DOE/EA-1792S

DRAFT SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT FOR THE

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

Castine

US Department of Energy
Office of Energy Efficiency and Renewable Energy
Golden, Colorado

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ACRONYMS AND ABBREVIATIONS

CMP	Central Maine Power
CFR	Code of Federal Regulations
DMR	Maine Department of Marine Resources
DOE	U.S. Department of Energy
DPS	distinct population segment
EA	environmental assessment
EFH	essential fish habitat
EMAP	Environmental Monitoring and Assessment Program
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAD	fish aggregation device
MSA	Magnuson-Stevens Fishery Conservation Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
PVC	polyvinyl chloride
ROW	right-of-way
SHPO	State Historic Preservation Office
UMaine	University of Maine
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 Requirements

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. The proposal to provide federal financial support is considered a federal action and, therefore, is subject to the procedural requirements of the NEPA and DOE's NEPA. To comply with NEPA, DOE has determined the need to prepare a supplemental environmental assessment (EA) to evaluate the potential impacts that could result from their Proposed Action. The provision of financial assistance for the Proposed Project is conditional upon the completion of the NEPA process whereupon a final decision would then be made by DOE.

In compliance with these regulations, this Supplemental 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 Supplemental EA provides DOE and other decision makers the information needed to make an informed decision about the temporary installation, operation, and eventual removal of a proposed reduced-scale wind turbine at the Castine site described below. The Supplemental EA evaluates the potential individual and cumulative impacts of the proposed project. For purposes of comparison, this Supplemental 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.

1.2 Background

DOE is proposing to authorize the expenditure of Congressionally Directed federal funding by the University of Maine (UMaine) to deploy, test, and retrieve one small-scale floating turbine offshore of Castine, in Hancock County, Maine, as part of UMaine's DeepCwind Consortium Research Program. DOE has previously authorized the expenditure of federal funding by UMaine to conduct similar deployment, testing, and retrieval activities at the UMaine Deepwater Offshore Wind Test Site at Monhegan Island, Maine (Monhegan test site).

UMaine originally planned to fabricate and temporarily deploy up to two, 1/3-scale turbines within the Monhegan test site. DOE completed an Environmental Assessment (DOE/EA-1792, DOE 2011) and determined a Finding of No Significant Impact regarding that project in September 2011. The EA for the Monhegan test site is incorporated by reference. UMaine has since proposed to downscale the size of the tower and turbine from 1/3 scale to 1/8 scale. Because of this change to a smaller size, for part of the year UMaine is proposing to deploy the tower and turbine at a more sheltered nearshore location just west of Castine, Maine (Figure 1-1) (Castine site).

DOE prepared this Supplemental EA to evaluate the potential environmental impacts of providing funding to UMaine for their proposed wind turbine platform testing at Castine. In compliance with NEPA and its implementing procedures, this Supplemental EA examines the potential environmental effects of DOE's Proposed Action (authorizing UMaine to expend Congressionally Directed 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 Supplemental EA is to inform DOE and the public of the potential environmental impacts of the proposed project and the alternatives.

DOE reviewed the DOE/EA-1792 that described the potential effects of UMaine deploying up to two 1/3-scale platforms and wind turbines at the Monhegan test site (DOE 2011), and concluded that effects to the environment from deploying a single 1/8-scale turbine in that area following deployment in Castine would be similar to or less than that described in the EA for the Monhegan test site. Therefore, UMaine's proposal to deploy the 1/8-scale turbine near Monhegan Island is not discussed in this Supplemental EA, though cumulative impacts related to both deployments and additional foreseeable activities are discussed in Chapter 4.

1.3 Purpose and Need

The DOE Office of Energy Efficiency and Renewable Energy's Wind and Water Power Program supports the development and deployment of advanced wind and water power devices, including the advancement of offshore wind technologies and floating offshore wind turbine platforms. One goal of the program is to help industry harness the renewable, emissions-free offshore wind resource to generate environmentally sustainable and cost-effective electricity. To meet this goal, DOE supports the design and development of offshore wind technologies as well as the

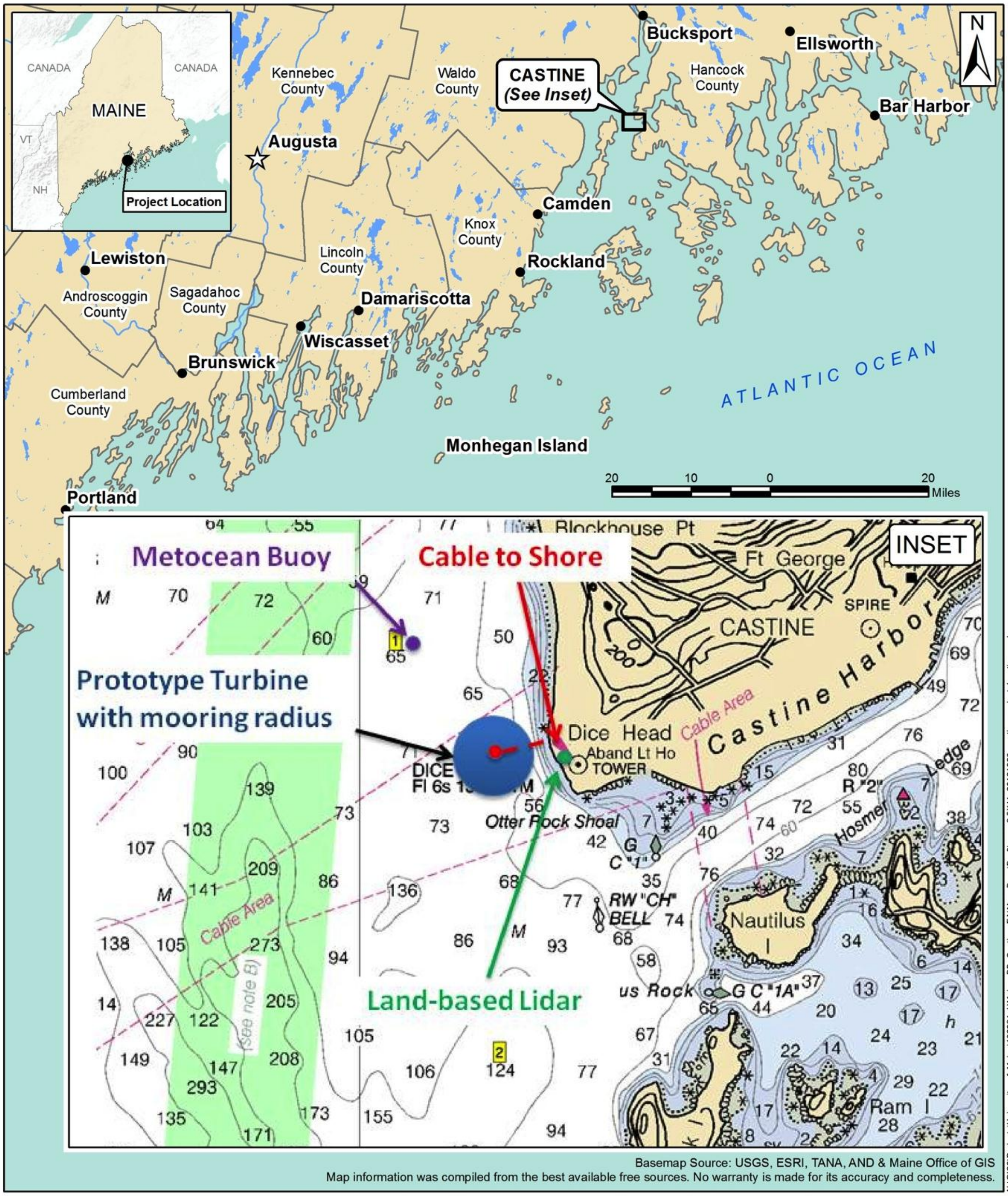


Figure 1-1. Proposed location of deployment of floating offshore wind turbine platform.

technological demonstration of those devices. UMaine is proposing to perform research on and development of a small-scale floating offshore wind turbine platform at Castine, Maine, as part of the DeepCwind Consortium Research Program. The primary objective of UMaine's testing a 1/8-scale floating wind turbine is to obtain motion and structural response data to compare and validate numerical models developed by NREL and others that predict structural loads, deflections, dynamics, and turbine power output under various meteorological and oceanographic conditions. Experimentally validated numerical models would aid in the development of floating platform technology for offshore wind energy. These models, once validated, would be used for design and optimization of floating turbines to help reduce the cost per installed kilowatt. Providing federal financial assistance to UMaine's proposed project would support the mission, vision, and goals of DOE's Wind and Water Power Program objectives to increase the development of reliable, affordable, and environmentally sustainable wind power technologies to realize the benefits of domestic renewable energy production.

1.4 Public and Agency Involvement

1.4.1 UMAINE PUBLIC INVOLVEMENT

UMaine selected the proposed project site following a comprehensive review of available information and meetings with the Castine-based Maine Maritime Academy (a research partner) and public meetings with the town of Castine. Maine Maritime Academy is leading public outreach efforts in the town of Castine, including meetings with town officials, coordinating with local stakeholder groups, and presenting at public town meetings. Maine Maritime Academy's President, Bill Brennan, made a presentation about the project at a February 22, 2012 meeting of the town's municipal officers. This meeting was open to the public and was attended by mostly year-round residents, the fishing community, and local press. President Brennan updated the town on project progress at subsequent town meetings, and Vice President Mercer of Maine Maritime Academy has been in regular communication about the project with town officials. Both Maine Maritime Academy and the town of Castine have been receptive to this project.

1.4.2 DOE AGENCY CONSULTATION AND PUBLIC INVOLVEMENT

DOE has initiated consultation with the following federal agencies and Tribal organizations regarding the potential environmental impacts associated with the proposed project (Appendix A contains consultation letters):

- Section 7 *Endangered Species Act, Marine Mammal Protection Act, Magnuson-Stevens Fishery Conservation and Management Act*
  - Request for information sent to the National Marine Fisheries Service (NMFS) on October 18, 2012

- Section 7 *Endangered Species Act*
  - Request for information sent to the U.S. Fish and Wildlife Service (USFW)S on October 18, 2012
- Section 106 *National Historic Preservation Act*
  - Letter sent to the Maine State Historic Preservation Office (SHPO) on January 2, 2013.
  - Letters sent on November 2, 2012, to five Indian tribes or tribal organizations that may have historic ties to the Gulf of Maine.

NMFS responded to DOE in a letter dated November 16, 2012. Information contained in this letter is discussed in Section 3.2. SHPO stated in a letter dated January 2, 2013 that the project will have no adverse effect on historic properties as defined by Section 106 of the National Historic Preservation Act. The Penobscot Indian Nation and the Aroostook Band of Micmacs each responded to DOE in transmittals dated November 29, 2012. These responses are discussed in Section 3.5.

DOE sent a Notice of Availability announcing this draft EA to local stakeholders, government agencies, and tribal organizations. This notice was also posted in the *Bangor Daily News* and the *Castine Patriot* newspapers, and requested that the public comment on the EA's analysis of the environmental impacts of implementing DOE's proposed action.

2. PROPOSED ACTION AND ALTERNATIVES

2.1 DOE's Proposed Action

Under the Proposed Action, DOE would authorize UMaine to expend Congressionally Directed federal funding to temporarily deploy an offshore wind turbine test platform at the Castine site.

DOE has authorized UMaine to use a percentage of the federal funding for preliminary activities, which include preparing this Supplemental EA, conducting analyses, and agency consultations, and has approved similar deployment, testing, and retrieval activities at the Monhegan site. 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 University of Maine's Proposed Project

UMaine proposes to use DOE funding to deploy, test, and retrieve one approximately 1/8-scale wind turbine on a floating platform offshore of Castine, Maine, as part of its DeepCwind Consortium Research Program.

2.2.1 OVERVIEW

UMaine proposes to use DOE funding to deploy and retrieve one 20-kW wind turbine on a floating platform offshore of Castine, Maine. Prior to deployment at the Monhegan site (the site evaluated in the original EA – see Section 1.3), UMaine proposes to conduct initial, temporary testing of the floating system at the Castine site in an existing cable right-of-way (ROW) within state waters (Figure 1-1). The system would be deployed for about four months in spring of 2013, offshore of Dyce Head at approximately N44° 23' 07", W 68° 49' 25". Water depth in the area is approximately 100 feet. The turbine would be connected to the Central Maine Power (CMP) grid via a cable to be installed along the seabed surface from below the turbine to shore, and along the ground to an existing CMP power pole.

During the site selection process, the following parameters were considered to evaluate potential sites: suitability of metocean (wind, wave, and current) conditions to achieve representative scale environmental conditions, proximity to marine infrastructure, historical metocean data, geophysical suitability, public support, and permitting. Castine was the only site that met all of the research programs needs. The sheltered harbor is desirable because the environmental conditions at this scale closely replicate full-scale conditions at the Monhegan site, and the design can be demonstrated at the smaller scale with the same desired effect.

The turbine would measure about 41 feet from waterline to the hub, the rotor diameter would measure about 32 feet, and the total turbine height would be about 57 feet (Figure 2-1). The final dimensions of the floating platform are currently under development as part of this research effort, but would not be any larger than what is shown below.

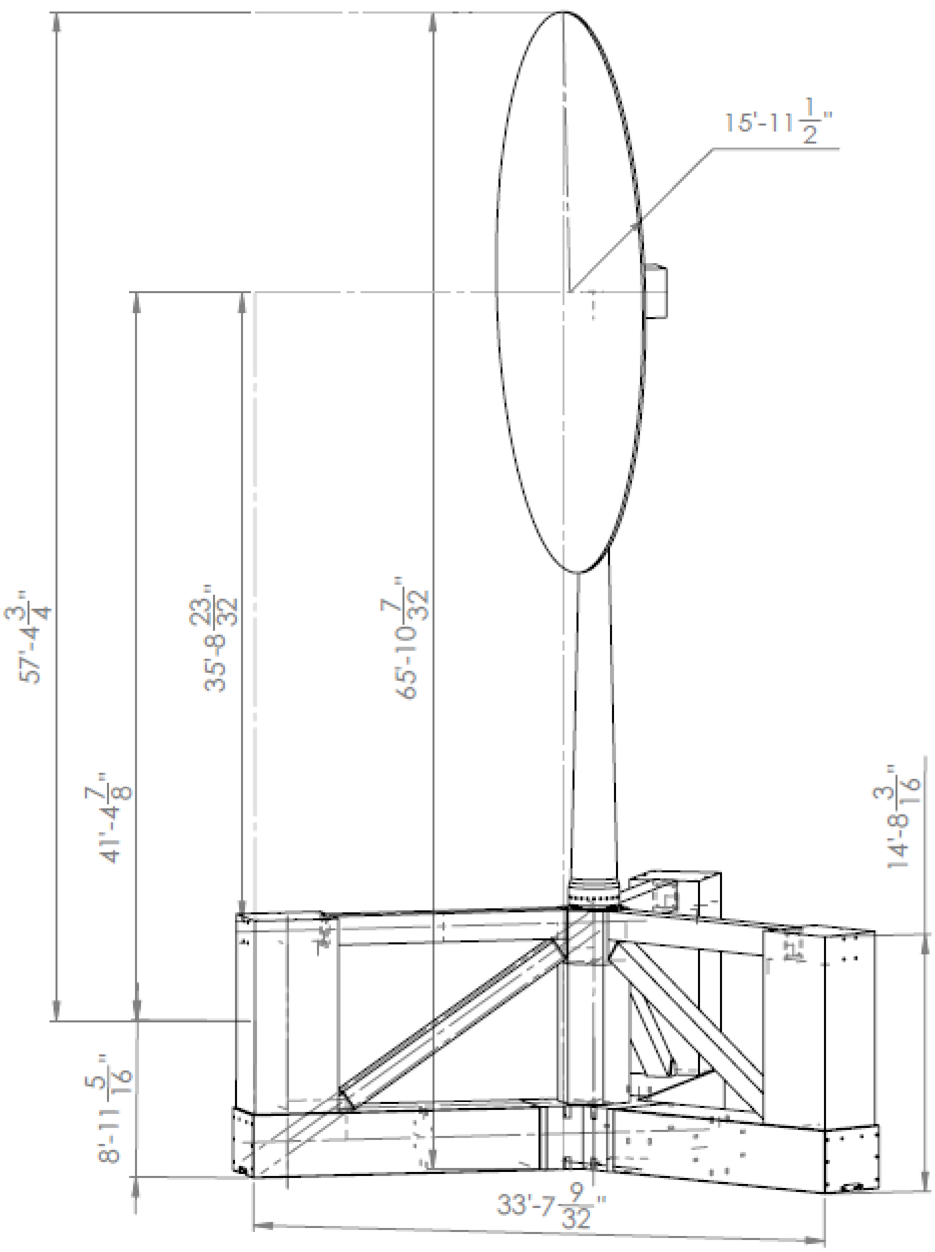


Figure 2-1. Anticipated dimensions of the proposed floating offshore wind turbine to be deployed at Castine.

The wind turbine system would be fabricated at UMaine, shipped to a coastal facility, and towed to and moored just outside of Castine Harbor in the proposed location. It would be tested in the spring of 2013, and it would then be towed to the UMaine Deepwater Offshore Wind Test Site at Monhegan Island, Maine for part of the remainder of the year. Retrieval of the platform would occur following the deployment period. All anchors and the electrical cable would also be retrieved. Upon completion of that effort, the floating turbine platform would be towed back to the mainland, disassembled, and transported back to UMaine.

2.2.2 WIND TURBINE AND PLATFORM

UMaine proposes to deploy one 20-kW Renewegy wind turbine within the project area on a floating platform. The turbine was selected based on the needs of the testing program, including the following: power control method (variable control pitching), lead-time for receiving the turbine, costs, suitability for use on this scale platform (mass, geometry, power output), structural capacity, and the availability of design information for numerical modeling. Several turbine options were considered, and the Renewegy model ranked the highest with regard to these needs.

The proposed wind turbine is a horizontal-axis generator with a power rating of 20 kW, or 27 horsepower. Although the onboard electronics, safety system, data acquisition system, and turbine operational controls would consume some power, the excess electrical power would be transferred to the Maine power grid via a 20-kW capacity cable to shore.

The proposed foundation is a semi-submersible tri-floater structure fabricated out of pre-stressed concrete. The approximate dimensions of the turbine and floating foundation are shown in Figure 2-1.

2.2.3 MOORING AND ANCHORING SYSTEM

The mooring and anchoring system selected for the semi-submersible system is four drag embedment anchors with catenary mooring lines. The mooring lines would consist of synthetic/wire rope or chain, approximately 2-3 inches diameter. A number of shallow foundations/anchors were considered for mooring the project. A drag embedment anchor is preferred because it would minimize impact to the seafloor compared to other anchor designs, work with the bottom conditions at the proposed site, and would be easily removed at project completion. These anchors have dimensions similar to anchors used by large sailing vessels in Castine and along the Maine coast (Figure 2-2).

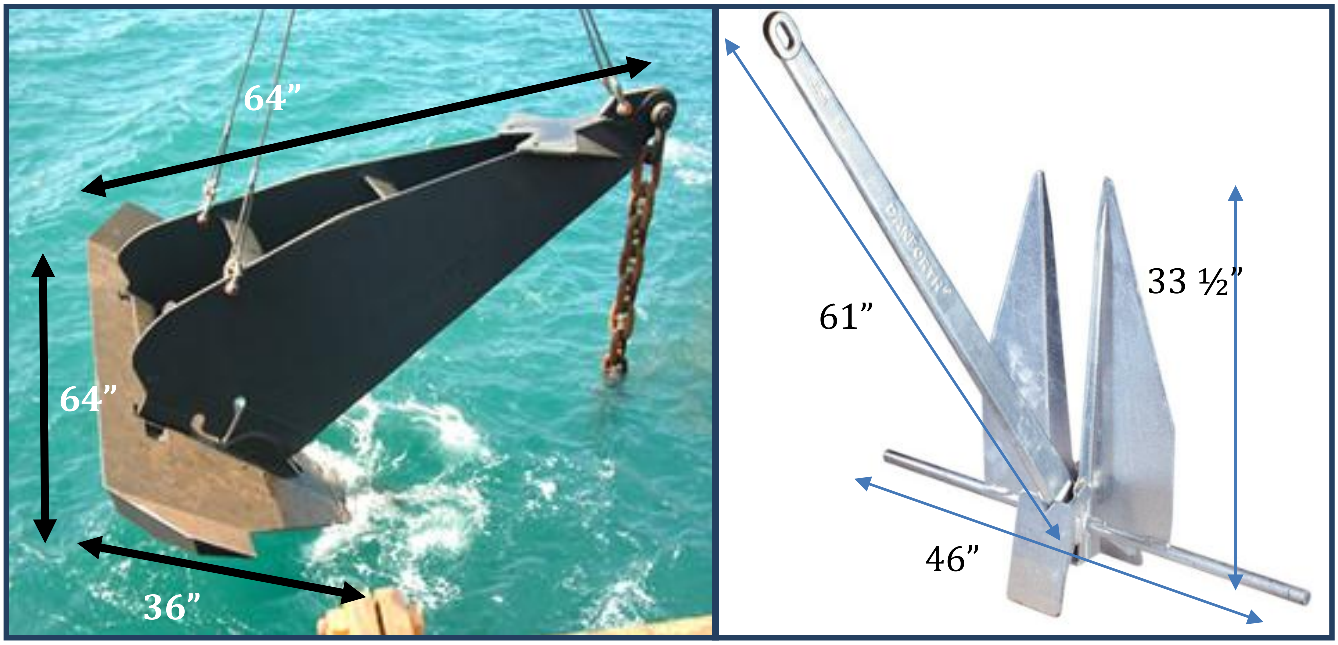


Figure 2-2. Dimensions of proposed anchor for Castine floating turbine deployment (left) and typical boat anchor for vessels up to 83 feet long (right).

Additional details of the anchors and mooring lines are shown in Table 2-1 and an elevation view drawing of the mooring lines is shown in Figure 2-3.

Table 2-1. Mooring and anchoring dimensions and description.

	Drag Embedment Anchor	Gravity Anchor
Mooring type and quantity	Catenary- 4 Lines	
Water Depth	100 ft	
Line length	Up to 1,000 ft	
Line material	Synthetic/wire rope or chain	
Anchor type and material	Steel drag embedment anchor	Concrete gravity anchor
Anchor weight	440 pounds	6,000 pounds
Anchor dimensions	36 inches x 64 inches	10 feet x 10 feet
Mooring radius (1:4 depth to horizontal radius)	Up to 600 ft	

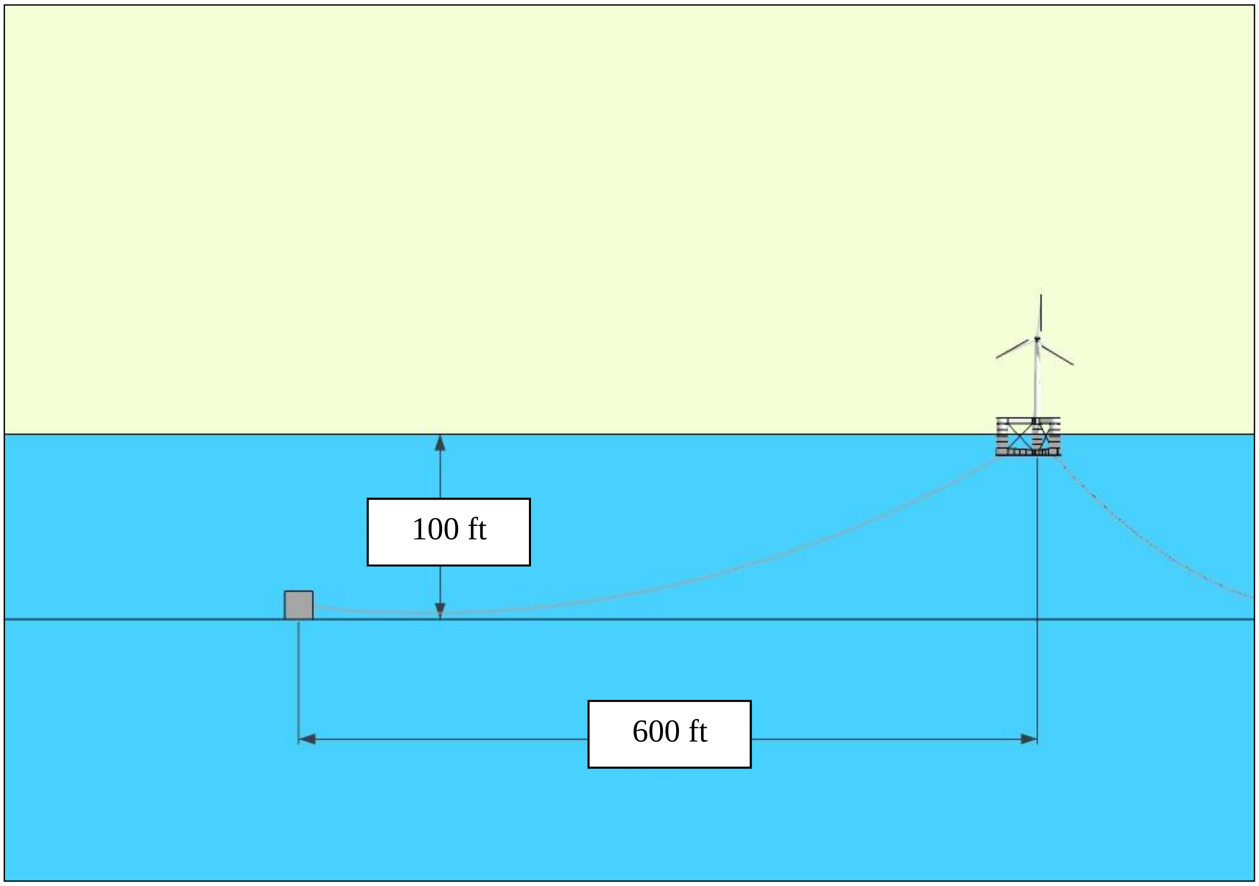


Figure 2-3. Elevation view of the proposed mooring line design (not to scale).

In the event that the drag embedment anchors prove infeasible, UMaine would use gravity anchors. These anchors would be made of concrete, weigh approximately 6,000 pounds, and have dimensions of approximately 10 ft by 10 ft by 2 ft (Figure 2-4). Each anchor would have one catenary mooring line connected to the floating turbine platform, and the anchors would be removed at the end of the deployment.

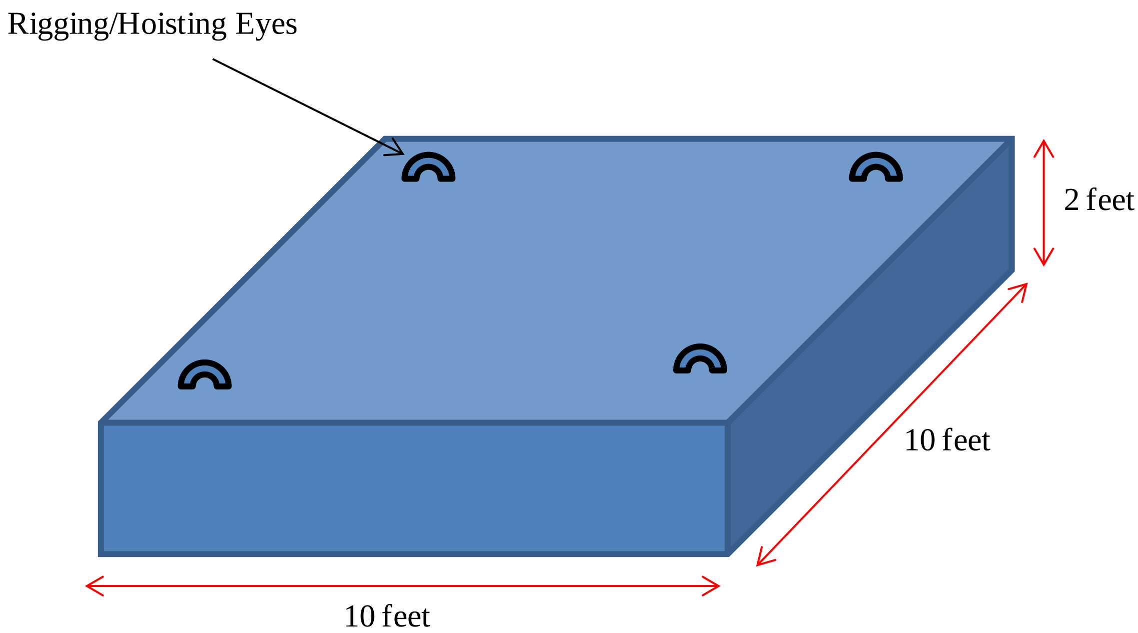


Figure 2-4. Alternative gravity anchor.

2.2.4 ELECTRICAL INTERCONNECTION

Power would be generated at the turbine at 480-V, 3-phase, and would be delivered to the CMP grid through a combination of submarine and land based cables. The cables extending from the turbine to the point of interconnection on the shore would consist of three power cables, one per phase, one grounding conductor and one communications cable. The five cables would be contained in a single cable. The cable would run underwater for about 500 to 1,000 feet to shore. From just below the low tide line the cable would extend along the ground in a protective conduit to the point of interconnection at an existing CMP power pole. The terrestrial portion of the cable would be about 300 feet long.

2.2.5 INSTALLATION

The floating offshore wind turbine system would be constructed at UMaine's Advanced Structures and Composites Center and assembled at a shipyard or similar existing coastal facility, such as Cianbro's Modular Fabrication Facility in Brewer, Maine. The platform would be towed and moored within the Castine site for the testing period.

Each of the four anchors for the floating system would be installed by positioning the anchor on the sea floor and then tensioning the mooring line using a small tug boat. During the tensioning, the flukes would penetrate the seabed, and as tension increases, the anchor would be embedded. In the event that gravity anchors are used, they would just be placed on the seabed. Following anchor deployment, small buoys would be installed to hold the mooring lines in place. After installation of the anchor and mooring system, the floating system would be towed from the launch site to the Castine test site. It is anticipated that it would take approximately two hours to tow the floating turbine from the launch site to the final destination at Castine. Notice would be given to the Maine Marine Patrol and USCG to alert fishermen about towing operations and to advise for the removal of gear from the planned tow route. When the floating system arrives on station, it would be connected to the pre-laid mooring system.

The floating platform and its anchorages would be installed using Maine Maritime Academy's unlimited tugboat *The Pentagoet*. This tugboat is 70 feet long and 24.5 feet at the beam, and weighs 99 gross tons. It is powered by a 1,200 horsepower design engine and is staffed by a crew of three. The vessel has onboard supplemental power systems and a lifting derrick, and routinely performs offshore installations similar to what is required for the pilot prototype unit. In the event that *The Pentagoet* is not available, a vessel with similar qualities and size would be used.

The onboard management of fuels and lubricating fluids aboard all vessels would be managed in accordance with U.S. Coast Guard regulations applicable to each vessel. The requirements are dictated by vessel size and intended operations, but in each case do not permit the discharge of petroleum or hazardous substances into the environment and require a spill prevention plan and certificate of financial responsibility.

Beginning at the offshore turbine mooring anchor, the electrical cable would run along the seabed approximately 500 to 1,000 feet to the shore, just below the low tide line. The cable would be anchored to the seafloor using simple weight strands every five feet; these would be removed with the cable at the project's conclusion. At that point the cable would be contained in a Schedule 40 rigid metal conduit within the tidal zone and Schedule 80 polyvinyl chloride (PVC) from the high tide location to the CMP point of interconnection in order to meet electrical code requirements.

The 2½-inch PVC conduit would extend approximately 300 feet from the high tide line to the point of interconnection near Dyce's Head Road. The conduit would be laid on the ground and anchored a minimum of every 10 feet along that route to meet code requirements. A single strap anchor would be mounted to concrete blocks at each anchoring location, one concrete block on either side of the conduit. The conduit would be placed and anchored by hand. In select locations where the concrete blocks would not provide a suitable and safe anchorage for the conduit, such as on steep slopes, hand held power tools would be used to drill holes and set anchors in rock. ATVs may be used to transport and handle materials, but no other heavy tools or vehicles would be operated on the site. Minimal hand cutting of limbs and brush would be conducted to facilitate routing and placement of the conduit. No trees would be removed and select trimming would be focused on the centerline of the conduit with no trimming occurring beyond three feet on either side of the conduit. In areas of uneven terrain, the conduit might be supported with wooden blocks installed on the ground beneath the conduit to keep it level. The blocks would not require anchoring and would be removed along with the conduit at the end of the project. The blocks would be three feet or less in length.

The upland interconnection equipment, consisting of a transformer, a 3-phase to single-phase converter, and an electrical metering pack, would be installed temporarily on secure footings adjacent to the CMP interconnection point. Communications equipment also would be installed there for the data being collected for analysis of the project. Requirements for the CMP component of the installation are currently being finalized by UMaine. Requirements include completion of an interconnection application, which included specific electrical characteristics of the turbine. CMP has evaluated the proposed installation for electrical stability as a generator on the grid. Further, CMP's field planning teams met with UMaine's electrical engineering firm to determine the best routing of lines from power poles to the proposed termination point. A power terminal pole may be installed at the edge of the public way and the Town of Castine property to facilitate the connection to the grid. The entire footprint of the upland equipment would be approximately 10 feet by 12 feet.

Excess dust or debris that is deposited on the ground would be managed in manner to prevent off-site migration. Areas along the route that are disturbed to bare ground would be covered with straw mulch, and standard erosion control Best Management Practices would be implemented; for example, straw mulch would be placed along areas of the route that are disturbed to bare ground to minimize erosion.

The anticipated time required for project installation would be two days to deploy the four anchors, one day to install the turbine platform, two days to install the subsea cable, and two weeks for the land-side work.

2.2.6 OPERATIONS AND MAINTENANCE

Following deployment of the platform, the focus of UMaine's proposed project would be testing the response of the turbine platform to various conditions of combined wind/wave loading. The turbine platform would carry sensor and telemetry systems that would provide data to evaluate the engineering, structural, and motion performance of the turbine platform under combined wind, wave, and environmental conditions. The comparison of the measured motions of a nearby metocean buoy (Figure 1-1) and the turbine platform would allow the response of the turbine platform to be evaluated relative to the oceanographic and meteorological conditions. The same conditions would then be simulated in the numerical models and compared as part of the model validation process.

While deployed, personnel access to the floating platform would be required for scheduled and unscheduled inspections, maintenance, and repairs. Access to this scale prototype would be via a standard size workboat from Maine Maritime Academy or other partner organization. The prototype 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 tools and equipment, and limited amounts of lubricants and hydraulic oils (30 ounces of brake fluid and one gallon of gear lubricant) would be within the turbine itself. For any unforeseen major repairs to the turbine or system, the platform is designed to easily re-attach to tug boats and be tugged back to port.

Environmental monitoring for birds (visual surveys and web camera observation), marine mammals (visual surveys), bats (echolocation detectors), and benthic invertebrates (remotely operated vehicle surveys and visual surveys) was initiated by UMaine in 2012 to support development of this Supplemental EA. In addition, ongoing monitoring results of fish in the project area, including acoustic detection of tagged fish and Maine Department of Marine Resources inshore fisheries surveys, were reviewed as well. These studies would continue in the area surrounding the test site during the deployment.

2.2.7 REMOVAL

The floating offshore wind turbine system would be retrieved from Castine at the end of the deployment period in late June or early July 2013. It is possible that unanticipated removal of the turbine would be necessary in the case of an extreme weather event. Therefore, the design incorporates the capability to disconnect the floating turbine system from its moorings and tow it safely to port.

The removal of the floating turbine system and its associated moorings would be completed in two stages: 1) removal of the floating turbine system and 2) removal of the catenary moorings lines and anchors. For removal of the floating turbine, the same process would be used as for the deployment, but in reverse. The mooring line would then be towed in the opposite direction to remove the anchoring and mooring system.

All electrical interconnection equipment also would be removed. Upon completion of the project, the electrical cable anchors on shore would be removed and any bolts would be cut flush with existing grade, and support blocks and conduits would be removed. Disturbed areas would again be stabilized with straw mulch. Project removal activities would take a similar amount of time as the installation activities (see Section 2.2.7).

2.3 No Action Alternative

Under the No-Action Alternative, DOE would not authorize the expenditure of federal funds for the temporary deployment of the wind turbine test platform. 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 the DOE Wind and Water Power Program's mission and goals for offshore wind advancement would be impaired.

While it is possible that the wind turbine test platform could be constructed and operated in lieu of DOE financial assistance, such a scenario would not provide for a meaningful No Action Alternative, as it would be identical to the Proposed Project. Therefore, for the purposes of this EA, the No Action Alternative is evaluated as if the Proposed Project were not built and operated.

2.4 Required Agency Permits and Approval Types

Prior to installation of the turbine, DOE and UMaine will complete and comply with all required federal and state consultations, permits, and approvals (Table 2-2). UMaine submitted a permit application to the Army Corps on December 18, 2012.

Table 2-2. Required permits and approvals.

Agency	Permit/Approval
Maine Department of Environmental Protection	National Resources Protection Act, Section 9 Permit By Rule Notification
U.S. Army Corps of Engineers	River and Harbors Act, Section 10 Permit
National Oceanic and Atmospheric Administration (NOAA) NMFS, U.S. Fish & Wildlife Service (USFWS)	Endangered Species Act, Section 7 Consultation
NMFS and USFWS	Fish and Wildlife Coordination Act
NMFS	Marine Mammal Protection Act, Consultation
NMFS	Magnuson-Stevens Fishery Conservation and Management Act, EFH Consultation
U.S. Coast Guard	Ports and Waterways Safety Act, Consultation
Maine State Historic Preservation Office	National Historic Preservation Act, Section 106 Consultation

2.5 Applicant-Committed Measures

If DOE decides to provide federal funding for the proposed project the following measures will be implemented by UMaine to minimize or avoid potential environmental effects.

2.5.1 BIOLOGICAL RESOURCES

- To prevent seals from using the turbine platform for resting (seal haul out), the platform has been designed to limit the horizontal surfaces, and the platform deck height will preclude haul out of seals.
- The turbine tower will not have external ladders or other structures that will allow birds to perch near the turbine blades.
- The specifications for lighting of the floating platform and turbine will be developed in compliance with USFWS lighting requirements.
- UMaine will conduct monitoring for birds, bats, marine mammals, benthic invertebrates, and fish[1]. The monitoring will complement the pre-deployment monitoring that has already been performed. Results of the monitoring will be provided to DOE and applicable resources agencies.
- NMFS marine mammal avoidance and best management procedures will be implemented in the event that a marine mammal is encountered by a construction or maintenance vessel.
- The onboard management of fuels and lubricating fluids aboard all vessels will be managed in accordance with U.S. Coast Guard regulations applicable to each vessel. The requirements are dictated by vessel size and intended operations, but in each case do not permit the discharge of petroleum or hazardous substances into the environment and require a spill prevention plan and certificate of financial responsibility.

2.5.2 OCEAN AND LAND USE

- Notice will be given to the Maine Marine Patrol and USCG to alert fishermen about towing operations and to advise for the removal of gear from the planned tow route.
- Minimal hand cutting of limbs and brush will be conducted to facilitate routing and placement of the conduit. No trees will be removed and select trimming will be focused on the centerline of the conduit with no trimming occurring beyond three feet on either side of the conduit. Excess dust or debris that is deposited on the ground will be managed in manner to prevent off-site migration. Areas along the route that are disturbed

[1] 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.

to bare ground will be covered with straw mulch, and standard erosion control Best Management Practices will be implemented.

- A navigation safety plan for the project has been developed in consultation with the USCG Waterways Management division.
- The turbine will be monitored via webcam and could be shut off remotely, if necessary.
- Following completion of the project, the floating turbine platform, anchors, and the electrical cable will be retrieved. The electrical cable anchors on shore will be removed, any bolts will be cut to flush with existing grade, and support blocks and the conduit will be removed. Disturbed areas will be stabilized with straw mulch.

2.5.3 CULTURAL RESOURCES

- To minimize visual effects, the project will be sited out of view of the Village of Castine and in a previously disturbed cable ROW, and the project will be temporary and removed following completion of the testing.
- To minimize bottom effects, UMaine conducted a magnetometer survey and confirmed that there are no shipwrecks at the project site.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

3.1 Environmental Categories Evaluated and Dismissed From Further Analysis

3.1.1 GEOPHYSICAL RESOURCES

The only effect of the project upon marine geological resources would be from temporary placement of four anchors and cable, both within a previously disturbed cable ROW. No pile driving would occur, and no blasting would be required. The drag embedment anchor to be used would minimize impact to the seafloor compared to other anchor designs, works well with the bottom conditions at the proposed site, and is easily removed at project completion. The footprint of the anchors would be small, with the anchors having similar dimensions to (though heavier than) typical anchors used by large sailing vessels in Castine Harbor and along the Maine coast (Figure 2-2). During installation, drag embedment anchors would be pulled about 50 feet in order to set them with 10 feet of penetration. It is anticipated that half of this distance would be within the substrate below the seabed surface. The actual footprint of each anchor would be at most 16 ft^2, with the four anchors therefore having a combined footprint of about 64 ft^2 and the footprint of the subsea cable and strip weights would be about 357 ft^2. In the event that gravity anchors are used, each anchor would have a footprint of 100 ft^2 for a combined footprint of 400 ft^2. The anchors and subsea cable would have a temporary effect on the thick sediment of the test area. The terrestrial portion of the cable would be laid on the ground and would not disturb geological resources.

3.1.2 WATER RESOURCES

Due to the short duration of the deployment, there would be minimal accumulation of marine organisms (i.e., biofouling) on the floating turbine platform, and therefore, antifouling paint would not be applied. The onboard management of fuels and lubricating fluids aboard vessels would be managed in accordance with U.S. Coast Guard regulations applicable to each vessel. No intentional discharge of petroleum or hazardous substances would be allowed. Installation and operation of the project is not expected to influence dissolved oxygen concentration, pH, or temperature of the surrounding water. Deployment of the anchors and the cable to shore would result in a temporary and localized increase in turbidity during deployment, as would removal.

3.1.3 ELECTROMAGNETIC FIELDS

Transmission of electricity produces electromagnetic fields (EMF). EMF consists of two components, electric and magnetic fields. Magnetic fields may create a second induced component, a weak electric field, called an induced electric field. An iE field is generated by the flow of particles (water) or organisms through a magnetic field. Some marine animals (e.g. sharks, skates, and rays) have specialized organs and can sense EMF.

Operation of the project would result in a temporary, small, and very localized magnetic field. The Renewegy turbine has a capacity of 20 kW. Power would be generated at the turbine at 480-V, 3-phase, and would be delivered to shore through a submarine cable. The strength of electric and magnetic fields depends on the magnitude and type of current flowing, in this case, through the transmission cable. If the turbine is at full capacity, the current would be approximately 30 amperes. The shielding of the cable will eliminate electric fields, however, magnetic fields cannot be shielded. It is estimated that with the turbine generating at maximum power, the magnetic field would be 22 microtesla at 6 inches from the cable and 5 microtesla at 12 inches from the cable. In comparison, the strength of the earth's magnetic field is approximately 50 microtesla. The electrical set up for the project is less than what would be used for a normal residential service, which would have generally at least twice the current.

3.1.4 AESTHETIC RESOURCES

The floating platform would be deployed offshore and to the north of the Dyce Head. There is a lighthouse on Dyce Head, which is open to the public. The area surrounding the lighthouse has dense vegetation, including conifers and typical coastal undergrowth, which obscures any view of the ocean from the area around the lighthouse. In addition, the proposed deployment would not be visible from the end of the hiking path leading from the lighthouse to end of Dyce Head. The platform, which would be similar in size to large sail boats in the area, would be visible from a few homes to the north of the lighthouse.

The project deployment off Castine would be for only up to four months in the spring of 2013 and it would be removed before the period of the summer when peak boating and tourism/recreational activity occurs. Because the floating turbine platform is small (1/8 scale) and because it and the cable would be removed after the short-term deployment, any potential visual effects would be temporary.

3.1.5 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

The small size of the floating turbine platform and short duration of deployment will minimize effects to lobstering, commercial fishing activities, tourism activities, or area businesses.

Executive Order 12898 (February 11, 1994) directs federal agencies to incorporate environmental justice considerations into the NEPA process. The purpose of this order is 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. No potential adverse impacts to human health have been identified resulting from the proposed project. Therefore, there would be no disproportionately high and adverse human health or environmental effects on minority populations and low-income populations.

3.1.6 INTENTIONAL DESTRUCTIVE ACTS

Installation and operation of a floating wind turbine platform outside of Castine Harbor 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 Biological Resources

This section analyzes potential project effects to the following biological resources, including threatened and endangered species:

- Invertebrates
- Fish
- Marine Mammals
- Reptiles
- Birds
- Bats
- Terrestrial Biological Resources.

3.2.1 AFFECTED ENVIRONMENT

3.2.1.1 Habitat Overview

The proposed project's test site is located in Penobscot Bay, Maine. The 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).

The substrate at the test site is primarily fine grain sediment (i.e., mud). 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). The nearshore subtidal habitat is marked by shell hash (shells of dead shellfish) and coarser grain sediment.

The intertidal area is dominated by rockweed (*Fucus vesiculosus*). The land rises very steeply from the intertidal zone, and terrestrial habitat is typical temperate coastal scrub, dominated by coniferous trees and shrubs. No wetlands are located at the site. Figure 3-1 shows views of the terrestrial vegetation in the area where the cable will be deployed. Terrestrial resources are further discussed further in Section 3.2.1.8.

Figure 3-1. View of the property where the onshore cable would be deployed, looking toward shore (top) and inland (bottom).

3.2.1.2 Invertebrates

Penobscot Bay supports a diverse variety of marine invertebrate species. A number of studies have characterized the invertebrate population in Penobscot Bay including those conducted by the Environmental Protection Agency (EPA 2007, benthic grabs for its Environmental Monitoring and Assessment Program [EMAP]), Maine-New Hampshire Inshore Trawl Surveys

(Sherman et al. 2010), and the Gulf of Maine Research Institute (angling and dive surveys, Sherwood et al. 2012). In addition to these sources of information, in 2012 UMaine conducted a diver survey along the cable route.

EPA's EMAP survey of eastern Penobscot Bay indicates that the benthic infauna is likely comprised, in order of highest count in samples, of Nephtyidae (catworms), *Haplocytheridea setipunctata* (an ostracod – a planktonic crustacean), *Aricidea suecica*, among other polycheate species (EPA 2007). The UMaine diver survey documented that sites very close to shore were dominated by sand dollars (*Echinarachnius parma*) and starfish (*Pisaster brevispinus*). However, 400 feet offshore the habitat transitions from coarse grain shell hash to fine muds; no species were observed other than sparse tube forming polychaetes (segmented worm) (Kennedy 2012).

Although no other conspicuous signs of macroinvertebrates were observed at the site by UMaine during diver surveys, trawl surveys conducted by the Maine Department of Marine Resources (DMR, the Maine-New Hampshire Inshore Trawl Surveys) indicate that the following invertebrates are relatively common elsewhere in Penobscot Bay: blue mussel (*Mytilus edulis)*, sea scallop (*Placopecten magelanicus*), American oyster *(Crassostrea virginica)*, Northern quahog (*Mercenaria mercenaria*), softshell clam (*Mya arenaria)*, green sea urchin *(Strongylocentrotus droebachiensis)*, daggerblade grass shrimp (*Palaemonetes pugio*), northern shrimp (*Pandalus borealis*), sevenspine bay shrimp (*Crangon septemspinosa*), American lobster (*Homarus americanus*), Jonah crab (*Cancer borealis*), Atlantic rock crab (*C. irroratus*), and green crab (*Carcinus maenas)* (Sherman et al. 2010) (Sherman et al. 2010). Atlantic rock crabs, green crabs, mussels, sea urchins, sea stars, and periwinkles (*Littorina littorea*) were the dominant macroinvertebrates documented in the project vicinity during angling and dive surveys conducted by researchers from the Gulf of Maine Research Institute (Sherwood et al. 2012). Lobsters are present in the area, as demonstrated by the presence of lobster buoys throughout the area offshore Castine (Kennedy 2012).

3.2.1.3 Fish

Penobscot Bay supports a diverse variety of finfish species. The Maine-New Hampshire Inshore Trawl Survey (Sherman et al. 2010) represents the best known source for fish species composition in the area. During a survey conducted during the time of the year that the project would be deployed, 34 fish species were captured in the sampling region that includes Penobscot Bay (Table 3-1) (Sherman et al. 2010). Many of the common marine species in Table 3-1 are uncommon as far up Penobscot Bay as Castine (e.g., redfish [*Sebastes fasciatus*], Atlantic cod [*Gadus morhua*], and haddock [*Melanogrammus aeglefinus*]), whereas some of the more estuarine species may regularly enter the test site (e.g., Atlantic herring [*Clupea harengus*], winter flounder [*Pseudopleuronectes americanus*], and windowpane flounder [*Scophthalmus* *aquosus*]). This was demonstrated by the Gulf of Maine Research Institute during sampling in 2010, when sampling indicated that marine fish were relatively less common at the test site than at sites closer to the open ocean (Sherwood et al. 2012).

Table 3-1. Summary of fish species most commonly captured in the Maine-New Hampshire Inshore Trawl Survey in or near Penobscot Bay, May 2010.

Common Name	Scientific Name	Number Sampled
Atlantic herring	*Clupea harengus*	51
Alewife	*Alosa pseudoharengus*	47
Silver hake	*Merluccius bilinearis*	44
American plaice	*Hippoglossoides platessoides*	38
Winter flounder	*Pseudopleuronectes americanus*	34
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	27
Windowpane flounder	*Scophthalmus aquosus*	25
Blueback herring	*Alosa aestivalis*	22
Red hake	*Urophycis chuss*	20
White hake	*Urophycis tenuis*	18
Witch flounder	*Glyptocephalus cynoglossus*	18
Rainbow Smelt	*Osmerus mordax*	16
Redfish	*Sebastes fasciatus*	13
Haddock	*Melanogrammus aeglefinus*	12
Pollock	*Pollachius virens*	9
American shad	*Alosa sapidissima*	8
Atlantic cod	*Gadus morhua*	7
Fourbeard rockling	*Enchelyopus cimbrius*	7

Less than 10 individuals of 20 other fish species also were captured, as were 20 shrimp (*Pandalus* sp.), a macroinvertebrate. Source: Sherman et al. 2010

Three fish species, all anadromous, listed under the Endangered Species Act (ESA) have the potential to occur in the project area:

- Atlantic salmon (*Salmo salar*) Gulf of Maine Distinct Population Segment are federally endangered;
- Shortnose sturgeon (*Acipenser brevirostrum*) are federally endangered; and
- Atlantic sturgeon (*A. oxyrinchus oxyrinchus*) are listed as federally threatened for the Gulf of Maine Distinct Population Segment (DPS) and federally endangered for the New York Bight DPS[2].

[2] NMFS (2012) estimated that 1% of Atlantic sturgeon in the Penobscot River are New York Bight origin, based on a mixed stock analysis conducted in the Bay of Fundy, Canada that concluded that 1% of Atlantic sturgeon in the Bay of Fundy were New York Bight origin.

The project site is not located within designated critical habitat for the Atlantic salmon Gulf of Maine Distinct Population Segment, and no other critical habitat designated by NMFS occurs in Maine (letter from NMFS to DOE dated November 16, 2012). No state-listed fish species occur in the project area.

NOAA Fisheries, U.S. Geological Survey, and UMaine have been deploying and maintaining an array of acoustic receivers in the Penobscot River since 2005, as well as throughout the Gulf of Maine, to gather information on a variety of tagged fish distribution and movement. There is a detection buoy located near the test site, and it is part of an array of seven detection buoys that extends across eastern Penobscot Bay off of Dyce Head (Zydlewski 2012). Species they typically detect are Atlantic salmon (smolts), Atlantic sturgeon, spiny dogfish (*Squalus acanthias*), striped bass (*Morone saxatilis*), and shortnose sturgeon (Zydlewski et al 2011). Between 200 and 400 Atlantic salmon, 15 and 25 Atlantic sturgeon, and 25 and 40 shortnose sturgeon were tagged each of the last three years in the Penobscot River system and available for detection at the Dice Head array (Zydlewski 2012). This array would be in operation during the project deployment and would allow for monitoring of the presence of tagged species.

Under the Magnuson-Stevens Fishery Conservation Act of 1998 (16 U.S.C. 1801 et seq.; MSA) the waters of Penobscot Bay that include the project area have been designated as essential fish habitat (EFH) for 16 federally managed fish species (Table 3-2). 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). EFH for the species listed in Table 3-2 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 2012).

Table 3-2. Marine species and life stages for which Essential Fish Habitat occurs in the portion of Penobscot Bay that includes Castine.

Species	Eggs	Larvae	Juveniles	Adults
Atlantic salmon *(Salmo salar)*			X	X
Atlantic cod *(Gadus morhua)*		X	X	X
pollock *(Pollachius virens)*			X	
whiting *(Merluccius bilinearis)*			X	X
red hake *(Urophycis chuss)*			X	X
white hake *(Urophycis tenuis)*			X	X
winter flounder *(Pseudopleuronectes americanus)*	X	X	X	X
yellowtail flounder *(Limanda ferruginea)*	X	X		
windowpane flounder *(Scophthalmus aquosus)*	X	X	X	X
American plaice *(Hippoglossoides platessoides)*	X	X	X	X

Species	Eggs	Larvae	Juveniles	Adults
ocean pout *(Macrozoarces americanus)*	X	X	X	X
Atlantic sea scallop *(Placopecten magellanicus)*	X	X	X	X
Atlantic sea herring *(Clupea harengus)*		X	X	X
bluefish *(Pomatomus saltatrix)*			X	X
Atlantic mackerel *(Scomber scombrus)*			X	X
bluefin tuna *(Thunnus thynnus)*				X

Source: NOAA 2012.

In a letter to DOE dated November 16, 2012, NMFS stated that the waters in the vicinity of Castine support populations of diadromous species including blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), rainbow smelt (*Osmerus mordax*), striped bass, American eel (*Anguilla rostrata*), and American shad (*Alosa sapidissima*). NMFS noted that diadromous fish serve as prey for a number of federally-managed species and several species are considered a component of EFH pursuant to the MSA.

3.2.1.4 Marine Mammals

The Gulf of Maine is host to numerous marine mammals including large and small whale species, and three species of seals. Five ESA-listed whales that have the potential to occur in the Gulf of Maine are North Atlantic right (*Eubalaena glacialis*), fin (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*), sei (*B. borealis*), and sperm (*Physeter macrocephalus*) whales. None of these species were observed during the 17 boat-based visual surveys UMaine conducted from March through June 2012 in the project vicinity (Kennedy 2012). Right whales are present year-round in the Gulf of Maine, but sightings are uncommon in nearshore waters (Letter from NMFS to DOE dated November 16, 2012). Humpback whales are typically seen in waters off the coast, and fin, sei, and sperm whales are typically found in deeper offshore waters and are not likely to occur in the action area (Letter from NMFS to DOE dated November 16, 2012). The project is not located within any critical habitat of whale species (Letter from NMFS to DOE dated November 16, 2012).

During the 2012 boat-based visual surveys, UMaine observers counted 66 harbor seal (*Phoca vitulina)*, one grey seal (*Halichoerus grypus*), and 34 harbor porpoise (*Phocoena phocoena*). Individuals of these three marine mammal species combined, were found at a density of 0.38 animals/km^2 (Kennedy 2012). In addition to these species, in a letter to DOE dated November 16, 2012, NMFS stated that minke whale (*B. acutorostrata*) Atlantic white-sided dolphin (*Lagernorhynchus acutus*), common dolphin (*Delphinus delphis*), short- and long-finned pilot whales (*Globicephala macrohynchus* and *G. melas*), and Kogia (pygmy sperm whale, *Kogia breviceps*) are also found in Maine coastal waters.

3.2.1.5 Reptiles

All sea turtles are protected under the ESA. Although sea turtle sightings are uncommon in the Gulf of Maine, leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), and Atlantic Ridley (Kemp's Ridley) (*Lepidochelys kempi*) sea turtles are known to occur there. The leatherback and Atlantic Ridley are endangered and the loggerhead is threatened under the ESA. The proposed project is not located within any critical habitat for marine turtles, and no turtles were observed during the boat-based visual surveys in the Castine Test Site vicinity over 17 weeks from March through June 2012 (Kennedy 2012).

3.2.1.6 Birds

Castine lies on the west side of the Blue Hill peninsula and on the northwest bank of the Bagaduce River, which is a 12-mile stretch of flowing tidal water that converges into Penobscot Bay. The BioDiversity Research Institute has created a Ranking of Bird Use map that categorizes areas from High to Low bird use. Near Castine and in the area surveyed in this report, bird use rates as "low" (BioDiversity Research Institute, 2012).

During UMaine's 17 boat-based surveys from March through June of 2012, a total of 1,009 birds, representing 33 identified species, were recorded, with the three most abundant species being common eider (*Somateria mollissima*, 38%), herring gull (*Larus argentatus*, 20%), and common loon (*Gavia immer*, 9%) (Kennedy 2012). A list of the most common bird species observed is presented in Table 3-3.

Table 3-3. Most common bird species observed offshore of Castine.

Common name	Scientific name	Total number	No. of observations
Common eider	*Somateria mollissima*	379	28
Herring gull	*Larus argentatus*	206	154
Common loon	*Gavia immer*	95	75
Black guillemot	*Cepphus grylle*	57	48
Ring-billed gull	*Larus delawarensis*	41	29
Double-crested cormorant	*Phalacrocorax auritus*	39	26
Unidentified duck species		35	12
Red-throated loon*	*Gavia stellata*	18	13
American crow	*Corvus brachyrhynchos*	17	11
Turkey vulture	*Cathartes aura*	16	3
Red-breasted merganser	*Mergus serrator*	13	3

*25 species other species were also observed in lesser numbers. Asterisk indicates Bird of Conservation Concern-species. Source: Kennedy 2012.

There are two ESA-listed birds that have the potential to occur in the project area, federally endangered roseate tern (*Sterna dougallii)* and federally threatened piping plover (*Charadrius melodus*). One unidentified tern (*Sterna* sp.) and no piping plovers were observed during the UMaine field surveys (Kennedy 2012).

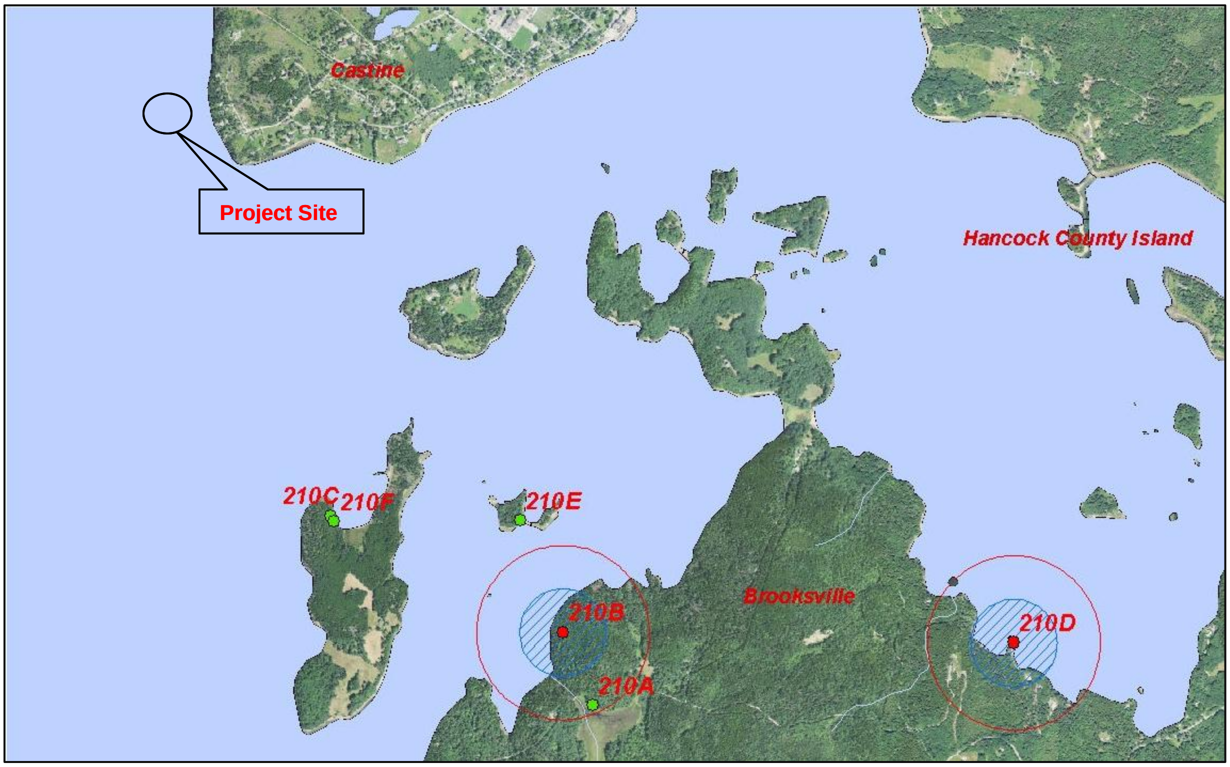
Bird species listed under the Maine Endangered Species Act are listed in Table 3-4 and also include roseate tern and piping plover, which are both listed as state endangered. Regarding the unidentified tern that was documented during the UMaine survey, Maine lists two additional species of terns in the genus Sterna: least tern (*S. antillarum*), which is listed as state endangered and Arctic tern (*S. paradisaea*), which is listed as state threatened. Two other state listed bird species were observed during the UMaine field surveys: two razorbills (*Alca torda*, state threatened) and one peregrine falcon (*Falco peregrines*, state endangered) were seen (Kennedy 2012).

Table 3-4. Bird species listed under the Maine Endangered Species Act.

Common name	Scientific name
Maine Endangered Species	
American Pipit*	*Anthus rubescens*
Black Tern	*Chlidonias niger*
Golden Eagle	*Aquila chrysaetos*
Grasshopper Sparrow	*Ammodramus savannarum*
Least Bittern	*Lxobrychus exilis*
Least Tern	*Sterna antillarum*
Peregrine Falcon*	*Falco peregrinus*
Piping Plover	*Charadrius melodus*
Roseate Tern	*Sterna dougallii*
Sedge Wren	*Cistothorus platensis*
Maine Threatened Species	
Arctic Tern	*Sterna paradisaea*
Atlantic Puffin	*Fratercula arctica*
Barrow's Goldeneye	*Bucephala islandica*
Black-crowned Night Heron	*Nycticorax nycticorax*
Common Moorhen	*Gallinula chloropus*
Great Cormorant*	*Phalacrocorax carbo*
Harlequin Duck	*Histrionicus histrionicus*
Razorbill	*Alca torda*
Short-eared Owl*	*Asio flammeus*
Upland Sandpiper	*Bartramia longicauda*

*Breeding population only
Source: MDIFW 2012.

The USFWS created a list of species requiring special conservation action and awareness: the Birds of Conservation Concern 2008 (USFWS 2008). Species of Conservation Concern counted in the project area included 18 red-throated loons (*Gavia stellata*), three bald eagles (*Hailaeetus leucocephalus*), one peregrine falcon (*Falco peregrines*), two razorbills (*Alca torda*), and one unidentified tern. The most recent bald eagle nest sites close to the test site are approximately 2.5 miles south of the test site on Brooks Island (Figure 3-2).



Map courtesy of C.Todd (Maine Department of Inland Fisheries and Wildlife). Source: Kennedy 2012.

Figure 3-2. Locations of most recent bald eagle nest sites in project vicinity (210B and 210D).

3.2.1.7 Bats

Eight species of bats occur in Maine, based upon their normal geographical range. These are the little brown bat (*Myotis lucifugus*), northern long-eared bat, (*M. septentrionalis*), eastern small-footed bat (*M. leibii*), silver-haired bat (*Lasionycteris noctivagans*), tri-colored bat (*Perimyotis subflavus*), big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), and hoary bat (*Lasiurus cinereus*) (DeGraaf and Yamasaki 2001). The red bat, hoary bat, and silver-haired bat are migratory in the 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 become active in early spring after emerging from hibernation. To understand the composition of the bat assemblage during the later period of the deployment, surveys were conducted from the tower of the Dyce Head Lighthouse in Castine, the nearest feasible monitoring location to the site at which the test turbine is to be deployed. An acoustic detector was deployed on the tower of the Dyce Head Lighthouse on May 22, 2012, and operated nightly through July 10, 2012. A total of 797 bat call sequences were recorded during this period. Between 0 and 107 call sequences were recorded per night, with an overall activity level of 15.9 call sequences per detector-night. Bats were detected during 42 out of 50 surveyed nights (84 percent). Of the 797 recorded call sequences, 422 (53 percent) were identified to species or guild. Call fragments that were too short to be identified were classified as either high frequency or low frequency "unknown" (Stantec 2012). Results by species are as follows:

- 235 calls - big brown bat/silver-haired bat guild, including the big brown bat and silver-haired bat;
- 153 calls - *Myotis* genus;
- 19 calls - eastern red bats;
- 15 calls - hoary bats;
- 228 calls – high frequency unknown (likely includes eastern red bats, tri-colored bats, and *Myotis* species); and
- 147 call – low frequency unknown (likely includes big brown, silver-haired, and hoary bats) (Stantec 2012).

3.2.1.8 Terrestrial Biological Resources

The terrestrial portion of the project area from the tidal habitat to the point of electrical interconnection is typical temperate coastal scrub habitat dominated by coniferous trees and shrubs. Above the intertidal zone, the terrestrial habitat rises steeply, transitioning to a combination of trees (i.e., firs, spruces, larch, juniper, and birch were all noted at the site) and shrubs (primarily *Rosa rugosa*, staghorn sumac [*Rhus hirta*], and similar undergrowth common to coastal temperate Maine) (Figure 3-1). There are no hardwoods in the area, and it is therefore likely that this area is a transitional forest, not a mature forest. The cable would be laid along the ground for 300 feet and cross one residential property, for which landowner permission has been granted and an agreement is in place.

Common terrestrial fauna that could be expected to occur in the project area includes white tail deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), red squirrel (*Tamiasciurus hudsonicus*), striped skunk (*Mephitis mephitis*), long-tail weasel (*Mustela frenata*), bats (see Section 3.2.1.7), eastern garter snake (*Thamnophis sirtalis*), black capped chickadee (*Poecile atricapillus*), American crow (*Corvus brachyrhynchos*), and blue jay (*Cyanocitta cristata*).

3.2.2 ENVIRONMENTAL IMPACTS RELATED TO BIOLOGICAL RESOURCES

The marine components of the project may have the following potential effects on biological resources:

- Alteration of habitat;
    - direct effects on marine life from deployment on and removal from the seabed of the anchors and subsea cable and
    - changes to the marine community composition at the deployment site (e.g., use patterns, attraction, aversion);
- Above-water collision of birds and bats; and
- Underwater collision and entanglement – marine mammals.

In this section these potential effects on marine life, as well as potential effects on terrestrial biological resources, are evaluated as follows:

- Invertebrates
- Fish
- Marine Mammals
- Reptiles
- Birds
- Bats
- Terrestrial Biological Resources
- Threatened and Endangered Species.

The potential effects of noise are discussed in Section 3.3.

3.2.2.1 Invertebrates

Some benthos would be disturbed during the deployment of the four anchors and the subsea cable on the seabed, and during their removal from the seabed. Specifically, the placement of anchors and the cable could cover or injure slow-moving or immobile benthic organisms, such as bivalves, sand dollars, and worms directly beneath the anchors and cable. Removal of the anchors and cable could also potentially harm slow-moving or immobile benthic organisms. UMaine plans to use drag embedment anchors because this anchor type minimizes impacts to the seafloor compared to other anchor designs, works with the bottom conditions at the proposed site, and is easily removed at project completion. During installation, drag embedment anchors would be pulled about 50 feet in order to set them with 10 feet of penetration. It is anticipated that half of this distance would be within the substrate below the seabed surface. This would cause 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 commercial fishing bottom dragging operations. The actual footprint of project components resting on the seabed would consist of the four anchors (combined footprint of 64 ft^2 at most) and the subsea cable and strip weights (combined footprint of about 357 ft^2). In the event that gravity anchors are used instead of drag embedment anchors, each anchor would have a footprint of 100 ft^2 for a combined footprint of 400 ft^2. Mobile invertebrates would likely move away from the immediate vicinity of the project during deployment and removal activities. The area of the seabed that would be disturbed or covered by the anchors or subsea cable would be small for this 1/8-scale test turbine, and because the turbine would be deployed less than four months, any effects would be temporary.

3.2.2.2 Fish

Fish would likely move away from the immediate vicinity of the project during deployment and removal activities. It is anticipated that due to the small scale of the project and the short duration of deployment and removal activities there would be minimal disturbance to fish caused by deployment and removal of project components.

The presence of floating turbine platforms in the water column may result in altered use of the area by fish and a resulting change in the marine community composition in the following ways:

- Artificial reef effect[3] - The anchors, mooring lines, below-water portions of the turbine platform, and subsea cable could provide habitat for biofouling organisms and structure-oriented fish.
- Fish aggregation device (FAD) effect – Fish are also known to aggregate around floating objects (Nelson 2003), which is often called a FAD effect.
- 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.

These potential effects were discussed in detail in DOE’s EA for the Monhegan Project (DOE 2011). The degree to which the project would affect use of the area by marine life would be minimized, and would not affect populations of species that use the area, because of:

- The small spatial scale of the project (revised to be even smaller – only one 1/8-scale platform, associated moorings, and a subsea cable deployed on the surface of the seabed);
- The deployment of the project in an existing subsea cable ROW;

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

- The short duration of installation activities - the short period of time required for deployment and removal minimizes the potential avoidance of the area of marine species; and
- The short duration of the project - biofouling organisms would have only four months to grow before the platform would be removed, which minimizes the artificial reef effect of the platform.

As discussed in Section 3.2.1, there are a number of federally managed fish species with EFH in waters off of Castine (Table 3-2). 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 2012). The footprint of the anchors and cable might slightly decrease available bottom foraging habitat and areas considered to be EFH. However, the maximum area covered by the anchors (combined area of about 64 ft^2 for drag embedment anchors, 400 ft^2 if gravity anchors are used) and the 2½-inch subsea cable and associated strip weights (footprint of about 357 ft^2) would be very small and the type of habitat to be disturbed is very prevalent along the Maine coast. Placement of anchors and the subsea cable in areas of soft bottom substrate would likely result in a temporary and localized increase in turbidity during deployment and removal; with only four anchors to be deployed, this effect would be small scale and short term. As discussed above, mobile species such as fish, would likely avoid the immediate deployment area during project installation activities. Project deployment activities for the marine components of the project are expected to total five days (two days to deploy the four anchors, one day to deploy the floating turbine platform, and two days to deploy the subsea cable). Project removal activities would take a similar amount of time. Therefore, any shift in habitat use by marine or diadromous species during installation or removal activities would be small scale and temporary.

3.2.2.3 Marine Mammals

During surveys in the project vicinity, 66 harbor seals, one gray seal, and 34 harbor porpoise were observed. No large whales were observed (Kennedy 2012). Harbor seals, gray seals, and harbor porpoise would likely avoid the immediate vicinity of the project during deployment and removal activities. A slight increase in vessel traffic associated with the project installation and maintenance would be negligible for this small scale and temporary project. While the potential for a vessel and marine mammal interaction is unlikely, NMFS marine mammal avoidance procedures, in compliance with the Marine Mammal Protection Act, would be implemented in the event that a marine mammal is encountered by a service vessel. The small scale of the project and the short duration of deployment and removal activities are expected to minimize any disturbance to marine mammals caused by deployment and removal of the project.

The presence of floating turbine platforms in the water column and floating above the water may result in temporary altered use by marine life. For example, seals are known to haul out on nearly any accessible floating platform. UMaine is implementing design measures to prevent seal haul out (the platform deck will be raised several feet above the water level). As discussed in the previous section, because of the small size and temporary nature of the project, it is not expected that it would change the habitat or the marine community in the deployment area in other ways (e.g. artificial reef effect, FAD effect, avoidance of the project area by resident and migratory species).

The remainder of this section evaluates the potential that marine mammals may become entangled, or collide, with the project mooring lines. Marine mammals in the Gulf of Maine are exposed to a variety of anthropogenic structures in the water column, including moored navigation aids and oceanographic buoys, anchored and moving ships, and lobster buoys. Moored vessels are common in harbors, such as Castine Harbor, and other locations along the Maine coast. During the UMaine biological surveys, researchers documented densities of lobster buoys as high as 9.9 buoys/km^2 in the project vicinity (Kennedy 2012).

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 the marine mammal species that occur in the project area would be able to detect and avoid underwater moorings.

There is generally more uncertainty regarding the ability of baleen whales, which do not use sonar, to avoid mooring lines. However, whale collisions with moored ships and buoys are uncommon. Also, large whales are not expected to occur in the project area, which is located in upper Penobscot Bay relatively close to shore.

In addition, the mass/buoyancy of the platform and mass of the anchors is expected to create substantial tension in the mooring lines. These factors would prevent the formation of loops around a passing whale. The potential for heavy mooring gear combined with relatively taut mooring lines to entangle whales has been shown to be negligible (Wursig and Gaily 2002).

In the event that the turbine is removed from the moorings for some reason (e.g., severe weather), the synthetic/wire rope or chain mooring lines would be connected to a light mooring rope and dropped to the bottom of the seafloor. The mooring rope would be connected to a floating mooring ball so that the steel portions of the mooring line can be later retrieved and re-connected to the platform. With the synthetic/wire rope or chain on the seafloor, the mooring lines would not be an entanglement hazard. The light mooring ropes would be similar to lobster pot lines which are very common in the area and along the Maine coast.

In addition, it is unlikely that large whales would encounter the project because of the small size of the project relative to surrounding open ocean area of Penobscot Bay, the fact that the platform would be temporarily deployed for up to only four months, and that large whale presence at the project area is unlikely.

3.2.2.4 Reptiles

Potential effects to the three sea turtle species that may occur off of Maine, which are listed under the ESA, are discussed in Section 3.2.2.8.

3.2.2.5 Birds

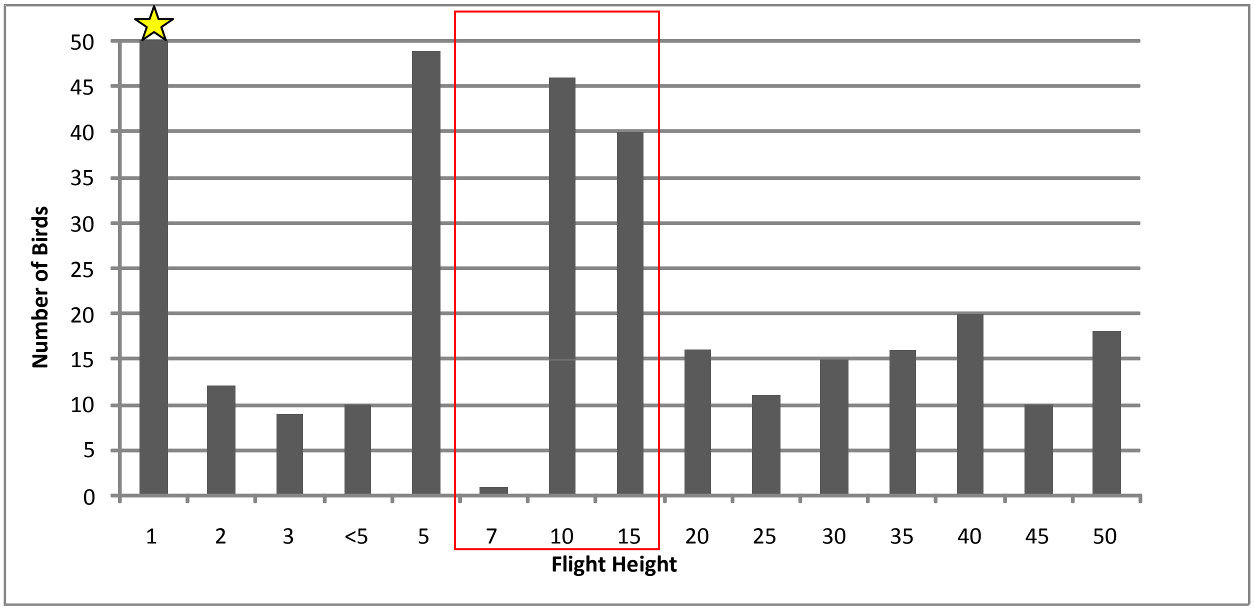
The presence of a turbine platform floating above the water may result in temporary altered use of the area for seabirds by providing a place to roost. UMaine would implement measures to minimize bird attraction and roosting. For example, the turbine would not have external ladders or other structures that would allow birds to perch near the turbine blades.

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, migrating and foraging birds could be at risk of colliding with the turbine. As described below, the probability of birds being killed or injured by the 1/8-scale turbine is low.

While varying with location, the national average of collision-related mortality for birds at land-based commercial wind farms is less than three birds per commercial-scale turbine (i.e., larger than about 1 megawatt) per year (Erickson et al. 2001). The Castine turbine would be lit at night with a flashing sequence for the purposes of navigational safety. Some bird species such as petrels and migrating songbirds can be attracted to light during nighttime and diurnal conditions with poor visibility (UMaine 2011), which could put such species at a higher risk of collision with the turbine.

The proposed turbine would have a rotor sweep zone ranging from approximately 25 feet to 57 feet above the water surface (actual rotor diameter of 31.5 feet). Of the 456 flying birds observed during the 17 surveys UMaine conducted between March through the end of June 2012, the majority flew at or under 16.4 feet (5 meters) and 40% flew at 3.2 feet (1 meter) high.

Approximately 19% flew between heights of the rotor sweep zone (Figure 3-3). Herring gulls, ring-billed gulls (*Larus delawarensis*), and common loons were the most common species to be flying in the height range of the rotor (Kennedy 2012).



The yellow star represents a total of 183 birds at one meter high. The red box shows the approximate height range of the turbine rotor. Source: Kennedy 2012.

Figure 3-3. Flight heights for bird species observed during UMaine 2012 visual surveys.

Some birds might collide with the turbine and be killed or injured during the four-month deployment. However, the rotor swept area would be 779 feet^2, which is much smaller than the 1/3 scale turbines evaluated at the Monhegan site, which had a rotor swept area of 6,165 feet^2, almost 8 times larger. The relatively small rotor diameter of the Castine 1/8-scale turbine, and the temporary nature of the deployment, would minimize collision risk for birds. During the period of deployment, boat based visual surveys of birds would be performed on site weekly and a web camera would be deployed on the unit to monitor bird strikes. Visual observation methods will replicate the pre-deployment monitoring.

3.2.2.6 Bats

As with birds, the operation of the proposed project would introduce static and moving above-water components at the site, potentially within the flyway of bats. During project operation, bats could be at risk of colliding with the turbine. As described below, the probability of bats being killed or injured by the 1/8-scale turbine is low.

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).

The results of the bat surveys conducted during the summer of 2012, demonstrated that bats are present at the Dyce Head Lighthouse, and it is expected that these bats may occasionally fly over the water or cross the mouth of the Penobscot River to forage at nearby islands or to access land on the opposite side of the bay (Stantec 2012). The surveys could not identify the height at which the bats were flying (Stantec 2012), and it is expected that bats thus flying over the water could be exposed to the turbine.

Some bats might collide with the turbine and be killed or injured during the four-month deployment. However, the relatively small rotor diameter of the Castine 1/8-scale turbine, and the temporary nature of the deployment, would minimize collision risk for bats. In addition, because the proposed project is not located near a forested ridgeline and is instead located about 500 to 1,000 feet from the shore in open water, the probability of bat fatalities at the test site is very low.

3.2.2.7 Terrestrial Biological Resources

For the terrestrial portion of the project, the cable, contained in a conduit, would be laid on and anchored to the ground for up 300 feet from the high tide line to the interconnect point. Some trimming of vegetation might be needed along the centerline of the conduit path, but no trimming would occur beyond three feet of that path. Deployment of the terrestrial portion of the project is expected to take two weeks. Following the approximately four-month (or less) deployment of the floating turbine platform, the cable would be removed. Because of the very small footprint of the shore component of the project, the design of the project so as to minimize terrestrial disturbance, and the short duration and subsequent removal of the project, the project effects to the terrestrial environment would be minimal and temporary.

3.2.2.8 Threatened and Endangered Species

For the larger floating wind turbine platforms proposed for deployment at the Monhegan test site and evaluated in the September 2011 DOE EA, NMFS in a letter dated February 22, 2011, concurred with DOE that the project may affect, but would not likely adversely affect ESA-listed fish, marine mammals, and sea turtles or EFH under the Magnuson-Stevens Fishery Conservation and Management Act. 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 (DOE 2011). As described below, the effects of temporarily deploying a single 1/8-scale platform and turbine at the Castine site would have similar or less effects than those identified for testing at the Monhegan site.

Three ESA-listed fish species, Atlantic salmon, shortnose sturgeon, and Atlantic sturgeon, have the potential to occur in the project area. All three species were detected at the Dice Head acoustic detection array during monitoring from 2009 to 2011. Movements through the array were seasonal with Atlantic salmon movements focused in May, Atlantic sturgeon movements throughout the year but focused in May and October, and shortnose sturgeon movements occurring from May to July (Zydlewski 2012). These three species use the project area as a migration corridor. This part of Penobscot Bay is very expansive and quite deep, and the project would not obstruct these species as they swim into and out of the Penobscot River and estuary. The small size of this research project relative to the surrounding marine habitat, the short nature of the deployment, the limited time these migratory fishes would be in the project site, and the overall lack of potential mechanism for effect to fish, all minimize the risk of effect to these three species.

Five ESA-listed whales that have the potential to occur in waters offshore of Maine are North Atlantic right, fin, humpback, sei, and sperm whales. None of these species were observed during the 17 boat-based visual surveys (Kennedy 2012), nor are they expected to occur near shore in the upper Penobscot Bay where the project is located. The likelihood of exposure of ESA-listed whales to the proposed project is extremely small, given that ESA-listed whales are uncommon in the project area, the small size of the project relative to the surrounding Penobscot Bay, and the fact that the platform would be temporarily deployed for up to only four months. In addition, the mass/buoyancy of the platform and mass of the anchors is expected to create substantial tension in the mooring lines, which would prevent the formation of loops around a passing animal. In the event that the turbine is removed from the moorings for some reason (e.g., severe weather), the synthetic/wire rope or chain mooring lines would be connected to a light mooring rope and dropped to the bottom of the seafloor. The mooring rope would be connected to a floating mooring ball so that the steel portions of the mooring line can be later retrieved and re-connected to the platform. With the synthetic/wire rope or chain on the seafloor, the mooring lines would not be an entanglement hazard. The light mooring ropes would be similar to lobster pot lines which are very common in the area and along the Maine coast.

There are three ESA-listed sea turtles with the potential to occur in the Gulf of Maine: Atlantic Ridley, loggerhead, and leatherback sea turtles. Sea turtle sightings in the Gulf of Maine are rare, and these species are very unlikely to occur near shore in upper Penobscot Bay where the project is located. The likelihood of exposure of sea turtles to the proposed project is extremely small given that sea turtles are uncommon in the project area, the small size of the project relative to the surrounding Penobscot Bay, and the fact that the platform would be temporarily deployed for up to only four months. Also, the substantial tension in the mooring lines would prevent the formation of loops that could entangle a passing animal. No other potential effects on sea turtles are anticipated.

There are two ESA-listed birds and a number of state-listed birds that have the potential to occur in the project area. Of these, only one unidentified tern (*Sterna* sp.), two razorbills, and one peregrine falcon were observed during the UMaine field surveys (Kennedy 2012)[4]. Because the proposed project would be small scale and have a short operational duration, there is a minimal likelihood that listed species would be harmed by the turbine rotor.

3.2.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the 1/8-scale floating wind turbine would not occur, and there would be no impacts to biological resources. Baseline conditions, as described in Section 3.2.1, would remain unchanged.

3.3 Noise and Vibration

3.3.1 AFFECTED ENVIRONMENT

Existing noise levels in the project area are expected to be typical of a near-shore/estuarine setting having relatively high boat traffic because of its proximity to Castine Harbor. In the marine/estuarine 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), 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).

During the boat-based visual survey at the Castine project site, observation of boat traffic occurred during 17 surveys from April to June 2012. A total of 13 boats were observed while

[4] Roseate tern is federally and state endangered, least tern is state endangered, and Arctic tern is state threatened. Razorbill is state threatened and peregrine falcon is state endangered.

surveys were performed. Six of the boats were various types of sailing vessels, four were assorted private motorized boats, and the remaining three were fishing vessels for lobster or fish.

The Port of Searsport is located northwest, across Penobscot Bay from Castine, and the Penobscot River ports of Bucksport and Bangor are located north of Castine, up the Penobscot River. NOAA navigation charts identify two Recommended Vessel Routes that run the length of Penobscot Bay, and the edge of the nearest route is located approximately 3,000 feet west of the proposed deployment location.

In the open ocean setting, the primary noise sources tend to be commercial shipping and wind and wave action on the sea surface (Richardson et al. 1995). Noise sources are expected to be similar at the project site, though upper Penobscot Bay, being more sheltered than the open ocean, would not have as much wind and wave action compared to the open ocean. Anthropogenic sources of noise in the project area would include fishing and recreational boats originating from Castine Harbor and elsewhere, as well as periodic traffic of larger ships and barges associated with the ports to the north of Castine.

3.3.2 ENVIRONMENTAL IMPACTS RELATED TO NOISE AND VIBRATION

The installation, operation, and removal of the floating wind turbine and subsea cable would result in a temporary increase in underwater noise created from service vessels and equipment, similar to vessels commonly used throughout the coast, and may temporarily cause marine life to avoid the project area. The Renewegy 20 kW turbine creates noise levels of about 50 dB at 120 feet (Renewegy 2012). For comparison, a 2-person conversation is about 47 dB (Bradley and Stearn 2008). At 500 to 1,000 feet, noise from operation of the wind turbine would decrease to a level that would likely not be detectable or would be barely audible to people on shore, close to the project (i.e. Dyce Head). In addition, during windy periods, turbine noise would be dampened by ambient noise (e.g., wind and waves) and during calm periods, the turbine would spin less or not all, resulting in less or no noise.

The predominant source of noise during project installation, maintenance, and removal would be the service vessels' propellers (MMS 2007). As discussed in Section 2.2.7, the pilot prototype unit and its anchorages would be installed using Maine Maritime Academy's unlimited tugboat *The Pentagoet*, or a similar vessel. *The Pentagoet* is 70 feet long and is powered by a 1,200 HP design engine. It is expected that the peak underwater sound intensity, generated by a tug fully underway, would 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). The tug or smaller research vessels should be fully underway only when traveling to and from the test site. 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. The Federal Regulatory Commission, 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).

UMaine expects installation of the marine components of the project would take a total of about five days (two days to deploy the four anchors, one day to deploy the turbine platform, and two days to install the subsea cable). Project removal activities would take a similar amount of time. Underwater noise associated with the installation, maintenance, and removal activities might cause some fish, marine mammals, birds, and other marine life to avoid the project area; however, this would be short term, with behavior 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. 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). Because of the low level of noise created by a Renewegy 20 kW turbine, the temporary nature of the deployment, and because only a small amount of sound can transfer through the sea surface from above, underwater noise levels resulting from turbine operation are expected to be very low.

Threatened and Endangered Species

Noise associated with project installation, maintenance, and removal activities might cause threatened and endangered 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 and short term with behavior returning to normal after the service vessels leave the site. Effects of project noise would be minimized because of the small scale and temporary nature of the turbine, the low likelihood that listed species would be exposed to the project, the low level of turbine noise to begin with, and because only a small amount of sound is expected to result from transfer of above-water sound through the sea surface.

3.3.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the 1/8-scale floating wind turbine would not occur, and there would be no change in noise conditions in the project area. Baseline conditions, as described in Section 3.2.1, would remain the same.

3.4 Ocean and Land Use

3.4.1 AFFECTED ENVIRONMENT

3.4.1.1 Commercial Fishing

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. In 2011, Maine's commercial fishing industry landed approximately 50 million pounds of fish in Hancock County and approximately 2.5 million pounds of fish in Waldo County, which includes the east and west sides of Penobscot Bay, respectively (DMR 2012b).

Currently, the largest commercial fishery in Penobscot Bay, and Maine in general, is for American lobster. Statewide, lobster accounts for 36% of the live catch by weight and 77% by commercial value as of 2011 (DMR 2012b). UMaine's surveys demonstrated that the area around Castine, including the project area, is targeted by lobster fishermen (Kennedy 2012).

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. While the last cannery in the region closed in April 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. The NOAA Estuarine Living Marine Resources Program compiled information on the distribution and abundance of all life stages of Atlantic herring in estuaries in New England (Jury et al. 1994). Compared to Mid-Atlantic estuaries, adults and juveniles were 'highly abundant' in the northernmost estuaries (Passamaquoddy Bay through Penobscot Bay). Larvae were 'highly abundant' from Englishman-Machias Bays through the Sheepscot River (Jury et al. 1994), an area which includes Penobscot Bay.

The groundfish fishery, or "Northeast multispecies fishery" is managed by the New England Fishery Management Council and NMFS, is primarily an offshore industry (UMaine 2011), and is not applicable to upper Penobscot Bay. With the exception of Atlantic herring, commercial landings in Maine of species represented commonly in the Maine-New Hampshire Trawl Surveys in the region that includes Penobscot Bay, 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 2010).

3.4.1.2 Recreation

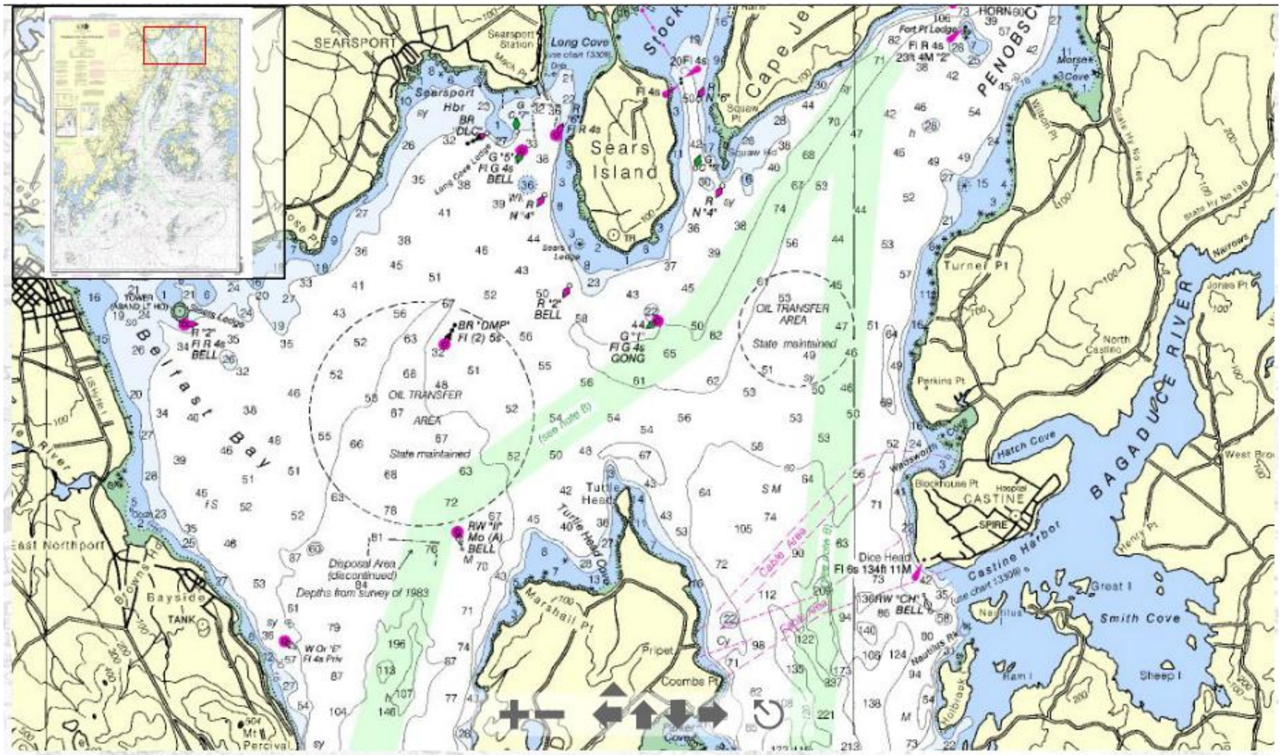
Within Hancock County, which includes the east side of Penobscot Bay, there are six for-hire boats, and within Waldo County, which includes the west side of Penobscot Bay, there are two for-hire boats (DMR 2012a). A number of recreational boating opportunities are available in Castine, including kayaking, boat tours, and sailing (e.g., Castine Yacht Club)(Town of Castine 2012b). The Maine Windjammer Association represents a fleet of 13 traditional Maine tall ships, ranging in size from 46 to 132 feet that offer windjammer cruises out of Rockland, Rockport, and Camden, all located on the west side of lower Penobscot Bay (Maine Windjammer Association 2012). Each summer, lobster boat races are held at Rockland. Additionally, the Gulf of Maine Ocean Racing Association promotes yacht racing in the ocean waters in the Gulf of Maine, including Penobscot Bay (Gulf of Maine Ocean Racing Association 2012). Maine Maritime Academy (2012) also offers a variety of sailing and boating opportunities to its students.

Maine coastal towns are valued for their unique aesthetic character and nautical history. Visitors from around the nation and from other parts of Maine are drawn to the Blue Hill peninsula, which includes Castine, by the scenic natural beauty and historical resource, such as Dyce Head Lighthouse, established in 1828. The grounds are open to the public daily until sunset.

3.4.1.3 Navigation

There are three major ports in Maine: Portland, Searsport, and Eastport. Of these, Castine is closest to Searsport (approximately 6.5 miles to the northwest of the test site). 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 2007, 33 percent of dry cargo was handled in the Penobscot ports (Searsport, Bucksport, and Bangor) (Maine Dept. of Transportation 2012a). In addition to large-scale commercial shipping, many of Maine's harbors have short-distance freight activity to transport goods and services. Figure 3-4 shows the location of major shipping lanes (Recommended Vessel Routes) in Penobscot Bay.

There are two ferry routes in Penobscot Bay: Lincolnville to Ilsesboro and Rockland to Vinalhaven/North Haven (Maine Dept. of Transportation 2012b). These ferry routes are approximately nine and 18 miles, respectively, southwest of the test site.



Source: http://www.charts.noaa.gov/OnLineViewer/13302.shtml

Figure 3-4. NOAA chart (13302) showing Recommended Vessel Routes (green shade) in upper Penobscot Bay.

3.4.1.4 Land Use

As previously mentioned, the terrestrial portion of the project would occur on Dyce Head, north of the light house, in an area dominated by spruce forest and scrub/shrub undergrowth. There are no wetlands. The cable would be laid along the ground across about 300 feet and cross one residential property, from which landowner permission has been granted. The cable would connect to a CMP pole next to the property's driveway.

3.4.2 ENVIRONMENTAL IMPACTS RELATED TO OCEAN AND LAND USE

This section evaluates the potential project effects to the following:

- Ocean use
  - Commercial fishing,
  - Recreation, and
  - Navigation
- Land Use

3.4.2.1 Commercial Fishing

When deployed, a navigation safety zone would be established extending around the turbine platform to a distance of approximately 100 feet beyond the anchors. The moorings have a radius of 600 feet, so the navigation safety zone would have a radius of 700 feet, centered on the turbine. This corresponds to an area of approximately 35 acres in which commercial fishing and other public access would be prohibited for the period during which the project is deployed. A navigation safety zone would also extend along the cable. Access would be permitted over the cable safety zone, but anchoring and deploying lobster traps would be prohibited. The development of the Navigational Safety Plan is discussed further in Section 3.4.2.3.

As mentioned, lobstering is prevalent in Penobscot Bay and the project area, as it is along the entire Maine coast. During deployment and removal operations, notice would be given to the Maine Marine Patrol and the USCG to alert fishermen about towing operations and to advise for the removal of gear from the planned tow route.

With the exception of the exclusion zone around the floating platform, lobstering and commercial fishing are expected to otherwise continue in this area. Given the relatively 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 anticipated to only minimally reduce or limit lobstering or commercial fishing activities.

3.4.2.2 Recreation

Recreational fishermen are expected to continue fishing activities in the greater Castine/eastern Penobscot Bay area with the only change being that they would not be able to enter the 35-acre turbine exclusion area or anchor along the cable route. Any boat that is approaching the turbine platform would have to alter their course by a maximum of 700 feet, and the test site is not expected to affect recreational boaters or cruising vessels approaching or leaving Castine Harbor or navigating through Penobscot Bay. The relatively small area of the navigation safety zone in comparison to the rest of Penobscot Bay and the short duration of the turbine deployment would unlikely reduce the recreational fishing, recreational boating and cruising, and other recreation activity that occurs in the area.

3.4.2.3 Navigation

The nearest ports to the project are Searsport, located northwest across Penobscot Bay from Castine, and the Penobscot River ports of Bucksport and Bangor. There are two Recommended Vessel Routes that run the length of Penobscot Bay and the edge of the nearest route is located approximately 3,000 feet west of the proposed deployment location.

Staff of Maine Maritime Academy, which is a partner with UMaine for this project, have developed a navigation safety plan for the project with the USCG Waterways Management division in Boston. In order to prevent vessels from getting hung up on project moorings, a "Navigation Safety Zone" would be established along the cable and within a 700-foot radius around the floating turbine platform. This designation would prohibit all mariners from entering the turbine platform zone, or anchoring along the cable route, for up to four months during which the turbine is deployed. This zone around the turbine would prevent vessels from dragging, anchoring, or fishing within the radius of the anchors and mooring lines.

The turbine would have two lights on the tower, at a height of 20 feet above the water, one on each side of the tower structure. Each light would be a 360°, white flashing light, flashing two short followed by one long flash every four seconds (Morse letter "U"), and visible for at least six miles. The turbine also would have a red Federal Aviation Administration light.

The turbine tower would be clearly labeled (e.g., DCW-1). 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 three feet high. The USCG would produce a Local Notice To Mariners warning mariners of the location of the project.

The Navigation Safety Plan, as summarized above, and the small and temporary nature of the project, minimizes the chance of boat collisions with the project.

3.4.2.4 Land Use

For the terrestrial portion of the project, the cable, contained in a conduit, would be laid on and anchored to the ground for up to 300 feet from the high tide line to the interconnect point. Following the approximately four-month project deployment, the cable would be removed.

The cable would cross one private residential property, from which landowner permission has been granted. It would not cross any other properties, and there are no other land use types in the proposed cable pathway. The terrestrial habitat consists of a combination of trees and shrubs. The footprint of the shore component of the project would be small, the cable and other components would be designed and located to minimize terrestrial disturbance (i.e., laying the cable in a conduit on the ground, and not burying it or suspending it from poles), and those components would be deployed for a short duration and removed at the end of the project.

3.4.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the 1/8-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.

3.5 Cultural Resources

3.5.1 AFFECTED ENVIRONMENT

More than 100 historic markers occur in Castine (Town of Castine 2012a), a town characterized by its 18th century Greek revival and federal architecture (National Historic Register 2012). The National Historic Register (2012) lists three historic or archeological districts and four historic properties in Castine:

- Castine Historic District (Figure 3-5, encompasses all of the below sites except for Off-the-Neck Historic District),
- Pentagoet Archeological District,
- Off-the-Neck Historic District,
- Fort George,
- *Bowdoin* (schooner),
- Cate House, and
- John Perkins House.

The Castine Historic District (Figure 3-5) was added to the National Register of Historic Places in 1973. The Pentagoet Archeological District is the site of a trading post built by the French during the 17th century located on the shore of Castine Harbor (National Historic Landmarks Program 2012). The Off-the Neck Historic District is located north of the Castine peninsula, facing the Bagaduce River, and contains a number of dwellings, many in the Federal style of architecture (Downeast and Acadia 2012). Fort George is an earthworks fort built by the British in 1779 during the American Revolutionary War. It has been partially restored as a state memorial. The *Bowdoin* is a historic ship built in 1921 for Arctic exploration and owned by Maine Maritime Academy. Cate House and Perkins House both located in the Village of Castine, are historic colonial residences (National Historic Register 2012). Also, Dyce Head Lighthouse is listed in the inventory of historic light stations and is included in the Castine Historical District. These sites are evaluated in the following environmental impacts section to determine whether they are in the Area of Potential Effects.

Shipwrecks represent an important component of the nautical history of Maine. Perhaps the most well-known shipwrecks in Penobscot Bay were associated with the Penobscot Expedition, an American Revolutionary era expedition to prevent the construction of Fort George. The closest of the known Penobscot Expedition shipwrecks to the proposed test site is that of the privateer *Defence* (Riess and Daniel 1997), which is located in Stockton Harbor, 5.5 miles to the northwest. Other shipwrecks in Penobscot Bay are mostly early 20th century shipwrecks located on ledges in southern Penobscot Bay around North Haven, Vinalhaven, and Islesboro (US Naval Shipwreck Database accessed 2012).

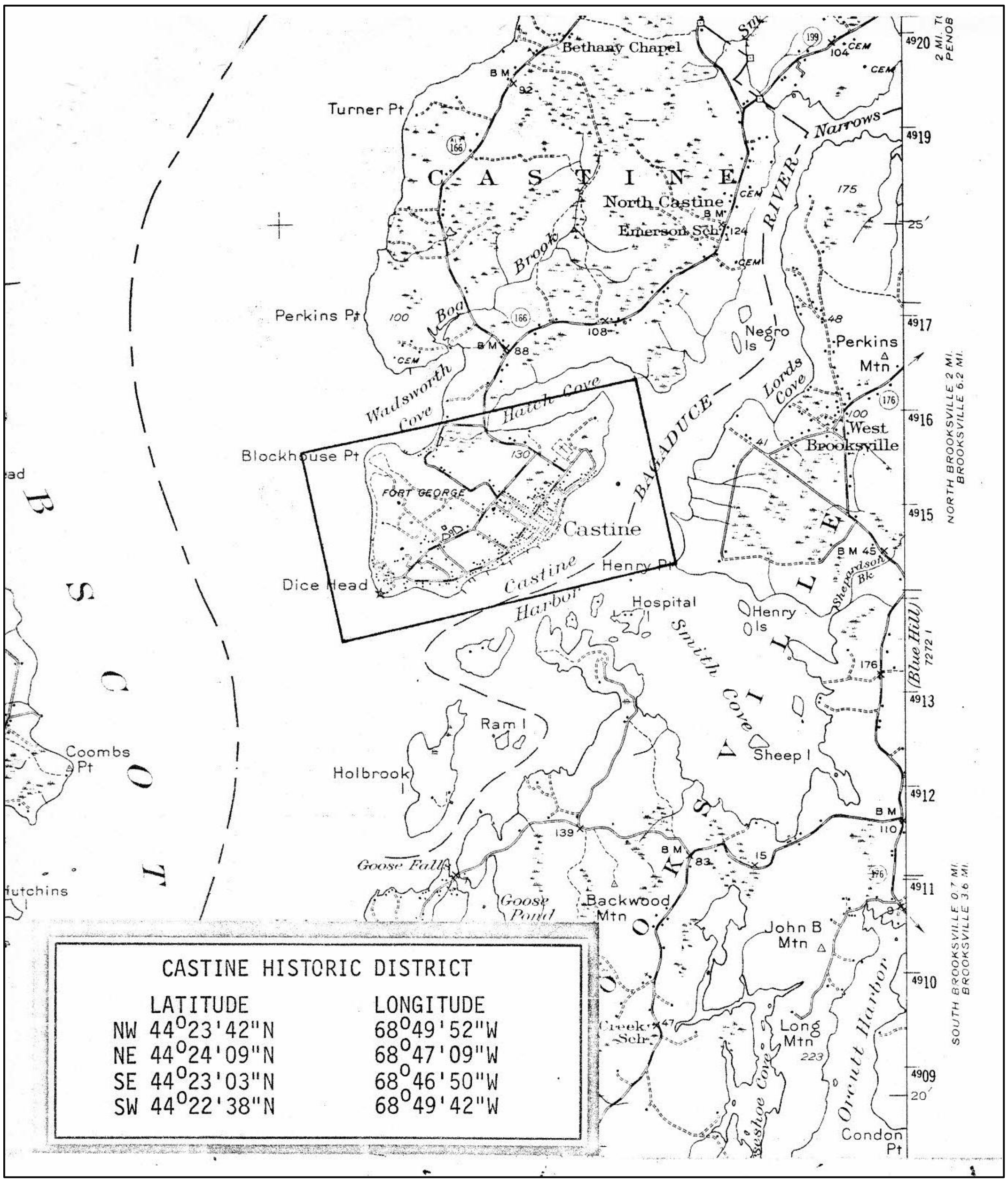


Figure 3-5. Castine Historic District (rectangle).

3.5.2 ENVIRONMENTAL IMPACTS RELATED TO CULTURAL RESOURCES

The Penobscot Indian Nation and the Aroostook Band of Micmacs, both in transmittals dated November 29, 2012, indicated that the project did not affect any sites of tribal significance. To comply with obligations under Section 106 of the National Historic Preservation Act, DOE has defined the area of potential effects to historic properties based on two components. First, the area of the seabed that would be directly disturbed by deployment of anchors is included to account for the potential direct effects of the project on shipwrecks. During installation, drag embedment anchors would be pulled about 50 feet in order to set them with 10 feet of penetration. It is anticipated that half of this distance would be within the substrate below the seabed surface. The actual footprint of each anchor would be at most 16 ft^2, with the four anchors therefore having a combined footprint of about 64 ft^2 and the footprint of the subsea cable and strip weights would be about 357 ft^2. In the event that gravity anchors are used, each anchor would have a footprint of 100 ft^2 for a combined footprint of 400 ft^2. Second, the area of the Castine peninsula from which the platform and turbine could be visible is included to address indirect impacts from a change in the viewshed from historic properties; the Castine Historic District as shown in Figure 3-5 has an area of three square miles.

The turbine platform would be located in a previously disturbed cable ROW to minimize the risk of disturbing shipwrecks or other underwater cultural resources. No known shipwrecks have occurred in the project area and no signs of shipwrecks were observed during UMaine's diver surveys conducted in 2012 within the proposed project site. As directed by the Maine SHPO, UMaine staff consulted with Dr. Warren Riess, a marine archaeology professor at UMaine, to further evaluate whether any Penobscot Expedition shipwrecks or other related historic resource concerns could be located in the project area (Pers. comm. R. Reed, Maine SHPO with D. Brady, UMaine, October 18, 2012). In correspondence with SHPO staff, Dr. Reiss stated "…that all of the known and assumed locations of the Penobscot Expedition vessel remains are well north of the proposed site, the only exception is the privateer *Defence*, which is miles west of Castine" (Pers. comm. Dr. W. Reiss, UMaine with R. Reed, Maine SHPO, October 19, 2012). Dr. Riess oversaw a magnetometer survey conducted at the proposed project site on December 10, 2012, and survey results confirmed that there are no shipwrecks at the site. SHPO stated in a letter dated January 2, 2013 that the project will have no adverse effect on historic properties as defined by Section 106 of the National Historic Preservation Act.

UMaine would locate the turbine off of the western shore of the Castine peninsula in part to minimize its visibility from historic properties. As such, it would not be visible from the Off-the-Neck Historic District or most occupied areas on the peninsula, including much of the Village of Castine, such as where the Cate and Perkins houses and the Pentagoet Archeological District are located and the schooner Bowdoin is docked. The closest historic property to the proposed turbine location is the Dyce Head lighthouse, which is accessible to the public. The turbine would not be visible from that lighthouse (Figure 3-6) or from some other areas on the west side of the peninsula because of the steep shoreline and dense vegetation there. However, the turbine might be visible from some areas along the western portion of the Castine Historic District and from some of the higher points on the peninsula, such as where Fort George is located. There likely are some properties in the areas where the turbine could be viewed that are eligible for listing under the National Register of Historic Places. Because the 1/8-scale turbine would have a maximum height of 57 feet above the waterline, it would appear small from any location within the Castine Historic District or elsewhere on the peninsula, and would not dominate or otherwise substantially change the view from historic properties. In addition, because the turbine would be deployed for less than four months, any change in the view from an historic property would be temporary.

Figure 3-6. View from the base of Dyce Head Lighthouse toward the shore.

Based on this analysis, DOE has concluded in the Section 106 consultation letter to the Maine SHPO that there would be no direct adverse impacts to underwater historic properties from deployment and retrieval of the floating platform or indirect adverse impacts to the viewshed from historic properties on the Castine peninsula. SHPO concluded the same in their letter dated January 2, 2013.

3.5.3 NO-ACTION ALTERNATIVE

Under the No-Action Alternative, DOE would not fund the proposed project, installation and operation of the 1/8-scale floating wind turbine would not occur. Therefore, no potential impacts to cultural resources would occur. Baseline conditions, as described in Section 3.5.1, would remain unchanged.

3.6 Irreversible and Irretrievable Commitments 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 result from resources being consumed during construction of the project, including fossil fuels and construction materials, which would be committed for the less than one 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 one small-scale floating wind turbine, project operations, and monitoring efforts.

The 700-foot radius navigation safety zone around the turbine corresponds to an area of approximately 35 acres for which commercial fishing and other public access would be prohibited for the period during which the project components are deployed. In addition, anchoring or setting lobster pots would not be permitted along the cable route for the four-month project deployment. 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.

The proposed project would not have other irreversible or irretrievable impacts because the project is short term and temporary; removal of the turbine 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.

3.7 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, 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.

4.0 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). 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.

Following testing of the proposed turbine at Castine for up to four months, UMaine is planning to move the turbine to the Monhegan site for additional testing. It is expected that the turbine would be tested for less than one month at the Monhegan site in 2013. In addition, UMaine may conduct testing at the Monhegan site the following year as well.

In October 2011, Statoil filed an Unsolicited Lease Application with the Bureau of Ocean Energy Management to develop a 12-MW pilot project, consisting of four 3-MW floating turbines in federal waters about 12 nautical miles southeast of Boothbay Harbor. Statoil is currently investigating the feasibility of the project with the State of Maine. Initially, Statoil planned to install the project in 2016.

UMaine is also beginning work on engineering and planning for the possible installation of a pilot floating offshore wind farm with two 6-MW direct-drive turbines on concrete semi-submersible foundations at the Monhegan test site. Pending required approvals by the Department of Energy and other regulatory agencies, the target date for deployment would be 2016.

During the four months that the 1/8–scale turbine would be deployed at Castine, combined with the subsequent deployment for up to one month at Monhegan, the proposed project might cumulatively add to the risk of foraging and migrating bird and bats colliding with man-made structures in the area. 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).

The proposed future deployments by Statoil and UMaine in 2016 would occur at least three years after the Castine deployment has been removed. As discussed in this Supplemental EA, effects of the proposed project at the Castine site would be short term and would end with the removal of the project after four months or less of operation. Thus, the proposed deployment at Castine would not cumulatively contribute to other future effects of those projects.

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APPENDIX A

CONSULTATION LETTERS