Transportation Maritime Administration (MARAD)/USCG	440 miles northeast	Existing
Offshore Boston, Massachusetts	Import terminal, authorized to re-export delivered LNG	Excelerate Energy—Northeast Gateway	MARAD/USCG	440 miles northeast (Buoy B)	Existing
Cove Point, Maryland (Chesapeake Bay)	Import terminal Export terminal	Dominion—Cove Point LNG	FERC	142 miles northwest	Existing

Terminal Name	Type	Company	Jurisdiction	Distance from Project (approximate)	Status
Elba Island, Georgia (Savannah River)	Import terminal Export terminal	Southern LNG	FERC	450 miles southwest	Existing
Elba Island, Georgia (Savannah River)	Export terminal	Southern LNG Company	FERC	450 miles southwest	Existing
Jacksonville, Florida	Export terminal	Eagle LNG Partners	FERC	600 miles southwest	Approved, not under construction

Source: FERC (2021a, 2021b).

F.2.13 Onshore Development Activities

Onshore development activities that may contribute to cumulative impacts include visible infrastructure such as onshore wind turbines and cell towers, port development, and other energy projects such as transmission and pipeline projects. Coastal development projects permitted through regional planning commissions, counties, and towns may also contribute to cumulative impacts. These may include residential, commercial, and industrial developments spurred by population growth in the region (Table F-8).

Table F-8 Existing, Approved, and Proposed Onshore Development Activities

Type	Description
Local planning documents	• City of Virginia Beach, Virginia – *2040 Comprehensive Plan*. The City of Virginia Beach is updating the City's Comprehensive Plan. Phase I of the public engagement process (online survey) for the 2040 plan development process has been concluded; the 2040 plan development process public outreach process initiated in 2019 has been suspended since 2020 due to COVID-19 restrictions (City of Virginia Beach Planning Commission 2021a). • City of Virginia Beach. Virginia – *Virginia Beach Resort Area Strategic Action Plan 2030*. The Resort Area Strategic Action Plan (RASAP) was adopted in December 2008 and updated in June 2020. The 2020 RASAP identifies planned and projected development for the Resort Area including private sector development and public works projects such as proposed open space and stormwater management infrastructure upgrades (City of Virginia Beach 2020). • City of Virginia Beach, Virginia – *Strategic Growth Areas*. The City of Virginia Beach Strategic Growth Area (SGA) Office has identified eight SGAs in the City: Burton Station, Centerville. Hilltop, Lynnhaven, Newtown, Pembroke, Resort Area, and Rosemont. Each SGA has a long-range master plan that describes the future vision and guides policy decisions for growth and development in each area (City of Virginia Beach 2017; 2021b). • City of Chesapeake, Virginia – *2035 Comprehensive Plan*. The *Moving Forward Chesapeake 2035 Comprehensive Plan* was adopted by the City Council on February 25, 2014, and amended on November 15, 2016, and December 18, 2018. The Comprehensive Plan includes plan vision; responsible growth strategies; infrastructure, including transportation and utilities; and quality of life, including education, public facilities and services, and parks and recreation planning elements (City of Chesapeake 2018a).

Type	Description
	• City of Chesapeake, Virginia – On June 16, 2020, the City Council approved the *Great Bridge Historic Gateway Overlay District* as an amendment to the City's Zoning Ordinance. The purpose of the Overlay District is to protect and enhance the historic and cultural significance of the Great Bridge community in the City. • City of Chesapeake, Virginia – *South Norfolk Municipal Facilities Study and Development Strategy.* The City of Chesapeake conducted a study of potential municipal facilities in the study area. The municipal facilities study area map extends down Poindexter Street and reaches north on Liberty Street to 16th Street plus south on Bainbridge Boulevard by Holly Avenue (City of Chesapeake 2018b; City of Chesapeake 2018c). • City of Chesapeake, Virginia – The *Indian River Planning Area Study* evaluated current and future land use patterns, impact of land development regulations, market and economic development, and infrastructure standards in the planning area. The planning area is bounded by Interstate 64 and Military Highway to the south, the Elizabeth River to the north, and the adjacent municipalities of Norfolk and Virginia Beach on the west and east (City of Chesapeake 2021c; City of Chesapeake 2021e). • City of Portsmouth, Virginia – The *Portsmouth 2018 Comprehensive Plan* includes a Strategic Plan, Geographic Plan, and Implementation Plan for the City of Portsmouth (City of Portsmouth 2018b). • City of Newport News, Virginia – *One City, One Future 2040 Comprehensive Plan.* The 2040 Plan was adopted by City Council on August 14, 2018. The plan contains City policies on land use, urban design, transportation, housing, public facilities and services, environment, and economic development (City of Newport News 2018a; City of Newport News 2018b).
Onshore wind projects – Virginia	• According to the Virginia Division of Energy there are no onshore commercial scale wind energy projects in Virginia (Virginia Division of Energy 2021).
Onshore wind projects – Texas	• According to the U.S. Wind Turbine Database (USWTDB) Map Viewer, there are approximately 757 commercial onshore wind turbines in 11 wind turbine project areas in San Patricio and Nueces Counties, Texas (USWTDB 2022).
Communications towers – Virginia	• There are 133 towers and 804 antennas within a 3.0-mile (4.8-kilometer) radius of the Portsmouth Marine Terminal (AntennaSearch.com 2022a). • There are 49 towers and 201 antennas within a 3.0-mile (4.8-kilometer) radius of the Newport News Marine Terminal (AntennaSearch.com 2022b). • There are 103 towers and 113 antennas within a 3.0-mile (4.8-kilometer) radius of the Harpers Road Switching Station location (AntennaSearch.com 2022c). • There are 52 towers and 56 antennas within a 3.0-mile (4.8-kilometer) radius of the Fentress Substation location (AntennaSearch.com 2022d). • There are 75 towers and 186 antennas within a 3.0-mile (4.8-kilometer) radius of the proposed cable landing location (AntennaSearch.com 2022e).
Communications towers – Texas	• There are 24 towers and 90 antennas within a 3.0-mile (4.8-kilometer) radius of Ingleside Point, Ingleside, Texas (Port of Ingleside) (AntennaSearch,com 2022f) • There are 35 towers and 67 antennas within a 3.0 mile (4.8 kilometer) radius of Aransas Pass, Texas (Port Aransas) (AntennaSearch.com 2022g) • There are 69 towers and 467 antennas within a 3.0 mile (4.8 kilometer) radius of Harbor Drive, Corpus Christi, Texas (Port of Corpus Christi) (AntennaSearch.com 2022h)

Type	Description
Development projects	• Naval Air Station Oceana Future Base Design – The U.S. Navy and City of Virginia Beach signed an agreement in August 2021 to explore potential commercial leases of land within Naval Air Station Oceana. Under the Future Base Design approximately 350–400 acres (142–162 hectares) could be leased and developed by the private sector (WVEC-TV 2021; WAVY.com 2020). The U.S. Navy estimated that the plan would be implemented over the next 5–7 years. • Naval Auxiliary Landing Field Fentress Encroachment Protection Acquisition Program—The City of Chesapeake (2021d) has identified properties in the vicinity of Naval Auxiliary Landing Field Fentress for acquisition to manage potential land use encroachment conflicts. Specific parcels have been identified for potential acquisition; acquisitions have been conducted subject to available funding (City of Chesapeake (2019).
Port studies/ upgrades – Virginia	A study commissioned by the Virginia Department of Mines Minerals and Energy and published in 2015 evaluated ten Virginia ports for their readiness to accommodate offshore wind manufacturing and construction activities and also evaluated five commercial shipyards for their readiness to manufacture offshore electrical substations. Using requirements including water side infrastructure, onshore infrastructure, and access requirements, five ports in Virginia more identified with a high level of readiness to support offshore wind, including the following: • Portsmouth Marine Terminal • Newport News Marine Terminal (Virginia Port Authority 2022) • Peck Marine Terminal • Virginia Renaissance Center (Jacoby Development 2017) • BASF Portsmouth Portsmouth and Newport News Marine Terminals were identified by the study team to have the highest level of port readiness due to the ample space available to accommodate multiple co-located offshore wind construction and deployment activities (BVG Associates 2015). In January 2020, the State of Virginia leased 40 acres of land within the Portsmouth Marine Terminal to Ørsted to support the CVOW-C Project (*Virginian Pilot* 2020a). The Portsmouth Marine Terminal was temporarily closed to shipping in April 2020 in response to COVID-19 restrictions (*Virginian Pilot* 2020b; Port of Virginia 2020a). The State of Virginia plans to invest $40 million from its 2021 budget to upgrade the Portsmouth Marine Terminal, near Norfolk, Virginia to handle offshore wind manufacturing, handling, and transportation (Reuters 2021).
Port studies/ upgrades – Texas	The Channel Improvement Project for the Port of Corpus Christi, Texas, will increase the channel depth from -47 feet MLLW to -54 feet MLLW and widen it to 530 feet, with an additional 400 feet of barge shelves. The proposed budget of $157.3 million is the largest single-year budgetary allocation from the federal government compared to prior years' budgets. The project has received nearly $250 million in federal appropriations to USACE thus far, with the Port of Corpus Christi appropriating another $190 million in cost share funds. The Channel Improvement Project is a four-phase project, with Phase 1 completed and Phases 2 and 3 under construction in 2022 (Port of Corpus Christi 2022).

F.3. Literature Cited

Abbot, Paul Scott. 2021. While Many Ports Suffer Congestion, The Port of Virginia Remains Fluid. *American Journal of Transportation.* March 8. Available: https://www.ajot.com/sponsored/article/ad-while-many-ports-suffer-congestion-the-port-of-virginia-remains-fluid. Accessed: August 6, 2021.

American Association of Port Authorities. 2016. *Port-Related Projects Awarded $61.8 Million in TIGER VIII Infrastructure Grants*. Available : https ://www.aapa-ports.org/advocating/PRDetail.aspx?ItemNumber=21393. Accessed: December 20, 2018.

AntennaSearch.com. 2021a. Tower and Antenna Database. Search address: 450 Harbor Road, Newport News, Virginia 23607. Search conducted August 11, 2021. Available: www.antennasearch.com.

———. 2021b. Tower and Antenna Database. Search address: 2000 Seaboard Avenue, Portsmouth, Virginia 23707. Search conducted August 9, 2021. Available: www.antennasearch.com.

———. 2021c. Tower and Antenna Database. Search address: 1741 Harpers Road, Virginia Beach, Virginia 23454: Search conducted July 12, 2022. Available: www.antennasearch.com.

———. 2021d. Tower and Antenna Database. Search address: 1011 Meredith, Chesapeake, Virginia 23322. Search conducted July 12, 2022. Available: www.antennasearch.com.

———. 2021e. Tower and Antenna Database. Search address: 499 Lockheed Avenue, Virginia Beach, Virginia 23451: Search conducted July 12, 2022. Available: www.antennasearch.com.

———. 2021f. Tower and Antenna Database. Search address: Aransas Pass, Texas. Search conducted July 11, 2022. Available: www.antennasearch.com.

———. 2021g. Tower and Antenna Database. Search address: Ingleside Point, Texas. Search conducted July 11, 2022. Available: www.antennasearch.com.

———. 2021h. Tower and Antenna Database. Search address: Harbor Dr., Corpus Christi, Texas. Search conducted July 11, 2022. Available: www.antennasearch.com.

Atlantic States Marine Fisheries Commission (ASMFC). 2014. *Five-Year Strategic Plan 2014–2018.* Available: http://www.asmfc.org/files/pub/2014-2018StrategicPlan_Final.pdf. Accessed: January 7, 2019.

———. 2018. *Management, Policy and Science Strategies for Adapting Fisheries Management to Changes in Species Abundance and Distribution Resulting from Climate Change*. February. Available: http://www.asmfc.org/files/pub/ClimateChangeWorkGroupGuidanceDocument_Feb2018.pdf. Accessed: January 7, 2019.

Blunden, J., and D. S. Arndt. 2020. *A Look at 2019: Takeaway Points from the State of the Climate.* Available: https://scholar.google.com/scholar?q=Blunden+and+Arndt+2020&hl=en&as_sdt=0&as_vis=1&oi=scholart. Accessed: August 15, 2022.

Bureau of Ocean Energy Management (BOEM). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf.* Available: https://www.boem.gov/Guide-To-EIS/. Accessed: January 1, 2019.

———. 2016. *Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New York*. OCS EIS/EA BOEM 2016-070. October 2016.

———. 2019. *National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Continental Shelf.* U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Sterling, VA. OCS Study 2019-036.

———. 2020. *Fishery Management Plan Revenue Exposure Analysis*. Revenue exposure by Fishery Management Plan for calendar years 2020 through 2030 based on data provided by National Marine Fisheries Service.

———. 2021a. *South Fork Wind Farm and South Fork Export Cable Project Draft Environmental Impact Statement.* OCS EIS/EA, BOEM 2020-057. January.

———. 2021b. Submitted Atlantic OCS Region Permit Requests. Available : https ://www.boem.gov/submitted-atlantic-ocs-region-permit-requests. Accessed: August 6, 2021.

———. 2021c. *Marine Minerals – Requests and Active Leases*. Available: https://www.boem.gov/marine-minerals/requests-and-active-leases. Accessed: August 5, 2021.

———. 2021d. *Atlantic OCS Facts And Figures – Offshore Natural Gas and Oil Operations*. Available : https ://www.boem.gov/oil-gas-energy/atlantic-ocs-facts-and-figures. Accessed: August 6, 2021.

———. 2021e. *Vineyard Wind 1 Offshore Wind Energy Project Final Environmental Impact Statement.* OCS EIS/EA, BOEM 2021-0012. March.

———. 2021f. *Commercial and Research Wind Lease and Grant Issuance and Associated Site Assessment Activities on the Atlantic Outer Continental Shelf of the New York Bight.* OCS EIS/EA BOEM 2021-073. December.

———. 2022. *South Carolina Activities.* Available: https://www.boem.gov/renewable-energy/state-activities/south-carolina-activities. Accessed: August 14, 2022.

BVG Associates. 2015. *Virginia Offshore Port Readiness Evaluation. Report 1: An Evaluation of 10 Virginia Ports.* A report to the Virginia Department of Mines, Minerals and Energy. April. Available: https://www.dmme.virginia.gov/de/LinkDocuments/OffshoreWind/PortsStudy-Report1.pdf. Accessed: July 22, 2021.

City of Chesapeake. 2018a. 2035 *Comprehensive Plan*. City of Chesapeake Planning Department, Adopted February 25, 2014, Amended December 21, 2021. Available: https://resources.cityofchesapeake.net/comp-plan-2035/#page=1. Accessed: July 13, 2022.

———. 2018b. *South Norfolk Municipal Facilities Study and Development Strategy*. Available: https://www.cityofchesapeake.net/government/city-departments/departments/Planning-Department/Planning-Library/South-Norfolk-Municipal-Facilities-Study-and-Development-Strategy.htm. Accessed: August 9, 2021.

———. 2018c. *South Norfolk Municipal Facilities Study*. Prepared for City of Chesapeake, Prepared by HBA, May 16, 2018. Available: https://www.cityofchesapeake.net/Assets/documents/departments/planning/South+Norfolk+Municipal+Facilities+Study+Final+Report.pdf. Accessed: August 9, 2021.

———. 2019. *FOIA Request Regarding the NALF Fentress Encroachment Protection Acquisition Program*. From Ms. Monica Wilburn Records/Freedom of Information Act Manager, City of Chesapeake Virginia, to Mr. Tom Nash. September 13, 2019.

———. 2021a. *Comprehensive Plan 2035*. City of Chesapeake Planning Department 2021. Available: https://www.cityofchesapeake.net/government/city-departments/departments/Planning-Department/movingforward-2035.htm. Accessed: August 11, 2021.

———. 2021b. *Great Bridge Historic Gateway Overlay District.* City of Chesapeake, Planning Department, March 25, 2021. Available: https://storymaps.arcgis.com/stories/4d1ebc7928ba4151af580f03e29ee6ed. Accessed: August 9, 2021.

———. 2021c. *Indian River Planning Area Study* Chesapeake, Virginia, Draft: February 2021. Available: https://www.cityofchesapeake.net/Assets/documents/departments/planning/2021IndianRiverPlan_FINAL+DRAFT.pdf. Accessed: August 11, 2021.

———. 2021d. *NALF Fentress Encroachment Protection Acquisition Program*. Available: https://www.cityofchesapeake.net/government/city-departments/departments/Planning-Department/Planning-Library/Land-Conservation/NALF-Fentress-Encroachment-Protection-Acquisition-Program.htm. Accessed: August 12, 2021.

———. 2021e. *Indian River Planning Area Study*, City of Chesapeake, Virginia, April 2021. Available: https://www.cityofchesapeake.net/Assets/documents/departments/planning/April+15+2021+Video_Indian+River+Study_Presentation.pdf. Accessed: August 11, 2021.

———. 2022. *Available Properties.* Available: https://properties.chesapeakeva.biz/?page=1&s%5BSortDirection%5D=true&s%5BradiusLat%5D=0&s%5BSizeUnits%5D=1&s%5Bradius%5D=0&s%5BradiusLng%5D=0&s%5BSortBy%5D=featured.

City of Newport News 2018a. *One City, One Future 2040 Comprehensive Plan.* City of Newport News Planning Department. August 18. Available: https://www.nnva.gov/1763/Comprehensive-Plan. Accessed: August 11, 2021.

———. 2018b. *One City, One Future 2040 Comprehensive Plan.* City of Newport News Planning Department. August 18. Available: https://www.nnva.gov/DocumentCenter/View/18190/Comprehensive-Plan-Final-Adopted.

City of Ocean City. 2019. *Master Plan Reexamination Report.* Available: https://services.ocnj.us/government/documents/department-documents/planning-department/93-2018-master-plan-re-examination-adopted-1-10-19-1/file. Accessed: July 22, 2021.

City of Portsmouth. 2018b. Portsmouth 2018 Comprehensive Plan. City of Portsmouth Virginia, 2018. Available: http://www.buildoneportsmouth.org/DocumentCenter/View/79/Build-One-Portsmouth-Adopted-11-27-2018-PDF. Accessed: August 11, 2021.

———. 2018a. *Comprehensive Plan*. Available: http://www.buildoneportsmouth.org/101/Comprehensive-Plan. Accessed: August 11, 2021.

City of Virginia Beach 2017. *8 Strategic Growth Areas*. City of Virginia Beach Planning and Community Development Department. https://www.vbgov.com/government/departments/sga/strategic-growth-areas/Pages/default.aspx. Accessed: August 11, 2021.

———. 2020. *Virginia Beach Resort Area Strategic Action Plan 2030* Adopted by Virginia Beach City Council on June 2, 2020. Available: https://www.vbgov.com/government/departments/sga/strategic-growth-areas/Documents/20_03-10%20RASAP%202030%20Update_v5b.pdf. Accessed: August 9, 2021.

———. 2021a. *2040 Comprehensive Plan Update*. City of Virginia Beach Planning Commission. Available: https://www.vbgov.com/government/departments/planning/2016ComprehensivePlan/Pages/2040-Comprehensive-Plan-Update.aspx. Accessed: August 11, 2021.

———. 2021b. *Strategic Growth Areas.* City of Virginia Beach Strategic Growth Area Office. 2021. Available: https://www.vbgov.com/government/departments/sga/Pages/about-sga.aspx. Accessed: August 9, 2021.

Department of Interior (DOI). 2022. *Biden-Harris Administration Announces Winners of Carolina Long Bay Offshore Wind Energy Auction*. May 11, 2022. Available: https://www.doi.gov/pressreleases/biden-harris-administration-announces-winners-carolina-long-bay-offshore-wind-energy. Accessed: August 14, 2022.

Federal Energy Regulatory Commission (FERC). 2012. *Order Issuing Project Pilot License.* Verdant Power, LLC. Project Number 12611-005. Available: https://www.ferc.gov/media/news-releases/2012/2012-1/01-23-12-order.pdf?csrt=4969462846396361735. Accessed: October 30, 2018.

———. 2018. Website for Liquefied Natural Gas with Listings for Existing, Approved, and Proposed LNG Import/Export Terminals. Available: https://www.ferc.gov/industries/gas/indus-act/lng.asp. Accessed: October 30, 2018.

———. 2021a. *North American LNG Export Terminals – Existing, Approved Not Yet Built, and Proposed.* Last Updated April 16, 2021. Available: https://cms.ferc.gov/media/north-american-lng-export-terminals-existing-approved-not-yet-built-and-proposed-1. Accessed: August 6, 2021.

———. 2021b. *North American LNG Import Terminals – Existing, Approved not Yet Built, and Proposed. Federal Energy Regulatory Commission*. Last Updated April 16, 2021. Available: https://cms.ferc.gov/media/north-american-lng-import-terminals-existing-approved-not-yet-built-and-proposed-1. Accessed: August 6, 2021.

Hare, J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, and R.B. Griffis. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. *PLoS ONE* 11(2): e0146756. DOI:10.1371/ journal.pone.0146756.

Hatch, S.K., E.E. Connelly, T.J. Driscoll, I.J. Stenhouse, and K.A. Williams. 2013. Offshore Observations of Eastern Red Bats (*Lasiurus borealis*) in the Mid-Atlantic United States Using Multiple Survey Methods. *PLoS ONE* 8(12):e83803. doi:10.1371/journal.pone.0083803.

Hoen, B.D., J.E. Diffendorfer, J.T. Rand, L.A. Kramer, C.P. Garrity, and H.E. Hunt. 2018. United States Wind Turbine Database (V4.0, April 9, 2021): U.S. Geological Survey, American Clean Power Association, and Lawrence Berkeley National Laboratory data release. Available: https://doi.org/10.5066/F7TX3DN0.

Intergovernmental Panel on Climate Change (IPCC). 2018. *IPCC Special Report on Impacts of Global Warming of 1.5 Degrees Celsius Above pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty: Summary for Policymakers*. Available: http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf. Accessed: November 5, 2018.

Jacoby Development. 2017. *Virginia Renaissance Center.* Available: https://www.jacobydevelopment.com/virginia.html.

Maryland Commission on Climate Change. 2020. *2020 Annual Report.* Maryland Commission on Climate Change. Submitted to the Honorable Larry Hogan, Governor and the Maryland General Assembly, November 15, 2020. Available: https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/MCCCAnnualReport2020.pdf. Accessed: August 6, 2021.

———. 2021. *Adaptation and Resiliency Working Group — 2021 Work Plan.* Available: https://mde.maryland.gov/programs/Air/ClimateChange/MCCC/Documents/ARWG%202021%20Work%20Plan.pdf. Accessed: August 6, 2021.

Maryland Department of Environment 2021. *The Greenhouse Gas Emissions Reduction Act 2030 GGRA Plan*. Maryland Department of Environment, February 19, 2021. Available: https://mde.maryland.gov/programs/Air/ClimateChange/Documents/2030%20GGRA%20Plan/THE%202030%20GGRA%20PLAN.pdf. Accessed: August 6, 2021.

Maryland Department of Natural Resources (DNR). 2016. *2015 Fishery Management Plans Report to the Legislative Committees.* Prepared by Maryland Department of Natural Resources Fishing and Boating Services Fishery Management Plan Program, December 2016. Available: https://dnr.maryland.gov/fisheries/Documents/Full_FMP_2016.pdf. Accessed: August 6, 2021.

Maryland Public Service Commission (PSC). 2021. *Maryland Renewable Energy Portfolio Standard Program – Frequently Asked Questions.* Maryland Public Service Commission, 2021. Available: https://www.psc.state.md.us/electricity/maryland-renewable-energy-portfolio-standard-program-frequently-asked-questions. Accessed: August 6, 2021.

Mid-Atlantic Fishery Management Council (MAFMC). 2019. *About the Council*. Available: http://www.mafmc.org/about/. Accessed: January 8, 2019.

Mid-Atlantic Regional Planning Body (MARCO). 2016. *Mid-Atlantic Regional Ocean Action Plan.* Mid-Atlantic Regional Council of the Ocean. November. Available: https://www.boem.gov/sites/default/files/environmental-stewardship/Mid-Atlantic-Regional-Planning-Body/Mid-Atlantic-Regional-Ocean-Action-Plan.pdf. Accessed: August 6, 2021.

National Marine Fisheries Service (NMFS). 2013. *Endangered Species Act Section 7 Consultation Biological Opinion for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf in Massachusetts, Rhode Island, New York and New Jersey Wind Energy Areas*. NER-2012-9211.

National Oceanic and Atmospheric Administration (NOAA). 1997. *Amendment 3 to the Interstate Fishery Management Plan for American Lobster*. Available: http://www.asmfc.org/uploads/file/lobsterAmendment3.pdf. Accessed: Feb 28, 2019.

New England Fishery Management Council (NEFMC). 2016. *Omnibus Essential Fish Habitat Amendment 2, Volume 6: Cumulative Effects, Compliance with Applicable Law and References*. Available: https://s3.amazonaws.com/nefmc.org/OA2-FEIS_Vol_6_FINAL_170303.pdf. Accessed: October 30, 2018.

North Carolina Department of Environmental Quality (DEQ). 2020. *North Carolina Climate Risk Assessment and Resilience Plan*. North Carolina. Department of Environmental Quality. June. Available: https://files.nc.gov/ncdeq/climate-change/resilience-plan/2020-Climate-Risk-Assessment-and-Resilience-Plan.pdf. Accessed: August 6, 2021.

———. 2021. *Climate Change & Clean Energy: Plans & Progress.* North Carolina Department of Environmental Quality. Available: https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-change-clean-energy. Accessed: August 6, 2021.

Northeast Regional Planning Body (NRPB). 2016. *Northeast Ocean Plan: Full Plan*. Available: https://neoceanplanning.org/wp-content/uploads/2018/01/Northeast-Ocean-Plan_Full.pdf. Accessed: August 30, 2018.

Port of Corpus Christi. 2022. Port of Corpus Christi Ship Channel Improvement Project Included in President Biden's Proposed FY '23 Budget, March 28, 2022. Available: https://portofcc.com/port-of-corpus-christi-ship-channel-improvement-project-included-in-president-bidens-proposed-fy-23-budget/. Accessed: May 2022.

Port of Virginia 2020a. *Portsmouth Marine Terminal*. Port of Virginia 2021. Available: https://www.portofvirginia.com/facilities/portsmouth-marine-terminal-pmt/. Accessed: August 11, 2021.

———. 2020b. *Virginia's Path to 55 feet is Set; First Phase of Dredging to Begin by January 2020.* Available: https://www.portofvirginia.com/who-we-are/newsroom/virginias-path-to-55-feet-is-set-first-phase-of-dredging-to-begin-by-january-2020/. Accessed: August 14, 2022.

———. 2022. *Final Piece of Federal Dredging Investment OK'd; Deepening Project Fully-Funded, On Schedule*. May 2022. Available: https://www.portofvirginia.com/who-we-are/newsroom/final-piece-of-federal-dredging-investment-okd-deepening-project-fully-funded-on-schedule/. Accessed: August 14, 2022.

Reuters. 2021. *US Port Spend Brings Offshore Wind Factories Closer*. Reporting by Neil Ford. Editing by Robin Sayles. Available: https://www.reutersevents.com/renewables/wind/us-port-spend-brings-offshore-wind-factories-closer. Accessed: July 22, 2021.

Royal Examiner. 2023. Virginia Making Progress on 55-ft Deep Channel and Becoming the US East Coast's Deepest Port. March 1, 2023. Available: https://royalexaminer.com/virginia-making-progress-on-55-ft-deep-channel-and-becoming-the-us-east-coasts-deepest-port/. Accessed: July 14, 2023.

State of North Carolina. 2018a. *State of North Carolina Hazard Mitigation Plan*, February 2018. Available: https://files.nc.gov/ncdps/documents/files/State%20of%20North%20Carolina%20Hazard%20Mitigation%20Plan%20Final%20As%20Adopted.pdf. Accessed: August 6, 2021.

State of North Carolina. 2018b. *Executive Order 80. North Carolina's Commitment to Address Climate Change and Transition to a Clean Energy Economy*. State of North Carolina, Office of the Governor. October 29, 2018. Available: https://files.nc.gov/ncdeq/climate-change/EO80--NC-s-Commitment-to-Address-Climate-Change---Transition-to-a-Clean-Energy-Economy.pdf. Accessed: August 6, 2021.

State of Virginia 2020. *Governor Northam Signs Clean Energy Legislation. Press Release.* State of Virginia, Office of the Governor, April 12, 2020. Available: https://www.governor.virginia.gov/newsroom/all-releases/2020/april/headline-856056-en.html. Accessed: August 6, 2021.

South Carolina Ports. 2022. *Harbor Deepening*. Available: https://scspa.com/facilities/port-expansion/harbor-deepening/. Accessed: August 14, 2022.

Texas General Land Office (GLO). 2019. Texas Coastal Resiliency Master Plan – Overview. Available: https://coastalstudy.texas.gov/resources/files/2019-coastal-master-plan-overview.pdf.

Texas Parks and Wildlife Department (TPWD). 2021. Fisheries Management at TPWD. Available: https://tpwd.texas.gov/fishboat/fish/management/.

U.S. Army Corps of Engineers (USACE). 2019a. *Dredging to Start in Norfolk Harbor Inner Channels*. U.S. Army Corps of Engineers Headquarters Website. By: Vince Little. December 26. Available: https://www.usace.army.mil/Media/News/NewsSearch/Article/2047595/dredging-to-start-in-norfolk-harbor-inner-channels/. Accessed: July 22, 2021.

U.S. Army Corps of Engineers (USACE). 2019b. *Thimble Shoal Channel Slated for Dredging after Norfolk District Award*. Andria Allmond, U.S. Army Corps of Engineers Norfolk District Public Affairs, Published March 5, 2019. Available: https://www.nao.usace.army.mil/Media/News-Stories/Article/1775378/thimble-shoal-channel-slated-for-dredging-after-norfolk-district-award/.Accessed: July 14, 2023.

U.S. Army Corps of Engineers (USACE). 2022a. *Norfolk District U.S. Army Corps of Engineers - Fy23+ Workload Forecast.* Michael R. Darrow, P.E., PMP, Deputy District Engineer for Programs and Project Management. October/November 2022. Available: https://www.nao.usace.army.mil/Portals/31/docs/business/NAO_Workload_Forecast_Oct_Nov_2022.pdf?ver=Z83SjY4f40NzXxCtvRHuNw%3D%3D. Accessed: July 14, 2023.

U.S. Army Corps of Engineers (USACE). 2022b. *Norfolk Harbor Navigation Improvements Project, Atlantic Ocean Channel and Meeting Area 1 – Proposed Maintenance and New Work Dredging, Transport, and Placement at the Dam Neck Ocean Disposal Site and the Craney Island Dredged Material Management Area.* NORFOLK DISTRICT, U.S. ARMY CORPS OF ENGINEERS, Published Feb. 28, 2022, Available: https://www.nao.usace.army.mil/Media/Public-Notices/Article/2947259/norfolk-harbor-navigation-improvements-project-atlantic-ocean-channel-and-meeti/. Accessed: July 14, 2023.

U.S. Army Corps of Engineers (USACE). 2022c. *Port of Virginia Unrestricted Navigation, USACE Norfolk District, September 2023.* Available: https://media.defense.gov/2022/Sep/23/2003083918/-1/-1/0/220923-A-YZ123-1001.JPG. Accessed: July 14, 2023.

———. 2021. Ocean Dredged Material Disposal Site Database. Available: https://odd.el.erdc.dren.mil/ODMDSSearch.cfm. Accessed: August 5, 2021.

U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. 2010. *Federal Land Managers' Air Quality Related Values Work Group (FLAG): Phase I Report—Revised (2010).* Natural Resource Report NPS/NRPC/NRR—2010/232. National Park Service, Denver, Colorado.

United States Wind Turbine Database (USWTDB). 2022. Map Viewer. Data release April 2022. United State Geological Survey, 2022. Available: https ://eerscmap.usgs.gov/uswtdb/viewer/#8.54/27.8757/-97.6055. Accessed July 11, 2022.

Verdant Power. 2018. RITE Project – FERC No. P-12611. Available: https://www.verdantpower.com/rite. Accessed: December 21, 2018.

Virginia Department of Environmental Quality (DEQ). 2021a. *Virginia Section 309 Coastal Needs Assessment.* Virginia Department of Environmental Quality, Coastal Zone Management Program. Approved by NOAA February 4, 2021. Available: https://www.deq.virginia.gov/home/showpublisheddocument/8346/637540014441970000. Accessed: August 6, 2021.

———. 2021b. *Coastal Resilience*. Available: https://www.deq.virginia.gov/coasts/coastal-resili. Accessed: August 9, 2021.

———. 2021c. *Coasts, Strategic Planning*. Virginia Department of Environmental Quality, Coastal Zone Management Program. Available: https://www.deq.virginia.gov/coasts/strategic-planning. Accessed: August 6, 2021.

———. 2021d. *Get Involved – About Us: Strategic Plan.* Available: https://www.deq.virginia.gov/get-involved/about-deq. Accessed: August 6, 2021.

———. 2022a. *Virginia Beach Development Authority.* Available: https://www.yesvirginiabeach.com/about-us/virginia-beach-development-authority.

———. 2022b. *Virginia Carbon Trading Rile and Regional Greenhouse Gas Initiative (RGGI) Participation. Cost and Benefits.* March 11, 2022. Available: https://www.deq.virginia.gov/home/showpublisheddocument/13813/637829669069026180. Accessed: August 14, 2022.

Virginia Division of Energy. 2021. *Wind Power.* Available: https://www.dmme.virginia.gov/de/WindPower2.shtml. Accessed: August 9, 2021.

Virginia Marine Resources Commission. 2021. *Fisheries Management.* Fisheries Management Division. Available: https://mrc.virginia.gov/fmac/fmoverview.shtm. Accessed: August 6. 2021.

———. 2021. *Habitat Management Permits and Applications*. Available: https://webapps.mrc.virginia.gov/public/oystergrounds/search_applications.php. Accessed: August 6, 2021.

Virginia Port Authority. 2021. *Dredging to Make Virginia the East Coast's Deepest Port is Underway*. Port of Virginia Press Release. Contact: Joseph D. Harris. Available: https://www.portofvirginia.com/who-we-are/newsroom/dredging-to-make-virginia-the-east-coasts-deepest-port-is-underway/. Accessed: July 22, 2021.

———. 2022. *Newport News Marine Terminal (NNMT).* Available: https://www.portofvirginia.com/facilities/newport-news-marine-terminal-nnmt/. Accessed: August 14, 2022.

Virginian Pilot. 2020a. Port of Virginia Leases 40 Acres to Offshore Wind Company at Portsmouth Terminal, Northam Says. By Gordon Rago. January 28. Available: https://www.pilotonline.com/business/shipyards/vp-nw-port-virginia-offshore-lease-20200128-ceubfnljhrer5dgkzfzofxcp5i-story.html. Accessed: August 11, 2021.

———. 2020b. *Citing Coronavirus, Port of Virginia to Close Portsmouth Marine Terminal for Now.* By Gordon Rago. April 16. Available: https://www.pilotonline.com/news/health/vp-nw-coronavirus-port-virginia-portsmouth-marine-terminal-20200416-kbbvid74wbfphgh5sqhkqbgr4q-story.html. Accessed: August 11, 2021

WAVY.com. 2020. *Naval Air Station Oceana Future Base Design: Making the Most of Options and Opportunities Recommendations by the CRE Consulting Corps*. Contract Number: N62470-17-D-5008, Task Order: N4008520F5274, CRE Consultants, October 2020. Available: https://www.wavy.com/wp-content/uploads/sites/3/2021/03/CRE-CC-NAS-Oceana-FBD-Report-2.pdf. Accessed: August 12, 2021.

Weeks Marine, Inc. 2021. *Norfolk Harbor Navigation Improvements – Thimble Shoal Channel West of Chesapeake Bay Bridge-Tunnel.* Weeks Marine, Inc. October 2021. Available: file:///C:/Users/27214/Downloads/9%20%20%20%20Weeks%20Thimble%20Shoals%20PPT.pdf. Accessed: July 14, 2023.

The White House. 2020a. *Memorandum on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition*. Available: https://www.whitehouse.gov/presidential-actions/memorandum-withdrawal-certain-areas-united-states-outer-continental-shelf-leasing-disposition/. Accessed: September 25, 2020.

———. 2020b. *Presidential Determination on the Withdrawal of Certain Areas of the United States Outer Continental Shelf from Leasing Disposition.* Available: https://www.whitehouse.gov/presidential-actions/presidential-determination-withdrawal-certain-areas-united-states-outer-continental-shelf-leasing-disposition/. Accessed: October 8, 2020.

WVEC-TV. 2021. *NAS Oceana, Virginia Beach Seek to Lease Out Under-Utilized Base Land to Private Developers.* Author: Mike Gooding. Published: 6:32 p.m. EDT, July 28. Available: https://www.13newsnow.com/article/news/national/military-news/nas-oceana-virginia-beach-to-lease-out-underutilized-base-land-private-developers/291-5e719e8d-a360-4989-9fc3-7ba46a6067ef. Accessed: August 12, 2021.

This page intentionally left blank.

ATTACHMENT F1
ONGOING AND FUTURE NON-OFFSHORE WIND ACTIVITY ANALYSIS

This page intentionally left blank.

Tables

Table F1-1 Summary of Activities and the Associated Impact-Producing Factors for Air Quality F1-1
Table F1-2 Summary of Activities and the Associated Impact-Producing Factors for Bats........ F1-3
Table F1-3 Summary of Activities and the Associated Impact-Producing Factors for Benthic Resources........ F1-5
Table F1-4 Summary of Activities and the Associated Impact-Producing Factors for Birds F1-10
Table F1-5 Summary of Activities and the Associated Impact-Producing Factors for Terrestrial and Coastal Fauna F1-14
Table F1-6 Summary of Activities and the Associated Impact-Producing Factors for Coastal Habitats........ F1-15
Table F1-7 Summary of Activities and the Associated Impact-Producing Factors for Commercial Fisheries and For-Hire Recreational Fishing F1-19
Table F1-8 Summary of Activities and the Associated Impact-Producing Factors for Cultural Resources........ F1-24
Table F1-9 Summary of Activities and the Associated Impact-Producing Factors for Demographics, Employment, and Economics........ F1-28
Table F1-10 Summary of Activities and the Associated Impact-Producing Factors for Environmental Justice........ F1-31
Table F1-11 Summary of Activities and the Associated Impact-Producing Factors for Finfish, Invertebrates, and Essential Fish Habitat........ F1-34
Table F1-12 Summary of Activities and the Associated Impact-Producing Factors for Land Use and Coastal Infrastructure F1-40
Table F1-13 Summary of Activities and the Associated Impact-Producing Factors for Marine Mammals F1-41
Table F1-14 Summary of Activities and the Associated Impact-Producing Factors for Navigation and Vessel Traffic F1-48
Table F1-15 Summary of Activities and the Associated Impact-Producing Factors for Other Uses: Military and National Security Uses........ F1-51
Table F1-16 Summary of Activities and the Associated Impact-Producing Factors for Other Uses: Aviation and Air Traffic F1-52
Table F1-17 Summary of Activities and the Associated Impact-Producing Factors for Other Uses: Cables and Pipelines........ F1-52
Table F1-18 Summary of Activities and the Associated Impact-Producing Factors for Other Uses: Radar Systems F1-53
Table F1-19 Summary of Activities and the Associated Impact-Producing Factors for Other Uses: Scientific Research and Surveys........ F1-53
Table F1-20 Summary of Activities and the Associated Impact-Producing Factors for Recreation and Tourism........ F1-54
Table F1-21 Summary of Activities and the Associated Impact-Producing Factors for Sea Turtles........ F1-57
Table F1-22 Summary of Activities and the Associated Impact-Producing Factors for Water Quality F1-64
Table F1-23 Summary of Activities and the Associated Impact-Producing Factors for Wetlands........ F1-67

This page intentionally left blank.

BOEM developed the following tables based on their 2019 study National Environmental Policy Act Documentation for Impact-Producing Factors in the Offshore Wind Cumulative Impacts Scenario on the North Atlantic Outer Continental Shelf (BOEM 2019), which evaluates potential impacts associated with ongoing and future non-offshore wind activities.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	Accidental releases of air toxics HAPs are due to potential chemical spills. Ongoing releases occur in low frequencies. These may lead to short-term periods of toxic pollutant emissions through surface evaporation. According to the U.S. Department of Energy, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and offshore it was up to less than 70,000 barrels.	Accidental releases of air toxics or HAPS will be due to potential chemical spills. See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. These may lead to short-term periods of toxic pollutant emissions through evaporation. Air quality impacts will be short term and limited to the local area at and around the accidental release location.
Air emissions: Construction and decommissioning	Air emissions originate from combustion engines and electric power generated by burning fuel. These activities are regulated under the CAA to meet set standards. Air quality has generally improved over the last 30 years; however, some areas in the Northeast have experienced a decline in air quality over the last 2 years. Some areas of the Atlantic coast remain in nonattainment for ozone, with the source of this pollution from power generation. Many of these states have made commitments toward cleaner energy goals to improve this, and offshore wind is part of these goals. Primary processes and activities that can affect the air quality impacts are expansions and modifications to existing fossil fuel power plants, onshore and offshore	The largest air quality impacts over the next 30 years will occur during the construction phase of any one project; however, projects will be required to comply with the CAA. During the limited construction and decommissioning phases, emissions may occur that are above *de minimis* thresholds and will require offsets and mitigation. Primary emission sources will be increased commercial vehicular traffic, air traffic, public vehicular traffic, and combustion emissions from construction equipment and fugitive emissions from construction-generated dust. As projects come online, power generation emissions overall will decline, and the industry as a whole will have a net benefit on air quality.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Air emissions: O&M	activities involving renewable energy facilities, and various construction activities.	Activities associated with operation and maintenance of onshore wind projects will have a proportionally very small contribution to emissions compared to the construction and decommissioning activities over the next 30 years. Emissions will largely be due to commercial vehicular traffic and operation of emergency diesel generators. Such activity will result in short-term, intermittent, and widely dispersed emissions and small air quality impacts.
Air emissions: Power generation emissions reductions		Many Atlantic states have committed to clean energy goals, with offshore wind being a large part of that. Other reductions include transitioning to onshore wind and solar. The No Action Alternative without implementation of other future offshore wind projects would likely result in increased air quality impacts regionally due to the need to construct and operate new energy generation facilities to meet future power demands. These facilities may consist of new natural-gas-fired power plants, coal-fired, oil-fired, or clean-coal-fired plants. These types of facilities would likely have larger and continuous emissions and result in greater regional scale impacts on air quality.
Air Emissions: Greenhouse Gases	The construction, operation, and decommissioning of offshore wind projects would produce GHG emissions (nearly all CO_2) that can contribute to climate change; however, these contributions would be minuscule compared to aggregate global emissions. CO_2 is relatively stable in the atmosphere and generally mixed uniformly throughout the troposphere and stratosphere. Hence the impact of GHG emissions does not depend upon the source location. Increasing energy production from offshore wind projects will likely decrease GHGs emissions by replacing energy from fossil fuels.	Development of future onshore wind projects will produce a small overall increase in GHG emissions over the next 30 years. However, these contributions would be very small compared to the aggregate global emissions. The impact on climate change from these activities would be very small. As more projects come online, some reduction in GHG emissions from modifications of existing fossil fuel facilities to reduce power generation. Overall, it is anticipated that there would be no cumulative impact on global warming as a result of onshore wind project activities.

% = percent; BOEM = Bureau of Ocean Energy Management; CAA = Clean Air Act; CO = carbon monoxide; final EIS = final environmental impact statement; EIS = environmental impact statement;
GHG = greenhouse gas; HAP = hazardous air pollutant; IPF = impact-producing factor; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; NOx = nitrogen oxides; O&M = operations and maintenance; $PM_{2.5}$ = particulate matter with diameters 2.5 microns or smaller; PM_{10} = particulate matter with diameters 10 microns or smaller; ppb = parts per billion; SO_2 = sulfur dioxide; USC = United States Code; USEPA = U.S. Environmental Protection Agency; VOC = volatile organic compounds.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded and would result in high-intensity, low-exposure level, long-term, but localized intermittent risk to bats in nearshore waters. Direct impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Indirect impacts (i.e., displacement from potentially suitable habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized.	Similar to ongoing activities, noise associated with pile driving activities would be limited to nearshore waters, and these high-intensity, but low-exposure risks would not be expected to result in direct impacts. Some indirect impacts (i.e., displacement from potentially suitable foraging habitats) could occur as a result of construction activities, which could generate noise sufficient to cause avoidance behavior (Schaub et al. 2008). Construction activity would be temporary and highly localized and no population-level effects would be expected.
Noise: Construction	Onshore construction occurs regularly for generic infrastructure projects in the bats geographic analysis area. There is a potential for displacement caused by equipment if construction occurs at night (Schaub et al. 2008). Any displacement would only be temporary. No individual or population-level impacts would be expected. Some bats roosting in the vicinity of construction activities may be disturbed during construction, but would be expected to move to a different roost farther from construction noise. This would not be expected to result in any impacts as frequent roost switching is a common component of a bat's life history (Hann et al. 2017; Whitaker 1998).	Onshore construction is expected to continue at current trends. Some behavioral responses and avoidance of construction areas may occur (Schaub et al. 2008). However, no injury or mortality would be expected.
Presence of structures: Migration disturbances	There may be few structures scattered throughout the offshore bats geographic analysis area, such as navigation and weather buoys and light towers (NOAA 2020a). Migrating bats can easily fly around or over these sparsely distributed structures, and no migration disturbance would be expected. Bat use of offshore areas is very limited and generally restricted to spring and fall migration. Very few bats would be expected to encounter structures on the OCS and no population-level effects would be expected.	The infrequent installation of future new structures in the marine environment of the next 30 years is expected to continue. As described under *Ongoing Activities*, These structures would not be expected to cause disturbance to migrating tree bats in the marine environment.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Turbine strikes	There may be few structures in the offshore bats geographic analysis area, such as navigation and weather buoys, turbines, and light towers (NOAA 2020a). Migrating tree bats can easily fly around or over these sparsely distributed structures, and no strikes would be expected.	The infrequent installation of future new structures in the marine environment of the next 30 years is expected to continue. As described under *Ongoing Activities*, these structures would not be expected to result in increased collision risk to migrating tree bats in the marine environment.
Land disturbance: onshore construction	Onshore construction activities are expected to continue at current trends. Potential direct effects on individuals may occur if construction activities include tree removal when bats are potentially present. Injury or mortality may occur if trees being removed are occupied by bats at the time of removal. While there is some potential for indirect impacts associated with habitat loss, no individual or population-level effects would be expected.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss and could result in injury or mortality of individuals.

EIS = Environmental Impact Statement; ESP = electrical service platform; IPF = impact-producing factors; NOAA = National Oceanic and Atmospheric Administration; OCS = outer continental shelf; ROW = right-of-way; WTG = wind turbine generator.

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

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	See Table F1-22 for a discussion of ongoing accidental releases. Accidental releases of hazmat occur periodically, mostly consisting of fuels, lubricating oils, and other petroleum compounds. Because most of these materials tend to float in seawater, they rarely contact benthic resources. The chemicals with potential to sink or dissolve rapidly often dilute to non-toxic levels before they affect benthic resources. The corresponding impacts on benthic resources are rarely noticeable.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. See previous cell and Table F1-22 on water quality for details.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on benthic resources (e.g., competitive disadvantage, smothering) depend on many factors, but can be noticeable, widespread, and permanent.	No future activities were identified within the geographic analysis area other than ongoing activities.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occurs from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. However, there does not appear to be evidence that ongoing releases have detectable impacts on benthic resources.	No future activities were identified within the geographic analysis area other than ongoing activities.
Anchoring	Regular vessel anchoring related to ongoing military, survey, commercial, and recreational activities continues to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and the potential for direct contact to cause injury and mortality of benthic resources, as well as physical damage to their habitats. All impacts are localized; turbidity is temporary; injury and mortality are recovered in the short term; and physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area other than ongoing activities.

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

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Noise: Cable laying/trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These disturbances are local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area. These disturbances would be infrequent over the next 30 years, local, temporary, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Port utilization: Expansion	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11on finfish, invertebrates, and EFH.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear are periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb, injure, or kill benthic resources, creating small, short-term, localized impacts.	Future new cables would present additional risk of gear loss, resulting in small, short-term, localized impacts (disturbance, injury).
Presence of structures: Hydrodynamic disturbance	See Table F1-11 on finfish, invertebrates, and EFH.	See Table F1-11 on finfish, invertebrates, and EFH.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes can adversely affect populations and communities of benthic resources. These impacts are local and permanent.	New cables installed in the geographic analysis area over the next 30 years would likely require hard protection atop portions of the route (see the “new cable emplacement/maintenance” row in this table). Any new towers, buoy, or piers would also create uncommon relief in a mostly flat, sandy seascape. Structure-oriented fishes could be attracted to these locations. Increased predation upon benthic resources by structure-oriented fishes could adversely affect populations and communities of benthic resources. These impacts are expected to be local and to be permanent as long as the structures remain.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables continuously provide uncommon hard-bottom habitat. A large portion is homogeneous sandy seascape but there is some other hard or complex habitat. Benthic species dependent on hard-bottom habitat can benefit on a constant basis, although the new habitat can also be colonized by invasive species (e.g., certain tunicate species). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	See above for quantification and timing. Any new towers, buoy, piers, or cable protection structures would create uncommon relief in a mostly sandy seascape. Benthic species dependent on hard-bottom habitat could benefit, although the new habitat could also be colonized by invasive species (e.g., certain tunicate species). Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: cable infrastructure	The presence of cable infrastructure, especially hard protection atop cables, causes impacts through entanglement/gear loss/damage, fish aggregation, and habitat conversion. Therefore, see those sub-IPFs within Presence of structures.	See other sub-IPFs within Presence of structures.
Discharges	The gradually increasing amount of vessel traffic is increasing the cumulative permitted discharges from vessels. Many discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated. However, there does not appear to be evidence that the volumes and extents have any impact on benthic resources.	There is the potential for new ocean dumping/dredge disposal sites in the Northeast. Impacts (disturbance, reduction in fitness) of infrequent ocean disposal to benthic resources are short term because spoils are typically recolonized naturally. In addition, the USEPA has established dredge spoil criteria and it regulates the disposal permits issued by the USACE; these discharges are required to comply with permitting standards established to ensure potential impacts on the environment are minimized or mitigated.
Cable emplacement and maintenance; Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, injury, and mortality) on benthic resources through this IPF. Dredging typically occurs only in sandy or silty habitats, which are abundant in the geographic analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little impact on benthic resources in the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IFPs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Cable emplacement and maintenance; Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have adverse impacts on some benthic resources, especially eggs and larvae, including smothering and loss of fitness. Impacts may vary based on season/time of year. Where dredged materials are disposed, benthic resources are smothered. However, such areas are typically recolonized naturally in the short term. Most sediment dredging projects have time-of-year restrictions to minimize impacts on benthic resources. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.	The USACE and private ports may undertake dredging projects periodically. Where dredged materials are disposed, benthic resources are buried. However, such areas are typically recolonized naturally in the short term. Most benthic resources in the geographic analysis area are adapted to the turbidity and periodic sediment deposition that occur naturally in the geographic analysis area.

BMP = best management practice; BOEM = Bureau of Ocean Energy Management; CO_2 = carbon dioxide; COP = Construction and Operations Plan; EFH = Essential Fish Habitat; EIS = Environmental Impact Statement; EMF = electromagnetic field; ESP = electrical service platform; G&G = Geological and Geophysical; hazmat = hazardous materials; IPF = impact-producing factors; met = meteorological;
NA = not applicable; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); USACE = U.S. Army Corps of Engineers; USEPA = U.S. Environmental Protection Agency; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	See Table F1-22 for a qualitative analysis of these risks. Ongoing releases are frequent/chronic. Ingestion of hydrocarbons can lead to morbidity and mortality due to decreased hematological function, dehydration, drowning, hypothermia, starvation, and weight loss (Briggs et al. 1997, Haney et al. 2017, Paruk et al. 2016). Additionally, even small exposures that result in feather oiling can lead to sublethal effects that include changes in flight efficiencies and result in increased energy expenditure during daily and seasonal activities including chick provisioning, commuting, courtship, foraging, long-distance migration, predator evasion, and territory defense (Maggini et al. 2017). These impacts rarely result in population-level impacts.	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the potential risk of accidental releases and associated impacts, including mortality, decreased fitness, and health effects on individuals. Impacts are unlikely to affect populations.
Accidental releases: Trash and debris	Trash and debris are accidentally discharged through onshore sources; fisheries use; dredged material ocean disposal; marine minerals extraction; marine transportation, navigation, and traffic; survey activities; and cables, lines, and pipeline laying on an ongoing basis. In a study from 2010, students at sea collected more than 520,000 bits of plastic debris per square mile. In addition, many fragments come from consumer products blown out of landfills or tossed out as litter. (Law et al. 2010). Birds may accidentally ingest trash mistaken for prey. Mortality is typically a result of blockages caused by both hard and soft plastic debris (Roman et al. 2019).	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. This may result in increased injury or mortality of individuals. However, there does not appear to be evidence that the volumes and extents would have any impact on bird populations.
Light: Vessels	Ocean vessels have an array of lights including navigational lights, deck lights, and interior lights. Such lights can attract some birds. The impact is localized and temporary. This attraction would not be expected to result in an increased risk of collision with vessels. Population-level impacts would not be expected.	Gradually increasing vessel traffic over the next 30 years would increase the potential for bird and vessel interactions. While birds may be attracted to vessel lights, this attraction would not be expected to result in increased risk of collision with vessels. No population-level impacts would be expected.
Light: Structures	Buoys, towers, and onshore structures with lights can attract birds. Onshore structures like houses and ports emit a great deal more light than offshore buoys and towers. This attraction has the potential to result in an increased risk of collision with lighted structures (Huppop et al. 2006). Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in proportion with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
New cable emplacement/ maintenance	Cable emplacement and maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be temporary and generally limited to the emplacement corridor. Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances will be temporary and limited to the emplacement corridor. Suspended sediment could impair the vision of diving birds that are foraging in the water column (Cook and Burton 2010). However, given the localized nature of the potential impacts, individuals would be expected to successfully forage in nearby areas not affected by increased sedimentation and no biologically significant impacts on individuals or populations would be expected.	Future new cables, would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in localized, short-term impacts. The FCC has two pending submarine telecommunications cable applications in the North Atlantic. Impacts would be temporary and localized, with no biologically significant impacts on individuals or populations.
Noise: Aircraft	Aircraft routinely travel in the geographic analysis area for birds. With the possible exception of rescue operations and survey aircraft, no ongoing aircraft flights would occur at altitudes that would elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.	Aircraft noise is likely to continue to increase as commercial air traffic increases; however, very few flights would be expected to be at a sufficiently low altitude to elicit a response from birds. If flights are at a sufficiently low altitude, birds may flush, resulting in non-biologically significant increased energy expenditure. Disturbance, if any, would be localized and temporary and impacts would be expected to dissipate once the aircraft has left the area.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities could result in diving birds leaving the local area. Non-diving birds would be unaffected. Any displacement would only be temporary during non-migratory periods, but impacts could be greater if displacement were to occur in preferred feeding areas during seasonal migration periods.	Same as ongoing activities, with the addition of possible future oil and gas surveys.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water could result in intermittent, temporary, localized impacts on diving birds due to displacement from foraging areas if birds are present in the vicinity of pile-driving activity. The extent of these impacts depends on pile size, hammer energy, and local acoustic conditions. No biologically significant impacts on individuals or populations would be expected.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Noise: Onshore construction	Onshore construction is routinely used in generic infrastructure projects. Equipment could potentially cause displacement. Any displacement would only be temporary and no individual fitness or population-level impacts would be expected.	Onshore construction will continue at current trends. Some behavior responses could range from escape behavior to mild annoyance, but no individual injury or mortality would be expected.
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Subsurface noise from vessels could disturb diving birds foraging for prey below the surface. The consequence to birds would be similar to noise from G&G but likely less because noise levels are lower.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Presence of structures: Entanglement, gear loss, gear damage	Each year, 2,551 seabirds die annually from interactions with U.S. commercial fisheries on the Atlantic (Sigourney et al. 2019). Even more die due to abandoned commercial fishing gear (nets)). In addition, recreational fishing gear (hooks and lines) is periodically lost on existing buoys, pilings, hard protection, and other structures and has the potential to entangle birds.	No future activities were identified within the geographic analysis area for birds other than ongoing activities.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various hard protections atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these objects. These impacts are local and can be short term to permanent. These fish aggregations can provide localized, short term to permanent, beneficial impacts on some bird species because it could increase prey species availability.	New cables, installed incrementally in the geographic analysis area for birds over the next 20 to 30 years, would likely require hard protection atop portions of the cables (see New cable emplacement/maintenance row). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are expected to be local and may be short term to permanent. These fish aggregations can provide localized, short-term to permanent beneficial impacts on some bird species due to increased prey species availability.
Presence of structures: Migration disturbances	A few structures may be scattered about the offshore geographic analysis area for birds, such as navigation and weather buoys and light towers (NOAA 2020a). Migrating birds can easily fly around or over these sparsely distributed structures.	The infrequent installation of future new structures in the marine or onshore environment over the next 30 years would not be expected to result in migration disturbances.
Presence of structures: Turbine strikes,	A few structures may be in the offshore geographic analysis area for birds, such as navigation and weather buoys, turbines, and light towers (NOAA 2020a). Given the limited number of structures	The installation of future new structures in the marine or onshore environment over the next 30 years would not be expected to result in an increase in collision

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
displacement, and attraction	currently in the geographic analysis area, individual- and population-level impacts due to displacement from current foraging habitat would not be expected. Stationary structures in the offshore environment would not be expected to pose a collision risk to birds. Some birds like cormorants and gulls may be attracted to these structures and opportunistically roost on these structures.	risk or to result in displacement. Some potential for attraction and opportunistic roosting exists, but would be expected to be limited given the anticipated number of structures.
Traffic: Aircraft	General aviation accounts for approximately two bird strikes per 100,000 flights (Dolbeer et al. 2019). Additionally, aircraft are used for scientific and academic surveys in marine environments.	Bird fatalities associated with general aviation would be expected to increase with the current trend in commercial air travel. Aircraft will continue to be used to conduct scientific research studies as well as wildlife monitoring and pre-construction surveys. These flights would be well below the 100,000 flights and no bird strikes would be expected to occur.
Land disturbance: Onshore construction	Onshore construction activity will continue at current trends. There is some potential for indirect impacts associated with habitat loss and fragmentation.	Future non-offshore wind development would continue to occur at the current rate. This development has the potential to result in habitat loss, but would not be expected to result in injury or mortality of individuals.

ADLS = Aircraft Detection Light System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; EIS = environmental impact statement; ESP = electrical service platform;
FAA = Federal Aviation Administration; FCC = Federal Communications Commission; G&G = Geological and Geophysical; GHG = greenhouse gas; IPF = impact-producing factors; m/s = meter per second; NOAA = National Oceanic and Atmospheric Administration; OCS = outer continental shelf; ROW = right-of-way; USCG = U.S. Coast Guard; WTG = wind turbine generator

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Land disturbance: Erosion and sedimentation	Periodic ground-disturbing activities contribute to elevated levels of erosion and sedimentation, but usually not to a degree that affects terrestrial and coastal fauna, assuming that industry standard BMPs are implemented.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance: Onshore construction	Periodic clearing of shrubs and tree saplings along existing utility ROWs causes disturbance and temporary displacement of mobile species and may cause direct injury or mortality of less-mobile species, resulting in short-term impacts that are less than noticeable. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, and cell tower projects also causes disturbance, displacement, and potential injury or mortality of fauna, resulting in small temporary impacts.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance: Onshore, land use changes	Periodically, undeveloped parcels are cleared and developed for human uses, permanently changing the condition of those parcels as habitat for terrestrial fauna. Continual development of residential, commercial, industrial, solar, transmission, gas pipeline, onshore wind turbine, transportation infrastructure, sewer infrastructure, and cell tower projects could permanently convert various areas.	No future activities were identified within the geographic analysis area other than ongoing activities.
Climate change: Warming and sea level rise, altered habitat/ecology	Climate change, influenced in part by greenhouse gas emissions, is altering the seasonal timing and patterns of species distributions and ecological relationships, likely causing permanent changes of unknown intensity gradually over the next 30 years.	No future activities were identified within the geographic analysis area other than ongoing activities.

BMPs = best management practices; BOEM = Bureau of Ocean Energy Management; IPF = impact-producing factors; ROW = right-of-way; WMA = wildlife management area

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	See Table F1-22 for a discussion of ongoing accidental releases. Accidental releases of fuel/fluids/hazmat have the potential to cause habitat contamination and harm to the species that build biogenic coastal habitats (e.g., eelgrass, oysters, mussels, slipper limpets, salt marsh cordgrass) from releases or cleanup activities. Only a portion of the ongoing releases contact coastal habitats in the geographic analysis area. Impacts are small, localized, and temporary.	See Table F1-22 for a discussion of accidental releases.
Accidental releases: Trash and debris	Ongoing releases of trash and debris occur from onshore sources, fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying. As population and vessel traffic increase, accidental releases of trash and debris may increase. Such materials may be obvious when they come to rest on shorelines; however, there does not appear to be evidence that the volumes and extents would have any detectable impact on coastal habitats.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.
Anchoring	Vessel anchoring related to ongoing military, survey, commercial, and recreational activities will continue to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. These impacts include increased turbidity levels and potential for direct contact to cause physical damage to coastal habitats. All impacts are localized; turbidity is short term and temporary; physical damage can be permanent if it occurs in eelgrass beds or hard bottom.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.
EMF	EMFs continuously emanate from existing telecommunication and electrical power transmission cables. New cables generating EMFs are infrequently installed in the analysis area. The extent of impacts is likely less than 50 feet from the cable, and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Light: Vessels	Navigation lights and deck lights on vessels would be a source of ongoing light. The extent of impacts is limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	Light is expected to continue to increase gradually with increasing vessel traffic over the next 30 years. The extent of impacts would likely be limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats would likely be undetectable.
Light: Structures	Ongoing lights from navigational aids and other structures onshore and nearshore. The extent of impacts is likely limited to the immediate vicinity of the lights, and the intensity of impacts on coastal habitats is likely undetectable.	No future activities were identified within the geographic analysis area for coastal habitats other than ongoing activities.
New cable emplacement/ maintenance	Ongoing cable maintenance activities infrequently disturb bottom sediments; these disturbances are local and limited to the emplacement corridor (see the Sediment deposition and burial IPF).	No future activities were identified within the geographic analysis area other than ongoing activities.
Noise: Onshore/offshore construction	Ongoing noise from construction occurs frequently near shores of populated areas in New England and the mid-Atlantic, but infrequently offshore. Noise from construction near shore is expected to gradually increase over the next 30 years in line with human population growth along the coast of the geographic analysis area. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary.	No future activities were identified within the analysis area other than ongoing activities.
Noise: G&G	Site characterization surveys and scientific surveys are ongoing. The intensity and extent of the resulting impacts are difficult to generalize, but are local and temporary.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water or through the seabed can reach coastal habitats. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Noise: Cable laying/trenching	Rare but ongoing trenching for pipeline and cable laying activities emits noise; cable burial via jet embedment also causes similar noise impacts. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.	New or expanded submarine cables and pipelines may occur in the geographic analysis area infrequently over the next 30 years. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on coastal habitats are discountable compared to the impacts of the physical disturbance and sediment suspension.
Presence of structures: Habitat conversion	Various structures, including pilings, piers, towers, riprap, buoys, and various means of hard protection, are periodically added to the seascape, creating uncommon relief in a mostly flat seascape and converting previously existing habitat (whether hard-bottom or soft-bottom) to a type of hard habitat, although it differs from the typical hard-bottom habitat in the analysis area, namely, coarse substrates in a sand matrix. The new habitat may or may not function similarly to hard-bottom habitat typical in the region (Kerckhof et al. 2019; HDR 2019). Soft bottom is the dominant habitat type on the OCS, and structures do not meaningfully reduce the amount of soft-bottom habitat available (Guida et al. 2017; Greene et al. 2010). Structures can also create an artificial reef effect, attracting a different community of organisms.	Any new cable or pipeline installed in the geographic analysis area would likely require hard protection atop portions of the route (see cells to the left). Such protection is anticipated to increase incrementally over the next 30 years. Where cables would be buried deeply enough that protection would not be used, presence of the cable would have no impact on coastal habitats.
Presence of structures: Transmission cable infrastructure	Various means of hard protection atop existing cables can create uncommon hard-bottom habitat. Where cables are buried deeply enough that protection is not used, presence of the cable has no impact on coastal habitats.	See above.
Land disturbance: Erosion and sedimentation	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term erosion and sedimentation of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.
Land disturbance: Onshore construction	Ongoing development of onshore properties, especially shoreline parcels, periodically causes short-term to permanent degradation of onshore coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Land disturbance: Onshore, land use changes	Ongoing development of onshore properties, especially shoreline parcels, periodically causes the conversion of onshore coastal habitats to developed space.	No future activities were identified within the geographic analysis area other than ongoing activities.
Cable emplacement and maintenance: Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized, short-term impacts on coastal habitats through this IPF. Dredging typically occurs only in sandy or silty habitats, which are abundant in the analysis area and are quick to recover from disturbance. Therefore, such impacts, while locally intense, have little effect on the general character of coastal habitats.	No future activities were identified within the geographic analysis area other than ongoing activities.
Cable emplacement and maintenance: Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition within coastal habitats. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. No dredged material disposal sites were identified within the geographic analysis area.	No future activities were identified within the geographic analysis area other than ongoing activities.

BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; EIS = Environmental Impact Statement; EMF = electromagnetic field; G&G = Geological and Geophysical;
IPF = impact-producing factors; OCS = Outer Continental Shelf; OECC = offshore export cable corridor; SSU = special, sensitive, and unique.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Anchoring	Impacts from anchoring occur due to ongoing military, survey, commercial, and recreational activities. The short-term, localized impact on this resource is the presence of a navigational hazard (anchored vessel) to fishing vessels.	Impacts from anchoring may occur on a semi-regular basis over the next 30 years due to offshore military operations, survey activities, commercial vessel traffic, and recreational vessel traffic. Anchoring could pose a temporary (hours to days), localized (within a few hundred meters of anchored vessel) navigational hazard to fishing vessels.
New cable emplacement/ maintenance	New cable emplacement and infrequent cable maintenance activities disturb the seafloor, increase suspended sediment, and cause temporary displacement of fishing vessels. These disturbances would be local and limited to the emplacement corridor.	Future new cables and cable maintenance would occasionally disturb the seafloor and cause temporary displacement in fishing vessels and increases in suspended sediment resulting in local, short-term impacts. The FCC has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the geographic analysis area for this resource, short-term disruption of fishing activities would be expected.
Noise: Construction, trenching, operations and maintenance	Noise from construction occurs frequently in coastal habitats in populated areas in New England and the mid-Atlantic, but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. Infrequent offshore trenching could occur in connection with cable installation. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Low levels of elevated noise from operational WTGs likely have low to no impacts on fish and no impacts at a fishery level. Noise is also created by operations and maintenance of marine minerals extraction, which has small, local impacts on fish, but likely no impacts at a fishery level.	Noise from construction near shore is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource. Noise from dredging and sand and gravel mining could occur. New or expanded marine minerals extraction may increase noise during their operations and maintenance over the next 30 years. Impacts from construction, operations, and maintenance would likely be small and local on fish, and not seen at a fishery level. Periodic trenching would be needed for repair or new installation of underground infrastructure. These disturbances would be temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise on commercial fish species are typically less prominent than the impacts of the physical disturbance and sediment suspension. Therefore, fishery-level impacts are unlikely.
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb fish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 30 years.	Ports would need to perform maintenance and upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Port utilization is expected to increase over the next 30 years, with increased activity during construction. The ability of ports to receive the increase in vessel traffic may require port modifications, such as channel deepening, leading to local impacts on fish populations. Port expansions could also increase vessel traffic and competition for dockside services, which could affect fishing vessels.
Presence of structures: Navigation hazard and allisions	Structures within and near the cumulative lease areas that pose potential navigation hazards include the Block Island Wind Farm WTGs, buoys, and shoreline developments such as docks and ports. An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. Two types of allisions occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements, or is distracted.	No known reasonably foreseeable structures are proposed to be located in the geographic analysis area that could affect commercial fisheries. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts on fish, but likely no impacts at a fishery level.	No future activities were identified within the analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion and fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard or complex habitat. Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat. Structure-oriented fishes are attracted to these locations. These impacts are local and can be short term to permanent. Fish aggregation may be considered adverse, beneficial, or neither. Commercial and for-hire recreational fishing can occur near these structures. For-hire recreational fishing is more popular, as commercial mobile fishing gear risk snagging on the structures.	New cables, installed incrementally in the analysis area over the next 20 to 30 years, would likely require hard protection atop portions of the route (see New cable emplacement/maintenance IPF above). Any new towers, buoys, or piers would also create uncommon relief in a mostly flat seascape. Structure-oriented species could be attracted to these locations. Structure-oriented species would benefit (Claisse et al. 2014, Smith et al. 2016). This may lead to more and larger structure-oriented fish communities and larger predators opportunistically feeding on the communities, as well as increased private and for-hire recreational fishing opportunities. Soft bottom is the dominant habitat type in the region, and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010). These impacts are expected to be local and may be long term.
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, buoys, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow species migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure (Secor et al. 2018). There is no evidence to suggest that structures pose a barrier to migratory animals.	The infrequent installation of future new structures in the marine environment over the next 30 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Secor et al. 2018). Migratory animals would likely be able to proceed from structures unimpeded. Therefore, fishery-level impacts are not anticipated.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	No known reasonably foreseeable structures are proposed for location in the geographic analysis area that could affect commercial fisheries and for-hire recreational fishing.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Seven subsea cable corridors cross cumulative lease areas. Shoreline developments are ongoing and include docks, ports, and other commercial, industrial, and residential structures.	No known proposed structures (other than those associated with offshore wind development) are reasonably foreseeable and proposed to be located in the geographic analysis area for this resource.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Traffic: Vessels and vessel collisions	No substantial changes are anticipated to the vessel traffic volumes. The geographic analysis area would continue to have numerous ports and the extensive marine traffic related to shipping, fishing, and recreation would continue to be important to the region's economy. The region's substantial marine traffic may result in occasional collisions. Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is more complex, as the vessels need to avoid both the structure and each other. The risk for collisions is ongoing but infrequent.	New vessel traffic in the geographic analysis area would consistently be generated by proposed barge routes and dredging demolition sites. Marine commerce and related industries would continue to be important to the regional economy.

BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; EIS = Environmental Impact Statement; FMPs = fishery management plans; G&G = Geological and Geophysical; GHG = greenhouse gas; IPF = impact-producing factors; met = meteorological; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; RI and MA Lease Area = Rhode Island and Massachusetts Lease Areas; SAR = search and rescue; VMS = vessel monitoring system; WTG = wind turbine generator

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

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	See Table F1-22 for water quality for a quantitative analysis of these risks. Accidental releases of fuel/fluids/hazmat occur during vessel use for recreational, fisheries, marine transportation, or military purposes, and other ongoing activities. Both released fluids and cleanup activities that require the removal of contaminated soils and seafloor sediments can cause impacts on cultural resources because resources are affected during by the released chemicals as well as the ensuing cleanup activities.	Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases within the geographic analysis area for cultural resources, increasing the frequency of small releases. Although the majority of anticipated accidental releases would be small, resulting in small-scale impacts on cultural resources, a single, large-scale accidental release such as an oil spill, could have significant impacts on marine and coastal cultural resources. A large-scale release would require extensive cleanup activities to remove contaminated materials resulting in damage to or the complete removal of terrestrial and marine cultural resources. In addition, the accidentally released materials in deep-water settings could settle on seafloor cultural resources such as wreck sites, accelerating their decomposition or covering them and making them inaccessible/unrecognizable to researchers, resulting in a significant loss of historic information. As a result, although considered unlikely, a large-scale accidental release and associated cleanup could result in permanent, geographically extensive, and large-scale impacts on cultural resources.
Accidental releases: Trash and debris	Accidental releases of trash and debris occur during vessel use for recreational, fisheries, marine transportation, or military purposes and other ongoing activities. While the released trash and debris can directly affect cultural resources, the majority of impacts associated with accidental releases occur during cleanup activities, especially if soil or sediment removed during cleanup affect known and undiscovered archaeological resources. In addition, the presence of large amounts of trash on shorelines or the ocean surface can impact the cultural value of TCPs for stakeholders. State and federal laws prohibiting large releases of trash would limit the size of any individual release and ongoing local, state, and federal efforts to clean up trash on beaches and waterways would continue to mitigate the effects of small-scale accidental releases of trash.	Future activities with the potential to result in accidental releases include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications). Accidental releases would continue at current rates along the northeast Atlantic coast.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Anchoring	The use of vessel anchoring and gear (i.e., wire ropes, cables, chain, sweep on the seafloor) that disturbs the seafloor, such as bottom trawls and anchors, by military, recreational, industrial, and commercial vessels can impact cultural resources by physically damaging maritime archaeological resources such as shipwrecks and debris fields.	Future activities with the potential to result in anchoring/gear utilization include construction and operations of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); military use; marine transportation; fisheries use and management; and oil and gas activities. These activities are likely to continue to occur at current rates along the entire coast of the eastern United States.
Gear utilization: Dredging	Activities associated with dredge operations and activities could damage marine archaeological resources. Ongoing activities identified by BOEM with the potential to result in dredging impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities.	Dredging activities would gradually increase through time as new offshore infrastructure is built, such as gas pipelines and electrical lines, and as ports and harbors are expanded or maintained.
Light: Vessels	Light associated with military, commercial, or construction vessel traffic can temporarily affect coastal historic structures and TCP resources when the addition of intrusive, modern lighting changes the physical environment ("setting") of cultural resources. The impacts of construction and operations lighting would be limited to cultural resources on the shoreline for which a nighttime sky is a contributing element to historic integrity. This excludes resources that are closed at night, such as historic buildings, lighthouses, and battlefields, and resources that generate their own nighttime light, such as historic districts. Offshore construction activities that require increased vessel traffic, construction vessels stationed offshore, and construction area lighting for prolonged periods can cause more sustained and significant visual impacts on coastal historic structure and TCP resources.	Future activities with the potential to result in vessel lighting impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Light pollution from vessel traffic would continue at the current intensity along the northeast coast, with a slight increase due to population increase and development over time.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Light: Structures	The construction of new structures that introduce new light sources into the setting of historic architectural properties or TCPs can result in impacts, particularly if the historic or cultural significance of the resource is associated with uninterrupted nighttime skies or periods of darkness. Any tall structure (commercial building, radio antenna, large satellite dishes, etc.) requiring nighttime hazard lighting to prevent aircraft collision can cause these types of impacts.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Port utilization: Expansion	Major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT was upgraded by the Port of New Bedford specifically to support the construction of offshore wind facilities. Expansion of port facilities can introduce large, modern port infrastructure into the viewsheds of nearby historic properties, impacting their setting and historic significance.	Future activities with the potential to result in port expansion impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; marine transportation; fisheries use and management; and oil and gas activities. Port expansion would continue at current levels, which reflect efforts to capture business associated with the offshore wind industry (irrespective of specific projects).
Presence of structures	The only existing offshore structures in the viewshed of the geographic analysis area are minor features such as buoys.	Non-offshore wind structures that could be viewed would be limited to meteorological towers. Marine activity would also occur in the marine viewshed of the geographic analysis area.
New cable emplacement/ maintenance	Current offshore construction activity is limited to subsea fiber optic and electrical transmission cables, including six existing power cables in the geographic analysis area.	Future activities with the potential to result in seafloor disturbances similar to offshore impacts include construction and operation of undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; and oil and gas activities. Such activities could cause impacts on submerged archaeological resources including shipwrecks and formerly subaerially exposed pre-contact Native American archaeological sites.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Land disturbance: Onshore construction	Onshore construction activities can impact archaeological resources by damaging or removing resources.	Future activities that could result in terrestrial land disturbance impacts include onshore residential, commercial, industrial, and military development activities in central Cape Cod, particularly those proximate to OECRs and interconnection facilities. Onshore construction would continue at current rates.

ADLS = Aircraft Detection Light System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; hazmat = hazardous materials; ESP = electrical service platform; IFP = impact-producing factors; MCT = New Bedford Marine Commerce Terminal; MHC = Massachusetts Historical Commission; NEPA = National Environmental Policy Act; NHL = National Historic Landmark; NHPA = National Historic Preservation Act; NRHP = National Register of Historic Places; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; OECR = Onshore Export Cable Route; RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; SHPO = state historic preservation office; TCP = Traditional Cultural Property; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Energy generation/ security	In 2017, Massachusetts energy production totaled 125.2 trillion Btu, of which 72.4 trillion Btu was from renewable sources, including geothermal, hydroelectric, wind, solar, and biomass (U.S. Energy Information Administration 2018).	Ongoing development of onshore solar and wind energy would provide diversified, small-scale energy generation. State and regional energy markets would require additional peaker plants and energy storage to meet the electricity needs when utility scale renewables are not producing.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors. In the geographic analysis area for demographics, employment, and economics there are six existing power cables.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables would disturb the seafloor and cause temporary increases in suspended sediment resulting in infrequent, localized, short-term impacts over the next 30 years.
Noise: O&M	Limited to South Fork Wind Project.	Not applicable.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the geographic analysis area for demographics, employment, and economics other than ongoing activities.
Noise: Cable laying/trenching	Infrequent trenching for pipeline and cable laying activities emit noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 30 years for repair or new installation of underground infrastructure.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The Marine Commerce Terminal at the Port of New Bedford was upgraded by the port specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. As ports expand, maintenance dredging of shipping channels is expected to increase.	Ports would need to perform maintenance and upgrades over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners, and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations, which may be known as fish aggregating devices (FADs). Recreational and commercial fishing can occur near the FADs, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on FADs.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	No existing offshore structures are in the viewshed of the Wind Farm Area except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Transmission cable infrastructure	The existing offshore cable infrastructure supports the economy by transmitting electric power and communications between mainland and islands. Additional communication cables run between the U.S. East Coast and European countries along the eastern Atlantic.	: No known proposed structures not associated with offshore wind development are reasonably foreseeable.
Traffic: Vessels	Geographic analysis area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	No substantial changes anticipated.
Land disturbance: Onshore construction	Onshore development activities support local population growth, employment, and economies. Disturbances can cause temporary, localized traffic delays and restricted access to adjacent properties. The rate of onshore land disturbance is expected to continue at or near current rates.	Onshore development projects would be ongoing in accordance with local government land use plans and regulations.

ADLS = Aircraft Detection Light System; BOEM = Bureau of Ocean Energy Management; Btu = British thermal unit; EIS = Environmental Impact Statement; ESP = electrical service platform; FADs = fish aggregating devices; FCC = Federal Communications Commission; FMPs = fishery management plans; G&G = Geological and Geophysical; GW = gigawatts; IPF = impact-producing factors; MA = Massachusetts; NA = not applicable; NOAA = National Oceanic and Atmospheric Administration; O&M = operations and maintenance; OECC = Offshore Export Cable Corridor(s); RI = Rhode Island; SAR = search and rescue; SEIS = Supplemental Environmental Impact Statement; USCG = United States Coast Guard; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Air emissions: Construction/ decommissioning	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses, and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.
Air emissions: Operations and maintenance	Ongoing population growth and new development within the analysis area is likely to increase traffic with resulting increase in emissions from motor vehicles. Some new industrial development may result in emissions-producing uses. At the same time, many industrial waterfront areas near environmental justice communities are losing industrial uses, and converting to more commercial or residential uses.	New development may include emissions-producing industry and new development that would increase emissions from motor vehicles. Some historically industrial waterfront locations will continue to lose industrial uses, with no new industrial development to replace it. Cities such as New Bedford are promoting start-up space and commercial uses to re-use industrial space.
Light: Structures	Offshore buoys and towers emit low-intensity light, while onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables would disturb the seafloor and cause temporary increases in suspended sediment, resulting in infrequent, localized, short-term impacts over the next 30 years.
Noise: Operations and maintenance	Offshore operations and maintenance of existing wind energy projects generates negligible amounts of noise.	There are no reasonably foreseeable offshore facilities that would generate noise from operations/maintenance.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Noise: Trenching	Infrequent trenching for pipeline and cable laying activities emits noise. These disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of trenching noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	Periodic trenching would be needed over the next 30 years for repair or new installation of underground infrastructure.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge route and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT at the Port of New Bedford is a completed facility developed by the port specifically to support the construction of offshore wind facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Entanglement, gear loss/ damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. Such loss and damage are direct costs for gear owners, and are expected to continue at or near current levels.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure, and each other.	Vessel traffic is generally not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	There are no existing offshore structures in the viewshed of the Wind Farm Area except buoys.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Transmission cable infrastructure	Seven subsea cable corridors cross cumulative lease areas.	Existing cable operation and maintenance activities would continue within the analysis area.
Traffic: Vessels	Geographic analysis area ports and marine traffic related to shipping, fishing and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the geographic analysis area employment.
Land disturbance: Erosion and sedimentation	Potential erosion and sedimentation from development and construction is controlled by local and state development regulations.	New development activities would be subject to erosion and sedimentation regulations.
Land disturbance: Onshore construction	Onshore development supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.
Land disturbance: Onshore, land use changes	Onshore development would result in changes in land use in accordance with local government land use plans and regulations.	Development of onshore solar and wind energy would provide diversified, small-scale energy generation.

ADLS = Aircraft Detection Light System; ESP = electrical service platform; FCC = Federal Communications Commission; FMPs = fishery management plans; G&G = Geological and Geophysical; HMS = Highly Migratory Species; IPF = impact-producing factors; MA/RI = Massachusetts/Rhode Island; MCT = New Bedford Marine Commerce Terminal; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); OECR = Onshore Export Cable Route; RI and MA Lease Areas = Rhode Island and Massachusetts Lease Areas; USEPA = U.S. Environmental Protection Agency; WTG = wind turbine generator

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Impacts, including mortality, decreased fitness, and contamination of habitat, are localized and temporary, and rarely affect populations.	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Impacts are unlikely to affect populations.
Accidental releases: Invasive species	Invasive species are periodically released accidentally during ongoing activities, including the discharge of ballast water and bilge water from marine vessels. The impacts on finfish, invertebrates, and EFH depend on many factors, but can be widespread and permanent.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Anchoring	Vessel anchoring related to ongoing military use, and survey, commercial, and recreational activities continues to cause temporary to permanent impacts in the immediate area where anchors and chains meet the seafloor. Impacts on finfish, invertebrates, and EFH are greatest for sensitive EFH (e.g., eelgrass, hard bottom) and sessile or slow-moving species (e.g., corals, sponges, and sedentary shellfish).	Impacts from anchoring may occur on a semi-regular basis over the next 30 years due to offshore military operations, survey activities, commercial vessel traffic, or recreational vessel traffic. These impacts would include increased turbidity levels and potential for direct contact causing mortality of benthic species and, possibly, degradation of sensitive habitats. All impacts would be localized; turbidity would be temporary; impacts from direct contact would be recovered in the short term. Degradation of sensitive habitats such as certain types of hard bottom (e.g., boulder piles), if it occurs, could be long term.
EMF	EMF emanates continuously from installed telecommunication and electrical power transmission cables. Biologically significant impacts on finfish, invertebrates, and EFH have not been documented for AC cables (CSA Ocean Sciences, Inc. and Exponent 2019 and see Thomsen et al. 2015), but behavioral impacts have been documented for benthic species (skates and lobster) near operating DC cables (Hutchison et al. 2018). The impacts are localized and affect the animals only while they are within the EMF. There is no evidence to indicate that EMF from undersea AC power cables negatively affects commercially and recreationally important fish species in the southern New England area (CSA Ocean Sciences, Inc. and Exponent 2019).	During operation, future new cables would produce EMF. (See cell to the left.) Submarine power cables in the geographic analysis area for this resource are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. EMF of any two sources would not overlap (even for multiple cables within a single OECC). Although the EMF would exist as long as a cable was in operation, impacts, on finfish, invertebrates, and EFH would likely be difficult to detect.
Light: Vessels	Marine vessels have an array of lights including navigational lights and deck lights. There is little downward-focused lighting,	See cell to the left.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	and therefore only a small fraction of the emitted light enters the water. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts.	
Light: Structures	Offshore buoys and towers emit light, and onshore structures, including buildings and ports, emit a great deal more on an ongoing basis. Light can attract finfish and invertebrates, potentially affecting distributions in a highly localized area. Light may also disrupt natural cycles, e.g., spawning, possibly leading to short-term impacts. Light from structures is widespread and permanent near the coast, but minimal offshore.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances are local, limited to the cable corridor. New cables are infrequently added near shore. Cable emplacement/ maintenance activities disturb, displace, and injure finfish and invertebrates and result in temporary to long-term habitat alterations. The intensity of impacts depends on the time (season) and place (habitat type) where the activities occur. (See also the IPF of Sediment deposition and burial.)	Future new cables would occasionally disturb the seafloor and cause temporary increases in suspended sediment, resulting in local short-term impacts. The FCC has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the geographic analysis area for this resource, short-term disturbance would be expected. The intensity of impacts would depend on the time (season) and place (habitat type) where the activities would occur.
Noise: Aircraft	Noise from aircraft reaches the sea surface on a regular basis. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH, as very little of the aircraft noise propagates through the water.	Aircraft noise is likely to continue to increase as commercial air traffic increases. However, there is not likely to be any impact of aircraft noise on finfish, invertebrates, and EFH.
Noise: Onshore/offshore construction	Noise from construction occurs frequently in near shores of populated areas in New England and the mid-Atlantic but infrequently offshore. The intensity and extent of noise from construction is difficult to generalize, but impacts are local and temporary. See also sub-IPF for Noise: Pile driving.	Noise from construction near shores is expected to gradually increase in line with human population growth along the coast of the geographic analysis area for this resource.
Noise: G&G	Ongoing site characterization surveys and scientific surveys produce noise around sites of investigation. These activities can disturb finfish and invertebrates in the immediate vicinity of the investigation and can cause temporary behavioral changes.	Site characterization surveys, scientific surveys, and exploratory oil and gas surveys are anticipated to occur infrequently over the next 30 years. Seismic surveys used in oil and gas exploration create high-intensity impulsive noise to penetrate deep into the seabed, potentially

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	The extent depends on equipment used, noise levels, and local acoustic conditions.	resulting in injury or mortality to finfish and invertebrates in a small area around each sound source and short-term stress and behavioral changes to individuals over a greater area. Site characterization surveys typically use sub-bottom profiler technologies that generate less-intense sound waves more similar to common deep-water echosounders. The intensity and extent of the resulting impacts are difficult to generalize, but are likely local and temporary.
Noise: O&M	Some finfish and invertebrates may be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Farm, this low frequency noise barley exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015), sound pressure levels would be expected to be at or below ambient levels at relatively short distances (approximately 164 feet [50 meters]) from WTG foundations. These low levels of elevated noise likely have little to no impact. Noise is also created by operations and maintenance of marine minerals extraction and commercial fisheries, each of which has small local impacts.	New or expanded marine minerals extraction and commercial fisheries may intermittently increase noise during their operations and maintenance over the next 30 years. Impacts would likely be small and local.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water or through the seabed can cause injury or mortality to finfish and invertebrates in a small area around each pile, and can cause short-term stress and behavioral changes to individuals over a greater area. Eggs, embryos, and larvae of finfish and invertebrates could also experience developmental abnormalities or mortality resulting from this noise, although thresholds of exposure are not known (Weilgart 2018, Hawkins and Popper 2017). Potentially injurious noise could also be considered as rendering EFH temporarily unavailable or unsuitable for the duration of the noise. The extent depends on pile size, hammer energy, and local acoustic conditions.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Noise: Cable laying/ trenching	Infrequent trenching activities for pipeline and cable laying, as well as other cable burial methods, emit noise. These	New or expanded submarine cables and pipelines are likely to occur in the geographic analysis area for this

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	disturbances are temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.	resource. These disturbances would be infrequent over the next 30 years, temporary, local, and extend only a short distance beyond the emplacement corridor. Impacts of this noise are typically less prominent than the impacts of the physical disturbance and sediment suspension.
Noise: Vessels	While ongoing vessel noise may have some effect on behavior, it is likely limited to brief startle and temporary stress responses. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels.	See cell to the left.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance, including dredging. Port utilization is expected to increase over the next 30 years.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. Certain types of vessel traffic have increased recently (e.g. ferry use and cruise industry) and may continue to increase in the foreseeable future. In addition, the general trend along the coast from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase may require port modifications, leading to local impacts. Future channel deepening activities will likely be undertaken. Existing ports have already affected finfish, invertebrates, and EFH, and future port projects would implement BMPs to minimize impacts. Although the degree of impacts on EFH would likely be undetectable outside the immediate vicinity of the ports, adverse impacts on EFH for certain species or life stages may lead to impacts on finfish and invertebrates beyond the vicinity of the port.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures. The lost gear, moved by currents, can disturb habitats and potentially harm individuals, creating small, localized, short-term impacts.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Presence of structures:	Manmade structures, especially tall vertical structures such as foundations for towers of various purposes, continuously alter local water flow at a fine scale. Water flow typically returns to	Tall vertical structures can increase seabed scour and sediment suspension. Impacts would likely be highly localized and difficult to detect. Indirect impacts of

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Hydrodynamic disturbance	background levels within a relatively short distance from the structure. Therefore, impacts on finfish, invertebrates, and EFH are typically undetectable. Indirect impacts of structures influencing primary productivity and higher trophic levels are possible but are not well understood. New structures are periodically added.	structures influencing primary productivity and higher trophic levels are possible but are not well understood.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. Structure-oriented fishes are attracted to these locations. These impacts are local and often permanent. Fish aggregation may be considered adverse, beneficial, or neutral.	New cables, installed incrementally in the geographic analysis area for this resource over the next 20 to 30 years, would likely require hard protection atop portions of the route (see the New cable emplacement/ maintenance IPF). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented fishes could be attracted to these locations. Abundance of certain fishes may increase. These impacts are local and may be permanent.
Presence of structures: Habitat conversion	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly sandy seascape. A large portion is homogeneous sandy seascape but there is some other hard or complex habitat. Structure-oriented species thus benefit on a constant basis; however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Structures are periodically added, resulting in the conversion of existing soft-bottom and hard-bottom habitat to the new hard-structure habitat.	New cable, installed incrementally in the analysis area over the next 20 to 30 years, would likely require hard protection atop portions of the route (see New cable emplacement/ maintenance). Any new towers, buoys, or piers would also create uncommon relief in a mostly sandy seascape. Structure-oriented species would benefit (Claisse et al. 2014, Smith et al. 2016); however, the diversity may decline over time as early colonizers are replaced by successional communities dominated by blue mussels and anemones (Degraer et al. 2019 [Chapter 7]). Soft bottom is the dominant habitat type from Cape Hatteras to the Gulf of Maine (over 60 million acres), and species that rely on this habitat would not likely experience population-level impacts (Guida et al. 2017; Greene et al. 2010).
Presence of structures: Migration disturbances	Human structures in the marine environment, e.g., shipwrecks, artificial reefs, and oil platforms, can attract finfish and invertebrates that approach the structures during their migrations. This could slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement than structure is (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018). There is no	The infrequent installation of future new structures in the marine environment over the next 30 years may attract finfish and invertebrates that approach the structures during their migrations. This could tend to slow migrations. However, temperature is expected to be a bigger driver of habitat occupation and species movement (Moser and Shepherd 2009; Fabrizio et al. 2014; Secor et al. 2018).

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	evidence to suggest that structures pose a barrier to migratory animals.	Migratory animals would likely be able to proceed from structures unimpeded.
Presence of structures: Cable infrastructure	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.	See other sub-IPFs within the Presence of structures IPF. See Table F1-6 on Coastal Habitats.
Cable emplacement and maintenance: Seabed profile alterations	Ongoing sediment dredging for navigation purposes results in localized short-term impacts (habitat alteration, change in complexity) on finfish, invertebrates, and EFH through this IPF. Dredging is most likely in sand wave areas where typical jet plowing is insufficient to meet target cable burial depth. Sand waves that are dredged would likely be redeposited in like-sediment areas. Any particular sand wave may not recover to the same height and width as pre-disturbance; however, the habitat function would largely recover post-disturbance. Therefore, seabed profile alterations, while locally intense, have little impact on finfish, invertebrates, and EFH on a regional (Cape Hatteras to Gulf of Maine) scale.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.
Cable emplacement and maintenance: Sediment deposition and burial	Ongoing sediment dredging for navigation purposes results in fine sediment deposition. Ongoing cable maintenance activities also infrequently disturb bottom sediments; these disturbances are local, limited to the emplacement corridor. Sediment deposition could have negative impacts on eggs and larvae, particularly demersal eggs such as longfin squid, which are known to have high rates of egg mortality if egg masses are exposed to abrasion or burial. Impacts may vary based on season/time of year.	No future activities were identified within the geographic analysis area for this resource other than ongoing activities.

°C = degrees Celsius; AC = alternating current; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; DC = direct current; EFH = essential fish habitat; EMF = electromagnetic field; EIS = Environmental Impact Statement; ESP = electrical service platform; FCC = Federal Communications Commission; G&G = Geological and Geophysical; GW = gigawatts; IPF = impact-producing factors; met = meteorological; NA = not applicable; NOAA = National Oceanic and Atmospheric Administration; O&M = operations and maintenance; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); USACE = United States Army Corps of Engineers; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	Various ongoing onshore and coastal construction projects include the use of vehicles and equipment that contain fuel, fluids, and hazardous materials that could be released.	Ongoing onshore construction projects involve vehicles and equipment that use fuel, fluids, or hazardous materials could result in an accidental release. Intensity and extent would vary, depending on the size, location, and materials involved in the release.
Light: Structures	Various ongoing onshore and coastal construction projects have nighttime activities, as well as existing structures, facilities, and vehicles that would use nighttime lighting.	Ongoing onshore construction projects involving nighttime activity could generate nighttime lighting. Intensity and extent would vary, depending on the location, type, direction, and duration of nighttime lighting.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The MCT at the Port of New Bedford is a completed facility developed by the port specifically to support the construction of offshore wind facilities.	Ports would need to perform maintenance and upgrade facilities to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Presence of structures: Viewshed	The only existing offshore structures in the offshore viewshed of the Project are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components would be limited to met towers. Marine activity would also occur in the marine viewshed.
Presence of structures: Transmission cable infrastructure	Onshore buried transmission cables are present in the area near the Project onshore and offshore improvements. Onshore activities would only occur where permitted by local land use authorities, which would avoid long-term land use conflicts.	No known proposed structures are reasonably foreseeable and proposed to be located in the geographic analysis area for land use and coastal infrastructure.
Land disturbance: Onshore construction	Onshore construction supports local population growth, employment, and economics.	Onshore development would continue in accordance with local government land use plans and regulations.
Land disturbance: Onshore, land use changes	New development or redevelopment would result in changes in land use in accordance with local government land use plans and regulations.	Ongoing and future development and redevelopment is anticipated to reinforce existing land use patterns, based on local government planning documents.

ADLS = Aircraft Detection Light System; IPF = impact-producing factors; MCT = New Bedford Marine Commerce Terminal; met = meteorological; NOAA = National Oceanic and Atmospheric Administration; ROW = right-of-way; USACE = U.S. Army Corps of Engineers; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent/chronic. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008, Smith et al. 2017; Sullivan et al. 2019; Takeshida et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-13).	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Marine mammal exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality or sublethal effects on the individual fitness, including adrenal effects, hematological effects, liver effects lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Kellar et al. 2017; Mazet et al. 2001; Mohr et al. 2008, Smith et al. 2017; Sullivan et al. 2019; Takeshida et al. 2017). Additionally, accidental releases may result in impacts on marine mammals due to effects on prey species (Table F1-13).
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Worldwide 62 of 123 (50.4%) marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Stranding data indicate potential debris induced mortality rates of 0 to 22%. Mortality has been documented in cases of debris interactions, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014). However, it is difficult to link physiological effects on individuals to population-level impacts (Browne et al. 2015).	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. Trash and debris may continue to be accidentally released through fisheries use and other offshore and onshore activities. There may also be a long-term risk from exposure to plastics and other debris in the ocean. Worldwide 62 of 123 (50.4%) of marine mammal species have been documented ingesting marine litter (Werner et al. 2016). Mortality has been documented in cases of debris interacts, as well as blockage of the digestive track, disease, injury, and malnutrition (Baulch and Perry 2014).
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e., changes in magnetic field levels with distance) of 0.1% of the earth's magnetic field or about 0.05 μT (Kirschvink 1990) and are thus likely to be very sensitive to **minor** changes in magnetic fields (Walker et al. 2003). There is a potential for animals to react to local variations	During operation, future new cables would produce EMF. Submarine power cables in the marine mammal geographic analysis area are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. EMF of any

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	of the geomagnetic field caused by power cable EMFs. Depending on the magnitude and persistence of the confounding magnetic field, such an effect could cause a trivial temporary change in swim direction or a longer detour during the animal's migration (Gill et al. 2005). Such an effect on marine mammals is more likely to occur with direct current cables than with AC cables (Normandeau et al. 2011). However, there are numerous transmission cables installed across the seafloor and no impacts on marine mammals have been demonstrated from this source of EMF.	two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Marine mammals have the potential to react to submarine cable EMF, however, no effects from the numerous submarine cables have been observed. Further, this IPF would be limited to extremely small portions of the areas used by migrating marine mammals. As such, exposure to this IPF would be low, and as a result impacts on marine mammals would not be expected.
New cable emplacement/ maintenance	Cable maintenance activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances will be local and generally limited to the emplacement corridor. Data are not available regarding marine mammal avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that since some marine mammals often live in turbid waters and some species of mysticetes and sirenians employ feeding methods that create sediment plumes, some species of marine mammals have a tolerance for increased turbidity. Similarly, McConnell et al. (1999) documented movements and foraging of grey seals in the North Sea. One tracked individual was blind in both eyes, but otherwise healthy. Despite being blind, observed movements were typical of the other study individuals, indicating that visual cues are not essential for grey seal foraging and movement (McConnell et al. 1999). If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on marine mammal prey species (Table F1-13).	The FCC has two pending submarine telecommunication cable application in the North Atlantic. The impact on water quality from accidental sediment suspension during cable emplacement is temporary and short term. If elevated turbidity caused any behavioral responses such as avoidance of the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative impacts would be temporary and short term. Turbidity associated with increased sedimentation may result in temporary, short-term impacts on some marine mammal prey species (Table F1-13).
Noise: Aircraft	Aircraft routinely travel in the marine mammal geographic analysis area. With the possible exception of rescue operations, no ongoing aircraft flights would occur at altitudes that would elicit a response from marine mammals. If flights are at a sufficiently low altitude, marine mammals may respond with behavioral changes, including short surface durations, abrupt dives, and percussive behaviors (i.e.	Future low altitude aircraft activities such as survey activities and navy training operations could result short-term responses of marine mammals to aircraft noise. If flights are at a sufficiently low altitude, marine mammals may respond with a behavior changes, including short surface durations, abrupt

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area. Similarly, aircraft have the potential to disturb hauled out seals if aircraft overflights occur within 2,000 feet (610 meters) of a haul out area (Efroymson et al. 2000). However, this disturbance would be temporary and short term, and would result in minimal energy expenditure. These brief responses would be expected to dissipate once the aircraft has left the area.	dives, and percussive behaviors (i.e. breaching and tail slapping) (Patenaude et al. 2002). These brief responses would be expected to dissipate once the aircraft has left the area.
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in high-intensity, high-consequence impacts, including auditory injuries, stress, disturbance, and behavioral responses, if present in the ensonified area (NOAA 2018). Survey protocols and underwater noise mitigation procedures are typically implemented to decrease the potential for any marine mammal to be in the area where sound levels are above relevant harassment thresholds associated with an operating sound source to reduce the potential for behavioral responses and injury (PTS/TTS) close to the sound source. The magnitude of effects, if any, is intrinsically related to many factors, including: acoustic signal characteristics, behavioral state (e.g., migrating), biological condition, distance from the source, duration and level of the sound exposure, as well as environmental and physical conditions that affect acoustic propagation (NOAA 2018).	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.
Noise: Turbines	Marine mammals would be able to hear the continuous underwater noise of operational WTGs. As measured at the Block Island Wind Facility, this low frequency noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base. Based on the results of Thomsen et al. (2015) and Kraus et al. (2016), sound pressure levels would be expected to be at or below ambient levels at relatively short distances from the WTG foundations.	This sub-IPF does not apply to future non-offshore wind development.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water or through the seabed can result in high-intensity, low-exposure level, long-term, but localized intermittent risk to marine mammals. Impacts would be localized in nearshore waters. Pile driving activities may negatively affect marine mammals during	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	foraging, orientation, migration, predator detection, social interactions, or other activities (Southall et al. 2007). Noise exposure associated with pile-driving activities can interfere with these functions, and have the potential to cause a range of responses, including insignificant behavioral changes, avoidance of the ensonified area, PTS, harassment, and ear injury, depending on the intensity and duration of the exposure. BOEM assumes that all ongoing and potential future activities will be conducted in accordance with a project-specific IHA to minimize impacts on marine mammals.	
Noise: Cable laying/ trenching	N/A	Cable laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects.
Noise: Vessels	Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, scientific and academic research vessels, as well as other construction vessels. The frequency range for vessel noise falls within marine mammals' known range of hearing and would be audible. Noise from vessels presents a long-term and widespread impact on marine mammals across in most oceanic regions. While vessel noise may have some effect on marine mammal behavior, it would be expected to be limited to brief startle and temporary stress response. Results from studies on acoustic impacts from vessel noise on odontocetes indicate that small vessels at a speed of 5 knots in shallow coastal water can reduce the communication range for bottlenose dolphins within 164 feet (50 meters) of the vessel by 26% (Jensen et al. 2009). Pilot whales in a quieter, deep-water habitat could experience a 50% reduction in communication range from a similar size boat and speed (Jensen et al. 2009). Since lower frequencies propagate farther away from the sound source compared to higher frequencies, low frequency cetaceans are at a greater risk of experiencing Level B Harassment produced by vessel traffic.	Any offshore projects that require the use of ocean vessels could potentially result in long-term but infrequent impacts on marine mammals, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes. However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of marine mammals and no stock or population-level effects would be expected.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in temporary, short-term impacts, if any, on marine mammals. Vessel	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	noise may affect marine mammals, but response would be expected to be temporary and short term (see Vessels: Noise sub-IPF above). The impacts on water quality from sediment suspension during port expansion activities is temporary and short term, and would be similar to those described under the New cable emplacement/maintenance IPF above.	from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g. ferry use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strike could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	There are more than 130 artificial reefs in the Mid-Atlantic region. This sub-IPF may result in long-term, high-intensity impacts, but with low exposure due to localized and geographic spacing of artificial reefs, long term. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of marine mammals encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Moore and van der Hoop 2012), if present nearshore where these structures are located. There are very few, if any, areas within the OCS geographic analysis area for marine mammals that would serve to concentrate recreational fishing and increase the likelihood that marine mammals would encounter lost fishing gear.	No future activities were identified within the marine mammal geographic analysis area other than ongoing activities.
Presence of structures: Habitat conversion and prey aggregation	There are more than 130 artificial reefs in the Mid-Atlantic region. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the 'reef' effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher	The presence of structures associated with non-offshore wind development in nearshore coastal waters have the potential to provide habitat for seals and small odontocetes as well as preferred prey species. This "reef effect" has the potential to result in long-term, low-intensity benefits. Bridge

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for seals and small odontocetes compared to the surrounding soft-bottoms.	foundations will continue to provide foraging opportunities for seals and small odontocetes with measurable benefits to some individuals. Hard-bottom (scour control and rock mattresses used to bury the offshore export cables) and vertical structures (i.e., WTG and ESP foundations) in a soft-bottom habitat can create artificial reefs, thus inducing the “reef effect” (Taormina et al. 2018; Causon and Gill 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for marine mammals compared to the surrounding soft-bottoms.
Presence of structures: Avoidance/ displacement	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the marine mammal geographic analysis area beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Traffic: Vessel collisions	Current activities that are contributing to this sub-IPF include port traffic levels, fairways, traffic separation schemes, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of death to	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	NARWs with as many as 75% of known anthropogenic mortalities of NARWs likely resulting from collisions with large ships along the US and Canadian eastern seaboard (Kite-Powell et al. 2007). Marine mammals are more vulnerable to vessel strike when they are in the draft of the vessel and when they are beneath the surface and not detectable by visual observers. Some conditions that make marine mammals less detectable include weather conditions with poor visibility (e.g., fog, rain, and wave height) or nighttime operations. Vessels operating at speeds exceeding 10 knots have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007). Reported vessel collisions with whales show that serious injury rarely occurs at speeds below 10 knots (Laist et al. 2001). Data show that the probability of a vessel strike increases with the velocity of a vessel (Pace and Silber 2005; Vanderlaan and Taggart 2007).	marine mammals makes stock or population-level effects unlikely (Navy 2018).

μPa = micropascal; μT = microtesla; AC = alternating current; BA = Biological Assessment; BOEM = Bureau of Ocean Energy Management; BMP = best management practice; BSW = Bay State Wind; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; dB = decibel; dB RMS = decibel root mean square; DP = dynamic positioning; EIS = Environmental Impact Statement; EMF = electromagnetic field; FCC = Federal Communications Commission; G&G = Geological and Geophysical; hazmat = hazardous material; HRG = High Resolution Geophysical; Hz = hertz; IHA = Incidental Harassment Authorization; IPF = impact-producing factors; met = meteorological; MW = megawatt; NARW = North Atlantic right whale; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; PAM = passive acoustic monitoring; PSO = protected species observer; PTS = permanent threshold shift; SOV = service operations vessel; TTS = temporary threshold shift; USCG = U.S. Coast Guard; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Anchoring	Larger commercial vessels (specifically tankers) sometimes anchor outside of major ports to transfer their cargo to smaller vessels for transport into port, an operation known as lightering. These anchors have deeper ground penetration and are under higher stresses. Smaller vessels (commercial fishing or recreational vessels) would anchor for fishing and other recreational activities. These activities cause temporary to short-term impacts on navigation in the immediate anchorage area. All vessels may anchor in an emergency scenario (such as power loss) if they lose power to prevent them from drifting and creating navigational hazards for other vessels or drifting into structures.	Lightering and anchoring operations are expected to continue at or near current levels, with the expectation of moderate increase commensurate with any increase in tankers visiting ports. Deep-draft visits to major port visits are expected to increase as well, increasing the potential for an emergency need to anchor, creating navigational hazards for other vessels. Recreational activity and commercial fishing activity would likely stay largely the same related to this IPF.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Impacts from these activities would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.	Ports would need to perform maintenance and perform upgrades to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size. Impacts would be short term and could include congestion in ports, delays, and changes in port usage by some fishing or recreational vessel operators.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. There are two types of allisions that occur: drift and powered. A drift allision generally occurs when a vessel is powered down due to operator choice or power failure. A powered allision generally occurs when an operator fails to adequately control their vessel movements, or is distracted.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 30 years. Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Fish aggregation	Items in the water, such as ghost fishing gear, buoys, and energy platform foundations can create an artificial reef effect, aggregating fish. Recreational and commercial fishing can occur near the artificial reefs. Recreational fishing is more popular than commercial near artificial reefs as commercial mobile fishing gear can risk snagging on the artificial reef structure.	Fishing near artificial reefs is not expected to change meaningfully over the next 30 years.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Habitat conversion	Equipment in the ocean can create a substrate for mollusks to attach to, and fish eggs to settle near. This can create a reef-like habitat and benefit structure-oriented species on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Migration disturbances	Noise-producing activities, such as pile driving and vessel traffic, may interfere and adversely affect marine mammals during foraging, orientation, migration, response to predators, social interactions, or other activities. Marine mammals may also be sensitive to changes in magnetic field levels. The presence of structures and operation noise could cause mammals to avoid areas.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions. When multiple vessels need to navigate around a structure, then navigation is made more complex, as the vessels need to avoid both the structure and each other.	Absent other information, and because total vessel transits in the area have remained relatively stable since 2010, BOEM does not anticipate vessel traffic to greatly increase over the next 30 years. Even with increased port visits by deep-draft vessels, this is still a relatively small adjustment when considering the whole of New England vessel traffic. The presence of navigation hazards is expected to continue at or near current levels.
Presence of structures: Space use conflicts	Currently, the offshore area is occupied by marine trade, stationary and mobile fishing, and survey activities.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: cable infrastructure	See IPF for Anchoring.	See IPF for Anchoring.
New cable emplacement/ maintenance	Within the geographic analysis area for navigation and vessel traffic, existing cables may require access for maintenance activities. Infrequent cable maintenance activities may cause temporary increases in vessel traffic and navigational complexity.	The FCC has two pending submarine telecommunication cable applications in the North Atlantic. Future new cables would cause temporary increases in vessel traffic during installation or maintenance, resulting in infrequent, localized, short-term impacts over the next 30 years. Care would need to be taken by vessels that are crossing the cable routes during these activities.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Traffic: Aircraft	USCG search and rescue (SAR) helicopters are the main aircraft that may be flying at low enough heights to risk interaction with WTGs. USCG SAR aircraft need to fly low enough that they can spot objects in the water.	SAR operations could be expected to increase with any increase in vessel traffic. However, as vessel traffic volume is not expected to increase appreciably, neither should SAR operations. Final EIS Section 3.16.6 provides a discussion of navigation impacts on fishing vessel traffic.
Traffic: Vessels	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.
Traffic: Vessels, collisions	See the sub-IPF for Presence of structures: Navigation hazard.	See the sub-IPF for Presence of structures: Navigation hazard.

AIS = Automatic Identification System; BOEM = Bureau of Ocean Energy Management; COP = Construction and Operations Plan; EIS = environmental impact statement; ESP = electrical service platform; FCC = Federal Communications Commission; IPF = impact-producing factors; MA = Massachusetts; MARIPARS = Massachusetts and Rhode Island Port Access Route Study; MCT = Marine Commerce Terminal; NOAA = National Oceanic and Atmospheric Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor(s); RI = Rhode Island; SAR = search and rescue; TSS = traffic separation scheme; USCG = U.S. Coast Guard; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Allisions	Existing stationary facilities that present allision risks include the five offshore wind turbines associated with Block Island Wind Farm, dock facilities, meteorological buoys associated with offshore wind lease areas, and other offshore or shoreline-based structures.	No additional non-offshore wind stationary structures were identified within the geographic analysis area. Stationary structures such as private or commercial docks may be added close to the shoreline.
Presence of structures: Fish aggregation	Existing stationary facilities that act as FADs include offshore wind turbines associated with Block Island Wind Farm.	No future non-offshore wind additional stationary structures that would act as FADs were identified within the geographic analysis area.
Presence of structures: Navigation hazard	Existing stationary facilities within the geographic analysis area that present navigational hazards include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.
Presence of structures: Space use conflicts	Existing stationary facilities within the geographic analysis area that present a navigational hazard include the five WTGs in the Block Island Wind Farm, onshore wind turbines, communication towers, dock facilities, and other onshore and offshore commercial, industrial, and residential structures.	No future non-offshore wind stationary structures were identified within the offshore analysis area. Onshore, development activities are anticipated to continue with additional proposed communications towers and onshore commercial, industrial, and residential developments.
Presence of structures: cable infrastructure	Seven subsea cable corridors cross cumulative lease areas.	Submarine cables would remain in current locations with infrequent maintenance continuing along those cable routes for the foreseeable future.
Traffic: Vessels	Current vessel traffic in the region is described in Final EIS Section 3.16.3. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region, as described in Final EIS Section 3.16.3.
Traffic: Vessels, collisions	Current vessel traffic in the region is described in Final EIS Section 3.16.3. Vessel activities associated with offshore wind in the cumulative lease areas is currently limited to site assessment surveys.	Continued vessel traffic in the region is described in Final EIS Section 3.16.3.

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

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

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Allisions and navigation hazards	Structures within and near the geographic analysis area that pose potential allision hazards include the five Block Island Wind Farm WTGs, meteorological buoys associated with offshore wind lease areas, and shoreline developments such as docks, ports, and other commercial, industrial, and residential structures.	Reasonably foreseeable non-offshore wind structures that could affect submarine cables have not been identified in the geographic analysis area.
Presence of structures: Space use conflicts	Two submarine cables cross the far western portion of OCS-A 0487. These cables are associated with a larger network of submarine cables that make landfall near Charlestown, Massachusetts.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.
Presence of structures: Transmission cable infrastructure	Seven subsea cable corridors cross cumulative lease areas.	Reasonably foreseeable non-offshore wind structures have not been identified in the geographic analysis area.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Navigation hazards	Wind developments in the direct line-of-sight with, or extremely close to, radar systems can cause clutter and interference. Existing wind developments in the area include scattered onshore wind turbines, and five WTGs in the Block Island Wind Farm.	Reasonably foreseeable non-offshore wind structures proposed for construction in the lease areas that could affect radar systems have not been identified.

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

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

AMSL = above mean sea level; BOEM = Bureau of Ocean Energy Management; CVOW = Coastal Virginia Offshore Wind; ESP = electrical service platform; FAA = Federal Aviation Administration; FAD = Fish Attracting Device; IPF = impact-producing factor; MA = Massachusetts; met = meteorological; NEXRAD = Next Generation Weather Radar; NMFS = National Marine Fisheries Service; NOAA = National Oceanic and Atmospheric Administration; OECC = Offshore Export Cable Corridor(s); OCS = outer continental shelf; RI = Rhode Island; SAR = search and rescue; USACE = United States Army Corps of Engineer; USCG = United States Coast Guard; WTG = wind turbine generator.

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

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Anchoring	Anchoring occurs due to ongoing military, survey, commercial, and recreational activities.	Impacts from anchoring would continue, and may increase due to offshore military operations, survey activities, commercial vessel traffic, and recreational vessel traffic. Modest growth in vessel traffic could increase the temporary, localized impacts of navigational hazards, increased turbidity levels, and potential for direct contact causing mortality of benthic resources.
Light: Vessels	Ocean vessels have an array of lights including navigational lights and deck lights.	Anticipated modest growth in vessel traffic would result in some growth in the nighttime traffic of vessels with lighting.
Light: Structures	Offshore buoys and towers emit low-intensity light. Onshore structures, including houses and ports, emit substantially more light on an ongoing basis.	Light from onshore structures is expected to gradually increase in line with human population growth along the coast. This increase is expected to be widespread and permanent near the coast, but minimal offshore.
New cable emplacement/ maintenance	Infrequent cable maintenance activities disturb the seafloor and cause temporary increases in suspended sediment; these disturbances would be local and limited to emplacement corridors.	Cable maintenance or replacement of existing cables in the geographic analysis area would occur infrequently, and would generate short-term disturbances.
Noise: O&M	Limited to Block Island Wind Farm	Not applicable
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. These disturbances are temporary, local, and extend only a short distance beyond the work area.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Noise: Cable laying/trenching	Offshore trenching occurs periodically in connection with cable installation or sand and gravel mining.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Noise: Vessels	Vessel noise occurs offshore and more frequently near ports and docks. Ongoing activities that contribute to this sub-IPF include commercial shipping, recreational and fishing vessels, and scientific and academic research vessels. Vessel noise is anticipated to continue at or near current levels.	Planned new barge routes and dredging disposal sites would generate vessel noise when implemented. The number and location of such routes are uncertain.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. The Marine Commerce Terminal at the Port of New Bedford was upgraded by the port specifically to support the construction of offshore wind energy facilities.	Ports would need to perform maintenance and upgrade facilities over the next 30 years to ensure that they can still receive the projected future volume of vessels visiting their ports, and to be able to host larger deep-draft vessels as they continue to increase in size.
Port utilization: Maintenance/ dredging	No major ports are within the geographic analysis area. Periodic maintenance is necessary for harbors within the analysis area.	Ongoing maintenance and dredging of harbors within the geographic analysis area will continue as needed. No specific projects are known.
Presence of structures: Allisions	An allision occurs when a moving vessel strikes a stationary object. The stationary object can be a buoy, a port feature, or another anchored vessel. The likelihood of allisions is expected to continue at or near current levels.	Vessel allisions with non-offshore wind stationary objects should not increase meaningfully without a substantial increase in vessel congestion.
Presence of structures: Entanglement, gear loss, gear damage	Commercial and recreational fishing gear is periodically lost due to entanglement with existing buoys, pilings, hard protection, and other structures.	No future activities were identified within the recreation and tourism geographic analysis area other than ongoing activities.
Presence of structures: Fish aggregation	Structures, including tower foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented fishes are attracted to these locations. Recreational and commercial fishing can occur near these aggregation locations, although recreational fishing is more popular, because commercial mobile fishing gear is more likely to snag on structures.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Habitat conversion	Structures, including foundations, scour protection around foundations, and various means of hard protection atop cables create uncommon relief in a mostly flat seascape. Structure-oriented species thus benefit on a constant basis.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Navigation hazard	Vessels need to navigate around structures to avoid allisions, especially in nearshore areas. This navigation becomes more complex when multiple vessels must navigate around a structure, because vessels need to avoid both the structure and each other.	Vessel traffic, overall, is not expected to meaningfully increase over the next 30 years. The presence of navigation hazards is expected to continue at or near current levels.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Space use conflicts	Current structures do not result in space use conflicts.	Reasonably foreseeable activities (non-offshore wind) would not result in additional offshore structures.
Presence of structures: Viewshed	The only existing offshore structures in the viewshed of the Project are minor features such as buoys.	Non-offshore wind structures that could be viewed in conjunction with the offshore components of the Project would be limited to meteorological towers. Marine activity would also occur in the marine viewshed.
Traffic: Vessels	Geographic analysis area ports and marine traffic related to shipping, fishing, and recreation are important to the region's economy. No substantial changes are anticipated to existing vessel traffic volumes.	New vessel traffic near the geographic analysis area would be generated by proposed barge routes and dredging demolition sites over the next 30 years. Marine commerce and related industries would continue to be important to the geographic analysis area economy.
Traffic: Vessel collisions	The region's substantial marine traffic may result in occasional vessel collisions, which would result in costs to the vessels involved. The likelihood of collisions is expected to continue at or near current rates.	An increased risk of collisions is not anticipated from future activities.

ADLS = Aircraft Detection Light System; EFH = essential fish habitat; ESP = electrical service platform; FAA = Federal Aviation Administration; IPF = impact-producing factors; MW = megawatts; OECC = Offshore Export Cable Corridor; RI and MA = Rhode Island and Massachusetts; SEIS = Supplemental EIS; USCG = U.S. Coast Guard; WTG = wind turbine generator

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

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	See Table F1-22 for a quantitative analysis of these risks. Ongoing releases are frequent and chronic. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).	See Table F1-22 for a quantitative analysis of these risks. Gradually increasing vessel traffic over the next 30 years would increase the risk of accidental releases. Sea turtle exposure to aquatic contaminants and inhalation of fumes from oil spills can result in mortality (Shigenaka 2010; Wallace et al. 2010) or sublethal effects on individual fitness, including adrenal effects, dehydration, hematological effects, increased disease incidence, liver effects, poor body condition, skin effects, skeletomuscular effects, and several other health effects that can be attributed to oil exposure (Camacho et al. 2013; Bembenek-Bailey et al. 2019; Mitchelmore et al. 2017; Shigenaka et al. 2010; Vargo et al. 1986). Additionally, accidental releases may result in impacts on sea turtles due to effects on prey species (Table F1-11).
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, cables, lines, and pipeline laying, as well as debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct ingestion of plastic fragments is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016; Schuylar et al. 2014). In addition to plastic debris, ingestion of tar, paper, Styrofoam™, wood, reed, feathers, hooks, lines, and net fragments have also been documented (Thomás et al. 2002). Ingestion can also occur when individuals mistake debris for potential prey items (Gregory 2009; Hoarau et al. 2014; Thomás et al. 2002). Potential ingestion of marine debris varies among species and life history stages due to differing feeding strategies (Nelms et al. 2016). Ingestion of plastics and other marine debris can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect (Gall and Thompson	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities and cables, lines and pipeline laying, and debris carried in river outflows or windblown from onshore. Accidental releases of trash and debris are expected to be low quantity, local, and low-impact events. Direct and indirect ingestion of plastic fragments and other marine debris is well documented and has been observed in all species of sea turtles (Bugoni et al. 2001; Gregory 2009; Hoarau et al. 2014; Nelms et al. 2016; Schuylar et al. 2014; Thomás et al. 2002). Ingestion can result in both lethal and sublethal impacts on sea turtles, with sublethal effects more difficult to detect

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
	2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Long-term sublethal effects may include dietary dilution, chemical contamination, depressed immune system function, poor body condition, as well as reduced growth rates, fecundity, and reproductive success. However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).	(Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). However, these effects are cryptic and clear causal links are difficult to identify (Nelms et al. 2016).
EMF	EMFs emanate constantly from installed telecommunication and electrical power transmission cables. Sea turtles appear to have a detection threshold of magnetosensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 μT for loggerhead turtles, and 29.3 to 200 μT for green turtles, with other species likely similar due to anatomical, behavioral, and life history similarities (Normandeau et al. 2011). Juvenile or adult sea turtles foraging on benthic organisms may be able to detect magnetic fields while they are foraging on the bottom near the cables and up to potentially 82 feet (25 meters) in the water column above the cable. Juvenile and adult sea turtles may detect the EMF over relatively small areas near cables (e.g., when resting on the bottom or foraging on benthic organisms near cables or concrete mattresses). There are no data on impacts on sea turtles from EMFs generated by underwater cables, although anthropogenic magnetic fields can influence migratory deviations (Luschi et al. 2007; Snoek et al. 2016). However, any potential impacts from AC cables on turtle navigation or orientation would likely be undetectable under natural conditions, and thus would be insignificant (Normandeau et al. 2011).	During operations, future new cables would produce EMF. Submarine power cables in the geographic analysis area for sea turtles are assumed to be installed with appropriate shielding and burial depth to reduce potential EMF to low levels. (Section 5.2.7 of BOEM's 2007 Final Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf.) EMF of any two sources would not overlap. Although the EMF would exist as long as a cable was in operation, impacts, if any, would likely be difficult to detect, if they occur at all. Further, this IPF would be limited to extremely small portions of the areas used by resident or migrating sea turtles. As such, exposure to this IPF would be low, and as a result, impacts on sea turtles would not be expected.
Light: Vessels	Ocean vessels such as ongoing commercial vessel traffic, recreational and fishing activity, scientific and academic research traffic have an array of lights including navigational, deck lights, and interior lights. Such lights have some limited potential to attract sea turtles, although the impacts, if any, are expected to be localized and temporary.	Construction, operations, and decommissioning vessels associated with non-offshore wind activities produce temporary and localized light sources that could result in the attraction or avoidance behavior of sea turtles. These short-term impacts are expected to be of low intensity and occur infrequently.

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

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Noise: G&G	Infrequent site characterization surveys and scientific surveys produce high-intensity impulsive noise around sites of investigation. These activities have the potential to result in some impacts including potential auditory injuries, short-term disturbance, behavioral responses, and short-term displacement of feeding or migrating sea turtles, if present in the ensonified area (NSF and USGS 2011). The potential for PTS and TTS is considered possible in proximity to G&G surveys utilizing air guns, but impacts are unlikely as turtles would be expected to avoid such exposure and survey vessels would pass quickly (NSF and USGS 2011). No significant impacts would be expected at the population level.	Same as ongoing activities, with the addition of possible future oil and gas exploration surveys.
Noise: Turbines	Available evidence suggests that typical underwater noise levels from operating WTGs would be below current cumulative injury and behavioral effect thresholds for sea turtles. Operating turbines were determined to produce underwater noise on the order of 110 to 125 dB_{RMS}, occasionally reaching as high as 128 dB_{RMS}, in the 10-Hz to 8-kHz range (Tougaard et al. 2020). As measured at the Block Island Wind Facility, low frequency operational noise barely exceeds ambient levels at 164 feet (50 meters) from the WTG base (Miller and Potty 2017). Operational noise impacts would be expected to be negligible.	This sub-IPF does not apply to future non-offshore wind development.
Noise: Pile driving	Noise from pile driving occurs periodically in nearshore areas when piers, bridges, pilings, and seawalls are installed or upgraded. Noise transmitted through water or through the seabed can result in high-intensity, low-exposure levels, and long-term, but localized intermittent risk to sea turtles. Impacts, potentially including behavioral responses, masking, TTS, and PTS, would be localized in nearshore waters. Data regarding threshold levels for impacts on sea turtles from sound exposure during pile driving are very limited, and no regulatory threshold criteria have been established for sea turtles. Based on current literature, the following thresholds are used to assess impacts on turtles: • Potential mortal injury: 210 dB cumulative SPL or greater than 207 dB peak SPL (Popper et al. 2014) • Potential mortal injury: 204 dB_{SEL}, 232 dB_{PEAK} (PTS) • 189 dB_{SEL}, 226 dB_{PEAK} (TTS) (Navy 2017) • Behavioral harassment: 175 dB referenced to 1 μPa RMS (Navy 2017)	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Noise: Cable laying/ trenching	N/A	Cable laying impacts resulting from future non-offshore wind activities would be identical to those described for future offshore wind projects.
Noise: Vessels	The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with sea turtles' known hearing range (less than 1000 Hz with maximum sensitivity between 200 to 700 Hz; Bartol 1994) and would therefore be audible. However, Hazel et al. (2007) suggest that sea turtles' ability to detect approaching vessels is primarily vision-dependent, not acoustic. Sea turtles may respond to vessel approach or noise with a startle response (diving or swimming away) and a temporary stress response (NSF and USGS 2011). Samuel et al. (2005) indicated that vessel noise could have an effect on sea turtle behavior, especially their submergence patterns.	See Section 3.19.6. Any offshore projects that require the use of ocean vessels could potentially result in long-term but infrequent impacts on sea turtles, including temporary startle responses, masking of biologically relevant sounds, physiological stress, and behavioral changes, especially their submergence patterns (NSF and USGS 2011; Samuel et al. 2005). However, BOEM expects that these brief responses of individuals to passing vessels would be unlikely given the patchy distribution of sea turtles and no stock or population-level effects would be expected.
Port utilization: Expansion	The major ports in the United States are seeing increased vessel visits, as vessel size also increases. Ports are also going through continual upgrades and maintenance. Port expansion activities are localized to nearshore habitats, and are expected to result in short-term, temporary impacts, if any, on sea turtles. Vessel noise may affect sea turtles, but response would be expected to be short term and temporary (see the Vessels: Noise sub-IPF above). The impacts on water quality from sediment suspension during port expansion activities is short term and temporary, and would be similar to those described under the New cable emplacement/maintenance IPF above.	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications. Future channel deepening activities are being undertaken to accommodate deeper draft vessels for the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
		use and cruise industry) and may continue to increase in the foreseeable future. Additional impacts associated with the increased risk of vessel strikes could also occur (see the Traffic: Vessel collisions sub-IPF below).
Presence of structures: Entanglement or ingestion of lost fishing gear	The Mid-Atlantic region has more than 130 artificial reefs. Currently bridge foundations and the Block Island Wind Facility may be considered artificial reefs and may have higher levels of recreational fishing, which increases the chances of sea turtles encountering lost fishing gear, resulting in possible ingestions, entanglement, injury, or death of individuals (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014) if present where these structures are located. At the scale of the OCS geographic analysis area for sea turtles, there are very few areas that would serve to concentrate recreational fishing and increase the likelihood that sea turtles would encounter lost fishing gear.	No future activities were identified within the geographic analysis area for sea turtles other than ongoing activities.
Presence of structures: Habitat conversion and prey aggregation	The Mid-Atlantic region has more than 130 artificial reefs. Hard-bottom (scour control and rock mattresses) and vertical structures (bridge foundations and Block Inland Wind Facility WTGs) in a soft-bottom habitat can create artificial reefs, thus inducing the reef effect (Taormina et al. 2018; NMFS 2015). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans (Taormina et al. 2018), providing a potential increase in available forage items and shelter for sea turtles compared to the surrounding soft-bottoms.	The presence of structures associated with non-offshore wind development in nearshore coastal waters has the potential to provide habitat for sea turtles as well as preferred prey species. This reef effect has the potential to result in long-term, low-intensity beneficial impacts. Bridge foundations will continue to provide foraging opportunities for sea turtles with measurable benefits to some individuals.
Presence of structures: Avoidance/ displacement	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF. There may be some impacts resulting from the existing Block Island Wind Facility, but given that there are only 5 WTGs, no measurable impacts are occurring.	Not contemplated for non-offshore wind facility sources.
Presence of structures: Behavioral disruption - breeding and migration	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.

Associated IPF: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Presence of structures: Displacement into higher risk areas (Vessels and Fishing)	No ongoing activities in the geographic analysis area for sea turtles beyond offshore wind facilities are measurably contributing to this sub-IPF.	Not contemplated for non-offshore wind facility sources.
Traffic: Vessel collisions	Current activities contributing to this sub-IPF include port traffic levels, fairways, traffic separation schemes, commercial vessel traffic, recreational and fishing activity, and scientific and academic vessel traffic. Propeller and collision injuries from boats and ships are common in sea turtles. Vessel strike is an increasing concern for sea turtles, especially in the southeastern United States, where development along the coasts is likely to result in increased recreational boat traffic. In the United States, the percentage of strandings of loggerhead sea turtles that were attributed to vessel strikes increased from approximately 10% in the 1980s to a record high of 20.5% in 2004 (NMFS and USFWS 2007). Sea turtles are most susceptible to vessel collisions in coastal waters, where they forage from May through November. Vessel speed may exceed 10 knots in such waters, and evidence suggests that they cannot reliably avoid being struck by vessels exceeding 2 knots (Hazel et al. 2007).	Vessel traffic associated with non-offshore wind development has the potential to result in an increased collision risk. While these impacts would be high consequence, the patchy distribution of sea turtles makes stock or population-level effects unlikely (Navy 2018).

μPa = micropascal; μT = microtesla; AC = alternating current; ADLS = Aircraft Detection Light System; AIS = Automatic Identification System; BMP = best management practice; BOEM = Bureau of Ocean Energy Management; BSW = Bay State Wind; CFR = Code of Federal Regulations; COP = Construction and Operations Plan; dB = decibel; dB re 1 μPa = decibels relative to one micropascal; dB RMS = decibel root mean square; DC = direct current; DP = dynamic positioning; DPS = distinct population segment; EMF = electromagnetic field; ESP = electrical service platform; FAA = Federal Aviation Administration; FCC = Federal Communications Commission; G&G = Geological and Geophysical; HRG = high resolution geophysical; Hz = hertz; IHA = Incidental Harassment Authorization; IPF = impact-producing factors; MCT = Marine Commerce Terminal; met = meteorological; NARW = North Atlantic right whale; NEPA = National Environmental Policy Act; NMFS = National Marine Fisheries Service; NRA = Navigational Risk Assessment; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; PAM = passive acoustic monitoring; PSO = protected species observer; PTS = permanent threshold shift; RMS = root mean square; SEIS = Supplemental EIS; SOV = service operations vessel; SPL = sound pressure level; TTS = temporary threshold shift; USACE = U.S. Army Corps of Engineers; USCG = US Coast Guard; WTG = wind turbine generator

Table F1-22 Summary of Activities and the Associated Impact-Producing Factors for Water Quality

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
Accidental releases: Fuel/fluids/ hazmat	Accidental releases of fuels and fluids occur during vessel usage for dredge material ocean disposal, fisheries use, marine transportation, military use, survey activities, and submarine cable lines, and pipeline-laying activities. According to the DOE, 31,000 barrels of petroleum are spilled into U.S. waters from vessels and pipelines in a typical year. Approximately 40.5 million barrels of oil were lost as a result of tanker incidents from 1970 to 2009, according to International Tanker Owners Pollution Federation Limited, which collects data on oil spills from tankers and other sources. From 1990 to 1999, the average annual input to the coastal Northeast was 220,000 barrels of petroleum and into the offshore was < 70,000 barrels. Impacts on water quality would be expected to brief and localized from accidental releases.	Future accidental releases from offshore vessel usage, spills, and consumption will likely continue on a similar trend. Impacts are unlikely to affect water quality.
Accidental releases: Trash and debris	Trash and debris may be accidentally discharged through fisheries use, dredged material ocean disposal, marine minerals extraction, marine transportation, navigation and traffic, survey activities, and cables, lines, and pipeline laying. Accidental releases of trash and debris are expected to be low probability events. BOEM assumes operator compliance with federal and international requirements for management of shipboard trash; such events also have a relatively limited spatial impact.	As population and vessel traffic increase gradually over the next 30 years, accidental release of trash and debris may increase. However, there does not appear to be evidence that the volumes and extents anticipated would have any effect on water quality.
Anchoring	Impacts from anchoring occur due to ongoing military use and survey, commercial, and recreational activities.	Impacts from anchoring may occur semi-regularly over the next 30 years due to offshore military operations or survey activities. These impacts would include increased seabed disturbance resulting in increased turbidity levels. All impacts would be localized, short term, and temporary.

Associated IPFs: Sub-IPFs	Ongoing Activities	Future Non-Offshore Wind Activities Intensity/Extent
New cable emplacement/ maintenance	Elevated suspended sediment concentrations can occur under natural tidal conditions and increase during storms, trawling, and vessel propulsion. Survey activities, and new cable and pipeline-laying activities disturb bottom sediments and cause temporary increases in suspended sediment; these disturbances would be short term and either be limited to the emplacement corridor or localized.	Suspension of sediments may continue to occur infrequently over the next 30 years due to survey activities, and submarine cable, lines, and pipeline-laying activities. Future new cables would occasionally disturb the seafloor and cause short-term increases in turbidity and minor alterations in localized currents resulting in local short-term impacts. The FCC has two pending submarine telecommunication cable applications in the North Atlantic. If the cable routes enter the water quality geographic analysis area, short-term disturbance in the form of increased suspended sediment and turbidity would be expected.
Port utilization: Expansion	Between 1992 and 2012, global shipping traffic increased fourfold (Tournadre 2014). The U.S. OCS is no exception to this trend, and growth is expected to continue as human population increases. In addition, the general trend along the coastal region from Virginia to Maine is that port activity will increase modestly. The ability of ports to receive the increase in larger ships will require port modifications, which, along with additional vessel traffic, could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. The increased sediment suspension could be long term depending on the vessel traffic increase. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.	The general trend along the coastal region from Virginia to Maine is that port activity will increase modestly over the next 30 years. Port modifications and channel deepening activities are being undertaken to accommodate the increase in vessel traffic and deeper draft vessels that transit the Panama Canal Locks. The additional traffic and larger vessels could have impacts on water quality through increases in suspended sediments and the potential for accidental discharges. Certain types of vessel traffic have increased recently (e.g., ferry use and cruise industry) and may continue to increase in the foreseeable future.
Presence of structures	The installation of onshore and offshore structures leads to alteration of local water currents. These disturbances would be local but, depending on the hydrologic conditions, have the potential to impact water quality through the formation of sediment plumes.	Impacts associated with the presence of structures includes temporary sediment disturbance during maintenance. This sediment suspension would lead to interim and localized impacts.

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

BOEM = Bureau of Ocean Energy Management; DO = dissolved oxygen; DOE = U.S. Department of Energy; EIS = Environmental Impact Statement; ESP = electrical service platform; FCC = Federal Communications Commission; gal = gallon; IPF = impact-producing factors; NASA = National Aeronautics and Space Administration; OCS = Outer Continental Shelf; OECC = Offshore Export Cable Corridor; USACE = U.S. Army Corps of Engineers; USCG = U.S. Coast Guard; USEPA = Environmental Protection Agency; WTG = wind turbine generator

Table F1-23 Summary of Activities and the Associated Impact-Producing Factors for Wetlands

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

LITERATURE CITED

Bartol, S.M. 1994. Auditory Evoked Potentials of the Loggerhead Sea Turtle (*Caretta caretta*). Master's Thesis, College of William and Mary – Virginia Institute of Marine Science. 66 pp. Available: https://scholarworks.wm.edu/cgi/viewcontent.cgi?article=2805&context=etd.

Baulch, S., and C. Perry. 2014. Evaluating the Impacts of Marine Debris on Cetaceans. *Marine Pollution Bulletin* 80:210–221.

Bembenek-Bailey, S.A., J.N. Niemuth, P.D. McClellan-Green, M.H. Godfrey, C.A. Harms, H. Gracz, and M.K. Stoskopf. 2019. NMR Metabolomics Analysis of Skeletal Muscle, Heart, and Liver of Hatchling Loggerhead Sea Turtles (*Caretta caretta*) Experimentally Exposed to Crude Oil and/or Corexit. *Metabolites* 2019(9):21. doi:10.3390/metabo9020021.

Berreiros J.P., and V.S. Raykov. 2014. Lethal Lesions and Amputation Caused by Plastic Debris and Fishing Gear on the Loggerhead Turtle *Caretta* (Linnaeus, 1758). Three case reports from Terceira Island, Azores (NE Atlantic). *Marine Pollution Bulletin* 86:518–522.

Briggs, K.T., M.E. Gershwin, and D.W. Anderson. 1997. Consequences of Petrochemical Ingestion and Stress on the Immune System of Seabirds. *ICES Journal of Marine Science* 54:718–725.

Browne, M.A., A.J. Underwood, M.G. Chapman, R. Williams, R.C. Thompson, and J.A. van Franeker. 2015. Linking Effects of Anthropogenic Debris to Ecological Impacts. *Proceedings of the Royal Society B* 282:20142929. Available: http://dx.doi.org/10.1098/rspb.2014.2929.

Bugoni, L., L Krause, and M.V. Petry. 2001. Marine Debris and Human Impacts on Sea Turtles in Southern Brazil. *Marine Pollution Bulletin* 42(12):1330–1334.

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

Burge, C.A., C.M. Eakin, C.S. Friedman, B. Froelich, P.K. Hershberger, E.E. Hofmann, L.E. Petes, K.C. Prager, E. Weil, B.L. Willis, S.E. Ford, and C.D. Harvell. 2014. Climate Change Influences on Marine Infectious Diseases: Implications for Management and Society. *Annual Review of Marine Science* 6:249–277.

Camacho, M., O.P. Luzardo, L.D. Boada, L.F.L. Jurado, M. Medina, M. Zumbado, and J. Orós. 2013. *Potential Adverse Health Effects of Persistent Organic Pollutants on Sea Turtles: Evidence from a Cross-Sectional Study on Cape Verde Loggerhead Sea Turtles*. Science of the Total Environment.

Causon, Paul D., and Andrew B. Gill. 2018. Linking Ecosystem Services with Epibenthic Biodiversity Change Following Installation of Offshore Wind Farms. *Environmental Science and Policy* 89:340–347.

Claisse, Jeremy T., Daniel J. Pondella II, Milton Love, Laurel A. Zahn, Chelsea M. Williams, Jonathan P. Williams, and Ann S. Bull. 2014. Oil Platforms off California are among the Most Productive Marine Fish Habitats Globally. *Proceedings of the National Academy of Sciences of the United States of America* 111(43):15462–15467. October 28, 2014. First published October 13, 2014. Available: https://doi.org/10.1073/pnas.1411477111. Accessed: March 2020.

Cook, A.S.C.P., and N.H.K. Burton. 2010. *A review of Potential Impacts of Marine Aggregate Extraction on Seabirds*. Marine Environment Protection Fund Project 09/P130. Available: https://www.bto.org/sites/default/files/shared_documents/publications/research-reports/2010/rr563.pdf. Accessed: February 25, 2020.

CSA Ocean Sciences, Inc. and Exponent. 2019. *Evaluation of Potential EMF Effects on Fish Species of Commercial or Recreational Fishing Importance in Southern New England*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-049.

Degraer, S., R. Brabant, B. Rumes, and L. Vigin, eds. 2019. *Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Marking a Decade of Monitoring, Research and Innovation*. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management, 134 pp.

Dolbeer, R.A., M.J. Begier, P.R. Miller, J.R. Weller, and A.L. Anderson. 2019. *Wildlife Strikes to civil aircraft in the United States, 1990 – 2018*. Federal Aviation Administration National Wildlife Strike Database Serial Report Number 25. 95 pp. + Appendices.

Efroymson, R.A., W. Hodge Rose, S. Nemth, and G.W. Suter II. 2000. *Ecological Risk Assessment Framework for Low Altitude Overflights by Fixed-Wing and Rotary-Wing Military Aircraft*. Research sponsored by Strategic Environmental Research and Development Program of the U.S. Department of Defense under Interagency Agreement 2107-N218-S1. Publication No. 5010, Environmental Sciences Division, ORNL.

Fabrizio, M.C., J.P. Manderson, and J.P. Pessutti. 2014. Home Range and Seasonal Movements of Black Sea Bass (*Centropristis striat*a) during their Inshore Residency at a Reef in the Mid-Atlantic Bight. *Fishery Bulletin* 112:82–97 (2014). doi: 10.7755/FB.112.1.5.

Gall, S.C., and R.C. Thompson. 2015. The Impact of Marine Debris on Marine Life. *Marine Pollution Bulletin* 92:170–179.

Gill, A.B., I. Gloyne-Phillips, K.J. Neal, and J.A. Kimber. 2005. *The Potential Effects of Electromagnetic Fields Generated by Sub-Sea Power Cables Associated with Offshore Wind Farm Developments on Electrically and Magnetically Sensitive Marine Organisms - A Review.* Collaborative Offshore Wind Research into the Environment (COWRIE), Ltd, UK.

Greene, J.K., M.G. Anderson, J. Odell, and N. Steinberg (editors). 2010. *The Northwest Atlantic Marine Ecoregional Assessment: Species, Habitats and Ecosystems. Phase One*. The Nature Conservancy, Eastern U.S. Division, Boston, MA.

Gregory, M.R. 2009. Environmental Implications of Plastic Debris in Marine Settings – Entanglement, Ingestion, Smothering, Hangers-on, Hitch-Hiking, and Alien Invasion. *Philosophical Transactions of the Royal Society* B 364:2013–2025.

Guida, V., A. Drohan, H. Welch, J. McHenry, D. Johnson, V. Kentner, J. Brink, D. Timmons, and E. Estela-Gomez. 2017. *Habitat Mapping and Assessment of Northeast Wind Energy Areas*. U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-088.

Haney, J.C., P.G.R. Jodice, W.A. Montevecchi, and D.C. Evers. 2017. Challenges to oil spill assessments for seabirds in the deep ocean. *Archives of Environmental Contamination and Toxicology* 73:33–39.

Hann, Z.A., M.J. Hosler, and P.R. Mooseman, Jr. 2017. Roosting Habits of Two Lasiurus borealis (eastern red bat) in the Blue Ridge Mountains of Virginia. *Northeastern Naturalist* 24 (2):N15–N18.

Hare J.A., W.E. Morrison, M.W. Nelson, M.M. Stachura, E.J. Teeters, and R.B. Griffis. 2016. A Vulnerability Assessment of Fish and Invertebrates to Climate Change on the Northeast U.S. Continental Shelf. *PLoS ONE* 11(2):e0146756. doi:10.1371/ journal.pone.0146756.

Hawkins, A., and A. Popper. 2017. A Sound Approach to Assessing the Impact of Underwater Noise on Marine Fishes and Invertebrates. *ICES Journal of Marine Science* 74(3):635–651. doi:10.1093/icesjms/fsw205.

Hazel, J., I.R. Lawler, H. Marsh, and S. Robson. 2007. Vessel Speed Increases Collision Risk for the Green Turtle *Chelonia mydas*. *Endangered Species Research* 3:105–113

HDR. 2019. *Benthic Monitoring during Wind Turbine Installation and Operation at the Block Island Wind Farm, Rhode Island – Year 2.* Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019- 019. Available: https://espis.boem.gov/final%20reports/BOEM_2019-019.pdf. Accessed: February 12, 2020.

Hoarau, L., L. Ainley, C. Jean, S. Ciccione. 2014. Ingestion and Defecation of Marine Debris by Loggerhead Sea Turtles, from By-catches in the South-West Indian Ocean. *Marine Pollution Bulletin* 84:90–96.

Hűppop, O., J. Dierschke, K. Exo, E. Frerich, and R. Hill. 2006. Bird Migration and Potential Collision Risk with Offshore Wind Turbines. *Ibis* 148:90–109.

Hutchison, Zoë, Peter Sigray, Haibo He, Andrew Gill, John King, and Carol Gibson. 2018. *Electromagnetic Field (EMF) Impacts on Elasmobranch (shark, rays, and skates) and American Lobster Movement and Migration from Direct Current Cables*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2018-003.

Jensen, J.H., L. Bejder, M. Wahlberg, N. Aguilar Solo, M. Johnson, and P.T. Madsen. 2009. Vessel Noise Effects on Delphinid Communication. *Marine Ecology Progress Series* 395:161–175.

Karp, M.A., J.O. Peterson, P.D. Lynch, R.B. Griffis, C.F. Adams, W.S. Arnold, L.A. Barnett, Y. deReynier, J. DiCosimo and K.H. Fenske. 2019. Accounting for Shifting Distributions and Changing Productivity in the Development of Scientific Advice for Fishery Management. *ICES Journal of Marine Science* 76 (5):1305–1315.

Kellar, N.M., T.R. Speakman, C.R. Smith, S.M. Lane, B.C. Balmer, M.L. Trego, K.N. Catelani, M.N. Robbins, C.D. Allen, R.S. Wells, E.S. Zolman, T.K. Rowles, and L.H. Schwacke. 2017. Low Reproductive Success Rates of Common Bottlenose Dolphins *Tursiops truncatus* in the Northern Gulf of Mexico Following the Deepwater Horizon Disaster (2010-2015). *Endangered Species Research* 33:1432–158.

Kerckhof, Francis, Bob Rumes, and Steven Degraer. 2019. About 'Mytilisation' and 'Slimeification': A Decade of Succession of the Fouling Assemblages on Wind Turbines off the Belgian Coast. In *Memoirs on the Marine Environment: Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea*, edited by Steven Degraer, Robin Brabant, Bob Rumes, and Laurence Vigin, pp. 73–84. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management. Available: https://tethys.pnnl.gov/sites/default/files/publications/Degraer-et-al-2018_0.pdf. Accessed: February 12, 2020.

Kirschvink, J.L. 1990. Geomagnetic Sensitivity in Cetaceans an Update with Live Strandings Recorded in the US. In *Sensory Abilities of Cetaceans*, edited by J. Thomas and R. Kastelein. Plenum Press, NY.

Kite-Powell, H.L., A. Knowlton, and M. Brown. 2007. *Modeling the Effect of Vessel Speed on Right Whale Ship Strike Risk*. Unpublished Report for NOAA/NMFS Project NA04NMF47202394. 8 pp.

Kraus, S.D., M.W. Brown, H. Caswell, C.W. Clark, M. Fujiwara, P.H. Hamilton, R.D. Kenney, A.R. Knowlton, S. Landry, C.A. Mayo, W.A. McLellan, M.J. Moore, D.P. Nowacek, D.A. Pabst, A.J. Read, and R.M. Rolland. 2005. North Atlantic Right Whales in Crisis. *Science* 309:561–562.

Kraus, S.D., S. Leiter, K. Stone, B. Wikgren, C. Mayo, P. Hughes, R.D. Kenney, C. W. Clark, A. N. Rice, B. Estabrook, and J. Tielens. 2016. *Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles. Final Report*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Sterling, Virginia. OCS Study BOEM 2016-054.

Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2001. Collisions between Ships and Whales. *Marine Mammal Science* 17(1):35–75.

La Sorte, Frank, K. Horton, C. Nilsson, and A. Dokter. 2018. Projected Changes in Wind Assistance under Climate Change for Nocturnally Migrating Bird Populations. Available: https://par.nsf.gov/servlets/purl/10092560. Accessed: February 10, 2021.

Law, K.L., S. Morét-Ferguson, N.A. Maximenko, G. Proskurowski, E.E. Peacock, J. Hafner, and C.M. Reddy. 2010. Plastic Accumulation in the North Atlantic Subtropical Gyre. *Science* 329:1185–1188.

Luschi, P., S. Benhamou, C. Girard, S. Ciccione, D. Roos, J. Sudre, and S. Benvenuti. 2007. Marine Turtles use Geomagnetic Cues during Open Sea Homing. *Current Biology* 17:126–133.

MacLeod, C.D. 2009. Global Climate Change, Range Changes, and Potential Implications for the Conservation of Marine Cetaceans: a Review and Synthesis. *Endangered Species Research* 7:125–136.

Mazet, J.A.K., I.A. Gardner, D.A. Jessup, and L.J. Lowenstine. 2001. Effects of Petroleum on Mink Applied as a Model for Reproductive Success in Sea Otters. *Journal of Wildlife Diseases* 37(4):686–692.

Maggini, I., L.V. Kennedy, A. Macmillan, K.H. Elliot, K. Dean, and C.G. Guglielmo. 2017. Light Oiling of Feathers Increases Flight Energy Expenditure in a Migratory Shorebird. *Journal of Experimental Biology* 220:2372–2379.

McConnell, B.J., M.A. Fedak, P. Lovell, and P.S. Hammond. 1999. Movements and Foraging Areas of Grey Seals in the North Sea. *Journal of Applied Ecology* 36:573–590.

McCreary, S., and B. Brooks. 2019. *Atlantic Large Whale Take Reduction Team Meeting: Key Outcomes Meeting.* April 23-26, 2019. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-mammal-protection/atlantic-large-whale-take-reduction-plan. Accessed: March 17, 2020.

Miller, J.H., and G.R. Potty. 2017. Overview of Underwater Acoustic and Seismic Measurements of the Construction and Operation of the Block Island Wind Farm. *Journal of the Acoustical Society of America* 141(5):3993–3993. doi:10.1121/1.4989144.

Mitchelmore, C.L., C.A. Bishop, and T.K. Collier. 2017. Toxicological Estimation of Mortality of Oceanic Sea Turtles Oiled during the Deepwater Horizon Oil Spill. *Endangered Species Research* 33:39–50.

Mohr, F.C., B. Lasely, and S. Bursian. 2008. Chronic Oral Exposure to Bunker C Fuel Oil Causes Adrenal Insufficiency in Ranch Mink. *Archive of Environmental Contamination and Toxicology* 54:337–347.

Moore, M.J., and J.M. van der Hoop. 2012. The Painful Side of Trap and Fixed Net Fisheries: Chronic Entanglement of Large Whales. *Journal of Marine Biology* 2012:Article ID 230653, 4 pp.

Moser, J., and G.R. Shepherd. 2009. Seasonal Distribution and Movement of Black Sea Bass (*Centropristis striata*) in the Northwest Atlantic as Determined from a Mark-Recapture Experiment. *J. Northw. Atl. Fish. Sci.* 40:17–28. doi:10.2960/J.v40.m638.

Nelms, S.E., E.M. Duncan, A.C. Broderick, T.S. Galloway, M.H. Godfrey, M. Hamann, P.K. Lindeque, and Bendan J. Godley. 2016. Plastic and Marine Turtles: a Review and Call for Research. *ICES Journal of Marine Science* 73(2):165–181.

National Marine Fisheries Service (NMFS). 2015. *Endangered Species Act (ESA) Section 7 Consultation Biological Opinion, Deepwater Wind: Block Island Wind Farm and Transmission System*. June 5.

———. 2016. *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing*. U.S. Dept. of Commerce., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 pp.

National Marine Fisheries Service and U.S. Fish and Wildlife Service (NMFS and USFWS). 2007. *Loggerhead Sea Turtle (*Caretta caretta*) 5-Year Review: Summary and Evaluation*. National Marine Fisheries Service and U.S. Fish and Wildlife Service.

National Oceanic and Atmospheric Administration (NOAA). 2018. *Biological Opinion on the Bureau of Ocean Energy Management's Issuance of Five Oil and Gas Permits for Geological and Geophysical Seismic Surveys off the Atlantic Coast of the United States, and the National Marine Fisheries Services' Issuance of Associated Incidental Harassment Authorizations*. Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. 267 pp. + appendices.

———. 2020a. *National Data Buoy Center.* Available: https://www.ndbc.noaa.gov/. Accessed: February 18, 2020.

———. 2020b. *Section 7 Effect Analysis: Turbidity in the Greater Atlantic Region*. NOAA Greater Atlantic Regional Fisheries Office. Available: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-effect-analysis-turbidity-greater-atlantic-region.

National Science Foundation (NSF) and U.S. Geological Survey (USGS). 2011. *Final Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for marine seismic research funded by the National Science Foundation or conducted by the U.S. Geological Survey*. 514 pp. Available: https://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/nsf-usgs-final-eis-oeis_3june2011.pdf.

Normandeau Associates, Inc., Exponent, Inc., T. Tricas, and A. Gill. 2011. *Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species*. Final Report. U.S. Department of the Interior, Bureau of Ocean Energy Management, Regulation and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09.

Nunny, L., and M.P. Simmonds. 2019. *Climate Change and Cetaceans: an update*. International Whaling Commission. May.

Pace, R.M., and G.K. Silber. 2005. Simple Analysis of Ship and Large Whale Collisions: Does Speed Kill? Presentation at the Sixteenth Biennial Conference on the Biology of Marine Mammals, San Diego, CA, December 2005.

Paruk, J.D., E.M. Adams, H. Uher-Koch, K.A. Kovach, D. Long, IV, C. Perkins, N. Schoch, and D.C. Evers. 2016. Polycylic Aromatic Hydrocarbons in Blood Related to Lower Body Mass in Common Loons. *Science of the Total Environment* 565:360–368.

Patenaude, N.J., W.J. Richardson, M.A. Smultea, W.R. Koski, and G.W. Miller. 2002. Aircraft Sound and Disturbance to Bowhead and Beluga Whales During Spring Migration in the Alaskan Beaufort Sea. *Marine Mammal Science* 18(2):309–335.

Popper, Arthur N., Anthony D. Hawkins, Richard R. Fay, David A. Mann, Soraya Bartol, Thomas J. Carlson, Sheryl Coombs, William T. Ellison, Roger L. Gentry, Michele B. Halvorsen, Svein Løkkeborg, Peter H. Rogers, Brandon L. Southall, David G. Zeddies, and William N. Tavolga. 2014. *Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report.* Prepared by ANSI - Accredited Standards Committee S3/SC1 and Registered with ANSI. ASAPress/Springer. ASA S3/SC1.4 TR-2014.

Roman, L., B.D. Hardesty, M.A. Hindell, and C. Wilcox. 2019. A Quantitative Analysis Linking Seabird Mortality and Marine Debris Ingestion. *Scientific Reports* 9(1):1–7.

Record, N.R., J.A. Runge, D.E. Pendleton, W.M. Balch, K.T.A. Davies, A.J. Pershing, C.L. Johnson, K. Stamieszkin, Z. Feng, S.D. Kraus, R.D. Kenney, C.A. Hudak, C.A. Mayo, C. Chen, J.E. Salisbury, and C.R.S. Thompson. 2019. Rapid Climate-driven Circulation Changes Threaten Conservation of Endangered North Atlantic Right Whales. *Oceanography* 32(2):162–196.

Samuel, Y., S.J. Morreale, C.W. Clark, C.H. Greene, and M.E. Richmond. 2005. Underwater, Low-frequency Noise in a Coastal Sea Turtle Habitat. *Journal of the Acoustical Society of America* 117(3):1465–1472.

Schaub, A., J. Ostwald, B.M. Siemers. 2008. Foraging Bats Avoid Noise. *Journal of Experimental Biology* 211:3147–3180.

Schuyler, Q.A., C. Wilcox, K. Townsend, B.D. Hardesty, and N.J. Marshall. 2014. Mistaken Identity? Visual Similarities of Marine Debris to Natural Prey Items of Sea Turtles. *BMC Ecology* 14(14). 7 pp.

Secor, D.H., F. Zhang, M.H.P. O'Brien, and M. Li. 2018. Ocean Destratification and Fish Evacuation Caused by a Mid-Atlantic Tropical Storm. *ICES Journal of Marine Science* 76(2):573–584. Available: https://doi.org/10.1093/icesjms/fsx241.

Shigenaka, G., S. Milton, P. Lutz, R. Hoff, R. Yender, and A. Mearns. 2010. *Oil and Sea Turtles: Biology, Planning, and Response*. NOAA Office of Restoration and Response Publication. 116 pp.

Sigourney, D.B. C.D. Orphanides, J.M. Hatch. 2019. *Estimates of Seabird Bycatch in Commercial Fisheries off the East Coast of the United States from 2015-2016*. NOAA Technical Memorandum NMFS-NE-252. Woods Hole, Massachusetts. 27 pp.

Simmons, A.M., K.N. Horn, M. Warnecke, and J.A. Simmons. 2016. Broadband Noise Exposure Does Not Affect Hearing Sensitivity in Big Brown Bats (Eptesicus fuscus). *Journal of Experimental Biology* 219:1031–1040.

Smith, C.R., T.K. Rowles, L.B. Hart, F.I. Townsend, R.S. Wells, E.S. Zolman, B.C. Balmer, B. Quigley, M. Ivnacic, W. McKercher, M.C. Tumlin, K.D. Mullin, J.D. Adams, Q. Wu, W. McFee, T.K. Collier, and L.H. Schwacke. 2017. Slow Recovery of Barataria Bay Dolphin Health Following the Deepwater Horizon Oil Spill (2013-2014) with Evidence of Persistent Lung Disease and Impaired Stress Response. *Endangered Species Research* 33:127–142.

Smith, James, Michael Lowry, Curtis Champion, and Iain Suthers. 2016. A Designed Artificial Reef is among the Most Productive Marine Fish Habitats: New Metrics to Address 'Production Versus Attraction.' *Marine Biology* 163:188.

Snoek, R., R. de Swart, K. Didderen, W. Lengkeek, and M. Teunis. 2016. *Potential Effects of Electromagnetic Fields in the Dutch North Sea.* Final Report submitted to Rijkswaterstaat Water, Verkeer en Leefmgeving.

Southall, B., A. Bowles, W. Ellison, J. Finneran, R. Gentry, C. Greene Jr., D. Kastak, D. Ketten, J. Miller, P. Nachtigall, W. Richardson, J. Thomas, and P. Tyack. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals* 33(4):411–509.

Sullivan, L., T. Brosnan, T.K. Rowles, L. Schwacke, C. Simeone, and T.K. Collier. 2019. *Guidelines for Assessing Exposure and Impacts of Oil Spills on Marine Mammals*. NOAA Tech. Memo. NMFS-OPR-62, 82 pp.

Takeshita, R., L. Sullivan, C. Smith, T. Collier, A. Hall, T. Brosnan, T. Rowles, and L. Schwacke. 2017. The Deepwater Horizon Oil Spill Marine Mammal Injury Assessment. *Endangered Species Research* 33:96–106.

Taormina, B, J. Bald, A. Want, G.D. Thouzeau, M. Lejart, N. Desroy, and A. Carlier. 2018. A Review of Potential Impacts of Submarine Power Cables on the Marine Environment: Knowledge Gaps, Recommendations and Future Directions. *Renewable and Sustainable Energy Reviews* 96(2018):380–391.

Thomás, J., R. Guitart, R. Mateo, and J.A. Raga. 2002. Marine Debris Ingestion in Loggerhead Turtles, *Caretta*, from the Western Mediterranean. *Marine Pollution Bulletin* 44:211–216.

Thomsen, Frank, A.B. Gill, Monika Kosecka, Mathias Andersson, Michel André, Seven Degraer, Thomas Folegot, Joachim Gabriel, Adrian Judd, Thomas Neumann, Alain Norro, Denise Risch, Peter Sigray, Daniel Wood, and Ben Wilson. 2015. *MaRVEN – Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy*. 10.2777/272281.

Todd, V.L.G., I.B. Todd, J.C. Gardiner, E.C.N. Morrin, N.A. MacPherson, N.A. DiMarzio, and F. Thomsen. 2015. A Review of Impacts on Marine Dredging on Marine Mammals. *ICES Journal of Marine Science* 72(2):328–340.

Tougaard, J., L. Hermannsen, and P.T. Madsen. How Loud is the Underwater Noise from Operating Offshore Wind Turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

Tournadre, J. 2014. Anthropogenic Pressure on the Open Ocean: The Growth of Ship Traffic Revealed by Altimeter Data Analysis. *Geophysical Research Letters* 41:7924–7932. doi:10.1002/2014GL061786.

Minerals Management Service (MMS). 2007. *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf*, *Final Environmental Impact Statement*. October. OCS EIS/EA MMS 2007-046. Available: https://www.boem.gov/Guide-To-EIS/. Accessed: July 3, 2018.

U.S. Department of the Navy (Navy). 2017. C*riteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)*. Technical report. Available: https://nwtteis.com/portals/nwtteis/files/technical_reports/Criteria_and_Thresholds_for_U.S._Navy_Acoustic_and_Explosive_Effects_Analysis_June2017.pdf.

———. 2018. *Hawaii-Southern California Training and Testing EIS/OEIS*. Retrieved from: https://www.hstteis.com/Documents/2018-Hawaii-Southern-California-Training-and-Testing-Final-EIS-OEIS/Final-EIS-OEIS.

U.S. Energy Information Administration. 2018. Table P5B. Primary Production Estimates, Renewable and Total Energy, in Trillion BTU, Ranked by State, 2017. State Energy Data 2017.

Vanderlaan, A.S.M., and C.T. Taggart. 2007. Vessel Collisions with Whales: The Probability of Lethal Injury Based on Vessel Speed. *Marine Mammal Science* 23(1):144–156.

Vargo, S., P. Lutz, D. Odell, E. Van Vleet, and G. Bossart. 1986. *Effects of Oil on Marine Turtles. Final Report prepared for the Minerals Management Service (MMS).* 12 pp. Available: http://www.seaturtle.org/PDF/VargoS_1986a_MMSTechReport.pdf.

Vegter, A.C., M. Barletta, C. Beck, J. Borrero, H. Burton, M.L. Campbell, M.F. Costa, M. Eriksen, C. Eriksson, A. Estrades, K.V.K. Gilardi, B.D. Hardesty, J.A. Ivar do Sul, J.L. Lavers, B. Lazar, L. Lebreton, W.J. Nichols, C.A. Ribic, P.G. Ryan, Q.A. Schuyler, S.D.A. Smith, H. Takada, K.A. Townsend, C.C.C. Wabnitz, C. Wilcox, L.C. Young, and M. Hamann. 2014. Global Research Priorities to Mitigate Plastic Pollution Impacts on Marine Wildlife. *Endangered Species Research* 25:225–247.

Walker, M.M., C.E. Diebel, and J.L. Kirschvink. 2003. Detection and Use of the Earth's Magnetic Field by Aquatic Vertebrates. In *Sensory Processing in Aquatic Environments*, edited by S.P. Collin and N.J. Marshall, pp. 53–74. Springer-Verlag, New York.

Wallace, B.P., B.A. Stacey, E. Cuevas, C. Holyake, P.H. Lara, A.C.J. Marcondes, J.D. Miller, H. Nijkamp, N.J. Pilcher, I. Robinson, N. Rutherford, and G. Shigenaka. 2010. Oil Spills and Sea Turtles: Documented Effects and Considerations for Response and Assessment Efforts. *Endangered Species Research* 41:17–37.

Weilgart, Lindy. 2018. The Impact of Ocean Noise Pollution on Fish and Invertebrates. Report for OceanCare. Switzerland. Available: https://www.oceancare.org/wp-content/uploads/2017/10/OceanNoise_FishInvertebrates_May2018.pdf. Accessed: April 21, 2020.

Werner, S., A. Budziak, J. van Franeker, F. Galgani, G. Hanke, T. Maes, M. Matiddi, P. Nilsson, L. Oosterbaan, E. Priestland, R. Thompson, J. Veiga, and T. Vlachogianni. 2016. *Harm Caused by Marine Litter. MSFD GES TG Marine Litter - Thematic Report*. JRC Technical report; EUR 28317 EN; doi:10.2788/690366.

Whitaker, J.O., Jr. 1998. Life History and Roost Switching in Six Summer Colonies of Eastern Pipistrelles in Buildings. *Journal of Mammalogy* 79(2):651–659.

This page intentionally left blank.

ATTACHMENT F2
MAXIMUM-CASE SCENARIO ESTIMATES FOR OFFSHORE WIND PROJECTS

This page intentionally left blank.

Tables

Table F2-1 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 1, Turbine and Cable Design Parameters) (data as of June 20, 2023) F2-3
Table F2-2 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 2, Seabed/Anchoring Disturbance and Scour Protection) (Data as of June 20, 2023) F2-9
Table F2-3 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 3, Gallons of Coolant, Oils, Lubricants, and Diesel Fuel) (Data as of June 20, 2023) F2-10
Table F2-4 Offshore Wind Leasing Activities on the U.S. East Coast: Projects and Assumptions (Part 4, Construction and Operation Emissions) F2-11

This page intentionally left blank.

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

This page intentionally left blank.

Table F2-1 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 1, Turbine and Cable Design Parameters) (data as of June 20, 2023)[1]

Region	Lease, Project, Lease Remainder	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]										Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Interarray Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality	Water Quality, Wetlands	Navigation	Benthic	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Coastal Habitat	Demographics, Environmental Justice, Land Use, Cultural Resources	Marine Archaeology	Other Marine Uses (excluding research surveys & navigation)	Visual, Recreation & Tourism									
ME	Aquaventis (Maine state waters)	State Project					X						2024	2	11					450	520
	Total Other State Waters													**2**	**11**						
EXISTING AND ONGOING PROJECTS																					
MA/RI	Block Island (state waters)	Built					X						Built	5	30	28	5	2	328	541	659
MA/RI	Vineyard Wind 1 part of OCS-A 0501	COP Approved (ROD issued 2021), PPA, SAP					X						2023	62	800	98	6.5	171	451	721	812
MA/RI	South Fork, OCS-A 0517	COP Approved (ROD issued 2021), PPA, SAP					X						2023	12	132	139	6.5	24	358	543	614
VA/NC	CVOW, OCS-A 0497	Built	X	X	X	X	X	X	X	X	X	X	Built	2	12	27	3.3	9	364	506	620
	Total Existing and Ongoing Projects													**81**	**974**	**292**		**206**			
PLANNED PROJECTS																					
Massachusetts/Rhode Island Region																					
MA/RI	Sunrise Wind, OCS-A 0487	COP, PPA, SAP					X						2024	94	934	209.2	13	180	459	656	787
MA/RI	Revolution Wind, part of OCS-A 0486	COP, PPA, SAP					X						2024	100	880	42	6.5	155	512	722	873
MA/RI	New England Wind, OCS-A 0534, and portion of OCS-A 0501 (Phase 1 [i.e., Park City Wind])	COP, PPA, SAP					X						2024	62	804	125	10	139	702	935	1,171
MA/RI	New England Wind, OCS-A 0534, and portion of OCS-A 0501 (Phase 2 [i.e., Commonwealth Wind])	COP, PPA, SAP					X						2025 or later	63	1,725	226	10	201	702	935	1,171
MA/RI	SouthCoast OCS-A 0521	COP, PPA, SAP					X						2025	147	2,400	1,179	6.5	497	605	919	1,066
MA/RI	Beacon Wind 1, part of OCS-A 0520	COP (unpublished), PPA, SAP					X						2026-2029	77	1,100	202	6.5	187	591	984	1,083
MA/RI	Beacon Wind 2, part of OCS-A 0520	COP (unpublished), PPA, SAP					X						2027-2030	78	1,128	202	6.5	187	591	984	1,083
MA/RI	Bay State Wind, part of OCS-A 0500	SAP, COP (unpublished)					X						By 2030	94	1,128	139	6.5	148	492	722	853
MA/RI	OCS-A 0500 remainder	Planning					X						By 2030	116	1,392	200	7	240	492	722	853
MA/RI	OCS-A 0487 remainder	Planning					X						By 2030			200	7		492	722	853
MA/RI	Vineyard Wind NE, part of OCS-A 0522	Planning					X						By 2030	157	2,400	532	33	221	787	1,050	1,312
	Total MA/RI Leases[2]													**988**	**13,891**	**3,256**		**2,155**			

			Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]																		
Region	Lease, Project, Lease Remainder	Status	Air Quality	Water Quality, Wetlands	Navigation	Benthic	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Coastal Habitat	Demographics, Environmental Justice, Land Use, Cultural Resources	Marine Archaeology	Other Marine Uses (excluding research surveys & navigation)	Visual, Recreation & Tourism	Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Interarray Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
New York/New Jersey Region																					
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP					X						2025-2027	200	2,837	441	3.3	547	576	919	1,049
NY/NJ	Atlantic Shores North, OCS-A 0549	COP (unpublished), SAP					X						By 2030, spread over 2026-2030	157	2,355	331	3.3	528	576	919	1,049
NY/NJ	Ocean Wind 1, part of OCS-A 0498	COP, PPA, SAP					X						2024-2025	98	1,100	194	7	190	512	788	906
NY/NJ	Ocean Wind 2, part of OCS- A 0532	PPA					X						By 2030, spread over 2026-2030	111	1,554	200	7	173	512	788	906
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP					X						2023–2026	57	816	46	5	133	525	853	951
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP					X						2023–2027	90	1,260	30	5	166	525	853	951
NY/NJ	OW Ocean Winds East LLC OCS-A 0537	Planning					X						By 2030, spread over 2026-2030	100	11,502	200	7	120	1,009	1,230	1,312
NY/NJ	Attentive Energy LLC OCS-A 0538	Planning					X						By 2030, spread over 2026-2030	102		200	7	120	1,009	1,230	1,312
NY/NJ	Bight Wind Holdings LLC OCS-A 0539	Planning					X						By 2030, spread over 2026-2030	145		200	7	120	1,009	1,230	1,312
NY/NJ	Atlantic Shores Offshore Wind Bight LLC OCS-A 0541	Planning					X						By 2030, spread over 2026–2030	93		200	7	120	1,009	1,230	1,312
NY/NJ	Invenergy Wind Offshore LLC OCS-A 0542	Planning					X						By 2030, spread over 2026-2030	97		200	7	120	1,009	1,230	1,312
NY/NJ	Vineyard Mid-Atlantic LLC OCS-A 0544	Planning					X						By 2030, spread over 2026-2030	102		200	7	120	1,009	1,230	1,312
	Total NY/NJ Leases													**1,352**	**21,424**	**2,442**		**2,457**			

Region	Lease, Project, Lease Remainder	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]										Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Interarray Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality	Water Quality, Wetlands	Navigation	Benthic	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Coastal Habitat	Demographics, Environmental Justice, Land Use, Cultural Resources	Marine Archaeology	Other Marine Uses (excluding research surveys & navigation)	Visual, Recreation & Tourism									
Maryland/Delaware Region																					
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA, SAP					X						2024	16	192	40	6.5	23.7	492	722	822
DE/MD	US Wind/Maryland Offshore Wind, part of OCS-A 0490	COP, PPA, SAP					X						2024	121	2,000	145	6.5	152	528	820	938
DE/MD	GSOE I, OCS-A 0482	Planning					X						By 2030	94	1,128	200	6.5	139.1	492	722	853
DE/MD	OCS-A 0519 remainder	Planning					X								1,128	200	6.5	139.1	492	722	853
	Total DE/MD Leases													**231**	**4,448**	**585**		**454**			
South Atlantic Region																					
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	X	X	X	X	2025–2027	202	3,000	337.9	16.4	300	489	761	869
VA/NC	Kitty Hawk North, OCS-A 0508	COP, SAP	X		X		X		X		X	X	2024–2030	69	1,242	112	30	149	574	935	1,042
VA/NC	Kitty Hawk Wind South OCS-A 0508	COP	X		X		X		X		X	X	2026-2027	121	2,178	353	30	200	574	935	1,042
SC	TotalEnergies Renewables Wind, OCS-A 0545	Planning					X						By 2030	64	785	200	6.5	179.1	492	722	853
SC	Duke Energy Renewables Wind, OCS-A 0546	Planning					X							64	788	200	6.5	94.7	492	722	853
	Total South Atlantic Leases													**520**	**7,993**	**1,203**		**923**			
	OCS TOTAL (PLANNED)[9,10]													**3,091**	**47,756**	**7,486**		**5,989**			
	OCS TOTAL[9,10]													**3,174**	**48,741**	**7,778**		**6,195**			

[1] BOEM recognizes that the estimates presented within this cumulative analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts.
[2] The spacing/layout for projects are as follows: NE State water projects include a single strand of WTGs and no OSS. For projects in the RI, MA, NY, NJ, DE, MD, VA, and NC lease areas, a 1×1–nm grid spacing is assumed, if not included in the COP. For the CVOW Project, the spacing is 0.7 nm; and the Dominion commercial lease area off the coast of Virginia would utilize 0.5 nm average spacing, which is less than the 1×1–nm spacing due to the need to attain the state's goals.
[3] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[4] The estimated construction schedule is based on information known at the time of this analysis and could be different when an applicant submits a COP. This estimate is for offshore components only.
[5] The number of turbines for those lease areas without an announced number of turbines has been calculated based on lease size, a 1×1-nm grid spacing, or the generating capacity.
[6] BOEM obtained project generating capacity from the COP (if available). If not included in the COP, BOEM used this formula: turbine number * expected turbine size (MW).
[7] BOEM assumes that each offshore wind development would have its own cable (both onshore and offshore) and that future projects would not utilize a regional transmission line. In cases where the export cable value was provided to BOEM as a range, BOEM used the higher value.
[8] BOEM used the estimated disturbance width provided in the COP (if available). If not available, BOEM assumed the disturbance width to be 6.5 feet based on COPs submitted to BOEM date.
[9] BOEM used the interarray cable length provided in the COP (if available). If not available, BOEM used this formula: turbine number * 1.48 miles.
[10] BOEM used the hub height provided in COP, if available. For those projects without announced WTG dimensions, BOEM used the known dimensions of turbines of the same capacity as the prototype capacity, rounded to the nearest even number, for the current year in DOE's most recent Offshore Wind Market Report.
[11] BOEM used the rotor diameter provided in COP, if available. For those projects without announced WTG dimensions, BOEM used the known dimensions of turbines of the same capacity as the prototype capacity, rounded to the nearest even number, for the current year in DOE's most recent Offshore Wind Market Report.
[12] BOEM used the turbine height provided in the COP (if available). If not available, BOEM used this formula: total height of turbine = rotor diameter (feet) + 100 feet OR 853 feet, whichever is higher.
[13] Atlantic Shores South consists of two energy facilities (Project 1 and Project 2). Project 1 would have a capacity of 1,510 MW; Project 2's capacity is not yet determined, but Atlantic Shores has a goal of 1,327 MW.
[14] Includes cable length from offshore export cables and substation interconnector cables.
COP = Construction and Operations Plan; CT = Connecticut; CVOW = Coastal Virginia Offshore Wind; DE = Delaware; FDR = Facility Design Report; FIR = Fabrication and Installation Report; MA = Massachusetts; MD = Maryland; NC = North Carolina; NE = New England; NJ = New Jersey; nm = nautical mile; NY = New York; PPA = Power Purchase Agreement; RAP = research activities plan; RI = Rhode Island; SC = South Carolina

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation and Tourism									
NE	Aquaventis (state waters)	State Project					X		2023	2	11					450	520
NE	Block Island (state waters)	Built					X		Built	5	30	28	5	2	328	541	659
	Total State Waters									**7**	41	**28**	**5**	**2**			
MA/RI	Vineyard Wind 1 part of OCS-A 0501	COP Approved (ROD issued 2021), PPA, SAP					X		2023	62	800	98	6.5	171	451	721	812
MA/RI	South Fork, OCS-A 0517	COP Approved (ROD issued 2021), PPA, SAP					X		2023	12	130	139	6.5	24	472	735	840
MA/RI	Sunrise, OCS-A 0487	COP, PPA, SAP					X		2024	94	1,034	105	6.5	180	459	656	787
MA/RI	Revolution, part of OCS-A 0486	COP, PPA, SAP					X		2023-2024	100	880	100	131	155	512	722	873
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 1 [i.e. Park City Wind])	COP, PPA, SAP					X		2024–2026	62	804	125	10	139	630	837	1,047
MA/RI	New England Wind, OCS-A 0534 and portion of OCS-A 0501 (Phase 2 [i.e. Commonwealth Wind])	COP, PPA, SAP					X		2024–2026	79	1,500	225	10	201	702	935	1,171
MA/RI	Mayflower OCS-A 0521	COP, PPA, SAP					X		2025	147	2,400	1,179	6.5	497	605	919	1,066
MA/RI	Beacon Wind 1, part of OCS-A 0520	COP (unpublished), PPA, SAP							2024–2029	78	1,230	232	33	186	591	984	1,083
MA/RI	Beacon Wind 2, part of OCS-A 0520	COP (unpublished), SAP					X		2025–2029	77	1,200	232	33	186	591	984	1,083
MA/RI	Bay State Wind, part of OCS-A 0500	SAP, COP (unpublished), the MW is included in the description below in the 5,148 MW.					X		By 2030, spread over 2025–2030	110	4,200	120	6.5	172	492	722	853
MA/RI	Liberty Wind (OCS-A 0522)	This group is exposed to 4,200 MW of demand--for MA (2,400 MW remaining), CT (900 MW remaining), and RI (900 MW expected). Collectively the remaining technical capacity is 5,148 MW.					X		By 2030, spread over 2025–2030	227		120	6.5	368	492	722	853
MA/RI	OCS-A 0500 remainder						X					120			492	722	853
MA/RI	OCS-A 0487 remainder						X					120			492	722	853
MA/RI	Remaining MA/RI Lease Area Total[2]	73%								337	4,200	480	6.5	540	492	722	853
	Total MA/RI Leases[2]									**1,048**	**14,178**	**2,915**		**2,279**			
NY/NJ	Ocean Wind 1, OCS-A 0498	COP, PPA, SAP					X		2023–2025	98	1,100	194[11]	98	190	512	788	906

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation and Tourism									
NY/NJ	Atlantic Shores South, OCS-A 0499	COP, PPA, SAP					X		2025-2027	200	1,510	342	58	547	576	919	1,049
NY/NJ	Ocean Wind 2, part of OCS- A 0532	PPA					X		By 2030, spread over 2026-2030	111	1,554	120	5	173	512	788	906
NY/NJ	Empire Wind 1, part of OCS-A 0512	COP, PPA, SAP					X		2024	57	816	46	5	133	525	853	951
NY/NJ	Empire Wind 2, part of OCS-A 0512	COP, PPA, SAP					X		2025	90	1,260	30	5	166	525	853	951
NY/NJ	Atlantic Shores North, OCS-A 0499 remainder	SAP					X		By 2030, spread over 2026–2030	157	2,198	99	58	249	576	919	1,049
NY/NJ	OW Ocean Winds East LLC, OCS-A 0537						X	X	By 2030, spread over 2026–2030	100	960	120	5	157	492	722	853
NY/NJ	Attentive Energy LLC, OCS-A 0538						X	X	By 2030, spread over 2026–2030	102	1,224	120	5	160	492	722	853
NY/NJ	Bight Wind Holdings, LLC, OCS-A 0539						X	X	By 2030, spread over 2026–2030	145	1,740	120	5	231	492	722	853
NY/NJ	Atlantic Shores Offshore Wind Bight, LLC, OCS-A 0541						X		By 2030, spread over 2026–2030	93	1,116	120	5	147	492	722	853
NY/NJ	Invenergy Wind Offshore LLC, OCS-A 0542						X		By 2030, spread over 2026–2030	97	1,164	120	5	153	492	722	853
NY/NJ	Vineyard Mid-Atlantic LLC, OCS-A 0544						X	X	By 2030, spread over 2026–2030	102	1,224	120	5	160	492	722	853
	Total NY/NJ Leases									**1,352**	**16,106**	**1,650**		**2,466**			
DE/MD	Skipjack, part of OCS-A 0519	COP, PPA, SAP					X		2024	16	120	40	10	30	492	722	853
DE/MD	US Wind, part of OCS-A 0490	COP, PPA, SAP					X		2024-2027	121	2,000	146	7	152	528	820	938
DE/MD	GSOE I, OCS-A 0482	Collectively the technical capacity of this is group is 1,080 MW (90 turbines). The remaining capacity may be utilized by demand from NJ or MD.					X		By 2030, spread over 2023–2030	90	1,080				492	722	853
DE/MD	OCS-A 0519 remainder						X										
	Remaining DE/MD Lease Area Total									90	1,080	240	5	139			
	Total DE/MD Leases									**227**	**3,200**	**426**		**321**			
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X	Built	2	12	27	3	9	364	506	620
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	2025–2027	2025	3,000	417	5	301	489	761	869
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X	2024–2030	69	1,242	100	30	149	574	935	1,042
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X	2026-2027	121	1,242	353	30	200	574	935	1,042

Region	Lease, Project, Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps geographic analysis area)[3]						Estimated Construction Schedule[4]	Turbine Number[5]	Generating Capacity (MW)	Offshore Export Cable Length (statute miles)[6]	Offshore Export Cable Installation Tool Disturbance Width (feet)	Inter-Array Cable Length (statute miles)[7]	Hub Height (feet)[8]	Rotor Diameter (feet)[8]	Height of Turbine (feet)[8]
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation and Tourism									
	Total VA/NC Leases									**397**	**5,496**	**897**		**659**			
	OCS Total[9,10]									**3,031**	**39,021**	**5,916**		**5,728**			

[1] The spacing/layout for projects are as follows: NE State water projects include a single strand of wind turbine generators (WTGs) and no offshore substation (OSS). For projects in the RI, MA, NY, NJ, DE, MD lease areas, a 1×1–nm grid spacing is assumed. For the CVOW Project, the spacing is 0.7 nm; and the Dominion commercial lease area off the coast of Virginia would utilize 0.5-nm average spacing, which is less than the 1×1–nm spacing due to the need to attain the state's goals.
[2] Because development could occur anywhere within the RI and MA lease areas and assumes a continuous 1x1–nm grid, the actual development for these projects is expected to be approximately 73% of the collective technical capacity. Under the scenario described in this appendix, the total area in the RI and MA lease areas is greater than the area needed to meet state demand. Therefore, if a project is not constructed, BOEM assumes that another future project would be constructed to fulfill the unmet demand.
[3] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas shown in Attachment 1 of this appendix.
[4] The estimated construction schedule is based on information known at the time of this analysis and could be different when an applicant submits a COP.
[5] The number of turbines for those lease areas without an announced number of turbines has been calculated based on lease size, a 1×1-nm (2×2-km) grid spacing, or the generating capacity.
[6] BOEM assumes that each offshore wind development would have its own cable (both onshore and offshore) and that future projects would not utilize a regional transmission line. The length of offshore export cable for those lease areas without a known project size is assumed to include two offshore cables totaling 120 miles (193 kilometers). The offshore export cable would be buried a minimum of 4 feet (1.2 meters) but not more than 10 feet (3.1 meters).
[7] If information for a future project could not be obtained from a COP, the length of inter-array cabling is assumed to be the average amount per foundation based on the COPs submitted to date, which is 1.48 miles (2.4 kilometers). In addition, for those lease areas that require more than one OSS, it is assumed that an additional 6.2 miles (9.9 kilometers) of inter-link cable would be required to link the two OSSs. Inter-array cable is assumed to be buried between 4 and 6 feet (1.2 and 1.8 feet).
[8] The hub height, rotor diameter, and turbine height for lease areas is based on worst-case scenario for the resource area. Presentation of heights vary by COP and may be presented relative to mean lower low water (MLLW), mean sea level, or height above highest astronomical tide.
[9] BOEM recognizes that the estimates presented in this analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts. Totals by lease area and by OCS may not fully sum due to rounding errors.
[10] New York's demand is not double-counted, this total comes from looking at New York's state demand, not adding up the potential of the areas because that would double-count New York.
CT = Connecticut; CVOW = Coastal Virginia Offshore Wind; DE = Delaware; FDR = Facility Design Report; FIR = Fabrication and Installation Report; MA = Massachusetts; MD = Maryland; NC = North Carolina; NE = New England; NJ = New Jersey; NY = New York; PPA = Power Purchase Agreement; RAP = research activities plan; RI = Rhode Island; SAP = Site Assessment Plan, VA = Virginia
[11] Includes cable length from offshore export cables and substation interconnector cables.

Table F2-2 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 2, Seabed/Anchoring Disturbance and Scour Protection) (Data as of June 20, 2023)[1]

Region	Lease/Project/Lease Remainder	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[3]										Estimated Foundation Number[2]	Foundation Footprint[3] (acres)	Seabed Disturbance (Foundation + Scour Protection) (acres)[4]	Offshore Export Cable Seabed Disturbance (acres)[5]	Offshore Export Cable Footprint (acres)[6]	Offshore Export Cable Hard Protection (acres)[7]	Anchoring Disturbance (acres)[8]	Interarray Construction Footprint/Seabed Disturbance (acres)[9]	Interarray Operating Footprint/ Seabed Disturbance (acres)[10]	Interarray Cable Hard Protection (acres)[11]
			Air Quality	Water Quality, Wetlands	Navigation	Benthic	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Coastal Habitat	Demographics, Environmental Justice, Land Use	Marine Archaeology	Other Marine Uses (excluding research surveys & navigation)	Visual, Recreation & Tourism										
EXISTING AND ONGOING PROJECTS																						
VA/NC	CVOW, OCS-A 0497	Built	X	X	X	X	X	X	X	X	X	X	2	2	0	33	11	10	3	5	3	0
	Total Existing and Ongoing Projects													**2**	**0**	**33**		**10**				**0**
PLANNED PROJECTS																						
South Atlantic Region																						
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	X	X	X	X	208	4	196	2,635	253	149	42	2,394	297	0
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X		X		X		X		X	X	70	1	66	407	45	32	2	5,931	14	0
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X		X		X		X		X	X	123	1	100	1,284	141	49	9	7,957	19	0
SC	TotalEnergies Renewables Wind, OCS-A 0545	Planning					X						65	17	82	158	24	24	4.7	4,632	12	0
SC	Duke Energy Renewables Wind, OCS-A 0546	Planning					X						65	17	82	158	24	24	4.7	4,632	12	0
	Total South Atlantic Leases												**533**	**44**	**526**	**4,708**	**498**	**298**	**65**	**25,551**	**357**	**0**
	Total DE, MA, MD, NJ, NY, RI Leases												**2,693**	**524**	**5,168**	**27,364**	**2,116**	**1,465**	**7,991**	**43,849**	**3,778**	**1,408**
	OCS TOTAL												**3,226**	**568**	**5,694**	**32,072**	**2,614**	**1,763**	**8,056**	**69,400**	**4,135**	**1,408**

[1] BOEM recognizes that the estimates presented within this cumulative analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts.
[2] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[3] BOEM used the estimated number of foundations from the COP (if available). It is the total number of turbines plus OSSs and met towers. If information for a future project could not be obtained from a publicly available COP, it is assumed that for every 50 turbines there would be one OSS installed.
[4] BOEM used the estimated foundation footprint acreage provided in the COP (if available). If not available, BOEM used this formula: foundation footprint = 0.26 acre * foundation number.
[5] The WTG seabed disturbance with the addition of scour protection was calculated based on scour protection expected in submitted COPs. If not available, BOEM used this formula: (1 acre * foundation #) + foundation footprint.
[6] BOEM used the estimated offshore export cable seabed disturbance provided in the COP (if available). If not available, BOEM used this formula: ((COP export cable length OR estimated export cable length) * 5,280 feet/mile * installation tool disturbance width) / (43,560 square feet/acre)
[7] BOEM used the estimated offshore export cable footprint provided in the COP (if available). If not available, BOEM used this formula: export cable length OR estimated export cable length * 5,280 feet (1 mile)/43,560 square feet/acre.
[8] BOEM used the estimated offshore export cable hard protection area provided in the COP (if available). If not available, BOEM used this formula: (COP export cable length OR estimated export cable length * 5,280 feet/mile * 0.20 * 9.8 feet) / (43,560 square feet/acre).
[9] BOEM used the estimated anchoring disturbance area provided in the COP (if available). If not available, BOEM used this formula: (COP export cable length OR estimated export cable length) * (the corresponding subregion total COP anchoring disturbance per export cable length total).
[10] BOEM used the estimated interarray construction footprint/seabed disruption area provided in the COP (if available). If not available, BOEM used this formula: foundation # * (the corresponding subregion total COP interarray construction seabed disruption per foundation total).
[11] BOEM used the estimated interarray operating footprint/seabed disruption area provided in the COP (if available). If not available, BOEM used this formula: foundation # * (the corresponding subregion total COP interarray operating seabed disruption per foundation total)
[12] BOEM used the estimated interarray hard protection area provided in the COP (if available). If not available, BOEM assumed the interarray cable hard protection to be zero.
[13] Includes disturbance from offshore export cables and substation interconnector cables. Assumes an 82-foot-wide corridor would be disturbed per cable, based on the Ocean Wind 1 COP.
[14] Assumes an 82-foot-wide corridor would be disturbed, based on the Ocean Wind 1 COP.
[15] Numbers represent the maximum collective amount within Lease Areas OCS-A 0482 and part of OCS-A 0519.
COP = Construction and Operations Plan; CVOW = Coastal Virginia Offshore Wind; NC = North Carolina; SAP = Site Assessment Plan; SC = South Carolina; VA = Virginia

Table F2-3 Offshore Wind Development Activities on the U.S. East Coast: Projects and Assumptions (Part 3, Gallons of Coolant, Oils, Lubricants, and Diesel Fuel) (Data as of June 20, 2023)1

			Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[2]															
Region	**Lease/Project/Lease Remainder**	**Status**	**Air Quality**	**Water Quality, Wetlands**	**Navigation**	**Benthic**	**Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys**	**Coastal Habitat**	**Demographics, Environmental Justice, Land Use**	**Marine Archaeology**	**Other Marine Uses (excluding research surveys & navigation)**	**Visual, Recreation & Tourism**	**Total Coolant Fluids in WTGs (gallons)**	**Total Coolant Fluids in OSSs or ESPs (gallons)**	**Total Oils and Lubricants in WTGs (gallons)**	**Total Oils and Lubricants in OSSs or ESPs (gallons)**	**Total Diesel Fuel in WTGs (gallons)**	**Total Diesel Fuel in OSSs or ESPs (gallons)**
EXISTING AND ONGOING PROJECTS																		
VA/NC	CVOW, OCS-A 0497	Built	X	X	X	X	X	X	X	X	X	X	846	0	7,660	0	1,586	0
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	X	X	X	X	86,715	0	430,664	258,300	0	20,409
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X				X						29,165	46	229,800	61,780	47,580	2,848
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP					X						51,144	93	447,507	247,117	95894	11,396
SC	TotalEnergies Renewables Wind, OCS-A 0545	Planning											27,268	23	181,219	94,533	23,563	5,776
SC	Duke Energy Renewables Wind, OCS-A 0546	Planning											27,268	23	180,939	94,533	23,563	5,776
	Total South Atlantic Leases												**222,406**	**185**	**1,477,789**	**756,263**	**192,186**	**46,205**
	Total DE, MA, MD, NJ, NY, RI Leases												**9,635,691**	**145,212**	**10,911,812**	**7,348,471**	**1,488,600**	**2,609,692**
	OCS TOTAL												**9,858,097**	**145,397**	**12,389,601**	**8,104,734**	**1,680,786**	**2,655,897**

[1] BOEM recognizes that the estimates presented within this cumulative analysis are likely high, conservative estimates; however, BOEM believes that this analysis is appropriately capturing the potential cumulative impacts and errs on the side of maximum impacts.
[2] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas.
[3] BOEM estimated the total coolant fluids in WTGs using this formula: (sum of all coolants provided in the COP [any material used as a coolant, not including water]) * turbine #.
[4] BOEM estimated the total coolant fluids in OSSs or ESPs using this formula: (sum of all coolants provided in the COP [any material used as a coolant, not including water]) * ESP/OSS #.
[5] BOEM estimated the total oils and lubricants in WTGs using this formula: (sum of all oils & lubricants provided in the COP) * turbine #.
[6] BOEM estimated the total oils and lubricants in OSSs or ESPs using this formula: (sum of all oils & lubricants provided in the COP) * turbine #.
[7] BOEM estimated the total diesel fuel in WTGs using this formula: (sum of all diesel fuel provided in the COP) * turbine #.
[8] BOEM estimated the total diesel fuel in OSSs or ESPs using this formula: (sum of all diesel fuel provided in the COP) * ESP/OSS #.
[9] Atlantic Shores South may include up to 10 small OSSs, up to 5 medium OSSs, or up to 4 large OSSs. The total values for diesel fuel, coolants, and oils/lubricants for Atlantic Shores OSS in Table D.A2-3 are based on 4 large OSSs; 4 large OSSs would result in larger volumes of diesel fuel, coolants, and oils/lubricants than would 10 small OSSs or 5 medium OSSs. The total values for 10 small OSSs for Atlantic Shores South would be 75,000 gallons diesel fuel; 370,050 gallons oils/lubricants, and 10,300 coolants. The total values for 5 medium OSSs would be 60,000 gallons diesel fuel, 555,050 gallons oils/lubricants, and 10,250 gallons coolants.
[10] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Atlantic Shores South based on number of turbines and OSSs; with assumption of 3 large OSS.
[11] Quantities of coolant, oil and lubricants, and diesel fuel are scaled to Ocean Wind 1 based on number of turbines and OSSs.
COP = Construction and Operations Plan; CVOW = Coastal Virginia Offshore Wind; ESP = electrical service platform; NC = North Carolina; OSS = Offshore Substation; SAP = Site Assessment Plan; SC = South Carolina; VA = Virginia; WTG = Wind Turbine Generator

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

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						2023	2024	2025	2026	2027	2028	2029	2030	Beyond 2030
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
Nitrogen oxides (tons)																	
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X									
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	794.67	4,204.76	6,931.30	2,714.30	1,139.42	480.31			
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X		20.91	2,334.97	3,118.56	286.87				
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X				378.31	4,487.59	4,393.83	851.4	582.24	
	Total Air Quality Analysis Area								794.67	4,225.67	9,266.27	6,211.17	5,913.88	4,874.14	851.4	582.24	0.00
Volatile organic compounds (tons)																	
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X									
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	31.61	172.67	288.00	109.31	43.60	17.65			
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X		1.31	99.27	135.37	16.77				
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X				16.63	191.22	188.37	37.82	26.34	
	Total Air Quality Analysis Area								31.61	173.98	387.27	261.31	251.59	206.025	37.82	26.34	0.00
Carbon monoxide (tons)																	
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X									
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	261.71	1,247.63	2,026.12	942.39	391.22	371.72			
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X		6.02	603.00	884.50	146.60				
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X				121.88	1,185.88	1,191.42	269.99	196.07	
	Total Air Quality Analysis Area								261.71	1,253.65	2,629.12	1,948.77	1,723.70	1,563.14	269.99	196.07	0.00
Particulate matter, 10 microns or less (tons)																	
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X									
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	26.13	139.22	233.46	96.16	36.45	19.40			

Region	Lease/Project/Lease Remainder[1]	Status	Geographic Analysis Area (X denotes lease area is within or overlaps analysis area)[1]						2023	2024	2025	2026	2027	2028	2029	2030	Beyond 2030
			Air Quality, Water Quality, Navigation	Benthic	Other Marine Uses (excluding research surveys & navigation)	Marine Archaeology	Birds, Bats, Marine Mammals, Sea Turtles, Finfish, Invertebrates, EFH, Fisheries, Research Surveys	Visual, Recreation & Tourism									
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X		0.82	76.77	112.06	14.60				
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X				13.36	149.75	151.14	33.60	24.36	
	Total Air Quality Analysis Area								26.13	140.04	310.23	221.58	200.80	170.54	33.60	24.36	0.00
Particulate matter, 2.5 microns or less (tons)																	
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X									
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	25.35	135.04	226.46	93.28	35.36	18.82			
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X		0.79	74.46	108.70	14.17				
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X				12.96	145.25	146.61	32.59	21.38	
	Total Air Quality Analysis Area								25.35	135.83	300.92	214.94	194.78	165.43	32.59	21.38	0.00
Sulfur dioxide (tons)																	
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X									
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	9.91	63.40	107.64	32.14	13.83	0.33			
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X		0.06	41.93	50.83	4.23				
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X				5.16	79.00	75.29	11.96	7.42	
	Total Air Quality Analysis Area								9.91	63.46	149.57	88.13	97.06	75.62	11.96	7.42	0.00
Carbon dioxide (tons)																	
VA/NC	CVOW, OCS-A 0497	RAP, FDR/FIR	X	X	X	X	X	X									
VA/NC	CVOW-C, OCS-A 0483	COP, SAP	X	X	X	X	X	X	59,590.80	275,647.20	435,327.30	174,190.90	72,908.40	41,623.50			
VA/NC	Kitty Hawk Wind North, OCS-A 0508	COP, SAP	X	X	X	X	X	X		8,518.00	140,229.00	186,464.00	27,825.00				
VA/NC	Kitty Hawk Wind South, OCS-A 0508	COP	X	X	X	X	X	X				41,580.00	274,535.00	259,916.00	52,360.00	36,391.00	
	Total Air Quality Analysis Area								59,590.80	284,165.20	575,556.30	402,234.90	375,268.40	301,539.50	52,360.00	36,391.00	0.00

[1] This column identifies lease areas that are applicable to each resource based on the geographic analysis areas shown in Attachment 1 of this appendix.

LITERATURE CITED

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

This page intentionally left blank.

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

This page intentionally left blank.

TABLE OF CONTENTS

G.1. Introduction G-1
3.5. Bats 3.5-1
3.5.1 Description of the Affected Environment for Bats 3.5-1
3.5.2 Environmental Consequences 3.5-4
3.5.3 Impacts of the No Action Alternative on Bats 3.5-5
3.5.4 Relevant Design Parameters and Potential Variances in Impacts 3.5-9
3.5.5 Impacts of the Proposed Action on Bats 3.5-9
3.5.6 Impacts of Alternatives B and C on Bats 3.5-13
3.5.7 Impacts of Alternative D on Bats 3.5-13
3.5.8 Agency-Required Mitigation Measures 3.5-15
3.11. Demographics, Employment, and Economics 3.11-1
3.11.1 Description of the Affected Environment for Demographics, Employment, and Economics 3.11-1
3.11.2 Environmental Consequences 3.11-7
3.11.3 Impacts of the No Action Alternative on Demographics, Employment, and Economics 3.11-8
3.11.4 Relevant Design Parameters and Potential Variances in Impacts 3.11-14
3.11.5 Impacts of the Proposed Action on Demographics, Employment, and Economics 3.11-14
3.11.6 Impacts of Alternative B on Demographics, Employment, and Economics 3.11-21
3.11.7 Impacts of Alternative C on Demographics, Employment, and Economics 3.11-22
3.11.8 Impacts of Alternative D on Demographics, Employment, and Economics 3.11-23
3.11.9 Agency-Required Mitigation Measures 3.11-24
3.14. Land Use and Coastal Infrastructure 3.14-1
3.14.1 Description of the Affected Environment for Land Use and Coastal Infrastructure 3.14-1
3.14.2 Environmental Consequences 3.14-3
3.14.3 Impacts of the No Action Alternative on Land Use and Coastal Infrastructure 3.14-3
3.14.4 Relevant Design Parameters and Potential Variances in Impacts 3.14-7
3.14.5 Impacts of the Proposed Action on Land Use and Coastal Infrastructure 3.14-7
3.14.6 Impacts of Alternatives B and C on Land Use and Coastal Infrastructure 3.14-12
3.14.7 Impacts of Alternative D on Land Use and Coastal Infrastructure 3.14-13
3.14.8 Agency-Required Mitigation Measures 3.14-14
3.18. Recreation and Tourism 3.18-1
3.18.1 Description of the Affected Environment for Recreation and Tourism 3.18-1
3.18.2 Environmental Consequences 3.18-7
3.18.3 Impacts of the No Action Alternative on Recreation and Tourism 3.18-7
3.18.4 Relevant Design Parameters and Potential Variances in Impacts 3.18-16
3.18.5 Impacts of the Proposed Action on Recreation and Tourism 3.18-17
3.18.6 Impacts of Alternatives B and C on Recreation and Tourism 3.18-23
3.18.7 Impacts of Alternative D on Recreation and Tourism 3.18-25
3.18.8 Agency-Required Mitigation Measures 3.18-25
3.19 Sea Turtles 3.19-1

3.19.1 Description of the Affected Environment for Sea Turtles 3.19-1
3.19.2 Environmental Consequences 3.19-6
3.19.3 Impacts of the No Action Alternative on Sea Turtles 3.19-7
3.19.4 Relevant Design Parameters and Potential Variances in Impacts 3.19-17
3.19.5 Impacts of the Proposed Action on Sea Turtles 3.19-18
3.19.6 Impacts of Alternatives B and C on Sea Turtles 3.19-27
3.19.7 Impacts of Alternative D on Sea Turtles 3.19-28
3.19.8 Agency-Required Mitigation Measures 3.19-28

LIST OF FIGURES

Figure 3.5-1 Birds and Bats Geographic Analysis Area 3.5-2
Figure 3.11-1 Demographics, Employment, Economic Characteristics, and Environmental Justice Geographic Analysis Area 3.11-2
Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area 3.14-2
Figure 3.18-1 Recreation, Tourism, and Visual Resources Geographic Analysis Area 3.18-2
Figure 3.19-1 Sea Turtles Geographic Analysis Area 3.19-2

LIST OF TABLES

Table 3.5-1 Impact Level Definitions for Bats 3.5-5
Table 3.5-2 Measures Resulting from Consultations: Bats1 .... 3.5-16
Table 3.11-1 Demographic Trends (2010–2019) 3.11-1
Table 3.11-2 Demographic Data (2019) 3.11-3
Table 3.11-3 Housing Data (2019) 3.11-3
Table 3.11-4 Employment of Residents by Industry (2019) 3.11-5
Table 3.11-5 At-Place Employment by Industry (2019) 3.11-6
Table 3.11-6 Impact Level Definitions for Demographics, Employment, and Economics 3.11-7
Table 3.14-1 Impact Level Definitions for Land Use and Coastal Infrastructure 3.14-3
Table 3.18-1 Impact Level Definitions for Recreation and Tourism 3.18-7
Table 3.18-2 Additional Agency-Required Measures: Recreation and Tourism1 .... 3.18-26
Table 3.19-1 Presence, Distribution, and Population Status of Sea Turtle Species Known to Occur in Coastal and Offshore Waters of Virginia Around the Project Area 3.19-4
Table 3.19-2 Impact Level Definitions for Sea Turtles 3.19-6
Table 3.19-3 Acoustic Thresholds for Sea Turtles for Each Type of Impact and Noise Category 3.19-11
Table 3.19-4 Summary of Underwater Acoustic Modeling Conducted for the Coastal Virginia Offshore Wind Project Construction and Operations Plan 3.19-20
Table 3.19-5 Measures Resulting from Consultations1 .... 3.19-28

G.1. Introduction

To focus on the impacts of most concern in the main body of this Final Environmental Impact Statement (EIS), BOEM has included the analysis of resources with no greater than **minor** adverse impacts below. These include demographics, employment, and economics; land use and coastal infrastructure; and recreation and tourism. Those resources with potential impact ratings greater than **minor** are included in Final EIS Chapter 3, *Affected Environment and Environmental Consequences*.

This page intentionally left blank.

3.5. Bats

This section discusses potential impacts on bat resources from the Proposed Action, alternatives, and ongoing and planned activities in the bat geographic analysis area. The bat geographic analysis area, as described in Appendix F, *Planned Activities Scenarios*, Table F-1 and illustrated on Figure 3.5-1, includes the East Coast from Maine to Florida, and extends 100 miles (161 kilometers) offshore and 5 miles (8 kilometers) inland to capture the movement range for species in this group. The offshore limit was established to capture the migratory movements of most species in this group, while the onshore limits cover onshore habitats used by species that may be affected by onshore and offshore components of the proposed Project.

3.5.1 Description of the Affected Environment for Bats

Detailed descriptions of bats occurring inland and offshore Virginia can be found in the COP (Section 4.2.3.1, Section 2.1 of Appendix O-1, Section 1.2 of Appendix O-2, and Section 2 of Appendix O-3; Dominion Energy 2023. Seventeen bat species are known to occur in Virginia; 14 of these species are thought to have the potential to occur in coastal areas of Virginia either in or adjacent to the proposed Project area (COP, Section 4.2.3.1, Table 4.2-12; Dominion Energy 2023). Two of the 14 bat species are federally listed; the northern long-eared bat (*Myotis septentrionalis*) and the Indiana bat (*Myotis sodalis*). The northern long-eared bat is endangered and is found throughout Virginia. The Indiana bat is endangered and typically does not occur in the eastern part of Virginia (Timpone et al. 2011), but more recent studies have documented its presence, including a maternity colony, in the coastal plain of the state (St. Germain et al. 2017; Silvis et al. 2017; De La Cruz 2020). On September 13, 2022, USFWS announced a proposal to list the tri-colored bat (*Perimyotis subflavus*), as endangered under the ESA. The northern long-eared bat, Indiana bat, and tri-colored bat also are listed as state threatened (northern long-eared) and endangered (Indiana and tri-colored) species, respectively (VDWR 2021). Two other state-listed bat species may also overlap the Project area: little brown bat (*Myotis lucifugus*) and Rafinesque's big-eared bat (*Corynorhinus rafinesquii macrotis*). Bats use a variety of terrestrial environments for foraging and roosting during summer breeding and migration periods. The Onshore Project components would be located primarily in already developed areas, but bats could use other types of nearby undeveloped habitats.

Bat species consist of two distinct groups based on their overwintering strategy: cave-hibernating bats (cave bats) and migratory tree bats (tree bats). Cave-hibernating bats migrate from summer habitat to winter hibernacula in the mid-Atlantic region (Maslo and Leu 2013), while tree bats migrate to southern parts of the United States (Cryan 2003), and some species are likely present year-round in Virginia (Timpone et al. 2011). Of the tree bat species, only the silver-haired bat (*Lasionycteris noctivagans*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*) are considered migratory in North America due to their seasonal (spring and fall) migrations over several degrees of latitude (Cryan 2003), with the eastern red bat being more likely to occur offshore (Hatch et al. 2013; Sjollema et al. 2014).

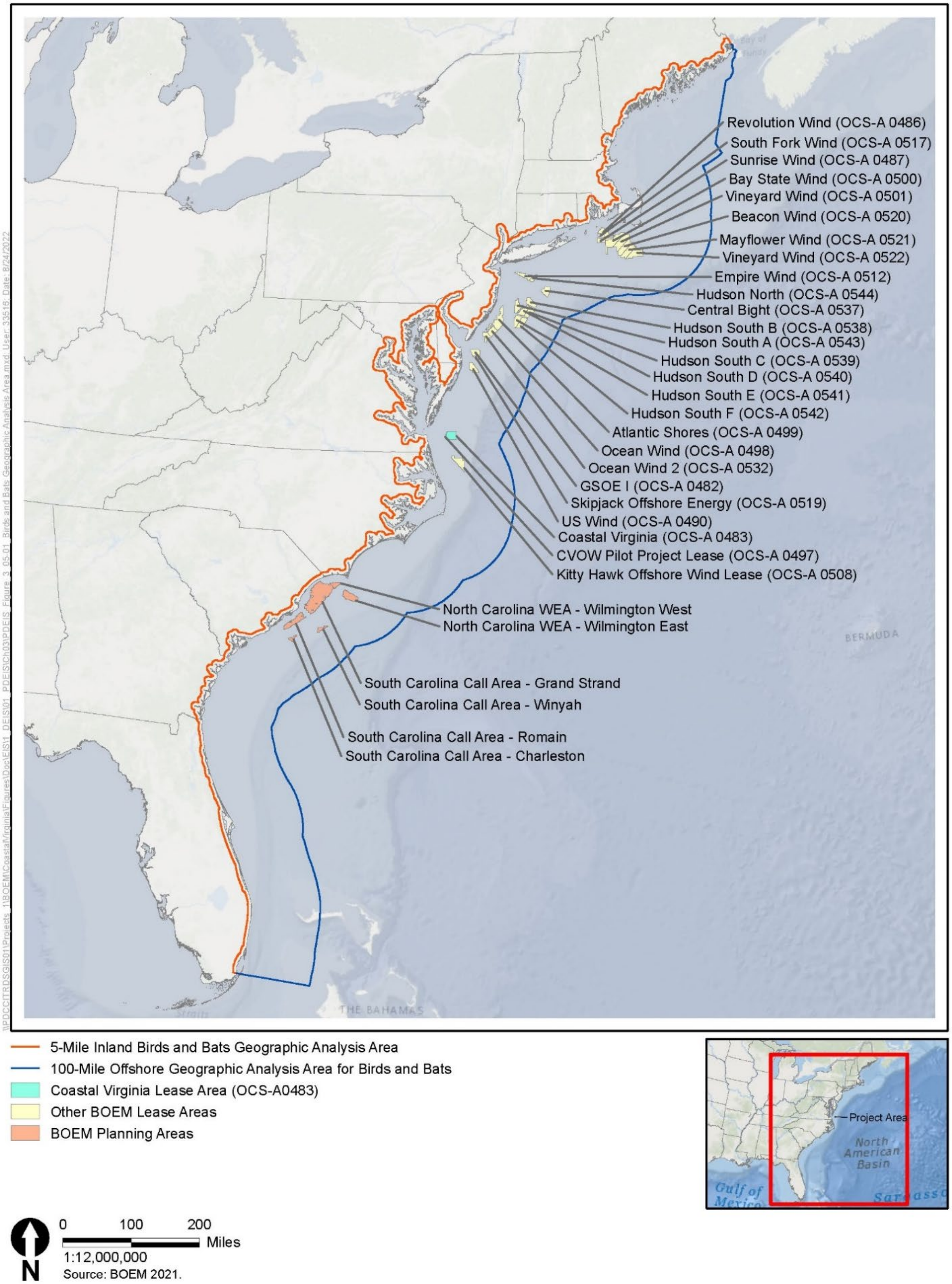


Figure 3.5-1 Birds and Bats Geographic Analysis Area

Bats are terrestrial species that spend almost their entire lives on or over land but can occasionally occur offshore during spring and fall migration and under very specific conditions such as low wind, good visibility, and high temperatures (Smith and McWilliams 2016; True et al. 2021). Generally, bat activity offshore is less than onshore and decreases with increased distance from shore (Brabant et al. 2021; Solick and Newman 2021). Recent studies, combined with historical anecdotal accounts, indicate that tree bats sporadically travel offshore during spring and fall migration, with 80 percent of acoustic detections occurring in August and September (Dowling et al. 2017; Hatch et al. 2013; Pelletier et al. 2013; Petersen 2016). However, unlike tree bats, the likelihood of detecting a *Myotis* species or other cave bat is substantially less in offshore areas because bat activity in the mid-Atlantic decreases 6 miles (20 kilometers) from shore (Pelletier et al. 2013; Sjollema et al. 2014; Petersen 2016). Solick and Newman (2021) reported over 83 percent of *Myotis* species detections occurring less than 5.2 miles (8.3 kilometers) from shore, though there have been rare detections farther offshore in association with research and fishing vessels.

Research based on Block Island and other coastal Rhode Island locations indicated *Myotis* species migrated short distances between the islands and the mainland primarily from July to September (Smith and McWilliams 2016). Acoustic surveys conducted during construction and post-construction at the Block Island Wind Farm did not yield detections of any northern long-eared bats; tri-colored bats were detected only during post-construction and in low numbers (Stantec 2018, 2020). Generally, the post-construction data found relatively low numbers of bats present only during the fall (Stantec 2020). During a long-term study of bat movements conducted from 2012 to 2014 in the coastal, nearshore, and offshore environments of the northeast, mid-Atlantic, and Great Lakes (Stantec 2016; Pelletier et al. 2013), bat calls were detected from 3 to 80 miles (5 to 130 kilometers) offshore. Eastern red bats and other migrants represented the most frequently observed species with peak activity during the spring and fall migrations; very little offshore activity of *Myotis* species in the mid-Atlantic was detected.

Results from the Project offshore bat acoustic survey (COP, Appendix O-2; Dominion Energy 2023) did not document *Myotis* species or any federally listed species in the Offshore Project area. All bat species conclusively identified from the acoustic survey results were long-distance migratory tree bat species (i.e., eastern red bat, Seminole bat [*Lasiurus seminolus*], silver-haired bat, and hoary bat), but some cave-hibernating species may be present among the bats that were unidentified. Overall survey results from April to May 2021 showed a mean of 1.07 bat passes per acoustic detector night, which represented low activity levels across seasons and were concentrated during the fall migration period. Bat passes were distributed across the Offshore Project area and although concentrations of passes occurred, they often represented single nights with multiple bat passes rather than repeated use of the same area over many nights. Additionally, groups of bats were continuously recorded and represented 69 percent of all bat passes recorded, suggesting that a small number of individual bats contributed to large amounts of detected bat activity. Additionally, bats were documented day and night roosting on the vessels in the Offshore Project area. Moreover, post- construction Acoustic and Thermographic Offshore Monitoring of birds and bats for the CVOW-Pilot Project has been underway since April 2021 to collect seasonal information with respect to bat presence at the two WTGs installed for the CVOW-Pilot Project (Dominion Energy 2022). Data through the spring (April 1 to June 15, 2021) and fall (August 15 to October 31, 2021) monitoring seasons showed three bat species were present at the WTGs during both seasons: the silver-haired bat, the eastern red bat, and hoary bat. The number of bat detections was much higher in the fall with 415 calls, compared to in the spring when there were only 4 calls. However, it is important to note that abundance cannot be inferred based on the number of detections as many detections could have been the same individual passing by the detector multiple times. Given these data, the potential exists for some migratory tree bats to encounter offshore facilities during spring and fall migration. BOEM expects this exposure risk to be limited to very few individual tree bats and to occur, if at all, during migration. Given the distance of the Wind Farm Area from shore, BOEM does not expect foraging bats to encounter operating WTGs outside spring and fall migration.

From June 9 to July 2, 2022, a presence/absence mist netting survey was conducted along the Onshore Project area resulting in the capture of 110 bats representing eight species (COP, Appendix O-3; Dominion Energy 2023). Captured bat species included big brown bat (*Eptesicus fuscus*), eastern red bat, southeastern myotis (*Myotis austroriparius*), tri-colored bat, little brown bat, northern long-eared bat, evening bat (*Nycticeius humeralis*), and Rafinesque's big-eared bat. Of the captured species, three lactating female northern long-eared bats were captured and fitted with radio transmitters. One maternity roost was found for one of the lactating females about 374 feet (114 meters) from the proposed onshore export cable route. Two tri-colored bats were captured and then were fitted with transmitters to identify nearby roost sites. One bat was tracked to a roost located approximately 935 feet (285 meters) from the proposed onshore export cable route, and the second roost could not be located due to impassible terrain. Separately, acoustic and mist-netting surveys were conducted from June 21 to July 2, 2022, at Naval Air Station Oceana Dam Neck Annex, which overlaps the cable landing location and a portion of the onshore export cable route (Gilardi and ISIL Engineering 2022). Acoustic analysis confirmed the probable presence of big brown, eastern red, silver-haired, and little brown bats. Mist netting resulted in the capture of 17 bats from six different species including seven eastern red bats, four big brown bats, two little brown bats, two northern long-eared bats, one Rafinesque's big-eared bat, and one Seminole bat. The northern long-eared bats did not have radio transmitters attached, because they were male and the Rafinesque's big-eared bat could not have a radio transmitter attached since it was released due to stress concerns. Previous bat mist netting efforts in the vicinity of the Onshore Project area near the cable landing location did not report captures of any federally listed species, although roost trees and nighttime foraging locations of non-listed species (e.g., tri-colored bat, southeastern myotis) were identified in the forested areas bordering the onshore export cable route along Birdneck Road (Tetra Tech 2019). Acoustic analysis in this same area had no confirmed northern long-eared bat calls, and 16 passes were identified as Indiana bat by KPro software; however, presence was not confirmed during manual vetting (Tetra Tech 2019).

Bats in the geographic analysis area are subject to pressure from ongoing activities generally associated with onshore impacts (e.g., onshore construction and climate change). Onshore construction activities and associated impacts are expected to continue at present trends and have the potential to result in impacts on bat species. Impacts associated with climate change have the potential to reduce reproductive output and increase individual mortality and disease occurrence. Additionally, cave bat species, including the northern long-eared bat, are experiencing drastic declines due to white-nose syndrome (WNS) caused by the fungal pathogen *Pseudogymnoascus destructans*. In Virginia, WNS has resulted in dramatic population declines for the little brown bat, Indiana bat, and tri-colored bat since 2009 (Reynolds 2021). The Proposed Action has the potential to result in impacts on cave bat populations already affected by WNS. While the WNS-related mortality of bats in northeastern North America reduces the likelihood of many individuals being present in the onshore portions of the proposed Project area (Cheng et al. 2021; Reynolds 2021), the biological significance of mortality resulting from the Proposed Action, if any, may be increased given the drastic reduction in cave bat populations in the region. Further, data collected from 2010 to 2019 by the U.S. Geological Survey (USGS) shows that predicted summer occurrence for the northern long-eared, little brown, and tri-colored bats is low along the coast of Virginia, indicating that at least some species are only present in low numbers in the onshore portion of the Offshore Project area (Udell et al. 2022).

3.5.2 Environmental Consequences

3.5.2.1 Impact Level Definitions for Bats

Definitions of impact levels are provided in Table 3.5-1. There are no beneficial impacts on bats.

Table 3.5-1 Impact Level Definitions for Bats

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

3.5.3 Impacts of the No Action Alternative on Bats

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

3.5.3.1 Impacts of the No Action Alternative

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

The following ongoing offshore wind activities in the geographic analysis area contribute to impacts on bats.

- Continued O&M of the Block Island Project (5 WTGs) installed in state waters.
- Continued O&M of the CVOW-Pilot Project (2 WTGs) installed in OCS-A 0497.
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork Project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing O&M of the Block Island and CVOW projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect bats through the primary IPFs of noise, presence of structures, and land disturbance. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and land disturbance that are described in detail in Section 3.5.3.2, *Cumulative Impacts of the No Action Alternative*, for planned offshore wind activities, but the impacts would be of lower intensity.

3.5.3.2 Cumulative Impacts of the No Action Alternative

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

Other planned non-offshore wind activities that may affect bats include increasing onshore construction and the infrequent installation of new structures on the OCS (see Appendix F, Section F.2 for a complete description of ongoing and planned activities). These activities may result in temporary and permanent onshore habitat impacts and temporary or permanent displacement and injury of or mortality to individual bats, but population-level effects would not be expected. See Appendix F, Attachment 1, Table F1-2 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for bats.

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

Noise: Construction of numerous offshore wind projects is projected between 2023 and 2030 in the geographic analysis area (Appendix F, Table F-3). Construction noise from these other projects, most notably from pile driving, may temporarily cause effects on some migrating bats if they are present during construction periods. However, notable noise impacts are not expected because research indicates that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals; no temporary or permanent hearing loss would be expected (Simmons et al. 2016).

Other noise impacts (i.e., displacement from potentially suitable habitats or migration routes) could occur as a result of construction noise (Schaub et al. 2008), but the likelihood of impact is low because only limited use of the OCS is expected, and the use would occur only during spring and fall migration. Additionally, onshore construction noise also has the potential to result in impacts on bats foraging or roosting in the vicinity of construction activities. BOEM anticipates that these impacts would be temporary and highly localized, and bats would be expected to move to a different roost farther from construction noise. This movement would not be expected to result in any impacts, as frequent roost switching is common among bats (Hann et al. 2017; Whitaker 1998).

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

Presence of structures: The primary threat to bats would be from collisions with offshore WTGs. Over 3,154 structures (WTGs, OSSs, and meteorological towers) could be constructed in the geographic analysis area (Appendix F, Table F-3), which could affect migration patterns or pose a collision risk to individual bats.

Although adverse impacts on bats from collisions with operating WTGs cannot be quantified, some level of mortality during operation of offshore wind facilities is assumed. Any new operating wind facility would require a thorough regulatory and environmental review to appropriately site the facility to avoid, minimize, and mitigate adverse impacts on bat species.

Cave bats (including the federally and state listed northern long-eared and Indiana bat) do not tend to fly offshore (even during migrations) and, therefore, exposure to construction vessels during construction or maintenance activities, or the rotor swept zone (RSZ) of operating WTGs in the lease areas is expected to be negligible, if exposure occurs at all (Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016).

Tree bats, include the eastern red bat, the hoary bat, and the silver-haired bat, may pass through the offshore wind lease area during migrations, with limited potential for migrating bats to encounter vessels during construction and conceptual decommissioning of WTGs, OSSs, and offshore export cable corridors, although structure and vessel lighting may attract bats due to increased prey abundance.

Some bats may encounter, or perhaps be attracted to, the offshore wind related structures to opportunistically roost or forage. Several authors, such as Cryan and Barclay (2009), Cryan et al. (2014), and Kunz et al. (2007), discuss several hypotheses as to why bats may be attracted to WTGs. Many of these, including the creation of linear corridors, altered habitat conditions, or thermal inversions, would not apply to WTGs on the Atlantic OCS (Cryan and Barclay 2009; Cryan et al. 2014; Kunz et al. 2007). As such, it is possible that some migrating bats may encounter, and perhaps be attracted to, operational WTGs and interact with turbine blades in the RSZ (Cryan et al. 2014; Cryan and Barclay 2009), in addition to OSSs and non-operational WTG towers, to opportunistically roost or forage. However, bats' echolocation abilities and agility make it unlikely that these stationary objects (OSSs and non-operational WTGs) or moving vessels would pose a collision risk to migrating individuals; this assumption is supported by the evidence that bat carcasses are rarely found at the base of onshore turbine towers (Choi et al. 2020). Offshore operations and maintenance would present a seasonal risk factor to migratory tree bats that may use the offshore habitats during spring or fall migration. While some potential exists for migrating tree bats to encounter operating WTGs during spring or fall migration, the overall occurrence of bats on the OCS is low (COP, Appendix O-2; Dominion Energy 2023; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022).

Given the expected infrequent and limited use of the OCS by migrating tree bats, very few individuals would be expected to encounter operating WTGs or other structures associated with offshore wind development. WTGs for the proposed Project would be spaced approximately 0.75 nautical mile (1.39 kilometers) in an east–west direction and 0.93 nautical mile (1.72 kilometers) in a north–south direction. BOEM assumes that WTGs for other projects would be similarly spaced.

Several factors would reduce potential interactions between bats and operating WTGs, including the proposed spacing between structures associated with offshore wind development and the distribution of anticipated projects. Individual bats migrating over the OCS in the RSZ of projected WTGs would likely fly through project areas with only slight course corrections, if any, to avoid operating WTGs.

Unlike terrestrial migration routes, there are no offshore landscape features that would concentrate migrating tree bats and increase exposure to the offshore wind lease area on the OCS (Baerwald and Barclay 2009; Cryan and Barclay 2009; Fiedler 2004; Hamilton 2012; Smith and McWilliams 2016).

- The potential collision risk to migrating tree bats varies with climatic conditions; for example, bat activity is associated with relatively low wind speeds and warm temperatures (Smith and McWilliams 2016; True et al. 2021). Given the rarity of tree bats in the offshore environment, when combined with broadly spaced turbines and the patchiness of projects, the likelihood of collisions is expected to be low.
- The likelihood of a migrating individual encountering one or more operating WTGs during adverse weather conditions is extremely low, as bats have been shown to suppress activity during periods of strong winds, low temperatures, and rain (Smith and McWilliams 2016; True et al. 2021).

Land disturbance: Onshore construction activities involving land disturbance could result in localized, minor, and temporary impacts on bats, including avoidance, displacement, and habitat loss. These impacts would not be biologically notable, and no population-level effects would occur (Hann et al. 2017; Whitaker 1998).

Onshore land development or port expansion activities could also result in limited loss of roosting or foraging habitat for some bat species. However, such minor impacts would be limited in extent, and would not measurably affect bat population abundance or viability as individual projects would be expected to minimize tree removal if not occurring in previously disturbed habitats. As such, onshore construction activities associated with offshore wind development would not be expected to appreciably contribute to overall impacts on bats.

Other considerations: The federally endangered northern long-eared bat is the only bat species listed under the ESA that may be affected by the proposed Project; the Indiana bat is considered extralimital and rare along coastal areas. The tri-colored bat may be affected by the proposed Project, and on September 13, 2022, USFWS announced a proposal to list the tri-colored bat as endangered under the ESA. Ongoing activities, future non-offshore wind activities, and offshore wind activities other than the proposed Project may also affect the northern long-eared bat. As previously described and discussed further in the Biological Assessment (BA) (BOEM 2022, 2023), the possibility of impacts on the northern long-eared bat would be limited to onshore impacts that would generally be during facilities construction.

3.5.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, bats would continue to be affected by existing environmental trends and ongoing activities.

Ongoing activities are expected to have continuing temporary to long-term impacts (disturbance, displacement, injury, mortality, and habitat loss) on bats primarily through onshore construction impacts, the presence of structures, and climate change. BOEM anticipates that the potential impacts on bats resulting from ongoing activities would be **minor**. In addition to ongoing activities, the impacts of planned actions other than offshore wind development may also contribute to impacts on bats, including increasing onshore construction (Appendix F, Attachment 2), however these impacts would be **negligible**. BOEM expects the combination of ongoing and planned actions other than offshore wind development to result in **minor** impacts on bats.

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

Considering all the IPFs together, the overall impacts associated with offshore wind activities in the geographic analysis area would result in **minor** adverse impacts because of ongoing climate change, interactions with operating WTGs on the OCS, and onshore habitat loss. Offshore wind activities are not expected to materially contribute to the IPFs discussed above. Given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration and given that cave bats do not typically occur on the OCS, none of the IPFs associated with offshore wind activities that occur offshore would be expected to appreciably contribute to overall impacts on bats. Some potential for temporary disturbance and permanent loss of onshore habitat may occur as a result of offshore wind development. However, habitat removal would be minimal when compared with other past, present, and reasonably foreseeable activities, and any impacts resulting from habitat loss or disturbance would not result in individual fitness or population-level effects in the geographic analysis area.

3.5.4 Relevant Design Parameters and Potential Variances in Impacts

The primary proposed Project design parameters that would influence the magnitude of impact on bats are provided in Appendix E, *Project Design Envelope and Maximum Case Scenario*, and include the following.

- The number, size, and location of WTGs.
- The time of year during which construction occurs.

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

- WTG number, size, and location: the level of hazard related to WTGs is proportional to the number of WTGs installed; fewer WTGs would present less hazard to bats.
- Season of construction: the active season for bats in the geographical analysis area is generally from March through November. Construction outside of this window would have a lesser impact on bats than construction during the active season. However, non-hibernating populations may persist in the area during winter.

3.5.5 Impacts of the Proposed Action on Bats

Noise: Pile-driving noise and onshore and offshore construction noise associated with the Proposed Action alone would not increase the impacts of noise beyond the impacts described under the No Action Alternative (Section 3.5.3, *Impacts of the No Action Alternative on Bats*) and is expected to result in negligible impacts on bats because construction activity would be short term, temporary, and highly localized.

Auditory impacts are not expected to occur as recent research has shown that bats may be less sensitive to temporary threshold shifts than other terrestrial mammals (Simmons et al. 2016). Impacts, if any, are expected to be limited to behavioral avoidance of pile driving or other construction activities and no temporary or permanent hearing loss would be expected (Schaub et al. 2008; Simmons et al. 2016).

Per the Project BA prepared for the U.S. Fish and Wildlife Service (USFWS) (BOEM 2022, 2023), the interconnection cable route would pass through several areas designated as high or very high ecological value and are in areas with documented northern long-eared bat maternity roosts; however, there are no hibernacula present in the vicinity of Onshore Project components. Mist netting conducted in 2022 indicated that nine species of bat occur along and near the onshore export cable route including northern long-eared bat (five individuals captured) and tri-colored bat (two individuals captured) (COP, Appendix O-3; Dominion Energy 2023; Gilardi and ISIL Engineering 2022).

Behavioral impacts from onshore construction activities could occur associated with use of Direct Steerable Pipe Thrusting for the installation of the offshore export cables to the cable landing location, which would result in temporary noise impacts from installation of the cofferdam, from Direct Steerable Pipe Thrusting in the sea-to-shore transition, and at beach work areas and could result in temporary, localized disturbance or displacement of bats. While the total acreage of the cable landing location footprint is 11.1 acres (4.5 hectares), most of the area would be used for equipment laydown, staging and would not require any vegetative clearing or grading, and permanent impacts would only occur within a 2.27-acre (0.92 hectares) area that is a proposed parking lot. Disturbance impacts at the cable landing location would be short term and limited because the landing is located in a proposed parking lot. The onshore export cable predominately follows developed corridors and previously disturbed land to a common location north of Harpers Road. The onshore export cable route would pass through several habitat types, including open space, developed, forested, agricultural, and wetlands (Tables 3.8-2, 3.8-3, and 3.22-3) that may support bat species, resulting in temporary disturbance impacts on bats. From that point, onshore clearing and construction (and associated noise) would be required at the Harpers Switching Station and for the overhead lines from Harpers Switching Station to Fentress Substation resulting in impacts on varying acreages of wetlands and National Land Cover Database (NLCD) land cover classes, as shown in Tables 3.8-2 and 3.22-3.

Onshore clearing and construction would result in disturbance to bats at the Harpers Switching Station. The Harpers Switching Station would require approximately 5.52 acres (2.23 hectares) for stormwater management facilities; approximately 6.2 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the Aeropines Golf Club; 0.9 acre (0.4 hectare) for relocation of Dewey Road Drive; and 12.5 acres (5.1 hectares) for workspace, fence relocation, and tree removal. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station (Dominion Energy 2023). While impacts at the Harpers Switching Station would largely be on previously developed areas within the Aeropines Golf Club (Table 3.8-2 and 3.8-3), approximately 27.02 acres (10.93 hectares) of tree clearing would be required to support relocation of fairways, construction of the maintenance building, relocation of Dewey Road, and construction of stormwater management facilities and the footprint of Harpers Switching station. With respect to the interconnection cable route, Interconnection Cable Route Option 1 is approximately 14.3 miles (23.0 kilometers) long and would be installed entirely overhead and result in permanent disturbance impacts on a total of 144.2 acres (58.4 hectares) of wetland and NLCD land cover classes (Tables 3.8-2, 3.8-3, and 3.22-3) and would require 117 acres (47 hectares) of tree clearing. The interconnection cable route would culminate at the onshore substation, which would also require land clearing and result in impacts on wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3) and subsequent disturbance impacts on bats. Overall, noise from onshore clearing and construction would be localized and temporary. If the noise disturbs bats, they would likely temporarily move away, potentially from preferred foraging or roosting habitats. However, BOEM expects that no individual fitness or population-level impacts would be expected to occur resulting in negligible impacts on bats from the Proposed Action, and lasting impacts on local breeding populations are not anticipated. Conceptual decommissioning of the Project would have similar impacts as construction and would likely be conducted under similar seasonal restrictions.

For onshore construction activities, Dominion Energy will comply with the existing 4(d) provisions in accordance with the interim guidance until April 1, 2024. Following implementation of the new regulations, Dominion Energy has committed to complying with two time-of-year restrictions for tree-clearing activity, which will reduce noise impacts on bats. The timeframe restrictions are from December 15 to February 15 when bats are wintering in the trees and the weather is typically too cold for them to be moving; and April 15 to July 30 to provide protection to pups, which are typically born after May 1.

Presence of structures: The various types of impacts on bats that could result from the presence of structures, such as migration disturbance and turbine strikes are described in detail in Section 3.5.1, *Description of the Affected Environment for Bats*. The Proposed Action would add up to 202 new WTGs on the OCS where few currently exist.

There is some correlative evidence from inland studies that bat mortality increases with tower height (Barclay et al. 2007; Georgiakakis et al. 2012). Therefore, the Proposed Action could result in higher probability of bat mortality if 16-MW WTGs are chosen over 14-MW WTGs. However, because the overall occurrence of bats (including listed species) on the OCS is low (COP, Appendix O-2, Dominion Energy 2023; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022), the impacts of the Proposed Action are expected to result in minor long-term impacts in the form of mortality; BOEM anticipates the occurrence of such impacts to be rare. In addition, Dominion Energy would use BMPs identified by BOEM COP guidelines (BOEM 2020) and comply with FAA and USCG requirements for lighting and, to the extent practicable, use lighting technology (e.g., low-intensity strobe lights, flashing red aviation lights) that minimize impacts on bat species.

Land disturbance: Impacts associated with construction of onshore elements of the Proposed Action could occur if construction activities occur during the active season (generally March through November). Impacts may include injury or mortality of individuals, particularly juveniles who are nonvolant (i.e., unable to fly) and cannot flush from a roost, if occupied by bats at the time of removal.

There would be potential for habitat impacts on bats as a result of the loss of potentially suitable roosting or foraging habitat. However, the cable landing location would be located in a proposed parking lot, which is highly unlikely to provide important habitat for any bat species. Although acoustic analyses using KPro software had no confirmed northern long-eared bat call but identified 16 passes as Indiana bat, the identities could not be confirmed by manual vetting. No Indiana bats were captured during mist netting efforts in the area (Tetra Tech 2019). While bats may be present in habitat adjacent to the onshore export cable route, exposure is expected to be limited (COP, Appendices O-1 and O-3; Dominion Energy 2023; Gilardi and ISIL Engineering 2022) because much of the routing is collocated with existing roads. Mist netting conducted in 2022 indicated that nine species of bat occur along or near the onshore export cable route, including the northern long-eared bat (five individuals captured) and tri-colored bat (two individuals captured) (COP, Appendix O-3; Dominion Energy 2023; Gilardi and ISIL Engineering 2022). However, the onshore substation and switching station would require tree and vegetation clearing on varying acreages of wetlands and various NLCD land cover classes (Tables 3.8-2 and 3.22-3).

Interconnection Cable Route Option 1 would be approximately 14.3 miles (23.0 kilometers) long and would result in approximately 78.3 acres (31.7 hectares) of temporary disturbance to various NLCD land cover classes (Table 3.8-2). Permanent impacts resulting in the loss of potential habitat would be 127.2 acres (51.5 hectares). While the NLCD does include wetland land cover classes, refer to Section 3.22, *Wetlands*, Table 3.22-3 for wetland impacts on the Onshore Project components based on wetland delineation survey data. The portion of the route that passes through the forested and wetland areas associated with the North Landing River likely provides quality roosting and/or foraging habitat for bats.

Approximately 76 percent of Interconnection Cable Route Option 1 would be collocated with existing linear development. Overall, impacts on bat habitat during construction are expected because northern long-eared bat maternity roosts have been documented close to the proposed route, within 0.04 mile (0.06 kilometer), adjacent to the Naval Auxiliary Landing Field Fentress; within 2.57 miles (4.14 kilometers) of the proposed route, there have been acoustic detections of Indiana bats in the region (12 to14 miles [19 to 22 kilometers] from both the cable landing location and Fentress Substation), and bat activity has been documented throughout the year (COP, Appendix O-1; Dominion Energy 2023). Tree/vegetation clearing would occur along the route in various NLCD land cover class types (Table 3.8-2), and clearing activities would follow existing 4(d) provisions in accordance with the interim guidance until April 1, 2024, and would then follow two timeframe restrictions: December 15 to February 15 and April 15 to July 30. Dominion Energy would maintain a minimum no-tree-clearing buffer of 150 feet (45 meters) around any known northern long-eared bat maternity roosts, and Dominion Energy conducted mist-netting surveys along the Onshore Project area. Additionally, due to the potential impacts, monitoring and mitigation during all seasons may be required.

The switching station parcel at Harpers Road (Interconnection Cable Route Option 1) would be built in a semi-developed area within the Aeropines Golf Club (COP, Appendix O-1; Dominion Energy 2023). Because the Harpers Switching Station would be located adjacent to non-disturbed areas, there is potential for impacts on bat habitat due to anticipated tree clearing (27.02 acres [10.93 hectares]) in mixed forest and woody wetland NLCD land cover classes (Table 3.8-2). The Harpers Switching Station would require approximately 5.52 acres (2.23 hectares) for stormwater management facilities, and approximately 6.2 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the

Aeropines Golf Club, 0.9 acre (0.4 hectare) for relocation of Dewey Road Drive, and 12.5 acres (5.1 hectares) for workspace, fence relocation, and tree removal. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station (Dominion Energy 2022a). The onshore substation parcel (Fentress) is in an existing developed area and is associated with fragmented habitat; expansion of the parcel would require clearing within forested and wetland NLCD land cover classes (Table 3.8-2); therefore, impacts on potentially suitable roosting or foraging habitat would occur but would be limited (COP, Appendix O-1; Dominion Energy 2023; BOEM and Dominion Energy 2022). Refer to Section 3.21, Section 3.14, *Land Use and Coastal Infrastructure*, and Section 3.22, *Wetlands,* for additional details of potential impacts on surface waters, land use, and wetlands.

BOEM anticipates that minor impacts would occur due to adherence to USFWS northern long-eared bat conservation measures; further, these minor habitat impacts would not result in individual fitness or population-level effects given the limited amount of habitat removal. Dominion Energy would likely leave onshore facilities in place for future use. There are no plans to disturb the land surface or terrestrial habitat during conceptual decommissioning of the Proposed Action. Therefore, onshore temporary impacts of conceptual decommissioning would be negligible.

3.5.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities. In the context of reasonably foreseeable environmental trends, combined noise impacts on bats from ongoing and planned actions, including the Proposed Action, would likely be negligible. Combined impacts on bats arising from the presence of structures from ongoing and planned actions, including the Proposed Action, would likely be minor given the expected limited use of the OCS by migrating tree bats. As the Proposed Action would account for about 9.6 percent (up to 202 of 3,287) of the new WTGs on the OCS, a majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action. The combined land disturbance impacts from ongoing and planned actions, including the Proposed Action, would likely be minor, as a small amount of habitat loss would be expected.

3.5.5.2 Conclusions

Impacts of the Proposed Action. Construction, installation, operation, and conceptual decommissioning of the Proposed Action alone would have **negligible** to **minor** impacts on bats, especially if tree-clearing activities are conducted outside the active season. The main notable risk would be from operation of the offshore WTGs, which could lead to **minor** long-term impacts in the form of mortality, although BOEM anticipates this to be rare, and from onshore construction, which could lead to **minor** long-term impacts from loss of suitable onshore roosting and/or foraging habitat. The impact conclusions for ongoing and future non-offshore wind activities are presented in Section 3.5.3, *Impacts of the No Action Alternative on Bats*.

Cumulative impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action, would be **negligible** to **minor**. Considering all the IPFs collectively, BOEM anticipates that the impacts from ongoing and planned actions, including the Proposed Action, would result in **minor** impacts on bats in the geographic analysis area. The main drivers for this impact rating are ongoing climate change and onshore habitat loss. The Proposed Action would contribute to the overall impact rating primarily through the permanent but limited impacts attributed to onshore habitat loss. Thus, the overall impacts on bats would likely be **minor** because while most impacts are expected to be avoided due to the limited occurrence of bats in the offshore wind lease area (23.75 nautical miles [44 kilometers] from land), some mortality and a small amount of onshore habitat loss is expected.

3.5.6 Impacts of Alternatives B and C on Bats

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. With the exception of the number and size of WTGs, impacts of the construction and installation, operations and maintenance, non-routine activities, and conceptual decommissioning under Alternatives B and C would be similar to those described under the Proposed Action. IPFs associated with the construction and installation of up to 176 WTGs plus spare locations under Alternative B (each 14 MW) and up to 172 WTGs under Alternative C (each 14 MW), including pile-driving noise and temporary avoidance and displacement, would be decreased by approximately 14 percent (Alternative B) or up to approximately 16 percent (Alternative C) compared to the Proposed Action. Fewer WTGs under Alternatives B and C when compared the Proposed Action may allow greater opportunity for migrating tree bats (if present) to avoid WTGs. Overall, the expected negligible to minor impacts on bats would not be materially different than those described under the Proposed Action. The use of 14 MW WTGs under Alternatives B and C may have some potential to decrease collision risk in comparison to the largest WTGs contemplated under the Proposed Action (16 MW) based on early studies of terrestrial wind facilities (Barclay et al. 2007; Georgiakakis et al. 2012). However, more recent research indicates there is no correlation between bat fatality rates and wind turbine size (Smallwood 2020). Given the expected limited use of the OCS by migrating tree bats (COP, Appendix O-2; Dominion Energy 2023; Pelletier et al. 2013; Sjollema et al. 2014; BOEM 2015; Petersen 2016; Deepwater Wind 2020; Dominion Energy 2022), impacts would be expected to remain minor.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.5.6.1 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would involve fewer and potentially smaller WTGs, compared to the Proposed Action, which would have an associated decrease in potential collision risk to bats. However, BOEM expects that the impacts resulting from these alternatives would be similar to the Proposed Action with individual IPFs leading to impacts ranging from **negligible** to **minor**.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on bats from ongoing and planned actions, including Alternatives B and C, would be similar to those described for the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts. While Alternatives B and C may result in a slightly lower level of impact on bats than described under the Proposed Action, the overall impacts of Alternatives B and C on bats would be the same level as under the Proposed Action: **minor**. This impact rating is derived primarily by ongoing conditions such as climate change, as well as disturbance and habitat removal associated with onshore construction. As described above for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.5.7 Impacts of Alternative D on Bats

Impacts of Alternative D. All offshore components of Alternative D-1 or D-2 are the same as the Proposed Action (202 WTGs and 3 OSSs for the Proposed Action) and impacts on bats from the Offshore Project components would be the same as evaluated under the Proposed Action. Onshore, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The impacts resulting from individual IPFs under Alternative D-1 would be the same as those described under the Proposed Action because the onshore components would stay the same.

In contrast to the Proposed Action, Alternative D-2 involves approval of only Interconnection Cable Route Option 6 (Hybrid Route), which would be approximately 14.3 miles (23.0 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods and installed via open trench, micro tunneling, and HDD. It would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.8 miles (15.8 kilometers) to the onshore substation (Fentress).

In contrast to the Proposed Action, Alternative D-2 involves approval of only Hybrid Interconnection Cable Route Option 6, which would be approximately 14.3 miles (23.0 kilometers) long and mostly follow the same route as the Proposed Action, with the exception of the switching station. Interconnection Cable Route Option 6 would be installed via a combination of overhead and underground construction methods including open trench, micro tunneling, and HDD. The route would follow Interconnection Cable Route Option 1 as an underground transmission line for approximately 4.5 miles (7.2 kilometers) to a point north of Princess Anne Road, where the route would then transition to an overhead transmission line configuration. The Chicory Switching Station would be built north of Princess Anne Road; therefore, no aboveground switching station would be built at Harpers Road. From the Chicory Switching Station, Interconnection Cable Route Option 6 would align with Interconnection Cable Route Option 1 for the remaining 9.8 miles (15.8 kilometers) to the onshore substation (Fentress).

Noise and land disturbance from onshore construction activities of Interconnection Cable Route Option 6 would result in behavioral and habitat loss/fragmentation impacts on bats as a result of temporary disturbance and clearing of a total of 72.1 acres (29.2 hectares) of NLCD land cover classes (Tables 3.8-4 and 3.8-5), whereas the Proposed Action would result in impacts on 78.3 acres (31.7 hectares) (Table 3.8-2). Permanent impacts resulting in the loss of potential habitat would be 116.3 acres (47.1 hectares) for Interconnection Cable Route Option 6 and 127.2 acres (51.5 hectares) for Interconnection Cable Route Option 1. While the NLCD does include wetland land cover classes, refer to Section 3.22 (Table 3.22-4) for wetland impacts on the Onshore Project components based on wetland delineation survey data. Total estimated tree clearing would be 117 acres (47 hectares) for Interconnection Cable Route Option 1 and 101 acres (41 hectares) for Interconnection Cable Route Option 6. Approximately 76 percent of Interconnection Cable Route Option 1 (Proposed Action) and 70 percent of Interconnection Cable Route Option 6 (Alternative D-2) would be collocated with existing linear development. The Chicory Switching Station (Interconnection Cable Route Option 6) is in an area identified as general ecological integrity (C5), and would be built within a forested parcel, with potential for habitat loss/fragmentation for bats due to tree clearing within multiple forest NLCD land cover classes (Table 3.8-4). The Chicory Switching Station would have a footprint of 35.5 acres (14.4 hectares) but would result in a greater area of impact on undeveloped NLCD land cover classes than the Harpers Switching Station, which would be located entirely within the existing Aeropines Golf Club and permanently affect 35.3 acres (14.3 hectares) of NLCD land cover classes. Overall, impacts at the Chicory Switching Station (Alternative D-2) would predominantly occur on previously undisturbed forest/wetland habitats (Tables 3.8-4 and 3.8-5), whereas impacts at the Harpers Switching Station (Proposed Action) would be on portions of developed areas (Tables 3.8-2 and 3.8-3). Similar to the

Proposed Action, impacts associated with onshore clearing and construction would be localized and temporary. While Alternative D-2 would result in a slight increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates the difference in potential impacts on bats would be nominal.

The impacts resulting from noise and land disturbance under Alternative D-1 would be the same as those described under the Proposed Action. Alternative D-2 would have a slightly increased potential to permanently affect forested and wetland habitats when compared to the Proposed Action. As described for the Proposed Action, and based on wetland and NLCD cover class mapping, Alternative D-1 (Interconnection Cable Route Option 1) would have the least potential to permanently affect forested and wetland habitats as compared to Alternative D-2 (Hybrid Interconnection Cable Route Option 6). No individual fitness or population-level effects would be expected from onshore construction and associated loss/fragmentation of foraging associated with Alternatives D-1 or D-2, and, as a result, BOEM anticipates minor impacts. While Alternative D-2 would result in an increase in the duration of noise and habitat loss/fragmentation compared to the Proposed Action, BOEM anticipates impacts of Alternatives D-1 or D-2 to be similar on bats to those described under the Proposed Action: negligible to moderate impacts with overall moderate impacts on bats.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternatives D-1 or D-2 to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.5.7.1 Conclusions

Impacts of Alternative D. The Proposed Action only considers Interconnection Cable Route Option 1 while Alternative D considers Interconnection Cable Route Option 1 (Alternative D-1) or Interconnection Cable Route Option 6 (Alternative D-2). BOEM anticipates the impacts on bats resulting from Alternative D-1 to be the same as the Proposed Action. Impacts under Alternative D-2 would be slightly greater than under the Proposed Action due to construction and clearing occurring on a larger area of undisturbed forest/wetland habitats; however, the impacts are not expected to change under Alternatives D-1 or D-2 relative to the Proposed Action. Impacts on bats would range from **negligible** to **minor**. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on bats from ongoing and planned actions, including Alternative D-1 or D-2, would be similar to those described for the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts that range from temporary to long term. While Alternative D-1 would result in the same level of impact on bats and Alternative D-2 may result in a slightly higher level of impact on bats than described under the Proposed Action, the overall impacts of Alternatives D-1 or D-2 on bats would be the same as under the Proposed Action: **minor**. This impact rating is derived primarily by ongoing conditions such as climate change, as well as disturbance and habitat removal associated with onshore construction. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.5.8 Agency-Required Mitigation Measures

The measures listed in Table 3.5-2 are recommended for inclusion in the Preferred Alternative. If the measures analyzed below are adopted by BOEM or cooperating agencies, some adverse impacts could be further reduced.

Table 3.5-2 Measures Resulting from Consultations: Bats[1]

Measure	Description	Effect
Adaptive mitigation for birds and bats	BOEM will require that Dominion Energy develops and implements a Post-Construction Monitoring (PCM) plan based on Dominion Energy's Proposed Bird and Bat Monitoring Framework in coordination with USFWS and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. Prior to commencing offshore construction activities, Dominion Energy must submit the PCM for BOEM and USFWS review. BOEM and USFWS will review the PCM and provide any comments on the plan within 30 calendar days of its submittal. Dominion Energy must resolve all comments on the PCM to BOEM and USFWS's satisfaction before implementing the plan. a. Monitoring. Dominion Energy must conduct monitoring as outlined in Dominion Energy's Proposed Bird and Bat Monitoring Framework, which will include acoustic monitoring of bat presence, the use of motus receivers and tags to monitor bird and bat movements, and others TBD. b. Annual Monitoring Reports. Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov), USFWS, and BSEE (at OSWSubmittals@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 6 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, USFWS, and BSEE will use the annual monitoring reports to assess the need for reasonable revisions (based on	If the reported post-construction bat monitoring results indicate bat impacts deviate substantially from the impact analysis included in this EIS, then Dominion Energy must make recommendations for new mitigation measures or monitoring methods.

Measure	Description	Effect
	subject matter expert analysis) to the PCM. BOEM, BSEE, and USFWS reserve the right to require reasonable revisions to the PCM and may require new technologies as they become available for use in offshore environments. c. Post-Construction Quarterly Progress Reports. Dominion Energy must submit quarterly progress reports during the implementation of the PCM to BOEM (at renewable_reporting@boem.gov) and the USFWS by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered. d. Monitoring Plan Revisions. Within 15 calendar days of submitting the annual monitoring report, Dominion Energy must meet with BOEM and USFWS to discuss the following: the monitoring results; the potential need for revisions to the PCM, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If BOEM or USFWS determines after this discussion that revisions to the PCM are necessary, BOEM may require Dominion Energy to modify the PCM. If the reported monitoring results deviate substantially from the impact analysis included in the Final BA, Dominion Energy must transmit to BOEM recommendations for new mitigation measures and/or monitoring methods. e. Operational Reporting (Operations). Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) an	

Measure	Description	Effect
	annual report summarizing monthly operational data calculated from 10-minute SCADA data for all turbines together in tabular format: the proportion of time the turbines were operational (spinning at >x rpm) each month, the average rotor speed (monthly rpm) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the impact analysis included in the Final BA. f. Raw data. The Lessee must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE and USFWS, upon request for the duration of the Lease. The Lessee must work with BOEM to ensure the data are publicly available. USFWS may specify third-party data repositories that must be used, such as the Motus Wildlife Tracking System or MoveBank, and such parties and associated data standards may change over the duration of the monitoring plan.	
Annual bird and bat mortality reporting	Dominion Energy must provide an annual report to BOEM and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory, available at https://www.pwrc.usgs.gov/bbl/. Any	Annual bat mortality reporting can inform the Avian and Bat Post-Construction Monitoring Plan (see previous measure), which could lead to Dominion Energy recommending new mitigation measures or monitoring methods to reduce impacts on bats. In addition, mortality data can inform future BOEM offshore wind EIS analyses for proposed wind farms on the Atlantic OCS.

Measure	Description	Effect
	occurrence of a dead ESA-listed bird or bat must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state.	
Surveys, Avoidance, and Minimization (bat acoustic surveys)	To minimize potential impacts on northern long-eared bats and Indiana bats, which may be present year-round, Dominion Energy has conducted surveys (mist-net) and is developing avoidance and minimization measures, including adhering to the existing requirements for tree clearing under 4(d) provisions prior to implementation of the new regulations on April 1, 2024 and adhering to the year-round time of year restrictions for suitable habitat included in the new regulation in coordination with BOEM, USFWS, and VDWR.	This measure could result in additional impact reduction on ESA-listed bats and non-protected bats.

[1] Also Identified in Appendix H, Table H-2.

3.5.8.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.5-2 and Appendix H, *Mitigation and Monitoring*, Table H-2 are incorporated in the Preferred Alternative. These measures, if adopted, would further define how the effectiveness and enforcement of APMs would be ensured and improve accountability for compliance with APMs by requiring monitoring, reporting, and adaptive management of potential bat impacts on the OCS. However, given the infrequent and limited anticipated use of the OCS by migrating tree bats during spring and fall migration, and given that cave bats do not typically occur on the OCS, offshore wind activities are unlikely to appreciably contribute to impacts on bats regardless of measures intended to address potential offshore bat impacts. In the onshore environment, conducting pre-construction surveys and coordinating with VDWR and USFWS would ensure impacts on bats and their habitats would be avoided and minimized to the extent practicable. Because these measures ensure the effectiveness of and compliance with APMs that are already analyzed as part of the Proposed Action, implementation of these measures would not further reduce the impact level of the Proposed Action from what is described in Section 3.5.2, *Environmental Consequences*.

3.11. Demographics, Employment, and Economics

This section discusses potential impacts on demographics, employment, and economics from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.11-1, includes the cities where proposed onshore infrastructure and potential port cities are located, as well as the cities closest to the Wind Farm Area: Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach Cities, Virginia. All incorporated cities in Virginia are classified as independent cities and considered as county equivalents by the U.S. Census Bureau for the purposes of data collection.

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

The cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach are notable for coastal activities such as swimming, fishing, surfing, and sailing along Virginia's ocean beaches from Grandview Beach in Hampton to False Cape State Park in Virginia Beach. Coastal communities provide hospitality, entertainment, and recreation for many visitors each year and benefit from high tourism employment. In 2019, travel to Virginia Beach yielded $1.6 billion in spending to employ 13,000 people (COP, Section 4.4.5; Table 4.4-17; Dominion Energy 2023a). The geographic analysis area is part of the Virginia Beach–Norfolk–Newport News VA-NC Metropolitan Statistical Area (MSA) (also known as the Hampton Roads MSA), which had a total estimated population of 1,768,901 in 2019. The Hampton Roads region is known for its maritime industry, large military installations, and tourism industry, which is dominated by cultural history and coastal recreation (COP, Section 4.4.1.1; Dominion Energy 2023a). Data on population and demographics for the state of Virginia and for the cities of Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach are provided in Table 3.11-1 and Table 3.11-2. The population of Hampton, Newport News, and Portsmouth declined between 2010 and 2019, while the population of Virginia and Chesapeake, Norfolk, and Virginial Beach increased. The U.S. Census Bureau estimated the 2019 population of Norfolk at about 240,000 residents. Norfolk has the lowest percentage of residents over age 65 and the lowest median age. The population of Chesapeake City grew at the highest rate, 9.4 percent from 2010 to 2019, followed by Virginia Beach with 3.3 percent and Norfolk with 1 percent; while, the population of Newport News, Portsmouth, and Hampton declined by 1.2 percent, 1.7 percent, and 2.9 percent, respectively. The population of the six cities are all younger than or the same as, on average, Virginia, with a higher percentage of residents aged 65 or older and a higher median age.

Table 3.11-1 Demographic Trends (2010–2019)

Jurisdiction	2010 Population	2019 Population	2010–2019 Percent Population Change	2019 Percent Population 18–64	2019 Percent Population 65 or Older	2019 Median Age
Virginia	7,841,754	8,454,463	7.8	62.9	15	38.2
Chesapeake city	219,268	239,982	9.4	62.8	13	36.9
Hampton city	139,046	135,041	-2.9	63.9	15	36.2
Newport News city	181,822	179,673	-1.2	64.1	12.7	33.5
Norfolk city	242,143	244,601	1.0	69.4	10.9	30.7
Portsmouth city	96,785	95,097	-1.7	62.1	14.5	35.3
Virginia Beach city	435,996	450,201	3.3	64.0	13.7	36.2

Source: U.S. Census Bureau 2021a, 2021b.

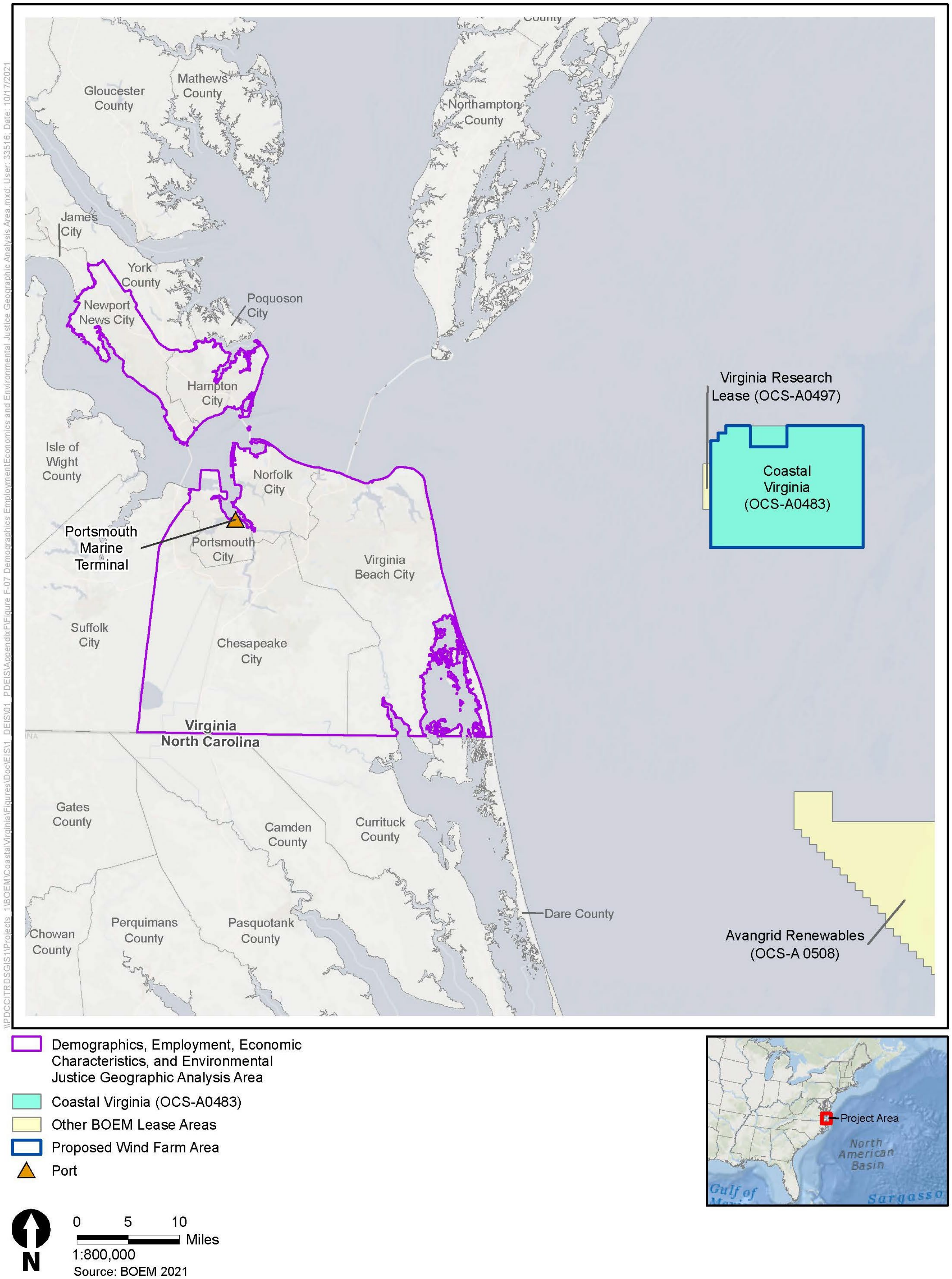


Figure 3.11-1 Demographics, Employment, Economic Characteristics, and Environmental Justice Geographic Analysis Area

Table 3.11-2 Demographic Data (2019)

Jurisdiction	Population	Population Density (persons per mi²)[1]	Per Capita Income (in USD)	Total Employment	Unemployment Rate (percent)
Virginia	8,454,463	214.1	39,278	4,156,018	4
Chesapeake city	239,982	703.8	35,536	111,227	5.2
Hampton city	135,041	990.8	30,135	61,782	5.6
Newport News city	179,673	1502.3	28,294	81,407	6.4
Norfolk city	244,601	2537.4	29,830	104,945	6
Portsmouth city	95,097	2037.2	26,312	41,396	5.1
Virginia Beach city	450,201	905.8	37,776	221,998	4.1

Source: U.S. Census Bureau 2021c; 2021d.
mi^2 = square mile; USD = U.S. dollars.

Chesapeake occupies about 341 square miles (883 square kilometers) of land. Hampton occupies about 136 square miles (352 square kilometers) of land in the coastal region of Virginia. Newport News occupies about 120 square miles (311 square kilometers) of land bordering the Chesapeake Bay and the James River. Norfolk occupies about 96 miles (155 kilometers) of land in the coastal region of Virginia. Portsmouth occupies about 47 miles (76 kilometers) of land, and the Portsmouth Marine Terminal (PMT) resides in Portsmouth County. Virginia Beach, occupies around 497 square miles (1,287 square kilometers) of land and is where the onshore cable route would be located. Virginia Beach is composed of 38 miles (61 kilometers) of shoreline and 3 miles (5 kilometers) of boardwalk, which are important to Virginia Beach's economy (Section 3.18, *Recreation and Tourism*).

The percentage of housing units for seasonal, recreational, or occasional use in Virginia Beach is highest at 1.7 percent compared to 0.1 percent in Chesapeake, 0.4 percent in Norfolk, 0.2 percent in Portsmouth, 0.4 percent in Hampton, and 0.2 percent in Newport News in comparison to 2.3 percent in Virginia as a whole (U.S. Census Bureau 2022b; COP, Section 4.4.1.1; Table 4.4-3; Dominion Energy 2023a). Virginia Beach relies on tourism and visitors to its economy and has the closest proportion of seasonal housing to Virginia as a whole. Table 3.11-3 includes housing data for the geographic analysis area. Throughout Virginia, 2.5 percent of housing units are seasonally occupied; (COP, Section 4.4.1.1; Table 4.4-3) 450,201 residents lived in Virginia Beach County in 2019. More than 19 million people visited Virginia Beach in 2017 (City of Virginia Beach 2017).

Table 3.11-3 Housing Data (2019)

Jurisdiction	Housing Units	Seasonal Vacant Units	Vacant Units (Total)	Vacancy Rate (percent)	Median Value (Owner-Occupied, USD)	Median Monthly Rent (Renter-Occupied, USD)
Virginia	3,537,788	82,998	353,667	10.0	282,800	1,257
Chesapeake city	91,707	52	5,183	5.7	286,000	1,300
Hampton city	60,145	234	5,298	8.8	188,600	1,115
Newport News city	77,851	133	7,475	9.6	194,700	1,075
Norfolk city	98,142	397	8,744	8.9	215,800	1,077
Portsmouth city	40,879	78	4,229	10.3	174,200	1,083
Virginia Beach city	185,735	3,156	13,283	7.2	287,400	1,380

Source: U.S. Census Bureau 2022a, 2022b.

Table 3.11-4 includes data on the industries where residents in these cities work. The industries that employ workers reflect recreation and tourism's importance to Hampton, Newport News, Norfolk, and Virginia Beach. A greater or equal proportion of residents in these cities work jobs in arts, entertainment, recreation, and accommodation and food services (9.3 percent in Hampton, 10.6 percent in Newport News, 12.8 in Norfolk, and 11.1 percent in Virginia Beach) than in Virginia as a whole (8.9 percent) (U.S. Census Bureau 2021c). Table 3.11-5 contains data on at-place employment by industry in the geographic areas of interest. A greater proportion of jobs in these cities is generally in health care and social assistance (18.8 percent in Hampton, 17 percent in Newport News, 19.4 percent in Norfolk, and 28.3 percent in Portsmouth); whereas, accommodation and food services comprise the largest employment by industry for Virginia Beach (16 percent), and retail services comprises the largest employment by industry for Chesapeake (16 percent) (Table 3.11 5). In 2019, unemployment was 5.2 percent in Chesapeake, 5.6 percent in Hampton, 6.4 percent in Newport News, 6 percent in Norfolk, 5.1 percent in Portsmouth, and 4.1 percent in Virginia Beach, compared to 4 percent overall in Virginia.

NOAA tracks economic activity dependent upon the ocean in its "Ocean Economy" data, which generally include, among other categories, commercial fishing and seafood processing, marine construction, commercial shipping and cargo-handling facilities, ship and boat building, marine minerals, harbor and port authorities, passenger transportation, boat dealers, and coastal tourism and recreation. In Newport News and Virginia Beach Counties, tourism and recreation account for 67.5 percent and 95.0 percent, respectively, of the overall Ocean Economy gross domestic product (GDP) (NOAA 2021). The "living resource" sector of the Ocean Economy is smaller but contributes to the identity of local communities and tourism. This includes commercial fishing, aquaculture, seafood processing, and seafood markets. Among Newport News and Portsmouth Counties, there are 17 living resources fisheries (NOAA 2021).

Table 3.11-4 Employment of Residents by Industry (2019)

Industry	Virginia	Chesapeake	Hampton	Newport News	Norfolk	Portsmouth	Virginia Beach
Agriculture, forestry, fishing and hunting, and mining	0.9%	0.20%	0.5%	0.3%	0.1%	0.4%	0.3%
Construction	6.6%	6.7%	6.3%	5.5%	7.0%	6.9%	6.5%
Manufacturing	7.1%	8.1%	12.6%	13.7%	7.1%	10.3%	5.5%
Wholesale trade	1.8%	1.5%	1.6%	2.1%	1.6%	2.3%	2.0%
Retail trade	10.4%	10.5%	10.4%	11.8%	11.2%	13.4%	11.5%
Transportation and warehousing, and utilities	4.4%	5.3%	4.4%	4.3%	4.9%	5.8%	4.2%
Information	1.9%	2.2%	1.1%	1.4%	1.7%	1.3%	1.7%
Finance and insurance, and real estate and rental and leasing	6.3%	7.0%	5.1%	3.5%	5.7%	4.3%	7.7%
Professional, scientific, and management, and administrative and waste management services	15.5%	11.8%	12.6%	10.7%	11.7%	9.4%	12.8%
Educational services, and health care and social assistance	22.2%	24.1%	22.0%	23.4%	23.1%	24.5%	22.9%
Arts, entertainment, and recreation, and accommodation and food services	8.9%	7.7%	9.3%	10.6%	12.8%	8.4%	11.1%
Other services, except public administration	5.3%	5.4%	4.5%	4.5%	4.4%	4.2%	4.6%
Public administration	8.8%	9.5%	9.6%	8.2%	8.7%	8.8%	9.2%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: U.S. Census Bureau 2021c.

Table 3.11-5 At-Place Employment by Industry (2019)

Industry	Virginia	Chesapeake	Hampton	Newport News	Norfolk	Portsmouth	Virginia Beach
Agriculture, forestry, fishing	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Mining, quarrying, oil and gas	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Utilities	0.4%	0.1%	0.0%	0.1%	0.0%	0.1%	0.2%
Construction	5.6%	9.1%	4.4%	3.0%	3.6%	8.4%	6.7%
Manufacturing	7.0%	5.0%	4.9%	30.2%	6.4%	3.4%	3.8%
Wholesale trade	3.1%	4.2%	1.8%	2.3%	3.9%	2.3%	2.4%
Retail trade	12.5%	16.1%	15.4%	10.8%	10.7%	12.4%	15.3%
Transportation and warehousing	3.3%	4.8%	1.3%	1.6%	6.5%	7.0%	1.2%
Information	2.9%	2.5%	2.0%	1.9%	2.1%	0.5%	2.2%
Finance and insurance	4.8%	4.7%	2.1%	1.8%	4.1%	1.5%	7.4%
Real estate	1.6%	1.7%	1.8%	1.5%	3.3%	1.5%	3.4%
Professional services	14.3%	9.5%	12.2%	4.9%	10.4%	5.2%	9.7%
Management	2.4%	2.8%	0.3%	2.8%	2.4%	1.1%	1.6%
Administrative, business support, waste management	8.1%	9.1%	9.8%	6.7%	8.1%	8.7%	7.2%
Educational services	2.4%	1.7%	4.5%	1.2%	1.9%	0.8%	2.5%
Health care and social assistance	13.6%	10.6%	18.8%	17.0%	19.4%	28.3%	13.3%
Arts, entertainment, and recreation	1.9%	1.4%	1.3%	1.3%	1.4%	0.9%	2.3%
Accommodation and food services	10.8%	11.6%	14.7%	9.6%	11.1%	10.8%	16.0%
Other services (e.g., public administration)	5.0%	4.9%	4.4%	3.1%	4.3%	7.0%	4.8%
Industries not classified	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: U.S. Census Bureau 2021e.

3.11.1.1 Chesapeake and Virginia Beach

U.S. Census Bureau data indicate that over 70 percent of Virginia Beach's workforce resides in Virginia Beach and over 9 percent resides in both Chesapeake and Norfolk, suggesting significant economic linkages between the cities (COP, Section 4.4.1.1, Table 4.4-1; Dominion Energy 2023a). The population of Chesapeake grew over 9 percent from 2010 to 2019 while the population of Virginia Beach only grew about 3 percent. The share of Virginia's population in Chesapeake and Virginia Beach is roughly 8 percent. Median age in Chesapeake (36.9) and Virginia Beach (36.2) is slightly younger than Virginia as a whole (38.2 years) (Table 3.11-1).

Onshore recreational and tourism uses include beachgoing and other water borne activities, waterfront festivals, biking, freshwater fishing, and general use of open park spaces (COP, Section 4.4.5; Dominion Energy 2023a). Chesapeake is less dependent on tourism than Virginia Beach. The percentage of housing units for seasonal, recreational, or occasional use in Virginia Beach is 2.3 percent compared to less than 0.1 percent in Chesapeake (COP, Section 4.4.1.1; Table 4-4.3; Dominion Energy 2023a). Accommodation and food services comprises the largest employment by industry for Virginia Beach (16 percent) and retail services comprises the largest employment by industry for Chesapeake (16 percent) (Table 3.11-5).

3.11.1.2 Norfolk and Portsmouth

Norfolk and Portsmouth are key contributors to the Port of Virginia. From 2010 to 2019, Norfolk's population grew by 1.0 percent and Portsmouth's population decreased by 1.7 percent, while the population of Virginia grew by 7.8 percent (Table 3.11-1). Norfolk and Portsmouth's populations are much younger than Virginia's, 30.7 and 35.3, respectively. Compared to Virginia as a whole, Norfolk and Portsmouth have a higher portion of residents who work in health care and social assistance (19.4 percent and 28.3 percent) than Virginia (13.6 percent) (Table 3.11-5).

3.11.1.3 Hampton and Newport News

Across the inlet from Norfolk and Portsmouth are the cities of Hampton and Newport News. From 2010 to 2019, both Hampton and Newport News' population decreased by 2.9 and 1.2 percent, respectively, while Virginia grew by 7.8 percent (Table 3.11-1). Hampton and Newport News' populations are much younger than Virginia's median age of 38.2, 36.2, and 33.5, respectively. Compared to Virginia as a whole, Hampton and Newport News have a higher portion of residents who work in health care and social assistance (18.8 percent and 17 percent) than Virginia as a whole (13.6 percent) (Table 3.11-5).

3.11.2 Environmental Consequences

3.11.2.1 Impact Level Definitions for Demographics, Employment, and Economics

Definitions of impact levels are provided in Table 3.11-6.

Table 3.11-6 Impact Level Definitions for Demographics, Employment, and Economics

Impact Level	Impact Type	Definition
Negligible	Adverse	No impacts would occur, or impacts would be so small as to be unmeasurable.
	Beneficial	Either no effect or no measurable benefit.

Impact Level	Impact Type	Definition
Minor	Adverse	Impacts on the affected activity or geographic place would not disrupt the normal or routine functions of the affected activity or geographic place.
	Beneficial	Small but measurable benefit on demographics, employment, or economic activity.
Moderate	Adverse	The affected activity or geographic place would have to adjust somewhat to account for disruptions due to impacts of the Project.
	Beneficial	Notable and measurable benefit on demographics, employment, or economic activity.
Major	Adverse	The affected activity or geographic place would experience unavoidable disruptions to a degree beyond what is normally acceptable.
	Beneficial	Large local or notable regional benefit to the economy as a whole.

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

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

Impacts of the No Action Alternative Under the No Action Alternative, the baseline conditions demographics, employment, and economics of the geographic analysis area described in Section 3.11.1, *Description of the Affected Environment for Demographics,* would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Tourism, recreation, and marine industries (e.g., fishing) would continue to be important components of the regional economy. Ongoing non-offshore wind activities in the geographic analysis area that would contribute to impacts on demographics, employment, and economics include continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy. Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise (see Appendix F, Section F.2 for a description of ongoing and planned activities).

3.11.3.1 Cumulative Impacts of the No Action Alternative

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

Offshore wind could become a new industry for the Atlantic states and the nation. Although most offshore wind component manufacturing and installation capacity exists outside of the United States, some studies acknowledge that domestic capacity is poised to increase. This EIS uses available data, analysis, and projections to make informed conclusions on offshore wind's potential economic and employment impacts in the geographic analysis area.

The BVG Associates Limited (2017) study estimated that the percentage of jobs sourced in the United States during the initial implementation of offshore wind projects along the Northeast coast would range from 35 percent to 55 percent of jobs. As the offshore wind energy industry grows in the United States, this proportion of jobs would increase because of growth of a supply chain in the East Coast along with a growing number of maintenance and local operations jobs for established wind facilities. The proportion of jobs associated with offshore wind projected to be within the United States is approximately 65 to 75 percent from 2030 through 2056. Overseas manufacturers of components and specialized ships based overseas that are contracted for installation of foundations and WTGs would compose the rest of the jobs outside the United States (BVG Associates Limited 2017).

The American Wind Energy Association (AWEA) estimates that the offshore wind industry will invest between $80 and $106 billion in U.S. offshore wind development by 2030, of which $28 to $57 billion will be invested in the United States. This figure depends on installation levels and supply chain growth, as other investment would occur in countries manufacturing or assembling wind energy components for U.S.-based projects. While most economic and employment impacts would be concentrated in Atlantic coastal states where offshore wind development will occur—there are over $1.3 billion of announced domestic investments in wind energy manufacturing facilities, ports, and vessel construction—there would be nationwide effects as well (AWEA 2020). The AWEA report analyzes base and high scenarios for offshore wind direct impacts, turbine and supply chain impacts, and induced impacts. The base scenario assumes 20 gigawatts (GW) of offshore wind power by 2030 and domestic content increasing to 30 percent in 2025 and 50 percent in 2030. The high scenario assumes 30 GW of offshore wind power by 2030 and domestic content increasing to 40 percent in 2025 and 60 percent in 2030. Offshore wind energy development would support $14.2 billion in economic output and $7 billion in value added by 2030 under the base scenario. Offshore wind energy development would support $25.4 billion in economic output and $12.5 billion in value added under the high scenario. It is unclear where in the U.S. supply chain growth would occur.

The University of Delaware projects that offshore wind power will generate 30 GW along the Atlantic coast through 2030. This initiative would require capital expenditures of $100.1 billion by 2030 (University of Delaware 2021). Although the industry supply chain is global and foreign sources would be responsible for some expenditures, more U.S. suppliers are expected to enter the industry.

Compared to the $14.2 to $25.4 billion in offshore wind economic output (AWEA 2020), the 2020 annual GDP for states with offshore wind projects (Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Maryland, Virginia, and North Carolina) ranged from $60.6 billion in Rhode Island to $1.72 trillion in New York (U.S. Bureau of Economic Analysis 2021) and totaled nearly $4.3 trillion. The $14.2 to $25.4 billion in offshore wind industry output would represent 0.3 to 0.6 percent of the combined GDP of these states.

AWEA estimates that in 2030, offshore wind would support 45,500 (base scenario) to 82,500 (high scenario) full-time equivalent (FTE) jobs nationwide, including direct, supply chain, and induced jobs. Most offshore wind jobs (about 60 percent) would be created during the temporary construction phase while the remaining 40 percent would be long-term O&M jobs. The Responsible Offshore Development Alliance (RODA) in 2020 estimated that offshore wind projects would create 55,989 to 86,138 job through 2030 in construction and 5,003 to 6,994 long-term jobs in O&M (Georgetown Economic Services 2020). These estimates are generally consistent with the AWEA study in total jobs supported, although the RODA study concludes that a greater proportion of jobs would be in the construction phase. The two studies conclude that states hosting offshore wind projects would have more offshore wind energy jobs, while states with manufacturing and other supply chain activities may generate additional jobs.

In 2019, employment in Virginia was 4.1 million (Table 3.11-2). While the extent to which there would be impacts on the geographic analysis area is unclear due to the geographic versatility of offshore wind jobs, a substantial portion of the planned offshore wind projects in Virginia would likely be within commuting distance of ports in Hampton, Newport News, Norfolk, and Portsmouth for offshore wind staging, construction, and operations.

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

Energy generation and security: Once built, offshore wind energy projects could produce energy at long-term fixed costs. These projects could provide reliable prices once built compared to the volatility of fossil fuel prices. Kitty Hawk Offshore Wind North would consist of up to 69 WTGs and Kitty Hawk Offshore Wind South would have up to 121 WTGs; a total nameplate capacity has not yet been determined for the projects (Appendix F, Table F2-1). The economic impacts of future offshore wind activities (including associated energy storage and capacity projects) on energy generation and energy security cannot be quantified, but could be long term and beneficial.

Light: Offshore WTGs require aviation warning lighting that could have economic impacts on certain locations. Aviation hazard lighting from up to 190 WTGs and three OSSs could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions (Appendix F, Table F2-1). Visitors may make different decisions on coastal locations to visit, and potential residents may choose to select different residences because of nighttime views of lights on offshore wind energy structures. These lights would be incrementally added over the construction period and would be visible for the operating lives of future offshore wind activities. Distance from shore, topography, and atmospheric conditions would affect light visibility.

If implemented, an Aircraft Detection Lighting System would reduce the amount of time that WTG lighting is visible. Visibility would depend on distance from shore, topography, and atmospheric conditions. Such systems would likely reduce impacts on demographics, employment, and economics associated with lighting. Lighting for transit or construction could occur during nighttime transit or work activities. Vessel lights would be visible from coastal businesses, especially near the ports used to support offshore wind construction. However, vessel traffic is common along the Atlantic coast, and frequent ship traffic is especially common in the geographic analysis area (COP, Appendix I-1, Section I-1.5.5.1; Dominion Energy 2023a).

New cable emplacement and maintenance: Cable installation could temporarily cause commercial fishing vessels, static gear fishing vessels, and recreational vessels based in the geographic analysis area to relocate away from work areas and disrupt fish stocks, thereby potentially reducing income of commercial fishing vessels. Fishing vessels are not likely to access affected areas during active construction, as about 130,145[1] acres (52,667.8 hectares) of seafloor disturbance would occur associated with offshore cable and inter-array cable installation as a result of the Kitty Hawk Offshore Wind Projects (Appendix F, Table F2-2). In the long term, concrete mattresses covering cables in hard-bottom areas could hinder commercial trawlers and dredgers. Assuming similar installation procedures as under the Proposed Action, the duration and range of impacts would be limited, and the disturbance to marine species important to recreational fishing and sightseeing would recover following the disturbance. Impacts from onshore cable installation would depend on the specific location but could temporarily

[1] Kitty Hawk South has 3 export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Carolina) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-mile-wide corridor to Virginia and 1,000-mile-wide corridors to North Carolina to allow for optimal routing of the cables.

disrupt beaches and other recreational coastal areas. Disruptions may result in conflict over other fishing grounds, increased operating costs for vessels, and lower revenue. Seafood processing and wholesaling businesses could also experience short-term reductions in productivity.

Noise: Noise from O&M, pile driving, cable laying and trenching, and vessel traffic could result in temporary impacts on demographics, employment, and economics due to impacts on commercial/for-hire fishing businesses, recreational businesses, and marine sightseeing activities based in the geographic analysis area.

Assuming other offshore wind facilities generate vessel traffic similar to the Proposed Action vessel trips, construction of each offshore wind project would generate about 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods (Section 3.16, *Navigation and Vessel Traffic*). Noise from vessel traffic during the maintenance and construction phases could affect species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP, Section 4.2.5; Dominion Energy 2023a). This noise may also make these facilities less attractive to fishing operators and recreational boaters. Similarly, noise from pile driving from offshore wind activities would affect fish populations that are crucial to commercial fishing and marine recreational businesses (COP, Section 4.4.6.3; Dominion Energy 2023a). These impacts would be greater if multiple construction activities occur in close spatial and temporal proximity. An estimated 193 foundations (190 WTGs and three substations) would be installed in the North Carolina lease areas between 2024 and 2030 (Appendix F, Table F-3).

Onshore construction noise could possibly result in a short-term reduction of economic activity for businesses near installation sites for onshore cables or substations, temporarily inconveniencing workers, residents, and visitors. Noise would have intermittent and short-term impacts on demographics, employment, and economics.

Port utilization: Offshore wind installation would require port facilities for berthing, staging, and loadout. Development activities would bolster port investment and employment while also supporting jobs and businesses in supporting industries. Future offshore wind development would also support planned expansions and modifications at ports in the geographic analysis area, including the PMT. While simultaneous construction or decommissioning (and, to a lesser degree, operation) activities for multiple offshore wind projects in the geographic analysis area could stress port capacity, it would also generate considerable economic activity and benefit the regional economy and infrastructure investment.

Port utilization would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity. Improvements to existing ports and channels would be beneficial to other port activity. Port utilization in the geographic analysis area would occur primarily during development and construction projects, anticipated to occur primarily between 2026 and 2028. Ongoing O&M activities would sustain port activity and employment at a lower level after construction.

Offshore wind activities and associated port investment and usage would have long-term, beneficial impacts on employment and economic activity by providing employment and industries, such as marine construction, ship construction and servicing, and related manufacturing. The greatest benefits would occur during offshore wind project construction between 2026 and 2028. If offshore wind construction results in competition for scarce berthing space and port service, port usage could have short- to medium-term adverse impacts on commercial shipping.

Presence of structures: The presence of up to 190 WTGs, hard cover for scour and cable protection, and up to 81 acres (32.7 hectares) of hard coverage (Appendix F, Table F2-2) would increase the risk of gear loss connected with cable mattresses and structures along the East Coast. These offshore facilities would also pose allision and height hazard risks, creating obstructions and navigational complexity for marine vessels, which would impose fuel costs, time, and risk and require adequate technological aids and trained personnel for safe navigation (Appendix F, Table F2-1 and Table F2-2). In the event of an allision, vessel damage and spills could result in both direct and indirect costs for commercial/for-hire recreational fishing.

WTGs could encourage fish aggregation and generate reef effects that attract recreational fishing vessels from the geographic analysis area (COP, Section 4.4.6.3; Dominion Energy 2023a). Fish aggregation could increase human fishing activities, but this attraction would likely be limited to recreational fishing vessels that already travel as far from the shore as the wind energy facilities. Fish aggregation could potentially result in increases to recreational fishing activities if these effects are widespread enough to encourage more participants to travel farther from shore.

The offshore wind structures could attract various wildlife and consequently increase the number of vessels conducting ecotourism trips from the geographic analysis area. As a result, the presence of the offshore wind structures could increase economic activity associated with ecotourism.

As a result of fish aggregation and reef effects associated with the presence of offshore wind structures, there would be long-term impacts on commercial fishing operations and support businesses, such as seafood processing. The fishing industry is expected to be able to adapt its fishing practices over time in response to these changes. These effects could simultaneously provide new business opportunities, such as fishing and tourism. Overall, the presence of offshore wind structures would have continuous, long-term impacts on demographics, employment, and economics.

Vessel traffic: Offshore wind construction and decommissioning and, to a lesser extent, offshore wind operations would generate increased vessel traffic. This additional traffic would support increased employment and economic activity for marine transportation and supporting businesses and investment in ports. Assuming other offshore wind facilities generate vessel traffic similar to the projected Proposed Action vessel trips, construction of each offshore wind project would generate about 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods (Section 3.16, *Navigation and Vessel Traffic*). Construction of two future offshore wind projects could occur in the Virginia and North Carolina lease areas between 2024 and 2027, with a maximum of three projects under construction concurrently (Appendix F, Table F2-1; Dominion Energy 2023b). Increased vessel traffic would have continuous, beneficial impacts during all project phases, with stronger impacts during construction and decommissioning.

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

Vessel traffic would occur among ports (outside the demographics, employment, and economic geographic analysis area) and offshore wind work areas. COP, Section 3.4.1.5, Table 3.4-5 (Dominion Energy 2023a) summarizes the anticipated Project-related vessel traffic during construction of the Proposed Action. Construction vessel trips will likely originate or terminate at Portsmouth, Virginia.

Land disturbance: Land disturbance could result in localized, temporary disturbances of businesses near cable routes and construction sites for substations and other electrical infrastructure, due to typical construction impacts such as increased noise, traffic, and road disturbances. These impacts would be similar in character and duration to other common construction projects, such as utility installations, road repairs, and industrial site construction. Impacts on employment would be localized, temporary, and both beneficial (jobs and revenues to local businesses that participate in onshore construction) and adverse (lost revenue due to construction disturbances).

Climate change: Climate change could affect demographics, employment, and economics in the geographic analysis area. 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 marine species. There would likely be a net reduction in GHG emissions, which contribute to climate change, and no collective adverse impact on climate change as a result of offshore wind projects.

3.11.3.2 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, the geographic analysis area would continue to be influenced by regional demographic and economic trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on demographics, employment, and economics. Future non-offshore wind activities, and future offshore wind activities would continue to sustain and support economic activity and growth in the geographic analysis area based on anticipated population growth and ongoing development of businesses and industry. Tourism and recreation would continue to be important to the economies of the coastal areas, especially in Newport News and Virginia Beach. Marine industries, such as commercial fishing and shipping, would continue to be active and important components of the regional economy. Counties in the geographic analysis area would continue to seek to diversify their economies—including maintaining or increasing their year-round population—and protect environmental resources.

BOEM anticipates that ongoing activities in the geographic analysis area (continued commercial shipping and commercial fishing; ongoing port maintenance and upgrades; periodic channel dredging; maintenance of piers, pilings, seawalls, and buoys; and the use of small-scale, onshore renewable energy) would have **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics. Planned activities for coastal and marine activity, other than offshore wind, include development of diversified, small-scale, onshore renewable energy sources; ongoing onshore development at or near current rates; continued increases in the size of commercial vessels; potential port expansion and channel-deepening activities; and efforts to protect against potential increased storm damage and sea level rise. BOEM anticipates that there would be **minor** adverse and **minor beneficial** impacts on demographics, employment, and economics from these planned activities. BOEM expects the combination of ongoing and planned non-offshore wind activities to result in **minor** adverse impacts and **minor beneficial** impacts on ocean-based employment and economics, driven primarily by the continued operation of existing marine industries, especially commercial fishing, recreation/tourism, and shipping; increased pressure for environmental protection of coastal resources; the need for port maintenance and upgrades; and the risks of storm damage and sea level rise. Increased investment in land and marine ports, shipping, and logistics capability is expected to result along with component laydown and assembly facilities, job training, and other services and infrastructure necessary for offshore wind construction and operations. Additional manufacturing and servicing businesses would result either in the geographic analysis area or other locations in the United States if supply chains develop as expected. While it is not possible to estimate the extent of job growth and economic output in the geographic analysis area specifically, there would be notable and measurable benefits to employment, economic output, infrastructure improvements, and community services, especially job training, because of offshore wind development.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and demographics, employment, and economics would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on demographics, employment, and economics, due to increased onshore and offshore construction and operations. Many of the jobs generated by offshore wind projects are temporary construction jobs. The combination of these jobs over multiple activities and projects will create notable benefits during the construction phases of these projects. This will particularly be the case as the domestic supply chain for offshore wind evolves over time. Offshore wind projects also support long-term O&M jobs (25 to 35 years); long-term tax revenues; long-term economic benefits of improved ports and other industrial land areas; diversification of marine industries, especially in areas currently dominated by recreation and tourism; and growth in a skilled marine construction workforce. Therefore, BOEM anticipates that there would be overall **minor beneficial** impacts from future offshore wind activities in the geographic analysis area, combined with ongoing activities and planned activities other than offshore wind.

BOEM also anticipates **minor** adverse impacts associated with future offshore wind activities combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind. Future offshore wind activities are expected to affect commercial and for-hire fishing businesses and marine recreational businesses (tour boats, marine suppliers) primarily through cable emplacement, noise and vessel traffic during construction, and the presence of offshore structures during operations. These IPFs would temporarily disturb marine species and displace commercial or for-hire fishing vessels, which could cause conflicts over other fishing grounds, increased operating costs, and lower revenue for marine industries and supporting businesses. The long-term presence of offshore wind structures would also lead to increased navigational constraints and risks and potential gear entanglement and loss.

3.11.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following PDE parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on demographics, employment, or economics.

- The extent to which Dominion Energy hires local residents and obtains supplies and services from local vendors.
- The port(s) selected to support construction, installation, and decommissioning and the port(s) selected to support O&M.
- The design parameters that could affect commercial fishing and recreation and tourism because impacts on these activities affect employment and economic activity.

The size of the proposed Project would affect the overall investment and economic impacts; fewer WTGs would mean less materials purchased, fewer vessels, and less labor and equipment required. Beneficial economic impacts in the geographic analysis area would depend on the proportion of workers, materials, vessels, equipment, and services that could be locally sourced and the specific ports used by the Project.

3.11.5 Impacts of the Proposed Action on Demographics, Employment, and Economics

Within the SMR, the Onshore Export Cable Route Corridor crosses under Lake Christine via HDD, which also serves as a fishing and boating area. In addition to the above-mentioned resources, there are two elementary schools near the General Booth Boulevard and South Birdneck Road intersection, which have athletic fields and passive open space on their properties. A public bikeway/trail also travels along the

Onshore Export Cable Route Corridor on Oceana Boulevard (COP, Section 4.4.5; Dominion Energy 2023a).

The Proposed Actions beneficial impacts on demographics, employment, and economics depend on what proportion of workers, materials, vessels, equipment, and services can be locally sourced. In a study conducted by BW Research Partnership on behalf of E2, a national, nonpartisan group of advocates for policies that benefit both the economy and environment, every $1.00 spent building an offshore wind farm is estimated to generate $1.73 for Virginia's economy (E2 2018).

Dominion Energy's economic impact study estimates that the Proposed Action, through $8 billion of direct investment from Dominion Energy and up to a $40 million contribution from the State of Virginia for site improvement and readiness at the PMT, would support about 900 direct, indirect, and induced Virginia jobs[2] annually (about 60 percent in Hampton Roads), from 2020 through the end of 2026. Beginning in 2027, once construction is completed, it is estimated that O&M of the PMT facility would support 200 direct FTE jobs and 910 indirect and induced jobs annually in Hampton Roads over the 33-year operational life for the Proposed Action (COP, Figure 4.4-4, Table 4.4-7, Appendix EE-1, and Section 3.6; Dominion Energy 2023a).

The Proposed Action would generate employment during construction and installation, O&M, and decommissioning of the Project. The Proposed Action would support a range of positions for professionals such as engineers, environmental scientists, and financial analysts; administrative personnel; trade workers such as electricians, technicians, steel workers, welders, and ship workers; and other construction jobs during construction and installation. O&M would create jobs for maintenance crews, substation and turbine technicians, and other support roles. The decommissioning phase would also generate professional and trade jobs and support roles. Therefore, all phases of the Proposed Action would lead increases in local employment and economic activity.

Assuming that market conditions would be similar to those of the Massachusetts Vineyard Wind Project, job compensation (including benefits) is estimated to average between $88,000 and $96,000 for the construction phase, with occupations including engineers, construction managers, trade workers, and construction technicians. O&M occupations would consist of turbine technicians, plant managers, water transportation workers, and engineers, with average annual compensation of approximately $99,000 (BOEM 2021). A study from the New York Workforce Development Institute provided salary estimates for jobs in the wind energy industry that concur with the Vineyard Wind Project's projections. The expected salary range for trade workers and technicians ranges from $43,000 to $96,000, $65,000 to $73,000 for ships' crew and officers, and $64,000 to $150,000 for managers and engineers (Gould and Cresswell 2017).

Hiring local workers would stimulate economic activity through increased demand on housing, food, transportation, entertainment, and other goods and services. A large number of seasonal housing units are available in the vicinity of the Project. During the summer, competition for temporary accommodations may arise, leading to higher rents. However, this effect would be temporary during the active construction period and could be reduced if construction is scheduled outside the busy summer season. Permanent workers are expected to reside locally; there is adequate housing supply to accommodate the increase in the local workforce (COP, Section 4.4.1.2; Dominion Energy 2023a).Tax revenues for state and local governments would increase as a result of the proposed Project. Equipment, fuel, and some construction materials would likely be purchased from local or regional vendors. These purchases would result in short-term impacts on local businesses by generating additional revenues and contributing to the tax base.

[2] Direct employment refers to jobs created by the direct hiring of workers. Indirect employment refers to jobs created through increased demand for materials, equipment, and services. Induced employment refers to jobs created at businesses where offshore wind industry workers would spend their incomes.

Dominion Energy's economic impact study estimated total state and local taxes generated would be $41.7 million during construction and $10.6 million annually during operations (COP, Section 4.4.1.2; Dominion Energy 2023a). Once the proposed Project is operational, property taxes would be assessed on the value of the Dominion Wind facilities. The increased tax base during operations would be a long-term, beneficial impact on local governments in the Project area.

Additionally, Dominion Energy has stated that in September 2021, it signed a Memorandum of Understanding (MOU) with the North America's Building Trades Unions and its state affiliate to identify opportunities to use union labor. Since the Project would require skilled and qualified workers in Hampton Roads, the MOU also includes commitments to using local workers; the hiring, apprenticeship, and training of veterans; and using workers from historically economically disadvantaged communities. These commitments were included in the MOU because Dominion Energy is working to satisfy the provisions of the Virginia Clean Economy Act, which calls for the priority hiring of veterans, local workers, and individuals from economically disadvantaged communities. To meet these requirements, Dominion Energy has met with hundreds of businesses, chambers of commerce, minority serving institutions, workers, educational institutions and students. In addition, the company has hosted and will continue to host local events and open houses specific to potential business suppliers and workers to learn about working in the offshore wind industry. Through these efforts, Dominion Energy is in the process of establishing a Project Labor Agreement with North America's Building Trades Union in collaboration with DEME and Siemens Gamesa Renewable Energy. Dominion Energy does not currently have any Community Workforce Agreements in place (Dominion Energy 2023b).

The reasonably foreseeable environmental trends and impacts of the Proposed Action in addition to ongoing activities, future non-offshore wind activities, and future offshore wind activities are described by IPF below.

Energy generation and security: The Proposed Action would produce up to 3,000 MW of electricity, or 7.5 percent of the estimated 40,201 MW of reasonably foreseeable offshore wind generation potential for the East Coast (Appendix E, Table E-2) (Appendix F, Table F2-1); 5,496 MW of this capacity is estimated to occur in the Virginia and North Carolina offshore areas (Appendix F, Table F2-1). Offshore wind energy projects could produce energy at long-term fixed costs, which could provide stability against fossil fuel price volatility, once built. Therefore, the Proposed Action would provide long-term beneficial contributions to energy security and resilience through a stable supply of energy. Impacts related to energy generation and security would have long-term, regional, and minor beneficial impacts on demographics, employment, and economics.

Light: Both onshore and offshore structures emit light that could be visible from some beaches, coastlines, and elevated inland areas, depending on vegetation, topography, weather, and atmospheric conditions. Dominion Energy is committed to using ADLS to automatically turn the aviation obstruction lights on and off in response to the presence of aircraft in proximity to the wind farm. Such a system may reduce the amount of time that the lights are on, thereby potentially minimizing the visibility of the WTGs from shore and related effects on the local economy. Impacts related to structure lighting would have localized, long-term, and negligible impacts on demographics, employment, and economics.

Lighting from vessels would occur during nighttime Project construction or maintenance or during transit to/from the ports. This lighting would be visible from coastal businesses, but is not anticipated to discourage tourist-related activities and would not affect other businesses; therefore, the impact of vessel lighting would be short term and negligible.

Between 2025 and 2028, there may be three offshore wind projects in the Virginia and North Carolina lease areas, including as many as two projects under construction concurrently from 2025 through 2030 (CVOW-C and the Kitty Hawk Offshore Wind Projects) (Appendix F, Table F2-1; Dominion Energy

2023a). WTG lighting in future offshore wind activities would be visible from the same locations as the Proposed Action in addition to Virginia coastal locations.

New cable emplacement and maintenance: The Proposed Action cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism, with potential adverse effects on employment and income. Construction vessel trips would average 46 trips per day through the duration of construction activities (2023–2027). Daily estimated vessel trips would be dependent on the construction period and activity but are anticipated to range from a minimum of 3 trips per day to a maximum of 95 trips per day. Operation and maintenance activities are anticipated to consist of 26 annual round tips to port for service operation vessels and each crew transfer vessel (COP, Section 3.4.1.5 and Section 3.5.1; Dominion Energy 2023a).

The approximate 6,036.6 acres (2,443.7 hectares) of seafloor disturbance (COP, Section 3.4.1.4, Table 3.4-4; Dominion Energy 2023a) could hinder commercial trawlers/dredgers, potentially reducing income and increasing costs for affected businesses over the long term. Cable installation would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of new cables and other existing submarine cables would have intermittent, long-term, negligible impacts under the Proposed Action.

Noise: Vessel noise traffic would indirectly affect commercial fishing businesses and recreational businesses due to impacts on species important to commercial/for-hire fishing, recreational fishing, and marine sightseeing activities (COP, Section 4.4.11.2; Dominion Energy 2023a). Noise from O&M activities would have localized, intermittent, long-term, negligible impacts on demographics, employment, and economics. Vessel noise could affect marine species relied upon by commercial fishing businesses, marine recreational businesses, recreational boaters, and marine sightseeing activities. The number of vessels in the Offshore Project area is expected to temporarily increase during construction of the Project. Project-related vessels would use existing transit lanes and fairways, as required, while in transit (COP, Section 4.4.6.3; Dominion Energy 2023a). Noise from vessels would have short-term, intermittent, negligible impacts on demographics, employment, and economics.

The estimated 202 foundations (WTGs and substations) related to the Proposed Action would generate noise from pile driving, one of the most impactful noises on marine species, especially if multiple project construction activities occur in spatial and temporal proximity to the proposed Project (COP, Section 4.1.5.3, Dominion Energy 2023a). These disturbances would be temporary and localized and would extend only a short distance beyond the work area. Pile driving and associated noise would have localized, short-term, and minor impacts on demographics, employment, and economics. Infrequent trenching, cable-laying activities, and construction activities of onshore components would emit noise. This noise could temporarily disrupt commercial fishing, marine recreational businesses, and onshore recreational businesses and residences. Noise from trenching and trenchless technology would affect marine life populations, which would, in turn, affect commercial and recreational fishing businesses. Cable laying and trenching would have localized, intermittent, short-term, and negligible impacts on demographics, employment, and economics.

The Proposed Action is anticipated to overlap in time with construction of the Kitty Hawk Offshore Wind North Project (Appendix F, Table F2-1). While operational activity would overlap, indirect noise impacts during operations would be far less than during construction.

Port utilization: The Proposed Action would support port investment and employment and would also support jobs and businesses in supporting industries and commerce in the geographic analysis area. The Proposed Action would use facilities at the PMT as a construction management, O&M, and cable-staging base (COP, Sections 3.2 and 3.5; Dominion Energy 2023a). The port would require a trained workforce for the offshore wind industry including additional shore-based and marine workers that would contribute to local and regional economic activity.

The economic benefits would be greatest during construction when the most jobs and most economic activity at ports supporting the Proposed Action would occur. During operations, activities would be concentrated in the Hampton Roads, Virginia Region where the proposed Project's onshore O&M facility would be located; Dominion Energy's selected lease location for the O&M facility is Lambert's Point, now named Fairwinds Landing, in Norfolk, Virginia (COP, Section 3.5; Dominion Energy 2023a). Dominion Energy estimated that 200 permanent jobs would support operations in Virginia (COP, Section 4.4.1.2; Dominion Energy). The O&M facility would help diversify the local economy by providing a source of skilled, year-round jobs. Overall, operation of the Proposed Action would generate 3,756 job-years of skilled permanent labor (direct job-years) and 6,360 total job-years created (direct job-years plus indirect and induced job creation) (COP, Section 4.4.1.2; Dominion Energy 2023a). The Proposed Action would have a minor beneficial impact on demographics, employment, and economics due to greater economic activity and increased employment at ports used by the proposed Project.

Other offshore wind energy activities would provide business activities at the same ports as the proposed Project, as well as other ports in the geographic analysis area. Port investments are ongoing and planned in response to offshore wind activity. Maintenance and dredging of shipping channels are expected to increase, which would benefit other port users.

Presence of structures: The Proposed Action would add up to 202 offshore wind structures that could affect marine-based businesses (i.e., commercial and for-hire recreational fishing businesses, offshore recreational businesses, and related businesses) through impacts such as entanglement and gear loss/damage, navigational hazard and risk of allisions, fish aggregation, habitat alteration, and conflicting use of space. These structures may cause vessel operators to reroute, which would affect fuel costs, operating time, and revenue. Due to the risk of gear entanglement, fisheries using bottom gear may be permanently disrupted, which would increase economic impacts on the commercial and for-hire recreational fishing industries. This would have continuous, long-term, and minor impacts on demographics, employment, and economics.

Offshore wind structures could encourage fish aggregation and generate reef effects that attract recreational fishing vessels capable of reaching the offshore wind energy facilities. This would have long-term, negligible benefits on demographics, employment, and economics. The proposed Project structures could increase economic activity associated with offshore sightseeing because these structures create foraging opportunities for harbor and gray seals, sea turtles, bats, northern gannets, loons, and peregrine falcons. These forms of marine life could attract private or commercial recreational sightseeing vessels (COP, Section 4.4.2.2; Dominion Energy 2023a). This would have long-term, negligible beneficial impacts on demographics, employment, and economics.

Views of WTGs could have impacts on businesses serving the recreation and tourism industry. It is expected that the presence of WTGs in the Offshore Project area may change marine recreational usage; however, some of these impacts may be beneficial because WTGs have served as tourism and recreational fishing destinations in other regions, which can lead to opportunities for tours and chartered trips (COP, Section 4.4.5.2; Dominion Energy 2023a). Portions of the WTGs and substations are expected to have limited visibility from onshore viewpoints based on location of WTGs, curvature of the earth, topography, wave height, and atmospheric conditions (COP, Section 4.3.4.2 and 4.3.4.3; Dominion Energy 2023a). These structures would be visible to recreational boaters who could avoid waters where structures are visible. This would have continuous, long-term, negligible impacts on demographics, employment, and economics.

Across the Virginia and North Carolina lease areas, up to 403 offshore structures, including those of the Proposed Action, would affect employment and economics by affecting marine-based businesses (Appendix F, Table F2-2). The presence of these structures would have both beneficial impacts, such as providing sightseeing opportunities and fish aggregation that benefit recreational businesses, and adverse effects, such as causing fishing gear loss, navigational hazards, and viewshed impacts that could affect business operations and income.

Traffic: The Proposed Action would generate vessel traffic in the Project area and to and from the ports supporting Project construction, O&M, and decommissioning. Dominion Energy estimates that construction activity would generate 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods. During operations, the Proposed Action would generate approximately 52 annual round trip vessel trips to port (refer to Section 3.16, *Navigation and Vessel Traffic*, for additional information regarding anticipated vessel traffic). Increased vessel traffic would increase the use of port and marine businesses, including tug services, dockage, fueling, inspection/repairs, and provisioning. Vessel traffic generated by the Proposed Action alone would result in increased business for marine transportation and supporting services in the geographic analysis area with continuous, short-term, and minor beneficial impacts during construction and decommissioning, and negligible beneficial impacts during operations. Vessel traffic associated with the Proposed Action could also result in temporary, periodic congestion within and near ports, leading to potential delays and an increased risk for collisions between vessels, which would result in economic costs for vessel owners. There may also be roadway traffic impacts such as lane closures, shifted traffic patterns, or closed roadways with temporary detours. Traffic impacts would be limited to the immediate construction vicinity. After construction, roadways would be returned to pre-construction conditions. Dominion would also implement a Traffic Management Plan to offset any traffic-related impacts (COP, Section 4.4.4.2; Dominion Energy 2023a). As a result of potential delays from increased congestion and increased risk of damage from collisions, and the impacts from vehicle related traffic, the Proposed Action or would have continuous, short-term, and minor impacts during construction and negligible impacts during operations.

Land disturbance: Construction of the Proposed Action would require onshore cable installation and substation construction. The employment and economic impact of the Proposed Action caused by disturbance of businesses near the onshore cable route and substation construction site would result in localized, short-term, minor impacts. The extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for future offshore wind energy projects.

Climate change: Climate models predict climate change if current trends continue. Climate change has adverse implications for demographics and economic health of coastal communities due, in part, to the costs of resultant damage to property and infrastructure, fisheries, and other natural resources, among other factors. It is anticipated that there would be a net reduction in GHG emissions, which contribute to climate change, and no collective adverse impact on climate change as a result of offshore wind projects. To the degree that offshore wind facilities contribute to the overall effort to limit climate change, these projects would reduce the socioeconomic impacts associated with the effects of climate change. The Proposed Action would have long-term, negligible beneficial impacts on demographics, employment, and economics from this IPF due to the anticipated carbon dioxide reductions resulting from the displacement of electricity generated from fossil fuel-powered plants. Future offshore wind activities would have similar contributions as the Proposed Action but at a larger scale.

3.11.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

In context of reasonably foreseeable environmental trends, the Proposed Action would contribute to lighting impacts from ongoing and planned activities, but the impacts on demographics, employment, and economics are anticipated to be negligible.

In context of reasonably foreseeable trends, the new cable emplacement and cable maintenance when combined with ongoing and planned activities would have localized, short-term, minor impacts on demographics, employment, and economics, while maintenance of new cables and other existing submarine cables would have intermittent, long-term, negligible impacts.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action would contribute a noticeable increment to the combined noise impacts on demographics, employment, and economics from ongoing and planned activities including offshore wind, which would be short term and negligible.

In context of reasonably foreseeable environmental trends, the Proposed Action and other ongoing and planned activities would have combined long-term, minor beneficial impacts on demographics, employment, and economics resulting from port utilization and the associated trained and skilled offshore wind workforce that would contribute to localized increases in economic activity and the region as a whole.

In context of reasonably foreseeable environmental trends, the Proposed Action and other ongoing and planned activities would have a long-term, minor impact on demographics, employment, and economics, due to impacts on commercial and for-hire recreational fishing, for-hire recreational boating, and associated businesses.

In context of reasonably foreseeable environmental trends, increased vessel traffic from the Proposed Action and other ongoing and planned activities would produce demand for supporting marine services, with beneficial impacts on employment and economics during all Project phases, including minor beneficial impacts during construction and decommissioning and negligible beneficial impacts during operations. In context of reasonably foreseeable environmental trends, increased vessel traffic congestion and collision risk from the Proposed Action and other ongoing and planned activities would have long-term, continuous impacts on marine businesses during all Project phases, with minor impacts during construction and decommissioning and negligible impacts during operations.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined land disturbance impacts on demographics, employment, and economics from ongoing and planned activities would be short term and minor due to the short-term and localized disruption of onshore businesses.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts from ongoing and planned activities would have a long-term, minor benefit.

3.11.5.2 Conclusions

Impacts of the Proposed Action. BOEM anticipates that the Proposed Action would have **negligible** impacts on demographics in the geographic analysis area. While it is likely that some workers would relocate to the area due to the proposed Project, this volume of workers would not be substantial compared to the current population and housing supply.

The Proposed Action would affect employment and economics through job creation, expenditures on local businesses, tax revenues, grant funds, and support for additional regional offshore wind development, which would have **minor beneficial** impacts. Construction would have a **minor beneficial** impact on employment and economics due to jobs and revenue creation during the construction period.

The beneficial impact of employment and expenditures during O&M would have a modest magnitude over the 37-year duration of the proposed Project (4 years of construction and commissioning, and a 33-year Project lifespan). Although tax revenues and grant funds would be modest in magnitude, they also would provide a beneficial impact on public expenditures and local workforce and supply chain development for offshore wind. The impacts on demographics, employment, and economics from decommissioning would be short term, **minor,** and **beneficial** due to the construction activity necessary to remove wind facility structures and equipment. After decommissioning, the Proposed Action would no longer affect employment or produce other offshore wind-related revenues.

While the proposed Project investments in wind energy would largely benefit the local and regional economies through job creation, workforce development, and income and tax revenue, adverse impacts on individual businesses and communities would also occur. Short-term increases in noise during construction, cable emplacement, land disturbance, and the long-term presence of offshore lighting and structures would have **negligible** to **minor** adverse impacts on demographics, employment, and economics. The commercial fishing industry and other businesses that depend on local seafood production would experience impacts during construction. Overall, the impacts on commercial fishing and onshore seafood businesses would have **minor** impacts on demographics, employment, and economics for this component of the geographic analysis area's economy. Although commercial fishing is a small component of the regional economy, it is important to the identity of local communities in the region. The IPFs associated with the Proposed Action alone would also result in impacts on certain recreation and tourism businesses that range from **negligible** to **minor**, with an overall **minor** impact on employment and economic activity for this component of the geographic analysis area's economy.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts. Overall, BOEM anticipates that the Proposed Action and ongoing and planned activities would result in **minor** adverse impacts and **moderate beneficial** impacts on demographics, employment, and economics in the geographic analysis area. The **moderate beneficial** impacts primarily would be associated with the investment in offshore wind, job creation and workforce development, income and tax revenue, and infrastructure improvements, while the **minor** adverse effects would result from aviation hazard lighting on WTGs, new cable emplacement and maintenance, the presence of structures, vessel traffic and collisions during construction, and land disturbance. Impacts on commercial and for-hire recreational fishing are anticipated to be **minor**. Because they are not expected to disrupt normal demographic, employment, and economic trends, overall impacts in the geographic analysis area likely would be **minor**. In addition, in context of reasonably foreseeable environmental trends, the Proposed Action and ongoing and planned activities would have a notable and measurable benefit from construction and operations employment and would have **minor beneficial** impacts on demographics, employment, and economics.

3.11.6 Impacts of Alternative B on Demographics, Employment, and Economics

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, which is described in this section.

Impacts of Alternative B. Alternative B would result in a slight reduction in both adverse and beneficial impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitudes would be the same. Alternative B would construct 29 fewer WTGs and fewer associated inter-array cables than the Proposed Action. Alternative B would also use only 14 MW turbines (up to 14.7 MW each using power boost capability), resulting in a total Project capacity of approximately 2,587 MW; a reduction of 413 MW in total power-generating output compared to the Proposed Action. As a result, Alternative B would slightly reduce the offshore construction impact footprint and installation period. Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which would reduce impacts on commercial and for-hire recreational fishing. Because Alternative B would produce less energy, it would also offset fewer GHG emissions from fossil-fueled power generation compared to the Proposed Action, further reducing beneficial impacts. A reduced number of WTGs would slightly reduce port utilization and reduce expenditures, generating less economic activity at ports in general. However, the change in these impacts would not alter the overall impact rating compared to the Proposed Action.

This reduction in number and size of WTGs would also slightly reduce visual and light impacts from shore when compared to the Proposed Action, thereby reducing potential impacts on the tourism, recreation, and real estate businesses that are sensitive to viewshed impacts from WTGs. However, because most of the WTGs would still be visible, localized, long-term, minor impacts are still anticipated. Fewer WTGs and the avoidance of the Fish Haven area in the northern portion of the lease area could reduce reef effects and fish aggregation compared to the Proposed Action but are anticipated to reduce potential displacement of mobile target species from construction noise and the presence of structures. The reduction in WTGs would also reduce the impact of new cable emplacement and maintenance by requiring fewer worksites, slightly reducing the short-term disturbance to species important to recreation and tourism. However, because most of the WTGs would still be built, intermittent, long-term, negligible impacts are still anticipated. Fewer WTGs would reduce the risk of allisions and the need for vessels to reroute, which would reduce travel time, fuel costs, and other associated costs.

Cumulative impacts of Alternative B. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative B to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.6.1 Conclusions

Impacts of Alternative B. Alternative B would reduce the overall offshore footprint of the Project. The impacts resulting from individual IPFs associated with Alternative B would result in slightly lower adverse impacts and slightly lower beneficial impacts compared to the Proposed Action, but would not change the overall impact magnitudes, which are anticipated to range from **negligible** to **minor** adverse impacts and **minor beneficial** impacts on demographics, employment, and economics.

Cumulative impacts of Alternative B. In context of reasonably foreseeable environmental trends, the contribution of Alternative B to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts.

3.11.7 Impacts of Alternative C on Demographics, Employment, and Economics

Impacts of Alternative C. Alternative C would install 33 fewer WTGs and associated inter-array cables, which would slightly reduce the construction impact footprint and installation period. Alternative C could potentially reduce localized impacts on marine species that local commercial/for-hire and recreational fishing use for seafood production compared to the Proposed Action, but the overall impact magnitudes would not change. Alternative C would reduce impacts in priority sand ridge habitats, resulting in fewer impacts on species dependent on those habitat types while also reducing the potential for commercial fishing and recreational vessel allisions in the southern portion of the lease area. In addition, reduced underwater noise from pile driving and vessels during construction activities, and reduced habitat alteration, vessel strikes, artificial lighting, and decommissioning activities, would lessen the potential for displacement of marine species and associated impacts on commercial and recreational vessels.

Construction of fewer WTGs would result in a shorter duration of noise impacts and less vessel traffic, which could reduce impacts on commercial and for-hire recreational fishing. The reduced number of WTGs would also mean that the Project would generate less energy—with the removal of 33 WTGs, Alternative C would result in an expected total power output of 2,528 MW compared to 3,000 MW under the Proposed Action—and would therefore result in slightly lower beneficial impacts associated with delivering a reliable supply of energy and reduced GHG emissions from offsetting fossil-fueled power generation. A reduced number of WTGs would also generate less economic activity, which would reduce port utilization and result in lower expenditures in general. However, the change in these impacts would all be slight and would not alter the overall impact rating compared to the Proposed Action.

Cumulative impacts of Alternative C. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative C to the impacts from ongoing and planned activities including offshore wind would be similar to those described under the Proposed Action.

3.11.7.1 Conclusions

Impacts of Alternative C. Alternative C would result in slightly reduced impacts on demographics, employment, and economics compared to the Proposed Action, but the overall impact magnitude would not change. The removal of 33 WTGs under Alternative C would result in fewer impacts on marine species and, by extension, fewer impacts on commercial and for-hire recreational fisheries. Energy generation and associated beneficial impacts would be reduced under Alternative C because there would be fewer WTGs. Impacts under Alternative C are anticipated to be short term and range from **negligible** to **minor** adverse impacts and **minor beneficial** on demographics, employment, and economics.

Cumulative impacts of Alternative C. In context of reasonably foreseeable environmental trends, the impacts resulting from individual IPFs would be the same as those of the Proposed Action: **minor** adverse impacts and **moderate beneficial** impacts. Considering all the IPFs together, BOEM anticipates that the overall impacts on demographics, employment, and economics associated with Alternative C when combined with the impacts from ongoing and planned activities including offshore wind would be **negligible** to **minor** adverse and **negligible** to **moderate beneficial**.

3.11.8 Impacts of Alternative D on Demographics, Employment, and Economics

Impacts of Alternative D. The impacts of Alternative D on demographics, employment, and economics would be similar to those of the Proposed Action. Alternative D would have the same offshore layout of Project components and number of WTGs; however, Alternative D would consider two onshore interconnection cable route options. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). The overall length of Alternative D-1 or Alternative D-2 would be the same (14.3 miles [23.0 kilometers]). However, portions of Alternative D-2 would be installed via underground methods, while portions of Alternative D-1 would be installed entirely overhead. Overall, BOEM anticipates land disturbance and visual impacts on onshore businesses and residents from interconnection cable construction and operation under Alternative D to be the same as the Proposed Action.

The impacts on demographics, employment, and employment of Alternative D and the Proposed Action would be substantively the same, and the overall impact magnitude would not change. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the incremental impacts contributed by Alternative D to the impacts from ongoing and planned activities including offshore wind would be the same as those described under the Proposed Action.

3.11.8.1 Conclusions

Impacts of Alternative D. Alternative D would result in the same impacts on demographics, employment, and economics as the Proposed Action. All offshore components under Alternative D and the associated beneficial impacts from energy generation would be the same as described for the Proposed Action. While Alternative D could reduce impacts on sensitive onshore habitats, including wetlands, when compared to the Proposed Action, the impacts resulting from individual IPFs associated with Alternative D are anticipated to be similar because the same interconnection cable route option could be selected under the Proposed Action. Impacts on demographics, employment, and economics under Alternative D are anticipated to be **negligible** to **minor** adverse and **negligible** to **moderate beneficial**.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action: short term and ranging from **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities on demographics, employment, and economics would be the same as the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **moderate beneficial** impacts.

3.11.9 Agency-Required Mitigation Measures

No additional measures to mitigate impacts on demographics, employment, and economics have been proposed for analysis.

3.14. Land Use and Coastal Infrastructure

This section discusses potential impacts on land use and coastal infrastructure from the proposed Project, alternatives, and ongoing and planned activities in the geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.14-1, includes the City of Chesapeake; City of Hampton; City of Newport News; City of Norfolk; City of Portsmouth; and City of Virginia Beach, and municipal boundaries surrounding the ports that may be used for the Project.

3.14.1 Description of the Affected Environment for Land Use and Coastal Infrastructure

Within the Project area (subset of City of Virginia Beach and Chesapeake City), land use is diverse, including open water, wetlands, shrub/scrub, forest, and developed and undeveloped land uses.

The proposed cable landing location would be on a proposed[1] surface parking lot that is designated as commercial land use and adjacent to an SMR, which is owned by the Commonwealth of Virginia and primarily used for on-site training for the Virginia National Guard.

The onshore export cable route corridor would be installed underground from the cable landing location to a common location north of Harpers Road, Virginia Beach. The dominant land uses along the onshore export cable route corridor include low-, medium-, and high-intensity developed lands and open space. In addition, the route follows a relatively limited passage through cultivated cropland, deciduous forestland, emergent herbaceous wetlands, evergreen forestland, pastureland, open water, and herbaceous and woody wetlands. The route corridor crosses Lake Christine, General Booth Boulevard, and a tidal tributary area west of General Booth Boulevard (COP, Section 4.4.3.1; Dominion Energy 2023).

The switching station would be located at either a location north of Harpers Road (City of Virginia Beach) (Harpers Road switching station) or a location north of Princess Anne Road (City of Virginia Beach) (Chicory Switching Station) (COP, Section 2.1.2.3; Dominion Energy 2023). Only one switching station will be constructed. The switching station potentially located north of Harpers Road would be located on a mix of forestland, developed open space, and low- and medium-intensity development. The area surrounding the Harpers Switching Station parcel is also made up of the same land classifications, with cultivated crop land to the north, east, and west, and woody wetlands to the south. The switching station potentially located north of Princess Anne Road would be located on a parcel classified as woody wetlands and mixed forest surrounded by woody wetlands, mixed forest, and evergreen forest with low-intensity development to the north and existing roadway to the southwest (COP, Section 4.4.3.1; Dominion Energy 2023). The Harpers Switching Station would require approximately 5.52 acres (2.2 hectares) for stormwater management facilities, approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course, and 0.93 acre (0.4 hectare) for relocation of Dewey Drive. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station. The operational footprint of the Chicory Switching Station would be approximately 35.5 acres (14.4 hectares) (COP, Section 3.3.2.3; Dominion Energy 2023).

[1] The SMR plans to independently build the parking lot. The parking lot is not expected to be developed as part of the proposed Project. The operational footprint for the cable landing location is anticipated to be approximately 2.27 acres (0.92 hectare).

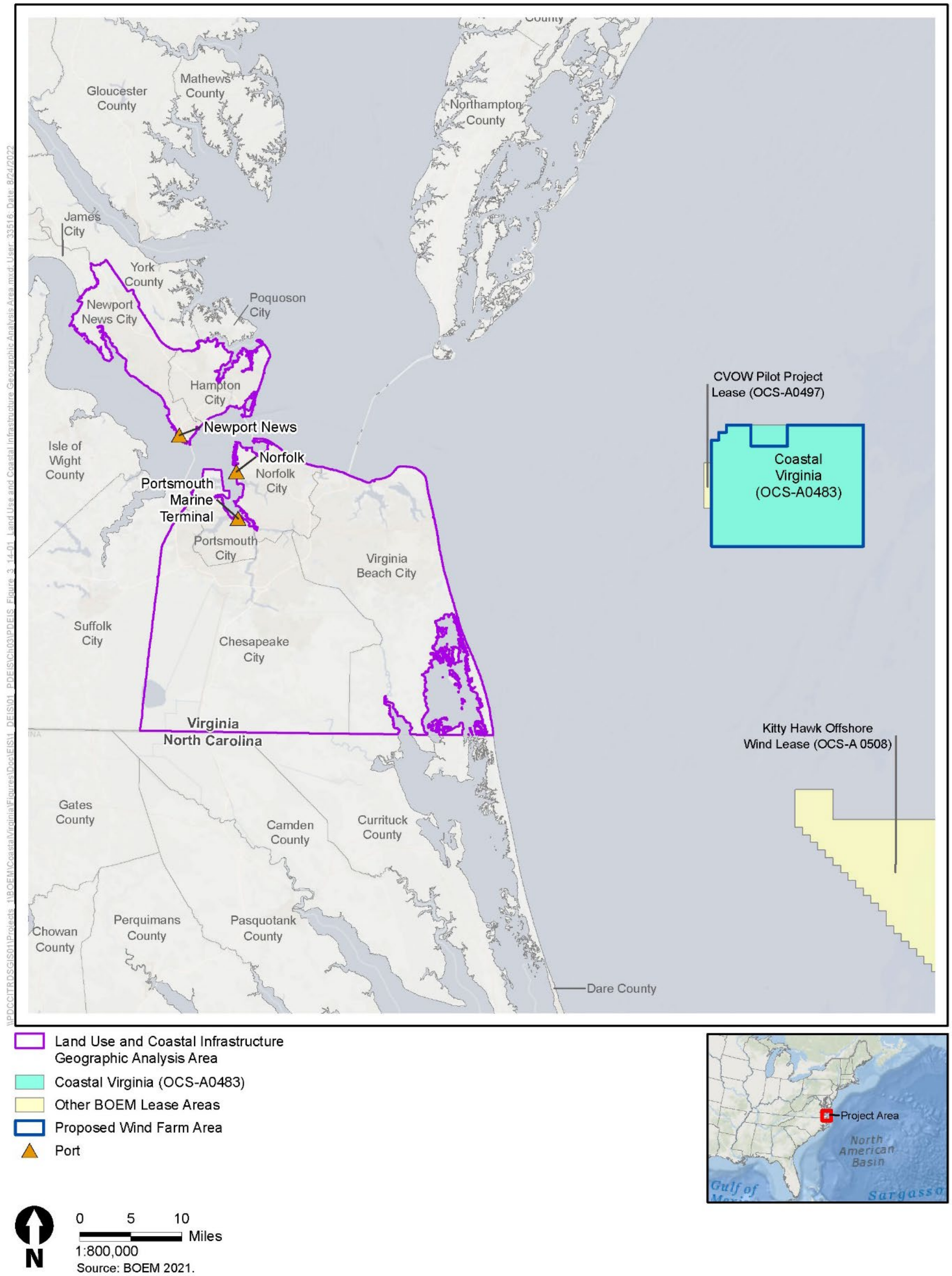


Figure 3.14-1 Land Use and Coastal Infrastructure Geographic Analysis Area

The onshore substation would be located off of Fentress Loop on a site that is currently designated as low density residential. As this site already has an existing substation, the upgrades/expansion to the onshore substation would be consistent with the existing site uses. The parcel is partially developed but surrounded by wooded and wetland areas to the north, east, south, and west. Forested wetlands are present in the west and north. Existing residential neighborhoods with large, single-family homes have been sited to the north, south, and west, with agricultural land to the east. There are also existing overhead transmission lines to the north and northeast of the onshore substation site (COP, Section 4.4.3.1; Dominion Energy 2023).

The interconnection cable routes lie within portions of the heavily developed cities of Virginia Beach and Chesapeake and include portions of the Gum Swamp, associated with the North Landing River wetlands complex, and more rural areas in the south. The two interconnection cable route options are located within areas containing very dense residential and commercial developments, large and numerous publicly owned lands, forested wetlands, major watercourses and associated floodplains, the Intracoastal Waterway, agricultural fields, military airport facilities, sports complexes, and golf courses (COP, Section 4.4.3.1; Dominion Energy 2023).

Important landscape features in the Project area include a combination of natural views such as beaches, shorelines, and scenic vistas, and human-made views such as unique buildings, landscaping, parks, and other cultural features.

3.14.2 Environmental Consequences

3.14.2.1. Impact Level Definitions for Land Use and Coastal Infrastructure

Definitions of potential impact levels are provided in Table 3.14-1.

Table 3.14-1 Impact Level Definitions for Land Use and Coastal Infrastructure

Impact Level	Impact Type	Definition
Negligible	Adverse	Adverse impacts on area land use would not be detectable.
	Beneficial	Beneficial impacts on area land use would not be detectable.
Minor	Adverse	Adverse impacts would be detectable but would be short term and localized.
	Beneficial	Beneficial impacts would be detectable but would be short term and localized.
Moderate	Adverse	Adverse impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
	Beneficial	Beneficial impacts would be detectable and broad based, affecting a variety of land uses, but would be short term and would not result in long-term change.
Major	Adverse	Adverse impacts would be detectable, long term, and extensive, and result in permanent land use change.
	Beneficial	Beneficial impacts would be detectable, long term, and extensive, and result in permanent land use change.

3.14.3 Impacts of the No Action Alternative on Land Use and Coastal Infrastructure

When analyzing the impacts of the No Action Alternative on land use and coastal infrastructure, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind and ongoing offshore wind activities, on the baseline conditions for land use. The cumulative impacts of the No Action

Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.14.3.1. Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for land use and coastal infrastructure described in Section 3.14.1, *Description of the Affected Environment for Land Use and Coastal Infrastructure*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and non-offshore wind and offshore wind activities. Ongoing non-offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure are generally associated with onshore construction. Onshore construction activities and associated impacts are expected to continue at current trends and have the potential to affect land use and coastal infrastructure through temporary and permanent land use change, development projects, and port expansion.

The geographic analysis area lies within developed communities that would experience continued commerce and development activity in accordance with established land use patterns and regulations. Most construction projects in the geographic analysis area would likely affect land that has already been disturbed from past development, although some development on undeveloped land may also occur. Ports in the geographic analysis area would continue to serve marine traffic and industries and experience periodic dredging and improvement projects to meet ongoing needs. A channel-deepening project at the Port of Virginia is currently underway and is anticipated to be completed in 2024 (Virginia Port Authority 2019). Dredging and port improvements would allow larger vessels to use the port and may result in increased port use and conversion of surrounding land use if the ports are expanded. See Appendix F, Table F1-12 for a summary of potential impacts associated with ongoing and planned non-offshore wind activities by IPF for land use and coastal infrastructure.

There are no ongoing offshore wind activities within the geographic analysis area that contribute to impacts on land use and coastal infrastructure.

3.14.3.2. Cumulative Impacts of the No Action Alternative

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

BOEM expects future offshore wind development activities to affect land use and coastal infrastructure through the following primary IPFs.

Accidental releases: Accidental releases of fuel/fluids/hazardous materials may increase because of future offshore wind activities. Accidental release risks would be highest during construction, but would still pose a risk during operation and decommissioning of offshore wind facilities. BOEM assumes all projects and activities would comply with laws and regulations to minimize releases. The overall impact of accidental releases on land use and coastal infrastructure is anticipated to be localized and short term and could result in temporary restrictions on use of adjacent properties and coastal infrastructure during the cleanup process. The extent of impacts would depend on the locations of landfall, substations, and cable routes, as well as the ports that support future offshore wind energy projects. The impacts of accidental releases on land use and coastal infrastructure would be localized and short term (except in the case of very large spills that affect a large land or coastal area).

Lighting: As described in Section 3.20, *Scenic and Visual Resources*, aviation hazard lighting on portions of Kitty Hawk Offshore Wind Projects (encompassing 190 WTGs) could be visible from beaches and coastal areas in the geographic analysis area. A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The majority of the WTG positions associated with other offshore wind activities would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

Nighttime lighting from onshore electrical substations could affect the ability to use nearby properties or decisions about where to establish permanent or temporary residences. Nighttime lighting impacts would be localized, constant, and long term. However, it is likely that other offshore wind projects would expand or construct new substations near existing substations, or would construct new substations in areas where land development regulations (i.e., zoning and land use plan designations) allow such uses. For new or expanded substations in business or industrial areas, lighting would have no adverse impacts on land uses. Lighting impacts would depend on the proposed substation locations, but would generally be negligible.

Port utilization: Offshore wind energy projects would make productive use of port facilities for shipping, berthing, and staging throughout construction, operations, and decommissioning. Offshore wind would likely increase port utilization, and ports would experience beneficial impacts, such as greater economic activity and increased employment due to demand for vessel maintenance services and related supplies, vessel berthing, loading and unloading, warehousing and fabrication facilities for offshore wind components, and other business activity related to offshore wind. In particular, the Virginia Port Authority is planning improvements to the PMT to support broadscale offshore wind development (COP, Section 3.3.2.6; Dominion Energy 2023).

There are two additional planned offshore wind projects (Kitty Hawk Offshore Wind Projects) in the geographic analysis area that would overlap with construction of the Proposed Action (Appendix F, Table F2-1). Offshore wind energy projects that are constructed at the same time and rely on the same ports have the potential to stress port resources and could increase the marine and road traffic, noise, and air pollution in the area. Overall, the No Action Alternative would have constant, long-term, beneficial impacts on port utilization due to the productive use of ports designated for offshore wind activity, as well as localized, short-term, adverse impacts in cases where individual ports are stressed due to simultaneous project activity. The Kitty Hawk Offshore Wind Projects would use ports in the Lower Chesapeake Bay area for staging project components and construction vessels (Kitty Hawk Offshore Wind North 2021: Section 3.1.1; Kitty Hawk Offshore Wind South 2022: Section 3.1.1). Improvements may be made to these ports to accommodate offshore wind construction and staging activities; port improvements and the associated permitting activities will support multiple projects up and down the Eastern Seaboard and will be the responsibility of port owners/operators (Kitty Hawk Offshore Wind North 2021: Section 3.1.11; Kitty Hawk Offshore Wind South 2022: Section 3.1.1).

Presence of structures: During operations, the views of offshore wind WTGs from coastal locations on the coastlines of Northampton County and the City of Virginia Beach, Virginia could have effects on land use through impacts on recreation, tourism, and property values, if the views influence visitors in selecting coastal locations to visit or buy. While WTGs could be visible from shoreline areas of the Delmarva Peninsula, Virginia Beach, and the Carova and Corolla Beach areas of North Carolina, visual impacts are expected to range from negligible to moderate (COP, Section 4.3.4.3; Dominion Energy 2023). Visibility would vary with distance from shore, topography, and atmospheric conditions and impacts would generally be localized, constant, and long term.

The presence of onshore infrastructure is anticipated to have minor long-term impacts on land use. BOEM anticipates that new substations for offshore wind projects would be within or near existing substations, or in locations designated for such uses. Transmission cables would most likely be above or below ground and collocated with roads or other utilities. As a result, onshore infrastructure would affect existing and planned land uses for the local area.

Land disturbance: Future offshore wind installation would require installation of onshore transmission cable infrastructure that would require land-disturbing activities and could temporarily affect access to adjacent properties. These impacts would only last through construction and occasionally during maintenance events. The exact extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.

Noise: Future offshore wind projects would generate noise, primarily associated with onshore cable trenching and switching station or substation construction. Noise from offshore wind construction activities is not expected to reach the geographic analysis area. This IPF may affect land use if noise levels influence business activity or residents' and visitors' decisions on where to visit or live. Ongoing noise from human activity (e.g., transportation, construction projects) occurs frequently in populated areas in the Mid-Atlantic states. The intensity and extent of noise from construction are difficult to generalize, but impacts would be local and temporary. Noise from onshore construction activity is anticipated to be similar to noise from other ongoing construction projects in the geographic analysis area and would be temporary.

Traffic: Future offshore wind projects could result in increased road traffic and congestion that may affect land use and coastal infrastructure because traffic volumes may dictate where residents and businesses choose to locate. Onshore construction of cables and switching stations for future offshore wind projects would likely disrupt road traffic for a short period of time. Occasional, temporary traffic delays would result from repairs and maintenance. The extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects.

3.14.3.3. Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, land use and coastal infrastructure would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts on land use and coastal infrastructure. These effects are primarily driven by onshore construction impacts and the presence of structures.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing temporary and permanent impacts on land use and coastal infrastructure. The identified IPFs relevant to land use and coastal infrastructure are accidental releases, nighttime lighting of onshore construction activity and structures, port utilization and expansion, viewshed impacts of offshore structures, presence of onshore infrastructure, and land disturbance, noise, and traffic from construction.

BOEM anticipates that the impacts of ongoing activities, especially onshore and coastal commerce, industry, and construction projects, would have both **minor beneficial** and **minor** adverse impacts on land use in the geographic analysis area. Accidental releases and land disturbances could have temporary adverse impacts on local land uses, but overall, ongoing use and development sustains the region's diverse mix of land uses and provides support for continued maintenance and improvement of coastal infrastructure.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and land use and coastal infrastructure would continue to be affected by natural and human-caused IPFs. Planned activities other than offshore wind, primarily increased port maintenance and expansion and construction activity, would have impacts similar to those of ongoing activities, with **minor beneficial** and **minor** adverse impacts. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor beneficial** and **minor** adverse impacts on the IPFs affecting land use and coastal infrastructure.

Considering all the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities near the geographic analysis area, combined with ongoing and planned activities other than offshore wind, would result in **minor** adverse impacts and **minor beneficial** impacts. Future offshore wind would adversely affect land use through land disturbance (during installation of onshore cable, switching stations, and substations) and accidental releases during onshore construction, as well as through the presence of offshore lighting on wind energy structures and views of the structures themselves that could affect the use and value of onshore properties. Beneficial impacts on land use and coastal infrastructure would result because the development of offshore wind would support the productive use of ports and related infrastructure designed or appropriate for future offshore wind activity (including construction and installation, O&M, and decommissioning).

3.14.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The following proposed PDE parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on land use and coastal infrastructure.

- The number, size, and design of the turbines. The appearance of the turbines and the offshore component of the Project as a whole could affect property use and value.
- The location of the switching station. The proposed Harpers Road switching station is located on and around more disturbed land than the proposed Chicory Switching Station.
- Interconnection cable route paths. The onshore interconnection cable routing and switching station variants in the Onshore Project area cross different land uses and important landscapes, such as the Gum Swamp.
- The time of year during which construction occurs. The Project area experiences a peak tourism season in the summer. If Project construction were to occur during this season, impacts on roads and land uses during the busy tourist season would be exacerbated.

Changes to the turbine design capacity could alter the maximum potential impacts on land use and coastal infrastructure for the Project because the capacity could affect onshore infrastructure or port utilization. For example, turbines with a higher capacity would require a greater turbine height, which may affect port utilization by increasing construction duration and intensity.

3.14.5 Impacts of the Proposed Action on Land Use and Coastal Infrastructure

The Proposed Action would likely result in localized impacts that would lead to minor alterations to the overall character of land use and coastal infrastructure in the geographic analysis area. The most impactful IPFs would likely include land use change from switching station construction and substation expansion; land disturbance during cable installation; the visual impact of offshore WTGs; and the utilization of ports.[2] Dominion Energy has indicated that the Virginia Port Authority is planning to improve the PMT to support broadscale offshore wind development and anticipates that the port upgrades would meet the needs for construction of the Project (COP, Section 3.3.2.6; Dominion Energy 2023). Other IPFs would likely contribute impacts of lesser intensity and extent and would occur primarily during construction but may also occur during operations and decommissioning.

Accidental releases: Accidental releases from the Proposed Action could include release of fuel/fluids/hazardous materials as a result of port usage, installation of the onshore cables, switching

[2] The Proposed Action includes no port expansion activities but would use ports that would expand to support the wind energy industry generally.

station, and substation, and substation operation. Potential contamination may occur from unforeseen spills or accidents, and any such occurrence would be reported and addressed in accordance with the local authority. The impact of accidental releases on land use and coastal infrastructure could result in temporary restriction on use of adjacent properties and coastal infrastructure during the cleanup process. Accordingly, accidental releases from the Proposed Action alone would have localized, short-term, negligible to minor impacts on land use.

Lighting: The Proposed Action would include the installation and continuous use of aviation hazard avoidance lighting on WTGs and OSSs during low-light and nighttime conditions. At onshore facilities, downward-projecting lights and lights triggered by motion sensors would be used to mitigate light pollution (COP, Section 4.2.2.2; Dominion Energy 2023). During operations, lighting from the Proposed Action's up to 202 WTGs could be visible from certain coastal and elevated locations in the geographic analysis area. Field observations associated with visibility of FAA hazard lighting under clear-sky conditions indicate that FAA hazard lighting may be visible at 40 miles (64 kilometers) or more from the viewer. Darker-sky conditions may increase this distance due to increased contrast of the light dome (reflections from the ocean) and cloud reflections caused by the hazard lights. As a result, WTG lighting of the Proposed Action alone would have a long-term, continuous, negligible to minor impact on land use and coastal infrastructure in the geographic analysis area, due to potential effects on property use and value.

Port utilization: The Proposed Action includes no port expansion activities but would use ports that would expand to support the wind energy industry generally. Port upgrades and expansions may occur independent of the Proposed Action. For instance, the Virginia Port Authority is planning improvements to the PMT to support broadscale offshore wind development (COP, Section 3.3.2.6; Dominion Energy 2023).

Land uses and coastal infrastructure affected by construction of offshore components includes the PMT, which would be used to support component and construction vessel staging. The Proposed Action would also involve temporary construction laydown area(s) at port(s) in Europe or North America (COP, Section 3.1; Dominion Energy 2023). These ports are expected to be used during construction but have independent utility and would not be dedicated to the Proposed Action. Proposed uses at existing port facilities would be consistent with the current land uses occurring at these locations.

Activities associated with the Proposed Action construction would generate noise, vibration, and vehicular traffic at the ports temporarily used for construction described above. These impacts are typical for industrial ports and would not hinder other nearby land uses or use of coastal infrastructure.

Dominion Energy has evaluated several options to lease portions of existing facilities in the Hampton Roads, Virginia Region for an O&M facility for the Proposed Action. The selected lease location for an onshore O&M facility for the Proposed Action is Fairwinds Landing, which is on a brownfield site in Norfolk, Virginia (COP, Section 3.3.2.6; Dominion Energy 2023). Fairwinds Landing is an existing port facility operated by Norfolk Southern. Dominion Energy anticipates that they would require approximately 8 acres (3.2 hectares) with a building covering an area of up to approximately 0.8 acre (0.3 hectare), and a height of up to approximately 45 feet (13.7 meters) to meet the needs of an O&M facility for an offshore wind farm off the coast of Virginia (COP, Section 3.3.2.6; Dominion Energy 2023).

O&M of the Proposed Action offshore components would require daily activity at the chosen O&M facility. The increased activity at the chosen port and nearby areas would be consistent with current land uses and provide a source of investment in the coastal infrastructure.

Overall, the construction and installation of offshore components, O&M, and decommissioning for the Proposed Action alone would have minor beneficial impacts on land use and coastal infrastructure by supporting designated uses and infrastructure improvements at ports.

Presence of structures: WTGs could be visible from certain coastal and elevated mainland areas, depending on vegetation, topography, and atmospheric conditions for both the Proposed Action. WTGs would not dominate offshore views as a result of their proposed distance from shore, even under ideal weather and atmospheric conditions for viewing. The Proposed Action alone would have a long-term, continuous, minor impact on land use and coastal infrastructure in the geographic analysis area due to views of WTGs and the potential effects on property use and value.

The visual impacts of the WTGs from the Proposed Action, as well as other future offshore wind development, visible from coastlines and elevated inland locations, could have long-term impacts on land use if the views influence visitor decisions on locations or properties to visit or purchase. Portions of up to 202 WTGs from the Proposed Action and portions of the Kitty Hawk Offshore Wind Projects could be visible from coastal and elevated locations near the geographic analysis area. As noted in Section 3.18, *Recreation and Tourism*, impacts on recreation and tourism activities would be minor. Accordingly, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined visual impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be localized, long term, and minor to moderate.

The cable landing location of the Proposed Action is located on a proposed surface parking lot that is on an SMR.[3] The onshore cable route crosses several water bodies, including Lake Christine, where HDD would be used for construction. The entry and exit pits for the HDD construction would be located on previously disturbed lands and along roadways, to the extent practicable, which would minimize impacts to land use. The Proposed Action interconnection cable infrastructure would be installed either fully overhead (Interconnection Cable Route Option 1) or via a hybrid of overhead and underground installation methods (Interconnection Cable Route Option 6). The interconnection cable route variations cross federal property in some areas and also city-owned land, including the Virginia Beach National Golf Club; however, installation corridors would be predominantly located within existing roadways to minimize impacts on existing land use. Because the offshore export cable route and interconnection cable routes would follow mostly existing road rights-of-way, there would be minimal impacts on existing land uses. Where the onshore cable routes would cross currently undeveloped areas, there would be a permanent conversion of land to utility right-of-way or easement. The height of the overhead cables for all interconnection cable route option would be between 75 feet (22.9 meters) and 170 feet (51.8 meters), which would be well above the minimum height required by Virginia Administrative Code (Code of Virginia § 33.2-210) and sight lines.

The Harpers Switching Station would require approximately 5.5 acres (2.2 hectares) for stormwater management facilities, approximately 6.1 acres (2.5 hectares) for relocation of fairways and a maintenance building associated with the adjacent golf course, and 0.93 acre (0.4 hectare) for relocation of Dewey Drive. These acreages are included in the overall acreage of 46.5 acres (18.8 hectares) for the Harpers Switching Station (COP, Section 3.3.2.3; Dominion Energy 2023). Approximately 27.02 acres (10.9 hectares) of tree clearing would be required to support relocation of the fairways, construction of the maintenance building, relocation of Dewey Road, construction of stormwater management facilities, and the footprint of Harpers Switching Station. However, the location of the Harpers Switching Station is on and near previously disturbed land and would result in minimal or no changes to existing land use. The onshore substation would be developed through upgrades and expansion of an existing substation. The

[3] The SMR plans to independently build the parking lot. The parking lot is not expected to be developed as part of the proposed Project. The operational footprint for the cable landing location is anticipated to be approximately 2.8 acres (1.1 hectares).

parcel identified for the onshore substation contains forested land, and some vegetation removal would be necessary to accommodate the proposed upgrades/expansion of the onshore substation. However, the proposed upgrades/expansion of the onshore substation would be consistent with existing uses due to the presence of an existing substation, as well as transmission lines to the north and northeast of the onshore substation site (COP, Section 4.4.3.1; Dominion Energy 2023).

Landfall construction methods would minimize land use impacts and areas would be restored to their previous condition after construction. Temporarily increased noise levels, lighting, and traffic during construction may affect local sensitive receptors (e.g., schools, medical facilities), but would be minimized through BMPs and would not change existing land uses. Dominion Energy has committed to implementing a construction schedule to minimize impacts to the extent practicable where appropriate and as deemed necessary by local authorities (COP, Section 4.4.4.2; Dominion Energy 2023). This would include coordination with localities, including the Virginia SMR.

Land disturbance: Based on the existing conditions along the proposed onshore export cable route, the Project would use a combination of open trenches, HDD, and duct banks at varying depths along the selected route (COP, Section 3.4.2.1; Dominion Energy 2023). Construction and installation of the interconnection cable would include a combination of vibrated/driven pipe piles and open trench interconnect ducting depending on the interconnection cable route option.

Installation of the cable landfall sites, cable routes, and construction and expansion of the switching station and substation would temporarily disturb neighboring land uses through construction noise, vibration, dust, and travel delays along the affected roads. These impacts are anticipated to last for the duration of construction; following construction, the cable route corridors and temporary staging areas for switching station and substation construction would be returned to their previous condition and use. In particular, the portion of the parcel not required for long-term operation of the substation would be restored to previous conditions (COP, Section 4.4.3.2; Dominion Energy 2023). The corridors would be maintained through regular vegetation trimming and herbicide application. Installation of the onshore export and interconnection cables would occur within temporary construction corridors. The maximum area of temporary disturbance for the onshore export cable is approximately 26.6 acres (10.8 hectares) (COP, Section 4.4.3.2; Dominion Energy 2023).

Permanent disturbance: The total permanent disturbance for Interconnection Cable Route Option 1 to accommodate new permanent structures (i.e., transmission towers) would be 1.0 acre (0.4 hectare) (COP, Section 4.4.3.2; Dominion Energy 2023). O&M would not result in land disturbance except in the event that cable maintenance or replacement is required. Land use impacts would be minimized through the use of existing rights-of-way, co-locating Project components, using land that is primarily zoned for commercial or industrial development, and restoring areas to pre-disturbed conditions following construction (COP, Section 4.4.3.1; Dominion Energy 2023).

The Harpers Switching Station is located in industrial district. The onshore substation parcel is zoned A-1 Agricultural and R-15S Residential. Interconnection Cable Route Option 1 would travel from a common location north of Harpers Road to the onshore substation and would traverse mainly industrial, business, office, planned developments, residential, and agricultural districts (COP, Section 4.4.3.1; Dominion Energy 2023; City of Virginia Beach 2008, 2017). The construction of the interconnection cable route, new switching station, and expansion of the onshore substation would result in temporary and permanent impacts to land use. In order to implement a zoning use in a district that currently does not allow a specific use, a Conditional Use Permit is typically submitted to the local zoning department for review and approval. Under Virginia law, if a public utility is granted a Certificate of Public Convenience and Necessity from the Virginia State Corporation Commission, the Certificate of Public Convenience and Necessity approval shall be deemed to satisfy the requirements of all local zoning ordinance (COP, Section 4.4.3.1; Dominion Energy 2023; Code of Virginia § 56-265.2).

Noise: The Proposed Action would comply with Virginia Beach City and Chesapeake City Code noise regulations (COP, Section 4.1.4.1; Dominion Energy 2023), to the extent practicable, to minimize impacts on nearby communities. Typical construction equipment ranges from a generator or refrigerator unit at 73 A-weighted decibels (dBA) at 50 feet to an impact pile driver at 101 dBA at 50 feet. Given the extended distances between the Offshore Project area and coastal shorelines (approximately 28 and 42 miles [45 and 67 kilometers]), noise from offshore construction is not expected to result in negative impacts in the Onshore Project area (COP, Section 4.1.4.2; Dominion Energy 2023). Temporarily increased noise levels during construction of onshore components may affect local sensitive receptors (such as religious locations, recreational areas, schools, and other places that are particularly sensitive to construction) but would be minimized through BMPs and would not change existing land uses.

Traffic: Cable installation within the roadway under the Proposed Action could result in temporary traffic impacts such as lane closures, shifted traffic patterns, or closed roadways with temporary detours. Best management practices and maintenance of traffic plans would be developed and coordinated with local and state agencies. Traffic impacts would be limited to the immediate construction area. Roadways would be returned to pre-construction conditions and changes to the existing land use would not result. Prior to beginning construction, Dominion Energy would develop a Traffic Management Plan to offset any traffic-related impacts as applicable to offset any anticipated traffic-related impacts. Traffic-related impacts include Project-related construction, temporary modifications to roadway traffic patterns during construction, and an increase in O&M vehicle traffic. The Traffic Management Plan would include, but would not be limited to, highly visible markings, signage, and lighting of active construction sites construction parking areas, and development of vehicular travel routes to and from construction sites (COP, Section 4.4.4.2; Dominion Energy 2023).

3.14.5.1. Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the accidental release impacts on land use and coastal infrastructure from ongoing and planned activities would increase the risk of (and, thus, the potential impacts from) accidental releases of fuel/fluids/hazardous materials in the geographic analysis area and would result in localized, short-term, negligible to minor impacts on land use and coastal infrastructure.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to WTG lighting impacts on land use and coastal infrastructure from ongoing and planned activities would be continuous, long term and negligible.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined impacts on land use and coastal infrastructure from ongoing and planned activities would have long-term, minor beneficial impacts. Future offshore wind development, including the Proposed Action, would require port facilities for shipping, berthing, and staging, and development activities would support ongoing or new activity at authorized ports.

In context of reasonably foreseeable environmental trends, the incremental contributions of the Proposed Action to the combined onshore transmission cable infrastructure impacts on land use and coastal infrastructure from ongoing and planned activities are anticipated to be minor. Assuming that new switching stations or substations for offshore wind projects would be in locations designated for industrial or utility uses, and above or belowground cable conduits would primarily be co-located with roads or other utilities, operation of switching stations, substations and cable conduits would not affect the established and planned land uses for a local area.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the land disturbance impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be minor due to construction-related disturbance, access limitations along the cable routes, and land use changes due to the construction of the switching station and onshore substation expansion. Impacts on land use and coastal infrastructure would be additive if land disturbance associated with one or more other projects occurs in close spatial and temporal proximity.

Construction of onshore components of new offshore wind projects near the geographic analysis area would be required to comply with the same or similar noise regulations as the Proposed Action and noise levels are anticipated to be similar to noise levels from other ongoing activities.

Impacts on land use and coastal infrastructure would be additive only if construction associated with one or more other projects generates traffic in close spatial and temporal proximity. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to traffic impacts on land use and coastal infrastructure from ongoing and planned activities is anticipated to be minor, localized, and short term.

3.14.5.2. Conclusions

Impacts of the Proposed Action. In summary, BOEM anticipates that impacts on land use and coastal infrastructure from the Proposed Action alone would range from **negligible** to **minor** with **minor** beneficial impacts. The Proposed Action would have minor beneficial impacts resulting from port utilization, minor impacts resulting from land disturbance during onshore installation of the cable route and resulting from land use changes from the construction and expansion of the switching station and substation, and negligible to minor impacts resulting from accidental spills. Noise and traffic from onshore construction would have localized, short-term, minor impacts on land use and coastal infrastructure.

Cumulative impacts of the Proposed Action. In the context of other reasonably foreseeable environmental trends in the area, impacts resulting from individual IPFs would range from **negligible** to **minor** adverse and **negligible** to **minor beneficial** impacts. Considering all of the IPFs collectively, BOEM anticipates that the contribution of the Proposed Action to the impacts associated with ongoing and planned activities would result in **minor** adverse impacts and **minor** beneficial impacts on land use and coastal infrastructure in the geographic analysis area. The main drivers for this impact rating are the beneficial impacts of port utilization, minor impacts on the viewshed due to the presence of offshore structures, and minor impacts of land disturbance and land use change. The Proposed Action would contribute to the overall impact rating primarily through short-term impacts from onshore landfall, cable, switching station, and substation installation, as well as beneficial impacts due to the use of port facilities designated for offshore wind activity.

3.14.6 Impacts of Alternatives B and C on Land Use and Coastal Infrastructure

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, described in this section.

Impacts of Alternatives B and C. The impacts resulting from individual IPFs on land use and coastal infrastructure under Alternatives B and C would be the same as those described under the Proposed Action except for the presence of structures. Compared to the Proposed Action, Alternative B would remove 29 WTGs (for a total of up to 176 WTGs with seven locations identified as spares). Alternative C would remove 33 WTGs (for a total of up to 172 WTGs) from the Offshore Project area. All other offshore and onshore projects components would stay the same. As a result, Alternatives B and C would slightly modify the visibility of the WTGs from coastal and elevated onshore areas in the geographic analysis area, which could affect the potential effects on property use and values compared to the Proposed Action. However, as under the Proposed Action, the majority of the WTGs would still be visible, and there would be no meaningful difference in impacts on land use and coastal infrastructure.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of the Proposed Action.

3.14.6.1. Conclusions

Impacts of Alternatives B and C. Alternatives B and C would decrease the number of WTGs, resulting in slightly decreased visual impacts of WTGs on coastal communities compared to the Proposed Action but would not change the overall impact magnitudes. Impacts on land use and coastal infrastructure would be long-term and range from **negligible** to **minor** with **minor** beneficial impacts. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as that of the Proposed Action, ranging from **negligible** to **minor** impacts for onshore land use and infrastructure and **minor beneficial** impacts. The overall impacts of Alternative B and C combined with ongoing and planned activities on land use would be similar to those of the Proposed Action: **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change.

3.14.7 Impacts of Alternative D on Land Use and Coastal Infrastructure

Impacts of Alternative D. The impacts resulting from the majority of IPFs on land use and coastal infrastructure under Alternative D would be the same as those described under the Proposed Action except for land disturbance. Alternative D-2 would approve only the Hybrid Interconnection Cable Route Option 6, which would connect with the switching station north of Princess Anne Road (Chicory Switching Station). Alternative D-1 would approve only Interconnection Cable Route Option 1, which would connect with the Harpers Switching Station. The Chicory Switching Station would be located in agricultural and residential districts and would have a smaller total footprint at 35.5 acres (14.4 hectares) than the Harpers Switching Station (46.5 acres or 18.8 hectares), which would be located within an industrial district (COP, Section 3.3.2.3; Dominion Energy 2023). The temporary construction and installation corridors for Interconnection Cable Route Option 1 (Alternative D-1) and Hybrid Interconnection Cable Route Option 6 (Alternative D-2) is anticipated to be the same: 29.0 acres (11.7 hectares), inclusive of existing and proposed rights-of-way and access roads (COP, Section 3.4.2.3; Dominion Energy 2023). However, the Chicory Switching Station location associated with Hybrid Interconnection Cable Route Option 6 (Alternative D-2) would be in a less-disturbed area than the Harpers Switching Station associated with overhead Interconnection Cable Route Option 1 (Alternative D-1). Overall, Alternative D-1 would result in the fewer land-disturbing impacts from construction of the onshore components followed by Hybrid Interconnection Cable Route Option 6 (Alternative D-2).

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action.

3.14.7.1. Conclusions

Impacts of Alternative D. The Proposed Action and Alternative D considers two interconnection cable route options. The Chicory Switching Station location associated with Hybrid Interconnection Cable Route Option 6 (Alternative D-2) covers a smaller footprint but would be in a less disturbed area than the Harpers Switching Station associated with overhead Interconnection Cable Route Option 1 (Alternative D-1). Impacts on land use and coastal infrastructure would range from **negligible** to **minor** with **minor beneficial** impacts. Impact ratings associated with individual IPFs would not change.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action, long-term and ranging from **negligible** to **minor** impacts for onshore land use and infrastructure and **minor beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities for land use would also be the same as those of the Proposed Action: long-term **minor** adverse impacts and **minor beneficial** impacts. This impact rating is primarily driven by impacts from installation of onshore infrastructure and port utilization, which would not change.

3.14.8 Agency-Required Mitigation Measures

No measures to mitigate impacts on land use have been proposed for analysis.

3.18. Recreation and Tourism

This section discusses potential impacts on recreation and tourism resources from the proposed Project, alternatives, and ongoing and planned activities in the recreation and tourism geographic analysis area. The geographic analysis area, as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.18-1, includes the 40-mile (64.4-kilometer) visual analysis area measured from the borders of the Wind Farm Area. The geographic analysis area encompasses parts of Accomack County, Northampton County, the City of Norfolk, the City of Virginia Beach, and Chesapeake City, Virginia, and Currituck and Dare Counties, North Carolina. Section 3.11, *Demographics, Employment, and Economics*, discusses the economic aspects of recreation and tourism in the Project area.

3.18.1 Description of the Affected Environment for Recreation and Tourism

3.18.1.1 Regional Setting

Proposed Project facilities would be within and off the coast of Virginia and North Carolina. The coastal areas support ocean-based recreation and tourist activities that include boating, swimming, surfing, scuba diving, sailing, and paddle sports. As indicated in Section 3.11, *Demographics, Employment, and Economics*, recreation and tourism contribute substantially to the economies of Virginia and North Carolina's coastal counties. Tourism in Virginia's coastal communities is a multibillion-dollar industry. More than 19 million people visited Virginia Beach in 2017, generating about $1.7 billion annually in total expenditures (City of Virginia Beach 2017; COP, Section 4.4.5.1; Dominion Energy 2023).

Coastal Virginia and North Carolina have a wide range of visual characteristics, with communities and landscapes ranging from large cities to small towns, suburbs, rural areas, and wildlife preserves. As a result of the proximity of the Atlantic Ocean, as well as the views associated with the shoreline, the Virginia and North Carolina shore has been extensively developed for water-based recreation and tourism.

The scenic quality of the coastal environment is important to the identity, attraction, and economic health of many of the coastal communities. Additionally, the visual qualities of these historic coastal towns, which include marine activities within small-scale harbors, and the ability to view birds and marine life are important community characteristics.

3.18.1.2 Project Area

Recreational and tourist-oriented activities are concentrated in the coastal communities in the City of Virginia Beach and the City of Chesapeake. Coastal communities provide hospitality, entertainment, and recreation for hundreds of thousands of visitors each year. Although many of the coastal and ocean amenities, such as beaches, that attract visitors to these regions are accessible to the public for free and, thus, do not directly generate employment, these nonmarket features function as key drivers for recreation and tourism businesses.

Water-oriented recreational activities in the Project area include boating, visiting beaches, diving, fishing tournaments, and wildlife viewing. Boating covers a wide range of activities, from ocean-going vessels to small boats used by residents and tourists in sheltered waters, and includes sailing, sailboat races, fishing, shellfishing, kayaking, canoeing, and paddleboarding.

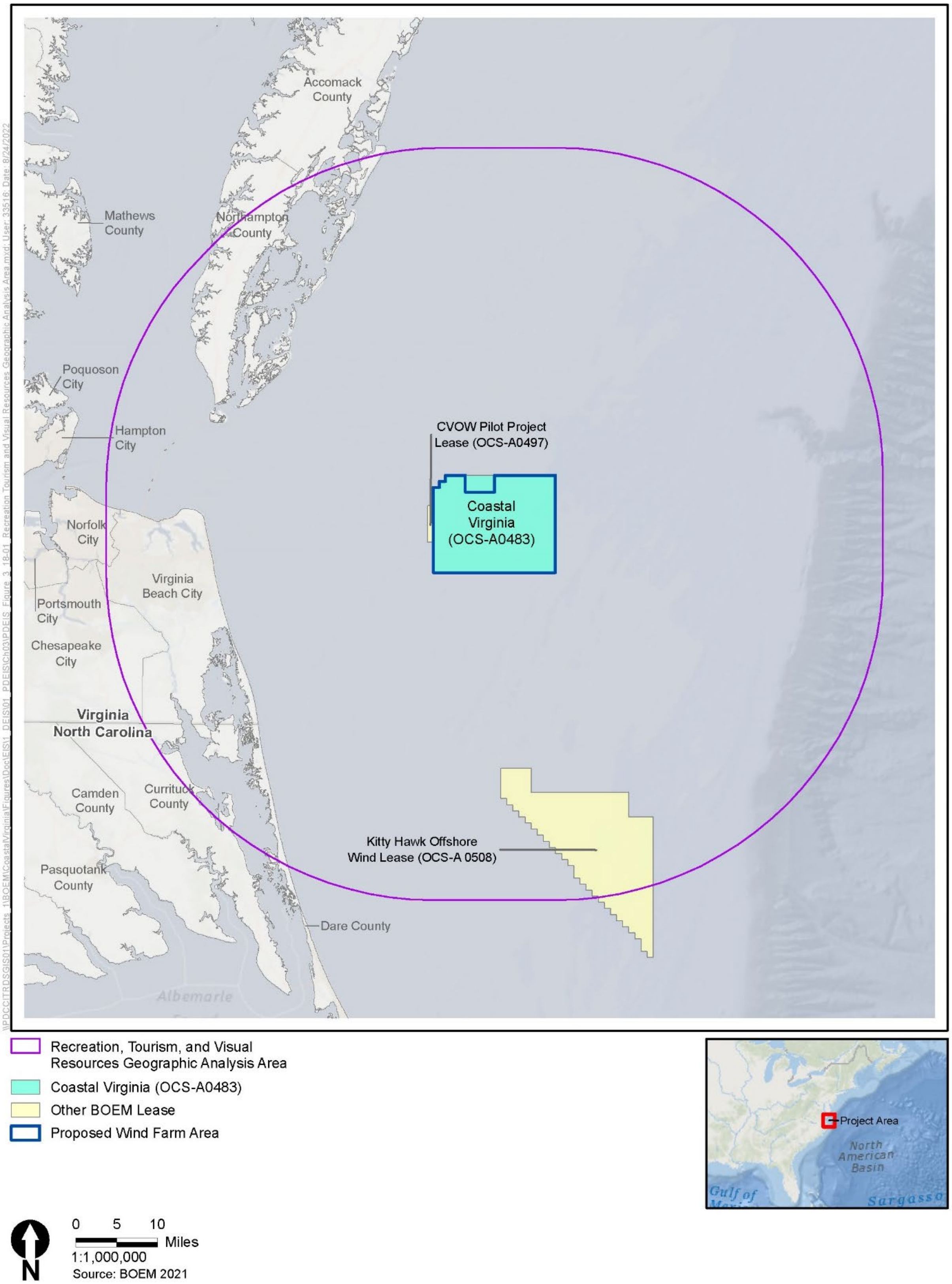


Figure 3.18-1 Recreation, Tourism, and Visual Resources Geographic Analysis Area

Commercial businesses offer boat rentals, private charter boats for fishing, whale watching and other wildlife viewing, and tours with canoes and kayaks. As discussed in Section 3.11, *Demographics, Employment, and Economics*, recreation and hospitality are major sectors of the economy in the City of Virginia Beach and the City of Chesapeake, supported by ocean-based recreation uses.

Inland recreational facilities are also popular but have less of a relationship to possible impacts of the Project; this section does not address these facilities in detail, except where Project components would intersect with these facilities. These include inland waters such as ponds and rivers, wildlife sanctuaries, golf courses, athletic facilities, parks, and picnic grounds.

3.18.1.2.1 Coastal and Offshore Recreation

Many marine recreational activities, such as swimming, surfing, kayaking, paddle boarding, wind surfing, fishing, sailing, and boating, occur along the coast of Virginia almost all year-round. Scuba diving and snorkeling are identified as a dominant use offshore from the Virginia coast year-round with dive sites that include shipwrecks, artificial reefs, and other structures. Recreational boating and sailing are very popular and primarily occur in nearshore coastal waters rather than offshore waters (COP, Sections 4.4.6.2 and 4.4.11.1; Dominion Energy 2023).

There is a large and robust recreational fishing industry in Virginia and North Carolina. In 2018, there were about 6.4 million recreational saltwater angler trips (i.e., charter, party, private/rental, and shore boats) in Virginia and about 16.6 million trips in North Carolina. The popular recreational saltwater species caught in the area include, but are not limited to, sciaenid drums including Atlantic croaker (*Micropogonias undulatus*) and seatrout, bluefish, tuna/mackerel, cartilaginous fishes (sharks, skates, and rays), porgies, jacks, and black sea bass (COP, Section 4.4.6.2; Dominion Energy 2023). There are also annual recreational fishing tournaments held in coastal towns in Virginia and North Carolina. Saltwater fishing tournaments target a variety of fish including billfish, tuna, seabass, shark, grouper, and others. Tournaments for specific highly migratory species occur from late June to early September (COP, Sections 4.4.6.2 and 4.4.11.1; Dominion Energy 2023).

Recreational shellfishing is important to the region and occurs primarily in state waters and not in the Offshore Project area, commonly targeting blue crabs, scallops, quahogs, Atlantic surf clams, and softshell clams. Spearfishing occurs in portions of the Offshore Project area and often targets fish at offshore structures, the Triangle wrecks, and surface structures, such as buoys (COP, Section 4.4.6.2; Dominion Energy 2023).

3.18.1.2.1.1 Accomack County

Accomack County lies on the Delmarva Peninsula, on the northern part of Virginia's eastern shore, and encompasses approximately 1,310 square miles (3,393 square kilometers). The county is known for its 45-mile (72-kilometer) stretch of oceanside barrier islands, which are kept in their natural state and can be accessed by the public (Accomack County 2021). Aside from its barrier islands, bays, and inlets, there are eight public beaches, one yacht club, 29 public boating access sites, and 40 miles (64 kilometers) of shoreline on both the Chesapeake Bay and the Atlantic Ocean (BOEM 2012). Popular marine recreational activities in the county include swimming in the Atlantic Ocean, surfing, fishing, boating, and wildlife viewing off the shore. There are many businesses that offer boat and fishing tours and rentals, and there are many public piers at which fishing tournaments, crabbing, and clamming take place. Scenic boat cruises are popular among tourists and take place through the Chincoteague and Assateague Channels and along the Assateague Island National Seashore (Chincoteague Chamber of Commerce 2021).

3.18.1.2.1.2 Northampton County

Northampton County is located on the southern part of the Delmarva Peninsula on Virginia’s eastern shore and encompasses 795 square miles (2,095 square kilometers). The county is known for its over 100 miles (161 kilometers) of shoreline on the Chesapeake Bay and Atlantic Ocean, and it has three public beaches and two marinas (BOEM 2012). Popular recreational activities include kayaking, fishing on the piers, renting yachts, and visiting the uninhabited barrier islands. There are 12 barrier islands, which are open to the public for non-commercial recreational day use, such as hiking, bird watching, fishing, hunting, crabbing, and clamming (Northampton County 2019). Private ecotours and sunrise/sunset cruises that go between the sandy beaches and islands are very popular (Cape Charles Harbor 2020).

3.18.1.2.1.3 City of Norfolk

The City of Norfolk encompasses 66 square miles (106 square kilometers), is located is southeastern Virginia, and is bordered by Chesapeake Bay. It has 7 miles (11 kilometers) of Chesapeake Bay beachfront, and all of the beaches are public. Popular recreational activities include sailing, kayaking, swimming, jogging and walking along the shoreline, surfing, and canoeing. There is a harbor for ocean-going cruise vessels of up to 3,000 passengers, and there is the East Ocean View Community Center Pier, which hosts anglers and boaters (City of Norfolk 2021). A lot of recreational diving that occurs along the Virginia coast is supported by several dive companies in the city that offer charters to artificial reefs, shipwrecks, ledges, and other sites in the Offshore Project area (COP, Section 4.4.11.1; Dominion Energy 2023).

3.18.1.2.1.4 City of Virginia Beach

The City of Virginia Beach is in southeastern Virginia and encompasses 310 square miles (499 square kilometers). It has 28 miles (45 kilometers) of public beach, 38 miles (61 kilometers) of shoreline, and 29 miles (74 kilometers) of scenic waterways (City of Virginia Beach 2017). There are about six public beaches, nine marinas, and 13 yacht clubs. The shorefront is one of the most popular attractions, where people partake in swimming, annual surfing championships, fishing, paragliding, and sailing (BOEM 2012). The city is also known for its 3-mile Virginia Beach Boardwalk, which is lined with hotels and restaurants, and for its guided boat tours of the Back Bay and Atlantic Ocean (Visit Virginia Beach 2021).

Several dive companies in Virginia Beach, such as Chesapeake Bay Diving Center and Lynnhaven Dive Center, support recreational scuba and free dives by offering charters to artificial reefs, shipwrecks, ledges, and other sites of interest in the Offshore Project area (COP, Section 4.4.11.1; Dominion Energy 2023). Recreational fishing vessels are supported by the ports of Rudee Inlet and Lynnhaven, from where fishermen travel to areas of “hard bottom” seabed structures and other structures near the Offshore Project area. Virginia Beach also hosts a number of very popular fishing tournaments for highly migratory species, which occur from late June to early September (COP, Section 4.4.6.2; Dominion Energy 2023). Whale-watching tours are also popular in coastal Virginia between late November and March but occur year-round in Virginia Beach. Dolphin tours take place between June and late October (COP, Section 4.4.11.1; Dominion Energy 2023).

3.18.1.2.1.5 Chesapeake City

The City of Chesapeake encompasses 353 miles and is adjacent to Virginia Beach City (City of Chesapeake 2021). Since it is surrounded by land, it does not offer as many opportunities for coastal recreation, as does Virginia Beach City.

3.18.1.2.1.6 Currituck County

Currituck County encompasses 526 miles (847 kilometers) and is located in the northeastern-most corner of North Carolina (United States Census Bureau 2010). It has six public beaches, 20 miles (32 kilometers) of shoreline, one marina, and two yacht clubs (BOEM 2012). The county is known for its sandy beaches, where tourists partake in surfing, fishing, kayaking, parasailing, paddleboarding, kiteboarding, and walking along the shore (Currituck County 2021). Fishing and crabbing are also popular activities in the Currituck Sound (Currituck County Tourism 2021). In 2009, there were 65 ocean-related establishments that directly employed 451 people (BOEM 2012).

3.18.1.2.1.7 Dare County

Dare County is in northeastern North Carolina, adjacent to the Atlantic Ocean, and it encompasses 1,563 square miles (2,515 square kilometers). It has 110 miles (177 kilometers) of shoreline, known as the Outer Banks (Dare County 2021). The county is known for its beaches, which offer sailing tours, fishing, snorkeling, water sports, and horseback riding (Outer Banks 2021). It has two public beaches, 10 marinas, and 13 yacht clubs. In 2009, there were 269 ocean-related establishments, which employed 3,746 people directly. Popular attractions include the Cape Hatteras Lighthouse and the Bodie Island Lighthouse (BOEM 2012).

3.18.1.2.2 Onshore Recreation

3.18.1.2.2.1 Accomack County

Accomack County is home to myriad habitats, such as farmland, marshes, forests, and wetlands. The 9,000-acre (3,642-hectare) Chincoteague National Wildlife Refuge is located in the north portion of the county and has opportunities for swimming, hiking, fishing, and bird watching. The beaches and salt marshes are particularly popular for viewing shorebirds, seabirds, and other migrating waterfowl. The Accomack County Department of Parks and Recreation takes care of three parks: Arcadia Park (25 acres (10 hectares]), Wachapreague Park (15 acres [6 hectares]), and Nandua Middle Park (Accomack County 2021). Along the nature trails, tourists partake in bird watching of over 300 species of migratory birds, pony watching, and biking (Chincoteague Chamber of Commerce 2021).

The main areas of tourism in the county are nature, agriculture, and beach and recreational resorts. Tourists partake in wine tours, horseback riding, and golfing. In 2010, domestic travelers spent about $145.08 million in the county, and there were 116 establishments dedicated to leisure and hospitality. Approximately 23 percent of all housing units in Accomack County are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.2.2.2 Northampton County

Northampton County is known for its undeveloped coastal landscapes that allow for many recreational activities, such as wildlife viewing, hiking, and cycling. The county is home to two wildlife refuges: the Eastern Shore of Virginia National Wildlife Refuge (1,200 acres [486 hectares]) and Fisherman Island National Wildlife Refuge (1,850 acres [749 hectares]) (BOEM 2012). Tourists enjoy bird watching along the Eastern Seaboard during spring and fall migration and enjoy the variety of artist markets, galleries, and film festivals more inland (Northampton County 2019). In 2010, domestic travelers spent $63.26 million, and there were 43 establishments dedicated to leisure and hospitality (BOEM 2012).

3.18.1.2.2.3 City of Norfolk

Inland Norfolk is home to three beach parks, museums, the National Maritime Center, art festivals, and the Norfolk Botanical Garden. Popular activities in the parks include walking, hiking, and wildlife viewing (City of Norfolk 2021). There are also many bike lanes and trails, such as the 10.5-mile (16.9-kilometer) Elizabeth River Trail, which are popular among cyclists. Tourists also partake in kayaking and fishing the Lafayette River (Visit Norfolk n.d.).

3.18.1.2.2.4 City of Virginia Beach

Virginia Beach is home to 255 local parks (covering 4,500 acres), several state parks, and one national wildlife refuge: the Back Bay National Wildlife Refuge (10,000 acres [4,047 hectares]) (BOEM 2012). Popular inland activities include traversing the Sandbridge dunes, hiking and cycling along the 200 miles (322 kilometers) of bikeways and trails, and kayaking and fishing in the 120 miles (193 kilometers) of waterways. First Landing State Park is a 2,888-acre park with 1.25 miles (2.01 kilometers) of beach, and 19 miles (31 kilometers) of hiking trails through salt marsh habitat, freshwater ponds, dunes, forests, tidal marshes, and cypress swamps. Other popular attractions include museums; Pungo, an 8,000-acre (3,237-hectare) farmland community; breweries; Atlantic Fun Park; and Cape Henry Light House (Visit Virginia Beach 2021). In 2010, domestic travelers spent $1.13 billion in the city, and there were 1,266 establishments for leisure and hospitality (BOEM 2012).

3.18.1.2.2.5 Chesapeake City

The City of Chesapeake is home to the Great Dismal Swamp National Wildlife Refuge, which is a protected area of more than 112,000 acres (45,325 hectares) and contains 200 species of birds, 100 species of butterfly, and other rare native mammals. The refuge has freshwater marshes, cypress swamps, and barrier islands. The city is also home to Lake Drummond, a 3,100-acre (1,255-hectare) lake popular among anglers. Popular activities in the city include hiking, camping, fishing, and birdwatching along the Virginia Birding and Wildlife Trail, which is home to over 213 species of birds (Visit Chesapeake 2021).

3.18.1.2.2.6 Currituck County

There are two wildlife refuges in Currituck County: Currituck National Wildlife Refuge (8,501 acres) and part of Mackay Island National Wildlife Refuge (8,219 acres [3,326 hectares] on Knotts Island). People partake in bird watching, hiking, kayaking, and cycling (BOEM 2012). Tourists also enjoy wildlife viewing due to the population of Corolla Wild Horses in the Currituck Outer Banks (Currituck County 2021). The county is also famous for its Historic Corolla Park and the Currituck Beach Lighthouse (Currituck County Tourism 2021). In 2010, domestic visitors spent $117.12 million in the county, and there were 87 establishments dedicated to leisure and hospitality. Approximately 31.8 percent of housing units in the county are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.2.2.7 Dare County

Dare County has five national protected areas, including the Pea Island National Wildlife Refuge (6,000 acres) and the Alligator National Wildlife Refuge (152,000 acres [61,512 hectares]), which is home to songbirds, raptors, and ducks (BOEM 2012; Dare County 2021; Outer Banks 2021). Popular activities include golfing, touring gardens, visiting historic sites and museums, bird-watching festivals, and traversing fresh and saltwater habitats. Tourism provides more than 13,800 jobs in the county, employing one-third of the county's residents. Annually, tourism generates more than $116.5 million in state and local tax revenue, and visitor spending is over $1.27 billion (Outer Banks 2021). In 2009, there were 381 establishments dedicated to leisure and hospitality. Approximately 44 percent of housing units are for seasonal, recreational, or occasional use (BOEM 2012).

3.18.1.3 Visual Resources

As discussed in Section 3.20, *Scenic and Visual Resources*, the proposed Project's Offshore Components, including the WTGs, inter-array cables, and OSSs would be in federal waters within the Lease Area. The boundary of the Lease Area is 20.45 nautical miles (37.87 kilometers) from the northwest corner to the Eastern Shore Peninsula and 23.75 nautical miles (43.99 kilometers) from Virginia Beach, Virginia. Existing visual intrusions offshore include buoys, channel markers, marine vessel traffic, the Chesapeake Light Tower, and the two existing WTGs of the CVOW-Pilot Project. These features are visible during daytime hours, and safety and warning lights are visible during nighttime hours from certain viewing locations. Air traffic (including nighttime safety lighting on aircraft) arriving and departing from military and civilian airports is also commonly seen in the Offshore Project area. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments (COP, Section 4.3.4.2; Dominion Energy 2023).

Within the 40-mile-radius geographic analysis area, the distance from coastal viewpoints to the Project would vary from slightly more than 25 miles (40 kilometers) to nearly 40 miles (64 kilometers) to the nearest WTG. The most apparent views of WTGs were found to be within 27 to 28 miles (43.5 to 45.1 kilometers) from the Lease Area, where views are oriented toward the ocean and horizon. Within these areas, beach/shoreline and elevated viewpoints, such as multi-story buildings and/or lighthouses with ocean views, would have the most conspicuous views of the WTGs (COP, Section 4.3.4.3; Dominion Energy 2023).

3.18.2 Environmental Consequences

3.18.2.1 Impact Level Definitions for Recreation and Tourism

Definitions of impact levels are provided in Table 3.18-1.

Table 3.18-1 Impact Level Definitions for Recreation and Tourism

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on the recreation setting, recreation opportunities, or recreation experiences would be so small as to be unmeasurable.
	Beneficial	No effect or measurable impact.
Minor	Adverse	Impacts would not disrupt the normal functions of the affected activities and communities.
	Beneficial	A small and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Moderate	Adverse	The affected activity or community would have to adjust somewhat to account for disruptions due to the Project.
	Beneficial	A notable and measurable improvement to infrastructure/facilities and community services, or benefit for tourism.
Major	Adverse	The affected activity or community would have to adjust to significant disruptions due to large local or notable regional adverse impacts of the Project.
	Beneficial	A large local, or notable regional improvement to infrastructure/facilities and community services, or benefit for tourism.

3.18.3 Impacts of the No Action Alternative on Recreation and Tourism

When analyzing the impacts of the No Action Alternative on recreation and tourism, BOEM considered the impacts of ongoing activities, including ongoing non-offshore wind activities and ongoing offshore wind activities, on the baseline conditions for recreation and tourism. The cumulative impacts of the No

Action Alternative considered the impacts of the No Action Alternative in combination with other planned non-offshore wind and offshore wind activities, as described in Appendix F.

3.18.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for recreation and tourism in the geographic analysis area described in Section 3.18.1, *Description of the Affected Environment for Recreation and Tourism*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing non-offshore wind and offshore wind activities. Ongoing activities within the geographic analysis area that contribute to impacts on recreation and tourism include ongoing vessel traffic; noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, and offshore cables; and onshore development activities. These activities would contribute to periodic disruptions to recreational and tourism activities but are a typical part of daily life along the Virginia and North Carolina coastline and would not substantially affect recreational enjoyment in the geographic analysis area. Visitors would continue to pursue activities that rely on the area's coastal and ocean environment, scenic qualities, natural resources, and establishments that provide services for tourism and recreation. The geographic analysis area has a strong tourism industry and abundant coastal and offshore recreational facilities, many of which are associated with scenic views. The beach, and by proxy the ocean, is a primary concern for the local jurisdictions' tourism industry (City of Virginia Beach 2017). There is one ongoing offshore wind activity within the geographic analysis area that could contribute to impacts on recreation and tourism.

3.18.3.2 Cumulative Impacts of the No Action Alternative

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

BOEM expects future offshore wind activities to affect recreation and tourism through the following primary IPFs.

Anchoring: This IPF would potentially affect recreational boating through both the presence of an increased number of anchored vessels in the geographic analysis area and the creation of offshore areas with scour protection where recreational vessels may experience limitations or difficulty in anchoring.

Future offshore wind development in the geographic analysis area is anticipated to result in increased survey activity and overlapping construction periods beginning in 2024, with two other projects (Kitty Hawk Offshore Wind Projects) under construction at one time during 2024 through 2027 (Appendix F, Table F3). Increased vessel anchoring during future offshore wind development between 2024 and 2030 would affect recreational boaters. The greatest volume of anchored vessels would occur in offshore work areas during construction. Future offshore wind projects may generate similar numbers of active and anchored vessels to the Proposed Action, depending on project size and construction schedule: the CVOW-C Project would have an estimated average of 46 daily vessel trips generated throughout the duration of construction, ranging from a minimum of 3 trips per day to a maximum of 95 trips per day (COP, Section 3.4.1.5; Dominion Energy 2023). Anchored construction-related vessels may be within temporary safety zones established in coordination with USCG for active construction areas (COP, Section 4.4.9.2; Dominion Energy 2023).

Vessel anchoring would also occur during maintenance and monitoring activities. Following construction of planned offshore wind projects (if approved), the presence of operating offshore wind projects in the geographic analysis area would result in a long-term increase in the number of vessels anchored during periodic maintenance and monitoring. One ongoing offshore wind project, the CVOW-Pilot Project, is currently in the operations phase. There are only two WTGs, so the long-term increase in the number of vessels during period maintenance and monitoring would be small.

Anchored construction, survey, or service vessels would have localized, temporary impacts on recreational boating. Recreational vessels could navigate around anchored vessels with only brief inconvenience. The temporary turbidity from anchoring would briefly alter the behavior of species important to recreational fishing (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*) and sightseeing (primarily whales, but also dolphins and seals) (Section 3.15, *Marine Mammals*). Inconvenience and navigational complexity for recreational vessels would be localized, variable, and long term, with increased frequency of anchored vessels during surveying and construction and reduced frequency of anchored vessels during operations.

Land disturbance: Future offshore wind development for Kitty Hawk Offshore Wind Projects would require installation of onshore transmission cable infrastructure, which would cause temporary traffic delays and could temporarily affect access to adjacent properties, resulting in localized, temporary disturbances of recreational activity or tourism-based businesses near cable routes and construction sites for substations and other electrical infrastructure. These impacts would only occur during construction and occasionally during maintenance events. The impacts during maintenance of the ongoing two-WTG CVOW-Pilot Project would be similar. The extent of impacts would depend on the locations of landfall and onshore transmission cable routes for future offshore wind energy projects; however, the No Action Alternative would generally have localized, short-term impacts during construction or maintenance and would not have long-term impacts on recreation and tourism use.

Lighting: Construction-related nighttime vessel lighting would be used if future 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 two future offshore wind projects (Kitty Hawk Offshore Wind Projects) in the geographic analysis area during the project's active construction phase. Vessel lighting would enable recreational boaters to safely avoid nighttime construction areas. The impact on recreational boaters would be localized, sporadic, short term, and minimized by the limited offshore recreational activities that occur at night.

Permanent aviation warning lighting required on the WTGs would be visible from beaches and coastlines in the geographic analysis area and could have impacts on recreation and tourism in certain locations if the lighting influences visitor decisions in selecting coastal locations to visit. FAA hazard lighting systems would be in use for the duration of O&M for up to 71 WTGs. The amassing of these WTGs and associated synchronized flashing strobe lights affixed with red flashing lights at the mid-section of each tower and one at the top of each WTG nacelle within the offshore wind lease areas would have long-term negligible to major impacts on sensitive onshore and offshore viewing locations, based on viewer distance and angle of view and assuming no obstructions. Atmospheric and environmental factors such as haze and fog would influence visibility and perception of hazard lighting from sensitive viewing locations (COP, Section 4.3.4.3; Dominion Energy 2023).

A University of Delaware study evaluating the impacts of visible offshore WTGs on beach use found that WTGs visible more than 15 miles from the viewer would have negligible impacts on businesses dependent on recreation and tourism activity (Parsons and Firestone 2018). The study participants viewed visual simulations of WTGs in clear, hazy, and nighttime conditions (without ADLS). A 2017 visual preference study conducted by North Carolina State University evaluated the impact of offshore wind facilities on vacation rental prices. The study found that nighttime views of aviation hazard lighting (without ADLS) for WTGs close to shore (5 to 8 miles [8 to 13 kilometers]) would adversely affect the rental price of properties with ocean views (Lutzeyer et al. 2017). It did not specifically address the relationship between lighting, nighttime views, and tourism for WTGs 15 or more miles (24.1 or more kilometers) from shore. All of the WTG positions envisioned in the geographic analysis area would be more than 15 miles (24.1 kilometers) from coastal locations with views of the WTGs.

The Virginia and North Carolina shore are within the viewshed of the WTGs and have been extensively developed for recreation and tourism. Because of the high development density, existing nighttime lighting is prevalent. Elevated boardwalks, jetties, and seawalls afford greater visibility of offshore elements for viewers in tidal beach areas. Nighttime views toward the ocean from the beach and adjacent inland areas are diminished by ambient light levels and glare of shorefront developments. Visible aviation warning lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean, broken only by transient lighted vessels and aircraft passing through the view.

In addition to recreational fishing, some recreational boating in the region involves whale watching and other wildlife-viewing activities. A 2013 BOEM study evaluated the impacts of WTG lighting on birds, bats, marine mammals, sea turtles, and fish. The study found that existing guidelines “appear to provide for the marking and lighting of [WTGs] that will pose minimal if any impacts on birds, bats, marine mammals, sea turtles or fish” (Orr et al. 2013). By extension, existing lighting guidelines or ADLS (if implemented) would impose a minimal impact on recreational fishing or wildlife viewing.

As a result, although lighting on WTGs would have a continuous, long-term, adverse impact on recreation and tourism, the impact in the geographic analysis area is likely to be limited to individual decisions by visitors to the Virginia and North Carolina shore and elevated areas, with less impact on the recreation and tourism industry as a whole.

The implementation of ADLS would activate the hazard lighting system in response to detection of nearby aircraft. The synchronized flashing of the navigational lights, if ADLS is implemented, would result in shorter-duration night sky impacts on the seascape, landscape, and viewers. The shorter-duration synchronized flashing of the ADLS is anticipated to have reduced visual impacts at night as compared to the standard continuous, medium-intensity red strobe FAA warning system due to the duration of activation. Based on historical air traffic data, activation of the ADLS, if implemented, would occur for about 25 hours and 33 minutes over a 1-year period, as compared to standard continuous FAA hazard lighting (COP, Appendix T; Dominion Energy 2023). It is anticipated that an ADLS-controlled obstruction lighting system could result in over a 99 percent reduction in system-activated duration as compared to a traditional always-on obstruction lighting system.

Cable emplacement and maintenance: Under the No Action Alternative, future offshore wind export cables from the Kitty Hawk Offshore Wind Projects could total approximately 453 miles (729 kilometers), while inter-array cables could total approximately 349 miles (562 kilometers) (Appendix F, Table F2-1). One existing offshore wind project (CVOW-Pilot Project) has approximately 24 miles (44.5 kilometers) of offshore export cable installed. Specific cable locations associated with future offshore wind projects are unknown and, therefore, have not been identified in the geographic analysis area. Cables for other future offshore wind projects would likely be emplaced in the geographic analysis area between 2024 and 2030. Based on the assumptions in Appendix F, these cables could affect up to 130,145[1] acres (52,667.8 hectares) (Appendix F, Table F2-2).

Offshore cable emplacement for future offshore wind development projects would have temporary, localized, adverse impacts on recreational boating while cables are being installed, because vessels would

[1] Kitty Hawk Wind South has three export cables (92 kilometers to Virginia, 322 kilometers to North Carolina, and an additional 154 kilometers of inshore export cable to North Carolina) for a total of 568 kilometers (352.9 miles), and corridor widths between 1,520-foot-wide corridor to Virginia and 1,000-foot-wide corridors to North Carolina to allow for optimal routing of the cables.

need to navigate around work areas, and recreational boaters would likely prefer to avoid the noise and disruption caused by installation. Cable installation could also have temporary impacts on fish and invertebrates of interest for recreational fishing, due to the required dredging, turbulence, and disturbance; however, species would recover upon completion (Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*). The degree of temporal and geographic overlap of each cable is unknown, although cables for some projects could be installed simultaneously. Active work and restricted areas would only occur over the cable segment being emplaced at a given time. Once installed, cables would affect recreational boating only during maintenance operations, except that the mattresses covering cables in hard-bottom areas could hinder anchoring and result in gear entanglement or loss.

Impacts of cable emplacement and maintenance on recreational boating and tourism would be short term, continuous, adverse, and localized.

Noise: Noise from construction, pile driving, HRG survey activities, trenching, O&M, and vessels could result in adverse impacts on recreation and tourism.

Onshore construction noise from cable installation at the landfall sites, and inland if cable routes are near parkland, recreation areas, or other areas of public interest, would temporarily disturb the quiet enjoyment of the site (in locations where such quiet is an expected or typical condition). Similarly, offshore noise from HRG survey activities, pile driving, trenching, and construction-related vessels would intrude upon the natural sounds of the marine environment. This noise could cause some boaters to avoid areas of noise-generating activity, although some of the most intense noise could be within safety zones that USCG may establish for areas of active construction, which would be off-limits to boaters. Noise from pile driving is estimated to produce sound power levels of 87 dBA in-air at 400 feet (122 meters) (COP, Section 4.1.4.2; Dominion Energy 2023). BOEM conducted a qualitative analysis of impacts on recreational fisheries for the construction phases of offshore wind development in the Atlantic OCS region. Results showed the construction phase is expected to have a slightly negative to neutral impact on recreational fisheries due to both direct exclusion of fishing activities and displacement of mobile target species by the construction noise (Kirkpatrick et al. 2017).

During operations, the continuous noise generated by WTG operation is not expected to produce sound in excess of background levels at any onshore locations (COP, Section 4.1.4.2; Dominion Energy 2023). Accordingly, the impact of noise on recreation and tourism during construction would be adverse, intense, and disruptive, but short term and localized. Multiple construction projects at the same time would increase the number of locations in the geographic analysis area that experience noise disruptions. The impact of noise during O&M would be localized, continuous, and long term, with brief, more-intensive noise during occasional repair activities.

Adverse impacts of noise on recreation and tourism would also result from the adverse impacts on species important to recreational fishing and sightseeing in the lease areas and along cable routes, as discussed in Sections 3.9, *Commercial Fisheries and For-Hire Recreational Fishing,* 3.13, *Finfish, Invertebrates, and Essential Fish Habitat,* and 3.15, *Marine Mammals*. Because most recreational fishing takes place closer to shore than the Lease Area, only a small proportion of recreational fishing would be affected by construction in the Lease Area, where most of the noise impacts would occur. Recreational fishing such as for tuna, shark, and marlin is more likely to be affected, as these fisheries are farther offshore than most fisheries and, therefore, more likely to experience temporary impacts resulting from the noise generated by future offshore wind construction. Construction noise could contribute to temporary impacts on marine mammals, with resulting impacts on marine sightseeing that relies on the presence of mammals, primarily whales. However, as noted in Section 3.15, *Marine Mammals,* future projects are expected to comply with mitigation measures (e.g., exclusion zones, protected species observers) that would avoid and minimize underwater noise impacts on marine mammals.

Noise from operational WTGs would be expected to have little effect on finfish, invertebrates, and marine mammals and, therefore, little effect on recreational fishing or sightseeing.

Future offshore wind surveying and construction would occur in the geographic analysis area between 2024 and 2030. Future offshore wind construction would result in short-term, localized, adverse impacts on recreational fishing and marine sightseeing related to fish and marine mammal populations. Multiple construction projects would increase the spatial and temporal extent of temporary disturbance to marine species in the geographic analysis area. BOEM's assumed construction schedule for future offshore wind projects in Appendix F, Table F-3 indicates the possibility of two other wind projects under development in the Lease Area. As indicated in Appendix F, up to 190 offshore WTGs and three OSSs could be installed within a 6-year period in the Lease Area, not including the Proposed Action. No long-term, adverse impacts are anticipated that would result in population-level harm to fish and marine mammal populations.

Port utilization: The geographic analysis area for recreation and tourism contains the PMT and Newport News Marine Terminal, which would be used by the Proposed Action (COP, Section 3.3.2.6; Dominion Energy 2023). Areas outside the geographic analysis area for recreation and tourism that are likely to be used for staging and construction, such as the ports that would be used by the Proposed Action, may provide facilities for recreational vessels or may be on waterways shared with recreational marinas, and may experience increased activity and undergo expansion and dredging. The ports listed above and other regional ports suitable for staging and construction of future offshore wind development are primarily industrial in character, with recreational activity as a secondary use.

Port improvements could result in short-term delays and crowding during construction but could provide long-term benefits to recreational boating if the improvements result in increased berths and amenities for recreational vessels, or improved navigational channels.

Presence of structures: The placement of 190 WTGs and three OSSs in the Lease Area in the geographic analysis area would contribute to impacts on recreational fishing and boating. The offshore structures would have long-term, adverse impacts on recreational boating and fishing through the risk of allision; risk of gear entanglement, damage, or loss; navigational hazards; space use conflicts; presence of cable infrastructure; and visual impacts. However, future offshore wind structures could have beneficial impacts on recreation through fish aggregation and reef effects.

The WTGs and OSSs installed in the Wind Farm Area are expected to serve as additional artificial reef structures, providing additional locations for recreational for-hire fishing trips, potentially increasing the number of trips and revenue. The increased number of fishing trips out of nearby ports could also support increased angler expenditures at local bait shops, gas stations, and other shore-side dependents (COP, Sections 4.2.4.3, 4.4.11.2, and 4.4.6.3; Dominion Energy 2023).

The presence of future offshore wind structures would increase the risk of allision or collision with other vessels and the complexity of navigation in the Lease Area. Generally, the vessels more likely to allide with WTGs or OSSs would be smaller vessels moving within and near wind installations, such as recreational vessels. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly over the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success, as described in greater detail in Section 3.17, *Other Uses (Marine Minerals, Military Use, Aviation).*

Future offshore wind development could require adjustment of routes for recreational boaters, anglers, sailboat races, and sightseeing boats, but the adverse impact of the future offshore wind structures on recreational boating would be limited by the distance of the wind turbines offshore. AIS data from 2018 show that there is typically very low recreational activity from craft/sailing vessels within and directly adjacent to the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2023). In addition, sailing in the geographic analysis area primarily occurs nearshore, just along the coastline, rather than farther offshore (COP, Section 4.4.11.1; Dominion Energy 2023).

The geographic analysis area would have an estimated 403 foundations with scour protection and 240 acres (97 hectares) of hard protection for export and inter-array cables, which results in an increased risk of entanglement (Appendix F, Table F2-2). The cable protection would also present a hazard for anchoring, as anchors could have difficulty holding or become snagged and lost. Accurate marine charts could make operators of recreational vessels aware of the locations of the cable protection and scour protection. If the hazards are not noted on charts, operators may lose anchors, leading to increased risks associated with drifting vessels that are not securely anchored. Lessees in the geographic analysis area continue to engage with both USCG and NOAA in developing a comprehensive aid to navigation plan for the entire Lease Area (COP, Section 4.4.7.1; Dominion Energy 2023). Buried offshore cables would not pose a risk for most recreational vessels, as smaller-vessel anchors would not penetrate to the target burial depth for the cables. Because anchoring is uncommon in water depths where the WTGs for future offshore wind projects excluding the proposed Project would be installed, anchoring risk is more likely to be an impact over export cables in shallower water closer to coastlines. The risk to recreational boating would be localized, continuous, and long term.

Future offshore wind structures could provide new opportunities for offshore tourism by attracting recreational fishing and sightseeing. The wind structures could produce artificial reef effects. The “reef effect” refers to the introduction of a new hard-bottom habitat that has been shown to attract numerous species of algae, shellfish, finfish, and sea turtles to new benthic habitat (COP, Sections 4.2.4.2, 4.4.11.2, and 4.4.6.3; Dominion Energy 2023). The reef effect could attract species of interest for recreational fishing and result in an increase in recreational boaters and sightseeing vessels traveling farther from shore to fish in the Lease Area. Although the likelihood of recreational vessels visiting the offshore WTG foundations would diminish with distance from shore, increasing numbers of offshore structures may encourage a greater volume of recreational vessels to travel to the offshore wind lease areas. Additional fishing and tourism activity generated by the presence of structures could also increase the likelihood of allisions and collisions involving recreational fishing or sightseeing vessels, as well as commercial fishing vessels (Section 3.9, *Commercial Fisheries and For-Hire Fishing*).

As it relates to the visual impacts of structures, the vertical presence of WTGs on the offshore horizon may affect recreational experience and tourism in the geographic analysis area. Section 3.20, *Scenic and Visual Resources*, describes the visual impacts from offshore wind infrastructure. If the purpose of the viewer’s sightseeing excursion is to observe the mass and scale of the WTGs’ offshore presence, then the increasing visual dominance would benefit the recreation/tourism experience as the viewer navigates toward the WTGs. However, if experiencing a vast pristine ocean condition is the purpose of the viewer’s sightseeing excursion, then the increasing visual dominance may detract from the viewer’s recreation/tourism experience.

Studies and surveys that have evaluated the impacts of offshore wind facilities on tourism found that established offshore wind facilities in Europe did not result in decreased tourist numbers, tourist experience, or tourist revenue, and that Block Island Wind Farm’s WTGs provide excellent sites for fishing and shellfishing (Smythe et al. 2018). A survey-based study found that, for prospective offshore wind facilities (based on visual simulations), proximity of WTGs to shore is correlated to the share of respondents who would expect a worsened experience visiting the coast (Parsons and Firestone 2018).

- At 15 miles (24.1 kilometers), the percentage of respondents who reported that their beach experience would be worsened by the visibility of WTGs was about the same as the percentage of those who reported that their experience would be improved (e.g., by knowledge of the benefits of offshore wind).

- About 68 percent of respondents indicated that the visibility of WTGs would neither improve nor worsen their experience.
- Reported trip loss (respondents who stated that they would visit a different beach without offshore wind development) averaged 8 percent when wind projects were 12.5 miles (20 kilometers) offshore, 6 percent when 15 miles (24.1 kilometers) offshore, and 5 percent when 20 miles (32 kilometers) offshore.
- About 2.6 percent of respondents were more likely to visit a beach with visible offshore wind facilities at any distance.

A study focused on the changes to the vacation rental market after the construction of Block Island Wind Farm found that Block Island Wind Farm led to significantly increased nightly reservations, occupancy rates, and monthly revenues for properties in Block Island during peak tourism season in July and August (Carr-Harris and Lang 2019). The study estimates that the Block Island Wind Farm caused a 7-night increase in reservations, a 19 percent increase in occupancy rates, and a $3,490 increase in rental property revenue during July and August. Outside of peak tourism season, the Block Island Wind Farm did not have an impact on the vacation rental market.

However, a 2003 survey focused on tourists' feelings about potential offshore wind development in Cape Cod, Massachusetts found that, based on visual simulations of prospective offshore wind facilities, 3.2 percent of tourists said they would spend an average of 2.9 fewer days in Cape Cod, and a further 1.8 percent said they would not visit at all if the wind turbines were built (Haughton et al. 2003).

A 2019 survey of 553 coastal recreation users in New Hampshire included participants in water-based recreation activities such as fishing from shore and boats, motorized and non-motorized boating, beach activities, and surfing at the New Hampshire seacoast. Most (77 percent) supported offshore wind development along the New Hampshire coast, while 12 percent opposed it and 11 percent were neutral. Regarding the impact on their outdoor recreation experience, 43 percent anticipated that offshore wind development would have a beneficial impact, 31 percent anticipated a neutral impact, and 26 percent anticipated an adverse impact (BOEM 2021).

The wind turbines used for the visual simulations in the studies cited above used smaller WTGs than are proposed for the planned offshore wind projects in the region, including the Proposed Action. The studies cited in the Final EIS used 579-foot (176.5-meter) WTGs that would be visible out to 32.4 miles (52.1 kilometers). The 869-foot (265-meter) CVOW-C Project WTGs would be visible out to 39 miles (62.8 kilometers). Greater eye-level heights would increase the visible distance in both cases. Both the WTGs used in the studies and the WTGs proposed as part of the CVOW-C Project would have the WTG hubs, nacelles, navigation lights, and rotor blades visible to viewers on the nearest beach. The visibility of the WTGs would be variable, depending on current meteorological, moonlight, and sunlight conditions. In views seaward, there would be periods of high, moderate, low and no visibility. Therefore, in both the 2018 Parsons and Firestone studies and for the CVOW-C Project, the WTGs' hubs, nacelles, navigation lights, and rotor blades would be visible to viewers on the nearest beach. The taller CVOW-C Project WTGs would result in increased numbers of WTGs visible in the wind farm. Such additional WTGs would be seen as lower than or below the tops of the forward row of WTGs and would be increasingly obscured by those intervening in the view. The wind farm would be perceived as a mass of WTGs, rather than as individual WTGs.

As described under the IPF for light, the Virginia and North Carolina shore within the viewshed of the WTGs is highly developed. Public beaches and tourism attractions in this area are highly valued for scenic, historic, and recreational qualities and draw large numbers of daytime visitors during the summertime tourism seasons. When visible (i.e., on clear days, in locations with unobstructed ocean views), WTGs would add a developed/industrial visual element to ocean views that were previously characterized by open ocean, broken only by transient vessels and aircraft passing through the view.

Based on currently available studies, portions of the 190 WTGs associated with the No Action Alternative could be visible from shorelines (depending on vegetation, topography, weather, atmospheric conditions, and the viewers' visual acuity). WTGs visible from some shoreline locations in the geographic analysis area would have adverse impacts on visual resources when discernable due to the introduction of industrial elements in previously undeveloped views. Based on the relationship between visual impacts and impacts on recreational experience, the impact of visible WTGs on recreation would be long term, continuous, and adverse. Seaside locations could experience some reduced recreational and tourism activity, but the visible presence of WTGs would be unlikely to affect shore-based or marine recreation and tourism in the geographic analysis area as a whole.

Traffic: Future offshore wind project construction and decommissioning and, to a lesser extent, future offshore wind project operation would generate increased vessel traffic that could inconvenience recreational vessel traffic in the geographic analysis area. The impacts would occur primarily during construction, along routes between ports and the future offshore wind construction areas.

Vessel traffic for two planned projects in the geographic analysis area (Kitty Hawk Offshore Wind Projects) is not known but is anticipated to be similar to that of the Proposed Action, which is projected to generate an average of 46 daily vessel trips between ports and offshore work areas over the entire construction phase and a maximum of 95 vessel trips daily during peak construction activity (COP, Section 3.4.1.5; Dominion Energy 2023). As shown in Appendix F, Table F-3, between 2024 and 2030 two offshore wind projects (not including the Proposed Action) could be under construction simultaneously (in 2024–2027). During such periods, assuming similar vessel counts as under the Proposed Action, construction of offshore wind projects would generate an average of 46 vessel trips daily from Atlantic Coast ports to worksites along the Virginia and North Carolina Lease Area, with as many as 95 vessels present (either underway or at anchor) during times of peak construction.

Establishment of two future offshore wind projects could occur in the Geographic Analysis Area between 2024 and 2030. O&M activities for the project are anticipated to generate an average of 46 vessel trips per day between a port and the Wind Farm Areas. Based on the estimates for the proposed projects, the cumulative No Action Alternative would generate an average of 46 vessel trips per day.

Increased vessel traffic would require increased alertness on the part of recreational or tourist-related vessels and would result in minor delays or route adjustments. The likelihood of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. The possibility of delays and risk of collisions would increase if more than one future offshore wind facility is under construction at the same time. Vessel traffic associated with future offshore wind would have long-term, variable, adverse impacts on vessel traffic related to recreation and tourism. Higher volumes during construction would result in greater inconvenience, disruption of the natural marine environment, and risk of collision. Vessel traffic during operations would represent only a modest increase in the background volumes of vessel traffic, with minimal impacts on recreational vessels.

3.18.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, recreation and tourism would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent, **minor** impacts on recreation and tourism.

Cumulative impacts of the No Action Alternative. Under the No Action Alternative, existing environmental trends and ongoing activities would continue, and recreation and tourism would continue to be affected by natural and human-caused IPFs. Planned activities would contribute to impacts on recreation and tourism due to noise, presence of structures, vessel traffic, and port utilization from increased onshore and offshore construction and operation.

BOEM expects ongoing activities, future non-offshore wind activities, and future offshore wind activities to have continuing impacts on recreation and tourism. BOEM anticipates that the impacts of ongoing activities, including ongoing vessel traffic and the noise and trenching from periodic maintenance or installation of piers, pilings, seawalls, or offshore cables, would be **negligible**. In addition to ongoing offshore wind activities, planned activities other than offshore wind may also contribute to impacts on recreation and tourism. Offshore activities other than offshore wind would have localized, temporary impacts on recreational boating and would not affect the area's scenic quality. BOEM anticipates that the impacts of planned activities other than offshore wind would be **minor**. BOEM expects the combination of ongoing and planned activities other than offshore wind to result in **minor** impacts on recreation and tourism, driven primarily by marine construction and dredging to install and maintain offshore cables, piers, seawalls, and harbors.

Considering all of the IPFs together, BOEM anticipates that the overall impacts associated with future offshore wind activities in the geographic analysis area combined with ongoing activities, reasonably foreseeable environmental trends, and planned activities other than offshore wind would result in **minor** adverse impacts and **minor beneficial** impacts. Future offshore wind activities are expected to contribute considerably to several IPFs, the most prominent being noise and vessel traffic during construction and the presence of offshore structures during operations. Noise and vessel traffic would have impacts on visitors, who may avoid onshore and offshore noise sources and vessels, and on recreational fishing and sightseeing as a result of the impacts on fish, invertebrates, and marine mammals. The long-term presence of offshore wind structures would result in increased navigational constraints and risks, potential entanglement and loss, and visual impacts from offshore structures. BOEM also anticipates that the future offshore wind activities in the geographic analysis area would result in **minor beneficial** impacts due to the presence of offshore structures and scour protection, which could provide opportunities for fishing and sightseeing.

3.18.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than described in the sections below. The following proposed PDE parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*) would influence the magnitude of the impacts on recreation and tourism.

- The Project layout including the number, type, height, and placement of the WTGs and OSSs, and the design and visibility of lighting on the structures.
- The arrangement of WTGs, as it affects accessibility of the Wind Farm Area to recreational boaters.
- The time of year during which onshore and nearshore construction occurs.

Variability of the proposed Project design exists as outlined in Appendix E, *Project Design Envelope and Maximum-Case Scenario*. Below is a summary of potential variances in impacts.

- **WTG number, size, location, and lighting:** More WTGs and larger, 16-MW turbines located within the Lease Area but closer to shore could increase visual impacts that affect onshore recreation and tourism, as well as recreational boaters. Arrangement and type of lighting systems would affect nighttime visibility of WTGs onshore.
- **WTG arrangement and orientation:** Different arrangements of WTG arrays may affect navigational patterns and safety of recreational boaters.

- **Time of construction:** Tourism and recreational activities in the geographic analysis area tend to be higher from May through September, and especially from June through August (Parsons and Firestone 2018). Impacts on recreation and tourism would be greater if Project construction were to occur during this season.

3.18.5 Impacts of the Proposed Action on Recreation and Tourism

The Proposed Action would have long-term, minor impacts on recreation and tourism in the geographic analysis area due to the visual impact of the up-to 202 WTGs from coastal locations and the greater navigational risks for recreational vessels in the Wind Farm Area. It would also have long-term, minor beneficial impacts due to the fish aggregation effects associated with the WTGs and OSSs, resulting in new fishing and sightseeing opportunities. The Proposed Action would have short-term, minor impacts during construction due to the temporary impacts of noise and vessel traffic on recreational vessel traffic, the natural environment, and species important for recreational fishing and sightseeing.

Anchoring: Anchoring by construction and maintenance vessels would contribute to disturbance of marine species and inconvenience recreational vessels that must navigate around the anchored vessels. The Proposed Action would generate an average of 46 daily vessel trips during the entire construction period and a maximum of 95 daily vessel trips during peak construction periods in the Wind Farm Area (COP, Section 3.4.1.5; Dominion Energy 2023). BOEM anticipates that USCG may establish temporary safety zones around offshore wind construction areas, which would minimize the potential for recreational boater interaction with anchored construction vessels in these areas. Vessel anchoring for construction of the Proposed Action would have localized, short-term, minor impacts on tourism and recreation due to the need to navigate around vessels and work areas and the disturbance of species important to recreational fishing (COP, Sections 4.2.4.3 and 4.4.9.2; Dominion Energy 2023).

Land disturbance: Onshore construction and installation of the export cables would affect recreation and tourism where construction activity interferes with access to recreation sites or increases traffic, noise, or temporary emissions that degrade the recreational experience.

The entirety of the 46.48 acres (18.8 hectare) footprint of the proposed Harpers Switching Station would overlap with the Aeropines Golf Club in Virginia Beach, Virginia. Within that footprint, the relocation of fairways and a maintenance building would occur on 6.1 acres (2.5 hectares). Construction of the switching station would result in a temporary disruption of access to these facilities until they are relocated. Another golf course, the Battlefield Golf Club, is adjacent to the existing Fentress Substation in Chesapeake, Virginia. Construction activities to upgrade the Fentress Substation may result in temporary impacts on the golf course, such as increases in traffic, noise, or temporary emissions; however, no long-term, permanent impacts on nearby recreational facilities are anticipated. Additionally, construction of the onshore interconnection cable along Dam Neck Road could result in temporary, construction-related impacts on the Princess Anne Athletic Complex in Virginia Beach, Virginia. Because the onshore interconnection cable corridor would use existing ROW to the maximum extent possible and the Princess Anne Athletic Complex is set off the road, long-term impacts are not anticipated.

As discussed in Section 3.11, *Demographics, Employment, and Economics*, the employment and economic impact would be localized, short term, and minor. As discussed in Section 3.14, *Land Use and Coastal Infrastructure*, technologies may be used to minimize impacts on land disturbance. Dominion Energy has committed to implementing a construction schedule to minimize activities in the onshore export cable route during the peak recreation and tourism season and to coordinate with local municipalities to minimize impacts on popular events in the area during construction, to the extent practicable (COP, Section 4.4.3.3; Dominion Energy 2023). These measures would minimize impacts on recreation and tourism from construction activities.

Light: When nighttime construction occurs, the vessel lighting for vessels traveling to and working at the Proposed Action's offshore construction areas may be visible from onshore locations depending on the distance from shore, vessel height, and atmospheric conditions. Visibility would be sporadic and variable. Although most construction is expected to occur during daylight hours, construction vessels would use work lights to improve visibility during night or poor visibility, in accordance with USCG requirements.

During operations, the Proposed Action would have a discrete contribution to nighttime visibility of the WTGs due to required aviation hazard lighting. FAA lighting from all of the Proposed Action's WTGs could be visible up to 36.2 miles away depending on weather and viewing conditions (COP, Section 4.3.4.3; Dominion Energy 2023). Dominion Energy has committed to implementing ADLS as an APM that would activate the Proposed Action's WTG lighting only when aircraft approach the WTGs (COP, Section 4.3.4.3; Dominion Energy 2023). The implementation of ADLS would reduce the duration of the potential impacts of nighttime aviation lighting to less than 1 percent of the normal operating time that would occur without using ADLS. During times when the Proposed Action's aviation warning lighting is visible, this lighting would add a developed/industrial visual element to views that were previously characterized by dark, open ocean. Due to the limited duration and frequency of such events and the distance of the Proposed Action's WTGs from shore, visible aviation hazard lighting for the Proposed Action would result in a long-term, intermittent, negligible impact on recreation and tourism. Onshore, Dominion Energy would implement lighting-reduction measures, such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable (COP, Section 4.2.2.3; Dominion Energy 2023).

New cable emplacement and maintenance: The Proposed Action's cable emplacement would generate vessel anchoring and dredging at the worksite, requiring recreational vessels to avoid and navigate around the worksites and resulting in short-term disturbance to species important to recreation and tourism. The Proposed Action would require up to 416.9 miles (671 kilometers) of total length of offshore export cables and up to 300 miles (484 kilometers) total length of inter-array cables (COP, Section 1.2, Table 1.2-1; Dominion Energy 2023). Array cable installation would require a maximum of 10 vessels (three main laying, two burial, four support vessels, and one post-installation survey vessel) (COP, Section 3.4.1.5; Dominion Energy 2023). Offshore export cable installation would require a maximum of 11 vessels (three main laying, three main cable jointing, three burial, and two support vessels) (COP, Section 3.4.1.5; Dominion Energy 2023). Recreational vessels traveling near the offshore export cable routes would need to navigate around vessels and access-restricted areas associated with the offshore export cable installation. Dominion Energy has committed to coordinate with USCG through the use of Local Notices to Mariners to communicate with recreational fishers, among others, of construction and maintenance activities and vessel movements, which would minimize potential adverse impacts associated with cable emplacement and maintenance activity (COP, Section 4.4.7.3; Dominion Energy 2023). The localized, temporary need for changes in navigation routes due to Proposed Action construction would constitute a minor impact.

Cable installation could also affect species of interest for recreational fishing and sightseeing through turbidity resulting from cable installation, although species would recover upon completion (Sections 3.19, *Sea Turtles*, and 3.16, *Navigation and Vessel Traffic*), resulting in localized, short-term, minor impacts on recreation and tourism (COP, Sections 4.2.4.3, 4.2.5.2, and 4.4.6.3; Dominion Energy 2023).

Specific cable locations associated with future offshore wind projects have not been identified in the geographic analysis area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of cable emplacement and maintenance on recreational marine activities from ongoing and planned activities would likely be short term and minor.

Noise: Noise from O&M, pile driving, trenching, and vessels could result in impacts on recreation and tourism. Temporary impacts on recreation and tourism would result from impacts in the Wind Farm Area and along the offshore export cable route on species important to recreational fishing and marine sightseeing (COP, Sections 4.4.5.2, 4.1.5.3 and 4.2.4.3; Dominion Energy 2023). The temporary behavioral disruptions of offshore fish, shellfish, and whales due to startle responses or avoidance of the ensonified area during construction (Sections 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, and 3.15, *Marine Mammals*) would have a minor impact on recreational fishing or marine sightseeing.

In addition to the temporary disruption to fish and shellfish, noise generated by offshore construction and onshore cable installation would have impacts on the recreational enjoyment of the marine and coastal environments, with minor impacts on recreation and tourism. Offshore construction noise would occur from vessels, trenching, and pile driving along the offshore export cable route and in the Wind Farm Area. Noise from pile driving is estimated to produce sound power levels of 87 dBA in-air at 400 feet (122 meters) (COP, Section 4.1.4.2; Dominion Energy 2023). Where areas within or near the offshore export cable route and Wind Farm Area are available for recreational boating during construction, increased noise from construction would temporarily inconvenience recreational boaters.

Overall, construction noise from the Proposed Action alone would have localized, short-term, minor impacts on recreation and tourism. Offshore operational noise from the WTGs would be similar to the noise described for other projects under the No Action Alternative and would, therefore, have continuous, long-term, negligible impacts.

Port utilization: Within the geographic analysis area, the Proposed Action would use facilities at PMT and Newport News Marine Terminal to support the staging of components and construction vessels for the Project. Planned upgrades to the PMT will derive from roughly $8 billion of direct investment by Dominion Energy and a contribution of up to a $40 million from the Commonwealth of Virginia for site improvement and readiness (Chapter 2, *Proposed Action and Alternatives*; COP, Section 4.4.1.2; Dominion Energy 2023). Increased vessel traffic and construction activity during upgrades at PMT and Newport News Marine Terminal may result in short-term delays and crowding during construction. The Proposed Action would have a short-term, negligible impact on recreation and tourism due to port utilization within the geographic analysis area.

Presence of structures: The Proposed Action's up-to 202 WTGs and three OSSs would affect recreation and tourism through increased navigational complexity; risk of allision or collision; attraction of recreational vessels to offshore wind structures for fishing and sightseeing; the adjustment of vessel routes used for sightseeing and recreational fishing; the risk of fishing gear loss or damage by entanglement due to scour or cable protection; and potential difficulties in anchoring over scour or cable protection.

Construction and installation, expected to begin in 2023 and be completed in 2027, would affect recreational boaters. Risk of allision with anchored vessels would increase incrementally during construction, because more anchored vessels would be in the geographic analysis area (Appendix F, Table F-3). Dominion Energy has committed to marking potential hazards in coordination with USCG, developing Local Notices to Mariners that would include locations of partially installed structures, and advising mariners of safety zones around all Offshore Project components, which would minimize potential adverse impacts associated with structure construction activities (COP, Section 4.4.7.2; Dominion Energy 2023). AIS data from 2019 show that there is typically very low recreational activity from craft/sailing vessels within and directly adjacent to the Lease Area (COP, Section 4.4.7.1; Dominion Energy 2023). In addition, sailing in the geographic analysis area primarily occurs nearshore, just along the coastline, rather than farther offshore (COP, Section 4.4.11.1; Dominion Energy 2023). Impacts would be mitigated through the use of navigation-related measures.

During O&M of the Proposed Action, the permanent presence of WTGs would create obstacles for recreational vessels. At their lowest point, WTG blade tips would be 82 feet (24 meters) above the surface (COP, Table 3.3-1; Dominion Energy 2023). At this height, larger sailboats would need to navigate around the Wind Farm Area, while smaller vessels could navigate unobstructed (except for the WTG monopiles).

Outside of avoiding certain operations during the construction phase, there are no planned or enforceable restrictions to vessels operating in the Wind Farm Area. USCG would need to adjust its SAR planning and search patterns to allow aircraft to fly within the geographic analysis area, leading to a less-optimized search pattern and a lower probability of success. Between 2010 and 2019, 18 SAR incidents were recorded in the geographic analysis area: 14 involved material failure or malfunction while three involved injury to personnel. Also during this time were 26 SAR incidents in the export cable geographic analysis area: 10 involved material failure or malfunction and five involved personnel injury, four of which were considered serious incidents (COP, Appendix S, Section 9.1.2; Dominion Energy 2023).

Recreational anglers may avoid fishing in the Wind Farm Area due to concerns about their ability to safely fish within or navigate through the area. Navigational hazards and scour/cable protection due to the presence of structures from ongoing and planned activities, including the Proposed Action, would result in major adverse impacts on commercial fisheries and moderate adverse impacts on for-hire recreational fishing; minimal beneficial impacts on for-hire recreational fishing due to the artificial reef effect may be long term. BOEM does not anticipate that fish aggregation due to the presence of structures would result in considerable changes in fish distributions across the geographic analysis area. For-hire fishing operations are part of the recreation and tourism industry and are included in the impacts on recreational boating and fishing anticipated in this section. The detailed discussion of impacts on for-hire fishing activities provided in Section 3.9, *Commercial Fisheries and For-Hire Recreational Fishing*, may also be applicable to impacts on recreational fishing in general. Overall, the impacts on recreational fishing, boating, and sailing generally would be negligible, while the impacts on for-hire fishing would be minor because these enterprises are more likely to be materially affected by displacement.

Although some recreational anglers would avoid the Wind Farm Area, the scour protection around the WTG foundations would likely attract forage fish and game fish, which could provide new opportunities for certain recreational anglers. Evidence from Block Island Wind Farm indicates an increase in recreational fishing near the WTGs (Smythe et al. 2018). The fish aggregation and reef effects of the Proposed Action could also create foraging opportunities for marine species and mammals, such as seals and harbor porpoises, possibly attracting recreational boaters and sightseeing vessels (Glarou et al. 2020). In addition, future offshore wind development could attract sightseeing boats offering tours of the wind facilities. Based on the impacts of the WTGs and OSSs on navigation and fishing, the potential reef effects of these structures, and the risks to anchoring and gear loss associated with scour or cable protection, the Proposed Action would have long-term, continuous, minor beneficial and minor adverse impacts on recreation and tourism (COP, Sections 4.2.5.2, 4.4.11.2, and 4.4.6.3; Dominion Energy 2023).

Structures from other planned offshore wind development would generate comparable types of impacts as the Proposed Action alone. The geographic extent of impacts would increase as additional offshore wind projects are constructed, but the level of impacts would likely be the same: minor adverse impacts on recreational fishing, recreational sailing and boating, and for-hire recreational fishing, as well as minor beneficial impacts. A lack of a common turbine spacing and layout throughout all wind projects within the geographic analysis area could make it more difficult for SAR aircraft to perform operations in the Lease Area. In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the impacts of offshore structures on marine recreational activities from ongoing and planned activities would be minor due to the increased number of offshore structures and reduction of SAR capacity based on the layout of the WTG and OSSs, and minor beneficial impacts would occur due to the opportunity for fishing and sightseeing provided by WTGs.

As it relates to visual impacts of presence of structures, the Proposed Action’s 202 WTGs would also affect recreation and tourism through visual impacts. During construction, viewers in certain locations along the Virginia and North Carolina shore would see increased vessel traffic transporting components from fabrication and manufacturing facilities to the Project area. Vessel traffic is commensurate along the Atlantic Coast and vessel use for construction would be similar to existing vessel traffic in the area. Based on the duration of construction activity, visual contrast associated with construction of the Proposed Action would have a temporary, negligible impact on recreation and tourism.

The WTGs would be in open ocean approximately 27 statute miles east of Virginia Beach. The maximum-case WTGs would have a height of 869 feet (265 meters) at the tip of the rotor blade, a hub height at 489 feet (149 meters) (COP, Appendix I-1, Figure I-1-2 and Section I-1.2.3; Dominion Energy 2023). At 31 miles (49.9 kilometers), the tip of the rotor blade (in the upright position) would be above the horizon line (COP, Appendix I-1, Section I-1.4.1; Dominion Energy 2023). Between 28.1 and 35.8 miles, only the WTG blades would be potentially visible above the horizon from the perspective of a beach-elevation viewer (COP, Appendix I-1, Section I-1.4.1, Figure I-1-7; Dominion Energy 2023). Dominion Energy has voluntarily committed to using ADLS and non-reflective pure white (RAL Number 9010) or light gray (RAL Number 7035) paint colors as described in Appendix I, *Environmental and Physical Settings*, to reduce impacts. Additionally, the lower sections of each WTG would be marked with high-visibility (RAL Number 1023) yellow paint from the water line to a minimum height of 50 feet (15 meters) (COP, Appendix I-1, Section I-1.2.3; Dominion Energy 2023).

The visual impact of future offshore wind structures could affect recreation and tourism. The visual contrast created by the WTGs could have a beneficial, adverse, or neutral impact on the quality of the recreation and tourism experience depending on the viewer's orientation, activity, and purpose for visiting the area. As discussed in Section 3.20, *Scenic and Visual Resources*, the magnitude of impact is defined by the contrast, scale of the change, prominence, field of view (FOV), viewer experience, geographical extent, and duration, correlated against the sensitivity of the receptor, as simulated from onshore KOPs. The seascape character units, open ocean character unit, landscape character unit, and viewer experiences would be affected during construction, O&M, and 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 in Appendix M.

BOEM expects the impact of visible WTGs on the use and enjoyment of recreation and tourist facilities and activities during O&M of the Proposed Action to be long term, continuous, and minor. Beaches with views of WTGs could gain trips from the estimated 2.5 percent of beach visitors for whom viewing the WTGs would be a positive result, offsetting some lost trips from visitors who consider views of WTGs to be negative (Parsons and Firestone 2018).

Portions of 392 WTGs from the Proposed Action combined with future offshore wind projects could be visible from coastal and elevated locations in the geographic analysis area. The simulations prepared by Dominion Energy show anticipated views in clear conditions of future offshore wind projects associated with the No Action Alternative combined with the Proposed Action (COP, Appendix I, Attachment I-1-5; Dominion Energy 2023). The WTGs would be discernable on a clear day, with the color and irregular forms of the WTGs contrasting with the uninterrupted horizontal horizon line associated with the open ocean. As shown in the simulations, the Proposed Action WTGs would contribute the most from the closest locations, such as Virginia Beach. Atmospheric conditions could limit the number of WTGs discernable during daylight hours for a significant portion of the year (COP, Appendix I, Section I-1.4.1; Dominion Energy 2023).

Traffic: The Proposed Action would contribute to increased vessel traffic and associated vessel collision risk, primarily during Project construction and decommissioning, along routes between ports and the offshore construction areas. The Proposed Action would generate an average of 46 and a maximum of 95 vessel trips during the construction period (COP, Section 3.4.1.5; Dominion Energy 2023).

Recreational vessels may experience delays within the ports serving construction (outside the geographic analysis area), but most recreational boaters in the geographic analysis area would experience only minor inconvenience from construction-related vessel traffic. Vessel travel requiring a specific route that crosses or approaches the offshore export cable routes could experience minor impacts (COP, Section 4.4.7.2; Dominion Energy 2023).

For regularly scheduled maintenance and inspections, Dominion Energy anticipates that, on average, the Proposed Action would generate approximately 46 trips daily. Operation of the Proposed Action would have localized, long-term, intermittent, minor impacts on recreational vessel traffic near ports and in open waters due to the periodic and limited nature of regularly scheduled maintenance. Impacts during decommissioning would be similar to the impacts during construction and installation.

Activities requiring repair of WTGs, equipment or cables, or spills from maintenance or repair vessels would generally require intense, temporary activity to address emergency conditions or respond to an oil spill. Non-routine activities could temporarily prevent or deter recreation or tourist activities near the site of a given non-routine event. With implementation of the navigation-related APMs, the impacts of non-routine activities on recreation and tourism would be minor.

3.18.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities.

The contribution of the Proposed Action to the anchoring impacts on recreational boating from ongoing and planned activities would likely be localized, short term, and minor during the period in which offshore wind projects are being constructed in the geographic analysis area. A greater number of vessels would be anchored when multiple offshore wind projects are under construction at one time within the Lease Area, potentially resulting in minor impacts.

The exact extent of land disturbance associated with other projects would depend on the locations of landfall, onshore transmission cable routes, and onshore substations for future offshore wind energy projects. Therefore, in context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the combined land disturbance impacts on recreation and tourism from ongoing and planned activities would be localized, short term, and minor, as impacts are expected to be similar to those of other common construction projects.

Future offshore wind projects could cause aviation hazard lighting from 190 additional WTGs (392 total WTGs, including the Proposed Action) to be potentially visible in the geographic analysis area. Without the use of ADLS, lighting from future offshore wind projects other than the Proposed Action would include red flashing lights on top of WTG nacelles and at the midpoint of WTG towers. In context of reasonably foreseeable environmental trends, ADLS would reduce the nighttime impact significance from minor to negligible due to substantially limited hours of lighting (COP, Section 4.3.4.3; Dominion Energy 2023).

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to the noise impacts on marine recreational activities from ongoing and planned activities would likely be localized, short term, and minor during construction, and long term and negligible during operation.

In context of reasonably foreseeable environmental trends, the contribution of the Proposed Action to port utilization impacts on recreation and tourism from ongoing and planned activities would be negligible.

The combined visual impacts on recreation and tourism from ongoing and planned activities, including the Proposed Action, would likely be continuous, long term, and minor in the overall geographic analysis area, with minor impacts on the closest locations. Impacts would be reduced when atmospheric conditions limit the number of WTGs discernable from any one viewing location.

The Proposed Action is anticipated to be under construction concurrently with two other projects: Kitty Hawk Offshore Wind North and South, OCS-A 0508. During anticipated concurrent construction periods, construction vessel traffic would increase between the proposed ports and the Lease Areas or cable installation work areas associated with each wind project, requiring increased alertness on the part of recreational or tourist-related vessels, and possibly resulting in a greater number of minor delays or route adjustments. The risk of vessel collisions would increase as a result of the higher volumes of vessel traffic during construction. Modest levels of vessel traffic are anticipated from offshore wind operations (COP, Section 4.4.7.2; Dominion Energy 2023). In context of reasonably foreseeable environmental trends, combined vessel traffic impacts on recreation and tourism from ongoing and planned activities, including the Proposed Action, would be short term, variable, and minor during construction and long term, intermittent, localized, and negligible during operations.

3.18.5.2 Conclusions

Impacts of the Proposed Action. In summary, the impacts resulting from individual IPFs associated with the Proposed Action alone would range from **negligible** to **minor** and **negligible** to **minor beneficial**. Impacts would result from short-term impacts during construction: noise, anchored vessels, and hindrances to navigation from the installation of the export cable and WTGs; and the long-term presence of scour protection and structures in the Wind Farm Area during operations, with resulting impacts on recreational vessel navigation and visual quality. Beneficial impacts would result from the reef effect and sightseeing attraction of offshore wind energy structures.

Cumulative impacts of the Proposed Action. In context of other reasonably foreseeable environmental trends in the area, the contribution of the Proposed Action to the impacts of individual IPFs resulting from ongoing and planned activities would range from **negligible** to **minor** with **negligible** to **minor beneficial** impacts. Considering all of the IPFs together, BOEM anticipates that the contribution of the Proposed Action to the impacts associated with ongoing and planned activities would result in **minor** impacts with **minor beneficial** impacts. The main drivers for this impact rating are the minor visual impacts associated with the presence of structures and lighting; impacts on fishing and other recreational activity from noise, vessel traffic, and cable emplacement during construction; and beneficial impacts on fishing from the reef effect.

3.18.6 Impacts of Alternatives B and C on Recreation and Tourism

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. The impacts of Alternatives B and C on recreation and tourism would be the same as those of the Proposed Action except for the impact of the presence of structures. The impacts resulting from individual IPFs associated with construction and installation, O&M, and decommissioning of the Project under Alternatives B and C would be similar to those described under the Proposed Action. Construction of Alternative B or C would install fewer WTGs—up to 176 WTGs (inclusive of three spare WTG positions)—and construction of Alternative C would install up to 172 WTGs (inclusive of two spare WTG positions) and their associated inter-array cables, which would reduce the construction impact footprint and installation period. Turbine sizes under Alternatives B and C would also be reduced by using only 14-MW WTGs, whereas the Proposed Action would allow for up to 16-MW WTGs. Alternatives B and C would also align the three OSSs with the common grid layout of the

WTGs, similar to the Proposed Action. Lastly, Alternative C would also allow for the removal of four WTGs within priority sand ridge habitat as well as the relocation of one WTG and associated inter-array cables. The removal and relocation of these WTGs would allow for a reconfiguration of inter-array cabling to minimize linear seafloor impacts on priority sand ridge habitat. All other design parameters and potential variability in the design would be the same as under the Proposed Action.

The removal of structures under Alternative B to avoid the Fish Haven area and under Alternative C to further avoid priority sand ridge habitats would decrease the risk of recreational or commercial fishing gear loss or damage due to entanglement on the scour protection and inter-array and export cable hard protection. Navigation would also be improved and the risk of allisions or collisions with other vessels would be reduced by aligning the three OSSs with the common grid layout of WTGs. Though minimized, the risk of allision and collisions would still exist under Alternatives B and C and could discourage recreational boaters traveling to and through the Wind Farm Area.

The exclusion zone would minimize impacts on commercial and recreational fisheries resources in the area. Fishing activities could continue, and mobile target species would be less likely to be displaced by construction noise and presence of structures. However, recreational fishing could see a slight decrease in fish due to fewer structures providing reef habitat for targeted species.

Construction of fewer WTGs proposed under Alternatives B and C would result in fewer vessels and vessel trips during construction as compared to the Proposed Action, which would reduce the risk of discharges, fuel spills, and trash in the area and decrease the risk of collision with marine mammals and sea turtles (Sections 3.15, *Marine Mammals*, and 3.19, *Sea Turtles*).

Alternative C's avoidance of priority sand ridge habitats in the southern portion of the Lease Area would protect soft-bottom habitat and benthic species of interest from disturbance, injury, or mortality; reduce changes in water quality; and reduce underwater noise and vibration during construction. Alternative C would also avoid shipwrecks, which may be of interest to recreational divers.

The removal of 29 WTGs for Alternative B and 33 WTGs for Alternative C would result in negligible impacts on the viewshed from the shore when compared to the Proposed Action. As described in Section 3.20, *Scenic and Visual Resources*, the visual differences between the WTG array of Alternatives B and C and the Proposed Action WTG array would not be noticeable to the casual viewer standing on the Virginia Beach oceanfront and would not have a substantive effect on recreation and tourism.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action.

3.18.6.1 Conclusions

Impacts of Alternatives B and C. Alternatives B and C would reduce the overall offshore footprint of the Project. Alternatives B and C would remove WTG positions without relocation and reduce turbine sizes, slightly reducing the visual impact of WTGs and reducing the impacts associated with construction and installation, O&M, and decommissioning. Alternatives B and C would also exclude the Fish Haven area in the northern portion of the Lease Area to reduce impacts on fisheries resources. Alternative C would avoid complex habitat through micrositing and relocation and removal of structures. Accordingly, the impacts resulting from individual IPFs associated with Alternatives B and C would be reduced in comparison to the impacts associated with the Proposed Action but would not change the overall impact magnitudes, which are anticipated to be short term and range from **negligible** to **minor** and **negligible** to **minor beneficial** on recreation and tourism.

Cumulative impacts of Alternatives B and C. In context of reasonably foreseeable environmental trends, the contribution of Alternatives B and C to the impacts from ongoing and planned activities would be the same as under the Proposed Action: **negligible** to **minor** adverse impacts with **negligible** to **minor beneficial** impacts.

3.18.7 Impacts of Alternative D on Recreation and Tourism

Impacts of Alternative D. Alternative D would have the same number of WTGs and the same offshore cable route as the Proposed Action and, therefore, the same anticipated impacts on offshore recreation and tourism. Alternative D has two potential cable routes. Under Alternative D, BOEM would approve only Interconnection Cable Route Option 1 (Alternative D-1) or Hybrid Interconnection Cable Route Option 6 (Alternative D-2). Alternative D-2 would follow the same route as Interconnection Cable Route Option 6, except for the switching station. Alternative D-1 would be installed entirely overhead. The overall length of Alternative D-1 and Alternative D-2 would be the same (14.3 miles [23.0 kilometers]). However, portions of Alternative D-2 would be installed via underground methods, while Alternative D-1 would be installed entirely overhead.

The Chicory Switching Station associated with Alternative D-2, Interconnection Cable Route Option 6, would cover a larger operational footprint than the Harpers Switching Station; however, this is not anticipated to result in additional impacts on recreation and tourism. Trenching required for underground installation of portions of the interconnection cable route under Alternative D-2 may have potential short-term implications for recreational beach users, such as temporary beach closures. No long-term implications are anticipated. Therefore, land disturbance and visual impacts associated with recreational activities and tourism from interconnection cable construction and operation would be slightly less under Alternative D in comparison to the Proposed Action. Overall, the differences in impacts on recreation and tourism between Alternative D and the Proposed Action would be negligible.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts of ongoing and planned activities would not be materially different from those described under the Proposed Action.

3.18.7.1 Conclusions

Impacts of Alternative D. No long-term implications are anticipated. Therefore, land disturbance and visual impacts associated with recreational activities and tourism from interconnection cable construction and operation would be slightly less under Alternative D in comparison to the Proposed Action. Overall, the differences in impacts on recreation and tourism between Alternative D and the Proposed Action would be negligible.

Cumulative impacts of Alternative D. In context of reasonably foreseeable environmental trends, the contribution of Alternative D to the impacts resulting from individual IPFs associated with ongoing and planned activities would be the same as the Proposed Action: short-term impacts ranging from **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts. The overall impacts of Alternative D combined with ongoing and planned activities on recreation and tourism would be the same as the Proposed Action: **negligible** to **minor** adverse impacts and **negligible** to **minor beneficial** impacts.

3.18.8 Agency-Required Mitigation Measures

The mitigation measure listed in Table 3.18-2 is recommended for inclusion in the Preferred Alternative.

Table 3.18-2 Additional Agency-Required Measures: Recreation and Tourism[1]

Measure	Description	Effect
Lighting	Dominion Energy will comply with BOEM's detailed Lighting and Marking Guidelines and NPS sustainable lighting best practices.	Compliance with BOEM's lighting and marking guidelines and NPS sustainable lighting best practices could reduce the impact of the Proposed Action on onshore parks and wildlife refuges where nighttime dark sky is a defining characteristic.

[1] Also Identified in Appendix H, Table H-3.

3.18.8.1 Effect of Measures Incorporated into the Preferred Alternative

No mitigation measures for recreation and tourism are required through completed consultations, authorizations, or permits as listed Appendix H, *Mitigation and Monitoring*, Table H-2. BOEM has identified the following additional mitigation measure in Table 3.18-2 and Appendix H, Table H-3 as incorporated in the Preferred Alternative: Lighting. If adopted, this mitigation measure would require Dominion Energy to comply with BOEM's detailed Lighting and Marking Guidelines and NPS sustainable lighting best practices. This mitigation measure has the potential to reduce impacts described under the Light IPF for the Proposed Action. If implemented, this mitigation measure could reduce the impact of WTG lighting on onshore parks and wildlife refuges where nighttime dark sky is a defining characteristic of the park and would be distributed by the Proposed Action.

3.19 Sea Turtles

This section discusses potential impacts on sea turtles likely to be present in the proposed Project area resulting from the Proposed Action, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area. The sea turtle geographic analysis area, as shown on Figure 3.19-1, encompasses two LMEs, namely the Northeast U.S. OCS and Southeast U.S. OCS LMEs. These LMEs capture most of the movement range of sea turtles within the U.S. Atlantic Ocean waters. Due to the large size of the geographic analysis area, analysis in this EIS focuses on sea turtles that would likely occur in the proposed Project area and be affected by Project activities. The geographic analysis area does not include all areas that could be transited by Project vessels (e.g., it does not consider vessel transits from Europe).

3.19.1 Description of the Affected Environment for Sea Turtles

This section discusses potential impacts on sea turtle species from the proposed Project, alternatives, and ongoing and planned activities in the sea turtle geographic analysis area as described in Appendix F, *Planned Activities Scenario*, Table F-1, and shown on Figure 3.19-1. The geographic analysis area for sea turtles includes LMEs along the Northeast and Southeast Atlantic OCS that capture the majority of habitats in the United States and movement for sea turtle species.

This section also summarizes information on sea turtles occurring offshore Virginia that is provided in the COP (Section 4.2.6, Appendix R, Table 4.2-26, Figure 4.2-37; Dominion Energy 2023) as well as BOEM wind project documents (e.g., BOEM 2012, 2014), the *Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf* (Baker and Howsen 2021), the Ocean Biodiversity Information System (OBIS 2021), and the most recent recovery plans and 5-year reviews available for each species. The CVOW-C COP (Dominion Energy 2023) Section 4.2.6.1 provides detailed descriptions of sea turtle occurrence, ecology, and distribution within the Project area; these sections may be incorporated by reference within this analysis or summarized, as applicable, for the effects determinations presented in the EIS. Information applicable to the analysis but not included in the COP is also provided in this section.

Five sea turtle species have reported occurrences along the East Coast in both coastal and offshore waters. They are the loggerhead sea turtle (*Caretta caretta*), leatherback sea turtle (*Dermochelys coriacea*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and hawksbill sea turtle (*Eretmochelys imbricata*). All five species are listed as either threatened or endangered under the Endangered Species Act and are also identified as threatened or endangered by Virginia Department of Wildlife Resources (2021a).

Except for the polar regions, sea turtles occupy all oceans, with higher densities and most nesting occurring in tropical and subtropical seas and foraging well into temperate regions. Sea turtles can remain underwater for extended periods, which allows them to spend as little as 3 to 6 percent of their time at the water surface (Lutcavage et al. 1997; NSF and USGS 2011). However, sea turtles may remain at the surface for long periods of time resting or basking. Freitas et al. (2019) found that tagged juvenile loggerhead sea turtles spent roughly one third of the time at the surface (0 to 3 feet [0 to 1 meter] deep), specifically, spending 43 percent of the time at the surface during the day and 29 percent of the time during the night. Therefore, while sea turtles have the capability for spending long periods submerged, dive patterns will vary with activity, temperature, life stage, and environment. Sea turtles in the Atlantic often travel long distances between temperate foraging areas, offshore nursery areas, and tropical or sub-tropical nesting beaches (Cailouet et al. 2020; Evans et al. 2019; Mansfield et al. 2021; Meylan 1995; Patel et al. 2021), making them a common fauna group found in offshore and nearshore environments of Virginia.

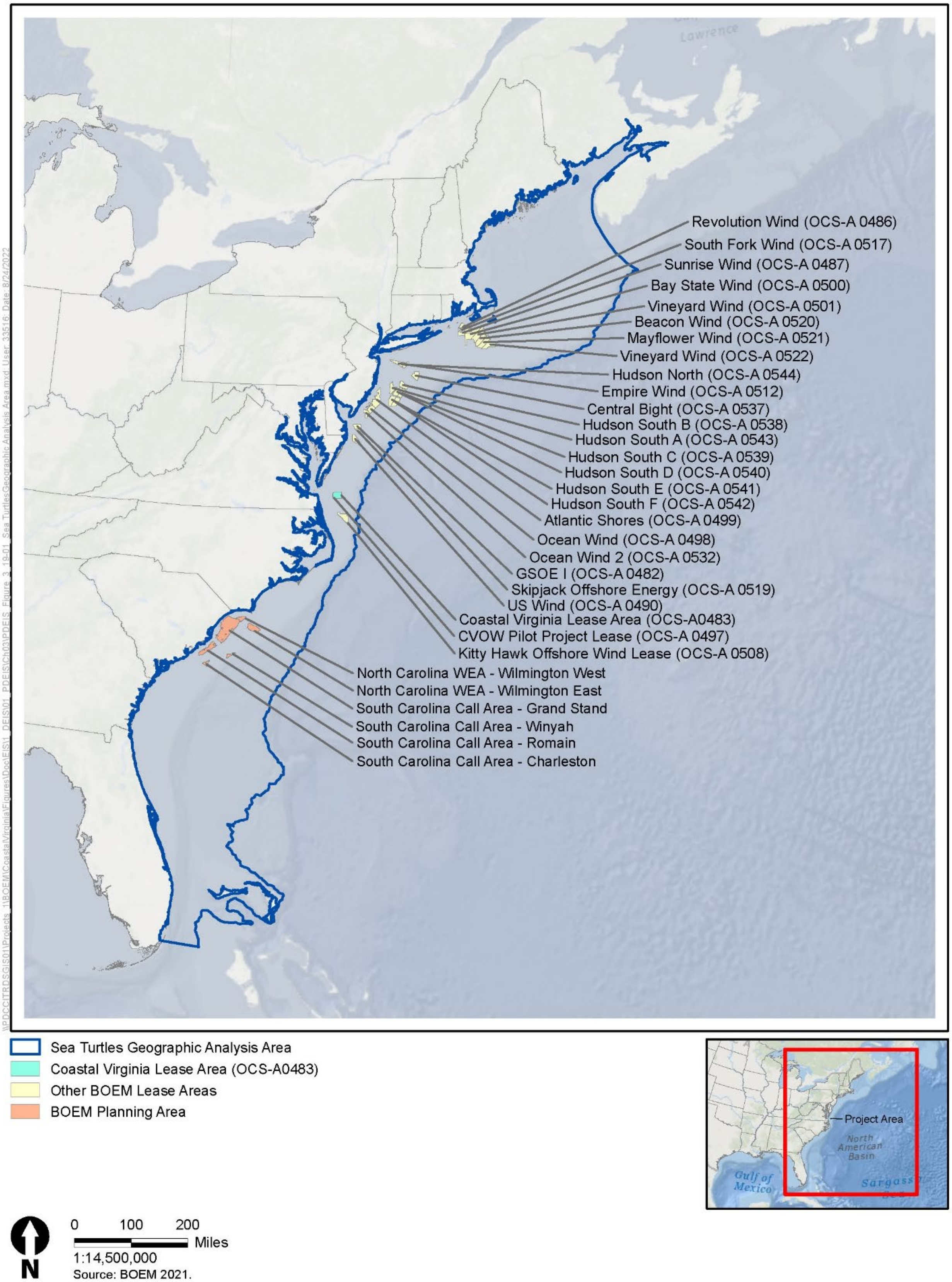


Figure 3.19-1 Sea Turtles Geographic Analysis Area

Sea turtle species distribution and presence in the Project area are summarized in Table 3.19-1 based on a review of protected species observer data, the NMFS sea turtle directory, Ocean Biodiversity Information System data (OBIS 2021), USFWS information for planning and consultation (USFWS 2021), VDWR (2021b) information, the Virginia Natural Heritage Data Explorer (Virginia Department of Conservation and Recreation 2021), and other available reports and literature.

The species most likely to occur in the Project area are loggerhead, Kemp's ridley, leatherback sea turtles, and green sea turtles. Visual survey and PSO sightings data indicate loggerhead and leatherback sea turtles are expected to be most common in waters offshore Virginia, while Kemp's ridley and green, though seen regularly, are observed in lower numbers offshore (COP, Section 4.2.6.1; Dominion Energy 2023; OBIS 2021; Virginia Institute of Marine Science 2021). Only two records of hawksbill sea turtles have been reported offshore Virginia since 1979 and they were considered an extralimital occurrence (Virginia Institute of Marine Science 2021). Hawksbill sea turtles typically prefers tropical habitats and occurrence in Virginia's offshore waters is considered extralimital (COP, Section 4.2.6.1, Dominion Energy 2023; OBIS 2021; Virginia Institute of Marine Science 2021).

There is no designated sea turtle critical habitat offshore Virginia (NMFS 2021), although sargassum critical habitat for loggerhead sea turtles extends into oceanic waters east of Virginia, beyond the OCS. Loggerhead sea turtles are commonly documented nesting in Virginia (Parker 2020), but there have been documented records of green sea turtles nesting in Croatan Beach in July 2021 just south of Virginia Beach (Croatan Civic League 2021), and records of green and Kemp's ridley sea turtles nesting or attempting to nest on Dam Neck Annex Beach just south of Virginia Beach starting around 2015 (Wright 2015; Wollam 2023). In cooler months when sea turtles face the risk of colder water temperatures decreasing their overall body temperature, sea turtles will spend significant time basking at the water surface to counteract this effect (Sapsford and van der Riet 1979; Dodge et al. 2014; Freitas et al. 2019). Lower water temperatures can also result in cold stunning of turtles, which causes them to become lethargic and float to the surface, making them more vulnerable to predators, anthropogenic effects, and strandings (NMFS 2021). Although these cold stunning events typically occur in coastal and inshore waters, temperature conditions anywhere in the Project area may affect sea turtle surface activities. Therefore, during cooler sea temperatures in the temperate ocean conditions offshore Virginia, sea turtles can raise their body temperatures by basking at the water surface, which may make them more vulnerable to vessel strikes. However, there is limited published data regarding basking behavior in all species of sea turtles in relation to sea temperatures or air temperatures. Published data that are available show more surface basking behavior off Nova Scotia than in Massachusetts (Dodge et al. 2014), inferring potentially more frequent or longer surface periods with increasing latitude. This suggests that while sea turtles may be more available for vessel strike in northern waters during cold conditions, this may not hold true for more temperate waters off Virginia.

Sea turtles are wide-ranging and long-lived, making population estimates difficult; population abundance estimation and visual survey methods vary depending on species and location (TEWG 2007; NMFS and USFWS 2013, 2015, 2019). Nesting data are widely used to estimate abundance, though nesting data may lag significantly in representing population increases or decreases. Leatherback sea turtle regional nesting trends were negative across three different temporal scenarios and became more negative as the time series became shorter (Northwest Atlantic Leatherback Working Group 2018).

Table 3.19-1 Presence, Distribution, and Population Status of Sea Turtle Species Known to Occur in Coastal and Offshore Waters of Virginia Around the Project Area

Common Name	Scientific Name	Distinct Population Segment	Estimated Population Abundance	Distribution Around Project Area	Relative Occurrence in Project Area[1]	Seasonality	Federal Population Status	Virginia Population Status
Loggerhead sea turtle	*Caretta caretta*	Northwestern Atlantic	588,000	Throughout; offshore and nearshore	Common	Year-round	Threatened	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	N/A	65,000	Predominantly offshore	Common	Year-round	Endangered	Endangered
Green sea turtle	*Chelonia mydas*	North Atlantic	215,000	Predominantly nearshore	Uncommon	Year-round	Threatened	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempii*	N/A	284,300	Predominantly nearshore	Common	Year-round	Endangered	Endangered
Hawksbill sea turtle	*Eretmochelys imbricata*	N/A	19,000	Extralimital	Extralimital	Spring/Summer	Endangered	Endangered

N/A = not applicable to species.
[1] Relative occurrence defined as:
- Common: Project area within typical range of the species, and species sightings are regularly documented.
- Uncommon: Project area within typical range of the species, but species sightings are only occasionally documented.
- Extralimital: Project area considered outside the typical range of the species, and few species sightings have been documented.

For loggerhead sea turtle, progress toward recovery has been made since publication of the *2008 Loggerhead Sea Turtle Recovery Plan*, but recovery units have not met most of the critical benchmark recovery criteria (NMFS and USFWS 2019). Recent models indicate a persistent reduction in survival, recruitment, or both to the nesting population of Kemp's ridley sea turtle, suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015). The most recent status review for the North Atlantic distinct population segment of green sea turtle estimates that nesting trends are generally increasing (Seminoff et al. 2015). However, a study by Ceriani et al. (2019) has indicated that using nest counts as a direct proxy for adult female population status can be misleading and is not evidence of a strong population recovery.

In addition to the complexity relating nesting trends to population trends, sea turtles can also have large geographic ranges that may vary by life stage or season; therefore, trends in one region may not fully reflect species distribution or occurrence within the specific Project area. The current conditions and trends of sea turtle populations are affected by factors present in the geographic analysis area, but key details about sea turtle foraging and nesting that are important to assessing sea turtle impacts within the specific Project area include the following:

- Loggerhead sea turtle:
  - Predominantly carnivores that feed on a variety of floating prey during their open ocean life phase as hatchlings and young juveniles; they feed mainly on benthic species such as whelks, other mollusks, horseshoe crabs, and decapod crabs during their late juvenile and adult phases when they have migrated to nearshore coastal habitats (NMFS 2021).
  - Primary nesting habitats in the United States are in Florida, Georgia, South Carolina, and North Carolina, but nests have been observed on beaches in Virginia, Maryland, and Delaware (Bies 2018; Parker 2020; Pomeroy 2020).
  - No critical habitat has been designated for this species in or near the Project area, but their *Sargassum* critical habitat occurs beyond the OCS from Florida to New Jersey over deeper waters of the continental slope, migratory critical habitat has been identified off the coast of North Carolina, overwintering critical habitat has been identified in offshore southern North Carolina, breeding critical habitat has been identified in offshore Florida, and there are areas of nearshore reproductive critical habitat extending from Florida to North Carolina (NMFS 2021).
- Kemp's ridley sea turtle:
  - Hatchlings inhabit the open ocean where they use *Sargassum* algae as a refuge to rest and forage on small animals and plants; adults travel to nearshore coastal areas where their preferred prey are crab species (NMFS 2021).
  - The main nesting habitat for this species is in the Gulf of Mexico; however, they have also been observed nesting in coastal areas of Georgia, South Carolina, and North Carolina, as well as the Atlantic coast of Florida (NMFS 2021). Though rare, there have been a few Kemp's ridley nests reported in Virginia since 2012 (Virginia State Parks 2012; USFWS 2012; Wright 2015; Wollam 2023).
  - The Chesapeake Bay estuary system supports one of the largest non-nesting populations of Kemp's ridley sea turtle in the world during summer months (VIMS 2023).
  - No critical habitat has been designated for this species.
- Leatherback sea turtle:
  - Preferred prey include soft-bodied animals such as jellyfish and salps (NMFS 2021).

  - In the western Atlantic, leatherbacks nest from North Carolina to Brazil. In the U.S., leatherbacks nest almost exclusively on the east coast of Florida (Florida Fish and Wildlife Commission 2023).
  - Critical habitat has been designated for this species around their main nesting habitat in the U.S. Virgin Islands (NMFS 2021).
- Green sea turtle:
  - Green sea turtles are the only herbivorous species feeding mainly on seagrass, although they will occasionally feed on sponges and invertebrates (NMFS 2021).
  - The primary nesting habitats for green sea turtles are in Costa Rica, Mexico, Cuba, and the Southeast U.S. including Florida, Georgia, South Carolina, and North Carolina (NMFS 2021). Though rare, there have been reports of green sea turtles nesting in Virginia (Croatan Civic League 2021; Wollam 2023).
  - Critical habitat has been designated for this species off Puerto Rico outside the Project area (NMFS 2021).
- Hawksbill sea turtle:
  - Hawksbills are omnivorous foragers whose preferred prey in most habitats are sponges, but they will also prey on marine algae, bivalves, and crustaceans (NMFS 2021).
  - Primary nesting habitats are in the Caribbean; nesting events for this species in the U.S. are rare and have been limited to southeast Florida and the Florida Keys (NMFS 2021).
  - Critical habitat has been designated for this species off Puerto Rico outside the Project area (NMFS 2021).

Risks to sea turtle populations include fisheries bycatch, marine debris, habitat loss, vessel traffic, underwater noise, EMFs, and artificial lighting, but fisheries bycatch, marine debris, and vessel traffic are the three IPFs that are most likely to affect population viability (NMFS 2021; NMFS and USFWS 2013, 2014, 2015, 2019). Globally, entanglement in and ingestion of human-made debris is a substantial threat to sea turtles and it is believed that entanglements are underestimated (i.e., not all are reported) (Duncan et al. 2017). Research by Duncan et al. (2017) estimated that globally, over 1,200 entangled sea turtles are encountered per year with just over a 90 percent mortality rate. Commercial fisheries operating in the geographic analysis area include bottom trawl, midwater trawl, dredge, gillnet, longline, and pots and traps. Commercial vessel traffic in the region is variable depending on location and vessel type.

3.19.2 Environmental Consequences

3.19.2.1 Impact Level Definitions for Sea Turtles

Definitions of impact levels are provided in Table 3.19-2.

Table 3.19-2 Impact Level Definitions for Sea Turtles

Impact Level	Impact Type	Definition
Negligible	Adverse	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.
	Beneficial	Impacts on sea turtles would be undetectable or barely measurable, with no consequences to individuals or populations.

Impact Level	Impact Type	Definition
Minor	Adverse	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.
	Beneficial	Impacts on sea turtles would be detectable and measurable, but of low intensity, highly localized, and temporary or short term in duration. Impacts could increase survival and fitness, but would not result in population-level effects.
Moderate	Adverse	Impacts on sea turtles would be detectable and measurable and could result in population-level effects that would likely be recoverable and would not affect the continued existence of any population or DPS.
	Beneficial	Impacts on sea turtles would be detectable and measurable and could result in population-level effects. Impacts would be measurable at the population level.
Major	Adverse	Impacts on sea turtles would be significant and extensive and long term in duration, and could have population-level effects that are not recoverable, even with mitigation.
	Beneficial	Impacts would be significant and extensive and contribute to population or DPS recovery.

3.19.3 Impacts of the No Action Alternative on Sea Turtles

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

3.19.3.1 Impacts of the No Action Alternative

Under the No Action Alternative, baseline conditions for sea turtles described in Section 3.19.1, *Description of the Affected Environment for Sea Turtles*, would continue to follow current regional trends and respond to IPFs introduced by other ongoing and planned non-offshore wind activities. The primary IPFs for sea turtles within the geographic analysis area are generally associated with noise and vessel strikes, the presence of structures, and ongoing climate change. Fuel spills and releases of trash and debris have lesser potential impact on sea turtles due to their low probability of occurrence and relatively limited spatial impact. Land use and coastal development affect sea turtles mostly through habitat loss from development near sea turtle nesting areas, which occur outside of the Project area. Specific non-offshore wind activities that may affect sea turtles include commercial fisheries bycatch; ingestion of or entanglement in marine debris; marine transportation (vessel strikes); military use; oil and gas activities; undersea transmission lines, gas pipelines, and other submarine cables; tidal energy projects; dredging and port improvement; marine mineral use and ocean dredged material disposal; and global climate change (see Appendix F, Section F.2, for a complete description of ongoing and planned activities). Most of these activities would only likely result in temporary displacement and behavioral changes; however, vessel strikes and entanglement in marine debris could result in potential injury or mortality of individuals. Global climate change could also result in population-level impacts on sea turtle species by displacement of prey species, changes in sea temperatures and circulations, changes in *Sargassum* abundance or distribution, fisheries displacement, and changes to sex determination ratios on nesting beaches, all of which may alter population dynamics and mortality rates.

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

- Continued O&M of the Block Island Project (5 WTGs) installed in state waters,
- Continued O&M of the CVOW-Pilot Project (2 WTGs) installed in OCS-A 0497, and
- Ongoing construction of two offshore wind projects, the Vineyard Wind 1 Project (62 WTGs and 1 OSS) in OCS-A 0501 and the South Fork Project (12 WTGs and 1 OSS) in OCS-A 0517.

Ongoing construction and O&M of the Block Island and CVOW-Pilot projects and ongoing construction of the Vineyard Wind 1 and South Fork projects would affect sea turtles through the primary IPFs of noise, presence of structures, and vessel traffic. Ongoing offshore wind activities would have the same types of impacts from noise, presence of structures, and traffic that are described in detail in Section 3.5.3.2 for planned offshore wind activities, but the risk of impacts would cover a smaller spatial and temporal scale given the relative number of ongoing projects compared to the planned offshore wind projects.

3.19.3.2 Cumulative Impacts of the No Action Alternative

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

Under the No Action Alternative, BOEM would not approve Dominion Energy's COP and impacts from IPFs during construction, operation, and maintenance directly associated with the Project would not occur. Existing environmental trends within the geographic analysis area would continue, potentially influenced by the development of planned future activities on the OCS and associated coastal areas over the coming decade. These include other offshore wind and renewable energy projects, and potential port improvements to support the development of this industry regionwide (see Appendix F).

BOEM expects future offshore wind activities to affect sea turtles through the following primary IPFs: accidental releases, discharges, EMFs, new cable emplacement/maintenance, noise, port utilization, the presence of structures, and vessel traffic. Offshore wind activities have the potential to produce impacts from site characterization studies, site assessment data collection activities that involve installation of meteorological towers or buoys, and installation and operation of turbine structures.

This section provides a general description of the IPF mechanisms resulting from future offshore wind development within the sea turtle geographic analysis area. However, the extent and significance of potential effects on cumulative conditions cannot be fully quantified for projects that are in the conceptual or proposal stage and have not been fully designed or permitted. Where appropriate, potential effects resulting from future offshore wind development activities are characterized through comparison to effects resulting from the Proposed Action that are likely to be similar in nature or significance. The intent of this section is to provide a general overview of how future activities might influence future environmental conditions. Should any or all of the future activities described in Appendix F proceed, each would be subject to independent NEPA analyses of environmental effects and regulatory approvals.

Accidental releases: Trash and debris or water quality contaminants could be accidentally released as a result of increased human activity associated with future offshore wind development activities. All species of sea turtles have been documented ingesting plastic debris (Bugoni et al. 2001; Hoarau et al. 2014; Nelms et al. 2016), as well as a variety of other anthropogenic waste (Tomás et al. 2002), likely mistaking debris for potential prey items (Schyuler et al. 2014). Ingesting trash or exposure to aquatic contaminants could result in lethal or sublethal effects including depressed immune system function; poor body condition; and reduced growth rates, fecundity, and reproductive success (Gall and Thompson 2015; Hoarau et al. 2014; Nelms et al. 2016; Schuyler et al. 2014). Additionally, entanglement in lost fishing gear and other marine debris is the primary anthropogenic cause of mortality in both juvenile and adult sea turtles (NMFS 2023a; National Research Council 1990 as cited in Shigenaka et al. 2010). Furthermore, accidental releases of contaminants may indirectly affect sea turtles through effects on prey species (see Section 3.13.1.1 for more details). Recognizing these risks, all vessels associated with offshore wind development projects would comply with USCG regulations and BOEM regulations designed to avoid and minimize accidental release of trash, debris, or other contaminants. Therefore, the release of solid trash or other debris into offshore waters would be extremely rare, and potential impacts from released trash and debris, though possibly injurious on an individual level, would not affect species on the population level. Each project would also be expected to have its own oil spill response plan to implement in the case of accidental releases. Therefore, potential accidental release volumes would not appreciably contribute to adverse impacts on sea turtles, and no population-level impacts are expected for any species.

Electromagnetic fields: Under the No Action Alternative, the future development of planned offshore wind projects would result in up to 5,595 miles (9,004 kilometers) of new submarine electrical transmission cables in the geographic analysis area for sea turtles (Appendix F, Table F2-1). Each cable would generate EMF potentially detectable by sea turtles in the immediate area around the cable (Klimley et al. 2021). Sea turtles are known to be geomagnetic-sensitive, but not electrosensitive (Normandeau et al. 2011). Sea turtles use their magneto-sensitivity for orientation, navigation, and migration; they use the Earth's magnetic fields for directional (compass-type) information to maintain a heading in a particular direction and for positional (map-type) information to assess a position relative to a specific geographical destination (Lohmann et al. 1997). Additional non-magnetic cues are also likely used by sea turtles during navigation and migration. Multiple studies have demonstrated magneto-sensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 µT for loggerhead turtles and 29.3 to 200 µT for green turtles (Normandeau et al. 2011). However, based on a review by Normandeau et al. (2011), sea turtles are unlikely to detect alternating current magnetic fields below 50 mG (5 µT) due to their magnetite-based detection mechanism. Hatchling sea turtles are known to use the Earth's magnetic field (and other cues) to orient and navigate from their natal beaches to their offshore habitat (Lohmann et al. 1997). Juvenile and adult sea turtles may detect EMFs when foraging on benthic prey or resting on the bottom in relatively close proximity to cables. Confounding EMF effects on sea turtles could range from trivial changes in swim direction to more significant migration alterations; the extent and magnitude of these potential effects are unclear, however, and may be compensated against to some degree by sea turtle's use of non-magnetic spatial cues. Overall, potential EMF effects would be reduced by cable shielding and burial to an appropriate depth, and new submarine cables would be installed to maintain a minimum separation of at least 330 feet (101 meters) from other known cables to avoid damaging existing infrastructure during installation. This separation distance would avoid additive EMF effects from adjacent cables. While artificial EMF effects on sea turtles are not well studied, current construction and mitigation methods would limit projected EMF effects to below levels that are expected to cause measurable biological effects. Short-term displacement of individual turtles from the Project area or deviations in their migrations would be small and would not be expected to substantially affect energy expenditure in sea turtles.

Light: Nighttime lighting associated with offshore structures and vessels could represent a source of attraction, avoidance, or other behavioral responses in sea turtles. Although responses to light have been studied in various species and life stages of sea turtles, the effects are expected to be negligible (BOEM 2019). Shoreline development is the predominant existing artificial lighting source in the nearshore component of the geographic analysis area while vessels, mainly fishing vessels, are the predominant source of artificial lighting offshore. Future wind energy development would contribute additional light sources to the offshore component of the geographic analysis area; onshore components of offshore wind projects are not expected to produce a substantial amount of light or be present in areas where sea turtles are expected. Offshore sources of light consist of short-term lighting from vessels used during construction and the long-term use of navigational lighting on new WTGs and OSSs. Over 3,287 structures are forecasted for construction in the geographic analysis area. Each structure would have minimal yellow flashing navigational lighting, as well as red flashing Federal Aviation Administration hazard lights in accordance with BOEM (2019) lighting and marking guidelines. Artificial light in coastal environments is an established stressor for juvenile sea turtles, which use light to aid in navigation and dispersal and can become disoriented when exposed to artificial lighting sources; however the significance of artificial light in offshore environments is less clear (Gless et al. 2008). Data from oil and gas platform operation in the Gulf of Mexico, which can have considerably more lighting than offshore WTGs, have not resulted in any known impacts on sea turtles (BOEM 2019) and no long-term or population-level impacts from offshore lighting produced by offshore wind projects is expected.

New cable emplacement/maintenance: Future offshore wind projects could disturb over 177,718[1] acres (719 square kilometers) of seabed while installing associated undersea cables, causing an increase in suspended sediment and seafloor disturbance (Appendix F, Table F2-2). This disturbance would be localized and temporary. Data are not available regarding effects of suspended sediments on adult and juvenile sea turtles, although elevated suspended sediments may cause individuals to alter normal movements and behaviors. However, these changes are expected to be limited in extent, short term in duration, and likely too small to be detected (NOAA 2021). Seafloor disturbance during construction of future offshore wind projects may affect sea turtle foraging success or prey species distribution; however, impacts would be temporary and generally localized to the cable corridor. Traditional dredging methods (e.g., trailing suction hopper dredgers) are not anticipated during installation of offshore wind projects; therefore, no significant entrainment risk to sea turtles is expected from cable emplacement activities (Ramirez et al. 2017). Given the likelihood of this activity occurring and the small time and spatial scale over which these activities would occur, no population-level effects on sea turtles would be expected.

Noise: Human activities would continue to generate underwater noise with potential to affect sea turtles. Several wind energy projects could be developed between 2023 and 2030 with overlapping construction periods that add several new sources of underwater noise to the ambient soundscape through pile driving and vessel traffic (Appendix F, Table F-3). As discussed in Appendix F, some projects could be constructed concurrently at multiple locations on the OCS, which could result in larger or overlapping areas of increased underwater anthropogenic noise.

A description of sea turtle hearing anatomy and perception of underwater sound is provided in Appendix J, Section J.2.6.2. Potential impacts on sea turtles from underwater noise include PTS, TTS, and behavioral disturbances, and the potential for the type of impacts would vary by phase and activity. Acoustic thresholds, which represent the estimated sound level at which the onset of a particular effect may occur, that are recommended by Finneran et al. (2017) for all sea turtle species by impact are listed in Table 3.19-3. Data are currently only available for sea turtle behavioral responses to impulsive sound sources (described in Section 3.15.1.1, *Future Offshore Wind Activities [without Proposed Action]*), so these thresholds are assumed to apply to all noise categories.

[1] Kitty Hawk Wind South has three export cables (57 miles [92 kilometers] to Virginia, 200 miles [322 kilometers] to North Carolina, and an additional 96 miles [154 kilometers] of inshore export cable to North Carolina) for a total of 352.9 miles (568 kilometers). Corridor widths range from the 1,520-mile-wide (2,414-kilometer-wide) corridor to Virginia and the 1,000-mile-wide (1,609-kilometer-wide) corridors to North Carolina to allow for optimal routing of the cables.

Table 3.19-3 Acoustic Thresholds for Sea Turtles for Each Type of Impact and Noise Category

Impact	Impulsive Noise Threshold	Non-impulsive Noise Thresholds
PTS	$L_{p,pk}$ 232 dB re 1 μPa $L_{E,24hr}$: 204 dB re 1 μPa^2 s	$L_{E,24hr}$: 220 dB re 1 μPa^2 s
TTS	$L_{p,pk}$: 226 dB re 1 μPa $L_{E,24hr}$: 189 dB re 1 μPa^2 s	$L_{E,24hr}$: 200 dB re 1 μPa^2 s
Behavioral disturbance	L_P: 175 dB re 1 μPa	

Source: Finneran et al. 2017.
μPa = micropascal; μPa^2 s = micropascal square second; dB = decibel; $L_{E,24hr}$ = sound exposure level over 24 hours; $L_{p,pk}$ = peak sound pressure level; L_P = root-mean-square sound pressure level.

There are few studies reporting sound production in sea turtles, despite their ability to hear sounds in both air and water. While the general importance of sound to the ecology of sea turtles is not well understood, there is a growing body of knowledge suggesting that sea turtles may use sound in a multitude of ways. Sea turtle embryos and hatchlings have been reported to make airborne sounds, thought to be produced for synchronizing hatching and nest emergence (Montiero et al. 2019; Ferrara et al. 2014a, 2014b, 2019; McKenna et al. 2019). Charrier et al. (2022) noted the production of 10 different underwater sounds in juvenile green sea turtles, including those within and above the frequency range of hearing reported for this species. A more comprehensive understanding of sound production and hearing is needed in sea turtles; however, the limited but growing information available suggests environmental acoustic cues are likely to be important to these animals.

3.19.3.2.1 HRG Surveys

The active acoustic sources used in site characterization surveys introduce noise into the water during site investigations. See Appendix J for a physical description of these sounds. Only a subset of geophysical sources (e.g., boomers, sparkers) are likely to be audible by sea turtles, given the frequency range of the sounds and the hearing range of turtles. Given the right context, these sounds may cause short-term behavioral disturbance, avoidance, or stress (NSF and USGS 2011). Recently, BOEM and USGS characterized underwater sounds produced by high-resolution geophysical sources and their potential to affect marine animals, including sea turtles (Ruppel et al. 2022). In addition to frequency range, other characteristics of the sources like the source level, duty cycle, and beamwidth make it very unlikely that these sources would result in behavioral disturbance of sea turtles, even without mitigation (Ruppel et al. 2022). Given the intensity of noise generated by this equipment (Crocker and Frantantonio 2016; Crocker et al. 2019) and short duration of proposed surveys, it is unlikely that PTS or TTS will occur in any turtle species as a result of being exposed to HRG survey noise. Although temporary displacement or behavioral responses may occur, they would not result in biologically notable consequences; impacts on sea turtles would be minor and would have no stock or population-level effects. Likewise, geotechnical surveys may introduce low-level, intermittent, broadband noise into the marine environment, though these sounds are unlikely to result in behavioral disturbance, given their low source levels and intermittent use.

3.19.3.2.2 Impact and Vibratory Pile Driving

Impulsive noise from impact pile driving during planned offshore wind development represents the highest risk of noise exposure and potential for adverse auditory effects on sea turtles in the geographic analysis area due to the anticipated frequency of pile driving activities and the spatial extent of effect. While these potential effects are acknowledged, their biological significance is unclear because sea turtle sensitivity and behavioral responses to pile-driving noise are not well known based on available studies. However, several studies conducted on responses to seismic airguns, an impulsive signal that can serve as a general proxy to other high intensity impulsive sources like pile driving, have shown that a range of behavioral effects are possible (McCauley et al. 2000; U.S. Department of the Navy 2018). In some seismic studies, observations of caged and free-swimming sea turtles exposed to airgun operations were reported as reacting to the sounds by initiating a startle dive (Weir 2007; DeRuiter and Doukara 2012), rising to the surface (Lenhardt 1994), and altering swimming patterns (McCauley et al. 2000). In other studies, sea turtles avoided the airgun source initially, but authors suggested that animals likely habituated to the source over time (Moein et al. 1994; Lenhardt 2002; Hazel et al. 2007). This type of noise habituation has been demonstrated even when the repeated exposures were separated by several days (Bartol and Bartol 2012; U.S. Department of the Navy 2018). The accumulated stress and energetic costs of avoiding repeated exposures to pile-driving noise over a season or life stage could have long-term effects on survival and fitness (U.S. Department of the Navy 2018).

Vibratory pile driving may be used prior to impact pile driving to reduce the risk of pile run for some offshore wind projects and during export cable installation and port facility construction. The term pile run refers to the quick penetration of a pile into the seabed as a result of its high self-weight and low resistance from the seabed. A physical description of vibratory pile-driving noise can be found in Appendix J. Typical noise levels generated by vibratory pile driving are lower than noise levels produced by impact pile driving. Available measurements indicate the SPL was, on average, 165 dB re 1 µPa at 33 feet (10 meters) and decreased to 140 dB re 1 µPa when measured 656 feet (200 meters) away (Illingworth and Rodkin 2017). These measurements are based on smaller piles in shallower water locations, appropriate for export cable installation activities, and it is expected that vibratory pile driving conducted for the foundations prior to impact pile driving will produce a greater area of ensonification. However, based on these sound levels, it is still not expected that the PTS thresholds (Finneran et al. 2017) would be exceeded more than 328 feet (100 meters) from the pile, even in deeper water environments. Ranges to the behavioral disturbance threshold for sea turtles (Finneran et al. 2017) may extend further; however, the behavioral disturbance threshold is an SPL of 175 dB re 1 µPa and would not be exceeded beyond 1,640 feet (500 meters) from the source. Additionally, vibratory pile driving activities would be relatively short-term, occurring over approximately 4 hours per pile for the foundations, and over several days for export cable installation.

Sea turtles that are exposed to pile driving noise have the potential to experience auditory impacts such as TTS or PTS. Reduced hearing sensitivity could limit the ability to detect predators, prey, or suitable habitat and reduce the survival and fitness of affected individuals; however, the role and importance of auditory cues in these biological functions for sea turtles remains poorly understood (Lavender et al. 2014).

Based on the available information provided above and in Appendix J, impacts on sea turtles from construction-related pile driving noise would be limited to effects on a small number of individuals. Auditory threshold shifts (TTS, PTS) are not likely to occur due to the short exposure times expected during piling; however, the risk of TTS and PTS cannot be fully eliminated. Therefore, given the number of projects anticipated within the geographic analysis area (Appendix D), impact pile driving would have minor impacts on sea turtles due to the potential for severe effects on individuals but no effects on population viability for any species. Vibratory pile driving is expected to have a reduced impact for sea turtles and would result in detectable impacts that are minor and would not result in population-level effects.

3.19.3.2.3 Vessel Noise

Vessel noise associated with non-offshore wind activities is likely to be present throughout the sea turtle geographical analysis area at a nearly continuous rate due to the prevalence of commercial shipping, fishing, and recreational boating activities that are ongoing and would be expected to continue in the geographic analysis area. During both the construction and operational phases of planned offshore wind projects, several types of vessels would 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 Appendix J. Construction and operational vessel noises are the most broadly distributed sources of non-impulsive noise associated with offshore wind projects. Sea turtle exposure to underwater vessel noise would incrementally increase as a result of ongoing and planned offshore wind projects, especially during construction periods (Appendix F). Sea turtles are less sensitive to sound as compared to faunal groups like marine mammals, as evidenced by the higher auditory threshold criteria (NMFS 2023b). No injury or behavioral effects from vessel noise are anticipated for planned offshore wind projects. It is unlikely that received levels of underwater noise from vessel activities would exceed PTS thresholds for sea turtles, as the PTS threshold for non-impulsive sources is an SEL_{24h} of 200 dB re 1 μPa^2 s (NMFS 2023b), which is comparable to the maximum source level reported for large shipping vessels (Appendix J). Hazel et al. (2007) demonstrated that sea turtles only appear to respond behaviorally to vessels at approximately 33 feet (10 meters) or closer.

Vessel noise effects for planned offshore wind projects are expected to be broadly similar to noise levels from existing vessel traffic in the region. Nonetheless, periodic localized, short-term behavioral impacts on sea turtles could occur; however, sea turtle behavioral disturbances are anticipated only to occur within a relatively small area around the vessels and are expected to return to normal when the vessel moves away. Therefore, the effects of vessel noise from planned offshore wind activities would be minor. No population-level effects are expected to occur.

3.19.3.2.4 Cable Laying and Trenching

Preparing a lease area for turbine installation and cable-laying may require jetting, plowing, or removal of soft sediments, as well as the excavation of rock and other material through various cable emplacement methods. Cable installation vessels are likely to use dynamic positioning systems while laying the cables. The sound associated with dynamic positioning generally dominates over other sound sources present, especially in relation to dredging, trenching, and cable-laying activities. A description of the physical qualities of these sound sources can be found in Appendix J. Given the estimated source levels (Appendix J) and transitory nature of these sources, exceedance of PTS and TTS sound levels are not likely for sea turtles (Heinis et al. 2013), and behavioral disturbances would likely be low-intensity, localized, and result in negligible impacts on sea turtles.

3.19.3.2.5 WTG Operations

No biologically notable effects on sea turtles are anticipated from noise produced by WTG operation. Noise associated with operational WTGs would be expected to attenuate below ambient levels at a relatively short distance from WTG foundations (Miller and Potty 2017; Thomsen et al. 2015; Tougaard et al. 2009). Maximum anticipated noise levels produced by operational WTGs are estimated to be between 125 and 130 dB re 1 μPa m (Lindeboom et al. 2011; Tougaard et al. 2009). HDR (2019) measured SPL below 120 dB re 1 μPa at 164 feet (50 meters) from operating turbines at the Block Island Wind Farm, which are below the sound level thresholds expected to cause sea turtle PTS, TTS, and behavioral disturbance (NMFS 2023b). Additionally, current generation WTGs use direct drive motors that could result in a sound decrease of approximately 10 dB from WTG using gear boxes that were considered in prior studies (Stöber and Thomsen 2021). However, a review of published literature also identified an increase in underwater source levels (up to 177 dB re 1 μPa) with increasing power size with a nominal 10 MW WTG (Stöber and Thomsen 2021). Given the number of foundations expected within the sea turtle geographic analysis area (Appendix F), the presence of WTG operational noise would be a persistent presence throughout the sea turtle geographic analysis area. Impacts on sea turtles would, therefore, be minor as the behavioral responses would be detectable but would not be expected to result in any population-level effects.

Port utilization: Port expansions could increase the total amount of disturbed benthic habitat and result in impacts on some sea turtle prey species. However, given that port expansions would likely occur in subprime areas for foraging and the disturbance would be relatively small in comparison to the overall sea turtle foraging areas in the geographic analysis area, port expansions are not expected to affect sea turtles. Dredging for port facility improvement could lead to additional impacts on turtles from incidental entrainment, impingement, or capture. Dredging impacts on sea turtles are relatively uncommon; most observed injury and mortality events in the U.S. were associated with hopper dredging in and around core habitat areas in the southern portion of the geographic analysis area and in the Gulf of Mexico outside the geographic analysis area (Michel et al. 2013; USACE 2020). Ongoing maintenance dredging of these facilities may incrementally increase related risks to individual turtles over the lifetime of the facilities; however, typical mitigation measures such as timing restrictions should minimize this potential. Additionally, the size, scope, and location of the dredging activities conducted for offshore wind projects would be less than that identified for other projects such as beach nourishment or port deepening, and the type of equipment used reduces the risk of entrainment or impingement. Compared to the dredging activities for planned offshore wind projects, navigation dredging projects, which occur primarily in channels close to shore, generally pose a greater risk of entrainment of sea turtles because of their tendency to concentrate in channels (Ramirez et al. 2017). For example, the number of sea turtles entrained by hopper dredging in BOEM offshore borrow areas has historically been relatively low when compared to navigation channel dredging (Ramirez et al. 2017). Between 1995 and 2015, there were 69 reported sea turtle takes in the North Atlantic (i.e., north of North Carolina) by trailing suction hopper dredges, versus approximately 260 taken in hopper dredges operating in the South Atlantic. The takes per project across the entire South Atlantic were estimated to be 0.96 (the North Atlantic was not analyzed). Therefore, given the extent of and location of navigation projects using hopper dredges, the limited amount of dredging conducted as part of the Proposed Action is not expected to result in population effects as few to no takes of sea turtles would reasonably be expected. The risk of injury or mortality to individual sea turtles resulting from dredging associated with future offshore wind projects exclusive of the Proposed Action is low and population-level effects are unlikely to occur.

Presence of structures: The addition of over 3,287 new offshore structures (WTGs, OSSs, and meteorological tower) in the geographic analysis area could increase sea turtle prey availability through the creation of new hard-bottom habitat, increasing pelagic productivity in local areas, or promoting fish aggregations at foundations (Bailey et al. 2014 cited in English et al. 2017). Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*, discusses reef creation and the potential for anthropogenic structures to attract fish. Fish aggregations around new wind farm structures can provide additional foraging opportunities for sea turtles that may result in negligible or minor beneficial impacts given the broad geographic range of species during their annual foraging migrations. However, the presence of structures may indirectly concentrate recreational fishing around foundations, which could indirectly increase the potential for sea turtle entanglement in both lines and nets and result in minor adverse impacts on sea turtles given their proclivity for entanglement in lost fishing gear (Nelms et al. 2016; Gall and Thompson 2015; Shigenaka et al. 2010).

Human-made structures, especially tall vertical structures like WTG and OSS foundations, alter local water flow at a fine scale and could result in localized impacts on sea turtle prey distribution and abundance. A discussion of the effects of altered water flow can be found in Section 3.13, *Finfish, Invertebrates, and Essential Fish Habitat*. The presence of many WTG structures could affect oceanographic and atmospheric conditions in ways that alter local environments and potentially increasing primary productivity in the vicinity of these structures (Carpenter et al. 2016; Schultze et al. 2020). However, this may not translate to a beneficial increase in sea turtle prey abundance if the increase in primary productivity is consumed by filter feeders (e.g., mussels) that colonize the surface of the structures (Slavik et al. 2019).

The long-term effects of offshore structure development on ocean productivity and sea turtle prey species; therefore, sea turtles are difficult to predict with certainty because they are expected to vary by location, season, and year depending on broader ecosystem dynamics. For example, the presence of new hard surfaces could increase the abundance of associated organisms (e.g., mussels, crustaceans) on and around the structures, providing a prey resource for sea turtles. Increased primary and secondary productivity in proximity to hard-bottom structures could increase the abundance of prey species like jellyfish (English et al. 2017). Additionally, hard-bottom (scour control, cable protection) and vertical structures (WTG and OSS foundations) in a soft-bottom habitat can create a 3-dimensional artificial reef structure, thus inducing the "reef effect" and resulting in higher densities and biomass of mollusks, fish, and decapod crustaceans (Causon and Gill 2018; Taormina et al. 2018). Recent studies have found increased biomass for benthic fish and invertebrates, and possibly for pelagic fish, sea turtles, and birds as well (Raoux et al. 2017; Pezy et al. 2018; Wang et al. 2019) indicating that offshore wind facilities can generate beneficial long-term impacts on local ecosystems, translating to increased foraging opportunities for sea turtle species. Sea turtles may also use vertical structures for shelter from strong currents to conserve energy and for cleaning their shells (Barnette 2017). In contrast, increased fish biomass around the structures could attract commercial and recreational fishing activity, creating an increased risk of injury or mortality from gear entanglement and ingestion of debris (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014).

Some level of displacement of sea turtles from future wind farm lease areas into areas with a higher potential for interactions with ships or fishing gear could occur. However, the addition of structures could locally increase pelagic productivity and prey availability for sea turtles and decrease the likelihood of long-term displacement from the wind farm lease areas. While the effect would be present long term throughout the life of future offshore wind projects, the overall impact of displacement on sea turtles is not expected to be biologically notable.

Vessel traffic: Vessel strikes are a concern for sea turtles. The percentage of loggerhead sea turtles with reported strandings due to vessel strikes increased from approximately 10 percent in the 1980s to 20.5 percent in 2004 (NMFS and USFWS 2007). Sea turtle strandings reported to have vessel strike injuries have been reported to be as high as 25 percent in Chesapeake Bay, Virginia (Barco et al. 2016), and Foley et al. (2019) reported that roughly one-third of stranded sea turtles in Florida had injuries indicative of a vessel strike. Sea turtles are expected to be most susceptible to vessel strikes in shelf waters where they forage (Barkaszi et al. 2021). Furthermore, they cannot reliably avoid being struck by vessels traveling in excess of 2 knots (Hazel et al. 2007); typical vessel speeds in the geographic analysis area may exceed 10 knots. Up to 207 vessels associated with offshore wind development may be operating in the geographic analysis area during the peak construction period in 2025 (BOEM 2019) (Appendix F, Table F1-14). Increased vessel traffic could result in a higher number of vessel strikes, resulting in injury or mortality of individual sea turtles. However, despite the potential for individual fatalities, potential impacts are localized and no population-level impacts on sea turtles are expected. It is expected that planned offshore wind projects will adhere to vessel speed restrictions and visual monitoring, which, while geared primarily towards marine mammals, will help reduce the risk of a strike occurring that results in a serious injury or mortality. PSO sightings data indicate sighting rates for sea turtles during vessel operations were approximately 13 sea turtle detections per 100 hours of vessel effort (Marine Ventures International, Inc. 2022; RPS 2021). These detection rates are relatively high, and even with these high detection rates there were only 18 vessel strike mitigation actions required (2.8 percent of all sea turtle detections) and no strikes reported. However, there are limited measures that have been proven to be effective at reducing collisions between sea turtles and vessels (Schoeman et al. 2020). The relatively small size of sea turtles makes detection very difficult when turtles are at the surface, during which time only a small portion of their body (e.g., head, top of carapace) is visible for detection at any distance that is reasonable for avoidance measures to be taken. Avoidance of vessels by sea turtles is not well documented but is expected to be initiated visually rather than acoustically (Hazel et al. 2007) and vessel strike probability increases significantly for vessels traveling greater than 4 knots (Hazel et al. 2007). Therefore, implementation of mitigation would not fully eliminate the risk of vessel strikes on sea turtles, but could help reduce it, and the seasonal patterns of sea turtles in the region would result in a reduction in risk during the early spring and winter months when sea turtle abundances in the area are expected to be lower (Section 3.19.1, *Description of the Affected Environment for Sea Turtles*). Vessel strikes are particularly lethal for sea turtles due to their size, and mortality risk increases with size and speed of the vessel. Therefore, the risk of vessel strikes on individuals cannot be discounted, and impacts are not expected to have population-level effects and so they are classified as minor.

Fishing gear utilization (biological/fisheries monitoring surveys): A primary threat to sea turtles is their unintended capture in fishing gear, which can result in drowning or cause injuries that lead to injury and mortality (e.g., swallowing hooks). For example, trawl fishing is among the greatest continuing primary threats to the loggerhead turtle (NMFS and USFWS 2019), and sea turtles are also caught as bycatch in other fishing gear including longlines, gillnets, hook and line, pound nets, pot/traps, and dredge fisheries. A substantial impact of commercial fishing on sea turtles is the entrapment or entanglement that occurs with a variety of fishing gear. Although the requirement for the use of bycatch mitigation measures—such as requirements for “turtle excluder devices” in trawl fishing gear in the southeastern U.S. shrimp fisheries (NMFS 2023c)—has reduced sea turtle bycatch, Finkbeiner et al. (2011) compiled data on sea turtle bycatch in U.S. fisheries and found that in the Atlantic, a mean estimate of 137,700 interactions, 4,500 of which were lethal, occurred annually since implementation of bycatch mitigation measures. The impacts of gear use associated with fisheries on sea turtles may result in the injury or mortality of individual sea turtles of any species that may occur within sampled area(s). These impacts are expected to be localized and short term in duration (limited to active sampling periods only). Loss or injuries of individual turtles resulting from these activities are not expected to result in population-level effects on any species and are, therefore, expected to be minor. A reduction of sea turtle interactions with fisheries is a priority for sea turtle recovery.

Climate change: Global climate change is an ongoing potential risk to sea turtles, although the associated impact mechanisms are complex, not fully understood, and difficult to predict with certainty. Possible impacts on sea turtles due to climate change include increased storm severity and frequency; increased erosion and sediment deposition; increased disease frequency; ocean acidification; and altered habitat, prey availability, ecology, and migration patterns. Over time, climate change, in combination with coastal development, would alter existing nearshore and coastal (nesting beach) habitats and render some areas unsuitable for some species and more suitable for others. Furthermore, regarding the effects of temperature on nesting sea turtles, termed ‘temperature-dependent sex determination' or TSD, increased temperatures could result in skewed and even lethal incubation conditions, which would result in impacts on turtle species, hatchling success (the proportion of eggs that produce viable hatchlings), hatchling size and locomotory performance, the prevalence of scute abnormalities, and possibly infectious disease outbreaks (National Ocean Service 2023; Laloë and Hays 2023; Patrício et al. 2021). However, the introduction of planned offshore wind projects would be expected to help slow the progression of climate change. Therefore, these activities would not contribute to the risks of climate change faced by sea turtles and may result in beneficial changes for sea turtles through operations of planned offshore wind projects. Beneficial effects may be offset by derelict or abandoned fishing gear or fishing line.

3.19.3.3 Conclusions

Impacts of the No Action Alternative. Under the No Action Alternative, sea turtle species would continue to be affected by existing environmental trends and ongoing activities. Ongoing activities are expected to have continuing temporary and permanent impacts (disturbance, displacement, injury, mortality, and habitat conversion) on sea turtles. These effects are primarily driven by offshore construction and operation impact, presence of structures, noise, and traffic.

BOEM expects ongoing activities and future offshore wind activities to have continuing temporary to permanent impacts on sea turtles, primarily through construction-related lighting, noise, habitat alteration, risk of vessel strikes, and artificial reef effect. In addition to ongoing activities, planned activities other than offshore wind development include increasing vessel traffic, new submarine cables and pipelines, maintenance dredging, channel-deepening activities, military activities, biological/fisheries monitoring surveys, and the installation of new towers, buoys, and piers (Appendix F).

Potential impacts on sea turtles from ongoing activities, particularly the risk of accidental releases of trash and debris and vessel strikes, would be **minor** for sea turtles. Additionally, impacts on sea turtles could occur from planned actions from non-offshore wind activities, which would likely incrementally increase the number of vessels in the water and may, therefore, increase the risk of accidental releases and vessel strikes. However, the incremental increase would not result in population-level impacts on sea turtles; therefore, impacts would remain **minor**. The combination of ongoing activities and reasonably foreseeable non-offshore wind activities would result in **minor** impacts on sea turtles in the geographic analysis area.

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

Considering all IPFs collectively, future offshore wind activities in the geographic analysis area would result in **minor adverse** impacts overall, particularly from pile driving, vessel strike risk, or entanglement risk posed by the presence of structures. They would also result in **minor beneficial** impacts throughout the life of the projects due to 'reef effect' associated with the presence of the structures. Beneficial effects may be offset by the risk of entanglement due to derelict or abandoned fishing gear or fishing line. Most of the structures in the geographic analysis area would be attributable to offshore wind development. Sea turtles present in these project areas during construction would be exposed to increased underwater noise levels during pile driving of new WTG and OSS foundations and would be at risk of vessel strikes from project vessels used throughout all phases of development. These impacts are expected to be localized to the project area of a given wind farm project, and impacts would not be biologically notable on the regional population or species level.

3.19.4 Relevant Design Parameters and Potential Variances in Impacts

This EIS analyzes the maximum-case scenario; any potential variances in the proposed Project build-out as defined in the PDE would result in impacts similar to or less than those described in the sections below. The primary PDE parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*) that would influence the magnitude of the impacts on sea turtles:

- Noise associated with the construction of Project structures (e.g., pile driving and construction vessels), which could have behavioral and physiological effects or cause auditory injury to sea turtles;
- Vessel traffic, which could increase collision risk to sea turtles due to increased recreational fishing vessels and vessels transiting to and from the Wind Farm Area during construction, operations, and decommissioning; and
- The presence of structures, which could cause both beneficial and adverse impacts on sea turtles through localized changes to hydrodynamic disturbance, prey aggregation and associated increase in foraging opportunities, incidental hooking from recreational fishing around foundations, entanglement in lost and discarded fishing gear, migration disturbances, and displacement.

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

- **Foundation type:** The potential acoustic impacts on sea turtles differ among the foundation types that the Project would use, which is up to 3 piled jacket foundations or monopile foundations for OSS and up to 98 monopile foundations for WTGs. Construction of the jacket-type foundation would have a higher acoustic impact than construction of the monopile foundation due to the increased risk of exposure because of the longer time required to install more piles (up to four 9.8-foot [3-meter] pin piles per jacket).
- **Monopile diameter:** The potential acoustic impacts on sea turtles differ among the WTG monopile diameters that may be used. The Project would use monopiles with a maximum diameter between 25 feet (8 meters) and 34 feet (11 meters). The acoustic modeling associated with construction of a monopile with a diameter of 34 feet (10.3 meters) differs from the acoustic modeling associated with construction of a monopile with a diameter of 30 feet (9 meters).
- **The WTG number:** All potential impacts would be lessened with a decrease in number of WTGs built.
- **Onshore export cable routes:** The route chosen (including variants within the general route) would determine the amount of habitat affected. Sections 3.19.3 through 3.19.6 detail the pertinent differences among the options with respect to sea turtles.
- **Season of construction:** Sea turtles may occur in Virginia waters year-round, but highest abundances occur from May through November (DiMatteo et al. 2023). Construction outside of the May–November window would have a lesser impact on sea turtles compared to construction during peak abundance periods.

Although some variation is expected in the design parameters, the impact assessment on sea turtles in this section analyzes the maximum-case scenario.

3.19.5 Impacts of the Proposed Action on Sea Turtles

Accidental releases: During construction, operation, and conceptual decommissioning of the Project there could be a short-term risk of sanitary and other waste fluids or fuels and other petrochemicals accidentally entering the water from vessels operating during Project activities. If sea turtles were exposed to an oil spill or discharge of waste material, potential impacts would be the same as those discussed in Section 3.19.3.2, *Cumulative Impacts of the No Action Alternative*. Any non-routine spills or accidental releases that could result in negligible and short-term impacts on surface water resources would be avoided or minimized through the implementation of the Project Oil Spill Response Plan and other environmental protection measures (COP, Section 4.2.6.3, Table 4.2-51; Dominion Energy 2023). Impacts on sea turtles from accidental spills or pollutant releases are considered minor because of the low probability of accidents and mitigation measures that will be implemented. Trash and debris from Project-related vessels that enter the water also represents a risk factor to sea turtles because they could ingest or become entangled in debris, causing lethal or injurious impacts. Plastic materials (e.g., plastic bags) are often mistaken for prey (e.g., jellyfish, salps) and ingested, which can block the turtles' intestinal tracts, causing injury or mortality. Personnel working offshore would receive training on sea turtle awareness and marine debris awareness (COP, Section 4.2.6.3, Table 4.2-51; Dominion Energy 2023). Other proposed measures that would be implemented include strict adherence to regulations specified in separate Annexes of MARPOL (the International Convention for the Prevention of Pollution from Ships), which would lower the probability of such a risk (USCG 2023). Therefore, impacts from accidental releases on sea turtles are expected to be negligible for the Proposed Action.

Electromagnetic fields: EMFs would be produced by the inter-array and offshore export cables throughout the life of the Project. These effects would be most intense directly above the cables at locations where they could not be buried to the full proposed burial depth and are laid on the seafloor beneath stone or concrete mattresses. Approximately 300 miles (484 kilometers) of inter-array cable and 417 miles (671 kilometers) of export cable in the offshore portion of the preferred cable route would be installed (COP, Table 1.2-1; Dominion Energy 2023). Estimated EMF levels modeled by Exponent for the COP (Appendix AA; Dominion Energy 2023) predict a maximum magnetic field from the inter-array cable of 68 milligauss, and 112 milligauss from the export cable at the seabed. However, the magnetic field is reduced to 5.2 and 8.7 milligauss for the inter-array and export cable, respectively, at 3 feet (1 meter) above the seafloor; similar reductions are expected at increasing horizontal distance from the cables (COP, Appendix AA; Dominion Energy 2023). BOEM has conducted literature reviews and analyses of potential EMF effects from offshore renewable energy projects on indigenous fauna (CSA Ocean Sciences and Exponent 2019; Normandeau et al. 2011). These and other available reviews and studies (Gill et al. 2005; Kilfoyle et al. 2018) suggest that most marine species cannot sense very low intensity electric or magnetic fields at the typical AC power transmission frequencies associated with offshore renewable energy projects. As discussed in Section 3.19.3.2, sea turtles are likely magnetosensitive and orient to Earth's magnetic field for navigation, but they are unlikely to detect magnetic fields below 50 milligauss (Normandeau et al. 2011). The transmission cables used during Project operations may exceed 50 milligauss at locations where full burial is not possible, but these areas would be limited (i.e., the magnetic field above 50 milligauss would be limited to the area immediately above the cables) (COP, Appendix AA; Dominion Energy 2023). This indicates that sea turtles would only be able to detect induced magnetic fields within a few meters of the exposed cables or immediately above buried cables. Given the lack of sensitive life stages of sea turtles present in the Project area, the limited extent of detectable magnetic field levels, and limited potential for sea turtles to encounter field levels above detectable levels for extended periods of time, the effects of Project-related EMF exposure on sea turtles would be negligible for the Proposed Action.

Light: Lights would be required on vessels and heavy equipment during construction and conceptual decommissioning, and would also include a variety of operational lighting, including navigational lighting for mariners, obstruction lighting for aviators, and vessel/work lighting for maintenance and operations. As discussed in Section 3.19.3.2, behavioral responses to artificial lighting of offshore structures and vessels have been observed in sea turtles; however, none of these responses are expected to result in long-term or biologically notable impacts. Additionally, typical migrating or foraging behavior of sea turtles (i.e., remaining predominantly submerged) limits their exposure to operational lighting, and lighting would be limited to the minimum required for by regulation for safety. Based on available information and Project design parameters (Appendix E, *Project Design Envelope and Maximum-Case Scenario*), it is expected the impact of Project-related lighting on sea turtles would be negligible for the Proposed Action.

New cable emplacement/maintenance: Sea turtles in or near the Project area would likely be foraging or migrating between foraging and nesting habitats. Prey items within the Project area could include benthic species that could be affected by seabed disturbance associated with installation of the offshore export cables and inter-array cables. This disturbance would be short-term and prey species would be expected to return to the area once the cables are installed (Section 3.13.3). Similar levels of impact would be realized during cable maintenance. While trailing hopper suction dredgers are being considered for use for the Proposed Action, it is not definite and potential risks of sea turtle entrainment would be low as discussed in Section 3.19.3.2. Because impacts during cable installation or maintenance would be temporary and localized, the impact of Project activities on sea turtles would be negligible for the Proposed Action.

Noise: A short-term increase in underwater noise is the most likely IPF that could affect sea turtles, predominantly during installation of the WTG and OSS foundations, cofferdams, and nearshore structures during Project construction. The Project PDE includes both impact and vibratory pile driving as an option for installation of the WTG monopile foundations and OSS jacket foundations, as well as vibratory pile driving, which would be used to install the cofferdams and impact pile driving of the goal post piles (COP, Appendix Z; Dominion Energy 2023). All these activities have potential to produce noise above recommended sea turtle acoustic thresholds (Table 3.19-3). Underwater acoustic modeling was conducted for the COP (Appendix Z; Dominion Energy 2023) for both activities, and the results are summarized in Table 3.19-4. For the purposes of this assessment, the deep modeling location using the maximum hammer energy with the noise attenuation proposed for each activity based on the LOA application (Tetra Tech 2022) is provided for each modeled scenario.

Table 3.19-4 Summary of Underwater Acoustic Modeling Conducted for the Coastal Virginia Offshore Wind Project Construction and Operations Plan

Scenario	Noise Attenuation (dB)	Distance (m) to PTS Threshold ($L_{p,pk}$)	Distance (m) to PTS Threshold ($L_{E,24hr}$)	Distance (m) to TTS Threshold ($L_{p,pk}$)	Distance (m) to TTS Threshold ($L_{E,24hr}$)	Distance (m) to Behavioral Threshold (L_P)
Standard Driving Installation – Impact Pile Driving	10	10	1,044	67	3,575	2,146
Standard Driving Installation – Vibratory Pile Driving	10	N/A	6	NA	179	82
Hard-to-Drive Installation – Impact Pile Driving	10	10	1,142	67	3,902	2,146
Hard-to-Drive Installation – Vibratory Pile Driving	10	N/A	0	NA	132	82
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	10	10	1,410	67	4,812	2,146
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	10	N/A	8	NA	200	82
OSS Piled Jacket – Impact Pile Driving	10	0	653	0	2,303	742
OSS Piled Jacket – Vibratory Pile Driving	10	N/A	0	NA	94	7
Cofferdam Installation – Vibratory Pile Driving	0	N/A	0	NA	NA	0

Scenario	Noise Attenuation (dB)	Distance (m) to PTS Threshold ($L_{p,pk}$)	Distance (m) to PTS Threshold ($L_{E,24hr}$)	Distance (m) to TTS Threshold ($L_{p,pk}$)	Distance (m) to TTS Threshold ($L_{E,24hr}$)	Distance (m) to Behavioral Threshold (L_P)
Goal Post Pile Installation – Impact Pile Driving	0	0	0	NA	NA	0

Source: Tetra Tech 2022.

As discussed in Section 3.19.3.2, the low-frequency noise associated with impact and vibratory pile driving during installation of the WTG and OSS foundations is within the estimated hearing range of sea turtles. Results of the modeling show there is some risk of exposure to noise above the PTS threshold during impact pile driving given the maximum range to the threshold may extend to 0.9 mile (1.4 kilometers) with 10 dB noise attenuation (Table 3.19-4). However, the PTS threshold is represented as a sound exposure level over 24 hours ($L_{E,24hr}$) indicating that the duration of the exposure is just as important as the level of the noise an animal is exposed to. The $L_{E,24hr}$ assumes an individual is exposed to noise at or above the threshold for the entire duration of the pile installation for the onset of PTS to occur, so if an animal moves away from the noise before accumulating enough sound to meet the threshold they are not likely to develop PTS. It is expected that sea turtles will swim away from the ensonified area during construction, which reduces the risk of PTS occurring. Additionally, mitigation measures such as soft start, pre-clearance, and shutdown procedures, while geared primarily towards marine mammals, will help ensure that the amount of time the Project area is ensonified above the thresholds and the amount of time an animal is present within the ensonified area is reduced, further reducing the risk of PTS being realized. The modeled behavioral threshold isopleths, with 10 dB noise mitigation, for sea turtles resulting from impact pile driving range from 2,434 to 7,041 feet (742 to 2,146 meters); the modeled TTS threshold isopleths with 10 dB noise mitigation range from 7,555 to 15,787 feet (2,303 to 4,812 meters). The behavioral threshold ranges use the SPL metric, which is based on the acoustic energy produced by a single hammer strike on the pile, while the TTS ranges are based on the $L_{E,24hr}$ metric, which requires accumulation of acoustic energy for the full duration of the pile installation. Therefore, while it appears animals would reach TTS thresholds prior to reaching behavioral thresholds, the time consideration in the TTS metric renders these ranges not fully comparable to the SPL ranges since the approach used assumes any given animal would be stationary for the full pile installation period, which is not representative of how an animal would be expected to behave in the wild. A shorter modeled time exposure, a single strike exposure for TTS, or modeled TTS exposure ranges that account for animal movement and behavior may provide more comparable results; however, these are not available in the modeling report and would not be expected to change the effects determinations. As discussed previously, TTS is a form of auditory fatigue that, unlike PTS, is non-permanent and reversible. As mentioned previously, very little is known about the onset of TTS in sea turtles and this metric is rarely used to assess potential impacts from impact pile driving beyond a few hammer strikes at the highest hammer energy. This metric is more often applied to sources such as underwater explosions where exposure to high sound energy could result in TTS when behavioral responses are unlikely to occur. Additionally, as discussed for behavioral responses, onset of TTS does not equate to an individual being removed from a population or facing any long-term restrictions on critical behaviors, as TTS is recoverable. As discussed for PTS, the proposed mitigation measures will help reduce the overall duration sea turtles may be exposed to above-threshold noise. If sea turtles avoid the ensonified area during pile driving that may represent a loss of foraging habitat during the construction period; however, this would not be expected to be a long-term behavioral disturbance as sea turtles would regain access to this habitat after pile driving, and there are likely to be ample foraging opportunities outside the Project area, so no impacts that would affect the viability of any sea turtle population are expected. Because of the risk of PTS for potentially large numbers of sea turtles of all species known to occur within the Project area, as well as temporary avoidance of these animals from the ensonified area, minor impacts on sea turtles are expected to result from the Proposed Action.

Vibratory pile driving during installation of the cofferdams is not expected to exceed PTS or behavioral thresholds at any distance (Table 3.19-4). Therefore, vibratory pile driving associated with cofferdam installation is expected to result in a negligible impact on sea turtles from the Proposed Action; it is more likely sea turtles would respond to noise from construction vessels staging on site prior to vibratory pile driving.

Impact pile driving during installation of the goal post piles used to support trenchless installation of the export cable is similarly not expected to result in any PTS-onset or behavioral disturbances. Though impact pile driving produces louder noise than vibratory pile driving, the size of the piles, location of the activity, and duration of the pile driving for the goal posts make this less likely to produce above-threshold noise for sea turtles. Modeling shows that PTS and behavioral thresholds will not be met or exceeded at any distance from the source (Table 3.19-4), and impacts on sea turtles during goal post installation under the Proposed Action would, therefore, result in negligible impacts.

Underwater noise levels produced by construction, maintenance, and decommissioning vessels throughout the life of the Project are not expected to exceed PTS thresholds for sea turtles. The main frequency range of vessels (10 to 1,000 Hz) overlaps with the frequency range of sea turtle hearing (100 to 1,200 Hz) (Ketten and Bartol 2006; Lavender et al. 2014); sea turtles can detect vessel noise and could respond with a startle or temporary stress response (NSF and USCG 2011). However, sea turtles may also habituate to vessel traffic associated with the Project as they inhabit areas that experience regular marine traffic (Hazel et al. 2007). A conservative assumption is that Project construction and support vessels could elicit behavioral changes in individual sea turtles present in the Project area during vessel operations, but these changes would be limited to evasive maneuvers such as diving, changes in swimming direction, or changes in swimming speed. These changes are not expected to be biologically notable and impacts on sea turtles from Project vessel noise would, therefore, be negligible for the Proposed Action.

The most likely cable burial methods being considered as part of the Proposed Action include jet plow, jet trenching, hydroplow (simultaneous lay and burial), and mechanical plowing (simultaneous lay and burial) (COP Section 3.4, Dominion Energy 2023), which produce low sound levels, as discussed in 3.15.3.2, *Cumulative Impacts of the No Action Alternative*. Potential impacts would be limited to behavioral disturbances that are short term and localized around the immediate area surrounding the cable installation activities and would, therefore, be negligible for sea turtles.

HRG survey equipment would likely be used during pre-construction surveys to support design finalization. This equipment produces noise in the 1.1 to 200 kHz frequency range at sound levels that may exceed sea turtle behavioral thresholds. No injurious impacts are expected for sea turtles from any HRG survey equipment (Baker and Howsen 2021). Behavioral disturbances may occur up to 295 feet (90 meters) from impulsive sources and up to 7 feet (2 meters) from non-impulsive sources assuming equipment are operating at the highest power settings (Baker and Howsen 2021). However, as discussed in Section 3.19.3.2, the assessment conducted by Ruppel et al. (2022) indicated that, even without mitigation, behavioral disturbances were unlikely to occur for sea turtles during operation of most HRG equipment, given the source levels and frequency range of the sources. Some low-level behavioral disturbances could potentially occur during Project-related HRG surveys; however, implementation of mitigation measures (Appendix H, *Mitigation and Monitoring*) and the relatively short duration of these surveys would reduce the risk of exposure. Impacts from HRG surveys on sea turtles are, therefore, expected to be negligible for the Proposed Action.

Sea turtles would likely be able to hear the continuous underwater noise of operational WTGs throughout the life of the proposed Project. Sea turtle hearing (frequencies less than 1,200 Hz) is within the frequency range for operational WTG (less than 500 Hz) (Popper et al. 2014; Thomsen et al. 2006; Tougaard et al. 2009, 2020). Thus, it is possible that WTG noise may influence sea turtle behavior. Potential responses to WTG noise generated during normal operations may be behavioral and include avoidance of the noise source, disorientation, and disturbance of normal behaviors such as feeding (MMS 2007). Noise generated during normal operations might affect many individuals and for a much longer time period (MMS 2007). As discussed previously for marine mammals in Section 3.15.3, operational WTGs can produce L_P ranging from 92 to 137 dB referenced to 1 micropascal at distances of 65 to 656 feet (20 to 200 meters) from the source (Tougaard et al. 2020). However, though WTG noise may exceed ambient sound levels present within the Project area, they are not expected to exceed noise produced by vessel traffic out to 0.6 mile (1 kilometer) (Tougaard et al. 2020) and impacts would, therefore, be similar to those described for vessel noise under *Cumulative Impacts of the No Action Alternative* and would be expected to be negligible.

Port utilization: No dredging activities related to port modifications are directly proposed under the Proposed Action, so sea turtles in the Project area would not be exposed to dredging activities under the Proposed Action. Additionally, most sea turtle nesting locations in this area are north of the Project switching station in military reserves and national wildlife refuges, outside the area of effect (Section 3.19.1). Therefore, dredging impacts on sea turtles from port utilization during Project construction would be negligible for the Proposed Action.

Presence of structures: The Proposed Action would alter approximately 203.3 acres (0.82 square kilometer) of seafloor, with 202 WTG and up to three OSS foundations with associated scour protection and over the life of the Project (COP, Table 4.2-17; Dominion Energy 2023). The alteration of the seafloor under the Proposed Action would result in a long-term conversion of existing benthic habitat to new, stable, hard structures. The presence of the foundations poses a potential risk for sea turtle displacement which would result in lost foraging opportunities or reduced access to foraging and breeding habitat. However, there is no designated critical habitat for any sea turtles in the Project area so there is not expected to be any substantial loss of foraging opportunities that could have population-level effects. Based on the best available information, negligible impacts, if any, are anticipated for the Proposed Action. Sea turtles would be expected to use habitat in between the WTGs, as well as around structures for feeding, breeding, resting, and migrating for short periods, but residency times around structures may increase with the age of structures if benthic communities develop on and around foundations. Although migrating sea turtles could make temporary stops to rest and feed during migrations, the presence of structures is not expected to result in noticeable changes to overall migratory patterns in sea turtles. However, presence of these structures is also expected to attract fishing activity, which may increase the risk of accidental releases of trash and debris or entanglement in fishing gear. Interactions with lost fishing gear, such as hook and line or gill net gear around WTG foundations is another potential long-term risk and may result in hooking, entanglement, ingestion, injury, and death of individual turtles (Berreiros and Raykov 2014; Gregory 2009; Vegter et al. 2014). Given sea turtle proclivity for using anthropogenic structures and documented effects of discarded fishing gear on sea turtles (Barnette 2017), it is likely that impacts from entanglement associated with the Proposed Action on sea turtles would be minor, as impacts would be detectable and measurable. These impacts may include injury or loss of individuals, but these impacts would not result in population-level effects.

Once construction is complete, these surfaces would be available for colonization by sessile organisms and would draw other species that are typically attracted to hard-bottom habitats (Causon and Gill 2018; Langhamer 2012). This phenomenon is known as the reef effect as discussed in Section 3.19.3.2. Additional information about the reef effect on sea turtle prey species can be found in Section 3.13.3. The Project foundations could result in localized increased primary production and zooplankton abundance, which could serve as food for some sea turtle species, as well as some sea turtle prey species. This may result in minor beneficial impacts from the presence of foundations for the Proposed Action.

Within the context of other available habitats along the OCS and expected future offshore wind projects (Appendix F, *Planned Activities Scenario*), habitat availability due to presence of WTG and OSS foundations, including the Proposed Action, would result in minor adverse impacts on sea turtles. The presence of structures, which would attract fish, may attract fishing vessels around the wind farms, which increases the risk of lost gear being present where sea turtles are foraging or migrating. However, the increased fish presence and potential primary productivity rates around these structures would also provide additional foraging opportunities, and the structures themselves provide shelter for sea turtles which may result in minor beneficial effects on sea turtles. However, it must be noted that these minor beneficial effects may be offset due to the risk of entanglement due to derelict or abandoned fishing gear or fishing line.

Vessel traffic: Vessels associated with Project construction, O&M, and conceptual decommissioning during the Proposed Action would result in a nominal increase in vessel traffic relative to the overall existing volume of vessel traffic offshore Virginia and within the OCS in general (Appendix F, Table F1-14). Larger vessels used during construction would largely transit to the Project work site and remain there for most of the construction period. Smaller support vessels are expected to make more frequent trips between Project ports and the work site to deliver supplies and crew members. Regular trips would also be made by Project vessels throughout operations and maintenance for routine maintenance of Project components. Increased vessel traffic from Project activities presents a vessel strike risk to individual sea turtles of the species identified as potentially occurring in the Project area, all of which are listed as threatened or endangered under the Endangered Species Act; a strike that results in serious injury or mortality could have severe consequences. Sea turtle stranding data reported that stranded sea turtles with evidence of vessel strike injury were as high as 25 percent in the Chesapeake Bay, Virginia (Barco et al. 2016). Similarly, Foley et al. (2019) reported that roughly one-third of stranded loggerhead, leatherback, and green sea turtles in Florida had injuries indicative of a vessel strike. However, all Project vessels would implement mitigation measures outlined in the COP (Section 4.2.6.3, Table 4.2-63; Dominion Energy 2023) following guidance from both NOAA and BOEM to reduce the likelihood of vessel strike on sea turtles. Mitigation measures such as vessel speed restrictions and protected species monitoring, while geared towards marine mammals, will subsequently benefit sea turtles by reducing the risk of a vessel strike occurring. PSOs for offshore wind site investigation surveys have reported sightings of sea turtles during vessel transits and survey operations (Marine Ventures International, Inc. 2022; RPS 2021). RPS (2021) recorded 75 leatherback sea turtles, 470 loggerhead sea turtles, and 83 unidentified turtles over a 2-year period totaling roughly 4,893 observation hours, which equates to approximately 13 sea turtle detections per 100 hours of survey and vessel effort. These detection rates are relatively high, and even with these high detection rates there were only 18 vessel strike mitigation actions required (2.8 percent of all sea turtle detections) and no strikes reported. Therefore, with the implementation of vessel strike avoidance measures such as visual monitoring, impacts from vessel traffic on sea turtles would be minor under the Proposed Action, including conceptual decommissioning.

Fishing gear utilization (biological/fisheries monitoring surveys): Under the Proposed Action, fisheries monitoring surveys would be conducted for whelk, black sea bass, and Atlantic surf clam (Appendix H, Table H-2). These survey activities would include use of trap/pot fishing gear for the welk and black sea bass and dredging for the Atlantic surf clam which would post a risk of entrainment or unintended capture for sea turtles. However, the Proposed Action also includes a number of mitigation and monitoring measures, such as removing all sampling gear from the water at least once every 30 days; recovering lost survey gear; having at least one onboard staff member who has completed the Northeast Fisheries Observer Program observer training (within the last 5 years) or other training in protected species identification and safe handling; and having adequate disentanglement equipment (i.e., knife and boathook) onboard vessels deploying fixed gear (Appendix H). Given the limited duration and spatial extent of all fisheries monitoring survey efforts and the implementation of the monitoring and mitigation measures (Appendix H), the effects from monitoring surveys (e.g., entanglement, reductions in prey) on sea turtles are considered extremely unlikely to occur and though they would be detectable and measurable, would not lead to population-level effects. The impact of survey gear utilization on sea turtles as a result of the Proposed Action, therefore, is expected to be minor.

3.19.5.1 Cumulative Impacts of the Proposed Action

The cumulative impacts of the Proposed Action considered the impacts of the Proposed Action in combination with other ongoing and planned wind activities. Ongoing and planned non-offshore wind activities within the geographic analysis area that contribute to cumulative impacts on sea turtles include but are not limited to various coastal development projects. As the Proposed Action would account for about 9.6 percent (up to 202 of 3,287) of the new WTGs on the OCS, a majority (approximately 90 percent) of these impacts would occur as a result of structures associated with other offshore wind development and not the Proposed Action.

Accidental releases: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, and conceptual decommissioning activities would be minor. Entanglement in lost fishing gear is the primary anthropogenic cause of mortality in both juvenile and adult sea turtles (National Research Council 1990 as cited in Shigenaka et al. 2010) and is expected to be the primary source of risk to sea turtles from accidental releases of trash and debris from ongoing and planned activities.

Electromagnetic fields: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be negligible. New subsea cable installation would be predominantly attributed to future offshore wind development, which would result in up to 5,595 miles (9,004 kilometers) of export cables and 5,554 miles (8,938 kilometers) of inter-array cables installed between 2023 and 2030, within which the Proposed Action comprises a relatively small portion of the overall length of the cables (Appendix F, Table F2-1). While each cable would generate EMF effects in the immediate surrounding area, only sea turtles at or directly above the seafloor near the cables would likely be able to detect it, and impacts would be limited to negligible, short-term behavioral responses.

Light: The expected negligible impact of the Proposed Action alone would not noticeably increase the overall impacts of light beyond the impacts described under the No Action Alternative (Section 3.19.3). Under the expanded planned action scenario, over 3,287 offshore structures would have lights, and these would be incrementally added over time beginning in 2023 and continuing through 2030 (Appendix F, Table F2-1). Lighting of turbines and other structures would be minimal (navigation and aviation hazard lights) and in accordance with BOEM (2021) guidance. In the context of reasonably foreseeable environmental trends, combined lighting impacts on sea turtles from ongoing and planned actions, including the Proposed Action would be expected to have negligible, non-measurable impacts on sea turtles. Ongoing and future non-offshore wind activities are not expected to cause permanent impacts, primarily driven by light from offshore structures and short-term and localized impacts from vessel lights.

New cable emplacement/maintenance: The expected negligible incremental impact of the Proposed Action or combined with ongoing and planned actions would result in seafloor disturbance from the offshore export cable and inter-array cables. In the context of reasonably foreseeable environmental trends, the combined cable emplacement impacts from ongoing and planned actions, including the Proposed Action, could occur if impacts are in close temporal and spatial proximity. However, these impacts from cable emplacement would be expected to be negligible and would not be expected to be biologically notable.

Noise: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be minor for sea turtles. The main activity that would result in adverse effects on sea turtles is impact pile driving during installation of WTG and OSS foundations. The expected minor incremental impact of the impact pile driving under the Proposed Action, combined with future offshore wind activities, would result in increased underwater noise levels during construction starting in 2023 and continuing through 2030, but the effects of this activity would cease once pile driving stopped (Appendix F, Table F2-1). All other noise-producing activities under the Proposed Action, including conceptual decommissioning, are expected to result in negligible impacts on sea turtles, and combined impacts with ongoing and planned actions would similarly be negligible. Impacts from other noise producing activities are lower in intensity relative to impact pile driving, and impacts would be localized, temporary, and not biologically notable for sea turtle populations.

Port utilization: In the context of reasonably foreseeable environmental trends, the combined impacts from this IPF from ongoing and planned actions, including the Proposed Action, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be negligible.

Presence of structures: The Proposed Action would contribute to the cumulative impacts of structures on sea turtles, which are expected to minor.

Vessel traffic: In the context of reasonably foreseeable environmental trends, the combined vessel traffic impacts from ongoing and planned actions, including the Proposed Action, and conceptual decommissioning, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be minor.

Fishing gear utilization (biological/fisheries monitoring surveys): In the context of reasonably foreseeable environmental trends, the combined fishing gear utilization impacts from ongoing and planned actions, including the Proposed Action, and conceptual decommissioning, would be expected to be similar to the impacts under the No Action Alternative and would be expected to be minor.

3.19.5.2 Conclusions

Impacts of the Proposed Action. Project construction, operations and maintenance, and conceptual decommissioning would likely result in habitat disturbance, underwater noise, vessel traffic, artificial lighting, and potential accidental discharges or spills and trash. BOEM anticipates the impacts resulting from the Proposed Action would range from **negligible** to **minor**. Therefore, the overall impacts on sea turtles are expected to be **minor**, as the overall effect would be notable, but the resource is expected to recover completely with remedial or mitigating action.

Cumulative impacts of the Proposed Action. In the context of reasonably foreseeable environmental trends in the area, impacts of individual IPFs resulting from ongoing and planned actions, including the Proposed Action, would range from **negligible** to **minor**. The Proposed Action could also result in **minor beneficial** impacts that may be offset by the risk of entanglement in derelict or abandoned fishing gear or fishing line. Considering all the IPFs collectively, impacts from ongoing and planned actions, including the Proposed Action, would result in **minor** impacts on sea turtles in the geographic analysis area. The main driver for this impact rating is underwater noise from impact pile driving (rated as a minor impact). Considering the fact that all sea turtle species in the region are currently listed as endangered or threatened under the ESA, the overall rating reflects this highest, or most severe rating from individual IPFs. The Proposed Action would contribute to the overall impact rating primarily through additional impact pile driving, vessel traffic, and WTG/OSS structures that would be present in the region during Project construction and operations and maintenance. Therefore, overall impacts on sea turtles are expected to be **minor** because a measurable impact is anticipated, but the resource would likely recover completely when activities cease or remedial or mitigating actions are taken.

3.19.6 Impacts of Alternatives B and C on Sea Turtles

BOEM identified a combination of Alternative B (Revised Layout to Accommodate the Fish Haven Area and Navigation) and Alternative D-1 (Interconnection Cable Route Option 1) as the Preferred Alternative. The analysis of the impacts of the Preferred Alternative would be the same as that for Alternative B, as described in this section.

Impacts of Alternatives B and C. Alternatives B and C would reduce the number of proposed WTGs but would lead to the same types of impacts on sea turtles from construction and installation, O&M, and conceptual decommissioning activities as described for the Proposed Action. However, Alternatives B and C would remove 29 and 33 turbines, respectively; therefore, there would be a smaller area of seabed disturbance and water column disturbance and a shorter duration of noise impacts. The area of seabed disturbed by Alternatives B and C would be decreased by approximately 14 percent and 17 percent compared to the Proposed Action, respectively. Although this would decrease the overall duration of impact pile driving expected during the construction period, the noise produced per pile would be expected to be similar to that described under the Proposed Action and impacts on sea turtles would be expected to remain minor.

Operational impacts of reduced WTGs on sea turtles under Alternatives B and C would be minimally decreased compared to the Proposed Action due to the fewer number of WTGs and subsequent smaller area of impact. Less habitat would be altered and affected by WTG operational noise, artificial lighting, and EMF from the inter-array cable. However, in the vicinity of the Project, effects would not be measurably different from those of the Proposed Action.

If Alternative B or Alternative C were approved, associated risks to sea turtles, particularly related to pile-driving noise, would be less than those expected under the Proposed Action.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action.

3.19.6.1 Conclusions

Impacts of Alternatives B and C. Although Alternatives B and C would decrease the number of WTGs and their associated inter-array cables, BOEM expects that the impacts resulting from Alternatives B and C alone would be similar to those of the Proposed Action and would range from **negligible** to **minor**.

Cumulative impacts of Alternatives B and C. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternatives B and C, would be similar to those described under the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts, and with the potential for **minor beneficial** impacts to be offset by the risk of entanglement in derelict or abandoned fishing gear or fishing line. While Alternatives B and C may result in a slightly lower risk of impacts on sea turtles than described under the Proposed Action, the overall impacts of Alternatives B and C on sea turtles would be the same as under the Proposed Action and would remain **minor**. This impact rating is determined primarily by ongoing activities such as those that produce underwater noise and vessel activities. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.19.7 Impacts of Alternative D on Sea Turtles

Impacts of Alternative D. Alternative D would result in the same types of impacts on sea turtles from construction, O&M, and decommissioning as the Proposed Action. The scope of construction and installation activities and their associated IPFs under Alternative D are designed to reduce the impact on onshore habitats but, as described in Section 3.19.1, sea turtles around the Project area are primarily expected to remain offshore in the Project area. Loggerhead sea turtles, green sea turtles, and Kemp's ridley sea turtles have been documented nesting in Virginia (USFWS 2005; Wright 2015; Parker 2020; Wollam 2023) but, given the availability of nest beaches relative to the proposed onshore cable construction footprint, no biologically relevant impacts on breeding for this population are expected under Alternative D. The primary IPFs that would affect sea turtles are underwater noise and vessel traffic, which would not differ from that described under the Proposed Action, and impacts on sea turtles would be expected to remain negligible to minor.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action.

3.19.7.1 Conclusions

Impacts of Alternative D. Although Alternative D would minimize impacts on onshore habitats, this is not expected to result in a notable benefit for sea turtles in this region, and overall potential impacts would be the same as under the Proposed Action and would range from **negligible** to **minor**.

Cumulative impacts of Alternative D. In the context of reasonably foreseeable environmental trends, the combined impacts on sea turtles from ongoing and planned actions, including Alternative D, would be the same as those described under the Proposed Action, with individual IPFs leading to **negligible** to **minor** impacts, and would also result in **minor beneficial** impacts. However, it is important to note that these benefits may be offset by the risk of entanglement in derelict fishing gear. While Alternative D is designed to minimize impacts on onshore habitats, the overall impacts of Alternative D on sea turtles would be the same as under the Proposed Action and would remain **minor**. This impact rating is determined primarily by ongoing activities, such as those that produce underwater noise and vessel activities. As described for the Proposed Action, Dominion Energy's existing commitments to mitigation measures and BOEM's potential additional mitigation measures could further reduce impacts but would not change the impact ratings.

3.19.8 Agency-Required Mitigation Measures

The mitigation measures listed in Table 3.19-5 are recommended for inclusion in the preferred alternative. If one or more of the measures analyzed below are adopted, the risk for some adverse impacts could be further reduced. There are no additional agency-required mitigation measures identified as relevant for sea turtles (Appendix H, Table H-3).

Table 3.19-5 Measures Resulting from Consultations[1]

Measure	Description	Effect
Vessel strike avoidance procedures	Applicant proposed measures plus: • As part of vessel strike avoidance, a training program will be implemented. The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet.	This measure would ensure effective monitoring and separation distances from sea turtles, which will reduce potential interactions between

Measure	Description	Effect
	Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event. Vessel operators and crew must maintain a vigilant watch for marine mammals and sea turtles by slowing down or stopping their vessels to avoid striking these protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures.	Project-related vessels and sea turtles.
BOEM PDCs and BMPs	BOEM will require Dominion Energy comply with all the Project Design Criteria and BMP for Protected Species at https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf, that implement the integrated requirements for threatened and endangered species resulting from the June 29, 2021, programmatic consultation under the ESA, revised September 1, 2021. This requirement also applies to non-ESA-listed marine mammals that are found in that document. Consultation conditions occurring in State waters outside of BOEM jurisdiction may apply to co-action agencies issuing permits and authorizations under this consultation	Compliance with PDCs and BMPs for protected species would minimize risk to sea turtles during site characterization and site assessment surveys.
Look out for sea turtles and reporting	a. For all vessels operating north of the Virginia/North Carolina border, between June 1 and November 30, Dominion Energy would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements in I below can be implemented. b. For all vessels operating south of the Virginia/North Carolina border, year-round, Dominion Energy would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements II below can be implemented. This requirement is in place year-round for any vessels transiting south of Virginia, as sea turtles are present year-round in those waters. c. The trained lookout would monitor https://seaturtlesightings.org/ prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. d. If a sea turtle is sighted within 330 feet (100 meters) or less of the operating vessel's forward path, the vessel operator would slow down to 4	Maintains safe operating distances to minimize vessel interactions with sea turtles. This measure would further clarify the distance at which vessels would divert their path and the distance at which vessels would reduce speed and shift to neutral.

Measure	Description	Effect
	knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 330 feet (100 meters), at which time the vessel may resume normal operations. If a sea turtle is sighted within 164 feet (50 meters) of the forward path of the operating vessel, the vessel operator would shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle. e. Vessel captains/operators would avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas. f. All vessel crew members would be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials would be available aboard all project vessels for identification of sea turtles. The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) would be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so. g. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements on an emergency basis. If any such incidents occur, they would be reported to NMFS within 24 hours. h. If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for NARWs, an additional lookout is not required and this PSO or trained lookout would maintain watch for marine mammals and sea turtles. Vessel transits to and from the Offshore Project area, that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 330 feet (100 meters) avoidance measure.	
Marine debris awareness training	Dominion Energy would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their	Marine debris and trash awareness training would minimize the risk of sea turtle ingestion of or entanglement in marine debris.

Measure	Description	Effect
	commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Record keeping and the availability of records for inspection by DOI. By January 31 of each year, Dominion Energy would submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. Dominion Energy would send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).	
BOEM/NMFS meeting requirements for sea turtle take documentation	To facilitate monitoring of the incidental take exemption for sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records. These meetings/conference calls would be bi-annually) and would use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations. These meetings would continue on an annual basis following year one of operations. Upon mutual agreement of NMFS and BOEM, the frequency of these meetings can be changed.	Reporting requirements to document take would improve accountability for documenting and reviewing sea turtle take associated with the Proposed Action.
Data Collection BA BMPs	BOEM would ensure that all PDC and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance and operations of the Dominion Energy project as applicable.	Compliance with PDCs and BMPs for protected species would minimize risk to sea turtles during site characterization and site assessment surveys during all Project phases.

Measure	Description	Effect
BOEM COP PDCs and BMPs	Use standard underwater cables that have electrical shielding to control the intensity of electromagnetic fields (EMF).	This measure would decrease the area and intensity of EMF effects.
BOEM COP PDCs and BMPs	Vessels related to project planning, construction, and operation should travel at reduced speeds when assemblages of cetaceans are observed. Vessels also should maintain a reasonable distance from whales, small cetaceans, and sea turtles, and these should be determined during site-specific consultations.	This measure would minimize the potential of vessel strikes for sea turtles from Project-related vessels.
BOEM COP PDCs and BMPs	Lessees and grantees should minimize potential vessel effects on marine mammals and sea turtles by having project-related vessels follow the NMFS Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	This measure would minimize the potential of vessel strikes for sea turtles from Project-related vessels.
BOEM COP PDCs and BMPs	Lessees and grantees should take efforts to minimize disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	This measure would minimize the potential and severity of noise-related effects.
BOEM COP PDCs and BMPs	Lessees and grantees should avoid and minimize effects on marine species and habitats in the Action Area by posting a qualified observer on site during construction activities. This observer should be approved by BOEM and NMFS.	This measure would increase accountability and ensure the effectiveness of mitigation and monitoring measures
Periodic Underwater Surveys, Reporting of Monofilament and Other Fishing Gear Around WTG Foundations	Dominion Energy must monitor indirect effects associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations by surveying at least 10 of the WTGs located closest to shore in the Dominion Energy Lease Area (OCS-A 0483) annually. Survey design and effort may be modified with review and concurrence by DOI. Dominion Energy may conduct surveys by remotely operated vehicles, divers, or other means to determine the frequency and locations of marine debris. Dominion Energy must report the results of the surveys to BOEM (at renewable_reporting@boem.gov) and BSEE (at marinedebris@bsee.gov) in an annual report, submitted by April 30, for the preceding calendar year. Annual reports must be submitted in Word format. Photographic and videographic materials must be provided on a portable drive in a lossless format such as TIFF or Motion JPEG 2000. Annual reports must include survey reports that include: the survey date; contact information of the operator; the location and pile identification number; photographic, video documentation, or both of the survey and debris encountered; any animals sighted; and the disposition of any located debris (i.e., removed or left in place).	This measure would establish requirement for monitoring and reporting of lost monofilament and other fishing gear around WTGs, which would reduce the risk of entanglement associated with the presence of structures.

Measure	Description	Effect
	Annual reports must also include claim data attributable to the Project from Dominion Energy corporate gear loss compensation policy and procedures. Required data and reports may be archived, analyzed, published, and disseminated by BOEM.	
PAM Plan	BOEM and USACE would ensure that Dominion Energy prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. This plan would be submitted to NMFS and BOEM for review and concurrence at least 120 days prior to the planned start of activities requiring PAM.	This measure would ensure the efficacy of PAM placement for appropriate monitoring.
Pile driving monitoring plan	BOEM would ensure that Dominion Energy prepare and submit a Pile Driving Monitoring Plan to BOEM, BSEE, and NMFS for review and concurrence at least 90 days before start of pile driving. The plan would detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan would also describe how BOEM and Dominion Energy would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Dominion Energy would obtain NMFS' concurrence with this plan prior to starting any pile driving.	This measure would ensure adequate monitoring and mitigation is in place during pile driving, which would minimize the potential for Level A or Level B exposures to marine mammals during foundation installation.
PSO Coverage	BOEM and USACE would ensure that PSO coverage is sufficient to reliably detect marine mammals and sea turtles at the surface in the identified clearance and shutdown zones to execute any pile driving delays or shutdown requirements during foundation installation. This will include a PSO/ PAM team on the construction vessel and two additional PSO vessels each with a visual monitoring team. The following equipment and personnel will be on each associated vessel: ***Construction Vessel:*** • 2, visual PSOs on watch • 2, (7x) or (10x) reticle binoculars calibrated for observer height off the water. • 2 (25x or similar) mounted "big eye" binoculars if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1, PAM operator on duty • 1, mounted thermal/IR camera system • 2, (25x or similar) "big eye" binoculars mounted 180 deg apart	This measure ensures adequate monitoring of zones during foundation installation to reduce risk to sea turtles.

Measure	Description	Effect
	• 1, monitoring station for real-time PAM system • 2, handheld or wearable NVDs with IR spotlights • 1, Data collection software system • 2, PSO-dedicated VHF radios • 1, digital single lens reflex camera equipped with a 300-mm lens **Each Additional PSO Vessels (2):** • 2, visual PSOs on watch • 2, (7x) or (10x) reticle binoculars calibrated for observer height off the water. • 1, (25x or similar) mounted "big eye" binoculars if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1, mounted thermal/IR camera system • 1, handheld or wearable NVD with IR spotlight • 1, Data collection software system • 2, PSO-dedicated VHF radios • 1, digital single lens reflex camera equipped with a 300-mm lens If, at any point prior to or during construction, the PSO coverage that is included as part of the Proposed Action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs, platforms, or both would be deployed. Determinations prior to construction would be based on review of the Pile Driving Monitoring Plan. Determinations during construction would be based on review of the weekly pile driving reports and other information, as appropriate.	
Sound Field Verification Plan	BOEM would require Dominion Energy to develop an operational sound field verification plan to determine the operational noises emitted from the Offshore Project area. The plan would be reviewed and approved by BOEM and NMFS. The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from percussive pile driving)	This measure would establish requirements for operational noise monitoring.
Sound field verification	Applicant proposed measures plus: BOEM and USACE would ensure that if the clearance, shutdown zones, or both are expanded due to the verification of sound fields from Project activities, PSO coverage is sufficient to reliably monitor the expanded clearance, shutdown zones, or both. Additional observers would be deployed on additional platforms for every 4,921 feet (1,500 meters) that a clearance or shutdown zone is	This measure would ensure adequate monitoring of clearance zones in order to minimize noise-related effects on sea turtles.

Measure	Description	Effect
	expanded beyond the distances modeled prior to verification.	
Adaptive shutdown zones	BOEM and USACE may consider reductions in the shutdown zones for sei, fin or sperm whales based on sound field verification of a minimum of 3 piles; however, BOEM/USACE would ensure that the shutdown zone for sei whales, fin whales, blue whales, and sperm whales is not reduced to less than 3,280 feet (1,000 meters), or 1,640 feet (500 meters) for sea turtles. No reductions in the clearance or shutdown zones for NARWs would be considered regardless of the results of sound field verification of a minimum of three piles.	This measure would ensure that shut down zones are sufficiently conservative in order to minimize noise-related effects on sea turtles.
Minimum visibility requirement	• In order to commence pile driving at foundations, PSOs must be able to visually monitor a 5,741-foot (1,750-meter) radius from their observation points for at least 60 minutes immediately prior to piling commencement. • In order to commence pile driving at trenchless installation sites, PSOs must be able to visually monitor a 3,280-foot (1,000-meter) from their observation points for at least 30 minutes immediately prior to piling commencement. Acceptable visibility will be determined by the Lead PSO.	This measure would ensure adequate monitoring of zones, which would minimize noise-related effects on sea turtles.
Monitoring zone for sea turtles	Applicant proposed measures plus: BOEM and USACE would ensure that Dominion Energy monitors the full extent of the area where noise would exceed the root-mean-square sound pressure level (SPL) 175 dB re 1 μPa behavioral disturbance threshold for turtles for the full duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and record all observations in order to ensure that all take that occurs is documented.	This measure would ensure accurate monitoring of sea turtle take in order to ensure that all take that occurs is documented.
Alternative Monitoring Plan (AMP) for Pile Driving	Dominion Energy must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones. • Dominion Energy must submit an AMP to BOEM and NMFS for review and approval at least 6 months prior to the planned start of pile-driving. This plan may include deploying additional observers, alternative monitoring technologies such as night vision, thermal, and infrared technologies, or use of PAM and must demonstrate the ability and effectiveness to maintain all clearance and shutdown zones during daytime as outlined below in Part 1 and nighttime as outlined in Part 2 to BOEM's and NMFS's satisfaction.	This measure would establish requirements for nighttime and low-visibility impact pile driving approval, which would serve to decrease the potential for noise-related impacts to occur during those conditions.

Measure	Description	Effect
	• The AMP must include two stand-alone components as described below: ○ Part 1 – Daytime when lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones. Daytime being defined as 1 hour after civil sunrise to 1.5 hours before civil sunset. ○ Part 2 – Nighttime inclusive of weather conditions (e.g., fog, rain, sea state). Nighttime being defined as 1.5 hours before civil sunset to 1 hour after civil sunrise. • If a protected marine mammal or sea turtle is observed entering or found within the shutdown zones after impact pile-driving has commenced, Dominion Energy would follow the shutdown procedures outlined in Table 1-7 of the NMFS Biological Assessment. Dominion Energy would notify BOEM and NMFS of any shutdown occurrence during piling driving operations with 24 hours of the occurrence unless otherwise authorized by BOEM and NMFS. • The AMP should include, but is not limited to the following information: ○ Identification of night vision devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable NVDs, infrared spotlights), if proposed for use to detect protected marine mammal and sea turtle species. ○ The AMP must demonstrate (through empirical evidence) the capability of the proposed monitoring methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as being capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable. ○ Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration), as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available).	

Measure	Description	Effect
	o Reporting procedures, contacts and timeframes. BOEM may request additional information, when appropriate, to assess the efficacy of the AMP.	
Sampling gear	All sampling gear would be hauled at least once every 30 days, and all gear would be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	The regular hauling of sampling gear would reduce risk of entanglement for sea turtles.
Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys would be uniquely marked to distinguish it from other commercial or recreational gear. Using black and yellow striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place 3 additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are, therefore, distinct. Any changes in marking would not be made without notification and approval from NMFS.	Gear identification would improve accountability in the case of gear loss and distinguish survey gear from other commercial or recreational gear.
Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (mailto:nmfs.gar.incidental-take@noaa.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	This measure would promote the recovery of lost gear, which would reduce risk of entanglement for sea turtles.
Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard. Any disentanglement would occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	This measure would promote safe handling and release of sea turtles, which would improve survivability of entangled and released individuals.
Sea turtle/ESA-fish identification and data collection	Any sea turtles or ESA-fish caught, retrieved, or both in any fisheries survey gear would first be identified to species or species group. Each ESA-listed species caught, retrieved, or both would then be properly documented using appropriate equipment and data collection forms. Biological data, samples, and tagging would occur as outlined below. Live, uninjured animals should be returned to the water as quickly as possible after completing the required handling and documentation. • The Sturgeon and Sea Turtle Take Standard Operating Procedures would be followed	This measure would require standard data collection and documentation of any sea turtles caught during surveys.

Measure	Description	Effect

	(download at: https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf).
	• Survey vessels would have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader) and this reader be used to scan any captured sea turtles and sturgeon for tags. Any recorded tags would be recorded on the take reporting form (see below).
	• Genetic samples would be taken from all captured ESA-fish (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This would be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (download at: https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf).
	  ○ Fin clips would be sent to a NMFS approved laboratory capable of performing genetic analysis and assignment to DPS of origin. To the extent authorized by law, BOEM is responsible for the cost of the genetic analysis. Arrangements would be made for shipping and analysis in advance of submission of any samples; these arrangements would be confirmed in writing to NMFS within 60 days of the receipt of this ITS. Results of genetic analysis, including assigned DPS of origin would be submitted to NMFS within 6 months of the sample collection.
	  ○ Subsamples of all fin clips and accompanying metadata forms would be held and submitted to a tissue repository (e.g., the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://media.fisheries.noaa.gov/2021-02/Sturgeon%20Genetic%20Sample%20Submission%20sheet%20for%20S7_v1.1_Form%20to%20Use.xlsx?null.
	All captured sea turtles and ESA-fish would be documented with required measurements and photographs. The animal's condition and any marks or injuries would be described. This information would be entered as part of the record for each incidental take. A NMFS Take Report Form would be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null)	

Measure	Description	Effect
	and submitted to NMFS as described below.	
Sea turtle/ESA-fish handling and resuscitation guidelines	Any sea turtles or ESA-fish caught and retrieved in gear used in fisheries surveys would be handled and resuscitated (if unresponsive) according to established protocols and whenever at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: • Priority would be given to the handling and resuscitation of any sea turtles or ESA-fish that are captured in the gear being used, if conditions at sea are safe to do so. Handling times for these species should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on the animals. • All survey vessels would have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) prior to the commencement of any on-water activity (download at: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures would be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during the Proposed Actions. • If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff would immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours following handling instructions provided by the Hotline, prior to transfer to a rehabilitation facility. • Attempts would be made to resuscitate any ESA-fish that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (download at: https://media.fisheries.noaa.gov/dam-migration/sturgeon_resuscitation_card_06122020_508.pdf). • Provided that appropriate cold storage facilities are available on the survey vessel, following the report of a dead sea turtle or sturgeon to NMFS, and if NMFS requests, any dead sea turtle or ESA-fish would be retained on board the survey vessel for transfer to an appropriately permitted partner or	This measure would promote safe handling and release of sea turtles, which would improve survivability of entangled and released individuals.

Measure	Description	Effect
	facility on shore as safe to do so. Any live sea turtles or ESA-fish caught and retrieved in gear used in any fisheries survey would ultimately be released according to established protocols and whenever at-sea conditions are safe for those releasing the animal(s) to do so.	
Take notification	GARFO PRD would be notified as soon as possible of all observed takes of sea turtles and ESA-fish occurring as a result of any fisheries survey. Specifically: • GARFO PRD would be notified within 24 hours of any interaction with a sea turtle or ESA-fish (nmfs.gar.incidental-take@noaa.gov). The report would include at a minimum (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the email would transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports would be submitted as soon as possible; late reports would be submitted with an explanation for the delay. At the end of each survey season, a report would be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report would also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities would be comprehensive of all activities, regardless of whether ESA-listed species were observed.	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action.
Monthly/annual reporting	Applicant proposed measures plus: BOEM would ensure that Dominion Energy implements the following reporting requirements necessary to document the amount or extent of take that occurs during all phases of the Proposed Action: • All reports would be sent to: nmfs.gar.incidental-take@noaa.gov.	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action.

Measure	Description	Effect
	• During the construction phase and for the first year of operations, Dominion Energy would compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), and piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. Beginning in year two of operations, Dominion Energy would compile and submit annual reports that include a summary of all project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (i.e., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed.	
Reporting	Dominion Energy will report to BOEM and BSEE within 24 hours of confirmation any incidental take of an endangered or threatened species.	Reporting requirements to document take would improve accountability for documenting sea turtle take associated with the Proposed Action.

[1] Also Identified in Appendix H, Table H-2.
BMP = best management practice; BOEM = Bureau of Ocean Energy Management; BSEE = Bureau of Safety and Environmental Enforcement; COP = Construction and Operations Plan; DMA = Dynamic Management Area; DOI = Department of the Interior; DPS = distinct population segment; ESA = Endangered Species Act; GARFO PRD = Greater Atlantic Regional Fisheries Office Protected Resources Division; IR = infrared; ITS = incidental take statement; NARW = North Atlantic right whale; NMFS = National Marine Fisheries Service; NVD = night vision device; O&M = operations and maintenance; PAM = passive acoustic monitoring; PDC = project design criteria; PSO = protected species observer; SMA = Seasonal Management Area; USACE = U.S. Army Corps of Engineers; VHF = very high-frequency; WTG = wind turbine generator.

3.19.8.1 Effect of Measures Incorporated into the Preferred Alternative

Mitigation measures required through completed consultations, authorizations, and permits listed in Table 3.19-5 and Appendix H, Table H-2 are incorporated into the preferred alternative. There are no additional agency-required mitigation measures identified as relevant for sea turtles (Appendix H, Table H-3). These measures, if adopted, would serve to reduce impacts on sea turtles and are broadly categorized as follows.

- **Vessel strike avoidance and look out for sea turtles and reporting:** Measures to minimize vessel interactions would reduce the risk of vessel strike. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination.
- **BOEM PDCs and BMPs for data collection activities:** Compliance with project design criteria and BMPs for protected species would minimize risk to sea turtles during site characterization and site assessment activities. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination.
- **BOEM COP PDCs and BMPs to minimize vessel interactions and EMF, noise, and habitat effects:** Compliance with project design criteria to minimize vessel interactions would reduce the risk

of vessel strike. Compliance with project design criteria to minimize EMF, noise, and habitat effects would minimize the potential and severity of effects for sea turtles. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determinations.

- **Marine debris awareness training:** Marine debris and trash awareness training would minimize the risk of sea turtle ingestion of or entanglement in marine debris. While adoption of this measure would decrease risk to sea turtles under the Proposed Action, it would not alter the impact determination.
- Passive Acoustic Monitoring Plan, Pile-Driving Monitoring Plan, adaptive shutdown zones, minimum visibility requirements, Alternative Monitoring Plan, protected species observer coverage, sound field verification, shutdown zones, and monitoring zones for sea turtles: The development of an Alternative Monitoring Plan, adaptive shutdown zones, minimum visibility requirements, protected species observer coverage, shutdown zones, and monitoring zones for sea turtles would minimize the potential for exposure to sound levels above recommended thresholds during impact pile driving. The development of a Pile-Driving Monitoring Plan and sound field verification would increase the accountability of underwater noise mitigation during pile driving. While adoption of these measures would decrease risk to sea turtles during impact pile driving or increase accountability during this construction activity under the Proposed Action, it would not alter the impact determination.
- **Operational Sound Field Verification Plan:** The development of an Operational Sound Field Verification Plan would allow BOEM to confirm that impacts of operating WTG noise do not exceed predicted impacts based on existing monitoring data and modeling efforts. While adoption of this measure would improve accountability of WTG operational noise under the Proposed Action, it would not alter the impact determination.
- **Periodic underwater surveys, and reporting of monofilament and other fishing gear around WTG foundations:** Periodic underwater surveys and reporting of monofilament and other fishing gear around WTG foundations would reduce the risk of entanglement associated with the presence of structures. While adoption of this measure would reduce risk to sea turtles under the Proposed Action, it would not alter the impact determination.
- **Sampling gear, gear identification, lost survey gear, survey training, sea turtle disentanglement, sea turtle identification and data collection, sea turtle handling and resuscitation guidelines, and take notification:** The regular hauling of sampling gear, survey staff training, sea turtle disentanglement, and handling and resuscitation guidelines would reduce risk of entanglement or effects of entanglement in fisheries survey gear. Gear identification and lost survey gear would improve accountability in the case of gear loss. Sea turtle identification and data collection and take notification would improve accountability for documenting take associated with fisheries surveys. While adoption of these measures would reduce risk and improve accountability under the Proposed Action, it would not alter the impact determination.
- **Incidental take, monthly, and annual reporting requirements and meeting requirements for sea turtle take documentation:** Reporting requirements and meeting requirements to document take would improve accountability for documenting take associated with the Proposed Action. While adoption of these measures would improve accountability, it would not alter the overall impact determinations.

Appendix H. Mitigation and Monitoring

The Final Environmental Impact Statement (EIS) assesses the potential biological, socioeconomic, physical, and cultural impacts that could result from the construction, operations and maintenance (O&M), and conceptual decommissioning of the Coastal Virginia Offshore Wind Commercial Project (CVOW-C or Project) proposed by Coastal Virginia Offshore Wind (CVOW) in its Construction and Operations Plan (COP) (Dominion Energy 2023). The Project described in the COP and this Final EIS would be approximately 2,500–3,000 megawatts (MW) in scale and sited 27 miles (23.75 nautical miles) off the Virginia Beach, Virginia Coastline within Lease Area OCS-A 0483. The Project is designed to serve demand for renewable energy in Virginia and North Carolina.

As part of the Project, CVOW has committed to implementing applicant-proposed measures (APMs) to avoid, reduce, mitigate, or monitor impacts on the resources discussed in Chapter 3, *Affected Environment and Environmental Consequences*, of the Final EIS. These APMs are described in Table H-1 of this appendix. The U.S. Department of the Interior, Bureau of Ocean Energy Management (BOEM) considers as part of the Proposed Action only those measures that CVOW has committed to in Section 4 of the COP (Dominion Energy 2023).

BOEM may select alternatives and require additional mitigation or monitoring measures to further protect and monitor these resources. Table H-2 provides additional mitigation and monitoring measures that may result from reviews under several environmental statutes (Clean Air Act, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act, and National Historic Preservation Act) that are described in Appendix A of the Final EIS. Please note that not all of these mitigation measures are within BOEM's statutory and regulatory authority but could be adopted and imposed by other governmental entities. Other measures identified during development of this EIS are listed in Table H-3, and Table H-4 identifies measures that may be required by authorizations and permits issued to the lessee.

If BOEM decides to approve the COP, the Record of Decision (ROD) would state which of the mitigation and monitoring measures identified by BOEM in Table H-1 have been adopted, and if not, why they were not. As such, the ROD would inform terms and conditions of COP approval and would compel compliance with or execution of identified mitigation and monitoring measures (40 Code of Federal Regulations [CFR] 1505.3). CVOW would be required to certify compliance with certain terms and conditions, as required under 30 CFR 585.633(b). Furthermore, BOEM would periodically review the activities conducted under the approved COP. The frequency and extent of the review would be based on the significance of any changes in available information and on onshore or offshore conditions affecting, or affected by, the activities conducted under the COP.

Monitoring measures may be required to evaluate the effectiveness of a mitigation measure or to identify if resources are responding as predicted to impacts from the Proposed Action. Monitoring programs would be developed in coordination among BOEM and agencies with jurisdiction over the resource to be monitored. The information generated by monitoring may be used to (1) adapt how a mitigation measure identified in the COP or ROD is being implemented, (2) revise or develop new mitigation or monitoring measures required under the COP in accordance with 30 CFR 585.634(b) or develop measures for future projects, or (3) contribute to regional efforts for better understanding of the impacts and benefits resulting from offshore wind energy projects in the Atlantic (e.g., potential cumulative impact assessment tool). Unless specified, the proposed mitigation measures described below would not change the impact ratings on the affected resource, as described in Chapter 3, *Affected Environment and Environmental Consequences*, of the Final EIS, but would further reduce expected impacts or inform the development of additional mitigation measures if required.

Table H-1 Applicant-Proposed Measures

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
Construction; Decommissioning	Offshore Project Area	Disturbance to seabed. Disturbance to objects along the seabed. Disturbance to onshore geology.	• Dominion Energy would identify the most appropriate locations, based on geologic conditions, for installation that would require the least disturbance to the seabed. By opting for locations that avoid the most challenging geology, Dominion Energy would be able to utilize the least-invasive tools for Project installation to the extent practicable. • Dominion Energy would implement appropriate avoidance buffers to avoid contact with any objects on the seabed, to the extent practicable. Objects that cannot be avoided would be further investigated and an appropriate mitigation would be implemented. For cable crossings, this would include optimization of the crossing geometry as well as engineering of the crossing and associated protection. For potential unexploded ordnance, this would include investigation of contacts and mitigation through micrositing if possible and further action and mitigation if necessary. • Dominion Energy would minimize disturbance to onshore geology during the installation of Onshore Project Components by optimizing routes along previously disturbed onshore locations to the extent practicable. • Dominion Energy would consider weather forecasts at all times during the construction stage, and would halt operations in the event that extreme weather events are likely to occur. • Dominion Energy would avoid and/or relocate boulders that are too close to the installation of the Offshore Export Cable. • The Project would site Offshore Project Components to avoid areas of steep and/or unstable seabed where determined to prove a challenge to specific Project	Physical and Oceanographic Conditions

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			features or installation methods during detailed design. • Dominion Energy would incorporate information on the location of mobile sediments and potential for scour into the design and installation of the Offshore Project Components. • The risk related to soft soils would be thoroughly considered when the jack-up vessel is deployed. • Dominion Energy has moved or eliminated some wind turbine generators (WTGs) locations near potential shallow gas from consideration for the Project. • The Project would implement an avoidance buffer around all wrecks, to the extent possible. Shipwrecks of cultural significance would be avoided in accordance to recommendations from the Project's QMA and are discussed in detail in COP Appendix F, Marine Archaeological Resources Assessment. • The Project would avoid identified debris during Project installation, to the extent possible. In the event that avoidance is not feasible, individual targets may be inspected by a remotely operated vehicle (ROV) to determine if the object poses a risk to operations and if it may be removed from the seabed. • Dominion Energy will engage with asset owners in order to complete crossing agreements which will detail the conditions and methodology for each cable crossing. • Dominion Energy would microsite and re-route Offshore Project Components to avoid an unexploded ordnance (MEC) when feasible. If potential MEC cannot be avoided through micrositing, ROV investigations will be implemented in order to fully assess the MEC potential. If ROV investigations determine MEC is present, MEC mitigation will be considered by the Project, subject to agency approval. If MEC mitigation is necessary, it is anticipated that only MEC relocation, and no MEC detonation, would occur in conjunction with Project	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			activities • The Offshore Export Cable Route Corridor has been reduced in width while crossing the Dam Neck Ocean Disposal Site (DNODS) in order to minimize the portion of the DNODS impacted by the Project. While seabed processes are likely to disperse dumped sediment through time, the accumulation of deposited dredge material overlying the buried cables could result in thermal and ampacity changes. This would be considered during the detailed design of the Offshore Project Components and installation works.	
O&M	Offshore Project Area	Disturbance to seabed. Disturbance to objects on the seabed.	• Operations would occur at locations of previously disturbed seabed to minimize the potential for disturbing new seabed whenever possible. • Whenever possible, operations and maintenance would occur at locations of previously disturbed seabed to minimize the potential for disturbing new objects along the seabed whenever possible. In addition, the Project would conduct routine geophysical surveys to monitor the status of the installed cable on the seabed as discussed in Section 3, *Description of Proposed Activity*.	Physical and Oceanographic Conditions
Construction; Decommissioning	Onshore Project Area	Short-term elevated in-air noise levels associated with vibratory pile driving at the cofferdam for Trenchless Installation exit at the Offshore Trenchless Installation Punch-Out location. Short-term elevated in-air noise levels associated with Trenchless Installation at the Cable Landing Location and the	• Trenchless Installation activities would occur during the daytime period. • Dominion Energy would consult with the appropriate regulatory agency regarding nighttime work in the case of an emergency. In the case of nighttime operations, only the drill rig, power unit, and light banks would be used unless otherwise deemed acceptable from the appropriate regulatory authority. • If necessary, subject to regulatory requirements and stakeholder engagement, Dominion Energy would install moveable temporary noise barriers as close to the sound sources as possible, which have been shown to effectively reduce sound levels by 5 to 15 A-weighted decibels (dBA).	In-Air Acoustic Environment

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		onshore cable crossing locations. Short-term elevated in-air noise levels associated with construction of the Onshore Export Cable Route, Switching Station, Interconnection Cable Route, and Onshore Substation.	• Dominion Energy would limit construction to the daytime period unless deemed acceptable from the appropriate regulatory authority. • Dominion Energy would ensure construction equipment is well maintained and vehicles using internal combustion engines equipped with mufflers would be routinely checked to ensure they are in good working order. • Dominion Energy would ensure construction equipment is located as far as possible from noise-sensitive areas. • If noise issues are identified, Dominion Energy would install moveable temporary noise barriers as close to the sound sources as possible, which have been shown to effectively reduce sound levels by 5 to 15 dBA. • Dominion Energy would make a Project Communications Plan available to help actively address all noise-related issues in a timely manner.	
Construction; Decommissioning	Offshore Project Area	Short-term elevated in-air noise levels associated with impact pile driving of Wind Turbine Generator Foundation and Offshore Substation Jacket Foundations. Short-term elevated in-air noise levels associated with offshore support vessels.	• If the final design engineering requires sound mitigation measures, Dominion Energy would implement such measures within the Project footprint, as necessary.	In-Air Acoustic Environment
O&M	Onshore Project Area	Long-term elevated in-air sound levels associated with Switching Station and Onshore Substation. Short-term elevated in-	• If the final design engineering requires sound mitigation measures, Dominion Energy would implement such measures within the Project footprint, as necessary.	In-Air Acoustic Environment

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		air sound levels associated with operations and maintenance activities.		
O&M	Offshore Project Area	Long-term elevated in-air sound levels associated with the Wind Turbine Generators, Offshore Substation, and, as necessary, operation of sound signals.	No mitigation measures are expected for the Offshore Project area.	In-Air Acoustic Environment
Construction; Decommissioning	Offshore Project Area	Short-term increase in underwater noise levels associated with WTG Foundations and/or pin pile impact pile driving activities required for the installation of WTG and Offshore Substation Jacket Foundations. Short-term increase in underwater noise levels associated with pile driving for cofferdam installation. Short-term increases in underwater noise levels associated with impact pile driving for goal post installation. Short-term increase in underwater noise levels associated with Offshore Export Cables and Inter-Array Cable laying	• Noise mitigation requirements and methods have not been finalized at this stage of permitting; therefore, two levels (6 decibels [dB] and 10 dB) of reduction were applied to potentially mimic the use of noise mitigation options such as bubble curtains. • The results of the analysis would be used to inform development of evaluation and mitigation measures that would be applied during construction and operations and maintenance (O&M) of the Project, in consultation with BOEM and National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries). • The Project would obtain necessary permits to address potential impacts on marine mammals, sea turtles and fisheries resources from underwater noise and would establish appropriate and practicable mitigation and monitoring measures through discussions with regulatory agencies.	Underwater Acoustic Environment

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		activities. Short-term increase in underwater noise levels associated with Project-related vessels.		
O&M	Offshore Project Area	Increase in underwater noise levels associated with WTG operations. Increase in intermittent underwater noise levels associated with Project O&M and Project-related vessels.	• No mitigation measures are expected to be needed during Project O&M to minimize underwater noise levels.	Underwater Acoustic Environment
Construction; Decommissioning	Onshore Project Area	Short-term increase in Project-related emissions.	• Most of the vessels and the onboard construction equipment would utilize diesel engines burning ultra-low sulfur fuel, while some larger construction vessels may use fuel containing up to 1,000 ppm sulfur by weight. • Onshore Project area construction activities would primarily utilize diesel-powered equipment, including horizontal directional drilling operations, trenching/duct bank construction, and cable pulling and termination. • Any fugitive dust generated during construction of the Onshore Project Components would be managed in accordance with the Project's Fugitive Dust Control Plan.	Air Quality
Construction; Decommissioning	Offshore Project Area	Short-term increase in Project-related emissions.	• Vessels constructed on or after January 1, 2016, would meet IMO Tier III nitrogen oxides requirements when operating within the North American Emission Control Area (200 nautical miles [370.4 kilometers]) established by the International Maritime Organization. • Vessels would use the highest-tier marine engines available to the Project at the time of vessel deployment. • The jack-up vessel used for WTG installation would use selective catalytic reduction for control of NO_x emissions	Air Quality

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			from its main engines. • Project-related vessels that are fueled exclusively at U.S. terminals would use ultra-low sulfur diesel fuel and vessels fueled at marine terminals outside the U.S. will, at a minimum, use fuel at or below the maximum fuel sulfur content requirement of 1,000 parts per million established per the requirements of 40 CFR 80.510(k). • Diesel generator engines (i.e., both permanent and temporary non-emergency and emergency engines) would comply with the applicable requirements in New Source Performance Standards for Stationary Compression Ignition Internal Combustion Engines in 40 CFR 60 Subpart IIII. • The Project would provide EPA with data on horsepower rating of all propulsion and auxiliary engines, duration of operating time, load factor, and fuel consumption for Project-related vessels to determine actual emissions from Project-related vessels, as applicable. • The Project would provide vessel engines and emissions control equipment information to BOEM and the USEPA, as applicable, in accordance with the requirements set forth in the ROD and/or the issued Outer Continental Shelf air permit.	
O&M	Offshore Project Area	Long-term increase in Project-related emissions.	• As detailed in COP Appendix N, *Air Emissions Calculations and Methodology*, operations and maintenance activities are assumed to include one service operations vessel, two crew transfer vessels, and several vessels for periodic surveys and maintenance over the operational life of the Project. • Operations and maintenance support vessels are assumed to operate out of a port located in the Hampton Roads area of Virginia (Lambert's Point in Norfolk, Virginia has been used for the purpose of estimating emissions).	Air Quality

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• Vessels would use the highest-tier marine engines available to the Project at the time of vessel deployment. • Vessels constructed on or after January 1, 2016, would meet IMO Tier III nitrogen oxides requirements when operating within the North American Emission Control Area (200 nautical miles [370.4 kilometers]) established by International Maritime Organization. • Project-related vessels that are fueled exclusively at U.S. terminals would use ultra-low sulfur diesel fuel and vessels fueled at terminals outside the U.S. will at a minimum, use fuel at or below the maximum fuel sulfur content requirement of 1,000 parts per million established per the requirements of 40 CFR 80.510(k). • Permanent diesel generator engines will comply with the applicable requirements in New Source Performance Standards for Stationary Compression Ignition Internal Combustion Engines in 40 CFR 60 Subpart IIII. • The Project would provide EPA with data on horsepower rating of all propulsion and auxiliary engines, duration of operating time, load factor, and fuel consumption for Project-related vessels to determine actual emissions from Project-related vessels, as applicable. • The Project would provide vessel engines and emissions control equipment information to BOEM and the USEPA, as applicable, in accordance with the requirements set forth in the ROD and/or the issued Outer Continental Shelf air permit.	
O&M	Onshore Project Area	Long-term increase in Project-related emissions.	• Onshore emergency generators would comply with applicable emission standards in 40 CFR Part 60 Subpart JJJJ and 40 CFR Part 63 Subpart ZZZZ.	Air Quality

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
Construction; Decommissioning	Offshore Project Area	Short-term disturbance of seabed sediment due to installation of the WTG Monopile Foundations and Offshore Substation Jacket Foundations, Inter-Array Cables, Offshore Export Cables, and site preparation for installation of scour protection. Short-term potential for inadvertent return of drilling fluids during horizontal directional drilling. Short-term potential for inadvertent return of drilling fluids during horizontal directional drilling. Short-term impacts due to accidental spills and/or releases offshore.	• Dominion Energy would develop and implement a horizontal directional drilling inadvertent release plan. Local pollution prevention and spill response procedures would be included in the Stormwater Pollution Prevention Plan (SWPPP) submitted to State agencies for the portions of the land-disturbing activity covered by the Virginia Pollutant Discharge Elimination System Construction General Permit. • Dominion Energy would manage accidental spills or releases of oils or other hazardous wastes through the Oil Spill Response Plan (Appendix Q). Project-related vessels would be subject to U.S. Coast Guard (USCG) wastewater and discharge regulations and would operate in compliance with oil spill prevention and response plans that meet USCG requirements. Specifically, all Project vessels would comply with USCG standards in U.S. territorial waters to legally discharge uncontaminated ballast and bilge water as well as standards regarding ballast water management. While outside the 3.0-nautical mile (5.6 kilometer) state-border/no-discharge zone (NDZ), vessels would deploy a USCG-certified marine sanitation device (MSD) with certifications displayed. While inside the 3.0 nautical mile (5.6 kilometer) state-border/NDZ, vessels would take normal vessel procedures to close off MSD-effluence discharge piping and redirect it to onboard	Water Quality

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
	Onshore Project Area	Short- term increase in erosion and runoff due to land disturbance. Short-term impacts due to dewatering trenches and excavations. Short-term potential for accidental releases from onshore construction vehicles or equipment.	"Zero-Discharge Tanks" for appropriate disposal either at dock or outside of an NDZ. Additionally, all vessels less than 79 feet (24 meters) would comply with the Small Vessel General Permit issued by USEPA on September 10, 2014, for compliance with National Pollutant Discharge Elimination System permitting. Prevention and response measures for accidental spills and releases are further described in Appendix Q, *Oil Spill Response Plan.* • Dominion Energy would avoid or minimize excavation dewatering in the location of the Battlefield Golf Club. • Dominion Energy would develop a SWPPP for construction activities that would conform with the Virginia Department of Environmental Quality Construction General Permit, Dominion Energy's approved Annual Standards and Specifications for Erosion and Sediment Control (ESC) and Stormwater Management (SWM) for Electric Transmission Line Development, and local pollution prevention and spill response procedures. The SWPPP would include steps that Dominion Energy must take to comply with the permit, including water quality requirements, and discuss the potential to encounter contaminated groundwater during excavation near the Battlefield Golf Club. The SWPPP would discuss how to protect surface water and groundwater quality if contaminated groundwater is encountered. • Dominion Energy would restrict access to only existing paved roads and approved access roads at wetland and stream crossings where possible. • Dominion Energy would restrict access through wetlands and waterbodies to identified construction sites, access roads, and work zones. • Dominion Energy would conduct onshore refueling and/or maintenance of construction equipment and vehicles outside resource areas to the extent	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			practicable. • Dominion Energy would implement an inadvertent return plan with use of non-toxic drilling fluids for review and approval by the appropriate regulatory agencies.	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
O&M	Offshore Project Area	Long-term effects due to WTG Monopile Foundations and Offshore Substation Jacket Foundations and associated scour protection. Short-term change in water quality due to oil spills or accidental release of fluids from vessels required during operations.	• Dominion Energy would use scour protection as necessary around the WTG Monopile Foundations and Offshore Substation Jacket Foundations and cable protection mats to minimize effects of local sediment transport. • Dominion Energy would subject Project-related vessels to USCG wastewater and discharge regulations and ensure they operate in compliance with oil spill prevention and response plans that meet USCG requirements. Specifically, all Project vessels would comply with USCG standards in U.S. territorial waters to legally discharge uncontaminated ballast and bilge water as well as standards regarding ballast water management. While outside the 3.0 nautical mile (5.6 kilometer) state-border/NDZ, vessels would deploy a USCG-certified MSD with certifications displayed. While inside the 3.0-nautical mile (5.6-kilometer) state-border/NDZ, vessels would take normal vessel procedures to close off MSD-effluence discharge piping and redirect it to onboard “Zero -Discharge Tanks” for the appropriate disposal either at dock or outside of an NDZ. Additionally, all vessels less than 79 feet (24 meters) would comply with the Small Vessel General Permit issued by USEPA on September 10, 2014, for compliance with National Pollutant Discharge Elimination System permitting. Prevention and response measures for accidental spills and releases are further described in Appendix Q, *Oil Spill Response Plan*. • Dominion Energy would develop an SWM Plan and ESC Plan ESC in accordance with Dominion Energy’s approved Annual Standards and Specifications for SWM and ESC for Electric Transmission Line Development, and local ordinances as applicable. Routinely inspect and clean on-site stormwater control features to remove debris or excess vegetation that may impede the designed functionality. The SWM plan would describe how the stormwater control facilities would be	Water Quality
	Onshore Project Area	Long-term effects due to stormwater runoff.		

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			operated and maintained after construction is complete.	
Construction; Decommissioning	Onshore Project Area	Installation of permanent structures within wetlands, wetland transition areas, riparian areas, and protected watersheds. The permanent conversion of existing wetland cover types. The temporary removal of vegetation within wetlands, wetland transition areas, riparian buffers, and protected watershed features. Erosion of sediment from construction activities into adjacent wetlands and waterbodies. The potential for an inadvertent release of non-toxic drilling fluids to the surface during horizontal directional drilling (HDD) activities The potential for accidental releases from construction vehicles or equipment.	• Temporary construction areas and workspaces would be restored to pre-construction conditions, while permanent structures would remain in place. • Dominion Energy would collocate Onshore Project Components in existing rights-of-way (ROWs), existing roads, previously disturbed areas, and otherwise urbanized locations to the maximum extent practicable. • Dominion Energy would site permanent structures outside of protected watershed features and flood-prone areas to the maximum extent practicable. • Dominion Energy would use a combination of HDD and overhead routing to the best extent practicable to avoid and minimize impacts on natural resources. • Dominion Energy would purchase stream and wetland mitigation credits in the applicable service area of a mitigation bank or contribute to an approved in-lieu-of-fee program, such as the Virginia Aquatic Resources Trust Fund Program, prior to construction to mitigate unavoidable impacts on wetlands and waterbodies. • Dominion Energy would restrict access during construction to existing paved roads or access roads constructed for stream or waterbody crossings. Where necessary, access would also be restricted to avoid alteration of soil properties (compaction) that may result in unintended impacts. • Dominion Energy would use temporary avoidance/minimization efforts for wetland access where avoidance is not possible. These efforts would include use of temporary timber mats, using 8- to 12-inch (20- to 30-centimeter)-thick timber, for heavy machinery movement and to avoid unintended impacts on wetlands such as soil compaction, damage to root systems, and development of ruts. • Dominion Energy would develop an invasive species	Wetlands

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			control plan to prevent the spread of invasive species throughout the maintained ROWs and recently disturbed locations. Only agency-approved native species would be replanted, and all plans would be guided by desktop and on-the-ground evaluation of invasive species present in the area. • Dominion Energy would develop a compensatory mitigation plan, where permanent conversion of wetlands is unavoidable, to include on-site mitigation where practicable, off-site mitigation, or purchase of mitigation credits. This mitigation plan would be further refined as a component of the U.S. Army Corps of Engineers (USACE) permitting package. • Dominion Energy would restrict access through wetlands except where approved by regional and local regulatory entities. • Dominion Energy would develop and implement erosion and sediment control plans in compliance with Dominion Energy's Virginia Department of Environmental Quality-approved Standards and Specifications for Erosion and Sediment Control and Stormwater Management for Electric Transmission Line Development and appurtenant facilities such as substations and switching stations, as well as any additional requirements specific to the U.S. Department of Defense (DoD) lands (if applicable). • Dominion Energy would install temporary timber matting for access routes through wetlands to protect vegetation to reduce compaction, minimize ruts, and reduce soil discharge. • Dominion Energy would develop and implement an inadvertent release plan with use of non-toxic drilling fluids to be reviewed and approved by the appropriate regulatory agencies. • Dominion Energy would manage accidental spills or releases of oils through a spill prevention, control, and	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			countermeasures plan for approval by the appropriate regulatory agency.	
O&M	Onshore Project Area	It is not anticipated that Project-related activities in association with O&M would result in new impacts on wetlands and waterbodies.	• Dominion Energy would take protective measures to prevent access to any active operation area including, but not limited to, security and safety fencing. • Dominion Energy would monitor revegetation throughout the life of the Project and leading up to decommissioning. Monitoring would comply with a restoration plan and invasive species control plan. Monitoring would serve as the primary measure for ensuring return of wetland, waterbody, and special area functionality following completion of construction and during necessary O&M. • Dominion Energy would monitor mitigation efforts where appropriate and define via the approved permitting package. • Dominion Energy would assess and maintain stormwater control and treatment features on a regular interval, as specified in the SWPPP. This would include removal of debris and a determination of functionality.	Wetlands
Construction; Decommissioning	Onshore Project Area	Vegetation removal associated with installation of all Onshore Project Components. The inadvertent release of drilling fluids to the surface during HDD activities within environmentally sensitive areas. Noise and light activities associated with construction equipment and other noise-generating activities	• Dominion Energy would collocate Onshore Project Components in or adjacent to existing ROWs, existing roads, previously disturbed areas, and other urbanized locations to the maximum extent practicable. • Dominion Energy would seed and stabilize construction areas involving temporary vegetation clearing with an appropriate grass seed mix (in urban areas) or native seed mix (in natural areas) and in accordance with Virginia Erosion and Sediment Control Law and Regulations (Virginia Department of Environmental Quality [VDEQ] 2014) and the Virginia Erosion and Sediment Control Handbook (VDEQ 1992). • Dominion Energy would prepare and submit a mitigation planting plan to the City of Virginia Beach for approval to address unavoidable temporary impacts that would	Terrestrial Vegetation and Wildlife [Coastal Habitat and Fauna]

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		associated with construction Impedance to local migration of terrestrial biota (such as reptiles and amphibians) from installation and placement of erosion- and sediment-control measures such as staggered silt fencing or stabilization matting. Accidental releases of petroleum products from construction vehicles or equipment. Potential for erosion into adjacent vegetation and wildlife habitat. Conversion of existing vegetation cover types (e.g., forested to herbaceous) where the onshore routes are not collocated with existing road corridors or utility ROWs. Permanent fragmentation of habitat as a result of clearing, particularly of large contiguous forested wetland habitats. Colonization and establishment of invasive vegetation in formerly undisturbed	occur within sensitive ecological areas (such as within the Southern Rivers Watershed). The City of Virginia Beach may require native plantings. • Dominion Energy would plant or seed larval host plants and forage plants in the Interconnection Cable Routes after construction efforts have been completed in order to avoid and minimize impacts on pollinator species. A list of regionally appropriate species as well as regional suppliers of native seed mixes are available from the U.S. Department of Agriculture Natural Resources Conservation Service (2020). • Dominion Energy would develop and implement an inadvertent release plan with use of non-toxic drilling fluids to be reviewed and approved by the appropriate regulatory entities. • Dominion Energy would coordinate with the U.S. Fish and Wildlife Service (USFWS), Virginia Department of Wildlife Resources (VDWR), and Virginia Natural Heritage Program to ensure potential impacts on threatened and endangered (T&E) species are avoided and minimized to the maximum extent practicable. • Dominion Energy would evaluate time-of-year restrictions for applicable T&E species via coordination with the USFWS, VD WR, and Virginia Natural Heritage Program. • Dominion Energy would limit lighting associated with construction vehicles and work zones when possible to reduce interaction with or disturbance of wildlife species such as bats and insectivorous birds. • Dominion Energy would initiate coordination with the VDWR and Virginia Natural Heritage Program to evaluate potential impacts on T&E reptile and amphibian species, including the canebrake rattlesnake. • Dominion Energy would install staggered silt fencing in areas surrounding wetlands, waterbodies, and areas with the potential to contain T&E species, rare natural	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		areas due to clearing. Impacts to locally rare or sensitive species and natural communities.	communities, and habitat for reptiles and amphibians. Staggered gaps would ensure reptiles and amphibians could continue to move relatively unrestricted through the Onshore Project area. This strategy would be employed on a site-specific basis following coordination with VDWR and the Virginia Natural Heritage Program. • Dominion Energy would, when applicable, employ snake-friendly erosion-control blankets containing natural or biodegradable fibers or loose-weave netting in areas surrounding wetlands, waterbodies, and areas with the potential to contain habitat for reptiles and amphibians. • Additional mitigation strategies would be adhered to in accordance with VDWR consultation regarding impacts on canebrake rattlesnake habitat if determined to be necessary. • Dominion Energy would restrict vehicular access to paved roads, approved road crossings, and designated construction areas. • Dominion Energy would manage accidental spills or releases of oils through a spill prevention, control, and countermeasures plan approved by the appropriate regulatory entity. • Dominion Energy would develop and implement erosion and sediment control plans in compliance with Dominion Energy's VDEQ-approved Standards and Specifications for ESC and Stormwater Management (SWM) for Electric Transmission Line Development and appurtenant facilities such as substations and switching stations. • Dominion Energy would prepare and maintain a SWPPP in compliance with Virginia Pollution Discharge Elimination System VAR10 Construction General Permit. A permit would be required because the land-disturbing activity would exceed 1.0 acre (0.4 hectare). As a component of the permit, the SWPPP would be	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			prepared and maintained throughout Project construction and retained for 3 years following construction completion as required by Virginia Law. • Dominion Energy would restrict construction access to existing paved roads or access roads constructed for stream or waterbody crossings. Where possible, restrict access to avoid alteration of soil properties (compaction) that may result in unintended impacts. • Dominion Energy would use temporary timber mats in wetlands, using 8- to 12-inch (20- to 30-centimeter)-thick timber, for heavy machinery movement and to avoid unintended impacts on wetland soils. • Dominion Energy would develop an invasive species control plan to prevent the spread of invasive vegetation into natural communities via maintained ROWs and recently disturbed locations. Replanting would be an approved use of native species only, and all plans would be guided by desktop and on-site evaluation of invasive species present in the area. • Dominion Energy would develop and implement a landscape restoration plan in compliance with applicable local and regional ordinances, paying specific attention to re-seeding and replanting with native plant stock. • Dominion Energy would revegetate temporary access areas with native plants and/or an appropriate native seed mix. • Dominion Energy would develop standard best management practices (BMPs) to reduce the spread of invasive species to previously uncolonized areas that would be incorporated into the invasive species control plan and implemented during construction. Resources detailing BMPs to prevent the introduction and spread of invasive species are recommended by the U.S. Department of Agriculture National Invasive Species Information Center (NISIC), and a comprehensive guide	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			was published by the University of Georgia in 2011 (USDA NISIC 2020; Moorhead et al. 2011). • Dominion Energy would coordinate with the USFWS, VDWR, and the Virginia Natural Heritage Program to avoid impacts on rare and T&E species or natural communities to the greatest extent practicable, and to identify additional minimization and mitigation measures if necessary. • Dominion Energy would develop and implement invasive species control and landscape restoration plans to prevent the introduction and spread of invasive species and to facilitate restoration of disturbed habitats. • Dominion Energy would develop a compensatory mitigation plan, where permanent conversion of wetlands is unavoidable, to include on-site mitigation where practical, off-site mitigation, or purchase of mitigation credits or payment of an in-lieu fee mitigation as appropriate. This mitigation plan would be further refined as a component of the USACE permitting package.	
O&M	Onshore Project Area	Conversion of existing vegetation cover types as a result of permanent access roads, structures, and facilities in previously vegetated areas. Vegetation disturbance as a result of routine or periodic facility maintenance (e.g., invasive species control, herbicide applications, and mowing) throughout the lifetime of the facility.	• Dominion Energy would implement an invasive species control plan to avoid the spread of invasive species for the lifetime of the Project, and provide the plan for agency review and approval, as applicable. • Dominion Energy would limit unauthorized access of Onshore Project personnel and vehicles beyond existing disturbed areas and approved access roads to the extent practicable. • Dominion Energy would plant and seed desirable noninvasive native species within the ROWs to reduce establishment of invasive woody vegetation requiring control. • Dominion Energy would adhere to all federal, state, and local laws and regulations pertaining to herbicide	Terrestrial Vegetation and Wildlife [Coastal Habitat and Fauna]

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		Noise or light disturbance associated with routine facility maintenance and activities (at permanent facilities such as substations) throughout the lifetime of the facility.	application. If herbicides are to be used in wetland habitats, use wetland-safe herbicide to avoid unintended impacts on sensitive wetland wildlife and vegetation. • During operations, the Project will be in compliance with relevant City of Virginia Beach and City of Chesapeake noise requirements. If the final design engineering requires sound mitigation measures, they will be implemented within the Project footprint, as necessary. • Dominion Energy would implement lighting-reduction measures, such as downward projecting lights, lights triggered by motion sensors, and limiting artificial light to the extent practicable, to avoid disruption to nocturnal avian and bat species. • Dominion Energy would take protective measures to prevent access to any active operation area including, but not limited to, security and safety fencing. • Dominion Energy would monitor revegetation throughout the life of the Onshore Project and leading up to decommissioning. Monitoring would comply with the approved landscape restoration plan and invasive species control plan, as required by the City of Virginia Beach and the City of Chesapeake, as well as an invasive species control plan. Monitoring would serve as the primary measure for ensuring return of natural habitat functionality following completion of construction and necessary operation. • Dominion Energy would employ vegetation control methods, including application of herbicides for maintenance of ROWs that would comply with all applicable federal, state, and local laws and regulations.	
Construction; Decommissioning	Offshore Project Area	Short-term attraction to, and potential collision with, Project-related vessels and partially installed Offshore	• To mitigate impacts from lighting, Dominion Energy would use BMPs identified by BOEM COP guidelines (BOEM 2020) and would comply with Federal Aviation Administration (FAA) and USCG requirements for lighting while, to the extent practicable, using lighting	Avian and Bat Species

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		Project Components. Short-term disturbance of, and displacement from, offshore habitat.	technology (e.g., low-intensity strobe lights) that minimize impacts on avian and bat species. • Dominion Energy would document any dead or injured birds or bats found on Project vessels or structures during the construction stage of the Project and would submit an annual report to BOEM and USFWS (any birds found with federal bands will be reported to the U.S. Geological Survey [USGS] Bird Band Laboratory). Any occurrence of dead ESA birds or bats must be reported to BOEM, Bureau of Safety and Environmental Enforcement (BSEE), and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and if practicable, carefully collect the dead specimen and preserve the material in the best possible state (BOEM requirement).	
Construction; Decommissioning	Onshore Project Area	Disturbance of, and displacement from, onshore habitat.	• Dominion Energy would avoid potential effects to birds and bats by using trenchless installation techniques in coastal areas at the Cable Landing Location; collocating the Onshore Export Cable Route with existing roads as much as possible; and timing construction activities to avoid critical periods when endangered and threatened species may be affected to the extent practicable. • If either or both of the Harpers or Chicory Switching Stations are constructed, then they would be constructed within either previously developed areas associated with an existing golf course or small areas of mixed forest and woody wetland. Some tree and vegetation clearing will be required, but will be minimized to the extent practicable. • To the extent practicable, Dominion Energy would collocate the Interconnection Cable Route within or adjacent to existing transmission line corridors and ROWs as much as possible, timing construction activities to avoid critical periods when endangered and threatened species may be affected.	Avian and Bat Species

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• Tree/vegetation clearing would avoid trees favorable for bat maternity roosting locations and would be conducted outside of the breeding/roosting season to avoid nesting birds and bat maternity roosting locations to the extent practicable. • Dominion Energy conducted presence/absence surveys for bats (acoustic and/or mist net) along the Onshore Project area, pursuant to discussions with VDWR, USFWS, and appropriate regulatory agencies that were performed in June/July 2022 under the approved bat survey plan. • Dominion Energy conducted an eagle/osprey/raptor nest survey along the Interconnection Cable Route in March 2022 of the Onshore Project area, pursuant to discussions with VDWR, USFWS, and appropriate regulatory agencies. • Where surveys indicate the presence of species of conservation concern, Dominion Energy would work with the VDWR and USFWS to minimize potential impacts prior to construction. • Dominion Energy has conducted presence/absence surveys for bats (acoustic and/or mist-net) along the interconnection cable route and developing avoidance and minimization measures in coordination with the VDWR, USFWS, and appropriate regulatory agencies to ensure protection of Indiana bats and northern long-eared bats. • Dominion Energy is developing avoidance and minimization measures in coordination with the VDWR, USFWS, and appropriate regulatory agencies to ensure protection of threatened and endangered species or to address the potential for incidental take, that may occur within the Project area; • These avoidance and minimization measures would include that Dominion Energy adhere to the existing 4(d) provisions for tree clearing activities performed	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			prior to the new regulation on April 1, 2024 and will adhere to the year-round time of year restrictions for suitable habitat after new regulation implementation. • Dominion Energy would ensure avoidance, minimization, and mitigation measures protective of wetlands, vegetation, and other wildlife species discussed in COP Section 4.2.1, *Wetlands and Waterbodies*, and COP Section 4.2.2, *Terrestrial Vegetation and Wildlife*, also would be protective of bird and bat species and their habitats.	
O&M	Offshore Project Area	Long-term risk of collision with WTGs and Offshore Substations. Long-term displacement from the Lease Area due to presence of WTGs and Offshore Substations. Long-term attraction to and displacement from Project-related maintenance vessels.	• To mitigate the potential for collision with WTGs and Offshore Substations during O&M stage of the Project, Dominion Energy would use BMPs identified by BOEM COP guidelines (BOEM 2020) and comply with FAA and USCG requirements for lighting and, to the extent practicable, use lighting technology (e.g., low-intensity strobe lights, flashing red aviation lights) that minimize impacts on bat species. • To continue the advancement of the understanding of avian and bat activity in the offshore environment, Dominion Energy will continue operation of one Acoustic Thermographic Offshore Monitoring System two additional years to inform the development of the CVOW Commercial Project as the CVOW Pilot WTGs are installed adjacent to the west side of the CVOW Commercial lease. • Dominion Energy will provide Motus Wildlife Tracking tags to the USFWS, which is currently studying the movements of piping plovers in the region. The specific deployment location will be determined in consultation with the USFWS. • Dominion Energy will purchase satellite tags to be attached to Rufa red knots (*Calidris canutus*; rufa subspecies). These tags will provide accurate data on Rufa red knot movements onshore, offshore, and flight heights that can be related to weather data. The	Avian and Bat Species

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			deployment location will be determined in consultation with USFWS. • Dominion Energy upgraded the Motus network/antennas on both CVOW Pilot WTG platforms to a "dual-mode" (166 and 434 megahertz [MHz]) system with one station prioritized for 434 MHz and the other prioritized for 166 MHz in accordance with the updated USFWS guidance document. This antenna upgrade increases the monitoring range from approximately 1 mile (2 kilometers) to approximately 9 miles (15 kilometers) and will remain in place for 2 years. • Dominion Energy would reduce perching opportunities on offshore structures to the extent practicable and, where possible, in compliance with health and safety requirements for the WTGs and Offshore Substations. • Dominion Energy would develop a robust post-construction monitoring plan with clear goals, monitoring questions, and methods, including monitoring that focuses on areas of uncertainty such as bird and bat presence offshored, and would install automated radio telemetry receiver stations (i.e., Motus towers) on select offshore structures. • Dominion Energy would document any dead or injured birds or bats found on Project vessels or infrastructure (offshore and onshore) during construction, O&M, or decommissioning, in an annual report submitted to BOEM and USFWS (any birds found with federal bands would be reported to the USGS Bird Band Laboratory); Any occurrence of dead ESA birds or bats must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and if practicable, carefully collect the dead specimen and preserve the material in the best possible state (BOEM requirement).	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• Dominion Energy would limit risks of long-term displacement of offshore bird species, to the extent practicable. • Potential impacts would be further minimized by reducing lighting on O&M vessels to the extent practicable.	
O&M	Onshore Project Area	Long-term risk of collision with overhead Interconnection Cables. Long-term displacement from onshore habitat at Onshore Project Components.	Dominion Energy would reduce potential impacts of the overhead lines by complying with Avian Power Line Interaction Committee (https://www.aplic.org/) best practices to reduce collision and electrocution.	Avian and Bat Species
Construction; Decommissioning	Offshore Project Area	Disturbance of softbottom habitat. Disturbance, injury, or mortality of benthic and pelagic species. Change in water quality, including turbidity, sediment deposition, and chemical contamination. Entrainment of plankton and ichthyoplankton. Increase in underwater noise and vibration.	• Dominion Energy would further microsite within the Offshore Export Cable Route Corridor to avoid such habitats where feasible to minimize the probability of adverse interactions with sensitive benthic resources. • The release of non-toxic drilling muds during Trenchless Installation activities is possible but unlikely. Dominion Energy would develop and implement an Inadvertent Release Plan that would include pollution prevention measures and spill response procedures covered by the SWPPP. • Dominion Energy would commit to using a soft-start procedure and noise mitigation systems such as bubble curtain technologies to avoid or minimize impacts on marine mammals, sea turtles, fishes, and mobile invertebrates. During pile-driving activities, Dominion	Benthic Resources; Marine Mammals; Sea Turtles; and Finfish, Invertebrates, and EFH

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			Energy will implement near-field and/or far-field noise mitigation systems to minimize underwater sound propagation. Examples of near-field noise mitigation systems include the Hydro Sound Damper, the Noise Mitigation Sleeve or the AdBm Noise Mitigation System. Dominion Energy is committed to the use of a double big-bubble curtain for far-field noise mitigation.	
O&M	Offshore Project Area	Long-term conversion of softbottom to artificial hardbottom habitat and introduction of vertical infrastructure to the water column. Habitat creation for nonindigenous species such as invasive tunicate (*Didemnun vexilium*). Increase in shading and artificial lights. Increase in underwater noise and vibration. Change in water quality, including fuel and chemical spills. Introduction of Project-related electromagnetic fields (EMF).	• Dominion Energy does not expect the installation of hard structure to introduce nonindigenous species to the Project Area; however, existing species in the area may colonize or become associated with the structures once they are installed (e.g., lionfish). • Dominion Energy will comply with USCG Lighting, Marking, and signage requirement for navigational safety, on all Project structures. • Dominion Energy would develop and implement an Oil Spill Response Plan describing measures to avoid accidental spills and protocols to be implemented should a spill occur. Dominion Energy also would require all Project-related vessels to operate in accordance with laws regulating at-sea discharges of vessel -generated waste. • Dominion Energy would commit to burying Project-related cables wherever feasible to minimize detectable EMF.	Benthic Resources
Construction; Decommissioning	Offshore Project Area	Short-term disturbance of habitat. Short term loss of local prey species. Short-term introduction of marine debris. Short-term increase in	• Dominion Energy has sited Offshore Project Components, including WTG Monopile and Offshore Substation Jacket Foundations and Offshore Export Cable Route Corridors, to avoid sensitive benthic habitats and minimize disturbance of benthic features to the extent practical. • Dominion Energy would implement practices to prevent	Marine Mammals

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		risk of entanglement and entrapment. Short-term increase in underwater noise. Short-term increase in risk of ship strike due to the increase in vessel traffic. Short-term change in water quality, including oil spills.	Project personnel from commencing or continuing certain construction activities should marine mammals be observed within clearance and exclusion zones based on required NOAA Fisheries monitoring and mitigation protocols and stipulations of the Lease. The specific clearance and exclusion zones for marine mammals are provided in Section 3.15, Marine Mammals, of the EIS. • During pile driving of WTG Monopile and Offshore Substation Jacket Foundations, Dominion Energy would apply monitoring and exclusion zones as appropriate to underwater noise assessments and impact thresholds. The specific clearance and exclusion zones for marine mammals are provided in Table 3.15-7 in Section 3.15, Marine Mammals, of the EIS. • Qualified NOAA Fisheries-approved Protected Species Observers, real-time monitoring systems, Passive Acoustic Monitoring systems, and reduced visibility monitoring tools (e.g., night vision, infrared, and/or thermal cameras) will be employed to enforce these zones. • Construction personnel will employ soft starts and shutdown procedures as appropriate to thresholds of noise-emitting survey equipment; soft starts will last 30 minutes at the onset of pile driving. • If shutdown is called for but it is determined that shutdown is not feasible due to risk of injury or loss of life, there will be a reduction of hammer energy. • Dominion Energy would use commercially and technically available noise-reducing technologies as appropriate to achieve a minimum of 10 dB noise reduction, and will provide marine mammal sighting and reporting training for each specific stage of construction to emphasize individual responsibility for marine mammal awareness and protection. • Foundation installation will only occur between May and	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			October, in order to avoid the winter and spring seasons when NARW presence is greatest. • Dominion Energy would ensure continued engagement with regulatory agencies regarding potential best practices. • All Project-related vessels larger than 65 feet (20 meters) will be required to abide by speed restrictions when transiting within the Seasonal Management Area (SMA) from November 1 to April 30. • Dominion Energy would conduct monitoring of NOAA's website for updates to Dynamic Management Area (DMA) locations. • All Project-related vessels will be required to comply with the Ship Strike Reduction Rule speed restrictions within the Mid-Atlantic U.S. SMA and any DMA that intersects the Study Area (10 knots [18.5 kilometers/hour] or less for vessels 65 feet [20 meters] or longer). • Dominion Energy would require Project-related vessels to maintain a distance of 328 feet (100 meters) or greater from all marine mammals and 1,640 feet (500 meters) from North Atlantic right whales. Vessels larger than 300 gross tons (305 metric tons) will receive whale sighting updates and vessel speed reminders when transiting North Atlantic right whale territory by reporting to the North Atlantic right whale Mandatory Ship Reporting System. • Project personnel, particularly marine mammal observers, will check the NOAA Fisheries website for DMA locations. • Dominion Energy would provide Project personnel with marine mammal sighting, take and harassment, and reporting training to emphasize individual responsibility for marine mammal awareness and protection. • Dominion Energy has also developed an Oil Spill	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			Response Plan (COP Appendix Q; Dominion Energy 2023), proposing measures to avoid inadvertent releases and spills and a protocol to be implemented should an event occur. Project-related vessels will operate in accordance with laws regulating at-sea discharges of vessel-generated waste.	
O&M	Offshore Project Area	Modification of habitat. Project-related EMF. Project-related marine debris. Project-related underwater noise. Increase in risk for ship strike due to the increase in vessel traffic. Changes in water quality, including oil spills.	• Dominion Energy proposes to use submarine high-voltage alternating-current (HVAC) offshore export cables; such cables emit EMF below levels documented to have adverse effects on fish or marine mammal behavior. • Dominion Energy would require all Project personnel to implement appropriate practices and protocols to prevent the release of marine debris. • Dominion Energy would implement several measures to avoid, minimize, and mitigate marine mammal physical disturbances, strikes, and collisions. • All Project-related vessels will be required to comply with the Ship Strike Reduction Rule speed restrictions within the Mid-Atlantic United States. SMA and any DMA that intersects the Project Area (10 knots [18.5 kilometers/hour] or less for vessels 65 feet [20 meters] or longer). • Dominion Energy would require Project-related vessels to maintain a distance of 328 feet (100 meters) or greater from all marine mammals and 1,640 feet (500 meters) from North Atlantic right whales. • Vessels larger than 300 gross tons (305 metric tons) will receive whale sighting updates and vessel speed reminders when transiting North Atlantic right whale territory by reporting to the North Atlantic right whale Mandatory Ship Reporting System. • Project personnel, particularly marine mammal observers, will check the NOAA Fisheries website for DMA locations.	Marine Mammals

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• Dominion Energy would provide Project personnel with marine mammal sighting and reporting training to emphasize individual responsibility for marine mammal awareness and protection. • Dominion Energy has also developed an Oil Spill Response Plan (Appendix Q) proposing measures to avoid inadvertent releases and spills and a protocol to be implemented, should a potential vessel oil and fuel spill or contaminant release from resuspended sediments occur. • Project-related vessels will operate in accordance with laws regulating at-sea discharges of vessel-generated waste.	

Construction; Decommissioning	Offshore Project Area	Short-term disturbance of habitat.
		Short-term loss of local prey species.
		Short-term increase in construction-related lighting.
		Short-term introduction of marine debris.
		Short-term increase in risk of entanglement and entrapment.
		Short-term increase in underwater noise.
		Short-term increase in risk of ship strike due to the increase in vessel traffic.
		Short-term change in water quality, including oil spills.
			• Dominion Energy has sited Offshore Project Components, including WTG and Offshore Substation Foundations and Offshore Export Cable Route Corridors, to avoid sensitive benthic habitats and minimize disturbance of benthic features to the extent practical.
			• Dominion Energy would require all offshore personnel and vessel contractors to implement appropriate debris control practices and protocols to prevent the accidental release of marine debris. All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste.
			• Dominion Energy would implement the following measures as appropriate to avoid, minimize, and mitigate potential impacts of construction-related underwater noise:
			  ○ Implement monitoring and exclusion zones where pile-driven foundations are installed, enforced by qualified NOAA Fisheries-approved Protected Species Observers.
			  ○ Implement real-time monitoring systems.
			  ○ Employ soft starts and shutdown procedures where technically feasible.
				Sea turtles

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			o Employ soft starts for a duration of 30 minutes at the onset of pile-driving activities. o Use reduced visibility monitoring tools/technologies (e.g., night vision, infrared, and/or thermal cameras). o Use commercially and technically available noise-reducing technologies. o Provide sea turtle sighting and reporting procedures for appropriate Project-related personnel specific to construction and its potential impacts on sea turtles. • Dominion Energy would also ensure continued engagement with regulatory agencies regarding potential best practices. • Dominion Energy has developed an Oil Spill Response Plan (Appendix Q), detailing all proposed measures to avoid accidental spills and a protocol to be implemented should such an event occur. Additional information may be found in COP Section 4.4.12, *Public Health and Safety*. All Project-related vessels would operate in accordance with regulations pertaining to at-sea discharge of vessel-generated waste. • Dominion Energy would provide a full decommissioning plan to the appropriate regulatory agencies for approval prior to decommissioning activities, and potential impacts will be re-evaluated at that time.	
Operations and Maintenance	Offshore Project Area	Modification of habitat. Project-related EMF. Project-related lighting. Project-related marine debris. Project-related underwater noise. Increase in risk for ship strike due to the	• Dominion Energy has identified areas where sufficient cable burial is achievable, further buffering the pelagic environment from cable EMF, and cable protection would serve as an alternative barrier where sufficient cable burial is not feasible. • Dominion Energy would consult appropriate regulatory agencies regarding operational lighting requirements. • Dominion Energy would require all offshore personnel to implement appropriate practices and protocols to avoid and minimize the release of marine debris.	Sea Turtles

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		increase in vessel traffic. Changes in water quality, including oil spills.	• Dominion Energy would implement the following measures as appropriate to avoid, minimize, and mitigate potential vessel-related impacts: o Vessel speed restrictions while transiting to and from the review area. o Vessel collision avoidance measures for vessels working in or transiting to and from the Project area, including a 164 feet (50 meters) separation distance from all sea turtle species. • Dominion Energy has developed an Oil Spill Response Plan (Appendix Q) that details all measures proposed to avoid an inadvertent spill of vessel oil or fuel and a protocol to be implemented should such an event occur. • Dominion Energy would implement the following measures as appropriate to avoid, minimize, and mitigate potential impacts on water quality: o Vessel operation in accordance with regulations pertaining to at-sea discharges of vessel-generated waste.	
Construction; Decommissioning	Offshore Project Area	Disturbance to submerged marine archaeological and cultural resources.	• Dominion Energy will develop an operations plan prior to construction, to ensure that construction activities adhere to the recommended avoidance buffers. • Design and construction methods, including micrositing opportunities, will continue to be evaluated in order to avoid the extent of seabed disturbance and adverse effects to historic properties. • Disturbance to known resources that cannot practicably be avoided would only occur with appropriate consultations (i.e., BOEM, State Historic Preservation Offices, Tribal Historic Preservation Officers) and approvals. • Dominion Energy has developed and will implement an Unanticipated Discoveries Plan (UDP) to avoid and mitigate impacts to unknown resources and ancient submerged landform features.	Cultural Resources

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• Dominion Energy will establish and comply with requirements for all protective buffers recommended by the QMA for each marine cultural resource (i.e., archaeological resource and ancient submerged landform feature) based on the size and dimension of the resource.	
O&M	Offshore Project Area	Disturbance to submerged marine archaeological and cultural resources.	• Repairs and other future activities will only occur within previously disturbed portions of the area of potential effects (APE) which have been previously assessed by the QMA. • Adherence to the QMA recommended avoidance buffers would remain in effect during operations.	Cultural Resources
Construction; Decommissioning	All Onshore Project Areas	Disturbance to subsurface terrestrial archaeological and cultural resources	• All Project personnel involved in construction activities must be familiar with the Unanticipated Discoveries Plan (UDP) and the processes for notification of appropriate individuals if archaeological material is encountered. • An archaeological monitor will be on call and ready to assess unanticipated discoveries during all construction activities along the length of the APE. • The identity of the avoided, or partially avoided resources as archaeological sites will not be disclosed to the public or to construction/installation staff but will be known to the archaeological monitor.	Cultural Resources
Construction; Decommissioning	Cable Landing Location and Onshore Export Cable Route	Disturbance to subsurface terrestrial archaeological and cultural resources	• An archaeological monitor will be present at SMR Camp Pendleton during all construction activities that involve subsurface disturbance. • Portions of site 44VB0388 outside of the present APE will be delineated with temporary fencing during all construction activities.	Cultural Resources
Construction; Decommissioning	Switching Station	Disturbance to subsurface terrestrial archaeological and cultural resources	• A buffer of 10 ft (3 m) will be established around the grave/memorial site identified on NAS Oceana/Aeropines Golf Course. • The buffer will be surrounded by fencing during all construction activities.	Cultural Resources

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• An archaeological monitor will be present during all construction activities. • Any archaeological removal of human remains would require a permit from Virginia DHR, pursuant to Code of Virginia §10.1-2305, "Permit required for the archaeological excavation of human remains."	
Construction; Decommissioning	Interconnection Cable Route	Disturbance to subsurface terrestrial archaeological and cultural resources	• An archaeological monitor will be present at site 44VB0162 during all construction activities that involve subsurface disturbance. • Portions of site 44VB0162 outside of the present APE will be delineated with temporary fencing during all construction activities. • An archaeological monitor will be present at site 44CS0250 during all construction activities that involve subsurface disturbance. • Portions of site 44VCS0250 outside of the present APE will be delineated with temporary fencing during all construction activities.	Cultural Resources
Construction; Decommissioning	Laydown Yard	Disturbance to subsurface terrestrial archaeological and cultural resources	• The APE of site 44VB0412 will be delineated by fencing. Construction personnel will be instructed to stay within the fenced area and avoid work outside of the APE.	Cultural Resources
O&M	Offshore Project Area	Long-term visual effects from the presence of Offshore Project Components on cultural resources.	• Dominion Energy will provide financial support for the survey and documentation of Doyletown or Queen City. These funds will support scholarship on one of these historic resources and further the understanding of the property by the public. • Dominion Energy will provide financial support for the development of a renovation plan for the Cape Henry Lighthouse Visitor Services Center. These funds will support the interpretation of the first and second Cape Henry lighthouses and Fort Story for the public good. • Dominion Energy will provide financial support for the preparation of NRHP nominations for the Pocahontas Fowling Club and the Princess Anne County Gunning	Cultural Resources

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			and Hunt Clubs MPD. These funds will support scholarship on these historic resources and further the understanding of the properties by the public. This measure serves to educate the public on hunt clubs. • Dominion Energy will provide the funds for the City of Virginia Beach to hire a contractor to develop a Sea Level Rise Mitigation Plan. This mitigation measure will further preservation efforts of historic buildings in Virginia Beach for the public good. • Dominion Energy will provide funds for the Outer Banks Conservationists to help restore the Currituck Beach Lighthouse. This measure will further the preservation of the Currituck Beach Lighthouse.	
Construction; O&M	Onshore and Offshore Project Area	Physical impacts from Onshore Project components and long-term visual effects from the presence of Offshore Project Components on cultural resources.	• Documentation with a public outreach component of historic resources associated with the SMR. This would enhance the public's knowledge of the resource and ensure its protection.	Cultural Resources
O&M	Offshore Project Area	Long-term visual effects from the presence of Offshore Project Components on cultural resources and visual and scenic resources.	• Dominion Energy would implement an aircraft detection lighting system (ADLS) to automatically activate lights when aircraft approach and then return to darkness.	Cultural Resources and Visual Resources
Construction; Decommissioning	Onshore Project Area	Short-term visual impacts during offshore construction activities. Short-term visual impacts during onshore construction activities.	• Dominion Energy would implement a Fugitive Dust Plan to minimize dust and visual pollution. The Onshore Project area would be maintained free of debris, trash, and waste to the extent possible during construction, and areas temporarily disturbed during construction would be restored to the conditions required by state and/or local permits.	Visual Resources
O&M	Onshore Project Area	Long-term visual effects from the presence of Onshore Project	• Dominion Energy would evaluate vegetative screening to help screen views of the Onshore Substation and Switching Station and design the lighting of the Onshore	Visual Resources

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		Components.	Substation and Switching Station to reduce light pollution where feasible (e.g., downward lighting, motion-detecting sensors). • Dominion Energy would consult with the U.S. Navy, City of Virginia Beach, and the City of Chesapeake to evaluate color treatment and other visual impact mitigations for Switching Station and the Onshore Substation.	
Construction; Decommissioning	Onshore Project Area	Short-term increase in spending on construction materials and services and related economic activity in the region (Hamptons Road area) and state (Virginia). Short-term increase in construction-related employment and income in the region and state. Short-term increase in tax revenues for state and local governments. Short-term increase in the demand for housing. Potential short-term effects to property values. Short-term increase in the demand for public services.	• Project-related vessels transiting to the Lease Area would be consistent with existing vessel traffic off the coast of Virginia. • Dominion Energy would coordinate with local fire and police departments as needed throughout construction of the Project.	Demographics
O&M	Onshore Project Area	Long-term increase in spending on O&M and related economic activity in the region.	• Dominion Energy would coordinate with local fire and police departments as needed throughout operation of the Project.	Demographics

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		Long-term increase in O&M-related employment and income in the region. Long-term increase in tax revenues for state and local governments. Long-term increase in demand for housing. Long-term increase in the demand for public services. Long-term change in property values due to O&M activities.		
Construction; Decommissioning	Onshore Project Area	Short-term increase in construction vehicle traffic and activity. Temporary shortage of affordable temporary housing due to increased demand. Short-term increase in tax revenues for state and local governments. Short-term increase in construction-related employment and income in the region and state. Short-term increase in the demand for public services.	• Dominion Energy would coordinate with local fire and police departments as needed throughout construction of the Project. • The Project would use existing roads, ROWs, and infrastructure where possible. • Communications and outreach to foster the meaningful public participation of potential environmental justice communities is ongoing to better understand how communities may be affected and identify related mitigation measures.	Environmental Justice
O&M	Onshore Project Area	Decrease in availability of long-term housing due to in-migration of	• Dominion Energy has attempted to site the Offshore Project area where it would have the least impact on commercial fishing. Further, the addition of Offshore	Environmental Justice

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		operations workers. Long-term presence of Offshore Project Components in the Lease Area (e.g., wind turbine generators [WTGs] and Offshore Substations). Long-term presence of Onshore Project Components. An increase in O&M-related vehicle traffic. Long-term increase in local and regional government tax revenues. Long-term increase in O&M-related employment and income in the region. Long-term increase in the demand for public services.	Project Components (WTGs and scouring) would facilitate natural reef building which can increase overall species abundance and diversity. This may have positive benefits for the fishing industries in the area. • Dominion Energy is committed to coexistence with commercial and recreational fishing and is conducting extensive outreach and engagement with the fishing community as part of this Project, which will assist in identifying additional environmental justice populations that may rely on the Offshore Project area for fishing and who may require additional engagement. • Dominion Energy would coordinate with local fire and police departments as needed throughout the operations period of the Project.	
Construction; Decommissioning	Onshore Project Area	Short-term disruption to adjacent land uses at the Cable Landing Location and along the Onshore Export Cable Route and Interconnection Cable Route Corridors, including recreational uses associated with the SMR property within the Onshore Export Cable	• A schedule showing the months when construction would occur is provided in Section 1, Table 1.1-3. • To avoid disruption of recreational uses, installation of the Onshore Export Cable would be coordinated with localities and stakeholders to avoid and minimize potential impacts on recreational and tourism uses to the extent practicable. Once construction is complete, the roads and parking lots would be restored to previous conditions. • To further minimize potential construction effects, adjacent landowners would be provided timely	Land Use and Coastal Infrastructure

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		Route Corridor. Direct disturbance during construction and installation of the Onshore Export Cable Route, Switching Station, Interconnection Cable Route, and Onshore Substation.	information regarding the planned construction activities and schedule, and work also would be coordinated with appropriate regulatory agencies. Dominion Energy would provide regular updates to the local community through social media, public notices, and/or other appropriate communications tools. • Temporary safety zones would be implemented around construction activities to ensure the safety of the public. • Dominion Energy would provide regular updates to the local community through social media, public notices, and/or other appropriate communications tools. • Any additional temporary staging areas necessary to support onshore construction activities are anticipated to be located on either previously disturbed lands or within the area of disturbance for construction, to the extent practicable. • During construction, the Project would additionally involve temporary construction laydown area(s). The portion of the parcel not required for long-term operation of the Onshore Substation would be restored to previous conditions once construction is complete.	
O&M	Onshore Project Area	Long-term conversion of land for the access to facilities of Onshore Export Cable, Switching Station, Interconnection Cable Route, and the Onshore Substation.	• If necessary, permitting, regulatory actions, and other actions would be taken in the future for development of the Interconnection Route as part of the Preferred Alternative if direct land use displacement, land acquisitions, or re-zonings are required. • Dominion Energy intends to coordinate with permitting authorities and stakeholders to identify what, if any, land use may continue within land acquired for the Interconnection Route, as well as any additional mitigation measures that may be appropriate related to impacts on local land use and resources during construction and operations and maintenance.	Land Use and Coastal Infrastructure
Construction; Decommissioning	Onshore Project Area	Short-term increase in Project-related	• Dominion Energy would develop a Traffic Management Plan (TMP) in coordination with, and approved by, the	Land Use and Coastal

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		construction vehicle traffic, including workforce commuting trips. Temporary modification of roadway traffic patterns due to lane closures, street closures, and travel restrictions (e.g., one-way traffic, alternating traffic).	affected federal, state, and local agencies as applicable to offset any anticipated traffic-related impacts associated with increased vehicle demand during construction. As part of the preparation of the TMP, Dominion Energy would coordinate with local and state transportation and public works departments to identify any planned roadway improvements that may impact traffic operations within the Transportation and Traffic geographic analysis area. The TMP would include, but not be limited to, the development of vehicular travel routes to and from the Project construction site; provision of highly visible markings, signage, and lighting of active construction sites; provision of sufficient on-site parking; and implementation of temporary, localized construction zones to minimize areas or sections of road closure. • Dominion Energy would provide regular updates to the local community through social media, public notices, and other appropriate communications methods and schedule construction activities to minimize impacts on the summer peak tourism season to the extent practicable where appropriate and as deemed necessary by local authorities.	Infrastructure
O&M	Onshore Project Area	An increase in operation and maintenance vehicle traffic, including workforce commuting trips.	• Dominion Energy would develop a TMP that would offset any anticipated traffic-related impacts associated with increased vehicle demand during construction in the same manner as described above for Project-related construction vehicle traffic.	Land Use and Coastal Infrastructure
Construction; Decommissioning	Offshore and Onshore Project Area	Short-term displacement of marine users due to the establishment of safety zones around Project-related vessels and structures. Short-term displacement of recreational users onshore due to the	• Dominion Energy would establish a Project-specific website to share information about the Project's construction progress with the community and to give guidance on the construction activities and how they may affect marine traffic in the area. Dominion Energy would also issue specific local notices to mariners (LNTMs) in coordination with USCG throughout the construction period. To ensure the safety of commercial and recreational mariners, temporary vessel restrictions	Recreation and Tourism

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		establishment of safety zones around Project-related equipment and construction areas. Minor and temporary increases to local traffic during construction for the Onshore Project area.	may reduce access within the temporary Wind Turbine Generator work areas, the nearshore HDD area, and along the offshore installation corridor during construction. As appropriate, these areas would be marked and illuminated in accordance with USCG requirements and monitored by a security boat available to assist local mariners. • Dominion Energy would coordinate shoreline construction activities with localities and stakeholders to avoid and minimize conflicts with users to the extent practicable. In addition, Dominion Energy intends on coordinating construction activities with the Virginia SMR to avoid and minimize conflicts with recreational uses to the extent practicable. • To avoid disruption of recreational uses, installation of the Onshore Export Cable would be coordinated with localities and stakeholders to avoid and minimize potential impacts on recreational and tourism uses to the extent practicable. Once construction is complete, the roads and parking lots would be restored to previous conditions. • Dominion Energy intends to coordinate construction activities to minimize impacts on the extent practicable and to provide regular updates to the local community through social media, public notices, and/or other appropriate communications tools. • Dominion Energy would not block roadways to the SMR vehicular traffic for long periods of time for onshore construction activities.	
O&M	Offshore and Onshore Project Area	Long-term modification of existing marine uses in the Offshore Project area. Long-term displacement of recreational activities in the Onshore Project	• Dominion Energy would notify recreational mariners of all non-emergency Project-related maintenance activities on its website and social media sites and work in accordance with the USCG requirements. When possible, Dominion Energy would schedule and plan maintenance activities to minimize impact and interruption to recreation and tourism activities in the	Recreation and Tourism

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		area.	Project Area. In order to maintain navigational safety for marine recreational users, Dominion Energy would place a radar beacon (RACON; radar responder) at the WTG site comply with USCG Lighting, Marking, signage requirement • When possible, Dominion Energy would schedule and plan maintenance activities to minimize impact and interruption to recreation and tourism activities in the Project Area.	
Construction; Decommissioning	Offshore Project Area	Potential for temporary displacement of fishing activity. Potential for temporary disturbance to local commercial fish species. Potential for risk of gear entanglements on partially installed structures. Potential for increase in Project-related vessel traffic.	• Closures would be limited to discrete segments of the Offshore Project Components that would have restricted access on a temporary basis while construction is active. • Dominion Energy would work with fishermen and the head of marine construction operations to review operational planning and schedules in order to identity any areas where fishing operations may be temporarily displaced. Dominion Energy would also work with the USCG and make notices of area closures publicly available through LNTMs posted to Dominion Energy's website and social media. • Dominion Energy would work with those affected fishermen to minimize any potential impact. Dominion Energy would remain committed to coexistence with the commercial and recreational fishing industries. • Dominion Energy is planning to utilize underwater noise mitigation (e.g., bubble curtain or equivalent) to mitigate temporary impacts of pile driving on marine species. • The Fisheries Communications Plan (COP Appendix V; Dominion Energy 2023) developed for the Project, combined with the direct outreach activities anticipated during construction, would provide the fishing community with advance notice, prior to formal LNTM, describing the extent and duration of construction activities and locations of all fixed structures within the Offshore Project area, including partially installed	Commercial Fisheries and For-Hire Recreational Fishing

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			structures within the safety zone. • For the safety of both mariners and Project technicians, Dominion Energy would establish safety zones around construction activities as applicable. Dominion Energy would notify all mariners via LNTM of the presence and location of partially installed structures. • Dominion Energy would ensure that all Project-related vessels follow appropriate navigational routes and communicate to other mariners via LNTM and/or radio communications to mitigate risks to the commercial and recreational fishing industries as well as other mariners.	
O&M	Offshore Project Area	Potential for loss of access to traditional fishing grounds, or temporary displacement of fishing activity during maintenance activities. Potential for modification of habitat and displacement of target commercial species. Potential for increased Project-related vessel traffic. Potential for positive beneficial increases in species diversity and abundance. Potential for impacts on marine radar/navigation instruments due to the presence of WTGs.	• Dominion Energy would continue to coordinate with existing commercial fishermen that utilize the Offshore Project area (largely using fixed gear [pots/traps and gillnets]) and emerging fisheries to ensure they can deploy and recover their gear safely during operations and maintenance. • Dominion will also ensure that the operation WTGs and Offshore Substations comply with USCG safety zones (should they become effective during the operational life of the Project) when offshore service vessels/crew transfer vessels are present and/or WTG technicians are aboard Project components, to ensure safe working conditions and safe vessel operation. • Dominion will also ensure that the operational wind turbine generators and Offshore Substations include adequate marking and lighting in accordance with USCG approved measures to ensure safe vessel operation. • Dominion Energy is in the process of establishing partnerships with local and regional experts from institutions, including the Virginia Institute of Marine Science and the Virginia Aquarium to facilitate preparation of pre- and post-construction monitoring plans, driven by the stakeholders' interests and built upon existing data.	Commercial Fisheries and For-Hire Recreational Fishing

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• Dominion Energy would continue to ensure that all Project-related vessels follow appropriate navigational routes and other USCG "rules of the road," communicate via USCG LNTM, issue regular mariner updates and/or direct offshore radio communications to help mitigate risks to the commercial and recreational fishing industry as well as other mariners. • Dominion Energy would leverage its experience on this topic with the CVOW Pilot Project and would work with the USCG and the local fishing community to refine site-specific controls or settings that may help to mitigate potential interference of marine radar associated with the presence of Offshore Project Components.	
Construction; Decommissioning	Offshore Project Area	Temporary displacement of existing regional vessel traffic. Vessel allision risk with partially installed structures.	• Project-related vessel traffic would follow existing transit routes to the extent practicable and Dominion Energy would coordinate with USCG and local port authorities during the construction stage of the Project. • Project-related construction and vessel activities would be communicated to the maritime community by use of LNTMs in coordination with the USCG throughout the construction stage. This information would also be posted on Dominion Energy's social media pages and website. • The Project will require operational Automated Identification System (AIS) on all vessels associated with the construction, operation, and decommissioning of the Project, pursuant to USCG and AIS carriage requirements. AIS will be required to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements. • To reduce the risks of vessel allision, Dominion Energy would mark potential hazards in coordination with USCG. • Dominion Energy would develop LNTMs that would include locations of partially installed structures. In addition, Dominion Energy would advise mariners of	Navigation

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			safety zones around all Offshore Project Components under construction and construction-related activities for the safety of mariners.	
O&M	Offshore Project Area	Long-term displacement of maritime vessels due to new fixed structures. Temporary diversion of maritime vessel traffic because of occasional O&M activities to the Offshore Project Components. Long-term vessel collision risk. Long-term vessel allision risk with WTGs and Offshore Substations.	• The WTG layout was designed to have a 397-foot (121-meter) buffer to the edges of the Lease Area to ensure that no structures would be outside of the Lease Area including the blades. • Dominion Energy would provide information to the USCG for publication in the LNTM, which provides schedules and locations for all O&M activities, and would continue to coordinate with the USCG. • All Offshore Project Components (i.e., infrastructure associated with the Project) would be charted on the relevant nautical charts (electronic and print) in conjunction with NOAA Fisheries. Dominion Energy would seek to have infrastructure charted prior to the start of the construction stage. This includes precise, planned Offshore Export Cable location information provided in spreadsheet and geographic information system formats. • Dominion Energy will Comply with Federal Aviation Administration (FAA), BOEM, and U.S. Coast Guard (USCG) lighting, marking and signage requirements to aid navigation for each WTG.	Navigation
Construction; Decommissioning	Offshore Project Area	Short-term increase in Project-related vessel traffic due to the construction of Offshore Project Components. Short-term adjustments to military vessel traffic during offshore construction activities.	• Dominion Energy would schedule and track Project-related vessels to best manage congestion and traffic flow in coordination with the USCG, DoD, and other national security stakeholders. • Where practical, Project vessels would utilize transit lanes, fairways, and predetermined passage plans consistent with existing waterway uses. • Dominion Energy would continue to communicate and engage with key national security stakeholders, including the USCG, DoD, and others, to coordinate installation activities.	Other Uses

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			• USCG would publish LNTMs and broadcast LNTMs to inform mariners and aviators of Project activities in the area. • Dominion Energy would publish an operations plan on the Project website to inform mariners and other interested parties on what work is being done in the Offshore Project area. • Dominion Energy would establish and enforce safety zones around active construction areas. • Should USCG safety zone authorities not extend beyond 12 nautical miles (22 kilometers) at the time of construction, Dominion Energy would utilize a combination of safety vessels, LNTMs, and Convention on the International Regulations for Prevention of Collisions at Sea to promote both awareness of these activities and the safety of the construction equipment and personnel. Project vessels will also send and receive AIS signals for awareness and collision avoidance.	
Construction; Decommissioning	Onshore Project Area	Short-term disturbance at the Cable Landing Location and along the Onshore Export Cable Corridor.	• Once construction is complete, the lands, roads, and parking lots would be restored to previous conditions. • To minimize potential construction effects on DoD activities, DoD would be provided timely information.	Other Uses
O&M	Offshore Project Area	Long-term modification of existing waterway use. Long-term presence of new fixed structures (e.g., Offshore Project Components) in the Offshore Project area. Occasional diversion of national security maritime vessel traffic	• Dominion Energy may need to implement temporary safety zones (e.g., foundation locations and/or cable installation vessels) during O&M activities. • Dominion Energy would maintain regular communications and updates with all key national security stakeholders on timing and locations of maintenance activities in order to avoid, minimize, and mitigate impacts. • Dominion Energy would ensure that Wind Turbine Generators and Offshore Substations are properly marked and lighted in accordance with FAA Advisory	Other Uses

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		due to short-term inspection, repair, or replacement of Offshore Export Cables or Inter-Array Cables, and other such O&M activities.	Circular 70/7460-1M (FAA 2020), BOEM's Proposed Guidelines for Providing Information on Lighting and Marking of Structures Supporting Renewable Energy Development (BOEM 2021), the International Association of Marine Aids' (IALA's) Navigation and Lighthouse Authorities Recommendation G1162 the Marking of Man-Made Offshore Structures (IALA 2021), and referencing COP Appendix T, *Obstruction Evaluation and Additional Analysis*. • Dominion Energy would provide as-built information to NOAA) National Ocean Service to support necessary updates to navigation charts in coordination with other stakeholders as needed. • Dominion Energy would work with USCG to facilitate training exercises within the Offshore Project area as requested. Dominion Energy would also provide regular communications and updates with key national security stakeholders on Project-related activities that may affect national security operations. • Dominion Energy would employ helicopters for O&M activities for the transfer of personnel and materials to the Offshore Project area. Dominion Energy would control Project vessel and helicopter movements through the Control Center to minimize vessel encounters during training operations in and near the Offshore Project area. • Dominion Project vessels will also send and receive AIS signals for awareness and collision avoidance. • Dominion Energy would communicate with key national stakeholders on the timing and location of O&M activities. Dominion Energy would also follow the USCG establishment of safety zones around O&M activities.	
O&M	Offshore Project Area	Long-term conversion of land for the access to facilities (e.g., Cable Landing Location) in the	• Dominion Energy intends to coordinate with the SMR to identify what, if any, land use may continue within land acquired or leased for the Cable Landing Location, as well as any additional mitigation measures that may be	Other Uses

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		Onshore Project area.	appropriate related to impacts on DoD activities and resources during O&M.	
Construction; Decommissioning	Offshore Project Area	Short-term restricted access to sand resources and dredge disposal sites due to the implementation of safety zones. Short-term disturbance to seafloor, including existing submarine cables during construction. Short-term increase in vessel traffic during construction. Short-term noise impacts during construction.	• Dominion Energy would provide advance notice of construction and maintenance activities through LNTMs and broadcast LNTMs as well as on the Project website. • Dominion Energy would monitor and control Project vessel movements to minimize impacts on sand-borrowing and dredge spoil dumping activities. • Because safety zones would be implemented during construction activities, marine users are expected to be outside of this potential area of effect and are, therefore, not anticipated to be affected by this temporary disturbance in the Offshore Project area, other than temporarily being restricted from accessing these areas during construction activities. • Installation of the Offshore Export Cables in proximity to the four existing submarine cables (BRUSA fiber optic cable, MAREA fiber optic cable, DUNANT fiber optic cable, and Commercial Virginia Offshore Wind Pilot Export Cable) would be coordinated with these asset owners to avoid impacts on any of these critical seabed assets. • Dominion Energy would schedule and track Project-related vessels to best manage congestion and traffic flow in coordination with USCG and other maritime stakeholders. • All Dominion Project vessels will send and receive AIS signals for awareness and collision avoidance. • Where practical, Project vessels would utilize traffic separation schemes, fairways (should they be developed), and predetermined passage plans consistent with existing waterway uses. • The USCG would publish LNTMs and broadcast LNTMs to inform mariners of Project activities in the area. Additionally, a Project website with the operations plan	Other Uses

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			would be updated so that mariners know what work is being done in the various offshore Project locations. • During pile driving of WTG Monopile Foundations, Dominion Energy would apply monitoring and exclusion zones as appropriate to underwater noise assessments and impact thresholds. • Construction personnel would employ soft starts and shutdown procedures as appropriate to thresholds of noise-emitting survey equipment; soft starts would last 30 minutes at the onset of pile driving. • Dominion Energy would use commercially and technically available noise-reducing technologies as appropriate and provide marine mammal sighting and reporting training for each specific stage of construction to emphasize individual responsibility for marine mammal awareness and protection. • Dominion Energy would ensure continued engagement with regulatory agencies regarding potential best practices for noise mitigation.	
O&M	Offshore Project Area	Short-term restricted access in the vicinity of inspection, survey, maintenance, or repair. Long-term restricted access for inspection, maintenance, and repairs to existing cables.	• Should this activity be conducted near the Atlantic Ocean Channel and shipping lanes, Dominion Energy would schedule and control Project-related vessels to best manage congestion and traffic flow in coordination with USCG, as well as DoD exercises and training activities, as appropriate. • Dominion Energy has proactively sited the Offshore Export Cables to avoid active sand borrow sites and disposal sites to the extent practicable in an effort to avoid impacts. • Dominion Energy would work with the appropriate federal and state agencies to safeguard the export cable assets.	Other Uses
Construction; Decommissioning	Onshore and Offshore Project Area	Short-term interference with airspace and aviation radar systems	• Notice Criteria check (14 CFR § 77.9) and/or additional airspace and aviation radar system assessment would be performed to determine whether there are potential	Other Uses

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
		due to the temporary presence of construction equipment onshore and offshore as well as transportation of Project Components to the Project Area.	airspace impacts and FAA filing is required during the storage or transit of Project materials and Offshore Project Components. FAA coordination for the onshore portion of the Project will occur following further detailed engineering of structures, when structure heights have been determined. It is also possible that the DoD would request to be informed through the Informal Review Process for the transit of large materials. Further coordination with the DoD will occur as a result of the findings of the Informal Review Process and any notifications requested by the DoD will be applied to the Project as needed. • Dominion Energy would be in direct communication with applicable agencies and personnel to alert the appropriate parties to planned construction movements and actions. All WTG Components and construction equipment would be properly lighted and marked in accordance with FAA's Advisory Circular 70/7460-1M within FAA jurisdiction and beyond, or other methods as deemed required during consultation and as applicable.	
Operations	Onshore and Offshore Project Area	Long-term interference with regulated airspace due to the presence of fixed structures (Onshore and Offshore Project Components). Long-term interference with regulated aviation radar systems. Long-term interference with military radar operations. Long-term interference with high-frequency radar operations.	• Dominion Energy would coordinate with the FAA to make this required change to the airspace as necessary. In addition, all WTGs would be properly lighted and marked in accordance with FAA's Advisory Circular number 70/7460-1M within FAA jurisdiction and beyond. • Dominion Energy would continue to engage and coordinate with applicable military contacts to assess and address potential impacts as needed. • Dominion Energy would continue to engage and coordinate with applicable owners and operators of these high-frequency radar systems to assess and address potential impacts as needed.	Other Uses
Construction;	Offshore	Short-term change in	• Dominion Energy would take measures to minimize	Other Uses

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
Decommissioning	Project Area	Project-related vessel traffic. Short-term displacement of marine users due to the establishment of safety zones around Project-related vessels and structures. Short-term interference with access to nearshore and beach area. Short-term increases in turbidity and water quality. Short-term disturbance and displacement of local marine wildlife.	impacts associated with construction vessels, including transiting within existing traffic lanes to the extent feasible, regular communication with stakeholders regarding Project activity, completing construction as quickly as is safely practicable, and limiting vessel activity to necessary transits. • Dominion Energy would continue to coordinate with appropriate personnel from the Navy to ensure construction activities do not conflict with training and testing activities within the Virginia Capes Range Complex, including transits to/from such activities. • Dominion Energy would minimize displacement of other marine users by establishing restricted zones in portions of the Offshore Project area only for the time required to complete the work. • Dominion Energy would provide frequent and regular updates of construction activity and implemented safety zones to the local marine community through the Project website, social media, and the LNTMs and by actively engaging other stakeholders. Impacts on other marine and coastal uses will be short term and localized. • Dominion Energy would minimize the size of safety areas and duration of exclusion to reduce impacts on other users of the area. Dominion Energy is committed to keeping the coastal community informed by providing advance notice of area restrictions and regular updates to the public via local news, on-site signage, social media, and other suitable information outlets. • All Dominion Energy vessel crews would be familiar with practices to avoid and minimize accidental spills as detailed in Dominion Energy's Marine Trash and Debris Prevention Training, Emergency Response Plan, and Oil Spill Response Plan (see Appendix Q). • Dominion Energy would avoid and minimize disturbance of wildlife, particularly endangered sea turtles and	

Project Stage	Location	Impact	Description of Applicant-Proposed Avoidance, Minimization, and Mitigation Measures	Resource Area Mitigated
			marine mammals. Avoidance, minimization, and mitigation measures include soft-start pile driving, dedicated marine mammal and sea turtle observers on vessels, and other activities.	
O&M	Offshore Project Area	Long-term modification of existing uses. Long-term changes in vessel traffic. Increase in diving, snorkeling, and other tourism in the wind farm in the Offshore Project area. Increase in recreational fishing (including tournaments) near the WTGs as artificial reefs become established on the Foundations.	• Dominion Energy would minimize and mitigate impacts on other users by notifying local marine users when any major repairs are planned and reducing any necessary restriction to the extent that safety precautions allow. The crew transfer and O&M vessels would use established transit lanes and will not substantially restrict other uses. No measurable impact of vessel traffic is expected.	Other Uses

Table H-2 Mitigation and Monitoring Measures Resulting From Consultations

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
NHPA Section 106 Mitigation and Monitoring Measures					
1	Prior to C, C, O&M, D	Compliance with Section 106 Memorandum of Agreement	Dominion Energy will comply with stipulations of *The Memorandum Of Agreement Among the Bureau Of Ocean Energy Management, the State Historic Preservation Officers of Virginia and North Carolina, and the Advisory Council on Historic Preservation Regarding the Coastal Virginia Offshore Wind Commercial Project* (hereafter referred to as the *MOA*; Appendix O, Attachment A) as developed by BOEM, federally recognized tribes, State Historic Preservation Officers (SHPOs), the ACHP, and consulting parties (as defined in the Section 106 regulations) through NHPA Section 106 consultations. Consulting parties include those who are property owners of or have demonstrated interest in the historic properties BOEM has determined would be adversely affected by the Project.	Cultural Resources	BOEM, BSEE, VA SHPO, NC SHPO, USACE, U.S. Navy, ACHP, VDMA-VaARNG
2	C	Avoidance of Adverse Effects on Historic Properties in Marine Area of Potential Effect	Per MOA Stipulation I.A.1 and the associated avoidance plan for marine cultural resources (MOA, Attachment 3), Dominion Energy will comply with horizontal protective buffers recommended by the Qualified Marine Archaeologist for all 31 identified marine archaeological resources (i.e., Targets 1–31) and six (6) identified ancient submerged landform features (i.e., P-01, P-02, P-03, P-04-A, P-04-B, and P-05) to avoid adverse effects on these historic properties in the marine area of potential effects (APE).	Cultural Resources	BOEM, BSEE, VA SHPO, USACE
3	C	Marine Archaeology Post-Review Discovery Plan	Per MOA Stipulation XI, if historic properties are discovered that may be historically significant or unanticipated effects on historic properties are found; or in the event of a post-review discovery of a historic property or unanticipated effects on a historic property prior to or during construction, installation, O&M, or decommissioning of the Project,	Cultural Resources	BOEM, BSEE, VA SHPO, USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			Dominion Energy will implement actions which are consistent with the post-review discovery plan (PRDP) for marine archaeology (MOA, Attachment 7).		
4	C	Avoidance of Adverse Effects on Historic Properties in Terrestrial Area of Potential Effect	Per MOA Stipulation I.A.2 and the associated avoidance plan for cultural resources located in the terrestrial APE (MOA, Attachment 4), Dominion Energy will install temporary fencing for avoiding adverse effects on three (3) terrestrial archaeological resources (i.e., 44CS0250, 44VB0162, and 44VB0412) and one (1) grave/memorial on Naval Air Station Oceana (i.e., 34-5027-0050) in the terrestrial APE; and on one (1) terrestrial archaeological resource outside of but adjacent to the terrestrial APE.	Cultural Resources	BOEM, BSEE, VA SHPO, U.S. Navy, VDMA-VaARNG
5	C	Archaeological Monitoring in the Terrestrial Area of Potential Effects	Per MOA Stipulation II.A.1, Stipulation X, and the associated minimization plan for cultural resources located in the terrestrial APE (MOA, Attachment 4), Dominion Energy will conduct archaeological monitoring of construction activities such that an archaeological monitor will be present at the locations of the following historic properties and cultural resources during construction activities that involve subsurface disturbance: 44CS0250; Camp Pendleton/State Military Reservation Historic District; and the grave/memorial on Naval Air Station Oceana (i.e., 34-5027-0050).	Cultural Resources	BOEM, BSEE, VA SHPO, U.S. Navy, VDMA-VaARNG
6	C	Terrestrial Archaeology Post-Review Discovery Plan	Per MOA Stipulation XI, if historic properties are discovered that may be historically significant or unanticipated effects on historic properties are found; or in the event of a post-review discovery of a historic property or unanticipated effects on a historic property prior to or during construction, installation, O&M, or decommissioning of the Project, Dominion Energy will implement actions which are consistent with the PRDP for terrestrial archaeology (MOA, Attachment 8).	Cultural Resources	BOEM, BSEE, VA SHPO, U.S. Navy, VDMA-VaARNG
7	C	Avoidance of Adverse Effects on Historic	Per MOA Stipulation I.A.3, to maintain avoidance of adverse effects on historic properties in the visual APE where BOEM determined no adverse effects or where no	Cultural Resources	BOEM, BSEE, VA SHPO, NC SHPO,

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
		Properties in Visual Area of Potential Effect	effects would occur, BOEM will require Dominion Energy to ensure Project structures are within the design envelope, sizes, scale, locations, lighting prescriptions, and distances that were used by BOEM to inform the definition of the APE for the Project and for determining effects in the *Finding of Adverse Effect for the Coastal Virginia Offshore Wind Commercial Construction and Operations Plan* (Appendix O).		U.S. Navy
8	C	Minimization of Adverse Effects on Historic Properties in the Visual Area of Potential Effect	Per MOA Stipulation II.A.2, a. Dominion Energy will use uniform WTG design, speed, height, and rotor diameter to reduce visual contrast and decrease visual clutter; b. Dominion Energy will reserve the option to reduce the number of constructed WTGs from a maximum proposed number of 202 positions. c. Dominion Energy will apply a paint color to the WTGs no lighter than RAL 9010 pure white and no darker than RAL 7035 light gray to help reduce potential visibility of the turbines against the horizon during daylight hours. Dominion Energy has committed to the use of an aircraft detection lighting system (ADLS) to automatically activate lights when aircraft approach and then return to darkness. The WTGs and OSS will be lit and marked in accordance with Federal Aviation Administration and U.S. Coast Guard lighting standards and consistent with BOEM's *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development* (April 28, 2021) to reduce light intrusion.	Cultural Resources	BOEM, BSEE, VA SHPO, NC SHPO, USACE, U.S. Navy, VDMA-VaARNG
9	Prior to C	Historic Property Treatment Plans	Per MOA Stipulation III.A.1 and the associated Historic Property Treatment Plans (HPTPs; MOA, Attachments 5, 6, and 7), BOEM will ensure measures described in the HPTPs to resolve adverse effects on the 24 adversely affected historic properties are required as conditions of approval of the Project COP and are funded and	Cultural Resources	BOEM, BSEE, VA SHPO, NC SHPO, U.S. Navy, VDMA-VaARNG

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			implemented by Dominion Energy according to a timeline determined through consultation; the 24 adversely affected historic properties are: • Atlantic Wildfowl Heritage Cottage/De Witt Cottage (Virginia Beach, Virginia); • Camp Pendleton/State Military Reservation Historic District (Virginia Beach, Virginia); • Cavalier Hotel and Beach Club (Virginia Beach, Virginia); • Cavalier Shores Historic District (Virginia Beach, Virginia); • Chesapeake Bay Bridge-Tunnel (Northampton County and Virginia Beach, Virginia); • Chesapeake Light Tower (Virginia Beach, Virginia); • Currituck Beach Lighthouse (Corolla, North Carolina); • Cutty Sark Motel Efficiencies (Virginia Beach, Virginia); • Econo Lodge/Empress Motel (Virginia Beach, Virginia); • First Cape Henry Lighthouse (National Historic Landmark; Virginia Beach, Virginia); • Fort Story Historic District[1] (Virginia Beach, Virginia); • Hilton Washington Inn/Quality Inn and Suites (Virginia Beach, Virginia); • House (100 54th Street, Virginia Beach, Virginia); • House (4910 Ocean Front Avenue, Virginia Beach, Virginia); • House (5302 Ocean Front Avenue, Virginia Beach, Virginia);		

[1] The Fort Story Historic District is part of the Joint Expeditionary Base Little Creek-Fort Story (JEBLCFS).

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			• House (7900 Ocean Front Avenue, Virginia Beach, Virginia); • House (8304–8306 Ocean Front Avenue, Virginia Beach, Virginia); • House (8600 Ocean Front Avenue, Virginia Beach, Virginia); • Oceans II Condominiums/Aeolus Motel (Virginia Beach, Virginia); • Sandbridge Historic District (Virginia Beach, Virginia); • Seahawk Motel (Virginia Beach, Virginia); • Seatack Lifesaving Station/U.S. Coast Guard Station (Virginia Beach, Virginia); • Second Cape Henry Lighthouse (Virginia Beach, Virginia); and • Virginia House (Virginia Beach, Virginia) The HPTPs have been developed in consultation with consulting parties, including those who are property owners of or have demonstrated interest in the historic properties BOEM has determined would be adversely affected by the Project.		
BOEM-Proposed Mitigation and Monitoring Measures in the NMFS BA					
1	C, O&M, D	Vessel strike avoidance procedures	Applicant proposed measures plus: • As part of vessel strike avoidance, a training program will be implemented. The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event. • Vessel operators and crew must maintain a vigilant	Marine mammals and sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			watch for marine mammals and sea turtles by slowing down or stopping their vessels to avoid striking these protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures will include, but are not limited to the following, except under extraordinary circumstances when complying with these measures would put the safety of the vessel or the crew at risk: o If underway, vessels must steer a course away from any sighted NARW at 10 knots (18.5 km/hr) or less until the 1,640 feet (500 meters) minimum separation distance has been established. If a NARW is sighted in a vessel's path, or within 330 feet (100 meters) of an underway vessel, the underway vessel must reduce speed and shift the engine to neutral. Engines will not be engaged until the NARW has moved outside of the vessel's path and beyond 330 feet (100 meters). If stationary, the vessel must not engage engines until the NARW has moved beyond 330 feet (100 meters); o All vessels will maintain a separation distance of 330 feet (100 meters) or greater of any sighted whales. If sighted, the vessel underway must reduce speed and shift the engine to neutral and must not engage the engines until the whale has moved outside the vessel's path and beyond 330 feet (100 meters). If a survey vessel is stationary, the vessel will not engage engines until the whale has moved out of the vessel's path and beyond 330 feet (100 meters); o Vessel operators will use all available sources of information of NARW presence, including daily monitoring of the Right Whale Sightings Advisory System, WhaleAlert app, and monitoring of USCG		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			VHF Channel 16 to receive notifications of right whale detections, SMAs, DMAs, and Slow Zones to plan vessel routes to minimize the potential for co-occurrence with right whales. ○ All vessels will comply with NMFS regulations and speed restrictions and state regulations as applicable for NARW. ○ All vessels regardless of size operating from November 1 through April 30 will operate at speeds of 10 knots or less when transiting from port to port within the Lease Area and export cable route, or within the boundaries of any DMA, slow zone, or SMA.		
2	C, O&M, D	Incorporate LOA requirements	The measures required by the final MMPA LOA would be incorporated into COP approval, and BOEM, BSEE, or both would monitor compliance with these measures.	Marine mammals	BOEM and BSEE
3	C, O&M, D	BOEM PDCs and BMPs	BOEM will require Dominion Energy comply with all the Project Design Criteria and BMP for Protected Species at https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf, that implement the integrated requirements for threatened and endangered species resulting from the June 29, 2021, programmatic consultation under the ESA, revised September 1, 2021. This requirement also applies to non-ESA-listed marine mammals that are found in that document. Consultation conditions occurring in State waters outside of BOEM jurisdiction may apply to co-action agencies issuing permits and authorizations under this consultation	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS
4	C, O&M, D	Look out for sea turtles and reporting	a. For all vessels operating north of the Virginia/North Carolina border, between June 1 and November 30, Dominion Energy would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would	Sea turtles	BOEM, BSEE and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			communicate any sightings, in real time, to the captain so that the requirements in I below can be implemented. b. For all vessels operating south of the Virginia/North Carolina border, year-round, Dominion Energy would have a trained lookout posted on all vessel transits during all phases of the project to observe for sea turtles. The trained lookout would communicate any sightings, in real time, to the captain so that the requirements II below can be implemented. This requirement is in place year-round for any vessels transiting south of Virginia, as sea turtles are present year-round in those waters. c. The trained lookout would monitor https://seaturtlesightings.org/ prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. d. If a sea turtle is sighted within 330 feet (100 meters) or less of the operating vessel's forward path, the vessel operator would slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 330 feet (100 meters), at which time the vessel may resume normal operations. If a sea turtle is sighted within 164 feet (50 meters) of the forward path of the operating vessel, the vessel operator would shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots. The vessel may resume normal operations once it has passed the turtle. e. Vessel captains/operators would avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas.		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			f. All vessel crew members would be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials would be available aboard all project vessels for identification of sea turtles. The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) would be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so. g. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements on an emergency basis. If any such incidents occur, they would be reported to NMFS within 24 hours. h. If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for NARWs, an additional lookout is not required and this PSO or trained lookout would maintain watch for marine mammals and sea turtles. Vessel transits to and from the Offshore Project area, that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 330 feet (100 meters) avoidance measure.		
5	C, O&M, D	Marine debris awareness training	Dominion Energy would ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris or by contacting BSEE. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities would continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are in fact trained. The training process would include the following elements: • Viewing of either a video or slide show by the personnel specified above; • An explanation from management personnel that emphasizes their commitment to the requirements; • Attendance measures (initial and annual); and • Record keeping and the availability of records for inspection by DOI. By January 31 of each year, Dominion Energy would submit to DOI an annual report that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. Dominion Energy would send the reports via email to BOEM (at renewable_reporting@boem.gov) and to BSEE (at marinedebris@bsee.gov).		
6	C and year 1 of O&M	BOEM/NMFS meeting requirements for sea turtle take documentation	To facilitate monitoring of the incidental take exemption for sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records. These meetings/conference calls would be bi-annually) and would use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations. These meetings would continue on an annual basis	Sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			following year one of operations. Upon mutual agreement of NMFS and BOEM, the frequency of these meetings can be changed.		
7	C, O&M, D	Data Collection BA BMPs	BOEM would ensure that all PDC and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (June 2021) shall be applied to activities associated with the construction, maintenance and operations of the Dominion Energy project as applicable.	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS
8a	C, O&M	BOEM COP PDCs and BMPs	Use standard underwater cables that have electrical shielding to control the intensity of electromagnetic fields (EMF).	Marine Mammals, Sea Turtles, and ESA-listed Fish; Finfish, Invertebrates, and EFH	BOEM, BSEE, and NMFS
8b	Pre-C	BOEM COP PDCs and BMPs	Lessees and grantees should evaluate marine mammal use of the proposed Action Area and should design the project to minimize and mitigate the potential for mortality or disturbance. The amount and extent of ecological baseline data required should be determined on a project basis.	Marine Mammals	BOEM, BSEE, and NMFS
8c	C, O&M, D	BOEM COP PDCs and BMPs	Vessels related to project planning, construction, and operation should travel at reduced speeds when assemblages of cetaceans are observed. Vessels also should maintain a reasonable distance from whales, small cetaceans, and sea turtles, and these should be determined during site-specific consultations.	Marine Mammals and Sea Turtles	BOEM, BSEE, and NMFS
8d	C, O&M, D	BOEM COP PDCs and BMPs	Lessees and grantees should minimize potential vessel effects on marine mammals and sea turtles by having project-related vessels follow the NMFS Regional Viewing Guidelines while in transit. Operators should undergo training on applicable vessel guidelines.	Marine Mammals and Sea Turtles	BOEM, BSEE, and NMFS
8e	C, O&M, D	BOEM COP	Lessees and grantees should take efforts to minimize	Marine	BOEM, BSEE, and

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
		PDCs and BMPs	disruption and disturbance to marine life from sound emissions, such as pile driving, during construction activities.	Mammals, Sea Turtles, and ESA-listed Fish; Finfish, Invertebrates, and EFH	NMFS
8f	C	BOEM COP PDCs and BMPs	Lessees and grantees should avoid and minimize effects on marine species and habitats in the Action Area by posting a qualified observer on site during construction activities. This observer should be approved by BOEM and NMFS.	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS
9	O&M	Periodic Underwater Surveys, Reporting of Monofilament and Other Fishing Gear Around WTG Foundations	Dominion Energy must monitor indirect effects associated with charter and recreational fishing gear lost from expected increases in fishing around WTG foundations by surveying at least 10 of the WTGs located closest to shore in the Dominion Energy Lease Area (OCS-A 0483) annually. Survey design and effort may be modified with review and concurrence by DOI. Dominion Energy may conduct surveys by remotely operated vehicles, divers, or other means to determine the frequency and locations of marine debris. Dominion Energy must report the results of the surveys to BOEM (at renewable_reporting@boem.gov) and BSEE (at marinedebris@bsee.gov) in an annual report, submitted by April 30, for the preceding calendar year. Annual reports must be submitted in Word format. Photographic and videographic materials must be provided on a portable drive in a lossless format such as TIFF or Motion JPEG 2000. Annual reports must include survey reports that include: the survey date; contact information of the operator; the location and pile identification number; photographic, video documentation, or both of the survey and debris encountered; any animals sighted; and the disposition of any located debris (i.e., removed or left in place). Annual reports must also include claim data	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			attributable to the Project from Dominion Energy corporate gear loss compensation policy and procedures. Required data and reports may be archived, analyzed, published, and disseminated by BOEM.		
10	C and post-C	PAM Plan	BOEM and USACE would ensure that Dominion Energy prepares a PAM Plan that describes all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. This plan would be submitted to NMFS and BOEM for review and concurrence at least 120 days prior to the planned start of activities requiring PAM.	Marine Mammals, Sea Turtles, and ESA-listed Fish; Finfish, Invertebrates, and EFH	BOEM, BSEE, and NMFS
11	C	Pile driving monitoring plan	BOEM would ensure that Dominion Energy prepare and submit a Pile Driving Monitoring Plan to BOEM, BSEE, and NMFS for review and concurrence at least 90 days before start of pile driving. The plan would detail all plans and procedures for sound attenuation as well as for monitoring ESA-listed whales and sea turtles during all impact and vibratory pile driving. The plan would also describe how BOEM and Dominion Energy would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving with the vibratory hammer to install the cofferdam at the sea to shore transition. Dominion Energy would obtain NMFS' concurrence with this plan prior to starting any pile driving.	Marine Mammals and Sea Turtles	BOEM, BSEE, and NMFS
12	C	PSO Coverage	BOEM and USACE would ensure that PSO coverage is sufficient to reliably detect marine mammals and sea turtles at the surface in the identified clearance and shutdown zones to execute any pile driving delays or shutdown requirements during foundation installation. This will include a PSO/ PAM team on the construction vessel and two additional PSO vessels each with a visual monitoring team. The following equipment and personnel will be on each associated vessel: ***Construction Vessel:***	Marine Mammals and Sea Turtles	BOEM, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			• 2, visual PSOs on watch • 2, (7x) or (10x) reticle binoculars calibrated for observer height off the water. • 2 (25x or similar) mounted "big eye" binoculars if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1, PAM operator on duty • 1, mounted thermal/IR camera system • 2, (25x or similar) "big eye" binoculars mounted 180 deg apart • 1, monitoring station for real-time PAM system • 2, handheld or wearable NVDs with IR spotlights • 1, Data collection software system • 2, PSO-dedicated VHF radios • 1, digital single lens reflex camera equipped with a 300-mm lens **Each Additional PSO Vessels (2):** • 2, visual PSOs on watch • 2, (7x) or (10x) reticle binoculars calibrated for observer height off the water. • 1, (25x or similar) mounted "big eye" binoculars if vessel is deemed appropriate to provide a platform in which use of the big eye binoculars would be effective. • 1, mounted thermal/IR camera system • 1, handheld or wearable NVD with IR spotlight • 1, Data collection software system • 2, PSO-dedicated VHF radios • 1, digital single lens reflex camera equipped with a 300-mm lens		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			• If, at any point prior to or during construction, the PSO coverage that is included as part of the Proposed Action is determined not to be sufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs, platforms, or both would be deployed. Determinations prior to construction would be based on review of the Pile Driving Monitoring Plan. Determinations during construction would be based on review of the weekly pile driving reports and other information, as appropriate.		
13	O	Sound Field Verification Plan	BOEM would require Dominion Energy to develop an operational sound field verification plan to determine the operational noises emitted from the Offshore Project area. The plan would be reviewed and approved by BOEM and NMFS. The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from percussive pile driving)	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and USACE
14	C	Sound field verification	Applicant proposed measures plus: BOEM and USACE would ensure that if the clearance, shutdown zones, or both are expanded due to the verification of sound fields from Project activities, PSO coverage is sufficient to reliably monitor the expanded clearance, shutdown zones, or both. Additional observers would be deployed on additional platforms for every 4,921 feet (1,500 meters) that a clearance or shutdown zone is expanded beyond the distances modeled prior to verification.	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and USACE
15	C	Adaptive shutdown zones	BOEM and USACE may consider reductions in the shutdown zones for sei, fin or sperm whales based on sound field verification of a minimum of 3 piles; however, BOEM/USACE would ensure that the shutdown zone for	Marine Mammals and Sea Turtles	BOME, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			sei whales, fin whales, blue whales, and sperm whales is not reduced to less than 3,280 feet (1,000 meters), or 1,640 feet (500 meters) for sea turtles. No reductions in the clearance or shutdown zones for NARWs would be considered regardless of the results of sound field verification of a minimum of three piles.		
16	C	Minimum visibility requirement	• In order to commence pile driving at foundations, PSOs must be able to visually monitor a 5,741-foot (1,750-meter) radius from their observation points for at least 60 minutes immediately prior to piling commencement. • In order to commence pile driving at trenchless installation sites, PSOs must be able to visually monitor a 3,280-foot (1,000-meter) from their observation points for at least 30 minutes immediately prior to piling commencement. • Acceptable visibility will be determined by the Lead PSO.	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and USACE
17	C	Monitoring zone for sea turtles	Applicant proposed measures plus: • BOEM and USACE would ensure that Dominion Energy monitors the full extent of the area where noise would exceed the root-mean-square sound pressure level (SPL) 175 dB re 1 μPa behavioral disturbance threshold for turtles for the full duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and record all observations in order to ensure that all take that occurs is documented.	Sea Turtles	BOEM, BSEE, and USACE
18	C	Alternative Monitoring Plan (AMP) for Pile Driving	Dominion Energy must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring of the full extent of the clearance and shutdown zones. • Dominion Energy must submit an AMP to BOEM and NMFS for review and approval at least 6 months prior to the planned start of pile-driving. This plan may include deploying additional observers, alternative monitoring	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			technologies such as night vision, thermal, and infrared technologies, or use of PAM and must demonstrate the ability and effectiveness to maintain all clearance and shutdown zones during daytime as outlined below in Part 1 and nighttime as outlined in Part 2 to BOEM's and NMFS's satisfaction. • The AMP must include two stand-alone components as described below: • Part 1 – Daytime when lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones. Daytime being defined as 1 hour after civil sunrise to 1.5 hours before civil sunset. • Part 2 – Nighttime inclusive of weather conditions (e.g., fog, rain, sea state). Nighttime being defined as 1.5 hours before civil sunset to 1 hour after civil sunrise. • If a protected marine mammal or sea turtle is observed entering or found within the shutdown zones after impact pile-driving has commenced, Dominion Energy would follow the shutdown procedures outlined in Table 1-7 of the NMFS Biological Assessment. Dominion Energy would notify BOEM and NMFS of any shutdown occurrence during piling driving operations with 24 hours of the occurrence unless otherwise authorized by BOEM and NMFS. • The AMP should include, but is not limited to the following information: • Identification of night vision devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable NVDs, infrared spotlights), if proposed for use to detect protected marine mammal and sea turtle species. • The AMP must demonstrate (through empirical evidence) the capability of the proposed monitoring		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as being capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable. • Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration), as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available). • Reporting procedures, contacts and timeframes. • BOEM may request additional information, when appropriate, to assess the efficacy of the AMP.		
19	C, O&M, D	Sampling gear	All sampling gear would be hauled at least once every 30 days, and all gear would be removed from the water and stored on land between survey seasons to minimize risk of entanglement.	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM and BSEE
20	C, O&M, D	Gear identification	To facilitate identification of gear on any entangled animals, all trap/pot gear used in the surveys would be uniquely marked to distinguish it from other commercial or recreational gear. Using black and yellow striped duct tape, place a 3-foot-long mark within 2 fathoms of a buoy. In addition, using black and white paint or duct tape, place 3 additional marks on the top, middle and bottom of the line. These gear marking colors are proposed as they are not gear markings used in other fisheries and are, therefore, distinct. Any changes in marking would not be made	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			without notification and approval from NMFS.		
21	C, O&M, D	Lost survey gear	If any survey gear is lost, all reasonable efforts that do not compromise human safety would be undertaken to recover the gear. All lost gear would be reported to NMFS (nmfs.gar.incidental-take@noaa.gov) within 24 hours of the documented time of missing or lost gear. This report would include information on any markings on the gear and any efforts undertaken or planned to recover the gear.	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS
22	C, O&M, D	Training	At least one of the survey staff onboard the trawl surveys and ventless trap surveys would have completed NEFOP observer training (within the last 5 years) or other training in protected species identification and safe handling (inclusive of taking genetic samples from Atlantic sturgeon). Reference materials for identification, disentanglement, safe handling, and genetic sampling procedures would be available on board each survey vessel. BOEM would ensure that Dominion Energy prepares a training plan that addresses how this requirement would be met and that the plan is submitted to NMFS in advance of any trawl or trap surveys. This requirement is in place for any trips where gear is set or hauled.	Atlantic sturgeon	BOEM, BSEE, and NMFS
23	C, O&M, D	Sea turtle disentanglement	Vessels deploying fixed gear (e.g., pots/traps) would have adequate disentanglement equipment (i.e., knife and boathook) onboard. Any disentanglement would occur consistent with the Northeast Atlantic Coast STDN Disentanglement Guidelines at https://www.reginfo.gov/public/do/DownloadDocument?objectID=102486501 and the procedures described in "Careful Release Protocols for Sea Turtle Release with Minimal Injury" (NOAA Technical Memorandum 580; https://repository.library.noaa.gov/view/noaa/3773).	Sea Turtles	BOEM, BSEE, and NMFS
24	C, O&M, D	Sea turtle/ESA-fish identification and data	Any sea turtles or ESA-fish caught, retrieved, or both in any fisheries survey gear would first be identified to species or species group. Each ESA-listed species caught, retrieved, or both would then be properly documented using	Sea Turtles and ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
		collection	appropriate equipment and data collection forms. Biological data, samples, and tagging would occur as outlined below. Live, uninjured animals should be returned to the water as quickly as possible after completing the required handling and documentation. • The Sturgeon and Sea Turtle Take Standard Operating Procedures would be followed (download at: https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). • Survey vessels would have a passive integrated transponder (PIT) tag reader onboard capable of reading 134.2 kHz and 125 kHz encrypted tags (e.g., Biomark GPR Plus Handheld PIT Tag Reader) and this reader be used to scan any captured sea turtles and sturgeon for tags. Any recorded tags would be recorded on the take reporting form (see below). • Genetic samples would be taken from all captured ESA-fish (alive or dead) to allow for identification of the DPS of origin of captured individuals and tracking of the amount of incidental take. This would be done in accordance with the Procedures for Obtaining Sturgeon Fin Clips (download at: https://media.fisheries.noaa.gov/2021-11/Sturgeon%20%26%20Sea%20Turtle%20Take%20SOPs_external_11032021.pdf). • Fin clips would be sent to a NMFS approved laboratory capable of performing genetic analysis and assignment to DPS of origin. To the extent authorized by law, BOEM is responsible for the cost of the genetic analysis. Arrangements would be made for shipping and analysis in advance of submission of any samples; these arrangements would be confirmed in writing to NMFS within 60 days of the receipt of this ITS. Results		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			of genetic analysis, including assigned DPS of origin would be submitted to NMFS within 6 months of the sample collection. • Subsamples of all fin clips and accompanying metadata forms would be held and submitted to a tissue repository (e.g., the Atlantic Coast Sturgeon Tissue Research Repository) on a quarterly basis. The Sturgeon Genetic Sample Submission Form is available for download at: https://media.fisheries.noaa.gov/2021-02/Sturgeon%20Genetic%20Sample%20Submission%20sheet%20for%20S7_v1.1_Form%20to%20Use.xlsx?null. • All captured sea turtles and ESA-fish would be documented with required measurements and photographs. The animal's condition and any marks or injuries would be described. This information would be entered as part of the record for each incidental take. A NMFS Take Report Form would be filled out for each individual sturgeon and sea turtle (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and submitted to NMFS as described below.		
25	C, O&M, D	Sea turtle/ESA-fish handling and resuscitation guidelines	Any sea turtles or ESA-fish caught and retrieved in gear used in fisheries surveys would be handled and resuscitated (if unresponsive) according to established protocols and whenever at-sea conditions are safe for those handling and resuscitating the animal(s) to do so. Specifically: • Priority would be given to the handling and resuscitation of any sea turtles or ESA-fish that are captured in the gear being used, if conditions at sea are safe to do so. Handling times for these species should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on the animals.	Sea Turtles and ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			• All survey vessels would have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) prior to the commencement of any on-water activity (download at: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf). These handling and resuscitation procedures would be carried out any time a sea turtle is incidentally captured and brought onboard the vessel during the Proposed Actions. • If any sea turtles that appear injured, sick, or distressed, are caught and retrieved in fisheries survey gear, survey staff would immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-6622 for further instructions and guidance on handling the animal, and potential coordination of transfer to a rehabilitation facility. If unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held on board for up to 24 hours following handling instructions provided by the Hotline, prior to transfer to a rehabilitation facility. • Attempts would be made to resuscitate any ESA-fish that are unresponsive or comatose by providing a running source of water over the gills as described in the Sturgeon Resuscitation Guidelines (download at: https://media.fisheries.noaa.gov/dam-migration/sturgeon_resuscitation_card_06122020_508.pdf). • Provided that appropriate cold storage facilities are available on the survey vessel, following the report of a dead sea turtle or sturgeon to NMFS, and if NMFS requests, any dead sea turtle or ESA-fish would be		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			retained on board the survey vessel for transfer to an appropriately permitted partner or facility on shore as safe to do so. • Any live sea turtles or ESA-fish caught and retrieved in gear used in any fisheries survey would ultimately be released according to established protocols and whenever at-sea conditions are safe for those releasing the animal(s) to do so.		
26	C, O&M, D	Take notification	GARFO PRD would be notified as soon as possible of all observed takes of sea turtles and ESA-fish occurring as a result of any fisheries survey. Specifically: • GARFO PRD would be notified within 24 hours of any interaction with a sea turtle or ESA-fish (nmfs.gar.incidental-take@noaa.gov). The report would include at a minimum: (1) survey name and applicable information (e.g., vessel name, station number); (2) GPS coordinates describing the location of the interaction (in decimal degrees); (3) gear type involved (e.g., bottom trawl, gillnet, longline); (4) soak time, gear configuration and any other pertinent gear information; (5) time and date of the interaction; and (6) identification of the animal to the species level. Additionally, the email would transmit a copy of the NMFS Take Report Form (download at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null) and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports would be submitted as soon as possible; late reports would be submitted with an explanation for the delay. • At the end of each survey season, a report would be	Sea Turtles and ESA-listed Fish	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report would also contain information on all survey activities that took place during the season including location of gear set, duration of soak/trawl, and total effort. The report on survey activities would be comprehensive of all activities, regardless of whether ESA-listed species were observed.		
27	C, O&M, D	Monthly/annual reporting	Applicant proposed measures plus: BOEM would ensure that Dominion Energy implements the following reporting requirements necessary to document the amount or extent of take that occurs during all phases of the Proposed Action: • All reports would be sent to: nmfs.gar.incidental-take@noaa.gov. • During the construction phase and for the first year of operations, Dominion Energy would compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), and piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. • Beginning in year two of operations, Dominion Energy would compile and submit annual reports that include a summary of all project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (i.e., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed.	Marine Mammals, Sea Turtles, and ESA-listed Fish	BOEM, BSEE, and NMFS
28	C, O&M, D	Special	Dominion Energy will comply with any special conditions	ESA-listed	USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
		conditions	and required mitigation associated with work authorized or permitted through Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, and ESA terms and conditions landward of the Submerged Lands Act boundary.	Fish, marine mammals, sea turtles	
Reasonable and Prudent Measures and Terms and Conditions from the NMFS Biological Opinion Issued September 18, 2023					
RPM 1	C	Pile Driving	Effects to ESA-listed species must be minimized during pile driving.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
RPM 2	C, O&M, D	Reporting Requirements	Effects to, or interactions with, ESA-listed Atlantic sturgeon, whales, and sea turtles must be documented during all phases of the proposed action, and all incidental take must be reported to NMFS GARFO.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
RPM 3	C, O&M, D	Review of Plans	Plans must be prepared that describe the implementation of activities or monitoring protocols for which the details were not available at the time this consultation was completed. All required plans must be submitted to NMFS GARFO with sufficient time for review, comment, and concurrence.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
RPM 4	C, O&M, D	On-site Observation and Inspection	BOEM and BSEE must exercise their authorities to assess and ensure compliance with the implementation of measures to avoid, minimize, monitor and report incidental take of ESA-listed species during activities described in this Opinion. On-site observation and inspection must be allowed to gather information on the implementation of measures, and the effectiveness of those measures, to minimize and monitor incidental take during activities described in this Opinion, including its Incidental Take Statement.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 1	C	Pile Driving Shutdown Zone	Establish a shutdown zone for sea turtles extending 500 m around any pile being installed during impact pile driving of WTG and OSS foundations. BOEM must ensure that there is sufficient PSO coverage to reliably document sea turtle	ESA-listed Sea Turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			presence within the 500 m shutdown zone. In the event that a PSO detects a sea turtle within the 500 m clearance zone, the shutdown procedures described as part of the proposed action must be implemented.		
T&C 2	C	Pile Driving	To implement the requirements of RPM 1 for ESA-listed whales, to the extent that the final MMPA ITA requires additional measures from those in the proposed ITA (which are incorporated into the proposed action) to minimize effects of pile driving on ESA-listed whales, CVOW-C must comply with those measures. To facilitate implementation of this requirement: a. BOEM must require, through an enforceable condition of their approval of CVOW-C's Construction and Operations Plan, that CVOW-C comply with any measures in the final MMPA ITA that are revised from, or in addition to, measures included in the proposed ITA, which already have been incorporated into the proposed action. b. NMFS OPR must ensure compliance with all mitigation measures as prescribed in the final ITA. We expect this will be carried out through NMFS OPR's review of plans and monitoring reports, including interim and final sound field verification (SFV) reports, submitted by CVOW-C over the life of the MMPA ITA and taking any responsive action within its statutory and regulatory authority it deems necessary to ensure compliance based on the foregoing review. c. The USACE must review the final MMPA ITA as issued by NMFS OPR and determine if an amendment or revision is necessary to the permit issued to CVOW-C by USACE to incorporate any new or revised measures for pile driving or related activities addressed in the USACE permit, to ensure compliance with any measures in the final MMPA ITA that are revised from, or in addition to, measures included in the proposed	ESA-listed marine mammals	BOEM, BSEE, NMFS, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			ITA, which have been incorporated into the proposed action; and, if necessary, exercise its regulatory authority to make appropriate amendments or revisions.		
T&C 3	C	Sound Field Verification	To implement the requirements of RPM 1, the following related to SFV must be implemented by BOEM, BSEE, USACE, and/or CVOW-C. The purpose of SFV and the steps outlined here are to ensure that CVOW-C does not exceed the distances to the injury or behavioral harassment threshold (Level A and Level B harassment, respectively) for ESA-listed marine mammals, the injury or behavioral harassment thresholds for sea turtles, or the injury or behavioral disturbance thresholds for Atlantic sturgeon that are identified in this opinion and that underpin the effects analysis, exposure analysis and our determination of the amount and extent of incidental take exempted in this ITS, including the determination that no incidental take is anticipated. The measures outlined here are based on the expectation that CVOW-C's initial pile driving methodology and sound attenuation measures will result in noise levels that do not exceed the identified distances (as modeled assuming 10 dB attenuation) but, if that is not the case, provide a step-wise approach for modifying operations and/or modifying or adding sound attenuation measures that can reasonably be expected to avoid exceeding those thresholds prior to the next pile being driven. a. Consistent with the measures incorporated into the proposed action, BOEM, BSEE, and USACE must require and CVOW-C must implement Sound Field Verification (SFV) on at least the first three monopiles installed (see also T&C 8.d. below) in accordance with the additional requirements specified here. If any of the SFV measurements from any of the piles indicate that the distance to any isopleth of concern is greater than those modeled assuming 10 dB attenuation (see Table	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, NMFS, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			34, Table 37,and Table 40), before the next pile is installed CVOW-C must implement the following measures as applicable: b. Identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances (e.g., if the pile was installed with a single bubble curtain and a near field sound attenuation device, add a second bubble curtain or if the pile was installed with a double bubble curtain without a near field sound attenuation device, add a nearfield noise attenuation device; adjust hammer operations; adjust noise attenuation system to improve performance); provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures on any subsequent piles that are installed (e.g., if threshold distances are exceeded on pile 1 then additional measures must be deployed before installing pile 2). NMFS GARFO will strive to provide concurrence as quickly as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving CVOW-C's proposal and request for concurrence. c. If any of the SFV measurements indicate that the distances to level A thresholds for ESA-listed whales (peak or cumulative) or PTS peak or cumulative thresholds for sea turtles are greater than the modeled distances assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), the clearance and shutdown zones (see Table 47) for subsequent piles must be		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			increased so that they are at least the size of the distances to those thresholds as indicated by SFV (e.g., if threshold distances are exceeded on pile 1 then the clearance and shutdown zones for pile 2 must be expanded). For every 1,500 m that a marine mammal clearance or shutdown zone is expanded, additional PSOs must be deployed from additional platforms/vessels to ensure adequate and complete monitoring of the expanded shutdown and/or clearance zone; CVOW-C must submit a proposed monitoring plan for NMFS GARFO's concurrence describing the proposed deployment of additional PSOs including the number of PSOs and location of all PSOs. In the event that the clearance or shutdown zone for sea turtles needs to be expanded, the proposed monitoring plan must also include a description of how additional PSOs will be deployed to ensure effective monitoring for sea turtles in the expanded zones. d. If, after implementation of 3.a.i, any subsequent SFV measurements indicate that the distances to any identified isopleth of concern are still greater than those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), CVOW-C must identify and propose for review and concurrence: additional modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed (e.g., if threshold distances are still exceeded on pile 2 the additional measures must be deployed for pile 3). NMFS GARFO will strive to provide concurrence as quickly as possible		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving CVOW-C's proposal and request for concurrence. Clearance and shutdown zones must be expanded consistent with the requirements of 3.b.ii. e. Following installation of the pile with additional modified, and/or alternative noise attenuation measures or operational changes required by 3.a.iii, if SFV results indicate that any isopleths of concern are still larger than those modeled assuming 10 dB attenuation, before any additional piles can be installed, CVOW-C must and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed. Following concurrence from NMFS GARFO, BOEM, BSEE, and USACE must require and CVOW-C must implement those measures and any expanded clearance and shutdown zone sizes (and any required additional PSOs) consistent with the requirements of 3.b.ii. Additionally, BOEM, BSEE, and USACE must require and CVOW-C must continue SFV for two additional piles with enhanced sound attenuation measures and submit the interim reports as required above (for a total of at least three piles with consistent noise attenuation measures). i. If no additional measures are identified for		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			implementation, or if the SFV required by 3.a.iv indicates that the distance to any isopleths of concerns for any ESA-listed species are still larger than those modeled assuming 10 dB attenuation, NMFS GARFO will presume that reinitiation of consultation is necessary, consistent with 50 CFR §402.16(a)(2) and/or (a)(3). NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of SFV monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR 402.16), including consideration of whether the SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation. ii. Following installation of the pile with additional alternative, or modified noise attenuation measures/operational changes required by 3.a.iii or 3.a.iv, if SFV results indicate that all isopleths of concern are within distances to isopleths of concern modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), SFV must be conducted on two additional piles (for a total of at least three piles with consistent noise attenuation measures). If the SFV results from all three of those piles are within the distances to isopleths of concern modeled assuming 10 dB attenuation, BOEM, BSEE, and USACE must require, and CVOW-C must continue to implement the approved additional, alternative, or modified sound attenuation measures/operational changes, BOEM, BSEE, USACE and/or CVOW-C can request concurrence from NMFS GARFO to the original clearance and shutdown zones (Table 48) or		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			CVOW-C can continue with the expanded clearance and shutdown zones with additional PSOs. f. Consistent with the measures incorporated into the proposed action, BOEM, BSEE, and USACE must require, and CVOW must implement SFV on all piles associated with installation of all three OSS foundations with the additional requirements specified here (see also T&C 8.d. below). If any of the SFV measurements from the first OSS foundation installation indicate that the distance to any isopleth of concern is larger than those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), before the second OSS foundation is installed BOEM, BSEE, and USACE must ensure that CVOW must: i. Identify and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO and NMFS OPR supporting that determination; and, following concurrence from NMFS GARFO, deploy those additional measures for the second OSS foundation. BOEM, BSEE, and USACE supporting that determination and request concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional, modified, and/or alternative measures or modifications to operations for the second OSS foundation. ii. If any of the SFV measurements indicate that the distances to level A thresholds for ESA-listed whales or PTS peak or cumulative thresholds for sea turtles are larger than the modeled distances (assuming 10 dB attenuation, see Table 34, Table 37,and Table 40), the clearance and shutdown zones (see Table		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			48) for the second OSS foundation must be increased to be at least the size of the distances to those thresholds as indicated by SFV. For every 1,500 m that a marine mammal clearance or shutdown zone is expanded, additional PSOs must be deployed from additional platforms or vessels to ensure adequate and complete monitoring of the expanded shutdown and/or clearance zone; CVOW must submit a proposed monitoring plan for NMFS GARFO's concurrence describing the proposed deployment of additional PSOs including the number and location of all PSOs. In the event that the clearance or shutdown zone for sea turtles needs to be expanded, the proposed monitoring plan must also include a description of how additional PSOs will be deployed to ensure effective monitoring for sea turtles in the expanded zones. iii. If, after implementation of 3.b.i, any subsequent SFV measurements indicate that the distances to any identified isopleth of concern are still greater than those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), CVOW-C must identify and propose for review and concurrence: additional modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's concurrence, deploy those additional measures or modifications on any subsequent piles that are installed (e.g., if threshold distances are still exceeded on OSS, 2 the additional measures must be deployed for OSS 3). NMFS GARFO will strive to provide concurrence as quickly		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			as possible following review of the submission and necessary coordination with the action agencies and will ensure communication with the action agencies and BOEM no later than two business days after receiving CVOW-C's proposal and request for concurrence. Clearance and shutdown zones must be expanded consistent with the requirements of 3.b.ii. iv. Following installation of the OSS with additional modified, and/or alternative noise attenuation measures or operational changes required by 3.b.iii, if SFV results indicate that any isopleths of concern are still greater than those modeled assuming 10 dB attenuation, before the third OSS can be installed, CVOW-C must and propose for review and concurrence: additional, modified, and/or alternative noise attenuation measures or operational changes that present a reasonable likelihood of reducing sound levels to the modeled distances; provide an explanation to NMFS GARFO, BOEM, BSEE, and USACE supporting that determination and requesting concurrence to proceed; and, following NMFS GARFO's, BOEM, BSEE, and USACE must require and CVOW-C must implement those measures and any expanded clearance and shutdown zone sizes (and any required additional PSOs) consistent with the requirements of 3.b.ii. 1. If no additional measures are identified for implementation and NMFS concurs with that determination, NMFS GARFO will presume that reinitiation of consultation is necessary, consistent with 50 CFR §402.16(a)(2) and/or (a)(3). NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of SFV		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR §402.16), including consideration of whether the SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation. v. Following installation of the second OSS with additional noise attenuation measures required by 3.b.iii, if SFV results indicate that all isopleths of concern are within distances those modeled assuming 10 dB attenuation (see Table 34, Table 37,and Table 40), BOEM, BSEE, and USACE must require, and CVOW-C must continue to implement the approved additional, alternative, or modified sound attenuation measures/operational changes, BOEM, BSEE, USACE and/or CVOW-C can request concurrence from NMFS GARFO to the original clearance and shutdown zones (Table 48) or CVOW-C can continue with the expanded clearance and shutdown zones with additional PSOs. g. Abbreviated SFV Monitoring (consisting of a single acoustic recorder placed at an appropriate distance from the pile) must be performed on all foundation installations for which the complete SFV monitoring outlined in 3a and 3b is not carried out. Results must be included in the weekly reports. Any indications that distances to the identified Level A and Level B harassment thresholds for whales or distances to injury or behavioral disturbance distances for sea turtles or Atlantic sturgeon must be addressed by CVOW-C, including an explanation of factors that contributed to		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			the exceedance and corrective actions that were taken to avoid exceedance on subsequent piles. BOEM, BSEE, USACE, and CVOW-C must meet with NMFS GARFO within two business days of CVOW-C's submission of a report that includes an exceedance to discuss if any additional action is necessary. h. CVOW-C must inspect and carry out appropriate maintenance on the noise attenuation system prior to every pile driving event and prepare and submit a Noise Attenuation System (NAS) inspection/performance report. For piles for which full SFV is carried out, this report must be submitted as soon as it is available, but no later than when the interim SFV report is submitted for the respective pile. Performance reports for all subsequent piles must be submitted with the weekly pile driving reports. All reports must be submitted by email to nmfs.gar.incidental-take@noaa.gov. i. Performance reports for each bubble curtain deployed must include water depth, current speed and direction, wind speed and direction, bubble curtain deployment/retrieval date and time, bubble curtain hose length, bubble curtain radius (distance from pile), diameter of holes and hole spacing, air supply hose length, compressor type (including rated Cubic Feet per Minute (CFM) and model number), number of operational compressors, performance data from each compressor (including Revolutions Per Minute (RPM), pressure, start times, and stop times), free air delivery (m^3/min), total hose air volume (m^3/(min m)), schematic of GPS waypoints during hose laying, maintenance procedures performed (pressure tests, inspections, flushing, re-drilling, and any other hose or system maintenance) before and after installation and timing of those tests, and the length of time the bubble curtain was on the		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			seafloor prior to foundation installation. Additionally, the report must include any important observations regarding performance (before, during, and after pile installation), such as any observed weak areas of low pressure. The report may also include any relevant video and/or photographs of the bubble curtain(s) operating during all pile driving.		
T&C 4	C, O&M, D	Reporting Requirements	To implement the requirements of RPM 2, CVOW-C must file a report with NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BSEE (via TIMSWeb and notification email to protectedspecies@bsee.gov) in the event that any ESA-listed species is observed within the identified shutdown zone during active pile driving. This report must be filed within 48 hours of the incident and include the following: duration of pile driving prior to the detection of the animal(s), location of PSOs and any factors that impaired visibility or detection ability, time of first and last detection of the animal(s), distance of animal(s) at first detection, closest point of approach of animal(s) to pile, behavioral observations of the animal(s), time the PSO called for shutdown, hammer log (number of strikes, hammer energy), time the pile driving began and stopped, and any measures implemented (e.g., reduced hammer energy) prior to shutdown. If shutdown was determined not to be feasible, the report must include an explanation for that determination and the measures that were implemented (e.g., reduced hammer energy).	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 5	C, O&M, D	Reporting Requirements	To implement the requirements of RPM 2, BOEM, BSEE, USACE, and CVOW-C must implement the following reporting requirements necessary to document the amount or extent of incidental take that occurs during all phases of the proposed action: a. If a North Atlantic right whale is observed at any time by PSOs or project personnel, CVOW-C must ensure the sighting is immediately reported to	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, NMFS, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			NMFS. If immediate reporting is not possible, the report must be made within 24 hours of the sighting. i. The report must be made to the appropriate geographic reporting line: • If in the Northeast Region (ME to VA/NC border) call (866-755-6622). • If in the Southeast Region (NC to FL) call (877-WHALE-HELP or 877-942-5343). • If calling the hotline is not possible, reports can also be made to the U.S. Coast Guard via channel 16 or through the WhaleAlert app (http://www.whalealert.org/). The sighting report must include the time (note time format, e.g., UTC, EST), date, and location (latitude/longitude in decimal degrees) of the sighting, number of whales, animal description/certainty of sighting (provide photos/video if taken), lease area/project name, PSO/personnel name, PSO provider company (if applicable), and reporter's contact information. ii. If a North Atlantic right whale is detected at any time by PSOs/PAM Operators via PAM, CVOW-C must ensure the detection is reported as soon as possible and no longer than 24 hours after the detection to NMFS via the 24-hour North Atlantic right whale Detection Template (https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates). Calling the hotline is not necessary when reporting PAM		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			detections via the template. iii. A summary report must be sent within 24 hours to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and NMFS OPR (PR.ITP.MonitoringReports@noaa.gov) with the above information and confirmation the sighting/detection was reported to the respective hotline, the vessel/platform from which the sighting/detection was made, activity the vessel/platform was engaged in at time of sighting/detection, project construction and/or survey activity ongoing at time of sighting/detection (e.g., pile driving, cable installation, HRG survey), distance from vessel/platform to animal at time of initial sighting/detection, closest point of approach of whale to vessel/platform, vessel speed, and any mitigation actions taken in response to the sighting. b. In the event of a suspected or confirmed vessel strike of any ESA-listed species (e.g., marine mammal, sea turtle, listed fish) by any vessel associated with the Project or other means by which project activities caused a non-auditory injury or death of a ESA-listed species, CVOW-C must immediately report the incident to NMFS. If in the Greater Atlantic Region (ME-VA), call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (NC-FL), call the NMFS Southeast Stranding Hotline (877-942-5343). As well as notify BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Separately, CVOW-C must immediately report the		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			incident to NMFS GARFO (*nmfs.gar.incidental-take@noaa.gov*), and if in the Southeast region (NC-FL), also to NMFS SERO (*secmammalreports@noaa.gov*). The report must include: (A) Time, date, and location (coordinates) of the incident; (B) Species identification (if known) or description of the animal(s) involved (i.e., identifiable features including animal color, presence of dorsal fin, body shape and size); (C) Vessel strike reporter information (name, affiliation, email for person completing the report); (D) Vessel strike witness (if different than reporter) information (name, affiliation, phone number, platform for person witnessing the event); (E) Vessel name and/or MMSI number; (F) Vessel size and motor configuration (inboard, outboard, jet propulsion); (G) Vessel's speed leading up to and during the incident; (H) Vessel's course/heading and what operations were being conducted (if applicable); (I) Part of vessel that struck whale (if known); (J) Vessel damage notes; (K) Status of all sound sources in use; (L) If animal was seen before strike event; (M) behavior of animal before strike event; (N) Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike; (O) Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; (P) Estimated (or actual, if known) size and length of animal that was struck; (Q) Description of the behavior of the marine mammal immediately preceding and following the strike; (R) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike; (S)		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			Other animal details if known (e.g., length, sex, age class); (T) Behavior or estimated fate of the animal post-strike (*e.g.*, dead, injured but alive, injured and moving, external visible wounds (linear wounds, propeller wounds, non-cutting blunt-force trauma wounds), blood or tissue observed in the water, status unknown, disappeared); (U) To the extent practicable, photographs or video footage of the animal(s); and (V) Any additional notes the witness may have from the interaction. For any numerical values provided (i.e., location, animal length, vessel length), please provide if values are actual or estimated. Reports of Atlantic sturgeon take must include a statement as to whether a fin clip sample for genetic sampling was taken. Fin clip samples are required in all cases to document the DPS of origin; the only exception to this requirement is when additional handling of the sturgeon would result in an imminent risk of injury to the fish or the survey personnel handling the fish, we expect such incidents to be limited to capture and handling of sturgeon in extreme weather. Instructions for fin clips and associated metadata are available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic, under the "Sturgeon Genetics Sampling" heading. c. In the event that personnel involved in the Project discover a stranded, entangled, injured, or dead ESA-listed species (e.g., marine mammal, sea turtle, listed fish), CVOW-C must immediately report the observation to NMFS. If in the Greater Atlantic Region (ME-VA) call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (NC-FL) call the NMFS		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			Southeast Stranding Hotline (877-942-5343). Separately, CVOW-C must report the incident, if in the Greater Atlantic region (ME to VA) to GARFO (nmfs.gar.incidental-take@noaa.gov) or if in the Southeast region (NC-FL) to NMFS SERO (secmammalreports@noaa.gov) as soon as feasible. As well as notify BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Note, the stranding hotline may request the report be sent to the local stranding network response team. Reports of listed fish should only be sent to nmfs.gar.incidental-take@noaa.gov. The report must include: (A) Contact information (name, phone number,), time, date, and location (coordinates) of the first discovery (and updated location information if known and applicable); (B) Species identification (if known) or description of the animal(s) involved; (C) Condition of the animal(s) (including carcass condition if the animal is dead); (D) Observed behaviors of the animal(s), if alive; (E) If available, photographs or video footage of the animal(s); and (F) General circumstances under which the animal was discovered. Staff responding to the hotline call will provide any instructions for handling or disposing of any injured or dead animals, which may include coordination of transport to shore, particularly for injured sea turtles d. CVOW-C must compile and submit weekly reports during pile driving that document the pile ID, type of pile, pile diameter, start and finish time of each pile driving event, hammer log (number of strikes, max hammer energy, duration of piling) per pile, any changes to noise attenuation systems and/or hammer schedule, details on the deployment of PSOs and PAM operators, including the start and		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			stop time of associated observation periods by the PSOs and PAM Operators, and a record of all observations/detections of marine mammals and sea turtles, including time (UTC) of sighting/detection, species ID, behavior, distance (meters) from vessel to animal at time of sighting/detection (meters), animal distance (meters) from pile installation vessel, vessel/project activity at time of sighting/detection, platform/vessel name, and mitigation measures taken (if any) and reason. Sightings/detections during pile driving activities (clearance, active pile driving, post-pile driving) and all other (transit, opportunistic,) sightings/detection must be reported and identified as such. These weekly reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov), BOEM, and BSEE by CVOW-C or the PSO providers and can consist of QA/QC'd raw data. Weekly reports are due on Wednesday for the activities occurring the previous week (Sunday–Saturday, local time). e. Starting in the first month that in-water activities occur (e.g., cofferdam installation, fisheries surveys, and HRG activities), CVOW-C must compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including dates and location of any fisheries surveys carried out, vessel transits (name, type of vessel, number of transits, vessel activity, and route (this includes transits from all ports, foreign and domestic), cable installation activities (including sea to shore transition), number of piles installed and pile IDs, and all sightings/detections of ESA-listed whales, sea turtles, and sturgeon, inclusive of any mitigation measures taken as a result of those observations. Sightings/detections		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			must include species ID, time, date, initial detection distance, vessel/platform name, vessel activity, vessel speed, bearing to animal, project activity, and if any mitigation measures taken. These reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and are due on the 15th of the month for the previous month. f. CVOW-C must submit to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) an annual report describing all activities carried out to implement their Fisheries Research and Monitoring Plan. This report must include a summary of all activities conducted, the dates and locations of all fisheries surveys, summarized by month, number of vessel transits inclusive of port of origin and destination, and a summary table of any observations of ESA-listed species during these surveys. Each annual report is due by February 15 (i.e., the report for 2024 activities is due by February 15, 2025). g. BOEM, BSEE, and/or CVOW-C must submit full detection data, metadata, and location of recorders (or GPS tracks, if applicable) from all real-time hydrophones used for monitoring during construction within 90 calendar days after pile-driving has ended. Reporting must use the webform templates on the NMFS Passive Acoustic Reporting System website at https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates. BOEM, BSEE, and/or CVOW-C must submit the full acoustic recordings from all the real-time hydrophones to the National Centers for Environmental Information (NCEI) for archiving within 90 calendar days after pile-driving has		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			ended and instruments have been pulled from the water. Archiving guidelines outlined here (https://www.ncei.noaa.gov/products/passive-acoustic-data#tab-3561) must be followed. Confirmation of both submittals must be sent to NMFS GARFO.		
T&C 6	C, O&M, D	BOEM/NMFS meeting requirements for sea turtle take documentation	To implement the requirements of RPM 2 and to facilitate monitoring of the incidental take exemption for sea turtles, BOEM, BSEE, USACE, and NMFS must meet twice annually to review sea turtle observation records. These meetings/conference calls will be held in September (to review observations through August of that year) and December (to review observations from September to November) and will use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations.	Sea turtles	BOEM, BSEE, NMFS, and USACE
T&C 7	C	Review of Plans	To implement RPM 2, within 10 business days of BOEM, BSEE, and/or USACE obtaining updated information on project plans (i.e., as obtained through a relevant Facility Design Report (FDR)/Fabrication and Installation Report (FIR) or other submission), BOEM, BSEE, and/or USACE must provide NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) with the following information: number and size of foundations to be installed to support wind turbine generators and offshore substations, installation method for the sea to shore transition (e.g., casing pipe, cofferdam, no containment), the proposed construction schedule (i.e., months when pile driving is planned), and any available updates on anticipated vessel transit routes (e.g., any changes to the ports identified for use by project vessels) that will be used by project vessels. NMFS GARFO will review this information and request a meeting with BOEM, BSEE, and USACE if there is any indication that there are	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, NMFS, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			changes to the proposed action that would cause an effect to listed species or critical habitat that was not considered in this Opinion, including the amount or extent of predicted take, such that any potential trigger for reinitiation of consultation can be discussed with the relevant action agencies. days of BOEM's submission to NMFS, and NMFS' receipt of the requested information.		
T&C 8	C	Review of Plans	To implement RPM 3, the plans identified below must be submitted to NMFS GARFO at nmfs.gar.incidental-take@noaa.gov by BOEM, BSEE, and/or CVOW-C. Any of the identified plans can be combined such that a single submitted plan addresses multiple requirements provided that the plan clearly identifies which requirements it is addressing. For each plan, within 45 calendar days of receipt of the plan, NMFS GARFO will provide comments to BOEM, BSEE, and CVOW-C, including a determination as to whether the plan is consistent with the requirements outlined in this ITS and/or in Section 3 (Description of the Proposed Actions) of this Opinion. If the plan is determined to be inconsistent with these requirements, BOEM, BSEE and/or CVOW-C must resubmit a modified plan that addresses the identified issues within 30 days of the receipt of the comments, but at least 15 calendar days before the start of the associated activity. At that time, BOEM, BSEE and NMFS GARFO and OPR will discuss a timeline for review and approval of the modified plan. If further revisions are necessary, at all times, NMFS GARFO, BOEM, and BSEE will be provided at least three business days for review and, whenever possible, NMFS GARFO, BOEM, and BSEE will aim to provide responses within four business days. BOEM, BSEE and CVOW-C must receive NMFS GARFO's concurrence with these plans before the identified activity is carried out: a. Passive Acoustic Monitoring Plan for Pile Driving. BOEM, BSEE, and/or CVOW-C must submit this Plan to		BOEM, BSEE, NMFS, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			NMFS GARFO at least 180 calendar days before impact pile driving is planned. BOEM, BSEE, and CVOW-C must obtain NMFS GARFO's concurrence with this Plan prior to the start of any pile driving. The Plan must include a description of all proposed PAM equipment and hardware, the calibration data, bandwidth capability and sensitivity of hydrophones, and address how the proposed passive acoustic monitoring will follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs et al., 2021). The Plan must describe and include all procedures, documentation, and protocols including information (i.e., testing, reports, equipment specifications) to support that it will be able to detect vocalizing whales within the clearance and shutdown zones, including deployment locations, procedures, detection review methodology, and protocols; hydrophone detection ranges with and without foundation installation activities and data supporting those ranges; communication time between call and detection, and data transmission rates between PAM Operator and PSOs on the pile driving vessel; where PAM Operators will be stationed relative to hydrophones and PSOs on pile driving vessel calling for delay/shutdowns; and a full description of all proposed software, call detectors, and filters. The Plan must also incorporate the requirements relative to North Atlantic right whale reporting in 5.a. b. Marine Mammal and Sea Turtle Monitoring Plan – Pile Driving. BOEM, BSEE, and/or CVOW-C must submit this Plan to NMFS GARFO at least 180 calendar days before any pile driving for foundation installation is planned. BOEM, BSEE, and/or CVOW-C must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of any pile driving for foundation installation. The Plan(s) must include: a description of how all		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			relevant mitigation and monitoring requirements contained in the incidental take statement will be implemented, a pile driving installation summary and sequence of events, a description of all training protocols for all project personnel (PSOs, PAM Operators, trained crew lookouts,), a description of all monitoring equipment and evidence (i.e., manufacturer's specifications, reports, testing) that it can be used to effectively monitor and detect ESA-listed marine mammals and sea turtles in the identified clearance and shutdown zones (i.e., field data demonstrating reliable and consistent ability to detect ESA-listed large whales and sea turtles at the relevant distances in the conditions planned for use), communications and reporting details, and PSO monitoring and mitigation protocols (including number and location of PSOs) for effective observation and documentation of sea turtles and ESA-listed marine mammals during all pile driving events. The Plan(s) must demonstrate sufficient PSO and PAM Operator staffing (in accordance with watch shifts), PSO and PAM Operator schedules, and contingency plans for instances if additional PSOs and PAM Operators are required. The Plan must detail all plans and procedures for sound attenuation, including procedures for adjusting the noise attenuation system(s) and available contingency noise attenuation measures/systems if distances to modeled isopleths of concern are exceeded during SFV. The plan must also describe how CVOW-C would determine the number of sea turtles exposed to noise above the 175 dB harassment threshold during impact pile driving of WTG and OSS foundations and how CVOW-C would determine the number of ESA-listed whales exposed to noise above the Level B harassment (behavioral disturbance) threshold during impact pile driving of WTG and OSS foundations.		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			c. Reduced Visibility Monitoring Plan. BOEM, BSEE, and/or CVOW-C must submit this Plan to NMFS GARFO at least 180 calendar days before impact pile driving is planned to begin. BOEM, BSEE, and CVOW-C must obtain NMFS GARFO's concurrence with this Plan prior to the start of pile driving. This Plan must contain a thorough description of how CVOW-C will monitor pile driving activities during reduced visibility conditions (e.g., rain, fog) and at night (i.e., between 1.5 hours prior to civil sunset and 1 hour after civil sunrise), including proof of the efficacy of monitoring devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable night vision devices NVDs, spotlights) in detecting ESA-listed marine mammals and sea turtles over the full extent of the required clearance and shutdown zones, including demonstration that the full extent of the minimum visibility zones (2,000 m for WTG and OSS foundations, 1,000 m for goal posts) can be effectively and reliably monitored. The Plan must identify the efficacy of the technology at detecting marine mammals and sea turtles in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting. The Plan must include a full description of the proposed technology, monitoring methodology, and data demonstrating to NMFS GARFO's satisfaction that marine mammals and sea turtles can reliably and effectively be detected within the clearance and shutdown zones for foundation piles before and during impact pile driving. Additionally, this Plan must contain a thorough description of how CVOW-C will monitor pile driving activities during daytime when unexpected changes to lighting or weather occur during pile driving that prevent visual monitoring of the full extent of the clearance and shutdown zones.		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			d. Sound Field Verification Plan - WTG and OSS Installation. BOEM, BSEE, and/or CVOW-C must submit this Plan to NMFS GARFO at least 180 calendar days before pile driving for WTG and/or OSS foundations is planned to begin. BOEM, BSEE, and CVOW-C must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of these pile driving activities. To validate the estimated sound fields, SFV measurements will be conducted during pile driving of the first three monopiles and the three OSS foundations (inclusive of all four pin piles) installed over the course of the Project, with noise attenuation activated (inclusive of vibratory and impact driving). The Plan(s) must describe how the first three monopile installation sites and installation scenarios (i.e., hammer energy, number of strikes) are representative of the rest of the monopile installations and, therefore, why these monopile installations would be representative of the remaining monopile installations. If the monitored pile locations are different from the ones used for exposure modeling, justification must be provided for why these locations are representative of the modeling. In the case that these sites are not determined to be representative of all other monopile installation sites, CVOW-C must include information on how additional monopiles/sites would be selected for SFV. The Plan(s) must also include the piling schedule and sequence of events, communication and reporting protocols, methodology for collecting, analyzing, and preparing SFV data for submission to NMFS GARFO, including instrument deployment, locations of all hydrophones, including direction and distance from the pile, hydrophone sensitivity, recorder/measurement layout, and analysis methods, and a template of the interim report to be submitted. The Plan must also identify the number and location of hydrophones that will be reported in the SFV		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			Interim Reports and any additional hydrophone locations that will be included in the final report(s). The Plan must describe how the effectiveness of the sound attenuation methodology will be evaluated based on the results. The Plan must address how CVOW-C will implement Terms and Conditions 3a and 3b (see above) which includes, but is not limited to identifying additional noise attenuation measures (e.g., add noise attenuation device, adjust hammer operations, adjust NMS) that will be applied to reduce sound levels if measured distances are greater than those modeled. The plan must describe how Abbreviated SFV Monitoring (consisting of a single acoustic recorder placed at an appropriate distance from the pile) required by Term and Condition 3.c. will be performed on all foundation installations for which the complete SFV monitoring outlined in 3a and 3b is not carried out. The plan must also outline the anticipated results that will be included in the weekly reports. The plan must also specify steps that will be taken should any exceedances occur. e. SFV Interim Reports - Pile Driving. BOEM, BSEE, and USACE must require and CVOW-C must provide, as soon as they are available but no later than 48 hours after the installation of each of the first three monopiles and after each of the three OSS foundations (inclusive of all four pin piles), the initial results of the SFV measurements to NMFS GARFO in an interim report. If technical or other issues prevent submission within 48 hours, CVOW-C must notify BOEM, BSEE, and NMFS GARFO within that 48-hour period with the reasons for delay and provide an anticipated schedule for submission of the report. These reports are required for each of the first three monopiles and each of the three OSS foundations installed, and any additional piles for which SFV is required. The interim report must include		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			data from hydrophones identified for interim reporting in the SFV Plan and include a summary of pile installation activities (pile diameter, pile weight, pile length, water depth, sediment type, hammer type, total strikes, total installation time [start time, end time], duration of pile driving, max single strike energy, NAS deployments), pile location, recorder locations, modeled and measured distances to thresholds, received levels (rms, peak, and SEL) results from Conductivity, Temperature, and Depth (CTD) casts/sound velocity profiles, signal and kurtosis rise times, pile driving plots, activity logs, and weather conditions. Additionally, any important sound attenuation device malfunctions (suspected or definite), must be summarized and substantiated with data (e.g., photos, positions, environmental data, directions,) and observations. Such malfunctions include gaps in the bubble curtain, significant drifting of the bubble curtain, and any other issues which may indicate sub-optimal mitigation performance or are used by CVOW-C to explain performance issues. Requirements for actions to be taken based on the results of the SFV are identified in 3.a. above. f. The final results of SFV for monopile and pin pile installations must be submitted as soon as possible, but no later than within 90 days following completion of pile driving for which SFV was carried out. g. Vessel Strike Avoidance Plan. BOEM, BSEE, and/or CVOW-C must submit this plan to NMFS GARFO as soon as possible after issuance of this Opinion but no later than 180 days prior to the planned start of in-water construction activities (including cable installation). The Plan must provide details on all relevant mitigation and monitoring measures for listed species, vessel speeds and transit protocols from all planned ports, vessel-based observer protocols for transiting vessels,		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			communication and reporting plans, proposed alternative monitoring equipment to maintain vessel strike avoidance zones in varying weather conditions, darkness, sea states, and in consideration of the use of artificial lighting. If CVOW-C plans to implement PAM in any transit corridor to allow vessel transit above 10 knots, the plan must describe how PAM, in combination with visual observations, will be conducted to ensure the transit corridor is clear of North Atlantic right whales. PAM information should follow what is required to be submitted for the PAM Plan in 8.a.		
T&C 9	C, O&M, D	On-site Observation and Inspection	To implement the requirements of RPM 4, BOEM and BSEE must exercise their authorities to assess the implementation of measures to avoid, minimize, monitor, and report incidental take of ESA-listed species during activities described in this Opinion. BOEM and/or BSEE shall immediately exercise their respective authorities to take effective action to ensure prompt implementation and compliance if CVOW-C is not complying with: any avoidance, minimization, and monitoring measures incorporated into the proposed action or any term and condition(s) specified in this statement, as currently drafted or otherwise amended in agreement between the BOEM, BSEE, and NMFS; if BOEM and/or BSEE fail to do so, the protective coverage of Section 7(o)(2) may lapse.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS
T&C 10	C, O&M, D	On-site Observation and Inspection	To implement the requirements of RPM 4, CVOW-C must consent to on-site observation and inspections by Federal agency personnel (including NOAA personnel) during activities described in the Biological Opinion, for the purposes of evaluating the effectiveness and implementation of measures designed to minimize or monitor incidental take.	ESA-listed fish, marine mammals, sea turtles	BOEM, BSEE, and NMFS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
BOEM-Proposed Mitigation and Monitoring Measures in the Essential Fish Habitat Assessment					
1	C, O&M, D	Essential Fish Habitat	The measures required by the final Essential Fish Habitat consultation would be incorporated into COP approval, and BOEM and/or NMFS would monitor compliance with these measures.	Benthic Resources	BOEM, BSEE
2	Pre-C, Post-C	Whelk Surveys	Perform Whelk surveys to help determine the relative abundance, length frequency and demographic characteristics (age structure and reproduction) of whelk within the Study Area before and after construction	Finfish, Invertebrates, and EFH (Whelk)	BOEM
3	Pre-C, Post-C	Black Sea Bass Surveys	Perform Black sea bass surveys to help determine the relative abundance, length frequency and demographic characteristics (age structure and reproduction) of whelk within the Study Area before and after construction	Finfish, Invertebrates, and EFH (Black Sea Bass)	BOEM, BSEE
4	Pre-C, Post-C	Atlantic Surf Clam Surveys	Perform Atlantic surf clam surveys to examine abundance and population structure within the CVOW Lease Area	Finfish, Invertebrates, and EFH (Atlantic Surf Clam)	BOEM, BSEE
NMFS Essential Fish Habitat (EFH) Conservation Recommendations (CRs)[2] issued July 21, 2023.					
1	C	Benthic habitat impact minimization	Recommendations to minimize impacts to benthic habitats: 1. Relocate the four priority WTGs identified and discussed in the Habitat Minimization Alternative (Alternative C) outside of the area of stable, spatially complex, high-relief sand ridge/trough habitats to avoid and minimize impacts to those habitats, while also still	Benthic Resources	BOEM, BSEE, and USACE

[2] NMFS issued conservation recommendations to BOEM and USACE for the CVOW project via letter on July 21, 2023. As required by section 305(b)(4)(B) of the Magnuson-Stevens Act, USACE and BOEM will provide a detailed response to these conservation recommendations to NMFS regarding which measures will be adopted, partially adopted, or not adopted along with a rationale. At the time of FEIS issuance, BOEM and USACE have yet not determined which conservation recommendations each agency intends to adopt or partially adopt. As such, the full list of conservation recommendations received from NMFS is included in this document.

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			avoiding shipwrecks. 2. All cables, including export cable bundles, should be routed/rerouted around the area characterized by stable, spatially complex, high-relief sand ridges and troughs. 3. Develop and implement a WTG, OSS and cable micrositing plan to facilitate the avoidance and minimization of impacts to complex habitats[3] and benthic features. We recommend the plan use habitat maps depicting areas of complex habitats and benthic features to inform micrositing around complex habitat and benthic features. A copy of the final plan should be provided to NMFS HESD prior to construction. 4. To the extent practicable, if cables must cross complex habitat they should do so at the narrowest points perpendicularly; cables that must cross benthic features such as sand waves should be sited along natural benthic contours within troughs/lows to maximize cable burial while minimizing disturbance to local submarine topography. 5. To minimize impacts of benthic habitat modification, in all project areas where seafloor preparation activities include the use of plows, jets, grapnel runs or similar methods, post-construction acoustic surveys (e.g., multibeam backscatter and side scan sonar) capable of detecting bathymetry changes of 0.5 feet (ft.) or less, should be completed to demonstrate how the bottom was modified by preparation and construction activities. 6. In areas where plows, jets, or other similar methods are used and the created berm height exceeds three feet above the existing grade, the created berm should be		

[3] Defined in the NMFS March 2021 Recommendations for Mapping Fish Habitat.

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			restored to match that of the existing grade/pre-construction conditions. 7. Avoid anchoring or placing jack-up barge spud cans or footings on/in complex habitats or areas with large benthic features (i.e., sand waves). 8. If anchoring is necessary in complex habitats or areas with large benthic features, anchor lines should be extended to the extent practicable to minimize the number of times the anchors must be raised and lowered to reduce the amount of habitat disturbance. 9. If anchoring must occur in any complex habitats or areas with large benthic features and vessels must remain stationary, dynamic positioning systems (DPS) or mid-line buoys on anchor chains should be required to minimize impacts to those habitats. 10. If placement of jack-up barge spud cans is necessary in complex habitats or areas with large benthic features, we recommend proposed locations for the spud cans be selected to avoid areas in the following order: (i) complex habitats; (ii) crests of large benthic features; and (iii) slopes of large benthic features. 11. Develop and implement an anchoring and jack-up barge plan to facilitate the avoidance and minimization of impacts to complex habitats and benthic features. We recommend the use of habitat maps depicting areas of complex habitats and benthic features to inform this plan. A copy of the final plan should be provided to NMFS HESD prior to construction. 12. To minimize permanent adverse impacts to existing benthic habitats from the placement of scour protection, all cables should be microsited to allow for full penetration/burial, regardless of habitat type (by siting cables in appropriate substrates). Additional bottom surveys should be conducted, as necessary, to inform		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			the micrositing of the cables. 13. To minimize the impacts of habitat conversion from scour protection, natural or engineered rounded stone of consistent grain size that mimics natural seafloor substrates should be used. At a minimum, any exposed surface layer should be designed and selected to provide three-dimensional structural complexity that creates a diversity of crevice sizes (e.g., mixed stone sizes) and rounded edges (e.g., tumbled stone), and be sloped such that outer edges match the natural grade of the seafloor. Alternatively, bioactive concrete (i.e., with bio-enhancing admixtures) should be used as primary scour protection (e.g., concrete mattresses) or veneer to support biotic growth. 14. Avoid the use of plastics/recycled polyesters/net material (i.e., fronded mattresses) in all scour protection, as these materials may degrade and result in plastic pollution. 15. Develop and implement a scour protection plan to facilitate the avoidance and minimization of impacts to complex habitats and benthic features. We recommend the plan use the Seabed Morphology and Habitat-CMECS interpretation maps depicting areas of complex habitats and benthic features to inform this plan. A copy of the final plan should be provided to NMFS HESD prior to construction.		
2	C	Acoustic impacts from pile driving	Recommendations to minimize acoustic impacts from pile driving: 1. The use of noise mitigating measures should be required during pile driving construction, including the use of soft start procedures and the deployment of noise dampening equipment such as bubble curtains or double-bubble curtains. 2. Additional noise dampening/mitigation measures (e.g.,	Benthic Resources	BOEM, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			double bubble curtains) should be used for any pile driving activity within 10.7 km of artificial reef sites/shipwrecks/fish havens, including those found at the north end of the lease area. 3. A plan outlining the noise mitigation procedures for both offshore and inshore activities should be filed with BOEM and the USACE for approval before construction commences. BOEM should provide NMFS HESD with a copy of the final plan before in- water work begins. The noise mitigation plan should include (i) passive acoustic sound verification monitoring during pile driving activities - additional noise dampening technology should be applied should real-time monitoring indicate noise levels exceed the modeled 10 decibel attenuation levels; (ii) a process for notifying NMFS HESD within 24 hours if any evidence of a fish kill during construction activity is observed, and contingency plans to resolve issues; and (iii) acoustic monitoring reports that include any/all noise-related monitoring should be provided to NMFS HESD.		
3	O&M	Address uncertainties and minimize impacts	Recommendations to address uncertainties and minimize impacts from project operation: 1. Develop a Benthic Habitat Monitoring Plan to address impacts related to the stable high-relief sand ridge/trough habitats and the introduction of artificial manmade substrate. The plan should incorporate sufficient samples and replications to identify potential changes to benthic features, habitat complexity, and associated macrobenthic communities across and within each habitat type in the project area, including the artificial substrates to be constructed. The plan should include the collection of at least three years of pre-construction data and post-construction acoustic data (multibeam bathymetry and backscatter and side scan sonar). The applicant should consult with the resource	Benthic Resources	BOEM, BSEE, and USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			agencies in development of this plan and give the resource agencies a minimum of 90 days to review and comment on the plan. The applicant should submit a final plan to BOEM that addresses, and includes, all resource agency comments, as well as the applicant's response to those comments. A copy of the final monitoring plan should be provided to NMFS HESD prior commencement of any in-water work. All data and metadata should be made available to NMFS HESD. 2. Develop an in situ project specific monitoring program to address uncertainties related to impacts of the operation of the CVOW project on EFH and federally managed species. This monitoring recommendation is consistent with principles outlined in NOAA's Mitigation Policy for Trust Resources which highlights the use of the best available scientific information, such as results of surveys and other data collection efforts when existing information is not sufficient for the evaluation of proposed actions and mitigation, or when additional information would facilitate more effective or efficient mitigation recommendations. The project specific monitoring program should measure in situ the stressors created by project operation on the ecosystem from the presence of turbines, operational noise, and oceanic-wind wake effects. Monitoring plans should include the collection of baseline data and be provided to NMFS HESD and NEFSC for review and comment within 90 days of ROD issuance. A response to NMFS comments should be provided. These monitoring studies should be developed in partnership with NMFS and other scientific institutions to aid in addressing these and other questions: a. How do construction and permanent placement of WTGs and OSSs impact sand ridge and trough habitat?		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			i. What are the effects of construction and operation (presence) on physical characteristics of the sandridge and trough complexes over time, including sediment properties and shape/geometry, depth, and rugosity. ii. To what extent do fish assemblages and food web dynamics change in the ridge and trough complexes as a result of construction and operation of the wind farm? b. Does the presence of novel hard structures (WTGs, OSS, and associated scour protection) change the distribution and abundance of invasive Indo-Pacific lionfish [Pterois volitans and P. miles]) in the project area? i. How do individual structures or wind farm as a whole change the thermal regime, especially in the context of facilitating overwintering/colonization of invasive lionfish? ii. Do lionfish exhibit age-specific habitat preferences on novel wind farm structures (i.e., do young-of-year lionfish prefer scour protection while adult lionfish prefer vertical monopile)? c. How far do effects on sound pressure, particle motion, and substrate vibration extend from the individual WTGs and the CVOW project collectively? i. How does construction and operation of the CVOW project impact fish assemblages at artificial reef sites/shipwreck, including those found at the north end of the lease area? d. How far does the marine/oceanographic and atmospheric wind wake extend from the CVOW project during operation? i. What are the effects on physical water column properties, primary and secondary production,		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			and larval dispersal for species with designated EFH in the project area? 2. Require the implementation of preventive measures to reduce the risk of contaminant emissions or accidental release of chemicals. Such measures may include backup systems, secondary containments, closed loop systems, and/or recovery tanks. 3. Information on any anti-corrosion protection methods or systems proposed should be provided to NMFS HESD. If sacrificial anodes are used, Al anodes should be selected over Zn anodes. Any application of anti- corrosion coatings should be allowed to cure fully on land, and BMPs for reducing spills should be implemented if reapplied offshore.		
4	D	Decommissioning	Project decommissioning: The EFH consultation should be reinitiated prior to decommissioning turbines to ensure that the impact to EFH as a result of the decommissioning activities have been fully evaluated and minimized to the extent practicable. Pre-consultation coordination related to decommissioning should occur at least five years prior to proposed decommissioning.	Benthic Resources	BOEM and BSEE
5	C, O&M, D	Fish and Wildlife Coordination Act	Fish and Wildlife Coordination Act Recommendations: 1. The project should be required to mitigate any major impacts to NMFS scientific surveys consistent with NMFS-BOEM Federal Survey Mitigation Strategy - Northeast U.S. Region. Plans to mitigate these impacts at the project and regional levels should be provided to NMFS for review and approval prior to BOEM's decision on its acceptance. Mitigation is necessary to ensure that NMFS can continue to accurately, precisely, and timely execute our responsibilities to monitor the status and	Benthic Resources	USACE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			health of trust resources. 2. Locations of scour protection, including cable protection measures (i.e., concrete mattresses) should be provided to NMFS and the public as soon as possible to help inform marine users, including, but not limited to the fishing industry and entities conducting scientific surveys of potential gear obstructions.		
BOEM-Proposed Measures in the USFWS BA					
1	C, O&M, D	Reporting	Dominion Energy must provide an annual report to BOEM and USFWS documenting any dead (or injured) birds or bats found on vessels and structures during construction, operations, and decommissioning. The report must contain the following information: the name of species, date found, location, a picture to confirm species identity (if possible), and any other relevant information. Carcasses with federal or research bands must be reported to the United States Geological Survey Bird Band Laboratory, available at https://www.pwrc.usgs.gov/bbl/. Any occurrence of a dead ESA-listed bird or bat must be reported to BOEM, BSEE, and USFWS as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours after the sighting, and, if practicable, the dead specimen will be carefully collected and preserved in the best possible state.	Birds and Bats	BOEM, BSEE, and USFWS
2		Monitoring	BOEM will require that Dominion Energy develops and implements a Post-Construction Monitoring [PCM] plan based on Dominion Energy's Proposed Bird and Bat Monitoring Framework in coordination with USFWS and other relevant regulatory agencies. Annual monitoring reports will be used to determine the need for adjustments to monitoring approaches, consideration of new monitoring technologies, and/or additional periods of monitoring. Prior to commencing offshore construction activities, Dominion Energy must submit the PCM for BOEM and USFWS review. BOEM and USFWS will review the PCM	Birds & Bats	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			and provide any comments on the plan within 30 calendar days of its submittal. Dominion Energy must resolve all comments on the PCM to BOEM and USFWS's satisfaction before implementing the plan. a. Monitoring. Dominion Energy must conduct monitoring as outlined in Dominion Energy's Proposed Bird and Bat Monitoring Framework, which will include acoustic monitoring of bat presence, the use of motus receivers and tags to monitor bird and bat movements, and others TBD. b. Annual Monitoring Reports. Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov), USFWS, and BSEE (at protectedspecies@bsee.gov) a comprehensive report after each full year of monitoring (pre- and post-construction) within 6 months of completion of the last avian survey. The report must include all data, analyses, and summaries regarding ESA-listed and non-ESA-listed birds and bats. BOEM, USFWS, and BSEE will use the annual monitoring reports to assess the need for reasonable revisions (based on subject matter expert analysis) to the PCM. BOEM, BSEE, and USFWS reserve the right to require reasonable revisions to the PCM and may require new technologies as they become available for use in offshore environments. c. Post-Construction Quarterly Progress Reports. Dominion Energy must submit quarterly progress reports during the implementation of the PCM to BOEM (at renewable_reporting@boem.gov) and the USFWS by the 15th day of the month following the end of each quarter during the first full year that the Project is operational. The progress reports must include a summary of all work performed, an explanation of overall progress, and any technical problems encountered.		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			d. Monitoring Plan Revisions. Within 15 calendar days of submitting the annual monitoring report, Dominion Energy must meet with BOEM and USFWS to discuss the following: the monitoring results; the potential need for revisions to the PCM, including technical refinements or additional monitoring; and the potential need for any additional efforts to reduce impacts. If BOEM or USFWS determines after this discussion that revisions to the PCM are necessary, BOEM may require Dominion Energy to modify the PCM. If the reported monitoring results deviate substantially from the impact analysis included in the Final BA, Dominion Energy must transmit to BOEM recommendations for new mitigation measures and/or monitoring methods. e. Operational Reporting (Operations). Dominion Energy must submit to BOEM (at renewable_reporting@boem.gov) and BSEE (at OSWSubmittals@bsee.gov) an annual report summarizing monthly operational data calculated from 10-minute SCADA data for all turbines together in tabular format: the proportion of time the turbines were operational (spinning at >x rpm) each month, the average rotor speed (monthly revolutions per minute (rpm)) of spinning turbines plus 1 standard deviation, and the average pitch angle of blades (degrees relative to rotor plane) plus 1 standard deviation. BOEM and BSEE will use this information as inputs for avian collision risk models to assess whether the results deviate substantially from the impact analysis included in the Final BA. f. Raw Data. The Lessee must store the raw data from all avian and bat surveys and monitoring activities according to accepted archiving practices. Such data must remain accessible to BOEM, BSEE and USFWS, upon request for the duration of the Lease. The Lessee		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			must work with BOEM to ensure the data are publicly available. The USFWS may specify third-party data repositories that must be used, such as the Motus Wildlife Tracking System or MoveBank, and such parties and associated data standards may change over the duration of the monitoring plan.		
3	C	Surveys, Avoidance, and Minimization (ESA-listed bats) - Onshore	To minimize potential impacts to northern long-eared bats and Indiana bats, which may be present year-round, Dominion Energy has conducted surveys (mist-net) and is developing avoidance and minimization measures, including adhering to the existing requirements for tree clearing under 4(d) provisions prior to implementation of the new regulations on April 1, 2024 and adhering to the year-round time of year restrictions for suitable habitat included in the new regulation in coordination with BOEM, USFWS, and VDWR.	Bats	USFWS, VDWR
4	C, O&M	Offshore structures	To minimize attracting birds to operating turbines, Dominion Energy must install bird perching-deterrent devices on WTGs and OSSs. The location of bird-deterrent devices must be proposed by Dominion Energy based on best management practices applicable to the appropriate operation and safe installation of the devices. Dominion Energy must confirm the locations of bird perching-deterrent devices with a monitoring plan to track the efficacy of the deterrents as part of the as-built documentation it must submit with the FDR.	Birds	BOEM, USFWS
5	C, O&M	Offshore structures	Dominion Energy must use an FAA-approved vendor for the Aircraft Detection Lighting System (ADLS), which will activate the FAA hazard lighting only when an aircraft is in the vicinity of the wind facility to reduce visual impacts at night. Dominion Energy must confirm the use of an FAA-approved vendor for ADLS on WTGs and OSSs in the FDR. (Tentative)	Birds	FAA, BOEM, BSEE
6	C, O&M	Offshore structures	Dominion Energy must light each WTG and OSS in a manner that is visible by mariners in a 360-degree arc	Birds	USCG, BOEM, BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			around the WTG and OSS. To minimize the potential of attracting migratory birds, the top of each light shall be shielded to minimize upward illumination (Conditional on USCG approval).		
7	C, O&M, D	Other	Reasonable and Prudent Measures and Terms and Conditions from the USFWS Biological Opinion, to be issued September 1	Birds, Bats, Sea Turtles	BOEM, BSEE, USFWS
Reasonable and Prudent Mitigation and Monitoring Measures and Terms and Conditions in the USFWS Biological Opinion Issued August 31, 2023					
RPM 1	C, O&M, D	Training	Ensure that all individuals performing work onshore (i.e., Dominion staff, concessioners, contractors) are familiar with the PIPL, REKN, NLEB, and TCB and their respective habitats and are aware of all protection measures detailed in this Opinion.	Birds, Bats	BOEM, BSEE, and USFWS
T&C 1	C, O&M, D	Training	Provide annual training to all individuals directly or indirectly responsible for implementing and/or overseeing actions described in the BA. The training will review the protection measures outlined in the BA and how the conservation measures are to be implemented, species habitat characteristics, and applicable locations for NLEB and TCB.	Birds, Bats	BOEM, BSEE, and USFWS
MRR 1	C, O&M	Monitoring and Reporting Requirements	Prior to commissioning the first WTG, BOEM must extract from existing project documentation (e.g., the BA, other consultation documents, the final Environmental Impact Statement, the COP) a stand-alone summary of technologies and methods that BOEM evaluated to reduce or minimize bird collisions at the CVOW-C WTGs. Provide this summary to the Service contact email provided below.	Birds	BOEM, BSEE, and USFWS
MRR 2	C, O&M	Monitoring and Reporting Requirements	Within 5 years of commissioning the first WTG, and then every 5 years for the life of the project, BOEM must prepare a Collision Minimization Report, reviewing best available scientific and commercial data on technologies and methods that have been implemented or are being studied, to reduce or minimize bird collisions at WTGs. The	Birds	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			review must be global in scope and include both offshore and onshore WTGs. A. BOEM must distribute a draft Collision Minimization Report to the Service and Dominion for a 60-day review period. BOEM must address all comments received during the review period and issue the final report within 60 days of the close of the review period. A. BOEM must distribute a draft Collision Minimization Report to the Service and Dominion for a 60-day review period. BOEM must address all comments received during the review period and issue the final report within 60 days of the close of the review period. B. Following issuance of the final Collision Minimization Report, the Service may request a meeting. Within 60 days following the Service's request, BOEM must convene a meeting with the Service and Dominion. Meeting participants will discuss the Collision Minimization Report and seek consensus on whether implementation of any technologies/methods is warranted. C. Within 60 days of the close of the review period if a meeting is not held, BOEM must provide a plan to the Service and Dominion that details how the technologies/methods will be implemented.		
MRR 3	C, O&M, D	Monitoring and Reporting Requirements	Provide updated model runs and associated input data from both SCRAM and Band (2012) for PIPL and REKN using the best available information on each species and provide a report containing this information by December 31 of each year until the year after decommissioning is complete to the Service contact email provided below.	Birds	BOEM, BSEE, and USFWS
MRR 4	C, O&M, D	Monitoring and Reporting Requirements	Care must be taken in handling any dead or injured specimens of proposed or listed species to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not	Birds, Bats	BOEM, BSEE, and USFWS

#	Proposed Project Phase	Mitigation & Monitoring Measures	Description of Mitigation and Monitoring Measures Resulting From Consultations	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			unnecessarily disturbed. The finding of dead or injured specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead or injured specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead or injured specimen, notify the Service's Virginia Law Enforcement Office at 804-771-2883 and the Virginia Field Office at the phone number provided below.		
MRR 5	C	Monitoring and Reporting Requirements	Notify the Service regarding the projected and actual start dates, progress, and completion of the project and verify that the removal of 117.04 acres of trees was not exceeded, and confirmation that all conservation measures were followed. Provide a report containing this information by December 31 of each year until the year after construction is complete to the Service contact email provided below.	Birds, Bats	BOEM, BSEE, and USFWS
BOEM-Proposed Measure for Reporting Incidental Take of Endangered or Threatened Species					
1	C, O&M, D	Reporting	Dominion Energy will report to BOEM and BSEE within 24-hours of confirmation any incidental take of an endangered or threatened species.	ESA-listed Fish, Marine Mammals, Sea Turtles	BOEM, BSEE

Table H-3. Additional Agency-Required Mitigation and Monitoring Measures

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
BOEM-Proposed Measures to Minimize Impacts on Air Quality					
1	O&M	SF_6 leak rate monitoring and detection	Leak detection and monitoring requirements of less than 1% would be required, in line with IEC and USEPA guidance.	Air Quality	BOEM and BSEE
DoD Measures Resulting from DoD Clearinghouse Review					
1	C, O&M	Mitigation for NORAD radar impacts	Dominion Energy will enter into a mitigation agreement with DoD for impacts on the North American Aerospace Defense Command (NORAD). Mitigation measures include the following: • Notify the NORAD 30-to-60 days ahead of project completion and when the project is complete and operational for Radar Adverse Impact Management (RAM) scheduling. • Contribute funds ($80,000) toward the execution of the RAM for each affected radar. • Curtailment for National Security or Defense Purposes as described in the leasing agreement.	Other Uses – Radar Systems	BOEM and BSEE
4	C	Mitigation for impacts to DON operations	Dominion Energy will enter into a mitigation agreement with DoD for impacts on the Department of the Navy (DON). Mitigation measures include the following:	Other Uses – National Security and Military Uses	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			• Coordinate prior to mobilization and work with DON to develop communication protocols for construction activities, providing relevant notifications and regular updates to U.S. Fleet Forces Command (USFFC) and the Naval Air Warfare Center Aviation Division (NAWCAD). • Following construction, develop communication protocols to ensure notification and coordination with USFFC and NAWCAD on relevant operations and maintenance activities with the potential to impact military activities. • Work with DoD/DON to prevent, minimize, or mitigate effects on radar systems to potentially include curtailment of turbine operation for National Security or Defense purposes. • Spinning turbines may conflict with the DON's Advanced Dynamic Aircraft Measurement System. Dominion Energy must facilitate a DON risk assessment through deployment of distributed fiber optic sensing technology and passive acoustic monitoring, and mitigate risks to national		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			security, if identified. • Provide DoD/DON notification and opportunity to assess risk related to foreign investment and material vendors for the project, and must address risk to national security requiring mitigation, if identified. • Continue to coordinate with the DON regarding real estate leasing with NAS Oceana regarding access for the proposed Interconnection Cable Route Options.		
10	O&M	Identification of impacts from UAS to US Army	Dominion Energy must coordinate with the US Army to safely deconflict any use of unmanned aircraft systems (UAS) by Dominion Energy with Army Aviation operations near Joint Base Langley-Eustis and training areas to the east.	Other Uses – National Security and Military Uses	BOEM and BSEE
BOEM OCS Study 2020-039 – Radar Systems Mitigations to Operations					
1	O&M	Mitigation for ARSR-4 and ASR-8/9 radars	Dominion Energy will enter into a mitigation agreement with DoD for impacts on ARSR-4 and for ASR-8/9 radars. Possible mitigation measures might include the following: • Passive aircraft tracking using ADS-B or signal/transponder • Increasing aircraft altitude near	Other Uses - Radar	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency

			radar
			• Sensitivity time control (range-dependent attenuation)
			• Range azimuth gating (ability to isolate/ignore signals from specific range-angle gates)
			• Track initiation inhibit, velocity editing, plot amplitude thresholding (limiting the amplitude of certain signals)
			• Modification mitigations for ARSR-4 and for ASR-8/9 systems:
			  ○ Utilizing the dual beams of the radar simultaneously
			  ○ In-fill radars		

2	O&M	Mitigation for oceanographic high-frequency radars	• BOEM will require that Dominion Energy coordinates with the radar operators and the Surface Currents Program of NOAA Integrated Ocean Observing System (IOOS) Office 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 either is the case, the lessee must notify BOEM, make publicly available via NOAA IOOS the near real-time accurate	Other Uses - Radar	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			numerical telemetry of surface current velocity, wave height, wave period, wave direction, and other oceanographic data measured at Project locations selected by the Lessee in coordination with the affected radar operators and the NOAA IOOS Surface Currents Program; and, if requested by the affected radar operators or the NOAA IOOS Surface Currents Program, share with them accurate numerical time-series data of blade rotation rates, nacelle bearing angles, and other information about the operational state of each turbine in the wind development area to aid interference mitigation.		
USACE-Proposed Measures					
1	C, O&M, D	Clean Water Act (CWA) 404; Section 10 of the Rivers and Harbors Act	Dominion Energy will comply with all mitigation required by USACE for CWA Section 404 and Section 10 impacts.	Wetlands	USACE
NPS- and BOEM-Proposed Measures					
1	C, O&M, D	Lighting	Dominion Energy will comply with BOEM's detailed Lighting and Marking Guidelines and NPS sustainable lighting best practices.	Cultural, Historic, and Archaeological Resources; ESA-listed Species; Recreation	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
				and Tourism; Scenic and Visual Resources	
BOEM-Proposed Measures for Fisheries Compensation					
1	C, O&M, D	Fisheries compensation	BOEM would require that Dominion Energy implement a compensation program for lost income for commercial and recreational fishermen and other eligible fishing interests (including shoreside support services) for construction and operations consistent with BOEM's draft guidance for *Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585* or as modified in response to public comment. This measure, if adopted, would reduce impacts from the impact-producing factor (IPF) presence of structures by compensating commercial and recreational fishing interests for lost income during construction and a minimum of 5 years post-construction. Levels of funding required by Dominion Energy to be set aside for fulfilling verified claims would be commensurate with commercial fishing revenue amounts in the Project area as described in Section 3.9.1.3. If adopted, this	Commercial Fisheries and For-Hire Recreational Fishing	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			measure would reduce the negligible to major impact level from the presence of structures to negligible to moderate. This is because a compensation scheme will 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.		
2	C, O&M, D	Compensation for gear loss and damage	The lessee must implement a gear loss and damage compensation program consistent with BOEM's draft guidance for *Mitigating Impacts to Commercial and Recreational Fisheries on the Outer Continental Shelf Pursuant to 30 CFR 585* or as modified in response to public comment. The fisheries gear loss and damage claims procedure must be maintained throughout the life of the Project and must be available to all fishermen impacted by Project activities or infrastructure regardless of homeport BOEM recognizes that Dominion Energy has a fishing gear damage or loss claims process resulting from survey activities (Appendix V-1: Fisheries Communications Plan of the COP). This measure, if adopted, would be applicable to the IPF presence of structures during both construction	Commercial Fisheries and For-Hire Recreational Fishing	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			and operations. If adopted, this measure would reduce negative impacts resulting from loss of gear associated with uncharted obstructions resulting from the Proposed Action.		
USCG-Proposed Measures for Navigation					
1	C, O&M	Safety zones	Establishing safety zones should not be used as the key mitigating factor when considering risks and impacts. Commander, USCG Fifth District, may consider safety zones in the lease area, but safety zones will not be granted for the sole purpose of keeping project construction on track.	Navigation and Vessel Traffic	USCG
BOEM-Proposed Measures for Cable Protection					
1	C, O&M, D	Mobile gear–friendly cable protection measures	Cable protection measures should reflect the pre-existing conditions at the site. This mitigation measure, if adopted, ensures that seafloor cable protection does not introduce potential for snags for mobile fishing gear (reducing impacts from the presence of structures IPF). Therefore, the cable protection measures should be trawl-friendly with tapered/sloped edges. This measure, if adopted, would be applicable to the IPF new cable emplacement and maintenance activities during both construction and operations. If adopted, this	Commercial Fisheries and For-Hire Recreational Fishing	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			measure would reduce negative impacts resulting from loss of gear associated with cable protection resulting from the Proposed Action.		
BOEM-Proposed Measure for Long-Term PAM					
1	C, O&M, D	Long-term PAM	The Lessee must conduct long-term monitoring of ambient noise, baleen whale and commercially-important fish vocalizations in the Lease Area before, during, and following construction. The Lessee must conduct continuous recording at least 1 year before construction, during construction, and for at least 3 but no more than 10 full calendar years of operation to monitor for potential noise impacts. The Lessee must meet with BOEM and BSEE at least 60 days prior to conclusion of the third full calendar year of operation monitoring (and at least 60 days prior to the conclusion of each subsequent year until monitoring is concluded) to discuss: 1) monitoring conducted to-date, 2) the need for continued monitoring, and 3) if monitoring is continued, whether adjustments to the monitoring are warranted. Following this meeting, BOEM will make a determination as to continued monitoring requirements and inform the Lessee of any changes to monitoring	Marine Mammals, Finfish	BOEM and BSEE

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			requirements. The instrument(s) must be configured to ensure that the specific locations of vocalizing NARW anywhere within the lease area could be identified, based on the assumption of a 10 km detection range for their calls. The lessee may execute the implementation of this condition through Option 1 or Option 2, as below. The timing requirement (i.e., monitoring for at least 3 but no more than 10 full calendar years of operation) will be reevaluated by BOEM and BSEE at the end of the third year and each year subsequently thereafter at the request of the Lessee (at a maximum frequency of requests of once per year). a) Option 1 - Lessee Conducts Long-term Passive Acoustic Monitoring. The Lessee must conduct PAM, including data processing and archiving following the Regional Wildlife Science Collaborative (RWSC) best practices to ensure data comparability and transparency. PAM instrumentation must be deployed to allow for identification of any NARW that vocalize anywhere within the lease area. The sampling rate (minimum 10		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			kHz) of the recorders must prioritize baleen whale detections, but must also have a minimum capability to record noise from vessels, pile-driving, and WTG operation in the lease area. The system must be configured for continuous recording over the entire year. If temporal gaps in recording are expected, the Lessee must ensure that additional recorders can be deployed to fill gaps. The Lessee must use trawl-resistant moorings to ensure that instruments are not lost, and must replace any lost instruments as soon as possible. The Lessee must also notify BOEM if this occurs. The Lessee must follow the best practices outlined in the RWSC best practices document, unless otherwise required through conditions of COP approval. The best practices include engaging with the RWSC, calibrating the instruments, running QA/QC on the raw data, following the templates for reporting species vocalizations, and preparing the data for archiving at National Centers for Ecological Information (NCEI). Although section III of the RWSC best practices document specifies steps for Section 106 compliance, the Lessee must instead follow the conditions outlined		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			in the Section 106 Memorandum of Agreement. In terms of data processing, the Lessee must document the occurrence of whale vocalizations (calls of North Atlantic right, humpback, sei, fin, and minke whales, as well as odontocete clicks, as available based on sample rate) using automatic or manual detection methods. The Lessee must submit a log of these detections as well as the detection methodology to BOEM (at renewable_reporting@boem.gov), BSEE (at protectedspecies@bsee.gov) and NMFS (at nmfs.pacmdata@noaa.gov) within 120 days following each recorder retrieval. All raw data must be sent to the NCEI Passive Acoustic Data archive on an annual basis and the Lessee must follow NCEI guidance for packaging the data and pay the fee. i. Long-term Passive Acoustic Monitoring Plan. The Lessee must prepare and implement a Long-term PAM Plan under this option. No later than 120 days prior to instrument deployment and before any construction		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			begins, the Lessee must submit to BOEM and BSEE (renewable_reporting@boem.gov and OSWsubmittals@bsee.gov) the Long-term PAM Plan that describes all proposed equipment (including number and configuration of instruments), deployment locations, mooring design, detection review methodology, and other procedures and protocols related to the required use of PAM. As the Lessee prepares the Long-term PAM Plan, it must coordinate with the RWSC. BOEM and BSEE will review the Long-term PAM Plan and provide comments, if any, on the plan within 45 days of its submittal. The Lessee may be required to submit a modified Long-term PAM Plan based on feedback from BOEM and BSEE. The Lessee must address all outstanding comments to BOEM's and BSEE's satisfaction and must receive written concurrence from BOEM and BSEE. If BOEM or BSEE do not provide comments on the Long-term PAM Plan within 45 days of its submittal, the Lessee may conclusively presume BOEM's and BSEE's 's concurrence with the		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			Long-term PAM Plan. Option 2 – Economic and Other Contributions to BOEM's Environmental Studies Program. As an alternative to conducting long-term PAM in the Lease Area, the Lessee may opt to make an economic contribution to BOEM's Environmental Studies Partnership for an Offshore Wind Energy Regional Observation Network (POWERON) initiative on an annual basis and cooperate with the POWERON team to allow access to the Lease Area for deployment, regular servicing, and retrieval of instruments. The Lessee's economic contribution will provide for all activities necessary to conduct PAM within the Lease Area, such as vessel and staff time for regular servicing of instruments, QA/QC on data, data processing to obtain vocalizations of sound-producing species and ambient noise metrics, as well as long-term archiving of data at NCEI. At the Lessee's request, the amount of the economic contribution will be estimated by BOEM's Environmental Studies Program. The Lessee will also be invited to contribute to discussions about the scientific approach of the POWERON initiative via the RWSC.		

#	Proposed Project Phase	Mitigation & Monitoring Measures	Table H-3. Description of Additional Agency-Required Mitigation and Monitoring Measures	Resource Area Mitigated	BOEM's Identification of the Anticipated Enforcing Agency
			The Lessee may request temporary withholding of the public release (placement into the NCEI public data archive) of raw acoustic data collected within the Lease Area or up to 180 days after it is collected. During this temporary hold, the Lessee may be provided a copy of the raw PAM data that was collected in the Lease Area or ROW after it has been cleared for any national security concerns under the RWSC best practices document.		

Table H-4. Lessee Authorization and Permit Conditions

#	Table H-4. Description of Lessee Authorization and Permit Conditions
North Carolina Department of Environmental Quality Consistency Determination Conditions Issued June 24, 2022	
1	NC DEQ's coastal consistency determination did not include any conditions.
Virginia Department of Environmental Quality Consistency Determination Conditions	
1	Conditions included in the VA DEQ coastal consistency determination would be noted in BOEM's ROD.
NMFS Proposed Incidental Take Regulations (ITR) and Associated 5-year Letter of Authorization Issued Pursuant to the Marine Mammal Protection Act (MMPA) on May 4, 2023	
1	*General conditions.* The following measures apply to the CVOW–C Project: 1. A copy of any issued LOA must be in the possession of Dominion Energy and its designees, all vessel operators, visual protected species observers (PSOs), passive acoustic monitoring (PAM) operators, pile driver operators, and any other relevant designees operating under the authority of the issued LOA. 2. Dominion Energy must conduct briefings between construction supervisors, construction crews, and the PSO and PAM team prior to the start of all construction activities, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring and reporting protocols, and operational procedures. A simple guide must be included with the Marine Mammal Monitoring Plan to aid personnel in identifying species if they are observed in the vicinity of the project area. 3. Prior to and when conducting any in-water construction activities and vessel operations, Dominion Energy personnel (*e.g.,* vessel operators, PSOs) must use available sources of information on North Atlantic right whale presence in or near the project area including daily monitoring of the Right Whale Sightings Advisory System, and monitoring of Coast Guard VHF Channel 16 throughout the day to receive notification of any sightings and/or information associated with any Slow Zones (i.e., Dynamic Management Areas (DMAs) and/or acoustically-triggered slow zones) to provide situational awareness for both vessel operators and PSO. 4. Dominion Energy must ensure that any visual observations of an Endangered Species Act (ESA)-listed marine mammal are communicated to PSOs and vessel captains during the concurrent use of multiple project-associated vessels (of any size; e.g., construction surveys, crew/supply transfers,). 5. Dominion Energy must establish and implement clearance and shutdown zones as described in the LOA. 6. Dominion Energy must instruct all vessel personnel regarding the authority of the PSO(s). Any disagreement between the Lead PSO and the vessel operator would only be discussed after shutdown has occurred. 7. If an individual from a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has been met, is observed entering or within the relevant Level B harassment zone for a specified activity, pile driving and HRG acoustic sources must be shut down immediately, unless shutdown would result in imminent risk of injury or loss of life to an individual, pile refusal, or pile instability, or be delayed if the activity has not commenced. Impact and vibratory pile driving and initiation of HRG acoustic sources must not commence or resume until the animal(s) has been confirmed to have left the relevant clearance zone or the observation time has elapsed with no further sightings.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	8. Construction and survey activities shall only commence when visual clearance zones are fully visible (e.g., not obscured by darkness, rain, fog,) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of equipment (i.e., vibratory and impact pile driving, HRG surveys that use boomers, sparkers, and Compressed High-Intensity Radiated Pulses (CHIRPs)). 9. Any visual or acoustic detection within the clearance or shutdown zones must trigger a delay to the commencement of construction and survey activities. Any marine mammals observed within a clearance or shutdown zone must be allowed to remain in the area (i.e., must leave of their own volition) prior to commencing pile driving activities or HRG surveys. 10. Dominion Energy must treat any large whale sighted by a PSO or acoustically detected by a PAM operator as if it were a North Atlantic right whale and apply the mitigation measures applicable to North Atlantic right whales, unless a PSO or a PAM operator confirms the large whale is another type of whale. 11. Following a shutdown, construction and survey activities shall not recommence until the minimum visibility zone is fully visible and clear of marine mammals for 30 minutes and no marine mammals have been detected acoustically within the PAM clearance zone for 30 minutes. 12. For in-water construction heavy machinery activities, other than impact and vibratory pile driving, if a marine mammal is on a path towards or comes within 10 m of equipment, Dominion Energy must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment. 13. All vessels must be equipped with an Automatic Identification System (AIS) and Dominion Energy must report all Maritime Mobile Service Identify (MMSI) numbers to NMFS Office of Protected Resources prior to initiating in-water activities.
2	*Vessel strike avoidance measures.* The following measures apply to all vessels associated with the CVOW–C: 1. Prior to the start of construction activities, all vessel operators and crew must receive a protected species identification training that covers, at a minimum: i. Identification of marine mammals and other protected species known to occur or which have the potential to occur in the Dominion Energy project area; ii. Training on making observations in both good weather conditions (i.e., clear visibility, low winds, low sea states) and bad weather conditions (i.e., fog, high winds, high sea states, with glare); iii. Training on information and resources available to the project personnel regarding the applicability of Federal laws and regulations for protected species; iv. Observer training related to vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of in-water construction activities; and v. Confirmation of marine mammal observer training must be documented on a training course log sheet and reported to NMFS; 2. All vessel operators and crews, regardless of their vessel's size, must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course, as appropriate, to avoid striking any marine mammal; 3. All vessels must have a visual observer on board who is responsible for monitoring the vessel strike avoidance zone for marine mammals. Visual observers may be a PSO or crew member, but crew members responsible for these duties must

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	be provided sufficient training by Dominion Energy to distinguish marine mammals from other types of animals or objects and must be able to identify a marine mammal as a North Atlantic right whale, other whale (defined in this context as sperm whales or baleen whales other than North Atlantic right whales), or other marine mammal. Crew members serving as visual observers must not have duties other than observing for marine mammals while the vessel is operating over 10 knots (kts); 4. Year-round and when a vessel is in transit, all vessel operators must continuously monitor U.S. Coast Guard VHF Channel 16, over which North Atlantic right whale sightings are broadcasted. At the onset of transiting and at least once every four hours, vessel operators and/or trained crew members must monitor the project's Situational Awareness System, WhaleAlert, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales. Any observations of any large whale by any Dominion Energy staff or contractors, including vessel crew, must be communicated immediately to PSOs, PAM operator, and all vessel captains to increase situational awareness. Conversely, any large whale observation or detection via a sighting network (*e.g.,* Mysticetus) by PSOs or PAM operators must be conveyed to vessel operators and crew; 5. Any observations of any large whale by any Dominion Energy staff or contractor, including vessel crew, must be communicated immediately to PSOs and all vessel captains to increase situational awareness; 6. Nothing in this subpart exempts vessels from applicable speed regulations at 50 CFR 224.105; 7. All vessels must transit active Slow Zones (i.e., Dynamic Management Areas (DMAs) or acoustically-triggered slow zone), and Seasonal Management Areas (SMAs) at 10 kts or less; 8. Between November 1st and April 30th, all vessels must transit at 10 kts or less; 9. All vessels, regardless of size, must immediately reduce speed to 10 kts or less when any large whale, mother/calf pairs, or large assemblages of non-delphinid cetaceans are observed (within 500 m) of an underway vessel; 10. All vessels, regardless of size, must immediately reduce speed to 10 kts or less when a North Atlantic right whale is sighted, at any distance, by anyone on the vessel; 11. All transiting vessels operating at any speed must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180 degree direction of the forward path of the vessel (90 degrees port to 90 degree starboards) located at the best vantage point for ensuring vessels are maintaining appropriate separation distances from marine mammals. Visual observers must be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog,). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. Visual observers may be third-party observers (i.e., NMFS-approved PSOs) or crew members. Observer training related to these vessel strike avoidance measures must be conducted for all vessel operators and crew prior to the start of vessel use; 12. All vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If underway and making way, all vessels must steer a course away from any sighted North Atlantic right whale at 10 kts or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale is sighted within 500 m of a transiting vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	outside of the vessel's path and beyond 500 m. If a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale; 13. All vessels must maintain a minimum separation distance of 100 m from sperm whales and baleen whales other than North Atlantic right whales. If one of these species is sighted within 100 m of a transiting vessel, that vessel must shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 100 m; 14. All vessels must maintain a minimum separation distance of 50 m from all delphinoid cetaceans and pinnipeds, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). If a delphinid cetacean or pinniped is sighted within 50 m of a transiting vessel, that vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.,* bow-riding dolphins). Engines must not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m; 15. When a marine mammal(s) is sighted while a vessel is transiting, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.,* attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If a marine mammal(s) is sighted within the relevant separation distance, the vessel must shift the engine to neutral and not engage the engine(s) until the animal(s) outside and on a path away from the separation area. This does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (i.e., any situation where the vessel is navigationally constrained); 16. All vessels underway must not divert or alter course to approach any marine mammal. If a separation distance is triggered, any vessel underway must avoid abrupt changes in course direction and transit at 10 kts or less until the animal is outside the relevant separation distance; and 17. Dominion Energy must submit a North Atlantic right whale vessel strike avoidance plan 180 days prior to the commencement of vessel use. This plan must describe, at a minimum, how PAM, in combination with visual observations, would be conducted to ensure the transit corridor is clear of right whales and would also provide details on the vessel-based observer protocols on transiting vessels.
3	*WTG and OSS foundation installation.* The following requirements apply to pile driving activities associated with the installation of WTG and OSS foundations: 1. Foundation vibratory and impact pile driving may not occur November 1st through April 30th; 2. Monopiles must be no larger than 9.5-m in diameter, representing the larger end of the tapered 9.5/7.5-m monopile design. Pin piles must be no larger than 2.8-m in diameter. During all monopile and pin pile installation, the minimum amount of hammer energy necessary to effectively and safely install and maintain the integrity of the piles must be used. Hammer energies must not exceed 4,000 kilojoules (kJ) for monopile installations and 3,000 kJ for pin pile installation. No more than two monopile foundation or two pin piles for jacket foundations may be installed per day; 3. Dominion Energy must not initiate pile driving earlier than 1 hour after civil sunrise or later than 1.5 hours prior to civil sunset, unless Dominion Energy submits, and NMFS approves an Alternative Monitoring Plan as part of the Pile Driving and Marine Mammal Monitoring Plan that reliably demonstrates the efficacy of their night vision devices;

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	4. Dominion Energy must utilize a soft-start protocol for each impact pile driving event of all monopiles and pin piles by performing 4–6 strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes; 5. Soft-start must occur at the beginning of monopile and pin pile installation and at any time following a cessation of impact pile driving of 30 minutes or longer; 6. If a marine mammal is detected, visually or acoustically, within or about to enter the applicable clearance zones, prior to the beginning of soft-start procedures, impact pile driving must be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings. The specific time periods are 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other species; 7. Dominion Energy must deploy dual noise abatement systems that are capable of achieving, at a minimum, 10 decibel (dB) of sound attenuation, during all vibratory and impact pile driving of monopiles and pin piles and comply with the following requirements related noise abatement: i. A single bubble curtain must not be used unless paired with another noise attenuation device; ii. A big double bubble curtain may be used without being paired with another noise attenuation device; iii. The bubble curtain(s) must distribute air bubbles using an air flow rate of at least 0.5 m^3 /(min*m). The bubble curtain(s) must surround 100 percent of the piling perimeter throughout the full depth of the water column. In the unforeseen event of a single compressor malfunction, the offshore personnel operating the bubble curtain(s) must make appropriate adjustments to the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtain(s) is achieved; iv. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact; v. No parts of the ring or other objects may prevent full seafloor contact; vi. Construction contractors must train personnel in the proper balancing of airflow to the ring. Construction contractors must submit an inspection/performance report for approval by Dominion Energy within 72 hours following the performance test. Dominion Energy must then submit that report to NMFS; and vii. Corrections to the bubble ring(s) to meet the performance standards in this paragraph (c)(7) must occur prior to impact pile driving of monopiles and pin piles. If Dominion Energy uses a noise mitigation device in addition to the bubble curtain, Dominion Energy must maintain similar quality control measures as described in this paragraph (c)(7); 8. Dominion Energy must conduct sound field verification (SFV) during all vibratory and impact pile driving of the first three monopiles and all piles associated with the first OSS foundation installed. Subsequent SFV is required should additional piles be driven that are anticipated to produce louder sound fields than those previously measured; 9. Dominion Energy must conduct SFV after construction is complete to estimate turbine operational source levels based on measurements in the near and far-field at a minimum of three locations from each foundation monitored. These data must be used to also identify estimated transmission loss rates; 10. Dominion Energy must submit a sound field verification (SFV) plan to NOAA Fisheries for review and approval at least 180

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	days prior to planned start of pile driving that identifies how Dominion Energy will comply with the following requirements: i. Dominion Energy must empirically determine source levels, the ranges to the isopleths corresponding to the Level A harassment and Level B harassment thresholds in meters, and the transmission loss coefficient(s). Dominion Energy may estimate ranges to the Level A harassment and Level B harassment isopleths by extrapolating from *in situ* measurements conducted at several distances from the piles monitored; ii. Dominion Energy must perform sound field measurements at four distances from the pile being driven, including, but not limited to, 750 m and the modeled Level B harassment zones to verify the accuracy of those modeled zones; iii. The recordings must be continuous throughout the duration of all impact and vibratory hammering of each pile monitored; iv. The measurement systems must have a sensitivity appropriate for the expected sound levels from pile driving received at the nominal ranges throughout the installation of the pile; v. The frequency range of the system must cover the range of at least 20 hertz (Hz) to 20 kilohertz (kHz); vi. The system will be designed to have omnidirectional sensitivity and will be designed so that the predicted broadband received level of all impact pile-driving strikes exceeds the system noise floor by at least 10 dB. The dynamic range of the system must be sufficient such that at each location, pile driving signals are not clipped and are not masked by noise floor; and vii. Identify operational noise levels and transmission loss rates; 11. If acoustic field measurements collected during installation of foundation piles indicate ranges to the isopleths, corresponding to Level A harassment and Level B harassment thresholds, are greater than the ranges predicted by modeling (assuming 10 dB attenuation), Dominion Energy must implement additional noise mitigation measures prior to installing the next monopile. Each modification must be evaluated empirically by acoustic field measurements; 12. In the event that field measurements indicate ranges to isopleths, corresponding to Level A harassment and Level B harassment thresholds, are greater than the ranges predicted by modeling (assuming 10 dB attenuation), NMFS may expand the relevant harassment, clearance, and shutdown zones and associated monitoring protocols; 13. If the harassment zones are expanded beyond an additional 1,500 m, additional PSOs must be deployed on additional platforms, with each observer responsible for maintaining watch in no more than 180 degrees and of an area with a radius no greater than 1,500 m; 14. If acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10 dB attenuation), Dominion Energy may request to NMFS a modification of the clearance and shutdown zones for impact pile driving of monopiles and pin piles; 15. For NMFS to consider a modification request for reduced zone sizes, Dominion Energy must have had to conduct SFV on three or more monopiles and four or more pin piles to verify that zone sizes are consistently smaller than those predicted by modeling (assuming 10 dB attenuation) and subsequent piles would be installed within and under similar conditions (e.g., monitoring data collected during installation of a typical pile cannot be used to adjust difficult-to-drive pile ranges);

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	16. If a subsequent monopile installation location is selected that was not represented by the previous three locations (i.e., substrate composition, water depth), SFV is required; 17. Dominion Energy must utilize, at minimum, four PSOs who must be actively observing for marine mammals before, during, and after pile driving. At least two PSOs must be stationed on the primary pile driving vessel and at least two PSOs must be stationed on a secondary, dedicated PSO vessel. The dedicated PSO vessel must be positioned approximately 3 km from the pile being driven and must circle the pile at a speed of less than 10 knots; 18. PSOs must be able to visually clear (i.e., confirm no marine mammals are present) an area that extends around the pile being driven as described in the LOA. The entire minimum visibility zone must be visible (i.e., not obscured by dark, rain, fog,) for a full 30 minutes immediately prior to commencing vibratory and impact pile driving (2,000 m); 19. PSOs must visually monitor clearance zones for marine mammals for a minimum of 60 minutes prior to commencing pile driving. Prior to initiating soft-start procedures, all clearance zones must be visually confirmed to be free of marine mammals for 30 minutes before pile driving can begin; 20. At least one PAM operator must review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. All clearance zones must be acoustically confirmed to be free of marine mammals for 60 minutes before activities can begin immediately prior to starting a soft-start of impact pile driving; 21. If a marine mammal is observed entering or within the relevant clearance zone prior to the initiation of vibratory and/or impact pile driving activities, pile driving must be delayed and must not begin until either the marine mammal(s) has voluntarily left the specific clearance zones and have been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species; 22. For North Atlantic right whales, any acoustic detection must trigger a delay to the commencement of pile driving. The clearance zone may only be declared clear if no confirmed North Atlantic right whale acoustic detections (in addition to visual) have occurred within the PAM clearance zone during the 60-minute monitoring period. Any large whale sighting by a PSO or detected by a PAM operator that cannot be identified by species must be treated as if it were a North Atlantic right whale; 23. If a marine mammal is observed entering or within the respective shutdown zone, as defined in the LOA, after pile driving has begun, the PSO must call for a temporary shutdown of pile driving; 24. Dominion Energy must immediately cease pile driving when a marine mammal is detected within a shutdown zone, unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. In this situation, Dominion Energy must reduce hammer energy to the lowest level practicable and the reason(s) for not shutting down must be documented and reported to NMFS; 25. If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection; 26. Upon restarting impact pile driving, soft-start protocols must be followed; and 27. Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and has been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and 30 minutes for all other marine mammal species. In cases where these criteria are not met, pile driving may restart only if necessary to maintain pile stability at which time Dominion Energy must use the lowest hammer energy practicable to maintain stability.
4	*Cable landfall construction.* The following requirements apply to cable landfall pile driving activities: 1. Dominion Energy must conduct pile driving during daylight hours only. 2. Dominion Energy must have a minimum of two PSOs on active duty during any installation and removal of the temporary cofferdams and goal posts. PSOs must be located at the best vantage point(s) on the pile driving platform or secondary platform in the immediate vicinity of the pile driving platform, in order to ensure that appropriate visual coverage is available for the entire visual clearance zone and as much of the Level B harassment zone, as possible. 3. Prior to the start of pile driving activities, at least two PSOs must monitor the clearance zone for 30 minutes, continue monitoring during pile driving and for 30 minutes post-pile driving. 4. If a marine mammal(s) is observed entering or is observed within the clearance zones, pile driving must not commence until the animal(s) has exited the zone or a specific amount of time has elapsed since the last sighting. The specific time periods are 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other marine mammal species. 5. If a marine mammal is observed entering or within the respective shutdown zone, as defined in the LOA, after pile driving has begun, the PSO must call for a temporary shutdown of pile driving. 6. Dominion Energy must immediately cease pile driving when a marine mammal is detected within a shutdown zone, unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual, pile refusal, or instability. In this situation, Dominion Energy must reduce hammer energy to the lowest level practicable and the reason(s) for not shutting down must be documented and reported to NMFS. 7. Pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and has been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other marine mammal species. In cases where the criteria in this paragraph (e)(7) is not met, pile driving may restart only if necessary to maintain pile stability at which time Dominion Energy must use the lowest hammer energy practicable to maintain stability. 8. If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection. 9. Dominion Energy must employ a soft-start for all impact pile driving. Soft start requires contractors to provide an initial set of three strikes at reduced energy, followed by a 30-second waiting period, then two subsequent reduced-energy strike sets.
5	*HRG surveys.* The following requirements apply to HRG surveys operating sub bottom profilers (SBPs): 1. Dominion Energy is required to have at least one PSO on active duty per vessel during HRG surveys that are conducted during daylight hours i.e., from 30 minutes prior to civil sunrise through 30 minutes following civil sunset) and at least two

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	PSOs on active duty per vessel during HRG surveys that are conducted during nighttime hours. 2. Dominion Energy must deactivate acoustic sources during periods where no data are being collected, except as determined to be necessary for testing. Unnecessary use of the acoustic source(s) is prohibited. 3. Dominion Energy is required to ramp-up sub-bottom profilers (SBPs) prior to commencing full power, unless the equipment operates on a binary on/off switch. Ensure visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog,) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to the initiation of survey activities using acoustic sources specified in the LOA. 4. Prior to a ramp-up procedure starting or activating SBPs, the operator must notify the Lead PSO of the planned start time. This notification time must not be less than 60 minutes prior to the planned ramp-up or activation as all relevant PSOs must monitor the clearance zone for 30 minutes prior to the initiation of ramp-up or activation. 5. Prior to starting the survey and after receiving confirmation from the PSOs that the clearance zone is clear of any marine mammals, Dominion Energy must ramp-up sources to half power for 5 minutes and then proceed to full power, unless the source operates on a binary on/off switch in which case ramp-up is not required. Ramp-up and activation must be delayed if a marine mammal(s) enters its respective shutdown zone. Ramp-up and activation may only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until 15 minutes for small odontocetes and pinnipeds, and 30 minutes for all other species, has elapsed with no further sightings. 6. Dominion Energy must implement a 30-minute clearance period of the clearance zones immediately prior to the commencing of the survey or when there is more than a 30 minute break in survey activities or PSO monitoring. A clearance period is a period when no marine mammals are detected in the relevant zone. 7. If a marine mammal is observed within a clearance zone during the clearance period, ramp-up or acoustic surveys may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until a specific time period has elapsed with no further sighting. The specific time period is 15 minutes for small odontocetes and seals, and 30 minutes for all other species. 8. Any large whale sighted by a PSO within 1 km of the SBP that cannot be identified by species must be treated as if it were a North Atlantic right whale and Dominion Energy must apply the mitigation measure applicable to this species. 9. In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (infrared (IR)/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations would be allowed to commence (i.e., no delay is required) despite periods of inclement weather and/or loss of daylight. 10. Once the survey has commenced, Dominion Energy must shut down SBPs if a marine mammal enters a respective shutdown zone, except in cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (i.e., no shutdown is required) so long as no marine mammals have been detected. The shutdown requirement does not apply to small delphinids of the following genera: Delphinus, Stenella, Lagenorhynchus, and Tursiops. If there is uncertainty regarding the identification of a marine mammal species (i.e., whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	delphinid that belongs to a genus other than those specified in this paragraph €(10) is detected in the shutdown zone. 11. If SBPs have been shut down due to the presence of a marine mammal, the use of SBPs may not commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or until a full 15 minutes (for small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting. 12. Dominion Energy must immediately shutdown any SBP acoustic source if a marine mammal is sighted entering or within its respective shutdown zones. If there is uncertainty regarding the identification of a marine mammal species (i.e., whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a delphinid that belongs to a genus other than those specified in this paragraph (e)(12) is detected in the shutdown zone. 13. If a SBP is shut down for reasons other than mitigation (*e.g.,* mechanical difficulty) for less than 30 minutes, it would be allowed to be activated again without ramp-up only if: i. PSOs have maintained constant observation; and ii. No additional detections of any marine mammal occurred within the respective shutdown zones.
6	*Fisheries monitoring surveys.* The following measures apply to fishery monitoring surveys using trap/pot gear: 1. All captains and crew conducting fishery surveys must be trained in marine mammal detection and identification. Marine mammal monitoring will be conducted by the captain and/or a member of the scientific crew before (within 1 nautical mile (nm) and 15 minutes prior to deploying gear), during, and after haul back. 2. Survey gear will be deployed as soon as possible once the vessel arrives on station. 3. Dominion Energy and/or its cooperating institutions, contracted vessels, or commercially-hired captains must implement the following “move-on” rule: If marine mammals are sighted within 1 nm of the planned location and 15 minutes before gear deployment, Dominion Energy and/or its cooperating institutions, contracted vessels, or commercially-hired captains, as appropriate, must move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammals are still visible from the vessel, Dominion Energy and/or its cooperating institutions, contracted vessels, or commercially-hired captains must move again or skip the station. 4. If a marine mammal is deemed to be at risk of interaction after the gear is set, all gear must be immediately removed from the water. 5. Dominion Energy must maintain visual monitoring effort during the entire period of time that gear is in the water (i.e., throughout gear deployment, fishing, and retrieval). 6. All fisheries monitoring gear must be fully cleaned and repaired (if damaged) before each use. 7. All lost gear must be reported to NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division (*nmfs.gar.incidental-take@noaa.gov*) within 24 hours of the documented time of missing or lost gear. This report must include information on any markings on the gear and any efforts undertaken or planned to recover the gear. All reasonable efforts, that do not compromise human safety, must be undertaken to recover gear. 8. Dominion Energy must implement measures within the Atlantic Large Whale Take Reduction Plan at 50 CFR 229.32.
7	*Protected species observer (PSO) and passive acoustic monitoring (PAM) operator qualifications.* Dominion Energy must

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	implement the following measures applicable to PSOs and PAM operators: 1. Dominion Energy must use independent, dedicated, qualified PSOs, meaning that the PSOs must be employed by a third-party observer provider, must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of protected species and mitigation requirements; 2. PSOs must successfully complete relevant training, including completion of all required coursework and passing a written and/or oral examination developed for the training; 3. PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or equivalent in the biological sciences, and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver shall be submitted to NMFS and must include written justification. Alternate experience that may be considered includes, but is not limited to: Secondary education and/or experience comparable to PSO duties; previous work experience conducting academic, commercial, or government sponsored marine mammal surveys; or previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties; 4. PSOs must have visual acuity in both eyes (with correction of vision being permissible) sufficient enough to discern moving targets on the water's surface with the ability to estimate the target size and distance (binocular use is allowable); ability to conduct field observations and collect data according to the assigned protocols; sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations; writing skills sufficient to document observations, including but not limited to, the number and species of marine mammals observed, the dates and times of when in-water construction activities were conducted, the dates and time when in-water construction activities were suspended to avoid potential incidental injury of marine mammals from construction noise within a defined shutdown zone, and marine mammal behavior; and the ability to communicate orally, by radio, or in-person, with project personnel to provide real-time information on marine mammals observed in the area, as necessary; 5. All PSOs must be approved by NMFS. Dominion Energy must submit PSO resumes for NMFS' review and approval at least 60 days prior to commencement of in-water construction activities requiring PSOs. Resumes must include dates of training and any prior NMFS approval, as well as dates and description of last experience, and must be accompanied by information documenting successful completion of an acceptable training course. NMFS shall be allowed three weeks to approve PSOs from the time that the necessary information is received by NMFS, after which PSOs meeting the minimum requirements will automatically be considered approved; 6. All PSOs must be trained in marine mammal identification and behaviors and must be able to conduct field observations and collect data according to assigned protocols. Additionally, PSOs must have the ability to work with all required and relevant software and equipment necessary during observations; 7. At least one PSO on active duty for each activity (i.e., foundation installation, cable landfall activities, and HRG surveys) must be designated as the "Lead PSO". The Lead PSO must have a minimum of 90 days of at-sea experience working in an offshore environment and is required to have no more than eighteen months elapsed since the conclusion of their last at-sea experience; 8. PAM operators must complete specialized training for operating PAM systems and must demonstrate familiarity with the

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	PAM system on which they must be working. PSOs may act as both acoustic operators and visual observers (but not simultaneously), so long as they demonstrate that their training and experience are sufficient to perform each task; and 9. PAM operators may additionally function as PSOs, assuming all qualifications and requirements in paragraphs (a)(1) through (7) of this section are met, but may only perform one role at any one time and must abide by the requirements specified for that role.
8	*General PSO requirements.* The following measures apply to PSOs during all project activities and must be implemented by Dominion Energy: 1. PSOs must monitor all clearance and shutdown zones prior to, during, and following pile driving, cable landfall construction activities, and during HRG surveys that use boomers, sparkers, and CHIRPs (with specific monitoring durations and needs described in paragraphs (c) through (e) of this section, respectively). PSOs must also monitor the Level B harassment zones and document any marine mammals observed within these zones, to the extent practicable. PSOs must ensure that there is appropriate visual coverage for the entire clearance and shutdown zones and as much of the Level B harassment zone as possible; 2. All PSOs must be located at the best vantage point(s) on the primary vessel, pile driving platform, or secondary platform, whichever is most appropriate to the activity occurring, in order to obtain 360 degree visual coverage of the entire clearance and shutdown zones around the activity area, and as much of the Level B harassment zone as possible. PAM operators may be located on a vessel or remotely on-shore but must have the appropriate equipment (i.e., computer station equipped with a data collection software system (i.e., Mysticetus or similar system and acoustic data analysis software) available wherever they are stationed; 3. During all visual observation periods, PSOs must use high magnification (25x) binoculars, standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. During impact pile driving, at least one PSO on the primary pile driving vessel must be equipped with functional Big Eye binoculars (*e.g.,* 25 x 150; 2.7 view angle; individual ocular focus; height control). These must be pedestal mounted on the deck at the best vantage point that provides for optimal sea surface observation and PSO safety; 4. During periods of low visibility (*e.g.,* darkness, rain, fog, poor weather conditions,), PSOs must use alternative technology (i.e., infrared or thermal cameras) to monitor the clearance and shutdown zones; 5. PSOs must not exceed four consecutive watch hours on duty at any time, must have a two-hour (minimum) break between watches, and must not exceed a combined watch schedule of more than 12 hours in a 24-hour period; 6. Any PSO has the authority to call for a delay or shutdown of project activities; 7. Any observations of marine mammals must be communicated to PSOs on all nearby project vessels during construction activities and surveys; 8. PSOs must remain in contact with the PAM operator currently on duty regarding any animal detection that would be approaching or found within the applicable zones no matter where the PAM operator is stationed (i.e., onshore or on a vessel); 9. During daylight hours when equipment is not operating, Dominion Energy must ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports; and 10. Dominion Energy's personnel and PSOs are required to use available sources of information on North Atlantic right whale presence to aid in monitoring efforts. These include daily monitoring of the Right Whale Sightings Advisory System, consulting of the WhaleAlert app, and monitoring of the Coast Guard's VHF Channel 16 throughout the day to receive notifications of any sightings and information associated with any Dynamic Management Areas, to plan construction activities and vessel routes, if practicable, to minimize the potential for co-occurrence with North Atlantic right whales.
9	*PSO and PAM operator requirements during WTG and OSS foundation installation.* The following measures apply to PSOs and PAM operators during monopile and OSS foundation installation and must be implemented by Dominion Energy: 1. At least four PSOs must be actively observing marine mammals before, during, and after installation of foundation piles (i.e., monopiles and pin piles for jacket foundations). At least two PSOs must be stationed and observing on the pile driving vessel and at least two PSOs must be stationed on a secondary, PSO-dedicated vessel. Concurrently, at least one acoustic monitoring PSO (i.e., passive acoustic monitoring (PAM) operator) must be actively monitoring for marine mammals with PAM before, during, and after impact pile driving; 2. All on-duty visual PSOs must remain in contact with the on-duty PAM operator, who would monitor the PAM systems for acoustic detections of marine mammals in the area, regarding any animal detection that might be approaching or found within the applicable zones no matter where the PAM operator is stationed (i.e., onshore or on a vessel); 3. If PSOs cannot visually monitor the minimum visibility zone at all times using the equipment described in paragraphs (b)(3) and (4) of this section, pile driving operations must not commence or must shutdown if they are currently active; 4. All PSOs must begin monitoring 60 minutes prior to pile driving, during, and for 30 minutes after the activity. Pile driving must only commence when the minimum visibility zone is fully visible (*e.g.,* not obscured by darkness, rain, fog,) and the clearance zones are clear of marine mammals for at least 30 minutes, as determined by the Lead PSO, immediately prior to the initiation of pile driving. PAM operators must assist the visual PSOs in monitoring by conducting PAM activities 60 minutes prior to any pile driving, during, and after for 30 minutes for the appropriate size PAM clearance zone (dependent on season). The entire minimum visibility zone must be clear for at least 30 minutes, with no marine mammal detections within the visual or PAM clearance zones prior to the start of pile driving; 5. For North Atlantic right whales, any visual or acoustic detection must trigger a delay to the commencement of pile driving. In the event that a large whale is sighted or acoustically detected that cannot be confirmed by species, it must be treated as if it were a North Atlantic right whale; 6. Dominion Energy must conduct PAM for at least 24 hours immediately prior to pile driving activities; 7. During use of any real-time PAM system, at least one PAM operator must be designated to monitor each system by viewing data or data products that would be streamed in real-time or in near real-time to a computer workstation and monitor; 8. Dominion Energy must use a minimum of one PAM operator to actively monitor for marine mammals before, during, and after pile driving activities. The PAM operator must assist visual PSOs in ensuring full coverage of the clearance and shutdown zones. The PAM operator must inform the Lead PSO(s) on duty of animal detections approaching or within applicable ranges of interest to the pile driving activity via the data collection software system (i.e., Mysticetus or similar

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	system) who will be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (i.e., delay or shutdown); 9. PAM operators must be on watch for a maximum of four consecutive hours, followed by a break of at least two hours between watches, and may not exceed a combined watch schedule of more than 12 hours in a single 24-hour period; 10. Dominion Energy must prepare and submit a Pile Driving and Marine Mammal Monitoring Plan to NMFS for review and approval at least 180 days before the start of any pile driving. The plan must include final pile driving project design (*e.g.,* number and type of piles, hammer type, noise abatement systems, anticipated start date,) and all information related to PAM PSO monitoring protocols for pile-driving and visual PSO protocols for all activities; and 11. A Passive Acoustic Monitoring (PAM) Plan must be submitted to NMFS for review and approval at least 180 days prior to the planned start of WTG or OSS installation. The authorization to take marine mammals would be contingent upon NMFS' approval of the PAM Plan.
10	*PSO requirements during cable landfall construction.* The following measures apply to PSOs during pile driving associated with cable landfall construction activities and must be implemented by Dominion Energy: 1. At least two PSOs must be on active duty during all activities related to the installation and removal of cofferdams, goal posts, and casing pipes; 2. The PSOs must be located at the best vantage points on the pile driving platform or secondary platform in the immediate vicinity of the pile driving; and 3. PSOs must monitor the clearance zone for the presence of marine mammals for 30 minutes before, throughout the installation of the sheet piles and casing pipes, and for 30 minutes after all pile driving activities have ceased. Pile driving must only commence when visual clearance zones are fully visible (*e.g.,* not obscured by darkness, rain, fog,) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to initiation of impact or vibratory pile driving.
11	*PSO requirements during HRG surveys.* The following measures apply to PSOs during HRG surveys using SBPs and must be implemented by Dominion Energy: 1. Between four and six PSOs must be present on every 24-hour survey vessel and two to three PSOs must be present on every 12-hour survey vessel; 2. At least one PSO must be on active duty monitoring during HRG surveys conducted during daylight (i.e., from 30 minutes prior to civil sunrise through 30 minutes following civil sunset) and at least two PSOs must be on activity duty monitoring during HRG surveys conducted at night; 3. PSOs on HRG vessels must begin monitoring 30 minutes prior to activating SBPs during the use of these acoustic sources, and for 30 minutes after use of these acoustic sources has ceased; 4. During daylight hours when survey equipment is not operating, Dominion Energy must ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources. Off-effort PSO monitoring must be reflected in the monthly PSO monitoring reports; and 5. Any acoustic monitoring would complement visual monitoring efforts and would cover an area of at least the Level B

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	harassment zone around each acoustic source.
12	*Reporting.* Dominion Energy must comply with the following reporting measures: 1. Prior to initiation of project activities, Dominion Energy must demonstrate in a report submitted to NMFS Office of Protected Resources that all required training for Dominion Energy personnel (including the vessel crews, vessel captains, PSOs, and PAM operators) has been completed. 2. Dominion Energy must use a standardized reporting system during the effective period of this subpart and LOA. All data collected related to the CVOW–C project must be recorded using industry-standard softwares (*e.g.,* Mysticetus or a similar software) that is installed on field laptops and/or tablets. Dominion Energy must submit weekly (during foundation installation only), monthly, and annual reports as described in paragraphs (f)(5) through (8) of this section. For all monitoring efforts and marine mammal sightings, the following information must be collected and made available to NMFS: i. Date and time that monitored activity begins or ends; ii. Construction activities occurring during each observation period; iii. Watch status (i.e., sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform); iv. PSO who sighted the animal; v. Time of sighting; vi. Weather parameters (*e.g.,* wind speed, percent cloud cover, visibility); vii. Water conditions (*e.g.,* sea state, tide state, water depth); viii. All marine mammal sightings, regardless of distance from the construction activity; ix. Species (or lowest possible taxonomic level possible); x. Pace of the animal(s); xi. Estimated number of animals (minimum/maximum/high/low/best); xii. Estimated number of animals by cohort (*e.g.,* adults, yearlings, juveniles, calves, group composition,); xiii. Description (i.e., as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics); xiv. Description of any marine mammal behavioral observations (e.g., observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity; xv. Animal's closest distance and bearing from the pile being driven or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zones; xvi. Activity at time of sighting (*e.g.,* vibratory installation/removal, impact pile driving, construction survey), use of any noise attenuation device(s), and specific phase of activity (*e.g.,* ramp-up of HRG equipment, HRG acoustic source on/off, soft-start for pile driving, active pile driving,); xvii. Marine mammal occurrence in Level A harassment or Level B harassment zones;

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	xviii. Description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.,* delay, shutdown,) and time and location of the action; and xix. Other human activity in the area. 3. If a marine mammal is acoustically detected during PAM monitoring, the following information must be recorded and reported to NMFS: i. Location of hydrophone (latitude & longitude; in Decimal Degrees) and site name; ii. Bottom depth and depth of recording unit (in meters); iii. Recorder (model & manufacturer) and platform type (i.e., bottom-mounted, electric glider,), and instrument ID of the hydrophone and recording platform (if applicable); iv. Time zone for sound files and recorded date/times in data and metadata (in relation to Universal Coordinated Time (UTC); i.e., Eastern Standard Time (EST) time zone is UTC–5); v. Duration of recordings (start/end dates and times; in International Organization for Standardization (ISO) 8601 format, yyyy–mm–ddTHH:MM:SS.sssZ); vi. Deployment/retrieval dates and times (in ISO 8601 format); vii. Recording schedule (must be continuous); viii. Hydrophone and recorder sensitivity (in dB re. 1 microPascal (μPa)); ix. Calibration curve for each recorder; x. Bandwidth/sampling rate (in Hz); xi. Sample bit-rate of recordings; and, xii. Detection range of equipment for relevant frequency bands (in meters). 4. Information required for each detection, the following information must be noted: i. Species identification (if possible); ii. Call type and number of calls (if known); iii. Temporal aspects of vocalization (date, time, duration,; date times in ISO 8601 format); iv. Confidence of detection (detected, or possibly detected); v. Comparison with any concurrent visual sightings; vi. Location and/or directionality of call (if determined) relative to acoustic recorder or construction activities; vii. Location of recorder and construction activities at time of call; viii. Name and version of detection or sound analysis software used, with protocol reference; ix. Minimum and maximum frequencies viewed/monitored/used in detection (in Hz); and x. Name of PAM operator(s) on duty. 5. Dominion Energy must compile and submit weekly reports to NMFS Office of Protected Resources that document the daily

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	start and stop of all pile driving and HRG survey, the start and stop of associated observation periods by PSOs, details on the deployment of PSOs, a record of all detections of marine mammals (acoustic and visual), any mitigation actions (or if mitigation actions could not be taken, provide reasons why), and details on the noise attenuation system(s) used and its performance. Weekly reports are due on Wednesday for the previous week (Sunday–Saturday) and must include the information required under this section. The weekly report must also identify which turbines become operational and when (a map must be provided). Once all foundation pile installation is completed, weekly reports are no longer required. 6. Dominion Energy must compile and submit monthly reports to NMFS (at itp.potlock@noaa.gov and PR.ITP.monitoringreports@noaa.gov) that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, and route), number of piles installed, all detections of marine mammals, and any mitigative action taken. Monthly reports are due on the 15th of the month for the previous month. The monthly report must also identify which turbines become operational and when (a map must be provided). Once foundation installation is complete, monthly reports are no longer required. 7. Dominion Energy must submit a draft annual report to NMFS Office of Protected Resources no later than 90 days following the end of a given calendar year. Dominion Energy must provide a final report within 30 days following resolution of comments on the draft report. The draft and final reports must detail the following information: i. The total number of marine mammals of each species/stock detected and how many were within the designated Level A harassment and Level B harassment zones with comparison to authorized take of marine mammals for the associated activity type; ii. Marine mammal detections and behavioral observations before, during, and after each activity; iii. What mitigation measures were implemented (i.e., number of shutdowns or clearance zone delays,) or, if no mitigative actions was taken, why not; iv. Operational details (i.e., days of impact and vibratory pile driving, days/amount of HRG survey effort,); v. Any PAM systems used; vi. The results, effectiveness, and which noise attenuation systems were used during relevant activities (i.e., impact pile driving); vii. Summarized information related to situational reporting; and viii. Any other important information relevant to the CVOW–C project, including additional information that may be identified through the adaptive management process. ix. The final annual report must be prepared and submitted within 30 calendar days following the receipt of any comments from NMFS on the draft report. If no comments are received from NMFS within 60 calendar days of NMFS' receipt of the draft report, the report must be considered final. 8. Dominion Energy must submit its draft final report to NMFS Office of Protected Resources on all visual and acoustic monitoring conducted under the LOA within 90 calendar days of the completion of activities occurring under the LOA. A final report must be prepared and submitted within 30 calendar days following receipt of any NMFS comments on the draft report. If no comments are received from NMFS within 30 calendar days of NMFS' receipt of the draft report, the report shall be considered final.

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	9. Dominion Energy must submit a SFV plan at least 180 days prior to the planned start of vibratory and/or impact pile driving. The plan must describe how Dominion Energy would ensure that the first three WTG monopile and OSS jacket (using pin piles) foundation installation sites selected for SFV are representative of the rest of the monopile and pin pile installation sites. In the case that these sites/scenarios are not determined to be representative of all other monopile/pin pile installation sites, Dominion Energy must include information on how additional sites/scenarios would be selected for SFV. The plan must also include methodology for collecting, analyzing, and preparing SFV data for submission to NMFS. The plan must describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. Dominion Energy must also provide, as soon as they are available but no later than 48 hours after each installation, the initial results of the SFV measurements to NMFS in an interim report after each monopile for the first three piles and after each OSS jacket foundation using pin piles are installed. i. The SFV plan must also include how operational noise would be monitored. Dominion Energy must estimate source levels (at 10 m from the operating foundation) based on received levels measured at 50 m, 100 m, and 250 m from the pile foundation. These data must be used to identify estimated transmission loss rates. Operational parameters (*e.g.,* direct drive/gearbox information, turbine rotation rate) as well as sea state conditions and information on nearby anthropogenic activities (*e.g.,* vessels transiting or operating in the area) must be reported. ii. Dominion Energy must provide the initial results of the SFV measurements to NMFS in an interim report after each monopile and pin pile foundation installation for the first three monopiles piles and/or two full OSS foundations (consisting of 8 total pin piles) as soon as they are available, but no later than 48 hours after each installation. Dominion Energy must also provide interim reports on any subsequent SFV on foundation piles within 48 hours. The interim report must include hammer energies used during pile driving, peak sound pressure level (SPL_{pk}) and median, mean, maximum, and minimum root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}) and single strike sound exposure level (SEL_{ss}). iii. The final results of SFV of foundation installations must be submitted as soon as possible, but no later than within 90 days following completion of pile driving of monopiles and pin piles. The final report must include, at minimum, the following: A. Peak sound pressure level (SPL_{pk}), root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), single strike sound exposure level (SEL_{ss}), integration time for SPL_{rms}, spectrum, and 24-hour cumulative SEL extrapolated from measurements at specified distances (*e.g.,* 750 m); B. All these levels must be reported in the form of: 1. Median; 2. Mean; 3. Maximum; and 4. Minimum; C. The SEL and SPL power spectral density and one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported;

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	D. The sound levels reported must be in median and linear average (i.e., average in linear space), and in dB; E. A description of depth and sediment type, as documented in the Construction and Operation Plan (COP), at the recording and pile driving locations; F. Hammer energies required for pile installation and the number of strikes per pile; G. Hydrophone equipment and methods (i.e., recording device, bandwidth/sampling rate, distance from the pile where recordings were made; depth of recording device(s)); H. Description of the SFV PAM hardware and software, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, any limitations with the equipment, and other relevant information; I. Local environmental conditions, such as wind speed, transmission loss data collected on-site (or the sound velocity profile), baseline pre- and post-activity ambient sound levels (broadband and/or within frequencies of concern); J. Spatial configuration of the noise attenuation device(s) relative to the pile; K. He extents of the Level A harassment and Level B harassment zones; and L. A description of the noise abatement system and operational parameters (*e.g.,* bubble flow rate, distance deployed from the pile,) and any action taken to adjust the noise abatement system. 10. Dominion Energy must submit situational reports if the following circumstances occur: i. If a North Atlantic right whale is observed at any time by PSOs or personnel on or in the vicinity of any project vessel, or during vessel transit, Dominion Energy must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System (866) 755–6622, through the WhaleAlert app (*https://www.whalealert.org/*), and to the U.S. Coast Guard via channel 16, as soon as feasible but no longer than 24 hours after the sighting. Information reported must include, at a minimum: time of sighting, location, and number of North Atlantic right whales observed. ii. When an observation of a large whale occurs during vessel transit, the following information must be recorded and reported to NMFS: A. Time, date, and location (latitude/longitude; in Decimal Degrees) B. The vessel's activity, heading, and speed; C. Sea state, water depth, and visibility; D. Marine mammal identification to the best of the observer's ability (*e.g.,* North Atlantic right whale, whale, dolphin, seal); E. Initial distance and bearing to marine mammal from vessel and closest point of approach; and F. Any avoidance measures taken in response to the marine mammal sighting. iii. If a North Atlantic right whale is detected via PAM, the date, time, location (i.e., latitude and longitude of recorder)

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	of the detection as well as the recording platform that had the detection must be reported to nmfs.pacmdata@noaa.gov as soon as feasible, but no longer than 24 hours after the detection. Full detection data and metadata must be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic right whale Passive Acoustic Reporting System website at https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates. iv. In the event that the personnel involved in the activities defined in § 217.290(a) discover a stranded, entangled, injured, or dead marine mammal, Dominion Energy must immediately report the observation to the NMFS Office of Protected Resources (OPR), the NMFS Greater Atlantic Stranding Coordinator for the New England/Mid-Atlantic area (866–755–6622), and the U.S. Coast Guard within 24 hours. If the injury or death was caused by a project activity, Dominion Energy must immediately cease all activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. Dominion Energy may not resume their activities until notified by NMFS. The report must include the following information: A. Time, date, and location (latitude/longitude; in Decimal Degrees) of the first discovery (and updated location information if known and applicable); B. Species identification (if known) or description of the animal(s) involved; C. Condition of the animal(s) (including carcass condition if the animal is dead); D. Observed behaviors of the animal(s), if alive; E. If available, photographs or video footage of the animal(s); and F. General circumstances under which the animal was discovered. v. In the event of a vessel strike of a marine mammal by any vessel associated with the CVOW–C project, Dominion Energy must immediately report the strike incident to the NMFS OPR and the NMFS Greater Atlantic Regional Fisheries Office (GARFO) within and no later than 24 hours. Dominion Energy must immediately cease all on-water activities until NMFS OPR is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. Dominion Energy may not resume their activities until notified by NMFS. The report must include the following information: A. Time, date, and location (latitude/longitude; in Decimal Degrees) of the incident; B. Species identification (if known) or description of the animal(s) involved; C. Vessel’s speed leading up to and during the incident; D. Vessel's course/heading and what operations were being conducted (if applicable); E. Status of all sound sources in use; F. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;

#	Table H-4. Description of Lessee Authorization and Permit Conditions
	G. Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; H. Estimated size and length of animal that was struck; I. Description of the behavior of the marine mammal immediately preceding and following the strike; J. If available, description of the presence and behavior of any other marine mammals immediately preceding the strike; K. Estimated fate of the animal (*e.g.,* dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and L. To the extent practicable, photographs or video footage of the animal(s).

H.1. References

Bureau of Ocean Energy Management (BOEM). 2020. *BOEM Construction and Operations Plan (COP) Guidelines.*

Bureau of Ocean Energy Management (BOEM). 2021. *Guidelines for Lighting and Marking of Structures Supporting Renewable Energy Development*. April 28. Available: https://www.boem.gov/sites/default/files/documents/renewable-energy/2021-Lighting-and-Marking-Guidelines.pdf.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. February.

Moorhead, D.J., K.A. Rawlins, C.W. Evans, C.E. Barlow, and C.T. Bargeron. 2011. *A Land Manager's Guide to Best Management Practices (BMPs) to Prevent the Introduction and Spread of Invasive Species*. The University of Georgia. Center for Invasive Species and Ecosystem Health, Tifton GA. BW-2011-03. 28 pp. Available: https://bugwoodcloud.org/mura/gist/assets/File/LMBMP.pdf. Accessed: October 13, 2020.

U.S. Department of Agriculture, National Invasive Species Information Center (USDA NISIC). 2020. "Invasive Species Resources." U.S. Department of Agriculture, National Invasive Species Information Center Available: https://www.invasivespeciesinfo.gov/resourcesindexed? f[0]=field_subject:239. Accessed: October 13, 2020.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NISIC). 2020. *Pollinator-Friendly Plants for the Northeast United States*. U.S. Department of Agriculture, Natural Resource Conservation Service. Available: https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/nypmctn11164.pdf. Accessed: October 8, 2020.

Virginia Department of Environmental Quality (VDEQ). 1992. *Virginia Erosion and Sediment Control Handbook*. Third Edition. Virginia Department of Environmental Quality. Available: https://www.deq.virginia.gov/programs/water/stormwatermanagement/publications/eschandbook.asp x. Accessed: October 12, 2020.

Virginia Department of Environmental Quality (VDEQ). 2014. *Virginia Erosion and Sediment Control Law and Regulations. Virginia Department of Environmental Quality, Richmond, Virginia.* Available: https://www.deq.virginia.gov/Portals/0/DEQ/Water/StormwaterManagement/Erosion_Sediment_Control_Handbook/ESC_Handbook_Law_Regulations.pdf. Accessed: October 12, 2020.

U.S. Fish and Wildlife Service (USFWS). 2016. *Programmatic Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and Activities Excepted from Take Prohibitions.* U.S. Fish and Wildlife Service. Midwest Regional Office. Bloomington, Minnesota.

Appendix I. Environmental and Physical Settings

The environmental and physical settings section is prepared by the Environmental Impact Statement (EIS) third-party contractor, but relies heavily on information presented in the Construction and Operations Plan (COP) (Dominion Energy 2023). This section describes environmental and physical settings in the area(s) in which the actions are proposed to occur, and areas that may have interrelated or interdependent activities with the Proposed Action. These descriptions are utilized by various environmental resource sections in Chapter 3, *Affected Environment and Environmental Consequences,* to assess the reasonable, foreseeable impacts on those resources. Sections of this appendix may include physical oceanography, biological oceanography, meteorological conditions, geology, and acoustic environment. This section is to be used to provide additional information on resources within the Project area that is relevant to the impact discussions, but due to page limitations, could not be incorporated into Chapter 3.

I.1. General Regional Setting

I.2. Climate and Meteorology

Conditions that affect the weather and climate in an area include wind velocity, air temperature, and precipitation. Long-term averages of these conditions produce the regional climate. The state of Virginia straddles the Mid-Atlantic and Southeast regions of the United States. Northern parts of the state have a temperate climate while the southern parts of the state have a subtropical climate. Virginia officially classifies the state as a humid, subtropical climate due to winter frost and humid conditions in the summer influenced by the Chesapeake Bay and the Atlantic Ocean (Virginia Tourism Corporation 2021). Extreme meteorological conditions can be produced in both the Mid-Atlantic and Southeast regions during tropical and extratropical storms. Over the open ocean, meteorological characteristics are fundamentally influenced by oceanographic conditions and are, therefore, sometimes jointly discussed as “metocean” conditions. Several metocean conditions are highly seasonal and driven by both atmospheric and oceanic circulation patterns. Daily variability in meteorological conditions will drive fluctuations in wind farm power production and associated stresses on the wind turbine generators (WTGs), while long-term performance may be estimated based on the climatic conditions.

I.2.1 Regional Climate Overview

Virginia is classified as a mid-latitude climate zone based on the Köppen Climate Classification System. The mid-latitude climate zone is characterized by mostly moist subtropical conditions, generally warm and humid in the summer with relatively mild winters (BOEM 2021a). More specifically, the Lease Area is located in the Mid-Atlantic Bight. Oceanographic conditions along the Mid-Atlantic Bight are comparable to conditions along the mid-latitude East Coast, with warmer summer months and cooler yet mild winter months (BOEM 2021b).

Virginia has a varied topography with the Appalachian Mountains and Blue Ridge Mountains in the west and the Atlantic coastal region in the east. The eastern tidewater coastal region experiences more precipitation and humidity than the rest of the state, registering up to 50 inches of precipitation per year as compared to less than 40 inches in the central and western parts of the state (NCEI 2021a). The tidewater coastal region is also prone to coastal flooding, extreme winds, and high levels of rainfall from coastal storms. Coastal storms, including tropical storms and hurricanes, primarily affect the region between the months of June and November (BOEM 2021b).

The North Atlantic Oscillation (NAO) also affects climate in the Northwest Atlantic on the scale of decades (Townsend et al. 2004). The NAO is calculated as the wintertime pressure difference between the high-pressure system over the Azores Islands and the low-pressure system over Iceland (Townsend et al. 2004). Shifts in the ratio of these pressures contribute to warmer or cooler average winters. Since the late 1970s, warmer NAO conditions have persisted on average (NJDEP 2010; Townsend et al. 2004). The NAO may be influenced by the El Niño-Southern Oscillation, which is a large-scale multi-year fluctuation in sea surface temperatures in the Pacific Ocean (NJDEP 2010). The NAO may also be correlated with an 11-year solar cycle (IPCC 2021).

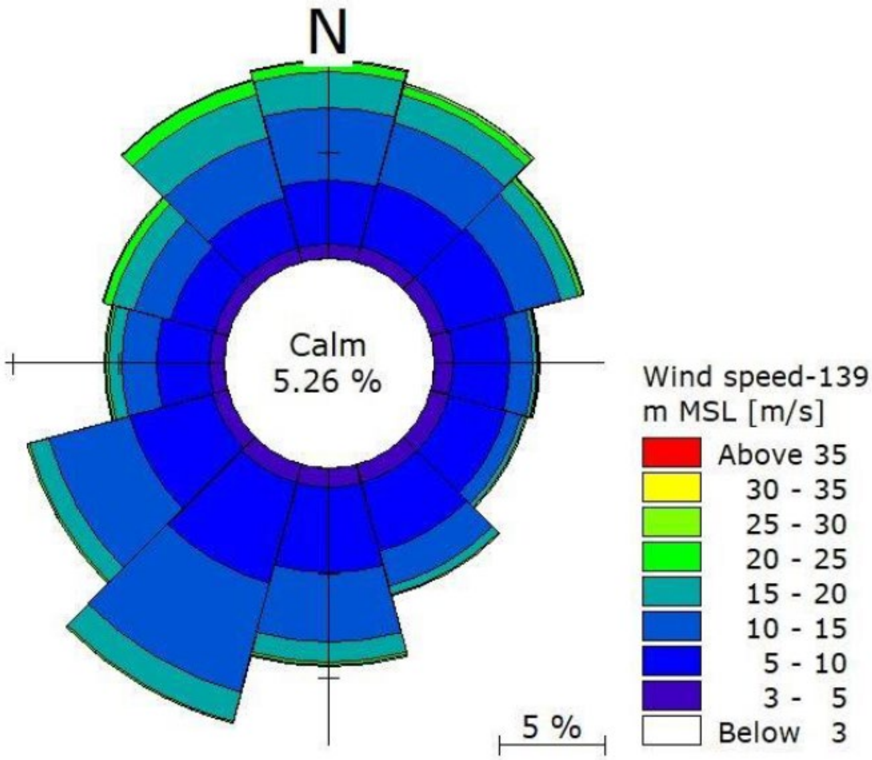
IPCC classifies Virginia to be in the Southeast region of the United States for its climate change reports. The U.S. Southeast region is currently subject to climate changes associated with global warming that are primarily attributed to human activities, especially the production of heat-trapping (i.e., “greenhouse”) gases (Carter et al. 2018; Hayhoe et al. 2018; IPCC 2021). The Southeast region has experienced gradual warming since the 1960s, and the number of very cold nights in Virginia (minimum temperature below 0 degrees Fahrenheit [°F]) was below the long-term average for the last two decades recorded (Carter et al. 2018; NCEI 2021a). There is also an upward trend in the number of extreme precipitation events in Virginia, with the number of such events between 1995 and 1999 surpassing the previous record set in the early 1940s (NCEI 2021a). Continued climate change is likely to change the frequency and intensity of storms in the Project area because of its coastal location (EPA 2017 as cited in BOEM 2021b). Nuisance-level tidal floods associated with storms in the region, which can damage infrastructure and cause road closures, are increasing in frequency. Between 1980 and 2012, Virginia was affected by 35 of the 144 unique U.S. billion-dollar disaster events (NCEI 2021a).

I.2.2 Winds

Prevailing winds at the middle latitudes over North America occur mostly west to east (“westerlies”). Westerlies within the Lease Area vary in strength, pattern, and directionality and contribute to seasonal variability in the region. In the Mid-Atlantic Bight, winds during the summer are typically from the southwest, while winds in the winter months are typically from the northwest. Spring and fall are more variable, with wind currents from either the southwest or northeast (Schofield et al. 2008).

According to the Climate Forecast System Reanalysis data set, winds in the Lease Area are strongest from the north, while the highest frequency of winds come from the southwest and the north (NOAA n.d. as cited in BOEM 2021b). Average wind speed and direction are depicted as a wind rose in Figure I-1.

In addition to the wind data presented above and representative data for wind speed and wind direction are publicly available from the NOAA National Data Buoy Center. The Chesapeake Light, Virginia buoy (Station CHLV2) located approximately 12 miles west of the Lease Area at coordinates of 36.905, -75.713 (latitude, longitude) was the closest National Data Buoy Center station to the Lease Area measuring wind speed and wind direction data. The Chesapeake Light, Virginia buoy was decommissioned in August 2016 due to deteriorating structural conditions (NOAA National Data Buoy Center 2021a). Data are also available from the Cape Henry, Virginia station (Station CHYV2), which is located on the coast in the Cape Henry Lighthouse approximately 29 miles west of the Lease Area at coordinates of 36.926, -76.007 (latitude, longitude) (NOAA National Data Buoy Center 2021b).



Source: NOAA n.d. as cited in BOEM 2021b.
Note: Operational wind parameters analyzed measured at a height of 32.8 feet (10 meters) above mean sea level (MSL); however, the data points were scaled to hub height of 456.0 feet (139 meters) above MSL. Lease Area is modeled at 36.947, -75.217 (latitude, longitude).

Figure I-1 Wind Rose of Mean Wind Speeds and Directions at Hub Height for the Lease Area (1979–2018)

Before it was decommissioned, the maximum wind speed[1] recorded at the Chesapeake Light, Virginia buoy (Station CHLV2) was 83.0 miles per hour (mph) (37.1 meters per second [m/s]) in September 1985, with annual average wind speeds from 15.1 to 18.0 mph (6.8 to 8.0 m/s) across the 25 year data collection period. Monthly average wind speeds, monthly average peak wind gusts, and hourly peak wind gusts for each individual month are shown in Table I-1. Monthly mean wind speeds range from a low of 13.1 mph (5.9 m/s) in July and August to a high of 19.1 mph (8.5 m/s) in January. The monthly wind mean peak gusts reach a maximum during January at 23.8 mph (10.6 m/s), while the 1-hour average wind gusts reach a maximum during August at 98.9 mph (44.2 m/s) (NOAA National Data Buoy Center 2021a). Extreme wind conditions along the mid-latitude East Coast are influenced by tropical storms and higher hourly peak wind gusts registered in summer and fall months are often due to tropical cyclones.

Data from the Cape Henry, Virginia station (Station CHYV2) are available for the more recent period of March 2006 through December 2012. The Cape Henry, Virginia station, located on the coast as opposed to offshore, has measured lower wind speeds than the Chesapeake Light, Virginia buoy. The maximum wind speed at the Cape Henry, Virginia station was 59.5 mph (26.6 m/s) recorded in March 2009, and

[1] NOAA buoy measurements for wind speed are averaged over an 8-minute period. Higher speeds are recorded for 5- to 8-second gusts.

average annual wind speeds measured from 11.7 to 12.8 mph (5.2 to 5.7 m/s) across the 6 years recorded (NOAA National Data Buoy Center 2021b).

Table I-1 Representative Wind Speed Data

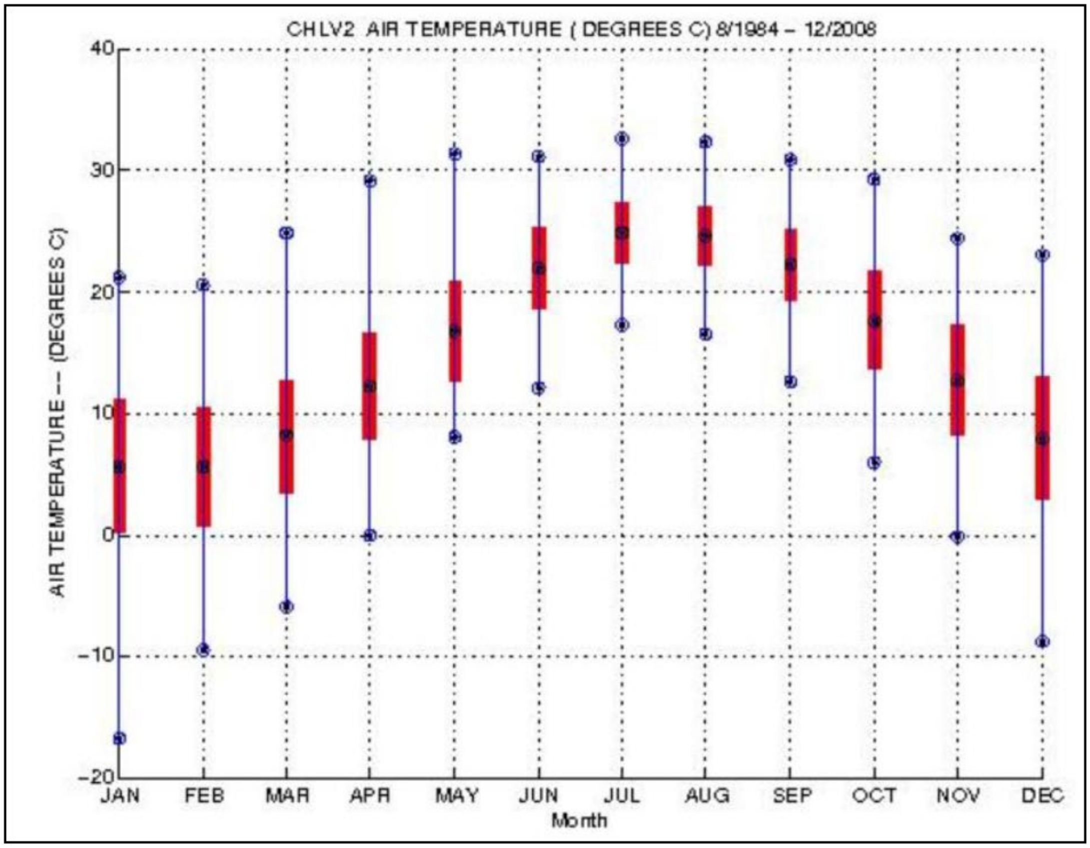
Month	Monthly Average Wind Speed (1984–2008)		Monthly Average of Hourly Peak Gust (1990–2005)		Monthly Maximum Hourly Peak Gust (1990–2005)	
	mph	m/s	mph	m/s	mph	m/s
January	19.1	8.5	23.8	10.6	79.2	35.4
February	18.6	8.3	23.1	10.3	75.1	33.6
March	18.8	8.4	23.2	10.4	83.0	37.1
April	18.5	8.3	23.4	10.5	72.5	32.4
May	16.2	7.2	20.4	9.1	64.2	28.7
June	14.3	6.4	17.7	7.9	55.7	24.9
July	13.1	5.9	16.8	7.5	72.5	32.4
August	13.1	5.9	16.7	7.5	98.9	44.2
September	15.2	6.8	19.6	8.8	93.3	41.7
October	16.0	7.2	20.4	9.1	73.9	33.0
November	17.5	7.8	21.6	9.7	63.5	28.4
December	18.3	8.2	23.6	10.6	87.0	38.9
Annual	16.6	7.4	20.8	9.3	98.9	44.2

Source: NOAA National Data Buoy Center 2021a.
Note: Data presented are for National Data Buoy Center Station CHLV2 (Chesapeake Light, Virginia).

I.2.3 Air Temperature and Precipitation

NOAA's National Centers for Environmental Information (NCEI), formerly the National Climatic Data Center, defines distinct climatological divisions to represent areas that are nearly climatically homogeneous. Locations within the same climatic division are considered to share the same overall climatic features and influences. The site of the Proposed Action is located within the Virginia tidewater division or Virginia Climate Division 1 (NCEI 2021b).

The mean average annual air temperature in the tidewater division of Virginia was 58.0°F (14.4 degrees Celsius [°C]) between 1895 and 2021 (NCEI 2021c). The seasonal mean ranged from 39.5°F (4.2°C) in winter (December through February) to 76.1°F (24.5°C) in summer (June through August) (NCEI 2021c). According to Dominion Energy's preliminary metocean analysis, air temperatures in the Project area range from -0.4 to 95°F (18 to 35°C) (Ramboll 2020; NOAA 2020 as both cited in BOEM 2021b). The monthly mean and extreme air temperatures are shown graphically in Figure I-2.



Source: NOAA 2020 as cited in BOEM 2021b.

Figure I-2 Monthly Mean, One Standard Deviation, and Monthly Extreme Air Temperatures at National Data Buoy Center Station CHLV2 (1984–2008)

Air temperature information is also available from NOAA’s National Data Buoy Center Chesapeake Light, Virginia buoy (Station CHLV2) and Cape Henry, Virginia Station (Station CHYV2). This information is presented in Table I-2 and shows average air temperatures near the Lease Area ranging from 41 to 78°F (4.7 to 25.8°C), with the higher temperatures during the summer months (NOAA National Data Buoy Center 2021a; 2021b).

Table I-2 Average Air Temperature at NDBC Buoys Near the Lease Area

Average Air Temperature in °F														
Buoy	**Years**	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
CHLV2	1984-2008	42.1 (5.6)	42.1 (5.6)	46.6 (8.1)	54.1 (12.3)	62.2 (16.8)	71.4 (21.9)	76.6 (24.8)	76.3 (24.6)	72.0 (22.2)	63.9 (17.7)	54.9 (12.7)	46.4 (8.0)	59.0 (15.0)
CHYV2	2006-2012	40.5 (4.7)	42.1 (5.6)	50.2 (10.1)	59.5 (15.3)	65.8 (18.8)	75.4 (24.1)	78.4 (25.8)	78.1 (25.6)	72.7 (22.6)	64.0 (17.8)	54.0 (12.2)	45.9 (7.7)	60.8 (16.0)

Source: NOAA National Data Buoy Center 2021a; 2021b.

The mean annual precipitation for the tidewater region of Virginia between 1895 and 2021 was 44.84 inches (113.9 centimeters) (NCEI 2021d). During the same period, the mean monthly precipitation ranged from 2.86 inches (7.3 centimeters) in November to 5.11 inches (13.0 centimeters) in July (NCEI 2021d). A summary of monthly and annual mean temperature and precipitation data collected for the Virginia tidewater division between 1895 and 2021 is presented in Table I-3.

Table I-3 Mean Temperatures and Precipitation for Virginia Tidewater Division (1895–2021)

Month	Average Mean Temperature		Maximum Mean Temperature		Minimum Mean Temperature		Total Mean Precipitation	
	°F	°C	°F	°C	°F	°C	Inches	cm
January	38.1	3.4	48.0	8.9	28.3	-2.1	3.37	8.56
February	39.7	4.3	50.1	10.1	29.2	-1.6	3.21	8.15
March	47.5	8.6	58.7	14.8	36.4	2.4	3.81	9.68
April	56.6	13.7	68.3	20.2	44.9	7.2	3.31	8.41
May	65.9	18.8	77.1	25.1	54.6	12.6	3.80	9.65
June	73.9	23.3	84.4	29.1	63.4	17.4	4.13	10.49
July	78.0	25.6	87.9	31.1	68.0	20.0	5.11	12.98
August	76.5	24.7	86.3	30.2	66.7	19.3	4.84	12.29
September	70.7	21.5	80.8	27.1	60.6	15.9	3.90	9.91
October	59.8	15.4	70.8	21.6	48.8	9.3	3.23	8.20
November	49.2	9.6	60.1	15.6	38.3	3.5	2.86	7.26
December	40.6	4.8	50.5	10.3	30.8	-0.7	3.31	8.41
Annual	**58.0**	**14.4**	**68.6**	**20.3**	**47.5**	**8.6**	**44.84**	**113.89**

Source: NCEI 2021c; 2021d.
°C = degrees Celsius; °F = degrees Fahrenheit; cm = centimeters.

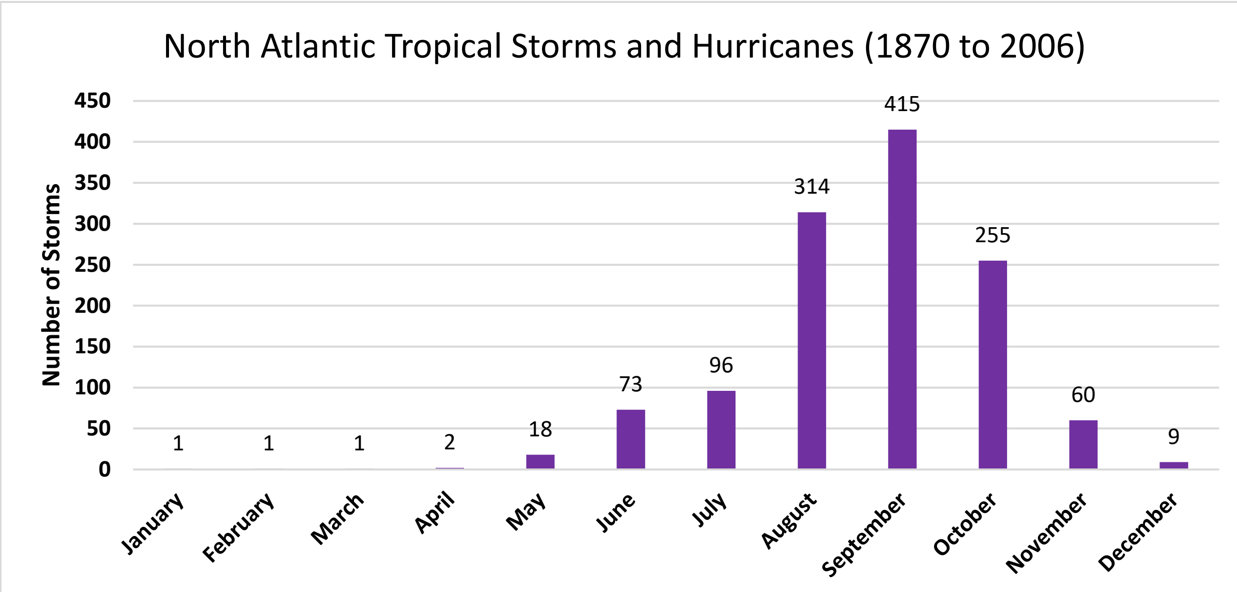
I.2.4 Extreme Storm Events

Storm events are known to occur within the Mid-Atlantic Bight and include, but are not limited to, tropical storms and hurricanes. Tropical storms and hurricanes tend to increase in intensity and frequency toward the southern portion of the East Coast. Furthermore, the storms will build and intensify offshore, indicating that the Offshore Project area may be subject to more extreme-weather events than the Onshore Project Area. Tropical storms and hurricanes can cause extreme waves and winds, extreme tides, and temporary shifts in the currents (BOEM 2021b).

The annual hurricane season typically occurs from the beginning of June to the end of November (BOEM 2021b). This is consistent with the peak period for tropical cyclones throughout the North Atlantic basin (Figure I-3) (McAdie et al. 2009). Such storms that travel along the coastline of the eastern U.S. have the potential to impact the Project area with high winds and severe flooding.

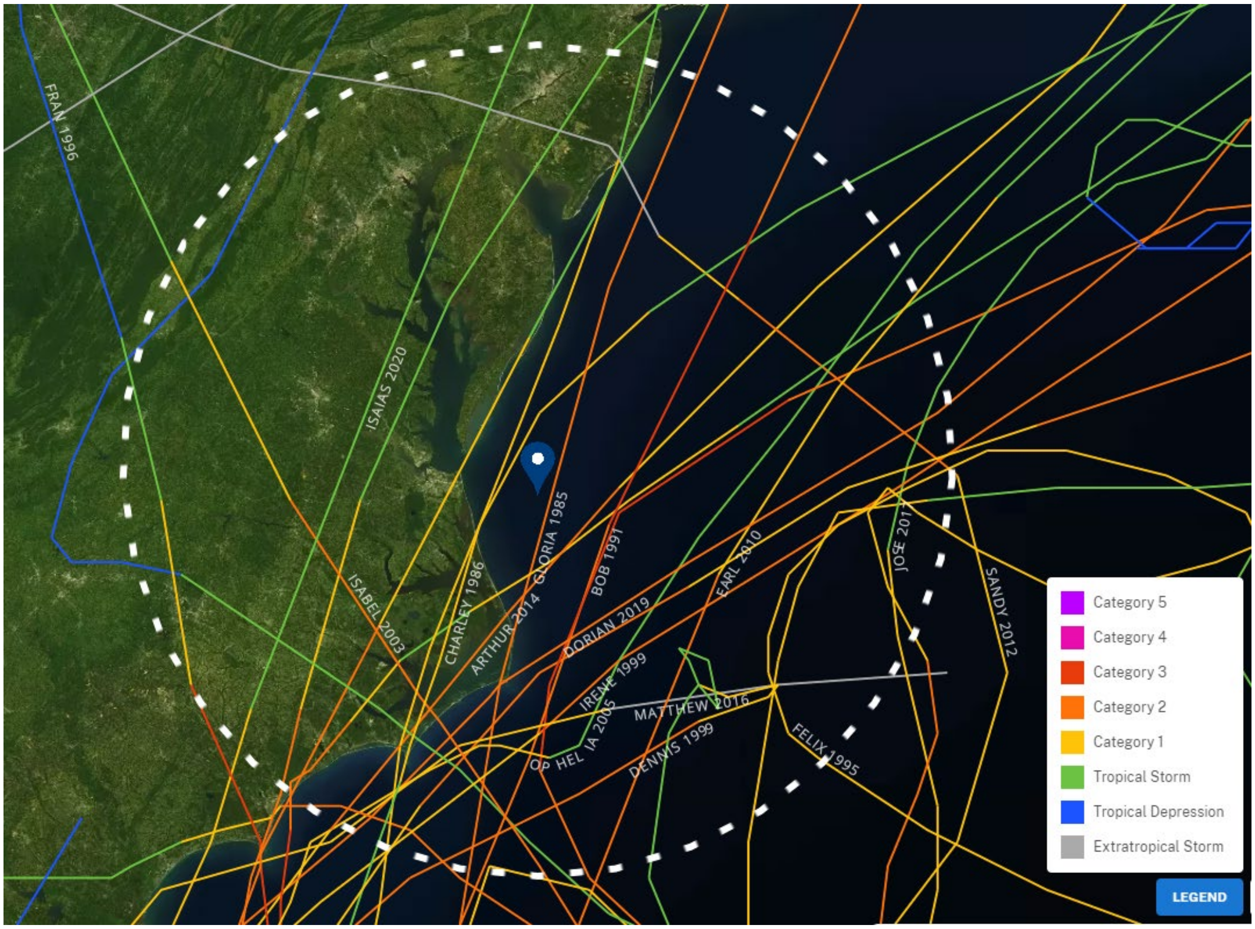
Figure I-4 identifies the hurricane tracks surrounding the Lease Area between 1984 and 2020 (NOAA 2021). Though data on tropical systems go back to 1851, the quality and consistency of the data are lacking the further back one looks. The analyzed storm period was selected based on the availability of consistent wind data for tropical and extratropical systems and for the Project area. The category for each storm is designated by a color for each segment of its track in Figure I-4. Table I-4 lists each of the hurricanes affecting the Lease Area and the corresponding maximum storm categories as the hurricane occurred within 200 nautical miles (370 kilometers) of the Lease Area for the corresponding period

(NOAA 2021). Most historical hurricanes affecting the Lease Area are Category 1, but storms as powerful as Category 3 hurricanes have passed nearby the Lease Area.



Source: McAdie et al. 2009

Figure I-3 Total Number of North Atlantic Basin Tropical Storms and Hurricanes per Month (1870–2006)



Source: NOAA 2021

Figure I-4 Tracks of Hurricanes that Occurred within a Radius of 200 Nautical Miles (370 kilometers) around the Lease Area between 1984 and 2020

Table I-4 Hurricanes with Tracks Passing within 200 Nautical Miles of Lease Area between 1984 and 2020

Storm Name	Year	Maximum Storm Category within 200 Nautical Miles of Lease Area
Isaias	2020	Category 1 Hurricane
Dorian	2019	Category 2 Hurricane
Florence	2018	Category 2 Hurricane
Maria	2017	Category 1 Hurricane
Jose	2017	Category 1 Hurricane
Matthew	2016	Category 1 Hurricane
Arthur	2014	Category 2 Hurricane
Sandy	2012	Category 2 Hurricane
Irene	2011	Category 1 Hurricane
Earl	2010	Category 2 Hurricane
Ophelia	2005	Category 1 Hurricane
Alex	2004	Category 2 Hurricane
Isabel	2003	Category 2 Hurricane
Irene	1999	Category 2 Hurricane
Floyd	1999	Category 2 Hurricane
Dennis	1999	Category 2 Hurricane
Bonnie	1998	Category 2 Hurricane
Fran	1996	Category 1 Hurricane
Bertha	1996	Category 2 Hurricane
Felix	1995	Category 1 Hurricane
Gordon	1994	Category 1 Hurricane
Emily	1993	Category 3 Hurricane
Bob	1991	Category 3 Hurricane
Charley	1986	Category 1 Hurricane
Gloria	1985	Category 2 Hurricane
Josephine	1984	Category 1 Hurricane

Source: NOAA 2021.
Notes: The Lease Area location was represented by a point with the following coordinates: Latitude 36.947, Longitude -75.217. Hurricane categories are identified as 1 through 5 based on the Saffir-Simpson scale.

The costliest weather event to ever affect the state of Virginia was Superstorm Sandy in 2012 (NCEI 2021a). Superstorm Sandy was, at its maximum, a Category 2 Hurricane within 200 nautical miles of the Lease Area but was considered a post-tropical storm as it affected onshore portions of Virginia. Superstorm Sandy caused severe coastal flooding from storm surges. In Wachapreague on the Eastern Shore of Virginia, tide gauges measured a storm surge of 4.95 feet (1.5 meters) and inundations of 2 to 4 feet (0.6 to 1.2 meters) were prevalent along the coast (Blake et al. 2013). During Superstorm Sandy, the Norfolk International Airport (location code KORF) recorded maximum sustained wind speeds of 34 knots (39.1 mph; 17.5 m/s), while marine observations at the Chesapeake Light, Virginia buoy (Station CHLV2) recorded maximum sustained wind speeds of 49 knots (56.4 mph; 25.2 m/s) and a peak gust of 59 knots (67.9 mph; 30.4 m/s) (Blake et al. 2013).

I.2.5 Potential General Impacts of Offshore Wind Facilities on Meteorological Conditions

A known impact of offshore wind facilities on meteorological conditions is the wake effect. A wind turbine generator (WTG) extracts energy from the free flow of wind, creating turbulence downstream of the WTG. The resulting "wake effect" is the aggregated influence of the WTGs for the entire wind farm on the available wind resource and the energy production potential of any facility located downstream. Christiansen and Hasager (2005) observed offshore wake effects from existing facilities via satellite with synthetic aperture radar to last anywhere from 1.2 to 12.4 miles (2 to 20 kilometers) depending on ambient wind speed, direction, degree of atmospheric stability and the number of turbines within a facility. During stable atmospheric conditions, these offshore wakes can be longer than 43.5 miles (70 kilometers).

Under certain conditions, offshore wind farms can also affect temperature and moisture downwind of the facilities. For example, from September 2016 to October 2017, a study using aircraft observations accompanied by mesoscale simulations examined the spatial dimensions of micrometeorological impacts from a wind energy facility in the North Sea (Siedersleben et al. 2018). Measurements and associated modeling indicated that measurable redistribution of moisture and heat were possible up to 62 miles (100 kilometers) downwind of the wind farm. However, this occurred only when (a) there was a strong, sustained temperature inversion at or below hub height and (b) wind speeds were greater than approximately 13.4 mph (6 m/s) (Siedersleben et al. 2018). Typically, air temperature will decrease with height above the sea surface in the lower atmosphere (i.e., the troposphere), and air will freely rise and disperse up to a "mixing height" (Holzworth 1972; Ramaswamy et al. 2006). A temperature inversion occurs when a warmer overlying air mass causes temperatures to increase with height; a strong inversion inhibits the further rise of cooler surface air masses, thus limiting the mixing height (Ramaswamy et al. 2006). Therefore, the North Sea study suggests that rapidly spinning turbines with hub heights at or above a strong inversion may induce mixing between air masses that would otherwise remain separated, which can significantly affect temperature and humidity downwind of a wind farm.

The mixing height over open waters of the North Atlantic Ocean is typically greater than 1,640 ft (500 m) above mean sea level, except over areas of upwelling, where the mixing height may be closer to the sea surface (Holzworth 1972; Fuhlbrügge et al. 2013). Table I-5 presents atmospheric mixing height data from the nearest measurement location to the Project area (Wallops Island, Virginia). As shown in the table, the minimum average mixing height is 640 meters (2,100 feet), while the maximum average mixing height is 1,505 meters (4,938 feet).

Table I-5 Representative Seasonal Mixing Height Data

Season	Data Hours Included[1]	Wallops Island, Virginia Average Mixing Height (meters)
Winter (December, January, February)	Morning – No-Precipitation Hours	692
	Morning – All Hours	739
	Afternoon – No-Precipitation Hours	1,098
	Afternoon – All Hours	1,010
Spring (March, April, May)	Morning – No-Precipitation Hours	640
	Morning – All Hours	687
	Afternoon – No-Precipitation Hours	1,489
	Afternoon – All Hours	1,369
Summer (June, July, August)	Morning – No-Precipitation Hours	672
	Morning – All Hours	720

Season	Data Hours Included[1]	Wallops Island, Virginia Average Mixing Height (meters)
	Afternoon – No-Precipitation Hours	1,505
	Afternoon – All Hours	1,413
Fall (September, October, November)	Morning – No-Precipitation Hours	662
	Morning – All Hours	717
	Afternoon – No-Precipitation Hours	1,241
	Afternoon – All Hours	1,178
Annual Average	Morning – No-Precipitation Hours	666
	Morning – All Hours	716
	Afternoon – No-Precipitation Hours	1,333
	Afternoon – All Hours	1,244

Source: USEPA 2021.
[1] Missing values are not included.

Díaz et al. (2019) reported that measurements over the Atlantic Ocean between 1981 and 2010 indicated a trend of decreasing strength and thickness of inversion layers, accompanied by a general increase in the mixing height, which is correlated with an increase in sea surface temperatures. Therefore, WTG hub heights are expected to remain well below the typical mixing height and associated temperature inversions over the open ocean in the Mid-Atlantic and Southeast U.S. regions. Thus, the redistribution of moisture and heat due to rotor-induced vertical mixing, and any associated shifts to the microclimate, would be limited to the immediate vicinity of a wind facility in this region.

Additionally, mixing height affects air quality by acting as a lid on the height to which air pollutants can vertically disperse. Lower mixing heights allow less air volume for pollutant dispersion and lead to higher ground-level pollutant concentrations than do higher mixing heights.

I.3. Benthic/Finfish

Triangle Reef fish haven is an artificial reef located in the northern section of the CVOW-C Lease Area. WTGs are proposed in this area under Alternatives A and D. Triangle Reef construction began in 1971 with World War II-era ships, tires, cable spools, and other materials. These reef materials provide shelter for structure-affiliated fish species such as black sea bass, striped bass, scup, and tautog, as well as commercially important invertebrates like conch and whelk. Highly migratory species such as tuna and sharks also use these artificial reefs within the Atlantic. Triangle Reef would be accessible for activities related to recreational fisheries throughout the operations and maintenance phases of the CVOW-C project.

I.4. Water Quality

Figure I-5 shows impaired waterbodies within the geographic analysis area for water quality. Table I-6 contains a complete listing of 303(d) impaired waters in the geographic analysis area and the reasons for their impairment.

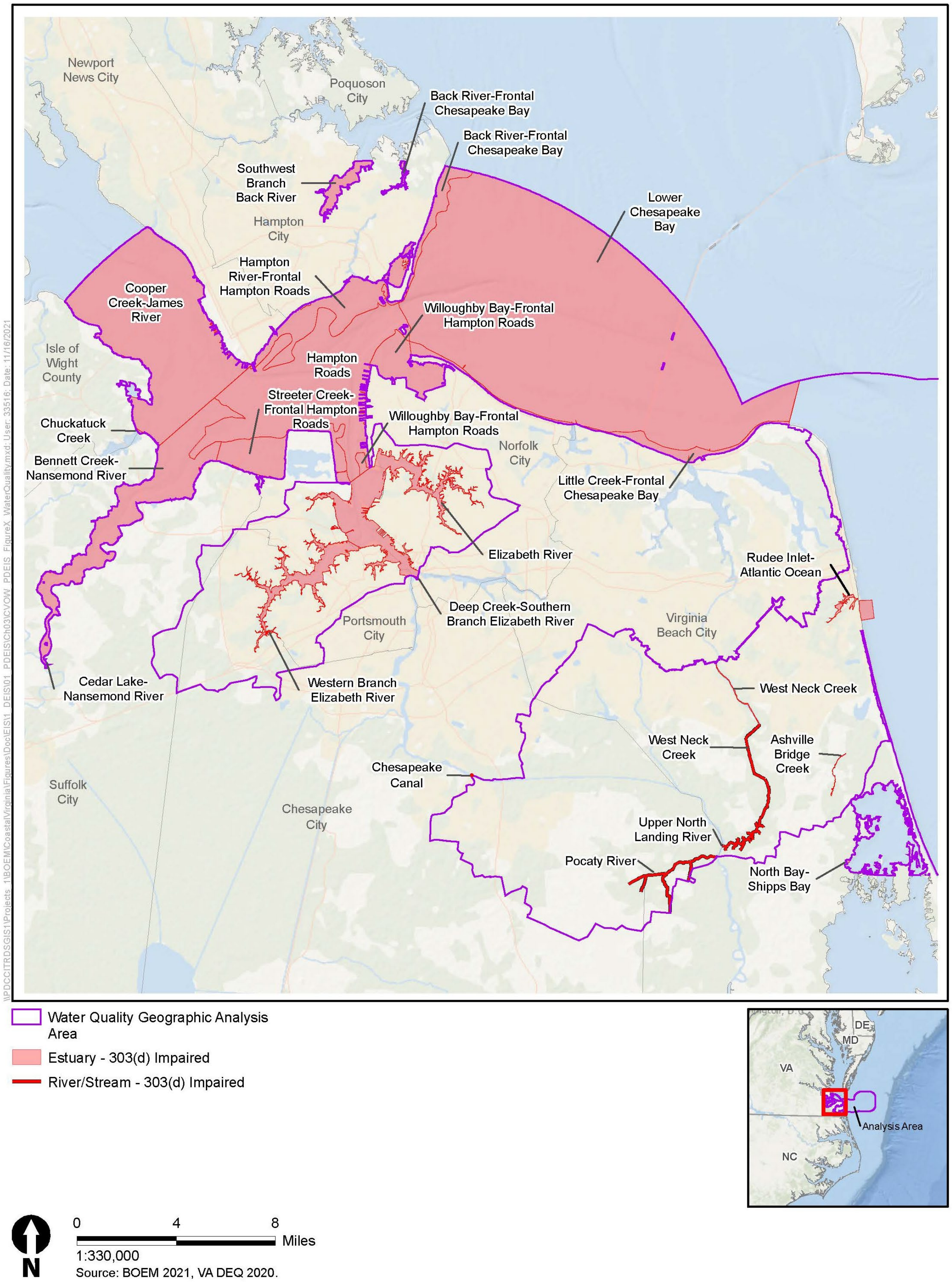


Figure I-5 303(d) Impaired Surface Waters in the Water Quality Geographic Analysis Area

Table I-6 303(d) Impaired Surface Waters in the Water Quality Geographic Analysis Area

Water Name	Location	Impairment Cause(s)	Source(s)
303(d) Impaired Estuarine Waters in the Geographic Analysis Area			
10th View Beach	Located along Chesapeake Bay, in cities of Norfolk and Virginia Beach. Portion of CBP segment CB8PH. No DSS shellfish direct harvesting condemnations present.	Enterococcus, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
13th View Beach	Located along Chesapeake Bay, in Norfolk. Portion of CBP segment CB8PH. No DSS shellfish direct harvesting condemnations present.	Enterococcus, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Atlantic Ocean Beaches - Croatan	Croatan Beach along shore of City of Virginia Beach. VDH bathing beach areas.	Enterococcus	Wet Weather Discharges (Non-Point Source)
Buckroe Beaches	From northeast of Buckroe Beach southwest to parallel with start of Mill Cr. Portion of CBP Segment CB8PH. No DSS shellfish condemnations.	Enterococcus, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Ches Bay Beaches	Located along Chesapeake Bay, in cities of Norfolk and Virginia Beach. Portion of CBP segment CB8PH. No DSS shellfish direct harvesting condemnations present.	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source

Water Name	Location	Impairment Cause(s)	Source(s)
Chesapeake Bay - CBP Segment CB8PH	This assessment unit is the mainstem portion of Chesapeake Bay Program segment CB8PH, located in the Virginia Chesapeake Bay between the mouths of the James River and mouth of Chesapeake Bay. HUC: 02080101.	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Chesapeake Bay - Off Little Creek BSS #068-017, Areas A & B	Virginia Dept of Health Shellfish (administrative) closure #068-017, Off Little Creek, Sections A and B. HUC: 02080101.[effective 2005-3-08]	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Chesapeake Bay - Off Little Creek BSS #068-017, Section C	Virginia Dept of Health Shellfish (administrative) closure #068-017, A portion of section C. Off Little Creek. HUC: 02080101.[effective 2005-3-08]	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Chesapeake Bay - S. Thimble Island BSS Condemnation #163	Virginia Dept of Health Shellfish zone #163. Open to shellfish harvesting as of 4/25/2007. S. Thimble Island. HUC: 02080101	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Clean Sediments, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Source Unknown, Non-Point Source, Sources Outside State Jurisdiction or Borders, Sediment Resuspension (Clean Sediment), Wet Weather Discharges (Non-Point Source)
Chicks Beach	Located along Chesapeake Bay near Chesapeake Bay Bridge Tunnel, in cities of Norfolk and Virginia Beach. Portion of CBP segment CB8PH. No DSS shellfish direct harvesting condemnations present.	Enterococcus, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source

Water Name	Location	Impairment Cause(s)	Source(s)
Chuckatuck Creek and Mouth in James	South shore tributary to James R., after confluence with Brewers Creek to mouth. Portion of CBP segment JMSMH. DSS OPEN shellfish direct harvesting condemnation # 062-080 (effective 20171011).	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown
DSS Inlet #1 - Unnamed Inlet at Mouth of SW Branch	South shore trib. to mainstem Back R. Located east of mouth of SW Branch. CBP Segment MOBPH. DSS shellfish harvesting condemnation # 054-021 C (effective 20181018).	Dissolved Oxygen, Fecal Coliform, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4), Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Marina/Boating Sanitary On-vessel Discharges, Muni
DSS Inlet #2 - Unnamed Inlet S. Shore of SW Br. Back River	South shore trib. to Southwest Branch Back R. Located near mouth of SW Branch, west of unnamed DSS Inlet #1. DSS OPEN condemnation # 054-021 (effective 20181018). CBP Segment MOBPH.	Dissolved Oxygen, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Fort Monroe Beaches	All of Fort Monroe Beach from the start of Mill Cr south to Lighthouse Old Point Comfort. Portion of CBP Segment CB8PH. No DSS shellfish condemnations.	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Grandview Pier & Saltponds Beaches	From Grandview beach southwest to northeast of Buckroe Beach. Offshore of Buckroe Beach VDH monitoring. area Portion of CBP Segment CB8PH. No DSS shellfish condemnation present.	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source

Water Name	Location	Impairment Cause(s)	Source(s)
Grandview Pier & Saltponds Beaches [No TMDL]	From southernmost point of Grandview Beach southwest to northeast of Buckroe Beach. Shoreward of GRV01A06. Portion of CBP Segment CB8PH. DSS ADMIN shellfish condemnation # 055-216 A (effective 20080530).	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Harris River - Upper	South shore trib. to mainstem Back R. Adjacent to Fox Hill area. DSS shellfish condemnation # 054-215 A (effective 20181018). CBP Segment MOBPH.	Dissolved Oxygen, Fecal Coliform, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4), Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Marina/Boating Sanitary On-vessel Discharges, Muni
James River - Along Lower North Shore	Mainstem along north shore, from Jail Point (Mulberry Isle) downstream to line following Rt. 664. CBP segment JMSMH. Portions of DSS (ADMIN) shellfish condemnation # 058-034 A (effective 20080518) & 057-007 A (effective 20120529).	Estuarine Bioassessments, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown
James River - Hilton Beach Area	North shore James R. NW of James R. Bridge. Mainstem along north shoreline beach in Hilton Village area. CBP segment JMSMH. Portion of DSS (ADMIN) shellfish condemnation # 058-034 A (effective 20080518).	Enterococcus, Estuarine Bioassessments, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown
James River - Hilton Village to Craney Island	Mainstem from a line between Hilton Village (Newport News)/Kings Creek (Isle of Wight) downstream to the end of DSS (OPEN) shellfish harvesting condemnation # 059-069 F (effective 20141219). CBP segment JMSMH.	Estuarine Bioassessments, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown

Water Name	Location	Impairment Cause(s)	Source(s)
James River - Huntington Beach Area	North shore James R. near foot of James R. Bridge. Mainstem along north shoreline beach in Hilton Village area. CBP segment JMSMH. Portion of DSS (ADMIN) shellfish condemnation # 058-034 A (effective 20080508).	Enterococcus, Estuarine Bioassessments, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown
James River - Jail Point to Hilton Village	Mainstem from line between Jail Pt (Mulberry Isle) to Days Pt (Mouth Pagan R) downstream to line Hilton Village (Newport News)/Kings Creek (Isle of Wight). CBP segment JMSMH. DSS (OPEN) shellfish harvesting condemnation # 059-069 (effective 20141219).	Estuarine Bioassessments, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown
James River - Newport News Point to NW Corner Craney Isl.	Line following the Rt. 664 crossing mid-river, SW to mid-mouth Nansemond R. to SW tip Craney Isl. Line. The NW line from NW tip Craney Isl. to Lincoln Pk. CBP segment JMSMH. DSS (ADMIN) condition # 056-007 A, B, C (effective 20120529).	Estuarine Bioassessments, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown
James River at Hampton Roads Harbor	Mainstem from a line between Lincoln Park and the NW corner of Craney Isl. downstream to mouth at Hampton Roads Tunnel. CBP segment JMSPH. DSS (ADMINISTRATIVE) shellfish condemnation # 056-007 A (effective 20120529).	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Source Unknown

Water Name	Location	Impairment Cause(s)	Source(s)
Lake Rudee - Lower (Rudee Inlet Canal)	Lower portion of Lake Rudee, including Rudee Inlet Canal. From RM 0.4 (upstream of confluence of Lake Holly with Rudee Inlet canal) downstream through Inlet canal to mouth. Portion of DSS shellfish harvesting condemnation # 073-074 (effective 2013-06-11).	Fecal Coliform	Source Unknown
Lake Rudee - Upper	Lake Rudee, from end of Owl Creek downstream to approx. RM 0.4 (upstream of confluence of Lake Holly with Rudee Inlet canal). Portion of DSS shellfish condemnation # 073-074 A (effective 2013-06-11).	Fecal Coliform	Source Unknown
Lake Rudee - Upper (northwest trib.)	Tributary of Lake Rudee between Terrace Ct and Caspian Ave	Enterococcus, Fecal Coliform	Source Unknown
Lake Wesley - Upstream Branches	From start of both branches downstream to confluence with Rudee Inlet; eastern portion. Segment reflects status of station at mid-embayment. DSS shellfish condemnation # 073-074 A (effective 2013-06-11).	Enterococcus, Fecal Coliform	Source Unknown
	From start of both branches downstream to confluence with Rudee Inlet; western portions. Segment reflects status of station at mid-embayment. DSS shellfish condemnation # 073-074 A (effective 2013-06-11).	Fecal Coliform	Source Unknown
Nansemond River - Lower [No TMDL]	Nansemond R mouth. From Olds Cove downstream to mouth. CBP segment JMSMH. DSS (OPEN) condemnation 063-046 (effective 20140826) & 063-008 (effective 20170823).	(blank)	(blank)

Water Name	Location	Impairment Cause(s)	Source(s)
Newmarket Creek - Lower	South of Blue Bird Gap Farm area. From the I-64 crossing (RM 3.68) downstream to confluence with SW Br. Back R. CBP Segment MOBPH. Portion of DSS shellfish condemnation # 054-021 B (effective 20181018).	Enterococcus, Dissolved Oxygen, Fecal Coliform, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4), Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wastes from Pet
North Community Beach	Located along Chesapeake Bay, in cities of Norfolk and Virginia Beach. Portion of CBP segment CB8PH. No DSS shellfish direct harvesting condemnations present.	Enterococcus, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Owl Creek - Lower	Headwaters tributary to Lake Rudee, located west of Lake Christine. Segment from mid-way point where creek broadens downstream to confluence with Lake Rudee. Portion of DSS shellfish direct harvesting condemnation # 073-074 A (effective 2013-06-11).	Fecal Coliform	Source Unknown
Owl Creek- Upper	Headwaters tributary to Lake Rudee, located west of Lake Christine. Segment from headwaters downstream to point where creek broadens. Portion of DSS shellfish direct harvesting condemnation # 073-074 A (effective 2013-06-11).	Enterococcus, Fecal Coliform	Source Unknown
Owl Creek- Upper Trib.	Headwaters tributary to Lake Rudee, located west of Lake Christine. Segment from headwaters upstream to the upper-middle portion. Portion of DSS shellfish direct harvesting condemnation # 073-074 A (effective 2013-06-11).	Enterococcus, Dissolved Oxygen, Fecal Coliform	Source Unknown

Water Name	Location	Impairment Cause(s)	Source(s)
Sara Constance Park and Ocean View Park Beaches	Located along Chesapeake Bay, in Norfolk. Portion of CBP segment CB8PH. No DSS shellfish direct harvesting condemnations present.	Enterococcus, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Shore Drive Beaches - East	Located along Chesapeake Bay, Virginia Beach. Portion of CBP segment CB8PH. No DSS shellfish direct harvesting condemnations present.	PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wet Weather Discharges (Point Source and Combination of Stormwater, SSO or CSO), Source Unknown, Non-Point Source
Southwest Br. Back River - Mouth	Lower portion to confluence with mainstem Back R. CBP Segment MOBPH. Portion of DSS shellfish (OPEN) condemnation # 054-021 (effective 20181018).	Estuarine Bioassessments, Dissolved Oxygen, Fecal Coliform, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4), Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wastes from Pet
SW Br Back River - Incl Tides Mill Cr [TMDL area]	Headwaters of Southwest Branch (incl tidal Tides Mill Cr) downstream to Langley View. CBP segment MOBPH. Portion of DSS shellfish condemnation # 054-021 B (effective 20181018).	Dissolved Oxygen, Fecal Coliform, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4), Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wastes from Pet
	Headwaters of Southwest Branch (incl tidal Tides Mill Cr) downstream to Langley View. CBP segment MOBPH. Portion of DSS shellfish condemnation seasonally restricted and conditionally condemned areas # 054-021 B (effective 20181018).	Dissolved Oxygen, Fecal Coliform, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4), Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wastes from Pet

Water Name	Location	Impairment Cause(s)	Source(s)
Unsegmented estuaries in Back River - DSS	Non-segmented areas of C07E. CBP Segment MOBPH. DSS Condemnation # 054-021 B (effective date 20181018).	Dissolved Oxygen, Fecal Coliform, PCBs in Fish Tissue, Aquatic Plants (Macrophytes)	Atmospheric Deposition - Nitrogen, Clean Sediments, Discharges from Municipal Separate Storm Sewer Systems (MS4), Industrial Point Source Discharge, Internal Nutrient Recycling, Loss of Riparian Habitat, Municipal Point Source Discharges, Wastes from Pet
303(d) Impaired Streams in the Geographic Analysis Area			
Pocaty River	Pocaty River and selected tributaries from headwaters at mile 3.92 to confluence with North Landing River at mile 0.00.	Benthic Macroinvertebrates Bioassessments, Escherichia coli (E. coli), Dissolved Oxygen	Source Unknown, Non-Point Source, Crop Production (Crop Land or Dry Land), Agriculture, Urban Runoff/Storm Sewers
West Neck Creek - Lower	Segment and tribes. from widening of creek (RM 3.10) approx. 0.55 mile downstream of Indian River Road crossing downstream to mouth (RM 0.0) at confluence with North Landing River.	Escherichia coli (E. coli)	Source Unknown
West Neck Creek - Middle	Segment from south side of Princess Anne Road crossing (RM 6.20) downstream to widening of creek (RM 3.10) near Indian River Road crossing.	Escherichia coli (E. coli), Dissolved Oxygen, PCBs in Fish Tissue	On-site Treatment Systems (Septic Systems and Similar Decentralized Systems), Source Unknown, Livestock (Grazing or Feeding Operations), Natural Conditions - Water Quality Standards Use Attainability Analyses Needed, Urban Runoff/Storm Sewers

Source: VDEQ 2020.

I.5. Wetlands

Notable natural habitats and/or rare natural communities are located within or adjacent to the Onshore Project Components. These include areas of the North Landing River, Gum Swamp, Pocaty River, and West Neck Creek which support a variety of wetland communities, including forested bottomlands. Additional information on these areas is provided below and in COP Section 4.2.2 and COP Appendix U, Wetland Delineation Report (Dominion Energy 2023). As stated in Chapter 2, *Alternatives Including the Proposed Action*, on October 7, 2022, Dominion Energy requested that BOEM remove from consideration Interconnection Cable Route Options 2, 3, 4, and 5. However, for context about notable natural habitats and/or rare natural communities within the geographic analysis area, BOEM has included discussion of Interconnection Cable Route Options 2, 3, 4 and 5 in the following subsections.

I.5.1 North Landing River

The North Landing River watershed occurs through large portions of western and southwestern portions of the city of Virginia Beach and eastern portions of the city of Chesapeake. Rare communities that are associated with the North Landing River and its tributaries include non-riverine swamp forest, pond pine (*Pinus serotina*) woodland and high pocosin subtype, peatland Atlantic white cedar (*Chamaecyparis thyoides*) forest, and several globally rare types of oligohaline marshes (VDCR-DNH 2001). The North Landing River Natural Area Preserve occurs approximately 1.7 miles (2.7 kilometers) southeast of the Onshore Project Area and consists of state-owned conservation lands maintained by the Virginia Department of Conservation and Recreation (VDCR). The North Landing River Preserve consists of approximately 7,599 acres (3,075 hectares) of conservation lands privately managed by The Nature Conservancy (TNC) and preserves large swathes of forested wetland habitat on the west side of the North Landing River from the Virginia-North Carolina border and northwards to include Gum Swamp. Two of the interconnection cable route options (1 and 6) would cross TNC-protected lands. Several of the interconnection cable route options screened by Dominion Energy and subsequently removed from consideration in this Final EIS (Options 2, 3, 4, and 5) would also cross the North Landing River at its upper limits, in the vicinity of the North Landing River Bridge located on North Landing Road and Mount Pleasant Road. These areas support wetland types considered rare in the Commonwealth of Virginia including pocosins, which are characterized by dense evergreen shrubs and vines with scattered pond pine. These areas also contain numerous swamps and freshwater tidal marshes and host rare plant and wildlife species (VDCR-DNH 2020; TNC 2020). Rare plant and wildlife species with the potential to occur within these areas based on publicly accessible database searches is provided in this section below. Potential threats to these ecosystems include habitat loss and fragmentation and introduction of exotic and invasive species (VDCR-DNH 2001) (COP, Section 4.2.2; Dominion Energy 2023).

Interconnection Cable Route Options (Option 5, which has been removed from consideration in this Final EIS) would cross the northernmost portion of Naval Auxiliary Landing Field Fentress, north of Mount Pleasant Road. This area contains significant wetland habitats associated with the North Landing River. In a 2018 study at Naval Auxiliary Landing Field Fentress, a state rare community, bald cypress-mixed tupelo intermediate swamp, was documented on the facility north of Mount Pleasant Road (Dominion Energy 2021 citing NAVFAC 2019). The forested wetlands along the northern portion of Naval Auxiliary Landing Field Fentress are designated by the Navy as the "North Landing River Special Interest Area." The area contains documented natural heritage resources and is managed to protect and enhance those resources (Dominion Energy 2021 citing NAVFAC 2019). The North Landing River Special Interest Area is geographically contiguous with TNC North Landing River Preserve protected lands discussed above (COP, Section 4.2.2; Dominion Energy 2023).

I.5.2 Gum Swamp

Gum Swamp is located near the border of the city of Chesapeake and the city of Virginia Beach and directly north of the Intracoastal Waterway. Gum Swamp is crossed by Interconnection Cable Route Options 1 and 6. Gum Swamp includes large contiguous areas of forested wetlands extending from Stumpy Lake to the north, the Centerville Turnpike Bridge crossing of the Intracoastal Waterway to the southwest, and east to the North Landing River bridge. Located within the North Landing River watershed, Gum Swamp contains the western headwaters of the North Landing River, which adjoin the Intracoastal Waterway, also known as the Chesapeake and Albemarle Canal. Natural heritage community types within Gum Swamp include swamp tupelo (*Nyssa biflora*)–bald cypress swamps, and seasonally flooded forests/non-riverine swamp forests (VDCR-DNH 2001). Potential threats include drainage and hydrological perturbations, land use conversion, habitat loss, clearcutting and forest fragmentation, road construction, and non-point source pollution (COP, Section 4.2.2; Dominion Energy 2023).

I.5.3 West Neck Creek (Upper and Lower)

The upper section of West Neck Creek, an eastern tributary of the North Landing River, is crossed by all of the interconnection cable route options. The lower portions of West Neck Creek contain rare natural heritage communities, including Atlantic white cedar swamp, big cordgrass (*Spartina cynosuroides*) oligohaline marsh, sweetbay (*Magnolia virginiana*)–red bay (*Persea borbonia*) shrub swamp, and threesquare bulrush (*Schoenoplectus americanus*)–cattail (*Typha spp.*) oligohaline marsh (VDCR-DNH 2001) (COP, Section 4.2.2; Dominion Energy 2023).

I.5.4 Pocaty River

The Pocaty River occurs within the North Landing River watershed and is a western tributary of the North Landing River. The Pocaty River would be crossed by Interconnection Cable Route Option 5, which has been eliminated from further analysis this Final EIS. This waterway contains extensive associated forested wetlands and documented natural heritage communities (designated by the VDCR-DNH as North Pocaty) situated west of the North Landing River and north of the Pocaty River and include tidal shrub swamp (southern bayberry [*Morella caroliniensis*]–Carolina willow [*Salix caroliniana*] type), pond pine woodland, and big cordgrass marsh (oligohaline type). These rare communities are predominantly owned by TNC and managed as a part of the North Landing River Natural Area Preserve, which is discussed above. Natural communities along the upper reaches of the Pocaty River are also managed by the Navy as the Pocaty Creek Special Interest Area, located along the southern boundary of Naval Auxiliary Landing Field Fentress. Potential hydrological threats include agricultural and urban non-point source pollution, toxic or hazardous materials spills on the Intracoastal Waterway, and shoreline damage from excessive boat traffic and wakes. Other threats include reduction or lack of a natural fire regime in fire-maintained marshes and peatland pond pine woodlands, and displacement of native marsh species by invasive clones of common reed (VDCR-DNH 2001) (COP, Section 4.2.2; Dominion Energy 2023).

I.6. Navigation and Vessel Traffic

Table I-7 Allision and Collision Risk Summary (COP, Appendix S, Section 10.2.7, Table 10.2)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Vessel to vessel collision	Base case	1.08E-02 (1 in 93 years)	1.93E-02 (1 in 52 years)	8.50E-03 (1 in 118 years)
	Future case (10%)	1.30E-02 (1 in 77 years)	2.33E-02 (1 in 43 years)	1.03E-02 (1 in 97 years)
	Future case (20%)	1.55E-02 (1 in 65 years)	2.78E-02 (1 in 36 years)	1.23E-02 (1 in 81 years)
Powered vessel to structure allision	Base case	N/A	2.54E-03 (1 in 394 years)	2.54E-03 (1 in 394 years)
	Future case (10%)	N/A	2.80E-03 (1 in 357 years)	2.80E-03 (1 in 357 years)
	Future case (20%)	N/A	3.05E-03 (1 in 328 years)	3.05E-03 (1 in 328 years)
Drifting vessel to structure allision	Base case	N/A	3.27E-03 (1 in 306 years)	3.27E-03 (1 in 306 years)
	Future case (10%)	N/A	3.59E-03 (1 in 279 years)	3.59E-03 (1 in 279 years)
	Future case (20%)	N/A	3.92E-03 (1 in 255 years)	3.92E-03 (1 in 255 years)
Fishing vessel to structure allision	Base case	N/A	5.91E-04 (1 in 1,692 years)	5.91E-04 (1 in 1,692 years)
	Future case (10%)	N/A	6.41E-04 (1 in 1,560 years)	6.41E-04 (1 in 1,560 years)
	Future case (20%)	N/A	6.91E-04 (1 in 1,447 years)	6.91E-04 (1 in 1,447 years)

Risk	Scenario	Annual Frequency (Return Period)		
		Pre Wind Farm	Post Wind Farm	Change
Total	**Base case**	**1.08E-02 (1 in 93 years)**	**2.57E-02 (1 in 39 years)**	**1.49E-02 (1 in 67 years)**
	Future case (10%)	**1.30E-02 (1 in 77 years)**	**3.03E-02 (1 in 33 years)**	**1.73E-02 (1 in 58 years)**
	Future case (20%)	**1.55E-02 (1 in 65 years)**	**3.55E-02 (1 in 28 years)**	**2.00E-02 (1 in 50 years)**

Table I-8 FSA Summary (COP, Appendix S, Section 21, Table 21.1)

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
Commercial vessels	Deviations	Tolerable	• Charting of infrastructure; • Construction vessel and schedule notification system; • Ongoing engagement with stakeholders, and • Promulgation of information.	**Further mitigation required to ascertain necessary mitigation to bring impact to within ALARP parameters**
	Increased vessel to vessel collision risk	Tolerable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Construction vessel and schedule notification system; • Marine coordination; • Minimum advisory safe passing distance around cable installation vessels; • Ongoing engagement with stakeholders; • Project Vessel AID Carriage; • Project vessel compliance with international and flag state regulations; • Project vessel operational procedures; • Promulgation of information; and • Safety vessel where appropriate.	**Further mitigation required to ascertain necessary mitigation to bring impact to within ALARP parameters**
	Powered vessel to structure allision risk	Tolerable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure;	**Further mitigation required to ascertain necessary mitigation to bring impact to within**

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			• Lighting and marking; • Marine pollution contingency plans; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability; • Emergency Response Plan; and • Use of PATON.	**ALARP parameters**
	Drifting vessel to structure risk	Tolerable	• Marine pollution contingency plans; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of Information; • Provision of self-help capability; • Emergency Response Plan; and • Safety vessel where appropriate.	**Further mitigation required to ascertain necessary mitigation to bring impact to within ALARP parameters**
Military vessels	Deviations	Broadly Acceptable	• Charting of infrastructure; • Construction vessel and schedule notification system; • Ongoing engagement with stakeholders; and • Promulgation of information.	Risk level has been reduced to ALARP and no further mitigation is required
	Increased vessel to vessel collision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Construction vessel and schedule notification system; • Marine coordination; • Minimum advisory safe passing distance around cable installation vessels; • Ongoing engagement with stakeholders; • Project Vessel AIS Carriage; • Project vessel compliance with international and flag state regulations; • Project vessel operational procedures; • Promulgation of information; and • Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
	Powered vessel to structure allision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Lighting and marking; • Marine pollution contingency plans; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability; • Emergency Response Plan; • USCG SAR trials; • Safety vessel where appropriate; and • Use of PATON.	Risk level has been reduced to ALARP and no further mitigation is required
	Drifting vessel to structure allision risk	Broadly Acceptable	• Marine pollution contingency plans; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability; • Emergency Response Plan; and • Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required
Recreational vessels	Deviations	Broadly Acceptable	• Charting of infrastructure; • Construction vessel and schedule notification system; • Ongoing engagement with stakeholders; and • Promulgation of information.	Risk level has been reduced to ALARP and no further mitigation is required
	Adverse weather conditions	Broadly Acceptable	• Charting of infrastructure; • Construction vessel and schedule notification system; • Lighting and marking; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability; • Emergency Response Plan; • Safety vessel where appropriate; and • Use of PATON	Risk level has been reduced to ALARP and no further mitigation is required

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
	Increased vessel to vessel collision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Construction vessel and schedule notification system; • Marine coordination; • Minimum advisory safe passing distance around cable installation vessels; • Ongoing engagement with stakeholders; • Project Vessel AIS Carriage; • Project vessel compliance with international and flag state regulations; • Project vessel operational procedures; • Promulgation of information; and • Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
	Powered vessel to structure allision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Lighting and marking; • Marine pollution contingency plans; • Minimum blade clearance; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability; • Emergency Response Plan; • USCG SAR trials; • Safety vessel where appropriate; and • Use of PATON.	Risk level has been reduced to ALARP and no further mitigation is required.
	Drifting vessel to structure allision risk	Broadly Acceptable	• Marine pollution contingency plans; • Minimum blade clearance; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			• Emergency Response Plan; and • Safety vessel where appropriate.	
Commercial fishing vessels	Deviations	Broadly Acceptable	• Charting of infrastructure; • Construction vessel and schedule notification system; • Ongoing engagement with stakeholders; and • Promulgation of information.	Risk level has been reduced to ALARP and no further mitigation is required.
	Adverse weather deviations	Broadly Acceptable	• Charting of infrastructure; • Construction vessel and schedule notification system; • Lighting and marking; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability; • Emergency Response Plan; • Safety vessel where appropriate; and • Use of PATON	Risk level has been reduced to ALARP and no further mitigation is required.
	Increased vessel to vessel collision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Construction vessel and schedule notification system; • Marine coordination; • Minimum advisory safe passing distance around cable installation vessels; • Ongoing engagement with stakeholders; • Project Vessel AIS Carriage; • Project vessel compliance with international and flag state regulations; • Project vessel operational procedures; • Promulgation of information; and • Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
	Powered vessel to structure allision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Lighting and marking;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
			• Marine pollution contingency plans; • Minimum blade clearance; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of Information; • Provision of self-help capability; • Emergency Response Plan; • USCG SAR trials; • Safety vessel where appropriate; and • Use of PATON.	
	Drifting vessel to structure allision risk	Broadly Acceptable	• Marine pollution contingency plans; • Minimum blade clearance; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of information; • Provision of self-help capability; • Emergency Response Plan; and • Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
Anchored vessels	Displacement of Anchoring	Broadly Acceptable	• Cable Burial Risk Assessment; • Cable Installation Plan; • Charting of infrastructure (including prior to installation); • Minimum advisory safe passing distance around cable installation vessels; • Monitoring of cable and associated protection; • Ongoing engagement with stakeholders; and • Promulgation of information.	Risk level has been reduced to ALARP and no further mitigation is required.
	Underwater snagging or contact risk	Broadly Acceptable	• Cable Burial Risk Assessment; • Cable Installation Plan; • Charting of infrastructure (including prior to installation); • Monitoring of cable and associated protection; • Ongoing engagement with stakeholders; • Promulgation of information; and • Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
Emergency responders	Emergency response capability	Broadly Acceptable	• Marine coordination; • Marine pollution contingency plans; • Ongoing engagement with USCG vis specialist helicopter consultancy; • Operational SAR procedures; • Project vessel compliance with international and flag state regulations; • Provision of self-help capability; • Emergency Response Plan; • USCG SAR trials; and • WTG shut down procedures.	Risk level has been reduced to ALARP and no further mitigation is required.
Ports and Services	Restricted access at ports – Project Vessels	Broadly Acceptable	• Construction vessel and schedule notification system; • Marine coordination; • Ongoing engagement with stakeholders; • Project Vessel AIS Carriage; • Project vessel compliance with international and flag state regulations; • Project vessel operational procedures; and • Promulgation of information.	Risk level has been reduced to ALARP and no further mitigation is required.
Ports and Services	Restricted access at ports – Cable Installation	Broadly Acceptable	• Cable Burial Risk Assessment; • Cable Installation Plan; • Charting of infrastructure; • Construction vessel and schedule notification system; • Marine coordination; • Minimum advisory safe passing distance; • Monitoring of cables and associated protection; • Ongoing engagement with stakeholders; • Project Vessel AIS Carriage; • Project vessel compliance with international and flag state regulations; • Project vessel operational procedures; and • Promulgation of information.	Risk level has been reduced to ALARP and no further mitigation is required.
All users (cumulative)	Deviations	Broadly Acceptable	• Charting of infrastructure; • Construction vessel and schedule notification system; • Ongoing engagement with stakeholders; and • Promulgation of information;	Risk level has been reduced to ALARP and no further mitigation is required.

User	Impact	ALARP Risk Level	Embedded Mitigation Measures	Additional Mitigation Measures
	Increased vessel to vessel collision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Construction vessel and schedule notification system; • Marine coordination; • Minimum advisory safe passing distance around cable installation vessels; • Ongoing engagement with stakeholders; • Project Vessel AIS Carriage; • Project vessel compliance with international and flag state regulations; • Project vessel operational procedures; • Promulgation of information; and • Safety vessel where appropriate.	Risk level has been reduced to ALARP and no further mitigation is required.
	Powered and drifting vessel to structure allision risk	Broadly Acceptable	• Application and use of safety zones up to 1,640-foot (500-meter) radius during construction and decommissioning; • Charting of infrastructure; • Lighting and marking; • Marine pollution contingency plans; • Minimum blade clearance; • Ongoing engagement with stakeholders; • Operational SAR procedures; • Promulgation of Information; • Provision of self-help capability; • Emergency Response Plan; • Safety vessel where appropriate; and • Use of PATON.	Risk level has been reduced to ALARP and no further mitigation is required.

I.7. References Cited

Christiansen M.B., and C.B. Hasager. 2005. Wake Effects of Large Offshore Wind Farms Identified from Satellite SAR. *Remote Sensing of Environment*. 98(2–3):251–268. doi:10.1016/j.rse.2005.07.009. Available: https://linkinghub.elsevier.com/retrieve/pii/S0034425705002476. Accessed March 28, 2023.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. May.

NAVFAC. 2019. *Natural Heritage Inventory and Milkweed Survey Report, Naval Air Station Oceana, Virginia Beach, Virginia and Naval Auxiliary Landing Field Fentress, Chesapeake, Virginia. U.S.* Department of the Navy, Naval Facilities.

The Nature Conservancy (TNC). 2020. '*Places We Protect: North Landing River, Virginia'. The Nature Conservancy*. Available: https://www.nature.org/en-us/get-involved/how-to-help/places-we-protect/north-landing-river/. Accessed: March 5, 2022.

Virginia Department of Conservation and Recreation, Division of Natural Heritage (VDCR-DNH). 2001. *Conservation Plan for the Southern Watershed Area. Natural Heritage Technical Report 00-12*. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Available: https://www.vbgov.com/government/departments/planning/areaplans/Documents/Pungo-Blackwater-RuralArea/consplanrpt.pdf. Accessed: March 5, 2022.

Virginia Department of Conservation and Recreation, Division of Natural Heritage (VDCR-DNH). 2020. North Landing River Natural Area Preserve. *Virginia Department of Conservation and Recreation, Division of Natural Heritage*. Available: https://dcr.virginia.gov/natural-heritage/natural-area-preserves/northlanding. Accessed: March 5, 2022.

Virginia Department of Environmental Quality (VDEQ). 2020. 2020 305(b)/303(d) *Water Quality Assessment Integrated Report* [also see Appendix 1a of the report for official 303(d) impaired waters list]. Virginia Department of Environmental Quality. Available: https://www.deq.virginia.gov/water/water-quality/assessments/integrated-report. Accessed: October 5, 2021.

Appendix J. Overview of Acoustic Modeling Report

J.1. Introduction and Short Project Description

This appendix is focused on providing a brief background on underwater sound and a description of the sound sources applicable to this Project based on published literature, as well as an overview of the methods, assumptions, and results of the technical acoustic modeling report prepared for the Project (COP, Appendix Z; Dominion Energy 2023) and the accompanying exposure assessment included in the Letter of Authorization (LOA) application submitted to the National Marine Fisheries Service (NMFS) for incidental take authorization under the Marine Mammal Protection Act (MMPA) (Tetra Tech 2022a, 2022b, 2023). The Project would consist of up to 176 wind turbine generators (WTGs) with seven potential spares, up to three offshore substations (OSS), inter-array and export cables, and onshore components (interconnection cables, switching station[s] and substation). The Project would be on the OCS offshore Virginia in BOEM Lease Area OCS-A 0483. Primary noise-generating activities which have the potential to expose marine mammals to noise above recommended permanent threshold shift (PTS) and behavioral thresholds (NMFS 2018) include impact and vibratory pile driving during WTG and OSS foundation installation; impact pile driving during installation of goal post piles to support trenchless installation of the export cable offshore at the cable landing location; vibratory pile driving during cofferdam installation; and high-resolution geophysical (HRG) survey activities.

For the installation of the WTG and OSS foundations, underwater sound propagation modeling was completed using dBSea, a software developed by Marshall Day Acoustics for the prediction of underwater noise in a variety of environments. The three-dimensional model was built by importing bathymetry data and placing noise sources in the environment. Noise levels were calculated throughout the entire Offshore Project area and displayed in three dimensions (COP, Appendix Z; Dominion Energy 2023). Noise associated with installation of the goal post piles, cofferdam installation, and HRG surveys was modeled using guidance from NMFS which involved updates to their User Spreadsheet tool (NMFS 2018) to incorporate new adjustment factors in the spreadsheets which account for the accumulation of noise using the source characteristics (duty cycle and speed) following work by Silve et al. (2014) for PTS (i.e., Level A) thresholds; and a simple spreading loss calculation to estimate the distance to the behavioral (i.e., Level B) threshold (Tetra Tech 2022a).

Noise associated with all other Project activities such as vessel noise, cable laying and trenching, and WTG operations was not modeled, but it is qualitatively described in Section J.2 for reference.

J.2. Background on Underwater Sound

Ocean sounds originate from a variety of sources. Some come from non-biological sources such as wind and waves, while others come from the movements or vocalizations of marine life (Hildebrand 2009). In addition, humans introduce sound into the marine environment through activities like oil and gas exploration, construction, military sonars, and vessel traffic (Hildebrand 2009). The acoustic environment or “soundscape” of a given ecosystem comprises all such sounds—biological, non-biological, and anthropogenic (Pijanowski et al. 2011). Soundscapes are highly variable across space, time, and water depth, among other factors, due to the properties of sound transmission and the types of sound sources present in each area. A soundscape is sometimes called the “acoustic habitat,” as it is a vital attribute of a given area where an animal may live (i.e., habitat) (Hatch et al. 2016).

J.2.1 Physics of Underwater Sound

Sounds are created by the vibration of an object within its medium (Figure J-1). This movement generates kinetic energy (KE), which travels as a propagating wave away from the sound source. As this wave moves through the medium, the particles undergo tiny back-and-forth movements ("particle motion") along the axis of propagation, but the particles themselves do not travel with the wave. Instead, they oscillate in roughly the same location, transferring their energy to surrounding particles. The vibration is transferred to adjacent particles, which are pushed into areas of high pressure (compression) and low pressure (rarefaction). Acoustic pressure is a non-directional (scalar) quantity, whereas particle motion is an inherently directional quantity (a vector) taking place in the axis of sound transmission. The total energy of the sound wave includes the potential energy (PE) associated with the sound pressure as well as the KE from particle motion.

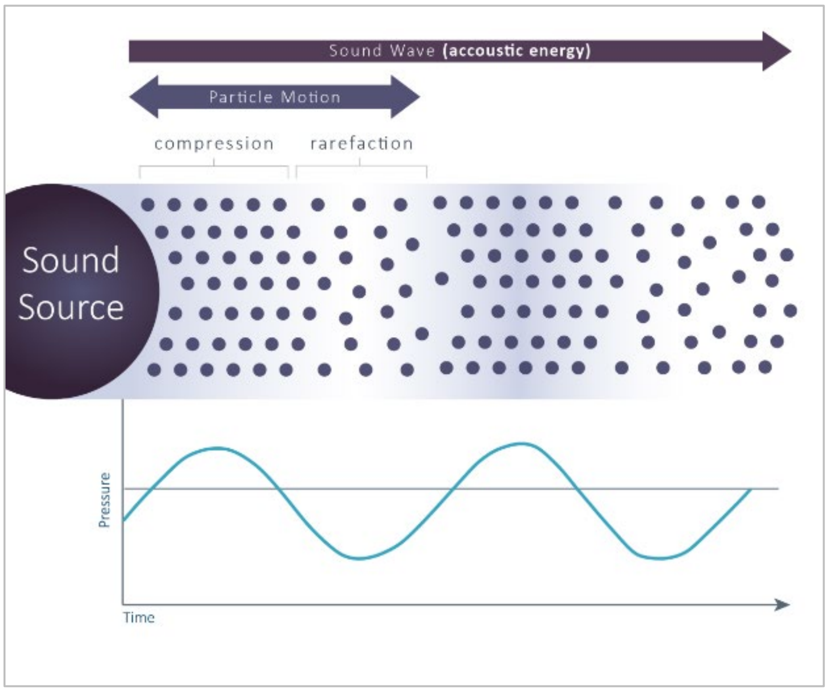


Figure J-1 Basic Mechanics of an Underwater Sound Wave

J.2.2 Particle Motion

Particle motion is the displacement, or back and forth motion, of the water molecules that create the compression and rarefaction. Both factors contribute to the potential for impacts on affected resources from underwater noise. However, marine mammal and sea turtle hearing is based on the detection of sound pressure, and there is no evidence to suggest either group is able to detect particle motion for the purposes of hearing and noise detection (Bartol and Bartol, 2012; Nedelec et al. 2016). Conversely, all fishes and invertebrates are capable of sensing the particle motion component of a sound. 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). Many invertebrates have structures called statocysts which, 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). Some invertebrates also have sensory hairs on the exterior of their bodies, allowing them to sense changes in the particle motion field around them (Budelmann 1992), and the lateral line in fishes also plays a role in hearing (McCormick 2011). The research thus far shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2021).

In fish with primitive swim bladders that are not involved in hearing, like Atlantic sturgeon, particle motion is thought to play a key role in detection of underwater noise (Hawkins and Chapman 2020). However, measurements of sensitivity to particle motion and pressure were rarely performed simultaneously, leaving a data gap in the understanding of particle motion sensitivity in fish (Popper and Hawkins 2018). Currently, there are no regulatory thresholds for particle motion for any noise-producing activities from which the potential for impact may be assessed. Therefore, information available on particle motion detection in fish and invertebrate species is provided for reference, but the modeling described in Sections J.3 through J.9 below as well as the impact assessment in Section 3.13 of the FEIS focus on the pressure component of underwater noise.

J.2.3 Propagation of Sound Pressure in the Ocean

Underwater sound can be described through a source-path-receiver model. An acoustic source emits sound energy that radiates outward and travels through the water and the seafloor. The sound level decreases with increasing distance from the acoustic source as the sound travels through the environment. The amount by which the sound levels decrease between the theoretical source level and a receiver is called propagation loss. Among other things, the amount of propagation loss that occurs depends on the source-receiver separation, the geometry of the environment the sound is propagating through, the frequency of the sound, the properties of the water column, and the properties of the seafloor and sea surface.

When sound waves travel through the ocean, they may encounter areas with different physical properties that will likely alter the propagation pathway of the sound, compared to a homogenous and boundaryless environment. For example, near the ocean's surface, water temperature is usually higher, resulting in relatively fast sound speeds. As temperature decreases with increasing depth, the sound speed decreases. Sounds bend toward areas with lower speeds (Urick 1983). Ocean sound speeds are often slowest at mid-latitude depths of about 1,000 meters, and, because of sound's preference for lower speeds, sound waves above and below this "deep sound channel" often bend toward it. Sounds originating in this layer can travel great distances. Sounds can also be trapped in the mixed layer near the ocean's surface (Urick 1983). Latitude, weather, and local circulation patterns influence the depth of the mixed layer, and the propagation of sounds near the surface is highly variable and difficult to predict.

At the boundaries near the sea surface and the sea floor, acoustic energy can be scattered, reflected, or attenuated depending on the properties at the surface (e.g., roughness, presence of wave activity, or bubbles) or seafloor (e.g., bathymetric features, substrate heterogeneity). For example, fine-grain sediments tend to absorb sounds well, while hard bottom substrates reflect much of the acoustic energy back into the water column. The presence of ice on the ocean's surface can also affect sound propagation. For example, the presence of solid ice may dampen sound levels by blocking surface winds. The presence of ice can also increase sound levels when pieces of ice break and/or scrape together (Urick 1983). The effect will also depend on the thickness and roughness of the ice, among many other factors related to the ambient conditions. As a sound wave moves from a source to a receiver (i.e., an animal), it may travel on multiple pathways that may be direct, reflected, refracted, or a combination of these mechanisms, creating a complex pattern of transmission across range and depth. The patterns may become even more complicated in shallow waters due to repeated interactions with the surface and the bottom, frequency-specific propagation, and more heterogenous seafloor properties. All these variables contribute to the difficulty in reliably predicting the sound field in a given marine environment at any particular time.

J.2.4 Sound Source Classification

In the current regulatory context, anthropogenic sound sources are divided into four types: impulsive, non-impulsive, continuous, and intermittent, based on their differing potential to affect marine species (NMFS 2018). Specifically, when it comes to potential damage to marine mammal hearing, sounds are classified as either impulsive or non-impulsive, and when considering the potential to affect behavior or acoustic masking, sounds are classified as either continuous or intermittent.

Impulsive noises are characterized as having (Finneran 2016):

- Broadband frequency content
- Fast rise-times and rapid decay times
- Short durations (i.e., <1 s)
- High peak sound pressures

Whereas the characteristics of non-impulsive sound sources are less clear but may:

- Be variable in spectral composition, i.e., broadband, narrowband, or tonal
- Have longer rise-time/decay times, and total durations compared to an impulsive sound
- Be continuous (e.g., vessel engine radiated noise), or intermittent (e.g., echosounder pulses)

It is generally accepted that sources like explosions, airguns, sparkers, boomers, and impact pile-driving are impulsive and have a greater likelihood of causing hearing damage than non-impulsive sources. At close distances to impulsive sounds, physiological effects to an animal are likely, including temporary threshold shift (TTS) and permanent threshold shift (PTS). This binary, at-the-source classification of sound types, therefore, provides a conservative framework upon which to predict potential adverse hearing impacts on marine mammals.

For behavioral effects of anthropogenic sound on marine mammals, NMFS classifies sound sources as either intermittent or continuous (NMFS 2018). Continuous sounds, such as drilling or vibratory pile-driving, remain "on," i.e., above ambient noise, for a given period of time, though this is not well-defined. An intermittent sound typically consists of bursts or pulses of sound on a regular on-off pattern, also called the duty-cycle. Examples of intermittent sounds are those from scientific echosounders, sub-bottom profilers, and even pile-driving. It is important to recognize that these delineations are not always practical in application, as a continuous yet moving sound source (such as a vessel passing over a fixed receiver) could be considered intermittent from the perspective of the receiver.

In reality, animals will encounter many signals in their environment that may contain many or all of these sound types, called complex sounds. Even for sounds that are impulsive at the source, as the signal propagates through the water, the degree of impulsiveness decreases (Martin et al. 2020). While there is evidence, at least in terrestrial mammals (Hamernik and Hsueh 1991), that complex sounds can be more damaging than continuous sounds, there is not currently a regulatory category for this type of sound. One current approach for assessing the impulsiveness of a sound that has gained attention is to compute the kurtosis of that signal. *Kurtosis* is a statistical measure that describes the prevalence of extreme values within a distribution of observations, in other words the "spikiness" of the data. Martin et al. (2020) showed that a sound with a kurtosis value of 3 or less has very few extreme values and is generally considered Gaussian (i.e., normally distributed) noise, whereas a kurtosis value greater than 40 represents a distribution of observations with many extreme values and is very spiky. This generally describes an impulsive noise. A distribution of sound level observations from a time series with a kurtosis value somewhere in between these two values would be considered a complex sound.

J.2.5 Sound Sources Related to the Project Not Included in the Modeling

J.2.5.1. Vessels

During construction, vessels may be used to transport crew and equipment. Large vessels will be used during the construction phase to conduct pile-driving, and may use dynamic positioning (DP) systems. DP systems are used on vessels to hold station over a specific seafloor location without the use of a physical anchor using input from gyrocompasses, motion sensors, GPS, active acoustic positioning systems, and wind sensors to determine relative movement and environmental forces at work. Most acoustic energy for vessels using DP systems is below 1,000 Hz, often below 50 Hz, with tones related to engine and propeller size and type. The sound can also vary directionally, and this directionality is much more pronounced at higher frequencies. Because this is a dynamic operation, the sound levels produced will vary based on the specific operation, DP system used (e.g., jet or propeller rotation, versus a rudder or steering mechanism), and factors such as the blade rate and cavitation, in some cases. Representative sound field measurements from the use of DP are difficult to obtain because the sound transmitted is often highly directional and context specific. The direction of sound propagation may change as different DP needs requiring different configurations are applied.

Many studies have found that the measured sound levels of DP alone are, counterintuitively, higher than those of DP combined with the intended activities such as drilling (Jiménez-Arranz et al. 2020; Kyhn et al. 2011; Nedwell and Edwards 2004) and coring (Warner and McCrodan 2011). Nedwell and Edwards (2004) reported that DP thrusters of the semi-submersible drill rig *Jack Bates* produced periodic noise (corresponding to the rate of the thruster blades) with most energy between 3 to 30 Hz. The received SPL measured at 100 meters from the vessel was 188 dB re 1 µPa. Warner and McCrodan (2011) found that most DP related sounds from the self-propelled drill ship, R/V *Fugro Synergy* were in the 110 to 140 Hz range, with an estimated source level of 169 dB re 1 µPa m. Sounds in this frequency range varied by 12 dB during DP, while the broadband levels, which also included diesel generators and other equipment sounds, varied by only 5 dB over the same time period. All the above sources report high variability in levels with time, due in part to the intermittent usage and relatively slow rotation rates of thrusters used in DP. It is also difficult to provide a realistic range of source levels from the data thus far because most reports do not identify the direction from which sound was measured relative to the vessel, and DP thrusters are highly directional systems.

The active acoustic positioning systems used in DP can be additional sources of high frequency sound. These systems usually consist of a transducer mounted through the vessel's hull and one or more transponders affixed to the seabed. Kongsberg High Precision Acoustic Positioning (HiPAP) systems produce pings in the 10 to 32 kHz frequency range. The hull-mounted transducers have source levels of 188 to 206 dB re 1 µPa m depending on adjustable power settings (Kongsberg Maritime AS 2013). The fixed transponders have maximum source levels of 186 to 206 dB re 1 µPa m depending on model and beam width settings from 15 to 90° (Jiminez-Arranz et al. 2020). These systems have high source levels, but beyond 2 kilometers they are generally quieter than other components of the sound from DP vessels for various reasons, including: their pulses are produced in narrowly directed beams, each individual pulse is very short, and their high frequency content leads to faster attenuation.

During operations, small vessels may be used to transport crew and supplies. Noise from vessels in transit is considered to be continuous, with a combination of broadband and tonal sounds (Richardson et al. 1995; Ross 1976). Transiting vessels generate continuous sound from their engines, propeller cavitation, onboard machinery, and hydrodynamics of water flows (Ross 1976). The actual radiated sound depends on several factors, including the type of machinery on the ship, the material conditions of the hull, how recently the hull has been cleaned, interactions with the sea surface, and shielding from the hull, which reduces sound levels in front of the ship.

In general, vessel noise increases with ship size, power, speed, propeller blade size, number of blades, and rotations per minute. Source levels for large container ships can range from 177 to 188 dB re 1 μPa m (McKenna et al. 2013) with most energy below 1 kHz. Smaller vessels typically produce higher-frequency sound concentrated in the 1 to 5 kHz range. Kipple and Gabriele (2003) measured underwater sound from vessels ranging from 14 to 65 feet long (25 to 420 horsepower), and back-calculated source levels were estimated to be 157 to 181 dB re 1 μPa m. Similar levels are reported by Jiménez-Arranz et al. (2020), who provide a review of measurements for support and crew vessels, tugs, rigid hull inflatable boats, icebreakers, cargo ships, oil tankers, and more.

During transit to and from shore bases, survey vessels typically travel at speeds that optimize efficiency, except in areas where transit speed is restricted. The vessel strike speed restrictions that are in place along the Atlantic OCS are expected to offer a secondary benefit of underwater noise reduction. For example, recordings from a speed reduction program in the Port of Vancouver (210 to 250 meter water depths) showed that reducing speeds to 11 knots reduced vessel source levels by 5.9 to 11.5 dB, depending on the vessel type (MacGillivray et al. 2019). Vessel noise is also expected to be lower during geological and geophysical surveys, as they typically travel around 5 knots when towing instruments.

J.2.5.2. Cable Laying and Trenching

The installation of cables can be done by towing a tool behind the installation vessel to simultaneously open the seabed and lay the cable, or by laying the cable and following with a tool to embed the cable. Possible installation methods for these options include jetting, vertical injection, control flow excavation, trenching, and plowing. Burial depth of the cables is typically 1 to 2 meters. Cable installation vessels may use dynamic positioning to lay the cables (Section J.2.5.1). Nedwell et al. (2003) recorded underwater sound at 160 meters from trenching, in water depths of 7 to 11 meters, and the back-calculated the source level was estimated to be 178 dB re 1 μPa m. They describe trenching sound as generally broadband in nature, but variable over time, with some tonal machinery noise and transients associated with rock breakage. Johansson and Andersson (2012) recorded underwater noise levels generated during a comparable operation involving pipelaying and a fleet of nine vessels. Mean noise levels of 130.5 dB re 1 μPa were measured at 4,924 feet (1,500 meters) from the source.

J.2.5.3. Wind Turbine Operations

Once windfarms are operational, low-level noise is generated by each wind turbine generator (WTG), but sound levels are much lower than during construction. This type of sound is considered to be continuous, omnidirectional radially from the pile, and non-impulsive. Most of the energy associated with operations is below 120 Hz. Sound levels from wind turbine operations are likely to increase somewhat with increasing generator size and power ratings, as well as with wind speeds. Recordings from Block Island Wind Farm indicated that there was a correlation between underwater sound levels and increasing wind speed, but this was not clearly influenced by turbine machinery; rather, it may have been explained by the natural effects that wind and sea state have on underwater sound levels (Elliott et al. 2019; Urick 1983).

A recent compilation (Tougaard et al. 2020) of operational noise from several wind farms, with turbines up to 6.15 MW in size, showed that operational noise generally attenuates rapidly with distance from the turbines, falling to near ambient sound levels within ~1 kilometer from the source; the combined noise levels from multiple turbines are lower or comparable to those generated by a small cargo ship. Tougaard et al. (2020) developed a formula predicting a 13.6 dB increase for every 10-fold increase in WTG power rating. This means that operational noise could be expected to increase by 13.6 dB when increasing in size from a 0.5 MW turbine to a 5 MW one, or from 1 MW to 10 MW. The least squares fit of that dataset would predict that the SPL measured 100 meters from a hypothetical 15 MW turbine in operation in 10 m/s (19 kt or 22 mph) wind would be 125 dB re 1 μPa. However, all of the 46 data points in that dataset, with the exception of the two from the Block Island Wind Farm, were from WTGs operated with gear boxes of various designs rather than the newer use of direct drive technology, which is expected to lower underwater noise levels significantly. Stöber and Thomsen (2021) make predictions for source levels of 10 MW turbines based on a linear extrapolation of maximum received levels from WTGs with ratings up to 6.15 MW. The linear fit is likely inappropriate, and the resulting predictions may be exaggerated. Tougaard et al. (2020) point out that received level differences among different pile types could be confounded by differences in water depth and turbine size. In any case, additional data is needed to fully understand the effects of size, foundation type properties (e.g., structural rigidity and strength), and drive type on the amount of sound produced during turbine operation.

J.2.6 Underwater Sound and Marine Life

J.2.6.1. Marine Mammals

Marine mammals rely heavily on acoustic cues for extracting information from their environment. Sound travels faster and farther in water (~1500 m/s) than it does in air (~350 m/s), making this 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 a call from a nearby predator. Finally, toothed whales produce and listen to echolocation clicks to locate food and to navigate (Madsen and Surlykke 2013).

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. 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 basiliar 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 both in 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. But 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, 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 towards 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 of 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 relatively high-frequency (tens of kHz) 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.

J.2.6.2. Sea Turtles

While the general importance of sound to sea turtles is not well understood, there is a growing body of knowledge suggesting that sea turtles use sound in a multitude of ways. Sea turtles may use sound for navigation, locating prey or preferred habitat, predator avoidance, and environmental awareness (Piniak et al. 2016). They occupy different ecological niches throughout their life cycle, each characterized by unique acoustic conditions. There are few studies reporting sound production in sea turtles, despite their ability to hear sounds in both air and water. Cook and Forrest (2005) found that nesting leatherback sea turtles produce sound when breathing in air, but this work suggested the sound was a byproduct of labored breathing rather than a communication signal. Sea turtle embryos and hatchlings have been reported to make airborne sounds, thought to be produced for synchronizing hatching and nest emergence (Ferrara et al. 2014a, 2014b, 2019; McKenna 2016; Monteiro et al. 2019). Charrier et al. (2022) noted the production of 10 different underwater sounds in juvenile green sea turtles including those within and above the frequency range of hearing reported for this species. A more comprehensive understanding of sound production and hearing is needed in sea turtles, but the growing available information thus far suggests sound may be important to these animals.

In general, sea turtle auditory perception is thought to occur through a combination of both bone and water conduction rather than air conduction (Lenhardt et al. 1983, 1985). The outermost part of the sea turtle ear, or tympanum, is covered by a thick layer of skin covering a fatty layer that conducts sound in water to the middle and inner ear. This is a distinguishing feature from terrestrial and semi-aquatic turtles. This thick outer layer makes it difficult for turtles to hear well in air, but it facilitates the transfer of sound from the aqueous environment into the ear (Ketten et al. 1999). The middle ear has two components that are encased by bone, the columella and extracolumella, which provide the pathway for sound from the tympanum on the surface of the turtle head to the inner ear consisting of the cochlea and basilar membrane. This arrangement enables sea turtles to hear low-frequency sounds while underwater. The middle ear is also connected to the throat by the Eustachian tube. Because there is air in the middle ear, it is generally believed that sea turtles detect sound pressure rather than particle motion. Vibrations can also be conducted through the bones of the carapace to reach the middle ear. Based on studies of semi-aquatic turtles, Christensen-Dalsgaard et al. (2012) speculated that the sea turtle ear may not be specialized for bone conduction, but rather that sound-induced pulsations may drive the tympanic disc if the middle ear cavity is air-filled.

Hearing in sea turtles has been measured through electrophysiological and/or behavioral studies both in air and water on a limited number of life stages for each of the five species. In general, sea turtles hear best in water between 100 and 750 Hz, do not hear well above 1 kHz, and are generally less sensitive to sound than marine mammals (Reese et al. 2023; Papale et al. 2020). While there are still substantial data gaps on hearing sensitivity across species and throughout ontogeny, there is data on Loggerhead hearing capabilities at the post-hatchling (Lavender et al. 2012, 2014b), juvenile (Bartol et al. 1999a; Lavender et al. 2012, 2014b), and adult stages (Martin et al. 2012). Available data on sea turtle hearing capabilities is summaries in Table J-1.

Table J-1 Hearing Capabilities of Sea Turtles

Sea Turtle Species		Hearing[1] Range of audibility (Hz)	Hearing[1] Range of highest sensitivity (Hz)	Sources
Green (Chelonia mydas)	Juvenile	50–1,600	200–400	Bartol and Ketten 2006; Dow Piniak et al. 2012c; Piniak et al. 2016; Ridgway et al. 1969a
Hawksbill (Eretmochelys imbricata)	Hatchling	50–1,600	400	Piniak 2012
Kemp's ridley (Lepidochelys kempii)	Juvenile	100–500[2]	100–500[2]	Bartol and Ketten 2006
Leatherback (Dermochelys coriacea)	Hatchling	50–1,200	300	Dow Piniak et al. 2012b; Piniak 2012
Loggerhead (Caretta caretta)	Post-Hatchling[3]	50–1,100	200	Bartol et al. 1999a; Lavender et al. 2014b; Lenhardt 2002; Martin et al. 2012
	Juvenile	50–1,100	50–800	
	Adult	35–1,131	100–400	

[1] Data adapted from Papale et al. 2020 and Reese et al. 2023 based on highest and lowest frequency of underwater audibility that was reported for each species including both auditory evoked potential and behavioral studies.
[2] Only in-air measurements are available for Kemp's ridley sea turtles.
[3] Post-hatchling refers to the size classification given to hatchlings when they reach a straight maximum length of 5 centimeters.

J.3. Acoustic Models and Assumptions

As mentioned above, the acoustic assessment for pile driving activities associated with installation of the WTG and OSS foundations and installation of the cofferdams relied on dBSea software developed by Marshall Day Acoustics for the prediction of underwater noise. Noise levels were calculated throughout the entire Offshore Project area and displayed in three dimensions. Levels were calculated in third octave bands. For the Project, two different solvers were used for the low and high-frequency ranges:

- dBSeaPE (Parabolic Equation Method): The dBSeaPE solver makes use of the parabolic equation method, a versatile and robust method of marching the sound field out in range from the sound source. This method is one of the most widely used in the underwater acoustics community and offers excellent performance in terms of speed and accuracy in a range of challenging scenarios.
- dBSeaRay (Ray Tracing Method): The dBSeaRay solver forms a solution by tracing rays from the source to the receiver. Many rays leave the source covering a range of angles, and the sound level at

each point in the receiving field is calculated by coherently summing the components from each ray. This is currently the only computationally efficient method at high frequencies.

The underwater acoustic modeling analysis used a split solver, with dBSeaPE evaluating the 12.5 Hz to 630 Hz and dBSeaRay addressing 800 Hz to 20,000 Hz. Additional assumptions and information pertaining to pile driving sound source development and sound propagation modeling can be found in the acoustic modeling report (COP, Appendix Z; Dominion Energy 2023).

For the installation of the goal post piles and HRG survey activities, distances to the PTS thresholds were calculated using the NMFS User Spreadsheet tool with adjustments to account for accumulation using the Safe Distance Methodology outlined by Silve et al. (2014) and source characteristics such as duty cycle and speed (e.g., pile strike rate for goal post installation, pulse rate for HRG survey equipment). Distances to the behavioral disturbance thresholds were calculated using the following formula:

$SPL(r) = SL - PL(r)$

Where SPL is the root-mean-square sound pressure level (in units of dB re 1 µPa) at a given range, r (in meters). SL is the estimated source level 1 meter from the source, and PL is the propagation loss calculated as:

$PL(r) = 20\log_{10}(r) + a(f) \times r/1{,}000$

Where a is an attenuation factor at a given frequency, f (Tetra Tech 2022a).

J.3.1 Physical Environment

The bathymetry information used in the modeling was obtained from the National Geophysical Data Center (NGDC) and the U.S. Coastal Relief Model (COP, Appendix Z, citing NOAA and Information Service 2020; Dominion Energy 2023). The bathymetric data were sampled by creating a fan of radials at a given angular spacing. This grid was then used to determine depth points along each modeling radial transect. The underwater acoustic modeling was conducted over these radial planes in set increments depending on the acoustic wavelength and the sampled depth. These radial transects were used for modeling acoustic impacts during both the construction and operation of the Project, with each radial centered on the given Project sound source or activity (COP, Appendix Z; Dominion Energy 2023). The water column properties change seasonally. Because the construction timeframe for WTGs and OSSs is expected from May to October, the June sound speed profile was selected as is exhibited maximum case characteristics for long-range noise propagation effects (Dominion Energy 2023).

The sediment layers used in the modeling and the main geoacoustic properties are defined in Table J-2 and Table J-3for the WTG and OSS installation scenarios and the cofferdam installation scenarios, respectively. The term “compressional” refers to the fact that particle motion of the sound wave is in the same direction as propagation. The term “compressional sound speed” refers to the speed of sound in the sediment along the direction of acoustic propagation. The term “compressional attenuation” refers to how much sound (in dB) is lost per wavelength (λ) of the signal. Finally, density is the physical density (ρ) of the sediment. Ranges are provided for the different geoacoustic properties because the values vary depending on the location specifically being modeled for a given scenario (COP, Appendix Z; Dominion Energy 2023).

Table J-2 Geoacoustic Properties of Sub-bottom Sediments as a Function of Depth for the WTG and OSS Modeling Scenarios

Seabed Layer (meters)	Material	Geoacoustic Properties
0 to 12	Sand	Cp = 1650 m/s αs (dB/λ) = 0.8 dB/λ ρ = 1900 kg/m^3
12 to 15	Clay	Cp = 1500 m/s αs (dB/λ) = 0.2 dB/λ ρ = 1500 kg/m^3
15 to 22	Dense Silty and	Cp = 1650 m/s αs (dB/λ) = 1.1 dB/λ ρ = 1800 kg/m^3
22 to 31	Stiff Sandy Clay	Cp = 1560 m/s αs (dB/λ) = 0.2 dB/λ ρ = 1600 kg/m^3
31 to 37	Clay	Cp = 1500 m/s αs (dB/λ) = 0.2 dB/λ ρ = 1500 kg/m^3
37 to 42	Silty Sand	Cp = 1650 m/s αs (dB/λ) = 1.1 dB/λ ρ = 1800 kg/m^3
42 to 53	Clay, Fine Sand	Cp = 1598 m/s αs (dB/λ) = 0.5 dB/λ ρ = 1575 kg/m^3
53 to 87	Sandy Silt	Cp = 1605 m/s αs (dB/λ) = 1.0 dB/λ ρ = 1700 kg/m^3
>87	Dense Sand	Cp = 1800 m/s αs (dB/λ) = 0.9 dB/λ ρ = 2000 kg/m^3

Source: COP, Appendix Z, Table Z-5; Dominion Energy 2023.

Table J-3 Geoacoustic Properties of Sub-bottom Sediments as a Function of Depth for the Cofferdam Installation Modeling Scenario

Seabed Layer (meters)	Material	Geoacoustic Properties
0 to 2	Silty Sand	Cp = 1650 m/s αs (dB/λ) = 1.1 dB/λ ρ = 1800 kg/m^3
2 to 6	Medium Dense Sand	Cp = 1725 m/s αs (dB/λ) = 0.8 dB/λ ρ = 1950 kg/m^3
6 to 9	Lean Clay	Cp = 1485 m/s αs (dB/λ) = 0.1 dB/λ

Seabed Layer (meters)	Material	Geoacoustic Properties
		ρ = 1300 kg/m^3
9 to 15	Silty Sand	Cp = 1650 m/s αs (dB/λ) = 1.1 dB/λ ρ = 1800 kg/m^3
15 to 26	Sandy Lean Clay	Cp = 1560 m/s αs (dB/λ) = 0.2 dB/λ ρ = 1600 kg/m^3
26 to 32	Medium Dense Sand	Cp = 1725 m/s αs (dB/λ) = 0.8 dB/λ ρ = 1950 kg/m^3

Source: COP, Appendix Z, Table Z-6; Dominion Energy 2023.

J.3.2 Vibratory Driving Source Details

The vertical array was assigned third-octave band sound characteristics adjusted for site-specific parameters discussed above, including expected hammer energy and number of blows. Third octave band center frequencies from 12.5 Hz up to 20 kHz were used in the modeling. In addition, a constant 15 dB/decade roll-off was applied to the modeled spectra after the second spectral peak. A roll-off is a filter, which can be imposed on a signal at either the low- or high-frequency range in order to more closely match expected sound propagation characteristics of that signal indicated by modeling or measurement results. Applying the 15 dB/decade roll-off is a conservative measure, which was based on guidance from NOAA Fisheries regarding the representation of pile-driving sound source characteristics in the high-frequency range (COP, Appendix Z; Dominion Energy 2023).

If required, the temporary offshore cofferdams will be constructed by installing steel sheet piles in a tight configuration around an area of approximately 20 by 50 feet (6.1 by 15 meters). For estimating source levels and frequency spectra, the vibratory pile driver was estimated assuming an 1,800 kN vibratory force. Modeling was accomplished using adjusted one-third-octave band vibratory pile-driving source levels from measurements of a similar offshore construction activity and adjusted to account for the estimated force necessary for driving Project cofferdam sheet piles. The assumed sound source level for vibratory pile driving corresponded to and SEL of 195 dB re 1 $\mu Pa^2 m^2$ s (COP, Appendix Z; Dominion Energy 2023).

J.4. Noise Attenuation

A range of potential sound reduction was applied to the modeled sound fields associated with impact pile driving. Attenuation factors of 6 dB and 10 dB were applied to all impact pile-driving scenarios to evaluate potential mitigated underwater noise impacts (COP, Appendix Z; Dominion Energy 2023).

The main energy associated with vibratory pile driving is radiated at lower frequencies compared to impact piling, and sound waves below a lower cut-off frequency do not propagate in shallow waters. As a result, high peak levels can be avoided and continuous sound levels can be kept low. Noise emissions from vibratory pile driving are on the order of 10 to 20 dB below mitigated impact pile driving at identical monopiles (COP, Appendix Z, citing Koschinski and Lüdemann 2020; Dominion Energy 2023). To date, there is very limited information available regarding the use, effectiveness, and noise emissions produced using vibratory pile driving for installation of larger pile diameters consistent with those proposed for the Project; therefore, further investigation is required. Correspondingly, the lower frequencies radiated by vibratory pile driving may restrict the ability of a bubble curtain to allow for a further 6 to 10 dB reduction in noise level. For the purposes of the Project underwater acoustic assessment, a 6 and 10 dB reduction was still applied for consistency. From a feasibility standpoint, it is unlikely that another noise mitigation measure (e.g., isolation casing, cofferdam) along with a bubble curtain would be implemented in the field. As indicated previously, use of vibratory pile driving is considered a somewhat mitigative activity, and unmitigated vibratory pile driving modeling results shown in COP, Appendix Z, Section Z.6.2 suggest that vibratory pile driving, when compared to impact pile driving results, will likely not dictate noise mitigation measures used for the Project (COP, Appendix Z; Dominion Energy 2023).

J.5. Methodology

Underwater acoustic model simulations were conducted for primary noise-generating activities occurring during Project construction and operation. The following subsections summarize the modeling calculations approach, modeled scenarios, and model input values contained in COP, Appendix Z (Dominion Energy 2023).

J.5.1 Acoustic Modeling Scenarios

A summary of construction and operational scenarios included in the underwater acoustic modeling analysis is provided in Table J-4. Model scenarios included locations where potential underwater noise impacts of marine species were anticipated including impact and vibratory pile driving associated with WTG and OSS foundation installation; impact pile driving of the goal post piles; vibratory pile driving during cofferdam installation associated with nearshore trenchless installation activities; and HRG survey activity (COP, Appendix Z; Dominion Energy 2023; Tetra Tech 2022a). The modeling scenarios for the WTG foundation installation occur at representative foundation locations; one at a shallow water depth of 69 feet (21 meters) (Universal Transverse Mercator [UTM] Coordinates: 459846 m, 4075324 m) within the Lease Area and another at a deep-water depth of 121 feet (37 meters) (UTM Coordinates: 48066 m, 4089018 m) within the Lease Area. These two locations were selected so that the effects of sound propagation at the range of water column depths occurring within the Lease Area could be observed. Sound fields for the OSS foundations were modeled at the location where the greatest sound propagation was expected out of the three proposed OSS locations. Installation of the goal post piles was modeled at one representative location, and the central cofferdam location was used as the representative location for this activity in the model (COP, Appendix Z; Dominion Energy 2023). The source level for the vibratory hammer was developed using an empirical model similar to the model used for the impact hammer. Further details pertaining to the underwater sound propagation modeling analysis, pile driving sound source development, vibratory hammer sound source development, and a model verification completed for the CVOW Pilot Project is provided in COP, Appendix Z (Dominion Energy 2023).

The model accommodates for differences in hammer energy, number of strikes, installation duration, sound source level, and pile progression as appropriate for the jacket pin piles and/or monopiles. This analysis also assumes a conservative duration for the use of the vibratory hammer. The pile diameters selected for the impact pile-driving modeling scenarios were based on maximum Project Design Envelope considerations provided by Dominion Energy. Scenarios 1 through 8 occur at representative WTG locations while Scenario 9 occurs at the cofferdam locations at the Nearshore Trenchless Installation Area. Several of the scenarios (1, 2, 3, 4, and 5) include monopile foundation impact pile driving using the maximum rated hammer energy of 4,000 kilojoules (kJ); however, that hammer energy assumption is considered conservative. The actual transferred energy to the pile during installation will be less than the maximum rated hammer energy, with losses in energy from sources such as heat and friction. Scenarios 6, 7, and 8 represent activities associated with pin pile installation and Scenarios 4, 5, 7, and 8 represent activities that involve a combination of impact and vibratory pile driving to achieve installation (COP,

Appendix Z; Dominion Energy 2023). Propagation modeling was conducted using the maximum projected blow energy as applicable for the various scenarios; however, a soft start and pile progression were also incorporated into the model for each pile (see COP, Appendix Z, Table Z-6; Dominion Energy 2023).

Table J-4 Underwater Acoustic Modeling Scenarios

Scenario	Activity Description	Maximum Hammer Energy (kilojoules)	Duration of Single Pile Installation (minutes)	Total Hammer Blows	Location (UTM Coordinates)	Sound Source Level[1]
1: Standard Driving Installation	Monopile Foundation (includes 1 pile per day) Diameter: 9.5 m	Impact Pile Driving: 4,000[2]	85	3,240	Deep: 480,666 m, 4,089,018 m Shallow: 459,846 m, 4,075,324 m	Lpk: 249 dB re 1 μPa m SEL$_{1s}$: 226 dB re 1 $\mu Pa^2 m^2$ s SPL: 236 dB re 1 μPa m
		Vibratory Pile Driving	60	N/A		SEL$_{1s}$: 202 dB re 1 $\mu Pa^2 m^2$ s
2: Hard-to-Drive Installation	Monopile Foundation (includes 1 pile per day) Diameter: 9.5 m	Impact Pile Driving: 4,000[2]	99	3,720	Deep: 480,666 m, 4,089,018 m Shallow: 459,846 m, 4,075,324 m	Lpk: 249 dB re 1 μPa m SEL$_{1s}$: 226 dB re 1 $\mu Pa^2 m^2$ s SPL: 236 dB re 1 μPa m
		Vibratory Pile Driving	30	N/A		SEL$_{1s}$: 202 dB re 1 $\mu Pa^2 m^2$ s
3: One Standard and One Hard-to-Drive Installation	Monopile Foundation (includes 2 piles per day) Diameter: 9.5 m	Impact Pile Driving: 4,000[2]	184	6,960	Deep: 480,666 m, 4,089,018 m 471,303 m, 4,085,595 m Shallow: 459,846 m, 4,075,324 m 467,653 m, 4,080,459 m	Lpk: 249 dB re 1 μPa m SEL$_{1s}$: 226 dB re 1 $\mu Pa^2 m^2$ s SPL: 236 dB re 1 μPa m
		Vibratory Pile Driving	90	N/A		SEL$_{1s}$: 202 dB re 1 $\mu Pa^2 m^2$ s
4: OSS Foundation	Pile Jacket Foundation (includes 2 piles per day) Diameter: 2.8 m	Impact Pile Driving: 3,000	410	15,120	Deep: 480,666 m, 4,089,018 m Shallow: 459,846 m, 4,075,324 m	Lpk: 240 dB re 1 μPa m SEL$_{1s}$: 214 dB re 1 $\mu Pa^2 m^2$ s SPL: 224 dB re 1 μPa m
		Vibratory Pile Driving	120	N/A		SEL$_{1s}$: 194 dB re 1 $\mu Pa^2 m^2$ s
5: Cofferdam Installation	Cofferdam, Vibratory Pile Driving	Vibratory Pile Driving	60	NA	414,213 m, 4,074,917 m	SEL$_{1s}$: 195 dB re 1 $\mu Pa^2 m^2$ s
6: Goal Post Pile Installation	Goal Post Piles (includes 2 piles per day) Diameter: 1.07	Impact Pile Driving	130	260	414,396 m 4,074,917 m	Lpk: 210 dB re 1 μPa m SEL$_{1s}$: 183 dB re 1 $\mu Pa^2 m^2$ s

Scenario	Activity Description	Maximum Hammer Energy (kilojoules)	Duration of Single Pile Installation (minutes)	Total Hammer Blows	Location (UTM Coordinates)	Sound Source Level[1]
	m					

Source: COP, Appendix Z, Table Z-7; Dominion Energy 2023.
m = meter; kJ = kilojoule SEL_{1s} = sound exposure level over 1 second; Lpk= peak sound pressure; SPL = root-mean-square sound pressure level
[1] Source levels are based on the SERO Pile Driving Noise Data Spreadsheet – Humboldt Bay Bridges (CALTRANS 2015).
N/A s included in the table for vibratory pile driving because this activity is not quantified in terms of hammer blows.
[2] 4,000 kJ corresponds to the maximum rated hammer energy; however, actual hammer energy transferred to the pile during installation will be less.

J.5.2 Threshold Range Calculations

To determine the ranges to the defined threshold isopleths, a maximum received level-over-depth approach was used. This approach uses the maximum received level that occurs within the water column at each calculation point. Both the R_{max} and the $R_{95\%}$ ranges were calculated for each of the regulatory thresholds. The R_{max} is the maximum range in the modeled environment at which the sound level was calculated to occur. The $R_{95\%}$ excludes major outliers or protruding areas associated with the underwater acoustic modeling environment and is determined by calculating the radius based on 95 percent of the area of the threshold isopleths. This is conducted by generating a circle approximating the extent of the sound contour isopleths and then calculating the associated radius using the following equation: the $R_{95\%}$ Radius (m) = $\sqrt{(\text{Area}*0.95)/\pi}$. The intent of this approach is to determine the predicted range encompassing at least 95 percent of the threshold isopleth area that would be exposed to noise from the source at or above the specified threshold level. All distances to injury thresholds reported in the Underwater Acoustic Assessment Report (COP, Appendix Z; Dominion Energy 2023) are presented in terms of the $R_{95\%}$ range. Based on the site- specific conditions and review of the resultant acoustic model output, even though this methodology for evaluating threshold ranges may differ from other acoustic models and may result in some slight irregularities in data trends (i.e., inconsistences in predictions in the near-field relative to pile driving activities), this methodology is representative of expected Project-related underwater acoustic impacts (COP, Appendix Z; Dominion Energy 2023).

J.6. Animal Movement Model Methodology

To estimate the number of animals expected to receive sound levels above established thresholds, Marine Acoustics, Inc. (MAI) conducted exposure modeling which combines animal movement modeling with the sound fields produced by each pile type and scenario using their Acoustic Integration Model© (AIM) (Tetra Tech 2022a). Different simulations were run in AIM for each species, modeling scenario, and modeled location in which simulated animals (i.e., animats) were randomly distributed throughout the modeling environment and the predicted received level was recorded every 30 seconds for each animat to create a sound exposure history. Animats move throughout the simulated environment following known behavioral rules for each species based on available studies (Tetra Tech 2022a). The sound exposure histories are then subsampled based on the expected duration of the activity (e.g., a monopile foundation may take up to 3 hours to install so 3 hour exposure histories were extracted from each scenario for each species), and then normalized using the ratio of real-world density estimates to the animat simulation densities for each species modeled (Tetra Tech 2022a).

J.7. Marine Species Present in the Project Area

J.7.1 Marine Mammal Presence and Seasonality for the Project Duration

Several sources of data, reports, and studies were reviewed by Dominion Energy to identify which marine mammals are expected to be present in the study area and their seasonal occurrence including: the most recent stock assessment reports from NMFS (Hayes et al. 2022); and Protected Species Observer (PSO) sighting data (and some Passive Acoustic Monitoring [PAM] data), which were also collected during Project-related vessel-based survey activities conducted in 2018–2019 which are provided in the PSO report sightings report (Milne 2018 as cited in COP, Section 4.2; Dominion Energy 2023). The most recent 2020-2021 PSO sighting data made available since the Milne (2018) report was published are summarized below in Table J-5. Marine mammals known to occur in the marine waters of coastal and offshore Virginia are listed in Table J-6T.

Table J-5 PSO Sighting Data Summary

PSO Sightings in 2020–2021 by Month																		
Species	**2020**									**2021[1]**								
	Apr	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Atlantic spotted dolphin	5	34	77	260	112	44	53						20	36	68			
Common bottlenose dolphin	10	59	102	107	303	377	150	124	27	3	20	6	11	126	46	362	130	
Common dolphin			27	46	16				224	840	366	620	945					
False killer whale						4												
Fin whale				1							13							
Humpback whale		1					7	1	23	10	25							
Minke whale									1					1				
North Atlantic right whale									3		3	1						
Pantropical spotted dolphin			72		7									10	10			
Pilot whale spp.					5											3		
Pygmy sperm whale								1										
Sperm whale					1													
Spinner dolphin			1															

Source: COP, Section 4.2, Table 4.2-19; Dominion Energy 2023.
[1] Data for 2021 are preliminary and will undergo additional review before reports are finalized.

Table J-6 Marine Mammals Known to Occur in the Marine Waters of Coastal and Offshore Virginia

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality[1]	Federal Status	Virginia Status
High-Frequency Cetaceans							
Harbor Porpoise	*Phocoena*	Gulf of Maine/Bay of Fundy	95,543	Shallow, inshore and nearshore, estuarine and coastal waters	Common/Winter/Spring	MMPA—non- strategic	—
Mid-Frequency Cetaceans							
Atlantic Spotted Dolphin	*Stenella frontalis*	Western North Atlantic	39,921	Continental shelf and slope	Common/Year-round	MMPA—non- strategic	—
Atlantic White-Sided Dolphin	*Lagenorhynchus acutus*	Western North Atlantic	93,233	Continental shelf and slope	Uncommon/Fall/Winter/Spring	MMPA—non- strategic	—
Common Bottlenose Dolphin	*Tursiops truncatus*	Western North Atlantic	62,851	Deeper, offshore waters	Common/Year-round	MMPA—non- strategic	—
		Southern Migratory Coastal	3,751	Shallow, inshore, and nearshore, estuarine and coastal waters	Common/Year-round	MMPA—strategic	—
Clymene Dolphin	*Stenella clymene*	Western North Atlantic	unknown	Deeper, offshore waters	Extralimital/Summer	MMPA—non- strategic	—
Dwarf Sperm Whale	*Kogia sima*	Western North Atlantic	7,750	Continental shelf and deeper, offshore waters	Uncommon/Variable	MMPA—non- strategic	—
False Killer Whale	*Pseudorca crassidens*	Western North Atlantic	1,791	Continental shelf and deeper, offshore waters	Uncommon/Variable	MMPA—non- strategic	—
Fraser's Dolphin	*Lagenorhynchus hosei*	Western North Atlantic	unknown	Deeper, offshore waters	Uncommon/Variable	MMPA—non- strategic	—
Killer Whale	*Orcinus orca*	Western North Atlantic	unknown	Continental shelf and deeper, offshore waters	Uncommon/Year-round	MMPA—non- strategic	—
Long-finned Pilot Whale	*Globicephala melas*	Western North Atlantic	39,493	Continental shelf	Common/Year-round	MMPA—non- strategic	—

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality[1]	Federal Status	Virginia Status
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	28,924	Continental shelf	Uncommon/Year-round	MMPA—non- strategic	—
Pan-tropical Spotted Dolphin	*Stenella attenuata*	Western North Atlantic	6,593	Deeper, offshore waters	Uncommon /Summer	MMPA—non- strategic	—
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	unknown	Continental shelf and deeper, offshore waters	Uncommon/Variable	MMPA—non- strategic	—
Pygmy Killer Whale	*Feresa attenuata*	Western North Atlantic	unknown	Deeper, offshore waters	Uncommon/Variable	MMPA—non- strategic	—
Pygmy Sperm Whale	*Kogia breviceps*	Western North Atlantic	7,750	Continental shelf and deeper, offshore waters	Uncommon/Year-round	MMPA—non- strategic	—
Risso's Dolphin	*Grampus griseus*	Western North Atlantic	35,493	Continental shelf	Common/Year-round	MMPA—non- strategic	—
Rough Toothed Dolphin	*Steno bredanensis*	Western North Atlantic	136	Continental shelf and deeper, offshore waters	Uncommon/Year-round	MMPA—non- strategic	—
Common Dolphin	*Delphinus delphis*	Western North Atlantic	172,974	Continental shelf and slope	Common/Year-round	MMPA—non- strategic	—
Sperm Whale	*Physeter macrocephalus*	North Atlantic	4,349	Deeper, offshore waters and slope	Uncommon/Year-round	MMPA—strategic; Endangered ESA	Endangered
Spinner Dolphin	*Stenellalongirostris orientalis*	Western North Atlantic	4,102	Deeper, offshore waters and slope	Uncommon/Year-round	MMPA—non- strategic	—
Striped Dolphin	*Stenella coeruleoalba*	Western North Atlantic	67,036	Deeper, offshore waters and slope	Uncommon/Year-round	MMPA—non- strategic	—
White Beaked Dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	536,016	Continental shelf	Uncommon/Variable	MMPA—non- strategic	—
Blainville's Beaked Whale	*Mesoplodon densirostris*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon/Spring/Summer	MMPA—non- strategic	—

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality[1]	Federal Status	Virginia Status
Cuvier's Beaked Whale	*Ziphius cavirostris*	Western North Atlantic	5,744	Deeper, offshore waters	Uncommon/Variable	MMPA—non- strategic	—
Gervais' Beaked Whale	*Mesoplodon europaeus*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon/Spring/Summer	MMPA—non- strategic	—
Sowerby's Beaked Whale	*Mesoplodon bidens*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon/Variable	MMPA—non- strategic	—
True's Beaked Whale	*Mesoplodon mirus*	Western North Atlantic	10,107	Deeper, offshore waters	Uncommon/Spring/Summer	MMPA—non- strategic	—
Low-Frequency Cetaceans							
Blue Whale	*Balaenoptera musculus*	Western North Atlantic	unknown	Continental shelf and deeper, offshore waters	Uncommon/Year-round	MMPA—strategic; Endangered ESA	Endangered
Fin Whale	*Balaenoptera physalus*	Western North Atlantic	6,802	Continental shelf and deeper, offshore waters	Common/Year-round	MMPA—strategic; Endangered ESA	Endangered
Humpback Whale (West Indies DPS)	*Megaptera novaeangliae*	Gulf of Maine	1,396	Continental shelf and coastal waters	Common/Fall/Winter/Spring	MMPA—non- strategic[2]	Endangered
Minke Whale	*Balaenoptera acutorostrata*	Canadian East Coast	21,960	Continental shelf	Common/Year-round	MMPA—non- strategic	—
Sei Whale	*Balaenoptera borealis*	Nova Scotia	6,292	Continental Shelf	Uncommon/Winter/Spring/Summer	MMPA—strategic; Endangered ESA	Endangered
North Atlantic Right Whale	*Eubalaena glacialis*	Western Atlantic	412	Continental shelf and coastal waters	Common/Year-round	MMPA—strategic; Endangered ESA	Endangered
Sirenians							
West Indian Manatee	*Trichechus manatus*	Florida	unknown	Coastal, bays, estuaries, and inlets	Extralimital/Variable	MMPA—strategic; Threatened ESA	Endangered
Phocid Pinnipeds in Water							
Gray Seal	*Halichoerus grypus*	Western North Atlantic	27,131	Coastal, bays, estuaries, and inlets	Uncommon/Fall/Winter/Spring	MMPA—non- strategic	—
Harbor Seal	*Phoca vitulina*	Western North Atlantic	75,834	Coastal, bays, estuaries, and inlets	Common/Fall/Winter/Spring	MMPA—non- strategic	—

Common Name	Scientific Name	Stock	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence/Seasonality[1]	Federal Status	Virginia Status
Harp Seal	*Pagophilus groenlandicus*	Western North Atlantic	unknown	Coastal, bays, estuaries, and inlets	Uncommon/Winter/Spring	MMPA—non- strategic	—
Hooded Seal	*Cystophora cristata*	Western North Atlantic	unknown	Coastal, bays, estuaries, and inlets	Extralimital/Summer/Fall	MMPA—non- strategic	—

Source: COP, Section 4.2, Table 4.2-20; Dominion Energy 2023.
Notes:
Marine Mammal Protection Act (MMPA)
[1] Occurrence defined as:
Common: occurrences are regularly documented, and the study area is generally considered within the typical range of the species. Uncommon: occurrences are occasionally documented, and the study area is generally considered within the typical range of the species.
Extralimital: few occurrences have been documented and the study area is generally considered outside the typical range of the species; any occurrences would likely be of incidental individuals.
[2] Note that the humpback whale (*Megaptera novaeangliae*) was previously federally listed as endangered; however, based on the revised listing completed by NOAA Fisheries in 2016, the Distinct Population Segment (DPS) of humpback whales that occurs along the East Coast of the U.S., the West Indies DPS, is no longer considered endangered or threatened. The Commonwealth of Virginia has retained the endangered state listing status for the humpback whale.
Status denoted as (--) indicates no regulatory status for that species under Federal or Virginia authority.

J.7.2 Marine Mammal Densities

The marine mammal species potentially occurring in the Project modeling areas were determined by Tetra Tech (2022b) based on habitat-based marine mammal density models developed by Roberts et al. (2022). Density estimates are a necessary part of the analysis process to determine acoustic exposure for each potentially occurring marine mammal in an area. Density estimates for each marine mammal species or species group by season were derived from the best available scientific information (Table J-7). As per Dominion Energy's commitment to seasonal restrictions from November through April, no WTG or OSS foundation installation activities are planned for winter, so modeling was conducted for the remaining three seasons, with spring including the months of March through May, summer ranging from the months of June to August, and fall extending from September through November. Construction activities, however, are not planned to occur for the entirety of spring through fall. Monopile and OSS construction is planned for only part of spring (May) and part of fall (September through October) annually. Using the Roberts et al. (2022) density data (which are delineated by grid cell), the densities for all of the grid cells within the modeling area were averaged for each month to provide a monthly average density. The three seasonal densities were calculated as the average of the months within each of the three seasons when construction is expected to occur.

Some marine mammal species were modeled as representative groups rather than individual species. For instance, members of the same genus that inhabit the same type of habitat and have similar dive and swim behaviors, such as the two pilot whale species, were modeled as an inclusive generic group (pilot whales) rather than by their individual species (long- and short-finned pilot whales). The two potentially occurring species of phocid seals, the harbor and gray seals, were also modeled as a representative group (seals). A summer density for the seals is given as 0.00001 animals/km^2 which is not the density derived from Roberts et al. (2022). A higher density estimate, 0.0004 animals /km^2, was derived for the summer season for this species group from Roberts et al. (2022). However, the Roberts et al. (2022) derived density estimate is unrealistic given that neither seal species is expected to occur in the waters of the Project area during summer (Hayes et al. 2022). For harbor seals, Hayes et al. (2022) estimates the occurrence in mid-Atlantic waters to range only from September through May, not during summer. The summer distribution of both species is well documented in more northern waters. To reconcile the known distribution of these species with the need for a density estimate, the conservative density estimate of 0.00001 animals/km^2 was used to represent the summer density of both seal species.

Two bottlenose dolphin stocks are present within the Project area, but density values are only available in the Roberts et al. density data for the species. Hayes et al. (2022) defines the boundary between the Western North Atlantic, Southern Coastal Migratory stock and the Western North Atlantic, offshore stock of bottlenose dolphins as the 20 m isobath north of Cape Hatteras, North Carolina. The 20 m isobath was used with the Roberts et al. (2022) to differentiate the two stocks and derive densities for the bottlenose dolphins in the Project area less than 20 m for the Southern Coastal Migratory stock and more than 20 m for the offshore stock.

The modeled marine mammal animats were set to populate each of the model areas with representative nominal densities. In some cases, the modeled animat density was higher than the real-world density estimate. This "over population" ensures that the result of the animat model simulation is not unduly influenced by the chance placement of a few simulated marine mammals and provides statistical robustness without overestimating risk. To obtain final exposure estimates, the modeled results are normalized by the ratio of the modeled animat density to the real-world (Roberts et al. 2022) marine mammal seasonal density estimates. Density estimates for all species considered common in Table J-7, or have confirmed sightings within the Lease Area based on PSO data in Table J-5 are provided in Table J-7.

Table J-7 Mean Seasonal Density Estimates (animals/km²) for the Potentially Occurring Marine Mammal Species in the Project Area

Marine Mammal Species or Model Group	Spring (May)	Summer (June to August)	Fall (September to October)
Atlantic spotted dolphin	0.00507	0.05873	0.03822
Common bottlenose dolphin Western North Atlantic Southern Coastal Migratory Stock[1]	0.13098	0.13509	0.13852
Common bottlenose dolphin Western North Atlantic Offshore Stock[1]	0.07352	0.07415	0.06439
Common dolphin	0.05355	0.00559	0.00103
Minke whale	0.00519	0.00028	0.00011
Fin whale[2]	0.00069	0.00036	0.00019
Harbor porpoise	0.00315	0.00000	0.00000
Humpback whale	0.00136	0.00023	0.00040
North Atlantic right whale[2]	0.00015	0.00004	0.00005
Pantropical spotted dolphin[3]	0.00008	0.00008	0.00008
Pilot whale *spp*. (long- and short-finned pilot whales)[4]	0.00098	0.00098	0.00098
Risso's dolphin	0.00084	0.00042	0.00021
Seals[5]	0.01828	0.00001	0.00047
Sei whale[2]	0.00021	0.00001	0.00004
Sperm whale[2]	0.00003	0.00000	0.00000

Source: Table 24, Tetra Tech 2022b.
[1] Common bottlenose dolphin density values from Duke University (Roberts et al. 2016b, 2017, 2018, 2020) are reported as "bottlenose" and not identified to stock. Given the foundation installation sound would be confined to beyond the 20 m isobath, where the offshore stock is anticipated to predominate, estimated Level B take for cofferdam installation was accrued to the offshore stock.
[2] Indicates species listed under the Endangered Species Act.
[3] Pantropical spotted dolphins are included due to challenges with PSO identification of Atlantic spotted versus pantropical
spotted dolphins.
[4] Pilot whale density values from Duke University (Roberts et al. 2016a, 2016b, 2017, 2018, 2020) are reported as "Kogia *spp*." and are not species-specific.
[5] Seal density values from Duke University (Roberts et al. 2016a, 2016b, 2017, 2018, 2020) are reported as "seals" and not
species-specific; therefore, 50% were attributed to harbor seals and 50% to gray seals.

J.7.3 Sea Turtle Presence and Seasonality for the Project Duration

Five species of sea turtles have historically been reported to occur in mid-Atlantic waters off the coast of Virginia, all of which are listed as threatened or endangered under the Endangered Species Act (ESA). These species include the federally endangered Atlantic hawksbill (*Eretmochelys imbricata*), federally threatened green (*Chelonia mydas*), federally Endangered Kemp's ridley (*Lepidochelys kempii*), federally endangered leatherback (*Dermochelys coriacea*), and federally threatened loggerhead (*Caretta caretta*) (COP, Section 4.2; Dominion Energy 2023). Table J-8 provides a summary of key information for these species and their known distribution within the study area.

Table J-8 Sea Turtles Known to Occur in the Marine Waters of Coastal and Offshore Virginia

Common Name	Scientific Name	Estimated Abundance	Known Offshore Project Area Distribution	Occurrence[1] Seasonality	Federal Status	State of Virginia Status
Leatherback Sea Turtle	*Dermochelys coriacea*	34,000–94,000	Offshore, continental shelf and deeper	Uncommon/Year-round	Endangered	Endangered
Atlantic Hawksbill Sea Turtle	*Eretmochelys imbricata*	19,000[2]	N/A	Extralimital/Year-round	Endangered	Endangered
Green Sea Turtle (North Atlantic Distinct Population Segment)	*Chelonia mydas*	215,000[2]	Coastal, bays, estuaries, and inlets	Uncommon/Year-round	Threatened	Threatened
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	248,300	Coastal, bays, estuaries, and inlets	Common/Year-round	Endangered	Endangered
Loggerhead Sea Turtle (Northwest Atlantic Distinct Population Segment)	*Caretta*	588,000	Throughout: offshore, continental shelf and deeper; coastal, bays, estuaries, and inlets	Common/Year-round	Threatened	Threatened

Source: COP, Section 4.2, Table 4.2-28.
Notes:
[1] Occurrence defined as:
Common: Occurrences are regularly documented, and the study area is generally considered within the typical range of the species. Uncommon: Occurrences are occasionally documented, and the study area is generally considered within the typical range of the species.
Extralimital: Few occurrences have been documented, and the study area is generally considered outside the typical range of the species; any occurrences would likely be of incidental individuals.
[2] Abundance estimates based on current nesting female and sex ratio estimates.

J.7.4 Sea Turtle Densities

Two sources of sea turtle densities represent the best available at-sea density data for sea turtles in the Project area: U.S. Department of the Navy (DON 2007) and Barco et al. (2018) (Tetra Tech 2022a). The DON (2007) density estimates were prepared for the Navy's U.S. Atlantic operating areas, which include the CVOW-C Project area. More recent loggerhead turtle density estimates for the Project area are available in Barco et al. (2018); however, these densities are much higher than the older DON (2007) estimates for the loggerhead turtle. Additionally, Barco et al. (2018) included a seasonal availability correction factor. Instead of selecting one of these loggerhead density estimates to apply to the exposure modeling output, both the DON (2007) and Barco et al. (2018) density estimates for the loggerhead turtle have been included.

Though green sea turtles may occur seasonally in the Project area, no at-sea density estimates are available for this species. Rather, the only available data for green sea turtles are those grouped into the "hardshelled guild" in the DON (2007) dataset, so the seasonal estimates from this guild were used as surrogate densities for green sea turtles (Tetra Tech 2022a). Densities for all sea turtle species likely to occur in the Project area are provided in Table J-9.

Table J-9 Mean Seasonal Density Estimates (animals km^{-2}) for Sea Turtles Potentially Occurring in the Project Area

Common Name	Scientific Name	Spring (May)	Summer (June – August)	Fall (September and October)
Leatherback Sea Turtle	*Dermochelys coriacea*	0.00509	0.00427	0.00509
Green Sea Turtle [1]	*Chelonia mydas*	0.04561	0.07241	0.04867
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	0.04687	0.04687	0.04687
Loggerhead Sea Turtle (DON 2007)	*Caretta caretta*	0.13534	0.13062	0.13475
Loggerhead Sea Turtle (Barco et al. 2018)	*Caretta caretta*	2.514	1.385	1.289

Source: Appendix D, Table 8; Tetra Tech 2022a.
Notes:
[1] Population data were insufficient to determine an individual species density estimate for green sea turtles from the DON (2007) dataset; therefore the hardshelled guild densities were used as a surrogate for green sea turtles in the Project area.

J.7.5 Seasonal Restrictions

Portions of the study area fall within the Mid-Atlantic U.S. North Atlantic Right Whale Seasonal Management Area (SMA). Restrictions associated with these dynamic management areas are in effect between November 1 and April 30 annually. Vessels transiting these areas must comply with NMFS regulations and speed restrictions as applicable for North Atlantic right whales.

J.8. Acoustic Impact Criteria

NMFS (2018) defined acoustic threshold criteria at which PTS and temporary threshold shift (TTS) are predicted to occur for each hearing group for impulsive and non-impulsive signals (Table J-10), which are presented in terms of dual metrics; SEL_{24h} and Lpk. The Level B (behavioral) harassment thresholds are also provided in Table J-11.

Table J-10 Acoustic Threshold Criteria for Marine Mammals

Hearing Group	Sound Source Type					
	Impulsive			Non-Impulsive		
	PTS-Onset	TTS-Onset	Behavior	PTS-Onset	TTS-Onset	Behavior
Low-frequency cetaceans	Lpk: 219 dB re 1 µPa SEL$_{24h}$: 183 dB re 1 µPa^2 s	Lpk: 213 dB re 1 µPa SEL$_{24h:}$ 168 dB re 1 µPa^2 s	SPL:160 dB re 1 µPa	SEL$_{24h:}$ 199 dB re 1 µPa^2 s	SEL$_{24h:}$ 179 dB re 1 µPa^2 s	SPL: 120 dB re 1 µPa (continuous) SPL: 160 dB re 1 µPa (intermittent)
Mid-frequency cetaceans	Lpk: 230 dB re 1 µPa SEL$_{24h}$:185 dB re 1 µPa^2 s	Lpk: 224 dB re 1 µPa SEL$_{24h:}$ 170 dB re 1 µPa^2 s		SEL$_{24h:}$ 198 dB re 1 µPa^2 s	SEL$_{24h:}$ 178 dB re 1 µPa^2 s	
High-frequency cetaceans	Lpk: 202 dB re 1 µPa SEL$_{24h}$:155 dB re 1 µPa^2 s	Lpk: 196 dB re 1 µPa SEL$_{24h:}$ 140 dB re 1 µPa^2 s		SEL$_{24h:}$ 173 dB re 1 µPa^2 s	SEL$_{24h:}$ 153 dB re 1 µPa^2 s	
Phocid pinnipeds underwater	Lpk: 218 dB re 1 µPa SEL$_{24h}$:185 dB re 1 µPa^2 s	Lpk: 212 dB re 1 µPa SEL$_{24h:}$ 170 dB re 1 µPa^2 s		SEL$_{24h:}$ 201 dB re 1 µPa^2 s	SEL$_{24h:}$ 181 dB re 1 µPa^2 s	

Sources: NMFS 2018.
µPa = micropascal; dB = decibel; PTS = permanent threshold shift; re = referenced to; SEL$_{24h}$ = sound exposure level over 24 hours; Lpk = peak sound pressure level; SPL = root-mean-square sound pressure level; TTS = temporary threshold shift.

NOAA Fisheries anticipates behavioral response for sea turtles from impulsive sources such as impact pile driving to occur at SPL 175 dB re 1 µPa, which has elicited avoidance behavior of sea turtles (Blackstock et al. 2018). There is limited information available on the effects of noise on sea turtles, and the hearing capabilities of sea turtles are still poorly understood. In addition, the U.S. Navy introduced a weighting filter appropriate for sea turtle impact evaluation in their 2017 document titled "Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III)" (Finneran et al. 2017). That weighting has been applied to both impulsive and non-impulsive criteria for PTS and TTS (Table J-11).

Fish noise injury thresholds have been established by the Fisheries Hydroacoustic Working Group, which was assembled by NOAA Fisheries with thresholds subsequently adopted by NOAA Fisheries. The NOAA Fisheries Greater Atlantic Regional Fisheries Office (GARFO) has applied these standards for assessing the potential effects of ESA-listed fish species and sea turtles exposed to elevated levels of underwater sound produced during pile driving, which were just recently updated (GARFO 2019) (COP, Appendix Z; Dominion Energy 2023). These noise thresholds are based on sound levels that have the potential to produce injury or illicit a behavioral response from fishes (Table J-10).

A Working Group organized under the American National Standards Institute-Accredited Standards Committee S3, Subcommittee 1, Animal Bioacoustics, also developed sound exposure guidelines for fish and sea turtles (Table J-12; Popper et al. 2014) (COP, Appendix Z; Dominion Energy 2023). They identified three types of fishes depending on how they might be affected by underwater sound. The categories include fishes with no swim bladder or other gas chamber (e.g., flounders, dab, and other flatfishes); fishes with swim bladders in which hearing does not involve the swim bladder or other gas volume (e.g., salmonids); and fishes with a swim bladder that is involved in hearing (e.g., channel catfish) (COP, Appendix Z; Dominion Energy 2023).

Table J-11 Acoustic Threshold Criteria for Fishes and Sea Turtles

Hearing Group	Impulsive Signals		Non-Impulsive Signals		Behavior (Impulsive and Non-Impulsive)
	PTS-Onset/Injury[1]	TTS-Onset	PTS-Onset/Injury[1]	TTS-Onset	
Fishes	Lpk: 206 dB re 1 μPa SEL_{24h}: 187 dB re 1 μPa^2 s	--	--	--	SPL: 150 dB re 1 μPa
Sea turtles	Lpk: 232 dB re 1 μPa SEL_{24h}: 204 dB re 1 μPa^2 s	Lpk: 226 dB re 1 μPa SEL_{24h}: 189 dB re 1 μPa^2 s	SEL_{24h}: 200 dB re 1 μPa^2 s	SEL_{24h}: 220 dB re 1 μPa^2 s	SPL: 175 dB re 1 μPa

Sources: Stadler and Woodbury (2009); GARFO 2019; Blackstock et al. 2018; Finneran et al. 2017.
-- = not applicable for fishes; μPa = micropascal; dB = decibel; PTS = permanent threshold shift; re = referenced to; SEL_{24h} = sound exposure level over 24 hours; Lpk = peak sound pressure level; SPL = root-mean-square sound pressure level; TTS = temporary threshold shift.
[1] PTS-onset thresholds are applicable for sea turtles based on work from Finneran et al. (2017), where GARFO (2019) only provides thresholds for acoustic injury in fish.

Table J-12 Acoustic Threshold Levels for Fishes

Hearing Group	Impulsive Sounds			Non-Impulsive Sounds	
	Mortality and Potential Mortal Injury	Recoverable Injury	TTS	Recoverabl e Injury	TTS
Fishes without swim bladders	Lpk: >213 dB re 1 μPa SEL_{24h}: >219 dB re 1 μPa^2 s	Lpk: >213 dB re 1 μPa SEL_{24h}: >216 dB re 1 μPa^2 s	SEL_{24h}: >186 dB re 1 μPa^2 s	--	--
Fishes with swim bladder not involved in hearing	Lpk: 207 dB re 1 μPa SEL_{24h}: 210 dB re 1 μPa^2 s	Lpk: 207 dB re 1 μPa SEL_{24h}: 203 dB re 1 μPa^2 s	SEL_{24h}: >186 dB re 1 μPa^2 s	--	--
Fishes with swim bladder involved in hearing	Lpk: 207 dB re 1 μPa SEL_{24h}: 207 dB re 1 μPa^2 s	Lpk: 207 dB re 1 μPa SEL_{24h}: 203 dB re 1 μPa^2 s	SEL_{24h}: 186 dB re 1 μPa^2 s	SPL: 170 dB re 1 μPa	SPL: 158 dB re 1 μPa
Eggs and larvae	Lpk: 207 dB re 1 μPa SEL_{24h}: 210 dB re 1 μPa^2 s	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	--	--

Sources: Popper et al. 2014.
μPa = micropascal; dB = decibel; SEL_{24h} = sound exposure level over 24 hours; Lpk = peak sound pressure level; SPL = root-mean-square sound pressure level; TTS = temporary threshold shift., N = near (10s of meters), I = intermediate (100s of meters), and F = far (1000s of meters); -- = not applicable.

J.9. Results

J.9.1 WTG and OSS Foundation Installation

The complete dBSea acoustic modeling results to assess distances to the various acoustic threshold levels identified above in Sections J.5.2 and J.8 are provided in COP, Appendix Z (Dominion Energy 2023). The modeling scenarios analyzed are described in Table J-4 and include monopile impact pile-driving activities for pile diameters of 31.2 feet (9.5 meters) using hammer energy of 4,000 kilojoules, and pin pile impact pile driving for 9.2-foot (2.8-meter) pile diameter. Modeling scenarios also include a combination of vibratory and impact pile-driving activities to achieve installation as described for Scenarios 1, 2, 3, and 4 (Table J-4). All those activities may occur at the two representative WTG locations within the Lease Area, where one location is in the deepest region (121 feet [37 meters]) of the

Lease Area while the other location is in the shallowest region (69 feet [21 meters]) of the Lease Area; and the one representative for the OSS where the greatest sound propagation ranges will occur.

The results for impact and vibratory pile driving for the representative WTG location at the deepest water depth and the representative OSS foundation location are shown in Table J-13, Table J-14, and Table J-15 for marine mammals, sea turtles, and fish, respectively. Results are presented without mitigation and with two different levels of mitigation: a 6-dB reduction and a 10-dB reduction. Noise mitigation requirements and methods have not been finalized at this stage of Project design; therefore, these two levels of reduction were applied to potentially mimic the use of noise mitigation options such as bubble curtains (COP, Appendix Z; Dominion Energy 2023). The results in Table J-13 indicate that the unmitigated distances to the Lpk thresholds for marine mammals are generally below 1,640 feet (500 meters) except for results for the high-frequency cetaceans group. Thresholds to the SEL_{24h} PTS onset thresholds were larger for all marine mammal hearing groups (Table J-13). Similar results were seen for sea turtles (Table J-13) and fish (Table J-14), with ranges to applicable thresholds varying depending on the threshold value, installation method, and pile type. Expectedly, the largest ranges to thresholds are the ones for the marine mammal and fish behavioral response thresholds, which are and SPL of 160 and 120 dB re 1 µPa for marine mammals in response to impulsive and non-impulsive, continuous sound sources, respectively; and an SPL of 150 dB re 1 µPa for fish in response to all sound source types (Section J.7). Refer to COP, Appendix Z, Figures Z-8 through Figure Z-31 for sound maps of unweighted and unmitigated underwater received sound pressure levels for deep and shallow modeling scenarios (Dominion Energy 2023).

Table J-13 Marine Mammal Permanent Threshold Shift Onset and Behavioral Criteria Threshold Distances (meters) During Impact and Vibratory Pile Driving for Installation of the Wind Turbine Generator and Offshore Substation Foundation Scenarios

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold (Lpk)				Distance to PTS Threshold (SEL_{24hr})				Distance to Behavioral Threshold (SPL)
		LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	All Hearing Groups
Standard WTG Driving Installation – Impact Pile Driving	0	344	116	1,621	371	11,325	598	5,686	3,405	15,010
	6	182	67	927	213	6,020	320	2,946	1,852	8,700
	10	132	29	663	141	4,396	170	2,139	1,267	6,182
Standard WTG Driving Installation – Vibratory Pile Driving	0	--	--	--	--	414	0	367	104	21,404
	6	--	--	--	--	199	0	193	52	12,267
	10	--	--	--	--	141	0	85	0	10,114
Hard-to-Drive WTG Installation – Impact Pile Driving	0	344	116	1,621	371	12,423	664	6,273	3,809	15,010
	6	182	67	927	213	6,738	354	3,230	1,987	8,700
	10	132	29	663	141	4,980	187	2,304	1,358	6,182
Hard-to-Drive WTG Installation – Vibratory Pile Driving	0	--	--	--	--	356	0	507	133	21,404
	6	--	--	--	--	150	0	258	72	12,267
	10	--	--	--	--	113	0	120	31	10,114
One Standard and One Hard-to-Drive WTG Installation – Impact Pile Driving	0	344	116	1,621	441	14,363	840	7,647	4,651	15,010
	6	182	67	927	228	7,997	443	3,933	2,570	8,700
	10	132	29	663	158	5,663	226	2,884	1,756	6,182
One Standard and One Hard-to-Drive WTG Installation – Vibratory Pile Driving	0	--	--	--	--	534	0	507	133	21,404
	6	--	--	--	--	256	0	258	72	12,267
	10	--	--	--	--	158	0	120	31	10,114
OSS Piled Jacket – Impact Pile Driving	0	35	0	508	55	6,807	258	3,485	3,188	5,530
	6	0	0	284	0	3,697	121	1,938	1,746	3,291
	10	0	0	197	0	2,680	48	1,435	1,283	2,172
OSS Piled Jacket – Vibratory Pile Driving	0	--	--	--	--	218	0	190	63	8,921
	6	--	--	--	--	130	0	112	35	5,272
	10	--	--	--	--	75	0	68	0	3,601

Source: COP, Appendix Z; Dominion Energy 2023.

Table J-14 Sea Turtle Permanent Threshold Shift Onset and Behavioral Criteria Threshold Distances (meters) During Impact and Vibratory Pile Driving for Installation of the Wind Turbine Generator and Offshore Substation Foundation Scenarios

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold (Lpk)	Distance to PTS Threshold (SEL_{24hr})	Distance to Behavioral Threshold (SPL)
Standard Driving Installation – Impact Pile Driving	0	104	2,628	5,162
	6	48	1,408	2,829
	10	10	1,044	2,146
Standard Driving Installation – Vibratory Pile Driving	0	N/A	65	189
	6		18	119
	10		6	82
Hard-to-Drive Installation – Impact Pile Driving	0	104	2,918	5,162
	6	48	1,533	2,829
	10	10	1,142	2,146
Hard-to-Drive Installation – Vibratory Pile Driving	0	N/A	40	189
	6		0	119
	10		0	82
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	0	104	3,685	5,162
	6	48	2,053	2,829
	10	10	1,410	2,146
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	0	N/A	78	189
	6		24	119
	10		8	82
OSS Piled Jacket – Impact Pile Driving	0	0	1,695	2,041
	6	0	914	1,134
	10	0	653	742
OSS Piled Jacket – Vibratory Pile Driving	0	N/A	14	85
	6		0	38
	10		0	7

Source: COP, Appendix Z; Dominion Energy 2023.
OSS = offshore substation; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa); WTG = wind turbine generator.

Table J-15 Fish Acoustic Injury and Behavioral Threshold Distances (meters) During Impact and Vibratory Pile Driving for Installation of the Wind Turbine Generator and Offshore Substation Foundation Scenarios

Scenario	Noise Attenuation (dB)	Fish with no Swim Bladder		Fish with Swim Bladder Not Involved in Hearing		Fish with Swim Bladder Involved in Hearing		Eggs and Larvae		Fish <2 g		Fish ≥2 g		Behavioral (SPL)
		Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	All Fish
Standard Driving Installation – Impact Pile Driving	0	605	810	1,007	1,729	1,007	2,348	1,007	1,729	1,105	14,940	1,105	11,907	36,030
	6	344	489	605	1,021	605	1,301	605	1,021	663	8,653	663	6,131	20,512
	10	242	352	402	748	402	955	402	748	445	6,131	445	4,501	15,010
Standard Driving Installation – Vibratory Pile Driving	0	-	-	-	-	-	-	-	-	-	3,188	-	2,199	2,528
	6	-	-	-	-	-	-	-	-	-	1,831	-	1,216	1,359
	10	-	-	-	-	-	-	-	-	-	1,216	-	796	903
Hard-to-Drive Installation – Impact Pile Driving	0	605	906	1,007	1,986	1,007	2,683	1,007	1,968	1,105	16,655	1,105	12,722	36,030
	6	344	540	605	1,120	605	1,466	605	1,120	663	9,302	663	6,824	20,512
	10	242	389	402	829	402	1,041	402	829	445	6,824	445	5,085	15,010
Hard-to-Drive Installation – Vibratory Pile Driving	0	-	-	-	-	-	-	-	-	-	2,476	-	1,641	2,528
	6	-	-	-	-	-	-	-	-	-	1,338	-	886	1,359
	10	-	-	-	-	-	-	-	-	-	886	-	601	903
One Standard and One Hard-to-Drive Installation – Impact Pile Driving	0	605	1,121	1,007	2,439	1,007	3,315	1,007	2,439	1,105	20,786	1,105	14,787	36,030
	6	344	672	605	1,386	605	1,860	605	1,386	663	11,508	663	8,291	20,512
	10	242	477	402	1,042	402	1,266	402	1,042	445	8,291	445	5,880	15,010
One Standard and One Hard-to-Drive Installation – Vibratory Pile Driving	0	-	-	-	-	-	-	-	-	-	3,822	-	2,666	2,528
	6	-	-	-	-	-	-	-	-	-	2,191	-	1,442	1,359
	10	-	536-	-	-	-	-	-	-	-	1,442	-	961	903
OSS Piled Jacket – Impact Pile Driving	0	172	536	311	1,231	311	1,599	311	1,231	344	10,069	344	7,306	13,641
	6	35	310	172	696	172	907	172	696	197	5,959	197	4,000	8,243
	10	0	213	74	488	74	633	74	488	94	4,000	94	2,959	5,530
OSS Piled Jacket – Vibratory Pile Driving	0	-	-	-	-	-	-	-	-	-	1,664	-	1,088	991
	6	-	-	-	-	-	-	-	-	-	887	-	569	540
	10	-	-	-	-	-	-	-	-	-	569	-	427	393

Source: COP, Appendix Z; Dominion Energy 2023.
OSS = offshore substation; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa); WTG = wind turbine generator.

This page intentionally left blank.

J.9.2 Goal Post Pile Installation

Up to 12 goal posts consisting of nine 42-inch (1.07-meter) steel pipe piles for a total of 108 piles would be installed using impact pile driving (impulsive source) to support trenchless installation of the export cable offshore of the cable landing location. Sound fields were modeled at one representative location assuming two posts would be installed per day requiring up to 130 minutes to install both piles (COP, Appendix Z; Dominion Energy 2023). For the goal posts, up to 260 strikes per pile were assumed for installation. All goal post piles would be installed between May 1 and October 31 in 2024 and would occur over a total of 24 days for all 108 piles, assuming up to two piles are installed per day. Similar to the WTG and OSS installation modeling, noise mitigation is also included assuming 0-, 6-, and 10-dB noise attenuation. Results of the modeling of the goal post pile installation are provided in Table J-16, Table J-17, and Table J-18 for marine mammals, sea turtles, and fish, respectively.

Table J-16 Marine Mammal Permanent Threshold Shift Onset and Behavioral Criteria Threshold Distances (meters) During Impact Pile Driving for Installation of the Goal Posts to Support Trenchless Installation of the Export Cable

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold (Lpk)				Distance to PTS Threshold (SEL_{24hr})				Distance to Behavioral Threshold (SPL)
		LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	All Hearing Groups
Goal Post Pile Installation – Impact Pile Driving	0	2	0	31	3	591	21	704	316	1,450
	6	0	0	12	1	235	8	280	126	580
	10	0	0	7	0	127	4.5	152	68	314

Source: COP, Appendix Z Dominion Energy 2023.
HFC = high-frequency cetacean; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; PPW = phocid pinniped in water; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa).

Table J-17 Sea Turtle Permanent Threshold Shift Onset and Behavioral Criteria Threshold Distances (meters) During Impact Pile Driving for Installation of the Goal Posts to Support Trenchless Installation of the Export Cable

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold (Lpk)	Distance to PTS Threshold (SEL_{24hr})	Distance to Behavioral Threshold (SPL)
Goal Post Pile Installation – Impact Pile Driving	0	0	0	0
	6	0	0	0
	10	0	0	0

Source: COP, Appendix Z Dominion Energy 2023.
PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa).

Table J-18 Fish Acoustic Injury and Behavioral Criteria Threshold Distances (meters) During Impact Pile Driving for Installation of the Goal Posts to Support Trenchless Installation of the Export Cable

Scenario	Noise Attenuation (dB)	Fish with No Swim Bladder		Fish with Swim Bladder Not Involved in Hearing		Fish with Swim Bladder Involved in Hearing		Eggs and Larvae		Fish <2 g		Fish ≥2 g		Behavioral (SPL)
		Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	All Fish
Goal Post Pile Installation – Impact Pile Driving	0	-	-	-	-	-	-	-	-	-	-	-	-	6,750
	6	-	-	-	-	-	-	-	-	-	-	-	-	2,700
	10	-	-	-	-	-	-	-	-	-	-	-	-	1,450

Source: COP, Appendix Z Dominion Energy 2023.

PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa).

J.9.3 Cofferdam Installation

Vibratory pile driving will be used to install up to nine temporary cofferdams at the Offshore and Nearshore Trenchless Installation Punch-Out. The nine proposed locations are within the same general area; therefore, the center cofferdam was used as the representative location in the model (COP, Appendix Z; Dominion Energy 2023). The cofferdams will be constructed using 20-inch (0.51-meter) steel sheet piles surrounding a 20-by-50-foot (6.1-by-15-meter) area. The modeling assumed up to 1,800 kilonewton vibratory force for all sheet piles, and source levels and spectral levels were obtained by adjusting measurements from similar offshore construction activity. The modeling assumed up to 60 minutes to install each pile, and included 0-, 6-, and 10-dB noise attenuation (Dominion Energy 2023). Installation activities are anticipated to take approximately 9 to 12 months in 2024, but all installation activities would occur between May and October to avoid peak NARW presence.

Table J-19, Table J-20, and Table J-21 summarize the maximum distances to acoustic thresholds for marine mammals, sea turtles, and fish, respectively.

Table J-19 Marine Mammal Permanent Threshold Shift Onset and Behavioral Criteria Threshold Distances (meters) During Vibratory Pile Driving for Installation of Cofferdams to Support Trenchless Installation of the Export Cable

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold (Lpk)				Distance to PTS Threshold (SEL_{24hr})				Distance to Behavioral Threshold (SPL)
		LFC	MFC	HFC	PPW	LFC	MFC	HFC	PPW	All Hearing Groups
Cofferdam Installation – Vibratory Pile Driving	0	--	--	--	--	108	0	0	0	3,097
	6	--	--	--	--	16	0	0	0	2,228
	10	--	--	--	--	0	0	0	0	1,814

Source: COP, Appendix Z Dominion Energy 2023.
HFC = high-frequency cetacean; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; PPW = phocid pinniped in water; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa).

Table J-20 Sea Turtle Permanent Threshold Shift Onset and Behavioral Criteria Threshold Distances (meters) During Vibratory Pile Driving for Installation of Cofferdams to Support Trenchless Installation of the Export Cable

Scenario	Noise Attenuation (dB)	Distance to PTS Threshold (Lpk)	Distance to PTS Threshold (SEL_{24hr})	Distance to Behavioral Threshold (SPL)
Cofferdam Installation – Vibratory Pile Driving	0	N/A	0	0
	6		0	0
	10		0	0

Source: COP, Appendix Z Dominion Energy 2023.
PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa).

Table J-21 Fish Acoustic Injury and Behavioral Criteria Threshold Distances (meters) During Vibratory Pile Driving for Installation of Cofferdams to Support Trenchless Installation of the Export Cable

Scenario	Noise Attenuation (dB)	Fish with No Swim Bladder		Fish with Swim Bladder Not Involved in Hearing		Fish with Swim Bladder Involved in Hearing		Eggs and Larvae		Fish <2 g		Fish ≥2 g		Behavioral (SPL)
		Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	Lpk	SEL_{24hr}	All Fish
Cofferdam Installation – Vibratory Pile Driving	0	-	-	-	-	-	-	-	-	-	567	-	506	470
	6	-	-	-	-	-	-	-	-	-	389	-	317	349
	10	-	-	-	-	-	-	-	-	-	317	-	206	248

Source: COP, Appendix Z Dominion Energy 2023.
PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); Lpk = peak sound pressure level (dB re 1 μPa); SPL = root-mean=square sound pressure level (dB re 1 μPa).

J.9.4 HRG Surveys

HRG survey activities may be required pre-, during-, and post-construction site characterization surveys in the Lease Area and export cable route corridor. The types of equipment that will be used during the proposed HRG surveys with operational frequencies less than 180 kHz include both impulsive and non-impulsive equipment such as parametric sub-bottom profilers; ultra-short baseline positioning equipment; compressed high-intensity radiated pulse (CHIRP) sonar; sparkers; and boomers (Tetra Tech 2022a). Of these equipment types, only the CHIRP sonar, sparkers, and boomers have the potential to propagate sound to appreciable distances whereby marine mammals may be exposed to sound levels above established thresholds (Baker and Howsen 2021). Ranges to acoustic thresholds provided in Table J-22 for marine mammals were estimated using NMFS User Spreadsheets for PTS thresholds and interim guidance from NMFS (2019) for behavioral thresholds (Tetra Tech 2022a). Only ranges to the SEL_{24h} PTS threshold for marine mammals are shown as these represent the maximum distances. Ranges to the acoustic thresholds for sea turtles and fish in Table J-22 were obtained from the Programmatic Biological Assessment conducted by BOEM (Baker and Howsen 2021).

Table J-22 Permanent Threshold Shift Onset and Behavioral Criteria Threshold Distances (meters) for Marine Mammals, Sea Turtles, and Fish During High-Resolution Geophysical Surveys

Equipment Type	Distance to PTS Threshold (SEL_{24hr})						Distance to Behavioral Threshold (SPL)		
	LFC	MFC	HFC	PPW	Sea Turtles	Fish ≥2 g	All Marine Mammals	Sea Turtles	All Fish
CHIRP Sonar	0	0	0.4	0	NA	NA	10.2	2	708
Sparker	0.1	0	1.5	0.1	0	9	100	90	1,996
Boomer	5.9	0.2	54.2	3.5	0	3.2	21.9	40	32

Source: COP, Appendix Z Dominion Energy 2023; Baker and Howsen 2021.
HFC = high-frequency cetacean; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; NA = not applicable due to sound source being outside the hearing range of the group; PPW = phocid pinniped in water; PTS = permanent threshold shift; SEL_{24h} = sound exposure level over 24 hours (dB re 1 μPa^2 s); SPL = root-mean=square sound pressure level (dB re 1 μPa).

J.9.5 Animal Exposure Estimates

The modeled ranges represent the total area over which noise produced by the Project activity may exceed a given threshold following a single impact hammer strike or 1 second of vibratory hammering (for Lpk and SPL metrics) and for 24-hours of pile driving activity based on pre-defined piling schedules (for SEL_{24h} metric). The ranges only account for source characteristics and environmental parameters within the Action Area which contribute to how sound may propagate through the water. They do not incorporate animal movement or behavior to account for how any animal may respond to noise or how their movement would influence their total duration of exposure to the noise. This is accomplished through estimates of exposure using the animal movement modeling methodology described in Section J.5. No behavioral or animal movement information is available for fish species, so exposures could not be calculated for that group.

To estimate the number of marine mammals and sea turtles likely to be exposed above the acoustic thresholds discussed in Section J.7, a conservative construction schedule included all possible WTG monopile and OSS jacket foundation installation scenarios, and all possible HRG survey days was assumed (Tetra Tech 2022a). The construction schedule used to estimate the number of exposures throughout the entire construction period is provided in Table J-23.

Table J-23 Proposed Pile Driving and High-Resolution Geophysical Survey Schedule Used to Estimate the Number of Marine Mammals and Sea Turtles Potentially Exposed to Above-Threshold Noise during Project Activities

Year	Month	Total Number of Foundations Installed	Number Standard WTG Installations	Number Hard-to-Drive WTG Installations	Number of Days with Two WTG Installed	Number of Active HRG Survey Days
	May	18	5	13	1	
	June	25	6	19	6	
2024	July	26	7	19	6	
	August	2 WTG, 12 OSS	1	1	1	65
	September	13	3	10	0	
	October	11	1	10	0	
2024 Total		95 WTG, 12 OSS	23	72	14	
	May	17	6	11	1	
	June	24	8	16	6	
2025	July	26	8	18	6	
	August	20	6	14	6	249
	September	5	2	3	0	
	October	3	1	2	0	
2025 Total		95	31	64	19	
	May	3	0	3	0	
	June	5	0	4	0	
2026	July	5	0	4	0	
	August	4	0	3	0	58
	September	1	0	1	0	
	October	0	0	0	0	
2026 Total		15	0	15	0	
2027 Total		NA	NA	NA	NA	368
2027 Total		NA	NA	NA	NA	368

Source: Tetra Tech 2022a.
HRG = high-resolution geophysical; NA = not applicable for this activity as construction is assumed to be completed by 2026, whereas HRG surveys will continue after construction to ensure Project components are not in need of maintenance; OSS = offshore substation; WTG = wind turbine generator.

J.9.5.1. Marine Mammals

The total number of marine mammals exposed to above-threshold noise from all noise-producing activities under the Proposed Action is provided in Table J-24.

Table J-24 Total Number of Marine Mammal Exposed to Sound Levels Above PTS and Behavioral Thresholds from all Project Activities

Marine Mammal Species		PTS	Behavioral
WTG and OSS Foundation Installation (10 dB attenuation)			
LFC	NARW	3	6
	Fin whale	9	45
	Minke whale	18	113
	Humpback whale	9	36
	Sei whale	3	7
MFC	Sperm whale	0	3
	Atlantic spotted dolphin	0	4,473
	Common bottlenose dolphin (southern migratory coastal and western North Atlantic offshore stocks)	0	8,809
	Common dolphin	0	1,293
	Pantropical spotted dolphin	0	9
	Long- and Short-finned pilot whale	0	124
	Risso's dolphin	0	54
HFC	Harbor porpoise	3	49
PPW	Gray seal	2.5	128.5
	Harbor seal	2.5	128.5
Goal Post Pile Installation			
LFC	NARW	0	0
	Fin whale	0	0
	Minke whale	0	2
	Humpback whale	0	0
	Sei whale	0	0
MFC	Sperm whale	0	0
	Atlantic spotted dolphin	0	6
	Common bottlenose dolphin (southern migratory coastal and western North Atlantic offshore stocks)	0	46
	Common dolphin	0	6
	Pantropical spotted dolphin	0	0
	Long- and Short-finned pilot whale	0	0
	Risso's dolphin	0	1
HFC	Harbor porpoise	0	0
PPW	Gray seal	0	1
	Harbor seal	0	1

Marine Mammal Species		PTS	Behavioral
Cofferdam Installation			
LFC	NARW	0	1
	Fin whale	0	1
	Minke whale	0	2
	Humpback whale	0	1
	Sei whale	0	0
MFC	Sperm whale	0	0
	Atlantic spotted dolphin	0	37
	Common bottlenose dolphin (southern migratory coastal and western North Atlantic offshore stocks)	0	267
	Common dolphin	0	28
	Pantropical spotted dolphin	0	0
	Long- and Short-finned pilot whale	0	1
	Risso's dolphin	0	0
HFC	Harbor porpoise	0	7
PPW	Gray seal	0	14
	Harbor seal	0	14
HRG Surveys (5-Year Total)			
LFC	NARW	0	5
	Fin whale	0	5
	Minke whale	0	13
	Humpback whale	0	8
	Sei whale	0	3
MFC	Sperm whale	0	0
	Atlantic spotted dolphin	0	22,160
	Common bottlenose dolphin (southern migratory coastal and western North Atlantic offshore stocks)	0	1,858
	Common dolphin	0	22,160
	Pantropical spotted dolphin	0	100
	Long- and Short-finned pilot whale	0	125
	Risso's dolphin	0	125
HFC	Harbor porpoise	0	90

Marine Mammal Species		PTS	Behavioral
PPW	Gray seal	0	87
	Harbor seal	0	87

Source: Tetra Tech 2022b.
dB = decibels; HRG = high-resolution geophysical; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; NARW = North Atlantic right whale; OSS = offshore substation; PTS = permanent threshold shift; WTG = wind turbine generator.

J.9.5.2. Sea Turtles

The total number of marine mammals exposed to above-threshold noise from all noise-producing activities under the Proposed Action is provided in Table J-25.

Table J-25 Annual Estimated Number of Sea Turtles Exposed to Sound Levels Above PTS and Behavioral Thresholds from Installation of the Wind Turbine Generator and Offshore Substation Foundation Scenarios

Species	Construction Year	PTS Exposures	Behavioral Exposures
Green sea turtles	2024	26	123
	2025	25	118
	2026	4	19
Total		**55**	**260**
Kemp's ridley sea turtle	2024	20	96
	2025	18	84
	2026	3	14
Total		**41**	**194**
Leatherback sea turtle	2024	57	270
	2025	2	9
	2026	1	2
Total		**60**	**281**
Loggerhead sea turtle (Barco et al. 2018)[1]	2024	657	3,134
	2025	597	2,829
	2026	91	450
Total		**1,345**	**6,413**

Source: Tetra Tech 2022b.
dB = decibels; PTS = permanent threshold shift.
[1] Exposures for the loggerhead sea turtles comprise the estimates scaled using densities from Barco et al. (2018) rather than the DON (2007) as these represent the maximum potential for exposure to above-threshold noise from the Proposed Action.

J.10. References

Baker, K., and U. Howsen. 2021. *Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf. Biological Assessment*. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. October 2018, Revised February 2021. 152 p.

Barco, S.G., M.L. Burt, R.A.D. Jr., W.M. Swingle, and A.S. Williard. 2018. Loggerhead Turtle *Caretta caretta* Density and Abundance in Chesapeake Bay and the Temperate Ocean Waters of the Southern Portion of the Mid-Atlantic Bight. *Endangered Species Research* 37:269-287.

Bartol, S.M., and I.K. Bartol. 2012. Hearing Capabilities of Loggerhead Sea Turtles (*Caretta caretta*) throughout Ontogeny: An Integrative Approach involving Behavioral and Electrophysiological Techniques: Final Report E&P & Marine Life Programme. Prepared by Virginia Wesleyan College and Old Dominion University. JIP Grant No. 22 07-14. 37 p.

Blackstock, Sarah A., J.O. Fayton, P.H. Hulton, T.E. Moll, K.K. Jenkins, S. Kotecki, E. Henderson, S. Rider, C. Martin, and V. Bowman. 2018. *Quantifying Acoustic Impacts on Marine Mammals and Sea Turtles: Methods and Analytical Approach for Phase III Training and Testing.* Naval Undersea Warfare Center Division, Newport United States. 51 p.

Bradbury J.W., and S.L. Vehrencamp. 2011. *Principles of Animal Communication*. Sinauer Associates.

Budelmann, B.U. 1992. Hearing in crustacea. In: D. B. Webster, A. N. Popper and R. R. Fay (Eds.), *The Evolutionary Biology of Hearing*. New York, NY: Springer New York. pp. 131-139.

California Department of Transportation (CALTRANS). 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Division of Environmental Analysis; Environmental Engineering; Hazardous Waste, Air, Noise, Paleontology Office. 532 p.

Department of the Navy. 2007. *Navy OPAREA Density Estimates (NODES) for the Northeast, Southeast, and Gulf of Mexico OPAREAs*. Norfolk, Virginia: Naval Facilities Engineering Command, Atlantic Contract N62470-02-D-9997, Task Order 0046. Prepared by Geo-Marine, Inc., Hampton, Virginia. 163 p.

Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. July.

Elliot, J., A. A. Khan, L. Ying-Tsong, T. Mason, J. H. Miller, A. E. Newhall, G. R. Potty, and K J. Vigness-Raposa. 2019. *Field Observations During Wind Turbine Operations at the Block Island Wind Farm, Rhode Island*. Final Report to the U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. OCS Study BOEM 2019-028. Available at: https://espis.boem.gov/final%20reports/BOEM_2019-028.pdf. Accessed June 20, 2022.

Fay, R.R., and A.N. Popper. 2000. Evolution of Hearing in Vertebrates: The Inner Ears and Processing. *Hearing Research* 149: 1-10.

Finneran, J.J. 2016. *Auditory Weighting Functions and TTS/PTS Exposure Functions for Marine Mammals Exposed to Underwater Noise. Marine Mammal Scientific and Vet Support Branch of the Biosciences Division, Space and Naval Warfare Systems Center, San Diego, CA*. Technical Report 3026. 134 p.

Finneran, J., E. Henderson, D. Houser, K. Jenkins, S. Kotecki, and J. Mulsow. 2017. *Criteria and Thresholds for US Navy Acoustic and Explosive Effects Analysis (Phase III)*. Technical report by Space and Naval Warfare Systems Center Pacific (SSC Pacific). 183 p.

Greater Atlantic Regional Fisheries Office (GARFO). 2019. GARFO Acoustics Tool: Analyzing the Effects of Pile Driving on ESA-Listed Species in the Greater Atlantic Region.

Hamernik, R.P., and K.D. Hsueh. 1991. Impulse Noise: Some Definitions, Physical Acoustics and Other Considerations. *The Journal of the Acoustical Society of America* 90(1):189–196.

Hatch, L.T., C.M. Wahle, J. Gedamke, J. Harrison, B. Laws, S.E. Moore, J.H. Stadler, and S.M. Van Parijs. 2016. Can You Hear Me Here? Managing Acoustic Habitat in US Waters. *Endangered Species Research* 30: 171-186.

Hawkins, A., and C. Chapman. 2020. Studying the Behaviour of Fishes in the Sea at Loch Torridon, Scotland. *ICES Journal of Marine Science*: fsaa118.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, and J. Turek. 2021. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2020*. NOAA Tech Memo NMFS-NE 271. 403 p.

Hayes, S.A., E. Josephson, K. Maze-Foley, P.E. Rosel, and J.E. Wallace. 2022. *U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports 2021*. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. May 2022. 386 p.

Hildebrand, J.A. 2009. Anthropogenic and Natural Sources of Ambient Noise in the Ocean. *Marine Ecology Progress Series* 395:5-20.

Jiménez-Arranz, G., N. Banda, S. Cook, and R. Wyatt. 2020. *Review on Existing Data on Underwater Sounds Produced by the Oil and Gas Industry*. E&P Sound & Marine Life, Joint Industry Programme, London, UK. 182 p.

Johansson, A.T., and M.H. Andersson. 2012. *Ambient Underwater Noise Levels at Norra Midsjöbanken during Construction of the Nord Stream Pipeline.* Prepared for the Swedish Environment Protection Agency. FOI-R-3469-SE. 67 p.

Ketten D.R. 1994. Functional Analyses of Whale Ears: Adaptations for Underwater Hearing. In: *Proceedings of OCEANS'94*: I/264–I/270.

Kipple, B., and C. Gabriele. 2003. *Glacier Bay Watercraft Noise.* Bremerton, Washington: Prepared for Glacier Bay National Park and Preserve, Naval Surface Warfare Center. Technical Report NSWCCDE-71-TR-2003/522. 54 p.

Kongsberg Maritime AS. 2013. *APOS for HiPAP Instruction Manual.* Available: https://www.kongsberg.com/globalassets/maritime/km-products/product-documents/319957_apos_for_hipap_complete_manual.pdf. Accessed: March 17, 2023.

Koschinski, S. and K. Lüdemann. 2020. Noise Mitigation for the Construction of Increasingly Large Offshore Wind Turbines. [German] Federal Agency for Nature Conservation.

Kyhn, L.A., J. Tougaard, and S. Sveegaard. 2011. *Underwater Noise from the Drillship Stena Forth in Disko West, Baffin Bay, Greenland.* National Environmental Research Institute, Aarhu University, Denmark. NERI Technical Report No. 838. 30 p.

MacGillivray AO, Li Z, Hannay DE, Trounce KB, Robinson OM. 2019. Slowing Deep-Sea Commercial Vessels Reduces Underwater Radiated Noise. *J Acoust Soc Am*. 146(1):340. doi:10.1121/1.5116140.

Madsen P.T., and A. Surlykke. 2013. Functional Convergence in Bat and Toothed Whale Biosonars. *Physiology (Bethesda)* 28(5):276–283.

Martin, S.B., K. Lucke, and D.R. Barclay. 2020. Techniques for Distinguishing between Impulsive and Non-Impulsive Sound in the Context of Regulating Sound Exposure for Marine Mammals. *The Journal of the Acoustical Society of America* 147(4): 2159-2176.

McCormick, C.A. 2011. Auditory/Lateral Line CNS: Anatomy. In: A.P. Farrell (Ed.), *Encyclopedia of fish physiology: from Genome to Environment*. San Diego, CA: Academic Press. pp. 283-291.

McKenna, M.F., S.M. Wiggins, and J.A. Hildebrand. 2013. Relationship between Container Ship Underwater Noise Levels and Ship Design, Operational and Oceanographic Conditions. *Scientific Reports* 3(1760): 1-10.

Milne, S. 2018. Protected Species Observer Report BEOM Lease No.: OCS-A 0497. Prepared for TerraSond on behalf of Ørsted and Dominion Energy, Virginia.

Mooney, T.A., R.T. Hanlon, J. Christensen-Dalsgaard, P.T. Madsen, D.R. Ketten, and P.E. Nachtigall. 2010. Sound Detection by the Longfin Squid (*Loligo pealeii*) Studied with Auditory Evoked Potentials: Sensitivity to Low-Frequency Particle Motion and Not Pressure. *The Journal of Experimental Biology* 213(21):3748.

National Marine Fisheries Service (NMFS). 2018. *2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts.* U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFSOPR- 59, 167 p.

National Marine Fisheries Service (NMFS). 2019. Interim Recommendation for Sound Source Level and Propagation Analysis for High Resolution Geophysical Sources, 24 October 2019.

Nedelec, S.L., J. Campbell, A.N. Radford, S.D. Simpson, and N.D. Merchant. 2016. Particle Motion: The Missing Link in Underwater Acoustic Ecology. *Methods in Ecology and Evolution* 7(7):836-842.

Nedwell, J.R., and B. Edwards. 2004. *A Review of Measurements of Underwater Man-Made Noise Carried Out by Subacoustech Ltd, 1993 – 2003*. Hampsire (UK): Subacoustech Ltd. 136 p.

Nedwell J, Langworthy J, Howell D. 2003. Assessment of Sub-Sea Acoustic Noise and Vibration from Offshore Wind Turbines and Its Impact on Marine Wildlife; Initial Measurements of Underwater Noise during Construction of Offshore Windfarms, and Comparison with Background Noise. *COWRIE.* Report No.: 544 R 0424.

NOAA Satellite and Information Service. 2020. U.S. Coastal Relief Model. 1999 to 2005. Available at: https://www.ngdc.noaa.gov/mgg/coastal/crm.html. Accessed September 2022.

Pijanowski, B.C., L.J. Villanueva-Rivera, S.L. Dumyahn, A. Farina, B.L. Krause, B.M. Napoletano, S.H. Gage, and N. Pieretti. 2011. Soundscape Ecology: The Science of Sound in the Landscape. *BioScience* 61(3): 203-216.

Popper, A., A. Hawkins, R. Fay, D. Mann, and S. Bartol. 2014. Sound Exposure Guidelines. In: *ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI*. pp. 33-51.

Popper, A.N., and A.D. Hawkins. 2018. The Importance of Particle Motion to Fishes and Invertebrates. *The Journal of the Acoustical Society of America* 143(1):470-488.

Popper, A.N., A.D. Hawkins, and J.A. Sisneros. 2021. Fish Hearing "Specialization" - A Re-Valuation. *Hearing Research* 425: 108393.

Richardson, W., C. Greene Jr., C. Malme, and D. Thomson. 1995. *Marine Mammals and Noise*. San Diego, CA: Academic Press. 575 pp.

Roberts, J. J., R.S. Schick, and P. N. Halpin. 2022. Habitat-based Marine Mammal Density Models for the U.S. Atlantic: Latest Versions (last updated 20 June 2022), provided by Duke University Marine Geospatial Ecology Laboratory. Retrieved from: https://seamap.env.duke.edu/models/Duke/EC/. Accessed November 14, 2022.

Ross, D. 1976. *Mechanics of Underwater Noise.* New York, Pergamon Press, Inc.

Silve, L.D., P.H. Kvadsheim, and M. A. Ainslie. 2014. Potential for Population-Level Disturbance by Active Sonar in Herring. *ICES Journal of Marine Science* 72:558-567.

Stadler, J. H., and D.P. Woodbury. 2009. *Assessing the Effects to Fish from Pile Driving: Application of New Hydroacoustic Criteria.* 8 p.

Stöber, U. and F. Thomsen. 2021. How Could Operational Underwater Sound from Future Offshore Wind Turbines Impact Marine Life? *Journal of the Acoustical Society of America* 149(3):1791–1795.

Tetra Tech, Inc. (Tetra Tech). 2022a. *Dominion Energy Coastal Virginia Offshore Wind Commercial Project, Request for Rulemaking and Letter of Authorization (LOA) for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0483 and the Associated Offshore Export Cable Route Corridor.* Prepared for Dominion Energy, Submitted to NOAA National Marine Fisheries Service February 2022, Revised March, May, June, and July 2022. 311 p.

Tetra Tech, Inc. (Tetra Tech). 2022b. *Dominion Energy Coastal Virginia Offshore Wind Commercial Project. Request for Rulemaking and Letter of Authorization (LOA) for Taking of Marine Mammals Incidental to Construction Activities on the Outer Continental Shelf (OCS) within Lease OCS-A 0483 and the Associated Offshore Export Cable Route Corridor: Roberts et al. 2022 Revision Addendum.* Prepared for Dominion Energy, Submitted to NOAA National Marine Fisheries Service September 2022. 88 p.

Tetra Tech, Inc. (Tetra Tech). 2023. *Dominion Energy Coastal Virginia Offshore Wind Commercial Project Reduced WTG Foundation Scenario – Up to 183 WTG Foundation Piling Events and Updated Marine Mammal Take Estimates*. Prepared for Dominion Energy, Submitted to NOAA National Marine Fisheries Service February 14, 2023. 16 p.

Tougaard, J., L. Hermannsen, and P.T. Madsen. 2020. How Loud is the Underwater Noise from Operating Offshore Wind Turbines? *Journal of the Acoustical Society of America* 148(5):2885–2893.

Urick, R.J. 1983. *Principles of Underwater Sound. 3rd Edition*. New York, NY: McGraw-Hill. 444 pp.

Warner, G., and A. McCrodan. 2011. *Underwater Sound Measurements*. Anchorage (AK).

Appendix K. List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

This Environmental Impact Statement (EIS) is available in electronic form for public viewing at https://www.boem.gov/renewable-energy/state-activities/CVOW-C. Hard copies and digital versatile disks (DVDs) of the EIS can be requested by contacting the Program Manager, Office of Renewable Energy in Sterling, Virginia. Publication of this Draft EIS initiated a 60-day comment period where government agencies, members of the public, and interested stakeholders could provide comments and input. The Bureau of Ocean and Energy Management (BOEM) accepted comments received or postmarked no later than February 14, 2023, in any of the following ways.

- In hard copy form, delivered by hand or by mail, enclosed in an envelope labeled "CVOW-C COP EIS" and addressed to Program Manager, Office of Renewable Energy, Bureau of Ocean Energy Management, 45600 Woodland Road, Sterling, Virginia 20166.
- Through the regulations.gov web portal by navigating to http://www.regulations.gov and searching for docket number "BOEM-2022-0069."
- By attending one of the EIS public meetings at the locations and dates listed in the Notice of Acceptance (NOA) and providing written or verbal comments. BOEM will use comments received during the public comment period to inform its preparation of the Final EIS, as appropriate. EIS notification lists for the Project are provided in Table K-1 through Table K-4.

K.1. Notification List

Table K-1 Federal Agencies

Agency	Contact
Cooperating Federal Agencies	
USEPA	Carrie Traver, NEPA Reviewer, USEPA Region 3
NOAA, NMFS	Sue Tuxbury, BOEM Activities/Hydropower, Greater Atlantic Regional Fisheries Office, Habitat and Ecosystems Services Division
USCG	George Detweiler, USCG, Marine Transportation Specialist, Navigation Standards Division (CG-NAV-2), Office of Navigation Systems
DOI, BSEE	Juliette Giordano, Lead Environmental Protection Specialist
USACE	Nicole Woodward, Norfolk District Regulatory Branch
DOI, USFWS	Caleb Spiegel, Marine Bird Biologist, Population Branch, Northeast Region
DOD	Steven Sample, Executive Director, DoD Siting Clearinghouse
Participating Federal Agencies	
National Park Service	Mary Krueger, Energy Specialist, Project Lead
U.S. Navy	Blake Waller, Regional Environmental Coordinator, Naval Facilities Engineering Systems Command

USEPA = U.S. Environmental Protection Act; NOAA = National Oceanic and Atmospheric Administration; NMFS = National Marine Fisheries Service; USCG = U.S. Coast Guard; DOI = U.S. Department of the Interior; BSEE = Bureau of Safety and Environmental Enforcement; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service; DOD = U.S. Department of Defense; NEPA = National Environmental Policy Act

Table K-2 State and Local Agencies or Other Interested Parties

Agency	Contact
Cooperating State Agencies	
VA DOE	Al Christopher, Director
Libraries	
Meyera E. Oberndorf Central Library (Virginia Beach, VA)	Clara Hudson, Support Services Administrator
Slover Library (Norfolk, VA)	Victoria Lannetti, Public Relations Office Assistant

VA DOE = Virginia Department of Energy

Table K-3 Tribes and Native Organizations

Agency	**Contact** (Primary and Alternates, as designated by the tribe)
Chickahominy Indian Tribe	Stephen Adkins, Chief Dana Adkins Wayne Adkins
Chickahominy Indian Tribe, Eastern Division	Gerald A. Stewart, Chief Doris Austin, Councilwoman Jessica Philips Tanya Stewart
Delaware Tribe of Indians	Susan Bachor, Tribal Historic Preservation Officer Jimmie Johnson, Delaware Tribe Environmental Program Director
Monacan Indian Nation	Kenneth Branham, Tribal Chief Pamela Johns Thompson, Assistant Chief Shelley Livoti, Environmental Director Kaleigh Pollak, Tribal Historic Preservation Officer
Nansemond Indian Nation	Keith Anderson, Chief
Pamunkey Indian Tribe	Allyson Gray, Tribal Coordinator/Enrollment Officer/ICWA Robert Gray, Chief Shaleigh Howells, Cultural Resources and Museum Director Kendall Stevens, Tribal Historic Preservation Officer
Rappahannock Tribe	Jack Ryan Anne Richardson, Chief
The Delaware Nation	Carissa Speck, Historic Preservation Director Katelyn Lucas, Tribal Historic Preservation Officer Deborah Dotson, President of Executive Committee
Upper Mattaponi Indian Tribe	Frank Adams, Chief Reggie Tupponce, Tribal Administrator Leigh Mitchell, Natural Resources and Environmental Protection Coordinator

Table K-4 Section 106 Consulting Parties

Government or Organization	Participating Consulting Parties	**Contact** (Primary and Alternates, as designated by the agency or organization)
SHPOs and State Agencies	North Carolina State Historic Preservation Office	Ramona Bartos, Director, Historical Resources Renee Gledhill-Earley, Environmental Review Coordinator
	Virginia Department of Historic Resources	Adrienne Birge-Wilson, Project Review Architectural Historian, Review and Compliance Division Julie Langan, Director/State Historic Preservation Officer Roger Kirchen, Director, Review and Compliance Division
Federal Agencies	Advisory Council on Historic Preservation	Christopher Daniel, Program Analyst, Federal Property Management Section Jamie Lee Marks, Office of Native American Affairs, Senior Program Analyst
	Bureau of Safety and Environmental Enforcement	Barry Bleichner, Marine Archaeologist W. Shawn Arnold, Federal Preservation Officer
	Naval History and Heritage Command (Underwater Archaeology Branch)	Alexis Catsambis, Maritime Archaeologist and Cultural Resource Manager Bradley Krueger, Archaeologist
	USACE, Southern Virginia Regulatory Section	Nicole Woodward, Environmental Scientist Todd Miller, Chief of Southern Virginia Regulatory Section
	U.S. Coast Guard	CDR Stephen West, Coast Guard Headquarters Office of Navigation Daniel Koski-Karell George Detweiler, Coast Guard Headquarters Office of Navigation Matthew Creelman, Program Manager, Private Aids to Navigation Maureen Kallgren, Coast Guard Headquarters Office of Navigation
	U.S. Fish and Wildlife Service	Amy Wood, Regional Historic Preservation Officer
	U.S. Fleet Forces Command	Dan Hurley James Casey Laura Busch, Natural Resources Program Manager
	U.S. National Park Service	Katherine Schlegel, Historical Landscape Architect Mary Krueger, Regional Energy Specialist

Government or Organization	Participating Consulting Parties	Contact (Primary and Alternates, as designated by the agency or organization)
	U.S. Navy Region Mid-Atlantic	Catherine Lantzas-Olson, NAS Oceana Cultural Resources Manager Clay Swindell Heather Robbins, Cultural Resources Supervisor Jessica Bittner, Cultural Resources/NEPA Manager, JEB Little Creek-Fort Story PWD
	Virginia Army National Guard	Emily Huffman, Installation Commander, State Military Reservation Lisa Jordan, Historic Preservation Specialist and Collections Manager Susan Smead, Cultural Resources Program Manager
Federal Facilities	Colonial National Historic Park	Jerri Marr
	NASA Wallops Flight Facility	Randall Stanley, Historic Preservation Officer Shari Miller, Center NEPA Manager
	USFWS Back Bay National Wildlife Refuge	Kathryn Owens, Acting Refuge Manager Lauren Mowbray, Refuge Biologist
	USFWS Chincoteague National Wildlife Refuge	John Kasbohm, Refuge Manager
Federally Recognized Tribes	Chickahominy Indian Tribe	Stephen Adkins, Chief/Tribal Administrator Dana Adkins Wayne Adkins
	Chickahominy Indian Tribe-Eastern Division	Gerald A. Stewart, Chief Doris Austin, Councilwoman Jessica Philips, Environmental Director Tanya Stewart, Cultural Resources Director
	Delaware Tribe of Indians	Brad KillsCrow, Chief Susan Bachor, Tribal Historic Preservation Officer Jimmie Johnson, Delaware Tribe Environmental Program Director
	Monacan Indian Nation	Kenneth Branham, Tribal Chief Pamela Johns Thompson, Assistant Chief Shelley Livoti, Environmental Director Kaleigh Pollak, Tribal Historic Preservation Officer
	Nansemond Indian Nation	Keith Anderson, Chief

Government or Organization	Participating Consulting Parties	**Contact** (Primary and Alternates, as designated by the agency or organization)
	Pamunkey Indian Tribe	Robert Gray, Chief Allyson Gray, Tribal Coordinator/Enrollment Officer/ICWA Kendall Stevens, Tribal Historic Preservation Officer Shaleigh Howells, Cultural Resources and Museum Director
	Rappahannock Tribe	Anne Richardson, Chief Jack Ryan
	The Delaware Nation	Deborah Dotson, President of Executive Committee Carissa Speck, Tribal Historic Preservation Director Katelyn Lucas, Tribal Historic Preservation Officer
	Upper Mattaponi Indian Tribe	Frank Adams, Chief Reggie Tuppence, Tribal Administrator Leigh Mitchell, Natural Resources and Environmental Protection Coordinator
State Recognized Tribes	The Coharie Tribe	Greg Jacobs, Tribal Administrator Phillip Bell
	Lumbee Tribe of North Carolina	Kevin Melvin, Tribal Historic Preservation Officer Larry Edwards Tammy Maynor, Interim Tribal Administrator
	Nottoway Indian Tribe of Virginia	Lynette Allston, Chief
	Patawomeck Indian Tribe of Virginia	Charles Bullock, Chief Minnie Lightner
Local Government Agencies	Accomack County	G. Christian Guvernator IV, Environmental Programs Director
	City of Norfolk	Kenneth C. Alexander, Mayor Susan McBride, Principal Planner (Historic Preservation)
	City of Virginia Beach	Kathy Warren, Director, Department of Planning and Community Development Mark Reed, Historic Preservation Planner
	Town of Chincoteague	J. Arthur Leonard, Mayor Michael T. Tolbert, Town Manager
	Town of Eastville	Jim Sturgis, Mayor
Nongovernmental Organizations or Groups	Atlantic Wildfowl Heritage Museum	Aimee Rhoads, President Lynn Hightower, Museum Director
	Cavalier Associates, LLC	D. Brian Carson, Chief Financial Officer Lee Westnedge, General Counsel, Gold Key/PHR Robert Howard, Chief Investment Officer, Gold Key/PHR

Government or Organization	Participating Consulting Parties	**Contact** (Primary and Alternates, as designated by the agency or organization)
	Chesapeake Bay Bridge and Tunnel District	Michael T. Crist, Deputy Executive Director, Infrastructure Timothy Holloway, Director of Maintenance
	Council of Virginia Archaeologists	Eleanor Breen, President
	Eastern Shore of Virginia Historical Society	Hilary Hartnett-Wilson, Executive Director
	Nansemond River Preservation Alliance	Elizabeth Taraski, President/CEO
	Outer Banks Conservationists	Ladd Bayliss, Executive Director Meghan Agresto
	Preservation Virginia	Elizabeth Kostelny, Chief Executive Officer Sonja Ingram, Preservation Field Services Manager
	Property owner for House at 4910 Ocean Front Avenue	Bonnie Williams T. Evan Williams
	Ruffin 86, LLC	John Babb, Managing Director, Ruffin Family Office
	Sandbridge Beach Civic League	James (Andrew) Horne, Vice President
	Sandswept, LLC	Gayle Johnson, Manager
	Virginia African American Cultural Center	Amelia Ross-Hammond, Founder and Chairman Tamar Smithers, Executive Director Wayne Jones
Lessee	Dominion Energy	Jason Ericson Mitchell Jabs

SHPO = State Historic Preservation Office; ACHP = Advisory Council on Historic Preservation; CDR = Commander; NASA = National Aeronautics and Space Administration; CEO = Chief Executive Officer

Appendix L. Other Impacts

L.1. Unavoidable Adverse Impacts of the Proposed Action

The Council on Environmental Quality's (CEQ) National Environmental Policy Act (NEPA)-implementing regulations (40 Code of Federal Regulations [CFR] 502.16(a)(2)) require that an Environmental Impact Statement (EIS) evaluate the potential unavoidable adverse impacts associated with a Proposed Action. Adverse impacts that can be reduced by mitigation measures but not eliminated are considered unavoidable. Table L-1 provides a listing of such impacts. Most potential unavoidable adverse impacts associated with the Proposed Action would occur during the construction phase and would be temporary. Chapter 3, *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 EIS, regardless of whether the Proposed Action is approved.

Table L-1 Potential Unavoidable Adverse Impacts of the Proposed Action

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Air Quality	• Air quality impacts from emissions from engines associated with vessel traffic, construction activities, and equipment operation
Bats	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic
Benthic Resources	• Suspension and re-settling of sediments due to seafloor disturbance • Conversion of soft-bottom habitat to new hard-bottom habitat • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor alternations • Disturbance, displacement, and avoidance behavior due to habitat loss/ alteration, equipment activity and noise, and vessel traffic • Individual mortality due to construction activities
Birds	• Displacement and avoidance behavior due to habitat loss/alteration, equipment noise, and vessel traffic • Increased risk of individual injury and mortality due to collision with WTGs
Coastal Habitat and Fauna	• Habitat alteration and removal of vegetation, including trees • Temporary avoidance behavior by fauna during construction activity and noise-producing activities • Individual fauna mortality due to collision with vehicles or equipment during clearing and grading activities, particularly species with limited mobility
Commercial Fisheries and For-Hire Recreational Fishing	• Disruption of access or temporary restriction in harvesting activities due to construction of offshore Project elements • Disruption of harvesting activities during operations of offshore wind facility • Changes to target species stemming from alterations in species composition due to habitat modification • Changes in vessel transit and fishing operation patterns • Changes in risk of gear entanglement or availability of target species

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Cultural Resources	• Impacts on viewsheds of aboveground historic properties • Physical impacts on ancient submerged landform features and archaeological and aboveground historic properties
Demographics, Employment, and Economics	• Disruption of commercial fishing, for-hire recreational fishing, and marine recreational businesses during offshore construction and cable installation • Hindrances to ocean economy sectors due to the presence of the offshore wind facility, including commercial fishing, recreational fishing, sailing, sightseeing, and supporting businesses
Environmental Justice	• Disruption of commercial fishing, for-hire recreational fishing, and marine recreation during offshore construction and cable installation and infrequent maintenance • Noise, vibration and dust disruptions from proposed action and staging operations • Delays in travel along affected roadways • 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 facility
Finfish, Invertebrates, and Essential Fish Habitat	• Suspension and re-settling of sediments due to seafloor disturbance • Displacement, disturbance, and avoidance behavior due to construction-related impacts, including noise, vessel traffic, increased turbidity, sediment deposition, and EMF • Individual mortality due to construction activities • Habitat quality impacts, including reduction in certain habitat types as a result of seafloor surface alterations • Conversion of soft-bottom habitat to new hard-bottom habitat
Land Use and Coastal Infrastructure	• Conversion of undeveloped areas to utility right-of-way or easement or cable maintenance or replacement • Land use disturbance due to construction as well as effects due to noise, vibration, and travel delays • Potential for accidental releases during construction
Marine Mammals	• Increased risk of injury (TTS or PTS) to individuals due to underwater noise from pile-driving activities during construction • Disturbance (behavioral effects) and acoustic masking due to underwater noise from pile driving, shipping and other vessel traffic, aircraft, geophysical surveys (HRG surveys and geotechnical drilling surveys), WTG operation, and dredging during construction and operations • Increased risk of individual injury and mortality due to vessel strikes • Increased risk of individual injury and mortality associated with fisheries gear
Navigation and Vessel Traffic	• Congestion in port channels • Increased navigational complexity, vessel congestion, and allision risk within the offshore Wind Farm Area • Potential for disruption to marine radar on smaller vessels operating within or in the vicinity of the Project, increasing navigational complexity • Hindrances to SAR missions within the offshore Wind Farm Area

Resource Area	Potential Unavoidable Adverse Impact of the Proposed Action
Other Uses	• Disruption to offshore scientific research and surveys and species monitoring and assessment • Increased navigational complexity for military or national security vessels operating within the Wind Farm Area • Changes to aviation and air traffic navigational patterns • Interference with radar systems
Recreation and Tourism	• Disruption of coastal recreation activities during onshore construction, such as beach access • Viewshed effects from the WTGs altering enjoyment of marine and coastal recreation and tourism activities • Disruption to access or temporary restriction of in-water recreational activities from construction of offshore Project elements • Temporary disruption to the marine environment and marine species important to fishing and sightseeing due to turbidity and noise • Hindrances to some types of recreational fishing, sailing, and boating within the area occupied by WTGs during operation • Potential recreational vessel delay within the ports serving construction
Sea Turtles	• Increased risk of for individual injury and mortality due to vessel strikes during construction, O&M, and decommissioning • Disturbance, displacement, and avoidance behavior due to habitat disturbance and underwater noise during construction
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, and electrical connections with the power grid
Water Quality	• Increase in suspended sediments due to seafloor disturbance during construction, O&M, and decommissioning
Wetlands	• Loss/conversion of existing wetland habitat and surface water alterations, including increased sediment deposition and removal of vegetation during construction

EMF = electromagnetic field; O&M = operations and maintenance; PTS = permanent threshold shift; SAR = search and rescue; SAV = submerged aquatic vegetation; TTS = temporary threshold shift; WTG = wind turbine generator

L.2. Irreversible and Irretrievable Commitment of Resources

CEQ's NEPA-implementing regulations (40 CFR 1502.16(a)(4)) require that an EIS review the potential impacts on irreversible or irretrievable commitments of resources resulting from implementation of a Proposed Action. CEQ considers a commitment of a resource irreversible when the primary or secondary impacts from its use limit the future options for its use. Irreversible commitment of resources typically applies to impacts on nonrenewable resources such as marine minerals or cultural resources. The irreversible commitment of resources occurs due to the use or destruction of a specific resource. An irretrievable commitment refers to the use, loss, or consumption of a resource, particularly a renewable resource, for a period of time.

Table L-2 provides a listing of potential irreversible and irretrievable impacts by resource area. EIS Chapter 3, *Affected Environment and Environmental Consequences*, and Appendix G, *Resources with Minor Impacts*, provide additional information on the impacts summarized in Table L-2.

Table L-2 Irreversible and Irretrievable Commitment of Resources by Resource Area for the Proposed Action

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Air Quality	No	No	BOEM expects air pollutant emissions to comply with permits regulating compliance with air quality standards. Emissions would be temporary during construction activities. To the extent that the Proposed Action displaces fossil-fuel energy generation, overall improvement of air quality would be expected.
Bats	Yes	No	Irreversible impacts on bats could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bat displacement from foraging habitat.
Benthic Resources	No	No	Although local mortality of benthic fauna and habitat alteration are likely to occur, BOEM does not anticipate population-level impacts on benthic organisms; habitat could recover after decommissioning activities.
Birds	Yes	No	Irreversible impacts on birds could occur if one or more individuals were injured or killed; however, implementation of mitigation measures developed in consultation with USFWS would reduce or eliminate the potential for such impacts. Decommissioning of the Project would reverse the impacts of bird displacement from foraging habitat.
Coastal Habitat and Fauna	No	No	Although limited removal of habitat associated with clearing and grading for construction of the onshore export cable and substation are likely to occur, BOEM does not anticipate population-level impacts on flora or fauna; coastal habitat could recover after construction in some areas, and after decommissioning activities in other areas.
Commercial Fisheries and For-Hire Recreational Fishing	No	Yes	Based on the anticipated duration of construction and O&M activities, BOEM does not anticipate irreversible impacts on commercial fisheries. The Project could alter habitat during construction and operations, limit access to fishing areas during construction, or reduce vessel maneuverability during operations. However, the conceptual decommissioning of the Project 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 previously unidentified cultural resources onshore and offshore could result in irreversible and irretrievable impacts.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Demographics, Employment, and Economics	No	Yes	Construction activities could temporarily increase contractor demand, housing needs, supply requirements, and demand for local businesses, leading to an irretrievable loss of workers for other projects. These factors could lead to increased housing and supply costs.
Environmental Justice	No	Yes	Impacts on environmental justice communities could occur due to loss of income or employment for low-income workers in marine industries; this could be reversed by Project decommissioning or by other employment, but income lost during Project operations would be irretrievable.
Finfish, Invertebrates, and Essential Fish Habitat	No	No	Although local mortality of finfish and invertebrates and habitat alteration could occur, BOEM does not anticipate population-level impacts on finfish, invertebrates, and essential fish habitat. It is expected that the aquatic habitat for finfish and invertebrates would recover following decommissioning activities.
Land Use and Coastal Infrastructure	Yes	Yes	Land use required for construction and operational activities could result in a minor irreversible impact. Construction activities could result in a minor irretrievable impact due to the temporary loss of use of the land for otherwise typical activities. Onshore facilities may or may not be decommissioned.
Marine Mammals	No	Yes	Irreversible impacts on marine mammal populations could occur if one or more individuals of an ESA-listed species were injured or killed or if those populations experienced behavioral effects of high severity. With implementation of mitigation measures, developed in consultation with NMFS (e.g., timing windows, vessel speed restrictions, safety zones), the potential for an ESA-listed species to experience high-severity behavioral effects or be injured or killed would be reduced or eliminated. No irreversible high-severity behavioral effects from Project activities are anticipated, as described in Section 3.15, *Marine Mammals*; however, due to the uncertainties from lack of information that are outlined in Appendix D, *Missing Information*, these effects are still possible. Irretrievable impacts could occur if individuals or populations grow more slowly as a result of displacement from the Project area.
Navigation and Vessel Traffic	No	Yes	Based on the anticipated duration of construction and operations, 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 Project.

Resource Area	Irreversible Impacts	Irretrievable Impacts	Explanation
Other Uses	No	Yes	Disruption of offshore scientific research and surveys would occur during proposed Project construction, operations, and decommissioning activities. Disruption of military training exercises and traffic in the Wind Farm Area, the cable landing location, and onshore export cable would last throughout the life of the project (being the highest during construction) until decommissioning was complete. Dominion Energy would coordinate with DoD to minimize impacts.
Recreation and Tourism	No	No	Construction activities near the shore could result in a minor, temporary loss of use of the land for recreation and tourism purposes.
Sea Turtles	No	Yes	Irreversible impacts on sea turtles could occur if one or more individuals of species listed under the ESA were injured or killed; however, the implementation of mitigation measures, developed in consultation with NMFS, would reduce or eliminate the potential for impacts on listed species. Irreversible impacts could occur if individuals or populations grow more slowly as a result of injury or mortality due to vessel strikes or entanglement with fisheries gear caught on the structures, or due to displacement from the Project area.
Scenic and Visual Resources	No	No	Long-term (until post-decommissioning) seascape unit, open ocean unit, and landscape units' character alterations, and effects on viewer experience, by the wind farm, vessel traffic, onshore landing sites, onshore export cable routes, onshore substations, and electrical connections with the power grid would occur.
Water Quality	No	No	BOEM does not expect activities to cause loss of, or major impacts on, existing inland waterbodies. Turbidity impacts in marine and coastal environments would be short term and minor.
Wetlands	Yes	Yes	Removal of wetland vegetation and the permanent conversion of wetland areas resulting from the construction of the interconnection cable could potentially create irreversible and irretrievable impacts.

BOEM = Bureau of Ocean Energy Management, ESA = Endangered Species Act, NMFS = National Marine Fisheries Service, O&M = operations and maintenance, SAV = submerged aquatic vegetation, USFWS = U.S. Fish and Wildlife Service

L.3. Relationship between the Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

CEQ's NEPA-implementing regulations (40 CFR 502.16(a)(3)) require that an EIS address the relationship between short-term use of the environment and the potential impacts of such use on the maintenance and enhancement of long-term productivity. Such impacts could occur as a result of a reduction in the flexibility to pursue other options in the future, or assignment of a specific area (land or marine) or resource to a certain use that would not allow other uses, particularly beneficial uses, to occur at a later date. An important consideration when analyzing such effects is whether the short-term environmental effects of the action will result in detrimental effects on long-term productivity of the affected areas or resources.

As assessed in EIS Chapter 3 *Affected Environment and Environmental Consequences*, and Appendix G, *Resources with Minor Impacts*, BOEM anticipates that the majority of the potential adverse effects associated with the Proposed Action would occur during construction activities and would be short term in nature and minor to moderate in severity/intensity. These effects would cease after decommissioning activities. In assessing the relationships between short-term use of the environment and the maintenance and enhancement of long-term productivity, it is important to consider the following long-term benefits of the Proposed Action.

- Promotion of clean and safe development of domestic energy sources and clean energy job creation.
- Promotion of renewable energy to help ensure geopolitical security, combat climate change, and provide electricity that is affordable, reliable, safe, secure, and clean.
- Delivery of power to the Virginia and North Carolina energy grid to contribute to the state's renewable energy requirements.
- Increased habitat for certain fish species.

Based on the anticipated potential impacts evaluated in this document and the Final EIS that could occur during Proposed Action construction, O&M, and decommissioning, and with the exception of some potential impacts associated with onshore components, BOEM anticipates that the Proposed Action would not result in impacts that would significantly narrow the range of future uses of the environment. 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 L-2 would be long term. After completion of the Proposed Action's operations and decommissioning phases, however, BOEM expects the majority of marine and onshore environments to return to normal long-term productivity levels.

Appendix M. Seascape, Landscape, and Visual Impact Assessment

M.1. Introduction

This appendix describes the Seascape, Landscape, and Visual Impact Assessment (SLVIA) methodology and key findings that BOEM used to identify the potential impacts of offshore wind structures (wind turbine generators [WTGs] and offshore substations [OSSs]) on scenic and visual resources within the geographic analysis area. This SLVIA methodology applies to any offshore wind energy development proposed for the outer continental shelf (OCS) and incorporates by reference the detailed description of the methodology described in the *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States* (BOEM 2021). Section M.2, *Method of Analysis*, describes the specific methodology used to apply the SLVIA methodology to the Construction and Operations Plan (COP) and Section M.3, *SLIA Results,* summarizes the wind farm distances, field of view (FOV), noticeable elements, visual contrasts, scale of change, and prominence that contributed to the determination of impact levels for each key observation point (KOP) under the Proposed Action and each of the action alternatives that include modifications to WTG array layouts (Alternatives B, C, and D). An overview map of scenic resources present in the geographic analysis area is included as Attachment M-1, *Scenic Resources Overview Map*. Visual simulations of the Proposed Action alone, other planned offshore wind projects without the Proposed Action, and other offshore wind projects in combination with the Proposed Action are included in Attachment M-2, *Cumulative Visual Simulations*. Visual simulations of Alternatives B, C, and D are included in Attachment M-3, *Visual Simulations of Action Alternatives*. The onshore geographic analysis area includes landfalls, buried onshore export cables, onshore substations, and transmission connections to the electric grid. The visual impacts of onshore components are assessed in Chapter 3, Section 3.20, *Scenic and Visual Resources*.

M.1.1 State and Local Codes, Ordinances, and Planning Guidance

State planning documents that refer to scenic resources and visual quality for coastal communities in Virginia and North Carolina within the geographic analysis area are summarized below.

- The Virginia Scenic Rivers Act (Code of Virginia 10.1-400, et seq.) requires all state agencies to "consider the visual, natural, and recreational values of a scenic river in planning and permitting processes," (VDCR 2020) but includes no specific land use or visual controls. A segment of the North Landing River is a Commonwealth-designated Scenic River.
- The State Scenic Highway and Virginia Byways Act of 1966 allows roads "having relatively high aesthetic or cultural value, leading to or within areas of historical, natural or recreational significance" to be designated as a scenic byway (VDOT 2019). The designation does not carry land use of visual impact controls, but instead recognizes roads "controlled by zoning or otherwise, so as to reasonably protect the aesthetic or cultural value of the highway" (Code of Virginia 33.2-406). A segment of Indian River Road crossed by several Project alternatives is a Virginia Byway.

The following local land use plans and guidance address scenic and visual resources include the following.

- Moving Forward City of Chesapeake Comprehensive Plan 2035 (Chesapeake Bay Planning Department 2018) outlines the vision for the City of Chesapeake's physical environment, built environment, and land use for 2023. The plan encourages the location or relocation of utilities underground and recommends working "with private energy providers to plan for high-capacity transmission lines and substations in order to minimize their impact on residences and businesses." (City of Chesapeake 2016; COP, Appendix I-2.3.2; Dominion Energy 2023).

- PlaNorfolk2030 (City of Norfolk 2021) is the City of Norfolk's comprehensive plan, which serves as a guide for the future physical, social, and economic development and as a basis for land use decisions within the city.
- It's Our Future: A Choice City – City of Virginia Beach Comprehensive Plan (City of Virginia Beach 2020) addresses long-term sustainable and strategic city planning including visual design of new development on the shore and shoreline. The Green Sea Blueway and Greenway Management Plan is a functional component of the Comprehensive Plan that addresses the North Landing River and tributaries and portions of Indian River Road. While the management plan does not establish regulations related to the scenic resources, it treats scenic resources as a contributing factor to environmental protection, agricultural preservation, passive recreation, tourism, growth management, and cultural heritage preservation goals. (City of Virginia Beach 2015.)
- The Imagine Currituck 2040 Vision Plan (Currituck County 2019) satisfies the Coastal Area Management Act requirement to produce and adopt a local land use plan for Currituck County. Geographical areas addressed in the plan relevant to this Project include the Off-Road Area and the Corolla Area.

M.2. Method of Analysis

The SLVIA has two separate but linked parts: seascape, open ocean, and landscape impact assessment (SLIA) and visual impact assessment (VIA). SLIA analyzes and evaluates impacts on both the physical elements and features that make up a landscape, seascape, or open ocean; and the aesthetic, perceptual, and experiential aspects of the landscape, seascape, or open ocean that make it distinctive. These impacts affect the "feel," "character," or "sense of place" of an area of landscape, seascape, or open ocean, rather than the composition of a view from a particular place. In SLIA, the impact receptors (the entities that are potentially affected by the proposed Project) are the seascape/open ocean/landscape itself and its components, both its physical features and its distinctive character.

VIA analyzes and evaluates the impacts on people of adding the proposed development to views from selected viewpoints. VIA evaluates the change to the composition of the view itself and assesses how the people who are likely to be at that viewpoint may be affected by the change to the view. Enjoyment of a particular view is dependent on the viewer, and, in VIA, the impact receptors are people. The inclusion of both SLIA and VIA in the Bureau of Ocean and Energy Management (BOEM) SLVIA methodology is consistent with NEPA's objective of providing Americans with aesthetically and culturally pleasing surroundings and its requirement to consider all potentially significant impacts of development.

The magnitude of effect in a seascape, open ocean, landscape, or view depends on the nature, scale, prominence, and visual contrast of the change and its experiential duration. The SLVIA offshore geographic analysis area consists of the following extent of the zone of theoretical visibility and zones of visual influence (COP, Appendix I-1; Dominion Energy 2023).

- A 40-mile (64.4-kilometer) radius area around the WTGs and OSSs. This distance is the maximum extent within which a seascape, landscape, or visual effect could occur, given visibility of the maximum height of the WTG rotor (869 feet [265 meters]).
- The OSSs (maximum height of 220 feet [67 meters]) would potentially be visible to a distance of 21 miles (33.7 kilometers).

WTG visibility would be variable through the day depending on many factors. View angle, sun angle, and atmospheric conditions would affect the WTG visibility. Visual contrast of WTGs would vary depending on the visual character of the horizon's backdrop and whether the WTGs are backlit, side-lit, or front-lit. If less visual contrast is apparent in the morning hours, then it is likely that the visual contrast may be more pronounced in the afternoon. The inverse is possible, as well.

When placing WTGs offshore, the visual interplay and contrasting elements in form, line, color, and texture may vary with the ever-changing character of the backdrop. Front-lit WTGs may have strong color contrast against a darker gray sky, giving definition to the WTG vertical form and line contrast to the ocean's horizontal character and the line where the sea meets sky, or visually dissipate against a whiter backdrop created by high levels of evaporative atmospheric moisture during clear sunny days. Partly cloudy skies may create varying degrees of sunlight reflecting off the white color wind turbines, placing some WTGs in the shadow and making them appear darker gray and less conspicuous while highlighting others with a bright white color contrast. The level of noticeability would be directly proportional to the degree of visual contrast and scale of change between the WTGs and the corresponding backdrop.

The magnitude of effect is also influenced by the viewers context including the direction of view, distance between the viewer and the WTGs, and elevation of the viewer. At closer distances, approximately 12 miles or closer, the form of the WTG may be the dominant visual element creating the visual contrast regardless of color. At greater distances, color may become the dominant visual element creating that gives definition to the WTG's form and line. As the elevation of the viewer increases, the less Earth's curvature (EC) screens the visible height of individual WTGs and therefore a greater portion of the WTG is visible.

While the East Coast shoreline has a prevailing eastward viewing direction, localized views may vary from southwest to north-northeast. All cardinal directions are conceivable when viewing from a water vessel while at sea. When viewing from onshore toward a northerly direction and scanning to the south, the color of the horizon backdrop will often vary. Variation will continue as the sun arcs across the sky from sunrise to sunset. Depending on sun angle, the backdrop sky color may have various intensities of white to gray and sky blue to pale blue to dark blue-gray. Partly cloudy to overcast conditions will also influence the color makeup of the horizon's backdrop. The sunrise and sunset have varying degrees of light blue to dark blue, light and dark purples intermixed with oranges, yellows, and reds. Partly cloudy skies may increase the remarkable color effects during the sunset and sunrise periods of the day. These variations through the course of the day may result in periods of moderate to major visual effect while at other times of day would have minor or negligible effect. The visibility variables described above are represented through the visual simulations found in the COP. Table M-1identifies the photo simulation for each condition. It should be noted that this EIS analysis treats the potential view at each Key Observation Point represented by the photo simulation as a clear sky day.

Table M-1 Visibility Variables for Key Observation Point Simulations

Visibility Condition	Key Observation Point Photo Simulation
Morning – back light	KOP-13 Cape Henry Lighthouse
Afternoon – side light	KOP-22 King Neptune Statue/Boardwalk
Midday – front light	KOP-31 Picnic Views on Beach at State Military Reservation
Nighttime	KOP-15b North End Beach – Residential View 1 (nighttime) KOP-24b Virginia Beach Boardwalk – 16th Street entrance (nighttime)
Sunny and clear	KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24d Virginia Beach Boardwalk – 16th Street entrance KOP-44 Back Bay National Wildlife Refuge (Little Island Park)[1]
Overcast and hazy	KOP-15a North End Beach – Residential View 1 KOP-30a Croatan Beach A

Visibility Condition	Key Observation Point Photo Simulation
Cloudy and rainy	KOP-29 Grommet Island Park

[1] KOP-44 was revised August 2023 in sunny fair sky conditions. Unlike the other simulations, the WTGs are rendered in RAL7035 Light Grey.

The SLVIA methodology and parameters assessed consider local stakeholders' identity, culture, values, and issues and the understanding of baseline maritime conditions. Project activities for all stages of the Project life cycle (construction and installation, O&M, and decommissioning) are assessed against the environmental baseline to identify the potential interactions between the Project and the seascape, landscape, and viewers. Potential impacts are assessed to determine an impact level consistent with the definitions in Table M-2.

Table M-2 Definitions of Potential Adverse Impact Levels

Impact Level	Historic Properties under Section 106 of the NHPA	Visual Resources
Negligible	No historic properties affected, as defined at 36 CFR 800.4(d)(1).	SLIA: Very little or no effect on seascape/landscape/ocean unit features, elements, or key qualities, either because unit has minimal visibility/susceptibility or lacks value (distinctive character or key features/elements/qualities). VIA: Very little or no effect on viewers experiences, because project visibility/contrast/magnitude of change are minimal, and/or view receptor sensitivity/susceptibility/value is minimal.
Minor	No adverse effects on historic properties could occur, as defined at 36 CFR 800.5(b).	SLIA: The project would introduce features that may have noticeable low to medium levels of visual prominence within the geographic area of an ocean/ seascape/ landscape character unit. The project features may introduce a visual character that is somewhat inconsistent with the character of the unit, which may have minor to medium negative effects to the unit's features, elements, or key qualities, but the unit's features, elements, or key qualities have low susceptibility or value. VIA: The visibility of the project 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 has a high level of viewer concern (combination of susceptibility/value) may justify adjusting to a moderate level of impact.
Moderate	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur but would be avoided or minimized using a less-impactful scenario contemplated under the PDE.	SLIA: The project would introduce features that would have medium to large levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The project would introduce a visual character that is inconsistent with the character of the unit, which may have a moderate negative effect to 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 and/ or value. VIA: The visibility of the project would introduce a moderate to large level of change to the view's character; may have moderate

Impact Level	Historic Properties under Section 106 of the NHPA	Visual Resources
		to large levels 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 in areas where the view's character has large changes. 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	Adverse effects on historic properties as defined at 36 CFR 800.5(a)(1) could occur; at least some would require mitigation to resolve.	SLIA: The project would introduce features that would have dominant levels of visual prominence within the geographic area of an ocean/seascape/landscape character unit. The project would introduce a visual character that is inconsistent with the character of the unit, which may have a major negative effect to the unit's features, elements, or key qualities. The concern for change (combination of susceptibility/value) to the character unit is high. VIA: The visibility of the project 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 susceptibility and 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.

M.3. SLIA Results

M.3.1 Impacts of the Proposed Action on Scenic and Visual Resources

Visual simulation from representative viewpoints included in the COP's Visual Impact Assessment Technical Report (COP, Appendix I-1, I-2; Dominion Energy 2023) indicate that daytime and nighttime visibility of WTGs and OSSs would be noticeable to the casual observer from seascape character areas, the open ocean character area, landscape character areas, and viewer viewpoints.

M.3.1.1. Offshore Seascape, Open Ocean, and Landscape Character Areas

Table M-3 lists the acreages of character areas overall in the offshore geographic analysis area and within the offshore WTA viewshed based on Table I-1-4 in the COP's VIA Technical Report (Dominion Energy 2023). Applicable effects from the Proposed Action and alternatives on seascape character areas, the open ocean character area, and landscape character areas are listed throughout this appendix.

Table M-3 Seascape, Open Ocean, and Landscape Character Areas within the Offshore Project Area Viewsheds

Character Areas	Total Area within Visual Study Area in Square Miles (square kilometers)	Area within the Zone of Potential Visual Influence (Refined Viewshed)	Percentage of Character Area in the Zone of Potential Visual Influence
Open Ocean Character Area			
Open Ocean[1]	6,302.55 (16,323.5)	2,540.79 (6,580.6)	100[1]
Seascape Character Areas			
Lower Coastal Plain/Tide Water	113.7 (294.5)	60.86 (157.6)	53.5
Inland Bay	405.87 v1,051.2)	215.46 (558.0)	53.1
Virginia Beach/Tourism	1.45 (3.75)	0.28 (0.73)	19.3
Beach[2]	0.42 (1.1)	0.42 (1.1)	100
Beachfront Residential[2]	0.69 (1.8)	0.55 (1.4)	79.7
Barrier Island Residential	5.92 (15.3)	4.93 (12.8)	83.3
Industrial/Military[2, 3]	23.58 (61.1)	3.4 (8.8)	14.4
Recreation[2, 3]	38.13 (98.7)	10.68 (27.7)	28.0
Landscape Character Areas			
Agriculture	126.65 (328.1)	9.24 (23.9)	7.3
Coastal Development	114.88 (375.2)	6.17 (16.0)	5.4
Rural Coastal Plain[3]	89.16 (231.0)	11.29 (29.2)	12.7
Important Designated Areas			
NRHP-listed Historic Districts	8.12 (21.0)	1.49 (3.9)	18.3
Designated Environmental Justice Communities	700.97 (1,815.5)	391.12 (1,013.0)	55.8

Source: COP, Appendix I-1, Table I-1-4, (Dominion Energy 2023).
[1] The Open Ocean character area within the zone of potential visual influence as described in the COP includes only the landward-facing ocean area as shown in COP, Appendix I-1, Figure I-1-3.
[2] The Beach character area calculation as described and illustrated in COP, Appendix I-1, Attachment I-3 maps includes approximately 13 linear miles of beach from the southern boundary of Fort Story to Croatan Beach in Virginia and the beach paralleling the Barrier Island Residential character area in the Corolla area of South Carolina.
[3] These character types are not differentiated between Seascape and Landscape character areas in the COP. They are listed under Seascape here because most of the area within the zone of potential influence is within the seascape. A small area of Rural Coastal Plain has ocean visibility and is categorized as Landscape throughout this document. These character types also include their adjacent beaches.

Summary descriptions of offshore geographic analysis area character areas are informed by the COP's VIA Technical Report (COP, Appendix I; Dominion Energy 2023).

M.3.1.1.1 Open Ocean Character Area

The open ocean zone includes the open water of the Atlantic Ocean off the coast of Virginia and North Carolina. The defining characteristic of this character area is the presence of open water as a dominant element and unobstructed views in all directions. There are three existing built structures in the open ocean off the coast of Virginia Beach. The Chesapeake Light Tower is located 15 miles offshore, and two existing WTGs associated with the Coastal Virginia Offshore Wind Pilot Project are located adjacent to the Lease Area. The COP only analyzed the landward-facing open ocean area (COP, Appendix I-1, Figure

I-1-3; Dominion Energy 2023). The open ocean area analyzed in the EIS includes the 360 degree viewshed around the Lease Area; therefore, approximately 93 percent of open ocean is within the zone of potential visual influence with variable levels of WTG visibility depending on distance, viewer height, and atmospheric conditions.

M.3.1.1.2 Seascape Character Areas

M.3.1.1.2.1 Lower Coastal Plain/Tidewater

The Lower Coastal Plain/Tidewater character area consists of the large lowland network of saltmarsh and brackish open water bays common between the mainland and barrier islands of Virginia and North Carolina. These barrier island landforms also include several named beaches that are only accessible by boat: Parramore Island Beach, Myrtle Island Beach, and Smith Island Beach. Most of this area is conservation land including National Wildlife Refuges (NWR), coastal reserves, state wildlife management areas, and others. Access from land is limited to boat ramp facilities. Oyster/Cobb Island Station and Horse Island Trail (KOP-5), Virginia NWR (KOP-9), and Currituck NWR are representative of this character type. The barrier island beaches of this character area are closest to the WTG lease area; 2.73 square miles (7.07 square kilometers) of the Lower Coastal Plain Tidewater character area has hub-up visibility and 0.4 square mile (1.04 square kilometers) has rotors-only visibility.

M.3.1.1.2.2 Inland Bay

The Inland Bay character area includes non-ocean open water bodies like Chesapeake Bay, Lynnhaven Bay, Broad and Linkhorn Bays, and Back Bay. It does not include the Back Bay NWR. In addition to saltwater bays, it includes inland freshwater lakes like Lake Rudee, Lake Wesley, and Lake Christine. This character area also includes the numerous inland channels and rivers within the visual study area including the North Landing River Natural Area Preserve. The North Landing River is also part of the Atlantic Intracoastal Waterway.

M.3.1.1.2.3 Virginia Beach/Tourism

The Virginia Beach city center is within 0.5 mile (0.8 kilometer) of the shoreline and features the Virginia Beach Boardwalk. The boardwalk is a tourist destination which parallels the shoreline from 40th Street to 3rd Street, approximately 2.5 miles (4 kilometers) in length and situated 325 feet (99 meters) from the surf. This urban district is characterized by dense development such as high-rise hotels, condominiums, restaurants, and retail shops. The number of people (viewers) in Virgina Beach varies seasonally, with large influxes of tourists during summer. KOP 22, 23, and 26 are in this popular destination.

M.3.1.1.2.4 Beach

The Beach character area is identified as shoreline areas with minimal development and includes rolling, vegetated dunes that lead to an open sandy beach that slopes gently to the water line. The dunes create a transition to the adjacent seascape, which includes residential development, military sites, public conservation, or recreation lands. The most prominent visual characteristic of beaches is the unobstructed distant views to the north and south, including sand and surf, and distant eastward views over the ocean. The visual character is highly variable depending on the season and weather conditions. During fair summer weather beaches adjacent to urban areas are lined with people sunbathing, swimming, and beachcombing, and the beaches are temporarily filled with beachgoer accessories. In some instances, human-made features such as break walls, stone jetties, or fishing piers extend from the beach out into the ocean.

The Beach character area calculation as described and illustrated in COP, Appendix I-1, Attachment I-3 (Dominion Energy 2023) includes approximately 13 linear miles of beach from the southern boundary of Fort Story to Croatan Beach in Virginia and beach paralleling the Barrier Island Residential character area in the Corolla area of South Carolina. It does not measure beach areas along the barrier islands of the Delmarva Peninsula, the Beachfront Residential character area of Sandbridge neighborhood/historic district, Industrial/Military character areas including Fort Story and Dam Neck (KOP-31), or Recreation character areas including False Cape State Park. KOP 15a and 15b represent the Beach character area as calculated in the COP.

For the NEPA analysis, all beaches are considered within the character unit including all sandy shoreline areas within the study area. The total area of beach including beaches in other character areas is 5.83 square miles (15.10 square kilometers) of which 96 percent has project visibility. Total Beach character area with hub-up visibility is 4.26 square miles (11.04 square kilometers). Total Beach character area with rotor blade only visibility is 1.35 square miles (3.50 square kilometers). Beach area was measured from the low water breakers to the base of the dune vegetation as visible on Google Earth (2023) imagery.

M.3.1.1.2.5 Beachfront Residential

The Beachfront Residential character area is a narrow subset of residential properties in Virginia Beach set on the seascape primarily along Ocean Front Avenue (near North End Beach), South Atlantic Avenue (near Croatan Beach), and Sandfiddler Road in the Sandbridge neighborhood. The single-family homes are arranged parallel to the shore, with narrow, tightly spaced lots and many homes with ocean views, upper story decks, and private beach access. The Sandbridge neighborhood is identified as a proposed Historic District in the Historic Resources Visual Effects Analysis. The beach area is 0.28 square mile (0.74 square kilometer).

M.3.1.1.2.6 Barrier Island Residential

The Barrier Island Residential character area is a narrow subset of residential properties along the barrier island of Corolla, North Carolina. Unlike the Beachfront Residential areas north of downtown Virginia Beach, the homes in Corolla are modern, large, multi-story residences on large lots. Residences sit behind and above the dunes, have ocean views, upper story decks, and private beach access that is typically an elevated boardwalk with a shaded viewing structure and stairs down to the beach. Whale Head Bay Residential (KOP-49a) and Whale Head Bay Albacore Entrance (KOP-49g) depict this character area. 0.24 square mile (0.62 square kilometer) of Barrier Island Residential area is beach with rotors-only visibility.

M.3.1.1.2.7 Industrial/Military

The Industrial/Military character area encompasses large military complexes around Virginia Beach including Fort Story, Joint Expeditionary Base Little Creek-Fort Story, Oceana Naval Air Station, Dam Neck Naval Base, and the State Military Reservation. These facilities are located within the seascape and landscape character areas; however, only the facilities within seascape fall into the zone of potential influence from the project. These include Fort Story, Dam Neck Naval Base, and State Military Reservation, which are all located adjacent to the coastline and have views of the ocean. These areas also have beaches and dune features that separate built facilities from the ocean. The beaches along these military bases are accounted for under this character area (0.13 square mile (0.34 square kilometer) of beach is visible from hub up), not under the Beach character area (COP, Appendix I-1, Attachment I-1-3, page 3; Dominion Energy 2023). This character area is represented by Fort Story Lighthouse (KOP-13) and Picnic Views on Beach (KOP-31). Fort Story, Dam Neck Annex, and Camp Pendelton are also Historic Districts.

M.3.1.1.2.8 Recreation

The Recreation character area includes both natural conservation areas and public open spaces along the seascape and private open spaces like golf courses in the inland landscape. These areas of recreation areas exhibit a wide range of environmental characteristics from natural undeveloped landscapes with the intention of protecting native habitat and wildlife species to developed and highly maintained artificial landscapes. First Landing State Park and False Cape State Park in Virginia both fall within the Seascape character area and would have views of the proposed project. Inland private and public recreation areas fall into the landscape character area and would not have views of the project due to surrounding forest vegetation and relative distance. The beaches along these recreation areas are accounted for under this character area, not under the Beach character area (COP, Appendix I-1, Attachment I-1-3 page 4; Dominion Energy 2023). Seascape recreation amounts to 0.56 square mile (1.46 square kilometers) of beach. Active seascape recreation is illustrated in KOP 29 and 30c. Natural conservation areas are represented by KOPs 5, 8, and 44.

M.3.1.1.3 Landscape Character Areas

M.3.1.1.3.1 Agriculture

The Agriculture character area is distinguished by relatively level terrain and expansive views of working agricultural fields broken up by dense mixed vegetation, forests, and hedgerows. The majority are farmed as row crops, but there are some small orchards. Within the visual study area, agriculture is located inland and south of Virginia Beach. Residences found throughout the agriculture character type are widely spaced and often screened by landscaping.

M.3.1.1.3.2 Coastal Development

Coastal Development is a broad character area in the landscape character area encompassing urban and suburban development set back from the shoreline. It includes high-, medium-, and low-density residential areas and commercial developments in Virginia Beach, Chesapeake, and Norfolk, Virginia, and Corolla, North Carolina. This character area includes all the typical elements of cities and communities: neighborhoods, shopping centers, office parks, streets and highways, schools, and infrastructure. This landscape character area offers very limited views of the shoreline except from special elevated vantage points such as high-rise buildings. This character type also includes several scenic byways: U.S. Routes 13 and 60, Sandbridge Road Scenic Byway, and Virginia Scenic Byway along Blackwater Road/Pungo Ferry Road/Princess Anne Road.

M.3.1.1.3.3 Rural Coastal Plain

This character area is primarily located inland on the Delmarva Peninsula of Virginia, but also includes the rural residential neighborhoods of North Carolina. Like agriculture, it is characterized by a flat rural landscape. Residences are situated far apart and interspersed by the occasional commercial building.

Views of the project on the Delmarva Peninsula are located along the immediate eastern shore where views of the ocean are present. The rural residential community of Carova, North Carolina, is a seascape character area. Carova's modern multi-story rural residential neighborhoods with unpaved sand streets and natural dune landscape presents a remote quality; 0.1 square mile (0.26 square kilometer) of Seascape Rural Coastal Plain beach has hub-up visibility while the majority, 0.67 square mile (1.74 square kilometers), has rotors-only visibility.

M.3.1.2. Onshore Landscape Character Areas

Onshore landscape character areas were identified and described, but not numerically quantified. The following nine landscape character areas are used to evaluate impacts from onshore facilities.

- **Transportation Corridors:** Areas along major roads or railroads, or surrounding airports or other transportation hubs. Transportation corridors are often linear, and are characterized by extensive paved areas, collocated utilities, signage, and appurtenant structures such as traffic signals.
- **Developed—Suburban Residential:** Areas characterized primarily by single-family detached homes on individual lots, often with landscaped yards. This includes planned residential communities and subdivisions with consistent architectural and landscaping standards.
- **Developed—Rural Residential:** Areas characterized by single-family homes, generally on large lots, with a variety of vegetation and landscaping patterns. These typically occur along rural roads, and are often surrounded by agriculture, open lands, or forested areas.
- **Developed—Commercial:** Areas characterized by retail (ranging from individual stores to shopping malls) or office uses. Commercial areas typically have low buildings with substantial parking and circulation and varied landscaping.
- **Developed—Industrial:** Areas characterized by activities involving production, storage, or distribution of bulk materials. Structures are typically low-lying, set amid paved areas, with minimal landscaping or vegetation.
- **Agricultural and/or Open, Undeveloped Lands:** Lands characterized by active agricultural uses (i.e., row crops, pasture, livestock grazing and feeding) or inactive, open fields with low vegetation. Views are often expansive, terminated by distant treelines, with homes or other structures on adjacent properties visible but not prominent.
- **Open Water:** Areas where inland lakes and rivers are the dominant feature. As with agricultural and open lands, views over the water can be extensive, and are terminated by vegetation along the banks.
- **Forested:** Areas primarily characterized by trees and forests. Surrounding uses may be visible along the periphery but are not the focus of the view. Forests may be on dry land (upland forests) interspersed with standing water, marshes, or other wetlands (forested wetlands).
- **Developed Recreational Areas:** Locations developed for specific types of active recreation, ranging from playgrounds and picnic areas to collections of athletic fields with associated stadium, restroom, and service facilities. Views primarily focus on the recreational facilities themselves, while other visible landscape features (e.g., vegetation or surrounding development) are secondary.

M.3.1.3. Visibility, Distances, Character-Changing Effects, Scale, Prominence, and Visual Contrasts

Atmospheric conditions offshore and near the shoreline limit views more than the typically drier-air conditions in inland areas. Visual simulations from representative viewpoints included as Appendix I-1 to the *Coastal Virginial Offshore Wind Visual Impact Assessment Report* (COP, Appendix I; Dominion Energy 2023) indicate that daytime and nighttime visibility of WTGs would be noticeable to the casual observer from beach viewpoints. The OSSs are not visible from beaches. Although 94 feet of the nearest OSS is visible from the upper floor restaurant of the Marriott Virginia Beach Oceanfront Hotel (KOP-26) it is 30 miles from shore. OSS views are completely obscured from the Cape Henry Lighthouse (KOP-13) and the Currituck Beach Lighthouse (KOP-47). The nearest view beaches are found along Myrtle Island, northwest of the PDE. The nearest mainland view beaches are found at False Cape State Park, Virginia. The farthest view conditions are found along Parramore Island, Virginia, north of the PDE and Corolla Beach, North Carolina, south of the PDE.

Distances to the Proposed Action WTG and OSSs array would be as follows.

- **Parramore Island Nature Preserve:** Range from 40 miles (64.4 kilometers) at the nearest WTG to 54.8 miles (88.2 kilometers).
- **Myrtle Island Beach.** Range from 23.7 miles (38.14 kilometers) at the northwestern-most WTG to 42 miles (67.5 kilometers) at the southeastern-most WTG.
- **Little Island Park/False Cape State Park (KOP-44).** Range from 26.85 miles (43.21 kilometers) at the nearest WTG to 44.18 miles (71.1 kilometers).
- **Corolla Beach**: Range from 40 miles (64.4 kilometers) at the nearest WTG to 57.5 miles (92.5 kilometers) on the southern-most WTG.

The noticeable daytime and nighttime elements of the Project's WTGs and their viewshed distances are listed in Table M-4. Each WTG would have two L-864 flashing red obstruction lights on the top of the nacelle, one of which is required to be lit (BOEM 2021). WTGs would have additional intermediate lighting on the tower utilizing low-intensity red-flashing (L-810) obstruction lighting (COP, Appendix HH; Dominion Energy 2023). Light mitigation has been incorporated into the project as is described later in this section. Line-of-sight calculations for onshore viewers (5-foot [1.5-meter] eye level) are based on intervening EC screening (7.98 inches [20.3 centimeters] height per mile). Heights of WTG and substation components are stated relative to MHW and highest astronomical tide (HAT).

Table M-5 and Table M-6 indicate the Proposed Action's effects based on horizontal FOV and vertical FOV, respectively, defined as the extent of the observable landscape seen at any given moment, usually measured in degrees (BOEM 2021). The horizontal FOV for each KOP is listed in COP, Appendix I-1, Attachment I-1-4 (Dominion Energy 2023). FOVs are one of several valid and reliable indicators of the Proposed Action facilities magnitude of impact. Typical human perception extends to 124° in the horizontal axis and 55° in the vertical axis. The nearest shoreline viewers would be 24.1 miles (38.8 kilometers) from the Wind Farm Area. At this distance, the EC reduces the observable height of the nearest WTG from 869 feet (265 meters) MHW to 602.3 feet (183.5 meters), resulting in 0.4° and 0.73 percent of the overall view above the horizon. WTGs would further diminish in perceived size with distance and EC.

Table M-4 Heights of Noticeable[1] 16-MW WTG Elements and Substations and Visible Distances[2]

Noticeable Element	Height in Feet (meters)	Visible Distance[2] in Miles (kilometers)
Rotor Blade Tip	869 (265) MHW	0–39 (62.8)
Aviation Obstruction Light	508 (162) MHW	0–30.5 (49.1)
Nacelle	498 (152) MHW	0–30.2 (48.6)
Indicative Hub Height	489 (149) MHW	0–29.9 (48.1)
OSS	177 (54) HAT	0–19.2 (30.9)
Mid-tower Light	244.5 (74.5) MHW	0–22 (35.4)
Yellow Tower Base Color	50 (15) MHHW	0–11.5 (18.5)

[1] Perception of Project elements, from 5.5-foot (1.7 meter) human eye level while standing at mean sea level, involves static distance-related sizes, forms, lines, colors, and textures; variable daytime lighting conditions; variable nighttime light conditions; and variable meteorological conditions.
[2] Based on intervening EC and clear-day conditions.
HAT = highest astronomical tide

Table M-5 Horizontal FOV Occupied by the Proposed Action

Noticeable Element	Width in Miles (kilometers)	Distance in Miles (kilometers)	Horizontal FOV	Human FOV	Percent of FOV
Wind Farm	17.8 (28.6)	24.1 (38.8)	36.4°	124°	29%

Table M-6 Vertical FOV Occupied by the Proposed Action

Noticeable Element	Height in Feet (meters)	Distance in Miles (kilometers)	Height Above Horizon[1] in Feet (meters)	Vertical FOV	Human FOV	Percent of FOV
Rotor Blade Tip	869 feet (265) MHW	24.1 (38.8)	569 (173.4)	0.28°	55°	.01%

[1] Based on intervening EC and clear-day conditions.

The visual analysis considers the introduction of WTGs and OSSs to an open ocean baseline. The scale, size, contrast, and prominence of change focuses on the following.

- Arrangement of WTGs and OSSs in the view.
- Horizontal FOV and vertical FOV scale of the wind farm array, based on WTG and OSS size and number.
- Position of the array in the open ocean.
- Position of the array in the view.
- Turbine array's distance from the viewer.

Visibility, character-changing effects, scale, prominence, and visual contrasts reduce steadily with distance from the observation point. Visibility, character-changing effects, scale, prominence, and visual contrasts increase with elevated observer position in comparison with the wind farm. Visibility thresholds have been described and rated through the research by Robert Sullivan at the Argonne Nation Laboratory based on WTGs in England. Table M-8 describes Visibility Threshold levels and ratings based on this work. This research along with distance and observer elevation considerations, informed by the VIA simulations (COP, Appendix I-1, Attachment I-1-5; Dominion Energy 2023), EC calculations, horizontal FOV, and vertical FOV in undeveloped open ocean provide the basis for evaluating visibility.

The wind farm and nearest WTGs would be as follows.

- Unavoidably dominant features in the view between 0 and 12 miles (0 and 19.3 kilometers) distance.
- Strongly pervasive features between 12 and 20 miles (19.3 and 32.2 kilometers) distance.
- Clearly visible features between 20 and 28 miles (19.3 and 45.1 kilometers) distance.
- Low on the horizon, but persistent features in the view between 28 and 31 miles (45.1 and 49.9 kilometers) distance.
- Intermittently noticed features between 31 and 39.6 miles (49.9 and 63.7 kilometers) distance.
- Below the horizon beyond 39.6 miles (63.7 kilometers) distance.

Visual contrast determinations involve comparisons of characteristics of the seascape, open ocean, and landscape before and after Project implementation. The range of potential contrasts includes strong, moderate, weak, and none (BOEM 2021). The strongest daytime contrasts would result from tranquil and flat seas combined with front-lit WTG towers, nacelles, flickering rotors, and a yellow tower base color against a dark background sky and an undifferentiated foreground. There would be daily variation in WTG color contrast as sun angles change from backlit to front-lit (sunrise to sunset), and the backdrop would vary under different lighting and atmospheric conditions. The weakest daytime contrasts would result from turbulent seas combined with overcast daylight conditions on WTG towers, nacelles, and rotors against an overcast background sky and a foreground modulated by varied landscape elements. The strongest nighttime contrasts would result from dark skies (absent moonlight) combined with navigation lights, activated lighting on the OSSs, mid-tower lights, and Project lighting reflections on low clouds and active (non-reflective) surf, and the dark-sky light dome. The weakest nighttime contrasts would result from moonlit, cloudless skies; tranquil (reflective) seas; Aircraft Detection Lighting System (ADLS) is not activated (aviation warning lights off); and mid-tower lights on.

The seascape character units, landscape character units, and viewer experiences would be affected by the Proposed Action's noticeable features, applicable distances and FOV extents, open views versus view framing and intervening foregrounds, and form, line, color, and texture contrasts, scale of change, and prominence in the characteristic seascape and landscape. Higher impact levels would stem from unique, extensive, and long-term appearance of strongly contrasting, large, and prominent vertical structures in the otherwise horizontal seascape environment; where structures are an unexpected element and viewer experience is of formerly open views of high-sensitivity seascape and landscape; and from high-sensitivity view receptors.

Viewer experience would change throughout the life cycle of the project. Construction operations involving moving and stationary barges, cranes, and lighting may have a greater visual effect on viewers than operational and decommissioning activities. However, construction impacts would be temporary and include the following.

- Daytime and nighttime movement of installation vessels, cranes, and other equipment visible in the seascape in and around the Lease Area.
- Dawn, dusk, and nighttime construction lighting on WTGs and OSSs.
- Beach, other sensitive land-based, and boat and cruise ship views of WTGs and OSSs under construction.
- Laying of the offshore and onshore buried export cables and the connections between offshore and onshore export cables near the Croatan Parking Lot east of Lake Christine, within the State Military Reservation.
- Activities along the onshore landfalls, export cable routes, Harpers Switching Station, and Fentress onshore substations.

Operational effects of the WTGs and transporting crews for maintenance would be long term and fully reversible.

Proposed Action impacts on high-sensitivity seascape character would be **moderate**. The daytime and nighttime (lighting) presence of the WTGs, OSSs, and construction and O&M vessel traffic would change perception of this area from natural, undeveloped seascape to a developed wind energy environment characterized by plainly visible WTGs with clear sky conditions in the afternoon.

Maintenance activities would cause **minor** effects on seascape character by increased O&M vessel traffic to and from the Wind Farm Area. Increases in these vessel movements would be noticeable to offshore viewers but are unlikely to have a significant effect.

Decommissioning would involve the removal of all offshore structures and is expected to follow the reverse of the construction activity. Decommissioning activities would cause effects similar to those of construction activities.

Viewshed analyses (COP, Appendix I-1; Dominion Energy 2023) determined that clear-weather visibility of the WTGs would occur within the Proposed Action's zone of visual influence. The Proposed Action would be visible along the eastern beaches. The majority of overland visibility would occur between 24 and 28 miles (39 and 45 kilometers) of the Proposed Action over inland bays. Visibility would diminish significantly between 28 and 40 miles (45 and 64 kilometers), contributing to the zone of visual influence. Due to coastal meteorological conditions, Proposed Action daytime views with visibility at 20 nautical miles for 50-percent of the day would occur approximately 20 percent of the year or 66 days per year, approximately 1 out of 5 days.

Daytime lighting of WTGs is not required. Nighttime aviation warning lights create a **major** impact. ADLS report (COP, Appendix T; Dominion Energy 2023) indicates that based on historical air traffic data for flights passing through the light activation zone would activate obstruction lights for a total of 25 hours 33 minutes and 49 seconds over a one-year period. March would have the highest proportion of ADLS night lighting activation and September would have the smallest proportion. Considering the local sunrise and sunset times, an ADLS-controlled obstruction lighting system would result in over a 99 percent reduction in system activated duration as compared to a traditional always-on obstruction lighting system; therefore, greatly reducing the impact levels from **major** to **minor**. Residual impacts would result from the presence of continuously flashing lights, sky light dome, and reflections on clouds during those limited hours. Lights of the three OSSs, when lit for maintenance, would not be visible from beaches and adjoining land during hours of darkness. Lights from the OSS nearest to shore would be visible from the upper floors of the Marriott Virginia Beach Oceanfront Hotel (KOP-26). The nighttime sky light dome and cloud lighting caused by reflections from the water surface may be seen from distances beyond the 40-mile (64-kilometer) geographic analysis area, depending on variable ocean surface and meteorological reflectivity. The incorporation of National Park Service (NPS) sustainable lighting best practices, (e.g., use LEDs in warm colors; recess and fully down-shield lights; use fixtures that include motion timers, motion detectors, hue adaptors, and dimmers; reduce light intensity to lowest lumens possible; and install lights properly) will minimize direct observation of onshore substation nighttime safety lighting in their immediate neighborhoods during hours of darkness.

Table M-7 Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

KOP	Offshore Components Distance in Miles (kilometers) Onshore Components Distance from Viewer in Feet (meters)				Proposed Action FOV Degrees (% of 124°) Visual Sim FOV Degrees % of image[1]	Noticeable Elements[2] & Impact Level	Contrast, Scale of Change, and Prominence							
	Proposed Action	Alternative B	Alternative C	Alternative D			Proposed Action Form	Proposed Action Line	Proposed Action Color	Proposed Action Texture	Proposed Action Scale	Proposed Action Prominence[3]	Alternatives B and C	Alternative D
KOP-5 Oyster Village Horse Island Trail	32.6 (52.5)	NA	NA	NA	14° (11%) 35.8%	R **Negligible**	Weak	Weak	Weak	None	Negligible	1	Same as Proposed Action	Same as Proposed Action
KOP-8 Eastern Shore of Virginia NWR	28.2 (45.4)	NA	NA	NA	14° (11%) 25.5%	R, AL, N, and H **Negligible**	Weak	Weak	Weak	Weak	Negligible	1	Same as Proposed Action	Same as Proposed Action
KOP-13 (elevated) Cape Henry Lighthouse	29.1 (46.8)	NA	NA	NA	21° (17%) 48.8%	R, AL, N, and H **Moderate**	Moderate	Moderate	Moderate	Weak	Medium	3	Same as Proposed Action	Same as Proposed Action
KOP-15a Beach Residential 1	28.1 (45.2)	NA	NA	NA	22° (18%) 73.3%	R, AL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-15b Beach Residential – Nighttime	28.1 (45.2)	NA	NA	NA	23° (18.5%) 41.8%	AL (ADLS) **Negligible**	Weak	Strong	Strong	Weak	Small	5	Same as Proposed Action	Same as Proposed Action
KOP-22 Neptune Statue/ V. B. Boardwalk	27.9 (45)	NA	NA	NA	23° (18.5%) 57.5%	R, AL, N, and H **Minor**	Weak	Weak	Moderate	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-23 National Aviation Monument Park	27.9 (45)	NA	NA	NA	23° (18.5%) 57.5%	R, AL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-24a Virginia Beach Boardwalk – 17th St Park	27.8 (33.9)	NA	NA	NA	23° (18.5%) 60.5%	R, AL, N, and H **Minor**	Moderate	Moderate	Moderate	Weak	Small	4	Same as Proposed Action	Same as Proposed Action
KOP-24b Virginia Beach Boardwalk – 16th Street Nighttime	27.8 (33.9)	NA	NA	NA	23° (18.5%) 54.8%	AL (ADLS) **Negligible**	Weak	Strong	Strong	Weak	Small	5	Same as Proposed Action	Same as Proposed Action
KOP-24d Virginia Beach Boardwalk Fishing Pier	27.6 (44.4)	NA	NA	NA	23° (18.5%) 48%	R, AL, N, and H **Minor**	Moderate	Moderate	Strong	Weak	Small	4	Same as Proposed Action	Same as Proposed Action
KOP-24d Virginia Beach Boardwalk Fishing Pier – Nighttime	27.6 (44.4)	NA	NA	NA	23° (18.5%) 48%	AL (ADLS) **Negligible**	Weak	Strong	Strong	Weak	Small	5	Same as Proposed Action	Same as Proposed Action
KOP-26 (elevated) Marriott Virginia Beach	28 (45)	NA	NA	NA	23° (18.5%) 57.5%	R, AL, N, O, and H **Moderate**	Moderate	Moderate	Moderate	Weak	Medium	4	Same as Proposed Action	Same as Proposed Action
KOP-29 Grommet Island Park	27.7 (44.6)	NA	NA	NA	23° (18.5%) 51%	R, AL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-30a Croatan Beach A – North (cloudy)	27.7 (44.6)	NA	NA	NA	22.5° (18%) 46%	R, AL, N, and H **Minor**	Weak	Moderate	Moderate	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-30c Croatan Beach C – South (cloudy)	27.7 (44.6)	NA	NA	NA	22.5° (18%) 35%	R, AL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	2	Same as Proposed Action	Same as Proposed Action
KOP-31 Picnic Views at State Military Reserve1	27.7 (44.6)	NA	NA	NA	22° (18%) 55%	R, AL, N, and H **Minor**	Weak	Weak	Weak	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-44 Little Island Park (revised)	26.8 (43.1)	NA	NA	NA	26° (21%) 66.7%	R, AL, N, and H **Moderate**	Moderate	Moderate	Moderate[4]	Weak	Small	4	Same as Proposed Action	Same as Proposed Action

[1] The SMR beachfront is not exclusively recreational in use. The SMR beachfront platform is also an observation point, because the beachfront and oceanfront environment are also used for training activities at the SMR.

KOP	Offshore Components Distance in Miles (kilometers) Onshore Components Distance from Viewer in Feet (meters)				Proposed Action FOV Degrees (% of 124°) Visual Sim FOV Degrees % of image[1]	Noticeable Elements[2] & Impact Level	Contrast, Scale of Change, and Prominence							
	Proposed Action	Alternative B	Alternative C	Alternative D			Proposed Action Form	Proposed Action Line	Proposed Action Color	Proposed Action Texture	Proposed Action Scale	Proposed Action Prominence[3]	Alternatives B and C	Alternative D
KOP-47 Currituck National Wildlife Refuge	34.7 (55.8)	NA	NA	NA	12.5° (10%) 35.7%	R **Negligible**	Weak	Weak	Weak	None	Small	1	Same as Proposed Action	Same as Proposed Action
KOP-48 Currituck Beach Lighthouse (elevated)	36.8 (59.2)	NA	NA	NA	22.5° (18%) 55%	R **Minor**	Moderate	Weak	Moderate	Weak	Small	3	Same as Proposed Action	Same as Proposed Action
KOP-49a Whale Head Bay – Residential	36.6 (58.9)	NA	NA	NA	14.5° (12%) 30.2%	R **Negligible**	Weak	Weak	Weak	Weak	Small	1	Same as Proposed Action	Same as Proposed Action
KOP-49g Whale Head Bay – Albacore Street	39.1 (62.9)	NA	NA	NA	9° (7%) 24.3%	R **Negligible**	Weak	Weak	Weak	Weak	Small	1	Same as Proposed Action	Same as Proposed Action
KOP-50 Fishing and Tour Boats	0–40 (0–64)	NA	NA	NA	NA	R, AL, N, H, and Y **Major**	Strong	Strong	Strong	Strong	Large	6	Same as Proposed Action	Same as Proposed Action
KOP-51 Commercial and Cruise Ships	0–40 (0–64)	NA	NA	NA	NA	R, AL, N, H, and Y **Major**	Strong	Strong	Strong	Strong	Large	6	Same as Proposed Action	Same as Proposed Action
Onshore Components														
IC Route 1 KOP-3 Harpers Switching Station	1,000 (304.8)	Same as Prop. Act.	Same as Prop. Act.	NA	NA	SS **Major**	Strong	Strong	Strong	Strong	Large	6	Same as Proposed Action	NA
KOP-5	WPC	Same as Prop. Act.	Same as Prop. Act.	NA	NA	IC **Major**	Strong	Strong	Moderate	Moderate	Large	5	Same as Proposed Action	NA
KOP-10 Fentress Substation	1,056 (231.8)	Same as Prop. Act.	Same as Prop. Act.	NA	NA	S **Major**	Moderate	Moderate	Strong	Moderate	Large	5	Same as Proposed Action	NA
KOP-11	1584 (482.8)	Same as Prop. Act.	Same as Prop. Act.	NA	NA	IC **Moderate**	Moderate	Moderate	Moderate	Moderate	Medium	4	Same as Proposed Action	NA
KOP-12	1584 (482.8)	Same as Prop. Act.	Same as Prop. Act.	NA	NA	IC **Negligible**	None	None	None	None	Not Visible	0	Same as Proposed Action	NA
KOP-13	1,000 (304.8)	Same as Prop. Act.	Same as Prop. Act.	NA	NA	IC **Negligible**	None	None	None	None	Not Visible	0	Same as Proposed Action	NA
KOP-14a	WPC	Same as Prop. Act.	Same as Prop. Act.	NA	NA	IC **Moderate**	Moderate	Major	Moderate	Moderate	Large	5	Same as Proposed Action	NA
KOP-14b	WPC	Same as Prop. Act.	Same as Prop. Act.	NA	NA	IC **Moderate**	Moderate	Moderate	Moderate	Moderate	Large	4	Same as Proposed Action	NA
KOP-17	WPC	Same as Prop. Act.	Same as Prop. Act.	NA	NA	IC **Moderate**	Moderate	Moderate	Moderate	Moderate	Medium	3	Same as Proposed Action	NA
IC Hybrid Route 6 KOP-10 Fentress Substation	1,056 (231.8)	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	S **Major**	Moderate	Moderate	Strong	Moderate	Large	5	Same as Proposed Action	Same as Proposed Action
KOP-11	1584 (482.8)	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	IC **Minor**	Minor	Minor	Moderate	Moderate	Medium	3	Same as Proposed Action	Same as Proposed Action
KOP-12	1584 (482.8)	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	IC **Negligible**	None	None	None	None	Not Visible	0	Same as Proposed Action	Same as Proposed Action

KOP	Offshore Components Distance in Miles (kilometers) Onshore Components Distance from Viewer in Feet (meters)				Proposed Action FOV Degrees (% of 124°) Visual Sim FOV Degrees % of image[1]	Noticeable Elements[2] & Impact Level	Contrast, Scale of Change, and Prominence							
	Proposed Action	Alternative B	Alternative C	Alternative D			Proposed Action Form	Proposed Action Line	Proposed Action Color	Proposed Action Texture	Proposed Action Scale	Proposed Action Prominence[3]	Alternatives B and C	Alternative D
KOP-13	1,000 (304.8)	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	IC **Negligible**	None	None	None	None	Not Visible	0	Same as Proposed Action	Same as Proposed Action
KOP-14a	WPC	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	IC **Moderate**	Moderate	Major	Moderate	Moderate	Large	4	Same as Proposed Action	Same as Proposed Action
KOP-14b	WPC	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	IC **Moderate**	Moderate	Moderate	Moderate	Moderate	Large	3	Same as Proposed Action	Same as Proposed Action
KOP-17	WPC	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	IC **Moderate**	Moderate	Moderate	Moderate	Moderate	Medium	5	Same as Proposed Action	Same as Proposed Action
KOP- 18 Chicory Switching Station	528 (160)	Same as Prop. Act.	Same as Prop. Act.	Same as Prop. Act.	NA	**Negligible**	Not Visible	Not Visible	Not Visible	Not Visible	Not Visible	0	Same as Proposed Action	Same as Proposed Action

[1] Horizontal Field of View is measured both in human visual perspective as a percentage of 124 degrees. The visual simulations (found in CVOW-C COP, Appendix I-1 Attachment I-1-5, Dominion 2022) calculate and illustrate FOV as a percentage of the photographic image.
[2] Noticeable elements: R = rotor, AL = aviation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color, SS = Switching Station, IC = Interconnecting Cable, S = Substation
[3] WTGs, OSS (onshore), and offshore component visibility based on the visual simulations: 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 (NAEP 2012).
HF = Harpers to Fentress, WPC = Within Proposed Corridor.
[4] The revised simulation for KOP-44 uses RAL 7035 light grey color to depict WTGs and is expected to diminish the WTGs overall contrast with the sky.

This page intentionally left blank

Table M-8 Visibility Threshold Levels

Visibility Rating	Description
Visibility level 1. Visible only after extended, close viewing; otherwise, invisible.	An object/phenomenon that is near the extreme limit of visibility. It could not be seen by a person who was unaware of it in advance and looking for it. Even under those circumstances, the object can be seen only after looking at it closely for an extended period.
Visibility level 2. Visible when scanning in the general direction of the subject; otherwise, likely to be missed by casual observers.	An object/phenomenon that is very small and/or faint, but when the observer is scanning the horizon or looking more closely at an area, can be detected without extended viewing. It could sometimes be noticed by casual observers; however, most people would not notice it without some active looking.
Visibility level 3. Visible after a brief glance in the general direction of the study subject and unlikely to be missed by casual observers.	An object/phenomenon that can be easily detected after a brief look and would be visible to most casual observers, but without sufficient size or contrast to compete with major landscape/seascape elements.
Visibility level 4. Plainly visible, so could not be missed by casual observers, but does not strongly attract visual attention or dominate the view because of its apparent size, for views in the general direction of the study subject.	An object/phenomenon that is obvious and with sufficient size or contrast to compete with other landscape/seascape elements, but with insufficient visual contrast to strongly attract visual attention and insufficient size to occupy most of an observer's visual field.
Visibility level 5. Strongly attracts the visual attention of views in the general direction of the study subject. Attention may be drawn to the strong contrast in form, line, color, or texture, luminance, or motion.	An object/phenomenon that is not large but contrasts with the surrounding landscape elements so strongly that it is a major focus of visual attention, drawing viewer attention immediately and tending to hold attention. Has strong contrasts in form, line, color, and texture. In addition, bright light sources and moving objects contribute substantially to drawing viewer attention. The study subject's visual prominence noticeably interferes with views of nearby landscape/seascape elements.
Visibility level 6. Dominates the view because the study subject fills most of the visual field of views in its general direction. Strong contrasts in form, line, color, texture, luminance, or motions may contribute to view dominance.	An object/phenomenon with strong visual contrasts that is so large it occupies most of the visual field, and views cannot be avoided except by turning one's head more than 45 degrees from a direct view of the object. The phenomenon is the major focus of visual attention, and its large apparent size is a major factor in its view dominance. The study subject's visual prominence noticeably detracts from views of other landscape /seascape elements.

Source: Sullivan et. al 2013.

Table M-9 lists the Proposed Action's noticeable features based on their heights, distances, and EC.

Table M-9 Noticeable Elements and Impacts by Seascape Character Area, Open Ocean Character Area, Landscape Character Areas, and KOP for the Proposed Action

Noticeable Elements[1] Impacts	Seascape, Open Ocean, and Landscape Character Areas, and Offshore and Onshore Key Observation Points
R, AL, N, H, O, M, and Y **Major**	Open Ocean Character Area, Historic Resources (Chesapeake Light Station) KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area KOP-51 Cruise Ship Shipping Lanes
R, AL, N, and H **Moderate**	Open Ocean Character Area Seascape Character Areas: Barrier Island Residential, Beach, Beachfront Residential, Recreation, Virginia Beach/Tourism, Historic and Disadvantage Communities, Industrial/Military Landscape Character Area: Inland Bay KOP-13 Cape Henry Lighthouse/Fort Story Military Base2 KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-44 Little Island Park/Back Bay National Wildlife Refuge
R, AL, N, and H **Minor**	Open Ocean Character Area Seascape Character Areas: Lower Coastal Plain/Tide Water Landscape Character Area: Inland Bay, Rural Coastal Plain KOP-8 Eastern Shore of Virginia NWR KOP-15a North End Beach – Residential View KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR KOP-47 Currituck NWR KOP-48 Currituck Beach Lighthouse KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance – Elevated
Unseen **Negligible**	Landscape Character Areas: Agriculture, Coastal Development KOP-15b North End Beach – Residential View – Nighttime (ALDS)[2] KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime (ALDS)[2] KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime (ALDS)[2]

[1] R = rotor, AL = aviation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[2] Negligible impacts with implementation of ALDS.
SMR = State Military Reservation, NWR = National Wildlife Refuge.

Table M-10 summarizes the Proposed Action's wind farm distance, percent of FOV occupied by the wind farm, and effects on the seascape areas, open ocean area, landscape areas, and KOPs.

[2] The Fort Story Military Base in the VIA refers to the Joint Expeditionary Base Little Creek-Fort Story, of which the Fort Story Historic District is a part.

Table M-10 Wind Farm Distance Effects by Seascape Character Areas, Open Ocean Character Area, Landscape Character Areas, and KOP for the Proposed Action

Distance in Miles (kilometers) Effects	Seascape, Open Ocean, and Landscape Character Areas, and Offshore and Onshore Key Observation Points
0–40.0 (0–64.4) Dominant/Major to Minor Noticeability	Open Ocean Character Area Historic Resources (Chesapeake Light Station) KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area
5.0–40.0 (8.0–64.4) Dominant/Major to Minor Noticeability	Open Ocean Character Area KOP-51 Cruise Ship Shipping Lanes
13 to 28 (20.9 to 45.1) High Noticeability Nighttime Views[1]	Open Ocean Character Area KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime[1] KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime[1] KOP-15b North End Beach – Residential View – Nighttime[1]
24.1 to 28 (38.8 to 43.5) Moderate Noticeability	Seascape Character Areas: Beach, Beachfront Residential, Recreation, Virginia Beach/Tourism, Historic Resources and Disadvantaged Communities KOP-44 Little Island Park/Back Bay National Wildlife Refuge
28 to 29.1 (45.1 to 46.8) Moderate Noticeability Elevated Views	Seascape Character Areas: Recreation (Historic), Virginia Beach/Tourism KOP-13 Cape Henry Lighthouse/Fort Story Military Base KOP-26 Marriott Virginia Beach Oceanfront Hotel
28.1 to 31 (43.6 to 49.9) Minor Noticeability	Seascape Character Areas: Beach, Barrier Island Residential, Recreation, Historic Resources and Disadvantaged Communities, Lower Coastal Plain/Tide Water Industrial/Military KOP-15a North End Beach – Residential View KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR
36.8 (59.2) Minor Noticeability Elevated Views	Seascape Character Areas: Recreation (Historic) KOP-48 Currituck Beach Lighthouse

Distance in Miles (kilometers) Effects	Seascape, Open Ocean, and Landscape Character Areas, and Offshore and Onshore Key Observation Points
31–40.0 (45.1–64.4) Negligible Noticeability	Landscape Character Areas: Those areas not within the zone of visual influence KOP-5 Oyster Village Horse Island Trail KOP-8 Eastern Shore of Virginia NWR KOP-47 Currituck NWR KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance – Elevated

[1] Negligible with ALDS
SMR = State Military Reservation, NWR = National Wildlife Refuge.

Table M-11 summarizes the Proposed Action's wind farm distance, percent of FOV occupied by the wind farm, and effects on the KOPs.

Table M-11 Wind Farm Percent FOV and Effects by KOP for the Proposed Action

Percent (°) of 124° FOV POV[1] Effects	Offshore and Onshore Key Observation Points
100% (124°) to 16% (20°) Dominant/Major to Minor	KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area
41% (51°) to 16% (20°) Dominant/Major to Minor	KOP-51 Cruise Ship Shipping Lanes
33% (37.6°) to 29% (36°) Moderate	none
28% (35°) to 20% (25°) Minor	KOP-44 Little Island Park/Back Bay NWR
20% (25°) to 7% (9°) Minor to Negligible	KOP-5 Oyster Village Hoarse Island Trail KOP-8 Eastern Shore of Virginia NWR KOP-13 Cape Henry Lighthouse KOP-15a North End Beach Residential View 1 KOP-15b North End Beach Residential View 1 nighttime KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24b Virginia Beach Boardwalk – 16th Street Entrance nighttime KOP-24d virginal Beach Boardwalk – Fishing Pier & Nighttime KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR KOP-47 Currituck Beach Lighthouse KOP-48 Currituck NWR KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Albacore Street Entrance – Elevated

[1] Percent of view.
SMR = State Military Reservation, NWR = National Wildlife Refuge.

Foreground influence assessments, involving the presence of intervening or framing elements and their influence on effects of Project characteristics, are based on each KOP's locale photography and visual simulations (COP, Appendix I; Dominion Energy 2023) and are summarized in Table M-12.

Table M-12 Foreground View Framing and Intervening Elements for the Proposed Action

Foreground Element(s) Influence[1]	Seascape,[2] Open Ocean, and Landscape Character Areas,[2] and Offshore and Onshore Key Observation Points
Open Ocean Negligible Influence	Open Ocean Character Area: Ocean VIA: KOP-26 Marriott Oceanfront Hotel KOP-24d Virginia Beach Boardwalk Fishing Pier KOP-24d Virginia Beach Boardwalk Fishing Pier Nighttime KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area KOP-51 Cruise Ship Shipping Lanes
Beach, Dunes, and Ocean Minor Influence	KOP-15a Beach Residential 1 KOP-15b Beach Residential 1 nighttime KOP-22 Neptune Statue Boardwalk KOP-23 National Aviation Monument Park KOP-24a Virginia Beach Boardwalk 17th Street Park KOP-29 Grommet Island Park KOP-30a Croatan Beach A – North KOP-30c Croatan Beach A – South KOP-31 Picnic Views at SMR KOP-44 Little Island Park KOP-48 Currituck NWR KOP-49a Whale Head Beach Residential KOP-49g Whale Head Beach Albacore Street Entrance
Buildings, Vegetation, and Topography Moderate to Dominant Influence	KOP-5 Horse Island Trail KOP-8 Eastern Shore Virginia NWR KOP-13 Cape Henry Lighthouse KOP-24b Virginia Beach Boardwalk 16th Street Entrance Nighttime KOP-48 Currituck Beach Lighthouse *Onshore Components* KOP-3 (IC Route 1) KOP-5 (IC Route 1) KOP-10 (IC Routes 1 and 6 Hybrid) KOP-11 (IC Route 1 and 6 Hybrid) KOP-12 (IC Routes 1 and 6 Hybrid) KOP-13 (IC Routes 1 and 6 Hybrid) KOP-14a (IC Routes 1 and 6 Hybrid) KOP-14b (IC Routes 1 and 6 Hybrid) KOP-17 (IC Routes 1 and 6 Hybrid) KOP-18 (IC Route 6 Hybrid)

SMR = State Military Reservation, NWR = National Wildlife Refuge, HF = Harpers to Fentress.
[1] Based on conditions portrayed by representative photography contained in COP, Appendix I-1 and I-2; Dominion Energy 2023, nearby view receptor locations may vary from screened to open views of the WTA.
[2] Variable foreground element conditions and influences within seascape and landscape character areas.

Proposed Action contrasts in the characteristic seascape and landscape, as perceived in views from each KOP, are based on visual simulations (COP, Appendix I, Attachment I-1-5; Dominion Energy 2023). Seascape unit view contrasts are estimated based on similar open view conditions in ocean environments. Landscape and seascape compatibility and photography conditions for each viewpoint are presented in COP, Appendix I, Attachment I-1-4 (Dominion Energy 2023). The COP landscape and seascape evaluation scale ranges from faint, apparent, conspicuous, and prominent to dominant. No onshore viewpoints would result in either prominent or dominant conditions. Offshore potential viewpoints' evaluations range from faint to dominant. Visual contrast determinations involve comparisons of characteristics of the seascape and landscape before and after Proposed Action implementation. The range of potential contrasts includes strong, moderate, weak, and none. The strongest daytime contrasts would result from tranquil and flat seas combined with sunlit WTG towers, nacelles, flickering rotors, and the yellow tower 50-foot (15.2-meter) base color against a dark background sky and an undifferentiated foreground. The weakest daytime contrasts would result from turbulent seas combined with overcast daylight conditions on WTG towers, nacelles, and rotors against an overcast background sky and a foreground modulated by varied landscape elements. The strongest nighttime contrasts would result from dark skies (absent moonlight) combined with navigation lights, activated lighting on the OSSs, mid-tower lights, and Project lighting reflections on low clouds and active (non-reflective) surf, and the dark-sky light dome. The weakest nighttime contrasts would result from moonlit, cloudless skies, tranquil (reflective) seas, ADLS activation, and only mid-tower lights.

Photographic comparisons of characteristics of the seascape's and landscape's existing conditions and Proposed Action implementation are included in Attachment I-1-5 of COP, Appendix I-1 (Dominion Energy 2023) for each of the KOPs in the following summary tables. Visual contrast determinations are listed in Table M-13.

Table M-13. Visual Contrasts to Seascape, Open Ocean, and Landscape Character Areas, and KOPs for the Proposed Action

Contrast Rating Effects	Seascape, Open Ocean, and Landscape Character Areas, and Offshore and Onshore Key Observation Points
Strong Contrasts **Major**	Open Ocean Character Area KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area KOP-51 Cruise Ship Shipping Lanes KOP-15b North End Beach Residential View 1 nighttime KOP-24b Virginia Beach Boardwalk – 16th Street Entrance nighttime KOP-24d Virginia Beach Boardwalk – Fishing Pier nighttime *Onshore Components* Landscape Character Areas: Developed – Suburban Residential, Open Water KOP-3 (IC Routes 1) KOP-4a/b (IC Route 1 and 6 Hybrid)
Moderate Contrasts **Moderate**	Open Ocean Character Area: Historic Resources (Chesapeake Light Station) Seascape Character Areas: Barrier Island Residential, Beach, Beachfront Residential, Recreation [1], Industrial/Military [1], Virginia Beach/Tourism, Historic Resources and Disadvantaged Communities KOP-13 Cape Henry Lighthouse KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-26 Marriott Virginia Beach Oceanfront Hotel *Onshore Components*

Contrast Rating Effects	Seascape, Open Ocean, and Landscape Character Areas, and Offshore and Onshore Key Observation Points
	Landscape Character Areas: Agriculture/Open Land, Developed – Rural Residential, Forested KOP-5 (IC Routes 1) KOP-14b (IC Routes 1 and 6) KOP-17 (IC Routes 1 and 6)
Weak Contrasts **Minor**	Seascape Character Areas: Lower Coastal Plain/Tidewater Landscape Character Areas: Inland Bay, Rural Coastal Plain, Recreation[1] KOP-15a North End Beach Residential View 1 KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR KOP-44 Little Island Park (raining) KOP-48 Currituck Beach Lighthouse *Onshore Components* Landscape Character Areas: Transportation Corridor, Developed Recreation Area, Developed – Industrial KOP-10 (IC Routes 1 and 6) KOP-11 (IC Route 1and 6) KOP-14a (IC Routes 1 and 6)
None (No Contrasts) **Negligible**	Landscape Character Areas: Agriculture, Coastal Development, Industrial/Military[1] KOP-5 Oyster Village Hoarse Island Trail KOP-8 Eastern Shore of Virginia NWR KOP-47 Currituck NWR KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Albacore Street Entrance – Elevated *Onshore Components* Landscape Character Areas: Developed – Commercial KOP-12 (IC Routes 1 and 6) KOP-13 (IC Routes 1 and 6) KOP-18 (IC Route 6)

[1] Combined area for Seascape and Landscape character area. Areas within the Seascape are considered moderate impact because of their ocean facing views. Areas within the Landscape are considered minor to negligible because they fall outside of the WTG viewshed and/or have minor susceptibility.
SMR = State Military Reservation, NWR = National Wildlife Refuge.

M.3.1.4. Impact Levels on Seascape Character, Open Ocean Character, and Landscape Character

Table M-14 summarizes Proposed Action impacts on the seascape character areas, open ocean character area, landscape character areas, and viewer experience (KOP locations) throughout the geographic analysis area. The seascape, open ocean, landscape, and viewer experience criteria listed in Table M-2 and consideration of the preceding assessments would result in impact levels to viewer experience for KOPs as shown in Table M-14.

Table M-14 Proposed Action Impact on Seascape Character, Open Ocean Character, Landscape Character, and Viewer Experience

Impact Level	Seashore, Open Ocean, and Landscape Character Areas, and Offshore and Onshore Key Observation Points
Major	Open Ocean Character Area KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area KOP-51 Cruise Ship Shipping Lanes *Onshore Components* Landscape Character Areas: Developed – Suburban Residential, Open Water KOP-3 (IC Routes 1) KOP-5 (IC Routes 1)
Moderate	Open Ocean Character Area (around Chesapeake Light Station) Seascape Character Area: Beach, Beachfront Residential, Recreation,[1] Virginia Beach/Tourism VIA KOP-13 Cape Henry Lighthouse/Fort Story Military Base KOP-15a North End Beach – Residential View KOP-15b North End Beach – Residential View – Nighttime KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR KOP-44 Little Island Park/Back Bay NWR *Onshore Components* Landscape Character Units: Agriculture/Open Land, and Developed – Rural Residential, Forested KOP-14a/b (IC Routes 1 and 6) KOP-17 (IC Routes 1and 6) KOP-18 (IC Route 6)

Impact Level	Seashore, Open Ocean, and Landscape Character Areas, and Offshore and Onshore Key Observation Points
Minor	Seascape Character Area: Barrier Island Residential, Historic Resources and Disadvantaged Communities, Industrial/Military[1] Landscape Character Areas: Rural Coastal Plain VIA: KOP-47 Currituck Beach Lighthouse KOP-48 Currituck NWR KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance – Elevated *Onshore Components* Landscape Character Areas: Developed – Industrial, Developed Recreation Area, Transportation Corridor KOP-11 (IC Route 1and 6)
Negligible	Seascape Character Area: Lower Coastal Plain/Tidewater Landscape Character Areas: Agriculture, Inland Bay, Coastal Development, Industrial/Military,[1] Recreation[1] KOP-5 Oyster Village Horse Island Trail KOP-8 Eastern Shore of Virginia NWR *Onshore Components* Landscape Character Areas: Developed – Commercial KOP-12 (IC Routes 1 and 6) KOP-13 (IC Routes 1 and 6)

[1] These character areas are combined in the COP, Appendix I-1 (Dominion Energy 2023). They are differentiated and analyzed both as Seascape and Landscape character areas in the EIS based on their location and ocean views.
SMR = State Military Reservation, NWR = National Wildlife Refuge, HF = Harpers to Fentress.

M.3.1.5. Impact Levels on the Viewer Experience

Table M-15 summarizes Proposed Action impacts on the viewer experience (KOP location) throughout the geographic analysis area. The seascape, landscape, and viewer experience criteria listed in Table M-14 and consideration of the preceding assessments would result in impact levels for KOPs as shown in Table M-15.

Table M-15 Impact Levels on Viewer Experience for the Proposed Action

Impact Level	Seashore Character Units, Open Ocean Unit, Landscape Character Units, and Offshore and Onshore Key Observation Points
Major	Open Ocean Character Area KOP-50 Recreational Fishing, Pleasure, and Tour Boat Area KOP-51 Cruise Ship Shipping Lanes *Onshore Components* Landscape Character Areas: Developed – Suburban Residential, Open Water KOP-3 (IC Routes 1) KOP-5 (IC Routes 1)

Impact Level	Seashore Character Units, Open Ocean Unit, Landscape Character Units, and Offshore and Onshore Key Observation Points
Moderate	Open Ocean (around Chesapeake Light Station) Seascape Character Areas: Beach, Beachfront Residential, Recreation,[2] Virginia Beach/Tourism VIA KOP-13 Cape Henry Lighthouse/Fort Story Military Base KOP-15a North End Beach – Residential View KOP-26 Marriott Virginia Beach Oceanfront Hotel KOP-44 Little Island Park/Back Bay NWR *Onshore Components* Landscape Character Units: Agriculture/Open Land, and Developed – Rural Residential, Forested KOP-14a/b (IC Routes 1 and 6) KOP-17 (IC Routes 1, and 6) KOP-18 (IC Route 6)
Minor	Seascape Character Area: Barrier Island Residential, Historic Resources/Disadvantaged Communities, Industrial/Military,[2] Landscape Character Areas: Rural Coastal Plain VIA: KOP-22 King Neptune Statue/Boardwalk KOP-23 Naval Aviation Monument Park KOP-24a Virginia Beach Boardwalk – 17th Street Park KOP-24d Virginia Beach Boardwalk – Fishing Pier KOP-29 Grommet Island Park/Boardwalk KOP-30a Croatan Beach A KOP-30b Croatan Beach C KOP-31 Picnic Views at SMR KOP-47 Currituck Beach Lighthouse KOP-48 Currituck NWR KOP-49a Whale Head Bay Residential View 4 KOP-49g Whale Head Bay Albacore Street Entrance – Elevated *Onshore Components* Landscape Character Areas: Developed – Industrial, Developed Recreation Area, Transportation Corridor KOP-11 (IC Route 1and 6)

Impact Level	Seashore Character Units, Open Ocean Unit, Landscape Character Units, and Offshore and Onshore Key Observation Points
Negligible	Seascape Character Area: Inland Bay, Lower Coastal Plain/Tide Water Landscape Character Areas: Agriculture, Coastal Development, Industrial/Military,[2] Recreation[2] KOP-5 Oyster Village Horse Island Trail KOP-8 Eastern Shore of Virginia NWR KOP-15b North End Beach – Residential View – Nighttime[1] KOP-24d Virginia Beach Boardwalk – Fishing Pier Nighttime[1] KOP-24a Virginia Beach Boardwalk – 16th Street Entrance Nighttime[1] *Onshore Components* Landscape Character Areas: Developed – Commercial KOP-12 (IC Routes 1 and 6) KOP-13 (IC Routes 1 and 6)

[1] ADLS.
[2] These character areas are combined in the COP, Appendix I-1 (Dominion Energy 2023). They are differentiated and analyzed both as Seascape and Landscape character areas in the EIS based on their location and ocean views.

M.3.1.6. Reasonably Foreseeable Planned Actions

NEPA requires consideration of other reasonably foreseeable activities in the Project's viewshed and the Project's incremental effects on seascape character, open ocean character, landscape character, and viewer experience. These effects include direct physical effects on the seascape, open ocean, and landscape or changes to the distinct character of the seascape, open ocean, and landscape.

Effects on seascape character, open ocean character, and landscape character can occur in the following conditions (BOEM 2021: Chapter 8).

- Multi-project WTGs and OSS visible within or from the open ocean character unit as overlapping or adjacent features and elements
- Multi-project WTGs and OSS visible from seascape character units as overlapping or adjacent features and elements
- Multi-project WTGs and OSS visible from landscape character units as overlapping or adjacent features and elements

Effects on viewer experience can occur in the following conditions (BOEM 2021: Chapter 8).

- Multi-project WTGs and OSS visible as overlapping features and elements
- Multi-project WTGs and OSS visible as adjacent features and elements
- Multi-project WTGs and OSS visible as viewers move through the seascape, open ocean, and landscape

Attachment M-2 presents simulations of the incremental effects of the Project in the context of other planned wind farms.

Consideration of effects of other planned wind farms on seascape character, open ocean character, and landscape character is listed in Table M-16.

Consideration of effects on viewer experience of other planned wind farms is listed in Table M-17.

Consideration of effects on seascape character, open ocean character, and landscape character of other planned wind farms in combination with the Proposed Action is listed in Table M-18.

Consideration of effects on viewer experience of other planned wind farms in combination with the Proposed Action is listed in Table M-19.

Table M-16 Other Planned Wind Farms' Seascape, Open Ocean, and Landscape Units Cumulative Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	Character Unit		
	Seascape (Beaches)[1]	**Open Ocean**	**Landscape[4]**
Distance in miles (kilometers)			
Kitty Hawk	28 (45)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
Kitty Hawk South	37 (59.5)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
FOV Degrees (1% of 124°)	35° (28%)	82° to 360° (66 to 290%)	35° (28%)
Noticeable Elements[2] & Impact Level	R, AL, N, H **Moderate**	R, AL, N, H, O, M, and Y **Major**	R, AL, N, H **Minor**
Contrast, scale of change, and prominence			
Form	Moderate to Weak	Strong	Moderate to Weak
Line	Moderate to Weak	Strong	Moderate to Weak
Color	Strong to Weak	Strong	Moderate to Weak
Texture	Weak	Strong	Weak
Scale	Small	Large	Small
Prominence[3]	3	6	3

[1] The most conservative onshore case involves the seaward edge of the beach nearest the projects. The seascape unit edge is 3.45 miles (5.6 kilometers) offshore (New Jersey jurisdictional boundary).
[2] Noticeable elements: R = rotor, AL = aviation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS Prominence (visibility): 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 (NAEP 2012).
[4] The seaward edge between landscape and seascape varies. The most conservative case is a 1.0-mile (1.6-kilometer) distance from the seaward beach edge.

Table M-17 Other Planned Wind Farms' Cumulative Viewer Experience Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	KOP[1]				
	KOP-26	**KOP-31**	**KOP-45**	**KOP-47**	**KOP-49a**
Distance in miles (kilometers)					
Kitty Hawk	45.9 (73.8)	43.0 (69.2)	33.2 (53.4)	28.3 (45.5)	27.9 (44.9)
Kitty Hawk South	54.0 (86.9)	52.9 (85.1)	43.5 (70.0)	38.5 (62.0)	38.2 (61.5)

	KOP[1]				
	KOP-26	KOP-31	KOP-45	KOP-47	KOP-49a
Cumulative FOV Degrees (% of 124°)	9° (50%)	9° (50%)	13° (11%)	24° (19%)	24° (19%)
Noticeable Elements[2] & Impact Level	R, AL, N, H **Moderate**	Not Visible **Negligible**	R **Minor**	R, AL, N, H, M, O **Moderate**	R, AL, N, H **Minor**
Contrast, scale of change, and prominence					
Form	Moderate	Not Visible	Weak	Moderate	Weak
Line	Moderate	Not Visible	Weak	Moderate	Weak
Color	Moderate	Not Visible	Weak	Moderate	Weak
Texture	Weak	Not Visible	Weak	Moderate	Weak
Scale	Medium	Not Visible	Small	Medium	Small
Prominence[3]	3	0	1	4	3

[1] KOP-26 Marriott Virginia Beach Oceanfront Hotel, KOP-31 Picnic/Beach Views at State Military Reserve; KOP-45 False Cape State Park, KOP-47 Currituck Beach Lighthouse; KOP-49a Whale Head Bay Residential Area.
[2] Noticeable elements: R = rotor, AL = aviation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS (onshore) visibility: 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 (NAEP 2012).

Table M-18 CVOW-C and Other Planned Wind Farms' Seascape, Open Ocean, and Landscape Cumulative Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	Character Area		
	Seascape (Beaches)[1]	Open Ocean	Landscape[4]
Distance in miles (kilometers)			
Proposed Action	23.7 (38.14)	0 to 40 (0 to 64.4)	Variable to 40 (64.4)
Alternative B	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Alternative C	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Alternatives D-1 and D-2	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Kitty Hawk North	28 (45)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
Kitty Hawk South	37 (59.5)	0 to 42.5 (0 to 68.4)	Variable to 42.5 (68.4)
FOV Degrees (% of 124°)	92° (74%)	92° to 124° (74 to 100%)	85° (68%)
Noticeable Elements[2] & Impact Level	R, AL, N, H **Moderate**	R, AL, N, H, O, M, and Y to R **Major**	R, AL, N, H **Moderate**

	Character Area		
	Seascape (Beaches)[1]	Open Ocean	Landscape[4]
Contrast, Scale of Change, and Prominence			
Form	Moderate to Weak	Strong	Moderate to Weak
Line	Moderate to Weak	Strong	Moderate to Weak
Color	Moderate to Weak	Strong	Moderate to Weak
Texture	Weak	Strong	Weak
Scale	Small	Large	Small
Prominence[3]	4	6	4

[1] The most conservative onshore case involves the seaward edge of the beach nearest the projects. The seascape unit edge is 3.45 miles (5.6 kilometers) offshore (New Jersey jurisdictional boundary).
[2] Noticeable elements: R = rotor, AL = aviation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS (onshore) visibility: 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 (NAEP 2012).
[4] The seaward edge between landscape and seascape varies.

Table M-19 CVOW-C and Other Planned Wind Farms' Cumulative Viewer Experience Wind Farm Distances, FOVs, Noticeable Elements, Visual Contrasts, Scale of Change, and Prominence

	KOP[1]				
	KOP-26	KOP-31	KOP-45	KOP-47	KOP-49a
Distance in miles (kilometers)					
Proposed Action	28.0 (45.0)	27.6 (44.4)	27.1 (43.6)	36.8 (59.2)	39.1 (62.9)
Alternative B	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Alternatives C	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Alternatives D-1 and D-2	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action	Same as Proposed Action
Kitty Hawk	45.9 (73.8)	43.0 (69.2)	33.2 (53.4)	28.3 (45.5)	27.9 (44.9)
Kitty Hawk South	54.0 (86.9)	65 (52.4)	43.5 (70.0)	38.5 (62.0)	38.2 (61.5)
Cumulative FOV Degrees (1% of 124°)	61° (50%)	64° (52%)	85° (68%)	76° (61%)	84° (68%)
Noticeable Elements[2] & Impact Level	R, AL, N, H **Major**	R, AL, N, H **Minor**	R, AL, N, H **Moderate**	R, AL, N, H **Moderate**	R, AL, N, H **Minor**

	KOP[1]				
	KOP-26	KOP-31	KOP-45	KOP-47	KOP-49a
Contrast, scale of change, and prominence					
Form	Moderate	Weak	Moderate	Moderate	Weak
Line	Moderate	Weak	Moderate	Moderate	Weak
Color	Moderate	Weak	Moderate	Moderate	Weak
Texture	Weak	Weak	Moderate	Moderate	Weak
Scale	Medium	Small	Medium	Medium	Small
Prominence[3]	4	3	4	4	3

[1] KOP-26 Marriott Virginia Beach Oceanfront Hotel, KOP-31 Picnic/Beach Views at State Military Reserve; KOP-45 False Cape State Park, KOP-47 Currituck Beach Lighthouse; KOP-49a Whale Head Bay Residential Area.
[2] Noticeable elements: R = rotor, AL = aviation light, N = nacelle, H = hub, O = OSS, M = mid-tower light, Y = yellow tower base color
[3] WTGs and OSS (onshore) visibility: 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 (NAEP 2012).

M.3.2 Impacts of Alternatives B and C on Scenic and Visual Resources

Visual contrast assessments—including form, line, color, and texture comparisons of characteristics of the seascape, open ocean, and landscape before and after implementation of Alternatives B and C—are indicated in Table M-7. The difference in contrasts between Alternatives B and C and the Proposed Action due to the removal of between 26 and 30 14-megawatt (MW) WTG positions from the northern end of the Lease Area would have a minor effect on visual resources. Table M-20 and Table M-21 list Alternatives B and C wind farm width-, height-, and distance-related occupation of views from the nearest shoreline area. Distance and FOV comparisons with the Proposed Action indicate similar effects. These results indicate perceptible changes to the FOV results compared to the Proposed Action would be minor (Table M-20 and Table M-21).

Table M-20 Horizontal FOV Occupied by Alternatives B and C

Noticeable Element	Width[1] in Miles (kilometers)	Distance[2] in Miles (kilometers)	Horizontal FOV	Human FOV	Percent of FOV
14-MW WTGs	17.8 (28.6)	24.1 (38.8)	36.4°	124°	29%

[1] Maximum extent of the wind farm array.
[2] Nearest onshore distance to the wind farm array.

Table M-21 Vertical FOV Occupied by Alternatives B and C

Noticeable Element	Height in Feet (meters) MHW	Distance in Miles (kilometers)	Visible Height[1] in Feet (meters)	Vertical FOV	Human FOV	Percent of FOV
Hub Up	836 (255)	24.1 (38.8)	586 (178.6)	0.26°	55°	0.01%

[1] Based on intervening EC, clear-day, and clear-night conditions.

M.3.3 Impacts of Alternative D on Scenic and Visual Resources

Visual contrast assessments—including form, line, color, and texture comparisons of characteristics of the seascape, open ocean, and landscape before and after implementation of Alternative D—are indicated in Table M-7. There would be a substantial difference in contrasts between Alternative D and the Proposed Action due to the undergrounding of 4.5 miles (7.2 kilometers) of Transmission Corridor and constructing the Chicory Switching Station instead of the Harpers Switching Station. The Interconnection Cable Route 6 (Hybrid) would follow Interconnection Cable Route 1 in its entirety but would remain underground between Harpers Road and the Chicory Switching Station site in Virginia Beach. This would avoid visual impacts on an area of suburban residential development (Castleton and Pine Ridge) at the eastern end of the route. The Chicory Switching Station would replace primarily forested areas adjacent to a Transportation Corridor (Princess Anne Road—a multi-lane divided highway flanked by forest). Existing ROW within or near the subdivisions would be expanded to accommodate the underground portion of the route, but no new structures would be built in these areas. The northern edge of the Chicory Switching Station could be visible from adjacent subdivisions, across an existing transmission right-of-way and through trees along the facility's northern boundary. As a result, Interconnection Cable Route 6 would have lower impacts on suburban residential Landscape Character Units than other alternatives.

M.4. Seascape, Open Ocean, and Landscape Impact Assessment Summary

The SLIA considers the impacts on the physical elements and features that make up a seascape, open ocean, or landscape and the aesthetic, perceptual, and experiential aspects of the seascape, open ocean, or landscape that contribute to its distinctive character. These impacts affect the "feel," "character," or "sense of place" of an area of seascape, open ocean, or landscape. Table M-22 summarizes the effects of the character of the offshore and onshore components of the Project with the aspects that contribute to the distinctive character of the seascape, open ocean, and landscape areas from which the Project would be visible (BOEM 2021).

The magnitude of the visual impact is determined by considering the size or scale of the change to the view, the geographic extent of the area experiencing impacts, and the duration and reversibility of the expected impacts. The size or scale of the change to the view refers not to the size or scale of the project itself, but rather the relative degree of change to the view caused by the visual presence of the project, as determined by assessing its visual contrast (BOEM 2021).

High magnitudes of visual impact would occur in the seascape character areas and diminish to low and negligible as distance increases and screening effects increase from topography, structures, and vegetation in landscape character areas. Visual contrasts to industrial/military character types and coastal development character types result in smaller size or scale changes to views than those of the open ocean character area, beach character types, and seascape recreation character types. Medium size or scale changes to views would occur in all other seascape character areas. Impacts of the Proposed Action on seascape character, open ocean character, and landscape character range from **negligible** to **major**.

M.5. Visual Impact Assessment Summary

The VIA considers the characteristics of the view receptor, characteristics of the view toward the Project facilities, and experiential impacts of the Project. Table M-23 summarizes the viewer sensitivity, view receptor susceptibility, view value, and measures of effects from the visible character and magnitude of the offshore and onshore components of the Project (BOEM 2021). Impacts of the Proposed Action on viewer experiences range from **negligible** to **major**.

Table M-22 Seascape, Open Ocean, and Landscape Character Areas; and Geographic Extent, Scale, Contrasts, Size and Scale; and Duration Impact of the Proposed Action

	Magnitude of Impact																Sensitivity			Impact Levels				
	Visibility			Geographic Extent[1]			Contrast				Size and Scale			Duration			Susceptibility and Value			Proposed Action				Alternatives B and C
Character Area	High	Medium	Low	High	Medium	Low	Strong	Moderate	Weak	None	Large	Medium	Small	Permanent	Long Term	Short Term	High	Moderate	Low	Major	Moderate	Minor	Negligible	Impact Level
Open Ocean[2]	X			X			X				X	X	X		X		X			X				Same as Proposed Action
Seascape Character Areas																								
Barrier Island Residential		X			X			X					X		X			X				X		Same as Proposed Action
Beach[3]		X		X				X					X		X		X				X			Same as Proposed Action
Beachfront Residential[3]		X			X			X					X		X			X			X			Same as Proposed Action
Historic Resources and Disadvantaged Communities			X	X				X					X		X		X					X		Same as Proposed Action
Industrial/ Military[3, 4]		X			X			X					X		X			X				X		Same as Proposed Action
Lower Coastal Plain/Tidewater			X		X				X				X		X			X					X	Same as Proposed Action
Recreation[3, 4]		X		X				X					X		X		X				X			Same as Proposed Action
Virginial Beach/Tourism					X			X					X		X			X			X			Same as Proposed Action
Landscape Character Areas																								
Agriculture			X			X				X			X		X				X				X	Same as Proposed Action
Inland Bay			X			X			X				X		X		X						X	Same as Proposed Action
Coastal Development			X			X				X			X		X				X				X	Same as Proposed Action
Industrial/Military[3, 4]			X			X				X			X		X				X				X	Same as Proposed Action
Recreation[3, 4]			X			X			X				X		X				X				X	Same as Proposed Action
Rural Coastal Plain			X			X			X				X		X				X			X		Same as Proposed Action
Onshore Landscape Character Areas																								
Agriculture, Open, and Undeveloped Lands		X						X			X			X				X			X			Same as Proposed Action
Developed – Commercial			X					X					X	X					X				X	Same as Proposed Action
Developed – Suburban Residential	X						X				X			X					X	X				Same as Proposed Action
Developed – Industrial			X						X			X		X					X			X		Same as Proposed Action
Developed Recreation Areas		X						X				X		X				X				X		Same as Proposed Action
Developed – Rural Residential		X						X			X			X					X		X			Same as Proposed Action
Forested		X					X				X			X			X				X			Same as Proposed Action
Open Water	X						X				X			X			X			X				Same as Proposed Action
Inland Streets and Highways		X						X				X		X					X			X		Same as Proposed Action

[1] Not calculated for Onshore character areas
[2] The area of Open Ocean analyzed in this EIS includes the 360 degree viewshed around the Lease Area; therefore, approximately 92.8% of open ocean is within the zone of potential visual influence.
[3] The Beach character area calculation as described and illustrated in COP, Appendix I-1, Attachment I-3 maps includes approximately 13 linear miles of beach from the southern boundary of Fort Story to Croatan Beach in Virginia and the beach paralleling the Barrier Island Residential character area in the Corolla area of South Carolina (Dominion Energy 2023). It does not measure beach areas along the barrier islands of the Delmarva Peninsula, the Beachfront Residential character area of Sandbridge neighborhood/historic district, Industrial/Military character areas including Fort Story and Dam Neck (KOP-31), or Recreation character areas including False Cape State Park. For the NEPA analysis, beaches are considered as whole character unit including all sandy shoreline areas within the study area.
[4] These character areas are combined in the COP, Appendix I-1 (Dominion Energy 2023). They are differentiated and analyzed both as Seascape and Landscape character areas in this document based on their location and ocean views.

Table M-23 Seascape Character, Open Ocean Character, and Landscape Character Impact Levels

Character Area	Affected Environment						Proposed Action													Impact Levels					
	Area Susceptibility			Area Value			Project Visibility				Character Key Feature[1] Change			Character Key Element[2] Change			Character Key Quality[3] Change			Proposed Action				Alternatives B and C
	High	Medium	Low	High	Medium	Low	Dominant	Substantial	Low	Unseen	High	Medium	Low	High	Medium	Low	High	Medium	Low	Major	Moderate	Minor	Negligible	Impact Level
Open Ocean [4]	X			X			X				X			X			X			X				Same as Proposed Action
Seascape Character Areas																								Same as Proposed Action
Barrier Island Residential		X		X					X		X			X			X					X		Same as Proposed Action
Beach[5]	X			X				X				X			X			X			X			Same as Proposed Action
Beachfront Residential[5, 6]	X			X				X			X			X			X				X			Same as Proposed Action
Historic and Disadvantaged Communities			X	X				X	X			X			X			X				X		Same as Proposed Action
Industrial/ Military[5, 6]	X				X			X			X				X			X				X		Same as Proposed Action
Lower Coastal Plain/Tidewater			X	X					X				X	X				X					X	Same as Proposed Action
Recreation[5, 6]	X			X				X			X			X			X				X			Same as Proposed Action
Virginial Beach/Tourism	X			X				X					X		X			X			X			Same as Proposed Action
Landscape Character Areas																								Same as Proposed Action
Agriculture			X		X					X			X			X			X				X	Same as Proposed Action
Inland Bay			X	X					X				X	X					X				X	Same as Proposed Action
Coastal Development			X		X					X			X			X			X				X	Same as Proposed Action
Industrial/Military[5, 6]			X		X					X			X			X			X				X	Same as Proposed Action
Recreation[5, 6]			X	X						X			X			X			X				X	Same as Proposed Action
Rural Coastal Plain		X		X					X			X			X				X			X		Same as Proposed Action
Onshore Landscape Character Areas																								
Agriculture, Open, and Undeveloped Lands		X			X			X				X		X				X			X			Same as Proposed Action
Developed – Commercial			X			X				X			X			X			X				X	Same as Proposed Action
Developed – Suburban Residential			X		X		X				X			X			X			X				Same as Proposed Action
Developed – Industrial			X			X			X			X				X		X				X		Same as Proposed Action
Developed Recreation Areas		X			X			X				X				X		X				X		Same as Proposed Action
Developed – Rural Residential			X		X			X				X		X				X			X			Same as Proposed Action
Forested	X			X				X			X			X				X			X			Same as Proposed Action
Open Water	X			X				X			X			X				X		X				Same as Proposed Action
Inland Streets and Highways			X		X			X				X			X			X				X		Same as Proposed Action

[1] Key Features = The distinctive visual attributes of the seascape, open ocean, or landscape character area.
[2] Key Elements = The essential visual components of the seascape, open ocean, or landscape character area.
[3] Key Quality = The main value factor of the seascape, open ocean, or landscape character area.
[4] The area of Open Ocean analyzed in this EIS includes the 360 degree viewshed around the lease area; therefore, approximately 92.8% of open ocean is within the zone of potential visual influence.
[5] The Beach character area calculation as described and illustrated in COP, Appendix I-1, Attachment I-3 maps includes approximately 13 linear miles of beach from the southern boundary of Fort Story to Croatan Beach in Virginia and the beach paralleling the Barrier Island Residential character area in the Corolla area of South Carolina (Dominion Energy 2023). It does not measure beach areas along the barrier islands of the Delmarva Peninsula, the Beachfront Residential character area of Sandbridge neighborhood/historic district, Industrial/Military character areas including Fort Story and Dam Neck (KOP-31), or Recreation character areas including False Cape State Park. For the NEPA analysis, beaches are considered as whole character unit including all sandy shoreline areas within the study area.
[6] These character areas are combined in the COP, Appendix I-1 (Dominion Energy 2023). They are differentiated and analyzed both as Seascape and Landscape character areas in this document based on their location and ocean views.

Table M-24 Viewer Sensitivity, Receptor Susceptibility, View Value, Viewer Experience, and Impact Levels

KOP[1]	Affected Environment									Viewer Experience				Impact Levels				
	Viewer Sensitivity			Receptor Susceptibility			View Value			Distance-Noticeable Elements-HFOV-VFOV-Contrast-Scale-Prominence Effects				Preferred Alternative				Alternatives B and C
	High	Medium	Low	High	Medium	Low	High	Medium	Low	Dominant	Moderate	Minor	Unseen	Major	Moderate	Minor	Negligible	
KOP-5	X			X			X					X					X	Same as Proposed Action
KOP-8	X			X			X					X					X	Same as Proposed Action
KOP-13[2]	X			X			X				X				X			Same as Proposed Action
KOP-15a	X	X		X			X					X				X		Same as Proposed Action
KOP-15b[3]	X			X			X						X				X	Same as Proposed Action
KOP-22	X			X				X				X				X		Same as Proposed Action
KOP-23		X		X			X					X				X		Same as Proposed Action
KOP-24a	X			X			X					X				X		Same as Proposed Action
KOP-24b[3]		X		X			X						X				X	Same as Proposed Action
KOP-24d	X			X			X					X				X		Same as Proposed Action
KOP-24d[3]	X			X			X						X				X	Same as Proposed Action
KOP-26[2]	X			X			X				X				X			Same as Proposed Action
KOP-29		X		X				X				X				X		Same as Proposed Action
KOP-30a	X			X			X					X				X		Same as Proposed Action
KOP-30b	X			X			X					X				X		Same as Proposed Action
KOP-31		X		X			X					X				X		Same as Proposed Action
KOP-44	X			X			X				X				X			Same as Proposed Action
KOP-47[2]	X			X			X				X	X					X	Same as Proposed Action

KOP[1]	Affected Environment									Viewer Experience				Impact Levels				
	Viewer Sensitivity			Receptor Susceptibility			View Value			Distance-Noticeable Elements-HFOV-VFOV-Contrast-Scale-Prominence Effects				Preferred Alternative				Alternatives B and C
	High	Medium	Low	High	Medium	Low	High	Medium	Low	Dominant	Moderate	Minor	Unseen	Major	Moderate	Minor	Negligible	
KOP-48	X			X			X					X				X		Same as Proposed Action
KOP-49a		X		X				X				X					X	Same as Proposed Action
KOP-49g		X		X				X				X					X	Same as Proposed Action
KOP-50	X			X			X			X				X				Same as Proposed Action
KOP-51	X			X			X			X				X				Same as Proposed Action
Onshore Components																		
IC Route 1 KOP-3		X			X			X		X				X				
KOP-5		X			X			X			X			X				Same as Proposed Action
KOP-10			X		X				X			X		X				Same as Proposed Action
KOP-11			X		X				X			X			X			Same as Proposed Action
KOP-12			X		X				X				X				X	Same as Proposed Action
KOP-13			X		X				X				X				X	Same as Proposed Action
KOP-14a		X			X			X				X			X			Same as Proposed Action
KOP-14b		X			X			X			X				X			Same as Proposed Action
KOP-17			X		X				X		X			X				Same as Proposed Action
IC Hybrid Route 6 KOP-10			X		X				X			X		X				
KOP-11			X		X				X			X			X			Same as Proposed Action
KOP-12			X		X				X				X		X			Same as Proposed Action

KOP[1]	Affected Environment									Viewer Experience				Impact Levels				
	Viewer Sensitivity			Receptor Susceptibility			View Value			Distance-Noticeable Elements-HFOV-VFOV-Contrast-Scale-Prominence Effects				Preferred Alternative				Alternatives B and C
	High	Medium	Low	High	Medium	Low	High	Medium	Low	Dominant	Moderate	Minor	Unseen	Major	Moderate	Minor	Negligible	
KOP-13			X		X				X				X				X	Same as Proposed Action
KOP-14a		X			X			X				X			X			Same as Proposed Action
KOP-14b		X			X			X			X				X			Same as Proposed Action
KOP-17			X		X				X		X			X				Same as Proposed Action
KOP-18		X												X				Same as Proposed Action

[1] KOP-5 Oyster Village Horse Island Trail; KOP-8 Eastern Shore of Virginia NWR; KOP-13 Cape Henry Lighthouse/Fort Story Military Base; KOP-15a North End Beach – Residential View; KOP-15b North End Beach – Residential View – Nighttime; KOP-22 King Neptune Statue/Boardwalk; KOP-23 Naval Aviation Monument Park KOP-24a Virginia Beach Boardwalk – 17th Street Park; KOP-24b Virginia Beach Boardwalk – 16th Street Entrance Nighttime; KOP-24d Virginia Beach Boardwalk – Fishing Pier, KOP-24d Virginia Beach Boardwalk – Fishing Pier – Nighttime, KOP-26 Marriott Virginia Beach Oceanfront Hotel, KOP-29 Grommet Island Park/Boardwalk, KOP-30a Croatan Beach A, KOP-30b Croatan Beach C, KOP-31 Picnic Views at SMR, KOP-44 Little Island Park/Back Bay NWR, KOP-47 Currituck Beach Lighthouse, KOP-48 Currituck National Wildlife Refuge, KOP-49a Whale Head Bay Residential View 4, KOP-49g Whale Head Bay Albacore Street Entrance – Elevated, KOP-50 Fishing and Tour Boats, KOP-51 Commercial and Cruise Ships, KOP-3 Harpers Switching Station, KOP-5 Interconnection Cable, KOP-10 Fentress Substation, KOP-11 All Interconnection Cable Route Alternatives, KOP-12 Interconnection Cable (Alternative 1 and Overhead Portion of Hybrid Alternative), KOP-13 Interconnection Cable (Alternative 1 and Overhead Portion of Hybrid Alternative), KOP-14a Interconnection Cable (Alternative 1 and Overhead Portion of Hybrid Alternative), KOP-14b Interconnection Cable (Alternative 1 and Overhead Portion of Hybrid Alternative), KOP-17 Interconnection Cable, KOP-18 Chicory Switching Station.
[2] Elevated observation deck or lighthouse.
[3] With implementation of ALDS the effect of aviation obstruction lighting becomes negligible.
HFOV = horizontal field of vision; VFOV = vertical field of vision

M.5.1 Impacts of Alternative B on Scenic and Visual Resources

Visual contrast assessments—including form, line, color, and texture comparisons of characteristics of the seascape, open ocean, and landscape before and after implementation of Alternative B—are indicated in Table M-7. The difference in contrasts between Alternative B and the Proposed Action due to the removal of between 26 14-MW WTG positions from the northern end of the Lease Area would have a minor effect on visual resources. Table M-25 and Table M-26 list Alternative B wind farm width-, height-, and distance-related occupation of views from the nearest shoreline area. Distance and FOV comparisons with the Proposed Action indicate similar effects. Although three WTGs at the northwestern corner of the wind farm are removed for navigational safety and eight along the northern edge are removed to protect a Fish Haven area, views of the northern boundary of the wind farm have limited access. Additional WTGs proposed for removal are located on the interior of the wind farm. These results indicate perceptible changes to the FOV results compared to the Proposed Action would be minor.

Table M-25 Horizontal FOV Occupied by Alternative B

Noticeable Element	Width[1] in Miles (kilometers)	Distance[2] in Miles (kilometers)	Horizontal FOV	Human FOV	Percent of FOV
14-MW WTGs	17.8 (28.6)	24.1 (38.8)	36.4°	124°	29%

[1] Maximum extent of the wind farm array.
[2] Nearest onshore distance to the wind farm array.

Table M-26 Vertical FOV Occupied by Alternative B

Noticeable Element	Height in Feet (meters) MHW	Distance in Miles (kilometers)	Visible Height[1] in Feet (meters)	Vertical FOV	Human FOV	Percent of FOV
Hub Up	836 (255)	24.1 (38.8)	586 (178.6)	0.26°	55°	0.01%

[1] Based on intervening EC, clear-day, and clear-night conditions.

M.5.2 Impacts of Alternative C on Scenic and Visual Resources

Visual contrast assessments—including form, line, color, and texture comparisons of characteristics of the seascape, open ocean, and landscape before and after implementation of Alternative C—are indicated in Table M-7. The difference in contrasts between Alternative C and the Proposed Action due to the removal of four 14-MW WTG positions from the sand ridge habitat area of the Lease Area, resulting in 172 total WTGs, would have a minor effect on visual resources. The horizontal FOV difference between the 14-MW (in Alternative C) and the 16-MW WTGs (in the Proposed Action) of 33 feet (10 meters) is imperceptible at 24.1 miles (38.8 milometers).

Table M-27 and Table M-28 list Alternative C wind farm width-, height-, and distance-related occupation of views from the nearest shoreline area. Although three WTGs at the northwestern corner of the wind farm are removed for navigational safety and eight along the northern edge are removed to protect a Fish Haven area, views of the northern boundary of the wind farm have limited access. Additional WTGs proposed for removal are on the wind farm's interior. This may slightly reduce the visible mass of the wind farm from certain shoreline locations during clear afternoons, but it will not reduce the overall horizontal FOV. These results indicate perceptible changes to the FOV results compared to the Proposed Action would be **minor**.

Table M-27 Horizontal FOV Occupied by Alternative C

Noticeable Element	Width[1] in Miles (kilometers)	Distance 22222[2] in Miles (kilometers)	Horizontal FOV	Human FOV	Percent of FOV
14-MW WTGs	17.8 (28.6)	24.1 (38.8)	36.4°	124°	29%

[1] Maximum extent of the wind farm array.
[2] Nearest onshore distance to the wind farm array.

Table M-28 Vertical FOV Occupied by Alternatives C-1, C-2 and C-3

WTG Size	Noticeable Element	Height in Feet (meters) MHW	Distance in Miles (kilometers)	Visible Height[1] in Feet (meters)	Vertical FOV	Human FOV	Percent of FOV
14-MW	Hub Up	836 (255)	24.1 (38.8)	536 (163.4)	0.26°	55°	0.01%

[1] Based on intervening EC, clear-day, and clear-night conditions.

M.5.3 Impacts of Alternative D on Scenic and Visual Resources

Visual contrast assessments—including form, line, color, and texture comparisons of characteristics of the seascape, open ocean, and landscape before and after implementation of Alternative D-2—are indicated in Table M-29. There would be a substantial difference in contrasts between Alternative D-2 and the Proposed Action D-1 due to the undergrounding of 4.5 miles (7.2 kilometers) of Transmission Corridor and constructing the Chicory Switching Station instead of the Harpers Switching Station. Alternative D-2 Interconnection Cable Route 6 (Hybrid Route) would follow Interconnection Cable Route 1 (Alternative D-1) in its entirety but would remain underground between Harpers Road and the Chicory Switching Station site in Virginia Beach. This would avoid visual impacts on an area of suburban residential development (Castleton and Pine Ridge) at the eastern end of the route. The Chicory Switching Station would replace primarily forested lands adjacent to a Transportation Corridor (Princess Anne Road—a multi-lane divided highway flanked by forest). The existing right-of-way within or near the subdivisions would be expanded to accommodate the underground portion of the route, but no new structures would be built in these areas. The northern edge of the Chicory Switching Station would likely be visible from adjacent subdivisions, across an existing transmission ROW and through trees along the facility’s northern boundary. The photo simulation for KOP-18 indicates the Chicory Switching Station is not visible from the street during the summer when trees are in leaf. However, the switching station would clearly be visible to residences from rear and second story windows, especially in the winter months when trees are out of leaf. Overall, Interconnection Cable Route 6 would have lower impacts on suburban residential character areas than other alternatives. This change to Developed – Suburban Residential character area is represented in Table M-29.

Table M-29 Landscape Character and Impact Levels for Onshore Components Alternative D-2

Character Unit	Affected Environment						Alternative D-2																Impact Levels			
	Unit Susceptibility			Unit Value			Project Visibility				Character Key Feature Change			Character Key Element Change			Character Key Quality Change			Alternative D-2			
	High	Medium	Low	High	Medium	Low	Major	Moderate	Minor	Negligible	High	Medium	Low	High	Medium	Low	High	Medium	Low	Major	Moderate	Minor	Negligible
Agriculture, Open, and Undeveloped Lands		X			X			X				X		X				X				X	
Developed – Commercial			X			X				X		X			X				X				X
Developed – Suburban Residential			X		X			X			X			X			X				X		
Developed – Industrial			X			X				X		X				X		X				X	
Developed Recreation Areas		X			X				X			X				X		X				X	
Developed – Rural Residential			X		X		X					X		X				X			X		
Forested	X			X			X				X			X				X			X		
Open Water	X			X			X				X			X				X		X			
Inland Streets and Highways			X		X				X			X			X			X				X	

M.6. References

Bureau of Ocean Energy Management (BOEM). 2021. *Assessment of Seascape, Landscape, and Visual Impacts of Offshore Wind Energy Developments on the Outer Continental Shelf of the United States*. OCS Study BOEM 2021-032. April.

Dominion Energy, LLC (Dominion Energy). 2021. *Coastal Virginia Offshore Wind Construction and Operations Plan, Appendix I-1 Offshore Visual Impact Assessment and Appendix I-2 Onshore Visual Impact Assessment.* October. Available: https://www.boem.gov/renewable-energy/state-activities/cvow-construction-and-operations-plan.

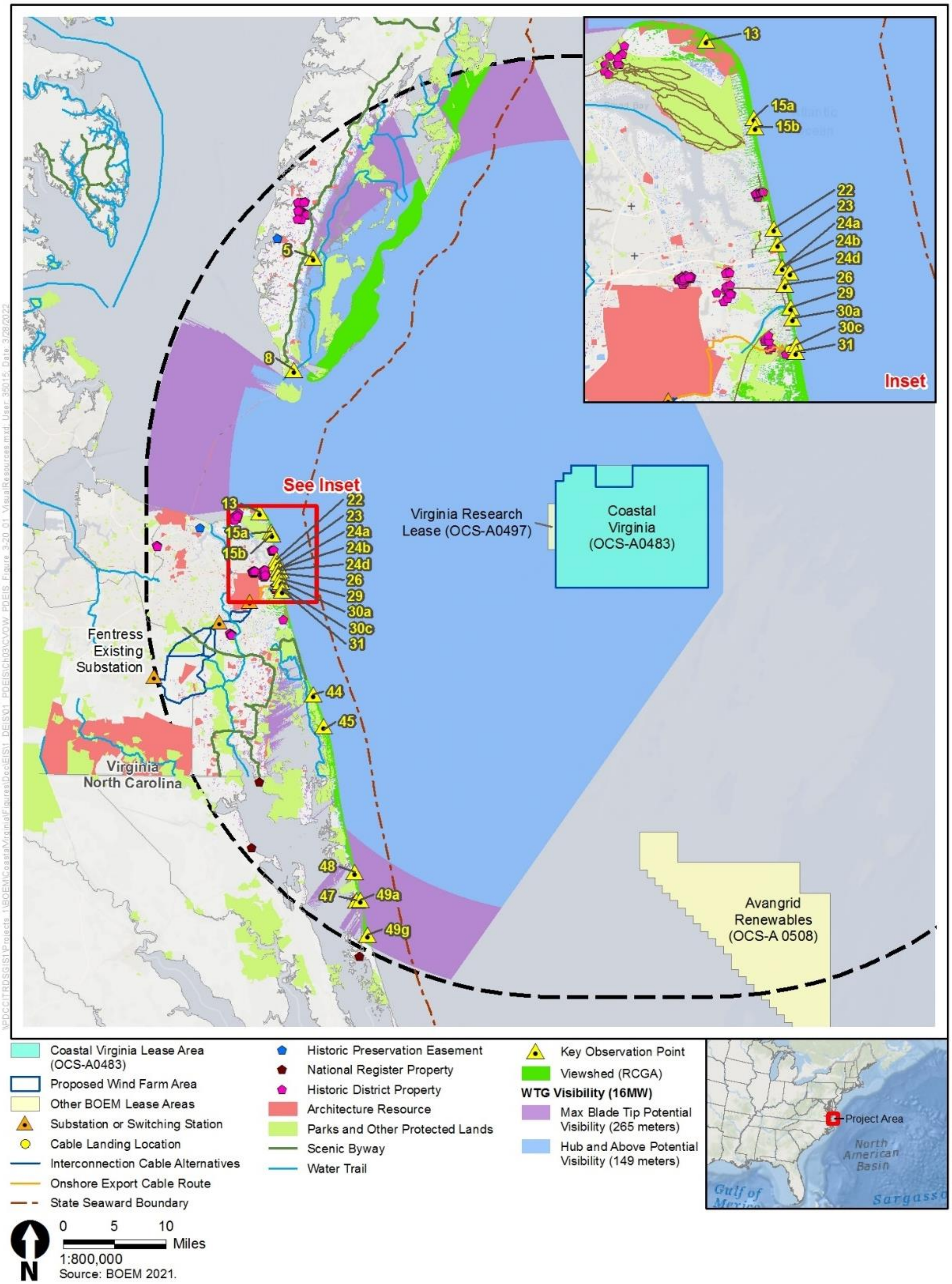
Dominion Energy, Inc. (Dominion Energy). 2023. *Construction and Operations Plan, Coastal Virginia Offshore Wind Commercial Project*. Prepared by Tetra Tech, Inc. February.

National Association of Environmental Professionals (NAEP). 2012. *Offshore Wind Turbine Visibility and Visual Impact Thresholds*. Available: https://blmwyomingvisual.anl.gov/docs/EnvPractice_Offshore%20Wind%20Turbine%20Visibility%20and%20Visual%20Impact%20Threshold%20Distances.pdf.

This page intentionally left blank.

ATTACHMENT M-1
SCENIC RESOURCES OVERVIEW MAP

This page intentionally left blank.



Scenic Resources and Key Observation Points

ATTACHMENT M-2
CUMULATIVE VISUAL SIMULATIONS

This page intentionally left blank.

Coastal Virginia Offshore Wind Commercial Project

Cumulative Effects Simulations

Coastal Virginia Offshore Wind Commercial Project: Cumulative Effects Simulations

Dominion Energy®

TABLE OF CONTENTS

Simulation Location 1: Oceanfront Hotel Rooftop 1
Virginia Beach, Virginia

Simulation Location 2: Beach Views at State Military Reservation 10
Virginia Beach, Virginia

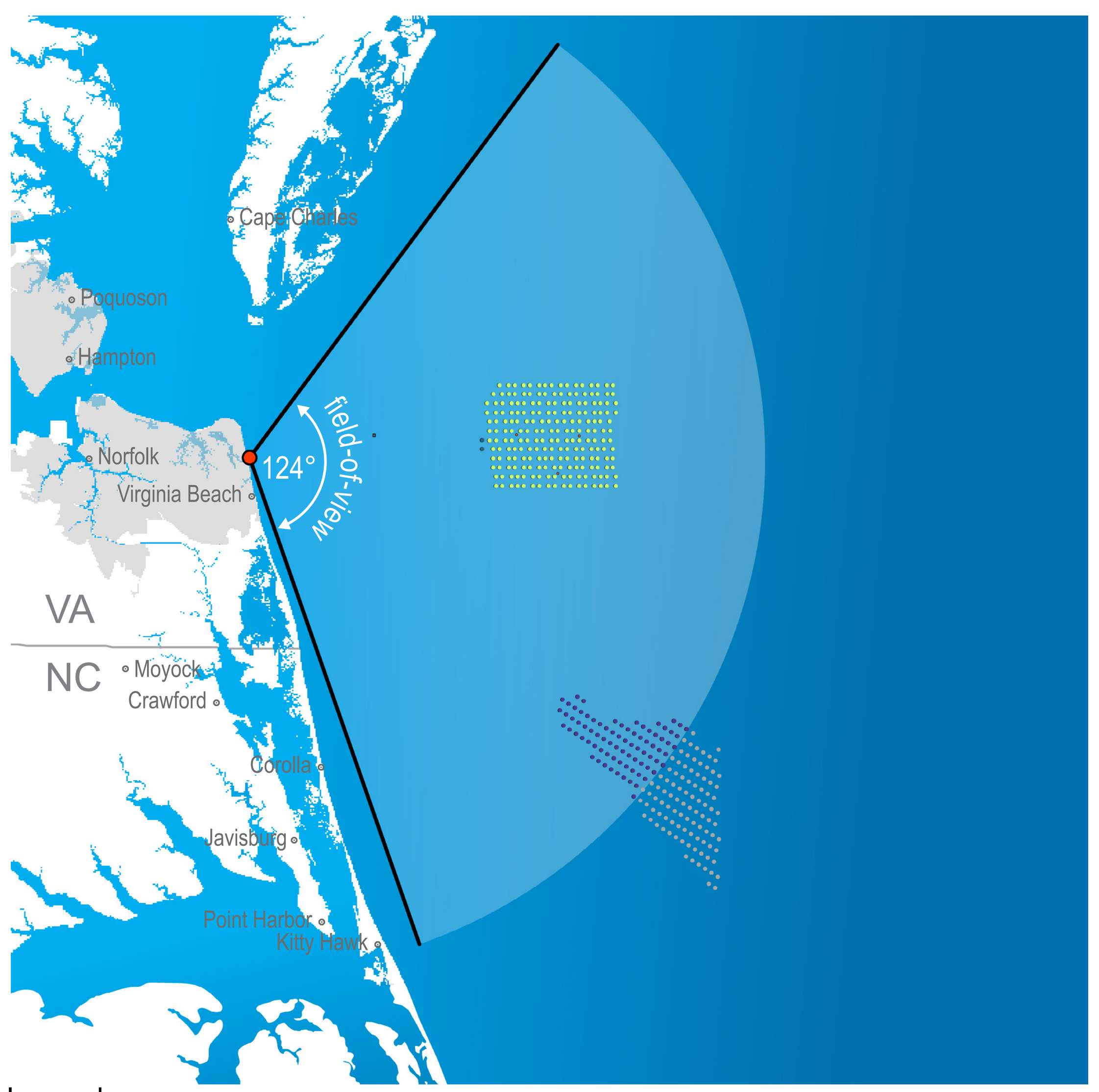
Simulation Location 3: False Cape State Park 19
Virginia Beach, Virginia

Simulation Location 4: Currituck Beach Lighthouse 28
Corolla, North Carolina

Simulation Location 5: Whale Head Bay Residential Area 37
Corolla, North Carolina

Existing Condition

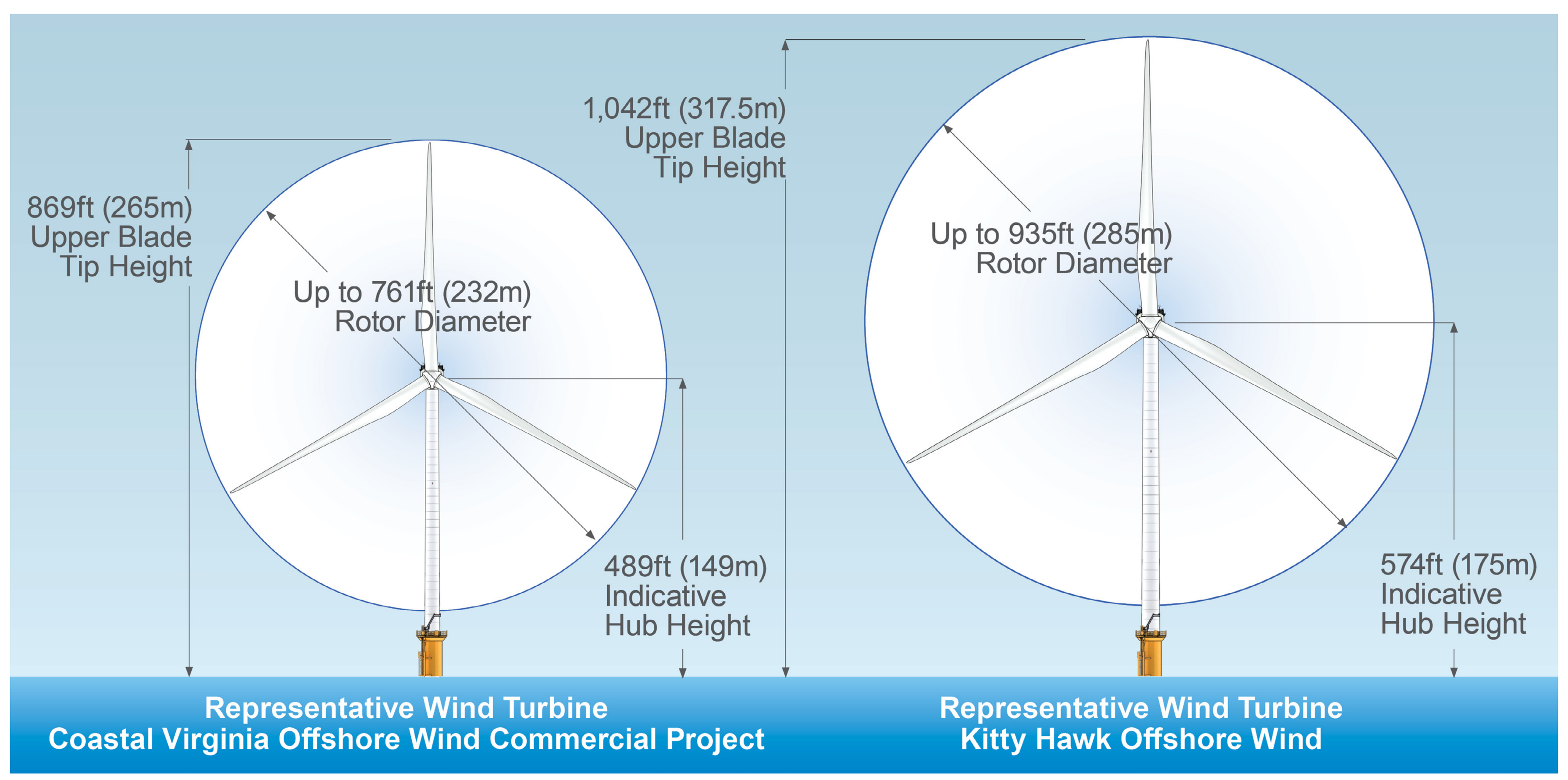
View of the existing condition at Marriott Virginia Beach Oceanfront



Legend

Visible	Not Visible	WTG Location	Visible	Not Visible	
●	●	Coastal Virginia Offshore Wind Commercial Project	●	●	OSS
●	●	Kitty Hawk Offshore Wind	■	■	Chesapeake Light Tower
●	●	Pilot Project Turbine	●		Photo Point

Locator Map



Project	Distance to the closest WTG (mi)	Distance to the farthest WTG (mi)
Coastal Virginia Offshore Wind Commercial Project WTG	28.0	42.8
Kitty Hawk Offshore Wind WTG	45.9	58.1

Turbine Data

Viewpoint Location:	Oceanfront Hotel Rooftop
Date of Photograph:	September 29, 2021
Time of Photograph:	10:56AM (EDT)
Latitude:	36.8617° N
Longitude:	-75.9856° W
Viewing Direction:	East
Ground Elevation + Tripod Height:	236 feet

ENVIRONMENTAL	
Temperature:	71° F
Humidity:	61%
Wind Direction:	NNE
Wind Speed:	10 mph
Weather Condition:	Fair

CAMERA			
	Type	Brand	Model
Camera	Mirrorless	Nikon	Z6
Lens			NIKKOR Z 50mm
Focal Length			50 mm

*The image on this page approximates the full horizontal field-of-view of typical human eyesight (124° horizontal)

Photograph Information

Simulation 1A.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

SIM 1 A

Simulation 1A.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 1A.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 1A.3: Kitty Hawk

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 1B.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 1B.2: CVOWC + Kitty Hawk

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 1B.2: CVOWC + Kitty Hawk - *Annotated*

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 1B.3: Kitty Hawk

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

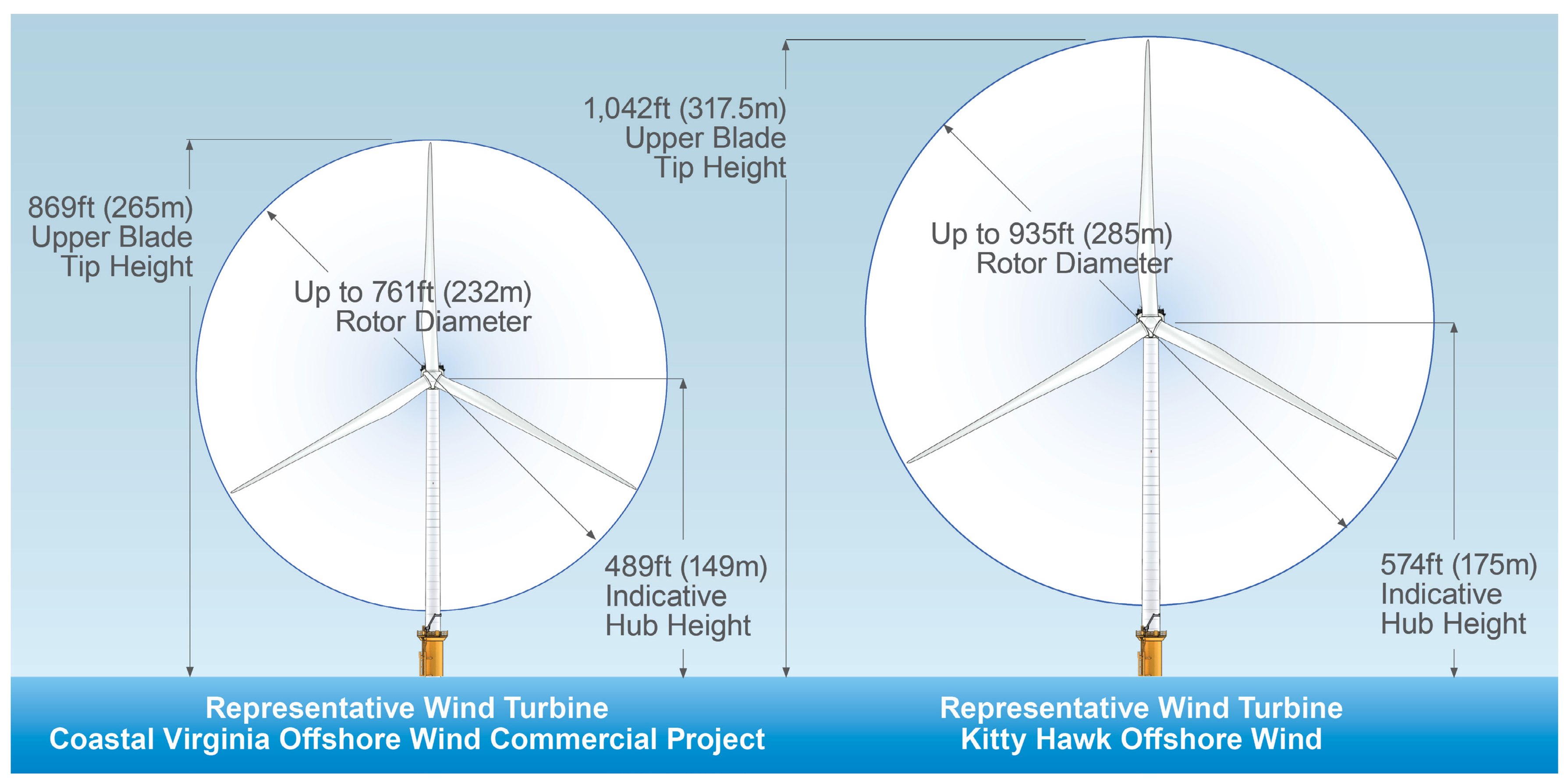
Existing Condition

Beach view of the existing condition at State Military Reservation

Legend

Visible	Not Visible	WTG Location	Visible	Not Visible	
		Coastal Virginia Offshore Wind Commercial Project			OSS
		Kitty Hawk Offshore Wind			Chesapeake Light Tower
		Pilot Project Turbine			Photo Point

Locator Map



Project	Distance to the closest WTG (mi)	Distance to the farthest WTG (mi)
Coastal Virginia Offshore Wind Commercial Project WTG	27.6	41.5
Kitty Hawk Offshore Wind WTG	43.0	44.8

Turbine Data

Viewpoint Location:	State Military Reservation
Date of Photograph:	September 28, 2021
Time of Photograph:	1:11pm (EDT)
Latitude:	36.815716° N
Longitude:	-75.966839° W
Viewing Direction:	East
Ground Elevation + Tripod Height:	14 feet

CAMERA			
	Type	Brand	Model
Camera	Mirrorless	Nikon	Z6
Lens	NIKKOR Z 50mm		
Focal Length	50 mm		

*The image on this page approximates the full horizontal field-of-view of typical human eyesight (124° horizontal)

ENVIRONMENTAL	
Temperature:	82° F
Humidity:	51%
Wind Direction:	SW
Wind Speed:	9 mph
Weather Condition:	Fair

Photograph Information

Simulation 2A.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 2A.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 2A.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 2A.3: Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project.
Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 2B.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 2B.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

Simulation 2B.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

SIM 2 B

Simulation 2B.3: Kitty Hawk

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

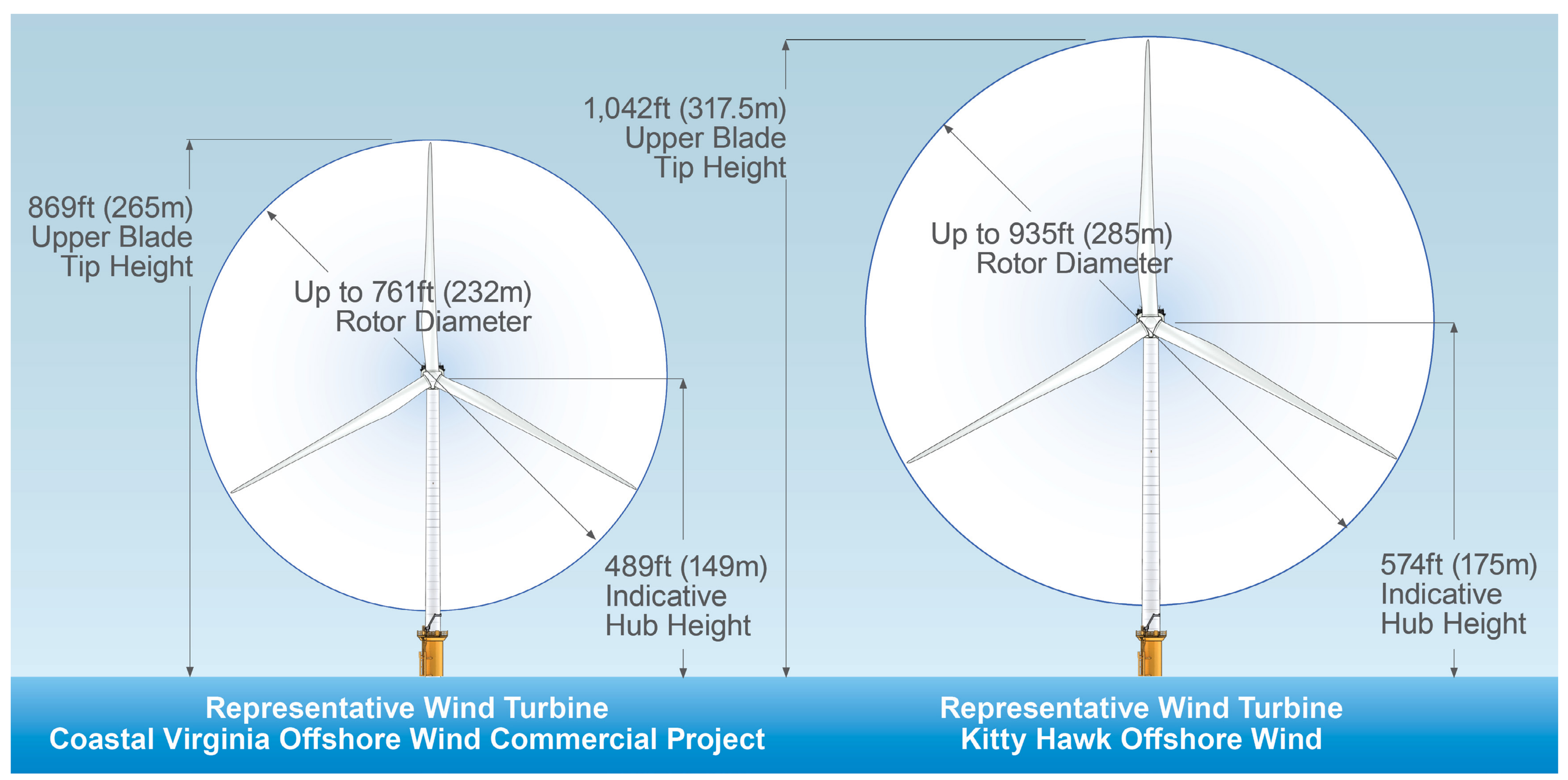
Existing Condition

View of the existing condition at False Cape State Park

Legend

Visible	Not Visible	WTG Location	Visible	Not Visible	
		Coastal Virginia Offshore Wind Commercial Project			OSS
		Kitty Hawk Offshore Wind			Chesapeake Light Tower
		Pilot Project Turbine			Photo Point

Locator Map



Project	Distance to the closest WTG (mi)	Distance to the farthest WTG (mi)
Coastal Virginia Offshore Wind Commercial Project WTG	27.1	40.9
Kitty Hawk Offshore Wind WTG	33.2	44.2

Turbine Data

Viewpoint Location:	False Cape State Park
Date of Photograph:	September 26, 2021
Time of Photograph:	12:55pm (EDT)
Latitude:	36.6252° N
Longitude:	-75.8885° W
Viewing Direction:	Southeast
Ground Elevation + Tripod Height:	15 feet

CAMERA			
	Type	Brand	Model
Camera	Mirrorless	Nikon	Z6
Lens			NIKKOR Z 50mm
Focal Length			50 mm

*The image on this page approximates the full horizontal field-of-view of typical human eyesight (124° horizontal)

ENVIRONMENTAL	
Temperature:	73° F
Humidity:	41%
Wind Direction:	N
Wind Speed:	7 mph
Weather Condition:	Fair

Photograph Information

Simulation 3A.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 3A.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 3A.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 3A.3: Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project.
Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 3B.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 3B.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

Simulation 3B.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

Simulation 3B.3: Kitty Hawk

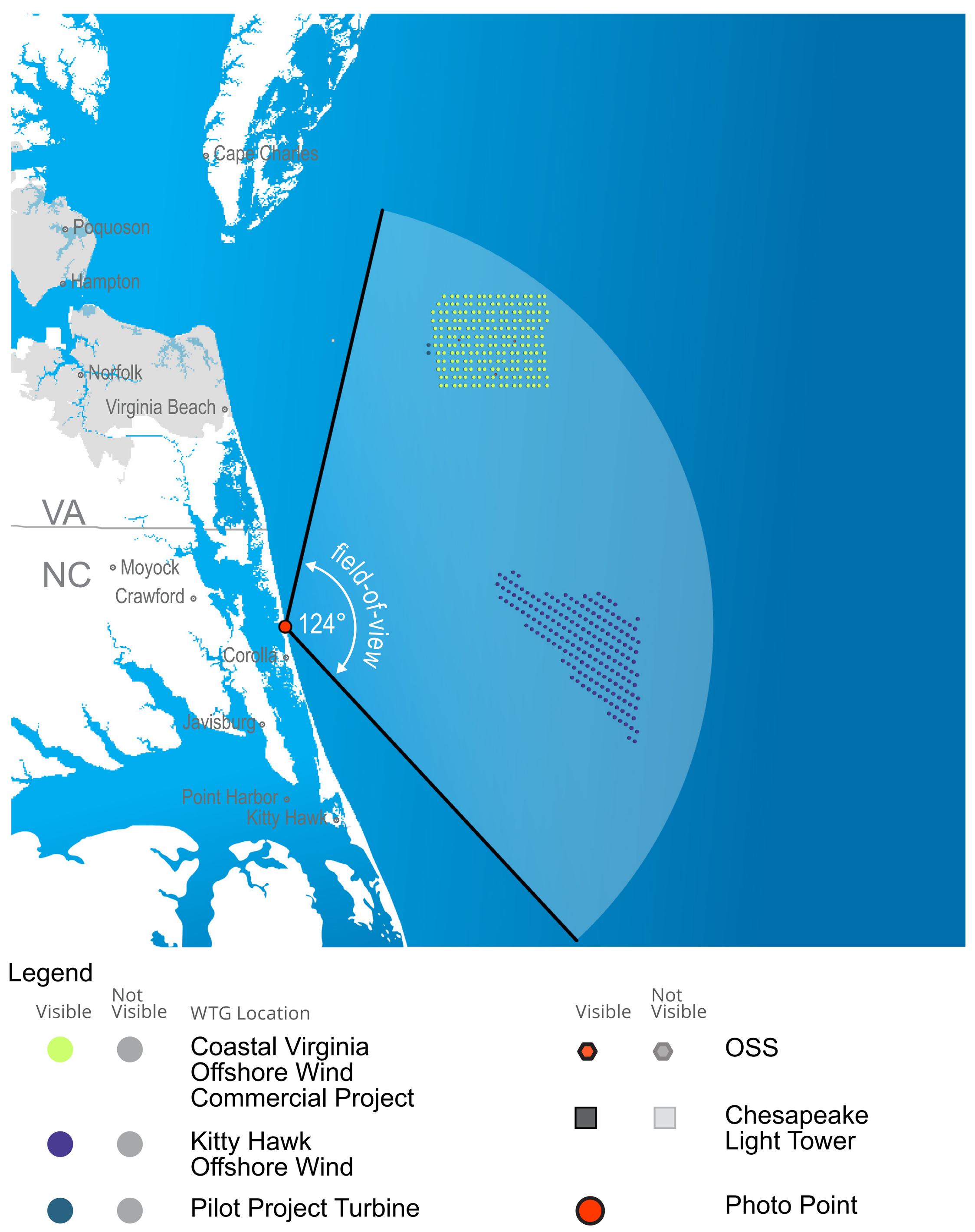
Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

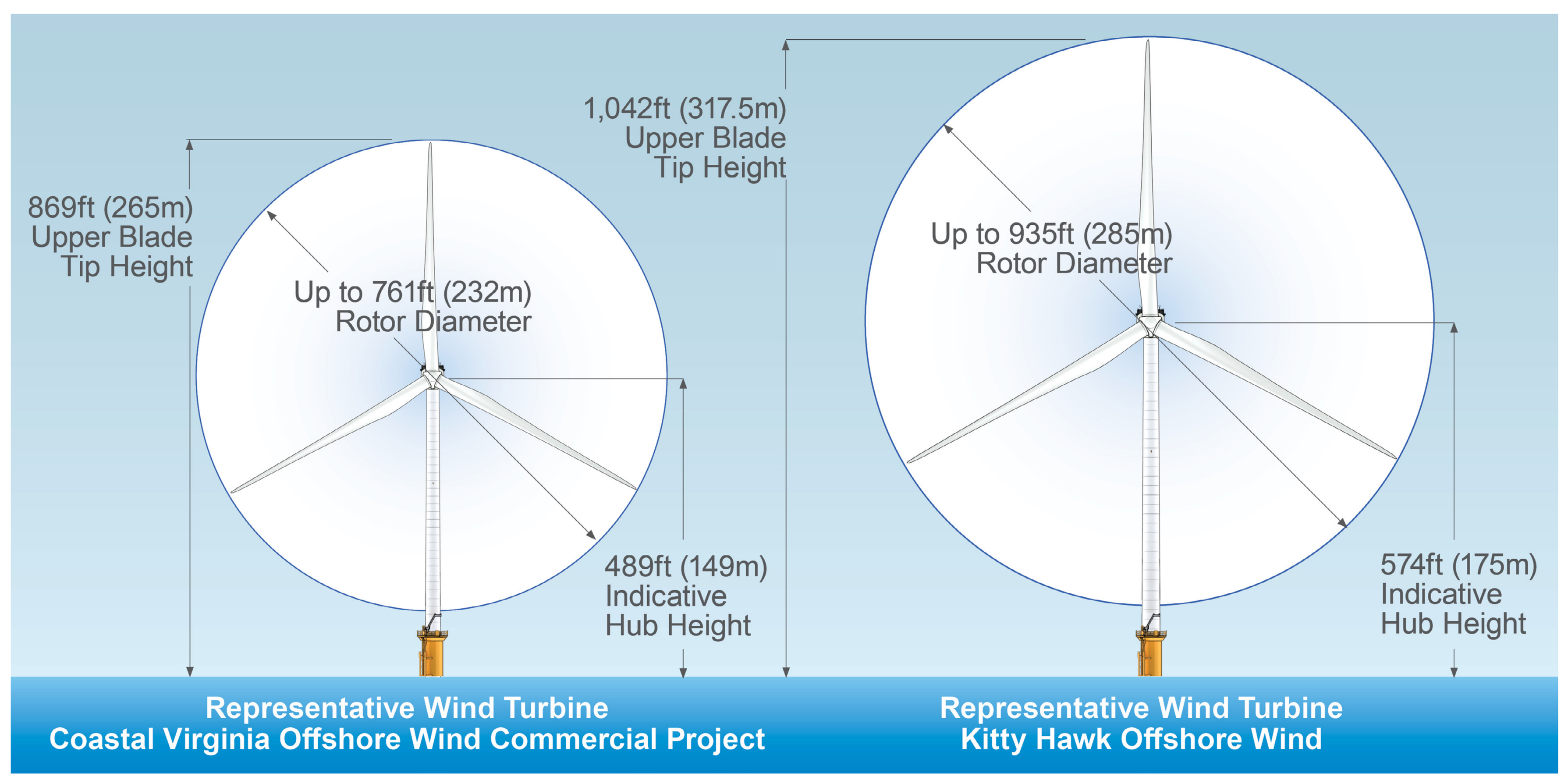
Complete Panoramic View

Existing Condition

View of the existing condition at Currituck Beach Lighthouse



Locator Map



Project	Distance to the closest WTG (mi)	Distance to the farthest WTG (mi)
Coastal Virginia Offshore Wind Commercial Project WTG	36.8	51.4
Kitty Hawk Offshore Wind WTG	28.3	39.1

Turbine Data

Viewpoint Location:	Currituck Beach Lighthouse
Date of Photograph:	July 7, 2021
Time of Photograph:	2:40 PM (EDT)
Latitude:	36.3767° N
Longitude:	-75.8307° W
Viewing Direction:	Northeast
Ground Elevation + Tripod Height:	155 feet

CAMERA			
	Type	Brand	Model
Camera	Mirrorless	Nikon	Z6
Lens	NIKKOR Z 50mm		
Focal Length	50 mm		

*The image on this page approximates the full horizontal field-of-view of typical human eyesight (124° horizontal)

ENVIRONMENTAL	
Temperature:	93° F
Humidity:	38%
Wind Direction:	S
Wind Speed:	14 mph
Weather Condition:	Clear

Photograph Information

Simulation 4A.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 4A.2: CVOWC + Kitty Hawk

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 4A.2: CVOWC + Kitty Hawk - *Annotated*

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 4A.3: Kitty Hawk

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 4B.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 4B.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

Simulation 4B.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

Simulation 4B.3: Kitty Hawk

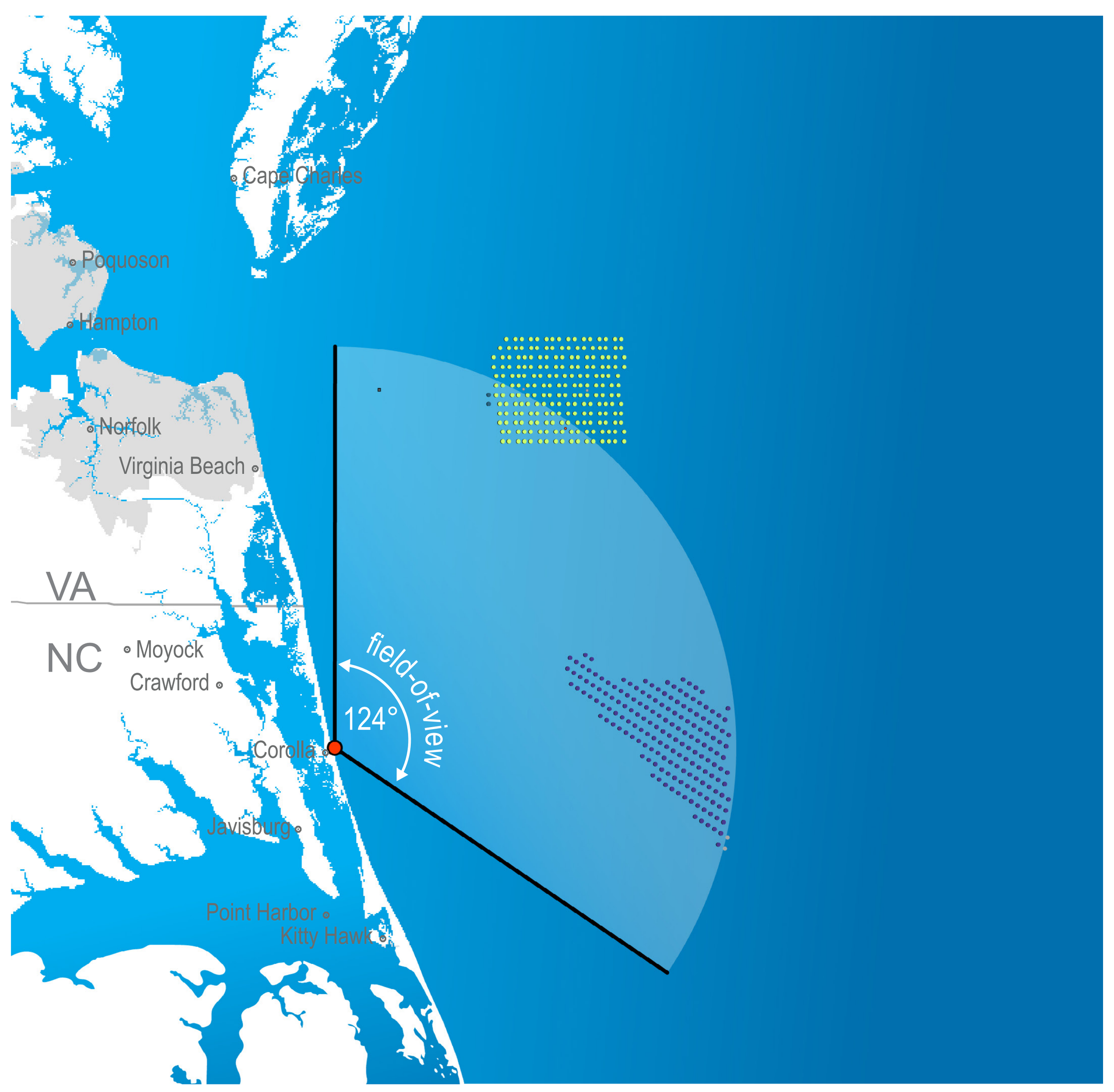
Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Existing Condition

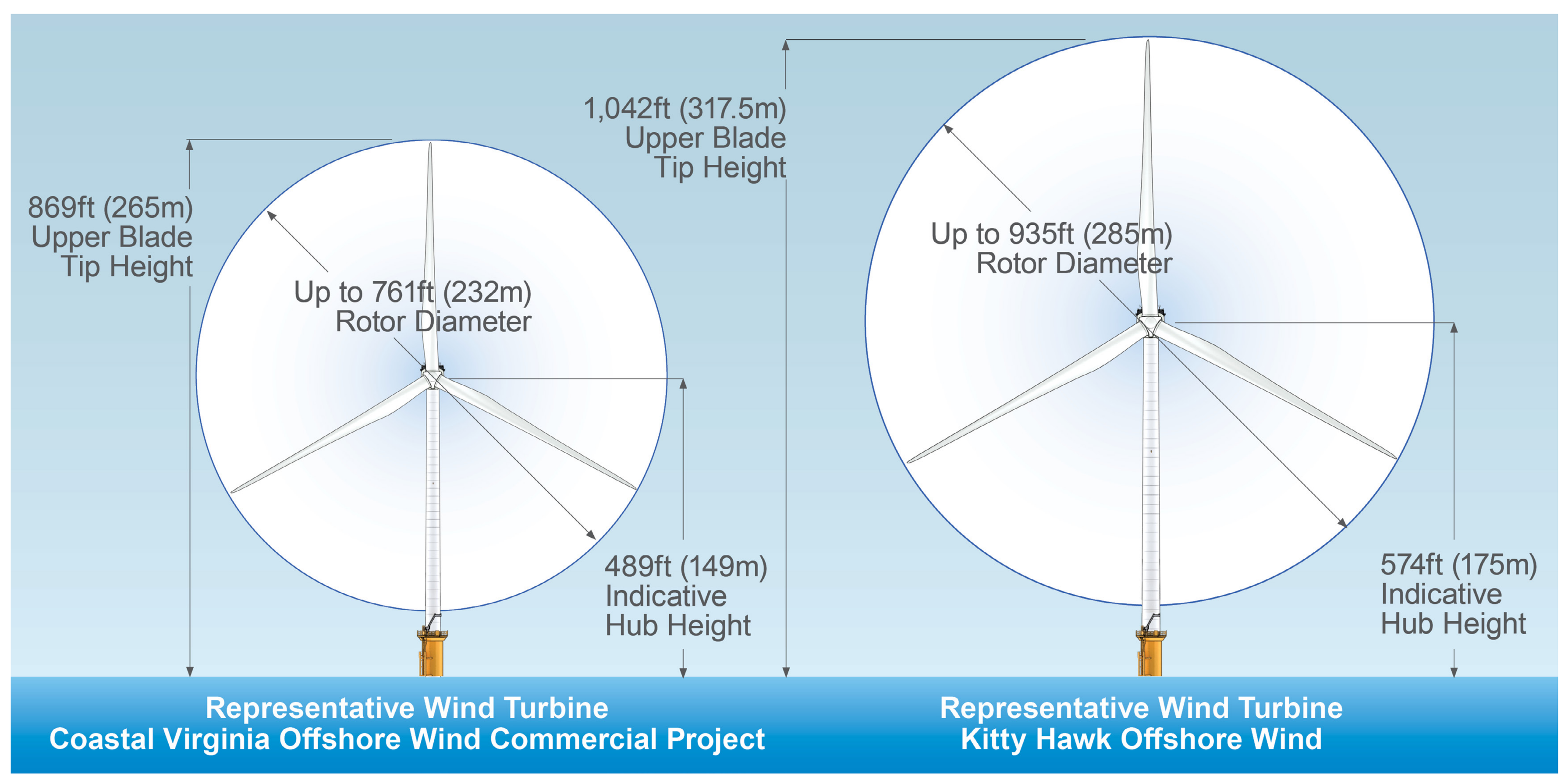
View of the existing condition at Whale Head Bay Residential Area



Legend

Visible	Not Visible	WTG Location	Visible	Not Visible	
		Coastal Virginia Offshore Wind Commercial Project			OSS
		Kitty Hawk Offshore Wind			Chesapeake Light Tower
		Pilot Project Turbine			Photo Point

Locator Map



Project	Distance to the closest WTG (mi)	Distance to the farthest WTG (mi)
Coastal Virginia Offshore Wind Commercial Project WTG	39.1	41.4
Kitty Hawk Offshore Wind WTG	27.9	37.6

Turbine Data

Viewpoint Location:	Whale Head Bay Residential Area
Date of Photograph:	July 7, 2021
Time of Photograph:	12:20 PM (EDT)
Latitude:	36.3776° N
Longitude:	-75.8242° W
Viewing Direction:	Northeast
Ground Elevation + Tripod Height:	25 feet

ENVIRONMENTAL	
Temperature:	91° F
Humidity:	48%
Wind Direction:	SW
Wind Speed:	13 mph
Weather Condition:	Fair

CAMERA

	Type	Brand	Model
Camera	Mirrorless	Nikon	Z6
Lens	NIKKOR Z 50mm		
Focal Length	50 mm		

*The image on this page approximates the full horizontal field-of-view of typical human eyesight (124° horizontal)

Photograph Information

Simulation 5A.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 5A.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 5A.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Kitty Hawk is not present in this view angle.

Complete Panoramic View

Simulation 5A.3: Kitty Hawk

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 5B.1: CVOWC

Simulation illustrating Coastal Virginia Offshore Wind Commercial Project without other foreseeable future changes

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

Simulation 5B.2: CVOWC + Kitty Hawk

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

Simulation 5B.2: CVOWC + Kitty Hawk - *Annotated*

*The simulation image includes approximately 62° horizontal field of view.

Simulation illustrating full lease buildout showing foreseeable projects located in leased area with Coastal Virginia Offshore Wind Commercial Project. Coastal Virginia Offshore Wind Commercial Project is not present in this view angle.

Complete Panoramic View

Simulation 5B.3: Kitty Hawk

Simulation illustrating full lease buildout not including Coastal Virginia Offshore Wind Commercial Project

*The simulation image includes approximately 62° horizontal field of view.

Complete Panoramic View

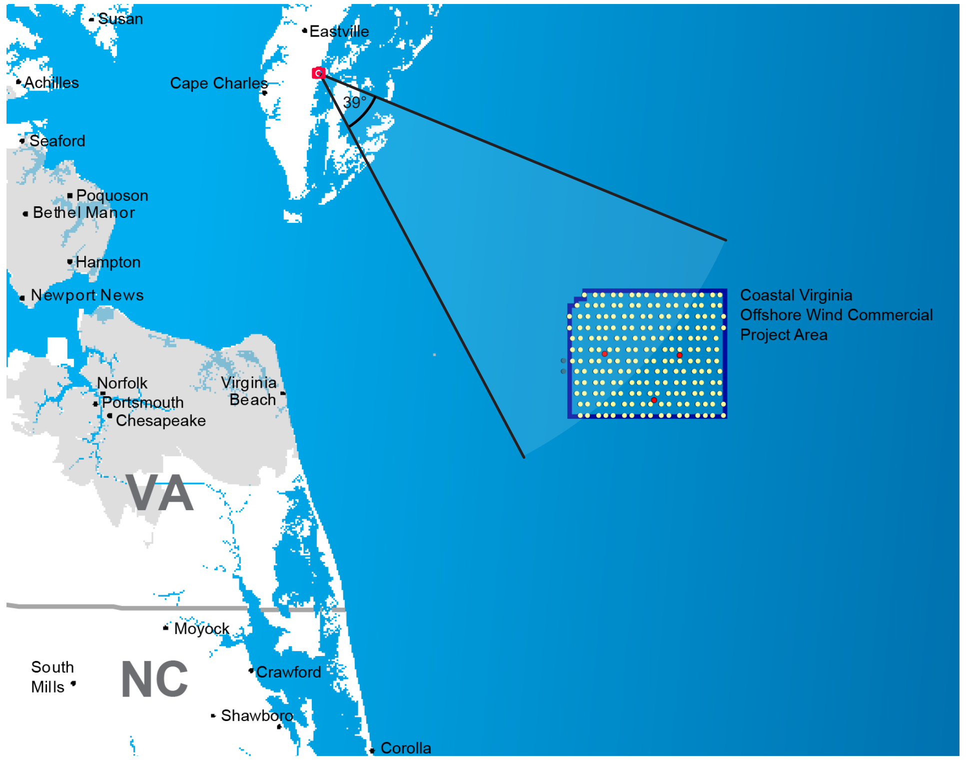
ATTACHMENT M-3
VISUAL SIMULATIONS OF ACTION ALTERNATIVES

This page intentionally left blank.

Coastal Virginia Offshore Wind Commercial Project

Attachment I-1-6: Visual Simulations

KOP 5: Oyster Village Horse Island Trail
Northhampton County, VA

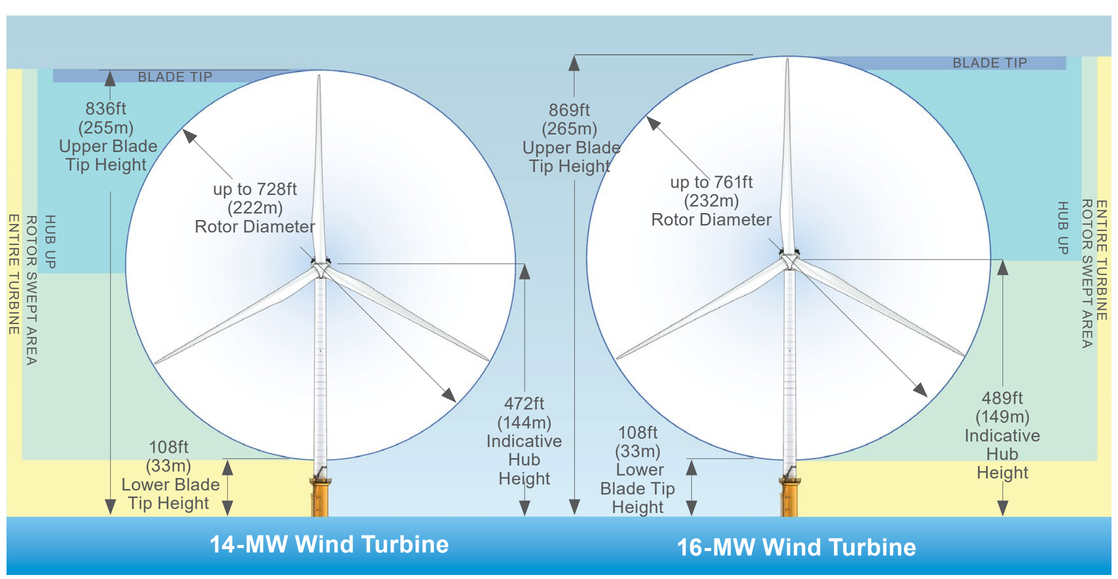


Vicinity Map

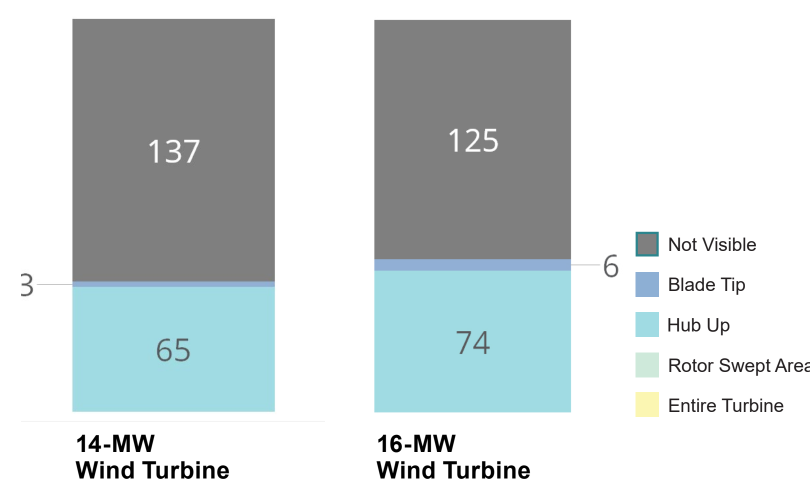
Pilot Project Turbine
Chesapeake Light Tower
Turbine Location
Offshore Substation
Photo Point
Lease Area

Existing Panoramic View

Located near Oyster Village Horse Island Trail



Turbine Dimensions



Turbine Visibility

FIELD ID # 5

PHOTO INFORMATION	
Date	7/12/2021
Time	10:12 AM
Latitude	37.287571°
Longitude	-75.917941°
Direction of View	SE
Elevation	10'
Horizontal Field of View Represented in Simulated Image	39°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	87° F
Humidity	63%
Wind Direction	SW
Wind Speed	13 mph
Weather Condition	Partly Cloudy

PROJECT VIEW	
Distance to Nearest Turbine	32.5 miles
Horizontal Area Occupied by Visible Turbines	14°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	35.8%
Vertical Area Occupied by Visible Turbines	0.1°

Image Data

KOP 5: Oyster Village Horse Island Trail

Northhampton County, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 5: Oyster Village Horse Island Trail

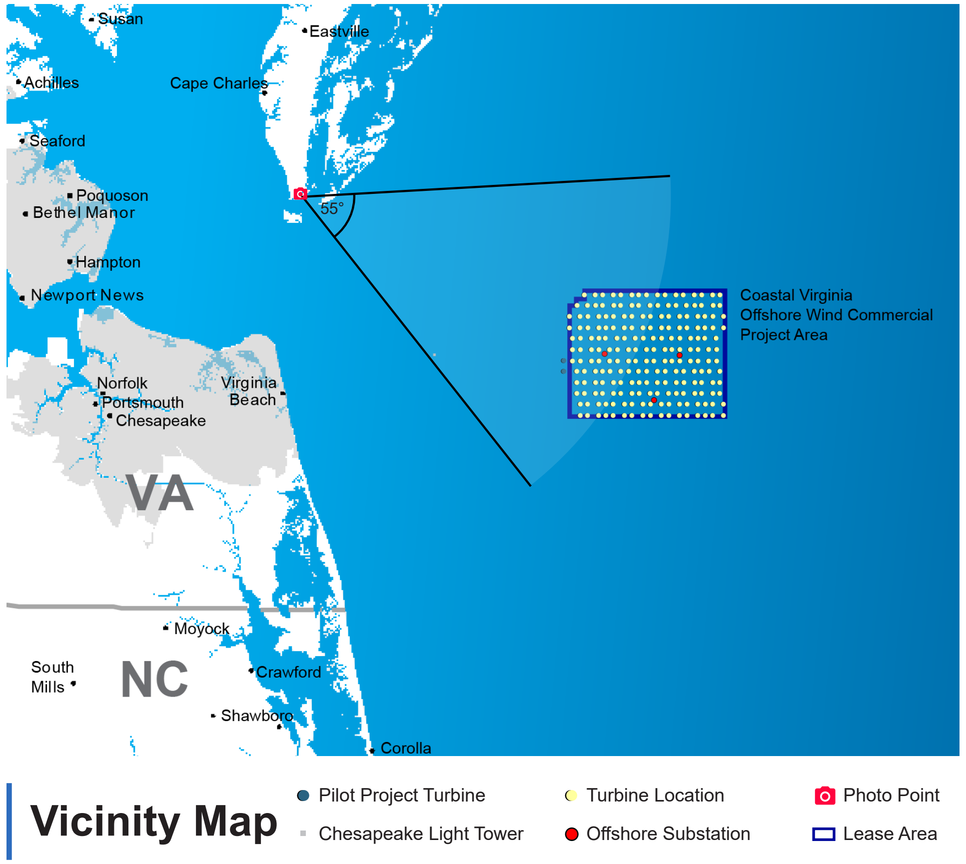
Northhampton County, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 8: Eastern Shore of Virginia National Wildlife Refuge

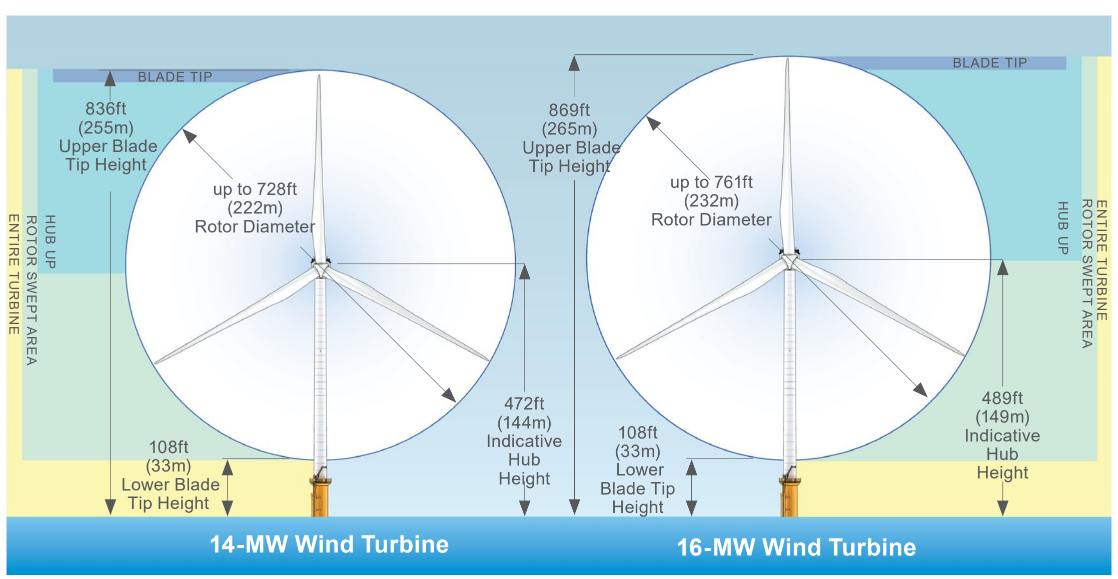
Northhampton County, VA



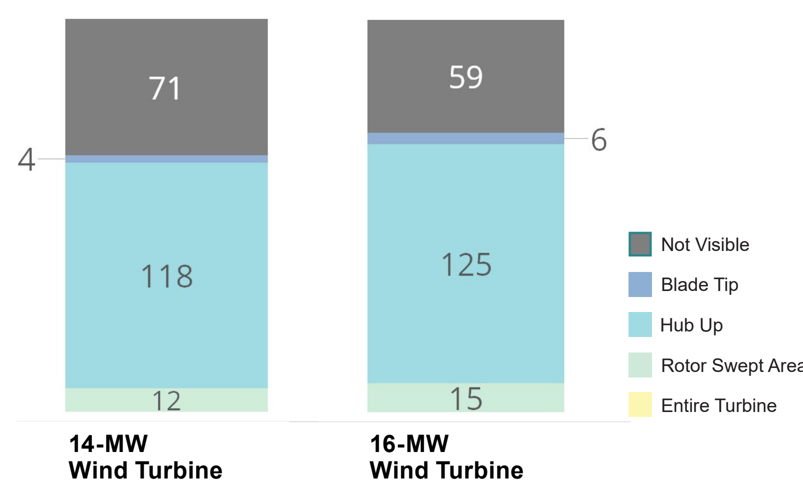
Vicinity Map

Existing Panoramic View

Located on Wise Point Boat Ramp



Turbine Dimensions



Turbine Visibility

FIELD ID # 8

PHOTO INFORMATION	
Date	7/12/2021
Time	10:12 AM
Latitude	37.127849°
Longitude	-75.949910°
Direction of View	SE
Elevation	8'
Horizontal Field of View Represented in Simulated Image	55°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	92° F
Humidity	52%
Wind Direction	SW
Wind Speed	8.7 mph
Weather Condition	Partly Cloudy

PROJECT VIEW	
Distance to Nearest Turbine	28.1 miles
Horizontal Area Occupied by Visible Turbines	14°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	25.5%
Vertical Area Occupied by Visible Turbines	0.15°

Image Data

KOP 8: Eastern Shore of Virginia National Wildlife Refuge
Northhampton County, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 8: Eastern Shore of Virginia National Wildlife Refuge

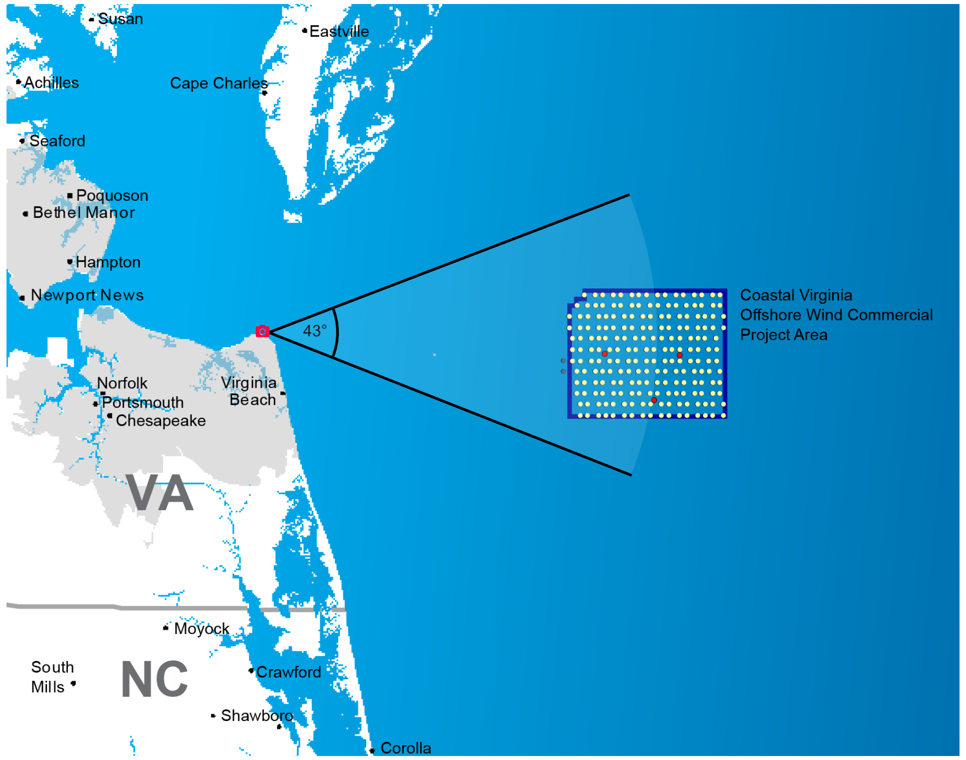
Northhampton County, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

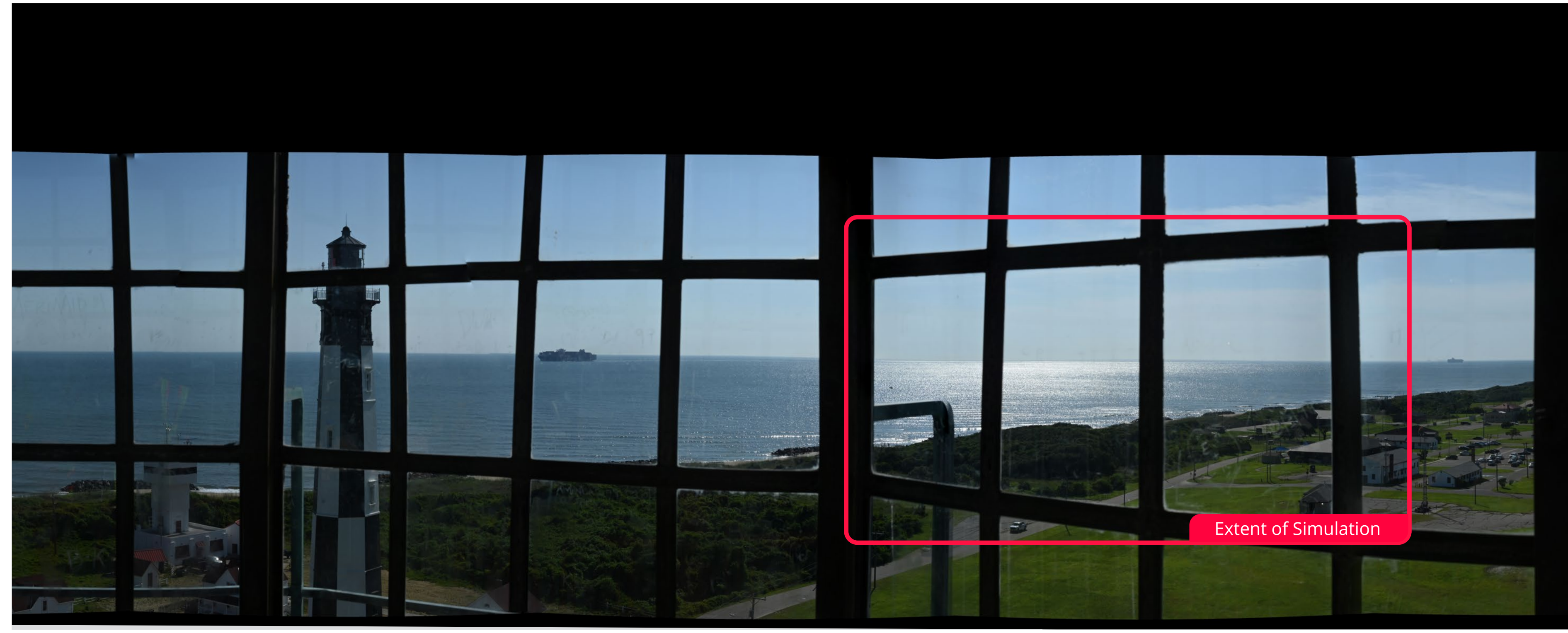
KOP 13: Cape Henry Lighthouse

Virginia Beach, VA



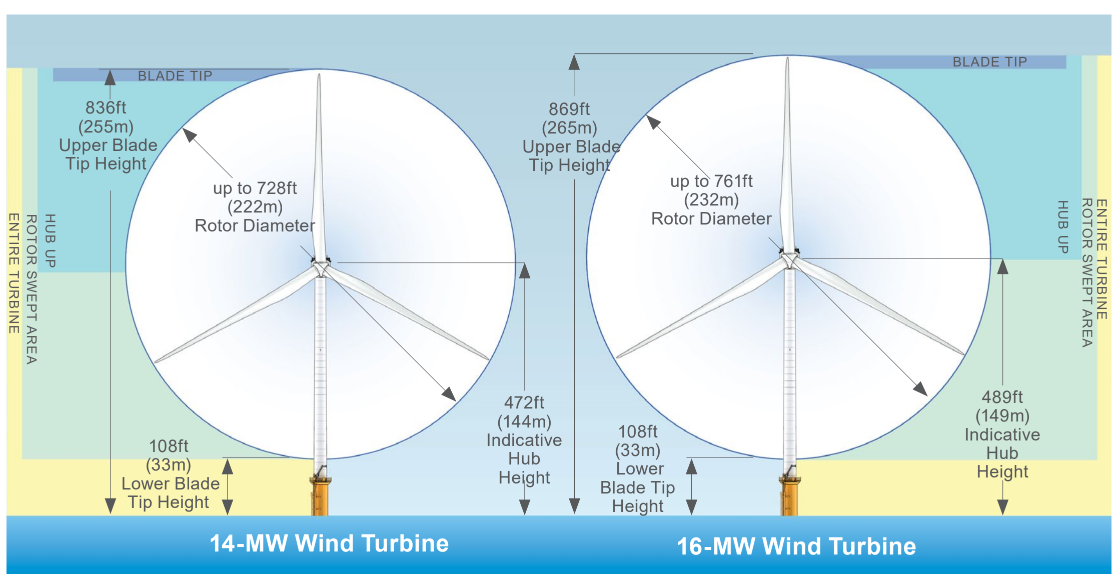
Vicinity Map

- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

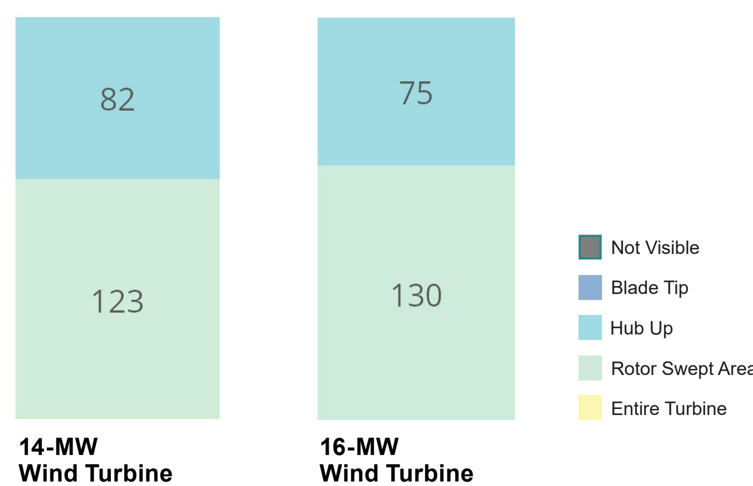


Existing Panoramic View

Located inside the Cape Henry Lighthouse



Turbine Dimensions



Turbine Visibility

FIELD ID # 13

PHOTO INFORMATION	
Date	7/9/2021
Time	9:18 AM
Latitude	36.925742°
Longitude	-76.008139°
Direction of View	ENE
Elevation	90'
Horizontal Field of View Represented in Simulated Image	43°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	80° F
Humidity	74%
Wind Direction	WSW
Wind Speed	9 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	29.1miles
Horizontal Area Occupied by Visible Turbines	21°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	48.8%
Vertical Area Occupied by Visible Turbines	0.25°

Image Data

KOP 13: Cape Henry Lighthouse
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

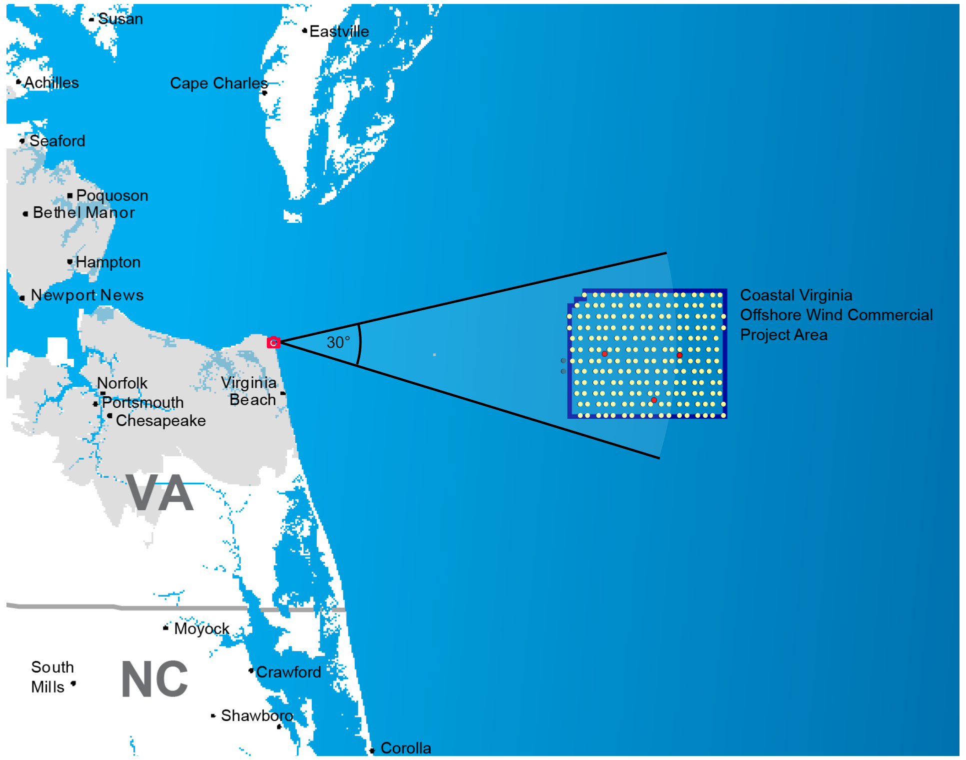
KOP 13: Cape Henry Lighthouse
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 15a: Beach Residential 1

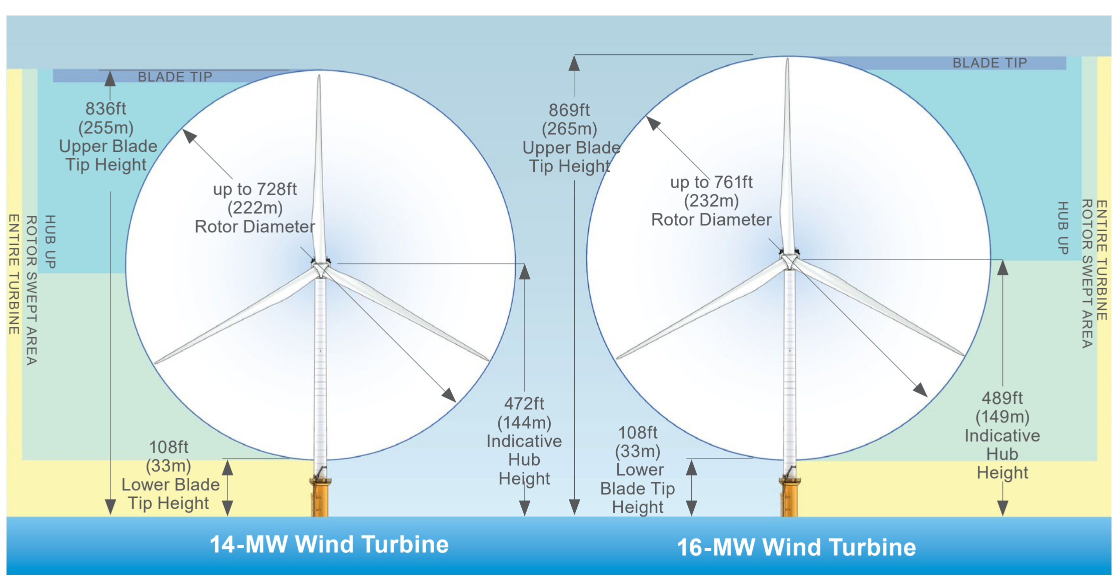
Virginia Beach, VA



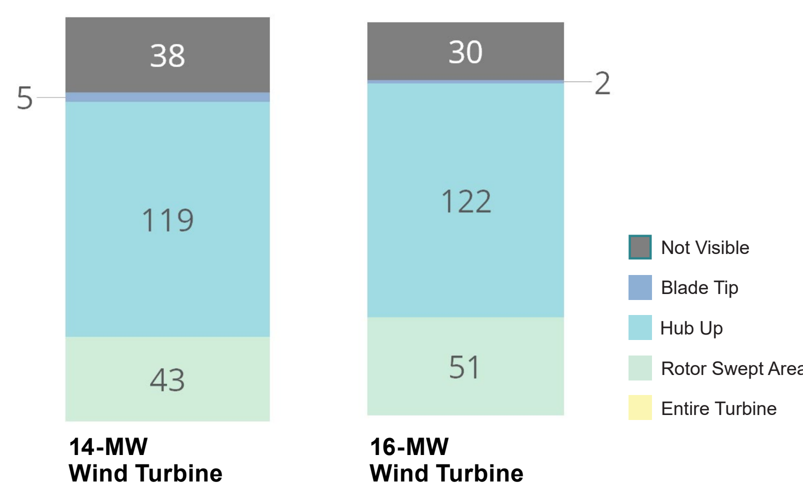
Vicinity Map

Existing Panoramic View

Located on North End Beaches, near 70th St.



Turbine Dimensions



Turbine Visibility

FIELD ID # 15a

PHOTO INFORMATION	
Date	7/9/2021
Time	10:00 AM
Latitude	36.898335°
Longitude	-75.986696°
Direction of View	E
Elevation	15'
Horizontal Field of View Represented in Simulated Image	30°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	83° F
Humidity	69%
Wind Direction	WSW
Wind Speed	6 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	28.1 miles
Horizontal Area Occupied by Visible Turbines	22°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	73.3%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 15a: Beach Residential 1

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

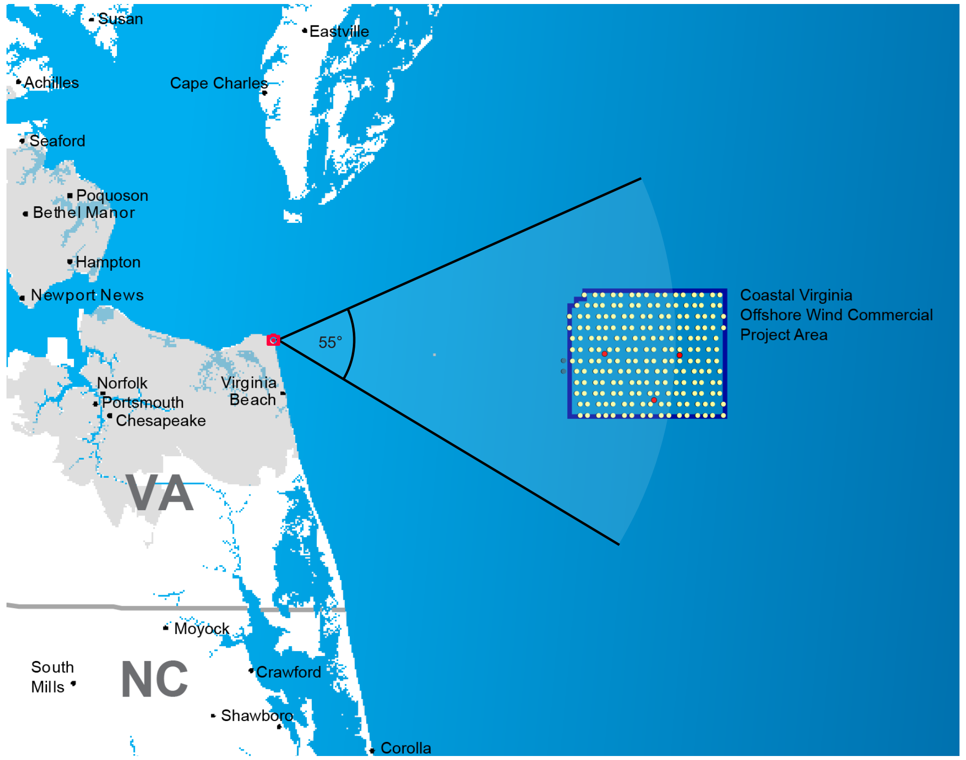
KOP 15a: Beach Residential 1
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 15b: Beach Residential 1 - Nighttime

Virginia Beach, VA

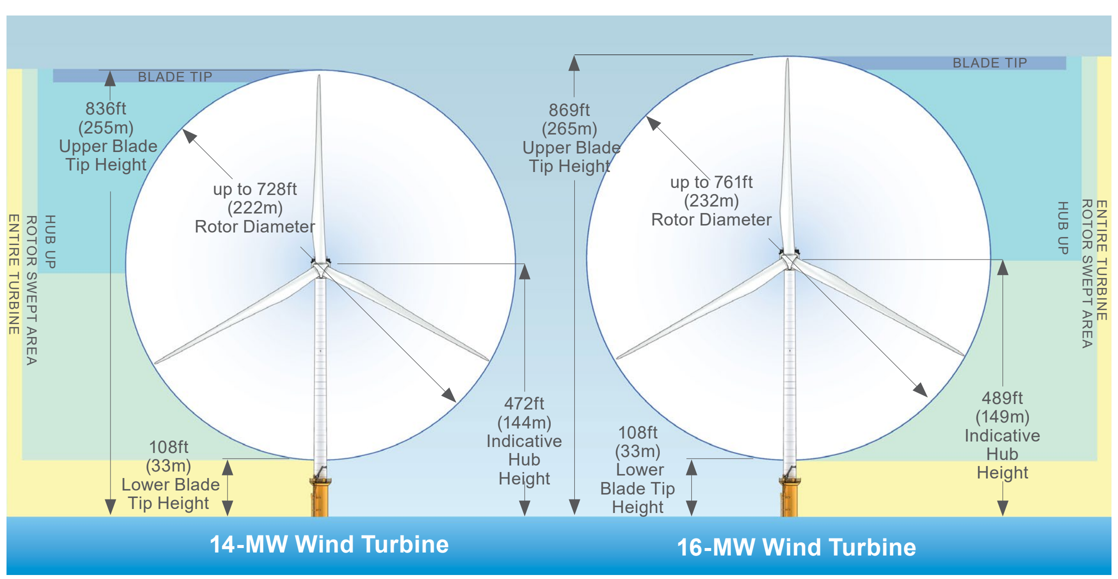


Vicinity Map

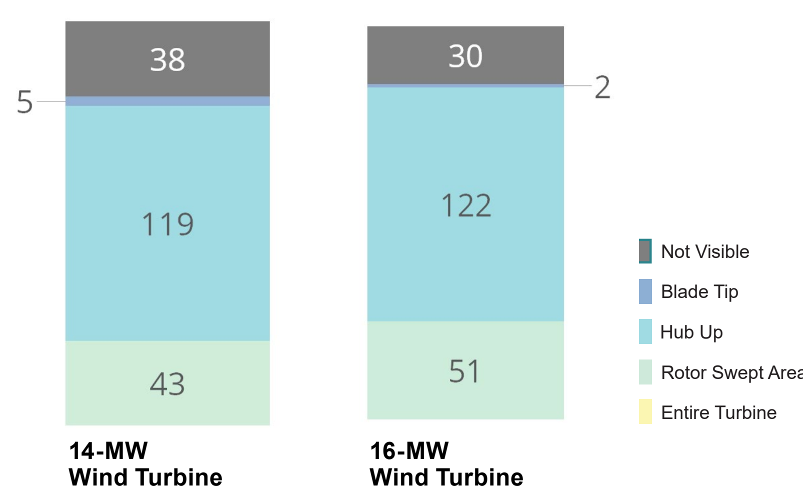
- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

Existing Panoramic View

Located on North End Beaches, near 70th St.



Turbine Dimensions



Turbine Visibility

FIELD ID # 15b

PHOTO INFORMATION	
Date	7/10/2021
Time	10:27pm
Latitude	36.898335°
Longitude	-75.986696°
Direction of View	E
Elevation	15'
Horizontal Field of View Represented in Simulated Image	55°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

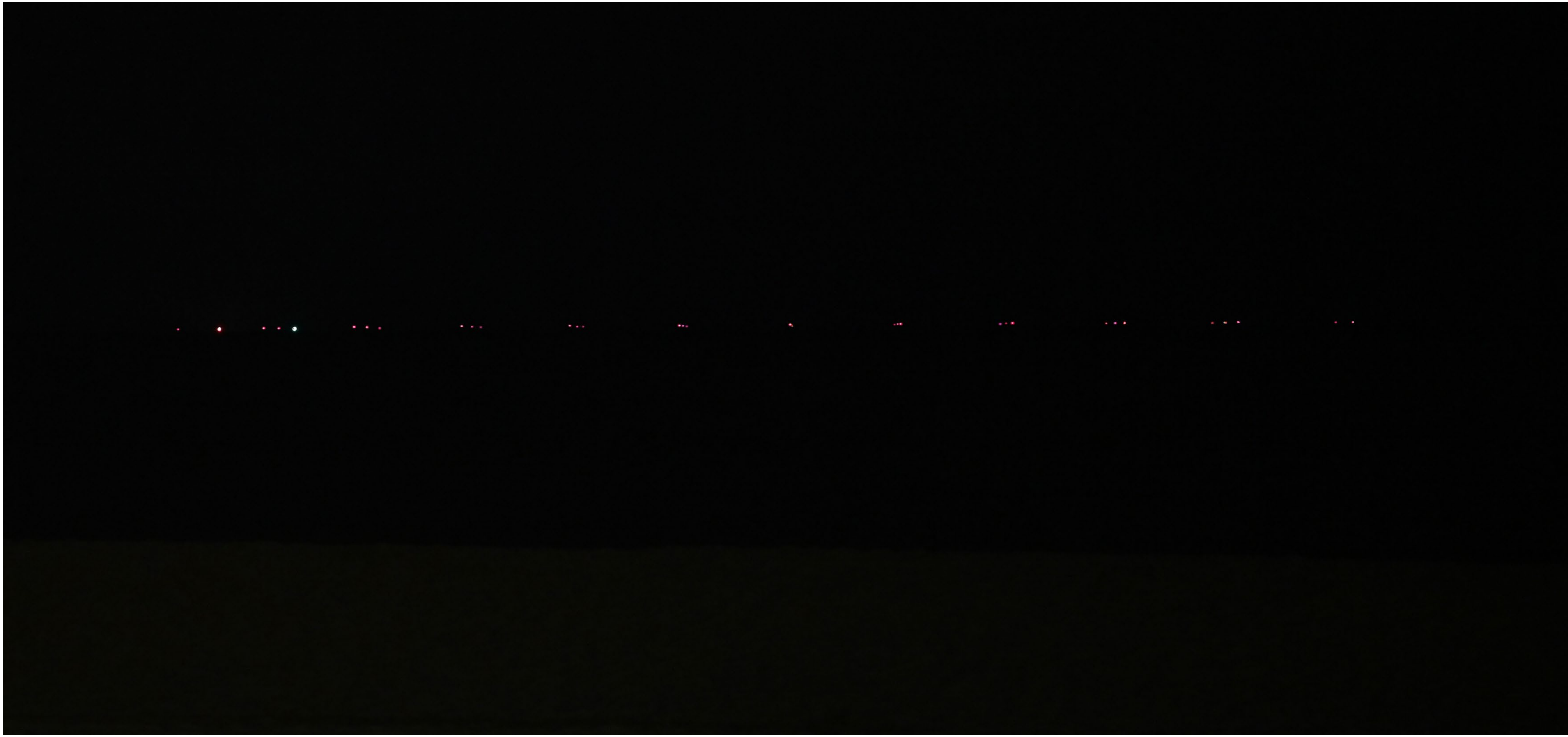
ENVIRONMENTAL	
Temperature	78° F
Humidity	64%
Wind Direction	SSE
Wind Speed	6 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	28.1 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	41.8%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 15b: Beach Residential 1 - Nighttime
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

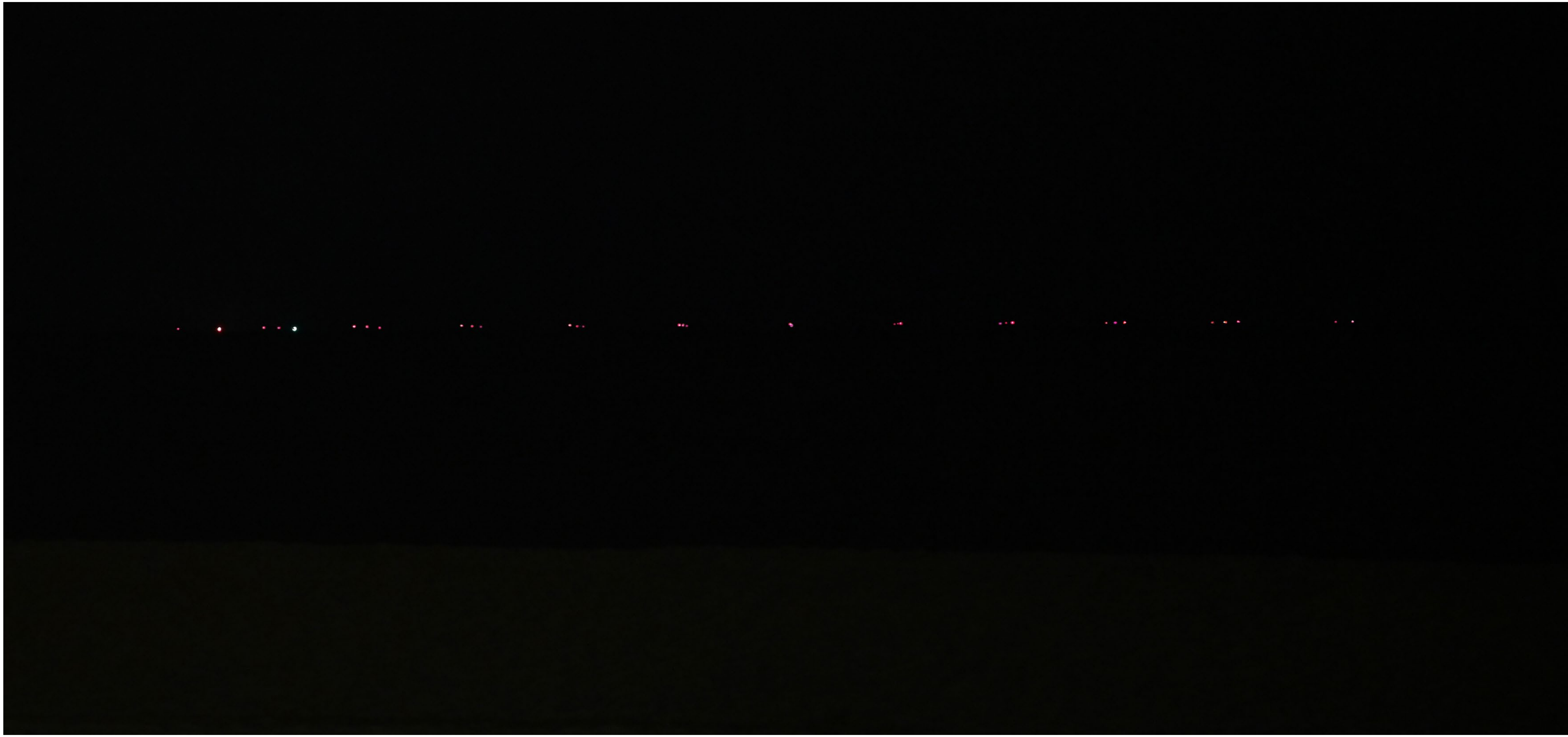


Visual Simulation: 14-MW Wind Turbine

KOP 15b: Beach Residential 1 - Nighttime

Virginia Beach, VA

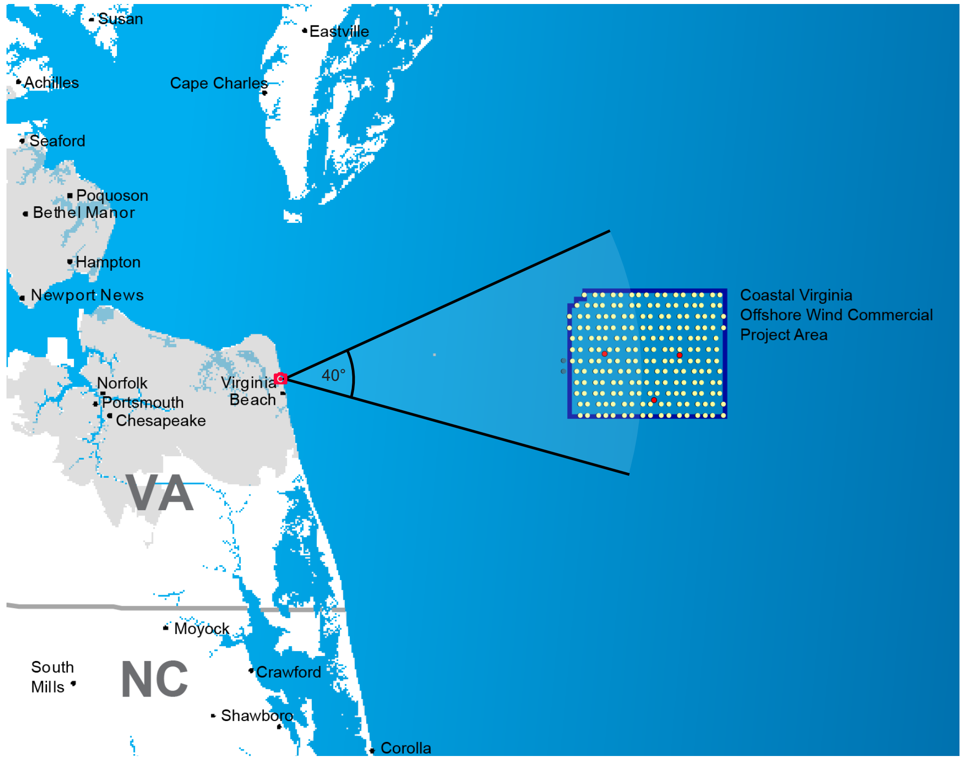
Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).



Visual Simulation: 16-MW Wind Turbine

KOP 22: Neptune Statue/Boardwalk

Virginia Beach, VA

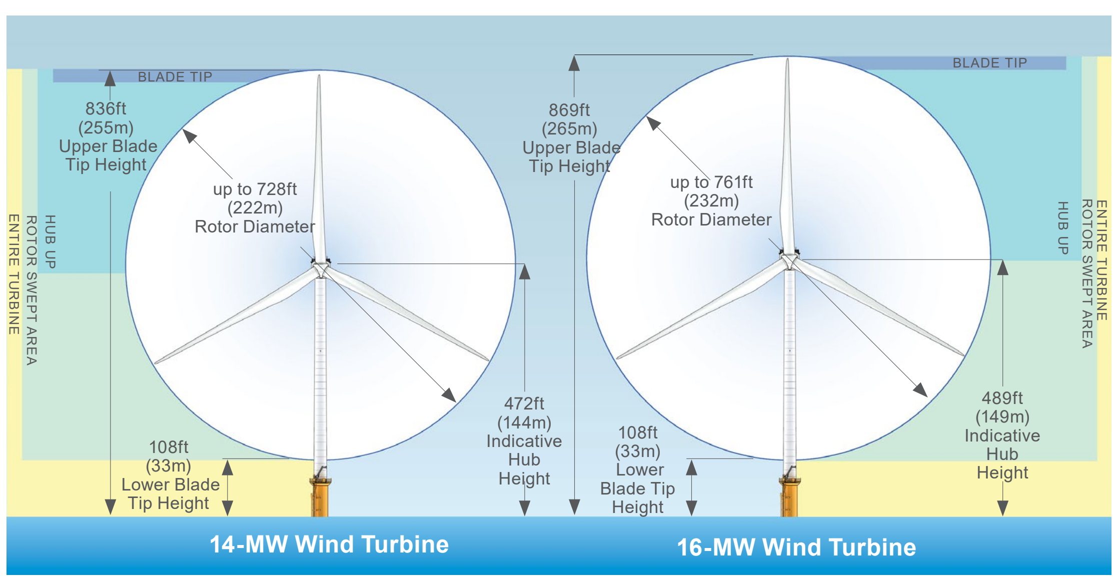


Vicinity Map

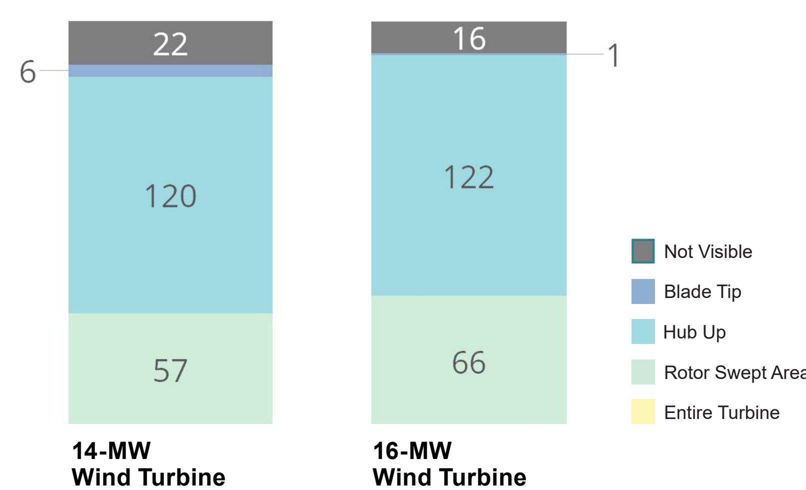
- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

Existing Panoramic View

Located on the Virginia Beach Boardwalk near the Neptune Statue



Turbine Dimensions



Turbine Visibility

FIELD ID # 22

PHOTO INFORMATION	
Date	7/7/2021
Time	2:40 PM
Latitude	36.859392°
Longitude	-75.977296°
Direction of View	E
Elevation	20'
Horizontal Field of View Represented in Simulated Image	40°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	88° F
Humidity	59%
Wind Direction	SW
Wind Speed	10 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	27.9 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	57.5%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 22: Neptune Statue/Boardwalk
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 22: Neptune Statue/Boardwalk

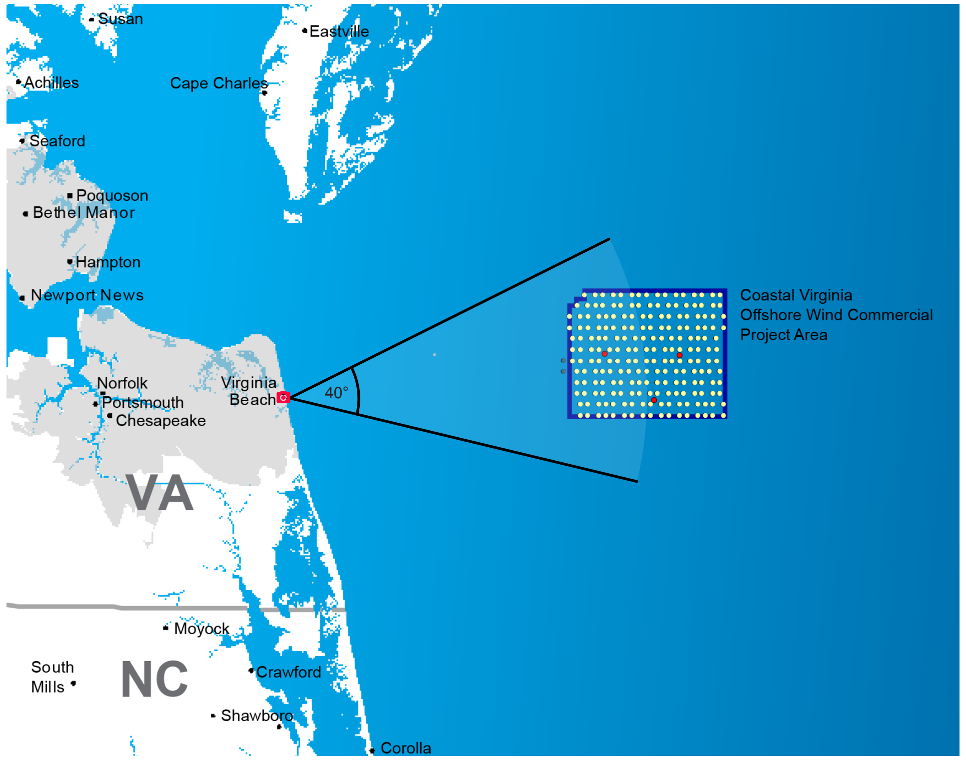
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 23: Naval Aviation Monument Park

Virginia Beach, VA

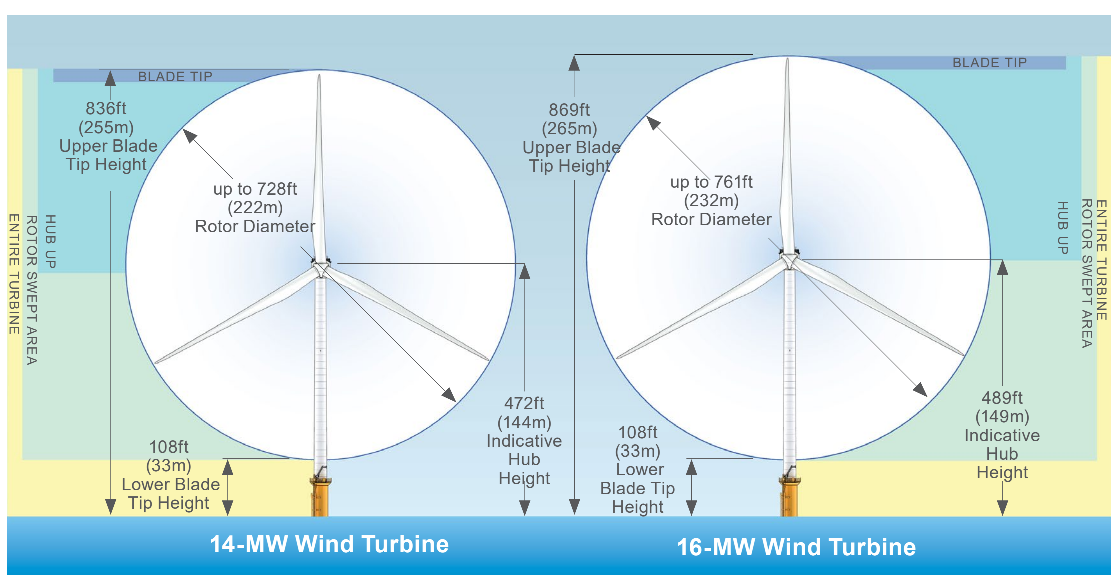


Vicinity Map

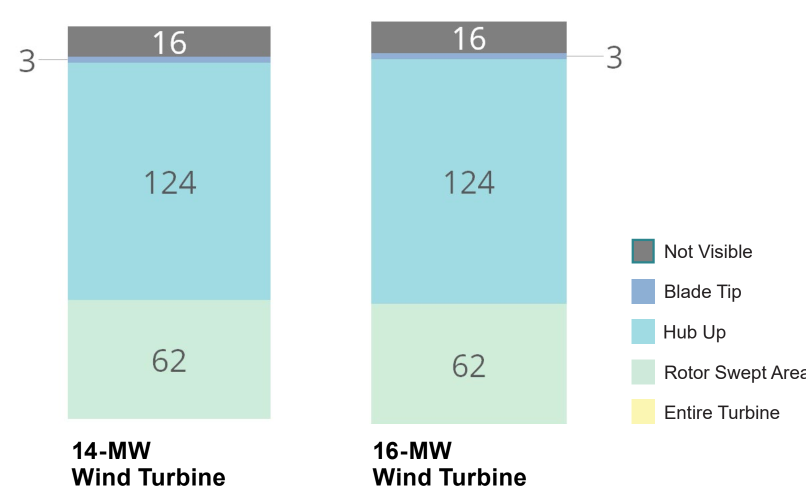
- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

Existing Panoramic View

Located on Virginia Beach Boardwalk, near Naval Aviation Monument - 25th St.



Turbine Dimensions



Turbine Visibility

FIELD ID # 23

PHOTO INFORMATION	
Date	7/9/2021
Time	12:20 PM
Latitude	36.853785°
Longitude	-75.975655°
Direction of View	NE
Elevation	18'
Horizontal Field of View Represented in Simulated Image	40°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	89° F
Humidity	57%
Wind Direction	SSW
Wind Speed	12 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	27.8 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	57.5%
Vertical Area Occupied by Visible Turbines	0.3°

Image Data

KOP 23: Naval Aviation Monument Park

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 23: Naval Aviation Monument Park

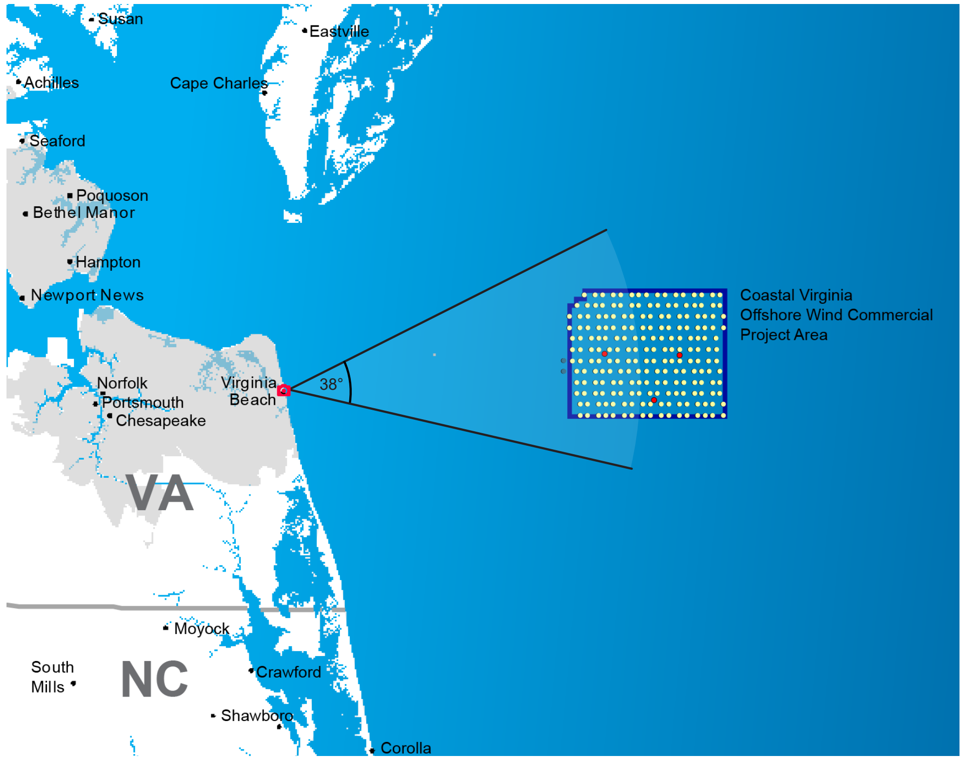
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 24a: Virginia Beach Boardwalk - 17th St Park

Virginia Beach, VA

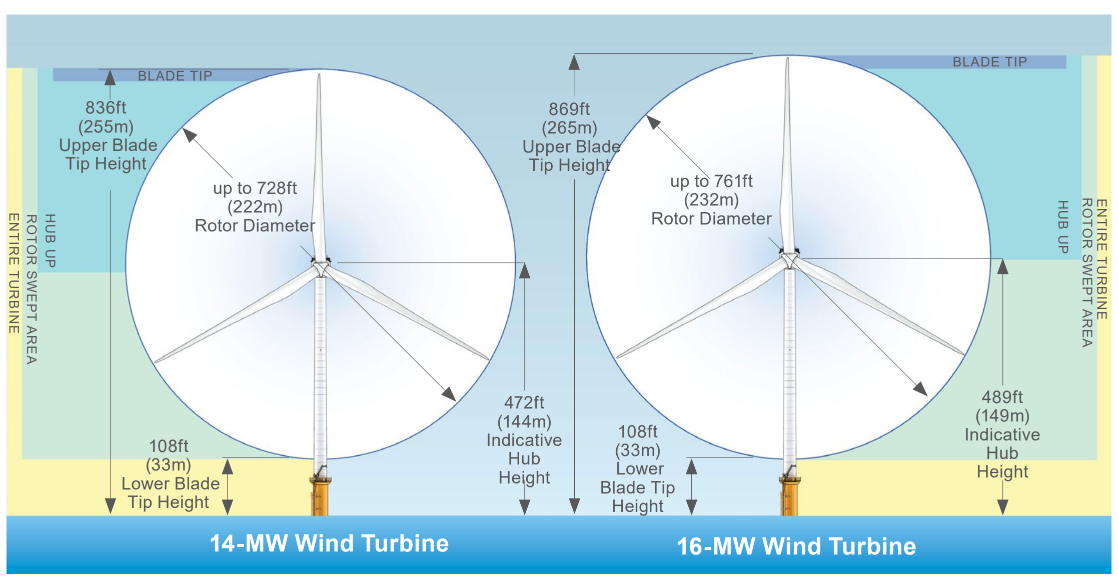


Vicinity Map

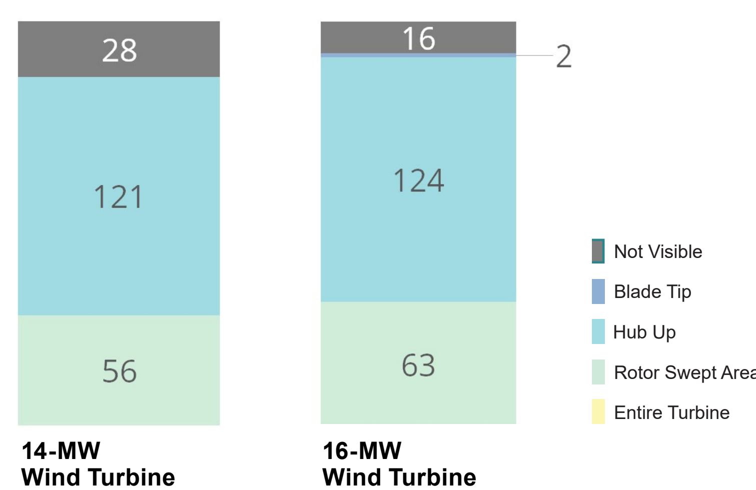
Pilot Project Turbine · Turbine Location · Photo Point · Chesapeake Light Tower · Offshore Substation · Lease Area

Existing Panoramic View

Located on Virginia Beach Boardwalk, near 17th St Park



Turbine Dimensions



Turbine Visibility

FIELD ID # 24a

PHOTO INFORMATION	
Date	7/9/2021
Time	1:33 pm
Latitude	36.845523°
Longitude	-75.973333°
Direction of View	E
Elevation	18'
Horizontal Field of View Represented in Simulated Image	38°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	91° F
Humidity	53%
Wind Direction	WSW
Wind Speed	5 mph
Weather Condition	Partly Cloudy

PROJECT VIEW	
Distance to Nearest Turbine	27.8 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	60.5%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 24a: Virginia Beach Boardwalk - 17th St Park

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 24a: Virginia Beach Boardwalk - 17th St Park

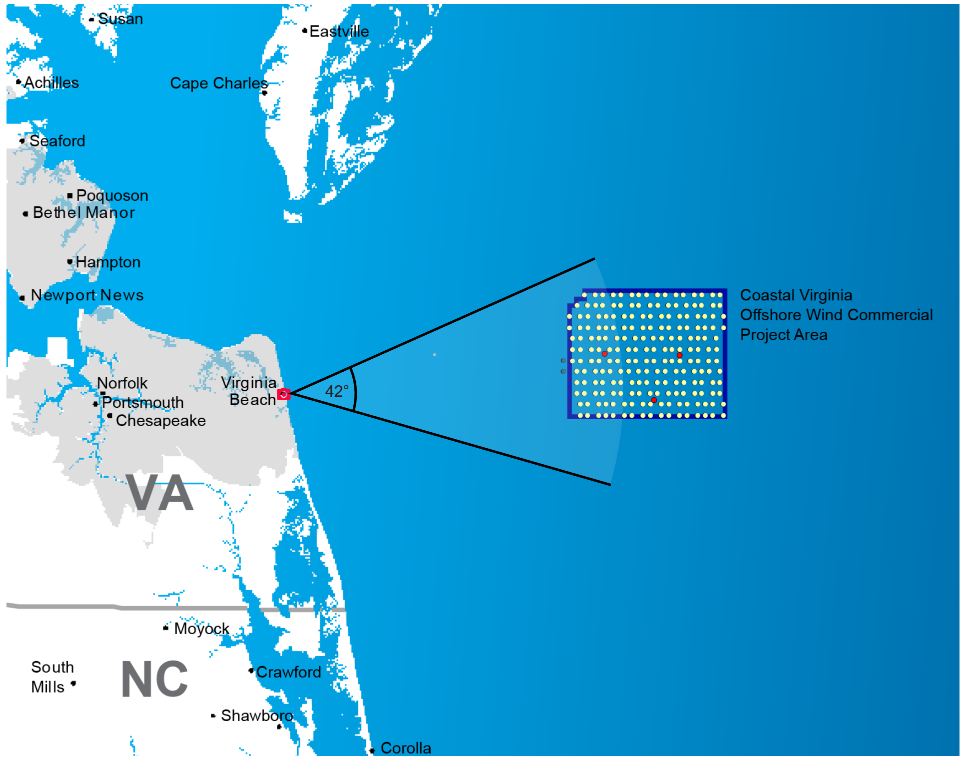
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 24b: Virginia Beach Boardwalk - 16th St Entrance - Nighttime

Virginia Beach, VA

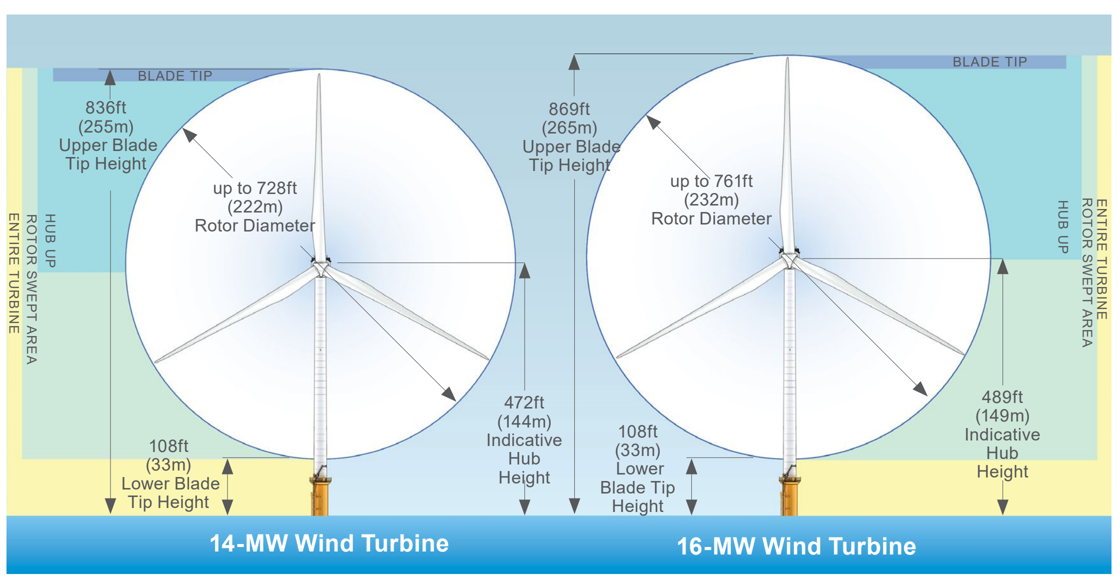


Vicinity Map

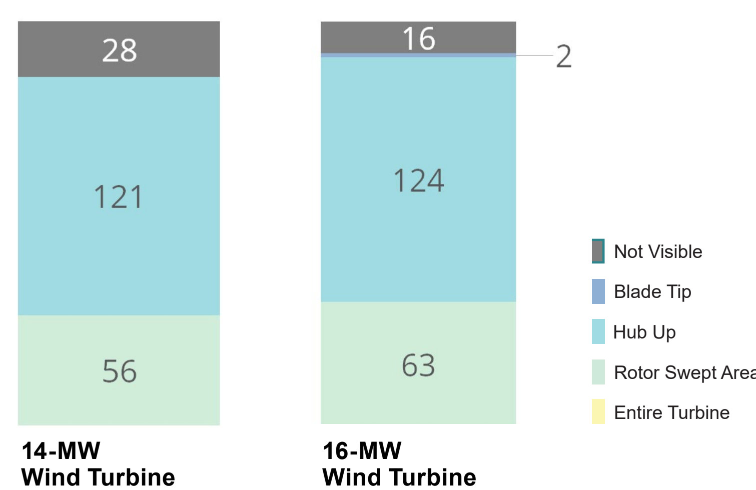
Pilot Project Turbine · Turbine Location · Photo Point · Chesapeake Light Tower · Offshore Substation · Lease Area

Existing Panoramic View

Located on Virginia Beach Boardwalk, near 16th St Entrance



Turbine Dimensions



Turbine Visibility

FIELD ID # 24b

PHOTO INFORMATION	
Date	7/10/2021
Time	9:54 pm
Latitude	36.844775°
Longitude	-75.973125°
Direction of View	E
Elevation	18'
Horizontal Field of View Represented in Simulated Image	42°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	78° F
Humidity	68%
Wind Direction	SSE
Wind Speed	6 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	27.7 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	54.8%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 24b: Virginia Beach Boardwalk - 16th St Entrance - Nighttime

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 24b: Virginia Beach Boardwalk - 16th St Entrance - Nighttime

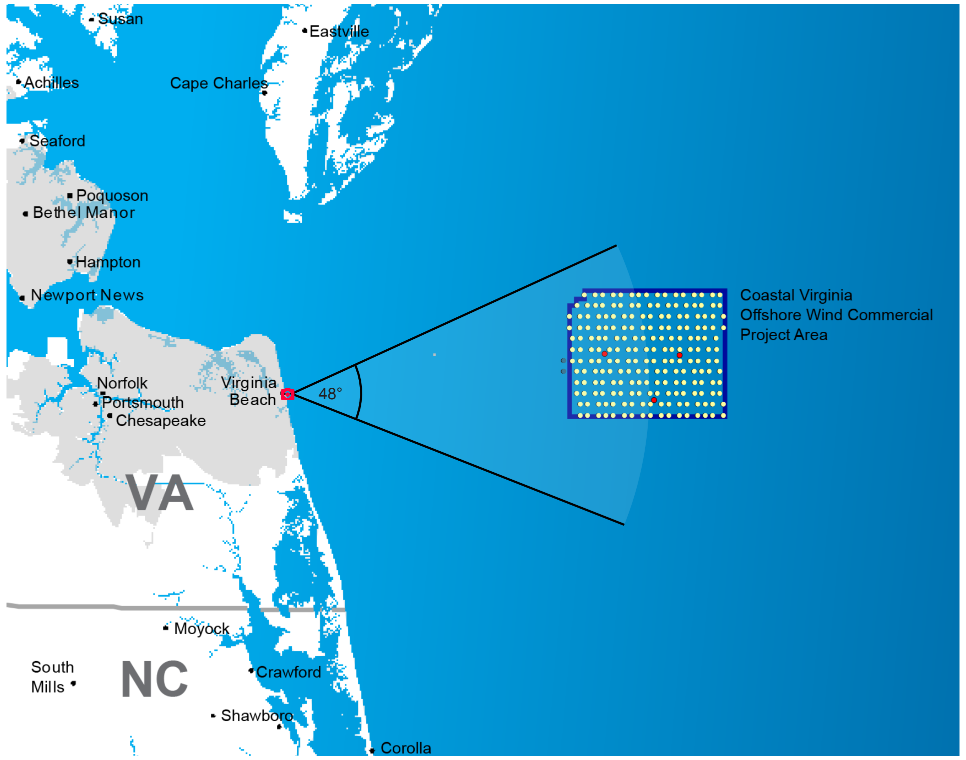
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

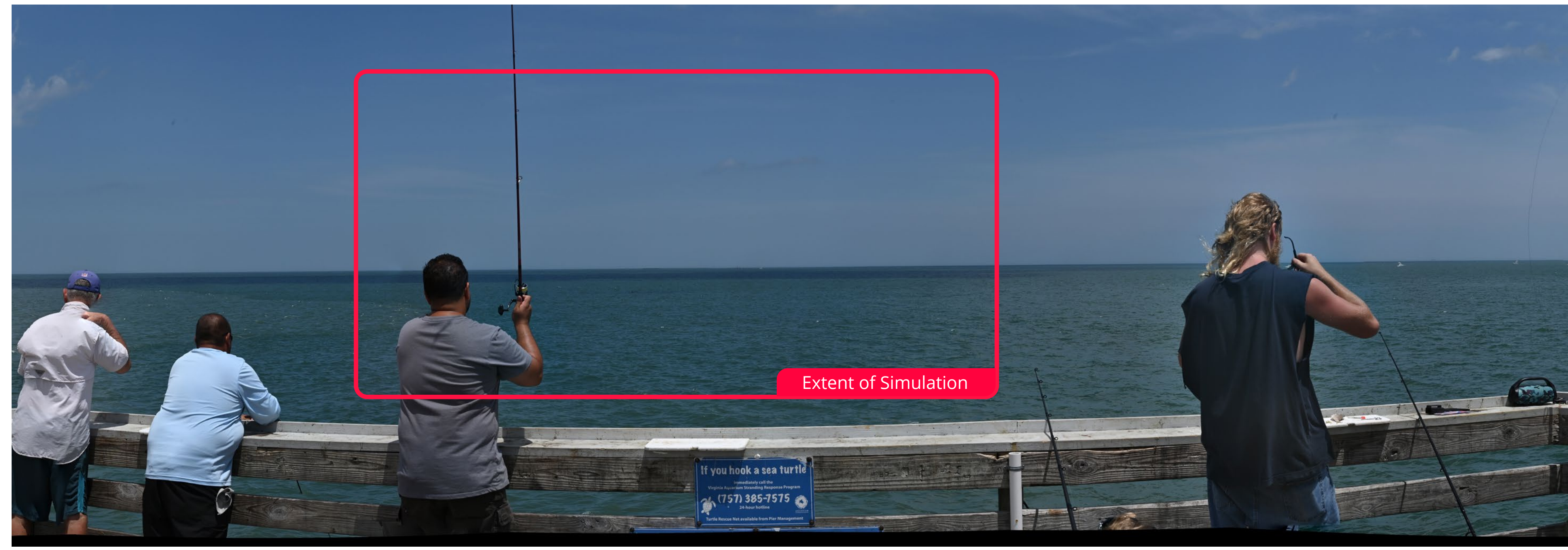
KOP 24d: Virginia Beach Boardwalk - Fishing Pier

Virginia Beach, VA



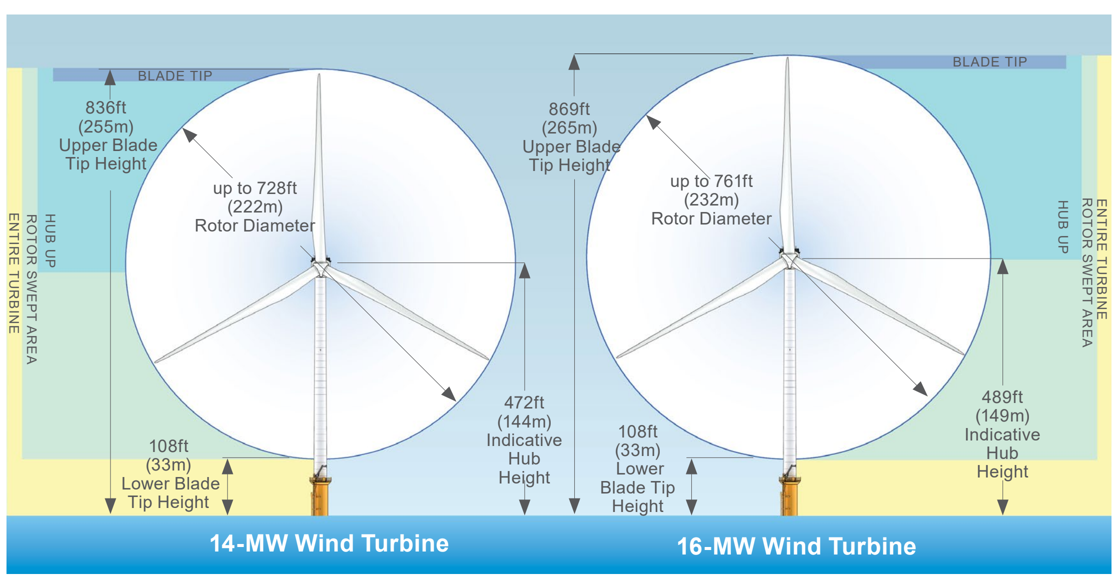
Vicinity Map

Pilot Project Turbine · Chesapeake Light Tower · Turbine Location · Offshore Substation · Photo Point · Lease Area

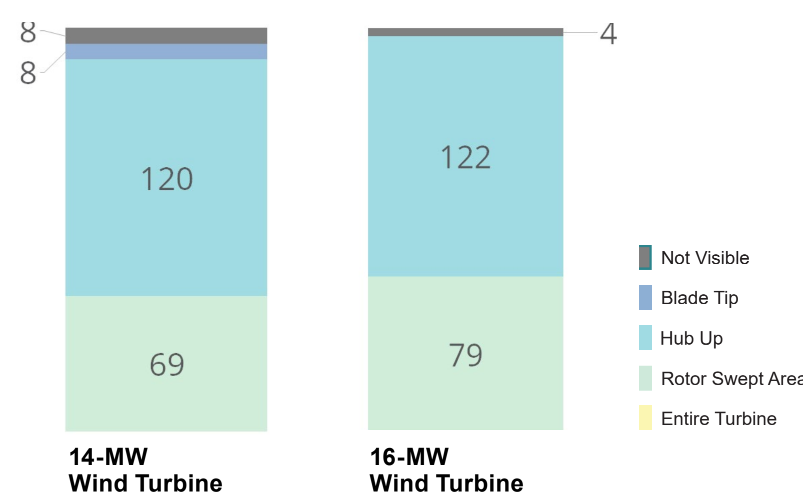


Existing Panoramic View

Located on Virginia Beach Boardwalk Fishing Pier



Turbine Dimensions



Turbine Visibility

FIELD ID # 24d

PHOTO INFORMATION	
Date	7/9/2021
Time	1:50 pm
Latitude	36.843709°
Longitude	-75.969876°
Direction of View	E
Elevation	25'
Horizontal Field of View Represented in Simulated Image	48°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	91° F
Humidity	53%
Wind Direction	WSW
Wind Speed	5 mph
Weather Condition	Partly Cloudy

PROJECT VIEW	
Distance to Nearest Turbine	27.6 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	47.9%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 24d: Virginia Beach Boardwalk - Fishing Pier

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 24d: Virginia Beach Boardwalk - Fishing Pier

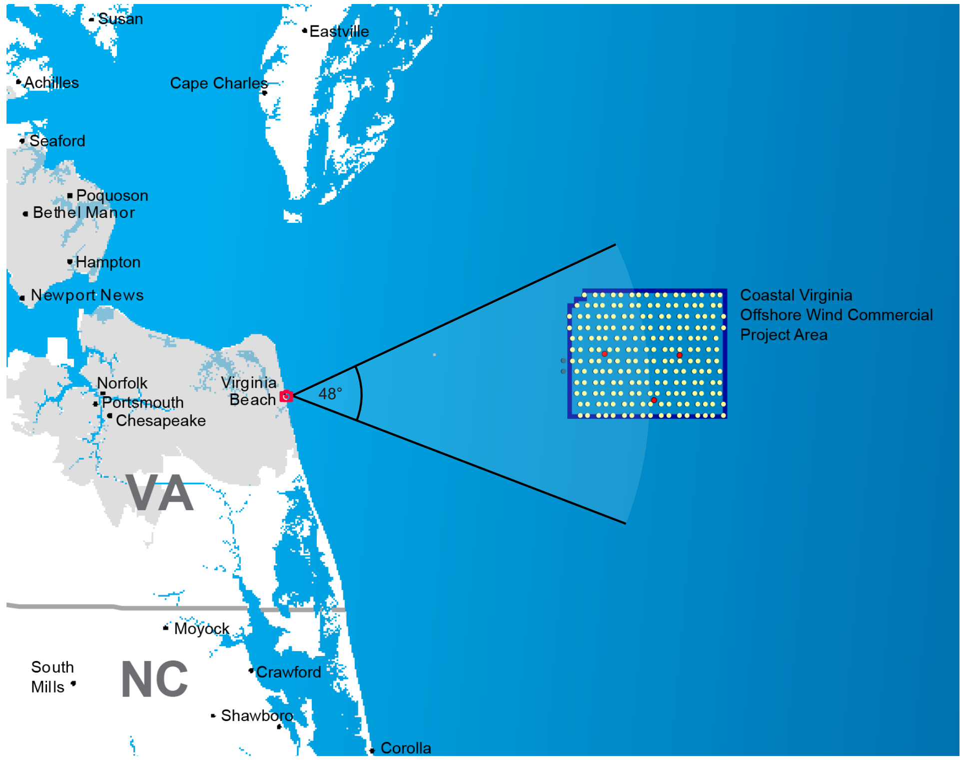
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

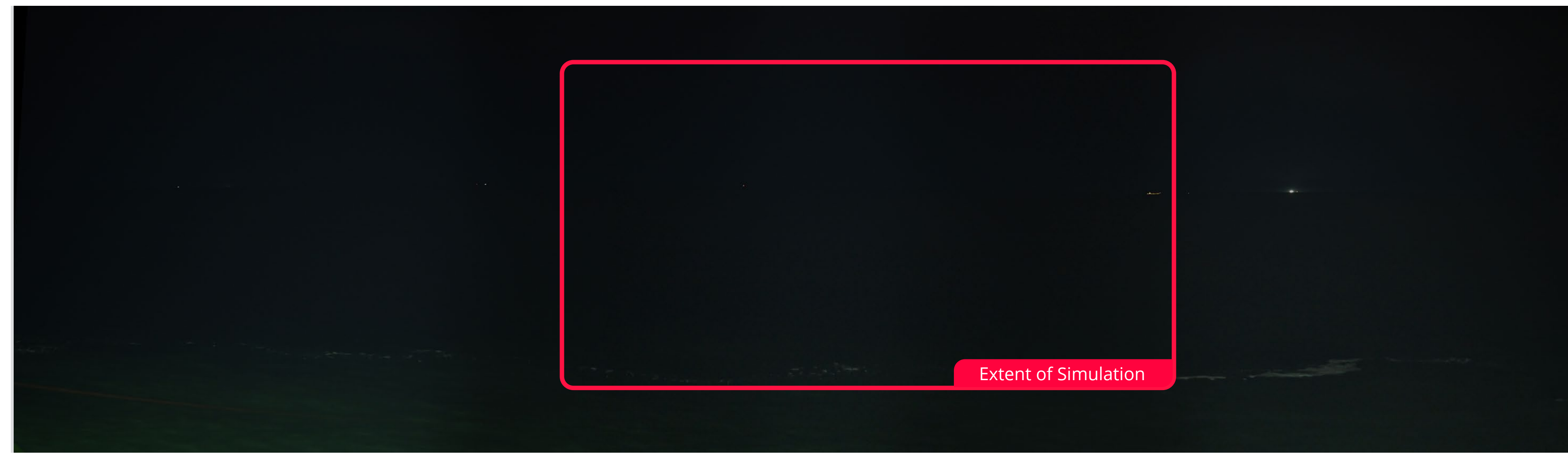
Visual Simulation: 16-MW Wind Turbine

KOP 24d: Virginia Beach Boardwalk - Fishing Pier Nighttime

Virginia Beach, VA

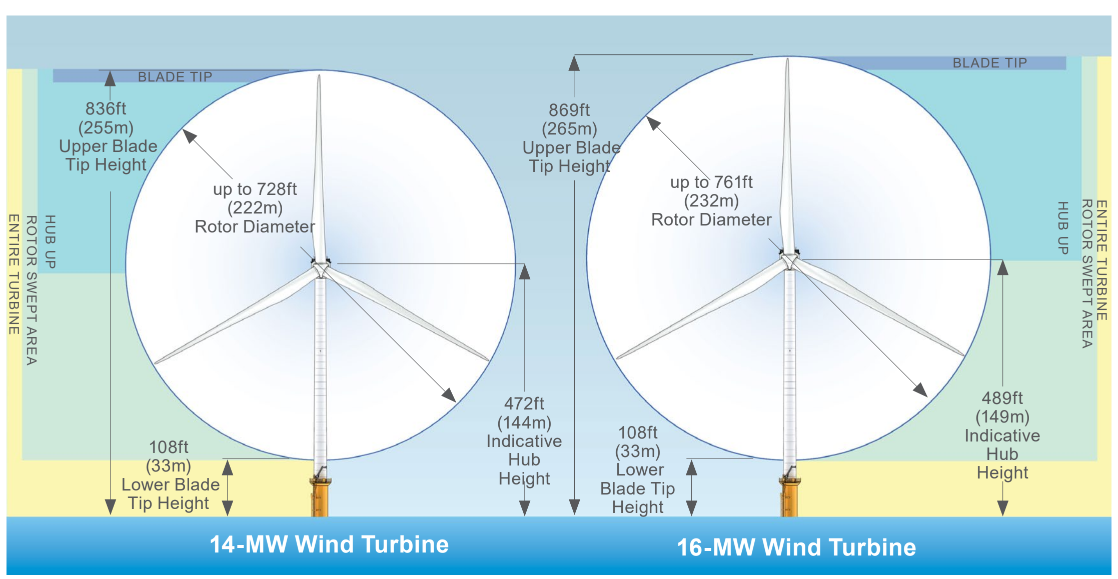


Vicinity Map

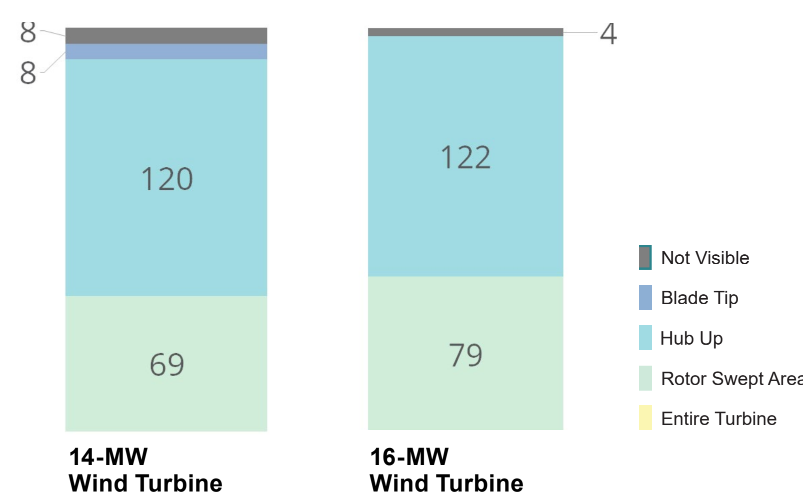


Existing Panoramic View

Located on Virginia Beach Boardwalk Fishing Pier



Turbine Dimensions



Turbine Visibility

FIELD ID # 24d

PHOTO INFORMATION	
Date	7/10/2021
Time	9:37 pm
Latitude	36.843709°
Longitude	-75.969876°
Direction of View	E
Elevation	25'
Horizontal Field of View Represented in Simulated Image	48°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	78° F
Humidity	6%
Wind Direction	SSE
Wind Speed	6 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	27.6 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	47.9%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 24d: Virginia Beach Boardwalk - Fishing Pier Nighttime
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

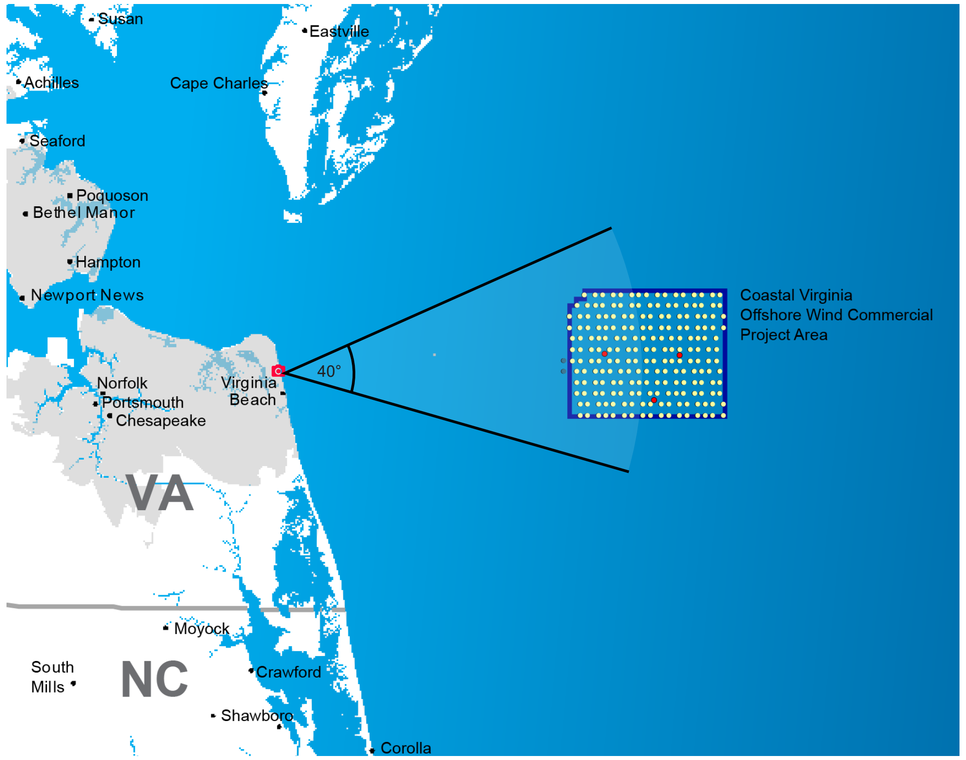
KOP 24d: Virginia Beach Boardwalk - Fishing Pier Nighttime
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 26: Marriott Virginia Beach Oceanfront Hotel

Virginia Beach, VA

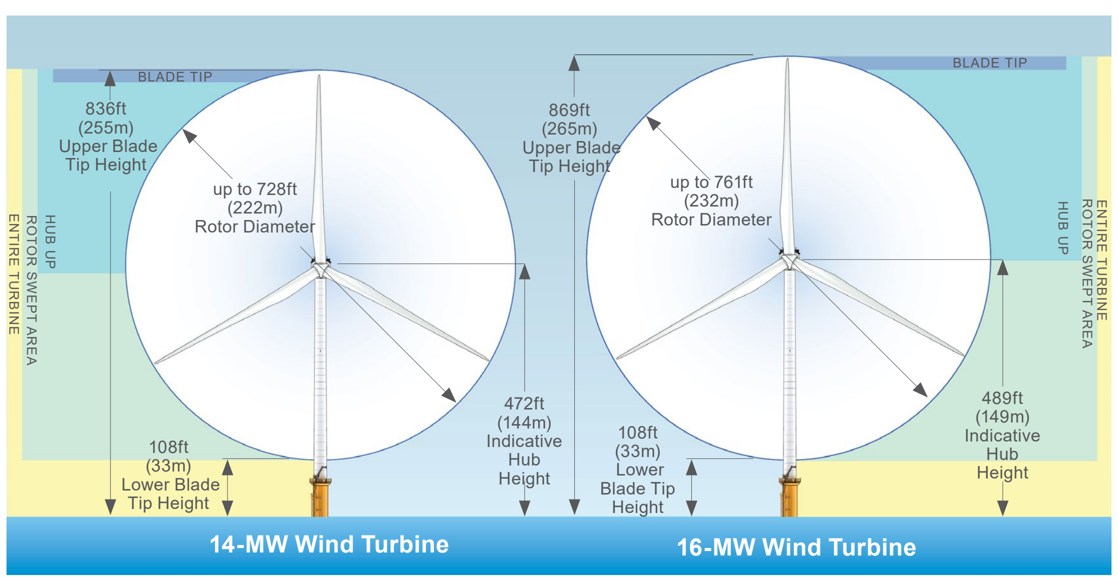


Vicinity Map

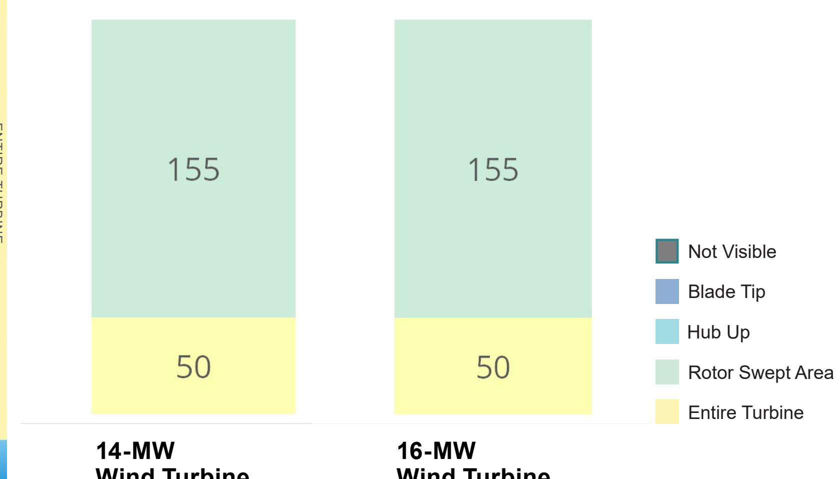
Pilot Project Turbine · Turbine Location · Photo Point · Chesapeake Light Tower · Offshore Substation · Lease Area

Existing Panoramic View

Located on rooftop of Marriott Virginia Beach Oceanfront hotel



Turbine Dimensions



Turbine Visibility

FIELD ID # 26

PHOTO INFORMATION	
Date	9/29/2021
Time	10:56am
Latitude	36.870082°
Longitude	-75.980527°
Direction of View	E
Elevation	236'
Horizontal Field of View Represented in Simulated Image	40°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	71° F
Humidity	61%
Wind Direction	NNE
Wind Speed	10 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	28.0 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	57.5%
Vertical Area Occupied by Visible Turbines	0.3°

Image Data

KOP 26: Marriott Virginia Beach Oceanfront Hotel
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

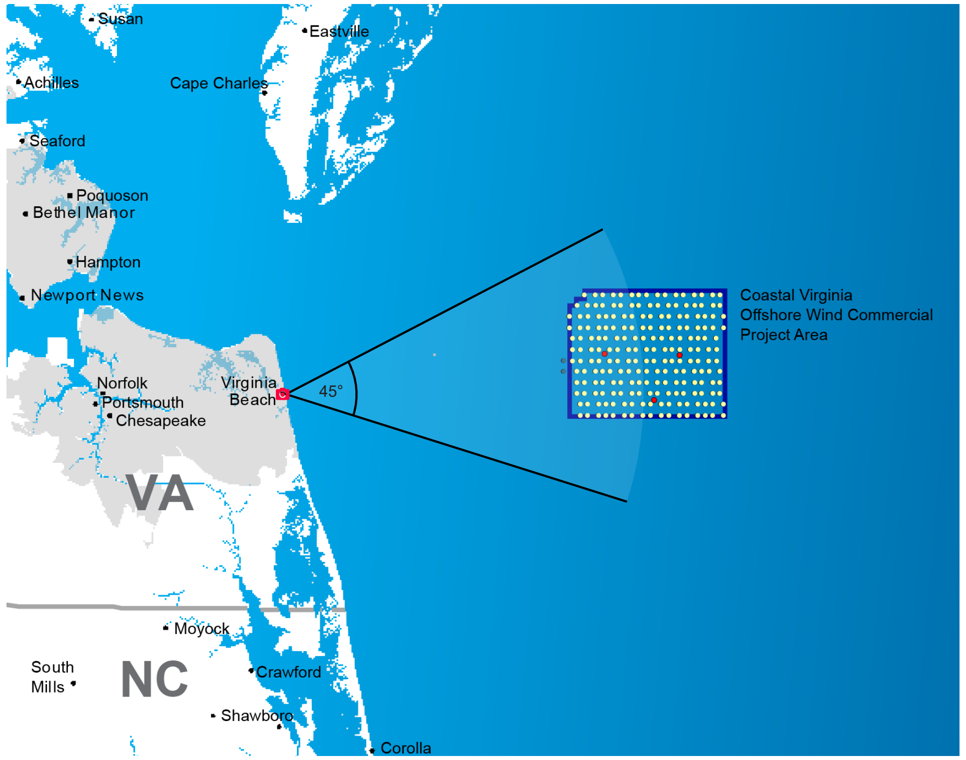
KOP 26: Marriott Virginia Beach Oceanfront Hotel
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 29: Grommet Island Park

Virginia Beach, VA

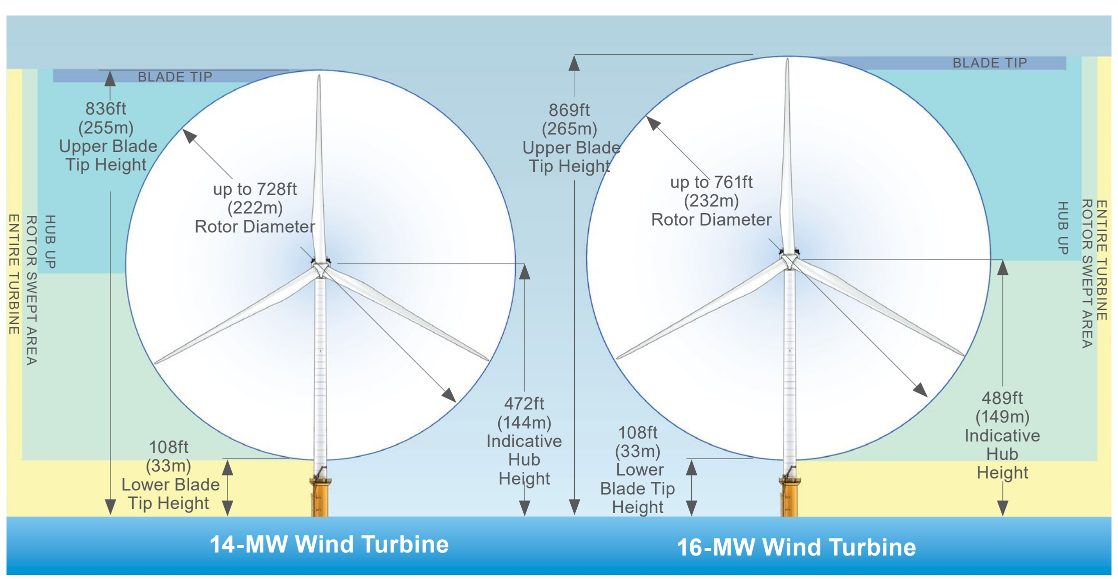


Vicinity Map

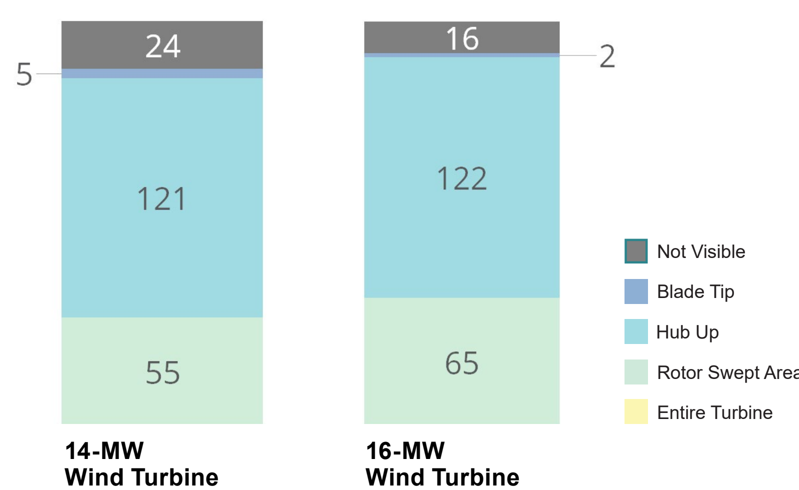
- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

Existing Panoramic View

Located on Virginia Beach Boardwalk, near Grommet Island Park



Turbine Dimensions



Turbine Visibility

FIELD ID # 29

PHOTO INFORMATION	
Date	7/8/2021
Time	12:04pm
Latitude	36.831427°
Longitude	-75.969656°
Direction of View	E
Elevation	18'
Horizontal Field of View Represented in Simulated Image	45°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

Image Data

ENVIRONMENTAL	
Temperature	82° F
Humidity	79%
Wind Direction	S
Wind Speed	18 mph
Weather Condition	Rain

PROJECT VIEW	
Distance to Nearest Turbine	27.7 miles
Horizontal Area Occupied by Visible Turbines	23°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	51.1%
Vertical Area Occupied by Visible Turbines	0.2°

KOP 29: Grommet Island Park

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

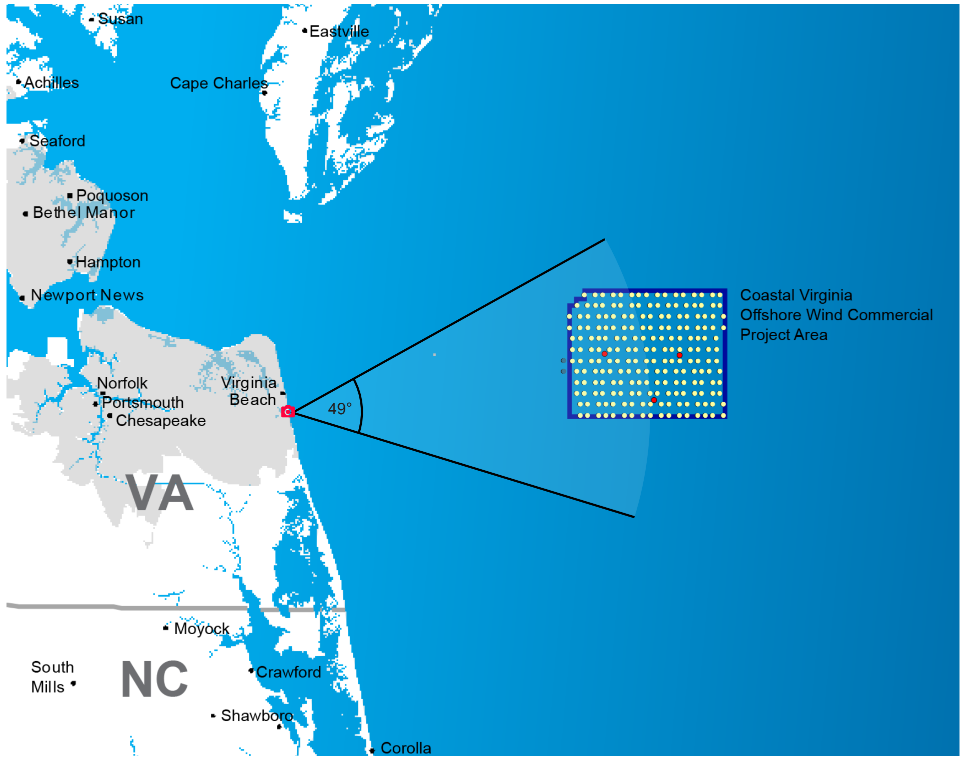
KOP 29: Grommet Island Park
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 30a: Croatan Beach A - North

Virginia Beach, VA

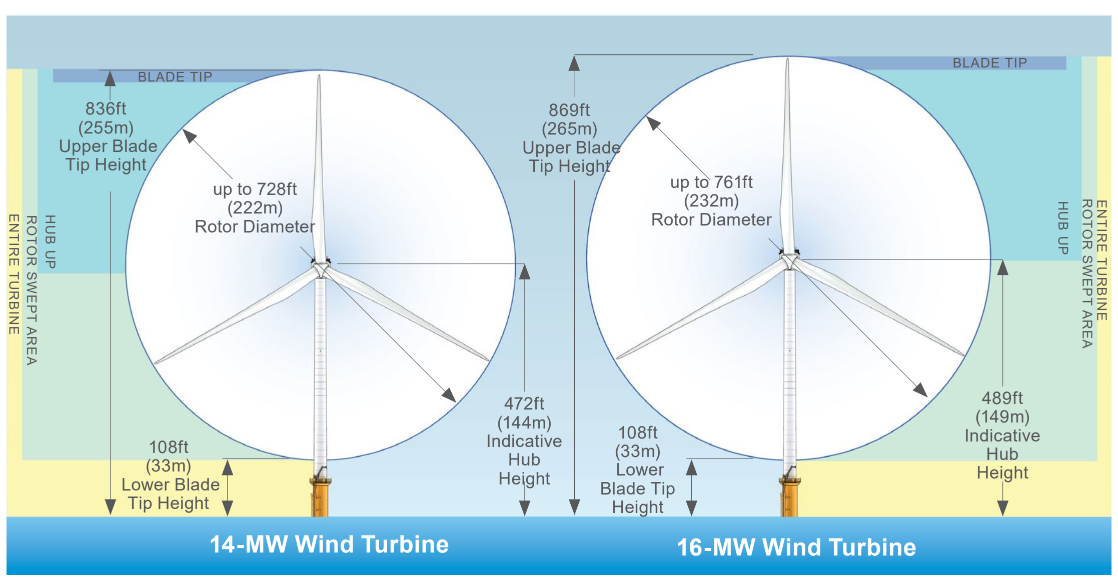


Vicinity Map

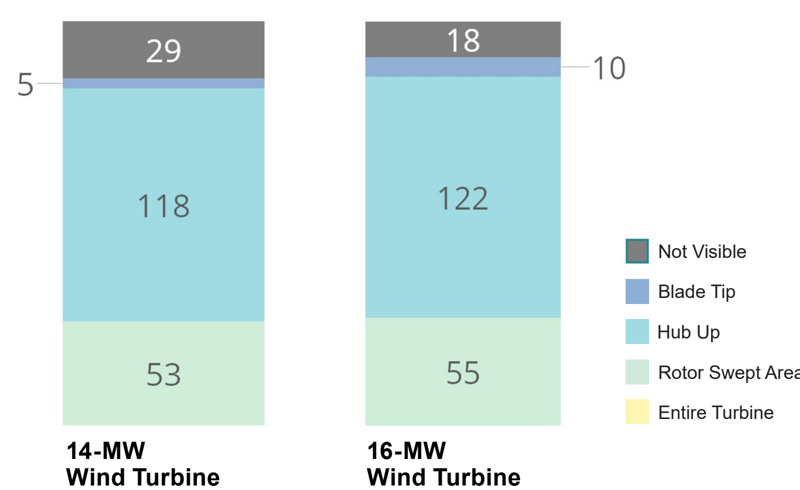
Pilot Project Turbine · Turbine Location · Photo Point · Chesapeake Light Tower · Offshore Substation · Lease Area

Existing Panoramic View

Located on Croatan Beach



Turbine Dimensions



Turbine Visibility

FIELD ID # 30a

PHOTO INFORMATION	
Date	7/8/2021
Time	11:00 AM
Latitude	36.827570°
Longitude	-75.968610°
Direction of View	ENE
Elevation	15'
Horizontal Field of View Represented in Simulated Image	49°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	84° F
Humidity	72%
Wind Direction	SSW
Wind Speed	15 mph
Weather Condition	Overcast

PROJECT VIEW	
Distance to Nearest Turbine	27.6 miles
Horizontal Area Occupied by Visible Turbines	22.5°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	45.9%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 30a: Croatan Beach A - North

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

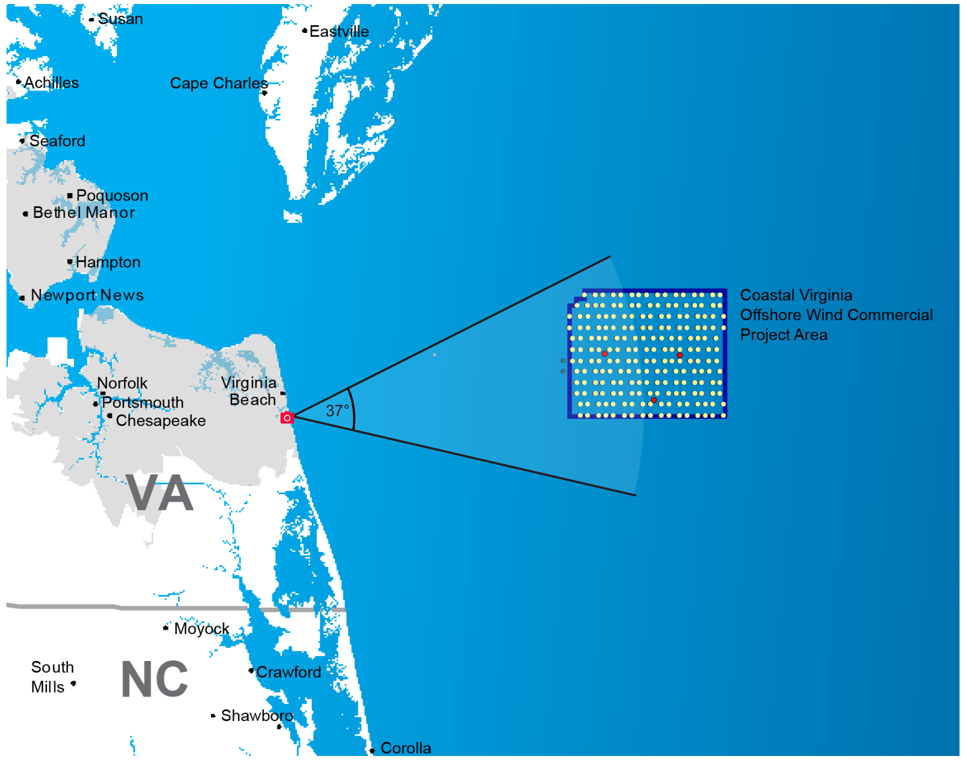
KOP 30a: Croatan Beach A - North
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

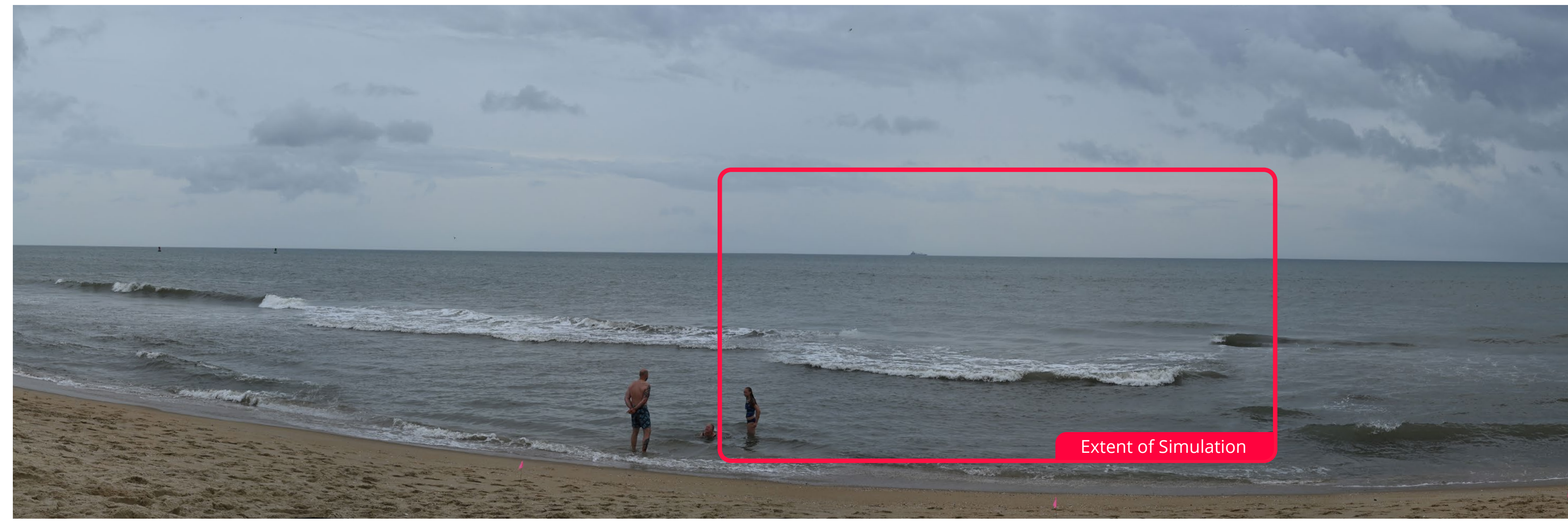
KOP 30c: Croatan Beach C - South

Virginia Beach, VA



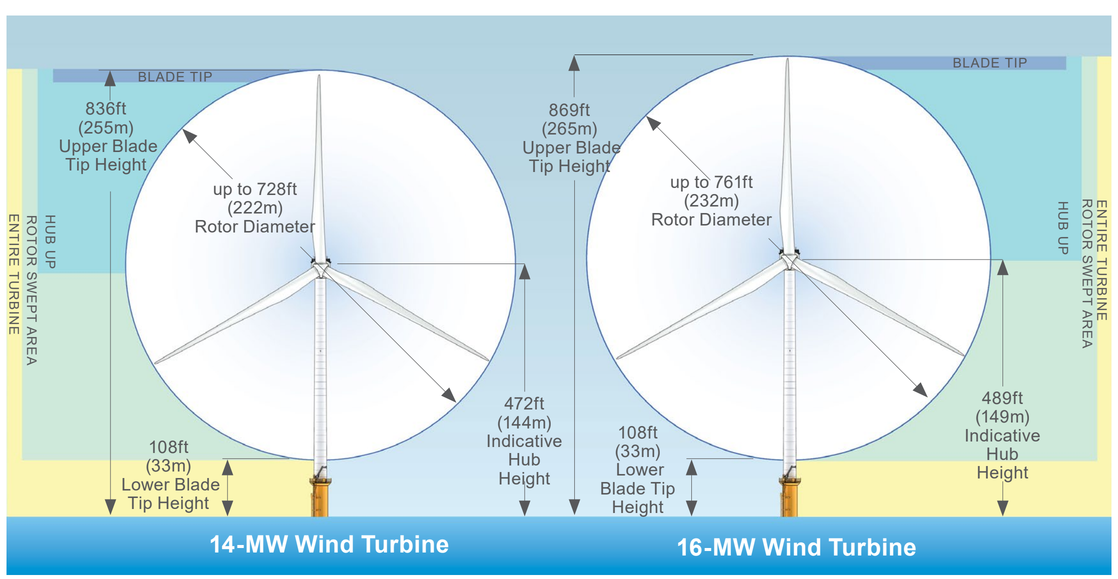
Vicinity Map

Pilot Project Turbine · Turbine Location · Photo Point · Chesapeake Light Tower · Offshore Substation · Lease Area

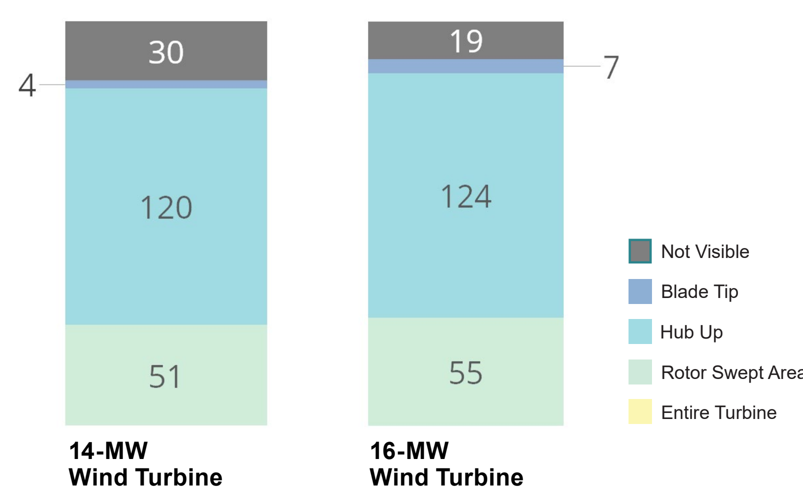


Existing Panoramic View

Located on Croatan Beach



Turbine Dimensions



Turbine Visibility

FIELD ID # 30c

PHOTO INFORMATION	
Date	7/8/2021
Time	11:18 am
Latitude	36.823557°
Longitude	-75.968028°
Direction of View	NE
Elevation	15'
Horizontal Field of View Represented in Simulated Image	37°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	84° F
Humidity	72%
Wind Direction	SSW
Wind Speed	15 mph
Weather Condition	Mostly Cloudy

PROJECT VIEW	
Distance to Nearest Turbine	27.6 miles
Horizontal Area Occupied by Visible Turbines	22.5°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	60.8%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 30c: Croatan Beach C - South

Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 30c: Croatan Beach C - South

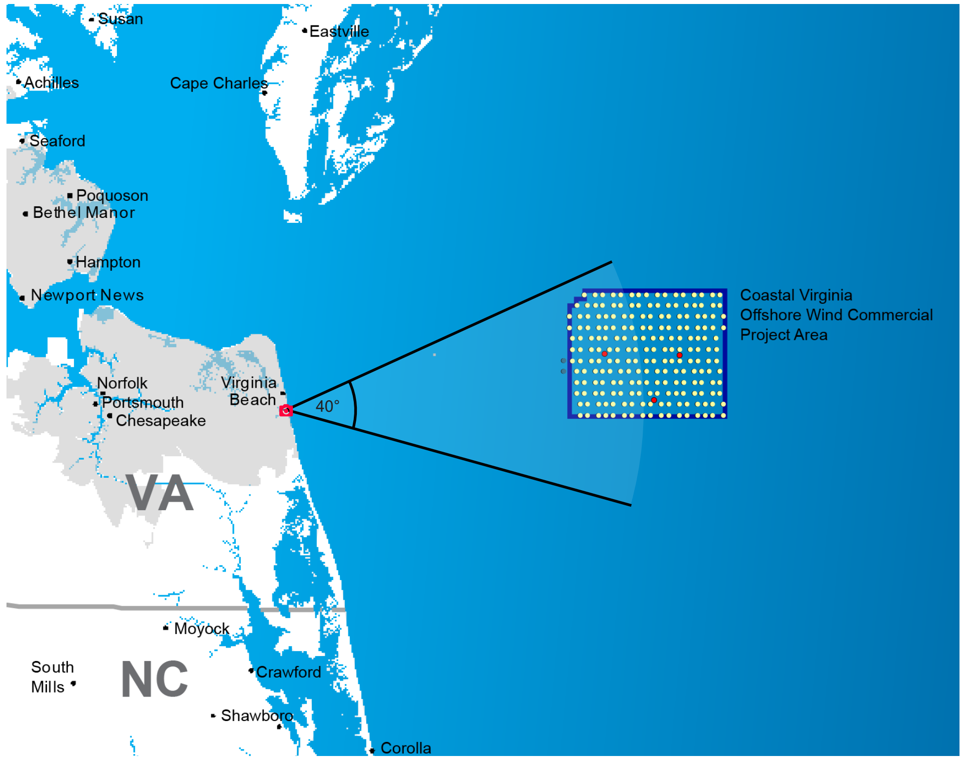
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

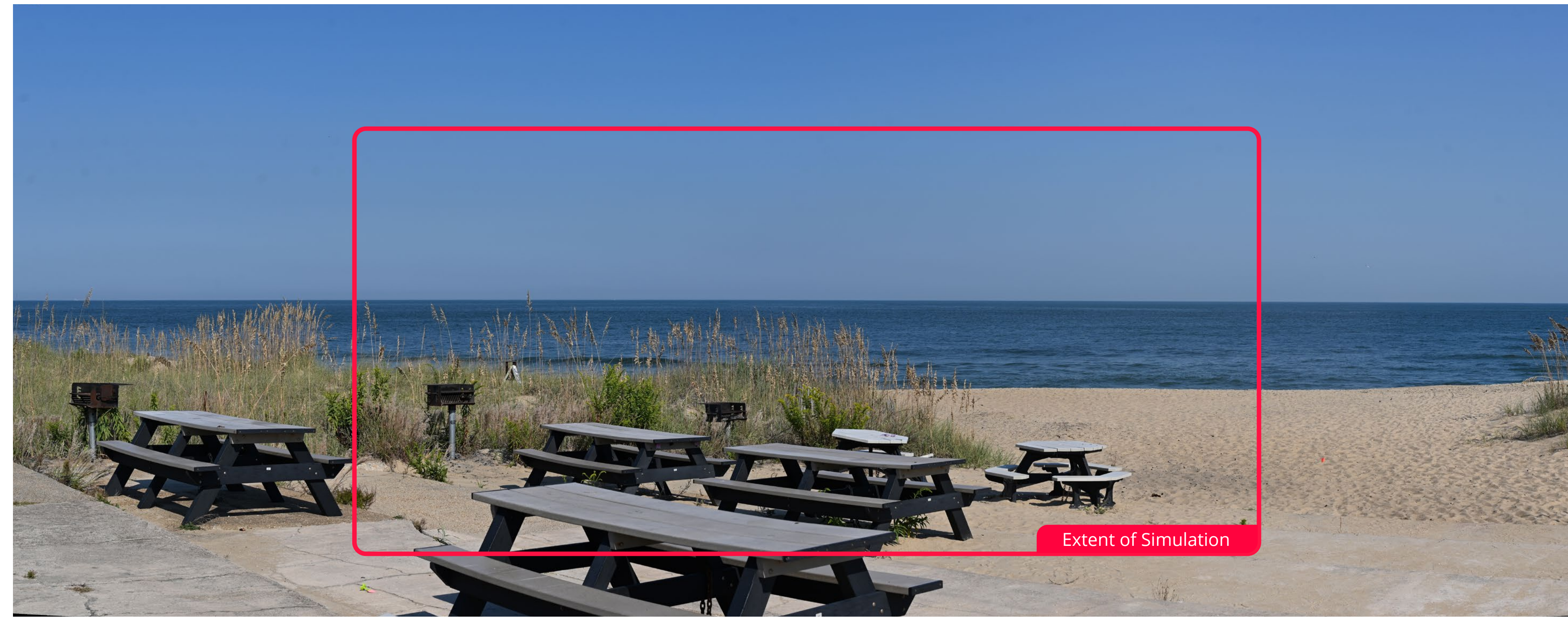
KOP 31: Picnic Views at State Military Reservation

Virginia Beach, VA



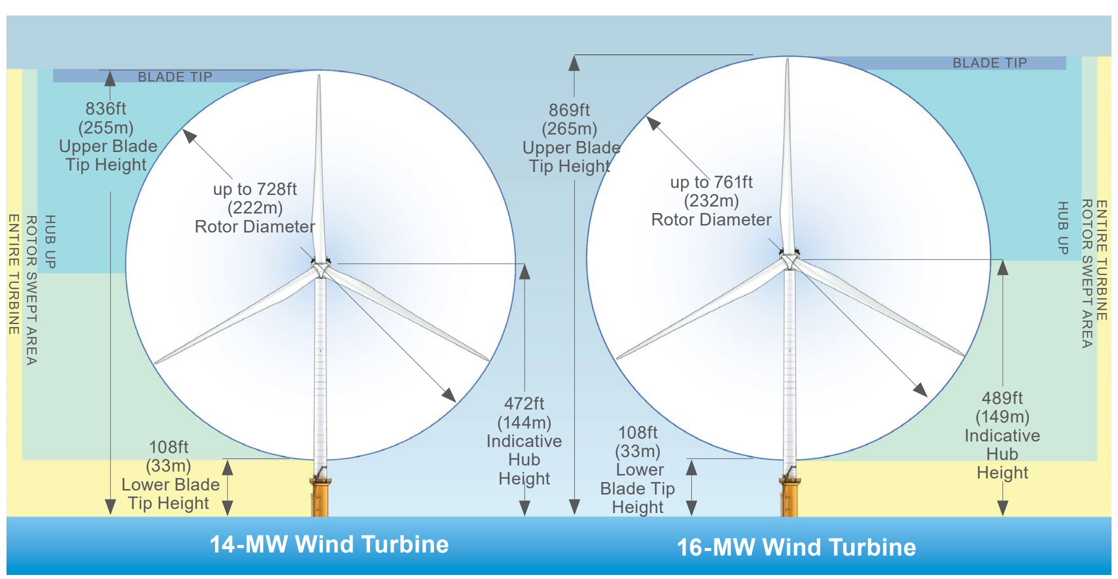
Vicinity Map

- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

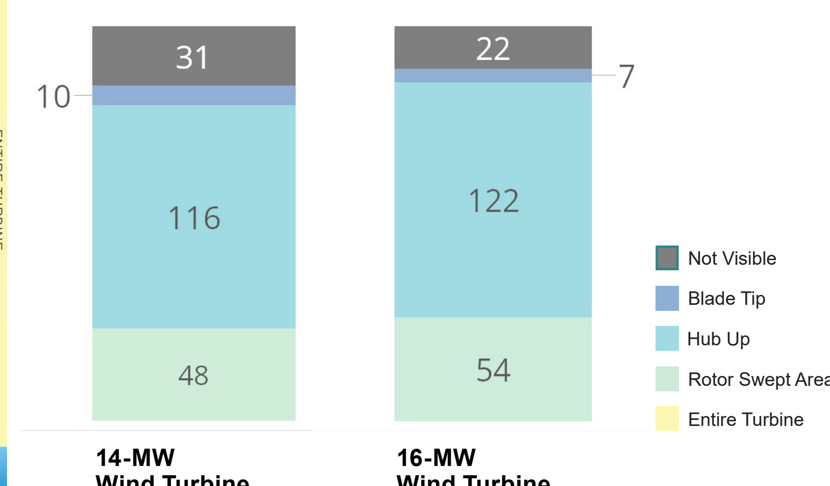


Existing Panoramic View

Located on Picnic Area near State Military Reservation



Turbine Dimensions



Turbine Visibility

FIELD ID # 31

PHOTO INFORMATION	
Date	9/28/2021
Time	1:11pm
Latitude	36.815689°
Longitude	-75.967075°
Direction of View	E
Elevation	14'
Horizontal Field of View Represented in Simulated Image	40°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	82° F
Humidity	51%
Wind Direction	SW
Wind Speed	9 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	27.6 miles
Horizontal Area Occupied by Visible Turbines	22°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	55.0%
Vertical Area Occupied by Visible Turbines	0.2°

Image Data

KOP 31: Picnic Views at State Military Reservation
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 31: Picnic Views at State Military Reservation

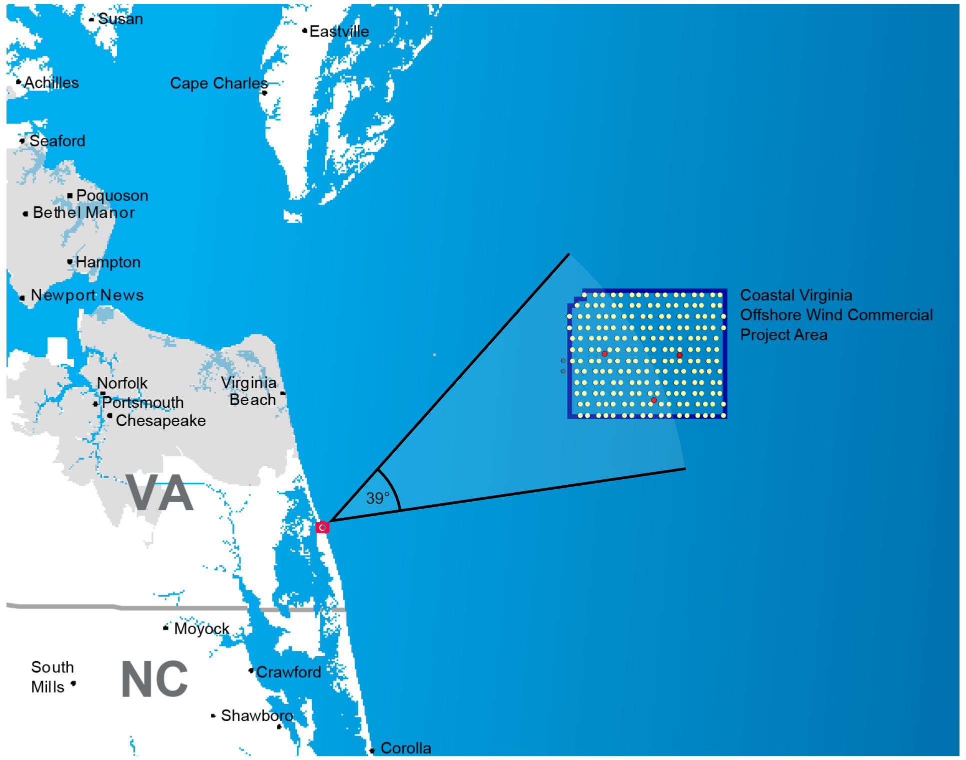
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 44a: Little Island Park/Back Bay NWR

Virginia Beach, VA

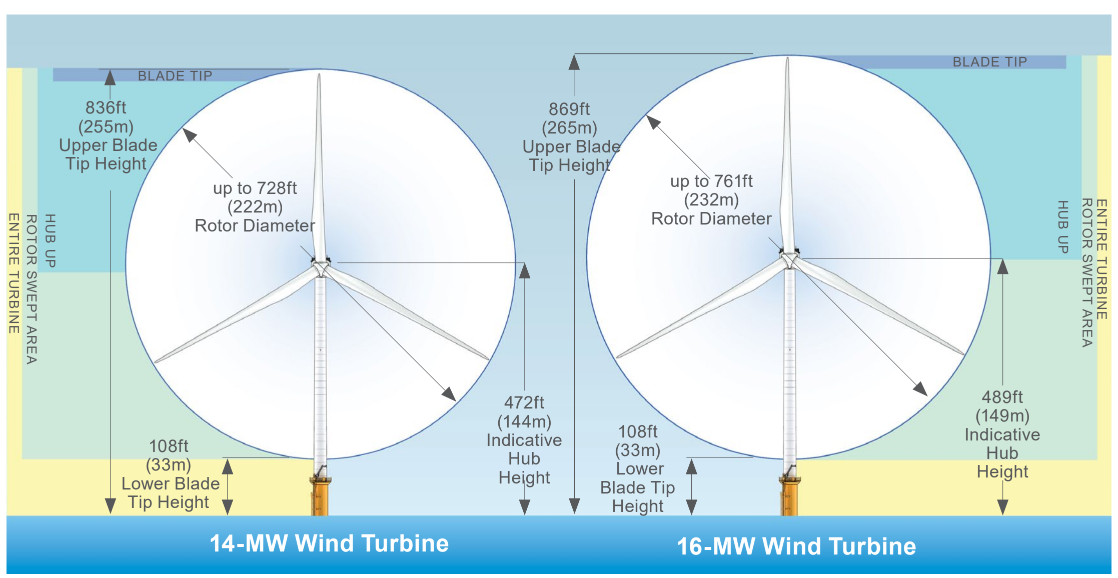


Vicinity Map

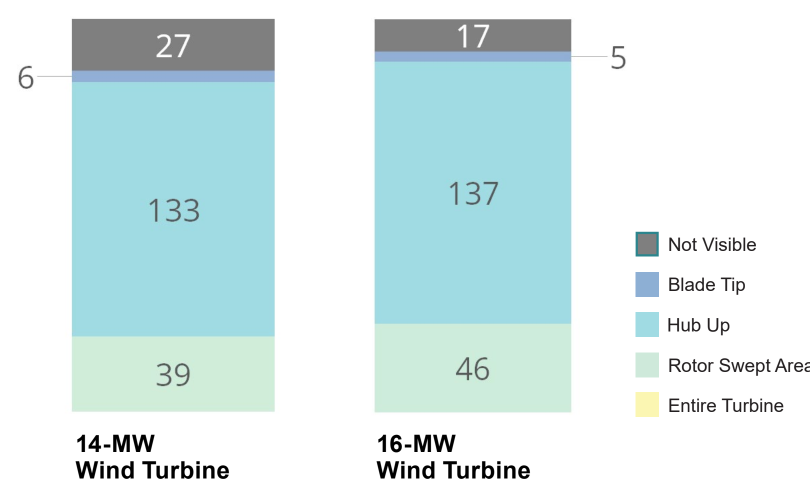
Pilot Project Turbine · Turbine Location · Photo Point · Chesapeake Light Tower · Offshore Substation · Lease Area

Existing Panoramic View

Located on Little Island Park near Sandpiper Rd.



Turbine Dimensions



Turbine Visibility

Image Data

FIELD ID # 44a

PHOTO INFORMATION	
Date	8/11/2023
Time	11:30 AM
Latitude	36.668282°
Longitude	-75.909911°
Direction of View	NE
Elevation	15'
Horizontal Field of View Represented in Simulated Image	39°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

CAMERA+LENS

Canon EOS R5, Canon RF 50mm

ENVIRONMENTAL	
Temperature	84° F
Humidity	49%
Wind Direction	VAR
Wind Speed	5 mph
Weather Condition	Clear

PROJECT VIEW	
Distance to Nearest Turbine	26.8 miles
Horizontal Area Occupied by Visible Turbines	26°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	66.7%
Vertical Area Occupied by Visible Turbines	0.2°

Note: The WTG's at KOP 44a have been rendered with RAL7035 as described in the VIA

KOP 44a: Little Island Park/Back Bay NWR
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

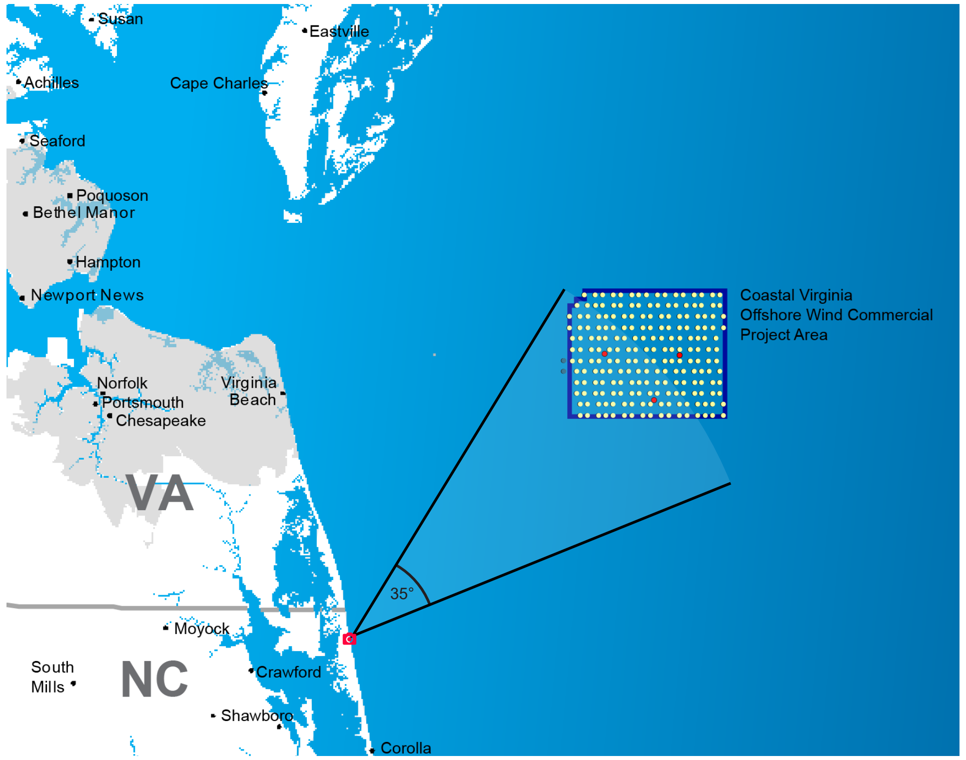
KOP 44a: Little Island Park/Back Bay NWR
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 47: Currituck National Wildlife Refuge

Corolla, NC



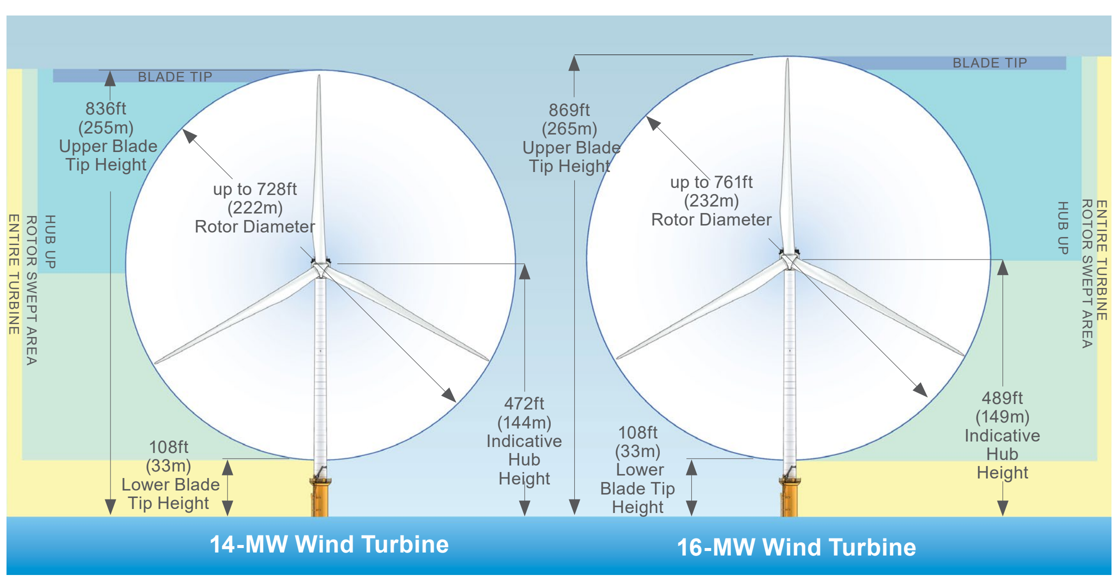
Vicinity Map

- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

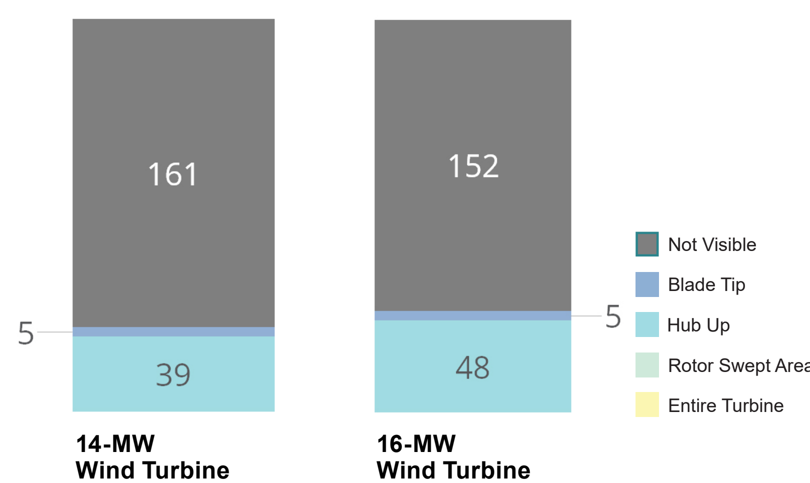
Existing Panoramic View

Located on Currituck National Wildlife Refuge
near N Beach Access Rd 12

FIELD ID # 47



Turbine Dimensions



Turbine Visibility

PHOTO INFORMATION	
Date	7/7/2021
Time	10:58am
Latitude	36.417169°
Longitude	-75.834243°
Direction of View	NE
Elevation	15'
Horizontal Field of View Represented in Simulated Image	35°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	88° F
Humidity	57%
Wind Direction	SSW
Wind Speed	9 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	34.6 miles
Horizontal Area Occupied by Visible Turbines	12.5°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	35.7%
Vertical Area Occupied by Visible Turbines	0.15°

Image Data

KOP 47: Currituck National Wildlife Refuge
Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

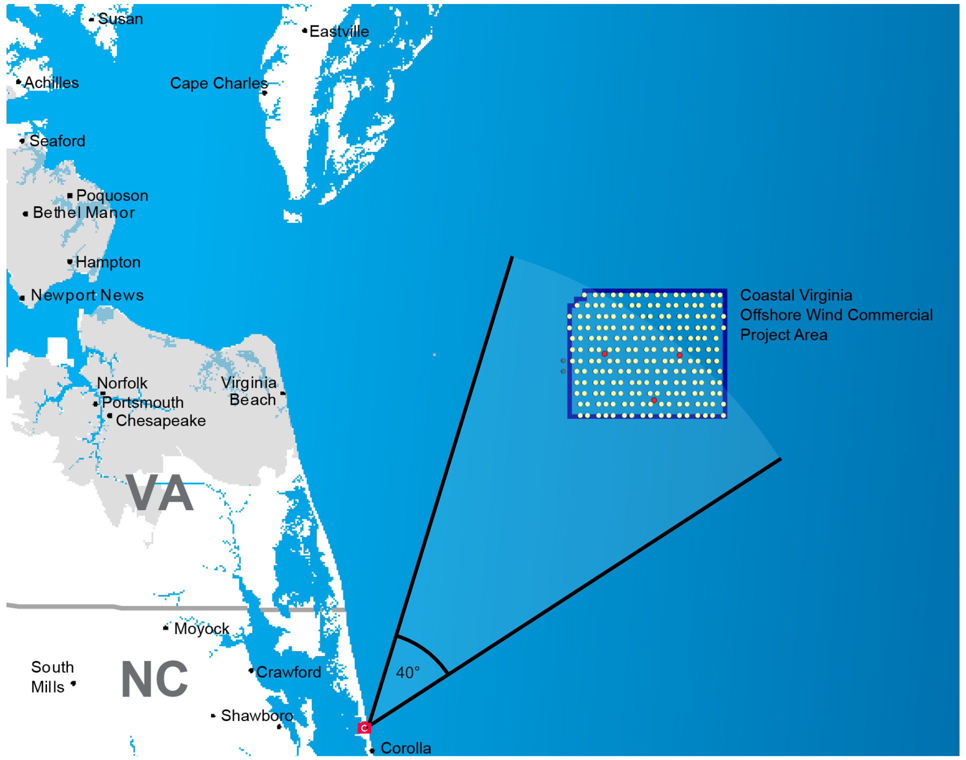
KOP 47: Currituck National Wildlife Refuge
Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

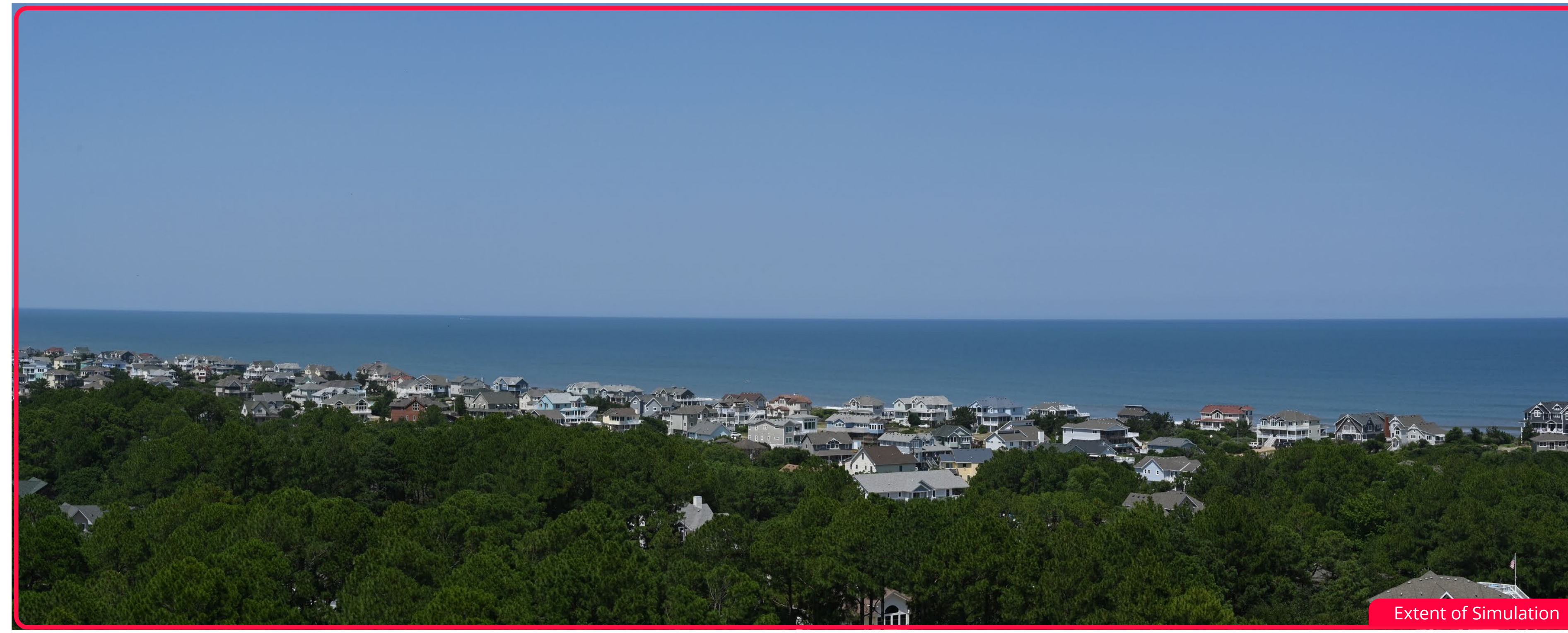
KOP 48: Currituck Beach Lighthouse

Corolla, NC



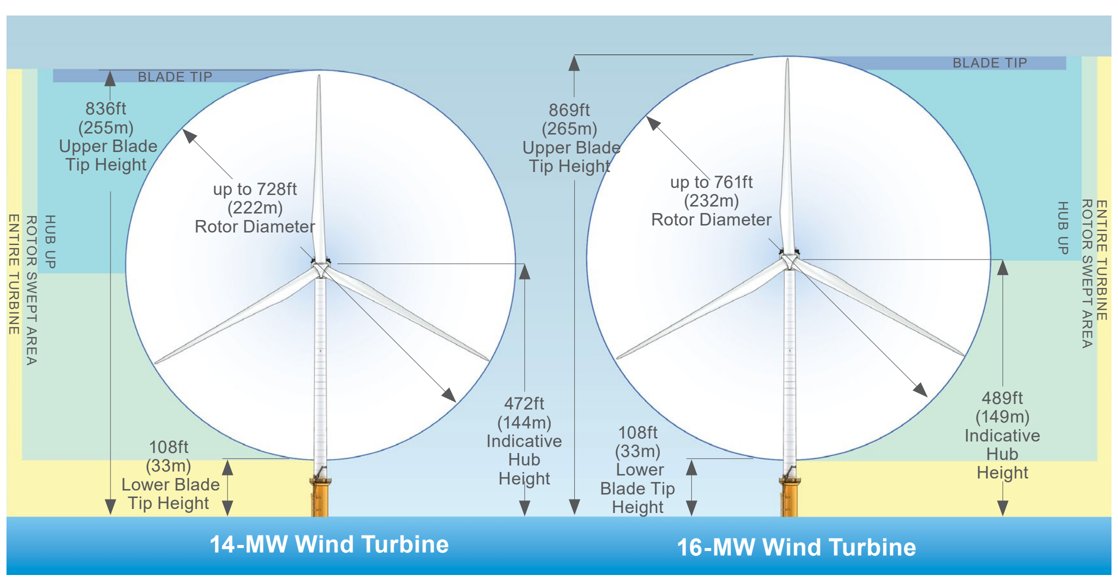
Vicinity Map

- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

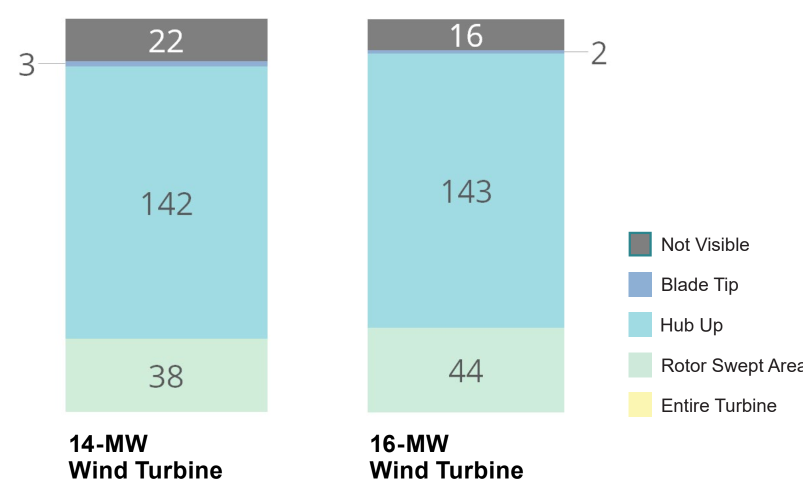


Existing Panoramic View

Located on the Currituck Beach Lighthouse observation deck.



Turbine Dimensions



Turbine Visibility

FIELD ID # 48

PHOTO INFORMATION	
Date	7/7/2021
Time	2:40 PM
Latitude	36.376709°
Longitude	-75.830790°
Direction of View	NE
Elevation	155'
Horizontal Field of View Represented in Simulated Image	40°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	93° F
Humidity	38%
Wind Direction	S
Wind Speed	14 mph
Weather Condition	Clear

PROJECT VIEW	
Distance to Nearest Turbine	36.8 miles
Horizontal Area Occupied by Visible Turbines	22°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	55.0%
Vertical Area Occupied by Visible Turbines	0.4°

Image Data

KOP 48: Currituck Beach Lighthouse

Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

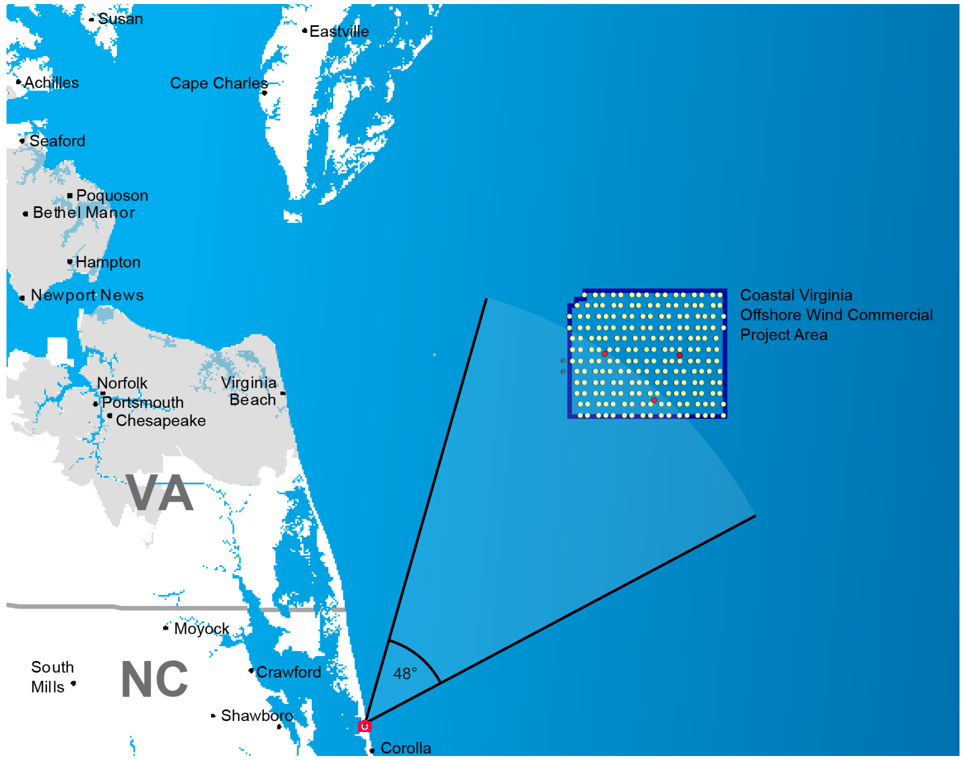
KOP 48: Currituck Beach Lighthouse
Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 49a: Whale Head Bay - Residential

Corolla, NC

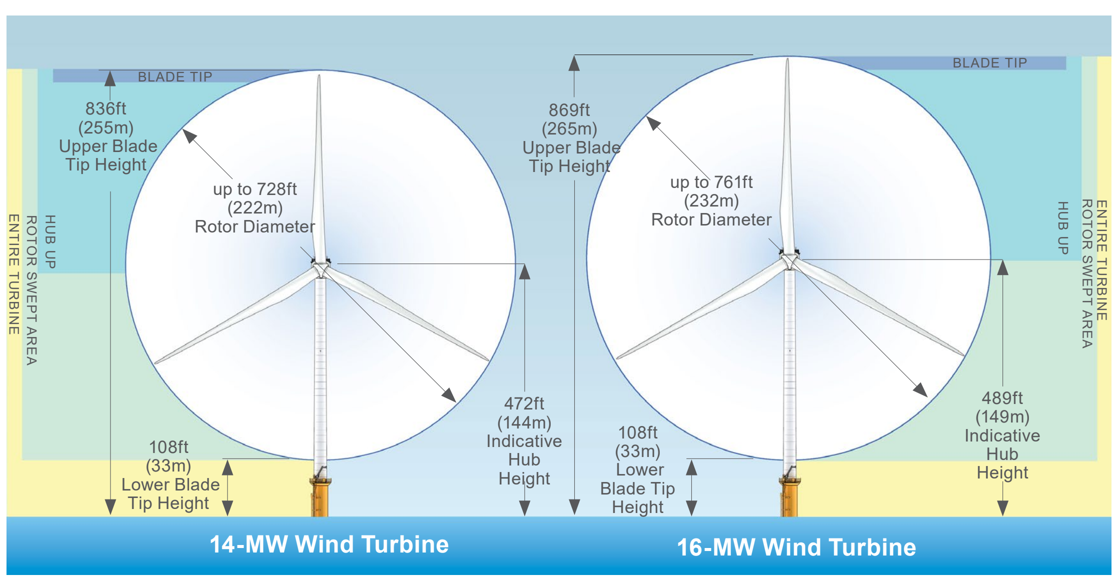


Vicinity Map

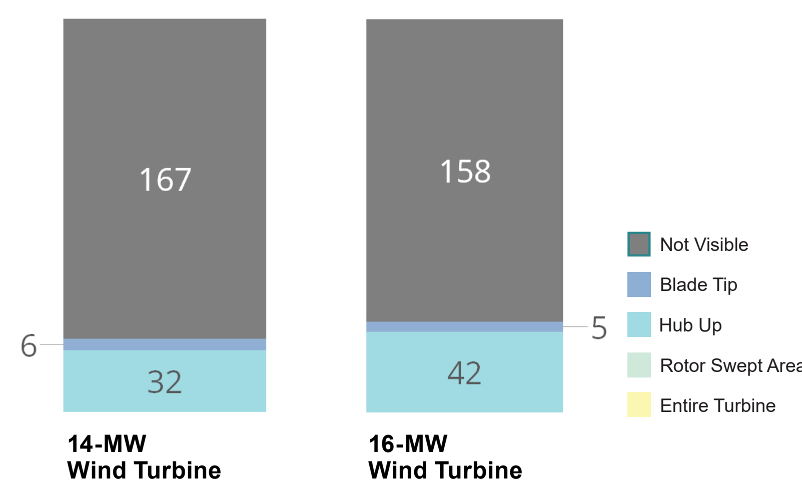
Pilot Project Turbine · Chesapeake Light Tower · Turbine Location · Offshore Substation · Photo Point · Lease Area

Existing Panoramic View

Located on Corolla Beach, near Corolla Beach Rd.



Turbine Dimensions



Turbine Visibility

FIELD ID # 49a

PHOTO INFORMATION	
Date	7/7/2021
Time	12:20 PM
Latitude	36.377628°
Longitude	-75.824152°
Direction of View	NE
Elevation	25'
Horizontal Field of View Represented in Simulated Image	48°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	91° F
Humidity	48%
Wind Direction	SW
Wind Speed	13 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	36.6 miles
Horizontal Area Occupied by Visible Turbines	14.5°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	30.2%
Vertical Area Occupied by Visible Turbines	0.1°

Image Data

KOP 49a: Whale Head Bay - Residential

Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

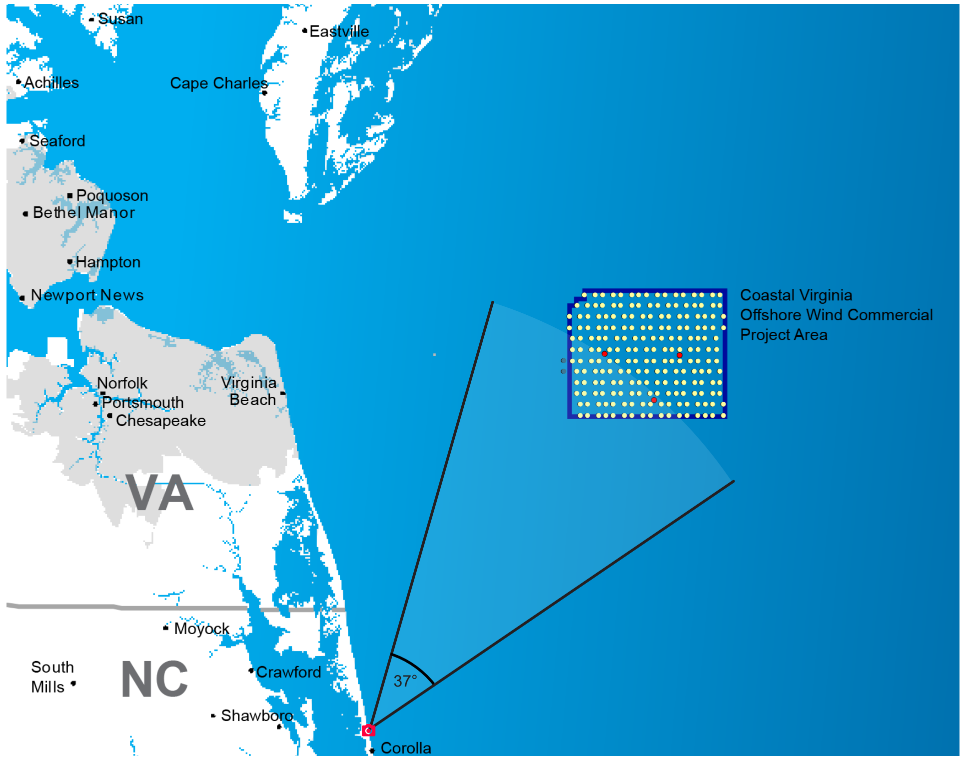
KOP 49a: Whale Head Bay - Residential
Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

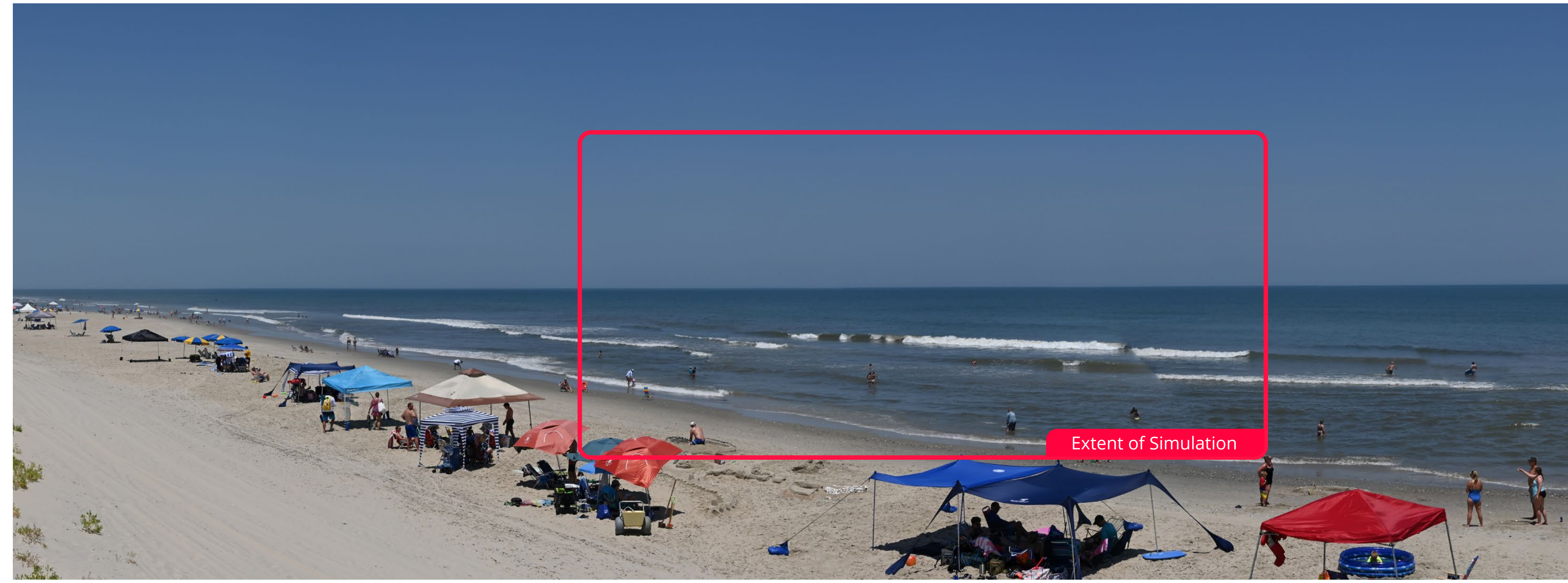
KOP 49g: Whale Head Bay - Albacore St Entrance

Corolla, NC



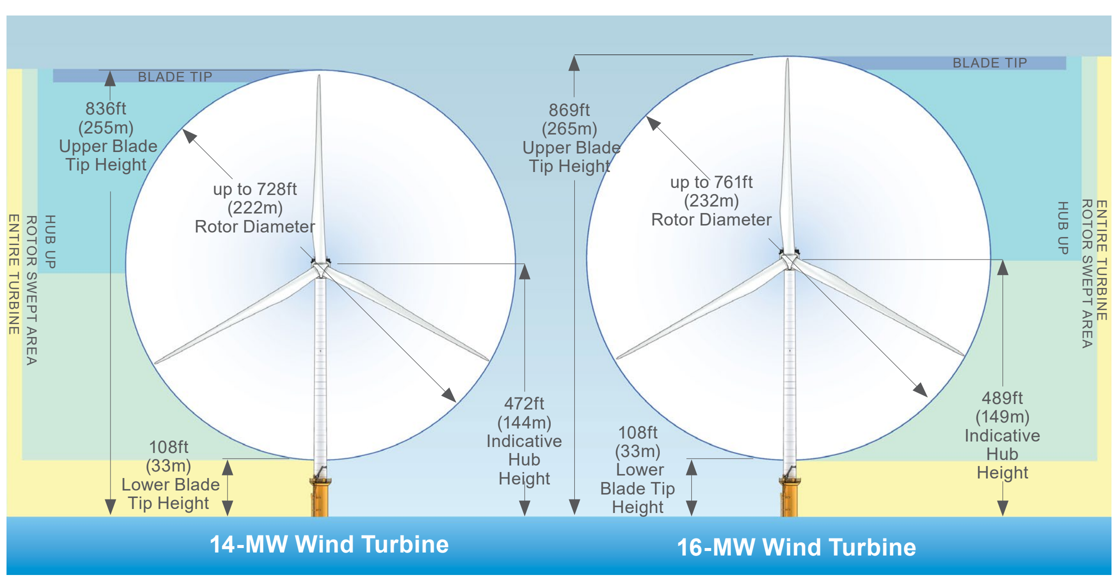
Vicinity Map

- Pilot Project Turbine
- Chesapeake Light Tower
- Turbine Location
- Offshore Substation
- Photo Point
- Lease Area

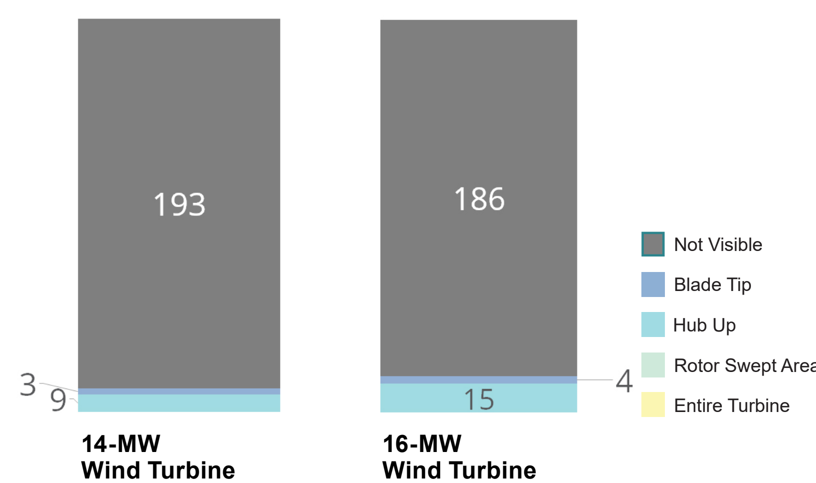


Existing Panoramic View

Located on Corolla Beach, near Corolla Beach Rd.



Turbine Dimensions



Turbine Visibility

FIELD ID # 49g

PHOTO INFORMATION	
Date	7/7/2021
Time	12:20 PM
Latitude	36.328344°
Longitude	-75.810450°
Direction of View	NE
Elevation	25'
Horizontal Field of View Represented in Simulated Image	37°

PROJECT INFRASTRUCTURE	
Turbines	205
Offshore Substations	3

ENVIRONMENTAL	
Temperature	93° F
Humidity	42%
Wind Direction	S
Wind Speed	12 mph
Weather Condition	Fair

PROJECT VIEW	
Distance to Nearest Turbine	39.1 miles
Horizontal Area Occupied by Visible Turbines	9°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	24.3%
Vertical Area Occupied by Visible Turbines	0.05°

Image Data

KOP 49g: Whale Head Bay - Albacore St Entrance

Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 14-MW Wind Turbine

KOP 49g: Whale Head Bay - Albacore St Entrance

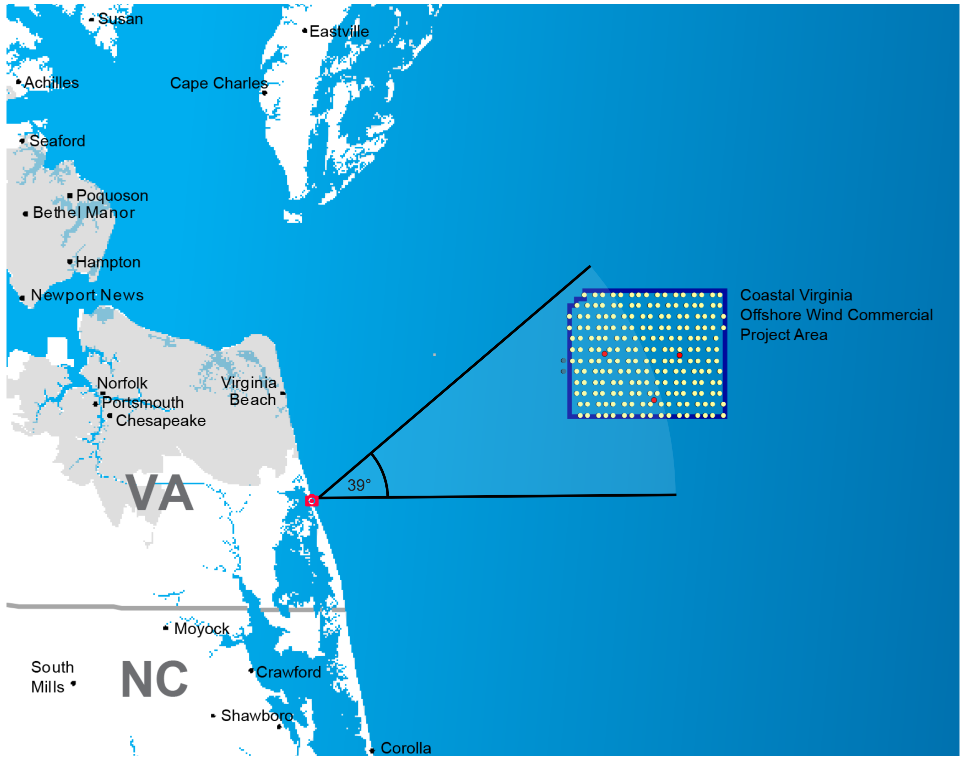
Corolla, NC

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).

Visual Simulation: 16-MW Wind Turbine

KOP 50: Little Island Park/Back Bay NWR - Nighttime

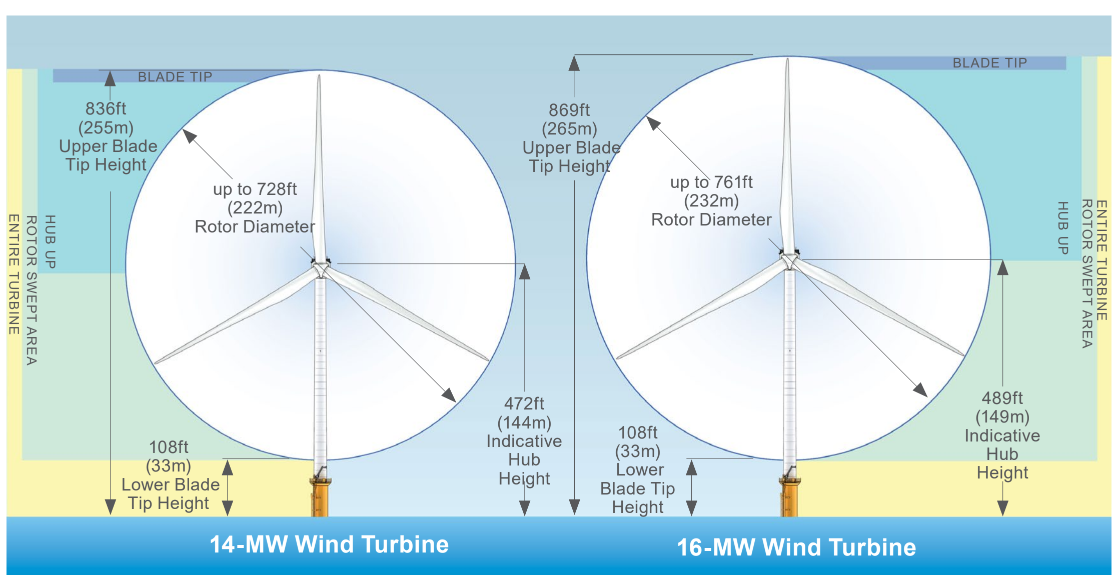
Virginia Beach, VA



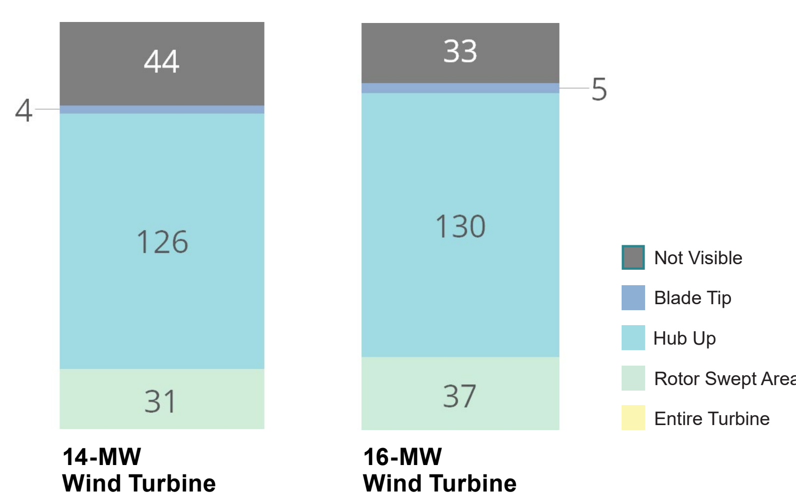
Vicinity Map

Existing Panoramic View

Located on Little Island Park, approx. .3mi south of the Sandbridge Fishing Pier



Turbine Dimensions



Turbine Visibility

FIELD ID # 50

PHOTO INFORMATION

Date	8/11/2023
Time	9:50 PM
Latitude	36.689965°
Longitude	--75.921312°
Direction of View	NNE
Elevation	10'
Horizontal Field of View Represented in Simulated Image	39°

PROJECT INFRASTRUCTURE

Turbines	205
Offshore Substations	3

CAMERA+LENS

Canon EOS R5, Canon RF 50mm

ENVIRONMENTAL

Temperature	77° F
Humidity	84%
Wind Direction	NW
Wind Speed	5mph
Weather Condition	Partly Cloudy

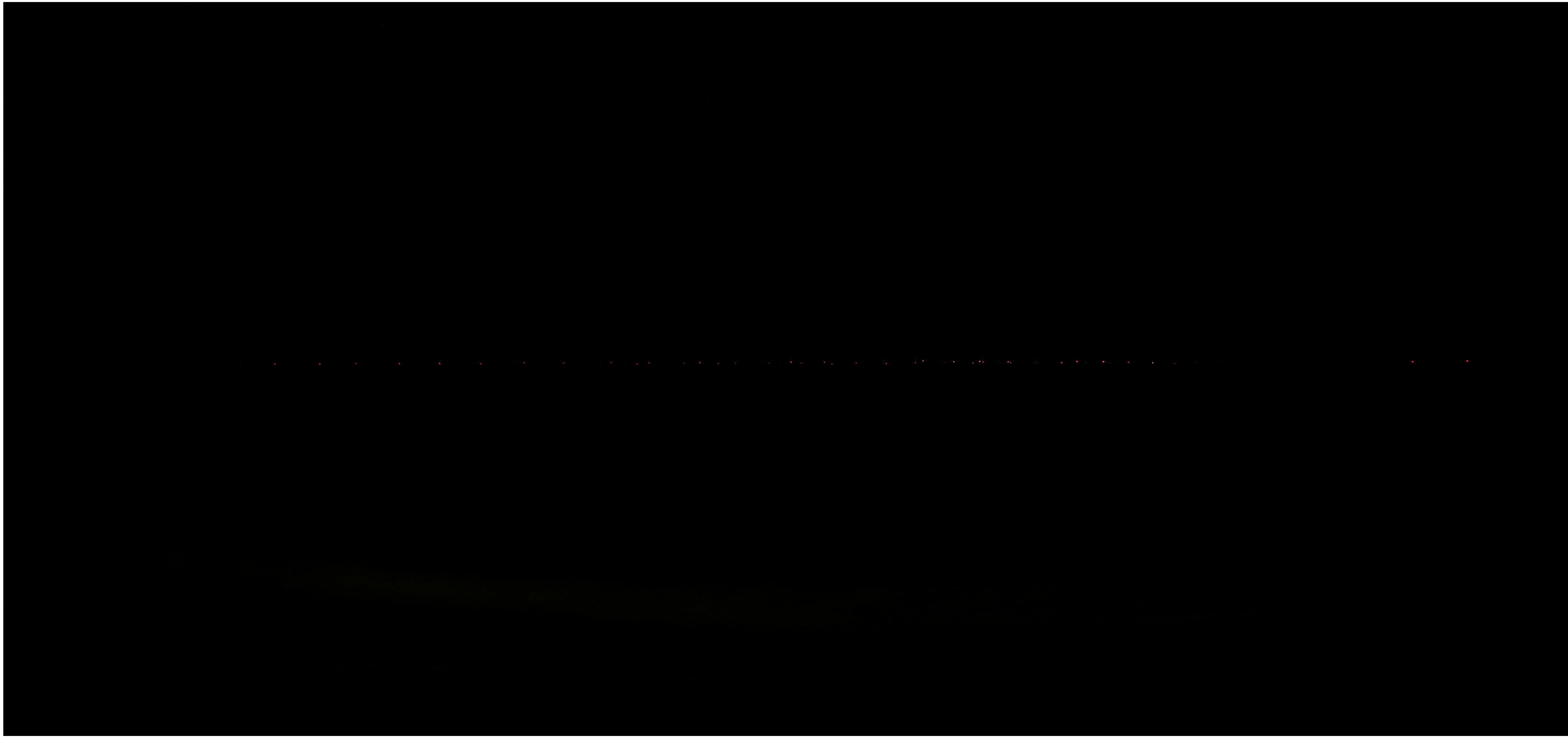
PROJECT VIEW

Distance to Nearest Turbine	26.9 miles
Horizontal Area Occupied by Visible Turbines	26°
Area Occupied by Visible Turbines as a Percent of the Horizontal FOV	66.6%
Vertical Area Occupied by Visible Turbines	0.17°

Image Data

KOP 50: Little Island Park/Back Bay NWR - Nighttime
Virginia Beach, VA

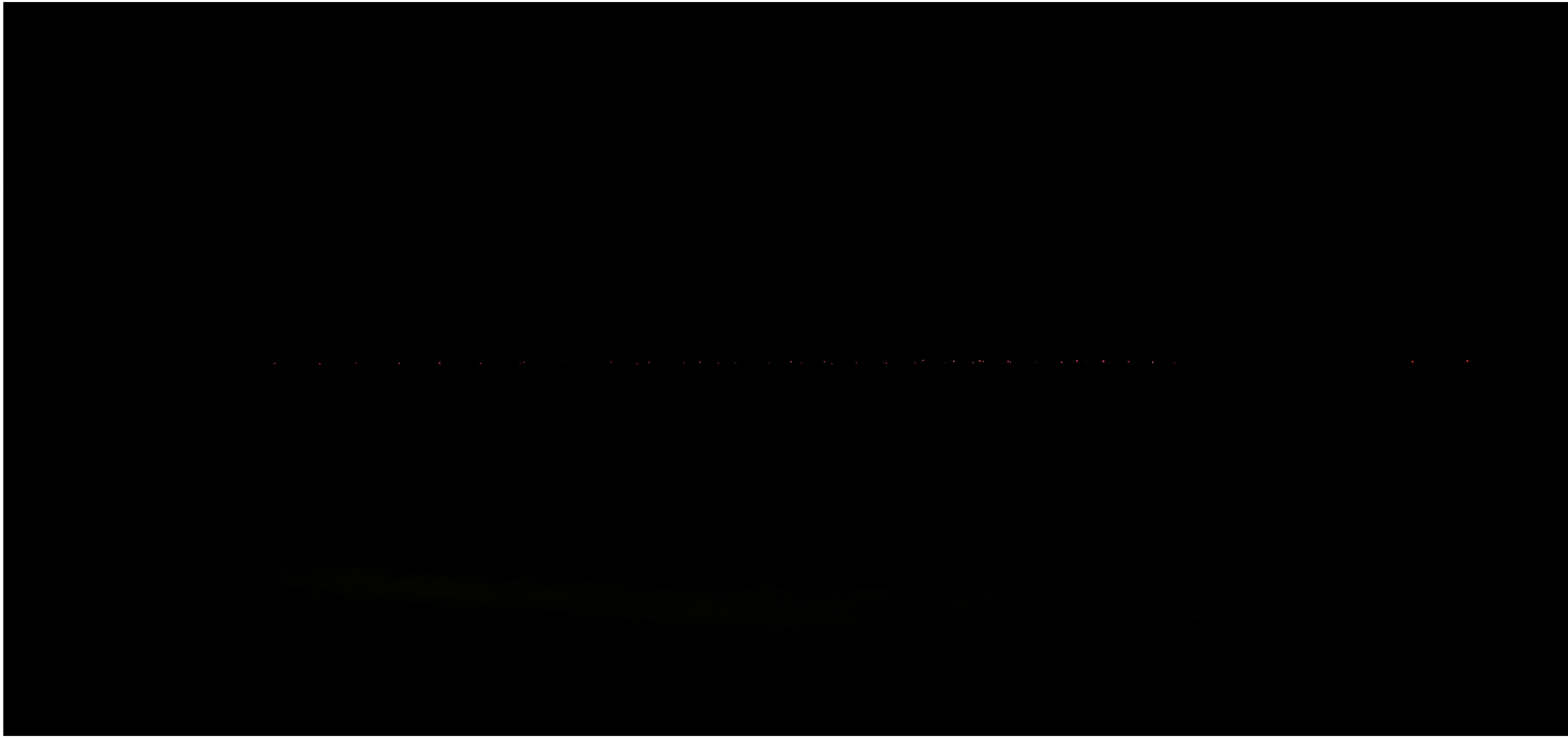
Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).



Visual Simulation: 14-MW Wind Turbine

KOP 50: Little Island Park/Back Bay NWR - Nighttime
Virginia Beach, VA

Print Guide / Image Notes:
This sheet should be printed at 11 by 17 inches; full size with no scaling; and viewed at arm's length (24 inches). If viewed on a computer monitor, the document should be scaled to 100 percent and viewed at arm's length (24 inches).



Visual Simulation: 16-MW Wind Turbine