DOE/EA-1792

FINAL
ENVIRONMENTAL ASSESSMENT

FOR

UNIVERSITY OF MAINE'S DEEPWATER OFFSHORE FLOATING WIND TURBINE TESTING AND DEMONSTRATION PROJECT

GULF OF MAINE

U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
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ACRONYMS AND ABBREVIATIONS

APE	area of potential effects
CFR	*Code of Federal Regulations*
dBA	decibel on the A-weighted scale, used to approximate the human ear's response to sound
DMR	Maine Department of Marine Resources
DOE	U.S. Department of Energy
DPS	Distinct population segment
EA	Environmental Assessment
EFH	essential fish habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAD	Fish aggregation device
GIS	Geographic Information Systems
MSA	*Magnuson-Stevens Fishery Conservation Act*
NASC	Nautical Area Scattering Coefficient
NEPA	*National Environmental Policy Act*
NERACOOS	Northeastern Regional Association of Coastal Ocean Observing Systems
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
PNNL	Pacific Northwest National Laboratory
SHPO	State Historic Preservation Office
TLP	tension leg platform
UMaine	University of Maine
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

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1. INTRODUCTION

1.1 National Environmental Policy Act

The *National Environmental Policy Act* [42 United States Code (U.S.C.) 4321 *et seq*.; NEPA], the Council on Environmental Quality's NEPA regulations [40 *Code of Federal Regulations* (CFR), Parts 1500 to 1508], and the U.S. Department of Energy's (DOE's) NEPA implementing procedures (10 CFR Part 1021) require that DOE consider the potential environmental impacts of a proposed action before making a decision. This requirement applies to decisions about whether to provide different types of financial assistance to States and private entities.

In compliance with these regulations, this Environmental Assessment (EA)

- Examines the potential environmental impacts of the Proposed Action and the No-Action Alternative;
- Identifies unavoidable adverse environmental impacts of the Proposed Action;
- Describes the relationship between local short-term uses of the human environment and the maintenance and enhancement of long-term productivity; and
- Characterizes any irreversible and irretrievable commitments of resources that would be involved should DOE decide to implement its Proposed Action.

DOE must meet these requirements before it can make a final decision to proceed with any proposed Federal action that could cause adverse impacts to human health or the environment. This EA provides DOE and other decision makers the information needed to make an informed decision about the installation, operation, and eventual decommissioning of the proposed wind turbine. The EA evaluates the potential individual and cumulative impacts of the proposed project. For purposes of comparison, this EA also evaluates the impacts that could occur if DOE did not provide funding (the No-Action Alternative), under which DOE assumes the project would not proceed. The EA does not analyze other action alternatives.

1.2 Background

In response to a 2010 congressional directive, DOE awarded Federal funding to the University of Maine (UMaine) and is proposing to authorize expenditure of the funding by UMaine to perform research on and development of floating offshore wind turbine platforms. The primary objective of UMaine's research is to experimentally validate coupled aeroelastic/ hydrodynamic computer models (i.e., computer models used for design and optimization of the turbine and turbine platform system that predict structural loads, deflections, dynamics, and turbine power output under various meteorological and oceanographic conditions) developed by the DOE National Renewable Energy Laboratory (NREL) and others for floating offshore wind turbines.

UMaine proposes to use DOE funding to design, fabricate, deploy, test, and retrieve one to two approximately one-third commercial scale wind turbines on floating platforms within UMaine's Deepwater Offshore Wind Test Site (test site) in the Gulf of Maine, located approximately 2 to 3 miles south of Monhegan Island (Figure 1-1). The floating offshore wind turbines would be temporarily moored at the test site during some or all of July through November of the initial deployment and possibly again during the same period in second deployment.

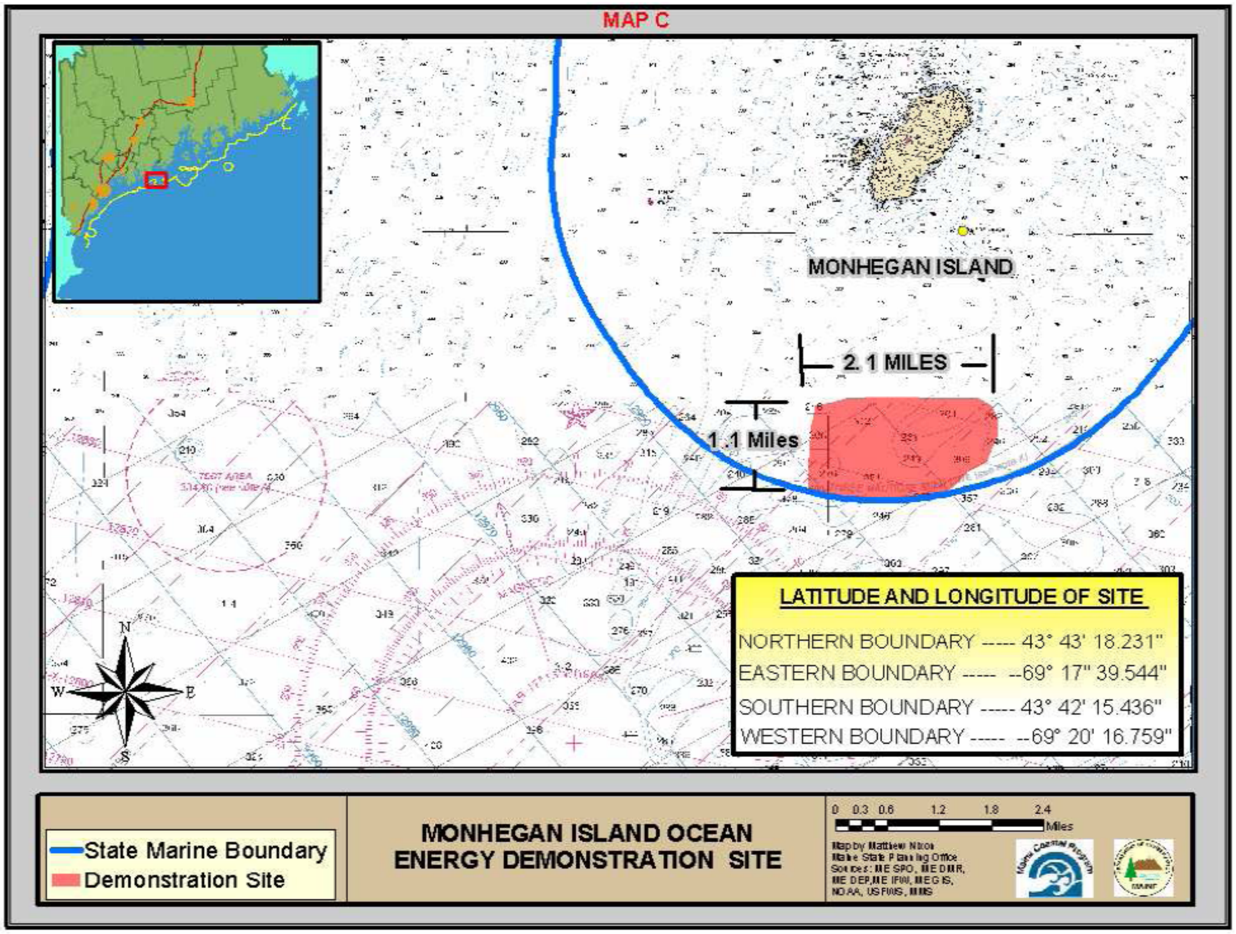


Figure 1-1. Project Location

An evaluation of turbine deployment during the second year is being analyzed by this EA; however, depending on the results of the first year deployment and available funding, the second may not occur.

The wind turbine platforms would carry sensors and telemetry systems that would provide data to evaluate motion and structural performance of the floating turbine platforms under combined wind, wave, and current (physical oceanographic and meteorological) conditions. The data provided by those sensors and systems would be collected to validate numerical models that predict how the turbines and supporting platforms would perform under various oceanographic and meteorological conditions. The collected data would be correlated with the corresponding data collected on an oceanographic buoy, already deployed at the test site, to evaluate the response of the floating turbine platforms to those physical conditions. Environmental monitoring would occur, including monitoring of bats and birds, marine life, and noise.

DOE, in coordination with the U.S. Army Corps of Engineers (USACE), which is a cooperating agency, prepared this EA to evaluate the potential environmental impacts of providing funding to UMaine for the testing of temporary deepwater offshore wind turbine platforms. In compliance with NEPA and its implementing procedures, this EA examines the potential environmental effects of DOE's Proposed Action (authorizing UMaine to expend Federal funds), UMaine's proposed project, and the No-Action Alternative (if DOE chooses not to provide financial assistance for this project). The purpose of this EA is to inform DOE, USACE, and the public of the potential environmental impacts of the proposed project and the alternatives.

1.3 Purpose and Need

1.3.1 DOE'S PURPOSE AND NEED

The purpose of the Proposed Action is to support research on floating offshore wind turbine platforms. This project would support the mission, vision, and goals of DOE's Office of Energy Efficiency and Renewable Energy Wind and Water Power Program to improve performance, lower costs, and accelerate deployment of innovative wind power technologies. Development of offshore wind energy technologies would help the nation reduce its greenhouse gas emissions, diversify its energy supply, provide cost-competitive electricity to key coastal regions, and stimulate revitalization of key sectors of the economy.

1.3.2 USACE'S PURPOSE AND NEED

The USACE has regulation and permitting authority under the *Clean Water Act* and the *Rivers and Harbors Act of 1899* pertaining to discharges of dredged or fill material into waters of the United States and authorization of structures or work in or affecting navigable waters of the United States. The USACE purpose is to support the installation and maintenance of one-third scale models of floating wind turbines within the waters of the state of Maine for the purpose of gathering data to assess the viability of the technology for future offshore wind development.

1.3.3 UMAINE'S PURPOSE AND NEED

UMaine is proposing the expenditure of federal and cost-share funding to perform research on and development of floating offshore wind turbine platforms. The primary objective of UMaine's testing one-third scale floating wind turbines is to obtain motion and structural response data to compare and validate numerical models developed by NREL that predict structural loads, deflections, dynamics, and turbine power output under various meteorological and oceanographic conditions. An experimentally validated numerical model would aid in the development of floating platform technology for offshore wind energy. These models take into account the time varying wind, wave, and current loads subjected on the platform and turbine and predict the response including structural loads in the blades, tower, platform, moorings, and anchors. Because the model takes into account waves, winds, and structural response, the models are called aeroelastic/hydrodynamic models. These models, once validated, would be used for design and optimization of floating turbines to help reduce the cost per installed kilowatt.

1.4 Public and Agency Involvement

1.4.1 PUBLIC SCOPING

On September 20, 2010, DOE sent scoping letters to potentially interested local, State, and Federal agencies, including the Governor of Maine, Maine State Historic Preservation Office (SHPO), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), USACE, and tribal organizations with historic ties to the region. DOE also sent scoping letters to other potentially interested individuals and organizations to solicit public comment (Appendix A), published the scoping letter on the DOE Golden Field Office Reading Room Website (www.eere.energy.gov/golden/Reading_Room.aspx), and published a public notice in the *Herald Gazette*, a local newspaper.

1.4.1.1 Summary of Scoping Responses

In response to the scoping letter, DOE received five comment letters as summarized below:

National Marine Fisheries Service

- Indicated the EA should address potential effects of the project to benthic habitat at the test site and the potential for whales or sea turtles to interact with or become entangled in the mooring system (addressed in Section 3.4).

- Stated that DOE is obligated to consult with NMFS about potential project effects to threatened or endangered species of fish, whales, and turtles that may occur in the project area (*Endangered Species Act*), essential fish habitat (*Magnuson-Stevens Fishery Conservation Act*), marine mammals (*Marine Mammal Protection Act*), and fish and wildlife resources (*Fish and Wildlife Coordination Act*). Further discussion of DOE's consultation with NMFS is provided in Section 1.4.2.

U.S. Environmental Protection Agency

- Indicated that the EA should evaluate how the project affects fish and shellfish resources (addressed in Section 3.4) and fishing (addressed in Section 3.6); benthic habitat and potential effects of the project on the seabed and sediment deposition (addressed in Sections 3.2 through 3.4); noise effects on marine life (addressed in Section 3.5); and operation and maintenance effects (addressed in Sections 3.3 and 3.4).

- Questioned how study results will be extrapolated to assess potential effects of a scaled-up project. The Proposed Action considered by DOE in this EA is whether to authorize the expenditure of Federal funding to perform research and development relating to floating offshore wind turbine platforms. This analysis will provide insights into whether scaled-up projects are reasonably foreseeable and help determine their related potential effects (addressed in Section 4); however, it is beyond the scope of this EA to extrapolate the results to larger-scale projects.

Maine Lobstermen's Association

- Indicated support of the State's goal of energy independence from foreign oil and cautious support of development of offshore wind energy (no response required).

- Stressed that development should be sensitive to the economy, local heritage, and the environment, including effects to lobster, other marine species, habitat, and fishing patterns (addressed in Section 3).

- Noted that the Monhegan Island test site was selected through a careful process that included extensive community outreach and meetings with stakeholders (addressed in Section 2.2).

- Urged DOE to continue public outreach activities to the affected parties to ensure that all economic, social, and environmental concerns are well understood (no response required).

Penobscot Bay Watch

- Stated that the EA should evaluate the cumulative effects of how the test project relates to anticipated future offshore wind development (addressed in Section 4);

- Stated that the EA should evaluate potential effects of the project on currents, nutrient flow, and lobster larvae (addressed in Sections 3.3 and 3.4); fish, shellfish, prey species, and birds (addressed in Section 3.4); commercial and recreation fisheries, pleasure sailors, and noise effects on people (addressed in Sections 3.5 and 3.6); and aesthetic resources (assessed in Section 3.7).

- Raised questions about the scope of the proposed project (addressed in Section 2.2).
- Stated that DOE should reexamine the State's process by which it selected the three test sites. The Proposed Action considered by DOE in this EA is whether to authorize the expenditure of Federal funding to perform research and development relating to floating offshore wind turbine platforms at the proposed Monhegan Island test site. (Evaluating the State's process by which the Monhegan Island test site was, or other sites were, selected is outside the scope of this EA and DOE's obligations under NEPA; no response required.)
- Because floating wind turbines are removable, stated that the project should have far fewer irreversible and irretrievable commitments of resources than fixed monopole wind turbines (addressed in Section 3.10).

Edie Caldwell, Rockport

- Stated general opposition to offshore wind turbines being in the Gulf of Maine (no response required).

1.4.2 CONSULTATION ACTIONS

DOE has initiated consultation with the following Federal and State agencies regarding the potential environmental impacts associated with the proposed project (Appendix B contains consultation letters):

- Section 7 *Endangered Species Act*, *Marine Mammal Protection Act*, *Magnuson-Stevens Fishery Conservation and Management Act*
  - Initial consultation letter sent to NMFS on February 2, 2011
  - Letter sent to NMFS on May 4, 2011 requesting concurrence with a *may affect, but not likely to adversely affect* finding for *Endangered Species Act* (ESA)-listed fish, marine mammals, and sea turtles and for Essential Fish Habitat under the *Magnuson-Stevens Fishery Conservation and Management Act,* and concurrence that incidental take of protected marine mammals is unlikely to occur.
- Section 7 *Endangered Species Act*
  - Initial consultation letter sent to USFWS on February 2, 2011
  - Letter sent to USFWS on May 4, 2011 requesting concurrence with a *may affect, but not likely to adversely affect* finding for the ESA-listed roseate tern and piping plover.
- Section 106 *National Historic Preservation Act*
  - Letters sent to SHPO on February 3 and 23, 2011 and March 23, 2011
  - Letters sent on October 28, 2010, to six separate Indian tribes or tribal organizations that may have historic ties to the Gulf of Maine

NMFS responded to DOE in a letter dated February 22, 2011. Information contained in the NMFS letter is discussed in Section 3.4.1.3. In a letter dated August 16, 2011, NMFS concurred with DOE that the project *may affect, but would not likely adversely affect* ESA-listed fish, marine mammals, and sea turtles or Essential Fish Habitat under the *Magnuson-Stevens Fishery Conservation and Management Act* (Appendix B). NMFS also concurred that impacts to protected marine mammals are unlikely to occur.

In a letter dated August 18, 2011, USFWS concurred with DOE that the project effects are likely to be insignificant and discountable and *would not likely adversely affect* the ESA-listed roseate tern and piping plover (Appendix B).

SHPO responded to DOE in an email dated February 9, 2011, and letters dated February 15 and April 29, 2011. Information contained in the SHPO correspondence is discussed in Section 3.8.

DOE did not receive responses from the tribes to the October 28, 2010, letters, which requested information on properties of traditional religious and cultural significance in the vicinity of the project and any concerns the tribes may have about how the project may affect those properties.

The USACE responded to DOE in a letter dated February 9, 2011, stating that it will coordinate with DOE as a cooperating agency in the development of the EA for this project.

1.4.3 DRAFT ENVIRONMENTAL ASSESSMENT

DOE issued the Draft EA for comment on May 11, 2011, and posted it on the DOE Golden Field Office Reading Room Website (http://www.eere.energy.gov/golden/Reading_Room.aspx) and DOE NEPA Website (http://www.energy.gov/nepa). DOE sent postcards to the individuals listed in Appendix A of this EA to notify them of the EA's availability on the web and to announce a 30-day public comment period on the Draft EA. A Notice of Availability was published in the local paper, the *Herald Gazette*. DOE received comments from six individuals, organizations, or agencies on the Draft EA (Appendix C), which are summarized below.

One citizen stated his opposition to offshore wind turbines in the vicinity of Monhegan Island. A second citizen requested that DOE consider the importance of the area for the health of the planet and wildlife. The Draft EA considered both the effect of the project on the ecosystem and wildlife including marine mammals, fish, sea turtles, birds, and bats, and therefore DOE did not modify the Final EA in this regard.

The Penobscot Bay Watch commented that the EA does not adequately address the likely climate changing-effects, such as interfering with the flow of the Eastern Maine Coastal Current by positioning the potential, future commercial-scale wind turbines within the Gulf of Maine that could occur from the commercialization of the research and development in the proposed project. In addition, the group stated that DOE should develop a supplemental EA or an Environmental Impact Statement (EIS) to deal with the predictable and connected offsite and indirect and cumulative impacts stemming from the proposed DeepCWind project. In Section 4 of this EA, DOE acknowledges that future commercial-scale deepwater offshore wind energy could be developed in the region. The primary objective of the proposed project is to test a one-third-scale floating wind turbine to obtain motion and structural response data to compare and validate numerical models that NREL developed that predict how the turbines and supporting platforms would perform under various meteorological and oceanographic conditions (see Section 2.3.1 of this EA). An experimentally validated numerical model would aid in the development of floating platform technology for offshore wind energy. Section 1021.212 of the DOE NEPA Implementing Procedures (10 CFR Part 1021) specifically addresses the NEPA review requirements for programs involving research, development, demonstration, and testing of new technologies that may lead to commercialization or other broad-scale implementation by DOE. Section 1021.212(b) states that DOE shall begin its NEPA review as soon as environmental effects can be meaningfully evaluated. Until the deepwater floating wind turbine technology has been sufficiently developed for commercial application and specific projects have been proposed, impacts cannot be evaluated. Section 1021.212(c) states DOE shall prepare one or more additional NEPA documents for subsequent phases of program development and application. Therefore, at this time, DOE is not considering the preparation of a supplemental EA or an EIS to address the impacts of utility-scale wind farms that might use the technology being evaluated in the proposed project. However, any future large-scale, deepwater offshore wind farm development would be evaluated pursuant to NEPA.

The Maine SHPO commented (email dated June 9, 2011) that the archaeological information as written in the Draft EA was correct.

The NMFS recommended that the proposed monitoring plan include an assessment of benthic impacts resulting from anchor placement and configuration (i.e., anchor line scour), as well as assess recovery of essential fish habitat (EFH) once the mooring system is removed. Section 2.9 of the Fish and Wildlife Monitoring Plan describes the experimental design and the video assessment of benthic and demersal species using drop camera surveys (UMaine 2011).

The USFWS recommended that the UMaine conduct a monitoring program to document movements of piping plovers, roseate terms, and other shorebirds, seabirds, and bats in the test site when the turbines are deployed as an integral part of its research program. In addition to radar surveys, which do not identify species, UMaine, in consultation with the USFWS and other agencies, has added acoustic monitoring for bats and birds and visual, boat-based surveys of birds to address USFWS's comment (Section 2.6.2). USFWS also suggested that UMaine develop a brief Avian and Bat Protection Plan to explain post-construction bird and bat studies, monitoring for mortality, and adaptive measures that would be taken if these studies indicated potential adverse effect to federally listed species and migratory birds and bats. Because the Fish and Wildlife Monitoring Plan contains much of the same information, there is little added value to developing an additional plan. In addition to monitoring studies, the monitoring plan also describes the reporting of monitoring results, coordination, and review by resource agencies, and the identification and implementation of remedial measures if adverse impacts to fish and wildlife occur.

1.4.4 CHANGES BETWEEN DRAFT AND FINAL ENVIRONMENTAL ASSESSMENT

As a testing and demonstration project, the design elements of the floating wind turbines for the UMaine Deepwater Offshore Wind Power test project continue to evolve to ensure that sufficient and adequate data are acquired. Since the issuance of the Draft EA on May 9, 2011, UMaine has made several design changes on the floating wind turbine tower and in the anchoring system. These changes are discussed separately in the following sections and are integrated into the description of the proposed project in Section 2.2. Changes are also marked with a left-side "change mark" throughout the document.

1.4.4.1 Battery and Electrical Grid Mimicking

An important aspect of testing an isolated wind turbine floating platform is electrical loading of the wind turbine generator. While providing stability, interconnecting the floating wind turbine with an onshore grid via a submarine power cable is not a cost-effective option for a temporary deployment. A more cost-effective solution is to implement a stand-alone grid simulator on the floating platform. Such a grid simulator must create a stable, fault-resilient voltage and frequency bus (a micro grid) for continuous operation of the test wind turbine. In March 2011, NREL , in coordination with the UMaine, performed a modeling exercise and developed a design specification for an electrical grid simulator for operating a Vestas V27 225-kilowatt wind turbine on a floating platform off the coast of Maine. The detailed description and diagrams of the design are provided in Appendix D. These systems were not presented in the Draft EA. The primary components would likely consist of a string of sealed batteries, a direct current battery bank, and an inverter. The battery system is an electrical service system separate from the grid simulation system. The wind turbine would charge the battery bank, which would provide continuous power to computers, instrumentation and control systems, data antennas, navigation lighting, and ventilation fans. The system components would be installed inside the hull portion of the turbine tower below the main deck. Because these system components would be internal to the turbine tower, the addition of these systems to the project design would not result in additional environmental impacts to those considered in the Draft EA.

1.4.4.2 Power Dissipation System

The proposed wind turbine is a Vestas V27 horizontal-axis generator with a power rating of 225 kilowatts, or 301.7 horsepower. Although the onboard electronics, safety systems, data acquisition systems, grid-mimicking system, and turbine operational controls would consume an appreciable amount of this power, UMaine would install electric immersion heaters (containing no fluids) to dissipate excess power not consumed by the other systems. The heaters would be located near the bottom of the upper column. The heating elements would protrude outward from the lower column side shell into the sea water. The heaters would connect to the hull by a bolted flange connection (Appendix D). This system was not presented in the Draft EA.

In principle, this system is similar to a marine diesel engine (e.g., a typical Maine lobster boat) that uses a wet-exhaust system that carries excess engine heat and exhaust gases away, using a pump and ocean water as a cooling agent. That is, the excess heat is pumped into the ocean. Assuming that a diesel engine is 24 percent efficient (Maclean and Lave 2003), and equating the 76 percent waste heat generated is equivalent to the waste heat of the V27 turbine at 301.7 horsepower, the diesel shaft power rating would be 95.3 horsepower. In a worst-case scenario, the waste heat generated would be equivalent to a 100-horsepower marine engine functioning at full operational load. Most personal and commercial working vessels (e.g., Maine lobster boat) require engines larger than 100 horsepower to perform their functions. Therefore, the amount of waste heat dissipated would be less than a normal working marine vessel. Because some of the power produced would be consumed by the onboard electronics, safety systems, data acquisition systems, grid-mimicking system, and turbine operational controls and not converted to waste heat, the amount of heat dissipated into the ocean would have negligible impacts on the surrounding environment. Therefore, this design change has minimal to no impact compared to the design evaluated in the Draft EA.

1.4.4.3 Floating Platform Tendon Lines

The original design described in the Draft EA used one tendon (i.e., mooring line) per anchor and platform arm to tether the floating platform in place. The proposed design assumes three anchors per floating platform arranged in a triangular pattern. After further design evaluations, UMaine is proposing to use two tendons per platform arm. The two tendons from each platform arm to the seabed anchor would be parallel, approximately 8 feet apart. Therefore, each platform would have six tendons instead of three. The tendons would be steel or synthetic mooring lines with an approximate diameter of 6 inches rather than the 1.2- to 2-inch steel cables initially planned. The addition of tendons is to provide redundancy in the structure in the unlikely event of a single mooring line failure. The configuration is illustrated in Appendix D for the Tensioned Leg Platform. A final platform has not been selected and the Draft EA discussed several types that may be used (Section 2.3.4).

The addition of tendons and increased size of mooring lines (2 versus 6 inches) will create more underwater structure and provide additional area for biofouling organisms to colonize. The two parallel mooring lines could pose a potential hazard to large whale species that may wedge between the cables.

However, because of the low number of whales observed in the area, the low probability of whales actually encountering the cables in the open ocean, and the low probability that a whale is just the right size to wedge between the mooring lines, the potential impact of the additional tendons is expected to be negligible.

1.4.4.4 Anchor Position Pipes and Cable Lines

The UMaine is still considering several types of seabed anchors (Section 2.3.5) that would be arranged in a triangular pattern. To maintain relative positioning of anchors, UMaine may consider the addition of interconnection pipes and cables between the three anchors (Appendix D). The potential interconnection pipes would be approximately 24 inches in diameter with the center about 5 feet above the seabed, providing 4 feet of clearance between the pipe and seabed. Interconnection cables between anchors would be located approximately 5 feet above the sea floor. Cables would be approximately 2 inches in diameter.

The primary effect of adding piping and cables near the sea floor would be a potential increase in the artificial reef effect. Biofouling is the accumulation of attaching marine organisms, such as algae, and sessile invertebrate species, such as barnacles, mussels, bryozoans, sponges, tunicates, and hydroids, on hard surfaces. Such biofouling organisms are expected to colonize exposed portions of the anchors, mooring lines, and submerged parts of the floating platforms. The addition of interconnection pipes and cables between the anchors provides additional surface for colonization. This may increase habitat heterogeneity in areas of soft-sediment seabed and attract structure-oriented species of fish to the area. However, even with the addition of the pipes and cables to the anchors, a relatively small reef effect is expected. The anchors, pipes, and cables are a relatively small area at depths of more than 300 feet. Most artificial reef structures are deployed in shallower water. Although the addition of pipes and cables may increase biofouling organisms locally and some species of fish, the effect is not likely to be measurably different than that evaluated in the Draft EA, i.e., without the pipes and cables.

The additional biofouling that may occur on the pipes and cables may benefit some fish species, such as groundfishes, but is a sufficiently small area that any changes in marine community composition would be very localized and would not impact essential fish habitat. The ESA-listed whale species are uncommon in the area and generally do not swim near the ocean floor. Many whale species have sensory abilities to help them avoid objects. Other marine mammal species that may occur in the project area have excellent vision and maneuverability that would help them avoid the pipes and cables approximately five feet above the seabed. The cables would be tensioned between the anchors and would not be an entanglement hazard. The addition of the interconnection pipes and cables would not change the impacts on ESA-listed fish, marine mammals, or essential fish habitat as evaluated and discussed in the Draft EA.

1.4.4.5 Summary

The four design changes on the floating wind turbine towers and in the anchoring system that were made between the Draft EA and Final EA were evaluated for new or increased environmental impacts. Based on the description of the proposed changes, DOE determined that one new environmental impact not previously considered would occur. However, the dissipation of waste heat into the ocean as a means to dissipate unused power from the wind turbine was determined to be negligible and therefore discountable. The installation of batteries and electrical micro-grid would occur within the turbine tower and would not have any impact. The addition of a second parallel tendon at each anchor and the use of 6-inch steel synthetic mooring lines could potentially present an additional hazard to whales. However, it was determined that the increased probability of whale species or other protected marine mammals being negatively impacted by the larger and additional mooring lines was unlikely and could be considered negligible compared to the impacts of a single mooring line of 2-inch steel cable. The addition of interconnection pipes and cables between the three anchors to maintain relative position could provide additional surfaces for biofouling organisms that would increase habitat heterogeneity and attract certain fish species such as groundfishes. This would be a beneficial impact for some marine species and mostly negligible effect to other species because the impact would be localized in a small area near the seabed. The pipes and cables at approximately 5 feet above the seabed were determined to be a negligible additional impact to essential fish habitat, protected marine mammals, and ESA-listed whales. The probability of marine mammals either colliding with or entangling in the cables is negligible. Therefore, DOE concludes that the proposed design changes represent negligible changes in environmental impacts from those evaluated and discussed in the Draft EA.

2. DOE PROPOSED ACTION AND ALTERNATIVES

2.1 DOE's Proposed Action

Under the Proposed Action, DOE would authorize UMaine to expend Federal funding to design, permit, and temporarily deploy wind turbine test platforms in the Gulf of Maine.

DOE has authorized UMaine to use a percentage of the Federal funding for preliminary activities, which include preparing this EA, conducting analysis, and agency consultation. Such activities are associated with the Proposed Action and do not significantly impact the environment nor represent an irreversible or irretrievable commitment by DOE in advance of its conclusion of the potential environmental impacts from the proposed project.

2.2 USACE's Proposed Project

The USACE will process a permit application for any temporary or permanent work in navigable waters and, if applicable, for the discharge of dredge or fill material into any waters, pursuant to Section 10 of the *Rivers and Harbors Act* and Section 404 of the *Clean Water Act*, respectively.

2.3 University of Maine's Proposed Project

UMaine proposes to use DOE funding to design, fabricate, deploy, test, and retrieve one to two approximately one-third commercial scale wind turbines on floating platforms within UMaine's Deepwater Offshore Wind Test Site (test site) in the Gulf of Maine.

2.3.1 BACKGROUND

Under the Proposed Action, DOE would authorize UMaine to expend additional funding to conduct final design, fabrication, deployment, testing, and retrieval of up to two one-third commercial scale wind turbines on floating platforms. The turbines would measure approximately 100 feet from waterline to the hub, the rotor diameter would measure 88.6 feet, and the total turbine height would be approximately 144 feet. The final dimensions of the turbines and platforms are currently under development as part of this research effort but would likely be close to a one-third scale. The wind turbine platforms would be fabricated at a shipyard, or similar existing coastal facility, and towed to and moored within the University of Maine Deepwater Offshore Wind Test Site in the Gulf of Maine, shown in Figure 1-1, and then removed. There would be no utilities or services connected to the turbines while deployed at the test site.

The primary objective of testing the one-third scale floating wind turbines is to obtain motion and structural response data to compare and validate numerical models developed by the NREL that predict how the turbines and supporting platforms would perform under various meteorological and oceanographic conditions. An experimentally validated numerical model would aid in the development of floating platform technology for offshore wind energy. These models take into account the time varying wind, wave, and current loads subjected on the platform and turbine and predict the response including structural loads in the blades, tower, platform, moorings, and anchors. Because the model takes into account waves, winds, and structural response, the models are called aeroelastic/hydrodynamic models. These models, once validated, would be used for design and optimization of floating turbines to help reduce the cost per installed kilowatt. Optimization of platform design would focus on the following objectives:

- Reduce platform weight above the waterline,
- Reduce platform cost,
- Improve manufacturability, and
- Improving durability.

Separate from, and prior to, the Proposed Action under this NEPA analysis, the UMaine Advanced Structures and Composites Center selected three generic floating platform designs for coupled aeroelastic/hydrodynamic tank testing at a 1:50 scale. The designs include three types of floating platforms (mooring line stabilized, ballast stabilized, and buoyancy stabilized). The results from this tank testing would be used to perform an initial validation of the NREL-coupled aeroelastic models, which could then be used to produce designs for the one-third scale turbines.

The proposed test site is located in State waters approximately 2 to 3 miles south of Monhegan Island, Lincoln County, Maine (Figure 1-1). Water depths in the area range from 180 to 360 feet. The site is approximately 1.1 miles wide and 2.1 miles long and is bounded at the southern edge by the 3-nautical-mile line, indicating the extent of State of Maine waters.

The project site was selected as a test site by the State of Maine following a comprehensive review of available information and numerous meetings with the public and interest groups, arising out of 2009 Maine legislation intended to encourage development of offshore wind energy off Maine's coast (Maine Public Law, Chapter 270 LD 1465).

The floating offshore wind turbines would be moored at the test site during some or all of July through November of the initial testing year and possibly during some or all of July through November of the second year deployment. Retrieval of the platforms would occur following both deployment periods (evaluation of turbine deployment during the initial testing year is being analyzed by this EA; however, depending on the results, the second deployment may not occur). Depending on the type of anchor selected for use, the anchors may be left in place.

2.3.2 SELECTION OF THE UNIVERSITY OF MAINE DEEPWATER OFFSHORE WIND TEST SITE

This section describes the process the State of Maine followed to select the offshore location where UMaine would temporarily deploy and test wind turbine platforms.

In June 2009, legislation recommended by the Governor-appointed Ocean Energy Task Force (LD 1465) was passed unanimously by the Maine State Legislature and passed into law by Governor John Baldacci. This legislation was developed to encourage the development of wind energy off the coast of Maine and mandated that State agencies identify and map up to five specific offshore ocean energy test areas in Maine State waters. To select these sites, the Maine State Planning Office and the Maine Department of Conservation conducted consultation with Federal and State resource agency staff, nongovernmental organizations, and the public to identify demonstration areas. State agency staff analyzed hundreds of layers of Geographic Information Systems (GIS) data and solicited public comment during a multi-faceted outreach effort. The State agencies evaluated the existing information regarding pertinent ecological, environmental, social, and development related factors, including but not limited to:

- Potential adverse effects on a protected natural resource or a scenic resource of State or national significance;

- Potential adverse effects on species listed as threatened or endangered; avian species, including seabirds, passerines, raptors, shorebirds, water birds and waterfowl; bats; and marine mammals;

- Potential adverse effects on commercial fishing, recreation, navigation, existing public access ways to intertidal and subtidal areas, and other existing uses;
- Proximity to deep water port facilities, rail transportation, transmission infrastructure facilities, and existing ocean-based environmental monitoring devices;
- Data regarding wind speed, ocean wave height and period, ocean currents, and water depth;
- Geology, including substrate type and other sea floor characteristics;
- Public support in pertinent coastal communities; and
- Historic sites and archaeological resources of State or national significance (LD 1465).

In analyzing this collected information, the State considered the following three broad categories (DOC 2010):

- "GIS showstoppers,"
- Human use and activities, and
- Environmental considerations.

The term "GIS showstoppers" was used to indicate the conditions that must (or in some cases, must not) be present to facilitate the construction and operation of ocean energy developments. The four key criteria used in the initial "showstopper" analysis consisted of:

- Wind speed greater than 17 miles per hour on an annual average;
- Areas that primarily consist of ocean depths greater than 200 feet of water;
- Areas that minimize conflicts with marine obstructions, dredge dumps, officially recognized shipping channels, and unexploded ordinances; and
- To a lesser extent, proximity to existing undersea cables or areas that have historically been pre-permitted for an undersea cable by the USACE (DOC 2010).

Using GIS, these criteria were overlaid with a base map of the state of Maine and its waters in an attempt to isolate particular areas of interest (DOC 2010).

The State sought to gather feedback from user groups and the general public that may have a concern, comment, or conflict with possible areas created by the initial GIS analysis. The State held more than 12 scoping meetings in August and September 2009 with fishermen, community leaders, and environmental organizations to receive comments and concerns on potential use and resource effects from ocean energy testing activities in these locations. For additional feedback, the State also held five regional public forums in September 2009. Additionally, the State consulted with the Department of Environmental Protection, the Public Utilities Commission, the Department of Inland Fisheries and Wildlife, the Maine Land Use Regulation Commission, the Department of Marine Resources, the Historic Preservation Commission, UMaine, and a number of Federal agencies regarding a broad range of ecological, environmental, and other considerations in evaluating the planning areas.

Examples of concerns raised during this process included proximity to existing infrastructure; visual aesthetics; and competing uses such as recreation, shipping, and commercial fishing[1]. Through this interactive process, the State strove to gather information on what types of conflicts may materialize, what type of activity is occurring in the possible planning areas, and where the best locations for ocean energy testing and demonstration sites would be. The State then narrowed down (or eliminated altogether) the larger scale areas identified in the first GIS phase (DOC 2010).

The final part of the siting effort took into account the environmental effects that ocean energy facilities may have. The State sought input and advice from various experts on topics including birds, bats, and marine mammals. Ecological concerns for the site selection process included whale activity; seal activity; bird migration; bird foraging; endangered, threatened, and rare birds; marine worm habitat; molluscan habitat; and presence of eelgrass (DOC 2010).

LD 1465 states that one of the selected sites shall be designated "…as the Maine Offshore Wind Energy Research Center for use by offshore wind energy demonstration projects conducted by or in cooperation with the University of Maine System and on terms and in a manner that the University of Maine System considers consistent with and in furtherance of its offshore wind energy research and development-related objectives, including but not limited to any such objectives to be supported with state bond revenues."

Through comprehensive review of the compiled anthropogenic, environmental, and geophysical analyses, and numerous meetings with the public and interest groups, the State rejected the majority of alternative sites along the coast, and selected three demonstration sites (Monhegan Island, Boon Island, and Damariscove) on December 15, 2009. These three sites were selected because they were located in areas with the least amount of physical, environmental, and human conflicts combined with elements that made them ideal sites (e.g., local support, distant from the mainland, good wind resource). The Monhegan Island site was designated by the State as the location for the UMaine test site.

2.3.3 WIND TURBINE

UMaine proposes to deploy up to two floating wind turbines within the project area. The turbines would be selected based on the needs of the testing program, including the following: power control method (variable pitching or stall controlled blades), lead time, costs, suitability for use on a one-third scale platform (mass, geometry, power output), structural capacity, availability of design information for numerical modeling, and the ability to publish turbine information as part of research publications. Several turbine options are under consideration and are currently being ranked with regard to these needs.

The Vestas V27 wind turbine is being considered by the UMaine for the testing program and the analysis is based on specifications of the Vestas V27. The Vestas V27 turbine has a generating capacity of 225 kilowatts. The turbine rotor diameter is 88.6 feet and the tower height would be approximately 100 feet for a maximum height of approximately 144 feet for the proposed project. The turbine is designed with a wind cut-in speed of 8 miles per hour and when the wind speed exceeds 55 miles per hour, the turbine automatically cuts out by slowing the rotor speed through the control system and feathering the turbine blades. The turbine also includes an emergency disk brake. The turbine is designed to withstand wind gusts up to 120 miles per hour. The maximum rotational speed of the turbine rotor is 44 revolutions per minute.

Electrical loading of the wind turbine generator is an important aspect of testing the floating turbine system. Interconnecting the floating wind turbine with an onshore gird via a submarine power cable

1. All 11 lobstermen on Monhegan Island, as well as other parties involved in commercial fishing, were consulted during this process (Nixon 2010b).

would not be a cost-effective option for a temporary deployment. A more cost-effective solution would be to implement a stand-alone grid simulator on the floating platform. Such a grid simulator must create a stable, fault-resilient voltage and frequency bus (a micro grid) for continuous operation of the test wind turbine. In March 2011, NREL, in coordination with the UMaine, performed a modeling exercise and developed a design specification for an electrical grid simulator for operating a Vestas V27 225-kilowatt wind turbine. The detailed description and diagrams of the design are provided in Appendix D of this EA. The primary components are a string of sealed batteries, a direct current battery bank, and an inverter. The battery system is an electrical service system separate from the grid simulation system. The wind turbine would charge the battery bank, which would provide continuous power to computers, instrumentation and control systems, data antennas, navigation lighting, and ventilation fans. The system components would be installed inside the hull portion of the turbine tower below the main deck.

The proposed wind turbine is a Vestas V27 horizontal-axis generator with a power rating of 225 kilowatts, or 301.7 horsepower. Although the onboard electronics, safety systems, data acquisition systems, grid-mimicking system, and turbine operational controls would consume an appreciable amount of this power, excess electrical power would be converted to heat energy with electric immersion heaters (containing no fluids) and dissipated into the sea water (Appendix D). The heaters would be located near the bottom of the upper column. The heating elements would protrude outward from the lower column side shell into the sea water. The heaters would connect to the hull by a bolted flange connection.

2.3.4 TURBINE PLATFORM

UMaine is currently selecting a platform concept for use in the testing program through a competitive proposal process involving industry designers. Industry designers submitted their proposed one-third scale floating platform concepts and proposed design work plans for review by a Blue Ribbon Panel composed of representatives of UMaine; Maine Maritime Academy; NREL; offshore design, construction, and deployment companies; and DOE. The selected industry designer would be the lead for the design of the floating platform and integration of the turbine working with UMaine and others. The Blue Ribbon Panel would then select up to two platform concepts for final design, fabrication, and deployment at the test site.

The concepts received are based on floating oil and gas platforms designed to resist wave loads from extreme sea states. Unlike oil and gas platforms, floating wind turbine platforms have a substantial sail area (i.e., the turbine tower and blades), requiring that they withstand combined wind (aeroelastic) and wave (hydrodynamic) loading. There are three distinct designs for providing platform stability:

- Mooring line stabilized [e.g., tension leg platform (TLP)];
- Ballast stabilized (e.g., spar buoy); and
- Buoyancy stabilized (e.g., barge or semi-submersible).

The selected one-third scale floating wind turbine/platform configurations would be similar to those presented in Figure 2-1. Final dimensions would be determined once the concept(s) are selected and designed using the currently available NREL numerical models.

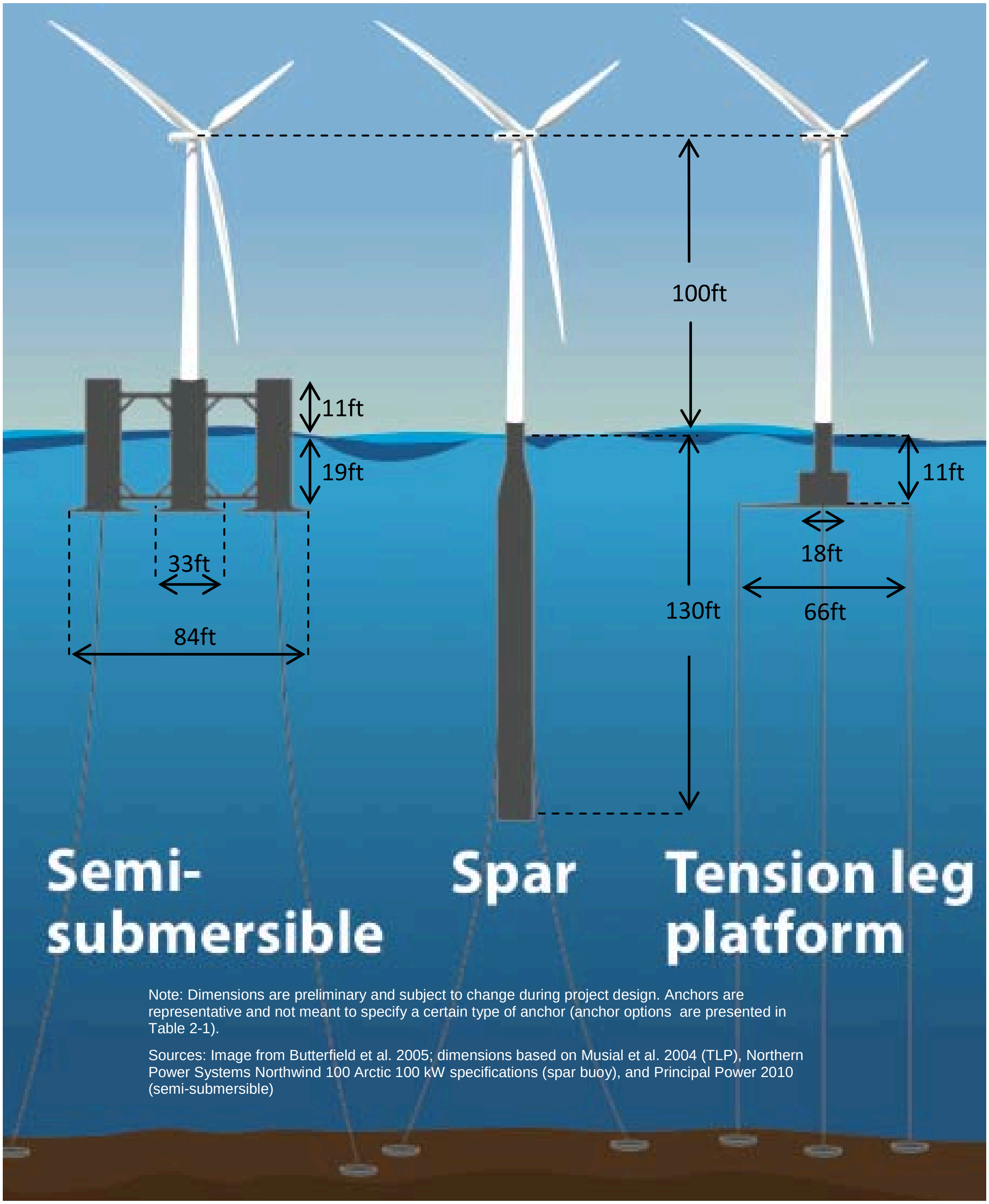


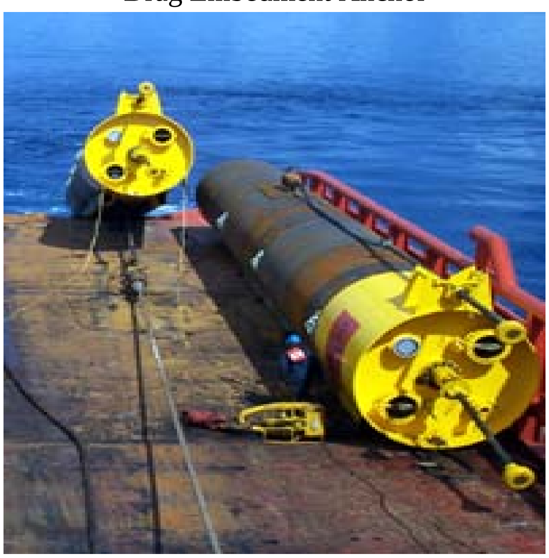
Figure 2-1. Floating Wind Turbine Platform Concepts

2.3.5 MOORING AND ANCHORING SYSTEM

The mooring and anchoring system selected for each floating turbine platform would depend on the final platform design chosen. A number of shallow foundations/anchors are being considered for mooring the project including drag embedment (fluke) anchors, gravity (weight) anchors, skirted mats, and suction caissons (representative anchors shown below in Figure 2-2).


Drag Embedment Anchor


Gravity Anchor


Suction Caisson Anchor

Note: The skirted mat anchor is not pictured. It is functionally the same as the gravity anchor.

Sources: Delmar 2011; Vryhof Anchors 2011; and Trelleborg 2011.

Figure 2-2. Representative Shallow Foundations/Anchors

As depicted in Figure 2-1, the spar buoy and buoyancy stabilized (semi-submersible) platform designs would utilize slack mooring lines (catenary lines) and likely utilize any of the anchor types listed above.

A TLP platform would utilize tension cable moorings[2] and suction caissons; however, gravity anchors are also being considered. Two steel or synthetic mooring lines or tendons would be used at each of the three anchor points to provide redundancy in the structure in the unlikely event of a single mooring line failure. The tendons would have an approximate diameter of 6 inches. The type of anchor selected would be influenced by the final platform design and the sub-sea floor conditions and sediment properties at the test locations. A geotechnical sampling and laboratory-testing program is being conducted to obtain information necessary for design of the anchors. For the TLP platform, cables and potential interconnection pipe would run between the three anchors approximately 5 feet off the sea floor to maintain the relative position of the three anchors (Appendix D). The potential pipe would be approximately 24 inches in diameter, and the cables approximately 2 inches in diameter. Additional mooring and anchoring specifications for the one-third scale floating turbine platforms that would be evaluated as part of the proposed project are provided in Table 2-1.

Table 2-1. One-Third Scale Floating Turbine Platform Anchoring Specifications

	Spar Buoy	Tension Leg Platform	Semi-Submersible
Mooring Type	Catenary	Tension Cable	Catenary
Water Depth (feet) (approx. at test site)	328	328	328
Cable Length (feet)	984	298	984
Cable Diameter (inches)	6	6	6
Cable Material	Steel or Synthetic		
Number of Mooring Lines/Anchors	6 minimum @ 120° (2 on each leg)	6 (2 on each leg)	6 minimum (2 on each leg)
Anchor Type [a]	Shallow foundations/anchors	Suction caisson or gravity anchors	Shallow foundations/anchors
Sample Anchor Geometry	e.g., skirted mat: W=16.1 ft, H=6.6 ft	e.g., suction caisson: D=18 ft, L=29.5 ft	e.g., skirted mat: W=16.1 ft, H=6.6 ft
Anchor Material	Steel, concrete, rock	Steel or concrete	Steel, concrete, rock
Anchor Location (distance on seabed from point under platform center) (feet)	984	33	984

a. Shallow foundations/anchors include drag embedment (fluke) anchors, gravity (weight) anchors, suction caissons, and skirted mats. Anchor type and dimensions would depend on the final platform design and the subsea floor conditions and sediment properties.

2.3.6 INSTALLATION

The floating offshore wind turbines would be constructed and assembled at a shipyard or similar existing coastal facility. In the summer following construction and fabrication, the floating offshore wind turbines would be towed to and moored within the test site. They would be moored at the test site during some or all of the deployment timeframe of July through November of the initial testing year and July through November of the subsequent year of testing.

Anchors for the floating platforms would need to be installed prior to platform and turbine deployment, mainly to allow anchor settlement or anchor capacity to develop within the seabed [e.g., recommended

2. Tension cable moorings have vertical mooring lines under tension and generally have a smaller footprint on the seabed, while catenary moorings have comparably less tension and have a larger footprint on the seabed (see Figure 2-1).

practice for suction caisson designs utilizing shear strength inside the skirt (wall) is for three months of soil setup after installation (Det Norske Veritas 2005)]. Therefore, the mooring and anchoring system would be deployed between one and six months, depending on the anchor type, before deployment of the floating turbines to account for soil set up and additional planning and weather logistics. The anchors would be loaded on barges and towed out to the UMaine test site. If drag anchors are used, a second anchor handling vessel would be required to deploy and set the anchors. If suction caissons are used, a floating crane would be required to lift and lower the caissons to the sea floor, and suction equipment, a remotely operated vehicle, control cabin, and launch cradle would also be needed.

Once the anchors arrived at the test site, the installation vessels would be positioned over preselected anchor locations. These locations would be selected based on the floating turbine mooring system design and engineering analysis of the sea floor geotechnics and geophysics. Most likely, the mooring system would be arranged in a triangular pattern. The deployment of each anchor is expected to occur over the course of one day.

As stated above, a number of shallow foundations/anchors are being considered for mooring the project including drag embedment anchors, gravity anchors, skirted mats, and suction caissons. Drag embedment anchors have flukes that are angled, with respect to the shank, appropriately for the anticipated sediment type and stiffness. These are installed by positioning the anchor orientation at the sea floor and then tensioning the mooring line using a vessel. During the tensioning, the flukes penetrate the seabed, and as tension increases, the anchor embeds itself to deeper depths. Removal is achieved by pulling the mooring line in the perpendicular direction to lift the anchor out of the sediment along the reverse of its initial traverse. Gravity anchors and skirted mats are placed directly on the seabed. Suction caissons penetrate the seabed; however, the top of the anchor is exposed at the sea floor.

Following installation of the anchor and mooring system, the floating platform and turbine units would be towed from the launch site to the UMaine test site. It is anticipated that it would take approximately 12 hours to tow the floating turbine from the launch site to the deployment site. Towing may have to be accomplished in stages depending on the weather and towing restrictions applied to the turbine. The deployment of a turbine is expected to occur over the course of one day. It would require the use of up to four vessels:

- Towing tug – to move the turbine from the launch site to the test site;
- Assist tug – to assist the towing tug if required during the turbine transit and to assist in turbine positioning during the mooring operation;
- Recovery vessel – this may be a vessel or crane barge (if it is a crane barge an additional tug would be required) that would recover the pre-laid moorings and connect them to the turbine; and
- Personnel transport – to transport personnel from the shore to the mooring site and to move personnel between the towing tug, assist tug, and recovery vessel as required.

When the floating turbine arrives on station, it would be connected to the pre-laid mooring system. Once the individual mooring connections are completed, the mooring system would be tensioned. Tensioning of the mooring system would be conducted using the towing tug and an assist tug, as required.

The onboard management of fuels and lubricating fluids aboard all vessels would be managed in accordance with U.S. Coast Guard (USCG) regulations applicable to each vessel. The requirements are dictated by the vessels size and intended operations but in each case permit no discharge of petroleum or hazardous substances into the environment and require a spill prevention plan and certificate of financial responsibility.

Notice would be given to the Maine Marine Patrol to alert fishermen about towing operations and to advise for the removal of gear from the planned tow route. While lobster fishing does not take place in the Monhegan Lobster Conservation Area during the summer[3], there is considerable lobster gear deployed between the mainland and outside of the Monhegan Lobster Conservation Area during the summer months.

2.3.7 OPERATIONS AND MAINTENANCE

Following deployment of the turbines, the focus of UMaine's proposed project would be testing the turbine platforms to validate numerical models that predict how the platforms would perform under various conditions of combined wind/wave loading. The wind turbine platforms would carry sensors and telemetry systems that would provide data to evaluate the engineering performance, providing motion and structural performance of the floating turbine platforms under combined wind, wave, and environmental conditions. These data would be correlated with the corresponding data collected on an oceanographic buoy already deployed at the site. The comparison of the measured motions of the wave-following buoy data and the turbine platforms would allow the response of the floating turbine platforms to be evaluated relative to the oceanographic and meteorological conditions. These same conditions would then be simulated in the numerical models and compared as part of the validation process.

While deployed, personnel access to the floating platforms would be required to accomplish scheduled and unscheduled inspections, maintenance, and repairs. Access to the one-third scale prototype(s) would be via a standard size workboat from Monhegan Island. The one-third scale prototype(s) would be equipped with a boat landing to facilitate personnel transfer and access means (e.g., Occupational Safety and Health Administration-compliant ladder) from the boat landing to the top deck. Maintenance and repair operations would require use of small tools and equipment. Means would be provided to handle small tools and equipment from the workboat to the top deck and vice versa. Auxiliary power would be required on the wind turbine platforms for several purposes, including operation of small tools and equipment, aids to navigation, operation of instrumentation, communication and control systems, and others. The auxiliary power source is described in Section 2.3.3 and Appendix D of this EA. Limited amounts of hazardous materials likely would be on board the one-third scale prototype(s), primarily in the form of lubricants, hydraulic oils, and possibly others. Appropriate measures would be implemented to provide for containment and collection of hazardous material spills should they occur.

Environmental monitoring would occur, including monitoring of bats and birds, marine life, and noise within and in the region surrounding the test site. This is discussed further in Sections 2.5 and 3.

During operation, the turbine would be inspected both remotely and by periodic visits. The schedule of monitoring is currently being developed as part of the testing plan. This plan would be based on the final design(s) selected for deployment and is expected to be available during the first quarter of 2011. The structure's response to wave, current, and wind loading would be monitored remotely via on-board sensor, data acquisition, and communications systems. In addition, periodic visits to the turbine would be completed by boat to visually inspect the structure, replace batteries, perform general maintenance of instruments, and address other issues as they arise. This plan would be developed once the design of the turbine(s) is available.

3. The Monhegan Lobster Conservation Area (§§6471-6477) was designated in 1998 by the Maine Legislature as an area around Monhegan Island where only Monhegan fishermen can obtain a permit to set traps (further discussed in Section 3.6.1.1 of this EA).

2.3.8 REMOVAL

The floating offshore wind turbines would be retrieved following both deployment periods. It is possible that unanticipated removal of the turbines would be necessary as the proposed installation location for the one-third scale prototype(s) is subject to occasional tropical storms or other extreme weather events. In these situations, it is possible that very large waves could occur that exceed the largest wave and associated period the one-third scale floating structure is designed to resist. Therefore, design of the one-third scale prototype(s) would incorporate the capability to be disconnected from its moorings and towed to safe harbor.

UMaine has developed a Project Removal Plan, as summarized in Sections 2.2.8.1 and 2.2.8.2. The floating turbine's position would be maintained by a set of mooring lines anchored to the sea floor. The removal of the floating turbine would be completed through an engineered process based on the final turbine and mooring design. The removal of the floating turbine and its associated moorings would be completed in two stages: 1) removal of the floating turbines and 2) the removal of the mooring lines, and depending on the design selected, the anchors.

2.3.8.1 Removal of Floating Turbine

The floating turbine would be prepared for transit according to an engineered transit plan. This transit plan may require actions such as adjusting the buoyancy (ballasting or deballasting) of the unit and locking the nacelle and rotor in a fixed position. There would be no utilities or services connected to the turbine while it is deployed at the test site.

A towing vessel would connect a towing bridle to the floating turbine at designed deployment/recovery points. When the unit is fully disconnected, it would be towed to a nearby facility yet to be determined. As with project installation, notice would be given to the Maine Marine Patrol to alert fishermen about towing operations for removal of the floating wind turbine platforms in order to advise for the removal of gear from the planned tow route. The current plan is that the turbine would be moored to a pier-side facility once the test period has been completed.

2.3.8.2 Removal of Anchoring/Mooring System

At this point in the design phase, it has been assumed that the anchoring system would be a drag embedment (fluke) anchor, gravity (weight) anchor, skirted mat, or suction caisson (see Figure 2-2). Two critical factors to be considered in the removal of the anchoring system are: (1) final recovery of the anchoring/mooring system (determined by the intended future use of the test site and potential mooring use) and (2) disruption of seabed due to subsequent removal of anchors.

There are two options for the removal of the test site anchor/mooring system components. The first involves complete removal of the anchor/mooring system, which would be accomplished using an anchor-handling vessel. This is a purposed designed vessel with large winches and a stern roller. The vessel would remove the anchors by either recovering a retrieval line or by pulling the anchor in the direction perpendicular to how it was set, depending on the type of anchoring system. A suction caisson would be pressurized and the mooring line pulled up to draw the caisson from the sediment. Once the anchor has broken free, it would be brought up onto the deck of the vessel and transported to shore. If a gravity anchor is used, the anchor would be transported, suspended from the vessel, on a route chosen to ensure it did not contact the bottom during transit. Once in a sheltered location, the anchor would be recovered by an inshore crane vessel. The anchor would then be brought to an undetermined shore side location for salvage. Following the completion of testing, UMaine would likely delay removing the anchors until the following summer in order to provide for safer and more predictable weather.

A second removal option involves abandonment of anchors and removal of the top mooring system. For example, skirted mat and gravity anchors would sink into the sediment and may not be removable, there could be more bottom disturbance from removal of a skirted mat or gravity anchor that sinks into the mud than if they are left in place, and lifting anchors of this size that have sunk in marine mud may require a crane that is only available in the Gulf of Mexico. Abandoning the anchors in place would require a system design approach that would include a release device system. In this system design, a release device would be operated via the use of a remotely operated vehicle or via a release/recovery line. The line would be operated from the water surface and allow for the recovery of the mooring system above the seabed. The mooring components would be recovered from the anchors and brought to shore by a properly equipped vessel.

2.4 No-Action Alternative

Under the No-Action Alternative, DOE would not authorize the expenditure of Federal funds for the temporary deployment of wind turbine test platforms. As a result, installation of the project would be delayed while UMaine sought other funding sources, or abandoned if other funding sources could not be obtained. Furthermore, research towards reductions in fossil fuel use and improvements in energy efficiency would not occur through the activity of this project, and DOE's ability to achieve its objectives under the Wind and Water Power Program would be impaired.

2.5 Required Agency Permits and Approval Types

As indicated in Section 1.4, the USACE is a cooperating agency in the development of the EA for this project. Prior to installation of the turbines, UMaine will comply with all required Federal and State permits and approvals (Table 2-2).

Table 2-2. Required Permits and Approvals

Agency	Permit/Approval
Maine Department of Environmental Protection	Maine Public Law, Chapter 270 LD 1465[a], general permit
USACE	*Clean Water Act*, Section 404 permit
USACE	*River and Harbors Act*, Section 10 permit
National Oceanic and Atmospheric Administration (NOAA) Fisheries and USFWS	*Endangered Species Act*, Section 7 consultation
NOAA Fisheries	*Marine Mammal Protection Act*, consultation
NOAA Fisheries	Magnuson-Stevens Fishery Conservation and Management Act, essential fish habitat consultation
U.S. Coast Guard	*Ports and Waterways Safety Act*, consultation
Maine State Historic Preservation Office	*National Historic Preservation Act*, Section 106 consultation

a. An act to facilitate testing and demonstration of renewable ocean energy technology (see Section 2.3.2 of this EA).

Maine Governor John Baldacci signed legislation to facilitate permitting of experimental ocean-based energy projects on June 4, 2009. The law (Maine Public Law, Chapter 270 LD 1465) streamlines the permitting process for renewable energy test projects in State waters and the State General Permit provides for State review required by the *National Historic Preservation Act* (Section 106), *Coastal Zone Management Act* (Section 307(c)(3)), and the *Clean Water Act* (Section 401 Water Quality Certification).

2.6 Applicant-Committed Measures

This section describes measures UMaine proposes to implement to minimize or avoid potential environmental effects.

2.6.1 WATER RESOURCES

- The marine construction and maintenance contractors that UMaine selects (e.g., tug operators) will be licensed, and UMaine will require that they have spill response plans and their own insurance.

- The on-board management of fuels, lubricating fluids, and other similar chemicals on board the towing, recovery, and assist vessels will be managed in accordance with USCG regulations applicable to each vessel. The requirements will be dictated by the vessel size and intended operations but, in each case, will permit no discharge of petroleum or hazardous substances into the environment and require a spill prevention plan and certificate of financial responsibility.

- UMaine and its contractors will use best management practices for handling the limited amounts of petroleum fuels and other chemicals that will be on board the one-third scale turbines, including approximately 19.3 gallons of lubricants and hydraulic oils. Wind turbine generators are designed to contain any potential fluid leakage (secondary containment) and to prevent overboard discharges. UMaine will research appropriate measures to implement to provide containment and collection of hazardous material spills associated with the turbines should they occur.

2.6.2 BIOLOGICAL RESOURCES

- To prevent seals from using the turbine platforms for resting (seal haul out), the platforms will be designed to limit the horizontal surfaces, raising the platform deck (if applicable) to several feet above the water level, or by adding fences or other barriers.

- The turbine towers will not have external ladders or other structures that will allow birds to perch near the turbine blades.

- To minimize potential effects on flying birds, UMaine will develop the specifications for lighting of the floating platforms and turbine, which will be dependent on the final turbine platform designs selected for the UMaine test site, in compliance with USFWS lighting requirements.

- UMaine will develop and implement a post-construction Fish and Wildlife Monitoring Plan, in consultation with resource agencies, in order to evaluate how fish and marine mammals interact with the floating platforms (UMaine 2011). The monitoring will complement the pre-installation monitoring that was performed and will include the following:

  – Drop camera surveys for benthic invertebrates and demersal fish,
  – Hydroacoustic surveys for pelagic fish,
  – Continuous radar monitoring for flying vertebrates (birds and bats),
  – Visual surveys for marine mammals,

  - Monitoring for acoustic telemetry-tagged fish[4],
  - Acoustic monitoring of birds and bats, and
  - Visual, boat-based monitoring for birds.

- UMaine will implement NMFS marine mammal avoidance procedures in the event that a marine mammal is encountered by a construction or maintenance vessel.

- In addition, in response to State permitting requirements (Maine Public Law, Chapter 270 LD 1465, General Permit), UMaine will develop a report that describes, based on a field investigation, the marine resources that occur in the marine waters and on the submerged lands and immediately adjacent areas in, on, or over the project (geophysical, marine biological, and bird/bat field studies were conducted in 2010).

2.6.3 NOISE AND VIBRATION

- To minimize effects of noise on inhabitants of Monhegan Island, the project will be deployed at least 2 miles from shore.

- UMaine will develop and implement an underwater noise survey, in consultation with resource agencies, to assess underwater noise from the operational turbines (UMaine 2011).

4. As noted in the Section 3.4.1 below, NOAA and others have tagged fish with acoustic tags, which can in turn be detected by acoustic receivers, in the Gulf of Maine since 2005 to gather information on a variety of fish distribution and movements.

2.6.4 OCEAN USE

- UMaine will develop and implement a navigation safety plan, in coordination with the USCG Sector Northern New England Waterways Management Division[5], which will include the following:

  – Lighting – The two one-third scale turbines will be lit at night for the purposes of navigational safety. The turbines will have two lights on each turbine tower, at a height of 20 feet above the water, one on each side of the tower structure. Each light will be a 360-degree, white flashing light, flashing two short followed by one long flash every four seconds, and visible for up to 6 nautical miles. In addition to the lights on the turbine tower, for a semi-submersible type of floating platform, the other pylons not directly supporting the turbine tower will be lit with flashing amber lights. These will be 360-degree lights flashing every four seconds and visible for at least 2 miles (see Section 3.6.2.3).

  – Navigation Safety Zone – A Navigation Safety Zone will be established with a 1,150-foot radius around each floating turbine platform for spar or buoyancy stabilized semi-submersible platforms, or 150-foot radius for a TLP platform. This designation will prohibit all mariners from entering this zone. This will protect them from any debris (such as ice) that might be thrown from the rotor blades, and also prevent any vessel from dragging, anchoring, or fishing within the radius of the anchors and mooring lines. For on-shore-based wind turbines, the standard safety zone is twice the rotor diameter. The UMaine project turbine rotor diameter is approximately 88.6 feet; therefore, the spar buoy and semi-submersible 1,150-foot radius safety zone will exceed that standard and give an additional margin of safety of 164 feet beyond the platform’s anchors. The navigation safety zone for a TLP platform will be less (see Section 3.6.2.3).

- During installation and removal activities, notice will be given to the Maine Marine Patrol to alert fishermen about towing operations and to advise for the removal of gear from the planned tow route.

- UMaine will develop and implement a project removal plan.

- In addition, in response to State permitting requirements (Maine Public Law, Chapter 270 LD 1465, General Permit), UMaine will develop a report that describes existing information regarding commercial fishing and other existing uses in the project area.

2.6.5 AESTHETIC RESOURCES

- To minimize visual effects, the project will be:
  – Deployed at least 2 miles from Monhegan Island;
  – Temporary; and
  – Removed following completion of the testing.

- Because the proposed wind turbines are one-third scale and will be located at least 2 miles from the nearest visual receptor, there will be no effect from shadow flicker.

5. The USCG was guided largely by its Offshore Wind Generators Aids to Navigation Administrative Manual (USCG 2005).

2.6.6 CULTURAL RESOURCES

- At the request of SHPO, all areas of planned bottom and sub-bottom disturbance from project anchors will be examined in more detail using a marine magnetometer survey to identify the presence of potential shipwrecks. In order to eliminate the potential for damage of any areas containing shipwrecks, UMaine will only deploy the project in an area where no shipwrecks are present. Results of the marine magnetometer survey and the turbine siting determination will be reviewed with SHPO prior to deployment. In a letter to DOE dated April 29, 2011, SHPO stated that UMaine's process for avoiding shipwrecks was acceptable.

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

This chapter of this EA examines in detail the potential environmental impacts of the proposed project and the No-Action Alternative on the affected environmental resource areas.

3.1 Considerations Not Carried Forward for Further Analysis

Consistent with Council on Environmental Quality and DOE NEPA implementing regulations and guidance, DOE focuses the analysis in an EA on topics with the greatest potential for significant environmental impact. For the reasons discussed below, the proposed project is not expected to have any measurable effects on certain resources; therefore, these resources are not carried forward for further analysis.

3.1.1 AIR QUALITY

The U.S. Environmental Protection Agency (EPA) Region 1 and the Maine Bureau of Air Quality regulate air quality in Maine. The *Clean Air Act*, as amended, gives EPA the responsibility to establish the National Ambient Air Quality Standards that set acceptable concentration levels for the six regulated criteria pollutants: particle pollution, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. EPA must designate areas as meeting (in attainment) or not meeting (nonattainment) the respective Standard. The proposed project area, which is located in Lincoln County, is currently in attainment for all criteria pollutants; however, it is also designated as an 8-Hour Ozone Maintenance Area.

As defined in the General Conformity Rule pursuant to 40 CFR 51.853, this project meets the Federal action criteria. This means, for applicable Federal actions, a conformity determination is required for each pollutant where the total of direct and indirect emissions in a nonattainment or maintenance area caused by a Federal action would equal or exceed the respective rates for this region. The proposed project area is located within the ozone transport region; therefore, the applicable rates for this determination are 100 tons per year and 50 tons per year for nitrogen oxides and volatile organic compounds, respectively.

To assess whether a conformity determination is required, an air emissions inventory was compiled to conservatively estimate the air emissions from marine vessels and other equipment that would be used to install the project moorings and turbines. The estimate also accounts for survey and crew boats that would be used to monitor the project. It is estimated that 17 tons of nitrogen oxides and 1 ton of volatile organic compound would be emitted as a result of installing and monitoring the pilot project. Based on this assessment, a conformity determination is not required for the proposed project.

3.1.2 TERRESTRIAL RESOURCES

The proposed project is a deepwater offshore wind test site located within the Gulf of Maine and does not include any terrestrial areas. Therefore, terrestrial resources including geology and soils; floodplains; and terrestrial wildlife, vegetation, and wetlands would not be affected.

3.1.3 WILD AND SCENIC RIVERS

Because the proposed project occurs offshore, no Maine scenic rivers or waterways included in the National Wild and Scenic River System occur in the project vicinity, and the proposed project would therefore not impact Federal- or State-designated wild and scenic rivers.

3.1.4 LAND USE

The proposed project is located within the Gulf of Maine, does not include any terrestrial areas, and would therefore not affect existing land uses such as recreation, farming, forestry, or residential or land-based commercial uses.

3.1.5 TERRESTRIAL TRANSPORTATION AND TRAFFIC

During installation of the turbines, there would be a small amount of vehicular traffic associated with the transportation of construction workers and supplies to ship docking areas. However, the project would not result in a noticeable increase in vehicular traffic or require a change in traffic circulation or pattern. No new roads would be required for the proposed project.

3.1.6 INFRASTRUCTURE AND ENERGY USE

The turbines would not connect to the power grid. The turbine platforms would be fabricated onshore at an existing, operational shipyard or other similar existing coastal facility and temporarily deployed in the Gulf of Maine over 2 miles south of Monhegan Island. Therefore, infrastructure and energy use would not be affected.

3.1.7 ELECTROMAGNETIC FIELDS

The proposed project would not connect to the power grid, and there would be no subsea transmission cable associated with the project. Wind turbine generators are not considered a significant source of electromagnetic fields (CMOH 2010). The small level of electromagnetic fields created by the turbine would be located 100 feet above the water surface and would result in negligible effects.

3.1.8 INTENTIONAL DESTRUCTIVE ACTS

Installation and operation of a deepwater offshore wind test site in the Gulf of Maine does not involve the transportation, storage, or use of radioactive, explosive, or toxic materials; therefore, it is unlikely that installation or operation of the project would be viewed as a potential target by saboteurs or terrorists. The project is not located near any national defense infrastructure or in the immediate vicinity of a major inland port, container terminal, freight trains, or other significant national structure. The project is not considered to offer any targets for intentional destructive acts.

3.2 Geophysical Resources

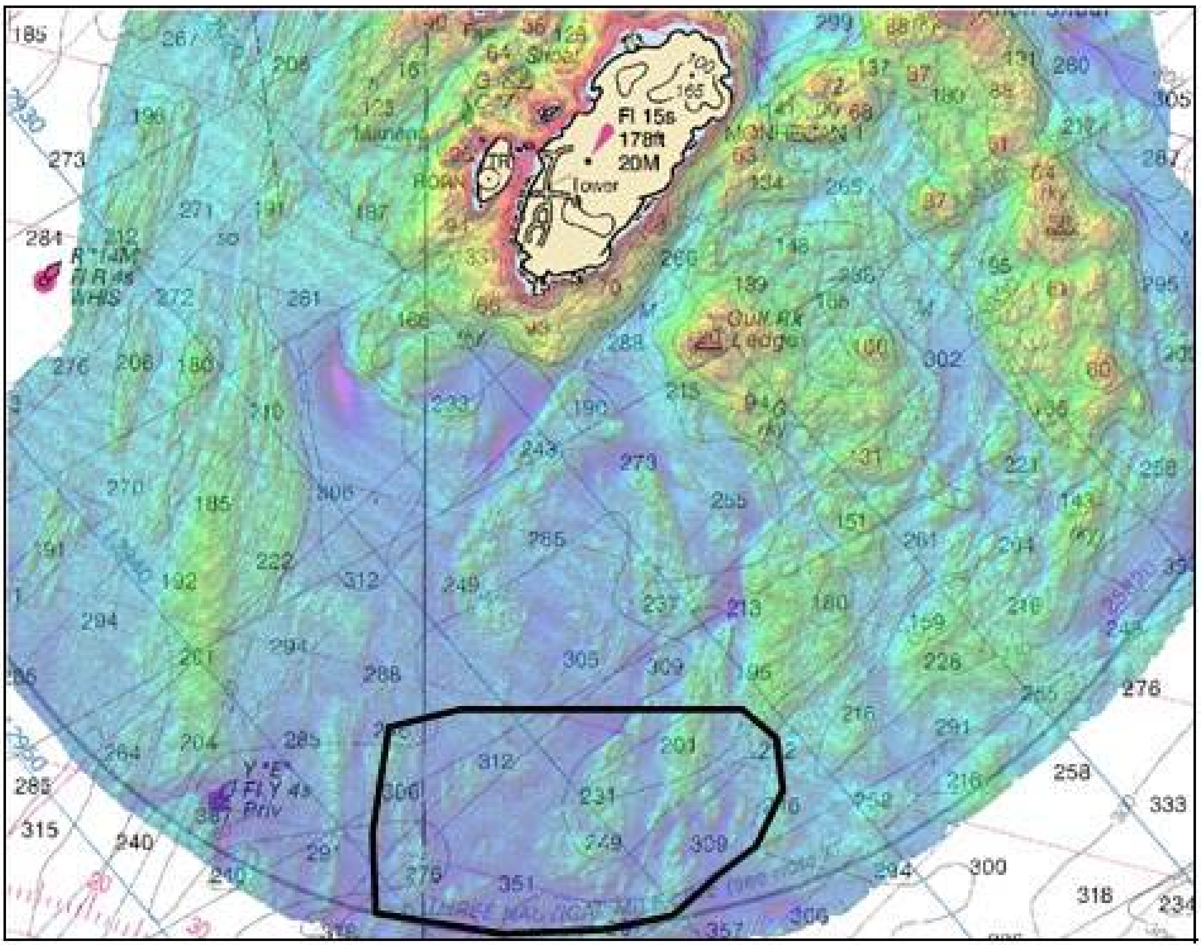
3.2.1 AFFECTED ENVIRONMENT

The Gulf of Maine sea floor is composed of a complex array of banks, ridges, gullies, and basins that extend as deep as 1,476 feet beneath the ocean surface. In areas such as Georges Bank and Browns Bank, which mark the offshore boundary between the Gulf of Maine and the open Atlantic Ocean, there are some places as shallow as 13 feet. These varied topographical features of the Gulf of Maine's sea floor, extending out to 198 miles offshore, distinguish it from the Atlantic Ocean (GoMOOS 2010a).

The seabed geology of the Gulf of Maine is primarily a complex mosaic of bedrock exposures and muddy basins. Rocky substrate is dominant in water depths less than 164 feet, while muddy substrate is dominant in depths greater than 164 feet. The relative abundance of sea floor types on the Maine inner continental shelf are as follows: rock (41 percent), mud (39 percent), gravel (12 percent), and sand 8 percent. Gravel (including boulders) is a minor bottom type at all depths, but is most common in the 32- to 100-foot depth range. Sandy sea floor is rare but present at all depths to 328 feet (Maine Geological Survey 2010). Barnhardt et al. (1996) compiled sea floor data along the inner continental shelf of Maine for water depths less than 328 feet. This includes an area just shoreward of the UMaine test site. The sea floor in the area was primarily composed of exposed bedrock outcroppings and fine-grained silt and clay sediment, referred to as mud.

Multi-beam bathymetric survey data exist for the Monhegan Island region, collected by the Maine Department of Marine Resources (DMR) (Figure 3-1).

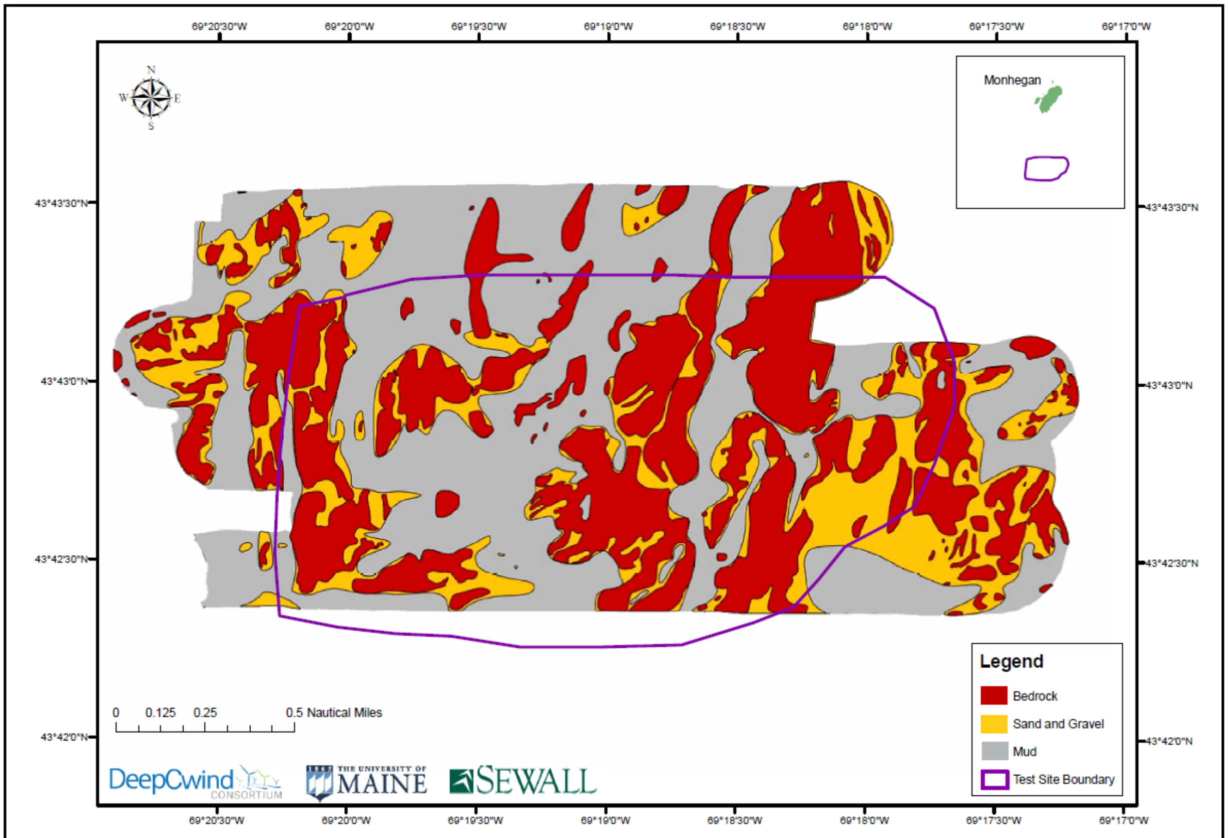
UMaine geology researchers, Drs. Daniel Belknap and Joseph Kelly, conducted multi-beam bathymetry surveys (October 12, 2010), digital seismic reflection profiling (June 15 and 16, 2010) and side scan sonar surveys (June 17 and 18, 2010) within the UMaine test site. UMaine conducted the bathymetry survey to provide more detail than was available from the DMR survey. The test site has water depths that range from approximately 180 to 360 feet. UMaine would use the more detailed bathymetry information in designing the turbine anchoring and platform moorings.



Note: Test site location (black outline), shown with water depths from NOAA coastal charts and a color-intensity image representing multi-beam bathymetry data (image courtesy of DMR). Water depth increases from red to blue and depth readings are in feet.

Figure 3-1 Monhegan Island Regional Sea floor Bathymetry

UMaine researchers developed a surficial geological map of the approximately 1.1 mile by 2.1 mile test site (Figure 3-2) based on an interpretation of the side scan backscatter imagery and the seismic profiling survey. Box cores (2.2 foot square by 1.6 feet deep) of surficial seabed sediments were collected to ground truth the side scan sonar data and to assess shallow sediment strengths and characterization. This map shows areas of rock (bedrock), sand and gravel, and mud. Areas of surficial sand, gravel, and boulders generally surround larger areas of bedrock ridges, and rarely occur in isolated patches (described in further detail below). Some bedrock ridges appear to arise abruptly from muddy basins. Numerous lines or cables and individual lobster traps were visible in several basins (Belknap et al. 2010).

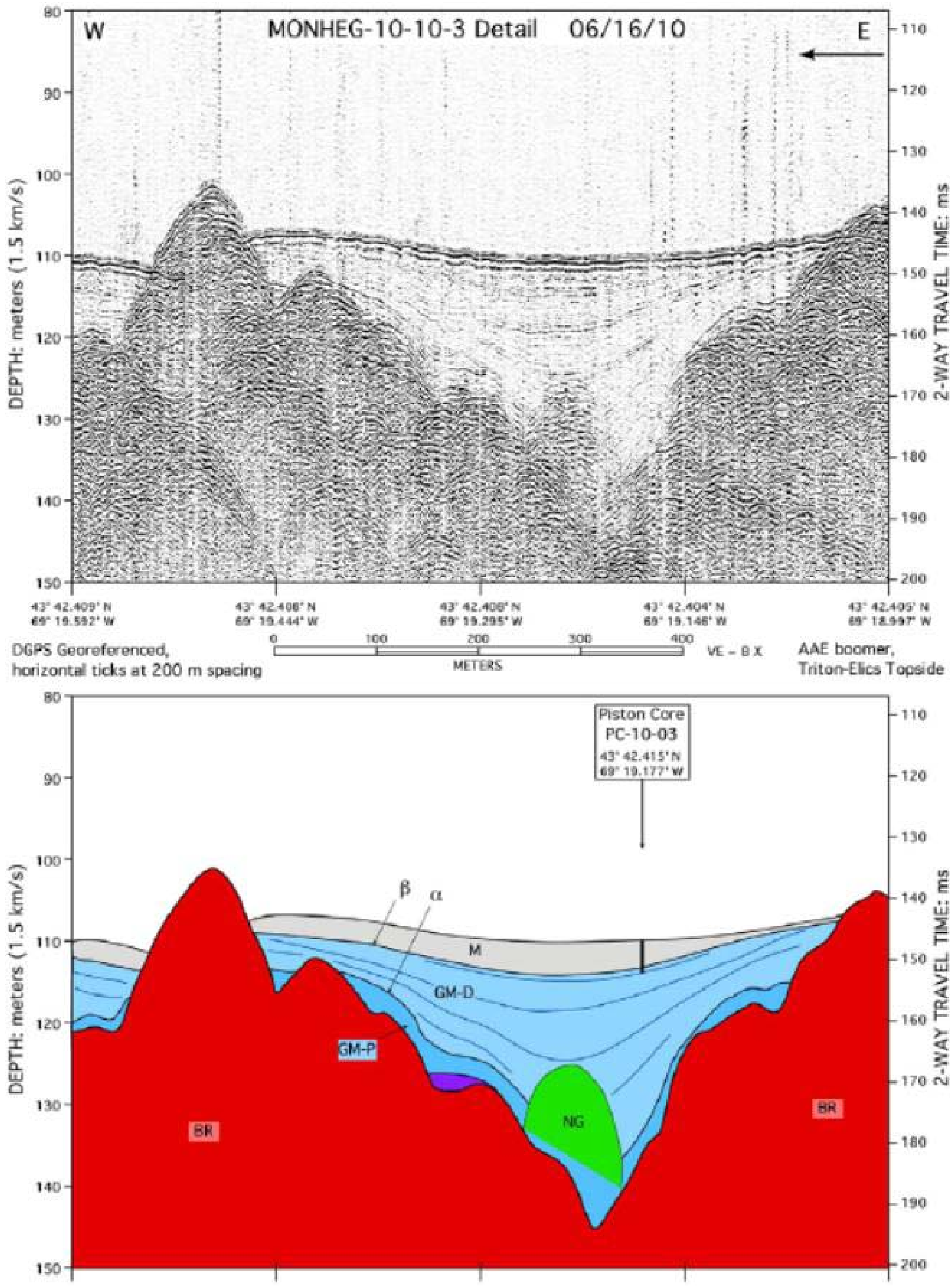


Source: Belknap et al. 2010.

Figure 3-2. Generalized Surficial Geological Map of Test Site

Much of the seabed within the eastern portion of the test site consists of bedrock outcropping at the surface, while muddy basins of various depths and widths are more common within the western portion of the site (Figure 3-2) (Belknap et al. 2010). The majority of the troughs identified in the muddy basins are less than 16 feet in depth; however, a significant number of basin troughs exist that are greater than 39 feet in depth. The basins and bedrock ridges appear to be preliminary oriented north-to-south and are separated by bedrock that outcrops on the sea floor, similar to the mainland topography north of Monhegan Island (Belknap et al. 2010).

A representative section of a seismic reflection profiling transect is shown in Figure 3-3. The cross section demonstrates interpretation of bedrock and rock outcropping, glacial till, deposition of glaciomarine mud and Holocene mud, a potential natural gas pocket (likely caused by decomposition of organic matter trapped within the sediment), and the location of a piston core sample (Belknap et al. 2010).



Note: Red is bedrock; blue is glaciomarine mud (GM-P is proximal to original glacial sources, and GM-D is glaciomarine mud distal to glacial sources); purple is till; grey is Holocene (recent) mud; green is natural gas; and α and β are unit reflectors.

Source: Belknap et al. 2010.

Figure 3-3. Seismic Reflection Profile Cross Section

3.2.2 ENVIRONMENTAL IMPACTS RELATED TO GEOPHYSICAL RESOURCES

The primary effect of the project upon geological resources would be from placement of the foundations/anchors on or in the seabed. No pile driving would occur, and no blasting would be required. As stated in Section 2.2.5 and 2.2.6, a number of shallow foundations/anchors are being considered for mooring the project including drag embedment (fluke) anchors, gravity (weight) anchors, skirted mats, and suction caissons. The degree to which the foundation/anchors would penetrate the seabed would also vary, ranging from approximately 6.6 feet for a skirted mat, approximately 29.5 feet for a suction caisson, and potentially even deeper for a drag embedment anchor. A gravity anchor deployed on a rock bottom (see Figure 2-2) would minimally penetrate the seabed. A removal option involves abandonment of anchors and removal of the top mooring system. For example, skirted mat and gravity anchors would sink into the sediment and may not be removable.

The footprint of the foundation/anchors being considered is variable and would depend upon final design of the turbine platform and condition of the seabed at the selected deployment site. The foundation/anchor that would have the largest footprint would be a skirted mat, which is expected to measure approximately 16 feet by 16 feet. Each of these foundations would cover an area approximately 256 square feet, and the total area of the sea floor covered by six foundations (assuming three foundations for each floating platform) would be 1,536 square feet (0.04 acre). During installation, drag embedment anchors would drag about 10 times the lateral distance of the penetration distance (i.e., 10 feet of penetration means dragging of 100 feet). It is anticipated that much of this distance would be within the substrate and not along the seabed surface.

In conclusion, the footprint of the anchors would be very small (less than 0.04 acre), and therefore, the proposed project would have negligible effects on the geophysical resources. Impacts on the benthic community and other marine life from disturbing the sea floor are discussed in Section 3.4.

3.2.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no impacts to the seabed. Baseline conditions, as described in Section 3.2.1, would remain unchanged.

3.3 Water Resources

3.3.1 AFFECTED ENVIRONMENT

The State of Maine has established classification standards for water quality to direct the State in the management of its surface waters; protect the quality of those waters for the intended management purposes; and where standards are not achieved, to direct the State to enhance the quality to achieve those standards. The State has three classes for marine and estuarine waters. The highest classification of marine and estuarine waters is termed SA. This classification is for waters that are outstanding natural resources and which should be preserved because of their ecological, social, scenic, economic, or recreational importance. Class SB waters have fewer restrictions on activities but still maintain high water quality criteria. Finally, Class SC waters have the least restrictions on use and the lowest (but not low) water quality criteria (Maine Bureau of Land and Water Quality 2010).

All marine and estuarine waters in Lincoln County are classified SB, with the exception of tidal waters lying south of the northernmost point of Damariscove Island and west of longitude 69°36'00" W. The UMaine test site is not located within this exception, and is therefore classified as SB waters by the Maine Bureau of Land and Water Quality (Title 38 MRSA Section 469).

The Gulf of Maine is bounded by underwater offshore banks, creating a self-contained oceanographic system with a prevailing counterclockwise current. The circulation patterns in the Gulf of Maine are also affected by freshwater influx, wind speed and direction, the spinning of Earth, and the density of the water masses (GoMOOS 2010b). As outlined in Figure 3-4, cold water generally enters the gulf over the Scotian Shelf and through the Northeast Channel. Once in the gulf, water flows counterclockwise along the coastal shelf moving surface waters about 8 miles per day. Tidal fluctuations and shallow water over Georges Bank form a secondary, clockwise-spinning gyre. Water leaves the gulf through the Great South Channel, over and around the eastern portion of Georges Bank, and in some cases, through the Northeast Channel (Pettigrew et al. 2008). It takes between three and six months for surface water to completely circle the Gulf of Maine (Deese 2009). Deep waters also circulate, but much more slowly, taking approximately one year to complete the circuit (GoMOOS 2010b).

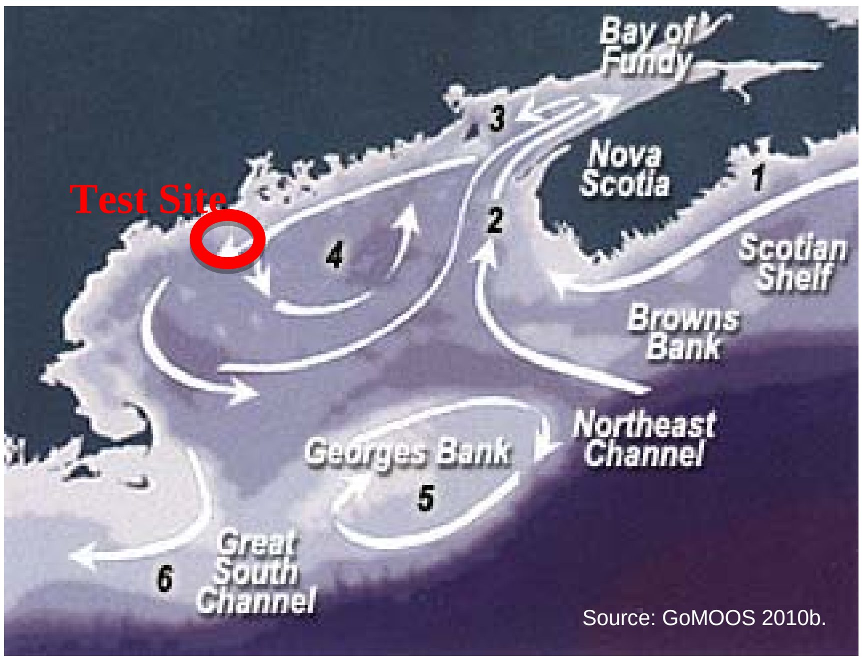


Figure 3-4. Currents in the Gulf of Maine

The Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS) has been established to network and expand the existing oceanographic observing and prediction capacities of a multitude of institutions and agencies throughout New England and Maritime Canada. Five of the 11 Gulf of Maine array oceanographic buoys, formerly funded by the Gulf of Maine Ocean Observing System, are currently maintained by UMaine.

Two of the Gulf of Maine array buoys are near the UMaine test site, Buoy E01 and Buoy E02. The buoys collect data on wave heights and periods, wind speeds and directions, temperatures, and current speeds and directions. Buoy E01 is located less than 1.2 miles west of the test site, and was deployed in 2001. Buoy E02, located within the UMaine test site, was deployed on August 11, 2010. The 2010 observed daily average wave height at each buoy is shown in Figure 3-5. As expected, the wave height observed at both buoys is nearly identical. The wave height is higher during winter months and ranges from a daily average of 0.98 foot to 18 feet. The maximum, mean, and minimum wave height at E01 during this period was 29, 3.9, and 0.3 feet, respectively (GoMOOS 2010c). The maximum current velocity observed in the test site, as recorded at Buoy E02, from August 11, 2010, to November 20, 2010, was 1.6 knots and the mean current velocity was 0.33 knots at a depth of 32 feet (GoMOOS 2010c). The mean tidal range on Monhegan Island is 8.9 feet, and the mean spring tide range is 10 feet (NOAA 2010c). Water temperatures recorded at Buoy E01 over the past year varied from 37 to 63 degrees Fahrenheit at the surface and 38 to 55 degrees Fahrenheit at a depth of 164 feet (GoMOOS 2010c).

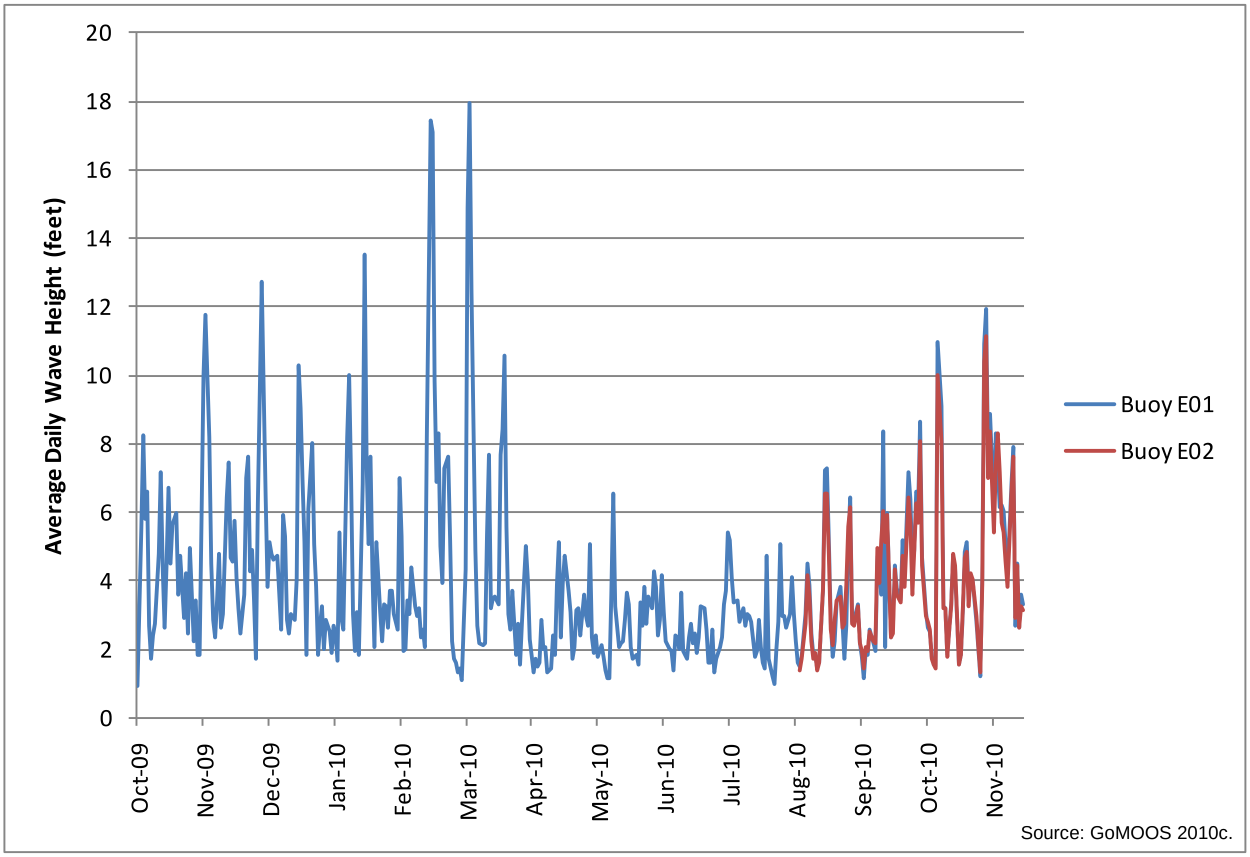


Figure 3-5. Average Daily Wave Height Recorded at Buoys E01 and E02

The wind resource at the UMaine test site has been recorded at Buoys E01 and E02. The average weekly wind from May 2009 through May 2010 ranged from 5.8 knots to 19.6 knots. The maximum wind speed recorded at Buoy E01 during this period was 42.2 knots. The wind speed recorded at 19.2 feet above the ocean surface at Buoy E01 is shown in Figure 3-6 (UMaine Physical Oceanography Group 2010).

No water quality monitoring has been conducted at or in the vicinity of the test site.

3.3.2 ENVIRONMENTAL IMPACTS RELATED TO WATER RESOURCES

The proposed project would temporarily deploy up to two floating offshore wind turbine platforms and associated moorings and anchors. The floating platforms would be deployed for up to two five-month periods. Due to the short duration of the turbine deployments at the test site, it is not expected that much accumulation of attaching marine organisms (biofouling) would occur on the turbine platforms, and therefore, UMaine does not plan to use antifouling paint. Installation and operation of the project is not expected to influence dissolved oxygen concentration, pH, or temperature of the surrounding water. Placement of anchors in areas of sand or mud would likely result in a temporary and localized increase in turbidity during deployment and removal; with only three anchors expected to be deployed for each

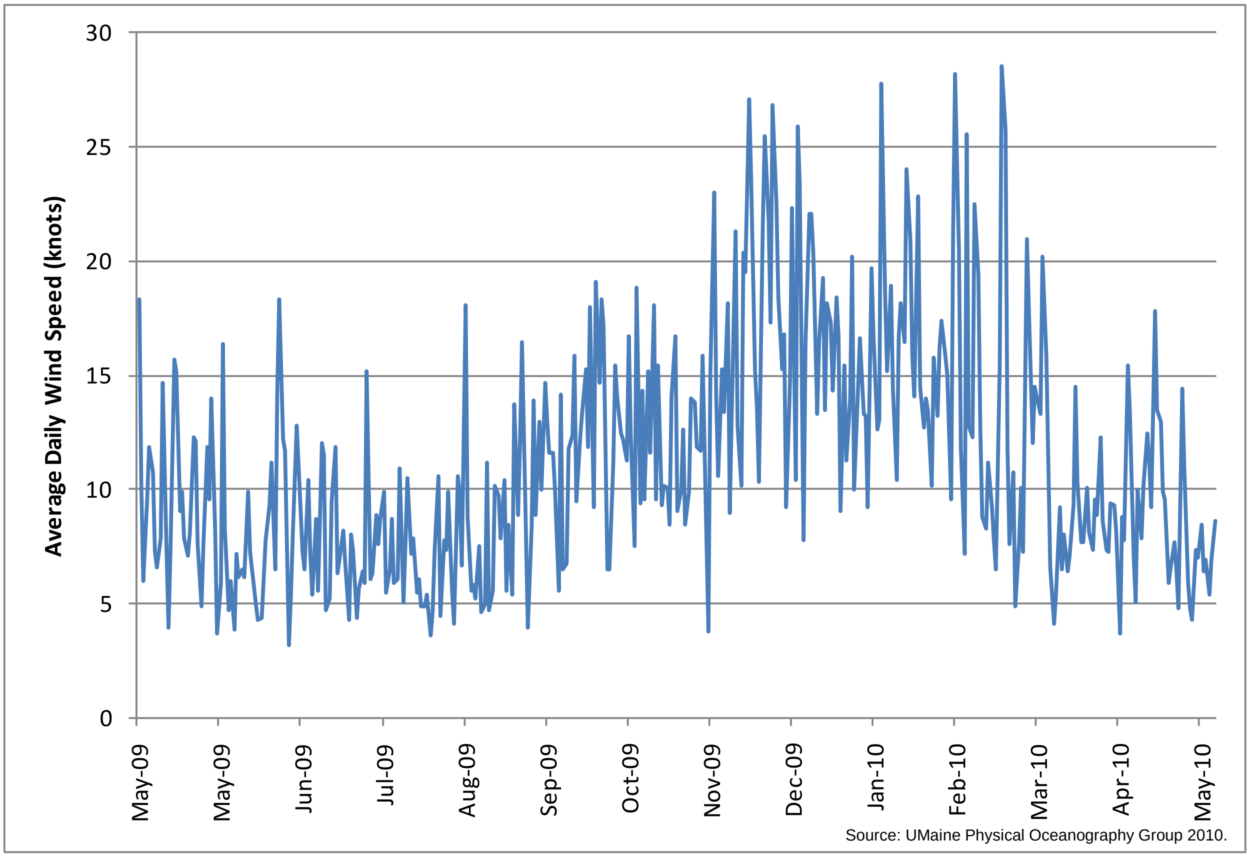


Figure 3-6. Wind Speed Recorded at Buoy E01

turbine, this effect would be short term and negligible. This section evaluates the following potential effects that relate to water resources:

- The potential for spills during construction, maintenance, and operations; and
- The potential for project effects on local hydrodynamic processes.

3.3.2.1 Spills During Construction, Maintenance, and Operations

A number of vessels, including tugs, installation vessels, and other workboats would be employed during the construction and maintenance of the project. The vessels used during the construction and maintenance operations would contain fuel, hydraulic fluid, and other potentially hazardous materials. In the event that a petrochemical spill did occur during construction or maintenance of the floating turbines, dispersal of these fluids could negatively affect the environment, including immediate effects on offshore birds and minor impacts to marine mammals or other marine species, including plankton, invertebrates, and fish.

Safeguards would be planned and deployed as necessary to minimize the effects of a spill in the unlikely event that one occurs. It is expected that each anchor would take one day to install, utilizing up to two vessels. Each turbine platform would likely have three anchors, though the number would be dependent on the final design. The deployment of each turbine platform is expected to occur in the course of one day, using up to four vessels. This installation time is short because the turbine and platform structures would be constructed and assembled at a shipyard or similar existing coastal facility.

Maintenance activities would be required to accomplish scheduled and unscheduled inspections, maintenance, and repairs. Maintenance actions would include periodic visits to the turbines to visually inspect the structure, conduct general maintenance of instruments, and respond to other issues as they arise. The actual schedule of maintenance is currently being developed by UMaine as part of the testing plan. This plan would be based on the final platform design and is expected to be completed during the first half of 2011.

To minimize potential effects on water resources, the marine construction and maintenance contractors that UMaine selects (e.g., tug operators) would be licensed, and UMaine would require that they have spill response plans and their own insurance. The on-board management of fuels, lubricating fluids, and other similar chemicals on board the towing, recovery, and assist vessels would be managed in accordance with USCG regulations applicable to each vessel. The requirements are dictated by the vessel size and intended operations but in each case permit no discharge of petroleum or hazardous substances into the environment and require a spill prevention plan and certificate of financial responsibility.

The installation of the test turbines would be completed in an environmentally safe manner with appropriate safeguards to minimize the effects of a spill in the unlikely chance that one occurs.

Limited amounts of petroleum fuels and other chemicals would be on board the one-third scale turbines, including approximately 19.3 gallons of lubricants and hydraulic oils. UMaine and its contractors would use best management practices for handling these materials. Wind turbine generators are designed to contain any potential fluid leakage (secondary containment) and to prevent overboard discharges. UMaine would research appropriate measures to implement to provide containment and collection of hazardous material spills associated with the turbines should they occur.

In conclusion, negligible impacts would occur as a result of spills during construction, maintenance, and operations because:

- Project turbine platforms and anchors can be deployed quickly, minimizing on-water time of service vessels.
- Safeguards would be planned and deployed as necessary to minimize the effects of a spill in the unlikely event that one occurs. These safeguards include:
  - The marine construction and maintenance contractors that UMaine selects (e.g., tug operators) would be licensed, and would be required to have spill response plans and their own insurance.
  - The on-board management of fuels, lubricating fluids, and other similar chemicals would be managed in accordance with USCG regulations applicable to each vessel.

3.3.2.2 Effects on Local Hydrodynamic Processes

In the scoping process, a concern was raised by one commenter about the potential effects of the project on local hydrodynamic processes and the related potential effects on marine life. The circulation in the Maine coastal shelf region surrounding the proposed test site is dominated by the Eastern and Western Maine Coastal currents, tidal currents, and other features, including meso-scale eddies (Pettigrew et al. 2005). These features arise due to multiple factors, including land features, bathymetry, wind speed and direction, spinning of the Earth, water density, freshwater influx, and the broad-scale circulation of the Gulf of Maine (Pettigrew et al. 2005). Circulation is important for ecology including nutrient cycles, plankton, and larval transport (Townsend et al. 1983). The proposed project would temporarily deploy new infrastructure (two floating turbine platforms) in the water column for up to two five-month periods. From August 11, 2010, to November 20, 2010, the maximum current velocity observed in the test site, as recorded at Buoy E02 located at the test site, was 1.6 knots at a depth of 32.8 feet, and the mean current velocity at this depth was 0.33 knots (GoMOOS 2010c). UMaine expects that the floating platforms would shed eddies from the water flowing past, producing minor localized stirring. The turbine structures would not create large eddies or gyres, as the water velocity in the test area is slow and the turbine structures are relatively small. There would only be two platforms in the water, and any changes to hydrodynamics proximal to the platforms would be subject to the far stronger influences affecting circulation throughout the Maine coastal shelf and to eddies shed from Monhegan Island by the Maine Coastal Current (Townsend et al. 1983).

Water circulation, vertical mixing and ocean upwelling, proximal to the UMaine test site is primarily driven by tides, bathymetry, and Monhegan Island (Townsend et al. 1983). Wind is also a component that contributes to ocean circulation, including upwelling and down-welling patterns (Townsend et al. 1983). Fluid dynamic modeling with simplified assumptions has indicated that large, commercial-scale offshore wind turbine farms have the potential to alter localized surface ocean upwelling and currents if the wind wake of multiple turbine rotors causing changes in wind stress at the sea surface (Broström 2008). It is important to note that Broström’s (2008) computational model displayed localized upwelling in association with modeled wind farms on a scale on the order of the Rossby radius of internal deformation[6] or larger. In reasonable conditions for the test site, this length scale would correspond to a wind farm measuring greater than 3 to 9 miles on one side and therefore does not apply to two one-third scale turbines deployed within a linear distance of less than 3 miles of each other.

The momentum extracted from the wind by a Vestas V27 is roughly equivalent to what would be lost to wind drag by the Maine Maritime Academy training ship at anchor into the wind (calculation by R. Kimball of the Maine Maritime Academy). Moreover only a small fraction of the momentum extracted by a turbine would have exerted stress on the sea surface. It is the large spatial scale and stable spatial structure of large wind farms, and not the magnitude of the momentum extraction per se, that creates the potential to alter local upwelling (Broström 2008).

In conclusion, given the temporary nature and small scale of the proposed floating turbines, the wind energy extracted by the two one-third scale turbines would not have a measurable effect on the localized ocean surface circulation.

3.3.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no potential impacts to water resources in the test site. Baseline conditions, as described in Section 3.3.1, would remain unchanged.

6. The Rossby radius of internal deformation, also called the internal Rossby radius, is the horizontal length scale, or distance, at which effects of the earth's rotation (Coriolis force), become as important as buoyancy forces due to differences in water temperature, salinity, and density. For typical water column conditions in the Gulf of Maine region during summer (the stratified season), the internal Rossby radius is on the order of 3 miles. During winter, when the water column is not strongly stratified, the internal Rossby radius is larger, on the order of 9 miles on the coastal shelf, and deeper in the central part of the Gulf.

3.4 Biological Resources

3.4.1 AFFECTED ENVIRONMENT

3.4.1.1 Habitat Overview

The proposed project's test site is located in open ocean habitat approximately 2 to 3 miles south of Monhegan Island. Water depths in the area are variable, ranging from 180 to 360 feet, and the test site contains habitat used by benthic communities (species that live on or in the sea floor), demersal species (species that live and feed near the bottom), and pelagic species (species that live and feed away from the bottom).

As discussed in Section 3.2.1, UMaine researchers evaluated the seabed at the test site, which consists of areas of rock (bedrock), sand and gravel, and mud (Figure 3-2). Areas of sand and gravel generally surround larger areas of bedrock ridges, with few isolated patches. Some bedrock ridges appear to arise abruptly from muddy basins. Much of the seabed within the eastern portion of the test site consists of bedrock outcropping at the surface, while muddy basins of various depths and widths are located within the western portion of the site (Figure 3-2) (Belknap et al. 2010).

Rocky habitats make up more than 50 percent of the Gulf of Maine's seabed, typically extending from the intertidal zone to depths of 328 feet. Rocky habitats have a variety of substrates ranging from ledge to cobble to gravel, and often includes a mixture of substrates. Substrates complexities within rocky habitat influence species use and abundance. Areas with subtidal sand can be influenced by waves and currents, which can form ripples and ridges, creating habitat complexity. Typical inhabitants of sandy or mud areas burrow into the sand, build protruding tubes, or have cryptic coloring to blend in with the seabed and avoid detection. Muddy habitats typically have lower diversity and productivity than other marine habitats, though they are important in making plankton and detritus available to higher trophic levels (Gulf of Maine Council 2005).

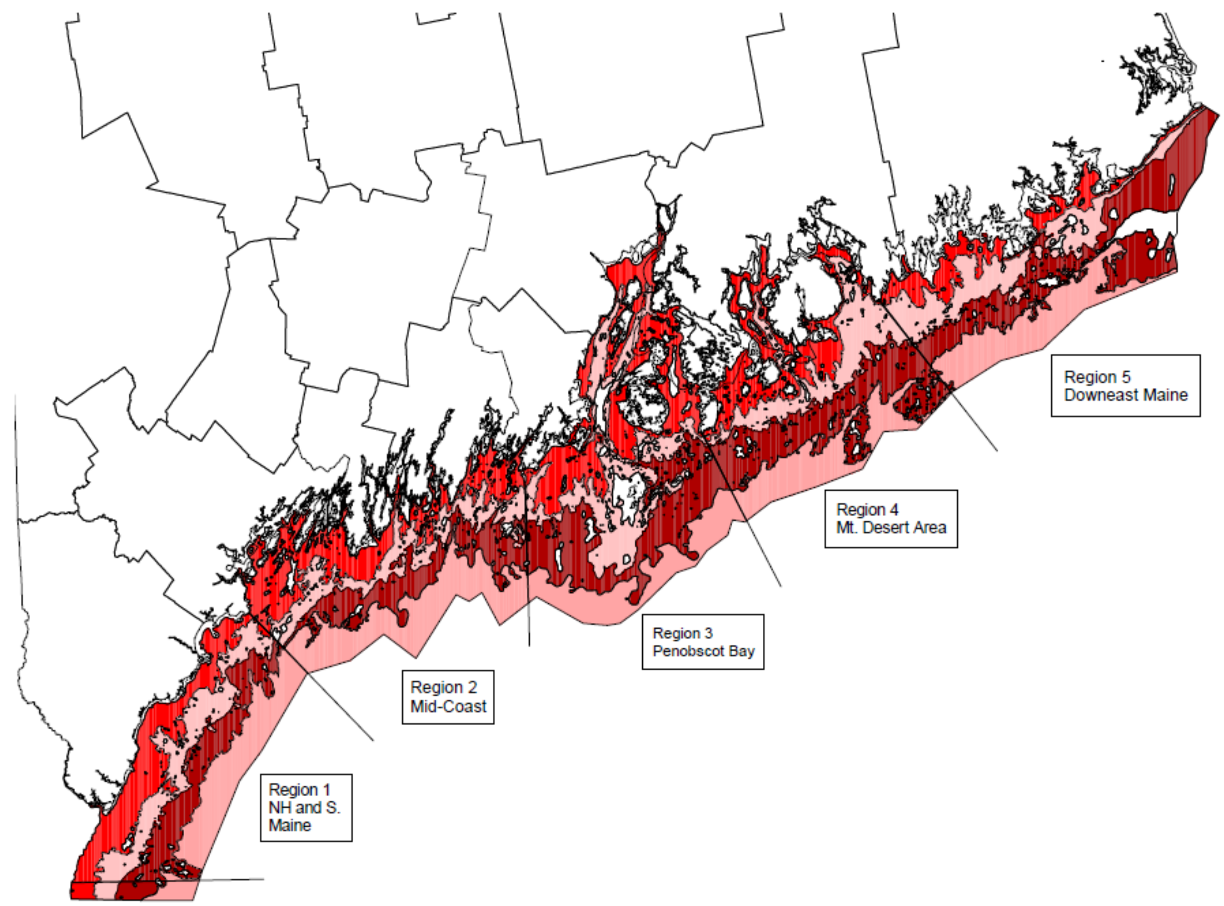
3.4.1.2 Invertebrates

The Gulf of Maine supports a diverse variety of marine invertebrate species. While many studies of marine life have occurred in different parts of the Gulf of Maine, the Maine-New Hampshire Inshore Trawl Survey represents the most recent, comprehensive, and long-term sampling program evaluating fish and invertebrates in the Gulf of Maine, including areas around Monhegan Island. This program, which began in the fall of 2000 and has continued each spring and fall, is a collaborative partnership between commercial fishermen and researchers at DMR and New Hampshire Department of Fish and Game. The purpose of the program is to assess inshore fish and invertebrate stocks along the Maine and New Hampshire coasts by providing an index of the distribution and abundance of a variety of fish and invertebrate species that is not influenced or biased by fishing effort or outside factors.

The trawl survey is conducted from commercial fishing vessels with a modified shrimp trawl, and all aspects of trawling and sample handling follows a standard protocol (Sherman et al. 2005). Sampling is randomized and segmented into different depth strata out to approximately the 12-mile limit. The sampling is also divided into five longitudinal strata, or regions, based on oceanographic, geologic, and biological features (Figure 3-7). Monhegan Island is located on the line separating Regions 2 and 3 near the outer limits of sampling. Actual tow depths in these regions ranged from 29.5 feet to 531 feet.

To characterize marine life likely to occur in the project area, DMR sampling data for an area 14.5 nautical miles east to west by 10.0 nautical miles north to south was selected from Regions 2 and 3 around the vicinity of Monhegan Island. In this area, DMR survey data for this region was collected each year from 2000 through 2009 between October to November and May to June. The 14 most abundant macroinvertebrate species caught in this area around Monhegan Island are shown in Table 3-1. The species composition in this area is similar to the other regions: 10 of the 14 most abundant species captured overall in Regions 2 and 3 were also among the most abundant species near the Monhegan Island test site, including four shrimp species and American lobster (McCleave 2011).

To further characterize the benthic habitats and marine communities of invertebrates that may occur in the project area, UMaine conducted video drop-camera surveys at two potential turbine deployment locations within the test site (experimental sites) and a control location (Figure 3-8). When compared to other coastal Maine sites with similar substrate and water depth, the experimental sites and control site had low invertebrate population densities and species diversity. Invertebrates observed included northern shrimp, *Telia* anemones, cerianthid anemones, Jonah crab, rock crab, blood star, radiated shanny, American lobster, frilled anemone, and spiny sun star (Steneck et al. 2010; Steneck 2010).



Note: The area sampled included four depth strata, represented by the different colors: 30-120 feet; 121-210 feet; 211-330 feet; and greater than 331 feet out to approximately the 12-mile limit.

Source: Sherman et al. 2005.

Figure 3-7. Regional and Depth Strata for the Maine-New Hampshire Inshore Trawl Survey

Table 3-1. Most Abundant Macro-Invertebrate Species from Maine-New Hampshire Inshore Trawl Survey in Vicinity of the Monhegan Island Offshore Wind Test between Fall 2000 and Fall 2009

Common name	Scientific name	Total Number	N	Fall Total	N	Spring Total	N
Northern shrimp	*Pandalus borealis*	94,044	30	19,441	11	74,603	19
Aesop shrimp	*Pandalus montagui*	57,948	31	17,029	12	40,919	19
Bristled longbeak	*Dichelopandalus leptocerus*	21,009	29	9,045	11	11,964	18
Krill	*Euphausiacea* spp.	4,330	17	1,920	7	2,410	10
Sea scallop	*Placopecten magelanicus*	900	20	516	7	384	13
American lobster	*Homarus americanus*	573	27	414	10	159	17
Sevenspine bay shrimp	*Crangon septemspinosa*	542	15	281	7	261	8
Longfin squid	*Loligo peali*	246	10	246	10	0	0
Jonah crab	*Cancer borealis*	236	22	121	11	115	11
Shortfin squid	*Illex illecebrosus*	197	10	197	10	0	0
Brittle stars	*Ophiuroidea* spp.	29	15	3	3	26	12
Northern cyclocardia	*Cyclocardia borealis*	13	2	0	0	13	2
Waved astarte	*Astarte undata*	6	2	0	0	6	2

Note: N = number of tows in the area positive for a given species.
Source: McCleave 2011.

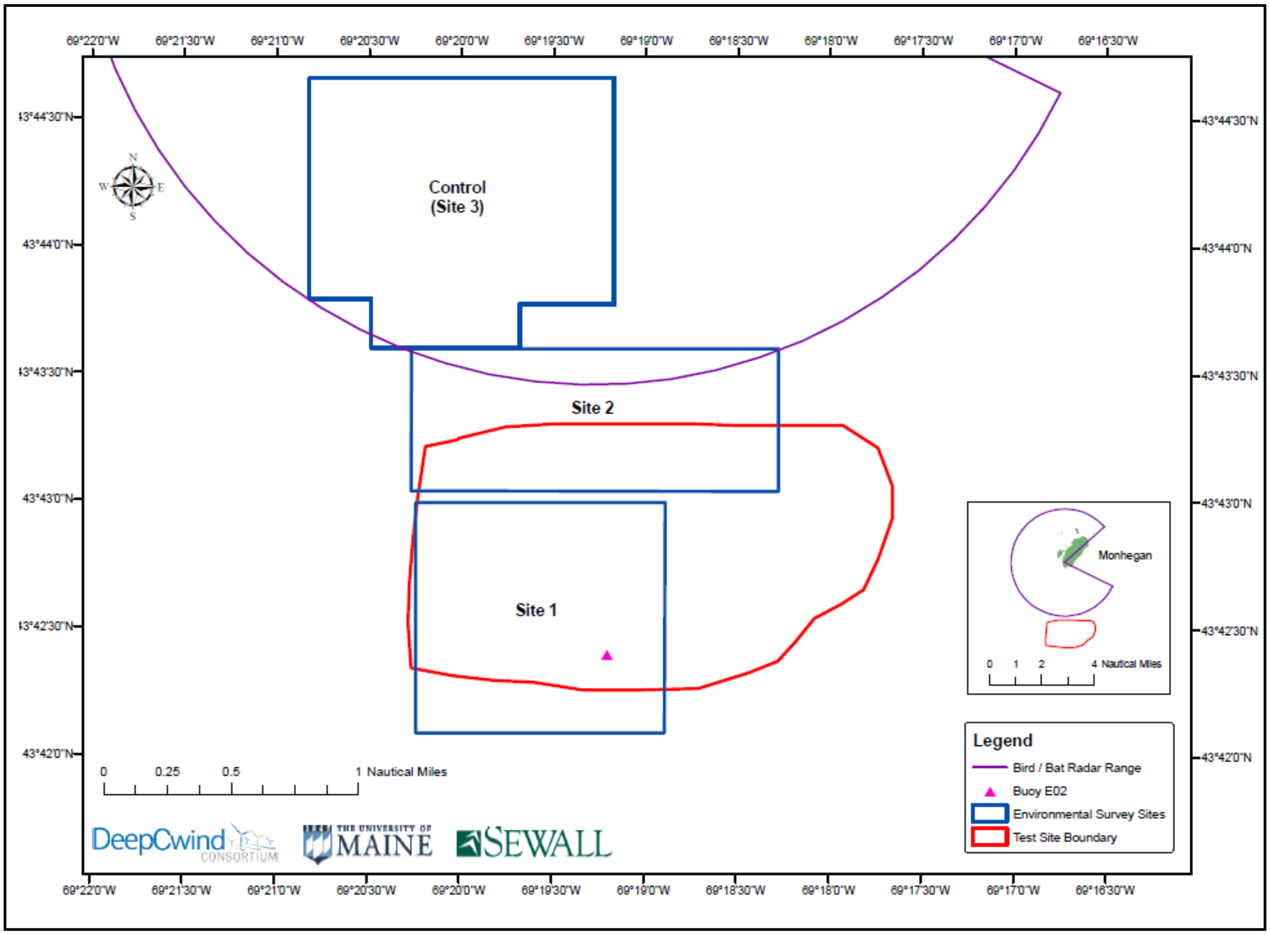
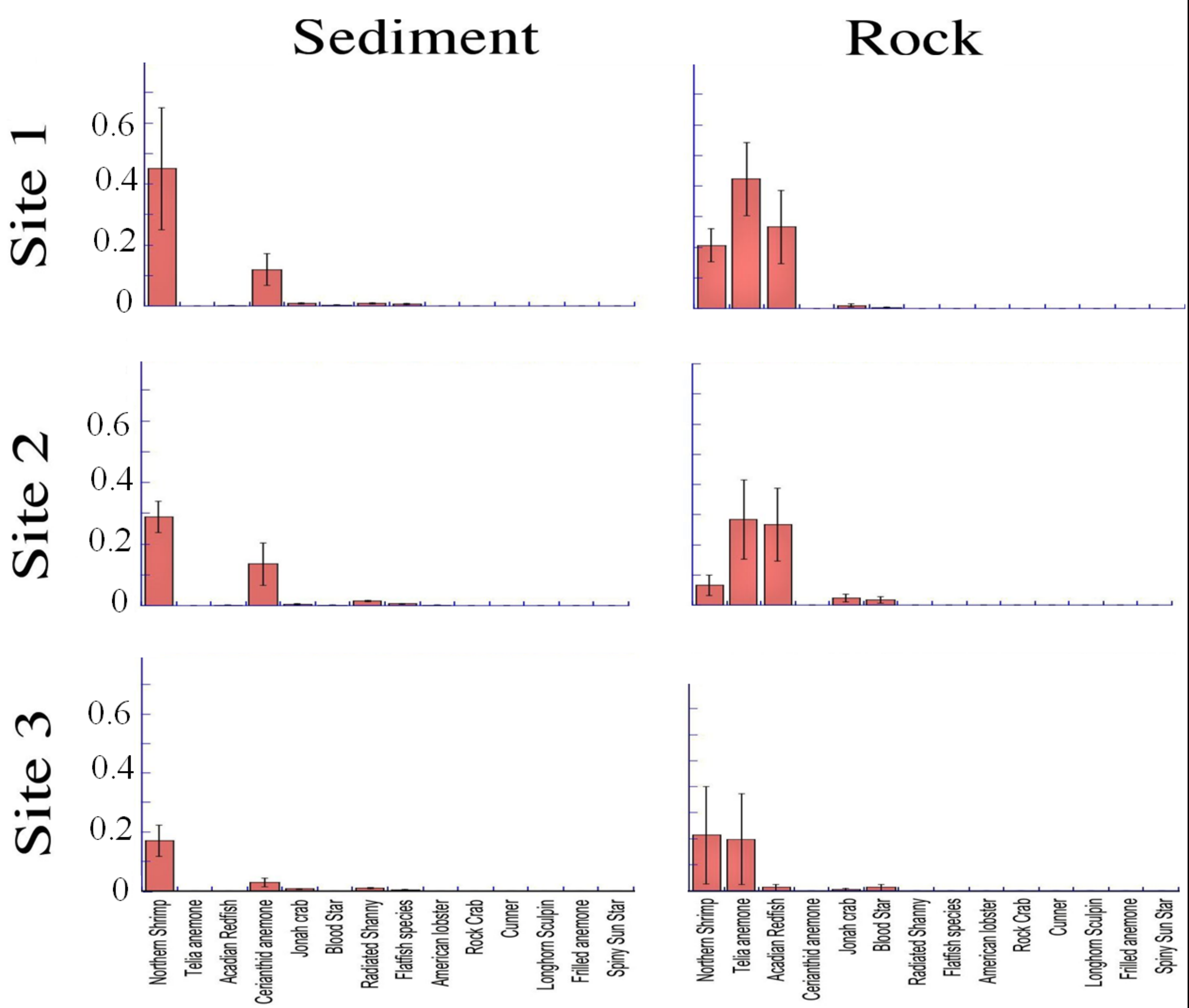


Figure 3-8. UMaine Offshore Wind Test Site – Environmental Surveys Location Map

Sediment and rock substrate habitats were occupied by different fauna. Northern shrimp and cerianthid anemones dominated the sediment substrate, while *Telia* anemones dominated the rock substrate. Northern shrimp density ranged from 0.1 to 0.5 animals per square meter in sediment substrate and *Telia* anemones ranged from 0.06 to 0.2 animals per square meter in rock substrate at the sampling locations in the UMaine test site (Steneck et al. 2010). Figure 3-9 shows the density of invertebrates observed at the experimental sites and control site.

American lobster represents the most commercially important invertebrate in Maine, constituting 70 percent of Maine's commercial landings by value, and over 80 percent of Maine's harvested marine resource value (UMaine 2011). During the video drop-camera surveys, the density of lobster increased towards shore with lobster being most abundant in rocky habitats (Steneck 2010).



Note: Population densities in number/m^2 (± SE) of all species (or groups) recorded at three study sites.

Source: Steneck et al. 2010.

Figure 3-9. Population Densities of Marine Species Observed During Video Surveys

3.4.1.3 Fish

The Gulf of Maine supports a diverse variety of finfish species. As discussed above, the best, most recent historical information on fish species composition and abundance in the project vicinity is available through a decade of data from the Maine-New Hampshire Inshore Trawl Survey. As discussed in the preceding section, to characterize marine life likely to occur in the project area, DMR sampling data was reviewed for an area around Monhegan Island. The most abundant 24 fish species are shown in Table 3-2. Only tows with positive fish counts are shown in the table. Eight of the 10 most abundant species overall (for Regions 2 and 3) were also among the 10 most abundant species in the area evaluated around the Monhegan Island test site (UMaine 2011).

Table 3-2. Most Abundant Fish Species from Maine-New Hampshire Inshore Trawl Survey in Vicinity of the Monhegan Island Offshore Wind Test between Fall 2000 and Fall 2009

Common Name	Scientific Name	Total Number	Number of Tows	Fall Total	Number of Tows	Spring Total	Number of Tows
Atlantic herring	*Clupea harengus*	23,748	27	334	12	23,414	15
Silver hake	*Merluccius bilinearis*	8,457	32	6,866	13	2,229	19
Alewife	*Alosa pseudoharengus*	3,432	30	1,778	12	1,654	18
American plaice	*Hippoglossoides platessoides*	1,881	32	697	13	1,184	19
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	871	28	148	10	723	18
Butterfish	*Poronotus triacanthus*	847	10	847	10	0	0
White hake	*Urophycis tenuis*	691	26	579	12	112	14
Witch flounder	*Glyptocephalus cynoglossus*	466	21	283	10	183	11
Blueback herring	*Alosa aestivalis*	370	19	70	6	300	13
Red hake	*Urophycis chuss*	339	29	212	12	127	17
Acadian redfish	*Sebastes fasciatus*	261	24	190	10	71	14
Goosefish	*Lophius americanus*	145	24	71	11	74	13
Fourbeard rockling	*Enchelyopus cimbrius*	136	25	44	10	92	15
Spiny dogfish	*Squalus acanthias*	124	5	124	5	0	0
American shad	*Alosa sapidissima*	72	19	18	6	54	13
Windowpane flounder	*Scophthalmus aquosus*	71	21	16	7	55	14
Winter flounder	*Pseudopleuronectes americanus*	59	19	17	8	42	11
Atlantic cod	*Gadus morhua*	14	9	6	4	8	5
Rainbow smelt	*Osmerus mordax*	4	2	0	0	4	2
Scup	*Shatenotomus chrysops*	2	1	2	1	0	0
Atlantic mackerel	*Scomber scombrus*	1	1	1	1	0	0
Haddock	*Melanogrammus aeglefinus*	1	1	1	1	0	0

Source: UMaine 2011.

The species richness of fishes in Regions 2 and 3 is high: 80 fish species were caught between fall 2000 and fall 2009. Six of the eight most abundant species in the bottom trawl survey were pelagic species (Atlantic herring, alewife, rainbow smelt, and blueback herring) or semi-pelagic species (silver hake, butterfish), so these species are components of both the demersal and pelagic communities. Among the others of the most abundant 24 species (including Atlantic cod and haddock), there was a mix of demersal (e.g., American plaice, longhorn sculpin, goosefish), pelagic (e.g., Atlantic menhaden, Atlantic mackerel), and semi-pelagic species (e.g., Acadian redfish) (UMaine 2011).

Seventy-six species were caught in fall surveys and 59 species in spring surveys. Despite the species richness, indices of diversity and equitability are low because of the numerical dominance of the three most abundant species in both fall and spring. The most abundant species was Atlantic herring. Atlantic herring, silver hake, and alewife composed 83 percent of the total catch in the fall surveys and 91 percent in the spring catch. There were other differences between fall and spring surveys. In fall, the 12 most abundant species constituted greater than 95 percent of the catch, while in spring the top five species, the three above plus American plaice and longhorn sculpin, constituted greater than 95 percent of the catch (UMaine 2011).

Fourteen of the most abundant 24 species in Regions 2 and 3 were resident species with a substantial presence through the decade and in both spring and fall surveys. Most of the abundant species showed little or no change in abundance during the decade of the 2000s, particularly alewife, winter flounder, and red hake. Atlantic herring, blueback herring, Acadian redfish, witch flounder, and haddock are species that had considerable inter-annual variability, but no overall trends. There were seasonal differences in some fish species: Atlantic herring and longhorn sculpin were more abundant in the spring, while alewife, red hake, witch flounder, and goosefish were more abundant in the fall (UMaine 2011).

All of the historically commercially important species could be present in the test site near Monhegan Island. However, winter flounder, Atlantic cod, haddock, and pollock are expected to be uncommon there based on the trawl survey data and reported commercial landings. Silver hake and American plaice were very abundant in the trawl surveys near Monhegan Island, but commercial landings in the Gulf of Maine have fallen to low or negligible levels. Silver hake, once harvested in large tonnage, has always received a low price per pound, and landings are negligible now. White hake and witch flounder landings have fallen to about one-fifth of those at the start of the decade, but they were common in the surveys near Monhegan Island (UMaine 2011).

The distinction between demersal and pelagic is unclear for many finfish species prominent in Regions 2 and 3 and near the Monhegan Island test site (i.e., there is considerable benthic-pelagic coupling in habitat use and predator-prey relations). Juvenile Atlantic herring tend to distribute themselves near the bottom during daytime and school throughout the water column or near the surface during nighttime (Brawn 1960; Nilsson et al. 2003). Acadian redfish and silver hake and perhaps other species move from near bottom of the water column to feed during nighttime (Scott and Scott 1988; UMaine 2011).

To assess fish distribution and abundance in the project area, the Gulf of Maine Research Institute, working on subcontract to UMaine, began hydroacoustic surveys for pelagic fish in the test site area in 2010. Sampling was performed on July 7-8, August 11-12, and September 9-10 at two experiment sites and one control site (sampling sites shown in Figure 3-8). Each survey event was conducted during the new moon phase to keep night light levels consistent. Sampling was performed during both day and night periods during each survey.

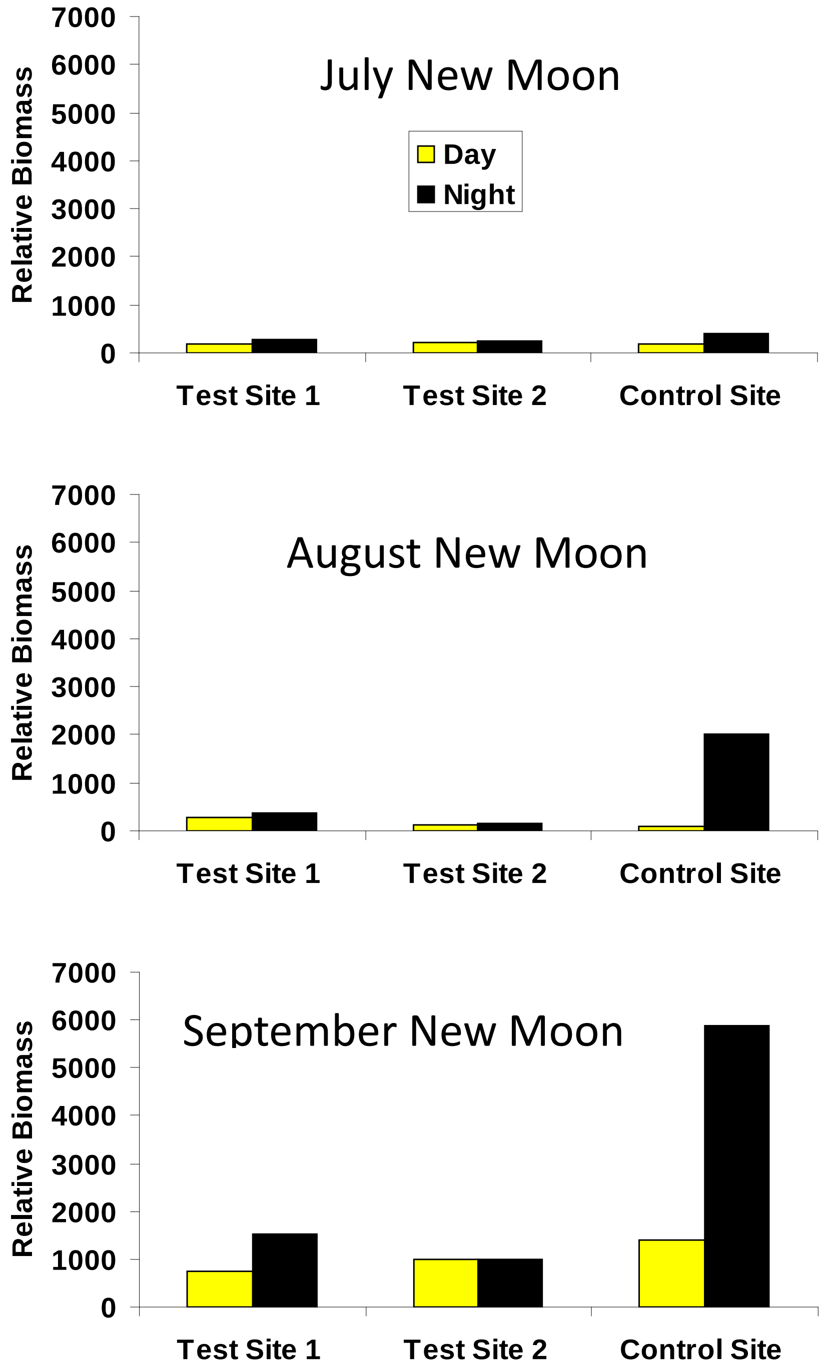
The hydroacoustic surveys show relatively little biomass in the water column (Figure 3-10). Relative biomass, measured acoustically in nautical area scattering coefficient (NASC), was low (in the hundreds) in the July and August surveys. As a comparison, NASC values from known herring aggregations measured in 2008 and 2009 elsewhere in the Gulf of Maine had values in the tens of thousands (UMaine 2011).

A two-way analysis of variance (time of day, location, and their interaction) indicated no significant differences in NASC values despite the relatively high values of the control site at night (Figure 3-10). The failure to detect differences may be an artifact of small samples sizes (i.e., only three sampling dates). There appears to be a general increase in relative biomass from July to September but this was not tested because there are too few samples to test for a month effect in a full factorial design (UMaine 2011).

One Federally endangered fish species that is known to occur in the Gulf of Maine may occur in the project area, Atlantic salmon (*Salmo salar*)[7]. On October 6, 2010, NMFS determined that Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) Gulf of Maine distinct population segment (DPS) is warranted for listing as Federally threatened (75 FR 61872). The proposed project is not located within any currently designated critical habitat for any ESA-listed fish species.

Atlantic salmon, an anadromous fish species, were historically found in all major river systems in Maine and many of their tributaries with suitable spawning habitat. They are currently found in the Saco, lower Kennebec, lower Androscoggin, Sheepscot, Penobscot, Machias, East Machias, Dennys, and Saint Croix rivers (NMFS and USFWS 2005; DIFW 2010a; NOAA 2010b). Adult Atlantic salmon mainly prey on fish such as Atlantic herring, alewife, rainbow smelt, capelin, mummichogs, sand lances, flatfish, and small Atlantic mackerel (NMFS 2011). The Atlantic salmon Gulf of Maine DPS includes all naturally reproducing remnant populations of Atlantic salmon from the Kennebec River downstream of the former Edwards dam site, northward to the mouth of the Saint Croix River (74 FR 29344, June 19, 2009) (Figure 3-11). Atlantic salmon may be seasonally present at the UMaine test site (letter from NMFS to DOE dated October 1, 2010).

7. Shortnose sturgeon (*Acipenser brevirostrum*) are also a Federally endangered fish species in Maine, but this species is not expected to occur in the project area (Jeff Murphy, NOAA, UMaine Offshore Wind Demonstration Project agency meeting, November 30, 2010).



Note: Experimental sites 1 and 2 are located within the UMaine test site, and the control site is located partially within the UMaine test site.

Source: UMaine 2011.

Figure 3-10. Relative Biomass Observed During Hydroacoustic Surveys

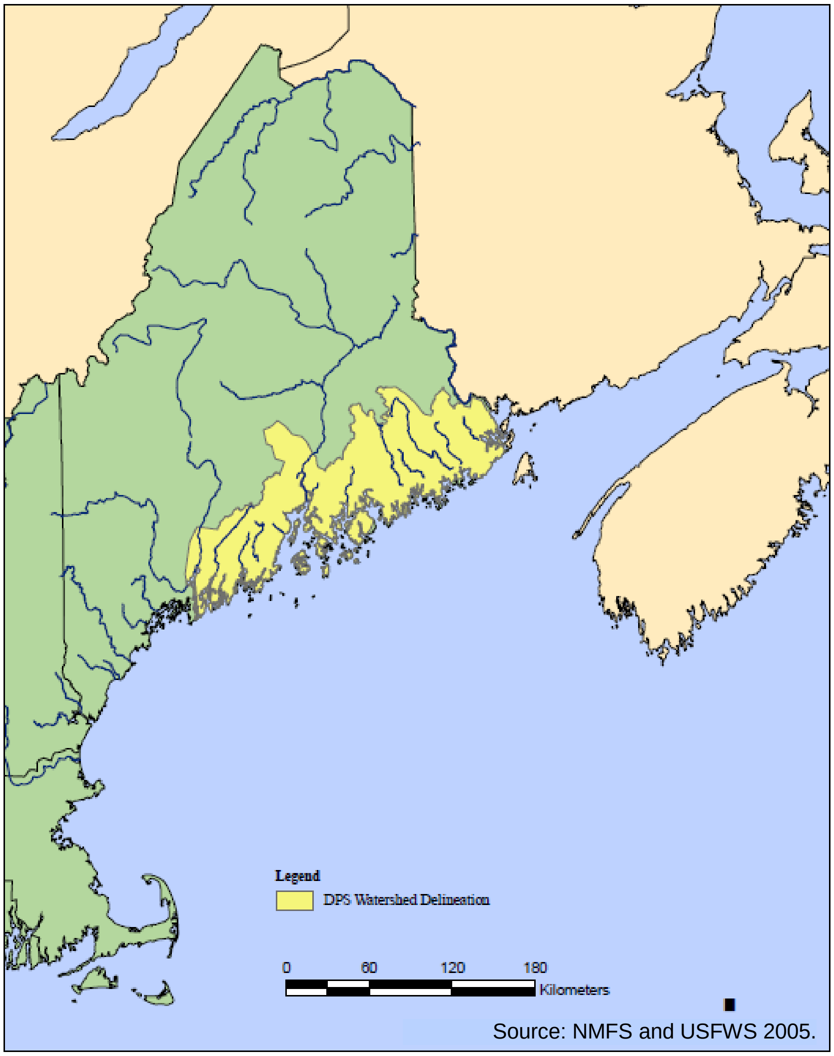
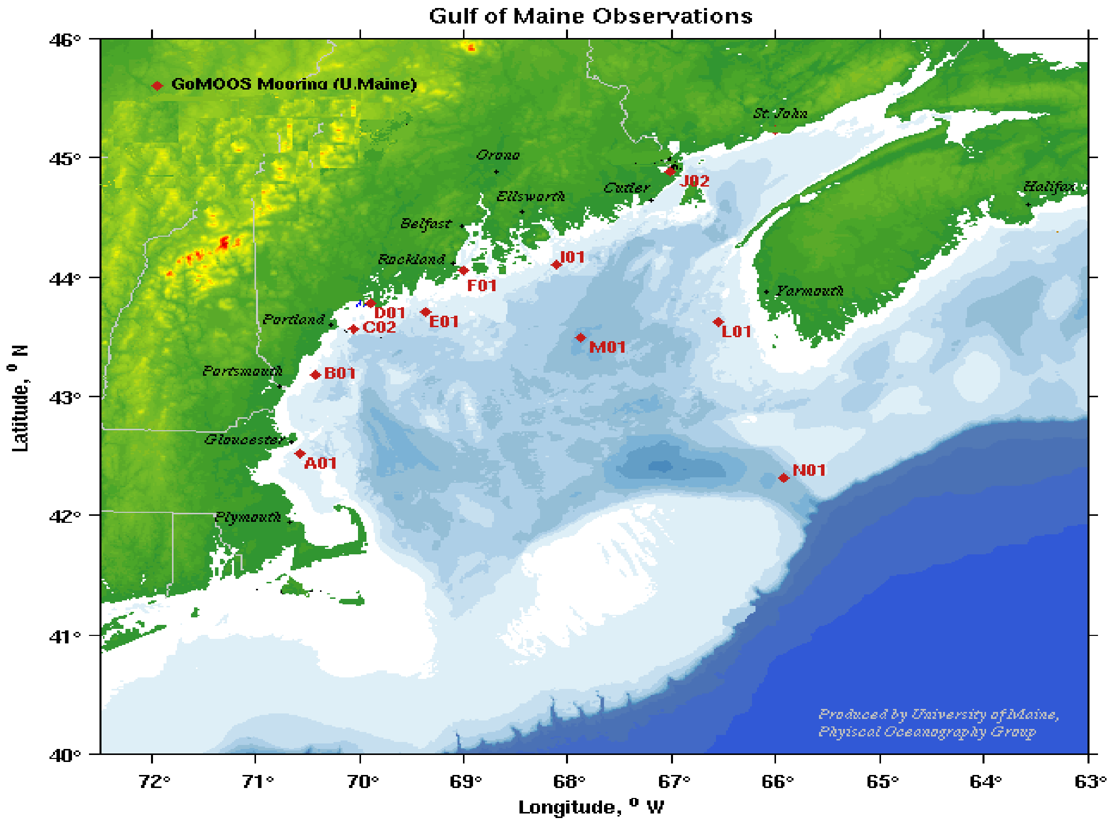


Figure 3-11. Geographic Range of the Gulf of Maine Distinct Population Segment of Atlantic Salmon

Atlantic salmon spawn in small, headwater streams in the fall. In Maine, juveniles remain in fresh water for a period of one to three years. After this time, when approximately one inch long, they undergo a substantial transformation, smolting, in preparation for seaward migration. Smolts migrate to Labrador and Greenland in the spring of each year, generally between late April and early June, depending on river conditions. The migratory path through the Gulf of Maine is uncertain but may be dependent on the position of the Eastern Maine Coastal Current (UMaine 2011). Smolts develop into mature adults over two to three years at sea and then return to Maine streams typically in the spring.

To gather information on a variety of tagged fish distribution and movements, acoustic receivers that detect tagged fish have been deployed throughout the Gulf of Maine as part of the Gulf of Maine Ocean Observing System/NERACOOS system since 2005 (Figure 3-12). Hundreds of juvenile Atlantic salmon smolts were tagged in the Penobscot River and in the Bay of Fundy between 2005 and 2009. Since 2005, the acoustic receivers, with a detection range of approximately 0.6 mile, have made over 9,000 detections of acoustic tags. These 9,000 detections were from 37 different individual acoustic tags. Twenty of the tags detected were implanted in salmon smolts: three from the Bay of Fundy and 17 from smolts tagged in the Gulf of Maine (UMaine 2011).



Note: All buoys had NOAA telemetry receivers on them at some time between 2005 and 2009. UMaine test site is located near Buoy E01.

Source: University of Maine Physical Oceanography Group 2010a.

Figure 3-12. Map of Gulf of Maine Acoustic Receivers Located on Ocean Observing System Buoys

Until late July 2010, Buoys D01 and E01 were the closest acoustic receivers to the offshore wind test site near Monhegan Island. Since 2005, five individual tags were detected in the vicinity of Buoy E01, four of which belonged to salmon smolts (the fifth belonging to a striped bass). Most detections occurred at Buoy F01 located in Penobscot Bay, the watershed of most smolt tagging (UMaine 2011). During late July 2010, Buoy E02 was deployed by UMaine in the offshore wind test site near Monhegan Island (Section 3.3.2). Two acoustic receivers were mounted on Buoy E02.

Similar to Atlantic salmon, Atlantic sturgeon, a species proposed to be listed as threatened under the ESA, is also an anadromous fish species. Atlantic sturgeon is a long-lived species, capable of reaching ages of 60 years, lengths of 13.7 feet, and weight of over 794 pounds (75 FR 61873, October 6, 2010). The Atlantic sturgeon Gulf of Maine DPS has been documented as individuals in the Penobscot, Kennebec, Androscoggin, Sheepscot, Saco, Piscataqua, and Merrimack rivers. The Kennebec River is currently the only known spawning river for the Gulf of Maine Atlantic sturgeon DPS (75 FR 61881, April 9, 2010). This species may occur at the UMaine test site (letter from NMFS to DOE dated October 1, 2010).

From 2000 to 2006, the Maine-New Hampshire Trawl Survey collected 31 Atlantic sturgeon from 773 trawls in the fall, and seven Atlantic sturgeon from 828 trawls in the spring. Trawling was conducted in depths ranging from 32.8 to 656 feet, and all of the Atlantic sturgeon were captured in depths between 49 and 295 feet. All but two Atlantic sturgeon were captured near the Kennebec estuarine complex, and the remaining were captured near the Saco River, approximately 19 miles and 49 miles southwest of the project site, respectively (Dunton et al. 2010).

Since 2006, 141 individual Atlantic sturgeon have been captured and seven recaptured in the Penobscot River (Zydlewski 2010). Thirty-seven individual fish have been implanted with acoustic tags (8 tagged in 2006 and 2007; 10 in 2008; 11 in 2009; and 8 in 2010). Twenty of these individuals carry tags that would continue to emit signals for 10 years. All individuals were tagged in the lower Penobscot River estuary (at approximately river mile 13.7). Each year all individuals left the estuary by mid-October. In winter 2009, 7 (of 11) Penobscot River-tagged Atlantic sturgeon were detected by Massachusetts Division of Marine Fisheries in the State's acoustic receiver array near Cape Cod, Massachusetts (Hoffman 2010). Each year, between 75 and 90 percent of the Atlantic sturgeon tagged in the Penobscot River during the summer return to the river the following spring (April to June/July) (Zydlewski 2010) .

In a notable exception to this pattern, two individual Atlantic sturgeon that were tagged in the Penobscot River wintered in the Kennebec River. One of these individuals wintered in the Kennebec one year and not the following (Zydlewski 2010). In 2010, an Atlantic sturgeon tagged in the Delaware River was detected off of Matinicus Island in the Gulf of Maine (23 miles from the test site). In Maine alone, approximately 100 Atlantic sturgeon have active acoustic tags (Zydlewski 2010). Thirty individuals have been tagged in Nova Scotia's Minas Basin (over 248 miles from the test site) and up to 30 were tagged in the St. John River, New Brunswick (over 124 miles from the test site) (Stokesbury 2010).

Under the *Magnuson-Stevens Fishery Conservation Act* of 1998 (16 U.S.C. 1801 *et seq*.; MSA) the waters off Monhegan Island have been designated as EFH for 15 Federally managed fish species (Table 3-3). EFH is broadly defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (1996 Amendments (PL 104-267) to the MSA) (letter from NMFS to DOE dated

Table 3-3. Marine Species and Life Stages for which Essential Fish Habitat Occurs in Waters off of Monhegan Island

Species	Eggs	Larvae	Juveniles	Adults
Atlantic cod *(Gadus morhua)*	X	X	X	X
Haddock *(Melanogrammus aeglefinus)*				X
Whiting *(Merluccius bilinearis)*			X	X
Red hake *(Urophycis chuss)*	X	X	X	X
White hake *(Urophycis tenuis)*	X	X	X	X
Redfish *(Sebastes fasciatus)*	NA	X	X	X
Witch flounder *(Glyptocephalus cynoglossus)*			X	X
Winter flounder *(Pleuronectes americanus)*	X	X	X	X
Windowpane flounder *(Scopthalmus aquosus)*			X	
American plaice *(Hippoglossoides platessoides)*			X	X
Atlantic halibut *(Hippoglossus hippoglossus)*	X	X	X	X
Atlantic sea herring *(Clupea harengus)*				X
Monkfish *(Lophius americanus)*			X	
Spiny dogfish *(Squalus acanthias)*	NA	NA		X
Bluefin tuna *(Thunnus thynnus)*				X

Source: NOAA 2010d; NA = not available.

October 1, 2010; NOAA 2010d). EFH for the species listed in Table 3-3, varies by species and life stage, and includes all portions of the water column as well as substrate types, such as soft bottom, hard bottom, or various mixtures of hard and soft (NOAA 2010d).

In a letter to DOE dated February 22, 2011, NMFS also identified four highly migratory species of fish listed under the MSA that could potentially occur off the waters of Monhegan Island: white shark (*Carcharodon carcharias*), basking shark (*Cetorhinus maximus*), common thresher shark (*Alopias vulpinus*), and porbeagle shark (*Lamna nasus*).

3.4.1.4 Marine Mammals

The Gulf of Maine is host to numerous marine mammals including large and small whale species, and three species of seals (Table 3-4). Cetaceans and seals are protected under the Marine Mammal Protection Act, and some whale species are protected under the ESA (Table 3-4). Large whale species, including

Table 3-4. Marine Mammal Species Known to Occur in the Gulf of Maine

Species	Federal Listing Status	ESA Management Plans
Baleen Whales		
North Atlantic right whale (*Eubalaena glacialis*)	Endangered	NMFS 2005; NMFS 2006a
Fin whale (*Balaenoptera physalus*)	Endangered	NMFS 2006b
Humpback whale (*Megaptera novaeangliae*)	Endangered	NMFS 1991
Minke whale (*Balaenoptera acutorostrata*)	NA	NA
Sei whale (*Balaenoptera borealis*)	Endangered	No
Blue whale (*Balaenoptera musculus*)	Endangered	NMFS 1998
Toothed Whales		
Harbor porpoise (*Phocoena phocoena*)	NA	NA
Atlantic white-sided dolphin (*Lagenorhynchus acutus*)	NA	NA
Pilot whale (*Globicephala* sp.)	NA	NA
Common dolphin (*Delphinus delphis*)	NA	NA
Killer whale (*Orcinus orca*)	NA	NA
Risso's dolphin (*Grampus griseus*)	NA	NA
White-beaked dolphin (*Lagenorhynchus albirostris*)	NA	NA
Bottlenose dolphin (*Tursiops truncatus*)	NA	NA
Sperm whale (*Physeter macrocephalus*)	Endangered	NMFS 2006c
Beluga whale (*Delphinapterus leucas*)	NA	NA
False killer whale (*Pseudorca crassidens*)	NA	NA
Seals		
Harbor seal (*Phoca vitulina*)	NA	NA
Gray seal (*Halichoerus grypus*)	NA	NA
Harp seal (*Phoca groenlandica*)	NA	NA

Source: UMaine 2011; NA = not applicable.
Note: The species are grouped by order and are organized from the most to least common based on number of sightings in the Right Whale Consortium database. The survey effort in the Gulf of Maine is strongly biased towards areas and seasons when right whales are likely to be found.

humpback, North Atlantic right, fin, and sei, are more common in the Gulf of Maine during the spring, summer, and autumn when food resources are in higher abundance; however, sightings of these species have occurred in all seasons. Approximately 3,500 of these whales visit the Gulf of Maine each year (GoMOOS 2010a).

Analysis of sightings of whale species collected through the Right Whale Consortium indicate that although large whales have been observed in the vicinity of the Monhegan Island test site, this area does not appear to be commonly used compared to other areas within the Gulf of Maine. Within the western Gulf of Maine, specific regions such as Jeffreys Ledge and Mt. Desert Rock are areas where whales are commonly sighted (UMaine 2011).

Smaller whales such as minke whales, pilot whales, harbor porpoise, and white-sided dolphin are common marine mammals in the Gulf of Maine. Additionally, harbor seal, gray seal, and harp seal occur in the Gulf of Maine. Harbor seal is the most common seal, with approximately 30,000 individuals spending all, or part, of the year in the Gulf of Maine (GoMOOS 2010a). Other marine mammal species that have been occasionally sighted in the region are offshore bottlenose dolphin, killer whales, white-beaked dolphin, and beluga whales (UMaine 2011).

During 2010, UMaine researchers conducted two marine mammal surveys along dedicated transects that traversed the test site. On-water time for each survey was approximately four hours. Eight harbor porpoise and no large whales were observed during the two marine mammal surveys. UMaine researchers also recorded opportunistic sightings of marine mammals during other survey efforts, by researchers that had training in marine mammal visual identification. Ten marine mammals (2 harbor porpoise and 8 white-sided dolphins) were observed during an eight-hour benthic invertebrate survey on July 7, 2010, and the one large whale, a fin whale, was observed during a 30-hour geophysical survey on June 17 and 18, 2010 (UMaine 2011).

Marine mammals that are listed under the ESA and have the potential to occur in the project area are North Atlantic right whale, fin, humpback, sei, blue, and sperm whales (Table 3-4). Right whales are of particular concern due to their low population numbers and slow recovery (UMaine 2011). Right whales feed on zooplankton, primarily copepods and especially large calanoid copepods such as *Calanus* spp. (Kenney et al. 2001). It is likely that all of the approximately 400 right whales in the North Atlantic visit the Gulf of Maine each year. Habitats that occasionally have significant numbers of right whales include Jeffreys Ledge in the western Gulf of Maine, especially in autumn (Kenney et al. 2001). The Gulf of Maine and adjacent Scotian Shelf contain all of the known feeding areas for this critically endangered species (Kenney et al. 2001). The UMaine project area is not located within right whale critical habitat.

Fin whale is the second largest species of whale, second in size only to the blue whale. New England waters are a major feeding area for North Atlantic populations. Primary prey include krill, small schooling fish (e.g., herring, capelin, and sand lance), and squid. Fin whales are the most common large whale in the Gulf of Maine, with peak abundance in April through October. They are most typically observed in 300- to 600-foot water depths over the continental shelf (DIFW 2010b). Critical habitat for the fin whale has not been designated.

The humpback whale is relatively common in the Gulf of Maine and is observed frequently by whale watchers. Humpback whales pass through New England waters during their northward and southward migrations, in April and May, and in October through December, respectively. Some individuals remain in the Gulf of Maine for the summer, where they feed primarily on herring, sand lance, and other small fish (DIFW 2010c). Critical habitat has not been designated for humpback whale.

Sei whales are commonly found in the Gulf of Maine and on Georges and Stellwagen Banks in the Western North Atlantic during the summer (NMFS 2010a; Waring et al. 2009). Sei whales are usually seen alone or in pairs, but sometimes large aggregations may occur if food is abundant. This species typically feeds on plankton (e.g., copepods and krill), small schooling fish, and cephalopods (e.g., squid) by both gulping and skimming. Sei whales are shallow divers and only remain submerged for five to 20 minutes (DIFW 2010d; NMFS 2010a). Critical habitat for sei whale has not been designated.

The blue whale is the largest known animal ever to exist on Earth. Blue whale occurrence in the western North Atlantic generally extends from the Arctic to at least mid-latitude waters. Blue whales are most frequently sighted in the waters off eastern Canada, with the majority of recent records from the Gulf of St. Lawrence (NMFS 2002). The first recorded sighting off New England came in 1981, with only sporadic sightings over the next two decades. In the past few years, sightings have been slightly more regular, although still uncommon. In 2002, five different blue whales were seen over a two-week period in September, and in the fall of 2007, three different individuals were seen off the Maine and New Hampshire coast (GMRI 2010). Critical habitat has not been designated for blue whale.

Sperm whales are the largest of the toothed whales. Sperm whales tend to inhabit areas with a water depth of 1,968 feet or more, and are uncommon in waters less than 984 feet deep. In summer, sperm whales may occupy areas east and north of Georges Bank and into the Northeast Channel region of the Gulf of Maine, as well as the continental shelf (inshore of the 328-foot isobath) (NMFS 2010b). Critical habitat has not been designated for sperm whale.

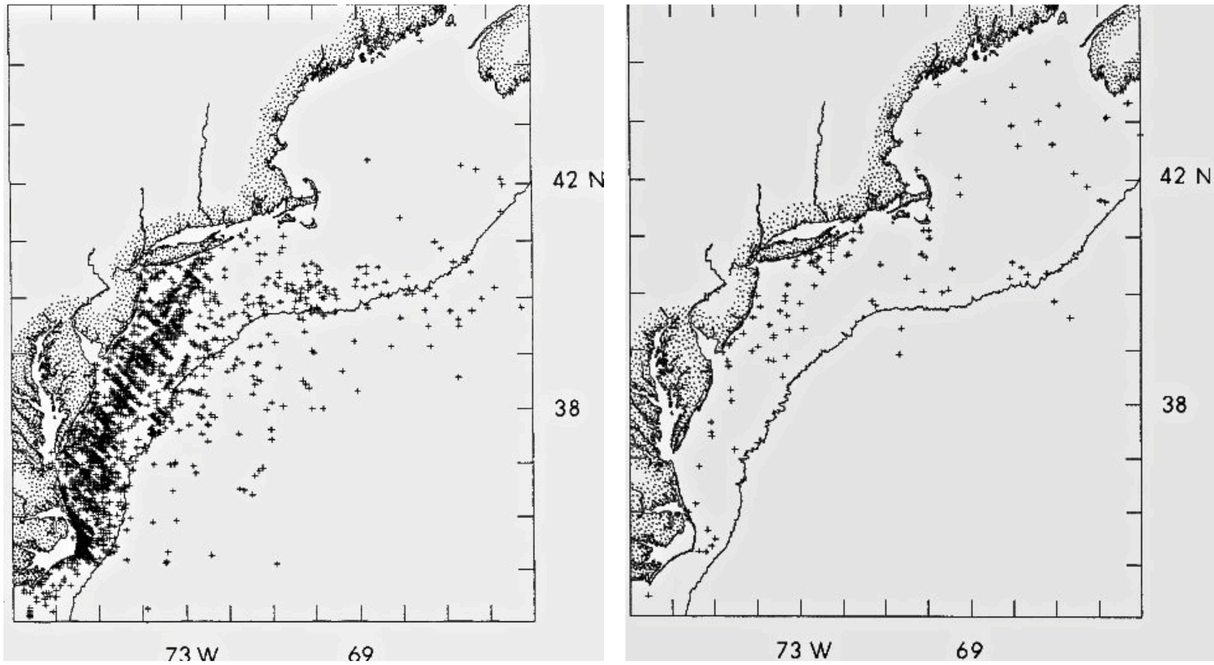
3.4.1.5 Reptiles

All sea turtles are protected under the ESA. While sea turtle sightings are uncommon in the Gulf of Maine, there are three sea turtle species that are known to occur: leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), and Atlantic Ridley (Kemp’s Ridley) (*Lepidochelys kempi*) turtles. The leatherback and Atlantic Ridley are federally endangered and the loggerhead is federally threatened under the ESA. The proposed project is not located within any critical habitat for marine turtles.

The Atlantic Ridley sea turtle is very rarely encountered in the Gulf of Maine. Loggerhead and leatherback sea turtles are more commonly seen. Although these species are primarily tropical in their distribution, sightings of both species extend up the eastern seaboard (UMaine 2011).

Loggerhead sea turtles have a global distribution, and the majority of nesting occurs in the western rims of the Atlantic and Indian Oceans (NMFS and USFWS 2007a). Loggerhead turtles undergo extensive migrations to feed on mid-water column organisms in the open ocean. In the northeast United States, loggerhead turtles are most abundant south of Cape Cod (Figure 3-13) (Shoop and Kenney 1992).

Leatherbacks have the widest distribution of sea turtles, nesting on beaches in the tropics and sub-tropics and foraging into higher-latitude sub-polar waters. They are also the largest sea turtle and have evolved physiological and anatomical adaptations that allow them to exploit waters far colder than any other sea turtle species would be capable of surviving (NMFS and USFWS 2007b). Along the East Coast, leatherback sightings are concentrated south of Long Island, New York, but they have been observed as far north as Nova Scotia (Shoop and Kenney 1992). Leatherback turtle sightings along the Northeast are shown in Figure 3-13.



Note: Sighting compiled from approximately three years of aerial and shipboard surveys. Loggerhead turtle sightings on left; leatherback turtle sightings on right.

Source: Reproduced from Shoop and Kenney 1992.

Figure 3-13. Loggerhead and Leatherback Turtle Sightings

3.4.1.6 Birds

The Maine coast is frequented by numerous species of migrating songbirds, seabirds, raptors, and shorebirds. Monhegan Island is utilized by a substantial number of migrant birds that use the island as a stopover location during the migratory season. Maine's coastal areas and islands also offer breeding grounds for seabird; shorebird; and raptor species including bald eagle, peregrine falcon, piping plover, roseate tern, arctic tern, Atlantic puffin, razorbill, Leach's storm petrel, great cormorant, black-crowned night heron, laughing gull, and common tern (UMaine 2011).

Pelagic seabirds utilize Maine's offshore waters to forage during the breeding, migration, and winter seasons. Seabirds such as arctic terns, Leach's storm petrels, Atlantic puffins, razorbills, and black guillemots all reach their southern extent of their breeding distribution in Maine. Tern and alcids (including Atlantic puffins, razorbills, and guillemots) are known to routinely fly 15 to 18 miles from their breeding grounds to forage, and have been observed foraging greater than 31 miles from their nearest breeding colony. Gannets, which regularly occur in Maine, are known to feed offshore of Monhegan Island (letter from DIFW to Maine SPO dated October 1, 2009).

Hundreds of thousands of shorebirds of over 50 species migrate to the coast of Maine in late summer from their breeding areas in the Canadian arctic. Shorebirds forage on intertidal invertebrates on their way to wintering grounds in Central and South America. Concentrations of nearly one million red-necked and red phalaropes have been known to occur off the coast of Maine. Nesting shorebirds in Maine include spotted sandpiper and willet (letter from USFWS to Maine SPO dated August 4, 2009).

Many species of waterfowl nest along the coast of Maine. Maine hosts significant populations of black ducks, long-tailed ducks, mergansers, goldeneye, scoters, and bufflehead, and as much as 90 percent of common eiders that breed in the U.S. visit Maine (letter from USFWS to Maine SPO dated August 4, 2009).

Migrating raptors concentrate at coastal locations, including Monhegan Island. Monhegan Island has the highest rate of passage by migrant peregrine falcons in Maine. Bald eagles, which are protected under the Migratory Bird Treaty Act and under the Bald and Golden Eagle Protection Act, occur in large numbers in coastal Maine and are known to nest on Monhegan Island. Approximately 200 nesting pairs are located on the Maine's coast and large concentrations of non-breeding eagles have been documented. In general, bald eagles travel up to 4 miles from their nests for foraging, but generally do not travel more than 1 to 2 miles from the nearest land or perch (letter from USFWS to Maine SPO dated August 4, 2009; letter from DIFW to Maine SPO dated October 1, 2009).

Table 3-5 lists birds that are federally listed under ESA, Maine listed species and species of concern, and important neotropical migrant species in Maine. All of the species listed may occur in the test area, including land areas or offshore water as stopover or transit sites, throughout the year, but particularly during spring and or fall migration (UMaine 2011).

Table 3-5. Bird Species of Concern

State Threatened or Endangered	
Harlequin duck	Least tern
Bald eagle	Black tern
Golden eagle	Atlantic puffin
Peregrine falcon	Razorbill
Upland sand piper	American pipit
Arctic tern	Grasshopper sparrow
Maine Species of Concern	
Leach's storm petrel	Laughing gull
Great cormorant	Common tern
Least bittern	Short-eared owl
Black-crowned night heron	Olive-sided flycatcher
Barrow's goldeneye	Loggerhead shrike
Cooper's hawk	Vesper sparrow
Northern goshawk	Eastern meadowlark
American coot	Rusty blackbird
Red-necked phalarope	Orchard oriole
Important Neotropical Migrant Species in Maine	
Yellow-bellied sapsucker	Blackburnian warbler
Veery	Black and white warbler
Northern parula	American redstart
Chestnut-sided warbler	Ovenbird
Cape May warbler	Canada warbler
Black-throated blue warbler	Rose-breasted grosbeak
Federally Threatened or Endangered	
Piping plover	Roseate tern

Source: DIFW 2010a; letter from USFWS to Maine SPO dated August 4, 2009.

In consultation regarding the State's review of potential ocean energy demonstration sites, which included the Monhegan Island test site, the USFWS indicated that the project could potentially affect two bird species listed under the ESA: roseate tern (*Sterna dougallii*) and piping plover (*Charadrius melodus*) (letter from USFWS to Maine SPO dated August 4, 2009). The project is not located within the federally designated critical habitat of these two species or any ESA bird species. The Federally endangered roseate tern breeds on five islands in Maine. While Monhegan Island is not used for breeding, roseate terns use the island and surrounding waters to rest and feed and are regularly observed (Welch 2010). Roseate terns usually forage over shallow bays, tidal inlets and channels (USFWS and NMFS 2008). After roseate terns breed for the first time, they are highly faithful to a nesting island, returning to the same breeding colony around mid-May in Maine (DIFW 2010e). Two hundred nesting pairs were counted in Maine in 2008. Roseate terns are known to nest in mixed seabird colonies of Arctic terns and common terns. While Arctic and common terns have increased in numbers, roseate terns have not. Likely causes are lower hatching success and smaller average clutches (letter from USFWS to Maine SPO dated August 4, 2009).

The Federally threatened piping plover breeds on coastal beaches in several locations in southern Maine (not in the project area). Piping plovers breed and forage on coastal beaches from Newfoundland and southeastern Quebec to North Carolina and winter primarily on the Atlantic coast from North Carolina to Florida, although some birds migrate to the Bahamas and West Indies. The current population decline is attributed to increased coastal development and recreational use of beaches. In the last 10 years Maine's population has declined substantially from about 65 pairs to 20 nesting pairs (letter from USFWS to Maine SPO dated August 4, 2009).

To assess aerial vertebrate movement patterns off Monhegan Island, the New Jersey Audubon Society conducted dual marine radar surveys over a period of 79 days from July 15 to September 30, 2010. Monitoring continued through November 30, though evaluation of the results of the October and November monitoring has not been completed. The marine radar system was deployed at the southwestern end of Monhegan Island overlooking Lobster Cove. The sampling range is shown above in Figure 3-8. The radar horizontal range of detection extended approximately 1.7 miles for resolving small songbirds. While the sampling range that allowed resolution of all individual birds did not cover the project area, located 2 to 3 miles from shore, the results are expected to be representative of the bird and bat behavior in the project area (Mizrahi 2010). The radar survey results from July 15 to September 30, 2010 showed that approximately 93 percent of targets during the day and 95 percent of targets during the night were detected at heights of 246 feet or greater (targets represent birds and bats, but cannot be distinguished) (NJAS 2010).

3.4.1.7 Bats

Eight bat species occur in Maine: eastern small-footed myotis (*Myotis leibii*), little brown bat (*M. lucifugus*), big brown bat (*Eptisicus fuscus*), northern long-eared myotis (*M. septentrionalis*), eastern pipistrelle (*Pipistrellus subflavus*), red bat (*Lasiurus borealis*), hoary bat (*L. cinerus*), and silver-haired bat (*Lasionycteris noctivagans*). The latter three are considered to be migratory in the northeast region, while the other species seek hibernacula in natural and man-made structures, including buildings, tree cavities, caves, and rock crevasses (UMaine 2011). None of these species is listed under the ESA.

Bats have been documented along coastal areas and on offshore islands, and have been observed landing in large numbers on ships as far as 130 miles offshore particularly during periods of spring and fall migration (UMaine 2011). As part of a separate effort, acoustic bat detectors were deployed on Monhegan Island, as well as 11 other offshore locations along the Maine coast, from July 28 to November 15, 2009. The acoustic bat detectors identified 27 echolocation sequences at Monhegan Island, of which 13 individual echolocation sequences were identified as noise made by bats classified as being from one of three bat guilds. The remaining 14 sequences were from unknown low and high frequency echolocation strings (unknown echolocation detections were either too short in duration or too poor in quality for identification). The three bat guilds identified were big brown/silver-haired bats, eastern red bats/tri-colored bats, and *Myotis* species. It should be noted that these data could represent the same animal detected more than once, and not necessarily 13 or 27 individual bats.

3.4.2 ENVIRONMENTAL IMPACTS RELATED TO BIOLOGICAL RESOURCES

This section evaluates the following potential effects upon biological resources:

- Effects on biological resources
  - Alteration of habitat
    - Direct effects from deployment of the anchors
    - Changes to marine community composition
  - Above-water collision – aerial vertebrates
  - Underwater entanglement and collision – marine mammals
- Effects on ESA-listed species and EFH

The potential effects of noise on marine life are discussed in Section 3.5.

3.4.2.1 Effects on Biological Resources

Alteration of Habitat

The deployment of the proposed project components on the seabed and in the water column would alter habitat in the project area and potentially create the following environmental effects:

- Direct effects on marine life from deployment of the anchors on the seabed; and
- Changes to marine community composition (e.g., use patterns, attraction, aversion).

The type and size of the mooring anchors or foundations would depend on the final selection of the platform design. The anchors would be loaded on barges and towed to the UMaine test site. In the event that drag anchors are selected, a second anchor-handling vessel would be required to deploy and set the anchors. If suction caissons are selected, a floating crane would be required to lift and lower the caissons to the sea floor. Additional equipment required for suction caissons includes suction equipment, a remotely operated vehicle, a control cabin, and a launch cradle.

Once the anchors arrive at the test site, the installation vessels would be positioned over preselected anchor locations. These locations would be selected based on the floating turbine mooring system design and engineering analysis of the sea floor geotechnics and geophysics. Most likely the mooring system would be arranged in a triangular pattern. The deployment of the turbine platforms and mooring lines would be temporary. The platforms would be deployed for a period of up to five months, from initial deployment. The mooring lines would be deployed with the anchors one to six months before the platforms are installed. They may be left connected to the anchors for the entire testing period (July to November), so that the platforms can be reattached to the same moorings for a follow-up deployment one year later. Following the completion of second year testing (ending in November), UMaine may further delay removing the mooring lines until the following summer in order to provide for a safer and more predictable weather window. This would result in the mooring lines being in the water for the following ranges of time:

- Minimum - up to five months from July to November for two testing year periods, if the moorings are removed after each deployment; and
- Maximum - up to 24 months, if the moorings are left in the water between the initial and second year deployments and removal is delayed to more favorable conditions in the summer after the second deployment [e.g., the moorings (only) would be in the water from approximately 90-days prior to the first deployment through the summer after the second deployment].

As discussed in Section 2.2.8, depending on anchor type selected and seabed conditions, the anchors may be left in place permanently (the mooring lines would be removed). For example, skirted mat and gravity anchors would sink into the sediment and may not be removable.

Direct Effects on Marine Life from Deployment of the Anchors on the Seabed

A potential project effect on aquatic organisms could occur during the installation and removal of the anchors for the turbine platforms, when the benthos is disturbed from anchor placement on, and removal from, the seabed (no blasting or pile driving is required for the project). As detailed in Section 2.2.5, a number of shallow foundations/anchors are being considered for mooring the project including drag embedment (fluke) anchors, gravity (weight) anchors, skirted mats, and suction caissons. The degree to which the foundation/anchors would penetrate the seabed would also vary ranging from approximately 6.6 feet for a skirted mat, approximately 29.5 feet for a suction caisson, and potentially even deeper for a drag embedment anchor. A gravity anchor deployed on a rock bottom would minimally penetrate the seabed.

During project installation, the placement of anchors could cover or injure slow-moving or immobile benthic organisms, such as bivalves, snails, and worms directly beneath the foundation/anchors. The footprint of the foundation/anchors being considered is variable and would depend upon final design of the turbine platform and condition of the seabed at the selected deployment site. The foundation/anchor that would have the largest footprint would be a skirted mat, which is expected to measure approximately 16 feet by 16 feet. Each of these foundations would cover an area approximately 256 square feet, and the total area of the sea floor ultimately covered by six foundations (assuming three foundations for each floating platform) would be 1,536 square feet (or 0.04 acre). During installation, drag embedment anchors would drag about 10 times the lateral distance of the penetration distance (i.e., 10 feet of penetration means dragging of 100 feet). It is anticipated that much of this distance would be within the substrate and not along the seabed surface. This would represent additional disruption to the seabed, potentially killing slow-moving or immobile benthic organisms, though any effect would be very minor considering the scale of and effect of bottom dragging operations. The expected maximum area disturbed or covered by all six anchors would be a negligible effect on immobile species that are covered by the anchors.

Mobile invertebrates (e.g., lobster and crabs), fish species that feed on or near the bottom (e.g., hakes and flatfishes), and species that shelter on the bottom at times (e.g., herring and redfish) would likely move away from the immediate vicinity of the anchors and move to nearby areas during deployment and removal activities. Project deployment and removal activities may also alter the distribution of prey species of some marine life (prey species avoid the area during deployment and removal activities), especially demersal fish and invertebrates, though this would only be expected to occur in the immediate vicinity of deployment activities. Highly mobile species, such as pelagic fish or marine mammals, would likely avoid the deployment area during project installation activities. Project deployment and removal activities are expected to total one day per anchor, and therefore any shift in habitat use of marine species during installation or removal activities would be temporary.

All proposed designs use a small number of cables under tension loading from a buoyant surface structure to anchors at or in the seabed. In some designs (e.g., skirted mat, drag embedment anchor), the anchor may be entirely buried in mud. Because of the limited surface area of these anchors and the generally slow currents at greater than 328-foot depths, scour and alteration of depositional patterns would be much more limited than what typically occurs around nearshore (shallower) wind platforms.

Some additional minor, and short-term, bottom disturbance would be expected from the anchoring of installation, service, and environmental monitoring vessels. Any effects on the seabed would be negligible and similar to the anchoring of vessels that occurs regularly along the Maine coast.

In conclusion, potential effects of anchor deployment and removal to benthic habitat would be minor and short term. While the placement of the anchors could cover slow moving or immobile benthic invertebrates, because of the small area covered by the anchors (approximately 0.04 acre), this effect would be negligible. Following deployment and removal of the anchors, if removal occurs, it is expected that sediments around the anchors would quickly redistribute. Benthic organisms would resettle in areas around the anchors (or, following removal, where the anchors were) where the disturbance occurred, and use of the area by benthic invertebrates and demersal fish would quickly return to pre-deployment levels. While sediment that becomes suspended during anchor removal could resettle and possibly cover immobile benthic invertebrates, given the number and small size of anchors, these effects would be negligible.

Changes to Marine Community Composition

The project could cause the following potential changes to the marine community composition in the area:

- Artificial reef[8] effect - The anchors, mooring lines, and below-water portions of the turbine platforms could provide habitat for biofouling organisms and structure-oriented fish, which may in turn result in an artificial reef effect.
- Fish aggregation device (FAD) effect – Fishes are also known to aggregate around floating objects (Nelson 2003), which is often called a FAD effect.
- Bird roosting/seal haul out – Birds may roost on the above-water portions of the platforms, and seals are known to haul out on nearly any floating platform.
- Avoidance of the project area by resident and migratory species – For commercial-scale offshore wind projects, concerns have been raised that resident or migratory species might avoid wind farms.

The presence of the project components in the water column and floating above the water may therefore result in altered use by marine life in the area and a resulting change in the marine community composition. These potential effects, described further below, are primarily direct effects, though species that may be attracted to the biofouling community, once established, and not necessarily the structures themselves, represent indirect effects of the proposed project. Also, the reduction of trawling disturbance within the anchor field area represents an indirect effect.

8. An artificial reef is a human-made underwater structure, typically built for the purpose of promoting marine life in areas of generally featureless bottom.

Artificial Reef Effect

Biofouling is the accumulation of attaching marine organisms on a surface in the water. Common biofouling organisms include algae and sessile invertebrate species, including those having a hard calcium carbonate exterior such as barnacles, mussels, and bryozoans, and soft organisms such as sponges, tunicates, and hydroids. Biofouling organisms occur at all ocean depths, and therefore these organisms could be expected to colonize the anchors and mooring lines, and portions of the floating platforms below the waterline. The UMaine Physical Oceanography Group, part of the School of Marine Sciences, maintains the Gulf of Maine Array oceanographic buoys. Figure 3-14 shows examples of biofouling colonizing one of the buoys. UMaine researchers have observed that, in general, the spring bloom is a very active period of marine growth that usually starts in March or April of each year and then slows down by September and October. Biological growth can be variable and is dependent on depth/light, temperature, and nutrients. Therefore, buoys deployed in the fall and recovered in late winter/early spring typically do not have much growth. Conversely, buoys deployed in the spring and recovered in the fall can have a large amount of fouling; UMaine researchers have reported approximately 5.9 inches of biofouling growth (species unspecified). These differences in summer and winter biofouling are seen in Figure 3-14. In August 2010 UMaine has deployed a new oceanographic buoy (Buoy E02) at the test site. The buoy will be recovered in 2011 and the marine growth on this buoy will be measured and quantified to provide a more definitive assessment of expected marine growth in the test site.

Note: Buoy E01 summer fouling shown on left and Buoy E01 winter fouling shown on right.

Figure 3-14. Representative Biofouling on Gulf of Maine Oceanographic Buoys

Areas of shelter, structure, or cover are typically sought by fish for protection from predators (Johnson and Stickney 1989). Artificial structures such as buoys or docks can serve as good sources of cover and refuge, particularly hard substrate having a vertical orientation (USACE 2004). Artificial structures that occur in marine areas where there is comparably little structure associated with the seabed can be particularly attractive to structure-oriented species, and subsequent colonization by marine life that otherwise would not occur in a particular area, in turn, attracts other predatory fish (Ogden 2005).

Many fish species have specific substrate and habitat requirements. In Maine, monkfish and many flatfish species such as American plaice and winter, witch, and windowpane flounder prefer sediment habitats. Other species such as longhorn sculpin, Acadian redfish and Atlantic cod recruit to and often are associated with rocky habitats (Collette and Klein-MacPhee 2002). In some cases, organisms that recruit to hard substrates such as deepwater corals create preferred nursery habitats for recruiting groundfishes (Auster 2005). Thus it is possible that the anchors and chains placed into soft-sediment habitats would diversify substrate heterogeneity that could increase the recruitment potential for some species of groundfish.

Sampling conducted before and after installation of the commercial Vindeby offshore wind farm along the Danish Coast found that fish abundance increased (Robert Gordon University 2002). The Minerals Management Service's Rigs to Reefs Program reported 20 to 50 times more fish near artificial reefs with biofouling than in the surrounding waters (MMS 2007). Previous environmental assessments for wave energy projects have identified marine biofouling as a potential direct benefit to marine biological resources (U.S. Department of the Navy 2003). For the UMaine project, a relatively small reef effect is expected; the two platforms and moorings would have a relatively small surface area below the waterline in comparison to that of floating offshore oil platforms or large European nearshore wind farms, and the UMaine platforms would be deployed only from July to November.

The area occupied by the two platforms and their moorings would become a no-trawl zone. The reduction of trawling disturbance within the anchor field represents an indirect effect of the project that could potentially beneficially affect the marine community composition. In the depth ranges of the Gulf of Maine similar to that of the Monhegan Island test site, trawling has substantially altered soft-bottom macrofaunal community structure. Under repeated trawling, structure-building animals, such as tube-building polychaetes, become conspicuously scarce. This trend has been most clearly documented by sampling programs that covered several years both inside and outside fishing closure areas in the western Gulf of Maine in mud bottoms between 328 and 623 feet deep (Grannis 2005; Knight 2005; Grizzle 2008; Nenadovic 2009; Grizzle et al. 2009). Studies at least as deep as 761 feet outside marine protected areas also suggest similar effects of trawling on community structure (Weissberger et al. 2008).

While artificial structures may benefit fish (Love et al. 2006) and may enhance local fisheries, the project would differ from typical artificial reefs in several ways. The two turbines' anchors would be relatively widely spaced, the mooring line diameter is expected to be approximately 6 inches, and the anchors would be located at depths of approximately 328 feet; in contrast, artificial reef structures are usually deployed in shallower water. Given these variables, it is unknown how structure-oriented species would react with the temporary deployment of the two turbine platforms and associated moorings.

FAD Effect

Related to artificial reef effects, fishes are also known to aggregate around floating objects (Nelson 2003), creating a FAD effect. FAD definitions vary, but generally FADs (or structures acting as FADs) are assumed to be floating at or near the surface of the water. The degree of proximity can vary by species, ranging from less than 3.3 feet from the structure for many juvenile fish, to 0.6 miles or more for large pelagic fish like tunas. These pelagic communities are usually more ephemeral than reef-associated communities (Nelson 2010). Nelson (2003) found that fish assemblages associated with FADs supporting a well-developed biofouling community were larger and more species-rich than those around FADs devoid of a biofouling community.

There are many documented cases of aggregations associated with drift algae (Mitchell and Hunter 1970; Kokita and Omori 1998; Safran and Omori 1990), oil platforms (Love et al. 2000), ice floes (Crawford and Jorgenson 1993), and other more durable debris (Parin and Fedoryako 1999) in higher latitudes. While anchored FAD designs consist fundamentally of an anchor, line, and buoy (McPhaden 1993; Friedlander et al. 1994; Hassan 1994; Higashi 1994; Nelson 2003), even very simple designs have been shown to attract fish in great numbers (Hunter and Mitchell 1968; Beets 1989; Hair et al. 1994; Hall et al. 1999a; Hall et al. 1999b; Nelson 1999).

The development of an artificial reef or attraction of structure-oriented fish may in turn also attract other predators including marine mammals and birds.

Bird Roosting/Seal Haul Out

Any above-water structure may be used as a perching or nesting surface, which may attract some bird species (potential bird attraction to lighting is discussed below). If a semi-submersible platform is deployed, seabirds may roost or nest on the above-water portion of the turbine and platform, and possibly fish in the vicinity of the project more than they would if there were no roosting structures available. Design considerations to prevent bird roosting and nesting would be implemented. For example, the turbine towers would not have external ladders or other structures that would allow birds to perch near the turbine blades.

Seals are known to haul out on nearly any floating platform. Of the three platform designs being considered, only the buoyancy-stabilized (semi-submersible) platform could have a portion of the platform upon which seals could haul out. A seal hauling out on a turbine platform is unlikely to be injured; rather, it is more likely that seals could become a nuisance during operations and maintenance. True seals such as the ubiquitous harbor seal seem to be less of a nuisance than the sea lions that occur on the West Coast. It is likely that the turbine platforms could be “seal proofed” by limiting the horizontal surfaces, raising the platform deck to several feet above the water level, or by adding fences or other barriers.

Avoidance of the Project Area by Resident and Migratory Species

At a commercial-scale offshore wind farm in Denmark eiders often deflected their flights away from wind turbines beginning at distances of 1,312 to 1,640 feet from the turbines (MMS 2009). While an array of structures above the water may be perceived as a barrier for birds, potentially causing migrating or foraging birds to expend additional energy avoiding the wind turbines, the two small one-third scale turbines proposed for this project are not likely to cause birds to deviate much from their flight paths or result in significantly increased energy expenditure if they do.

As discussed above, mobile species such as pelagic fish, birds, or marine mammals would likely temporarily avoid the deployment area during project installation activities. Project deployment and removal activities are expected to total one day per anchor and one day per turbine platform. Therefore, any shift in habitat use of marine species during installation or removal activities would be temporary.

As directed by the Maine Legislature, the State conducted a comprehensive screening process of potential sites for testing of ocean energy technologies along Maine’s coast. Monhegan Island and two other test sites were selected because they were located in areas with the least amount of environmental conflicts, as well as the least amount of physical and human conflicts. Examples of environmental criteria evaluated included seabird nesting islands, sensitive avian habitats, and other potentially sensitive habitats including areas of high marine mammal use. The Monhegan Island site was selected, in part, because it was determined that testing of wind turbines at this site would have minimum effects on resident and migratory species that occur in the area (DOC 2010).

Conclusion

Deployments of the project would result in minor, short-term, and possibly beneficial changes to habitat. Structure-oriented fish may be attracted by in-water project components, with the anchors and platforms representing an artificial reef effect and the platforms representing a FAD effect. Adding an anthropogenic structure to an open-water habitat may consequently result in a change in the type, distribution, and abundance of marine species near the two turbine platforms relative to a control site. However, the degree to which the project would change the habitat or the marine community in the test site area is expected to be negligible, and would not affect populations of species that use the area, because of:

- The small spatial scale of the project (only two one-third scale platforms and associated moorings having a combined footprint on the seabed of only 0.04 acres), and
- The short duration of the both installation activities and length of deployment of the floating platforms (the biofouling community would just have up to five months to grow before the platforms are removed).

In addition, design measures can be implemented to minimize bird attraction and roosting (e.g., not having external ladders or other structures that would allow birds to perch near the turbine blades) and to prevent seal haul out (e.g., for a semi-submersible platform, raising the platform deck to several feet above the water level). UMaine would be implementing a Fish and Wildlife Monitoring Plan that would monitor the marine community to better characterize any changes to the local marine community composition that is attributed to the presence of the project (see Section 2.6).

Above-Water Collision – Aerial Vertebrates

The operation of the proposed project would introduce static and moving above-water components at the site, potentially within the flyway of birds and bats. During project operation, flying vertebrates (migrating birds, foraging birds, and bats) could be at risk of colliding with the turbines.

Birds

Wind turbines are known to cause mortality to birds from direct collision. While varying with location, the national average of collision-related mortality for birds at land-based commercial wind farms is low, less than three birds per full-size turbine per year (Erickson et al. 2001). Peak bird casualty rates at most wind facilities occur during spring and fall migration periods (NWCC 2010).

It is expected that migrating and foraging birds at sea are habituated to flying through unobstructed habitats when away from nesting and roosting areas. The two one-third scale wind turbines would introduce a new vertical structure above the open ocean. The floating turbines, subject to final design, would have a rotor diameter of 88.6 feet, tower height of 100 feet, and total turbine height would be approximately 144 feet above the water surface. The maximum rotational speed of the turbine rotor would be 44 revolutions per minute.

Avian flight heights documented during 69 terrestrial radar surveys conducted in the northeast United States found that the average flight height during the day was 1,400 feet above ground level and nightly flight height ranged from 505 to 2,112 feet (MMS 2009). During migration, flight altitudes of landbird migrants over bodies of water and along coastal areas are lower than over inland areas (UMaine 2011), as evidenced by an avian radar survey conducted at sea in Nantucket Sound that found the average flight height was 1,066 and 1,522 feet above sea level for day and night, respectively (MMS 2009).

The New Jersey Audubon Society radar survey results at Monhegan Island, to date, showed that approximately 93 percent of targets during the day and 95 percent of targets during the night were detected at heights of 246 feet or higher (NJAS 2010), almost twice as high as the top of the proposed turbines.

The likelihood of a bird colliding with a turbine would depend on the ability of the birds to see the tower and blades and the bird's maneuverability, and is known to increase during periods of low visibility (e.g., precipitation, fog). When weather conditions are favorable, most migratory bird species migrate at altitudes generally well above the height of the rotor-swept areas of the project's two turbines. However, poor weather conditions cause songbirds to migrate at lower altitudes (NWCC 2010).

Bird species such as petrels and migrating songbirds are attracted to light during nighttime and diurnal conditions with poor visibility (UMaine 2011). Primary sources of artificial light in the marine environment, into which marine birds often collide, include vessels, lighthouses, light-induced fisheries, oil and gas platforms, and coastal resorts (Montevecchi 2006). The reason seabirds are attracted to light is thought to result from a predisposition of some species to prey on vertically migrating and bioluminescent prey (Montevecchi 2006). Nocturnal feeding of petrels, for example, is thought to result from adaptive behavior for targeting bioluminescent prey (Imber 1975) and for navigation using specific star patterns (Reed et al. 1985). The attractive effect of lights during cloudy nights is amplified by fog, haze, or light rain because the moisture droplets in the air refract the light and greatly increase the illuminated area (Weir 1976). In a study conducted during a heavy migration period, 50 percent of the avian collisions with a lighted radar platform occurred on two nights with fog and light rain conditions (MMS 2009).

The two one-third scale turbines would be lit at night for the purposes of navigational safety. The turbines would have two lights on each turbine tower, at a height of 20 feet above the water, one on each side of the tower structure. Each light would be a 360-degree, white flashing light, flashing two short followed by one long flash every four seconds and visible for up to 6 nautical miles. In addition to the lights on the turbine tower, for a semi-submersible type of floating platform, the other pylons not directly supporting the turbine tower would be lit with flashing amber lights. These would be 360-degree lights flashing every four seconds and visible for at least 2 miles. The exact specifications for lighting of the floating platforms and turbine would depend on the final design selected for the UMaine test site, and would comply with USFWS lighting requirements.

Bats

Bat fatalities have been documented at some utility-scale wind farms (Kunz et al. 2007). Bats appear to be attracted to tall structures, such as trees and lighthouses, and may be similarly attracted to wind turbines (Kunz et al. 2007; Horn et al. 2008), making them susceptible to collision risk. Attraction to wind turbines may not only risk direct collision with rotating blades, but can result in mortality due to pulmonary barotrauma caused by rapid air pressure reduction near moving turbine blades (Kunz et al. 2007; UMaine 2011). Bat fatalities at wind energy facilities appear to be highest along forested ridgetops in the eastern U.S. and lowest in relatively open landscapes in the midwestern and western states (Kunz et al. 2007). A consistent theme in most of the mortality monitoring studies conducted at utility-scale wind farms has been the predominance of migratory, tree-roosting species among the fatalities. Of them, nearly 75 percent were tree-roosting, eastern red bats, hoary bats, and tree cavity-dwelling silver-haired bats (Kunz et al. 2007).

During a study of bats on Monhegan Island, there were 13 positive bat echolocation sequences detected belonging to three bat guilds: big brown/silver-haired bats, eastern red bats/tri-colored bats, and *Myotis* species. Additionally, 14 unknown echolocation sequences were detected (Pelletier et al. 2010). These species are representative of tree roosting bats, which constitute the majority of bat fatalities at land-based wind farms. The proposed project is not located near a forested ridgeline and is instead located approximately 12 miles from the mainland, and 2 to 3 miles from Monhegan Island. Therefore, the probability of bats fatalities at the test site is very low.

Conclusion

While data indicate that bird flight altitudes over sea are lower than over land, the pre-installation monitoring indicates that during the day over 93 percent of targets fly at altitudes higher than 246 feet, well above the 144 foot height of the turbine rotors. In addition, the one-third scale turbines would have a small rotor-swept area (6,165 square feet each) and would be deployed for a short duration of no more than two five-month periods. As a vast majority of aerial vertebrates have been detected flying above the turbine-swept area, and the proposed project would be small scale and have a short operational duration, the number of birds and bats potentially affected by turbine strike would be minimal.

UMaine would monitor aerial vertebrates during operation of the project. As with the pre-installation monitoring that has already been conducted, post-installation monitoring would be performed with a horizontal and vertical array marine surveillance radar system based on Monhegan Island for control data during and after deployment. Analysis of radar would provide information on number of targets, height, direction, and speed of travel with continuous sampling at the level that can resolve individual songbirds only out to about 1.7 miles from Monhegan Island. Larger individuals and flocks of small birds can be tracked out farther. Comparison of flight patterns would allow analysis of potential effects of the turbine on target numbers and behavior. In addition to radar surveillance, the UMaine, in consultation with the USFWS and other resource agencies, has added acoustic monitoring for birds and bats and visual, boat-based surveys for birds. Flying vertebrate monitoring during the operational phases would occur beginning on July 15th and ending on November 30th of the initial year of deployment. This ensures data collection overlaps with the southbound migration (mid-July to end of November) period for flying vertebrates in the region. The proposed monitoring of aerial vertebrates would provide important information about how birds and bats behave in the project vicinity during project operation.

Underwater Entanglement and Collision – Marine Mammals

As stated in Section 3.4.1.4, while large whales have been observed in the vicinity of the Monhegan Island test site, this area does not appear to be commonly used (UMaine 2011). This section evaluates the potential that whales may become entangled, or collide, with the project mooring lines.

In selecting Monhegan Island as a test site, the State conducted a comprehensive screening process of different potential sites along Maine's coast to identify sites that had the fewest environmental, as well as human and physical, conflicts. The State considered marine mammal use of the potential sites, both anecdotally and from information collected from the Right Whale Consortium and DMR's whale sightings database (Nixon 2010a). The Monhegan Island site was selected, in part, because it was determined that testing of wind turbines at this site would have minimum effects on marine mammals (DOC 2010).

Entanglement

An examination of NMFS entanglement records from 1990 through 2007 showed that, for the 46 confirmed right whale entanglements during that time period, the whales were entangled in weirs, gillnets, and trailing line and buoys (NMFS 2009). The approximately 6-inch diameter mooring lines proposed for the floating wind turbine platforms are more substantial than the fishing or lobster pot lines that have been shown to cause the entanglement incidents. The mass/buoyancy of the platforms and mass of the anchors is expected to create substantial tension in the mooring lines, which themselves would be substantially inflexible cables and act more like a structure than a line. These factors would prevent the formation of loops around a passing whale. Heavy mooring gear combined with relatively taut mooring lines have been shown to render the potential for entanglement negligible (Wursig and Gailey 2002).

These expectations have been confirmed at a NOAA-funded open ocean aquaculture facility located 6 miles off the New Hampshire mainland in the Gulf of Maine (Atlantic Marine Aquaculture Center 2008). The facility, covering about 30 acres in depths of 164 feet, was installed in 1997 and has a mooring system comparable to the UMaine project. For this project, a biological assessment (Celikkol 1999) was requested by NMFS with an emphasis on marine mammal entanglement, and USACE permits were issued (Cicin-Sain et al. 2001). As with the UMaine test site, endangered right, fin, and humpback whales occur in the New Hampshire offshore aquaculture project area (Atlantic Marine Aquaculture Center 2008). Celikkol (1999) analyzed the risk of entanglement and concluded that "the chance of whale entanglement should be considered unlikely to very unlikely" because of the absence of structures that are known to cause entanglement such as slack lines and netting. Monitoring of whales and sea turtles in the project vicinity occurred following deployment of the project in 1997. While fin and humpback whales were observed in the project vicinity, they were not seen in the immediate project area. Researchers reported in 2006 that "…no incidents related to marine mammals or turtles have occurred at the open ocean aquaculture field site and no impacts have occurred since the beginning of aquaculture activities in 1997" (Atlantic Marine Aquaculture Center 2008).

Collisions

Marine mammals in the Gulf of Maine are exposed to a variety of anthropogenic structures that present collision risk, including moored navigation aids and oceanographic buoys, as well as anchored and moving ships. Whale collisions with moored ships and buoys are uncommon. Marine mammals have evolved to avoid colliding with natural features as well as to avoid predators. For example, many toothed whales have a well-developed ability to echolocate and avoid structures in the water (Akamatsu et al. 2005). In a study of finless porpoise (*Neophocaena phocaenoides*), Akamatsu et al. (2005) found that this species inspected ahead a distance of up to 250 feet and swam less than 65 feet without using sonar. Researchers concluded that the distance inspected was sufficient to provide awareness of any risk ahead (Akamatsu et al. 2005). Seals have well-adapted underwater vision (Schusterman and Balliet 1970) and use their vibrissae to detect changes in pressure or vibrations in the water (Dehnhardt et al. 2001; Mills and Renouf 1986). Because of the acute sensory capabilities of toothed whales (*echolocation*) and the small size and maneuverability of seals, it is expected that these species would be able to detect and avoid underwater moorings.

While unlikely to occur in the project area (UMaine 2011), there is generally more uncertainty regarding the ability of baleen whales, which do not use sonar, to avoid mooring lines. The marine mammal monitoring at the New Hampshire open ocean aquaculture facility described above, suggests that baleen whales do in fact avoid large moored structures in the open ocean; as mentioned above, while fin and humpback whales were observed in the project vicinity, they were not seen in the immediate project area and researchers concluded that no impacts to whales have occurred (Atlantic Marine Aquaculture Center 2008). In an analysis of a similarly moored proposed wave energy project in the state of Washington (Makah Bay Project), FERC (2007) concluded likewise, stating:

> We … suspect that because the project's cables would be similar in size and type to anchoring systems associated with navigation buoys, the potential for collisions and injury (of marine mammals) is low. We found no information that would suggest that navigation buoys have resulted in injury to marine mammals. While there would be an array of 10 such cables at the project compared to a single one associated with a navigation buoy, the spacing between the cables (60 feet) should be sufficient for most species to avoid hitting the cables.

The UMaine project consists of only two floating platforms, each having approximately six mooring lines, two at each of the three platform arms. There is ample space for minke whales, harbor porpoise, and other marine mammals likely to occur in the project area, to pass freely by. The floating platforms, though one-third scale, would nevertheless be substantial, solid structures that are expected to be readily perceived by approaching marine mammals. This may in turn trigger greater awareness as a whale approaches the platform, which would better allow the animal to detect the mooring lines. The chance of a whale colliding with the platforms or their anchoring system is expected to be low, and any such interaction would be unlikely to result in serious injury. The risks would appear comparable to those of running into a large anchor chain or cable of an anchored vessel.

The small size of the project relative to surrounding open ocean area to the south of Monhegan Island, the fact that the platforms would be temporarily deployed for five months or less in each of two consecutive years, and that large whale presence at the project area is uncommon, further reduces the likelihood of an adverse effect to marine mammals, including endangered species.

An increase in vessel traffic associated with the project installation and maintenance would be negligible for this temporary project. While the potential for a vessel and marine mammal interaction is unlikely, NMFS marine mammal avoidance procedures would be implemented in the event that a marine mammal is encountered by a construction or maintenance vessel.

Conclusion

Marine mammals would not become entangled in the project mooring lines because the mass/buoyancy of the platforms and mass of the anchors is expected to create substantial tension in the mooring lines, which would prevent formation of loops around a passing marine mammal. Whale collisions with moored ships and buoys are uncommon, and it is expected that marine mammals will detect and avoid the project's floating turbine platforms or the mooring lines. Vessel traffic associated with the project will be infrequent and short term; NMFS marine mammal avoidance procedures would be implemented in the event that a marine mammal is encountered by a construction or maintenance vessel. Therefore, the potential that marine mammals will become entangled or collide with the project or collide with service vessels is negligible.

3.4.2.2 Effects on ESA-Listed Species and Essential Fish Habitat

Potential effects on ESA-listed species are separated within this section into the following groups, which represent the types of ESA-listed species that may occur in the project area: fish, whales, birds, and sea turtles. Potential effects on EFH are also discussed.

Fish

Two ESA-listed fish species, both anadromous, have the potential to occur in the project area, Federally endangered Atlantic salmon, and Atlantic sturgeon, which is proposed as threatened. The proposed project is not located within any currently designated critical habitat for any ESA-listed fish species. As discussed, UMaine will deploy an acoustic telemetry receiver at the test site to monitor for the presence in the project area for tagged fish, including Atlantic salmon and Atlantic sturgeon.

Atlantic salmon are a highly mobile species; as discussed above in Section 3.4.1.3, smolts migrate to Labrador and Greenland in the spring of each year, generally between late April and early June, depending on river conditions, where they mature, and return after two to three years at sea to spawn in their natal streams. Atlantic sturgeon in Maine typically have been found near estuaries (Dunton et al. 2010), though individuals have infrequently been documented further out to sea (Zydlewski 2010). Both Atlantic salmon and Atlantic sturgeon could be expected to pass through the project area, but their exposure to the project would be temporary and short term given their migratory behavior and because the project will be temporary.

Atlantic salmon and Atlantic sturgeon are highly mobile species and would likely avoid the immediate deployment area during project installation activities. The project deployment and removal activities are expected to total one day per anchor, and therefore any avoidance of the project area during installation or removal activities would be temporary and short term.

As discussed above, the presence of turbine platforms and project moorings in the water column would introduce new structure and would have the potential to attract structure-oriented fish. ESA-listed Atlantic salmon are high migratory pelagic species in the open ocean (NOAA 2010b) and Atlantic sturgeon are typically found in bays and estuaries (75 FR 61881, April 9, 2010); therefore, neither species is expected to be attracted to the underwater project infrastructure. The degree to which the project would change the habitat or the marine community composition in the test site area is expected to be negligible because of the small size of the project, the limited duration of the deployment, and the limited time that Atlantic salmon and Atlantic sturgeon would be in the area.

In conclusion, because of the small size of this research project relative to the surrounding waters, the temporary nature of the deployment, and the low exposure of migratory Atlantic salmon and Atlantic sturgeon to the project site, the change in habitat caused by the deployment of the project represents a discountable and insignificant effect to Atlantic salmon and Atlantic sturgeon, and the project is not likely to adversely affect these two species.

Essential Fish Habitat

As discussed in Section 3.4.1.3, there are a number of Federally managed fish species with EFH in waters off of Monhegan Island. Habitat types that represent EFH include all portions of the water column or substrate types, such as soft bottom, hard bottom, and various mixtures of hard and soft (NOAA 2010d). The footprint of the anchors may slightly decrease available bottom foraging habitat and areas considered to be EFH. However, the maximum area covered by the anchors would be only 0.04 acres and the type of habitat to be disturbed is very prevalent offshore of Maine. Placement of anchors in areas of soft bottom substrate would likely result in a temporary and localized increase in turbidity during deployment and removal; with only three anchors expected to be deployed for each turbine, this effect would be short term and negligible. As discussed above, mobile species such as fish, would likely avoid the immediate deployment area during project installation activities. Project deployment and removal activities are expected to total one day per anchor and one day per turbine platform. Therefore, any shift in habitat use of marine species during installation or removal activities would be temporary. Because the project is small scale and temporary, effects on EFH (e.g., waters and substrate necessary for fish to spawn, breed, feed, etc.; see Section 3.4.1.3 and Table 3-3) are expected to be negligible.

Whales

The six ESA-listed whales that have the potential to occur in the project area are North Atlantic right, fin, humpback, sei, blue, and sperm whales (Table 3-4). As discussed in Section 3.4.1.4, while large species of whales have been observed in the vicinity of the Monhegan Island test site, the area does not appear to be commonly used (UMaine 2011). In fact, the State selected the Monhegan Island site, in part, because it was determined that testing of wind turbines at this site would have minimal effects on whales (DOC 2010). The likelihood of exposure of ESA-listed whales to the proposed project is very small, given that ESA-listed whales are uncommon in the project area, the small size of the project relative to surrounding open ocean area to the south of Monhegan Island, and the fact that the platforms would be temporarily deployed for five months or less in each of two consecutive years.

The potential project effects on ESA-listed whales would be underwater entanglement and collision, both of which are discussed in Section 3.4.2.1. (Potential effects of project noise to ESA-listed whales are discussed in Section 3.5.) The project is not located within any marine mammal critical habitat.

As stated in Section 3.4.2.1, heavy mooring gear combined with relatively taut mooring lines has been shown to render the potential for entanglement negligible (Wursig and Gailey 2002). ESA-listed whales would not become entangled in the project mooring lines because the mass/buoyancy of the platforms and mass of the anchors is expected to create substantial tension in the 6-inch-diameter mooring lines, which themselves would be substantially inflexible cables and act more like a structure than a line. These factors would prevent the formation of loops around a passing whale.

Whale collisions with moored ships and buoys are uncommon. ESA-listed whales are not expected to collide with the project's floating turbine platforms or the mooring lines. The floating platforms would be solid structures and are expected to be readily perceived by approaching whales. The presence of the floating platforms may trigger a greater awareness as a whale approaches the platform, which could facilitate the animal detecting the mooring lines.

Vessel traffic associated with the project installation and maintenance would be small, negligible, and discountable for this temporary project. While the potential for a vessel and ESA-listed whale interaction is unlikely, NMFS marine mammal avoidance procedures would be implemented in the event that a marine mammal is encountered by a construction or maintenance vessel.

In conclusion, given the low exposure of ESA-listed whales to the project, the mooring cables would not pose an entanglement risk, whales are expected to be able to detect and avoid the turbine platforms, and NMFS marine mammal avoidance procedures would be implemented in the event that a marine mammal is encountered by a construction or maintenance vessel, the proposed project is not likely to adversely affect ESA-listed whales.

Birds

There are two ESA-listed birds that have the potential to occur in the project area, roseate tern and piping plover. The project is not located within the federally designated critical habitat of these two species.

The operation of the proposed project would introduce static and moving above-water components at the site, potentially within the flyway of birds. During project operation, flying roseate tern and piping plover could be at risk of colliding with the turbines. The one-third scale turbines would have a small rotor-swept area (6,165 square feet) and would be deployed for duration of no more than two five-month periods. UMaine would develop and implement a post-construction fish and wildlife monitoring plan with radar monitoring for birds and bats. As stated in Section 3.4.2.1, the New Jersey Audubon Society radar survey results to date at Monhegan Island showed that approximately 93 percent of targets during the day and 95 percent of targets during the night were detected at heights of 246 feet or higher (NJAS 2010), almost twice as high as the top of the proposed turbines.

Roseate terns usually forage over shallow bays, tidal inlets, and channels (USFWS and NMFS 2008). As discussed in Section 3.4.1.6, while Monhegan Island is not used for breeding, roseate terns use the island and surrounding waters to rest and feed and are regularly observed (Welch 2010). Piping plovers breed on beaches in southern Maine and to the south, and forage on beaches (letter from USFWS to Maine SPO dated August 4, 2009). Monhegan Island is located approximately 10 miles from the mainland and there is very little beach habitat on the island, and it is therefore expected that Monhegan Island would not be a high use area for piping plovers. Potential effects to piping plovers would be during transiting or migration when they could interact with the turbine rotors. Piping plover migration flight routes and flight altitudes are largely unknown (USFWS 2009).

A vast majority of birds have been detected flying above the turbine-swept area (NJAS 2010). It is unknown how flight patterns and altitude of roseate terns and piping plovers would relate to these observed data, but because the proposed project would be small scale and have a short operational duration, the likelihood of these two species interacting with the turbine rotors is so small it is discountable. In conclusion, the project is not likely to adversely affect ESA-listed roseate tern or piping plover.

Sea Turtles

There are three ESA-listed sea turtles with the potential to occur in the project vicinity: Atlantic Ridley, loggerhead, and leatherback sea turtles. The proposed project is not located within any critical habitat for sea turtles. Sea turtle sightings in the Gulf of Maine are exceedingly rare. As discussed for other species, ESA-listed sea turtles would not become entangled in the project mooring lines because the mass/buoyancy of the platforms and mass of the anchors is expected to create substantial tension in the 6-inch diameter mooring lines. These factors would prevent the formation of loops around a passing turtle, and therefore potential effects from entanglement are negligible. No other potential effects on sea turtles are anticipated and the project is unlikely to adversely affect ESA-listed sea turtles.

3.4.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no impacts to biological resources. Baseline conditions, as described in Section 3.4.1, would remain unchanged.

3.5 Noise and Vibration

3.5.1 AFFECTED ENVIRONMENT

Noise levels in the project area are expected to be typical of an open-ocean setting. In the marine environment a variety of natural and anthropogenic sources create ambient noise, both intermittent and continuous. Sources of ambient noise include waves, wind, bubbles and spray, marine life, seismic events, commercial and recreational vessel traffic, and thermal noise from random agitation of water molecules (Bradley and Stern 2008; Richardson et al. 1995). Ambient noise pressure spectral densities can range from about 35 to 80 decibels [referenced to one micropascal squared per hertz (re 1 $\mu Pa^2/Hz$)] for usual marine traffic (10 to 1,000 hertz) as shown in Table 3-6, and 20 to 80 decibels (re 1 $\mu Pa^2/Hz$) for breaking waves and associated spray and bubbles (100 to 25,000 hertz; Richardson et al. 1995). In open oceans, the primary noise sources tend to be commercial shipping and wind and wave action on the sea surface (Richardson et al. 1995).

Table 3-6. Underwater Sound Pressure Levels for Various Types of Vessels

Vessel Length and Description	Frequency (hertz)	Source Level (dB re 1 µPa at 1 meter)
Outboard drive – 23 feet (2 engines, 80 horsepower each)	630	156
Twin diesel – 111 feet	630	159
Small supply ships – 180 to 278 feet	1,000	125 – 135 (at 164 feet)
Freighter – 443 feet	41	172

Source: Richardson et al. 1995.

To characterize the underwater ambient noise in the project area, UMaine conducted ship-based hydrophone surveys during the hydroacoustic fish survey efforts in August and September, 2010. The objective of the underwater ambient noise study was also to establish background noise levels prior to installation of the one-third scale wind turbines so that noise produced by the turbine, platform, and anchoring system could be compared to ambient noise levels across the frequencies of interest for marine mammals and other marine species. Underwater acoustic recordings were made during both the day and night at the center of two possible turbine deployment locations and at a nearby control area. The only sounds detected were the slapping of waves on the side of the vessel and some flow noise around the hydrophone cable.

3.5.2 ENVIRONMENTAL IMPACTS RELATED TO NOISE AND VIBRATION

The proposed project would involve installation, maintenance, operation, and removal of two one-third scale floating wind turbines located 2 to 3 miles offshore of Monhegan Island. The installation, maintenance, and removal of the floating wind turbines would result in underwater noise created from service vessels and equipment, similar to vessels commonly used throughout the coast, and may temporarily alter behavioral patterns of marine life within the project vicinity and along the route that the platforms would be transported during deployment and removal. Operation of the wind turbines would produce noise and may sometimes be audible to people on Monhegan Island. People, fish, marine mammals, and other animals detect noise through biological receptors that are sensitive to sound pressure [expressed in decibels referenced to one micropascal (dB re 1 µPa)], particle velocity (expressed in meters per second), and the frequency of sound (expressed in hertz).

The predominant source of noise during project installation, maintenance, and removal would be the service vessels' propellers (MMS 2007). It is expected that the peak underwater sound intensity, generated by tugs, barges, and diesel-powered vessels (representative of vessels that would be used for project installation, maintenance, and removal) fully underway, to be no greater than 130 to 160 decibels (re 1 µPa) over a frequency range of 20 hertz to 10 kilohertz (Richardson et al. 1995). Vessels should be fully underway only when traveling to and from the test site. Also, these noise levels may result from cavitation (sucking of a vacuum with rapid and loud collapse of the resulting bubbles) during vessel starts and stops during installation and removal activities. It is expected that most of the time during project activities the sound intensity would be much lower.

During project installation, maintenance, and removal, it is expected that the above-water sounds from the support vessels and equipment would not be transmitted into the water at a higher level than natural environmental noise from wind and wave action. FERC, in its environmental assessment for the Makah Bay Wave Energy Project in Washington, concluded that above-water sounds from support vessels and equipment would be largely damped by ambient ocean noise on all but the calmest of days (FERC 2007). Installation of the anchoring and mooring system for the UMaine project would not involve percussive pile driving or drilling, the noise source of particular concern during many marine installation projects (Halcrow Group 2006). Additionally, the proposed project would not include installation of a subsea transmission cable. Assuming that each turbine platform has three anchors, UMaine expects installation would take a total of about 8 days (one day to deploy each anchor and each turbine platform). Noise associated with the installation, maintenance, and removal activities may cause some fish, marine mammals, birds, and other marine life to avoid the project area and alter feeding patterns; however, any effects would be short term, with activities returning to normal after the service vessels leave the site.

Noise created during project operation would be from the mechanical motion of the internal turbine components as well as the aerodynamic interaction of the rotor blades with the surrounding air. The Vestas V27 wind turbine is being considered for the turbine model. The predominant noise output from the Vestas V27 turbines would be from the aerodynamic effects between the rotating turbine blades and the surrounding air (Jones et al. 2010). The intensity of aerodynamic noise is a strong function of wind speed and wind turbulence. To minimize wind turbulence, modern wind turbines, such as the Vestas V27, place the rotor upwind of the tower (Jones et al. 2010).

For the proposed project, Pacific Northwest National Laboratory (PNNL) estimated above-water source-level and Monhegan Island-arriving sound intensity for a Vestas V29 wind turbine generator (Aker et al. 2010, 2011). The required sound input data were not available for the Vestas V27, however the Vestas

V29 had a detailed sound resume available. While the Vestas V29 is a newer design based upon the Vestas V27, it has the same blade profile, same rated power, same tip speed ratio, and therefore is a suitable representation of the Vestas V27. The estimated noise model output for a Vestas V27 turbine operating in winds at 29 miles per hour, blowing directly onshore from the turbines, results in the most sound reaching the island of all cases modeled, 35.6 A-weighted decibels (dBA) (Aker et al. 2010, 2011). Decibels are measured on a log scale, and the A spectrum is tuned so that its loudness as a function of frequency matches human hearing. For reference, a whisper has a sound intensity of 30 dBA. The most common noise standard for wind turbine projects limits the average sound pressure level to 40 dBA at a received location of interest (Aker et al. 2010); therefore, even under the worst-case calculation, the maximum estimated received sound pressure level on Monhegan Island (35.6 dBA) is much less than the 40 dBA standard. When the winds are not blowing directly onshore, this sound estimate would be substantially reduced. Based on these calculations and the results of Boué (2007) and Bolin et al. (2009), it is likely that on most days the turbines could not be heard ashore, but the extensive data set in Boué (2007) suggests that it is possible that on a few days per year with strong atmospheric inversion and light winds from the south (little background noise) noise from the proposed one-third scale wind turbines could be detected. Detection of sound from the turbines on calm (light winds and minimal air turbulence) days could be judged as an adverse condition by some people on the island; however, because of the distance of the project from shore, the maximum predicted sound level on Monhegan Island (35.6 dBA) would be low and would not interfere with activities on the island.

Underwater noise created from the combined turbine and support structure would be caused by noise transferred from the turbine or nacelle into the substructure via vibration. The level of noise emissions would be a strong function of the turbine structure, platform configuration, and dynamic loads experienced by the substructure. It is expected that these noise emissions would have low amplitude and low frequency (Jones et al. 2010). Propagation of these noise emissions through the water would be affected by seawater characteristics and depth, thermal gradients, and the seabed type (Jones et al. 2010).

Marine mammals as a functional group have hearing ranges of 10 hertz to 200 kilohertz; this includes ultrasonic frequencies (greater than 20 kilohertz) and infrasonic frequencies (less than 20 hertz). Toothed whales (*odontocetes*) and seals are typically more sensitive to higher frequencies, and baleen whales (*mysticetes*) are more sensitive to lower frequencies (Richardson et al. 1995). A number of studies on baleen whales have shown that when exposed to different sound sources, both impulsive and low frequency sounds, they have displayed avoidance behaviors for received levels of 140 to 160 decibels (NMFS 2008).

Masking of whale communication mechanisms by anthropogenic noise has also been raised as a concern for human activities in the ocean. Baleen whales usually vocalize at lower frequencies (peak spectra of 12 hertz to 3 kilohertz) (Ketten 2000), though humpback whales have produced some signals above 24 kilohertz. Toothed whales communicate at higher frequencies, with social sounds from 1 kilohertz to tens of kilohertz and echolocation using very high frequencies, tens of kilohertz to 100+ kilohertz (Southall et al. 2007).

While there has been some noise analysis for commercial-scale bottom-mounted (shallow water) offshore wind turbines, the two one-third scale turbines proposed for the UMaine project are substantially different due to their smaller size, floating platform, foundation design, and greater water depth. The greatest difference is the lack of any rigid structure below the support platform that could transmit vibrations efficiently from the turbine and its supports into the water or seabed. It is expected that turbine noise propagation to the marine environment would be much lower for the proposed one-third scale floating turbines than a bottom-mounted commercial turbines, and consequently, monitoring results for the latter are not applicable to this project.

Only a small amount of sound is expected to result from transfer of above-water sound through the sea surface. According to modeling conducted by PNNL, the sound source level at the turbine hub for the Vestas V29 (a comparable turbine to the Vestas V27, as discussed above) is 98 dBA in wind speeds of 17.9 miles per hour. As described in Section 2.2, the distance from the waterline to the hub for the proposed project will be approximately 100 feet. Sound levels underwater resulting from turbine noise transferred through the sea surface are expected to be substantially lower than the sound source levels, due to the reflective nature of the sea surface (Jones et al. 2010).

Acoustic emissions underwater, due to vibrations of the turbine and platform structure are expected to be low frequency and low amplitude, and are strongly dependent on turbine and platform configuration and dynamic loads (Jones et al. 2010). UMaine plans to characterize the underwater noise produced by the two one-third scale floating wind turbines by conducting stationary and mobile underwater noise monitoring during turbine operation. The goal of the underwater noise monitoring would be to study sound levels across the frequency spectrum of concern for marine mammals and other marine life, including spatial and temporal variability in sounds produced compared to ambient sounds under a variety of wind and sea state conditions. Ambient noise and sounds created by the turbines and associated anchoring systems would be analyzed from the perspective of known effects of environmental noise on marine mammal physiology and behavior. During the period of turbine deployment, stationary hydrophones would be deployed at two of the following three locations: mounted on the turbine platform, Buoy E02 located at the test site, or Buoy E01, located less than 1.2 miles west from the test site. Mobile passive acoustic, ship-based surveys would be conducted during the pelagic fish surveys.

In conclusion, noise associated with installation, maintenance, and removal activities may cause some marine life to avoid the service vessels, as they might avoid any vessels commonly used along the coast; however, any effects associated with the temporary project would be infrequent, short term, and negligible, with activities returning to normal after the service vessels leave the site. During operation on days with light winds and minimal air turbulence, the noise generated from the wind turbines may be audible on Monhegan Island and could be judged as an adverse condition by some people on the island; however, because of the distance of the turbines from shore, the maximum predicted sound level received on Monhegan Island (35.6 dBA) would be low and would not interfere with activities on the island. Because of the small scale and temporary nature of the turbines, and because only a small amount of sound can transfer through the sea surface from above, underwater noise resulting from turbine operations is not expected to negatively affect marine mammals or fish. Because monitoring of underwater noise produced by floating turbines has not been conducted to date, UMaine's proposed noise monitoring plan would allow field testing of actual underwater noise levels from the operating floating wind turbines to determine if the noise produced would be high enough to affect whales or other marine life. The temporary nature of this research project mitigates this type of field testing, which would provide information on potential noise effects that would be important for future, commercial-scale developments.

ESA-Listed Species

Noise associated with the installation, maintenance, and removal activities may cause ESA-listed fish, whales, birds, and sea turtles to avoid project service vessels, as they might avoid any vessels commonly used along the coast. Any avoidance of service vessels associated with the temporary project would be infrequent, short term, and negligible, with activities returning to normal after the service vessels leave the site.

Underwater noise associated with operation of the project could affect ESA-listed whales, fish, and sea turtles. As discussed above, the likelihood exposure of ESA-listed whales, fish, and sea turtles to the project is low because these species are uncommon in the project area and because of the temporary nature of this research project. UMaine expects that the noise levels produced by the operating one-third scale turbines would not be high enough to negatively affect these species, and the proposed noise monitoring would allow field testing of actual underwater noise levels from the operating turbines to determine if operational noise would be high enough to affect these ESA-listed species.

In conclusion, because of the small scale and temporary nature of the turbines, because of the low likelihood that ESA-listed species will be exposed to the project, and because only a small amount of sound is expected to result from transfer of above-water sound through the sea surface, underwater noise resulting from turbine operations is not likely to adversely affect ESA-listed species.

3.5.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no change in noise conditions in the project area. Baseline conditions, as described in Section 3.5.1, would remain the same.

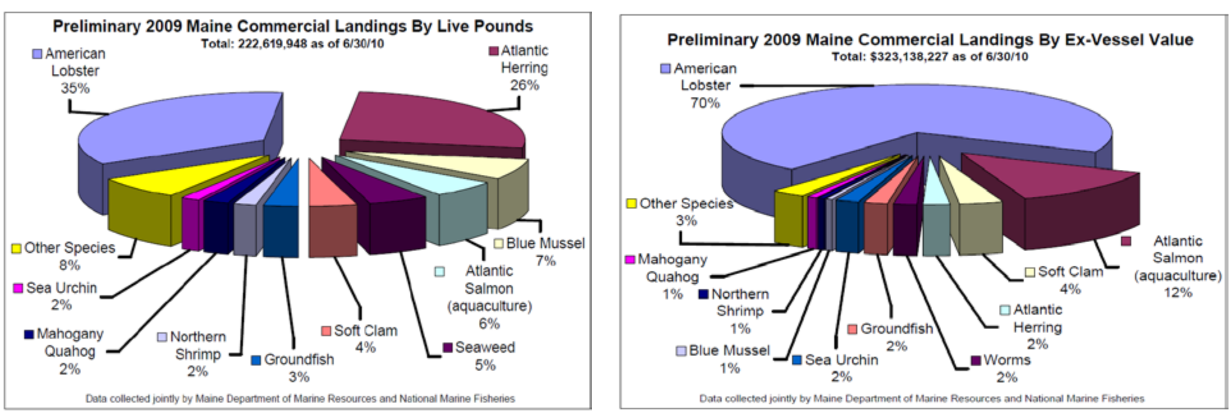
3.6 Ocean Use

3.6.1 AFFECTED ENVIRONMENT

3.6.1.1 Commercial Fishing

Overview

Commercial fisheries play an important role in Maine's economy. Commercial fish and shellfish species of value include American lobster, Atlantic herring, Atlantic salmon (aquaculture), and soft shell clam. To provide a perspective of the commercial landing and value per species or group of fish and shellfish, Figure 3-15 shows landings in Maine by pound and by value for 2009. In 2009, Maine's commercial fishing industry landed approximately 50 million pounds of fish in Knox County and approximately 20 million pounds of fish in Lincoln County (DMR 2010c).



Source: DMR 2010d.

Figure 3-15. Preliminary Maine Commercial Fishery Landings by Weight and by Value

Lobster

Lobstering is the most economically significant fishery in the State of Maine (Figure 3-15) (DMR 2010d). Although Maine fishermen commercially harvest a wide variety of other species, the percentage of commercial fishing licenses for lobstering, as opposed to other species, speaks to the dependence of the local fishing industry on lobster. Seven lobster management zones have been established along the Maine coast and extend out to the Exclusive Economic Zone. Lobster Management Zone D encompasses the area from Pemaquid to Cape Rosier, which includes the area of the proposed project. In 2009, a total of 1,093 lobster licenses and 646,977 lobster trap tags were issued for Zone D (DMR 2010a). Within Zone D, the Monhegan Lobster Conservation Area (Sections 6471 to 6477) was designated in 1998 by the Maine Legislature as an area around Monhegan Island where only Monhegan fishermen can obtain a permit to set traps. Currently, there are 11 lobstermen on Monhegan Island (Nixon 2010b). The open season for those registered to set traps in the Monhegan Lobster Conservation Area runs from October 1 to June 7. The UMaine offshore wind test site sits completely within the Monhegan Lobster Conservation Area.

Eighteen percent of Maine island residents have lobster licenses; this speaks to the important role lobster fishing plays in the vitality of Maine's island communities. In 2001, 2003, and 2005, lobster licenses accounted for more than 60 percent of the total number of fishing licenses issued on Maine's islands (with the exception of Peaks Island in 2003). Lobster licenses on Monhegan Island accounted for approximately 61 to 67 percent of the total fishing licenses during these years (Curran and Gabrielson 2007).

Small Pelagics

Small pelagic fish are caught using both mid-water trawls and weirs and include such species as herring, menhaden, and sand eels. Of these, Atlantic herring is Maine's most valuable pelagic fishery, with nearly 29,000 tons landed in 2009. Historically the fishery sustained a large sardine canning industry in Maine. While the last cannery closed in April of 2010, Atlantic herring remains a critical industry and is the primary bait used by the lobster fishery (UMaine 2011). Herring landings statewide over the last decade ranged from 28,898 to 57,912 tons and were valued from $4.6 to $10.7 million. Herring are relatively less abundant in deeper waters but were the most abundant species caught around Monhegan Island in the Maine-New Hampshire Trawl spring surveys (UMaine 2011).

Groundfish

The groundfish fishery, or "Northeast multispecies fishery" is managed by the New England Fishery Management Council and the NMFS and includes American plaice, Atlantic cod, Atlantic halibut, Atlantic wolffish, haddock, ocean pout, offshore hake, pollock, red hake, redfish, silver hake, white hake, windowpane flounder, winter flounder, witch flounder, and yellowtail flounder. Groundfish are caught off the Maine coast in trawls, gillnets, and to a lesser extent with long lines (UMaine 2011).

While groundfish fishing decreased substantially after stocks plummeted following overfishing in the 1970s and 1980s, substantial efforts have been made to bring these fish back and there is currently a complex management plan in place to allow groundfish species to return to their once abundant levels on Federally mandated rebuilding timetables (UMaine 2011). In Maine, fishermen belong to one of two groundfish sectors: the Port Clyde Community Groundfish Sector or the Sustainable Harvest Sector. Through sectors, a group is granted a total allowable catch for each groundfish species that can be caught over the year at the sector's discretion with the understanding that once the total allowable catch for one species in the allocation has been reached, sector members are no longer permitted to fish for any species. Those who do not belong to a sector fish under the "Days At Sea" allocation scheme and comprise what has come to be referred to as the "common pool."

Determining areas critical to the groundfish industry is more difficult than for some other fisheries, as there is an expectation that the industry will rebound over the next decade. Currently groundfishing is primarily an offshore industry; however, the expectation is that areas closer to shore will once again become productive and valuable to the fishery, as has occurred in recent years in the western Gulf of Maine, off New Hampshire and northern Massachusetts (UMaine 2011).

With the exception of Atlantic herring, commercial landings in Maine of species represented commonly in the Maine-New Hampshire Trawl Surveys in Regions 2 and 3 and in the Monhegan Island area, both described in Section 3.4.1.3, are mostly very low compared to historical records in the Gulf of Maine and many have trended downward over the decade of the 2000s (DMR 2010c). Silver hake was the second most abundant species caught near Monhegan Island, but commercial landings in the state have been near zero in recent years. Commercial landings in recent years in the Gulf of Maine have also shown dramatic declines for white hake, winter flounder, Acadian redfish, witch flounder, goosefish, yellowtail flounder, skates combined, and Atlantic wolfish. For example, goosefish landed value was nearly $9 million at the start of the decade but declined to about $0.5 million in 2009. Commercial landings of Atlantic cod, haddock, and pollock have been steady over the decade at low tonnage, but with values greater than $3 million in some years (McCleave 2011).

All of the historically commercially important species could be present in the test site near Monhegan Island. Traditionally targeted groundfish, such as winter flounder, Atlantic cod, haddock, and pollock, are expected to be uncommon there based on the trawl survey data and reported commercial landings. Silver hake and American plaice were very abundant in the trawl surveys near Monhegan Island, but commercial landings have fallen to low or negligible levels. Silver hake, once harvested in large tonnage in the Gulf of Maine, has always received a low price per pound, and landings are negligible now. Commercial landings in the Gulf of Maine of white hake and witch flounder, both common in the surveys near Monhegan Island, have fallen to about one-fifth of those at the start of the decade (McCleave 2011).

Northern Shrimp

The Gulf of Maine fishery for northern shrimp is managed across Maine, New Hampshire, and Massachusetts by the Interstate Fisheries Management Program of the Atlantic States Marine Fisheries Commission. Northern shrimp are caught in both trawls and traps in State of Maine and Federal waters, primarily during the winter months. Preliminary data for 2009 show nearly 4.8 million pounds of shrimp, valued at $1.92 million, were landed in Maine. The start date and length of the fishing season varies year to year, but in recent years has started in either November or December and ended in May (Island Institute 2010). DMR compiles maps of shrimp tows by region as well as names of draggers and operators; two shrimp tows occur in the project area (DMR 2010e).

The number of fishermen landing shrimp has varied widely over the past decade as the stock size has increased and decreased dramatically. It was estimated that just over 200 boats from Maine participated in the fishery in the 2007-2008 season. In the 2008-2009 season a number of boats from the lobster fishery rigged over to fish for shrimp in the winter months when the market for lobster was poor (UMaine 2011).

Hagfish

The fishery for hagfish has expanded across the northern Gulf of Maine over the last decade, and is now undertaken across large areas. The fishery is known as the ‘eel barrel’ fishery and is managed by the New England Fisheries Management Council. Landings, total commercial value, and number of participants are not well known for this fishery. However, the fishery has expanded eastward over the last five years (UMaine 2011).

3.6.1.2 Recreation

Saltwater angling is a popular activity along the Maine coast, focusing primarily on striped bass, bluefish, and mackerel. While recreational saltwater fishing takes place along the entire coast of Maine, the majority of boats operate in southern Maine (UMaine 2011). Maine's "for-hire" fleet primarily consists of two types of boats: charter and head boats. Charter boats carry six or fewer passengers while head boats carry seven or more passengers. Numerous charter and head boats from nearby Boothbay Harbor and Penobscot Bay offer offshore shark, bluefin tuna, and groundfishing trips (Maine Office of Tourism 2010). Within Knox County there are six charter boats and no head boats available "for-hire," and within Lincoln County there are 14 charter boats and two head boats available "for-hire" (DMR 2006). Saltwater sport fishing tournaments are held during summer months along Maine's coast, with most occurring south of Boothbay Harbor (UMaine 2011). In 2010, two tournaments were hosted from harbors north of Portland at Bailey Island and Boothbay Harbor (DMR 2010b).

Maine DMR lists the following species as recreationally important in Maine, but without figures on recreational catch: Acadian redfish, American shad, Atlantic cod, Atlantic halibut, Atlantic mackerel, Atlantic wolffish, bluefish, haddock, pollock, rainbow smelt, striped bass, and winter flounder. Of these species, redfish was the only species to be represented by greater than 100 individuals in the Maine-New Hampshire Trawl Survey tows near Monhegan Island (see Section 3.4.1.3). Wolffish, striped bass, and bluefish were exceedingly uncommon in all tows in Regions 2 and 3, but the latter two are swift pelagic species not very vulnerable to a trawl (UMaine 2011).

Maine's 5,500 miles of coastline provide many opportunities for boating recreation. The majority of Maine's recreational boating occurs within a few miles of shore or in the bays between islands and the coast. The Maine Windjammer Association represents a fleet of 12 traditional tall ships offering windjammer cruises out of Rockland and Camden sailing between Rockland and Bar Harbor (Maine Windjammer Association 2010). Maine's coast also plays host to numerous ocean racing events. Each summer, lobster boat races are held along Maine's coastline, including races in Boothbay Harbor, Rockland, and Pemaquid. Additionally, the Gulf of Maine Ocean Racing Association promotes yacht racing in the ocean waters in the Gulf of Maine and maintains a list of scheduled races held annually (Gulf of Maine Ocean Racing Association 2010).

Cruising in Maine has long been a popular vacation and recreational activity. Many cruise lines offer vacations departing from Portland, Maine with stops along many of Maine's most popular coastal communities, including Boothbay Harbor, Rockland, Camden, and Bar Harbor (Maine Office of Tourism 2010). Whales migrate into the waters in the Gulf of Maine during summer months to feed and nurse their young. During this time, approximately a dozen businesses in Maine's mid-coast offer whale-watching excursions. The majority of whale-watching vessels operate out of Casco Bay, Boothbay Harbor, and Bar Harbor (Island Institute 2010). The midcoast and eastern islands support high concentrations of seabirds. Seabird tours in these regions are popular, and efforts to restore Atlantic puffins to the midcoast have supported the industry (UMaine 2011).

Maine coastal islands are valued for their unique aesthetic character and undeveloped nature. Visitors from around the nation and from other parts of Maine are drawn to Monhegan Island by the scenic natural beauty, remote nature, and opportunities for wildlife viewing (aesthetic resources are discussed further in Section 3.7). Monhegan Island is a fishing village as well as an historic artist's colony. There are no paved roads and no visitor cars permitted (A Visitor's Guide to Monhegan Island 2010).

There are three ferry services that travel to Monhegan Island (discussed further under Navigation below). There are no charter or head boats, windjammers, or other for-hire boats based out of Monhegan Island, with the exception of an individual who provides dory service to Manana Island or for short excursions around the island.

Prominent features on Monhegan Island include forests, meadows, headlands, coves, and ledges. The cliffs on the east side of the island are some of the highest on the coast of New England and offer a magnificent panorama of the Atlantic. On the southwestern end of the island is Lobster Cove. Wildlife viewing includes harbor seals, which haul out on the Duck Rocks near Pebble Beach, migrating birds, and whales, which visitors can view from shore (Island Inn 2010).

The majority of Monhegan Island is uninhabited and open to the public for hiking and exploring. The Monhegan Associates, which is primarily a land trust, serves to protect the lands in perpetuity. Monhegan Associates has acquired land through gifts and purchases and currently owns approximately 480 acres, comprising about two-thirds of the island. This land is not developed, except for 17 miles of hiking trails, which are open to the public (Island Inn 2010). Swim Beach has the only swimming access on the island. Manana Island helps form Monhegan Harbor and transportation across the harbor can be arranged through one of the Inns. The pond in the center of the village is a good location for bird watching and is a popular spot for skating area in winter (Monhegan Associates, Inc. 2010).

An artists' colony continues at Monhegan Island, as it has been for over 100 years. Some artists provide viewing hours at their studios, and information is posted in the Village. Work of local artists can be viewed at various galleries located around the island (Monhegan Associates, Inc. 2010).

3.6.1.3 Navigation

There are three major ports in Maine: Portland, Searsport, and Eastport. Monhegan Island is located approximately 46 miles east of Portland and 56 miles southwest of Searsport. Currently, Maine's three cargo ports handle over 1.5 million tons of dry cargo collectively and roughly 125 million barrels of petroleum products have been handled by Portland and Searsport. In 2009, 41 percent of dry cargo was handled in Portland, 36 percent in Eastport, and 23 percent in the Penobscot Riverway ports (Searsport, Bucksport, and Bangor) (Maine DOT 2010). There are no cargo ports located between Portland and Searsport. In addition to large-scale commercial shipping, many of Maine's harbors have short-distance freight activity to transport goods and services.

According to the NOAA Nautical Chart No. 13288 for the area from Monhegan Island to Cape Elizabeth, Maine, there are no designated navigation channels, recommended vessel routes, or recommended two-way routes in the vicinity of Monhegan Island. Approximately 4 miles north of Monhegan Island, a recommended vessel route extends from the Gulf of Maine into Penobscot Bay and the Penobscot River (NOAA 2010a). Maine's islands depend on ferries, fishing boats, and other private boats to transport residents, visitors, groceries, and other goods to and from the islands. Numerous ferries provide transportation to many of Maine's islands, including Monhegan Island. There are three ferry services that travel to Monhegan Island (Table 3-7). All three ferries originate either north or northwest of Monhegan Island and approach the island from the opposite side from the test site. None of the ferry routes would be impacted by the test site that lies 2 to 3 miles south of Monhegan Island.

Table 3-7. Ferry Service to Monhegan Island

Ferry Name	Departing Location	Travel Time to Monhegan Island	Schedule (daily)	Schedule (limited)
Balmy Days Cruises	Boothbay Harbor	1h 30m	6/10 – 9/26	Late May & Early Oct
Hardy Boat Cruises	New Harbor	50m	6/12 – 9/29	Late May & Early Oct
Monhegan Boat Line	Port Clyde	50m – 1h 10m	5/1 – 10/31	11/1 – 4/30

3.6.2 ENVIRONMENTAL IMPACTS RELATED TO OCEAN USE

This section evaluates the potential project effects on the following ocean uses:

- Commercial fishing,
- Recreation, and
- Navigation.

3.6.2.1 Commercial Fishing

Two floating wind turbines would be moored for up to five months from July to November for two consecutive years. The two turbines would be located within the designated UMaine test site area, which measures approximately 1.1 miles wide and 2.1 miles long, and is bounded at the southern edge by the 3-nautical-mile state boundary. The exact turbine deployment locations within this test site area have not yet been determined. When deployed, a navigation safety zone, having a radius of 1,150 feet, would be established around each turbine platform [for spar or buoyancy stabilized (semi-submersible) platforms; safety zone for a TLP platform would be much smaller]. As discussed above, non-project related boat access within this zone would be prohibited for navigation safety.

Notice would be given to the Maine Marine Patrol to alert fishermen about towing operations and to advise for the removal of gear from the planned tow route. While lobster fishing does not take place in the Monhegan Lobster Conservation Area during the summer, there is considerable lobster gear deployed between the mainland and outside of the Monhegan Lobster Conservation Area during the summer.

The designated test site area for the proposed project was selected through a cooperative consultation process involving the Governor-appointed Ocean Energy Task Force, Federal and State agencies, numerous user groups including commercial fishermen, and the general public. All 11 lobstermen on Monhegan Island, as well as other parties involved in commercial fishing, were consulted during this process (Nixon 2010b). Three demonstration sites, one of which is the Monhegan Island test site, were selected because they were located in areas with the least amount of physical, environmental, and human conflicts.

The 1,150-foot radius, navigation safety zone corresponds to an area for each turbine of 95 acres for which commercial fishing and other public access would be prohibited for the period during which the project components are deployed. The deployment of the turbine platforms and moorings would be temporary. The platforms would be deployed for a period of up to five months in two consecutive years. The mooring lines would be deployed with the anchors one to six months before the platforms are installed. The mooring lines may be left connected to the anchors for the entire testing period, so that the platforms can be reattached to the same moorings for the second deployment. Following the completion of the second year testing, UMaine may further delay removing the mooring lines until the following summer in order to provide for a safer and more predictable weather window. This would result in the mooring lines being in the water for the following ranges of time:

- Minimum – up to five months from July to November in both testing years, if the moorings are removed after each deployment; and

- Maximum – up to 24 months, if the moorings are left in the water between each deployment and removal is delayed to more favorable conditions in the summer [e.g., the moorings (only) would be in the water from approximately 90-days prior to the initial testing period through summer following the second testing period].

As discussed above, depending on anchor type selected and seabed conditions, the anchors may be left in place permanently (the mooring lines would be removed).

With the exception of the small exclusion zone around each test wind turbine, lobstering and commercial fishing are expected to otherwise continue in this area. In conclusion, given the small size of the area covered by the navigation safety zone and the short duration during which the zone would be in effect, the project is not anticipated to adversely affect lobstering or commercial fishing activities.

3.6.2.2 Recreation

Because of the small area of the navigation safety zone, the short duration of the turbine deployments, and the distance of the site from the mainland (approximately 11.8 miles), the project is not anticipated to adversely affect recreational fishing activities in the area. Recreational fishermen are expected to continue fishing activities in the area without any changes resulting from the project.

The majority of Maine's recreational boating occurs within a few miles of shore or in the bays between islands and the coast. Additionally, cruise lines or sailing vessels offer trips along the coast with stops in towns including Boothbay Harbor, Rockland, Camden, and Bar Harbor. The test site is not anticipated to be located within an area of frequent passage or usage of recreational boaters or cruising vessels. Any boat that is approaching a turbine platform would have to alter their course by only a maximum of 1,150 feet [for spar or buoyancy stabilized (semi-submersible) platforms; safety zone for a TLP platform would be much smaller]. No adverse effects on recreational boating or cruising in Maine are expected from the project.

Whales and seabirds migrate into Maine's coastal areas and support wildlife viewing tourism excursions. No seabird or whale-watching tours are offered within the UMaine test site, and the project is not expected to adversely affect this industry.

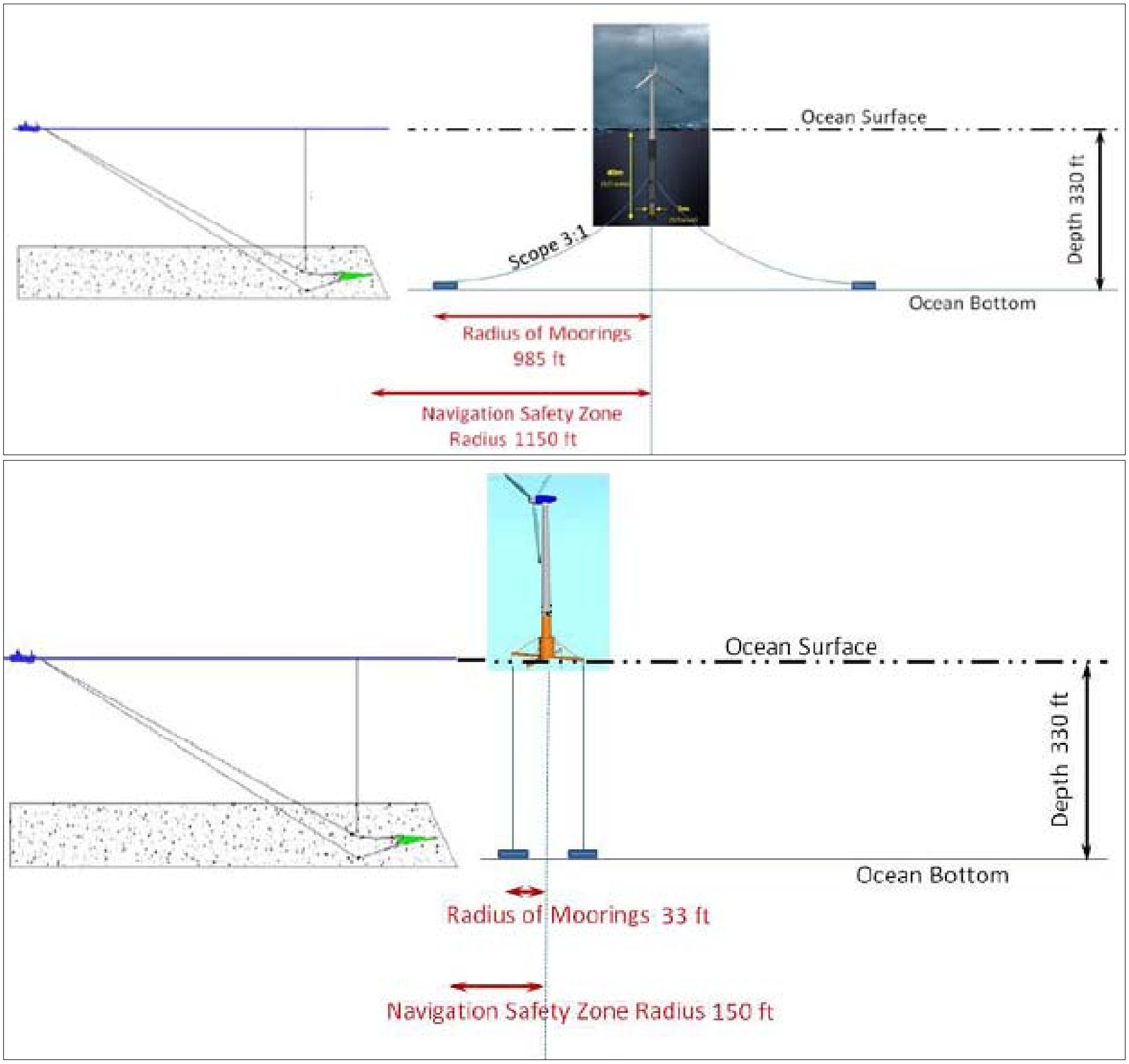
In conclusion, because of the small area of the navigation safety zone, the short duration of the turbine deployments, and the distance of the site from the mainland, the project is not anticipated to adversely affect recreation.

3.6.2.3 Navigation

The two nearest ports to the Monhegan Island test site are Portland, located approximately 46.6 miles west, and Searsport, located 56 miles northeast. There are no designated navigation channels, recommended vessel routes, or recommended two-way routes in the vicinity of Monhegan Island or the test wind turbine site area. Additionally, ferries travelling to/from Monhegan Island are recommended to approach the island from the west and dock along the west side of Monhegan Island, thereby avoiding the UMaine test area. The USACE maintains Federal navigation projects throughout the state of Maine, consisting of channels, anchorages, breakwaters, and jetties. The nearest such project to the proposed project area is located on the mainland, over 15 miles away. The nearest off shore Federal navigation project is on Matinicus Island, approximately 22 miles northeast of the test site. The proposed project would not affect any Federal navigation projects. Therefore, the proposed test site is not anticipated to affect current navigation patterns or routes.

Faculty from Maine Maritime Academy, in coordination with faculty from UMaine, consulted with the USCG Sector Northern New England Waterways Management Division to develop a Navigation Safety Plan for the project. The USCG was guided largely by the section for Offshore Renewable Energy Installation in its *Aids to Navigation Manual Administration*. The following is a summary of the navigation safety plan.

A “Navigation Safety Zone” would be established with a 1,150-foot radius around each floating turbine platform for spar or buoyancy stabilized semi-submersible) platforms, or 150-foot radius for a TLP platform. This designation would prohibit all mariners from entering this zone. This would protect them from any debris (such as ice) that might be thrown from the rotor blades, and also prevent any vessel from dragging, anchoring, or fishing within the radius of the anchors and mooring lines. For on-shore-based wind turbines, the standard safety zone is twice the rotor diameter. The UMaine project turbine rotor diameter is 88.6 feet; therefore, the spar buoy and semi-submersible 1,150-foot radius safety zone exceeds that standard, and gives an additional margin of safety of 164 feet beyond the platform’s anchors (Figure 3-16). The navigation safety zone for a TLP platform would be less (Figure 3-16).



Note: Vessel to left is representative of a bottom trawler. The Navigation Safety Zone would prohibit all entry by unauthorized vessels/personnel (e.g., no fishing, dragging, anchoring).

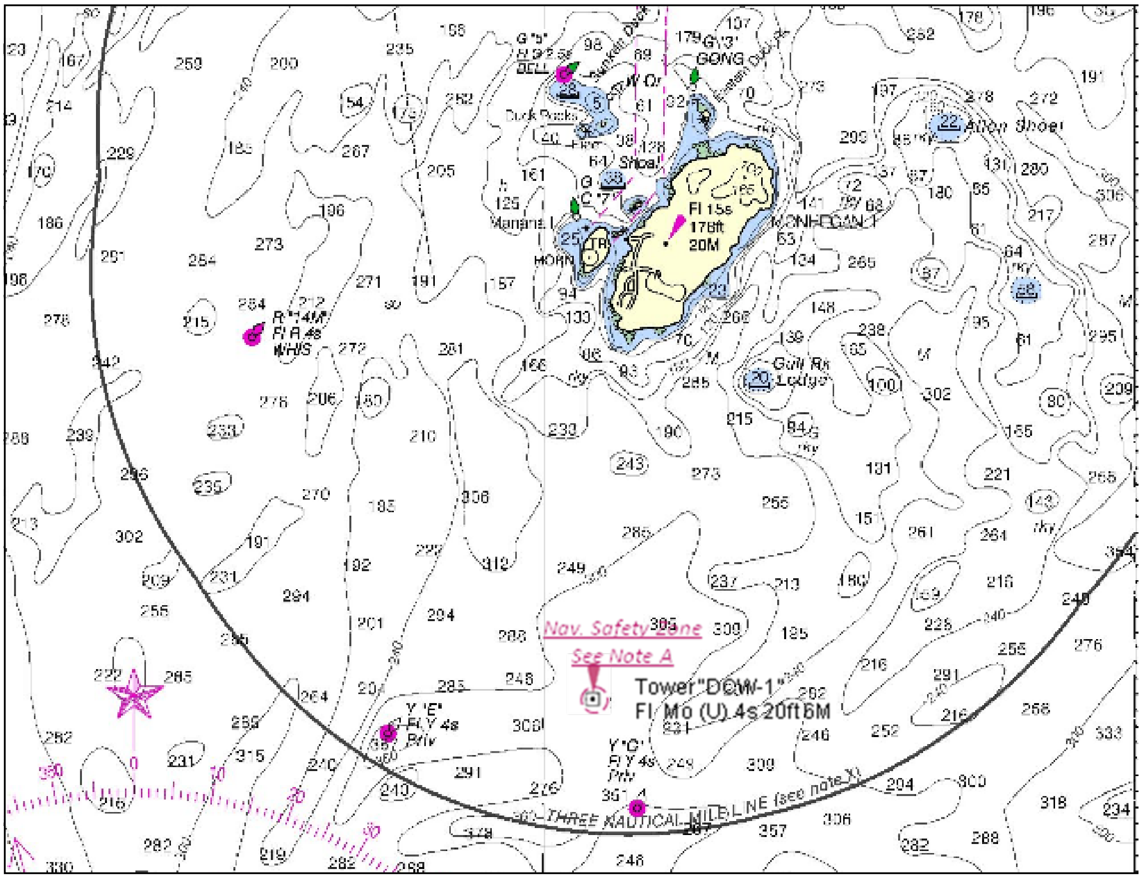
Figure 3-16. Proposed Navigation Safety Zone for Turbines Having a Catenary Mooring System (above, Spar Shown) and Tension Leg Platform (below)

Two identifying lights would be placed on the turbine tower, at a height of 20 feet above the water, one on each side of the tower structure (Figure 3-17). Each light would be a 360-degree, white flashing light, flashing two short followed by one long flash every four seconds and visible for up to 6 nautical miles. By placing a light on both sides of the tower, there would be no blind sector. These lights can be synchronized to flash simultaneously, so that from a distance they would appear as one light. The height of the lights is established to meet the USCG criteria detailed in its Administrative Manual on Lighting Offshore Structures, which specifies that the light(s) be not less than 20 feet or more than 50 feet above the highest astronomical tide. Since these are floating structures, the tide stipulation is not necessary.

For the buoyancy stabilized (semi-submersible) platform, in addition to the lights on the turbine tower, pylons that are not directly supporting the turbine tower would be lit with flashing amber lights. These would be 360-degree lights flashing every four seconds and visible for at least 2 miles (Figure 3-17). The project location would be marked on navigational charts, similarly to that shown in Figure 3-18.

Note: Not to scale.

Figure 3-17. Lighting Proposal for Spar (or TLP) Type Platform (left) and Semi-Submersible Platform (right)



Note: Only one turbine shown; position of turbine is not final.

Figure 3-18. Proposed Chart Marking Scheme

The turbine towers would be clearly labeled (e.g., DCW-1 and DCW-2). The label would be large enough and high enough to be readily identifiable to a small vessel nearby. The label would be painted in a contrasting color, retro-reflective material, of a letter size not less than 3 feet high, approximately 25 feet above the water, and reproduced as necessary around the tower structure so as to be visible on all sides (Figure 3-19).

Note: Not to scale.

Figure 3-19. Proposed Paint Scheme and Marking of Spar Buoy (or TLP) Platform (left) and Semi-Submersible Platform (right)

Anchors for the floating platforms would need to be installed prior to platform and turbine deployment, mainly to allow anchor capacity to develop within the seabed. There is also the potential that the anchors would remain in place after platform and turbine retrieval for use in subsequent deployments. Therefore, anchor locations would need to be marked when the turbine is not present. It is proposed that these anchor locations would be marked with a temporary hazard marker buoy.

In conclusion, the Navigation Safety Plan, as summarized above, and the temporary nature of the project, minimize the chance of boat collisions with the project. The presence of the test project is consequently not expected to adversely navigation safety in the area.

3.6.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no potential impacts to commercial fishing, navigation, and recreation in the project area. Baseline conditions, as described in Section 3.6.1, would remain unchanged.

3.7 Aesthetic Resources

3.7.1 AFFECTED ENVIRONMENT

Maine's mid-coast is dotted with harbors and fishing villages, many of which have remained largely unchanged over time. Maine coastal islands are valued for their unique aesthetic character and undeveloped nature. Visitors from around the nation and from other parts of Maine are drawn to Monhegan Island by the scenic natural beauty, remote nature, and opportunities for wildlife viewing at the island. Monhegan Island is a fishing village as well as an historic artist's colony. Remote in its nature, Monhegan Island is located 10 miles from the nearest mainland and is accessible only by boat. (A Visitor's Guide to Monhegan Island 2010).

Prominent features on Monhegan Island include forests, meadows, headlands, coves, and ledges. The cliffs on the east side of the island are some of the highest on the coast of New England and offer a panorama of the Atlantic. On the southwestern end of the island is Lobster Cove. Wildlife viewing includes harbor seals, which haul out on the Duck Rocks near Pebble Beach, migrating birds, and whales, which visitors can view from shore (Island Inn 2010). Prominent structures on Monhegan Island include the numerous inns and lighthouse. The Monhegan Island Light, constructed in 1824 and rebuilt in 1850, is the second highest Maine lighthouse, standing 178 feet above sea level (D'Entremont 2010).

The majority of Monhegan Island is uninhabited and open to the public for hiking and exploring. Monhegan Associates has acquired land through gifts and purchases and currently owns approximately 480 acres, comprising about two-thirds of the island. That land is not developed, except for 17 miles of hiking trails, which are open to the public (Island Inn 2010). Many of the wooded trails on the Headlands, on the backside of the Island, reveal open views toward the mainland, Muscongus Bay, and surrounding islands including Manana, Isle au Haut, Vinalhaven, and Matinicus.

For more than 100 years, Monhegan Island has been a summer haven for artists and other visitors who value its isolation, the beauty of its wilderness areas, and its quiet atmosphere (Monhegan Art Journal 2010).

3.7.2 ENVIRONMENTAL IMPACTS RELATED TO AESTHETIC RESOURCES

The Vestas V27 wind turbine is being considered as the turbine model for the floating platforms. The turbine rotor diameter is 88.6 feet and the tower height would be approximately 100 feet. The turbines would be lit with an identifying light. In consultation with the USCG Sector Northern New England Waterways Management Division, it was determined that two lights would be placed on each turbine tower, at a height of 20 feet above the water, one on each side of the tower structure. Each light would be a 360-degree, white flashing light, flashing two short followed by one long flash every four seconds and visible for up to 6 nautical miles. In addition to the turbine tower lighting, for the semi-submersible type of floating platform, the pylons not directly supporting the turbine tower would be lit with flashing amber lights. These would be 360-degree lights flashing every four seconds and visible for at least 2 miles. The nearest mainland point is approximately 12 miles from the test site, and as such, the lights would not be visible from the mainland. The exact specifications for lighting of the floating platforms and turbine would depend on the final design selected for the UMaine test site.

Seascapes along the Maine coast and islands are highly valued by both residents and tourists. The proposed project would be located 2 to 3 miles south of Monhegan Island in the open ocean in an area without existing anthropogenic structures. The two one-third scale wind turbines would be the only vertical feature on the ocean surface and would be visible from Monhegan Island during clear days and nights. There are numerous lookouts on Monhegan Island that are directed toward the proposed test site.

For example, Lobster Cove is a popular vista and is located at the southwestern extent of Monhegan Island.

Shadow flicker generated from wind turbines is the effect resulting from the shadows cast by the rotating blades of the turbine on sunny days. The flicker effect may be more or less pronounced depending on the intensity of the sun and shadow contrast and the distance of the wind turbine to a receptor. While there does not appear to be consensus on the potential range of shadow flicker from a wind turbine, available literature strongly suggests that the separation distance from the project to the nearest receptor (at least 2 miles) would be more than sufficient to avoid adverse effects. The Danish Wind Industry Association (2010) has stated that at distances of about 1,640 to 3,280 feet, the rotor of a utility-sized wind turbine does not appear to be creating a flicker effect, and therefore it is generally not necessary to consider shadow casting at such distances. A planning document issued by the South Australia government wrote that shadow flicker is unlikely to be a significant issue if a separation distance of at least 1,640 feet is maintained between a utility-sized turbine and any dwelling or any defined urban area. The Minnesota Department of Health (2009) conducted a review of available literature and concluded that with current wind turbine designs, flicker should not be an issue at distances over 10 rotational diameters (approximately 0.6 mile for most current utility-sized wind turbines). Because the proposed wind turbines are one-third scale and would be located at least 2 miles from the nearest visual receptor, there would be no effect from shadow flicker.

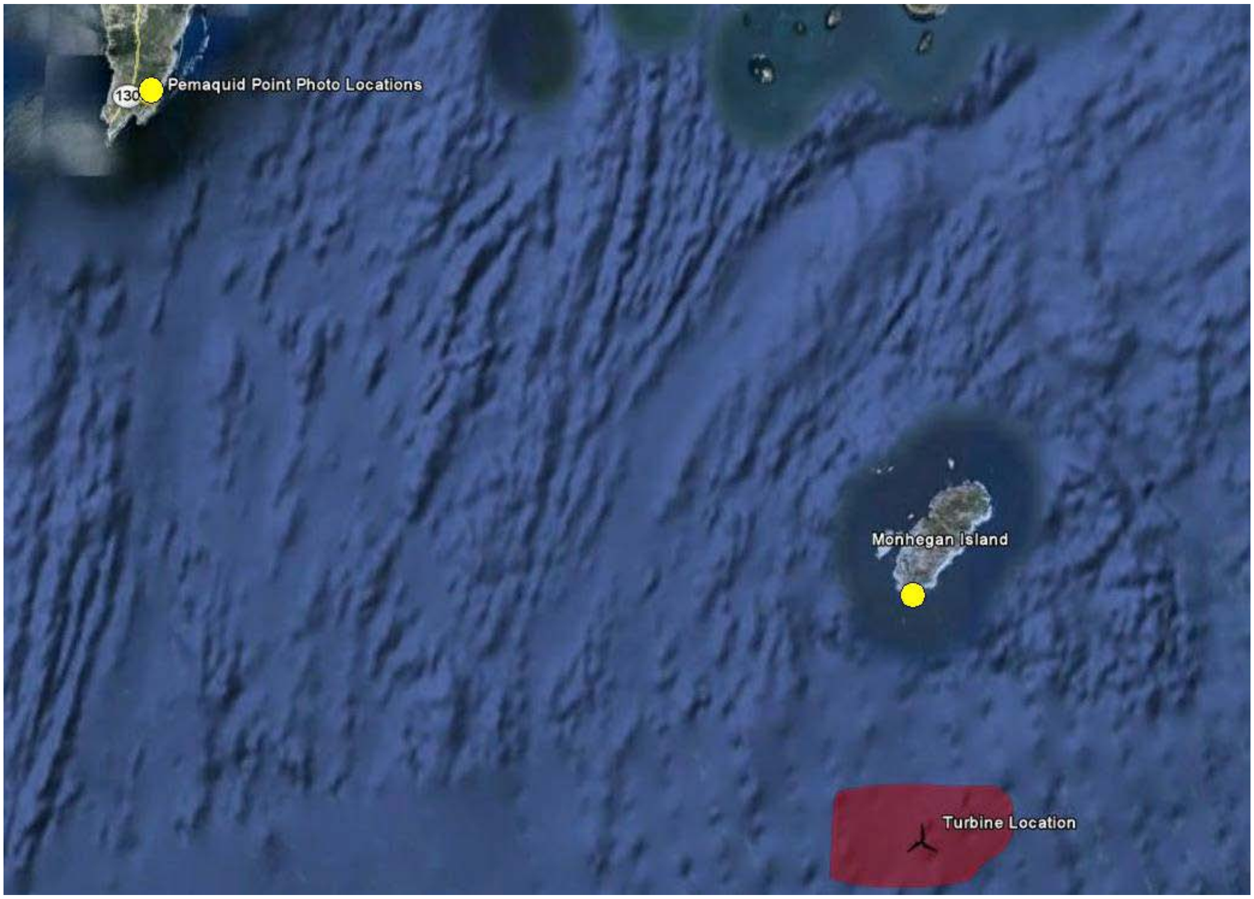
Sandia National Laboratories performed a visual assessment study for a single one-third scale floating wind turbine at the test site (Karlson 2011). Sandia created simulated views of a turbine having a 100-foot tower located in the center of the test site (43°42'46.86"N by 69°18'58.17"W) from multiple locations on Monhegan Island[9]. As seen in Figure 3-20, the view from Christmas Cove represents the point on Monhegan Island nearest to the test site, and Pemaquid Point represents the nearest point from the mainland (Karlson 2011).

When discussing the visual impacts of an offshore wind turbine sited approximately 2 to 3 miles to the closest island and over 12 miles to the mainland, it is important to note the factors that can impair natural visibility, such as atmospheric conditions, meteorology, and the curvature of the earth. Visibility impairment is caused by light scattering and light absorption from particles in the atmosphere. The range of natural visibility will vary with the season, daily meteorology, and time of day. The pictures used for this study were taken on clear days with relatively low humidity to represent days with the best viewing conditions (Karlson 2011).

As Figure 3-21 demonstrates, the turbine would be visible from Monhegan Island, but very small. At Pemaquid Point, the turbine would be difficult to discern on the horizon.

In conclusion, due to the temporary nature of the turbine deployments (two 5-month deployments), the distance of the turbines from shore, and the small scale of the turbines, the project would not have a significant effect on visual aesthetics on Monhegan Island. The view of the two turbines may result in an adverse effect for some people on Monhegan Island (Figure 3-21). Because the turbines would be removed, because they are one-third scale, and because they are located at least 2 miles offshore, any visual effects would be small and temporary.

9. Sandia's visual simulation evaluated a turbine having a tower height of 100 feet and a rotor diameter of 70 feet. The Vestas V27 turbine being considered by UMaine has a tower height of 100 feet, but has a diameter of 88.6 feet. While the assessment was for a slightly smaller diameter turbine, it is very similar, having the same tower height, and remains applicable to this evaluation.



Source: Karlson 2011.

Figure 3-20. Locations of Visual Simulation Photos

Note: Top photo from Christmas Cove, located 3 miles from the floating turbine; bottom photo from Pemaquid Point, located 12.7 miles from the turbine.

Source: Karlson 2011.

Figure 3-21. Visual Simulation Photos from Monhegan Island and Mainland

3.7.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no potential impacts to the visual aesthetics. Baseline conditions, as described in Section 3.7.1, would remain unchanged.

3.8 Cultural Resources

3.8.1 AFFECTED ENVIRONMENT

Maine’s complex sea level history and long history of fishing and maritime commerce creates the potential for both pre-Columbian and historic cultural resources within state offshore waters. Glaciation and deglaciation of the New England/Maritime region resulted in postglacial subaerial exposure of offshore regions between the modern day coast and depths of 200 feet between 13,000 and 5,000 years ago (Kelley 2010a).

Human occupation of these areas is established by the recovery of pre-Columbian stone artifacts from Maine’s nearshore region (Kelley 2010a). Artifacts recovered from surface collecting on Monhegan Island suggests that the island was used as a seasonal fishing camp 4,000 to 3,000 years ago and 1,200 to 1,000 years ago (Gage and Gage 2004).

There are several known shipwrecks in the Monhegan Island vicinity. The tugboat, D.T. Sheridan, ran aground at Lobster Point in 1948. Remnants of the steel hull remain exposed on the rocks. All known wrecks are located well outside of the UMaine test site (Maine Historic Preservation Commission 2009). The SHPO provided the following information about the island’s history in its letter to DOE dated February 15, 2011:

> Monhegan Island's history stretches back at least as early as the first quarter of the 17th century when it was visited by such explorers as George Weymouth, Samuel de Champlain, and John Smith. Its early use as a fishing station established the industry that would dominate the economy until the late 19th century when the local tourism trade developed. By then, Monhegan Island's landscape was already attracting major American artists who came to visit and in some cases establish residence on the island. The characteristics of Monhegan Island that attracted artists and tourists also fostered the development of a summer colony whose architecture both contrasted with and drew inspiration from the vernacular forms of the island's 18th and 19th century buildings. These early structures include the highest concentration of historic fish houses in Maine, the oldest of which can be traced to the 1780s. In addition to its fishery, Monhegan Island's importance in maritime history is underscored by the fact that a light station was established on the island by the Federal government in 1824. A companion fog signal station was erected on nearby Manana Island in 1855. In the area of archaeology, there are seven known prehistoric sites, and four known historic sites on the island.

Section 106 of the National Historic Preservation Act requires Federal actions to account for historical properties for all undertakings and to consult with SHPO. In order to identify potential cultural resources in the UMaine test site (high potential areas for pre-Columbian archaeological remains and exposed historic shipwrecks), multibeam bathymetry, seismic reflection, side scan sonar, and magnetometer survey data acquired by UMaine were analyzed. Side scan sonar images were reviewed for evidence of submerged historic resources. Magnet anomalies when analyzed with side scan sonar and subbottom profiler data may indicate the presence of shipwrecks (Riess 2011). Seismic reflection information was combined with side scan sonar images to evaluate potential pre-Columbian archaeological resources.

While this type of geophysical data cannot be used to identify individual artifacts or pre-Columbian archaeological sites, it is possible to identify geomorphic settings that have a high potential for preservation of cultural resources based on terrestrial settlement/preservation models (Kelley 2010a). This process was approved by the Maine State Historic Preservation Commission (Kelley 2010b). All areas with water depth greater than 200 feet within the UMaine test site have been analyzed using these methods and show no potential for pre-Columbian cultural resources, as these areas were not subaerially exposed since the last glaciation of the region.

The following properties on Monhegan Island and Manana Island are registered with the National Register of Historic Places: the Monhegan Island Lighthouse and Quarters, the Influence Building, and the Rockwell Kent Cottage and Studio - all on Monhegan Island, and Manana Island Fog Signal Station (National Register of Historic Places 2010; letter from SHPO to DOE dated February 15, 2011). The Monhegan Island Lighthouse was built in 1824. Still operating, it has not been manned since 1959 and is now controlled by computer (Monhegan Associates, Inc. 2010). In addition, as noted by SHPO in its letter to DOE dated February 15, 2011, in the opinion of SHPO (a new opinion of eligibility), Monhegan Island in its entirety merits listing in the Register under Criteria A, C, D and possibly B in the areas of Architecture, Archaeology, Art, Community Planning and Development, Exploration/Settlement, Maritime History, and Transportation. The SHPO stated that “Monhegan Island possesses most if not all of the seven aspects of integrity that are necessary for listing a property in the National Register. Of the seven aspects, integrity of location, setting, feeling, and association are particularly significant for this place.”

The Monhegan Historical and Cultural Museum, located in the keeper's house at the lighthouse, is open daily during the summer and is dedicated to Monhegan Island history (Maine Office of Tourism 2010).

3.8.2 ENVIRONMENTAL IMPACTS RELATED TO CULTURAL RESOURCES

In its letter to SHPO dated February 3, 2010, DOE proposed that the area of potential effect (APE) for the proposed project would include two components, the direct disturbance from the project footprint, and the area of potential visual and acoustic impacts from the above-water structures. The APE for the project footprint would depend on the final design selected for the floating offshore turbine platforms and number and design of the mooring anchors. It is estimated that the radius of maximum area of the seabed around which the anchors would be placed would be 1,000 feet. Therefore, DOE proposes that the APE for direct disturbance would consist of the area of the seabed under the center point of each turbine having a radius of 1,000 feet. The APE from potential indirect visual and noise impacts is an area with a radius of 5 miles, which is being proposed so as to include all of Monhegan Island and Manana Island.

3.8.2.1 Direct Disturbance from the Project Footprint

If the anchors are placed at the location where pre-Columbian or historic artifacts are located, these sites could be disrupted. As stated above, all areas with water depth greater than 200 feet within the UMaine test site have no potential for pre-Columbian cultural resources, as these areas were not subaerially exposed and not available for occupation by pre-Columbian inhabitants, even during the brief sea-level lowstand that occurred since the last glaciation of the region approximately 12,000 years ago (Kelley 2010a). The only region in the test site that may have been subaerially exposed at the maximum of the sea-level lowstand is located in the northeastern portion of the test site. This region has been excluded from turbine deployment on the basis of extensive rock outcrops with limited sediment accumulations. While this area would have been briefly exposed and subsequently inundated during the rapid sea-level rise 12,000 years ago, there is little potential for intact archaeological remains. During its brief subaerial exposure, this rocky, higher relief area probably had little original sedimentary cover to host archaeological remains, and what was present was most likely removed by wave activity as it passed through the surf zone during the sea level rise (Kelley 2010a).

Analysis of the bathymetric, seismic reflection and side scan sonar surveys indicate no areas of high potential for pre-Columbian archaeological remains in the areas of the test site feasible for turbine deployment. Visual analysis of side scan sonar image data has shown that no intact shipwrecks or other historic resources are exposed on the ocean bottom. There were numerous lines or cables, and individual lobster traps visible in several basins.

To ensure that no adverse effects on historic resources occur from the project, at the request of SHPO, all areas of planned bottom and sub-bottom disturbance from project anchors would be examined in more detail using a marine magnetometer survey to identify the presence of potential shipwrecks. A magnetometer survey was conducted in April and May 2011 on two areas [approximately 1,100 meters (0.68 mile) in diameter] that might be impacted from construction and installation of anchors to locate any historic boat or shipwreck sites (Riess 2011). After all the magnetic anomalies were analyzed using information from the magnetometer, side scan sonar, and subbottom profiler, all except one of the magnet anomalies appeared to be caused by either natural rock outcrops or modern fishing gear. The one possible cultural resource location was outside of the area being investigated for anchor installation, yet inside the area where construction activities could take place (Riess 2011). In order to eliminate the potential for damage to the possible cultural resource location, UMaine would either avoid the area and maintain a 30-meter (98-foot)-radius buffer area around the potential site or inspect the area with a remotely operated vehicle to ascertain its identity. SHPO will review the results of the marine magnetometer survey and the turbine siting determination prior to deployment.

In conclusion, given the depths at the site, which preclude the presence of pre-Columbian cultural resources, and the results of the magnetometer survey which will enable deployment of the platform anchors in a location that contains no shipwrecks, the installation and operation of the project would not have any effects on historic resources. In a letter to DOE dated April 29, 2011, the SHPO concurred, based on the condition that the wind turbines will be a temporary deployment, that the proposed undertaking will have no adverse effect on historic properties, as defined by Section 106 of the *National Historic Preservation Act*.

3.8.2.2 Potential Visual and Acoustic Impacts

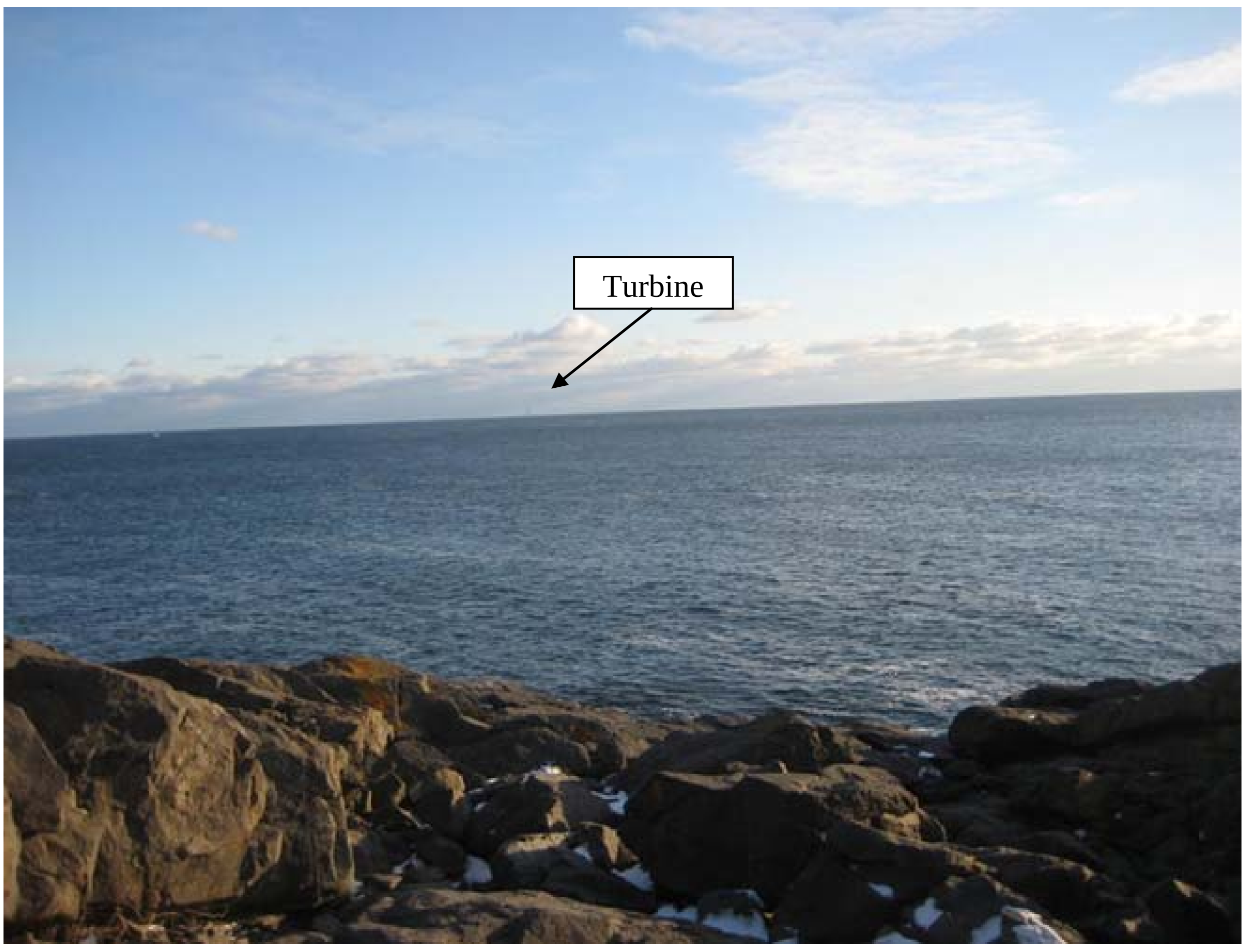
DOE also considered the potential indirect visual and noise impacts of the project on listed and eligible historic properties on Monhegan Island. As discussed above in Section 3.7.2, Sandia National Laboratories performed a visual assessment study for a single one-third scale floating wind turbine at the test site (Karlson 2011). The two one-third scale wind turbines would be visible, though very small, from Monhegan Island during clear days and nights (Figure 3-22), and would not be visible from the mainland. Due to the temporary nature of the turbine deployments (a maximum of two 5-month deployments), the distance of the turbines from shore, and the small scale of the turbines, the project would create a very small visual intrusion when viewed from the listed historic properties or anywhere else on the island. DOE provided the SHPO (letter dated March 23, 2011) additional information on the site selection process, the five mile APE, diagrams of a one-third scale wind turbine, and copies of the visualization study and photographs. The SHPO is currently evaluating this information for visual impacts on historic properties.

As discussed in Section 3.5.2, a study of the propagation of noise generated during operation of the wind turbines determined that under the worst case scenario conditions the received sound level at the nearest potential point on Monhegan Island would be 35.6 dBA under the most conservative model (Aker et al. 2010, 2011). For reference, a whisper has a sound intensity of 30 dBA. The most common noise standard for wind turbine applications limits the average sound pressure level at the point of interest to 40 dBA (Aker et al. 2010); therefore, even under the worst-case calculation, the maximum estimated received noise level on Monhegan Island is far from that level. When winds are not blowing directly onshore, this estimate would be substantially reduced.

In conclusion, based on this information and the temporary nature of the project, DOE concludes that there would be no indirect adverse effects from noise or visual intrusion on any eligible and listed historic properties on Monhegan Island.

3.8.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no impacts to the seabed. Therefore, no potential impacts to cultural resources would occur. Baseline conditions, as described in Section 3.8.1, would remain unchanged.



Note: Photo from Christmas Cove, located 3 miles from the floating turbine.

Source: Karlson 2011.

Figure 3-22. Visual Simulation Photos from Monhegan Island

3.9 Socioeconomics and Environmental Justice

3.9.1 AFFECTED ENVIRONMENT

The project area is located in the Gulf of Maine in Lincoln County, approximately 2 to 3 miles south of Monhegan Island. Located 10 miles from the nearest mainland, Monhegan is a small rocky island approximately 1 square mile in area. Approximately two-thirds of the land on Monhegan Island is owned by Monhegan Associates, which primarily functions as a land trust. The land owned by Monhegan Associates is undeveloped land, with the exception of hiking trails throughout the island that are open to the public (Monhegan Associates, Inc. 2010).

Information on recent population trends, median household income, per capita income, geographic area, housing units, poverty levels, and unemployment rates for Monhegan Island, Lincoln County, and the state of Maine is presented in Table 3-8. In 2009 the total population for Monhegan Island was 69, the population of Lincoln County was 34,576, and the population for the state of Maine was 1,274,915 (Bureau of the Census 2010). With the influx of visitors and seasonal residents during summer, the population of Monhegan Island can increase to 800 people (Curren and Gabrielson 2007).

Table 3-8. Project Area Demographic Information

Item	Monhegan Island	Lincoln County	Maine
Total Population (2000)	75	33,615	1,274,915
Total Population (2009)	69	34,576	1,318,301
Percent Change in Population (2000 to 2009)	-12.5%	2.9%	3.4%
Housing Units (2009)	46	22,792	704,578
Land Area in Square Miles	1	456	30,862
Population Per Square Mile of Land Area (2000)	75	73.7	41.3
Median Household Income (2008)	$26,250[a]	$49,862	$46,419
Per Capita Income (1999)	N/A	$20,760	$19,533

Source: Bureau of the Census 2010.
a. 2000.
N/A = not available.

According to the U.S. Census Bureau, Decennial (2000) Census, employment sectors consisted of the following for Monhegan Island: 32 percent of population employed by farming, fishing, and forestry occupations; 29.2 percent of population employed by management, professional, and related occupations; 20 percent of population employed by sales and office occupations; and 18.4 percent of population employed by construction, extraction, and maintenance occupations (Maine State Planning Office 2010). Table 3-9 shows employment information by occupation for Monhegan Island, Lincoln County, and the state of Maine as of 2000 (Maine State Planning Office 2010).

Table 3-9. Employment Information for Monhegan Island, Lincoln County, and Maine

Item	Monhegan Island	Lincoln County	Maine
Management, professional, and related occupations	19	5,142	196,862
Management, professional, and related occupations (percent)	29.2%	31.8%	31.6%
Service occupations	0	2,501	95,601
Service occupations (percent)	0%	15.4%	15.3%
Sales and office occupations	13	3,522	161,480
Sales and office occupations (percent)	20.0%	21.7%	25.9%
Farming, fishing, and forestry occupations	21	830	10,338
Farming, fishing, and forestry occupations (percent)	32.3%	5.1%	1.7%
Construction, extraction, and maintenance occupations	12	2,066	64,064
Construction, extraction, and maintenance occupations (percent)	18.5%	12.8%	10.3%
Production, transportation, and material moving occupations	0	2,136	95,666
Production, transportation, and material moving occupations (percent)	0%	13.2%	15.3%

Source: Maine State Planning Office 2010.

Preliminary 2009 data indicate that Maine commercial fishery landings by live pound totaled more than 222.6 million pounds, primarily consisting of American Lobster (35 percent) and Atlantic Herring (26 percent). However, in terms of value, the 2009 Maine commercial landings totaled more than $323 million dollars, with American Lobster accounting for approximately 70 percent of that value (DMR 2010a). In 2009, a total of more than 78 million pounds of lobster were landed in Maine, totaling more than $228.3 million dollars. Of that total, more than 5.58 million pounds of lobster were landed in Lincoln County equaling a value of approximately $16.4 million dollars (DMR 2010a).

A number of businesses are located on Monhegan Island that include inns and bed and breakfasts (Figure 3-23), art galleries, cafes, gift shops, and fish markets. The Monhegan Island Lighthouse was built in 1824. Still operational, it has not been manned since 1959 and is now controlled by computer. Views from the base of the lighthouse include the village, harbor, Manana Island, and the mainland, including the Camden Hills (Monhegan Associates, Inc. 2010). The Monhegan Historical and Cultural Museum, located in the keeper's house at the lighthouse, is open daily during the summer and is dedicated to Monhegan Island history (Maine Office of Tourism 2010). An artists' colony continues at Monhegan Island, as it has been for over 100 years. Some artists provide viewing hours at their studios, and information is posted in the Village. Work of local artists can be viewed at various galleries located around the island (Monhegan Associates, Inc. 2010). The island's fishing and lobstering activities occur in the Fish Beach area (Monhegan Associates, Inc. 2010).

Source: Island Inn 2010.

Figure 3-23. Photograph of the Island Inn

3.9.2 ENVIRONMENTAL IMPACTS RELATED TO SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

A study conducted for the DOE and NREL concluded, “Wind power can play a major role in meeting America’s increasing demand for electricity.” Under the scenario developed in this report, 46 states would experience significant wind power development and the U.S. wind industry could support an annual average of more than 150,000 workers directly in the industry and hundreds of thousands more in associated industries by 2030 (Renault 2009).

It is anticipated that the project would provide economic stimulus in the project area (State of Maine and Lincoln County) in support of the implementation of the project. Economic stimulus is expected to include the following tasks: (1) micrositing, geophysical investigations, and geotechnical engineering; (2) study of environmental and ecological effects; (3) environmental permitting; (4) floating turbine design; (5) turbine fabrication, deploying, testing, monitoring, and removal; (6) education and outreach; and (7) project management and reporting.

In support of the above referenced tasks, a Consortium has been identified to work on the project and includes universities, nonprofits, and utilities; a wide range of industry leaders in offshore wind design, offshore construction, and marine structures manufacturing; firms with expertise in wind project siting, environmental analysis, environmental law, composites materials to assist in corrosion-resistant material design and selection, and energy investment; and industry organizations to assist with education and technology transfer activities (DeepCwind Consortium 2010).

In conclusion, as discussed in Section 3.6.2, with the exception of the small exclusion zone around each test wind turbine, lobstering and commercial fishing are expected to otherwise continue in this area. Given the small size of the area covered by the navigation safety zone and the short duration during which the zone would be in effect, the project would not adversely affect lobstering or commercial fishing activities. The project also would not affect any of the businesses that occur on Monhegan Island, except for a slight increase in business at inns or for other expenditures of people working on the project who spend money while visiting Monhegan Island.

Executive Order 12898 (February 11, 1994) directed Federal agencies to incorporate environmental justice considerations into the NEPA process. The purpose of this order was to ensure that low-income households, minority households, and minority businesses do not experience a disproportionate share of adverse environmental effects resulting from any given Federal action.

The proposed offshore wind project would be located 2 to 3 miles offshore of Monhegan Island. No potential adverse impacts to human health have been identified in this EA. Therefore, there would be no disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

3.9.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the one-third scale floating wind turbines would not occur, and there would be no potential impacts to socioeconomics or environmental justice. Baseline conditions, as described in Section 3.9.1, would remain unchanged.

3.10 Irreversible and Irretrievable Commitment of Resources

An irreversible commitment of resources is defined as the loss of future options. The term applies primarily to the effects of use of nonrenewable resources such as minerals or cultural resources. It could also apply to the loss of an experience as an indirect effect of a “permanent” change in the nature or character of the land. An irretrievable commitment of resources is defined as the loss of production, harvest, or use of natural resources. The amount of production foregone is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume production.

Irreversible commitments of resources would be those consumed during construction of the project, including fossil fuels and construction materials, which would be committed for the two-year life of the project. Non-renewable fossil fuels would be lost through the use of gasoline and diesel-powered construction equipment during deployment and removal of the two one-third scale floating wind turbines and project operations and monitoring efforts.

The 1,150-foot radius navigation safety zone (for spar or buoyancy stabilized platforms; safety zone for a TLP platform would be much smaller) corresponds to an area for each turbine of 95 acres for which commercial fishing and other public access would be prohibited for the period during which the project components are deployed. While there may be some resulting catch of lobster and fish foregone, fish and lobsters would still be able to be caught when they move outside the exclusion area. Considering this, and because of the short time frame over which the project would be deployed, the exclusion of the turbine exclusion areas represents a negligible irretrievable loss of harvest.

The proposed project would not have other irreversible or irretrievable impacts because the project is short term and temporary; removal of the two turbines after the second year of testing would restore the site for alternative uses, including all current uses. No loss of future ocean use options would occur.

The expenditure of Federal funding from DOE would also be irreversible.

3.11 Unavoidable Adverse Impacts

Unavoidable adverse impacts associated with the project include:

- A small increase in noise levels during construction;
- Temporary avoidance of the test site area by pelagic fish and marine mammals during construction; and
- Temporary disruption of the ocean floor and marine life during anchor placement.

The impacts from temporary construction noise and activity would be temporary. Overall, impacts of the proposed project on the environment would be minimal.

3.12 The Relationship between Local Short-Term Uses of the Human Environment and the Maintenance and Enhancement of Long-Term Productivity

Short-term use of the environment, as the term is used in this document, is that used during the life of the project, whereas long-term productivity refers to the period of time after the project has been decommissioned and the equipment removed. As the proposed project would be temporary, and there would not be a change in ocean use. The short-term use of the site for the proposed project would not affect the long-term productivity of the test site area. It is possible that the anchors will be left in place during decommissioning. Depending on the anchor type used, the exposed (above the ocean sediment) parts of the anchors may provide substrate for benthic organisms that may enhance the productivity in the immediate surrounding area.

4. CUMULATIVE IMPACTS

Cumulative impacts are those potential environmental impacts that result "from the incremental impact of the action when added to other past, present, or reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Reasonably foreseeable future actions include potential testing of ocean energy technologies at the other two offshore testing sites designated by the Maine Legislature and the potential deployment and testing of a 3- to 5-megawatt turbine at the Monhegan Island test site. Boon Island, located 63 miles southwest of Monhegan, and Damariscove, located 15 miles west of Monhegan, are the other two test sites, which along with the Monhegan Island test site, were selected by the State after a comprehensive screening process of different sites along Maine's coast. These three sites were selected by the State for testing of ocean energy technologies because they were located in areas with the least amount of physical, environmental, and human conflicts. The Monhegan Island test site may also be used to test a commercial-scale 3- to 5-megawatt floating turbine subsequent to DOE's Proposed Action described this EA. In addition, depending on future funding sources, UMaine may seek to undertake subsequent permitting in order to perform up to two additional years of testing of two one-third scale wind turbines at the test site.

A potential future offshore wind development in the Federal waters of the Gulf of Maine is a 25-megawatt deepwater offshore wind pilot project. On September 1, 2010, the Maine Public Utilities Commission released a request for proposals for a 25-megawatt wind farm to be located at least 10 nautical miles offshore of any land, including islands, and in waters at least 300 feet deep. It is likely that a project of this scale would be composed of five 5-megawatt floating offshore wind turbines. This 25-megawatt project would require funding and development from a third party and it is unknown whether this project would be developed. This project would be developed in Federal waters, and because the Bureau of Ocean Energy Management, Regulation and Enforcement permitting process would take 5 to 7 years, it is expected that construction of the 25-megawatt project would not begin until 2017 to 2019 at the earliest. Because the deployment of such a project would occur after the proposed project (two one-third scale wind turbines at Monhegan Island) has been removed, any associated effects do not represent cumulative effects for the UMaine project evaluated in this EA. Therefore, this project does not meet the definition of reasonably foreseeable. For these reasons, this EA is not evaluating the potential 25-megawatt project in the cumulative effects analysis for this project.

The USACE has issued permits to work in navigable waters at and within 5 miles of Monhegan over the past 10 years. These actions authorized a variety of projects including piers and construction of similar structures. All of these projects were of a small scale with no relationship to the proposed wind power project. All of these actions had minimal individual impact to aquatic resources and were eligible for general permits. USACE has determined that the cumulative effect of these smaller projects to navigation and aquatic resources is minimal due to their small individual size, their widely distributed locations, the length of time between actions, and case-by-case avoidance minimization measures. It is anticipated that similar types of permitted activities might occur in the reasonably foreseeable future.

If two demonstration turbines are installed at the three test sites selected by the State, and, as a result of a separate permitting process, a single 3- to 5-megawatt turbine is installed at the Monhegan Island test site, then seven turbines, including the UMaine turbines, could be deployed in the Gulf of Maine during the time that UMaine's project is deployed. In addition to these reasonably foreseeable offshore wind development activities, other impacts in the greater project vicinity includes fishing and lobstering; open ocean aquaculture; other vessel traffic, including ferry service to the mainland and recreational boating; and a subsea cable running from the north side of Monhegan Island to the mainland.

Because of the small scale and temporary nature of the proposed project, any negative effects on existing human use of the area would be negligible and temporary. As stated in Section 3.9.2, the proposed project is expected to have a minor, beneficial economic impact in the project area.

A potential risk of the project that may represent an incremental impact when added to other reasonably foreseeable future actions is the potential of foraging and migrating bird and bats colliding with the two test turbines. Birds and bats are known to collide with numerous man-made structures such as vehicles, buildings and windows, power lines, communication towers, and wind turbines. It is estimated that from 100 million to over 1 billion birds are killed annually in the U.S. due to collisions with manmade structures (Erickson et al. 2001). Because of the small scale and temporary nature of the proposed project, and the fact that the three State-selected sites are separated by 73 miles (Boon Island to Monhegan Island), DOE concludes that cumulative impacts to birds and bats, as with other environmental impacts, would be negligible.

Because of the small size and scale of the proposed project, the similar small scale of the other potential offshore wind projects being considered and described above, and the overall negligible effects of the proposed project on fish, marine mammals, birds, and other marine life, the project does not represent an incremental impact. Cumulative impacts of the proposed project would be negligible because there are no past, present, or reasonable foreseeable future actions that, when combined with the proposed project, would result in impacts beyond those that already exist or have already been identified and discussed in Chapter 3 of this EA.

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