Oregon State University and Northwest National Marine Renewable Energy Center Wave Energy Test Project

Draft Environmental Assessment

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Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
AIS	automatic identification system
BA	biological assessment
BLM	U.S. Bureau of Land Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
dB	decibels
DCH	designated critical habitat
DOE	U.S. Department of Energy
DPS	Distinct Population Segments
DSL	Department of State Lands
DSL	Oregon Department of State Lands
EA	environmental assessment
EFH	essential fish habitat
EIS	environmental impact statement
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FCC	Federal Communications Commission
FERC	Federal Energy Regulatory Commission
FINE	Fishermen Involved in Natural Energy
FMPs	fishery management plans
FONSI	Finding of No Significant Impact
GIS	geographic information service
GPS	global positioning system
HMSC	Hatfield Marine Science Center

Hz	hertz
ICF	ICF International
kW	kilowatt
LASAR	Laboratory Analytical Storage and Retrieval Database
lb/gal	pounds per gallon
Lpeak	peak noise level
Magnuson-Stevens Act	Magnuson-Stevens Fisheries Conservation and Management Act
metocean	meteorological and oceanic
ms	millisecond
MW	megawatt
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NNMREC	Northwest National Marine Renewable Energy Center
NOAA	National Oceanic and Atmospheric Administration
NRHP	National Register of Historic Places
NSF	National Science Foundation
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OFWO	Oregon Fish and Wildlife Office
OOI	Ocean Observatories Initiative
OPRD	Oregon Parks and Recreation Department
OPT	Ocean Power Technologies
Oregon ESA	Oregon Endangered Species Act
ORS	Oregon Revised Statutes
OSU	Oregon State University
PADA	power analysis and data acquisition

Proposed Project	OSU and NNMREC Wave Energy Test Facility Project
PUD	People's Utility District
ROD	record of decision
SEL	sound exposure level
SHPO	State Historic Preservation Office
SPL	sound pressure level
TSP	Territorial Sea Plan
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
UW	University of Washington
WEC	wave energy conversion
WET-NZ	Wave Energy Technology-New Zealand
µg/L	micrograms per liter
µPa	micropascal

1.0 Introduction

1.1 Background

The Northwest National Marine Renewable Energy Center (NNMREC), a partnership between Oregon State University (OSU) and the University of Washington (UW), was established through the U.S. Department of Energy (DOE) Wind and Water Power Program and local funding to support wave and tidal energy development for the United States. OSU's focus is on wave energy development and UW's focus is on tidal energy development. The collective NNMREC activities facilitate commercialization of wave and tidal energy devices, inform regulatory and policy decisions, and close key gaps in marine renewable energy understanding.

The OSU and NNMREC Wave Energy Test Project (Proposed Project) is an effort to deliver a mobile capability for testing the output of wave energy conversion (WEC) devices. As the lead for NNMREC's wave energy work, OSU would be the technical agent for the Proposed Project which would be located approximately 2.0 miles (3.2 kilometers) off the coast of Oregon near the city of Newport, Oregon. The Wave Energy Technology-New Zealand (WET-NZ) device would be the first WEC device deployed at the site and tested using the testing equipment included in the Proposed Project in 2012 and 2013.

1.2 National Environmental Policy Act

DOE proposes to provide federal financial assistance to NNMREC for the design, construction, and operation of the Proposed Project. DOE also proposes to provide federal financial assistance to support controlled open-sea deployment of the WET-NZ WEC device using the testing equipment and at the site of the Proposed Project in the summer and fall of 2012 and summer of 2013. The 2012-2013 WET-NZ test is the first specific test proposed to take place at the project site and using the Ocean Sentinel. DOE's action to provide financial assistance for the Proposed Project and the 2012-2013 WET-NZ test is referred to hereafter as the "Proposed Action." The proposal to provide federal financial support is considered a federal action and, therefore, is subject to the procedural requirements of the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321) and DOE's NEPA regulations (10 Code of Federal Regulations [CFR] Part 1021). To comply with NEPA, DOE has determined the need to prepare an environmental assessment (EA) to evaluate the potential impacts that could result from their Proposed Action. The provision of financial assistance for the Proposed Project and the 2012-2013 WET-NZ test is conditional upon the completion of the NEPA process whereupon a final decision would then be made by DOE.

In compliance with the Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA (40 CFR Parts 1500–1508) and DOE's NEPA implementing procedures (10 CFR Part 1021.330 *et seq*.) this EA:

- assesses the environmental impacts of the Proposed Action and a No Action Alternative;
- identifies any adverse environmental impacts that cannot be avoided should the Proposed Action be implemented;

- describes the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; and
- characterizes any irreversible and irretrievable commitments of resources that would be involved should the Proposed Action be implemented.

DOE must meet these requirements before making a final decision to proceed with any proposed federal action that could cause significant impacts on the human or natural environment. This EA meets DOE's regulatory requirements under NEPA because it provides the necessary information for DOE and other federal agencies to make informed decisions regarding the construction, installation, operation, maintenance, removal, and decommissioning of the Proposed Project.

This EA evaluates the potential direct, indirect, and cumulative impacts of the Proposed Project. For purposes of comparison, this EA also evaluates the impacts that would occur if DOE does not provide financial assistance and the Proposed Project is not constructed (the No Action Alternative). The siting criteria used to minimize potential impacts and narrow the area for the Proposed Project to a feasible location are described in Section 2.4. This EA also provides information to evaluate the potential direct, indirect, and cumulative impacts of the 2012-2013 WET-NZ test.

DOE is the lead federal agency for the EA. Other federal, state, and local agencies and the public have been invited to participate in the environmental documentation process. DOE has posted this EA on the DOE Golden Field Office Reading Room website (http://www.eere.energy.gov/golden/NEPA_DEA.aspx).DOE sent postcards to the individuals listed in Chapter 5 of this EA to notify them of the EA's availability on the web and announce a 21-day public comment period. A Notice of Availability was published in the local paper, the *Newport News Times* and *The Oregonian*. This EA is available to interested members of the public, Native American tribes, and federal, state, and local agencies for review and comment prior to DOE's final decision on the Proposed Action. DOE will consider all comments received on the EA and will make revisions, if appropriate.

1.3 Purpose and Need

DOE's Wind and Water Power Program supports the development and deployment of advanced water power devices such as those that capture energy from waves, tides, ocean currents, and ocean thermal variables. A goal of the program is to help industry harness this renewable, emissions-free resource to generate environmentally sustainable and cost-effective electricity. To meet this goal, DOE supports the design and development of advanced water power devices and components as well as the deployment and testing of those devices. DOE also supports efforts to accelerate market development of wave energy technologies by providing financial assistance to projects that reduce the time and costs associated with siting water power projects. Another programmatic goal is to support research into the effects of marine energy technologies on aquatic ecosystems and marine species.

Providing financial assistance to support the Proposed Project and testing of the WET-NZ device would meet the DOE Wind and Water Power Program objectives to "increase the development and deployment of reliable, affordable, and environmentally sustainable wind power technologies to realize the benefits of domestic renewable energy production" (U.S. Department of Energy 2011b), and to "research, test, evaluate, and develop innovative technologies capable of generating renewable, environmentally responsible, and cost-effective electricity from water resources" (U.S. Department of Energy 2012).

Continued research and testing is needed to develop and advance different marine renewable energy technologies for cost-effective use by the industry and to evaluate the technical aspects, performance characteristics, and environmental impacts of developing marine renewable energy. Full-scale open ocean testing for wave applications is necessary to evaluate the technology, optimize energy extraction, and research potential environmental impacts. However, there currently is no open-ocean test site in United States waters where these devices can be tested off the electrical grid. Because testing facilities connected to the electrical grid are more costly to develop and take longer to construct, a test apparatus independent from the electrical grid would simplify and expedite ocean-based energy development.

The Proposed Project would provide WEC device developers with access to a testing apparatus in an open ocean environment where the response of their device to wave effects can be tested in a real-world setting. The Proposed Project would be the first of its kind in continental North America and would be an integral implementing step in the advancement of wave energy production. This mobile, floating capability to test wave energy technologies without a connection to an electrical grid would allow for the collection of data under different wave conditions.

1.4 Scoping and Public/Agency Involvement

1.4.1 NNMREC Public Involvement

Prior to the scoping meetings, NNMREC conducted outreach designed to engage stakeholders and interested parties in the early stages of its project. As part of the site-selection process, a cooperative partnership formed by NNMREC, Oregon Sea Grant, and the Hatfield Marine Science Center (HMSC) conducted public involvement activities to engage commercial fishing interests and members of the general public in Lincoln County, Oregon. As early as 2007, discussions with the Fishermen Involved in Natural Energy (FINE) Committee were initiated and community forums were held to engage citizens in Lincoln County in the planning and development of wave energy generation. The first forum was held on June 25, 2007, in Newport, Oregon. On August 25, 26, and 27, 2009, forums were held in the Oregon cities of Yachats, Newport, and Lincoln City, respectively. In 2009, NNMREC began coordinating with FINE to identify an area for the Proposed Project that would meet the technical and environmental requirements of the project, but would minimize impacts on the fishing industry. NNMREC met with FINE on over a dozen occasions to date.

On February 25, 2010, another pre-scoping meeting was held to provide a project overview to representatives of the U.S. Army Corps of Engineers (Corps). Other meetings included a March 19, 2010 meeting with the Confederated Tribes of the Siletz.

1.4.2 DOE Public Scoping

Scoping is the process of identifying alternatives to the Proposed Action and determining the scope of environmental issues to be addressed in the EA. In April 2010, DOE notified federal, state, and local agencies, tribal government representatives, elected officials, businesses, and organizations about the Proposed Project. DOE mailed notices directing the recipients to the DOE's Golden Office Public Reading Room website[1] to read a scoping letter that described the Proposed Project. The purpose of the notice was to request assistance in identifying potential issues that should be evaluated in the EA, and announced the date, time, and location of the planned public scoping meeting for the Proposed Project. The scoping letter with project location maps and the distribution list of recipients are included in Appendix A of this EA. Comments received from agencies and individuals during the scoping process are also included in Appendix A of this EA.

Written comments in response to the scoping process for the Proposed Project were received from the Oregon Fish and Wildlife Office (OFWO) of the U.S. Fish and Wildlife Service (USFWS), the Oregon Department of Fish and Wildlife (ODFW) Hydropower Program, the Oregon Chapter of the Surfrider Foundation, and several private citizens. The comments from OFWO pertained to fish and wildlife resources of special interest to OFWO. These included species such as marbled murrelet, short-tailed albatross, brown pelican, and northern bald eagle. OFWO comments also pertained to consultation under Section 7 of the Endangered Species Act (ESA); rocks, reefs, and islands along the coast; migratory seabirds; and gray whale migration corridors.

Comments from ODFW's Hydropower Program pertained to project siting, consultation with other state agencies, the temporal and geographic scope of the EA, the consideration of a power cable to shore as a foreseeable action, and alternatives to DOE's Proposed Action.

The Oregon Chapter of the Surfrider Foundation provided comments pertaining to wave dynamics, electromagnetic field generation, migration corridor overlap, substrate disruption, the coastal recreation community, and adaptive management.

Private citizens provided comments pertaining to the historic Yaquina Head lighthouse, the visual impacts of the Proposed Project, the local hospitality industry, mooring systems for the project, a possible future power cable to shore, whale migration, entanglement of fishing gear, marine navigation, noise, and electromagnetic fields.

On May 5, 2010, a public scoping meeting for the Proposed Project was held in Newport, Oregon. Prior to the scoping meeting, several public notices were issued. In addition to the notices mailed by DOE, two notices of scoping were published in the *Newport News Times* (the local newspaper) on April 30, 2010 and on May 5, 2010. One notice of scoping was published in the Oregonian (a state-wide publication) on May 1, 2010. There was also an article regarding the Proposed Project that included details about the scoping meeting published in the *Newport News Times* on April 30, 2010.

Oral comments were submitted during this meeting. A full transcript of these comments is included in Appendix A. Oral comments submitted during the scoping meeting pertained to alternative sites, recreational fishing, emergency response systems, seabirds, and mooring configurations. In response to scoping comments, two topic areas—emergency response and recreational fishing—were added to the analysis. All oral and written comments received during the scoping period were considered by DOE and addressed, if appropriate, in this EA.

At the conclusion of scoping it was anticipated that the Draft EA for the Proposed Action would be published in late 2010; however, the preparation of the Draft EA was postponed. During this time, NNMREC made minor changes to the Proposed Project. For example, these included changing the

[1] http://www.eere.energy.gov/golden/NEPA_DEA.aspx

test apparatus (described as the Mobile Ocean Test Berth or MOTB during scoping) from a 30- to 40-foot boat-shaped hull capable of testing loads up to 1 megawatt, to the Ocean Sentinel, a 6-meter NOMAD-shaped buoy capable of testing loads up to 100 kilowatts (see Section 2.2.2 for a full description of the Ocean Sentinel). The duration of deployments for the testing apparatus was shortened from 12 months to 3 to 6 months. The range of possible anchoring and mooring infrastructure was narrowed, and the standoff distance between the test buoy and the WEC device under test was decreased. The first WEC device (the WET-NZ device) to be tested at the project site was identified, though it fell within the parameters for likely WEC devices that would be tested as described in scoping. During scoping, the project site was defined as a 6-square-mile quadrant. Later, the project site was narrowed down to a 1-square-nautical-mile area within the original, larger site.

The minor project changes described above fell within the parameters described during the original scoping process; therefore, DOE determined that reinitiating a new scoping period was not necessary. Because the size of the instrumentation buoy and the project area decreased and the WET-NZ device to be deployed comports with the previous description of potential WEC devices for testing, the extent of the action did not change significantly and the range of alternatives and the potential impacts anticipated were not affected.

1.4.3 DOE Public and Agency Involvement

DOE consultation with the National Marine Fisheries Service (NMFS) and USFWS, pursuant to Section 7 of the ESA, is ongoing as part of this NEPA process. Early coordination and preconsultation with USFWS and NMFS occurred in the following emails and phone conversations:

- April 8, 2010: conference call to present project overview, attended by representatives of DOE, NNMREC, and NMFS.
- May 4, 2010: call between representatives of ICF International (ICF) and USFWS to establish USFWS jurisdictional species to be addressed.
- May 17, 2010: call between representatives of ICF and NMFS to discuss NMFS jurisdictional species to be addressed.
- May 26, 2010: NMFS provided a list of NMFS jurisdictional species to be addressed.

DOE prepared a biological assessment (BA), which was submitted by DOE to NMFS and USFWS for their evaluation on January 11, 2012. The BA evaluates the potential impacts of DOE's Proposed Action on species that are listed as endangered or threatened, or proposed for such listing, under the ESA. The BA also includes an assessment of essential fish habitat (EFH) under the Magnuson-Stevens Fisheries Conservation and Management Act (Magnuson-Stevens Act) and established Proposed Project compliance with the Marine Mammal Protection Act (MMPA), as amended in 2007.

After the BA was submitted, NNMREC, ICF, and Pacific Energy Ventures (PEV) participated in meetings with NMFS to discuss the development of monitoring plans, mitigation, and adaptive management that would be implemented as part of the Proposed Project to address potential impacts on the resources analyzed in the BA. This includes the following meetings and phone calls:

- February 22, 2012: conference call to discuss preliminary comments on the BA attended by representatives of NMFS, ICF, NNMREC and PEV.

- March 19, 2012: conference call to discuss monitoring plans and revisions to the BA to address comments attended by representatives of NMFS, ICF, and PEV.
- March 29, 2012: meeting at NMFS offices in Portland, Oregon to discuss the actions being considered in the BA and the approach to monitoring plans and adaptive management attended by representative of NMFS, NNMREC, ICF, and PEV.
- April 12, 2012: meeting at ICF offices in Portland, Oregon to refine the monitoring plans and adaptive management approach attended by representatives of NMFS and the Corps,
- April 26, 2012: conference call to discuss the refinements to the adaptive management framework document to be submitted as part of a revised BA attended by representatives of NMFS, NNMREC, ICF, and PEV.
- May 8 and 9, 2012: Conference calls between representatives of ICF, PEV, NNMREC, and NMFS to finalize the monitoring plans and adaptive management framework for the Proposed Project.
- A revised BA was prepared after stakeholder and other input and submitted to NMFS and USFWS on May 18, 2012. NMFS provided a request for additional information on June 7, 2012. A response was prepared and submitted on June 14, 2012.
- On June 21, 2012, NMFS submitted a letter indicating that it does not concur with the findings of the BA's *Not Likely to Adversely Affect* determination for ESA-listed species, critical habitat, and essential fish habitats occurring within the project area. The letter initiated formal consultation under Section 7 of ESA and identified that NMFS would prepare a biological opinion. Communication between DOE, USFWS, and NMFS is included in Appendix B of this EA.

As part of the NEPA process, DOE also consulted with the State Historic Preservation Officer (SHPO), pursuant to Section 106 of the National Historic Preservation Act (NHPA). In July 2010, DOE requested concurrence with its findings that from the SHPO that the Proposed Action would result in no effects on known cultural or historic resources. In a letter dated August 9, 2010, the SHPO concurred with DOE's findings and indicated that no further archaeological research is required. This letter and other agency correspondence are included in Appendix B of this EA. A second letter was sent to the SHPO on June 19, 2012, to provide a history of project developments subsequent to the August 9, 2010 letter and present the revised project description. Because the changes to the Proposed Project fell within the parameters presented to the SHPO in the August 9, 2010 letter, reinitiating consultation was not required.

1.5 Organization of Environmental Assessment

This EA is organized in a manner consistent with NEPA and DOE's NEPA implementation guidelines (40 CFR Parts 1500–1508, 10 CFR 1021). The organization, content, and objectives of each chapter are as follows:

Chapter 1 – Introduction presents the regulatory context and rationale for preparing this EA; provides background about the Proposed Project; defines the purpose and need for the Proposed Project; summarizes the public scoping and involvement process and results; and clarifies the organization, content, and objectives of this EA.

Chapter 2 – Proposed Action and Alternatives presents a detailed project description, including characteristics of the siting, design, construction, and operation of the Proposed Project. A number of Applicant Committed Measures that would be incorporated into the Proposed Project are included in this chapter. The monitoring plans and adaptive management strategies that would be implemented as part of the Proposed Project are also identified in this chapter. A description of the No Action Alternative and alternatives considered but eliminated is also included.

Chapter 3 – Affected Environment and Environmental Consequences is organized by resource area. For each resource, environmental baseline information is described and the potential impacts of the Proposed Project and No Action Alternative are compared.

Chapter 4 – Cumulative Impacts presents an evaluation of potential cumulative impacts on the resources identified in Chapter 3 that may result from past, present, and reasonably foreseeable future actions and projects.

Chapter 5 – Distribution List identifies agencies, organizations, and persons receiving the EA.

Chapter 6 – References lists key documents and resources used in the preparation of this EA.

Appendix A – Scoping Materials includes the scoping materials that were distributed and received.

Appendix B –Agency Correspondence includes communications with other governmental agencies that occurred outside of the scoping process.

Appendix C – Example WEC Device Technologies identifies a few example WEC devices that are similar to those that could be tested as part of the Proposed Project.

Appendix D – Adaptive Management Framework provides a means for the broader regulatory and stakeholder communities to stay informed of and provide feedback on NNMREC test center monitoring and mitigation for the entire lifetime of the Proposed Project; the framework provides a foundation for monitoring and adaptive management associated with individual tests at the project site.

Appendix E – Monitoring Plans includes plans and studies that are designed to increase the knowledge of the potential effects that could occur under the Proposed Project and, in some cases, to set a baseline for future monitoring have been conducted, are being conducted presently, or will be conducted by NNMREC and OSU.

2.0 Proposed Action and Alternatives

2.1 Overview

This chapter describes the Proposed Action and the No Action Alternative. The U.S. Department of Energy's (DOE's) Proposed Action is to provide financial assistance to the Northwest National Marine Renewable Energy Center (NNMREC) to support the design, construction, and operation of the Wave Energy Test Project (Proposed Project) located in the Pacific Ocean approximately 2.0 miles (3.2 kilometers) off the coast of the Oregon coast near the city of Newport, Oregon.

DOE also proposes to provide federal financial assistance to support controlled open-sea deployment and test of the WET-NZ WEC device using the testing equipment and at the site of the Proposed Project. This involves short-term testing of a scaled WEC device at the NNMREC ocean test site to collect environmental, technical, and energy resource information to support responsible development of wave energy technologies. Primary components include the half-scale WET-NZ WEC device, the Ocean Sentinel instrumentation buoy, a power and communications cable, a TRIAXYS™ wave measurement buoy, and associated mooring systems. Tests conducted in the summer and fall of 2012 and summer of 2013 would provide energy capture performance data and an improved understanding of the wave impedance matching ability of the WET-NZ design. The 2012-2013 WET-NZ test—which is also part of DOE's Proposed Action—would be the first specific test proposed to take place at the project site using the Ocean Sentinel. The devices would be deployed for approximately 6 weeks during the late summer and early fall of 2012 and up to 3 months during the summer of 2013; the mooring systems would remain in place for the duration of the proposed test (approximately 2 years).

2.2 Proposed Action

DOE's Proposed Action is to provide financial assistance to NNMREC to support the design, construction, and operation of the Proposed Project. The Proposed Project would be capable of testing the output of a variety of WEC devices without being connected to the electrical grid as a cost-effective means to evaluate the technical aspects, performance characteristics, and environmental impacts of developing marine renewable energy. The Proposed Project would include the design, construction, deployment, operation, removal, and decommissioning of up to two Ocean Sentinel instrumentation buoys. It would also include deployment of a TRIAXYS™ wave measurement buoy and other instrumentation (identified in Section 2.2.2 below) used in studies to characterize and monitor a number of environmental conditions within and near the project site and evaluate the effects of WEC devices on the natural and human environment. The Ocean Sentinel buoy(s) would be capable of receiving power from a variety of off-grid WEC devices (i.e., devices that do not have a cable connection to the onshore electrical grid) and would analyze and record technical data on the power generation of a variety of off-grid WEC devices. Alternative test scenarios involving the use of test equipment aboard a manned vessel and test equipment integrated into WEC devices may also be part of the Proposed Project and are described in Section 2.2.9, *Testing Scenarios*. The lifetime of the Proposed Project would be no more than 10 years.

2.2.1 Project Site

The proposed project site would consist of a square area of ocean, centered approximately 2 miles (3 kilometers) off the Oregon coast near the city of Newport, Oregon (Figure 2-1).

The majority of the operations, equipment, and infrastructure associated with the Proposed Project would be limited to the 1-square-nautical-mile (3.4-square-kilometer) proposed project site. The Ocean Sentinel, TRIAXYS™ buoy, WEC devices under test, and some of the other associated research and monitoring instrumentation would be located within the boundaries of the project site. The monitoring and research instrumentation that may be located outside the project site is identified in Section 2.2.2. The whole of the project site would be less than 3 miles (5 kilometers) from shore and entirely within Oregon State territorial waters. The coordinates marking the four corners of the project site are presented in Table 2-1.

Table 2-1. Project Site Coordinates

Project Site Corner	Latitude	Longitude[1]
Northwest	N44.697	W124.146
Northeast	N44.699	W124.123
Southeast	N44.682	W124.122
Southwest	N44.681	W124.145

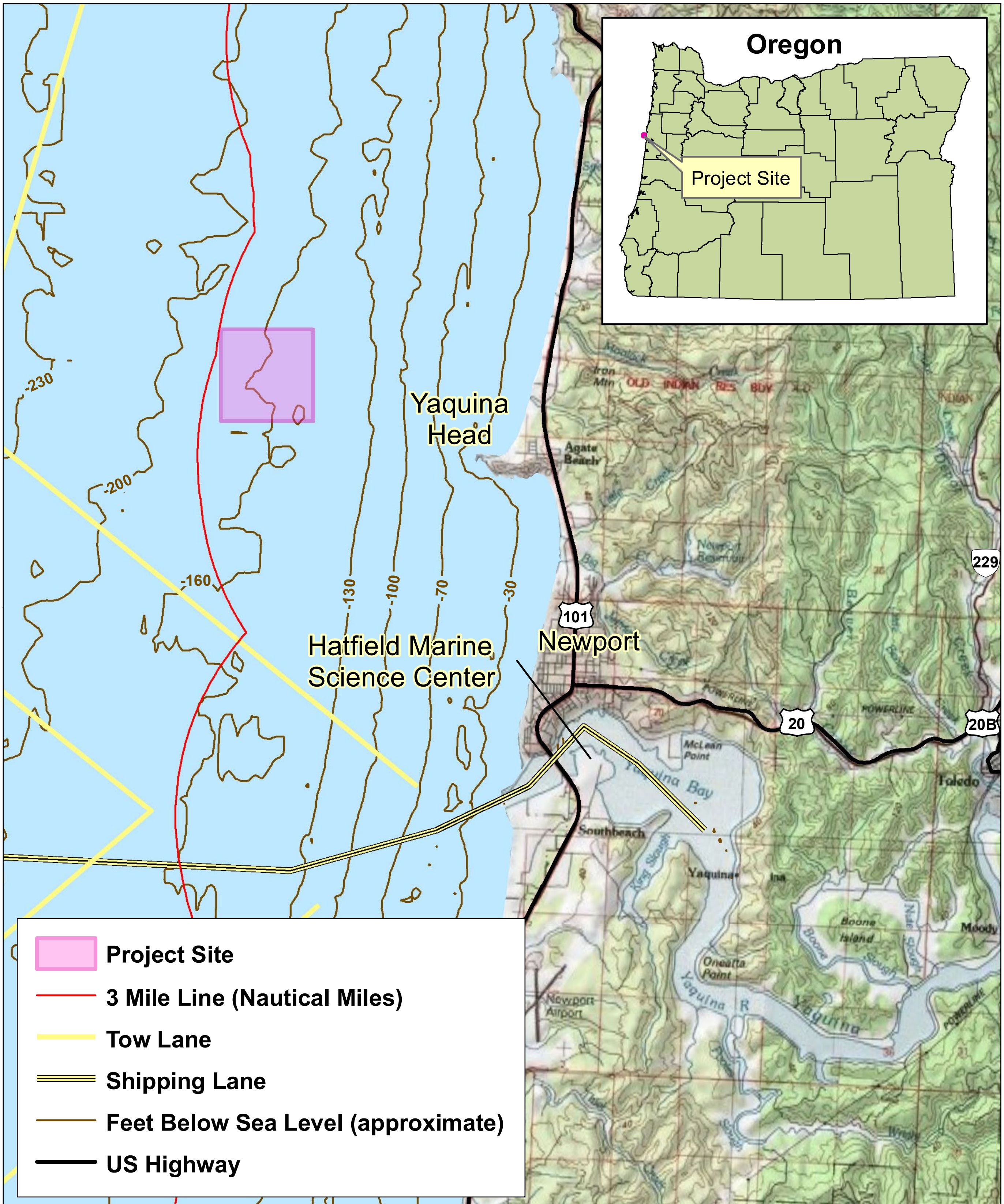
[1] Lambert Conformal Conic NAD83.

The proposed project site was identified through consultation and cooperation with interested groups and individuals, including the NNMREC research team, Hatfield Marine Science Center (HMSC), Fishermen Interested in Natural Energy (FINE), and Oregon Sea Grant. Over a 24-month period, NNMREC conducted a site-selection process, which involved stakeholders and interested parties and resulted in a variety of site criteria (see Section 2.4).

2.2.2 Ocean Sentinel Instrumentation Buoy

The Ocean Sentinel (Figure 2-2 and Figure 2-3) is a customized instrumentation buoy that would monitor and record WEC device performance and environmental data. The primary functions of the Ocean Sentinel are as follows:

- Provide standalone electrical loading and power conversion for the WEC under test.
- Measure and record WEC power output.
- Collect and store data transmitted from both the WEC under test and a wave measuring instrument moored close by.
- Transmit collected data to a shore station via a wireless telemetry system.
- Conduct environmental monitoring.



Source: National Geographic Society TOPO, courtesy of ESRI

Kilometers 0 1.5 3

Nautical Miles 0 1.5 3

Figure 2-1
Project Site

Figure 2-2. Ocean Sentinel Instrumentation Buoy—Exterior View in Dry Setting

Figure 2-3. Ocean Sentinel Instrumentation Buoy—Marine Setting

The Ocean Sentinel has an aluminum hull with steel/aluminum/composite instruments. The Ocean Sentinel measures 21.25 feet (6.5 meters) long, 10.5 feet (3.2 meters) wide and 24 feet (7.3 meters) high with approximately 15 feet (4.6 meters) from the mean water line to the antenna locations

(Figure 2-4). Including fuel and equipment, the Ocean Sentinel has a displacement of 19,600 pounds (8,890 kilograms). The Ocean Sentinel is also outfitted with radio antennae, data acquisition systems (DAS), telemetry systems, monitoring devices (seabird detection, atmospheric monitors, cameras, etc.), and power systems (solar panels, a wind turbine, and a diesel generator). The hull of the Ocean Sentinel would be coated with an antifouling compound to resist growth and colonization of marine organisms. The antifouling compound used for the Ocean Sentinel would be free of tributyltin (TBT) and copper.

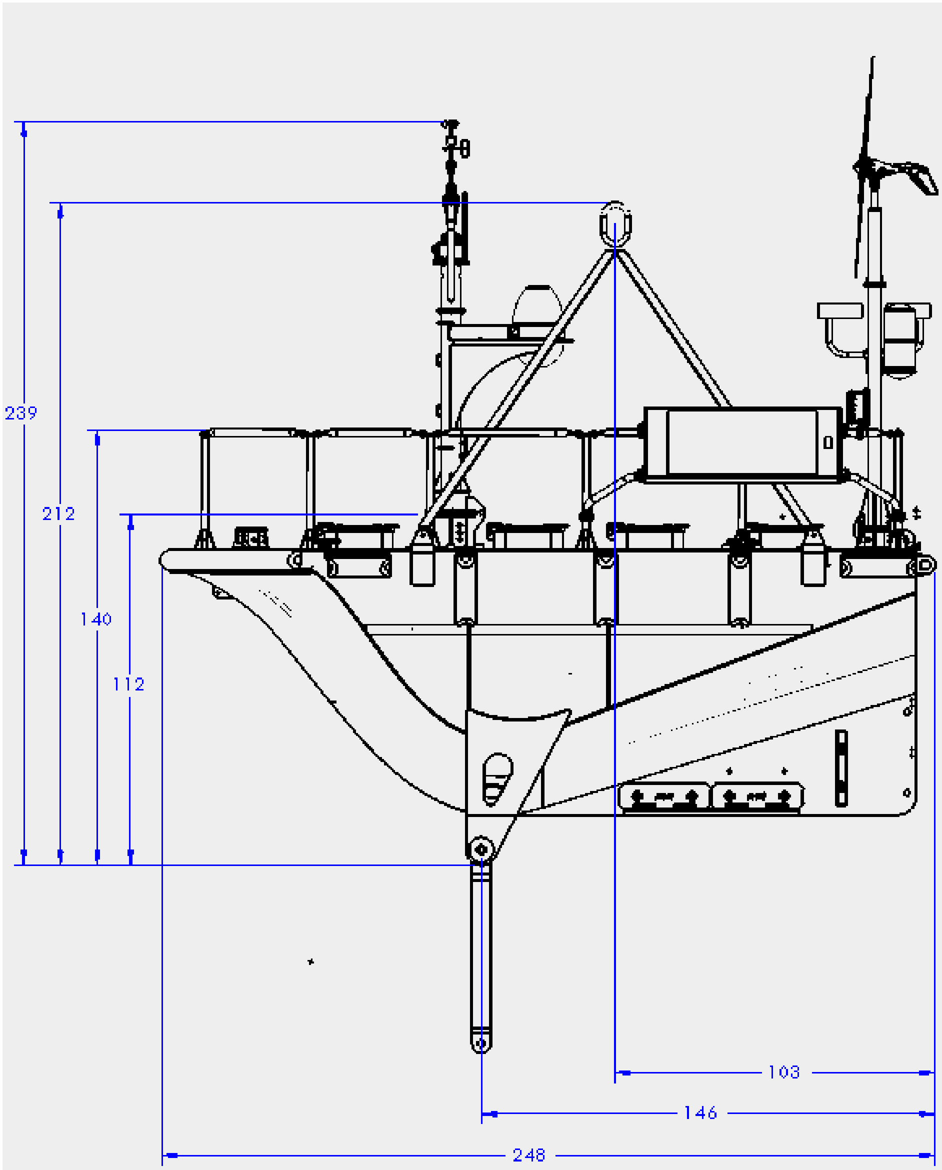
Data Acquisition System and Telemetry

Two DASs would be used: 1) a National Instruments CompactRIO based system developed by NNMREC to measure and record WEC device test data, and a Watchman500 DAS developed by AXYS Technologies to monitor and control the power system, monitor environmental sensors, and interface with the TRIAXYS™ wave measurement buoy. The two DASs would communicate to shore via a common telemetry system.

The DAS unit would measure the output current, voltage, phase, and frequency from a variety of conceivable WEC devices. The DAS unit would use a programmable logic controller to acquire systems data such as modal response (heave, pitch, yaw, and roll), WEC device power analysis outputs, and global positioning system (GPS) location. Using the Ocean Sentinel's radio antenna, this data would be transmitted to shore. The DAS unit would also store and back up data on an onboard computer. At times, the DAS unit may be powered by commercially available, marine-grade batteries and potentially, the connected WEC device.

Communications between the WEC device under test and the Ocean Sentinel would be provided by fiber optic cables integrated in the umbilical cable. Connectivity between the Ocean Sentinel and the shore station would be provided via two redundant, Federal Communications Commission (FCC)-compliant telemetry systems: an existing, 802.11b Ship to Shore Wireless Access Protocol network run by the OSU College of Earth, Ocean and Atmospheric Sciences; and 3G cellular. Both systems would be capable of providing real-time continuous monitoring of the WEC device and Ocean Sentinel. The shore-side receiver would be mounted on an existing antenna owned by the Central Lincoln People's Utility District. The telemetry system would also include a short-range wireless Ethernet connection to allow service vessels to access the system via laptop computer. The DAS unit would be deployed in any of the three testing scenarios discussed in Section 2.2.9, *Testing Scenarios*: fully contained in the WEC device, on the deck of a vessel, or inside the Ocean Sentinel.

Figure 2-4. Ocean Sentinel Instrumentation Buoy External Dimensions (inches)



Electrical Loading and Power Conversion

Because the WEC device would not be connected to the electrical grid, resistive load banks may be used as the electrical load for the WEC devices under test. A resistive load bank contained within the hull of the Ocean Sentinel would develop an electrical load, apply the load to the WEC devices under test, and convert and dissipate the power output of the WEC device. Thus, the load bank would mimic the real load that a WEC device would experience when in actual application. The load of a resistive load bank is created by the conversion of electrical power to heat by power resistors. A 100-kilowatt, air-cooled load bank would be installed on deck high enough above the waterline to avoid significant seawater spray penetrating the load bank enclosures or housed below deck in one of the buoy bulkheads depending on the size and cooling capacity of the load bank. Switch gear and power conversion equipment located onboard the Ocean Sentinel would provide control of the load bank.

Because NNMREC anticipates testing WEC devices with different power outputs and generator configurations, the Ocean Sentinel load system is designed for a high degree of flexibility, so that the air-cooled load bank could be reconnected for different voltages and powers. The power system is designed for expansion capabilities, to allow for a grid emulator or other power-conversion equipment onboard the buoy. Unlike a load bank, which mimics a constant and controllable load, a grid emulator would be used to simulate unpredictable, variable, and random loads that would be expected with a connection to the on-shore electrical grid.

The load bank transformer would be filled with a seed-oil coolant with food-grade additives. The electrical distribution system would distribute the energy from the WEC device to resistor banks in marine enclosures and would be equipped with ground fault protection to ensure operator safety.

Any component of the load bank exposed to seawater would be constructed from a suitable alloy, plastic, or composite. Lightning and corrosion protection would be provided for all components. All electrical systems housed within the load bank would be constructed from stainless steel to limit corrosion possibilities. An electrical ground system would be provided for the connection of the WEC device, safety grounds for all metal electrical equipment enclosures, and the load elements.

Instrumentation Power

The Ocean Sentinel would have the capacity to independently generate power to operate all on-board systems under normal and worst-case conditions. Instrumentation power would be generated by a combination of deck-mounted solar panels, wind generation, and a bio-diesel fuel generator. The wind and solar power generated (with battery backup storage) would be adequate for normal operations under typical conditions. The bio-diesel generator would not be required frequently; rather, it would only be necessary under atypical conditions where solar and wind generators could not provide enough instrumentation power and battery backup was exhausted. The battery would be designed to meet all applicable U.S. Coast Guard requirements to minimize risk of shorting, fire or explosion, and exposure to electrical current. The Ocean Sentinel would contain up to 240 gallons (908 liters) of biodiesel fuel in three baffled aluminum tanks inside water-tight buoy compartments. These tanks would be tested and must not leak during testspursuant to the requirements outlined in 33 CFR 183.510.

Other Components

Other components likely to be included in the Ocean Sentinel as part of the Proposed Project are described below.

Direct current bilge pumps would be housed within each compartment to address minor leaks. Two pumps could be independently equipped with a level alarm and would be activated by a level float. The wireless communications system would activate and transmit an alarm to NNMREC and any identified party, allowing for immediate action. The pumps would be powered by marine-grade batteries, which would be completely sealed to prevent hydrogen buildup.

Markers and auxiliary sensors to increase the visibility of the Ocean Sentinel would include a marine-grade beacon light, radar reflector, and GPS. The Ocean Sentinel would also include an indication, warning, and alarm subsystem designed to monitor system status, provide warnings for negative trends, and provide alarms for conditions requiring operator intervention. On-board video cameras would be mounted on the deck of the Ocean Sentinel. Using a low frame rate, they would monitor the deck and water immediately surrounding the Ocean Sentinel. The cameras could be monitored remotely and in real time with their signal broadcast through the telemetry system.

An automatic identification system transmitter would provide navigation assistance for locating the Ocean Sentinel both under moorage and in the improbable event the Ocean Sentinel breaks free from its mooring. The automatic identification system (AIS) would provide other vessels with the location and identity of the Ocean Sentinel at all times. The AIS would also be configured to communicate the location and identity of other components of the Proposed Project including the WEC device, wave-measurement buoy, and any surface or marker buoys.

A cable interface would be made using a marine-grade connector(s) designed to withstand harsh marine environments. This style of connector would allow the submarine power cable to couple to the Ocean Sentinel quickly and efficiently on the deck, without the need to access the inner watertight compartments. An input disconnect protective device would enable the complete electrical disconnection of the Ocean Sentinel from the cable that could be operated without entering any compartment of the Ocean Sentinel containing energized devices. The interface would be constructed of steel or other metal so that marine life could not become exposed to electrical current by chewing, gnawing, or pecking through the cable.

Associated monitoring equipment would be deployed to support the Proposed Project and to collect data to be used in physical and environmental studies. Most monitoring equipment would be deployed within the 1-square-nautical-mile (3.4-square-kilometer) project site. This equipment may include acoustic wave and current profilers, acoustic Doppler current profilers, wave riders (wave measurement buoy accelerometers), seafloor mapping devices, echosounders, sub-bottom profilers, acoustics data logger recovery devices, acoustic hydrophones, plankton collection plates, water quality monitoring devices (e.g., dissolved oxygen, temperature, salinity), fish tag receivers, and electromagnetic frequency monitoring equipment. However, some equipment—hydrophones mounted on a lander (Figure 2-5) being a most likely possibility—may be deployed anywhere in a 5-nautical-mile (9.3-kilometer) radius from the project site to collect reference samples for comparative analyses. In all cases, equipment would be held in place by a temporary mooring and would be either floating or settled on the seafloor. In the case of the wave-measurement buoy, it would be located sufficiently close to the Ocean Sentinel to allow it to transmit data to the Ocean Sentinel via wireless telemetry. Other monitoring equipment may or may not have this capability.

Figure 2-5. Hydrophone Mounted on Lander Prior to Deployment

Umbilical cable consisting of a copper conductor, steel armor, and polyethylene insulation would carry power and data signals between the WEC device and the Ocean Sentinel. The umbilical cable connecting the Ocean Sentinel and the WEC under test would measure approximately 656 feet (200 meters) long and 1.6 feet (50 centimeters) in diameter. Power generated by the WEC device would be transmitted through this cable to the Ocean Sentinel for monitoring, recording, and dissipation. The cable would be suspended beneath the surface by floats. Marking and lighting would be provided as directed by the U.S. Coast Guard.

2.2.3 TRIAXYS™ Wave Measurement Buoy

A TRIAXYS™ wave measurement buoy supplied by AXYS Technologies would be used for ocean wave and current measurements (Figure 2-6). This buoy is constructed of stainless steel and polycarbonate and contains instrumentation to measure and record the size and strength of wave activity at the site and to transmit data wirelessly to the Ocean Sentinel. It weighs approximately 440 pounds (220 kilograms), including batteries, and measures 3 feet (0.9 meter) in diameter. When deployed in the water, the top of the spherical buoy extends approximately 1.5 feet (0.5 meter) above the water line.

Figure 2-6. TRIAXYS™ Wave MeasurementBuoy

The TRIAXYS™ wave measurement buoy would be moored approximately 328 feet (100 meters) in the prevailing wave direction from the WEC device under test, and would transmit wave and current data to the Ocean Sentinel via radio telemetry. Accelerometer and rate gyro data would be processed onboard the TRIAXYS™ wave measurement buoy to produce both directional and non-directional wave frequency spectrums. An Acoustic Doppler Current Profiler onboard the TRIAXYS™ wave measurement buoy would measure the ocean current profile down to a depth of 131 feet (40 meters). The wave frequency spectrum and current profile data would be transmitted to the Ocean Sentinel at configurable intervals.

2.2.4 Testing Vessel

As described in Section 2.2.9, *Testing Scenarios*, the WEC device could be monitored using test equipment mounted on a deployed vessel. The vessel would be OSU's research vessel, the Pacific Storm (the vessel), which is an 84-foot (26-meter), steel-hulled, converted fishing vessel. The vessel has berthing for up to 12 people (crew and scientists), two showers, and three heads. It is equipped with a knuckle boom with a 6-ton (5,443-kilogram) lifting capacity and a 30-foot (9-meter) reach mounted to the back of the living area for loading/unloading supplies, boats, etc. The aft deck area is 24 feet (7 meters) long by 22 feet (6.7 meters) wide. The vessel is powered by a Caterpillar 3412 engine enabling it to reach a top speed of 9.5 knots (17.6 kilometers per hour). The vessel also has a 300-horsepower hydraulic engine and two electrical generators that provide 110- and 220-volt power. The vessel can carry a maximum of 15,000 gallons (56,781 liters) of fuel, 2,800 gallons (10,599 liters) of fresh water, 100 gallons (379 liters) of lube oil, and 400 gallons (1,514 liters) of hydraulic oil (Oregon State University Marine Mammal Institute 2011).

2.2.5 Wave Energy Converter Devices

Over the 10-year lifetime of the Proposed Project, a number of WEC devices are expected be tested at the project site. Because wave energy generation is in the early stages of development, a wide variety of technology designs are currently being conceptualized, designed, and tested. DOE's Marine and Hydrokinetic Technology Database[2], which also includes tidal, current, and thermal devices, lists over 250 different technologies (U.S. Department of Energy 2011). Known WEC devices can be grouped into the following categories.

Wave attenuators are devices designed to align with the predominant direction of the waves. Examples include long, multi-segment floating devices with their axes oriented parallel to the direction of the incoming wave. In this example, the device captures energy as the wave passes along the device, causing it to flex where the segments connect, which drives hydraulic pumps or other generators. Devices falling into this category would not be tested as part of the Proposed Project.

Pitching/surging/heaving/sway devices are any of several device designs that capture wave energy directly without a collector by using relative motion between a float, flap, or membrane and a fixed reaction point. The float, flap, or membrane oscillates along a given axis depending on the device and mechanical energy is extracted from the relative motion of the body part relative to its fixed reference.

Oscillating water columns are partially submerged structures in which water enters a chamber through a subsurface opening. Wave action causes the captured water column to move up and down like a piston. This action forces the air trapped above the water column to move through an opening connected to a turbine. No water would travel through the turbine blades during the operation of this type of WEC device. There are shore-based and floating models.

Overtopping devices are practically submerged structures that have reservoirs filled by incoming waves to levels above the average surrounding ocean. The water is then released back out to sea from the reservoir through a turbine generator. There are shore-based and floating models. Devices falling into this category would not be tested as part of the Proposed Project.

Point absorbers are floating or submerged structures with components that capture energy from the vertical motion of waves. This motion drives electromechanical or hydraulic generators. Point absorbers may be fully or partly submerged, they may be floating or rigidly anchored, and they are relatively small compared to the wave length.

During the lifetime of the Proposed Project a number of WEC devices may be tested in addition to the WET-NZ device. The specific WEC device prototypes and models that would be tested as part of the Proposed Project are not presently known, with the exception of the WET-NZ device, which has a planned deployment at the project site in August 2012 and would undergo testing in 2012 and 2013. This EA does not examine the potential impacts of every possible WEC device design category known or available; instead, the analysis includes only those general WEC device designs that are reasonably expected as part of this Proposed Project, which include pitching/surging/heaving/sway, point absorber and oscillating water column devices capable of operating in water depths of approximately 180 feet (55 meters). Examples of these designs are described in Appendix C that accompanies this EA and include the most probable types of devices

[2] Available online at: http://www1.eere.energy.gov/windandhydro/hydrokinetic/default.aspx

that could be tested under the Proposed Project. These examples provide a basis for the analysis of effects of the Proposed Project and are evaluated in the assessment of environmental impacts in Chapter 3 and Chapter 4 of this EA.

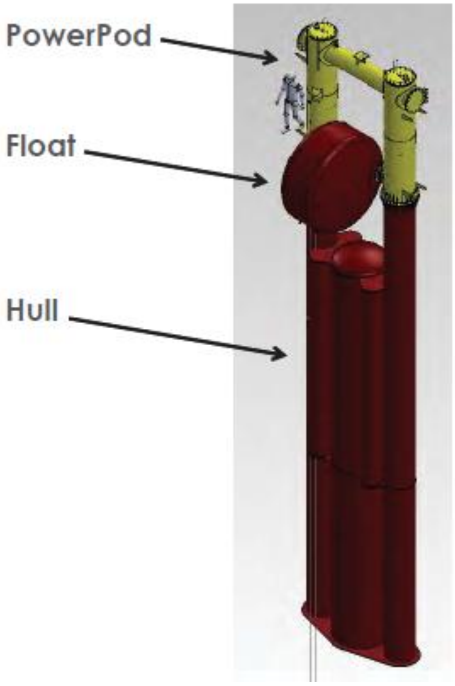
2.2.6 WET-NZ Multi-Mode Marine Power Conversion

Wave Energy Technology-New Zealand is a research and development collaboration program run by Industrial Research Limited, a Crown Research Institute, and Power Projects Limited, a privately owned company based in Wellington, New Zealand. The program seeks to develop a wave energy device that maximizes engineering efficiency through the novel use of direct-drive and adaptive response to changes in wave motion. The WET-NZ wave energy converter (Figure 2-7) is a point absorber device with some special characteristics that enable it to extract energy from passing waves. The device is floating but the majority of it is submerged so that as much of it as possible interacts directly with the wave energy. An object immersed in a wave field is subjected to complex motions—heave (up and down), surge (back and forth) and pitch (a rolling back and forth motion). Most devices extract only a small proportion of the total energy of a passing wave. The WET-NZ device is designed to operate in transitional / deep water waves (67 to 328 feet [20 to 100 meters]) and is designed to extract as much energy as possible from more than one type of motion. As mentioned above, the WET-NZ design is the only specific design which presently has a planned deployment at the project site. The device to be deployed at the project site is nominally half-scale of a final production model with a rated energy output of 20 kilowatts.

Figure 2-7. WET-NZ 1/2–Scale WEC Device (cylindrical flap not shown)

The hull is approximately 59 feet (18 meters) long and 11.5 feet (3.5 meters) wide. Nominal wet mass (flooded) is approximately 110,231 pounds (50 tonnes) and displacement volume is around 95% (i.e. the structure is almost fully immersed—the water line is nominally at the axle center). The float weighs approximately 8,818 pounds (4 tonnes) with a displacement volume of 50% (Figure 2-8). A deployment period of approximately 6 weeks is planned at the project site beginning in August 2012 and a period of up to 3 months is planned for the summer of 2013.

Figure 2-8. WET-NZ System Overview



Hull Height/Draft:	15.0 meters
Hull Width:	3.8 meters
Float Diameter:	2.4 meters
Main Tube Diameter:	1.5 meters
Side Tube Diameter:	0.7 meters
Draft (ballasted):	12.8 meters
Displacement (unballasted):	30 metric tons
Displacement (ballasted):	50 metric tons
Rated output:	20 kW

2.2.7 Anchors and Mooring Systems

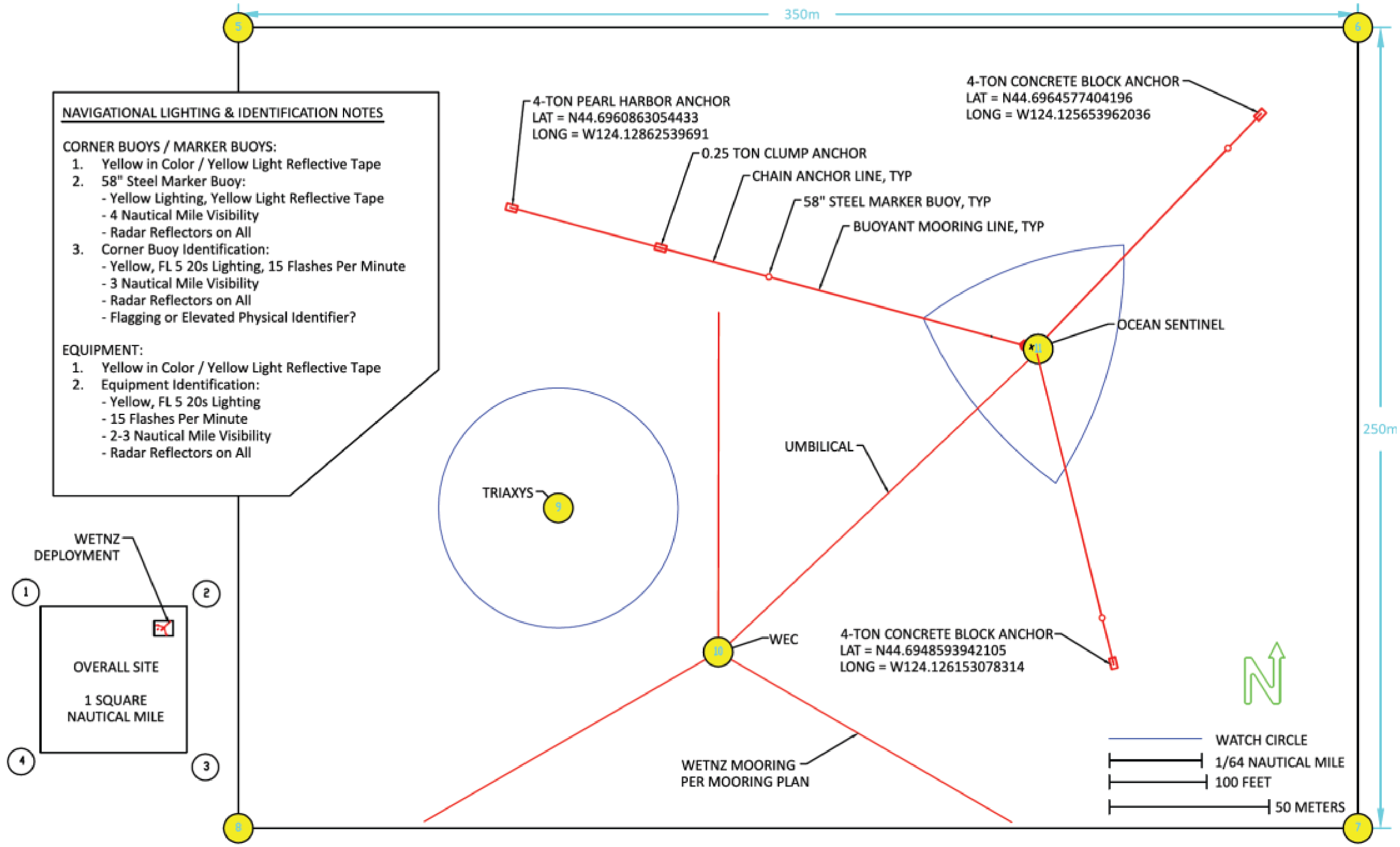
The Ocean Sentinel and the WEC devices under test would each be secured by independent mooring systems providing sufficient distance between the Ocean Sentinel and WEC devices to eliminate collision and accommodate the umbilical cable. The mooring system for the vessel would consist of the typical onboard anchor.

The mooring systems would be able to hold the Ocean Sentinel and WEC device within a prescribed distance from its center position regardless of wind, wave, and current conditions. This area of movement is known as the watch circle. The Ocean Sentinel and WEC devices would be moored with sufficient separation of their respective watch circles to prevent collision while not overstressing the umbilical cable. The mooring would place the WEC devices in front of the Ocean Sentinel in relation to the direction of the incident wave front. This would ensure that each incoming wave would first contact the WEC device with its full, unabated force.

Anchors and Mooring Systems to be used in the 2012–2013 WET-NZ Test

The Ocean Sentinel, the WET-NZ device, and the TRIAXYS™ wave monitoring buoy would each have their own mooring system, as described below. Water depth at the project site is approximately 150 feet. The maximum footprint of the Ocean Sentinel and TRIAXYS™ wave monitoring and their mooring systems is 800 feet by 625 feet (244 meters by 198 meters). The WET-NZ device would be moored approximately 492 feet (150 meters) from the Ocean Sentinel, and the footprint of the WET-NZ and its mooring system is approximately 700 feet by 700 feet (213 meters by 213 meters). Collectively, the project components would have a footprint of approximately 820 feet by 1,148 feet (250 meters by 350 meters) within the project site. The footprint would be approximately 21 acres (8.5 hectares). The deployed configuration of these devices for the 2012–2013 WET-NZ test is illustrated in Figure 2-9.

Figure 2-9. Deployed Configuration of Ocean Sentinel, WET-NZ, and TRIAXYS™ Buoys—Overhead View



Ocean Sentinel Instrumentation Buoy Anchors and Mooring System

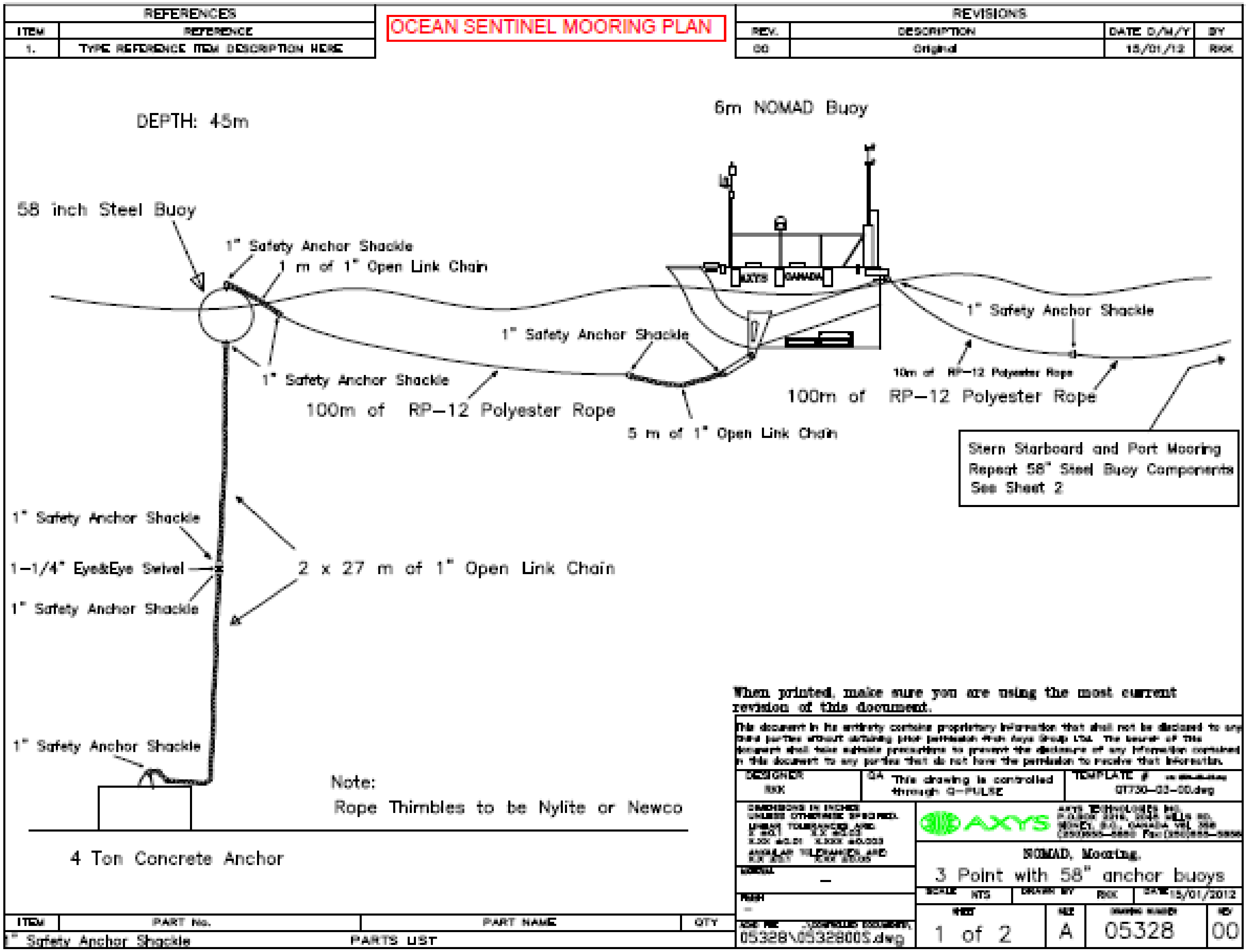
The Ocean Sentinel would use a three-point mooring system consisting of two, 4-ton (3,630-kilogram) concrete block anchors—each on independent mooring lines—and a 500-pound (227-kilogram) clump anchor and 4-ton (3,630-kilogram) Pearl Harbor deadweight anchor on a third mooring line. The mooring lines would be positioned 120 degrees apart around a center position with a radius of approximately 328 feet (100 meters).

For the two aft mooring lines, the Ocean Sentinel would be tethered with a 328-foot-long, (100-meter-long) 1.5-inch-diameter (3.8-centimeter-diameter) Samson RP-12, which would connect to two 58-inch (1.5-meter) spherical surface mooring buoys, each of which is made of steel and has a total buoyancy of approximately 3,000 pounds (1,360 kilograms). The Samson RP-12 is a polyester rope with a minimum breaking strength of 58,000 pounds (26,300 kilograms); it has a specific gravity of 1.38 (sinking line). At both ends, these lengths of rope would have a short pendant section with a shackle assembly, enabling them to be easily attached or detached from the mooring buoys and the Ocean Sentinel, at sea, in the case of deployment or towing, respectively. The mooring buoys would be attached with 1-inch (2.5-centimeter)-stud link chain to their respective anchors on the seabed. The anchors would be constructed of concrete according to International Association of Lighthouse Authorities standards at least 28 days prior to deployment and would be cured to full strength (to prevent leaching). Attached to each anchor would be two shots (90 feet [27.4 meters] each) of 1-inch (2.5 centimeter)-stud link chain, each of which would run to its corresponding mooring buoys and be attached to the padeye on the mooring buoy. A profile view of an Ocean Sentinel's mooring line is depicted in Figure 2-10[3].

The mooring line connected to the bow of the Ocean Sentinel would be a buoyant mooring line connecting the mooring yoke of the Ocean Sentinel to a 58-inch spherical surface mooring buoy with a total buoyancy of approximately 3,000 pounds (1,360 kilograms). From there the bow line would consist of chain anchor line leading to a 500-pound (227-kilogram) clump anchor and additional chain anchor line terminating in a 4-ton (3,630-kilogram) Pearl Harbor deadweight anchor.

[3] The anchoring and mooring in this figure would apply only to the aft mooring lines, and not the bow line as depicted in Figure 2-10.

Figure 2-10. Ocean Sentinel Instrumentation Buoy Mooring Plan—Side View



WET-NZ Mooring System

The WET-NZ device would use a three-point mooring system with a combination of drag anchors. Drag anchors are common in the industry, having broad use experience and reliable holding capacity. In addition, very large size and capacity drag anchors are available for use in sand bottom types like the project site. A drag anchor is similar to an inverted “kite” that is placed on the seafloor and dragged laterally until the anchor fluke trips and then penetrates the seafloor to a depth that depends on load, anchor weight, anchor configuration and seafloor properties. In addition to their ease of installation and removal, mooring line connections on drag anchors are easy to inspect and service.

In the three-point mooring system designed for the WET-NZ, each mooring leg would consist of an embedment anchor, a clump anchor, a subsurface float, and wire and synthetic mooring lines. A multi-leg mooring spread using drag anchors alone requires a large footprint on the seafloor, but the use of clump weights with the drag anchors allows for a shorter line scope and, therefore, a smaller footprint on the seabed. In the WET-NZ mooring system, 12,000-pound (5,443-kilogram) drag anchors would function as the primary mooring points. Each drag anchor would be secured to an 8,000-pound (3,629-kilogram) Navy Stockless anchor functioning as a clump weight. The EELS drag anchors and Navy Stockless anchors would be connected by a steel wire rope between 164 feet (50 meters) and 246 feet (75 meters) long (final lengths would be determined by exact water depth at time of deployment). The maximum footprint of the WET-NZ mooring system would be 696 feet by 696 feet (212 meters by 212 meters). The mooring schematics for the WET-NZ device are presented in Table 2-2; the mooring configuration and components are illustrated in Figure 2-11 and Figure 2-12.

Table 2-2. WET-NZ Device Mooring Schematics

Component	# Units	Description	Approximate Dimensions
Drag Anchor	3	EELLS (12,000 pounds)	11.9 feet x 7 feet x 3.7 feet
Clump weight	3	Navy Stockless (8,000 pounds)	7.2 feet x 5.5 feet x 3.4 feet
Anchor line	3	Steel Wire Rope	246 feet length x 1.5 in diameter
Mooring line	3	Steel Wire Rope	164 feet length x 1.5 in diameter
Subsurface float	3	Urethane Foam	5.6 feet height x 67.2 in diameter

Figure 2-11. WET-NZ Device Mooring Plan (Side View) and Components

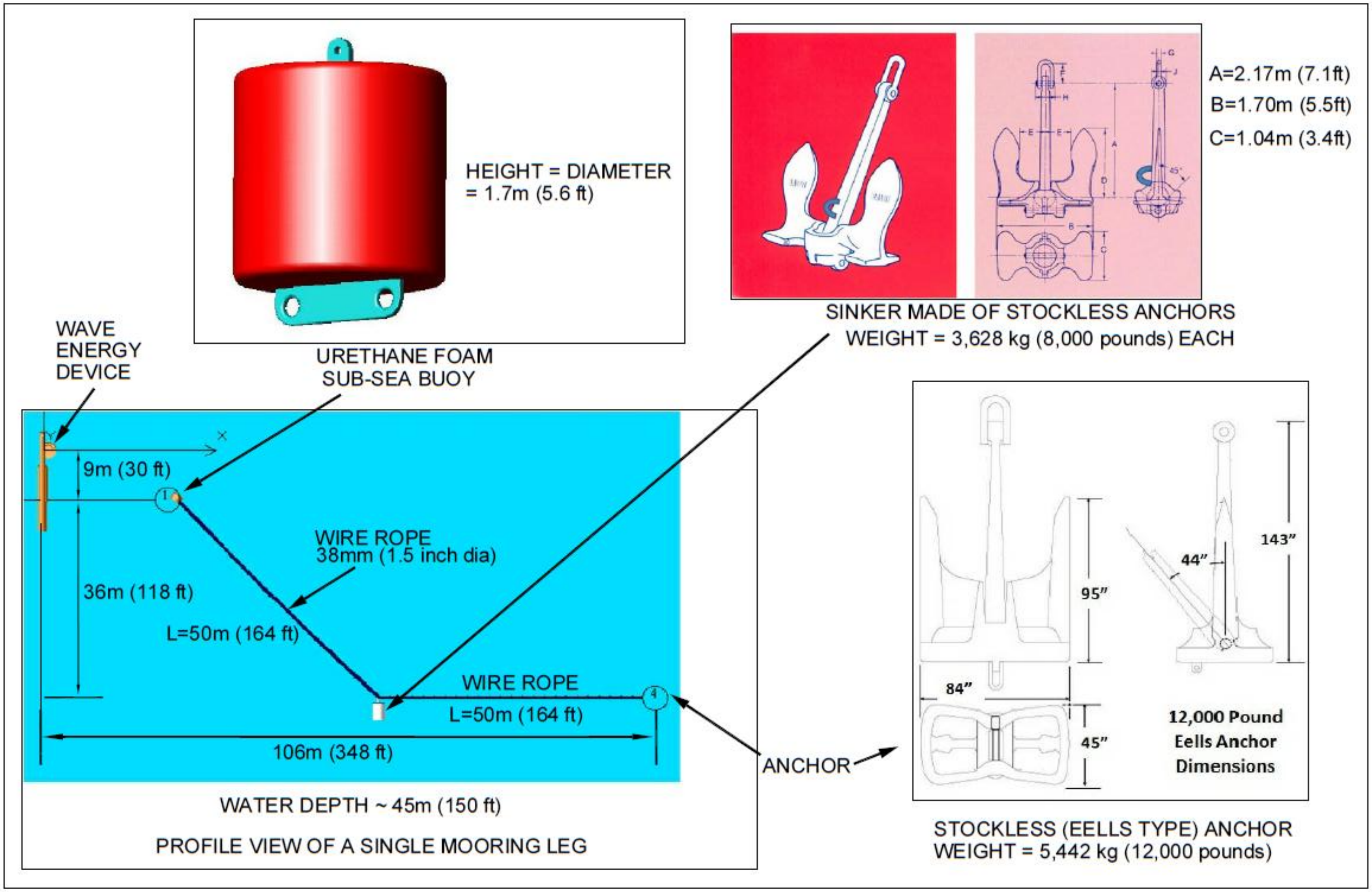
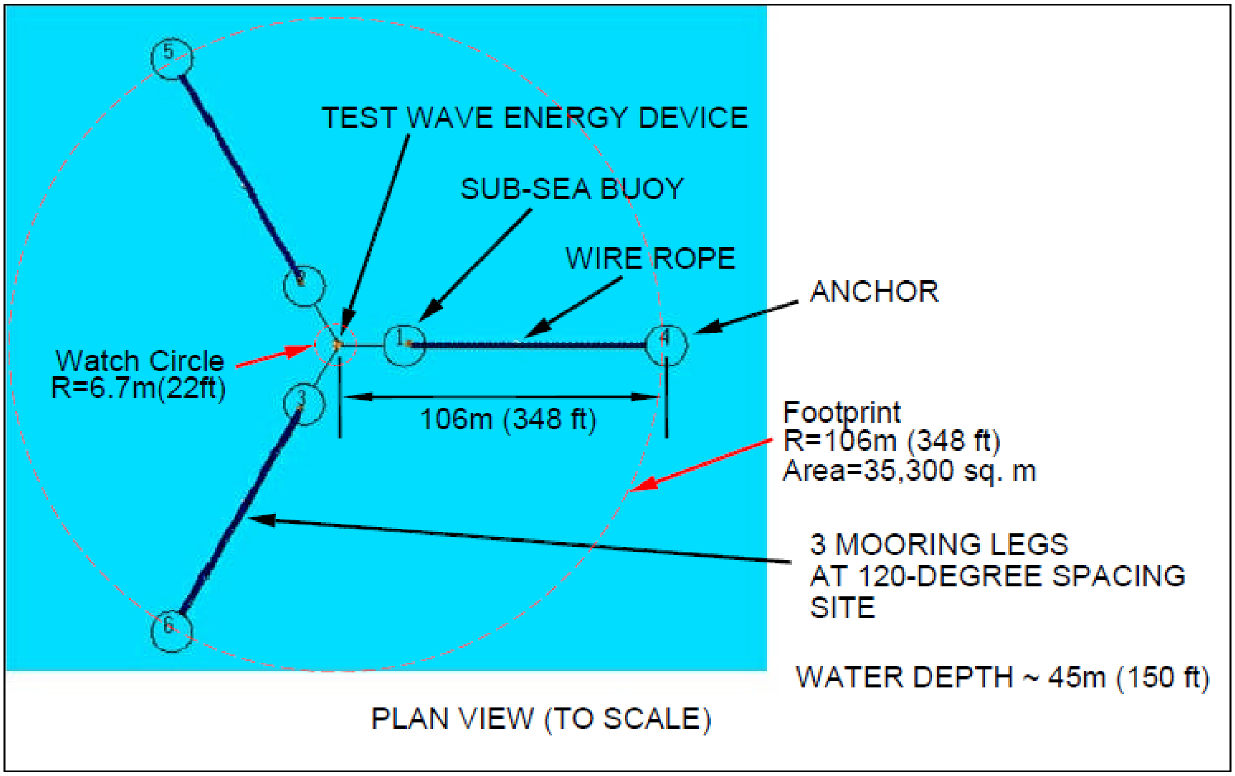


Figure 2-12. WET-NZ Mooring Plan—Overhead View



TRIAXYS™ Wave Measurement Buoy Mooring System

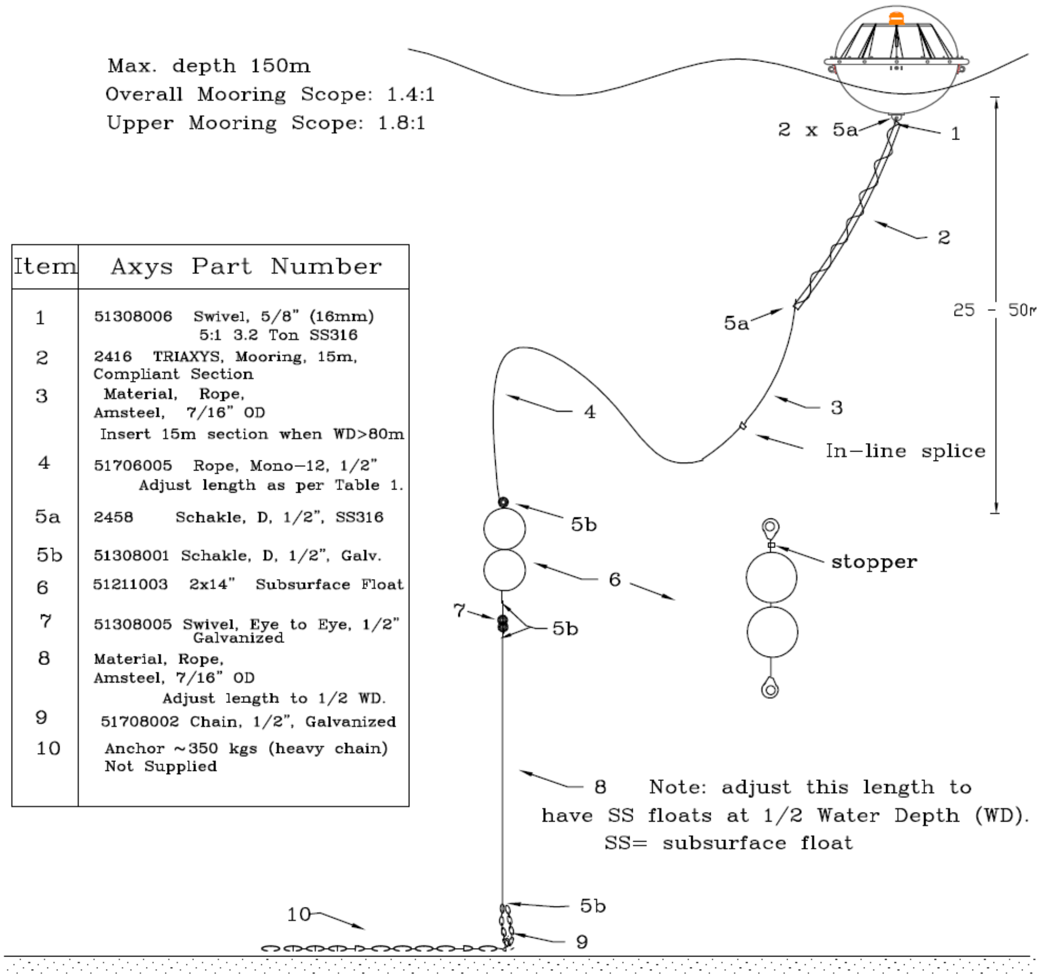
The mooring line for the TRIAXYS™ wave measurement buoy would be a 49.2-foot (15-meter) rubber bungee cord that would attach directly underneath the buoy to allow compliant wave following. The bungee cord would terminate to a synthetic Amsteel rope extending to the anchor system. The TRIAXYS™ anchor is a heavy steel chain with an approximate in-water weight of 800 pounds (363 kilograms) (Figure 2-13).

2.2.8 Anchoring and Mooring Systems Used in Future Tests

In addition to the 2012–2013 WET-NZ deployment, other potential WEC device designs may be tested as part of the Proposed Project. In future tests, up to two WEC devices may be tested simultaneously at the project site. For tests of two WEC devices, the Ocean Sentinel would be coupled to one of the WEC devices. The manned testing vessel or a second Ocean Sentinel would be coupled to the second WEC device under test during this time. One or two TRIAXYS™ wave measurement buoys would also be deployed in future tests.

The future deployment of WEC devices and their anchoring and mooring systems would require authorization by the Corps pursuant to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act prior to their deployment. Details specific to the anchoring and mooring systems that would be planned for proposed future tests would be detailed in required environmental reviews to support permit applications necessary for Corps authorization.

Figure 2-13. TRIAXYS™ Mooring System—Profile View



Item	Axys Part Number
1	51308006 Swivel, 5/8" (16mm) 5:1 3.2 Ton SS316
2	2416 TRIAXYS, Mooring, 15m, Compliant Section
3	Material, Rope, Amsteel, 7/16" OD Insert 15m section when WD>80m
4	51706005 Rope, Mono-12, 1/2" Adjust length as per Table 1.
5a	2458 Schakle, D, 1/2", SS316
5b	51308001 Schakle, D, 1/2", Galv.
6	51211003 2x14" Subsurface Float
7	51308005 Swivel, Eye to Eye, 1/2" Galvanized
8	Material, Rope, Amsteel, 7/16" OD Adjust length to 1/2 WD.
9	51708002 Chain, 1/2", Galvanized
10	Anchor ~350 kgs (heavy chain) Not Supplied

The deployed configuration of the Ocean Sentinels (or manned testing vessel), and the TRIAXYS™ wave measurement buoy would be very similar to that used by the Ocean Sentinel and TRIAXYS™ wave measurement buoy during the 2012–2013 WET-NZ test. Deployments may be located at different locations within the project site, the physical footprint of the test may be different, and the standoff distances may vary, and watch circles may be larger or smaller depending on the specific equipment used and the precise location of the test. However, the configuration would closely approximate those employed for the 2012–2013 WET-NZ test.

The general parameters and conditions of the anchoring and mooring systems for other future tests are described below.

Ocean Sentinel Instrumentation Buoy Mooring System

In future test deployments, the Ocean Sentinel would use anchoring and mooring equipment and a configuration that is nearly identical to the one that would be used during the 2012–2013 WET-NZ test. Subtle differences (e.g., anchor line length) may occur to optimize the anchoring and mooring configuration based on the specific conditions of the precise deployment location. However, because the physical and environmental conditions within the project site are relatively uniform, it is not likely that anchoring and mooring configurations for future deployments of the Ocean Sentinel would vary significantly from that described for the WET-NZ test.

TRIAXYS™ Wave Measurement Buoy Mooring System

In future test deployments, the TRIAXYS™ wave measurement buoy would use anchoring and mooring equipment and a configuration that is nearly identical to the one used during the 2012–2013 WET-NZ test. Subtle differences (e.g., anchor line length) may occur to optimize the anchoring and mooring configuration to match the specific conditions of the precise deployment location. However, because the physical and environmental conditions within the project site are relatively uniform, it is not likely that anchoring and mooring configurations for future deployments of the TRIAXYS™ wave measurement buoy would vary significantly from that described for the WET-NZ test.

Testing Vessel Mooring System

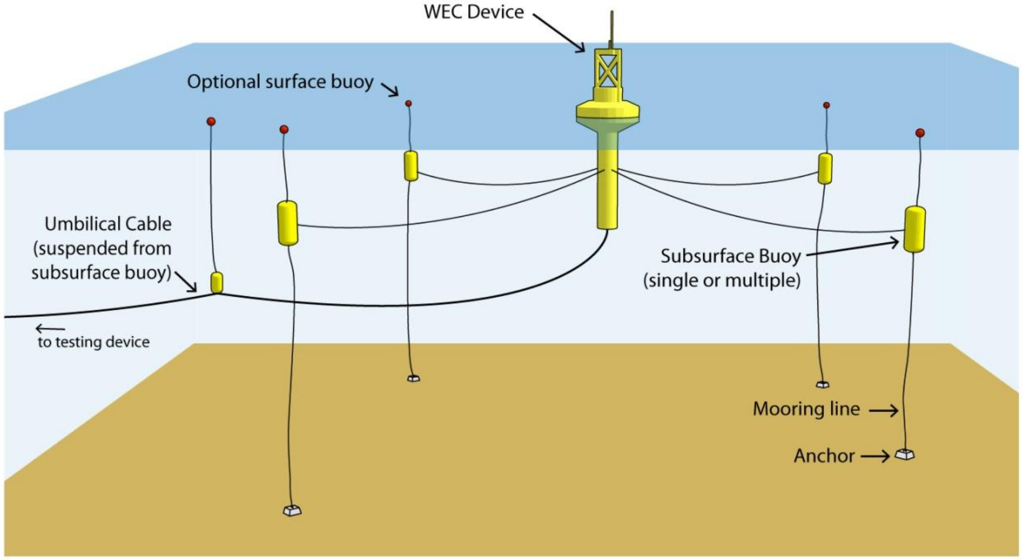
As described in Section 2.2.9, *Testing Scenarios*, the DAS, load bank, and other testing equipment could be installed onboard a testing vessel. In test scenarios where two WEC devices are under test simultaneously, one may be coupled to this manned testing vessel. The vessel's mooring system consists of a 600-pound (272 kilograms) Danforth anchor with 100 feet (30.5 meters) of chain attached to it, followed by 450 feet (137 meters) of 1.25-inch (3.2-centimeter) Samson double-braid nylon line, followed by 600 feet (183 meters) of 0.75-inch (1.9-centimeter) steel cable.

Wave Energy Conversion Device Mooring System

In other future tests, a number of different WEC devices could be tested at the project site. The category of devices that could be tested is identified in Section 2.2.5 and examples are provided in Appendix C. These WEC devices may or may not use mooring systems similar to that planned for use by the 2012–2013 WET-NZ deployment. For most WEC device prototypes, there is little information on mooring designs available to the public. Although the detailed mooring system for WEC devices has not yet been designed and will vary depending on the final location of the moorings within the project site, it is probable that the design of a mooring system at the site would require relatively taut moorings capable of testing large devices Figure 2-14 depicts one likely mooring configuration for a generic point absorber WEC device.

Likely anchoring systems could include drag anchors, deadweight anchors, suction-installed pile anchors, and plate anchors. Generally a three- to four-point anchoring layout would be used. It is also anticipated that the WEC device and optional subsurface floats would be coated with an antifouling paint prior to installation to prevent marine life from colonizing on these project components. The specific mooring configuration would vary depending on the WEC device under test. NNMREC would require that WEC device developers submit detailed mooring plans for their review and approval. NNMREC would require that all WEC devices to be tested as part of the Proposed Project use only TBT-free antifouling paints and coatings.

Figure 2-14. Conceptual Wave Energy Conversion Device 4-Point Mooring Configuration—Side View[4]



2.2.9 Testing Scenarios

2012–2013 WET-NZ Test

Components for this test would include the Ocean Sentinel instrumentation buoy, a half-scale WET-NZ device, the umbilical cable between these buoys, a TRIAXYS™ wave measurement buoy, and associated mooring systems. The test equipment would not be connected to the electric grid; power generated by the WET-NZ device would be transported through the umbilical cable to the Ocean Sentinel to be dissipated in resistors. The testing would take place during two short-term deployments, the first of which is planned for approximately 6 weeks beginning in August 2012. Upon conclusion of testing in September 2012, the devices would be removed and taken to a land-based storage facility for the winter. In June 2013, the devices would be redeployed for a second round of testing. Upon conclusion of testing in the summer of 2013 and within 30 days of the end of the Corps Nationwide Permit authorization period, all project components, including the devices and mooring systems, would be removed.

Other Potential Test Scenarios

In addition to the 2012-2013 WET-NZ test, a number of other test scenarios may occur during the lifetime of the Proposed Project. Any of the three following testing scenarios could be implemented at the project site:

1. **WEC Device Deployment with On-board Test Equipment:** Under this possible scenario future WEC developers would deploy WEC devices and monitor their power generation using equipment contained within the device. Such deployments would typically last at least several

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[4] A conceptual three-point mooring configuration for other future devices would appear nearly identical; however, it would consist of three mooring legs, likely to be spaced at equal intervals (120 degrees).

months and would continue for as long as 12 months, thus, allowing WEC developers to see how their devices handle the severe winter storms that affect this region. No more than two WEC devices would be tested at any given time under this scenario. NNMREC may support developers with the design and construction of the internal testing equipment.

2. **Testing by a Manned Vessel:** Under this scenario the WEC devices would be monitored using test equipment deployed on a powered and manned vessel. In this case the WEC devices would be connected to the vessel by a floating or in-water umbilical cable at a distance of approximately 492 feet (150 meters). The vessel would be manned at all times and located using its own anchor. Due to the expense of keeping a manned vessel on site, such tests would not be expected to last more than 10 days. The WEC devices might remain on site for a longer period of time to demonstrate the survivability of the device. In this case, the power generation unit would either be taken off line, or directed toward an on-WEC load bank (e.g., a resistor bank).
3. **Testing by Ocean Sentinel Instrumentation Buoy(s):** Under this scenario up to two WEC devices would be monitored using test equipment deployed on up to two Ocean Sentinel instrumentation buoys. The Ocean Sentinels would have their own mooring system that would consist of a three-point mooring configuration and would be connected to the WEC devices by a floating or in-water umbilical cable carrying power and data signals at a distance of approximately 492 feet (150 meters). The Ocean Sentinels would be unmanned during the test. Tests would run for 1 to 6 months during the months of May to October, although the WEC device might remain on site for up to 12 months to provide test results for conditions expected to be experienced in a full year of deployment.
4. **Testing by one Manned Vessel and One Ocean Sentinel:** Under this scenario two WEC devices would be deployed and under test. One WEC device would be coupled to an Ocean Sentinel and the other WEC device would be coupled to the vessel. Standoff distances, test durations, and other details specific to the Vessel and Ocean Sentinel would be identical to those identified in Scenario 3 and Scenario 4 above.

2.2.10 Installation

Installation of the 2012–2013 WET-NZ Test

Testing of the WET-NZ device would take place during two short-term deployments, the first of which is planned for approximately 6 weeks beginning in August 2012. The second test would take place for up to 3 months between June and September 2013.

Construction Methods

No on-site construction activities would be associated with the Proposed Project. All project components would be constructed at existing land-based facilities prior to being installed at the project site. Existing pier facilities at HMSC in Newport would serve as the mobilization site. The Ocean Sentinel, WET-NZ, and TRIAXYS™ wave measurement buoys, as well as all mooring materials, would be staged at this site for the installation vessels to pick up and transport to the project site. Prior to deployment, pier-side tests would be performed to check the operation and integration of all Ocean Sentinel and WET-NZ device systems to verify the readiness of systems for mooring, connection, power dissipation, and shore communications.

Mobilization of the Ocean Sentinel Instrumentation Buoy

Existing pier facilities at HMSC would serve as the mobilization site for receipt of equipment, final Ocean Sentinel outfitting, testing, and launch. Components for the final outfitting such as the transformer, load elements, and masts may be trucked separately from the Ocean Sentinel. Other components such as logistics support containers, mooring lines, anchors, and buoys would be received at the same location as the Ocean Sentinel for staging. Once received in full, the Ocean Sentinel would be outfitted with any final components and launched. Launch of the Ocean Sentinel would use methods available at the mobilization site; it is anticipated that a crane would be employed to launch the Ocean Sentinel into the water pier-side to the mobilization location.

Pier-side tests would check the operation and integration of all the Ocean Sentinel systems. These in-water tests would verify the readiness of systems for towing, power dissipation systems, shore communications, and backup storage. In addition to the Ocean Sentinel mobilization, HMSC and a local transmission tower would be outfitted with shore receiver radios, antennas, and computers to receive transmissions from the deployed Ocean Sentinel.

Mobilization of the WET-NZ Device

Existing pier facilities at HMSC in Newport would serve as the site for receipt of material and laydown area for the WET-NZ. Mooring material such as a mooring line, buoys, and anchors would be staged at this site for the mooring installation vessel to pick up and transport to the testing site.

Mobilization of the TRIAXYS™ Wave Measurement Buoy

The Port of Newport or other local pier area would serve as the site for receipt of material and laydown area for the TRIAXYS™ wave measurement buoy. Mooring material such as a mooring line, buoys, and anchors would be staged at this site for the mooring installation vessel to pick up and transport to the testing site.

Installation of the Ocean Sentinel Instrumentation Buoy and Anchoring and Mooring System

Installation of the Ocean Sentinel and its mooring system is described in detail in the *NOMAD Buoy and Mooring Deployment Procedures* developed by AXYS Technologies Inc. DOE anticipates that the Ocean Sentinel would be transported to the project site by a vessel of opportunity, where it would be attached to its mooring system. The Oceanus[5], a mid-sized research vessel which accommodates a crew of 12 and a scientific party of 19 for up to 30 days at sea, is the candidate vessel for deploying the mooring system. First an anchor would be lowered over the side, lowered to the seafloor, and set into location. The associated mooring line and possible subsurface buoy would follow attached to the anchor. A surface buoy would be used to secure the mooring line to the surface. This would be repeated for the two remaining mooring legs. Final vessel determinations would be provided to the Corps prior to project development.

[5] Complete vessel specifications can be found at <http://ceoas.oregonstate.edu/research/vessels/oceanus/>.

Installation of the WET-NZ and Anchoring and Mooring System

For the WET-NZ mooring system, the most efficient deployment method would be in two phases: deploy two seaward mooring legs and then deploy the single leeward leg. Each mooring leg would consist of a drag anchor, a clump anchor, a subsurface float, and wire and synthetic mooring lines. It is anticipated that the same vessels and marine engineers would be contracted for the deployment of the WET-NZ mooring system.

DOE anticipates that the WET-NZ device would be transported to the site by a tugboat, turned upright, and attached to its mooring system. The SEACOR QUEST, a 160-foot vessel out of Astoria, is the candidate vessel for deploying the mooring system. The deployment vessel would facilitate the connection of the WET-NZ device with its moorings, likely assisted by a smaller work skiff. Final vessel determinations would be provided to the Corps prior to project development. The WET-NZ deployment would likely be accomplished in one work day.

Umbilical Cable Connection

For the 2012–2013 WET-NZ test, the Ocean Sentinel would be configured specifically for WET-NZ. Current equipment includes an umbilical power and fiber-optic communications marine cable that would be connected between the WET-NZ and the Ocean Sentinel. This would be accomplished through a custom connection to the WET-NZ and the Ocean Sentinel, with a universal custom marine connector that would be installed on each device prior to deployment. After the devices are deployed, the umbilical cable would be deployed and connected to the previously installed mating connectors on the WET-NZ and Ocean Sentinel. The WET-NZ developers would be provided with the technical specifications of the cable and connector so they could prepare their device for quick connection to the umbilical cable.

On-Site Commissioning Tests

Once installed in the mooring, the Ocean Sentinel would undergo a series of commissioning tests to test at-sea systems and verify telemetry connectivity to shore. The Ocean Sentinel commissioning testing would occur prior to the installation of the WET-NZ.

Once installed onto the mooring system, the WET-NZ would undergo a complete commissioning systems test to verify proper installation and connectivity of the devices. All tests would be documented and reports issued at the conclusion of each testing phase. NNMREC would have a representative present during all WET-NZ installation activities to ensure boundaries are respected, clearance is given to the Ocean Sentinel and any other deployed equipment, and procedures are followed according to best practices.

Installation of Other Future Tests

Other WEC devices (as identified in Section 2.2.5) may be tested as part of the Proposed Project. The installation equipment and procedures for the installation of future WEC devices would be similar to that employed for the 2012–2013 WET-NZ test.

The general parameters and conditions of the installation of structures for other future tests are described below. The installation to support other future tests at the project site would require authorization by the Corps pursuant to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act prior to their deployment. Details specific to the installation that would be planned for proposed future tests would be detailed in required environmental reviews to support permit applications necessary for Corps authorization.

Construction and Transportation to Project Site

For future tests, the Ocean Sentinel would be stored at and deployed from HMSC in Newport, Oregon. The WEC devices would be constructed and tested at a location selected by the WEC device developer. Once preliminary WEC device testing is completed by the WEC device developers, the devices would be shipped to Newport, Oregon for deployment. The WEC devices would be transported by truck, barge, or marine tow transport. Identification of applicable permits required for shipment would be the responsibility of the WEC device developer. If transported from a foreign build location, proper permits and licenses would be required to enter the United States. The testing vessel has already been constructed and is presently located at its home port at HMSC.

Mobilization of the Ocean Sentinel Instrumentation Buoy

For other future tests that would occur during the Proposed Project, the methods to mobilize the Ocean Sentinel would be virtually identical to those that would be employed in the 2012–2013 WET-NZ test.

Mobilization of the Testing Vessel

The vessel’s home port is HMSC. If used for testing WEC devices, vessel deployment would originate and end at an existing pier at HMSC. No new facilities or infrastructure would be required to support the deployment of the vessel.

Mobilization for the Wave Energy Conversion Device

Existing pier facilities at HMSC, the Port of Newport, or other local pier area would serve as the site for receipt of material and laydown area for the WEC devices. Mooring material such as mooring lines, buoys, and anchors would be staged at this site for the mooring installation vessel to pick up and transport to the testing site.

Anchoring and Mooring Installation

Methods and equipment used to install the Ocean Sentinel and its anchoring and moorings for other future tests during the Proposed Project would be nearly identical to the methods and equipment used to install the Ocean Sentinel anchoring and moorings for the 2012–2013 WET-NZ test.

For other future tests at the project site, WEC device mooring installation would be closely coordinated with the Ocean Sentinel mooring installation to ensure the orderly installation of the mooring components, minimize mobilization cycles, and reduce the risk of entanglement of the umbilical cable with the mooring lines. The mooring system for future WEC devices—although designed to meet site-specific conditions and the specifications of a number of possible WEC devices—would be similar in design and installation to the WET-NZ mooring. NNMREC would require that the WEC device developer submit formal plans prior to the installation of any new WEC device for NNMREC’s review and approval. These would include an Installation and Removal Plan, Mooring Plan, Operations and Maintenance Plan, Decommissioning Plan, Spill Contingency and Emergency Response Plan, Emergency Response and Recovery Plan, Safety Management Plan, and Navigational Lighting Plan. All future WEC device deployments would also be subject to the conditions identified in the *Newport Open Ocean Wave Energy Test Site Northwest National Marine Renewable Energy Center Adaptive Management Framework (*Adaptive Management Framework) provided as Appendix D to this EA.

If used for future tests during the Proposed Project, a testing vessel would not require the installation of mooring components. Rather, it would be held in location in the project site with its own anchor.

Ocean Sentinel and Wave Energy Conversion Device Installation

The methods and equipment used to install the Ocean Sentinel for future tests during the Proposed Project would be nearly identical to methods and equipment used to install the Ocean Sentinel for the 2012–2013 WET-NZ test.

Future installations of the Ocean Sentinel would likely occur between May and September during the 10-year lifetime of the Proposed Project. The months between October and April would generally be avoided for any planned installation because weather conditions are typically not favorable for safe marine operations; however, the mooring system may be installed during these months if appropriate weather conditions exist.

WEC device deployment plans developed for other future tests would be unique to each specific WEC device. It is anticipated that the WEC device would be towed or barged to the site, turned upright (if appropriate) and attached to the WEC device mooring. An example vessel likely to be used for this task is The SEACOR QUEST, the 160-foot vessel out of Astoria, described above.

When ready, the umbilical cable would be placed and the ends connected to the Ocean Sentinel and WEC device. A detailed plan would be developed by the WEC device developer to address this installation and connection to the WEC device.

Testing Vessel Installation

Under the scenario in which the test equipment would be contained on board a manned vessel, installation would not be required. Rather, the vessel would simply navigate to the predetermined coordinates and anchor there temporarily for the duration of the test.

Commissioning Testing

In future tests, once installed onto the mooring system, the Ocean Sentinel would undergo a complete commissioning systems test including onsite tests and tests conducted remotely to confirm the working condition of remote communications and data acquisition systems. Commissioning testing would occur prior to the installation of the WEC devices. The WEC device developers would also conduct a series of commissioning tests to verify proper installation and connectivity of the WEC devices once installed on the mooring. All tests would be documented and reports issued at the conclusion of each testing phase. Tests would also be conducted on the testing equipment if contained on board a manned vessel.

2.2.11 Operations and Maintenance

Operations and Maintenance during the 2012–2013 WET-NZ Test

Upon conclusion of testing in 2012, the Ocean Sentinel, WET-NZ, and TRIAXYS™ devices would be removed and taken to a land-based storage facility for the winter. The anchoring and mooring systems for the Ocean Sentinel would remain in place until June 2013, at which time the devices would be redeployed for a second round of testing. The WET-NZ anchoring and mooring system may also remain in place between the summer tests. Upon conclusion of testing in the summer of 2013 and within 30 days of the end of the Corps Nationwide Permit authorization period, all project components, including the devices and mooring systems, would be removed (as described in Section 2.2.12 below).

Continuous on-shore monitoring of the Ocean Sentinel and WET-NZ devices would commence immediately after deployment. NNMREC would maintain a dedicated staff person to be in charge of daily monitoring of the instrumentation for the deployed equipment. This person would also respond to alarms and initiate emergency response, if required. The staff person would monitor a prearranged set of WET-NZ and Ocean Sentinel device parameters either directly through the umbilical cable or through an external Internet-based interface into the Ocean Sentinel's monitoring computer. A remote telemetry system would be used for this data monitoring. The data stream would be available for local and remote monitoring, data analysis, and reporting.

A detailed alarm response manual would be developed as part of the monitoring plan to address alarms. The alarm response manual would provide a series of decision trees to assist the ocean test facilities manager, or monitoring engineer, in determining the next step, logging procedures, and points of contact. All alarms would be logged by the system. Alarm logs would be periodically reviewed to assist in determining faulty sensors or problematic systems. WET-NZ representatives would monitor their alarms and advise the Ocean Sentinel monitoring engineer that they have received, acknowledge, and addressed their alarm in accordance with the WET-NZ alarm response manual. A WET-NZ-specific alarm manual would be prepared and submitted by the WET-NZ developer, reviewed and approved by NNMREC, then incorporated into the WET-NZ-specific deployment.

During the 2012–2013 WET-NZ test, visual inspections, maintenance operations, and safety checks of the project devices would be performed every 4 weeks, and weekly visits may be conducted initially. This would include retrieving data storage devices, replacing batteries, and conducting any other corrective maintenance as needed. Visual inspections of the devices above and below water line would be made for signs of premature wear or excessive bio-fouling. Aids to navigation would also be visually inspected during these visits. In addition, associated monitoring equipment would be periodically installed and recovered (depending on the parameters being monitored, battery life, and data storage capacity of the devices).

The Ocean Sentinel would be inspected visually through the deck-mounted video camera and regular maintenance trips on a predetermined schedule to determine maintenance requirements. NNMREC would conduct both announced and unannounced safety inspections. If pier-side, the inspection may include internal wiring and ground system.

Prior to removal of the deployment, appropriate inspection techniques would be used to view underwater components of the Proposed Project, including looking for any accumulation of derelict fishing gear. All inspections would be carried out in consideration of safety of personnel and weather permitting. This inspection would be logged and would help in gaining a greater understanding of system component aging.

Scheduled maintenance would be conducted based on length of operational use or at predetermined intervals of time. The results of the maintenance would provide an understanding of future maintenance requirements. A list of the basic maintenance items include:

- solar panel cleaning,
- anemometer and wind bird inspection,
- inspection and cleaning of marine growth buildup,
- evidence of bird or marine mammal presence,
- hull inspection following manufacturer's recommendations,
- load element inspection,
- mooring lines,
- umbilical cable connection point and integrity, and
- many other items compiled in maintenance plan.

The WET-NZ device and the Ocean Sentinel itself could undergo specific maintenance, in general, as follows:

- **Retrieval for on-shore inspection.** The WET-NZ device and Ocean Sentinel would be disconnected electrically, detached from their moorings, and taken to port for inspection and refurbishing as required. This maintenance may include the change of load elements, rerouting of electrical wires, etc. When the devices are removed from the mooring systems for maintenance, the mooring lines would be connected to each other as if the device were still on station and supported with an additional subsurface float (SSF). The SSF maintains tension on the mooring system so there is no slack introduced into the mooring system.
- **On-shore inspection and refurbishment.** When the devices are removed from moorings at the end of the deployment period, they would be taken out of water and cleaned, after which an external visual inspection would be carried out. Full internal inspections would also be performed, including replacement of worn or damaged components. The lid seals, hydraulic cylinder seals, and bearing pads would all be replaced as appropriate based on their condition. The hydraulic fluid would be tested and replaced, if required.
- **Redeployment after inspection.** The devices would be towed out from port, reconnected electrically, attached to all moorings, and the test would resume.

Corrective maintenance would occur when required and may be between scheduled maintenance. The change in schedule could be because of:

- failure of equipment or hardware,
- predicted failure during an inspection, or
- accelerated maintenance to be available during a specific time frame, when normal maintenance would be done.

In addition to the above, maintenance that can be done while in the moor would be identified as well as maintenance that must be done pier-side and in dry-dock.

Any unscheduled maintenance would be completed as necessary, with consideration for safety of personnel and protection of the environment. During operation, either the Ocean Sentinel or the WET-NZ device may require removal from the mooring. A vessel of opportunity would be employed to travel to the site, disconnect each mooring line, and transport the Ocean Sentinel or WET-NZ device back to Newport. The Ocean Sentinel or WET-NZ device would be repaired, serviced, or modified as needed; it would be subsequently tested, and once validated, towed back to the site for reinstallation. When removed from the project site mooring, there may be a need for dockside mooring in Newport for the WET-NZ device. These moorings would occur at existing piers and docks in the Port of Newport and in agreement with the owner.

A number of formal plans and procedures have been developed or would be developed prior to the deployment of the 2012–2013 WET-NZ test. These include an Installation and Removal Plan, Ocean Sentinel Mooring Plan, WET-NZ Mooring Plan, Operations and Maintenance Plan, Decommissioning Plan, Spill Contingency and Emergency Response Plan, Emergency Response and Recovery Plan, Safety Management Plan, Navigational Lighting Plan, a number of environmental monitoring plans, and an Adaptive Management Framework. Both NNMREC and WET-NZ would have plans to address the major types of emergency conditions that could occur during normal operation and maintenance activities for the Proposed Project, identify lines of communication with regulatory agency personnel, and establish response actions for emergency situations. Implementation of procedures in their plans would minimize the potential for adverse effects in the event an emergency situation was to occur.

Operations and Maintenance of Other Future Tests

The procedures for operations and maintenance of other future tests that could be conducted during the Proposed Project would be similar to those employed in the 2012–2013 WET-NZ test. Other future tests at the project site would require authorization by the Corps pursuant to Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act prior to their deployment and would undergo environmental reviews under this process.

In other future tests, the DAS, load bank, and other equipment may be contained onboard the testing vessel. In this scenario, the WEC device would be connected to the equipment on the vessel by an in-water umbilical cable enabling the separation between the vessel and the WEC device to be approximately 328 feet (100 meters). The vessel would be manned at all times and located using its own anchor. Such tests would not be expected to last more than 10 days, at which time the vessel would disconnect from the WEC device and return to shore. Testing conducted by equipment on board a manned vessel would be expected to occur in months of May to October. Though single test events would not exceed 10 days, the testing vessel may engage in multiple tests per season.

For future tests, the Ocean Sentinel would be capable of operating for a testing period of up to 6 months. The WEC devices would operate for a period of up to 12 months after they are installed. When not on station, the Ocean Sentinel's anchors would be left in place and its mooring lines would be buoyed off with marker buoys. Once installed, the anchoring and moorings for the Ocean Sentinel may be left installed at the project site until the conclusion of the Proposed Project to minimize disturbance to benthic habitats.

During future tests, visual inspections, maintenance operations, and safety checks of the Ocean Sentinel would be performed every 4 weeks and would include retrieval of data storage devices, replacement of batteries, cleaning of solar panels, replacement of broken wind turbines, and any other corrective maintenance needed. The 4-week inspection interval is frequent enough to identify and correct issues before they become serious. Initially, weekly visits to the Ocean Sentinel would be conducted to visually inspect the exterior for signs of premature wear, excessive biofouling, or to address minor modifications that cannot be accomplished from shore. NNMREC would maintain a trained and dedicated staff person to be in charge of daily monitoring of the Ocean Sentinel and WEC devices, responding to alarms, and initiating emergency response, if needed. The staff person would monitor a prearranged set of WEC device parameters either directly through the umbilical cable or through an external internet-based interface into the Ocean Sentinel monitoring computers. The data stream would be available for local and remote monitoring, data analysis, and reporting.

The Ocean Sentinel is designed for a maximum 3-month maintenance interval. Between each deployment, the Ocean Sentinel would undergo servicing such as replacing batteries, checking all alarms and component function, and checking for excessive bio-fouling around the mooring connections.

To limit bottom disturbance, if an incoming WEC device developer can use the same mooring configuration, the anchor and mooring system may be left in place temporarily between tests. If WEC device anchors are designed and installed by the device developers, they may be retrieved upon completion of the device's test.

NNMREC would require that all WEC devices under test during the lifetime of the Proposed Project to comply with various requirements designed to minimize the impact of tests on marine habitat and life, as well as human health and safety. NNMREC would also require that WEC device developers submit a number of plans to NNMREC for review and approval as part of their agreement for testing at the project site. These include an Installation and Removal Plan, Ocean Sentinel Mooring Plan, WET-NZ Mooring Plan, Operations and Maintenance Plan, Decommissioning Plan, Spill Contingency and Emergency Response Plan, Emergency Response and Recovery Plan, Safety Management Plan, and Navigational Lighting Plan. Both NNMREC and the WEC device developers would have local contingency response capability to respond to alarms or unexpected conditions and take corrective action, as needed. In addition to contingency response, salvage plans for the Ocean Sentinel and WEC device would be in place in the event of a catastrophic event. These plans would be developed in coordination with the Oregon Parks and Recreation Department and the Oregon Department of State Lands prior to any deployment of the Ocean Sentinel or a WEC device. A detailed set of WEC device operations and maintenance procedures would be developed for each specific WEC device to undergo testing. These procedures would include training and qualification requirements, startup, shutdown, and contingency response procedures. Maintenance of the WEC devices would be unique to each device and the responsibility of each developer. NNMREC would be supplied with a WEC maintenance plan for review and approval before deployment of the WEC devices.

In addition, during the Proposed Project, NNMREC and all WEC device developers would follow the procedures outlined in the Adaptive Management Framework (Appendix D). This requires that an adaptive mitigation plan be prepared prior to each individual test conducted as part of the Proposed Project. Each test-specific mitigation plan would include thresholds and mitigation actions for the particular test and would account for the unique attributes of that test, such as the characteristics of the technology being tested and duration of testing. In addition, results and analysis of previously completed monitoring studies would be used to inform the adaptive management plans for future tests. The adaptive management process would provide a framework for the broader regulatory and stakeholder communities to stay informed of and provide feedback on NNMREC test center monitoring. As part of the process, adaptive management thresholds have been developed to evaluate the monitoring results of both single-year and multi-year data from test activities.

Associated monitoring equipment would be periodically installed and recovered from the project site depending on the parameters being monitored, battery life, and data storage capacity of the devices. This includes equipment deployed directly within the 1-square-nautical-mile (3.4-square-kilometer) project site, as well as equipment deployed within the 5-nautical-mile (9.3-kilometer) monitoring area described in Section 2.2.2. Specific information detailing the known types and locations of scientific equipment that would be deployed as part of the Proposed Project are included in the monitoring plans and attached to this EA as Appendix E.

2.2.12 Removal and Decommissioning

Removal and Decommissioning for the 2012–2013 WET-NZ Test

Removal of the WET-NZ Device

When the WET-NZ developer has completed the testing in 2013, the device would be locked down and the umbilical cable would be divorced from the WET-NZ. A vessel of opportunity would be used to disconnect and recover the umbilical cable. The cable could be staged temporarily on hang-off buoys after disconnection from the WET-NZ. With the umbilical cable disconnected from the WET-NZ, the WET-NZ and all associated mooring components would be removed from the test site. The WET-NZ developer would responsibly recover the WET-NZ and all associated materials. Throughout this process, the WET-NZ developer would coordinate with NNMREC for a smooth and orderly removal.

Removal of the Ocean Sentinel Instrumentation Buoy

The Ocean Sentinel moorings would be removed at the end of the authorization period for the 2012–2013 WET-NZ test, at which time the mooring lines and anchors would be recovered by a vessel of opportunity. The vessel would recover using a winch and/or A-frame and slowly bring each component to the surface and locate on the deck.

Overall Decommissioning

During decommissioning of the 2012–2013 WET-NZ test, all system components would be removed from the project site, including the Ocean Sentinel, WET-NZ device, TRIAXYS™ wave measurement buoy, anchors, mooring lines, subsurface floats, and the shore station and associated telemetry antennas. The website would be decommissioned. Anchors and mooring lines would be disposed of in accordance with federal, state, provincial, and local environmental control regulations and at permitted facilities. Disposition of equipment and material would be in accordance with a detailed decommissioning plan.

Removal and Decommissioning of Other Future Tests

A number of WEC devices could be tested throughout the Proposed Project. It is likely that the equipment and procedures employed in removal and decommissioning of WEC devices in other future tests would be nearly identical to those employed in the removal and decommissioning of the 2012–2013 WET-NZ test. As part of their Proposed Project, NNMREC would require that all WEC device developers responsibly dispose of the WEC device and all associated materials, if they are to be disposed of after the testing period and would require that each WEC device developer prepare and submit a detailed removal and decommissioning plan as part of their agreement for testing at the project site. Throughout this process, the WEC device developers would coordinate with NNMREC for a smooth and orderly removal. General parameters for anticipated removal and decommissioning procedures are described below.

When a WEC device developer has completed testing, the power would be removed from the device and the umbilical cable disconnected from the Ocean Sentinel or vessel and from the WEC device. A vessel of opportunity would be used to disconnect and recover the umbilical cable from the WEC device. With the umbilical cable removed, the WEC device and all associated WEC device mooring components would be removed from the test site. Anchors could be retrieved by a vessel with adequate assets and load-handling capabilities or decommissioned on site. If being removed completely, the anchors and mooring lines would be retrieved by attaching a recovery line to the anchor and then winching it to the surface. This may be accomplished using a remote-operated vehicle (ROV). It may be possible to recover the anchors through the mooring lines; if this is the case, the ROV would not be needed. Suction-installed pile anchors could be retrieved by pumping water into the anchor chamber, creating positive pressure that forces the embedded anchor out of the sediment. If decommissioned on site, embedment anchors such as plate or pile anchors could also be cut off at the ocean floor using underwater acetylene torches.

The Ocean Sentinel moorings and anchors would remain in place for the 10-year lifetime of the Proposed Project to minimize disturbance in the project site, or they may be removed between deployments. The procedures and equipment employed in the removal of the Ocean Sentinel and its anchors and moorings would be identical to the procedures and equipment that would be employed at the conclusion of the 2012-2013 WET-NZ test. The decommissioning of the Ocean Sentinel at the conclusion of the Proposed Project would be identical with the overall decommissioning described above.

If the vessel is used during the 10-year lifetime of the Proposed Project, it would not be decommissioned; rather it would resume a schedule of research activities to support HMSC and OSU upon conclusion of the Proposed Project.

2.2.13 Permits and Approvals

The permits, reviews, and approvals required for the Proposed Project are provided in Table 2-3.

Table 2-3. Permits and Approvals

Agency	Permit/Approval
U.S. Army Corps of Engineers	Nationwide Permit #5 (for authorization under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act)
Oregon Department of State Lands	Removal/Fill Permit
Oregon Department of State Lands	Temporary Use Authorization
Oregon Department of Land Conservation and Development	Federal Consistency Certification (pursuant to the federal Coastal Zone Management Act)
Oregon Department of Environmental Quality	Water Quality Certification: advance certification provided for activities authorized under Nationwide Permit #5 (for authorization under Section 401 of the Clean Water Act)
United States Coast Guard	Private Aids to Navigation
Oregon Department of Parks and Recreation	Permit to Conduct Salvage Activities on the Ocean Shore
Oregon Department of Parks and Recreation	Permit for Motor Vehicle on the Ocean Shore

2.2.14 Applicant-Committed Measures

NNMREC has committed to incorporating the following measures in the implementation of the 2012–2013 WET-NZ test as well as throughout the Proposed Project to facilitate the safe and compliant deployment of the project technology, and to minimize impacts on the marine environment. A number of other provisions that will be in place during the operation of the Proposed Project are included in the Adaptive Management Framework (see Section 2.2.16) and the Monitoring Plans (see section 2.2.15)

Planning and Development

The following project measures address planning and development of the Proposed Project.

- NNMREC will require that WEC device developers submit to NNMREC a maintenance plan for review and approval prior to deployment and follow the provisions of the plan during deployment.
- NNMREC will establish and follow a decommissioning plan that outlines responsible methods for decommissioning or removal and disposal of the Ocean Sentinel and mooring system components. This will include, where applicable, recycling, reuse, or repurposing of materials.
- NNMREC will require that all WEC device developers that test their devices as part of the Proposed Project submit to NNMREC for review and approval a mooring removal and disposal plan. The plan will include provisions for the responsible disposal, recycling, or repurposing of mooring components installed to test their device. This will ensure that no impacts result from irresponsible removal, decommissioning, or disposal activities. NNMREC will require that all WEC device developers follow the provisions of approved plan.

- NNMREC will require that all WEC device developers responsibly dispose of the WEC devices and all associated materials pursuant to the conditions included in the approved decommissioning plans.

Navigation and Transportation

The following project measures address navigation and transportation of the Proposed Project.

- An automatic identification system transmitter will be part of the Proposed Project to provide navigation assistance for locating the Ocean Sentinel in the improbable event it breaks free from the mooring system.
- Should the Ocean Sentinel or any other deployed equipment break free during the deployment of the Proposed Project, NNMREC will commence efforts to retrieve the equipment as soon as safe operating conditions exist.
- Marker buoys will be placed at the project site when a WEC device or Ocean Sentinel has been removed (e.g., brought back to Newport for maintenance).
- The Ocean Sentinel will comply with applicable navigational regulations for marking, lighting, and informing boaters of the location of in-water and on-water system components.
- All project-related vessels will follow U.S. Coast Guard rules regarding marine navigation and safety.
- NNMREC will include the U.S. Coast Guard, the FINE committee, the Oregon State Police, and the Oregon Marine Board in determining the most appropriate navigational designations for the project site both during and between tests.
- Two weeks prior to deployment, installation, and removal of the Ocean Sentinel and WEC devices, NNMREC will request that the U.S. Coast Guard publish a Local Notice to Mariners describing the Proposed Project and potential navigation exclusion zone or area to be avoided.
- NNMREC would have a representative present during all WET-NZ installation activities to ensure boundaries are respected, clearance is given to the Ocean Sentinel and any other deployed equipment, and procedures are followed according to best practices.

Safety and Survivability

The following project measures address the safety of the Proposed Project and its resilience and operability in the marine environment.

- NNMREC will complete training for all personnel maintaining or working on the Ocean Sentinel. Training will be specific to the Ocean Sentinel and will include electrical safety, sensors, reporting, and maintenance logs, as well as the WET-NZ. This training may be conducted by the offsite engineering subcontractor and WET-NZ vendor in lieu of NNMREC.
- Prior to testing, contingency response and salvage plans for the Ocean Sentinel and WEC devices will be in place in the event of a catastrophic event. These plans will be developed in coordination with Oregon Parks and Recreation Department and Oregon Department of State Lands. The salvage plan will include available salvage resources and the ability of those resources to respond in real-time.

- The project design will identify and address safety features for installation, operations, maintenance, modification, repair, removal, and decommissioning.
- The Ocean Sentinel will be capable of surviving 50-year storm conditions at the site for which the Proposed Project was designed.
- The Ocean Sentinel will be capable of surviving a tsunami event consistent with Lincoln County guidance on tsunami planning.
- The Ocean Sentinel will have the capability to remotely trigger alarm conditions for events exceeding predetermined thresholds.
- Visual inspections, maintenance operations, and safety checks for the Ocean Sentinel and WEC devices will be performed every 4 weeks.
- Monitoring personnel will follow notification procedures in the event of Ocean Sentinel and WEC devices system failure. In particular, the procedures will address major or cataclysmic events affecting the system that require notification of emergency or safety services, including the U.S. Coast Guard, local emergency responders, law enforcement, or emergency response agencies.
- The Ocean Sentinel will contain automated safety features to avoid accidental shock or injury to system workers or to nearby personnel, property, or marine vessels.
- A separate set of backup batteries in the Ocean Sentinel will be reserved for emergency data transmissions and bilge operation.
- NNMREC will require that, before testing, each WEC device developer will submit to NNMREC for review and approval a spill contingency and emergency response plan, which would contain measures intended to ensure a rapid response and recovery that minimizes potential environmental harm.
- NNMREC would require that a WET-NZ-specific alarm manual would be prepared and submitted by the WET-NZ developer for NNMREC's review and approval, which would then be incorporated into the WET-NZ-specific deployment.

Biological Resources

The following project measures address the impacts of the Proposed Project on biological resources.

- Any WEC device that was tested in other waters prior to shipment to the project site will undergo purging of contained water, cleaning, and drying to prevent the spread of invasive species.
- Umbilical cables will have at least single armor to reduce electromagnetic fields (EMFs).
- The umbilical cable connection on the WEC devices and Ocean Sentinel will be constructed of steel or other metal to discourage chewing, gnawing, or pecking and prevent electrocution by marine life.
- The connection node on the power cable will be filled with biodegradable seed-based oil.
- The Ocean Sentinel will be constructed with National Marine Fisheries Service (NMFS)-approved passive deterrents, such as bull rails and netting, to prevent its use as a marine mammal haulout.

- The Ocean Sentinel will use only TBT-free and copper-free antifouling paints and coatings, and NNMREC will require that all WEC devices to be tested as part of the Proposed Project use only TBT-free antifouling paints and coatings.
- All vessels engaged in activities to support the Proposed Project will comply with NMFS marine mammal viewing guidelines

2.2.15 Research and Monitoring

A number of environmental studies to characterize the project site and, in some cases, to set a baseline for future monitoring have been conducted, are being conducted presently, or will be conducted by NNMREC and OSU. These studies are designed to increase the knowledge of the potential effects that the Proposed Project, and wave energy projects in general, may have on the environment. These studies include the following:

- NNMREC OTF Benthic Monitoring Studies;
- EMF Monitoring of WET-NZ half-scale Wave Energy Generator at NNMREC Ocean Test Facility; and
- NNMREC Ocean Test Facility (OTF) Short-Term Acoustic Test.

Detailed descriptions of the environmental studies and monitoring plans are attached to this EA as Appendix E. The monitoring results will be summarized and provided to the Adaptive Management Committee as outlined in the Adaptive Management Framework (Appendix D) (see Section 2.2.19).

2.2.16 Adaptive Management Framework

The Adaptive Management Framework is attached to this EA as Appendix D. The purpose of the Adaptive Management Framework is two-fold. First, it provides a means for the broader regulatory and stakeholder communities to stay informed of and provide feedback on NNMREC test center monitoring and mitigation for the entire lifetime of the Proposed Project. An Adaptive Management Committee will receive an Annual Operations and Monitoring Report that will be a compilation of monitoring results, adaptive management thresholds, and mitigation actions taken during each test conducted at the project site. The committee will meet on an annual basis to review results and provide guidance on future test center activities. Adaptive management thresholds that the Adaptive Management Committee will use in their review of monitoring results are identified.

Second, the Adaptive Management Framework provides a foundation for the monitoring and adaptive management associated with individual tests at the project site. For each test performed, an Adaptive Mitigation Plan will be developed that includes thresholds and mitigation actions for the particular test. The Adaptive Mitigation Plans will account for the unique attributes of that specific test, such as the characteristics of the technology being tested and duration of testing. In addition, results and analysis of previously completed monitoring studies will be used to inform the plans for future tests.

An Adaptive Mitigation Plan for the 2012–2013 WET-NZ test has been prepared and is included in the Adaptive Management Framework. It includes a number of thresholds that, if exceeded, would require a real-time mitigation action on behalf of NNMREC and/or the WEC device developer.

2.3 No Action Alternative

The No Action Alternative is considered in this EA and provides a benchmark, enabling decision-makers to compare the magnitude of environmental effects of the Proposed Project. Under the No Action Alternative, DOE would not provide financial assistance for development, construction, or operation of the Proposed Project. No area would be designated for the Ocean Sentinel or WEC device mooring, no anchoring structures would be placed, no Ocean Sentinel would be constructed, and no WEC devices would be deployed in the project site. The current ocean and resource uses would continue to occur in the project site. No applicant-committed measures would be required.

While it is possible that an Ocean Sentinel or similar instrumentation buoy 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 Alternatives Considered but Eliminated

Prior to scoping and during more than 24 months of preliminary project development, NNMREC conducted a site selection process that included involvement with stakeholders and interested parties, which resulted in a variety of siting criteria for the Proposed Project. Site criteria essential to the intended operation of the Proposed Project include:

- water depth of approximately 180 feet (55 meters),
- proximity to port facilities,
- exposure to unobstructed waves from the open ocean, and
- availability of a 1-square-nautical-mile (3.4-square-kilometer) project site.

In association with Sea Grant, NNMREC followed a site selection process to identify an area for the Proposed Project that would meet the project criteria, but would also minimize impacts on the fishing industry. The site selection process was first discussed with FINE at its March 17, 2009 regular meeting in Newport, Oregon. General steps in the site selection process are outlined below.

- May 19, 2009: FINE meeting in Newport, Oregon where NNMREC presented FINE with siting requirements and desired parameters.
- August 2009: NNMREC conducted community forums in Yachats, Lincoln City, and Newport on various aspects of wave energy on the Central Oregon Coast.
- May 19 and October 20, 2009: FINE presented preliminary site location recommendations to NNMREC.
- 2009 and 2010: OSU provided feedback to FINE on its preliminary site location recommendations.
- Fall 2010: NNMREC presented final selected site to FINE for comment.
- April 2011: NNMREC placed a notice in the local Newport paper announcing the final site and 30-day comment period.

During the site selection process, additional criteria were identified that represent conditions highly desirable for the successful and effective operation of the Proposed Project. These include criteria identified by NNMREC, outside parties, and stakeholders. It was determined that the project site should be located:

- near HMSC in Newport, Oregon, at a distance to shore of 1.5 to 3.0 miles (2.4 to 4.8 kilometers) (i.e., within Oregon Territorial Waters);
- over a soft or sandy seafloor;
- in an area with comparatively low levels of marine traffic but highly visible to marine navigation;
- sufficiently close to onshore roads to allow emergency access for salvage purposes if necessary;
- sufficiently distant from the Yaquina River mouth to avoid hydraulic sediment transport or other technical issues related to proximity to the river;
- either north or south of the directly westerly line-of-sight from Yaquina Head; and
- away from a recently-discovered rocky reef directly off Yaquina Head.

NNMREC has been coordinating with the FINE committee since March 2009 to identify an area for the Proposed Project that would meet the project criteria, but would also minimize impacts on the fishing industry. NNMREC has met with FINE on over a dozen occasions to date. During the early meetings, general site locations were discussed. In later meetings, alternative sites to the north and the south of the project site.

were discussed. In the last of these meetings, NNMREC and the FINE committee agreed on a final project site where the Proposed Project requirements would be met, and impacts on the fishing industry would be minimized.

Based on the criteria listed above, and the considerations of the FINE committee, the final 1-square-nautical-mile (3.4-square-kilometer) project site has been identified as the most feasible and preferred site. During the site selection process, NNMREC narrowed its consideration away from areas that did not meet the essential criteria for site selection, or would otherwise be infeasible based on the desirable established criteria. This project site was posted in the *Newport Times* on April 26, 2011, and the *Oregonian* on April 20, 2011, for final consideration by the public. After a 30-day period no objections were voiced. The project site was then registered with the Oregon Territorial Sea Plan under development by the Oregon Department of Land Conservation and Development.

3.0 Affected Environment and Environmental Consequences

The following sections of this environmental assessment (EA) describe the affected environment for each resource. The affected environment includes the study area unique to each resource (defined under the Environmental Setting sections for each resource) that would potentially be affected if the Proposed Action is implemented.

The description of the affected environment serves as a baseline from which to identify and evaluate the potential environmental impacts of the Proposed Project and No Action Alternative. The discussion of the affected environment is prepared to a level of detail commensurate with the potential for environmental impacts on each resource.

The potential direct and indirect, adverse and beneficial, and long-term and short-term impacts of the U.S. Department of Energy (DOE)'s Proposed Action in support of the Proposed Project are evaluated by resource and compared to the environmental consequences of the No Action Alternative.

The Wave Energy Technology-New Zealand (WET-NZ) wave energy conversion (WEC) device is the first that will be tested at the project site. The potential direct and indirect, beneficial and adverse, and long-term and short-term impacts of the 2012-2013 WET-NZ test are included in the analysis below.

3.1 Environmental Categories Evaluated and Dismissed from Further Analysis

National Environmental Policy Act (NEPA) guidance documents were used to identify environmental resources that may be present in the project vicinity, and to evaluate the potential impacts of the Proposed Project. Some environmental resources that are typically addressed in other NEPA documents are not present in the project vicinity or are not expected to have impacts associated with the Proposed Project. These resources dismissed from further consideration are discussed below.

3.1.1 Air Quality

Baseline ambient air quality in the vicinity of Newport, Oregon is acknowledged to be good and Lincoln County, Oregon is in attainment[6] for all criteria air pollutants measured by the U.S. Environmental Protection Agency (EPA) (U.S. Environmental Protection Agency 2012). The Proposed Project would emit only small amounts of air pollutant emissions. As described below, the minor emissions would have little potential to degrade ambient air quality.

[6] A designated attainment area, as defined by the EPA, is an area that meets the national primary or secondary ambient air quality standard for the pollutant in question. In this case, Lincoln County is in attainment for all EPA criteria pollutants.

Air quality throughout the state is regulated by the Oregon Department of Environmental Quality (ODEQ). Population density throughout Lincoln County is low and there are few major industrial facilities within a few miles of the coast. ODEQ does not operate any air quality monitoring stations in Lincoln County, acknowledging the limited potential for local air quality concerns.

Air pollutant emissions from the Proposed Project would be generated mainly during the installation phase and the removal and decommissioning phase, when support vessels would be used to deploy and retrieve anchors, test equipment, and umbilical cables. During the operational and maintenance phases, occasional air pollutant emissions would also be generated by support vessels traveling to and from the project site. It is expected that these vessels would burn low-sulfur diesel fuels that would emit some level of sulfur oxides. These vessels would generate most of their emissions at the test sites and in transit, which would occur infrequently throughout the Proposed Project and at locations that are approximately 2.0 miles from any onshore sensitive receptor locations. There would be little potential for marine vessel emissions to degrade onshore air quality; therefore, impacts are not anticipated and air quality is dismissed from further analysis.

3.1.2 Energy

The Proposed Project would not result in an increase in energy demand that would exceed available natural resources such as building materials or energy supplies. Because the Ocean Sentinel and WEC devices would not be connected to the electrical grid onshore, they would not affect electricity demand or supply. Although a shore-side server would be connected to facilities at Hatfield Marine Science Center and Lincoln County People's Utility District (PUD), the energy demands required to operate this equipment would be negligible. Furthermore, no new energy infrastructure would be required by the Proposed Project. Therefore, impacts are not anticipated and energy is dismissed from further analysis.

3.1.3 Floodplains

Prior to installation, the Ocean Sentinel and WEC devices would be launched into the water from an existing pier at Hatfield Marine Science Center (HMSC) in Newport, Oregon using the methods described in Section 2.2.10 of this EA. The project site would be located offshore and is not within any 100- or 500-year floodplain. The test vessel that could be used in place of the Ocean Sentinel (OSU's research vessel, the Pacific Storm) has already been launched into the ocean and would be docked at an existing moorage between deployments. Therefore, impacts are not anticipated and floodplains are dismissed from further analysis.

3.1.4 Geology and Soils

The Proposed Project would not result in changes to landforms, topography, soils, or minerals. No drilling, boring, excavation, or other ground disturbance would be required. No geological hazards would be encountered. Therefore, impacts are not anticipated and geology and soils are dismissed from further analysis. The affected environment and environmental consequences for offshore geology and benthic sediment are described in Section 3.2, *Biological Resources*.

3.1.5 Intentional Destructive Acts

In December 2006, the DOE Office of General Counsel issued interim guidance stipulating that NEPA documents completed for DOE actions and projects should explicitly consider intentional destructive acts (i.e., acts of sabotage or terrorism). No phases of the Proposed Project would involve transportation, storage, or use of radioactive, explosive, or toxic materials. Consequently, it is not anticipated that any phase or activity associated with the Proposed Project would be viewed as a potential target by saboteurs or terrorists.

The project site is not near any nuclear power plants. The Proposed Project is located near Yaquina Bay, which is home to port facilities, and there is national defense infrastructure (an office of the Homeland Security Department and an Oregon National Guard Armory) in Newport. However, there is no foreseeable way that sabotage or terrorist acts involving the Proposed Project could affect these resources. Therefore, impacts are not anticipated and intentional destructive acts are dismissed from further analysis.

3.1.6 Land Use

Land use is described by land ownership and the governing entities' management plans and zoning that define land use types and regulate development patterns. Onshore activities required by the Proposed Project would include construction in an existing shipyard, transportation to Newport, Oregon along existing roads, and mobilization and launch from an existing pier in Newport. All onshore activities would be consistent with the planned and zoned uses of the locations in which they would take place.

Section 307(c) (3) of the Coastal Zone Management Act requires that all federally licensed and permitted activities be consistent with approved state coastal zone management programs. Because it lies within Oregon's territorial limits, the Proposed Project is subject to the Oregon Coastal Zone Management Program as managed by the Oregon Department of Land Conservation and Development. The Territorial Sea Plan (TSP), which is based on the policies of the Ocean Resources Management Plan, is the primary plan against which the Proposed Project must be evaluated for consistency. On November 5, 2009, the Oregon Land Conservation and Development Commission adopted Oregon Administrative Rule (OAR) 660-036-0005 for the TSP, Part Five (Oregon Department of Land Conservation and Development 2009), which describes the process for making decisions concerning the development of renewable energy facilities in the state territorial sea, and specifies the areas where that development may be sited. The NNMREC is mentioned by name in Part Five: D of the TSP, which states that the Proposed Project would be subject only to the requirements of Part Five: A of the TSP. The installation, operation, maintenance, removal, and decommissioning of the Proposed Project components would be in accordance with the provisions outlined in Part Five: A, and therefore, would be consistent with state and federal ocean management plans for the project site. Nonetheless, before the installation of the Proposed Project, NNMREC would apply to the Oregon Department of Land Conservation and Development for a federal consistency certification pursuant to the federal Coastal Zone Management Act.

Part Five: D of the TSP states that experimental or test devices for use at the project site are required to obtain applicable authorizations and licenses. WEC devices tested as part of the Proposed Project would, therefore, be subject to the requirements of Part Five: B of the TSP. Part Five: B states that the Oregon Department of State Lands (DSL) would coordinate state and federal agencies as they apply their authorities to review the project. In this role, DSL would coordinate the review of requests for leases, permits, easements, and consultation for WEC devices that would be tested as part of the Proposed Project.

Therefore, because the Proposed Project would be consistent with the planned uses of terrestrial and marine areas in and adjacent to the project site, there would be no impacts on land use.

3.1.7 Noise Impacts on Sensitive Human Receptors

Airborne noise would be generated by equipment operating far from homes, businesses, or recreational areas. As discussed in Section 2 above, the proposed project site would consist of a square area of ocean, centered approximately 2 miles (3 kilometers) off the Oregon coast near the city of Newport, Oregon (Figure 2-1). As described below, there is little potential for these noise emissions to cause noise impacts on sensitive human receptors above negligible levels.

Existing noise levels at most locations along the coast are caused mainly by natural sources (wind and surf), although elevated noise levels are expected to occur close to highways, commercial sites, and industrial waterfront facilities. The Proposed Project would generate noise emissions mainly during the installation phase and removal and decommissioning phase, when support vessels would be used to deploy and retrieve anchors, test equipment, and umbilical cables. During the operational phase and maintenance phase, occasional noise emissions would also be generated by support vessels traveling to and from the project site. These vessels would generate most of their noise emissions at the onshore support docks and offshore test sites, and in transit, all at distances far removed from any onshore sensitive receptor locations. Even if sound from support vessel activities was perceived, it would be consistent with sounds generated by customary vessel traffic, which is common in Newport. However, based on the distances from receptors at which noise-generating activities would take place, and the ambient noise typically present on shore near the project site, noise resulting from project activities would be indistinguishable. Therefore, there would be little potential for marine vessels to cause elevated noise levels at places where people live, work, or recreate. Based on this conclusion, noise impacts on sensitive human receptors are not anticipated and such noise impacts have been dismissed from further analysis. Underwater noise impacts are described in Section 3.3, *Noise and Vibration*.

3.1.8 Transportation

Prior to installation and after removal and decommissioning, the Ocean Sentinel would be transported by one or two semi trucks with a "lowboy" trailer. During the operation of the Proposed Project, a number of WEC devices would be tested. Each of these would be transported to the site; potentially by semi trailer. Neither activity would require the construction of new roads nor would they result in a noticeable increase in the volume of traffic or potential for accidents on highways and roads. In addition, WEC devices could be transported to the project site by barge or other marine vessel depending on origin. This would not require the construction or modification of existing infrastructure for marine transportation (e.g., docks, cranes piers), nor would it result in a measureable increase in marine traffic. Therefore, impacts are not anticipated and transportation is dismissed from further analysis. The affected environment and potential environmental impacts on marine navigation are described in Section 3.5, *Marine Navigation*.

3.1.9 Wetlands

As defined by 10 CFR 1022.4, wetlands are: "an area that is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, including swamps, marshes, bogs, and similar areas." The U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory was reviewed and it was determined that there are no wetlands in the project site nor in the terrestrial areas that would be used as part of the Proposed Project that meet the definition under 10 CFR 1022.4. The Ocean Sentinel and WEC devices would be launched at an existing local marina. The test vessel that could be used in place of the Ocean Sentinel (the Pacific Storm) has already been launched into the ocean and would be docked at an existing moorage between deployments. No construction in wetlands would be required as part of the Proposed Project. Therefore, impacts are not anticipated and wetlands are dismissed from further analysis.

3.1.10 Wild and Scenic Rivers

The National Park Service's Nationwide Rivers Inventory (National Park Service 2012) was reviewed and it was determined that there are no national Wild and Scenic Rivers within the vicinity of the project site. The Ocean Sentinel and WEC devices would be launched at an existing marina in the Yaquina Bay or Yaquina River. This river is not a designated national Wild and Scenic River. Therefore, impacts are not anticipated and wild and scenic rivers are dismissed from further analysis.

3.2 Biological Resources

This section describes marine biological resources that occur or have the potential to occur in the project site or vicinity, and evaluates project-related impacts on these resources. Biological resources include marine plants, marine invertebrates, fish, sea turtles, marine birds, and marine mammals. Applicant-committed measures to reduce impacts on biological resources are identified. The primary sources of information for this section are EAs prepared by the U.S. Army Corps of Engineers (Corps) as part of their ocean dredged material disposal site evaluations for Yaquina Bay (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001), Umpqua River (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2008a), Rogue River (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2008b), the Oregon Nearshore Strategy (Oregon Department of Fish and Wildlife 2006), the proceedings from a workshop assessing the ecological effects of wave energy development in the Pacific Northwest (Boehlert et al. 2008), a report prepared for the California Energy Commission that assessed potential environmental effects of wave energy development in coastal California (Nelson et al. 2008), a report to Congress on the potential environmental effects of marine and hydrokinetic energy technologies (U.S. Department of Energy 2009a), and additional resources as cited in the text. Complete references for all cited materials are provided in Chapter 6, *References*.

3.2.1 Affected Environment

Regulatory Setting

There are no local (City of Newport or Lincoln County) biological resource laws or regulation specific to the project site. Appropriate federal and state regulations are summarized below.

Federal

Endangered Species Act

Under the federal Endangered Species Act (ESA), the Secretary of the Interior and the Secretary of Commerce jointly have the authority to list a species as threatened or endangered (16 U.S.C. 1533(c)). Pursuant to the requirements of ESA, an agency reviewing a proposed project within its jurisdiction must determine whether any federal listed threatened or endangered species may be present in the project site and determine whether the proposed project may affect such species. In addition, the agency is required to consult with USFWS and/or the National Marine Fisheries Service (NMFS) to determine whether the project is likely to jeopardize the continued existence of any species proposed to be listed under ESA or result in the destruction or adverse modification of critical habitat proposed to be designated for such species (16 U.S.C. 1536(3),(4)).

Areas of habitat considered essential to the conservation of a listed endangered or threatened species may be designated as critical habitat (referred to above), which is protected under ESA. Although critical habitat may be designated on private or government land, activities on these lands are not restricted unless there is federal involvement in the activities or direct harm to listed wildlife.

Migratory Bird Treaty Act

The federal Migratory Bird Treaty Act (16 U.S.C., Section 703, Supp. I, 1989) prohibits killing, possessing, or trading in migratory birds except in accordance with regulations prescribed by the Secretary of the Interior.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) (16 U.S.C. § 1801–1884) of 1976 applies to fisheries resources and fishing activities in federal waters that extend to 200 miles offshore. Conservation and management of U.S. fisheries, development of domestic fisheries, and phasing out of foreign fishing activities are the main objectives of the legislation.

The Magnuson-Stevens Act defines essential fish habitat (EFH) as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The Magnuson-Stevens Act, as amended through 2007, sets forth a number of new mandates for the National Oceanic and Atmospheric Administration (NOAA), regional fishery management councils, and federal agencies to identify essential fish habitat and to protect important marine and anadromous fish habitat. The Magnuson-Stevens Act provides NOAA Fisheries with legislative authority to regulate fisheries in the United States in the area between 3.0 miles and 200.0 miles offshore, and establishes eight regional fishery management councils that manage the harvest of the fish and shellfish resources in these waters. The councils, with assistance from NOAA, are required to delineate EFH in fishery management plans (FMPs) or plan amendments for all managed species. An FMP sets specific management goals for an identified fishery EFH and applies to all fish species managed by that FMP, regardless of whether the species is a protected species or not. Federal actions that fund, permit, or carry out activities that may adversely affect EFH are required to consult with NOAA regarding potential adverse impacts of their actions on EFH, and to respond in writing to NOAA's recommendations.

Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 establishes a federal responsibility for the protection and conservation of marine mammal species by prohibiting the harassment, hunting, capture, or killing of any marine mammal. The primary authority for implementing the act is accorded to USFWS and NMFS.

State

Oregon Endangered Species Act

The Oregon Endangered Species Act (Oregon ESA) was enacted in 1987 (Oregon Revised Statutes [ORS] 496.171 to 496.192 and 498.026) to ensure the conservation of threatened or endangered species through "the use of methods and procedures necessary to bring a species to the point at which [protective] measures are no longer necessary." Oregon's endangered species list includes all native species listed under the federal ESA as of May 15, 1987 plus any additional native species determined by the appropriate state agency to be in danger of extinction throughout any significant portion of its range within the state.

The species-recovery mechanism under the Oregon ESA is limited to state-owned land, state-leased land and land over which the state has a recorded easement. In addition, endangered species management planning is limited to state agencies. Although the Oregon ESA broadly prohibits take of listed species, the definition of take ("to kill or obtain possession or control") is narrower than that under federal law. Moreover, the Oregon ESA also provides that "nothing in [the state ESA] is intended by itself to require an owner of any commercial forest land or other private land to take action to protect a threatened or endangered species or to impose additional requirements or restrictions on the use of private land."

Upon listing a species, the state develops survival guidelines to ensure survival of individuals of the species. Endangered species management plans identify the role that state land plays in the conservation of the species. During implementation, state policy is to minimize duplication between the Oregon and federal ESA requirements.

Oregon State Water Quality Regulations

The ODEQ has responsibility for managing water quality (OAR 340-41 ODEQ) within the state's boundaries as well as administration and enforcement of the federal Clean Water Act (CWA) in all state jurisdictional areas. Specifically, ODEQ is charged with: supporting aquatic species without detrimental changes in the resident biological communities (OAR 340-041-0011); preventing a reduction in ambient dissolved oxygen concentrations (OAR 340-041-0016); maintaining pH between 7.0 and 8.5 (OAR 340-041-0021); preventing water temperature increases which adversely affect fish or other aquatic species (OAR 340-041-0028); and preventing the introduction of toxic substances above natural background levels in amounts, concentrations, or combinations that may be harmful to aquatic life, public health, or other designated beneficial uses (OAR 340-041-0033).

Environmental Setting

The study area for biological resources includes the project site and nearby surrounding areas. The project site is a 1-square-nautical-mile (3.4-square-kilometer) area offshore of Yaquina Head, Oregon, between Newport (and Yaquina Bay) to the south and Otter Rock (a coastal landmark) to the north. The project site is approximately 1.8 to 2.7 miles (2.9 to 4.3 kilometers) offshore, and is closest landward to the Yaquina Head Marine Garden. Water depths at this location are approximately 115 to 180 feet (35 to 55 meters).

Geology and Sediments

The Oregon coastal region has been influenced by regional tectonic uplift and glacial sea level fluctuations over the past several million years (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001). During the last glacial maximum, sea level was approximately 400 feet (122 meters) lower than at present. Marine terrace deposits that are less than 1 million years old and consist primarily of sand and silt were deposited over a sequence of much older Miocene siltstones, mudstones, and sandstones. Yaquina Head and offshore reefs were formed from a layer of basalt that intruded on the marine sedimentary rocks. Recent marine sands cover the older bedrock on the continental shelf.

Oregon's present-day continental shelf is relatively narrow, and extends about 10 to 46 miles off the coast (Electricity Innovation Institute 2004). A rocky submarine bank (Stonewall Bank) begins about 15 miles offshore of Yaquina Bay and extends southwest to the Siuslaw River, where the shelf is about 30 miles across (Electricity Innovation Institute 2004; U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001). The bottom sediments shoreward of Stonewall Bank are mostly fine sand to depths of 300 feet (91 meters), with little silt and clay. Sandy sediments extending 3 to 10 miles offshore are typical of much of the Oregon coast, with small variations in the concentration of fine-sized particles in the seafloor sediments due to local currents. (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001)

Data collected at Ocean Dredged Material Disposal sites off Yaquina Bay indicate that local sediments near the project site are consistent with those found on much of the Oregon shelf, predominantly consisting of medium-grained sand with little variation (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2011). There is little silt or clay in nearshore sediments of this region, as a result of winnowing by waves. (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001) Rocky outcrops are found in some locations, although sonar scans have indicated that there are none in the project site.

Marine Vegetation and Algae

Marine plants include phytoplankton and sessile algae. Phytoplankton are comprised of simple free-floating unicellular organisms like blue-green algae, diatoms, dinoflagellates, silicoflagellates, and coccolithophores. Sessile algae include the many species of large brown and red algae that are commonly referred to as seaweeds. Sessile algae occur in rocky intertidal and subtidal areas of the coast within the photic zone (water depths to which sunlight can penetrate). The largest such algae include several species of brown kelps, which along the Oregon coast consist almost exclusively of bull kelp, *Nereocystis luetkeana*, which grows subtidally and has special legal status because of its value as a commercial raw material and habitat for protected fish species (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001, 2008a).

No hard or rocky substrate is known to occur within the project site; however, a small amount of rocky reef was recently discovered in a narrow area in approximately 40 meters (131 feet) of water approximately 1 nautical mile (1.9 kilometers) east of the project site. Bull kelp have not been found on these rocky areas because water depths preclude the presence of any bull kelp (Henkel pers. comm*. 2010)*.

Zooplankton, Crab Larvae, and Fish Larvae

The zooplankton community inhabiting offshore central Oregon consists of small invertebrate organisms that spend their entire life cycle in the water column. Species composition changes and is influenced by various factors such as prevailing ocean currents, coastal upwelling, and offshore wind direction. The Corps and EPA (2008a, 2008b, citing Keister and Peterson 2003) describe the coastal zooplankton community inhabiting Central Oregon, including the project site, as being dominated by copepods. In total, 58 copepod species are reported being present in these waters, of which eight occur throughout the year, seven only occur during the summer, and six only occur in the winter. Species composition is seasonally dependent. Overall population biomass and individual species abundances are typically lower in the winter than in the summer months. During the summer months when the offshore winds blow predominantly from the northwest, surface waters move southward, allowing the colder, more saline and nutrient-rich waters from deeper water depths to upwell along the coast. Between January and May, the megalops larvae of the Dungeness crab, *Cancer magister*, are abundant inshore.

Three species assemblages of fish larvae have been described as inhabiting the coastal waters of Oregon: coastal, transitional, and offshore. The coastal assemblage occurs in the project site and is typically dominated by smelts (*Osmeridae*) which account for 50% of the population, and English sole (*Parophrys vetulus*), sandlance (*Ammodytes hexapterus*), sanddab (*Citharichthys sordidus*), starry flounder (*Platichthys stellatus*), and Pacific tomcod (*Microgadus proximus*). Highest fish larvae abundances are reported to occur between February and July (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001). Auth and Brodeur (2007) reported northern anchovy (*Engraulis mordax*), slender sole (*Lyopsetta exilis*), rockfish (*Sebastes* spp.), northern lampfish (*Stenobrachius leucopsarus*), and blue lanternfish (*Tarletonebeania crenulairs*) as the dominant taxa along the Newport hydrographic line.

Benthic Invertebrates

Benthic invertebrate communities inhabiting the nearshore marine environment provide important secondary production in marine food webs, are integral to the breakdown and recycling of organic material in the marine ecosystem, and provide a key food source for important commercial and recreational fish and macroinvertebrate species like Dungeness crab, as well as for other protected or managed fish species.

Benthic invertebrate studies conducted between 1984 and 2000 for the Corps' Ocean Dredged Material Disposal Site program offshore of Newport, Oregon and Yaquina Bay provide important local information on the benthic infaunal and epifaunal community of the project site. One of the investigated offshore disposal sites is located just south of the project site, north of Yaquina Bay (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001). Seafloor sediments at this site were described as being mostly medium to fine grain marine sands with some shell debris and were reported out to a water depth of 160 feet (49 meters) (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001). Based on benthic invertebrate studies conducted by the Corps between 1981 and 2007 at ocean disposal sites offshore Coos Bay, Rogue River, Siuslaw River, Chetco River, Umpqua River and Yaquina Bay, Oregon, this benthic invertebrate community is consistent throughout the nearshore coastal waters of Oregon at similar water depths and with comparable sediment types and can be expected to be representative of the benthic infaunal community inhabiting the project site (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2008a, 2008b).

The invertebrate infaunal[7] community described by the Corps and EPA (2001) is typical for sandy offshore habitats along the entire Oregon coast. This community is dominated by highly mobile organisms adapted to shifting sediments*.* The community also supports a highly successful species of sand burrower. The infaunal community includes assorted polychaete worms and barnacles (*Cirripedia*)*,* which attach to small rocks and shell debri*s* (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2008a, 2008b)*.* The infaunal community has higher species diversity and individual species abundance in the late summer than in late spring to summer, a condition that the Corps and EPA (2001) attributed to increased food availability following the upwelling period.

The invertebrate epifaunal[8] community includes the sand dollar (*Dendraster eccentricus*), the surface dwelling carnivorous gastropods *Olivella biplicata* and *O. pycna*, pink shrimp (*Pandalus jordanii*), assorted sea stars, anemones, and Dungeness crab (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001).

Benthic habitats at and near the project site have been characterized by Henkel (2011), reporting results of box cores, trawls, and videography performed on 10 occasions between May 2010 and December 2011. Six sampling stations were located within the project site and at several locations between the project site and Newport, at water depths of 98 to 164 feet (30 to 50 meters). Principal findings from this monitoring included (Henkel 2011):

- Two distinct sediment types occur in the project site: silty sand at approximately 30 meters and potentially shallower, and nearly pure sand at 40 meters and deeper.
- Distinct infaunal invertebrate assemblages occur in the two sediment types.
- Distinct infaunal invertebrate assemblages occur north and south of Yaquina Head at the deeper stations.
- Mysid shrimp and Crangon shrimp are highly abundant and likely form the basis of the food web in this nearshore zone, as opposed to the krill-supported food web further offshore.
- Videographic observations are more effective than trawls for sampling large invertebrate species such as crabs, sea stars, and sea pens.

Fish

The nearshore and offshore regions of the Yaquina Head area encompass both rocky and soft bottom subtidal habitats and the open water pelagic environment. This area therefore supports a

[7] Benthic infaunal species are those that dig into the seabed or construct tubes or burrows.
[8] Benthic epifaunal species are those that live on the surface of the sand or substrate.

variety of fish species that typically inhabit all three habitats with frequent movement of fish between them. Typical fish species that inhabit these areas are discussed below. Although very little hard bottom substrate is known to be present in the project site, natural subtidal reefs closer inshore at Yaquina Head support pelagic and benthic fish communities that associate with rocky rather than soft substrate.

Fish commonly observed in sandy bottom areas near the project site include English sole, Butter, sole, Pacific sanddab, speckled sanddab, and starry flounder (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001; Henkel pers. comm. 2011).

Rocky subtidal, or hard bottom, habitats typically experience a wide variety of wave and current regimes, substrate, depths, and food sources, producing diverse biological communities (Oregon Department of Fish and Wildlife 2006). The rocky reefs off Yaquina Head provide important habitat for fish species that include sculpins (*Cottidae*), surf perch (*Embiotocidae*), and rocky reef fishes. Shallow reefs up to 20 meters (66 feet) in depth are dominated by black rockfish (*Sebastes melanops*), while deeper reefs are dominated by lingcod (*Ophiodon elongates*), black-and-yellow rockfish (*Sebastes chrysomelas*), and black rockfish (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001; Henkel pers. comm. 2011). Although these areas of rocky subtidal habitat are located outside the project site, juvenile lingcod and rockfish will use nearby soft bottom habitat and older mature fish typically associated with rocky subtidal habitats will often be found swimming in the deeper soft bottom regions. As a consequence, these taxa may be present at the project site.

A number of environmental factors affect the fish species present in the pelagic zone, including light penetration, water temperature, proximity to river plumes, and underwater currents (Oregon Department of Fish and Wildlife 2006). Pelagic species commonly found near the project site include Pacific herring (*Clupea pallasi*), northern anchovy, and Pacific Ocean perch (*Sebastes alutus*). The area also has salmon, steelhead, and shad that migrate through the Yaquina Bay estuary to spawn upriver (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001).

Sea Turtles

Pacific leatherback sea turtles (*Dermochelys coriacea*) are known to occur in offshore waters of the central Oregon coast (National Oceanic and Atmospheric Administration 2010; National Marine Fisheries Service and U.S. Fish and Wildlife Service 1998, 2007a). Green sea turtles in the Pacific Ocean are generally found south of San Diego, California; however, they have been found from Baja, California to Alaska (National Marine Fisheries Service 2011). Loggerhead sea turtles (*Caretta caretta*) also have been seen as far north as Alaska, but most U.S. sightings have been made off the California coast. The olive Ridley sea turtle is also more commonly seen in California waters, although there is at least one case of a hypothermic olive Ridley sea turtle washing ashore near the study area (Hanson 2009).

Marine Mammals

Marine mammal species potentially present in or near the study area include cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions). The most common year-round inhabitants are the pinnipeds: Pacific harbor seal (*Phoca vitulina*), and Steller sea lion (*Eumetopias jubatus*)*.* Male California sea lions (*Zalophus californianus*) and northern elephant seals (*Mirounga angustirostris*) are occasionally observed foraging in southern and central Oregon coastal areas but are not regular inhabitants (Oregon Department of Fish and Wildlife 2010).

Cetaceans potentially present in or near the study area include transient killer whales (*Orcinus orca*), which appear along the Oregon coast in April, in conjunction with the California gray whale's northward migration, while killer whales of the southern resident group occasionally pass by during migrations from their principal range in Washington and British Columbia, en route to foraging grounds off central California, where they seasonally feed on migrating Chinook salmon (Northwest Fisheries Science Center 2007). Other whales commonly observed offshore of the Oregon coast include blue whale (*Balaenoptera musculus*), finback whale, (*Balaenoptera physatus*), sei whale (*Balaenoptera borealis*), Pacific right whale (*Balaena glacialis japonica*), humpback whale (*Megaptera novaeangliae*), and sperm whale (*Physeter catodon*). California gray whales (*Eschrichtius robustus*) occur along the central Oregon coast throughout the year with a small population of resident whales being present between May and October. Migrating gray whales occur between March and June on their northward migration and between December and March on their southward migration. Ortega-Ortiz and Mate (2008) report that in 2008, gray whales were observed offshore of Yaquina Head and transiting the study area during both southward and northward migrations. Gray whales migrated southward through the study area beginning in mid January, with the peak of the migration occurring in late January. Northbound migrating gray whales were observed as early as late February, with the peak of the migration occurring between late March and mid-April. Ortega-Ortiz and Mate (2008) further reported observing gray whale movements predominantly occurring in parts of the ocean where water depths are between 33 and 230 feet (10 and 70 meters).

In 2010 and 2011, Hatfield Marine Science Center (HMSC) conducted surveys in and around the project site to document the presence of a number of benthic fishes and invertebrate species. Although this research was not conducted to identify marine mammals, it may be noted that no whales were observed in the project site during the research.

Marine Birds

Bird species commonly observed inhabiting and using the coastal waters of central Oregon near Yaquina Bay include shearwaters, storm petrels *(Hydrobatidae*), gulls (*Laridae*), common murres (*Uria aalge*) and Cassin's auklets (*Ptychoramphus aleuticus*) during the late spring and early summer months, with phalaropes (*Phalaropus* spp*.),* fulmars (*Fulmarus* spp.), and California gull (*Larus californicus)* predominant during the fall months. During the winter months, phalaropes, California gull, fulmars, other assorted gulls, murres (*Uria* spp.), auklets *(Aethia* spp. and *Ptychorhamphus* spp.), and kittiwakes (*Rissa* spp.) are common. Western *(Aechmophorus occidentalis*), red-necked *(Podiceps grisegena),* horned *(P. auritus),* and eared *(P. nigricollis)* grebes, Caspian tern *(Sterna caspia),* three other species of tern, three species of cormorant, pigeon guillemot *(Cepphus columba),* and red-throated *(Gavia stellata),* Pacific *(G. pacifica),* and common or great northern *(G. immer)* loons also frequent the region (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001). Brown pelicans *(Pelecanus occidentalis*) are present in the summer and fall as post-breeding transients. Western snowy plovers *(Charadrius alexandrines nivosus),* an Oregon listed threatened species, are known to forage on shorelines south of the study area (U.S. Fish and Wildlife Service 2007a). Other protected species that may forage in or near the study area include short-tailed albatross (*Diomedea albatrus)* and marbled murrelet *(Brachyramphus marmoratus*) (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001).

Federal and State Special-Status Species

Special status species that could occur in the study area were identified through literature and database searches and communication with NMFS and USFWS (Table 3.2-1).

Federal status is based on listing under the ESA. Species listed as endangered are at risk of extinction in all or some of their current range in the foreseeable future. Species listed as threatened are at risk of becoming endangered in the foreseeable future. A species listed as a candidate is a species for which USFWS has adequate information to support a proposal to list the species under the ESA. Vertebrate species listed under the ESA may include infraspecific taxa described as Distinct Population Segments (DPS). Some DPSs have been described by the NMFS as Evolutionarily Significant Units (ESU).

As discussed above, all of the species listed in Table 3.2-1 are potentially present in or near the study area during all or part of the year. They would use the area for foraging or migration routes. None of these species, however, would be expected to breed in or near the study area.

Table 3.2-1. Federal and State Protected Species Potentially Present in the Study Area

Common Name	Scientific Name	State Status	Federal Status
Fish			
Coho salmon, lower Columbia River ESU	*Oncorhynchus kisutch*	E	T
Coho salmon, Oregon coast ESU	*Oncorhynchus kisutch*		T
Coho salmon, southern Oregon / Northern California coast ESU	*Oncorhynchus kisutch*		T
Chinook salmon, lower Columbia River ESU	*Oncorhynchus tshawytscha*		T
Chinook salmon, upper Willamette River ESU	*Oncorhynchus tshawytscha*		T
Chinook salmon, upper Columbia River spring-run ESU	*Oncorhynchus tshawytscha*		E
Chinook salmon, Snake River spring / summer-run ESU	*Oncorhynchus tshawytscha*		T
Chinook salmon, Snake River fall-run ESU	*Oncorhynchus tshawytscha*	T	T
Chinook salmon, Central Valley spring-run ESU	*Oncorhynchus tshawytscha*		T
Chinook salmon, Sacramento River winter-run ESU	*Oncorhynchus tshawytscha*		E

Common Name	Scientific Name	State Status	Federal Status
Chinook Salmon, California coastal ESU	*Oncorhynchus tshawytscha*		T
Green sturgeon, southern DPS	*Acipenser medirostris*		T
Eulachon	*Thaleichthys pacificus*		T
Herptiles			
Leatherback sea turtle	*Dermochelys coriacea*	E	E
Green sea turtle	*Chelonia mydas*	E	T
Loggerhead sea turtle, Pacific DPS	*Caretta caretta*	T	T
Olive (Pacific) Ridley sea turtle	*Lepidochelys olivacea*	T	T
Birds			
Short-tailed albatross	*Diomedea albatrus*	E	E
Brown pelican	*Pelecanus occidentalis*	E	
Marbled murrelet	*Brachyramphus marmoratus*	T	T
Western snowy plover	*Charadrius alexandrinus nivosus*	T	T (Coastal population only)
Mammals			
Blue whale	*Balaenoptera musculus*	E	E
Fin whale	*Balaenoptera physalus*	E	E
Humpback whale	*Megaptera novaeangliae*	E	E
North Pacific right whale	*Eubalaena japonica*	E	E
Sei whale	*Balaenoptera borealis*	E	E
Sperm whale	*Physeter macrocephalus*	E	E
Gray whale	*Eschrichtius robustus*	E	
Northern (Steller) sea lion	*Eumetopias jubatus*		T
Southern resident killer whale	*Orcinus orca*		E

Source: National Marine Fisheries Service 2010 and Oregon Department of Fish and Wildlife 2010

T = Threatened, E= Endangered, ESU = Evolutionarily Significant Unit.

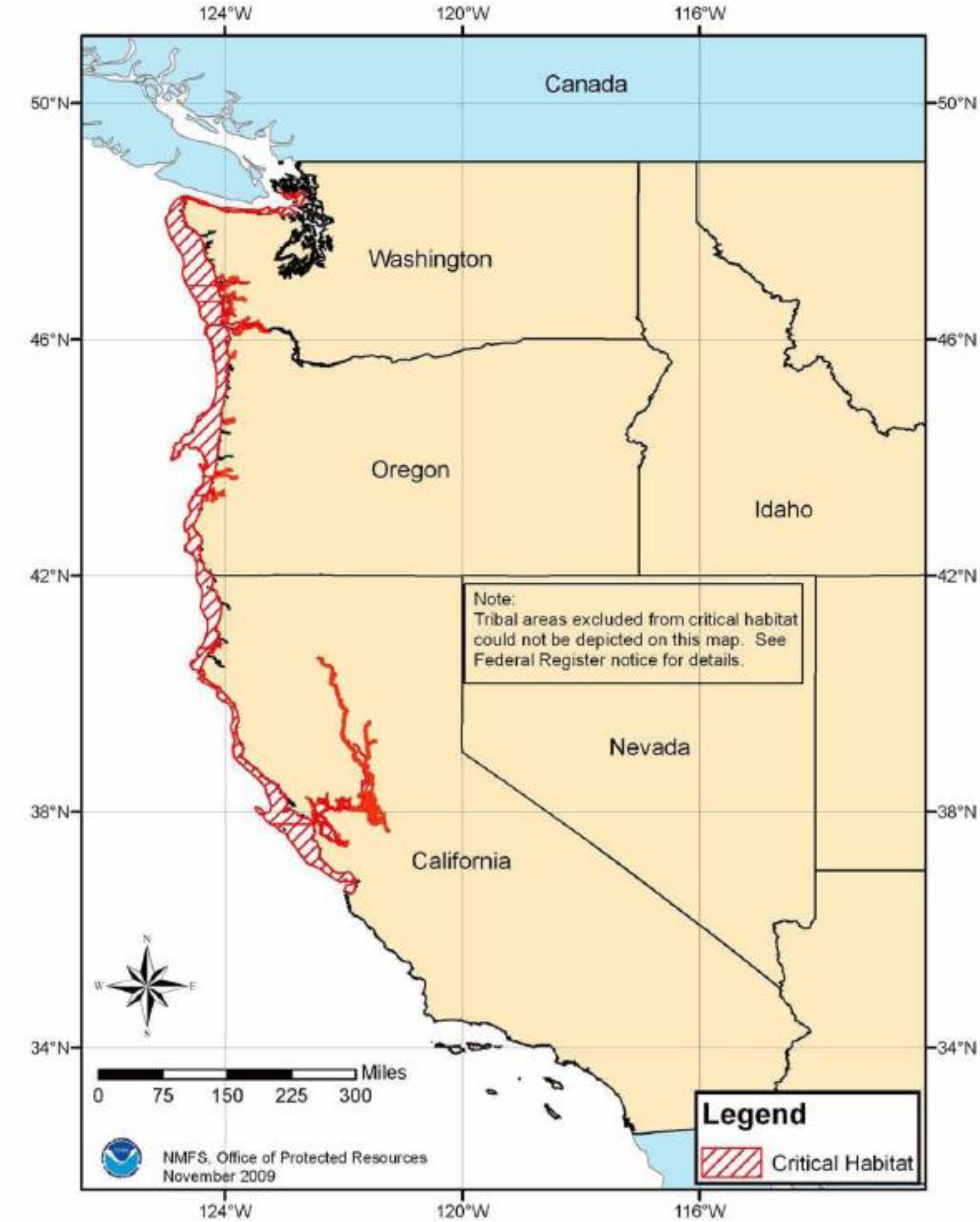
Habitat for Threatened and Endangered Species and Essential Fish Habitat

Threatened and Endangered Species

Critical habitat has been designated for some of the ESA-listed species identified in Table 3.2-1. Designated critical habitat (DCH) for the following species occurs in or near the study area:

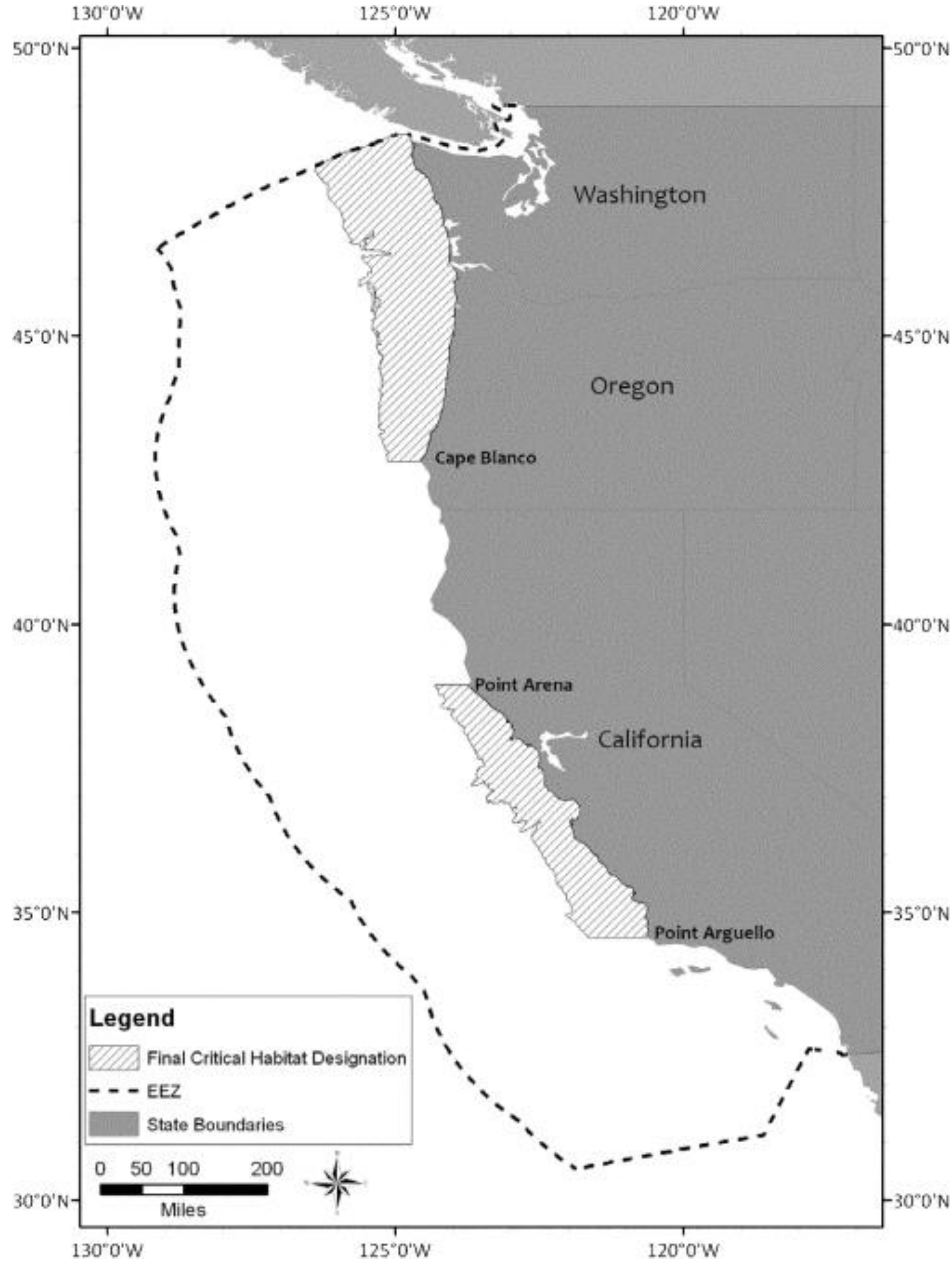
- **Coho salmon.** On February 11, 2008, NMFS listed the Oregon coast coho salmon ESU as threatened and DCH. Critical habitat for Oregon coast coho salmon includes riverine and estuarine areas within 80 occupied watersheds in 13 associated subbasins. Critical habitat includes the waters of Yaquina Bay in the study area, but does not extend out into offshore waters.
- **Green sturgeon.** In October 2009, NMFS designated all nearshore waters to a depth of 60 fathoms (360 feet or 110 meters) offshore Oregon as critical habitat for the southern DPS of the green sturgeon (National Marine Fisheries Service 2009). DCH includes the study area. Figure 3.2-1 illustrates the critical habitat for southern DPS green sturgeon.
- **Leatherback sea turtle**. Critical habitat was previously designated only in the Atlantic Ocean (44 FR 17710), but on January 26, 2012, NMFS designated critical habitat in the Pacific Ocean off areas of Washington, Oregon, and California (77 FR 4170). The area designated includes the offshore waters between Cape Flattery, Washington to the Umpqua River (Winchester Bay), Oregon out to the 2,000-meter depth contour and an similar area offshore California (National Oceanic and Atmospheric Administration 2010b). This area is illustrated in Figure 3.2-2. The study area is within the proposed critical habitat for the leatherback sea turtle.
- **Northern Steller sea lion.** Long Brown Rocks, Seal Rocks, and Pyramid Rock in Oregon are DCH for northern Steller sea lions. Long Brown and Seal Rocks are located inshore and north of the study area (National Marine Fisheries Service 2007a).

Figure 3.2-1. Southern DPS Green Sturgeon Critical Habitat



Source: National Marine Fisheries Service 2009

Figure 3.2-2. Leatherback Sea Turtle Designated Critical Habitat



Source: National Oceanic and Atmospheric Administration 2012

Essential Fish Habitat

The Pacific Fisheries Management Council manages, under federal FMPs, three groups of fish along the west coast of the United States: groundfish, salmon and pelagic species. The groundfish FMP includes more than 80 species of fish and the salmon FMP includes all species of salmon occurring along the west coast of the United States that are commercially fished. The pelagic FMP includes six taxa (northern anchovy, market squid (*Loligo opalescens*), Pacific sardine (*Sardinops sagax),* Pacific mackerel (*Scomber japonicas*), and jack mackerel (*Trachus summetricus*). As required under the Magnuson-Stevens Act, EFH has been designated for each of these groups, and all waters within and adjoining the study area constitute EFH as so defined. EFH has been designated as follows (Pacific Fisheries Management Council 2010):

- **Groundfish.** Water depths less than or equal to 11,483 feet (3,400 meters) to the mean higher high water level or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean- derived salts measure less than 0.5 parts per trillion during the period of average annual low flow; seamounts in depths greater than 11,483 feet (3,500 meters) as mapped in the EFH assessment geographic information service (GIS) data; areas designated as habitat areas of particular concern not already identified by the above criteria.
- **Salmon.** All waters of the United States between the Canadian border and the Mexican border and out 200 miles (370 kilometers) to the western extent of the Exclusive Economic Zone.
- **Pelagic.** All waters of the United States from the Canadian border to the Mexican border and out 200 miles (370 kilometers) to the western extent of the Exclusive Economic Zone.

Commercial and Recreational Fishing

Many important commercial and recreational fish species along the Oregon coast are known to spend a portion of their life history around and within the Yaquina Bay Estuary. Some commercially and recreationally important species landed at Newport reside predominantly as adults in the ocean waters beyond Yaquina Bay, but spend their juvenile phase or a portion of their adult life stage within the estuary itself (e.g., Dungeness crab). Others spend their entire life history in the deeper offshore areas of the Oregon coast (e.g., albacore tuna), and are not normally found near the study area.

Commercial Fisheries

Eight ports along the Oregon coast support commercial fishing vessels, and Newport is among the most important of these. The species, including both fish and invertebrate species, that comprised at least 1% of either the total catch value or total weight landed in Newport in 2010 are represented in Table 3.2-2. These figures include species collected both in the nearshore and offshore environment near Newport and those collected in Yaquina Bay itself. In reviewing the catch totals against those reported for the landing regions immediately to the north and south, Depoe Bay and Florence, respectively, the landings reported for Newport were at least an order of magnitude greater than either of the two adjacent ports (Oregon Department of Fish and Wildlife 2010).

Commercially important species in the Newport area inhabit a variety of positions in the water column and are caught with a variety of techniques. Key species are typically caught using traps (e.g., Dungeness crab), long-lines (e.g., sablefish and albacore), or trawling at different locations within the water column (e.g., midwater trawls for Pacific whiting and bottom trawls for sole species).

Some of the species listed in Table 3.2-2 are landed somewhat consistently throughout the year. For example, the catch for shortspine thornyhead ranged between approximately 2 to 44 tons (2 to 40 tonnes) per month over the course of the year, but typically fell within the 20 to 30 ton (18 to 27 tonne) range. Others are landed only seasonally (e.g., Dungeness crab and albacore tuna).

Table 3.2-2. Summary of Commercially Caught Fish and Shellfish, Newport 2010

Species	Typical Catch Method	Catch Value ($)	Portion of Total Value (%)	Landings (tons)	Landings (tonnes)	Portion of Total Landings (%)
Dungeness crab, ocean	Trap	11,774,848	38.1	2858	2593	9.1
Sablefish	Long-line	5,272,036	17.0	1021	926	3.2
Albacore tuna	Long-line	4,544,870	14.7	2,066	1,875	6.6
Pacific whiting	Trawl	3,482,824	11.2	19,074	17,303	60.9
Pink shrimp	Trawl	2,075,457	6.7	2,876	2,609	9.1
Dover sole	Trawl	823,626	2.6	1,349	1,224	4.3
Pacific halibut	Long-line	382,752	1.2	52	47	0.1
Shortspine thornyhead	Trawl	285,189	0.9	252	229	0.8
Petrale sole	Trawl	247,880	0.8	120	109	0.3
Skates and Rays	Trawl	153,917	0.4	259	235	0.8
Arrowtooth flounder	Trawl	40,111	0.1	207	187	0.6
Other species	Varies	1,804,216	5.8	1156	1049	3.6

Source: Oregon Department of Fish and Wildlife 2010

Recreational Fisheries

Sport fishing occurs in all regions along the Oregon Coast and coastal and ocean areas beyond, and is conducted via multiple trip types, including by shore, pier, small craft, and charter boat. For recreational fishing catch data, information from the Pacific States Marine Fisheries Commission and reported through the Pacific Recreational Fishing Information Network from the years 2004 to 2009, was reviewed. For this analysis, total recreational catch was estimated for ocean waters offshore the central Oregon coast for all recreational fishing conducted via boat trips. This data is limited in that it focuses beyond the project vicinity and is subject to the limitations of the estimation methodology used. However, the data can be considered as indicators of recreational fishing activity.

The predominant species collected by sport fishers in ocean waters outside of Yaquina Bay and to the immediate north and south, are various species of rockfish, salmon, lingcod, tuna, and Dungeness crab (Table 3.2-3).

Table 3.2-3. Estimated Recreational Fish Catch for Boat Trips in Ocean Waters along Oregon Central Coast (2004–2009)

Common Name	Estimated Catch (fish)	Percent of Total (%)
Black Rockfish	1,154,284	37
Dungeness Crab, Ocean	510,208	17
Coho Salmon	427,403	14
Lingcod	226,752	7
Albacore Tuna	143,081	5
Chinook Salmon	125,465	4
Blue Rockfish	120,109	4
Pacific Halibut	107,944	3
Yellowtail Rockfish	73,606	2
Cabezon	37,554	1
Kelp Greenling	28,766	1
Canary Rockfish	26,867	1
Quillback Rockfish	15,723	1
Other species	89,896	3
TOTAL	3,087,658	100

Source: Pacific Recreational Fishing Information Network 2009

3.2.2 Environmental Consequences of the Proposed Project

Installation, operation, maintenance, and removal and decommissioning of the Ocean Sentinel or vessel and associated WEC devices connected to the Ocean Sentinel or vessel have the potential to affect the marine environment. Many of these impacts have the potential to occur during multiple project phases; for instance, anti-fouling paints would be exposed to seawater during all project phases. The principal potential mechanisms of effect are described in detail below.

Anti-Fouling Paints

The vessel, WEC device, and floats used in the mooring system would be treated with antifouling coatings. The antifouling coatings would not contain tributyltin (TBT), but would likely use a combination of cuprous oxide and organic substances to discourage growth of fouling organisms. The WET-NZ device would use an antifouling coating that was TBT-free, but would contain copper oxides. The Ocean Sentinel would also be treated, but its antifouling coating would be free of both TBT and copper compounds. Antifouling paints used on the WEC devices and vessels would likely leach cupric ion to seawater, but at very low concentrations that are not expected to result in an impact on marine life occupying the water column (phytoplankton, zooplankton, fish, sea turtles, or marine mammals). The potential impacts of antifouling paints on water quality including anticipated copper leaching rates and concentrations are described in Section 3.4, *Water Resources*.

Larval zooplankton that otherwise would settle on the Ocean Sentinel or vessel and WEC devices as fouling organisms would be precluded from doing so by the chemical effects of the antifouling paints, but the effect would only be to exclude such organisms from colonizing in an area of the ocean (i.e., the project site) where they do not now occur. By in large, antifouling coatings work by discouraging the attachment of larval zooplankton which are floating in the water column. Accordingly, impacts resulting from the use of anti-fouling paints would be minimal.

Benthic Habitat Disturbance

Benthic habitat in the study area is the subject of studies and monitoring as described in Section 3.2.1 of this EA and Appendix E. It is similar to habitat off Yaquina Bay described by the Corps and EPA (2001) as dominated by highly mobile invertebrates adapted to shifting sediments. The soft bottom habitats used by the organisms would be lost in areas covered by anchors and would additionally be disturbed to some extent during installation and recovery of the mooring systems. Total estimated area of fill for the 2012-2013 WET-NZ test (which would consist of anchors for the WET-NZ device, the Ocean Sentinel, and a TRIAXYS™ wave measurement buoy) is 1,535.5 square feet (equivalent to 0.035 acre). Other future tests may consist of up to two Ocean Sentinels, two wave energy conversion (WEC) devices, and two TRIAXYS™ wave measurement buoys. Although devices used in future tests may use slightly different anchoring equipment and configurations, it is reasonable to expect that future tests would result in a placement of fill approximately twice the area estimated for the 2012-2013 WET-NZ test.

The area of soft bottom habitat lost under stationary anchors would be limited and negligible in comparison to the 1-square-nautical-mile (3.4-square-kilometer) project site and the much larger Oregon coastal zone that provides suitable habitat for the benthic infaunal community identified inhabiting the study area (United States Army Corps of Engineers and U.S. Environmental Protection Agency 2008a, 2008b).

Because the study area is a high-energy marine environment, the infaunal and epifaunal benthic communities inhabiting the study area are adapted to frequent physical disturbance (see Section 3.2.1 above) and can be expected to quickly repopulate the area of bottom habitat under the anchors after they are removed. Furthermore, benthic monitoring would be performed to measure effects on benthic habitat and organisms, as detailed in Appendix E (benthic habitat monitoring plan). Any detected project effects on benthic habitat would be reviewed and addressed annually as detailed in Appendix E (Adaptive Management Framework). Accordingly, the installation and removal of the mooring system would have a minor and temporary impact on marine life and benthic habitat.

Colonizing Organisms

Portions of the project installation (WEC devices, anchors, cables, and mooring system) not provided with antifouling coatings could be colonized by fouling organisms such as macroalgae and sessile invertebrates (anemones and sponges), creating artificial hard substrate in the project site that currently does not contain any known hard substrate habitat (Nelson et al. 2008, Boehlert et al. 2008). It is assumed that some tested WEC devices would have antifouling coatings and others would not.

Surfaces that do not have antifouling coatings could be colonized by marine algae, mollusks such as mussels, sea anemones, and other forms of marine invertebrate life. The introduction of this habitat would increase the productivity of the area and provide shelter and forage for many fish species inhabiting the study area and adjacent areas of the Oregon coast, including protected or managed species such as salmon and groundfish (Boehlert et al. 2008). Fish abundance might increase in such areas. Conversely, the potential for adverse effects is very limited. Many of the colonizing organisms would prey upon phytoplankton and zooplankton in the water column. However, the surface area available to support such organisms is very small within the scale of the project site, and phytoplankton and zooplankton have high intrinsic productivity related to available sunlight and nutrient influx. Thus, this mechanism has no potential to measurably affect the abundances of phytoplankton or zooplankton. Some colonizing organisms might prey upon epibenthic or benthic organisms in the surrounding soft bottom habitat, but such effects would be localized to the area of the anchors.

The presence of hard substrate habitat, particularly when colonized by fouling organisms, may also affect use of the water column by free-swimming invertebrates (e.g., squid), fish, sea turtles, and marine mammals. Each of these organisms has a tendency to congregate near floating or sessile hard structures located in an open water environment. For instance, some groundfish species may encounter increased foraging opportunities in the vicinity of hard substrates. Conversely, some coastal pelagic species such as anchovy, which primarily congregate in the open water column, may make reduced use of habitat in the study area. Sea turtles and marine birds and mammals attracted to the hard substrate habitat may forage on fishes and invertebrates in the area. Potential impacts of the Proposed Project on fish and commercially and recreationally important fish and invertebrates include increased predation by marine mammals, especially seals and sea lions attracted to the surface and subsurface infrastructure (Nelson et al. 2008; Boehlert et al. 2008; U.S. Department of Energy 2009a; Gill et al. 2009). These changes are subtle in the context of existing environmental variability in the study area and other nearby habitats. Accordingly, potential impacts related to this mechanism would be minor.

Hydraulic Fluid, Lubricant, or Other Contaminant Leaks

The potential impacts of fluid leaks on water quality are discussed in Section 3.4, *Water Resources*. That analysis finds that neither the Ocean Sentinel or vessel nor WEC devices would be subject to such leaks unless they were to suffer catastrophic damage. This outcome is highly improbable. Nonetheless, before testing, NNMREC would require that each WEC device developer submit a spill contingency and emergency response plan to NNMREC for review and approval, which would contain measures intended to ensure a rapid response and recovery that minimizes potential environmental harm. This applicant-committed measure would reduce the potential impact on marine organisms to a level that is considered temporary and minor.

Invasive Species Introductions

To minimize the risk of invasive species introductions, NNMREC would require that all WEC devices that have been previously deployed in other waters would undergo purging of all contained waters and rigorous cleaning and preparation of all external and internal components that come into contact with the water prior to deployment to ensure that nonindigenous and nonnative species would not be introduced into Oregon coastal waters. This applicant-committed measure would reduce, potential impacts related to this mechanism to a level that is considered negligible.

Underwater Noise

Underwater noise produced during Ocean Sentinel, vessel, and/or WEC device installation, operation, and removal may affect fishes, marine diving birds, sea turtles, and marine mammals in the area. The importance of these impacts depends on the characteristics of the underwater sound, as well as on the potential for each species to respond to that sound. Characteristics of the underwater sound are explained in detail in Section 3.3, *Noise and Vibration*.

Although sound sources would include installing anchors and anchor cables for the WEC devices and the Ocean Sentinel, the predominant source of sound during project installation of the Ocean Sentinel and WEC devices would originate from the propellers of support vessels involved in transport and placement of the anchoring and mooring system. Removal of WEC devices and the Ocean Sentinel would be accomplished using the same or similar equipment and methods (but in reverse order); therefore, the noise impacts anticipated during removal would be virtually identical to noise impacts from installation.

As described in Section 3.3. *Noise and Vibration*, the loudest noise generated by the Proposed Project, operation of support vessels during Ocean Sentinel and WEC device installation and removal, would be no greater than 130 to 160 decibels (dB) at 1 meter (3 feet) over a frequency range of 20 hertz (Hz) to 10 kilohertz (kHz). Assuming that underwater noise attenuates by an inverse-square law (i.e., a doubling of distance results in a noise that is half as loud), peak noise levels would be no more than 142 dB at 8 meters (26 feet) from the support vessels, or 118 dB at 128 meters (420 feet) from the support vessels. Such sounds levels would only be generated when support vessels are fully underway, which would only occur when vessels were travelling to or returning from the project site.

These noise levels are all far below levels that have been shown to affect health or behavior of fish. Scientific investigations on the potential affect of noise on fish indicate that sound levels below 200 dB do not appear to result in any acute physical damage or mortality in fish (Enger 1981). Startle responses in steelhead trout and salmon have been documented to occur at sound levels from 130 to 150 dB at a frequency of 100 Hz (San Luis and Delta Mendota Water Authority and Hanson 1996) and for Pacific herring from 180 to 186 dB (Dalen and Knutsen1986). Avoidance behavior by both salmon and steelhead trout has been reported to occur with continuous 166 dB sounds at a frequency of 100 Hz (Loeffelman et al. 1991). Consequently, anticipated noise levels emitted during installation and removal would have no impacts on fish.

Noise levels potentially affecting sea turtles have not been studied, but may be consistent with those known to affect marine mammals. Currently, NMFS (2010) assumes that continuous underwater noise at levels greater than 120 dB may affect the behavior of marine mammals; i.e., they may avoid or approach an area in response to the noise being produced. It is possible that the operation of support vessels during installation may generate noise levels in excess of 120 dB, but only when vessels were fully underway and within 128 meters of the vessels. Such conditions would only exist in a small area and for short periods of time during the installation of WEC devices or the Ocean Sentinel. Therefore, installation and removal of the Ocean Sentinel and WEC devices could temporarily cause avoidance and alter feeding patterns for the sea turtle and marine mammal species; however, due to the short duration of installation and removal activities, any impacts would be brief and of negligible magnitude.

The response of diving seabirds to underwater noise has been studied in varying contexts, reviewed in some detail by Teachout (2010). Although the publication focuses on the effects of pile driving noise on diving marbled murrelets, it also identifies prior studies of underwater sound effects on cormorants, ducks, penguins, and other diving birds. In no case have noise levels of the intensity that would be produced by support vessels during the installation and removal of the Proposed Project (about 160 dB) been observed to cause health or behavioral impacts on diving birds. Accordingly, noise levels generated by the installation and removal of the Proposed Project would have a negligible impact on diving seabirds.

During operation, sound from the WEC devices' impellors, gearbox, generator, or other moving components (all of which would be contained inside of the device) would be radiated into the surrounding water. In addition, cable strumming sound can be generated by waves or currents passing by anchor cables and submarine power cables. The magnitude of underwater sound generated by the operation of each WEC device would vary depending on the specific device being tested at any given time. Such sounds would be nearly continuous, but might vary depending on the amount of electricity being generated or mechanical motion at any given time.

No acoustic data are presently available for the WET-NZ device that would be used in the 2012-2013 test and, until recently, no definitive measurements of sound levels associated with the operation of hydrokinetic and ocean energy devices had been published (U.S. Department of Energy 2009a). One study has recently become available, describing acoustic monitoring of a 1/7 scale WEC in Puget Sound during 2011 (Bassett et al. 2011). The tested device is a point absorber secured to the seabed with a three-point mooring. Data collection was limited to a series of 1-minute hydrophone recordings collected on March 30, 2011, for approximately 4 hours. Sampling evaluated sound generation at frequencies of 20 Hz to 20 kHz. During these recordings, significant wave height varied from (1.3 to 2.3 feet (0.4 to 0.7 meters), peak wave periods varied from 2.9 to 3.2 seconds, and southerly winds varied from 16.4 to 32.8 feet per second (5 to 10 meters per second). Shipping vessel and ferry traffic levels were typical; in this portion of Puget Sound, they may produce ambient underwater sound levels of 130 dB root mean square (RMS) re 1 μPa. At times, ship traffic dominated the signal, as determined from spectral characteristics and vessel proximity. Received sound pressure levels attributed to the WEC cycle varied from 116 to 126 dB re 1 μPa at frequencies of 60 Hz to 20 kHz at distances from 33 to 4,920 feet (10 to 1,500 meters) from the WEC. The cycling was well correlated with the peak wave period. Masking by ship noise prevented rigorous extrapolation to estimate the WEC source level at a reference distance.

Recognizing the substantial uncertainty about underwater sound generation potential associated with experimental WEC devices, NNMREC would deploy monitoring equipment during the full 10-year lifetime of the Proposed Project. As described under *Associated Monitoring Equipment* in Section 2.2.2 of this EA, various types of monitoring equipment would be deployed within and around the project site to support the Proposed Project and to collect data to be used in physical and environmental studies. Equipment would be deployed during the operation of the Proposed Project, but may also be used before and after the operations phase. Associated monitoring equipment may include devices that actively generate or emit sound waves in a wide range of frequencies. Active devices could include acoustic wave and current profilers, acoustic Doppler current profilers, seafloor mapping devices, echosounders, sub-bottom profilers, acoustics releases, and acoustic telemetry devices. Any active acoustic device used as part of the Proposed Project would be an off-the-shelf, commercially available device. These devices may or may not operate at frequencies that are perceptible to marine life (see Section 3.3.2).

In June 2008, the National Science Foundation (NSF) Division of Ocean Science released the *Final Programmatic Environmental Assessment for the Ocean Observatories Initiative*. NSF's analysis included a review of active acoustic sources similar to those that could be used as part of the Proposed Project. The majority of fish are believed to hear within the frequency of 500 Hz to about 3 kHz: mysticetes hear within approximately 7 to 22 kHz, odontocetes hear within approximately 150 to 180 kHz, and pinnipeds hear within 1 to 180 kHz (National Science Foundation 2008). A 2010 NSF Programmatic Environmental Impact Statement/ Overseas Environmental Impact Statement (EIS/OEIS) for Marine Seismic Research was conducted to examine the potential impacts that may result from geophysical exploration and scientific research using seismic research funded by the NSF or conducted by the U.S. Geological Survey. The EIS/OEIS included analyses of potential noise impacts that could result on a variety of marine species from the use of active acoustic measurement devices similar to those described above. The EIS/OEIS considered available data and concluded that the best hearing sensitivity for sea turtles is probably 200 to 700 Hz with a possible upper hearing limit of 1.6 kHz (National Science Foundation 2010).

As shown in Table 3.3-1, all of the anticipated active acoustic devices that may be used as part of the Proposed Project operate at frequencies well above 180 kHz, with the exception of the 38 kHz configuration of the echosounder, the chirp profiler, the acoustic release, and the acoustic telemetry device. Although these devices operate at frequencies that could be detected by odontocetes and pinnipeds, significant impacts are not anticipated for a number of reasons.

Though the echosounder may operate at a frequency of 38 kHz, it would have a very short duty cycle of approximately 1 millisecond. Furthermore, the acoustic bursts of the echosounder device are narrow beams that travel relatively short distances. The chirp profiler would operate in the 2 to 6 kHz range with short duty cycles of approximately 64 milliseconds. If included in the Proposed Project, a chirp profiler would take one group of measurements, consisting of a number of profiles in a single day, but would be used less frequently than once per year. The acoustic release, which would produce a frequency between 7 kHz and 15 kHz, would operate for 30-second periods approximately once per month. The acoustic telemetry devices would be used once per test period (6 months to 12 months) to transmit data at a frequency of 3 to 15 kHz. Given that these active acoustic devices emit a narrow beam, transmit frequencies short distances, use short duty cycles, or would be operated infrequently (or one or more of these characteristics), the probability that a pinniped or odontocete may be in the limited location of exposure at the precise moment when a device would transmit detectable frequencies is considered to be very low. Therefore, the use of active acoustic measurement devices as part of the Proposed Project is not anticipated to result in significant noise impacts on biological resources.

The monitoring that would be performed and the equipment that would be used are specified in the acoustic monitoring plan (Appendix E). As noted in that plan, NNMREC would immediately notify NMFS if measured sound pressure levels created by the Ocean Sentinel or WEC device under test were to exceed NMFS criteria for potential harm caused by impulsive or continuous underwater sound effects on salmonid fishes and marine mammals. These criteria are presented in Table 3.2-4.

Table 3.2-4. NMFS Underwater Acoustic Impact Thresholds

Threshold	Stressor	Receptor
206 dB (peak)	Impulsive sound	Salmonids
187 dB (SEL)	Impulsive sound	Salmonids weighing over 2 g
183 dB (SEL)	Impulsive sound	Salmonids weighing up to 2 g
180 dB (RMS)	Impulsive sound	Cetaceans (Level A)
190 dB (RMS)	Impulsive sound	Pinnipeds (Level A)
160 dB	Impulsive sound	Marine mammals (Level B)
120 dB	Continuous sound	Marine mammals (Level B)
Note: All threshold values are listed in dB re: 1µPa.		

As described in the monitoring plan for the Proposed Project (Appendix E), if confirmed testing indicates that sound levels are above Level A (180 dB sound pressure level [SPL] for cetaceans and 190 dB for pinnipeds) or Level B (120 dB SPL) harassment threshold criteria, and that the sound levels are attributable to the WEC device test, NNMREC scientists and the ocean test facility manager, in coordination with NMFS and ODFW, would determine the appropriate action, which may include:

- Further recording to confirm acoustic pressure levels;
- Modifying the operation of the WEC or Ocean Sentinel;
- Ceasing operation and performing necessary modifications to minimize noise levels; testing would be conducted to verify that the noise associated with the test has been abated; and/or
- Applying for an Incidental Harassment Authorization.

Additionally, following each field deployment season, results of underwater sound monitoring would be presented to NMFS in a summary report, for discussion and potential action as detailed in the Adaptive Management Framework (Appendix D). This summary and review process provides a mechanism to assure periodic consideration of underwater sound effects associated with the Proposed Project in the context of ongoing developments in best available science regarding the effects of underwater sound on marine life.

Electromagnetic Fields

Electromagnetic field (EMF) transmissions from umbilical cables connecting the WEC devices to the, Ocean Sentinel or vessel could affect the behavior of marine organisms. The magnitude of such potential impacts would depend on the intensity of EMF fields generated by the WEC devices, Ocean Sentinel or vessel, and umbilical cables linking these components, and on the sensitivity of organisms to EMF. The intensity of the EMF field is not well understood, though it is generally accepted that higher electric voltage leads to stronger electric fields and higher electric currents leads to stronger magnetic fields (World Health Organization 2010). Although EMFs from power cables can be readily modeled and it is understood that many species exhibit sensitivity to EMF, information that enables a quantifiable impact analysis is limited and the consequences at the individual, population, or system level have not yet been addressed (Normandeau et al. 2011).

Actual power generation levels for this test facility are expected to be low, not exceeding a 30-kilowatt (kW) generating capacity for the 2012-2013 WET-NZ test and not exceeding 100 kW for any test during the life of the Proposed Project. Umbilical cables connecting Ocean Sentinel or vessel and WEC devices would have at least one layer of shielding. Because EMF effects attenuate rapidly with distance from a source, any impacts are expected to be confined within the project site, and largely to the project infrastructure. For example, Gill et al. (2009) reported that EMF transmissions could be detected by various marine fish, shark, and ray species up to 295 meters (968 feet) from a cable. Cable shielding, direct current vs. alternating current power transmission, and burial have been reported to reduce exposure levels and apparent detection by fish and sharks (U.S. Department of Energy 2009a).

Fish in the vicinity of the project infrastructure may also experience EMF effects, such as disorientation and reduced foraging efficiency (Gill et al. 2009). The magnitude of this effect would vary between fish species. Some shark and ray species, such as catsharks and thornback rays, have been reported to show more activity and attraction to EMF transmission (Gill et al. 2009). However, Normandeau et al. (2011) reported that data gaps in the fundamental biology of marine species and in the specific question of response to anthropogenic EMF make conclusions about potential impacts highly speculative.

Use of shielded cable is expected to reduce some of the effects of EMF on fish. The small size of the project infrastructure and the relatively low power transmission levels transmitted by the Ocean Sentinel and WEC devices are also expected to produce low levels of EMF transmissions. However, recognizing the great uncertainty concerning the magnitude and extent of project-related perturbations of the natural EMF background, EMF monitoring (as described in Appendix E) is part of the Proposed Project, and would be subject to adaptive mitigation and adaptive management provisions described in Appendix D. As described in the EMF monitoring plan, the EMF detector being used is a state-of-the-art instrument capable of detecting EMF signals smaller than one ten-millionth the magnitude of the earth’s magnetic field. The instrument would be deployed sequentially at locations along two grid axes centered on the WEC being tested, with each deployment consisting of lowering the device to the ocean floor, making measurements, and raising the device. Each measurement would take about 20 minutes and about a week of activity would be required to complete measurements associated with either a baseline characterization or a WEC device effects characterization.

Analysis of the EMF data from the monitoring would be complex and time-consuming, and would only be available several months after a WEC device test had been completed, presented in the form of an annual report. Thus, there are no adaptive mitigation measures proposed. Adaptive management measures addressing EMF effects, detailed in Appendix D, would be implemented following review of the annual reports and could be used to modify subsequent WEC device tests. Thus, as an adaptive management measure, NNMREC would do the following, after consultation with the Adaptive Management Committee, NMFS, and ODFW, and after approval by NMFS:

- Validate the effectiveness of the EMF Propagation Model and assess its efficacy in measuring EMF for future tests. If necessary, potential modifications to the model will be recommended.

- Consider both the ability to detect and the level of EMF from the project devices and determine whether there is a meaningful source of EMF from the Proposed Project.

Based on the evaluation and assessment described above, NNMREC would implement one or more of the following, after consultation with NMFS, ODFW, and the Adaptive Management Committee, and after approval by NMFS:

- Modified or additional monitoring techniques;
- If a meaningful source of EMF from the Proposed Project is measured or estimated from modeling, conduct an additional literature review to assess the sensitivity of potentially affected species; and/or
- Use data and information from existing studies to estimate EMF emissions and perform a potential effects analysis for future tests.

These measures do not alter the existing uncertainty regarding potential effects of EMF generated by the Proposed Project on marine organisms. However, these measures do provide an important opportunity to measure the magnitude of EMF perturbations and periodically review their potential effects on protected species, and modify the Proposed Project if potentially harmful effects are found. Thus, the measures offer high confidence that a continuously improving best available science standard would continue to be used to ensure that protected marine organisms suffer minimal harm from EMF effects related to WEC device operations. This—along with the evidence cited above that EMF fields generated by the Proposed Project are anticipated to have only low amplitude and short range—provides evidence that the Proposed Project has low potential to harm marine life.

Collision and Entanglement

Sea turtles, marine mammals, and seabirds are all at potential risk of collision or entanglement. Collision risks are primarily limited to flying seabirds that might encounter the Ocean Sentinel or vessel and WEC device superstructure, whereas entanglement risks are primarily limited to encounters between whales and the Ocean Sentinel or vessel and WEC device mooring lines and umbilical cables. There is much less risk that smaller animals such as birds, turtles, pinnipeds or dolphins could become entangled in the large-diameter (several inches thick) lines and umbilical cables.

Subsea floats would be used to maintain all mooring lines and umbilical cables under maximum tension. This would minimize the potential for entanglement. At most, 16 mooring cables would be used to anchor the Ocean Sentinel and WEC devices. This small number of cables is not expected to pose any substantial physical barrier or collision potential to foraging sea turtles or transiting whales. Although crab and lobster pot lines connected to surface floats are known to pose substantial entanglement risk to sea turtles and marine mammals (U.S. Department of Energy 2009a) primarily because of the small diameter of their floating ropes, the cables of larger diameter and taut lines used to moor the Ocean Sentinel and WEC devices are expected to pose a low entanglement risk (U.S. Department of Energy 2009a). Accordingly, this impact would be minor.

Ocean Sentinel and WEC devices could provide temporary haul-outs for pinnipeds. If used for the Proposed Project, a manned testing vessel would not provide for pinniped haul-out. These animals are expected to make increased use of the area, compared to current conditions; however, as described above, there is little risk that these animals could become entangled in or collide with the mooring lines. This situation only poses risk to the sea lion or seal population if it enables less fit animals to survive while the Ocean Sentinel, WEC devices, and other equipment are in place (timing and length of deployments for these components are described in detail in Section 2, *Proposed Action and Alternatives*). Once removed, this equipment would no longer attract fish and provide easier access and less foraging effort for pinnipeds. As such the potential impact would be temporary and limited in scope, and would be a minor impact.

Marine birds have the potential risk of collisions with floating equipment, including the Ocean Sentinel or vessel and WEC devices. They may also be attracted to increased night lighting (U.S. Department of Energy 2009a). At night, although birds may be attracted to increased lighting (U.S. Department of Energy 2009a), lighting on the Ocean Sentinel or vessel and WEC devices would be minimal and comparable to lighting for NOAA and U.S. Coast Guard navigation and oceanographic data collection buoys. As such, the potential impact would be minimal. However, the use of flashing, low-intensity lights, such as those that would be used as part of the Proposed Project, has been reported to reduce attraction by birds at night and potential collisions (Longcore et al. 2008).

Commercial and Recreational Fishing

Deployment of the Ocean Sentinel or vessel, WEC devices, and their mooring system would require the placement of marker buoys and other aids to navigation in the project site and the publication of a Local Notice to Mariners to minimize potential vessel collisions with the Ocean Sentinel or vessel and WEC devices or entanglement in the mooring lines. Before the installation of the Proposed Project, NNMREC would meet with the Oregon Marine Board, U.S. Coast Guard, Oregon State Police, and the Fisherman Involved in Natural Energy (FINE) Committee to discuss the appropriate uses of the project site during and between testing periods that would balance vessel safety with access. Nonetheless, it is anticipated that the Proposed Project would result in the temporary loss of a small area used by commercial fishers, especially salmon trawlers and Dungeness crab fishers. Trawling for pelagic fish will also be impossible in the areas directly occupied by the Ocean Sentinel or vessel and WEC devices without the risk of collision and entanglement. Access for sport fishers may also be limited in this area while Ocean Sentinel or vessel and WEC devices are deployed. If the surface equipment attracts fish as expected and discussed above, then it can be anticipated that sport fishers will continue to use the area for recreational fishing despite any potential navigational restrictions and the actual impact on recreational fishing would be minor or potentially positive. Overall, the potential impact on commercial and recreational fishing from the Proposed Project is expected to be minor because of the small project footprint of the Proposed Project when compared to the central Oregon coastline that would remain open to fishing.

Special-Status Species

All special-status species present in the study area are members of one of the groups discussed above (fish, sea turtles, marine mammals, and birds) and as such are not expected to be affected any differently than other species in those groups. No loss of spawning habitat, foraging grounds, or impairment or restriction of movement along migration routes is posed by the Proposed Project. As such, the impact on special-status species would be negligible.

Critical Habitat and Essential Fish Habitat

The study area is located in or near DCH for the leatherback sea turtle, the southern DPS of the green sturgeon, the Oregon coast ESU of coho salmon, and the northern Steller sea lion. The area provides

EFH for groundfish, salmon, and pelagic fishes. As discussed above, the Proposed Project would not result in any permanent alteration to pelagic or benthic habitat and the marine biota inhabiting those areas. The Proposed Project would only have a minor impact on foraging area or its quality. Applicant-committed measures would minimize potential impacts on marine animals and their food sources. Additionally, the introduction of hard substrate habitat could result in a short-term positive impact on groundfish habitat and foraging (Boehlert et al. 2008; Nelson et al. 2008).

3.2.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding to NNMREC to design, construct, and operate the Proposed Project. The Proposed Project would not go forward and there would be no impacts on biological resources.

3.3 Noise and Vibration

This section evaluates the potential impacts of underwater noise and vibration on fish and marine mammals. Airborne noise impacts on sensitive human receptors were eliminated from further discussion (see Section 3.1, *Environmental Categories Evaluated and Dismissed from Further Analysis*).

Underwater noise and vibration is defined as oscillating pressure fluctuations generated by mechanical disturbances near the source. Underwater noise is quantified in dBs. These disturbances can be caused within the water (e.g., impellors) or they can be transmitted through the casing of the enclosed WEC devices. Time-varying underwater noise levels are generally quantified using several statistical metrics:

- The peak noise level (L_{peak}) is the maximum instantaneous noise level during the measurement period.
- The root-mean-square sound pressure level (SPL) is the “average” noise level during the measurement period.
- The sound exposure level (SEL) is the measure of the cumulative sound energy during the measurement period, which takes into account the noise intensity and the noise duration.

The primary sources of information for this section are the *Report to Congress on the Potential Environmental Effects of Marine and Hydrokinetic Energy Technologies* (U.S. Department of Energy 2009b), and the noise impact analysis in an EA prepared for a wave energy project proposed in Reedsport, Oregon (Reedsport OPT Wave Park 2010). Additional resources are cited in the text and complete references for all cited materials are provided in Chapter 6, *References*.

3.3.1 Affected Environment

Regulatory Setting

There are no federal, state, or local (City of Newport or Lincoln County) laws or regulations regarding noise specific to the study area. Applicable federal agency guidance and agreements are summarized below.

Federal

There are no federal regulations that limit underwater noise levels. However, key federal agencies have participated in recent interdisciplinary workgroups to define hydroacoustic noise impact criteria for impact assessments under the ESA. NMFS and USFWS are signatories for the Fisheries Hydroacoustics Working Group. On June 12, 2008, that workgroup issued the policy document *Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities* (Fisheries Hydroacoustics Work Group 2008). That guidance document focuses on underwater noise impacts caused by high-intensity impact pile driving. To date there are no formal guidance documents that focus on noise impact criteria for continuous, low-intensity underwater activity.

Environmental Setting

The study area for underwater noise and vibration is defined as the vicinity within 3.0 miles (4.8 kilometers) of the project site, and the navigation lanes between the onshore support docks and the test site. The study area off the coast near Newport already experiences considerable commercial marine vessel traffic from the Port of Newport, which is home to one of Oregon's largest commercial fishing fleets. The study area is close enough to shore to possibly be affected by surf noise. Therefore, existing underwater noise levels are expected to be moderate to high (Oregon Wave Energy Trust 2009a).

The background noise levels in the study area are being studied by Haxel et al. (2011). Haxel et al. deployed a lander-mounted hydrophone in the northwest corner of the project site in March 2010. After 6 months of data collection, the device was retrieved and resulting data were collected. A second hydrophone was deployed approximately 3.0 miles (4.86 kilometers) southwest of the first hydrophone in September 2010 and retrieved after 6 weeks of data collection. The northwest hydrophone was redeployed in November 2010 and recovered in April 2011. The devices recorded continuously, monitoring underwater sound generated at frequencies of 1 Hz to 2 kHz. The underwater sound pressure levels recorded during the monitoring period ranged from a low of 95 dB RMS re:1 μPa to 136 dB RMS re:1 μPa, with a time-averaged sound pressure level for the monitoring period of 113 dB RM re:1 μPa; a histogram of hourly RMS values shows a normal distribution. The spectrum during periods of above-average underwater sound intensity was dominated by low-frequency noise associated with wave action, primarily surf along the shoreline. Investigators concluded that ambient noise levels in and around the project site consist of sounds primarily emanating from breaking waves, wind, vessel traffic, and marine mammal and fish activity, and that high amplitude signals are well observed in the project site (Haxel et al. 2011).

3.3.2 Environmental Consequences of the Proposed Project

The assessment of underwater noise and vibration impacts draws from a noise impact analysis from one representative technology, the Ocean Power Technologies (OPT) PowerBuoy® point absorber WEC device. This device is similar in design to those that are anticipated to be tested as part of the Proposed Project and the installation and mooring of the Ocean Sentinel and WEC devices under testing would be similar to that of the PowerBuoy®. Therefore, underwater noise impacts for the Ocean Sentinel and WEC devices included in the Proposed Project are anticipated to be similar.

Installation

Although noise sources would include installation of anchors, anchor cables, and umbilical cables from WEC devices to Ocean Sentinel or vessel, the predominant source of noise during project installation of the Ocean Sentinel and WEC devices would originate from the propellers of support vessels involved in transport and placement. Installation of the anchoring and mooring system for the Proposed Project would not involve percussive pile driving or drilling. These activities are often the greatest contributing noise source during marine construction.

The EA for the proposed Reedsport OPT project included an analysis of noise impacts from installation activities of the OPT PowerBuoy® device (Reedsport OPT Wave Park 2010). OPT expects the peak underwater sound intensity, generated by tugs, barges, and diesel-powered vessels (representative for project installation) fully underway, to be no greater than 130 to 160 dB at 1.0 meter (3.3 feet) over a frequency range of 20 hertz (Hz) to 10 kHz. The vessel should only be fully underway when traveling to and from the project area. Also, these peak noise levels may only occur during vessel starts and stops during installation activities. OPT projected that for most of project installation the sound intensity would be much lower. Noise impacts from the Proposed Project would be expected to be commensurate with the levels anticipated by OPT.

The EA noise analysis for the Reedsport OPT project concludes that during project installation, it is not expected that the above-water sounds from the support vessels and equipment would be transmitted into the water at a higher level than the natural environmental noise from wind and wave action. As the lead agency for that EA, the Federal Energy Regulatory Commission (FERC) concluded that they expected such above-water sounds to be largely damped by ambient ocean noise on all but the calmest of days. Because of the similarities between the Reedsport project area and the project site for this Proposed Project, this conclusion is expected to apply to the Proposed Project.

Furthermore, in its EA, FERC determined that while the noise associated with the installation activities of the Reedsport OPT project could temporarily cause avoidance and alter feeding patterns for certain marine species, any impacts would be short term and are anticipated to be negligible. The Proposed Project would be located approximately 70.0 miles (112.7 kilometers) north of the proposed Reedsport OPT project area and would include habitat and species expected to be found in the Reedsport OPT project area. Additionally, the Proposed Project would include installation of up to four structures (two Ocean Sentinel and two WEC devices), as compared to the 10-buoy array proposed by OPT. Therefore, the noise levels anticipated to result from the installation and maintenance of the Proposed Project would be lower than those for the Reedsport OPT project and would be expected to cause less avoidance and feeding pattern alteration behaviors by marine life.

Operation

During operation, noise from the WEC devices' impellor, gearbox, generator, or other moving components would be radiated into the surrounding water. In addition, "cable strumming" noise can be generated by waves or currents passing by anchor cables and umbilical cables. The magnitude of underwater noise generated by the operation of each WEC device would vary depending on the specific device being tested at any given time. Such noises would be nearly continuous, but might vary depending on the amount of electricity being generated or mechanical motion at any given time.

No acoustic data are presently available for the WET-NZ device that would be used in the 2012-2013 test, and until recently, no definitive measurements of sound levels associated with the operation of hydrokinetic and ocean energy devices had been published (U.S. Department of Energy 2009b). The recent Bassett et al. (2011) study describes acoustic monitoring of a 1/7 scale WEC in Puget Sound during 2011. The tested device is a point absorber secured to the seabed with a three-point mooring. Data collection was limited to a series of 1-minute hydrophone recordings collected on March 30, 2011, for approximately 4 hours. Sampling evaluated sound generation at frequencies of 20 Hz to 20 kHz. During these recordings, significant wave height varied from 0.4 to 0.7 m, peak wave periods varied from 2.9 to 3.2 seconds, and southerly winds varied from 5 to 10 m/s. Shipping vessel and ferry traffic levels were typical; in this portion of Puget Sound, they may produce ambient underwater sound levels of 130 dB RMS re 1 μPa. At times, ship traffic dominated the signal, as determined from spectral characteristics and vessel proximity. Received sound pressure levels attributed to the WEC cycle varied from 116 to 126 dB re 1 μPa at frequencies of 60 Hz to 20 kHz at distances from 33 to 4,920 feet (10 to 1,500 meters) from the WEC. The cycling was well correlated with the peak wave period. Masking by ship noise prevented rigorous extrapolation to estimate the WEC source level at a reference distance.

Recognizing the uncertainty about underwater sound generation potential associated with experimental WEC devices, NNMREC would deploy monitoring equipment during the lifetime of the Proposed Project. The monitoring to be performed and the equipment to be used are specified in the acoustic monitoring plan (Appendix E). As noted in that plan, NNMREC would immediately notify NMFS if measured sound pressure levels created by the Ocean Sentinel or WEC device under test exceeded NMFS criteria for potential harm caused by impulsive or continuous underwater sound effects on salmonid fishes and marine mammals.

As described in the monitoring plan for the Proposed Project (Appendix E), if confirmed testing indicates that sound levels are above Level A (180 dB SPL for cetaceans and 190 dB for pinnipeds) or Level B (120 dB SPL) harassment threshold criteria, and that the sound levels are attributable to the WEC device test, NNMREC scientists and ocean test facility manager, in coordination with NMFS and ODFW, would determine the appropriate action, which may include:

- Further recording to confirm acoustic pressure levels;
- Modifying the operation of the WEC or Ocean Sentinel;
- Ceasing operation and performing necessary modifications to minimize noise levels; testing would be conducted to verify that the noise associated with the test has been abated; and/or
- Applying for an Incidental Harassment Authorization.

Additionally, following each field deployment season, results of underwater sound monitoring would be presented to NMFS in a summary report, for discussion and potential action as detailed in the Adaptive Management Framework (Appendix D). This summary and review process provides a mechanism to assure periodic consideration of underwater sound effects associated with the Proposed Project in the context of ongoing developments in best available science regarding the effects of underwater sound on marine life.

As described in Section 2.2.2, a variety of types of monitoring equipment would be deployed in the study area to support the Proposed Project and to collect data to be used in physical and environmental studies. Equipment would be deployed during the operation of the Proposed Project, but may also be used before and after the operations phase as well. Associated monitoring equipment may include devices that actively generate or emit sound waves in a wide range of frequencies. Active devices could include acoustic wave and current profilers, acoustic Doppler current profilers, seafloor mapping devices, echosounders, sub-bottom profilers, acoustics releases, and acoustic telemetry devices. Any active acoustic device used as part of the Proposed Project would be an off-the-shelf, commercially available device. These devices may or may not operate at frequencies that are perceptible to marine life. Table 3.3-1 outlines some of the most likely active acoustic devices that may be used as part of the Proposed Project.

Table 3.3-1. Active Acoustic Devices that may be used as Part of the Proposed Project

Device Type	Anticipated Frequency	Purpose/Use
Acoustic Wave and Current Profiler (AWAC)	400 kHz, 600 kHz, 1 MHz	Measures wave height, wave direction, and the full current profile (speed, direction, and depth of current)
TRIAXYS™	400 kHz, 600 kHz	Measures water currents
Acoustic Doppler Current Profiler (ADCP)	400 kHz, 600 kHz, 1 MHz, 2 MHz	Current profiling
Multibeam Sonar with Backscatter	240 kHz	Seafloor mapping
Echosounder	38 kHz, 200 kHz	Locating mysids, forage fish, other marine life in water column
Chirp Profiler	2–6 kHz	Sub-bottom profiling
Acoustic releases	7–15 kHz	Recovery of underwater equipment
Acoustic Telemetry	3–15 kHz	Directional locating

kHz = kilohertz (1,000 cycles per second); MHz = megahertz (1,000,000 cycles per second)

With the exception of chirp profilers, acoustic releases, and acoustic telemetry, none of the active acoustic devices generate sound at a frequency that is detectable to marine life. Section 3.2.2, identifies perceived noise frequencies and assesses potential impacts on biological resources resulting from active acoustic devices.

Maintenance, Removal, and Decommissioning

Noise and vibration during maintenance of the Ocean Sentinel and WEC devices would be generated chiefly by support vessels traveling to and from the onshore support docks, as during installation. These activities are expected to cause minimal and temporary noise impacts.

Removal and decommissioning of the test site would also generate noise levels similar to installation (described in detail above). The Proposed Project is expected to cause minor noise or vibration impacts during this phase.

3.3.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding to design, construct, and operate the Proposed Project. No Ocean Sentinel or WEC devices would be deployed and no manned test vessel would be deployed to test WEC devices. There would be no impacts on noise or vibration.

3.4 Water Resources

Water resources conventionally include surface water and groundwater resources, and are evaluated with respect to both water quality and water quantity. Because the Proposed Project would occur in a marine area, this definition must be adapted to provide for a meaningful analysis of potential impacts of the Proposed Project on water resources. Surface water in this analysis includes waters of the Pacific Ocean within the study area (defined below in Environmental Setting). Groundwater resources are absent and are not further discussed. The water quality analysis addresses the water quality of the Pacific Ocean in the study area and includes conventional parameters such as temperature and salinity, as well as potential pollutants that may affect beneficial uses of the ocean waters. This water quality analysis also addresses the stratification and movement (currents) of ocean waters and wave characteristics in the study area, and is discussed under the heading of oceanography.

3.4.1 Affected Environment

Regulatory Setting

This section discusses the federal and state regulations that apply to the project site and surrounding areas. No applicable local regulations (City of Newport or Lincoln County) were identified during preparation of this EA.

Federal

Clean Water Act

The CWA, as amended, aims to restore and maintain the natural, chemical, physical, and biological integrity of the nation's waters. ODEQ is responsible under the CWA for maintaining the water quality of surface waters in the state. Regulations protecting water quality are codified under OAR 340-041, which provide numerical criteria for water temperature and a variety of chemical parameters, as well as narrative criteria designed to protect beneficial uses. Section 401 of the CWA requires that an applicant for a federal license or permit provide a certification that any discharges from the facility will comply with the CWA, including water quality standard requirements. The Proposed Project would require water quality certification pursuant to Section 401 of the CWA.

State

Oregon Administrative Rule 340-041

ODEQ must ensure that the Proposed Project complies with the water quality standards defined in OAR 340-041. Applicable regulations require maintaining water quality so as to:

- support aquatic species without detrimental changes in the resident biological communities (OAR 340-041-0011);
- prevent a reduction in ambient dissolved oxygen concentrations (OAR 340-041-0016);
- maintain pH between 7.0 and 8.5 (OAR 340-041-0021);
- prevent water temperature increases that adversely affect fish or other aquatic species (OAR 340-041-0028); and
- prevent the introduction of toxic substances above natural background levels in amounts, concentrations, or combinations that may be harmful to aquatic life, public health, or other designated beneficial uses (OAR 340-041-0033).

As designated by ODEQ, the study area lies in the Mid-Coast Basin for the purposes of water quality standards. The designated beneficial uses for marine waters adjacent to the Mid-Coast Basin are industrial water supply, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, commercial navigation and transportation (OAR 340-41-0220 and OAR 340-41-0320).

The OARs also include 16 statewide narrative criteria for water quality (340-041-0007). Criteria numbers 10 through 14, which most pertain to the Proposed Project, prohibit the following conditions:

- development of fungi or other growths having a deleterious effect on stream bottoms or aquatic life or that are injurious to public health, recreation, or industry;
- creation of tastes or odors or toxic or other conditions deleterious to aquatic life or affecting the potability of drinking water or the potability of fish or shellfish;
- formation of appreciable bottom or sludge deposits or the formations of any organic or inorganic deposits deleterious to aquatic life or injurious to public health, recreation, or industry;
- objectionable discoloration, scum, oily sheens, floating solids, or coating of aquatic life with oil films; and
- aesthetic conditions offensive to human senses of sight, taste, smell, or touch.

Environmental Setting

The study area for water resources is concurrent with the project site. Minimal data has been collected within the study area; therefore, sources cited below also present information from other central Oregon coast areas and discuss the likelihood that comparable conditions would occur within the study area. The principal sources of information include water quality data from the ODEQ Laboratory Analytical Storage and Retrieval Database (LASAR) (Oregon Department of Environmental Quality 2010), and sediment quality data reported during studies performed prior to designation of the dredged disposal area in Yaquina Bay, approximately 3 miles (5 kilometers) south of the study area (U.S. Army Corps of Engineers 2001). The dredged disposal area study analyzed conditions in an offshore area at a distance and in water depths comparable to those of the study area, and is therefore expected to be representative of conditions in the study area.

Oceanography

The high wave energy flux on the Oregon coast is due to prevailing western winds and large fetch[9] of the Pacific Ocean (Boehlert et al. 2008). Wave energy on the coast varies considerably by season, such that the wave energy flux is approximately eight times greater during winter than summer offshore of Douglas County, Oregon (Bedard 2005).

Episodic winter storms bring large waves from the west and southwest. Currents generated by these waves are uniform throughout the water column, and may have a substantial influence on the transport of fine sediments (silt and clay) at depths of greater than 120 feet (37 meters) (U.S. Army Corps of Engineers 2001).

The circulation of ocean surface waters on Oregon's continental shelf varies seasonally with changing wind stress patterns. During the summer, offshore high pressure systems and associated northerly or northwesterly winds drive upwelling of deep, dense, cold water toward the ocean surface. At this time, circulation of surface waters on the continent shelf is dominated by the southward-flowing California Current (U.S. Army Corps of Engineers 2001). In contrast, low offshore pressure systems during winter drive southwesterly storm winds that result in surface circulation dominated by the northward-flowing Davidson Current.

On the inner continental shelf (depths less than about 120 feet or 37 meters), bottom sediments are transported by a combination of wind-driven currents, wind waves, tidal currents, and estuarine-induced currents (U.S. Army Corps of Engineers 2001). Bottom currents on the inner continental shelf are capable of transporting sand-sized sediment.

On the middle continental shelf (depths of 120 to 300 feet, or 37 to 92 meters), water circulation is mainly influenced by wind-driven currents, whereas on the outer continental shelf (depths of 300 to 600 feet, or 92 to 183 meters), shoaling waves and regional currents control water circulation seasonally (U.S. Army Corps of Engineers 2001). The net direction of bottom currents on the mid- to outer continental shelf is northward, because the subsurface part of the Davidson Current is believed to flow northward year round. Bottom currents along the mid- to outer-continental shelf are capable of transporting silt and finer-grained sediments (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2001).

Water Quality

Water quality data are provided by ODEQ's LASAR database (Oregon Department of Environmental Quality 2010). The monitoring site closest to the study area is Site 30244, located at latitude 44.6851 N, longitude 124.1684 W, approximately 1.5 miles (2.5 kilometers) west of the study area. Water quality data were collected at this site on June 11, 2003, by lowering a sonde[10] from the surface to the sea floor and back, collecting water samples at depths of 6, 98, and 197 feet (2, 30, and 60 meters). Results are summarized in Table 3.4-1. They indicate a water depth of about 197 feet (60 meters) with a steady decline in chlorophyll A–a photosynthetic pigment–and dissolved oxygen with depth. At the time of sampling, there was no apparent thermocline[11]; temperatures declined

[9] Fetch is defined as the area over a waterbody in which the wind blows in an essentially constant direction. Longer fetch lengths are associated with the size of the waves produced.

[10] A sonde is a water quality monitoring device that measures a number of variables in the water column.

[11] A thermocline is a stratum where water temperatures change relatively rapidly with depth.

gradually from the surface to about 98 feet (30 meters) in depth, and were fairly uniform below that depth. Nutrient availability increases with depth, reflecting a reduced level of biological activity as a result of the low temperature, darkness, and low dissolved oxygen.

Table 3.4-1. Water Quality Data from ODEQ Site 30244

Parameter	Value Near Surface (2 meters) (6 feet)	Value in Mid-Water (30 meters) (98 feet)	Value Near Bottom (60 meters) (197 feet)
Chlorophyll a (µg/L, lb/gal)	25.46, 0.00000021	3.28, 0.000000027	0.33, 0.0000000028
Dissolved oxygen (mg/L, lb/gal)	9.1, 0.000076	4.9, 0.000041	2.9, 0.000024
pH	8.1	7.8	7.7
Salinity (parts per thousand)	32	33	34
Temperature (°C, °F)	11.3, 52.3	7.5, 45.5	7.3, 45.1
Transmittance (%)	68	94	92
Nitrate/nitrite as N (mg/L, lb/gal)	0.0317, 0.000000265	0.394, 0.00000329	0.482, 0.00000402
Percent saturation dissolved oxygen (%)	101	51	29
Pheophytin a (µg/L, lb/gal)	1.8, 0.000000015	0.2, 0.0000000017	0.2, 0.0000000017
Total suspended solids (mg/L, lb/gal)	19, 0.00016	15, 0.00013	12, 0.00010

Notes: µg/L=micrograms per liter, mg/L=milligrams per liter
Source: Oregon Department of Environmental Quality 2010

Water quality on the Oregon coast varies seasonally. During winter, temperatures of nearshore surface waters are about 48 to 50°F (9 to 10°C) and salinities are about 30 to 32 practical salinity units (Boehlert et al. 2008; Landry et al. 1989). Light transmission is higher during winter, and decreases with the transition to summer during upwelling conditions and when phytoplankton bloom (Boehlert et al. 2008). During summer, upwelling brings colder, more saline water onto the inner shelf. Summer surface temperatures are about 54 to 57°F (12 to 14°C) and salinities are about 30 to 32 practical salinity units (Boehlert et al. 2008, Landry et al. 1989). Wind and wave conditions are relatively calm during the spring (March and April) and fall (September and October) transitions between oceanographic regimes (Boehlert et al. 2008).

Sediment quality data have been recovered from Yaquina Bay during sampling performed between 1984 and 2000 (U.S. Army Corps of Engineers 2001). The sample locations, although several miles south of the study area, are in the open waters of Yaquina Bay, an area that, like the study area, has a uniform fine sand bottom. The data are summarized in Table 3.4-2. The data indicate very minor amounts of metals and an absence of artificially derived organic compounds in the sediments.

Table 3.4-2. Sediment Quality Data from Yaquina Bay

Parameter	Sample Date	Number of Samples	Range of Values
Percent gravel	July 2, 2000	*	0-1.5%
Percent sand	July 2, 2000	*	96.5-100%
Percent fines	July 2, 2000	*	0-3.5%
Total organic carbon	1984	13	0.6-1.5%
Total organic carbon	May 16, 1986	11	0.4-1.1%
Arsenic	July 2, 2000	*	3.1-4.06 mg/L 0.0000259-0.0000339 lb/gal
Cadmium	July 2, 2000	*	0.14-0.19 mg/L 0.0000012-0.0000016 lb/gal
Copper	July 2, 2000	*	2.0-2.8 mg/L 0.0000167-0.0000234 lb/gal
Lead	July 2, 2000	*	1.7-2.0 mg/L 0.0000142-0.0000167 lb/gal
Mercury	July 2, 2000	*	Not detected
Nickel	July 2, 2000	*	6.3-10.0 mg/L 0.0000526-0.0000835 lb/gal
Zinc	July 2, 2000	*	12-16 mg/L 0.0001001-0.0001335 lb/gal
Silver	July 2, 2000	*	0.03-0.04 mg/L 0.0000003-0.0000003 lb/gal
Organic compounds	July 2, 2000	**	Not detected

Notes:

mg/L=milligrams per liter

* Five composite samples from a total of 20 samples.

** Compounds sampled for included phenols (phenol, 2-methylphenol, 4-methylphenol, 2,4-dimethylphenol, pentachlorophenol), pesticides and polychlorinated biphenyls (PCBs) (total dichlorodiphenyltrichloroethane (DDT), total BHC, lindane, aldrin, alpha-chlordane, dieldrin, heptachlor, endrin, endosulfan, total PCBs), polynuclear aromatic hydrocarbons (naphthalene, acenaphthalene, acenaphthene, fluorene, phenanthrene, anthracene, 2-methyl-napthalene, fluoranthene, pyrene, benz(a)-anthracene, chrysene, benzofluoranthenes, benzo(a)-pyrene, indeno (1,2,3-c,d) pyrene, dibenz(a,b)anthracene, and benzo(g,h,i)perylene), chlorinated hydrocarbons (1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,2,4-trichlorobenzene, hexachlorobenzene), phthalates (dimethyl phthalate, diethyl phthalate, di-n-butyl phthalate, butyl benzyl phthalate, dis(2-ethylhexyl) phthalate, di-n-octyl phthalate), and miscellaneous extractables (benzyl alcohol, benzoic acid, dibenzofuran, hexachloroethane, hexachlorobutadiene, n-nitrosodi-phenylamine). Trace amounts, 4.5 to 6.4 μg/L, of dis(2-ethylhexyl) phthalate were found in three samples.

Source: U.S. Army Corps of Engineers 2001

3.4.2 Environmental Consequences of the Proposed Project

The Proposed Project has limited potential to result in altered water quality. The potential mechanisms of impact are listed below.

- Spills of fuel, lubricants, or hydraulic fluid associated with use of motorized vessels to visit the site while installing, servicing or removing equipment.
- Leakage from WEC devices being tested if the design includes hydraulic fluids.
- Leaching of antifouling treatments on the Ocean Sentinel or vessel and WEC devices being tested.
- Turbidity during installation or removal of mooring systems.

Installation

Spills

Ocean Sentinel and WEC device installation would require a number of vessels, including tugs, barges, cranes, and workboats. Each of these vessels contains fuel, hydraulic fluid, and potentially other hazardous materials that could spill during vessel operations. The marine construction contractors performing these operations are required to have spill response plans (such plans are required by U.S. Coast Guard regulations for facilities having the potential to spill oil into a navigable waterway). Accordingly, there is a low probability of such spills and a high probability of swift and effective response, minimizing the risk of materially affecting beneficial uses of the waters in the study area or along marine routes accessing the study area.

Turbidity

There is a potential for localized turbidity caused by disturbance of bottom sediments during placement or removal of mooring system components, principally anchors. Because the seabed in the study area consists of nearly 100% sand, any turbidity impacts would be localized within a few meters of the activity, and the sand would settle to the sea floor within seconds of the disturbance. Accordingly, turbidity impacts are not expected to result in any measurable alteration of water quality.

Operations

Antifouling Coatings

The vessel, WEC device, and floats used in the mooring system would be treated with antifouling coatings. The antifouling coatings would not contain TBT, but would likely use a combination of cuprous oxide and organic substances to discourage growth of fouling organisms. The Ocean Sentinel would also be treated, but its antifouling coating would be free of both TBT and copper compounds. The rate of leaching from antifouling paint into the environment is not consistent over time. Newly painted structures display the highest leaching rates that can be up to seven times greater than long-term release rates (Valkirs et al. 2003). After 2 months, copper release rates stabilize to a low consistent emission. The rate and level that copper releases into the environment is contingent upon several factors, including the movement of the structure, total surface area, and thickness of the paint (Castritsi-Catharios et al. 2007; Valkirs et al. 2003). Structures experiencing little movement or change in depth, as would be the case with the Ocean Sentinel and WEC devices (in comparison to moving ships), show the lowest release rates (Valkirs et al. 2003). Schiff et al. (2003) studied rates of copper leaching from two types of copper-containing antifouling paints used on recreational vessels and found leach rates of 3.7 to 4.3 μg/cm2 per day. Comparable leach rates would likely be associated with a WEC and moorings floats deployed for under 1 year. Schiff et al. (2003) performed their study in Southern California and although they do not state water temperature, it is likely that it exceeded the perennially cold water temperatures found off the Oregon coast, and thus, somewhat lower leach rates might occur at the project site.

Bulk leaching rates would depend on the total surface area of immersed antifouling paint. The WET-NZ device is roughly cylindrical, 18 meters long and 3.5 meters in diameter and has a surface area of 208.5 square meters. It would, therefore, be expected to leach copper at a rate of 7.7 to 9.0 grams per day, or 89 to 104 micrograms per second (μg/s). During the summer months, currents in the area average 0.5 meter per second (Ashford pers. comm.), and the WET-NZ device has a cross-sectional area in the water column of 63 square meters, so the leached copper would be dispersed into a passing water volume of 31.5 cubic meters per second, producing a net water concentration of 0.0028 to 0.0033 micrograms per liter (μg/L) adjacent to the WET-NZ device. Concentrations would further diminish downfield if mixing occurred with waters not flowing past the WET-NZ device. The area of wetted surface treated with antifouling coatings on other WEC devices that could be tested as part of the Proposed Project would be comparable to that of the WET-NZ device. Therefore, if other WEC devices tested at the project site were treated with copper-based antifouling coatings, the bulk leaching rates are expected to be similar.

The impact on water quality from the antifouling paint is expected to be negligible. In addition, the solubility of copper in sea water, wave and current activity in the study area, depth of water, and sandy bottom sediment in the vicinity of the study area minimize the potential of any antifouling paint contaminants being deposited on the sea floor and reentering the water column as a result of project installation or operation. The study area's location in the open Pacific Ocean and the short duration of the individual tests further reduces the possibility of installation or operation-related water quality impacts from the Ocean Sentinel, WEC devices, and associated mooring system.

Leakage

The WEC devices could contain dielectric or hydraulic fluid, or could contain no fluids at all, depending on the design of WEC device being tested. Again, release of such fluids would only occur in the event of catastrophic damage to the WEC device. Before testing, each WEC device developer would submit to NNMREC for review and approval a spill contingency and emergency response plan, which would contain measures intended to ensure a rapid response and recovery that minimizes potential environmental harm.

The Ocean Sentinel may be equipped with an onboard diesel generator and up to 240 gallons of diesel fuel contained in three baffled aluminum tanks. Only in instances of catastrophic damage, would there be a spill or leak of fuel. This is considered to be an extremely unlikely event.

If a manned vessel is used in place of the Ocean Sentinel, it would likely be OSU's research vessel, the Pacific Storm. As described in Section 2.2.4, the Pacific Storm can carry a maximum of 15,000 gallons (56,781 liters) of fuel, 100 gallons (379 liters) of lube oil, and 400 gallons (1,514 liters) of hydraulic oil. The release of any of these fluids would only occur in the event of a catastrophe such as collision resulting in hull damage or sinking. The Pacific Storm is equipped with state-of-the-art marking and navigation systems and an event of the severity necessary to result in the leakage of any fluid is considered to be extremely unlikely.

Maintenance, Removal, and Decommissioning

All impacts described above could occur during maintenance, removal, and decommissioning, except that application of new antifouling coatings would not occur on site, but would require removing the Ocean Sentinel from the water, cleaning the hull, and repainting at an appropriate terrestrial facility such as a licensed boatyard.

3.4.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding to NNMREC to design, construct, and operate the Proposed Project. No Ocean Sentinel and WEC devices would be deployed and no manned test vessel would be deployed to test WEC devices. There would be no impacts on water resources.

3.5 Marine Navigation

Marine navigation is defined as the movement of ships and other watercraft in oceans, inlets, and bays. This section describes existing conditions and applicable regulations related to marine navigation extending between Newport Bay and the project site, as well as potential impacts on marine transportation safety associated with the Proposed Project.

The primary sources of information for this section are general information provided by the Port of Newport and the CFR. Additional resources are cited in the text and complete references for all cited materials are provided in Chapter 6, *References*.

3.5.1 Affected Environment

Regulatory Setting

There are no state or local (City of Newport of Lincoln County) navigational laws or regulations specific to the study area. Applicable federal regulations are summarized below.

Federal

Ports and Waterways Safety Act

The Ports and Waterways Safety Act (33 U.S.C. *et seq*.) holds the U.S. Coast Guard responsible for providing DOE, the lead NEPA agency for the Proposed Project, with an evaluation of the potential impacts of the Proposed Project on the safety of navigation and the traditional uses of the waterway and other U.S. Coast Guard missions. During that evaluation, the U.S. Coast Guard takes into account all possible uses of a waterway to reconcile the need for safe access routes with the needs of other waterway uses (U.S. Coast Guard 2007).

Navigation and Navigable Waters

The U.S. Coast Guard is the federal agency responsible for marine safety, including maintaining all federal aids to navigation (e.g., LORAN[12] stations, lighthouses, buoys, and structures), permitting all private aids to navigation, and keeping the boating community abreast of changes in the navigational system (33 CFR). The 13th District of the U.S. Coast Guard, Waterways Management Branch, assumes these responsibilities for Oregon, Washington, Idaho, and Montana. Specific to the Proposed Project, the U.S. Coast Guard would be the federal agency responsible for requiring that the Ocean Sentinel and WEC devices be marked and maintained appropriately, as documented in an approved private aid to navigation permit. This application requires an assessment of the appropriate onsite aid, including the shape, dimensions, information and regulatory marks, and lighting characteristics of the marker.

Of note, in certain ports and high vessel traffic areas, the U.S. Coast Guard establishes systems and designations to protect and provide additional safe navigational access. However, none of these designations apply to the study area. Specifically, there are no designated special anchorage areas (33 U.S.C. 2030[g]); vessel traffic service areas (33 CFR 161), safety or security zones (33 CFR 165), traffic separation schemes (33 CFR 167), or shipping safety fairways (33 CFR 166) within or near the study area. There are shipping and towing lanes in the vicinity of the study area and leading to Yaquina Bay; however, they do not meet the designations listed above.

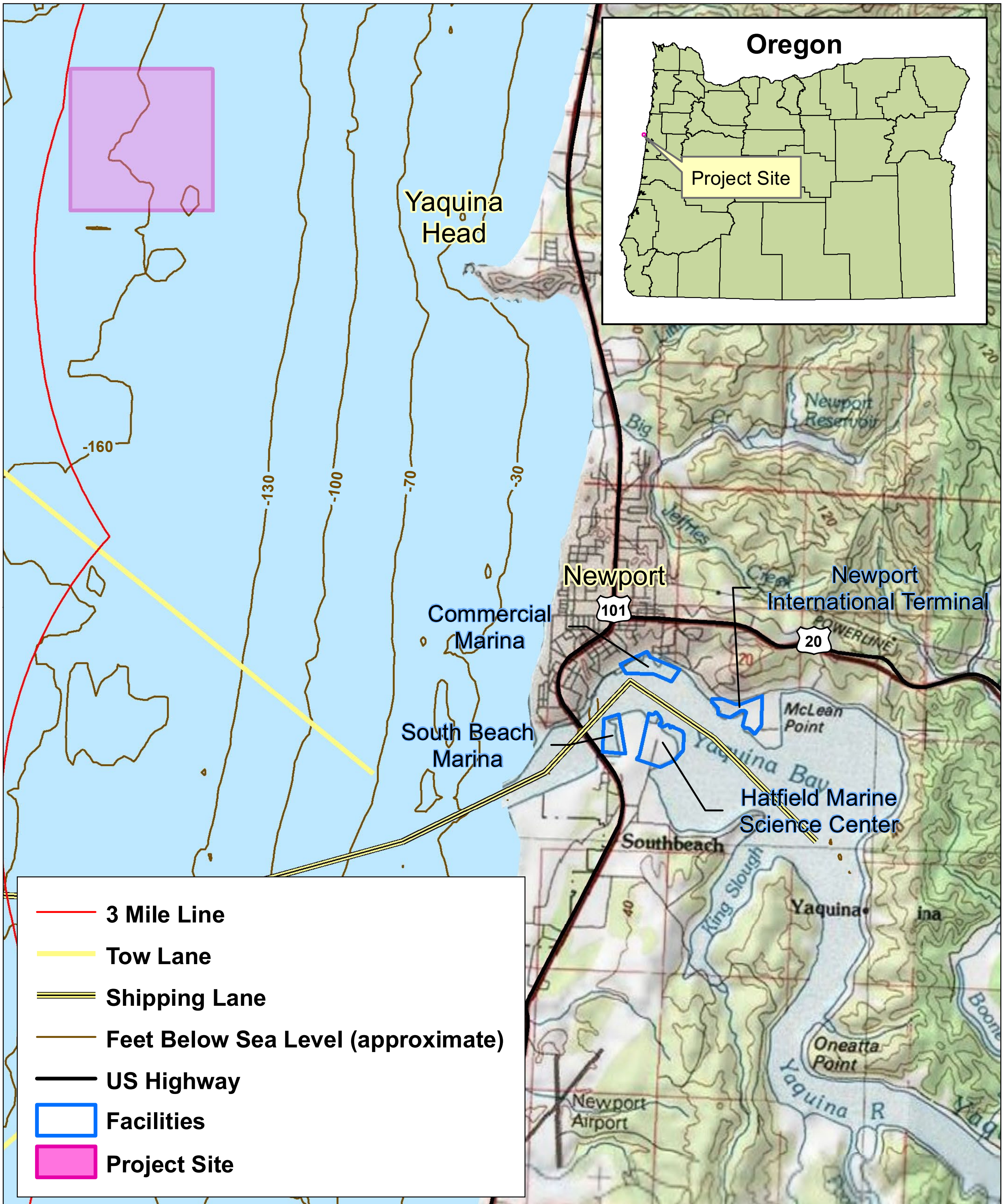
Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act (22 U.S.C. 401 *et seq*.) requires authorization from the Corps for the construction, excavation, or deposition of materials in, over, or under a navigable water of the United States, or for any work that would affect the course, location, condition, or capacity of those waters. It is generally intended to protect commerce in navigable streams and waters, and would apply to installation of the Ocean Sentinel, WEC devices, and related facilities at the project site. Pursuant to Section 10 of the Rivers and Harbors Act, authorization from the Corps would be required for the placement of structures into navigable waters of the United States. Because the purpose of the WET-NZ test is to install scientific measurement devices, the Corps may provide authorization under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act through issuance of Nationwide Permit #5. NNMREC submitted a Joint Permit Application to request Nationwide Permit #5 on March 27, 2012.

Environmental Setting

The study area for marine navigation is defined as the project site (i.e., the 1-square-nautical-mile [3.4-square-kilometer] area located approximately 1.8 to 2.7 miles [2.9 to 4.3 kilometers] offshore from Yaquina Head), moorage facilities at the Port of Newport, located in Yaquina Bay, and HMSC (i.e., locations where Proposed Project facilities may be deployed), as well as the area that generally extends between the project site and the Port of Newport and HMSC (i.e., the area where project-elated watercraft would transit to and from the project facilities). These features are presented in Figure 3.5-1.

[12] LORAN is the acronym for Long Range Navigation, a terrestrial radio navigation system using low-frequency radio transmitters that uses multiple transmitters to determine the location and speed of the receiver.



Source: National Geographic Society TOPO, courtesy of ESRI

Kilometers 0 1.5 3

Nautical Miles 0 1.5 3

Figure 3.5-1
Wave Energy Test Facility
Project Site and Marine Facilities

ICF INTERNATIONAL

Vessel Traffic and Moorage and Boat Launch Facilities

The Port of Newport, Oregon includes the Newport International Terminal, a commercial fishing vessel marina, and a recreational vessel marina (the South Beach Marina). The Newport International Terminal is one of only three deep draft ports on the Oregon coast. It has traditionally serviced the forest product industry and is located about 1.5 miles (2.4 kilometers) from the ocean buoy entrance. In 2009, the Port of Newport was selected as the new location for NOAA's Marina Operations Center-Pacific Homeport. The Port of Newport is currently in the process of providing additional moorage and support facilities for NOAA, and improving and retrofitting some of the existing facilities at the International Terminal (Port of Newport 2010).

The commercial fishing vessel marina supported 393 commercial fishing vessels in 2000. The primary fisheries exploited by boats out of the Port of Newport, Oregon, in terms of ex-vessel landing values, were groundfish, crab, shrimp, highly migratory species, and salmon (National Oceanic and Atmospheric Administration 2007). In the study area, crabbing and salmon fishing are the most popular commercial fishing activities, and halibut and salmon fishing are the most popular recreational fishing activities.

The recreational vessel marina (South Beach Marina) includes 450 moorage slips, a fuel dock, and a paved boat ramp (Port of Newport 2010). Roughly 10,000 boating days[13] originate at this facility each year (Fisherman Involved in Natural Energy 2008; Nielsen pers. comm.)

3.5.2 Environmental Consequences of the Proposed Project

Impacts on marine navigation were assessed by evaluating the potential for the Proposed Project to result in a hazard to marine navigation during installation, operation, maintenance, or removal of project facilities, or to result in an increase in vessel traffic that could not be accommodated by existing marine facilities in the vicinity.

Installation

Mobilization of the Ocean Sentinel or vessel, WEC devices, and ancillary equipment would require navigation between the shoreline and the 1.0-square-nautical-mile (3.4-square-kilometer) project site. In all instances, project-related vessel traffic would follow U.S. Coast Guard rules regarding marine navigation and safety, and would use existing moorage and boat launch facilities at either the Port of Newport or HMSC. Although several separate vessel trips to the project site would be required to install the Ocean Sentinel, WEC devices, and anchoring and mooring components, it is not anticipated that additional vessel traffic would affect marine navigation. No adverse impacts on marine navigation would result from the installation of the Proposed Project.

Operation

Operation of the Proposed Project would require the long-term (up to 12 months at a time) deployment of stationary watercraft and ancillary devices, held in place by a series of tethered anchors and buoys. These facilities have the potential to be a hazard to boaters in the area, or could

[13] A boating day is defined as one person spending any portion of one day boating.

become a hazard to navigation if they break free of their moorage. Boat traffic to and from the project site also has the potential to affect marine navigation if the volume is substantial.

To minimize these potential impacts, NNMREC would include the placement of marker buoys and other aids to navigation in the project site and the publication of a Local Notice to Mariners describing the Proposed Project to minimize potential vessel collisions with the Ocean Sentinel or vessel and WEC devices or entanglement in the mooring lines. This would minimize impacts on commercial and recreational navigation and provide for safe navigation during and between tests. NNMREC would include the U.S. Coast Guard, the FINE committee, the Oregon State Police, and the Oregon Marine Board in determining the most appropriate navigational designations for the project site. The Ocean Sentinel and WEC devices would be marked with the appropriate buoys and navigational lights, as permitted by the U.S. Coast Guard, and safety signs warning of the potential for high voltage hazards would be clearly visible in the event that a boater strays into the project site.

If an Ocean Sentinel or WEC device breaks free of its moorage, an automatic identification transmitter would help locate the structure. The transmitter would provide other vessels with the location of the displaced component, and would be monitored 24 hours a day by a dedicated NNMREC staff person from a shore-side server located at HMSC. Both NNMREC and the WEC device developer would have a local contingency response capability to respond to alarms or unexpected conditions and take corrective action as needed. In addition to a contingency response, salvage plans for the Ocean Sentinel and WEC devices would be in place in the event of a catastrophic event. These plans would be developed in coordination with the Oregon Parks and Recreation Department (OPRD) and the DSL during final design of the Ocean Sentinel.

Two weeks prior to deployment, installation, and removal of the Ocean Sentinel or vessel and WEC devices, NNMREC would request that the U.S. Coast Guard publish a Local Notice to Mariners describing the Proposed Project and identifying its location. These notices, in combination with the installation of aids to navigation, and implementation of the navigational safety elements described above would ensure that that there are no adverse impacts resulting from operation of the Proposed Project.

Maintenance, Removal, and Decommissioning

Maintenance and removal of the Ocean Sentinel, WEC devices, and ancillary equipment would require navigation between the project site and the shoreline. As described in Chapter 2, *Proposed Action and Alternatives*, weekly visits to the project site would initially be conducted to visually inspect the structures, followed, by routine visits about every 4 weeks. Similar to installation, several separate vessel trips to the project site would be required to remove the Ocean Sentinel, WEC devices, and anchoring and mooring installations; however, it is not anticipated that this additional vessel traffic would affect marine navigation. All project-related vessel traffic would follow U.S. Coast Guard rules regarding marine navigation and safety. Therefore, no adverse impacts on marine navigation are identified as a result of maintenance or removal of the Proposed Project.

3.5.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding to support the design, construction, and operation of NNMREC's Proposed Project. No Ocean Sentinel or WEC devices would be deployed and no manned test vessel would be deployed to test the WEC devices. There would be no impacts on marine navigation.

3.6 Aesthetic Resources

The analysis of aesthetic resources addresses the visual perception of the Proposed Project by nearby viewers and its potential impacts on sensitive visual resources in the vicinity. Aesthetic impacts can result from a number of activities, including the permanent or temporary obstruction of scenic views, the addition of an undesirable element to the visual landscape, or the removal or degradation of an aesthetically pleasing visual element.

The primary sources of information for this section are the Federal Highway Administration, the U.S. Bureau of Land Management (BLM), and Oregon State University. Additional resources are cited in the text and complete references for all cited materials are provided in Chapter 6, *References*.

3.6.1 Affected Environment

Regulatory Setting

This section discusses the federal and state regulations that apply to the project site and surrounding areas. No applicable local regulations (City of Newport or Lincoln County) were identified during preparation of this EA.

Federal

National Scenic Byways Program

U.S. Highway 101, which runs along the Pacific coast adjacent to the study area (defined below under Environmental Setting), is designated as a National Scenic Byway by the Federal Highway Administration (National Scenic Byways Program 2010). Byways are selected for inclusion in the program based on their scenic, historic, recreational, cultural, archaeological, or natural intrinsic qualities. The criteria set forth in United States Code (U.S.C.) Title 23, Section 131(c) must be met by any new signage erected along a National Scenic Byway, and local governments are responsible for implementing protective measures to preserve the character of scenic byways that cross their jurisdiction (Federal Highway Administration 1995).

National Landscape Conservation System

The BLM administers the National Landscape Conservation System, which includes approximately 27 million acres of federally recognized and protected lands. The mission of the National Landscape Conservation System is to “conserve, protect, and restore nationally significant landscapes recognized for their outstanding cultural, ecological, and scientific values” (U.S. Bureau of Land Management 2010a).

Yaquina Head, located just north of Newport, Oregon is included in the National Landscape Conservation System as an Outstanding Natural Area. Approximately 2.0 miles (3.2 kilometers) east of the project site, this Outstanding Natural Area is home to the Yaquina Head Lighthouse, as well as a BLM interpretive center. The park is a fee-based, day use facility open to the public for various recreation activities, including whale watching and bird watching, tide pool exploration, and observation of the local seal and sea lion populations. Onsite BLM staff members also offer tours of the Yaquina Head Lighthouse, taking visitors to the top of the tower for views of the ocean and adjacent coastline (U.S. Bureau of Land Management 2010b).

State

Oregon House Bill 1601

Enacted in 1967, Oregon's "Beach Bill" ensures that the public has free, uninterrupted use of Oregon's ocean coastline, and mandates that these shorelines be managed as a state recreation area. As such, the Oregon Parks and Recreation Department oversees the protection of recreational, scenic, and natural resources along the coast. Permits are issued for construction or alteration, vehicle use, signs, salvage, and driftwood removal in the ocean shore area (Oregon Parks and Recreation Department 2009).

Oregon Scenic Byways Program

As a designated National Scenic Byway, U.S. Highway 101 is also part of the Oregon Scenic Byway Program, administered by the Oregon Department of Transportation (ODOT). ODOT is responsible for local implementation of federal regulations for Scenic Byways (Federal Highway Administration and State of Oregon 2007).

Environmental Setting

The study area for aesthetics is defined as the project site with the addition of adjacent onshore areas from which installation, operation and maintenance, and removal of the Proposed Project could be visible to observers. These onshore areas consist generally of the beach areas between the city of Newport, Oregon and Beverly Beach (approximately 5.0 miles [8.0 kilometers] north of Newport, Oregon). The study area also includes Yaquina Head, which protrudes from the shoreline to offer increased views over the surrounding beaches, and U.S. Highway 101, which is renowned for its scenic vistas of the Pacific coast. Existing conditions for each of these portions of the study area are detailed below.

Yaquina Head

As described under Regulatory Setting, the Yaquina Head Outstanding Natural Area, which includes the Yaquina Head Lighthouse, is located approximately 2.0 miles (3.2 kilometers) east of the project site. Yaquina Head is a popular recreational area on this portion of the Oregon coast, as it is home to Oregon's tallest historic lighthouse and offers excellent ocean views and opportunities for wildlife observation, including sea birds, whales, seals, and sea lions (U.S. Bureau of Land Management 2010b). Because Yaquina Head is a spit of upland extending from the main shoreline, it has a higher vantage point, allowing visitors to see farther out to sea than would be possible from adjacent beach areas, which are at sea level. The top deck of the lighthouse is open to public tours, and is located at a height of 161 feet (49 meters) above sea level (Friends of Yaquina Lighthouses 2010).

Beach Area Viewers

Moolack Beach, immediately north of Yaquina Head, offers high-quality ocean views during clear weather conditions. The area is frequented by locals and tourists engaged in recreational activities such as swimming, hiking, fishing, and clam digging (GoingOutside.com 2010).

Agate Beach State Recreation Area, immediately south of Yaquina Head, also offers ocean views, and is locally popular for razor clam digging. The park also offers picnic facilities and fishing opportunities (Oregon Parks and Recreation Department 2010a).

Beverly Beach State Park, located approximately 3.5 miles (5.6 kilometers) north of Yaquina Head, consists primarily of woodland campsites along Spencer Creek, on the east side of U.S. Highway 101. The park provides beach access, and visitors who take advantage of this may enjoy activities such as camping, nature tours, and whale watching (Oregon Parks and Recreation Department 2010b).

U.S. Highway 101

U.S. Highway 101, which is designated as a National Scenic Byway, runs along the upland shoreline through the study area, offering intermittent ocean views to motorists. The highway closely approaches the beach near its intersection with 100th Way, offering excellent ocean views. However, as motorists travel south toward Yaquina Head and Newport, the highway moves away from the shoreline, and views are frequently interrupted by intervening vegetation.

3.6.2 Environmental Consequences of the Proposed Project

The Proposed Project would introduce new, human-made elements to the visual landscape. These new elements have the potential to create visual contrasts that affect the integrity, unity, or perceived quality of the visual landscape. Because visual impacts are subjective and linked to human experience, potential adverse impacts are discussed in the context of the number and sensitivity of viewers affected, as well as the duration of the impacts. As such, potential environmental consequences of the Proposed Project are discussed by project phase.

Installation

Installation of the Ocean Sentinel and WEC devices would be accomplished by towing the project components from a pier in Newport to the project site. Once at the project site, installation activities, including placement of anchors and moorings for the various project components, would take place, along with initial testing of the Ocean Sentinel and WEC device operational and data collection systems. The test vessel that could be used in place of the Ocean Sentinel would be installed by navigating to the project site under its own power and then deploying its onboard anchor.

Beach Areas

Installation activities are anticipated to be in visual range of a number of beach areas north of Newport, particularly during transport of the project components to the installation site. For an average adult standing on the beach near sea level, the distance to the horizon on flat terrain is approximately 3.0 miles (4.8 kilometers) (Nautical Know How 2009). Once at the project site, approximately 2.8 miles (4.5 kilometers) from shore, installation and commissioning activities would be near the limit of visual perception for beach viewers, though it is possible that on clear days with calm or flat seas, the tops of the Ocean Sentinel or vessel and WEC devices (particularly larger models) would be silhouetted against the sky. Installation activities would be temporary, occurring within a time frame of 2 weeks or less, and would not differ greatly in appearance from customary boat traffic. Negligible and temporary impacts on beach area viewers associated with installation are anticipated to occur.

Yaquina Head

Yaquina Head extends approximately 0.5 mile (0.8 kilometer) from the Oregon coast, bringing it closer to the project site than adjacent beach areas. The elevation of Yaquina Head is also approximately 68 feet (21 meters) above sea level, providing viewers with a higher viewpoint from which to experience ocean views. At this elevation, the distance to the horizon is nearly 10.0 miles (16.1 kilometers) and visitors to the Yaquina Head Lighthouse who view the ocean from the top level at 161 feet (49 meters) above sea level experience a horizon line that is nearly 15 miles (24.1 kilometers) away (Nautical Know How 2009). Installation activities at the project site would almost certainly be visible to visitors to Yaquina Head, although the level of detail observable would depend on weather conditions and wave heights. While it is anticipated that installation activities would be visible from Yaquina Head, the duration of this phase of the Proposed Project is anticipated to be very short, and installation of the Ocean Sentinel or vessel and WEC devices would not differ greatly in appearance from customary boat traffic. Minor and temporary visual impacts on Yaquina Head viewers are anticipated to result from installation and commissioning activities.

U.S. Highway 101

While vessels towing the Ocean Sentinel and WEC components or a manned testing vessel may be briefly visible to motorists on U.S. Highway 101, exposure would be inconsistent and limited to the period when the vessels are in transit to the project site. It is expected that installation activities at the project site would not be clearly visible to motorists on U.S. Highway 101 because of distance and intervening vegetation and topography. Negligible and temporary impacts associated with installation are anticipated for viewers along U.S. Highway 101.

Operations

During the 2012-2013 WET-NZ test, the device, an Ocean Sentinel, and a TRIAXYS™ wave measurement buoy would be deployed for up to 6 weeks beginning in August 2012 and for up to 3 months in the summer of 2013. During future operations, the Proposed Project would consist of up to two Ocean Sentinels (or an Ocean Sentinel and a vessel) and WEC devices moored at the project site. WEC devices would remain relatively stationary for periods of up to 12 months, while an Ocean Sentinel would be left in place for up to 6 months. If test equipment was deployed onboard a manned vessel, the vessel would be on site for no more than 10 days at a time. The elements that would be visible to observers during this period would be the portion of the Ocean Sentinel or vessel and WEC devices that protrudes from the water, onboard lighting, and any buoys deployed to mark the location of the project site for passing boats. Deployments of a testing vessel would not differ in appearance from customary marine traffic.

Beach Areas

At sea level, the distance to the horizon on flat terrain is approximately 3.0 miles (4.8 kilometers) (Nautical Know How 2010). It is possible that under clear sky and calm ocean conditions, the tops of the Ocean Sentinel or vessel and WEC devices (particularly larger models) may be silhouetted against the sky and visible to beach area viewers, as could the beacon lights on the Ocean Sentinel or vessel and WEC devices.

During night hours, lighting on board the Ocean Sentinel or vessel and WEC devices, necessary to make them visible to passing boat traffic, is anticipated to be visible from nearby beach areas, but only on clear days, of which there is an approximate average of 156 per year (Fast Forward, Inc.

2010), and when seas are flat or calm. When viewed from the beach areas under clear and calm conditions, these lights would appear to be very similar to the lighting customarily used by other vessels frequenting the area. Onboard lighting, while visible during nighttime hours, is not expected to affect a large number of viewers because use of beach areas declines after dark. Furthermore, the Proposed Project would be near the maximum distance to horizon visible from the nearest beach areas. Given the low number of structures to be placed in the water, the temporary nature of their deployment, their similarity in appearance to customary vessel lighting, and the distance from shore, negligible visual impacts on beach area viewers are anticipated from operation of the Proposed Project.

Yaquina Head

As described above, Yaquina Head extends approximately 0.5 mile (0.8 kilometer) from the Oregon coast, bringing it closer to the project site. It is located at a higher elevation, allowing viewers to see farther out to sea than they could from adjacent beaches. While the distance to the horizon at sea level is approximately 3.0 miles (4.8 kilometers), this distance increases to nearly 10.0 miles (16.1 kilometers) on Yaquina Head, which is 68 feet (21 meters) above sea level. Visitors who view the ocean from the top level at 161 feet (49 meters) above sea level from the Yaquina Head Lighthouse, experience a horizon line that is nearly 15.0 miles (24.1 kilometers) away. The Ocean Sentinel or vessel and WEC devices would be located anywhere from 1.8 to 2.7 miles (2.9 to 4.3 kilometers) from Yaquina Head, depending on their precise position in the project site. Regardless of final location, they would be within the visual horizon from both the Yaquina Head shoreline and from the lighthouse.

Although, the designs for the Ocean Sentinel and WEC devices are similar in appearance to navigation buoys, which are common and customary features of the maritime environment, these elements would be located near a popular tourist destination that is known for its ocean views. Additionally, during nighttime hours, lighting on board the Ocean Sentinel or vessel and WEC devices could be visible from Yaquina Head under the right conditions. However, the park is day use only, so evening viewers affected at Yaquina Head would consist only of the occasional park staff member.

The visibility of project equipment is expected to vary with weather conditions and wave heights. Additionally, if the project site were located directly west of Yaquina Head, this would result in higher visibility, as this is the primary axis for ocean views from the peninsula. However, the project site would be located to the northwest of Yaquina Head and would not block the east–west visual axis. The project site would also be further from Yaquina Head than other feasible sites within the study area that were originally evaluated and dismissed. A visual simulation was developed to depict how the Proposed Project would appear to viewers at Yaquina Head. Two visual simulations were developed by compositing a three-dimensional digital model of a structure approximating the size and appearance of the Ocean Sentinel paired with a WEC devices over photographs of the project site taken from the viewing deck at Yaquina Head (Figure 3.6-1) and from the top deck of the Yaquina Head Lighthouse (Figure 3.6-2). For the visual simulation, clear day and calm seas conditions were used. The visibility of the Proposed Project would be greatest under these specific conditions, thereby providing a conservative estimate of visibility for the simulation.

As presented in Figures 3.6-1 and 3.6-2, an Ocean Sentinel-WEC device pair would be nearly imperceptible to viewers from Yaquina Head without the aid of field glasses, binoculars, or other visual field magnification. A manned testing vessel was not included in the visual simulation, and although the vessel would be larger than the Ocean Sentinel, it would not be deployed for more than 10 days at a time and would be visually identical to customary marine navigation. Therefore, the visual impacts associated with the Proposed Project sited in these locations would be negligible to viewers at Yaquina Head.

U.S. Highway 101

It is not expected that operational activities at the project site would be clearly visible to motorists on U.S. Highway 101 for more than brief moments because of the distance and intervening vegetation and topography. Negligible impacts associated with operation are anticipated along U.S. Highway 101.

Maintenance, Removal, and Decommissioning

Maintenance, removal, and decommissioning activities would involve approximately the same number of vessels and a similar intensity of activity as installation and commissioning. As such, effects on the visual landscape are anticipated to be similar to those discussed above, in Installation.

3.6.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding to NNMREC to design, construct, and operate the Proposed Project. No Ocean Sentinel or WEC devices would be deployed and no manned vessel would be used for the purpose of testing WEC devices. There would be no impacts on aesthetic resources.

Recreation Resources

Recreation resources are defined as the natural resources and constructed facilities that support recreation activities. For the Proposed Project and No Action Alternative, recreation resources consist of the ocean and the marine fisheries in the 1-square-nautical-mile (3.4-square-kilometer) project site.

The primary sources of information for this section are an analysis of the commercial and recreational fisheries off Yaquina Head prepared by the FINE committee (2008); a recent survey of fishing, hunting, and wildlife-associated recreation in Oregon (U.S. Fish and Wildlife Service 2007b); and personal communications with individuals knowledgeable about boating, fishing, and surfing off Yaquina Head.

Figure 3.4-1
Simulated View of Instrumentation Buoys and WEC Dctgacq from Yaquina Head Viewing Desk

Figure 3.4-2
Simulated View of Instrumentation Buoys and WEC Devices from Yaquina Head Lighthouse

3.7 Recreation Resources

3.7.1 Affected Environment

Regulatory Setting

There are no federal, state, or local (City of Newport Beach or Lincoln County) laws or regulations governing recreation resources in the study area.

Environmental Setting

The study area for recreation resources is defined as the 1-square-nautical-mile (3.4-square-kilometer) study area located roughly 1.8 to 2.7 miles (2.9 to 4.3 kilometers) offshore from Yaquina Head (Figure 2-1), the shallow ocean landward of the project site, and the coastline from which the Ocean Sentinel or vessel and WEC devices could be visible.

The main recreation activities in the study area are boating, kayaking, and fishing. Swimming, diving, and wildlife and fish observation occur in association with boating. In addition, shore-based sightseeing, including whale watching and visiting the historic Yaquina Head Lighthouse, occurs in association with viewing the study area. Surfing occurs in the shallow ocean landward of the project site.

The Port of Newport-South Beach Marina is the only sport marina serving the study area communities of Newport and South Beach, and it supports most of the boating use in the study area. Roughly 10,000 boating days[14] originate at this facility each year (Fisherman Involved in Natural Energy 2008; Nielsen pers. comm.). Yaquina Head Lighthouse is the tallest lighthouse in Oregon and the oldest structure in Lincoln County. It is the focal attraction of the federal Yaquina Head Outstanding Natural Area, which attracts approximately 325,000 visitor days per year (Miller pers. comm.).

The study area is popular for recreational halibut and salmon fishing. Waters off Yaquina Head to a depth of 27 fathoms (162 feet or 49 meters), including most of the study area, were traditionally considered the most productive halibut waters in the vicinity. Although the sandy ocean bottom typical off Yaquina Head is also highly productive for Dungeness crab, study area waters are deeper than those usually accessed for recreational crabbing (Schindler pers. comm.).

3.7.2 Environmental Consequences of the Proposed Project

Installation

Under the Proposed Project, aids to navigation (e.g., marker buoys) would be installed somewhere within the 1.0-square-nautical-mile (3.4-square-kilometer) project site and a Local Notice to Mariners would be published to minimize potential vessel collisions with the Ocean Sentinel or vessel and WEC devices or entanglement in the mooring lines. Aids to navigation would be in place for the operational lifetime of the Proposed Project and would result in reduced or restricted marine

[14] A boating day is defined as one person spending any portion of one day boating.

navigational access in a small area within the project site. NNMREC would hold meetings with the Oregon Marine Board, the U.S. Coast Guard, the FINE committee, and Oregon State Police to identify the appropriate uses of the project site during and between WEC device test periods. This would not be expected to reduce substantially the number of boating days spent in the vicinity of the study area. Boaters intending to use the study area would be expected to adjust their navigation plans or navigate around the project site infrastructure rather than forego a day of boating.

The main direct recreation impact of a limited access within the project site would be a reduction in halibut fishing opportunities. However, a reduction in the quality of anglers' fishing experiences resulting from the loss of a small amount of navigational access within productive fishing waters in the project site is a more anticipated impact than a reduction in fishing days. As with boating, disruptions resulting from changes to navigational access are not expected to deter people from fishing in the study area.

The main indirect recreation impact would be a reduction in the quality of ocean viewing (including whale watching) experiences primarily by visitors to Yaquina Head Outstanding Natural Area resulting from placement of the Ocean Sentinel or vessel, WEC devices, and related buoys offshore. As discussed in Section 3.6, *Aesthetic Resources*, the proposed structures could potentially detract from the existing unobstructed ocean views; however, it is expected that the Proposed Project would be nearly imperceptible to viewers from the viewing deck at Yaquina Head and the top deck of the Yaquina Head Lighthouse.

During scoping, commenters raised the concern that the installation and operation of the Proposed Project could result in adverse impacts on surfing though altered wave characteristics. For an EA of a proposed installation of up to six 40 kW offshore PowerBuoys in Hawaii, the Office of Naval Research concluded that the PowerBuoys® would have only localized impacts on currents and wave direction. For example, the impacts on currents would not extend more than the diameter of a few PowerBuoys® (Department of the Navy 2003). A sediment transport study published by the Oregon Wave Energy Trust (2009b) that included wave modeling for the Reedsport wave energy test site determined that wave height variations up to 15% are possible within approximately 0.6 mile (1 kilometer) of a WEC device, but wave variations decrease to 3% over distance up to 2.5 miles (4 kilometers).

As described in Section 2, *Proposed Action and Alternatives*, the Proposed Project would be located approximately 2 miles from the coast of Oregon. Up to two WEC devices and two Ocean Sentinels could be deployed approximately 2.5 to 5.0 miles (4.0 to 8.0 kilometers) from the nearest beaches. Based on the studies and modeling described above, wave attenuation at this distance would be 3% or less. Therefore, installing and operating the Ocean Sentinel or vessel and associated WEC devices is not expected to discernibly affect the quality of waves used by surfers.

Operation

The impacts of the operation of the Proposed Project on recreation resources would be the same as those described under the heading entitled Installation, above.

During scoping, a concern was raised regarding the potential of the Proposed Project to act as a shark attractor because of the EMF that it would generate, thereby affecting recreational use of the nearshore area in the vicinity of the Proposed Project. Section 3.2.2 of this EA discusses the effects of EMF on sharks and other fishes.

Maintenance, Removal, and Decommissioning

The impacts of the maintenance, removal, and decommissioning of the Proposed Project on recreation resources would be the same as those described above under Installation, but would occur only for the duration of these activities.

3.7.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding to design, construct, and operate the Proposed Project. No Ocean Sentinel or WEC devices would be deployed and no manned test vessel would be deployed to test WEC devices. There would be no impacts on recreation.

3.8 Cultural Resources

Cultural resources referred to in this document include all historical and archaeological resources, regardless of status The term *historic property* refers to those cultural resources that are eligible for listing in the National Register of Historic Places (NRHP) and must be considered under Section 106 of the National Historic Preservation Act (NHPA) and NEPA.

3.8.1 Affected Environment

Regulatory Setting

This section addresses federal and state regulations that apply to cultural resources in the project site. No applicable local regulations (City of Newport or Lincoln County) were identified during preparation of this EA.

Federal

National Environmental Policy Act

NEPA requires the federal government to carry out its plans and programs in such a way as to preserve important historic, cultural, and natural aspects of our national heritage by considering, among other things, unique characteristics of the geographic area such as proximity to historical or cultural resources (40 CFR 1508.27(b)(3)) and the degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the NRHP (40 CFR 1508.27(b)(8)). Although NEPA does not define standards specific to cultural resource impact analyses, the implementing regulations of NEPA (40 CFR 1502.25) state that, to the fullest extent possible, "agencies shall prepare draft environmental impact statements concurrently with and integrated with environmental impact analyses and related surveys and studies required by…the National Historic Preservation Act of 1966 (16 United States Code [U.S.C.]470 *et seq*.)."

Although NEPA statutes and implementing regulations do not contain detailed information concerning cultural resource impact analyses, Section 106 of the NHPA, with which NEPA must be coordinated, details standards and processes for such analyses. The implementing regulations of Section 106 state, "Agency officials should ensure that preparation of an EA and finding of no significant impact (FONSI) or an environmental impact statement (EIS) and record of decision

(ROD) includes appropriate scoping, identification of historic properties, assessment of effects upon them, and consultation leading to resolution of any adverse effects" (36 CFR 800.8[a][3]). Section 106, therefore, typically forms the crux of federal agencies' NEPA cultural resources impact analyses. The identification, consultation, evaluation, effects assessment, and mitigation required for both NEPA and Section 106 compliance should be coordinated and completed simultaneously. This practice is followed in the present analysis.

Section 106 of the National Historic Preservation Act

The Proposed Project would be funded by the federal government (DOE) and must therefore comply with Section 106 of the NHPA, which sets forth national policy and procedures regarding historic properties. Section 106 of the NHPA requires federal agencies to take into account the impacts of their undertakings on such properties and to allow the Advisory Council on Historic Preservation (ACHP) the opportunity to comment on those undertakings, following regulations issued by the ACHP (36 CFR 800). To determine whether an undertaking could affect NRHP-eligible properties, cultural resources must be inventoried and evaluated for listing in the NRHP. Although compliance with Section 106 is the responsibility of the lead federal agency, others can undertake the work necessary to comply.

An adverse impact on a historic property is found when an activity may alter, directly or indirectly, any of the characteristics of the historic property that render it eligible for inclusion in the NRHP. The alteration of characteristics is considered an adverse impact if it may diminish the integrity of the historic property's location, design, setting, materials, workmanship, viewshed, feeling, or association. The assessment of impacts on historic properties is conducted in accordance with the guidelines set forth in 36 CFR 800.5.

State

The Oregon State Historic Preservation Office (SHPO) works in partnership with the National Park Service under authority of the NHPA (16 U.S.C. 470 *et seq.* and 36 CFR Parts 60 and 61) to administer the federally aided program that encompasses survey, planning, and registration activities, grants-in-aid, tax benefits, and federal project review. In addition, Oregon state legislation (Oregon Revised Statutes [ORS] 358, ORS 390) and administrative rule (Chapter 736, Divisions 50 and 51) mandate this program. For the purposes of cultural resources compliance, complying with Section 106 of the NHPA subsumes Oregon state requirements. As a result, compliance with Section 106 of the NHPA is the primary focus of cultural resources studies for the State of Oregon.

Environmental Setting

For the purposes of identifying historic properties, the study area for cultural resources is defined as the area concurrent with the project site (Figure 2-1).

Background

In February 2010, a records search was conducted for the Proposed Project at the SHPO in Salem, Oregon. The records search was conducted for the study area and for the area within a 1-mile (1.6-kilometer) radius of the study area. The purpose of the records search was to identify previously documented archaeological, historical, and architectural resources and to help establish a context for developing expectations about potential resources within the study area. No cultural resource surveys have been conducted and no cultural resources have been identified in, or within

1 mile (1.6 kilometers) of the study area. In addition, analyses of historic shipwreck locations along the Oregon coast (Marshall 1984) indicate that no recorded wrecked ships are located within or within 1 mile (1.6 kilometers) of the study area. Finally, there are no known precontact cultural resources located in marine waters along the coast of Oregon.

As part of their public outreach activities, DOE sent tribal consultation letters on April 29, 2009, and no responses or letters of concern have been received. The NNMREC also gave a presentation to a meeting of the Tribal Council of the Confederated Tribe of the Siletz Indians on March 19, 2010. This presentation included a description of the Proposed Project concept, and identified the project area. In a subsequent letter to the tribal chairperson, NNMREC requested additional feedback on the Proposed Project and specifically invited the Tribe to identify cultural resources that the Tribe believes could be affected by the Proposed Project. In subsequent communication, NNMREC also invited the Tribe to participate in the Test Berth Committee. To date, the Tribe has not replied to identify any cultural resources that could be affected by the Proposed Project.

Cultural Resources in the Study Area

Based on the activities described in the background section above, no known cultural resources or historic properties exist within the study area.

3.8.2 Environmental Consequences of the Proposed Project

Because no known historic properties, archaeological resources, or cultural resources are known to exist within the study area, the Proposed Project would not affect historical and cultural resources. There would be no impacts during the installation, operation, maintenance, removal, or decommissioning of the Proposed Project. As the lead agency, DOE has consulted with the SHPO in accordance with Section 106 of NHPA. In July 2010, DOE requested concurrence from the SHPO that the Proposed Action would result in no effects on known cultural or historic resources. In a letter dated August 9, 2010, the SHPO concurred with DOE's findings and indicated that no further archaeological research is required. This letter and other agency correspondence are included in Appendix B of this EA. A second letter was sent to the SHPO in June 2012 to provide a history of project developments subsequent to the August 9, 2010 letter and present the revised project description.

3.8.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding for the design, construction, and operation of the Proposed Project. No Ocean Sentinel or WEC devices would be deployed and no manned test vessel would be deployed to test WEC devices. There would be no impacts on cultural resources or historic properties.

3.9 Socioeconomics and Environmental Justice

This analysis addresses economic and social conditions related to the Proposed Project. The primary sources of information for this section include a 2007 NOAA report presenting community profiles for west coast fisheries; a 2008 report prepared by the FINE committee; the IMpact analysis for PLANning (IMPLAN®) economic impact analysis (Minnesota IMPLAN® Group 2007); and personal communication with a member of the FINE committee (Eder pers. comm.). Resources are cited in the text and complete references for all cited materials are provided in Chapter 6, *References*.

3.9.1 Affected Environment

Regulatory Setting

There are no state or local (City of Newport or Lincoln County) socioeconomic or environmental justice laws or regulations specific to the study area. Applicable federal regulations are summarized below.

Federal

Executive Order 12898

Executive Order 12898 (signed February 11, 1994) directs federal agencies to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations."

Environmental Setting

The study area for this analysis comprises the Lincoln County, Oregon communities of Newport (an incorporated city) and South Beach (an unincorporated area partially located within the Newport city limits) and the surrounding lands and waters. These communities are located on Yaquina Bay approximately 4.0 miles (6.4 kilometers) south of Yaquina Head. Their combined population in 2000 was estimated at 10,641. Approximately 90% of the population was white, while the next largest group identified with two or more races. Per-capita income was approximately $20,400 in 1999, while median household income was approximately $32,000. In comparison, the national per-capita and median household incomes were $21,587 and $41,994, respectively. Roughly 14% of the population had income below the poverty level. The study area's main employment sectors are government; education, health, and social services; and entertainment, recreation, accommodation, and food. The study area's main industries are tourism, fishing, and wood products (National Oceanic and Atmospheric Administration 2007).

Newport and South Beach flank the Port of Newport, the focus of the area's commercial fishing and recreation and tourism industries. In 2000, a total of 393 vessels delivered commercial fish landings to Newport. In that year, Newport and South Beach residents owned 90 and 19 active commercial fishing vessels, respectively. The main fisheries exploited by these boats, in terms of ex-vessel landing values, were groundfish, crab, shrimp, highly migratory species, and salmon; these species accounted for more than $24 million in Newport landings in 2000. Newport prides itself on having a "working waterfront," and recognizes that the seafood industry is at the core of its history and culture (National Oceanic and Atmospheric Administration 2007).

3.9.2 Environmental Consequences of the Proposed Project

Installation

The activities associated with the installation of the Proposed Project, especially the activities of installation vessels in the 1.0-square-nautical-mile (3.4-square-kilometer) project site, would limit the use of the immediate vicinity for commercial and recreational fishing and navigation. This localized impact would be short in duration and would be anticipated to result in negligible impacts on socioeconomics and environmental justice. The design and installation of the Proposed Project would create at least two new local jobs and would result in a minor beneficial impact employment impact in the study area. Additional local economic activity would result from the ongoing influx of personnel associated with the WEC devices during installation.

Operation

The operation of the Proposed Project would result in a small loss of navigational access in the project site due to the installation of aids to navigation in order to minimize potential vessel collisions with the Ocean Sentinel or vessel and WEC devices or entanglement in the mooring lines. Before the installation of the Proposed Project, NNMREC would meet with the Oregon Marine Board, U.S. Coast Guard, Oregon State Police, and the FINE committee to discuss the appropriate uses of the project site during and between testing periods that would balance vessel safety with access. For this analysis, it is assumed that navigation would be restricted in the direct footprint of the Proposed Project infrastructure (the Ocean Sentinel or vessel, the WEC devices, and the marker buoys). Although the exact size of this area has not yet been determined, it is conservatively estimated for this analysis that approximately 0.3 square mile (0.8 square kilometer) within the project site would experience impediments to navigation access as a result of the Proposed Project.

Establishing this potential restricted area would potentially reduce local commercial fishing opportunities and could increase travel distances for boats heading to or from the Port of Newport by forcing them to avoid the zone. Dungeness crab is the primary commercial species sought in the 1-square-nautical-mile (3.4-square-kilometer) project site off Yaquina Head in which the exclusion zone or area to be avoided would be located. Salmon and groundfish are also caught in this area (Fisherman Involved in Natural Energy 2008).

Commercial crabbing off Lincoln County generally occurs within 12.0 miles (19.3 kilometers) of shore, with approximately 90% of crabs taken in waters of 6 to 90 fathoms (36 to 540 feet or 11 to 156 meters) (Eder pers. comm.). The FINE committee estimated the per-square-mile value of the Newport-based crab fishery at $32,417. Crab accounted for 25% of the total value of Lincoln County landings in 2005 (Fisherman Involved in Natural Energy 2008). Extrapolating, the footprint of the structures deployed would reduce the annual output of the local commercial fishing industry by an estimated $39,000. Because some of the revenue generated by the Newport-based fishing industry is re-spent locally, a $1 reduction in the output of the commercial fishing industry results in an estimated reduction in the total output of the Lincoln County economy of $1.19. This relatively low output multiplier apparently reflects the limited amount of value added by the county's seafood processing industry, estimated at $5.3 million annually. Thus a $39,000 reduction in commercial fishing output would reduce county-wide output by $46,400. It would also reduce labor income in the fishing industry by $15,000 and county-wide labor income by $17,700 annually (Minnesota IMPLAN® Group 2007).

The Proposed Project would potentially disrupt recreational boating and fishing, but as discussed Section 3.7, *Recreation Resources*, no reduction in recreational boating or fishing use is expected to result. Thus, no measurable socioeconomic impacts would result from changes in recreation and tourism under the Proposed Project.

The operation of project-related facilities offshore of Yaquina Head Light could affect the recreational experiences of people viewing the ocean from the vicinity of the lighthouse, as discussed in Sections 3.6, *Aesthetic Resources* and 3.7, *Recreation Resources*. However, it is not expected to disrupt recreation use to the extent that recreation-related spending in the region is measurably affected.

The operation of the Proposed Project would create at least three new local jobs and would result in a minor beneficial employment impact in the study area. Additional local economic activity would result from the ongoing influx of personnel associated with the WEC devices during testing.

Based on the small number of minorities and the moderate income levels in the study area, no impacts on environmental justice populations are anticipated.

Maintenance, Removal, and Decommissioning

During maintenance of the Proposed Project, the Ocean Sentinel and WEC devices could be removed from their mooring and transported to shore. At this time it is not known what navigational restrictions would be designated during maintenance activities. As described above, NNMREC would meet with stakeholder groups prior to the installation of the Proposed Project to determine appropriate uses for the project site between testing periods. If the restricted area would remain unchanged during maintenance, the impacts on socioeconomics and environmental justice would be the same as those described above for installation.

The impacts of the removal and decommissioning of the Proposed Project on socioeconomics and environmental justice would be the same as those described for installation, but would occur only for the duration of these activities.

3.9.3 Environmental Consequences of the No Action Alternative

Under the No Action Alternative, DOE would not provide funding to design, construct, and operate the Proposed Project. No Ocean Sentinel or WEC devices would be deployed and no manned test vessel would be deployed to test WEC devices. There would be no socioeconomic or environmental justice impacts.

3.10 Irreversible and Irretrievable Commitment of Resources

A commitment of resources is considered irreversible when its primary or secondary impacts limit the future options for a resource or limit resources that are renewable only over long periods of time. Examples of nonrenewable resources are minerals, including petroleum, and cultural resources.

An irretrievable commitment of resources refers to the use or consumption of a resource that is neither renewable nor recoverable for use by future generations. Examples of irretrievable resources are the loss of production, harvest, or recreational use of an area. While an action may result in the loss of a resource that is irretrievable, the action may be reversible. For instance, paving over farmland would result in the irretrievable loss of harvests from that land. However, the parking lot could be removed and crops could be grown again. Hence, the action is reversible.

Human effort would be irretrievably committed during all phases of the Proposed Project. The commitment of time and available labor to construct and implement the Proposed Project would represent an irretrievable commitment of resources.

The materials used in the construction of the Proposed Project, except to the extent that they could be recycled, would be considered an irreversible commitment of resources. Energy and fuel would also be committed to the construction and the operation of the Proposed Project. If nonrenewable energy and fossil fuels are required, they would be considered an irreversible and irretrievable commitment of resources. To the extent that renewable energy and biofuels are used, they would be considered an irretrievable commitment of resources.

A small area of benthic habitat would be temporarily lost or altered by the anchors installed for the Proposed Project. Upon removal and decommissioning of the Proposed Project, this habitat would return to its original condition; therefore, the commitment of benthic habitat is not irreversible.

3.11 Unavoidable Adverse Impacts

Unavoidable adverse impacts include:

- Temporary disruption of the ocean floor during anchor placement including a small temporary loss in benthic habitat from anchors;
- A small increase in noise levels during installation;
- Temporary and localized avoidance of sea turtle and marine mammal species during installation activities when support vessels are fully underway.
- Impediments to navigation in the project area that may lead to a loss of access by vessels and a decrease in the amount of area where fishing activities are conducted.

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

3.12 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. The short-term use of the site for the proposed project would not affect the long-term productivity of the area. Once the project has concluded, components would be removed and the project site would be available for other uses.

4.0 Cumulative Impacts

4.1 Introduction

The National Environmental Policy Act (NEPA) requires that agencies consider the cumulative impacts of a proposed action or project. NEPA regulations define a cumulative impact as the effect on the environment that results from the incremental effect of the action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes the other actions and regardless of land ownership on which the other actions occur. An individual action when considered alone may not have a significant effect, but when its effects are considered in sum with the effects of other past, present, and reasonably foreseeable future actions, the effects may be significant (40 Code of Federal Regulations [CFR] 1508.7 and 1508.8).

This cumulative impact analysis considers impacts of the Northwest National Marine Renewable Energy Center (NNMREC)-Oregon State University (OSU) Wave Energy Test Project (Proposed Project), the 2012-2013 WET-NZ test, and other projects that have been proposed, or are reasonably foreseeable to take place in the project vicinity. Although a power cable connecting the instrumentation buoy to the onshore electrical grid may be developed by NNMREC in future applications, this is a speculative action that is not considered to be reasonably foreseeable and is not included in this cumulative impact analysis. The boundaries for the analysis are contingent on the type of impact to be assessed and the extent of the impacts from the Proposed Project and the 2012-2013 WET-NZ test. The potential impacts that would result from the installation, operation, maintenance, and removal and decommissioning of the Proposed Project and the 2012-2013 WET-NZ test are described in Section 3, *Affected Environment and Environmental Consequences*, of this environmental assessment (EA).

4.2 Other Projects in the Vicinity

4.2.1 Yaquina Ocean Dredged Materials Disposal Site

The present Yaquina Ocean Dredged Materials Disposal (ODMD) Site includes two areas approximately 1.75 miles (2.82 kilometers) offshore from the Yaquina Bay Entrance Channel. The Proposed Project and the 2012-2013 WET-NZ test would be over 2.5 miles (4.0 kilometers) away from the disposal sites. Each site occupies an area of 597 acres (2.4 square kilometers) of sea floor and has the capacity to receive dredged materials for 20 years. These areas are used to dispose of materials dredged in order to maintain safe deep-draft navigation through federal channels and permitted actions. Since the ODMD site began receiving dredged material in 1928, approximately 21,465,000 cubic yards of dredged material has been placed at this site (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2012).

4.2.2 Newport International Terminal Project

The Port of Newport is rebuilding the International Terminal, which includes two docks, warehousing, and administrative offices. The new terminal will be a crucial link between Oregon's central coast highways and the movement of marine commerce. Construction is in progress, with the completion of the second phase anticipated by June 2012 (Port of Newport 2011).

4.2.3 Ocean Observatories Initiative

The Ocean Observatories Initiative (OOI) is a National Science Foundation Division of Ocean Sciences program that focuses the science, technology, education, and outreach of an emerging network of science-driven ocean observing systems. The OOI will conduct ocean science using an integrated ocean observatory with a network of interactive nodes studying interrelated ocean processes on coastal, regional, and global spatial scales. The Endurance Array is a multi-scale array utilizing fixed and mobile assets to observe cross-shelf and along-shelf variability in the coastal upwelling region of the Oregon and Washington coasts. This array will consist of six observation sites—three off the coast of Newport and three near Grays Harbor, Washington—and a network of surface moorings, seafloor platforms, and undersea gliders. None of the components for the Newport sites would be located within the project site; however, the surface buoy at the inshore OOI site could be located east of the project site in approximately 82 feet (25 meters) of water. Construction and instrument testing began in the latter half of 2011. Installation is planned to begin by mid 2013 (Ocean Observatories Institute 2011).

4.2.4 National Oceanic and Atmospheric Administration Marine Operations Center

In August 2009, the National Oceanic and Atmospheric Administration (NOAA) signed a 20-year lease with the Port of Newport to house the Marine Operations Center-Pacific (MOC-P). On August 20 and 21, 2011, NOAA celebrated the construction of the MOC-P in the Port of Newport with a 2-day dedication event. The Newport facility includes a 1,300 foot-long pile-supported berthing pier in Yaquina Bay, a small boat dock, and a group of upland facilities, including buildings and site improvements. The facilities will support six NOAA vessels (Mann et al. 2011), 60 shoreside personnel, and 110 crew members. (NOAA Marine Operations 2011)

4.2.5 Strategic Business Plan for Oregon's Statewide Port System—Possible Areas of Future Development

A New Strategic Business Plan for Oregon's Statewide Port System (Parsons Brinckerhoff 2010), a report written for the Oregon Business Development Department and the Oregon Department of Transportation, discusses the economic potential of Oregon's ports and outlines possible industry uses. Although the strategic plan does not identify projects that could be considered reasonably foreseeable under NEPA, it does suggest that there is potential for future development in the Port of Newport. Furthermore, the report provides information on potential services and uses of Oregon's ports, but does not provide project-specific information in sufficient detail required for determining potential cumulative impacts. ORS 777.065 lists the Port of Newport as one of a few Oregon ports in which the development of deepwater port facilities is a state economic goal (Parsons and Brinckerhoff 2010). Possible future project types for the Port of Newport might include docking of small cruise ships (Port of Newport n.d.), export of forestry products, and additional oceanic research in conjunction with new NOAA facilities (Parsons Brinckerhoff 2010).

4.2.6 Additional Wave Energy Development

Reedsport OPT Wave Park

Ocean Power Technologies (OPT) has proposed a 10-buoy test array of the PB150 PowerBuoy® for deployment off the coast of Reedsport, Oregon. The Reedsport OPT Wave Park would be located 2.5 miles (4.0 kilometers) off the Oregon coast, approximately 70 miles (113 kilometers) south of the project site. The Reedsport OPT wave park would consist of 10 150-kilowatt PB150 buoys, an underwater substation pod, and an umbilical cable connecting the buoy array to a land-based substation. (Reedsport OPT Wave Park 2010; Ocean Power Technologies 2011a). The project is expected to generate approximately 4,140 megawatt-hours annually.

On August 24, 2011, the Department of Energy (DOE) issued a Notice of Adoption and Finding of No Significant Impact for the Reedsport single buoy project, which is phase 1 of the larger Reedsport project and would be followed by the deployment of a 10-buoy array. Assembly of the buoys and component testing is underway, with the completed PowerBuoy anticipated to be deployed in mid-2012. (Ocean Power Technologies 2011a)

Coos Bay OPT Wave Park

OPT has proposed to develop a commercial, 100 MW wave park approximately 2.7 miles (4.3 kilometers) off the coast of Oregon, closest to the cities of Coos Bay and North Bend, and approximately 21 miles (33.8 kilometers) south of the Proposed Project area. The Coos Bay OPT Wave Park would consist of up to 200 500-kilowatt PB500 PowerBuoys, 20 undersea substations, and an umbilical cable to connect the buoys to a land-based station. Once in operation, the project is expected to supply 275,000 megawatt-hours to the grid annually (Ocean Power Technologies 2011b). The Coos Bay OPT Wave Park is still in the planning stages, having filed a preliminary permit application with Federal Energy Regulatory Commission (FERC) in March 2010. (Ocean Wave Energy Partners 2010), FERC issued a Preliminary Permit for the project in August 2010.

4.3 Summary of Cumulative Impacts

4.3.1 Biological Resources

The Proposed Project and the 2012-2013 WET-NZ test, the Yaquina Ocean Dredged Disposal Materials Site, and the OOI would all result in the loss or alteration of benthic habitat. The Reedsport OPT Wave Park and the Coos Bay OPT Wave Park would also result in some loss of benthic habitat; however, these effects would take place 70 and 20 miles away, respectively.

Record of the placement of dredged materials at the Yaquina ODMD site dates back to 1928. Since then, over 21 million cubic yards of dredged material has been placed at this site. From 2001 to 2010, an average of approximately 217,000 cubic yards were placed annually (U.S. Army Corps of Engineers and U.S. Environmental Protection Agency 2012). The dumping of dredge disposal material results in the suffocation and death of immobile or slow-moving benthic organisms and a change in the seabed (loss of existing benthic habitat and creation of subsurface disposal mounds). The effects of dumping these quantities of sediment into the ocean over 84 years represents a large effect on the environment, particularly benthic species and their habitat, consisting of annual smothering of benthic organisms, increases in turbidity during dumping, and creation of underwater mounds. As noted previously, the total area of the Yaquina Bay ODMD site is 597 acres.

The anchors used in the 2012-2013 WET-NZ test and in other future tests could also kill immobile or slow-moving benthic organisms when the anchors are placed. Total estimated area of fill for the 2012-2013 WET-NZ test (which would consist of anchors for the WET-NZ device, the Ocean Sentinel, and a TRIAXYS™ wave measurement buoy) is 1,535.5 square feet (equivalent to 0.035 acre). Other future tests may consist of up to two Ocean Sentinels, two wave energy conversion (WEC) devices, and two TRIAXYS™ wave measurement buoys. Although devices used in future tests may use slightly different anchoring equipment and configurations, it is reasonable to expect that future tests would result in a placement of fill approximately twice the area estimated for the 2012-2013 WET-NZ test. Therefore, the amount of benthic organisms that would be affected by the anchors of the 2012-2013 WET-NZ test and other future tests represents a very minor additive effect to that of the dredging operations.

A very small amount of benthic habitat would be altered as a result of the mooring necessary for the OOI surface buoy. This would be a negligible addition in the amount of benthic habitat lost or altered when compared to the Yaquina Bay ODMD site.

The Proposed Project and the 2012-2013 WET-NZ test would not result in a cumulative impact on the other biological resources when considered with the other projects in the vicinity.

4.3.2 Noise and Vibration

Vessel traffic that would be generated by the Proposed Project and the 2012-2013 WET-NZ test, the NOAA Marine Operations Center-Pacific, the Newport International Terminal, and the Yaquina Ocean Dredged Materials Disposal Site would increase underwater noise levels for short periods of time, and localized to the area where the specific vessels were operating. If vessel traffic from these projects occurred at the same time and in close proximity, temporary and minor noise impacts could occur in a given location. Although the noise generated by the operation of WEC devices under test is not well known, it is generally anticipated to be low. Additionally, NNMREC would, though the Adaptive Management Framework (Appendix D), include provisions to ensure that noise from the Proposed Project and the 2012-2013 WET-NZ test would not result in adverse impacts. Nonetheless, the operation of vessels by the NOAA Marine Operations Center-Pacific, the Newport International Terminal, and the Yaquina Bay ODMD site could result in short-term noise impacts limited in area, if vessels associated with these projects operated near the project site. Therefore, cumulative impacts resulting from noise generated by these projects could occur; however, these impacts would be localized and temporary. Due to their distance from the Proposed Project, cumulative impacts resulting from the assembly of the Reedsport and Coos Bay OPT Wave Parks would be negligible.

4.3.3 Water Resources

As described in Section 3.4, *Water Resources,* the Proposed Project and the 2012-2013 WET-NZ test has the potential to affect water resources through spills, leakage, leaching of coatings, and turbidity. The activities associated with the Yaquina Ocean Dredged Materials Disposal Site would also result in increased turbidity; however, turbidity would be localized to the area where material is deposited and would be expected to settle in a short period of time. Therefore, no cumulative impacts on water resources resulting from increased turbidity are anticipated, unless the instrumentation buoy or

WEC device anchor removal occurs simultaneously with dredge disposal activity. In this case, cumulative impacts would be minor and temporary.

While marine vessel activity from the projects identified in Section 4.2, *Other Projects Listed in the Vicinity*, could result in spills or leakage, these are low-probability events and would have to occur within the same time and location as a spill or leakage from support vessels associated with the Proposed Project and the 2012-2013 WET-NZ test to result in cumulative impacts on water quality. This scenario is highly improbable and, furthermore, the Proposed Project and the 2012-2013 WET-NZ test would include spill response measures to minimize water quality impacts.

The increased number of vessels in the bay associated with the Newport International Terminal and NOAA Marine Operations Center could leach coatings that may be harmful to marine life. However (as noted in Section 3.4, *Water Resources*), the amount of copper that could be leached by the Proposed Project and the 2012-2013 WET-NZ test would be diluted to levels lower than those known to have an effect on studied marine species. As such, the Proposed Project and the 2012-2013 WET-NZ test are not anticipated to contribute to cumulative impacts on water resources through leaching when considered with other projects in the vicinity.

4.3.4 Marine Navigation

The Proposed Project and the 2012-2013 WET-NZ test would generate some additional vessel traffic during installation, maintenance, and removal. Additional vessel traffic would be anticipated to result from the operation of the NOAA Marine Operations Center-Pacific and the Newport International Terminal Project. However, because the impacts on marine navigation from the Proposed Project and the 2012-2013 WET-NZ test would be temporary and infrequent, they would not lead to a cumulative impact on marine navigation when added to the impacts anticipated from these projects. In addition, because the increased vessel traffic serving the dredged disposal site would be periodic and occasional, it is a remote possibility that it would coincide directly with vessel traffic associated with the Proposed Project and the 2012-2013 WET-NZ test. In the scenario that vessels from both projects would be navigating simultaneously, it is doubtful that a cumulative impact on navigation would result, as it would be easy for the vessels to avoid each other given the size of the navigable ocean area nearby. Although increased vessel traffic can be expected to occur during the installation of the Reedsport and Coos Bay OPT Wave Parks, their distance from the Proposed Project and the 2012-2013 WET-NZ test would make the impacts negligible and there is a low likelihood that installation of these projects would occur simultaneously; therefore, cumulative impacts on marine navigation are not anticipated.

4.3.5 Aesthetic Resources

The Proposed Project would involve the placement of up to two instrumentation buoys or a manned testing vessel and up to two WEC devices in the Pacific Ocean, approximately 2.0 miles (3.2 kilometers) off the Oregon coast near the city of Newport, Oregon. The 2012-2013 WET-NZ test would involve the placement of one half-scale WET-NZ device and one instrumentation buoy at the same location. The Proposed Project and the 2012-2013 WET-NZ test are not expected to be visible from the nearby beaches and would be nearly imperceptible to the unaided eye from the Yaquina Head Historic Lighthouse. Because all projects—except for the OOI described above—would not be visible from these locations, no cumulative impacts on aesthetic resources would occur. The OOI would result in the installation of a small surface buoy consisting of a foam module approximately 5.0 feet (1.5 meters) in diameter, with an antenna measuring 6.5 feet (2.0 meters) in height. Because of the small size of the OOI surface buoy and the minimal direct impacts from the Proposed Project and the 2012-2013 WET-NZ test, cumulative impacts on aesthetic resources resulting from these two projects would be minor.

4.3.6 Recreation Resources

The Proposed Project and the 2012-2013 WET-NZ test would result in a change to marine navigation designations in the 1.0-square-nautical-mile (3.4-square kilometer) project site, which is expected to have a minor impact on recreational navigation and fishing. A change in the visual landscape in the project site may also detract from the recreational activities of ocean viewing and whale watching. None of the projects described in Section 4.2, *Other Projects Listed in the Vicinity,* would have an impact on recreational navigation, fishing, ocean viewing, or whale watching. Therefore, the Proposed Project and the 2012-2013 WET-NZ test would not contribute to a cumulative impact on recreational resources when considered with the other projects in the vicinity.

4.3.7 Cultural Resources

As discussed in Section 3.7, *Cultural Resources*, the Proposed Project and the 2012-2013 WET-NZ test would not have any impact on cultural resources, and, therefore, would not contribute to a cumulative impact on cultural resources when considered with the other projects in the vicinity.

4.3.8 Socioeconomics and Environmental Justice

As described in Section 3.8, *Socioeconomics and Environmental Justice*, the Proposed Project and the 2012-2013 WET-NZ test would have no impact on environmental justice populations. The Proposed Project and the 2012-2013 WET-NZ test would result in a small impediment to navigational access in the project site for commercial and recreational fishing, which may result in a small reduction in the annual output of the commercial fishing industry in the area. However, this would not contribute to a cumulative socioeconomic impact primarily because impacts on commercial and recreational fishing attributable to the other projects described previously have either not been identified, or have been determined to be insignificant.

The Proposed Project and the 2012-2013 WET-NZ test would also alter the visual landscape from viewpoints that are used by tourists. The other projects in the vicinity listed previously would not result in permanent changes to navigational access or alter the visual landscape in the area. However, it is not expected to disrupt recreation use to the extent that recreation-related spending in the region would be measurably affected.

Therefore, the Proposed Project and the 2012-2013 WET-NZ test would not contribute to a cumulative impact on socioeconomics or environmental justice when considered with the other projects in the vicinity.

5.0 Distribution List

DOE notified federal, state, and local agencies; tribal government representatives; elected officials; business organizations; and special interest groups of the Proposed Action. The list of recipients that were notified of the availability of the EA and attachments is presented below.

Tribal Organizations

Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians

- Howard Crombie — Director, Department of Natural Resources
- J.R. Herbst — Environmental Specialist

Confederated Tribes of Siletz Indians

- Delores Pigsley — Tribal Chairman
- Mike Kennedy — Natural Resources Manager

Confederated Tribes of the Umatilla Indian Reservation

- Carey Miller — Tribal Historic Preservation Officer/Archaeologist

Confederated Tribes of the Warm Springs Reservation of Oregon

- Robert Brunoe — Tribal Historic Preservation Officer
- Sally Bird — Cultural Resources Manager

Coquille Indian Tribe

- Ed Metcalf — Tribal Chairman

Federal Agencies

Federal Energy Regulatory Commission

- Vince Yearick — Division of Hydropower Licensing

Bureau of Ocean Energy Management, Regulation, and Enforcement
(formerly known as Minerals Management Service)

- Maurice Hill — Office of Alternative Energy Programs

National Marine Fisheries Service

- Keith Kirkendall — Supervisory Natural Resource Specialist
- Kimberly Hatfield — Biologist
- Waldo Wakefield — Habitat Team Leader - Northwest Fisheries Science Center, Fishery Resource Analysis and Monitoring Division

U.S. Army Corps of Engineers

- Debra Henry — Biologist/Regulatory Project Manager

U.S. Coast Guard

- Edward Wandelt — Chief, Environmental Management (CG-443)
- David M. Pierias — Officer in Charge - Station Depoe Bay
- Keith A Taylor — Commander – District 13
- Mark Allstott — Commanding Officer - Station Yaquina Bay

U.S. Department of Transportation, Maritime Administration

- Richard Corley — Program Manager

U.S. Environmental Protection Agency, Office of Ecosystems, Tribal & Public Affairs

- Teena Reichgott — Manager - NEPA Review Unit

U.S. Fish and Wildlife Service

- Jeff Everett — Renewable Energy Projects Biologist

State Agencies and Associations

- Betsy Johnson — Oregon State Senator, District 16
- Richard Whitman — Senior Natural Resources Policy Advisor to Governor John Kitzhaber

Oregon Coastal Zone Management Association

- Onno Husing — Executive Director

Oregon Coast Community College

- Patrick O'Connor — President

Oregon Department of Environmental Quality

- Alexandria Liverman — 401 Water Quality Certification Coordinator, Northwest Region

Oregon Department of Fish and Wildlife

- Caren Braby — Marine Reserves Program Leader
- Delia Kelly — Ocean Energy Coordinator
- Ken Homolka — Hydropower Program Leader
- Patty Burke — Marine Resource Program
- Scott Groth — South Coast Shellfish Biologist - Marine Resource Program

Oregon Department of Land Conservation and Development

- Paul Klarin — Marine Affairs Coordinator

Oregon Department of State Lands

- Chris Castelli — Land Manager
- Jeff Kroft — Senior Policy Specialist, Land & Waterway Management Division

Oregon Ocean Policy Advisory Council

- Scott McMullen — Chair

Oregon Park and Recreation Department

- Dr. Dennis Griffin — State Archaeologist
- Jeff Farm — Ocean Shores Manager
- Laurel Hillman — Costal Resource Planner
- Roger Roper — Deputy State Historic Preservation Officer

Oregon Public Ports Association

- Mark Landauer — Executive Director

Oregon State Employment Department

- Sandra Mies-Grantham — Lincoln Workforce Development

Oregon State University

- Dr. Gil Sylvia — Superintendent - Coastal Oregon Marine Experiment Station
- George Boehlert — Director - Hatfield Marine Science Center
- Janet Webster — Head Librarian
- Jay Rasmussen — Program Leader - Oregon Sea Grant
- Jeff Feldner — Oregon Sea Grant Marine Extension
- Kath Fuller — Hatfield Marine Science Center
- Kaety Hildenbrand — Oregon Sea Grant Marine Extension
- Sam Angima — Staff Chair - Oregon Sea Grant Marine Extension

Oregon Water Resources Department

- Mary Grainey — Hydroelectric Coordinator

South Beach State Park

- Mike Rivers — Ranger Supervisor

Regional Agencies and Associations

Central Lincoln People's Utility District

- Bruce Lovelin — Chief Engineer/Systems Engineering Manager
- Chris Chandler — Community and Economic Development Manager
- Curt Abbot — Board Member
- Judy Matheny — Board Member
- Kay Moxness — Government Relations Manager
- Larkin Kaliher — Board Member
- Paul Davies — General Manager
- Ron Benefield — Board Member
- Tom Tymchuk — Board Member

Lincoln County Board of Commissioners

- Bill Hall — Commissioner
- Doug Hunt — Commissioner
- Terry Thompson — Commissioner

Lincoln County Planning Commission

- Onno Husing — Planning Director

Lincoln County School District

- Tom Rinearson — Superintendent

Tillamook Intergovernmental Development Entity

- Patrick Ashby — General Manager
- Paul Levesque — Board Member
- Trout Barbara — Board Member

Local Agencies and Associations

City of Depoe Bay

- Carrol Conners — Mayor

City of Lincoln City

- David Hawker — City Manager
- Joan Kelsey — City Attorney
- Dick Anderson — Mayor

City of Newport

- Jim Voetberg — City Manager
- Mark McConnell — Mayor
- Gary Firestone — City Attorney

City of Toledo

- Ralph Grutzmacher — Mayor
- Michelle Amberg — City Manager

City of Waldport

- Susan Woodruff Mayor
- Nancy Leonard City Manager

City of Yachats

- Ronald Brean Mayor

Depoe Bay Harbor Commission

- Phil Shane Harbormaster and Commissioner

Depoe Bay Near Shore Action Team

- Loren Goddard Chairman

Port of Newport

- Don Mann General Manager and Port Commissioner

Port of Toledo

- Bud Shoemaker Port Manager and Port Commissioner

Port of Alsea

- Maggie Rivers Director and Port Commissioner

Private Organizations and Other Interested Parties

American Kiteflyers Association

- Barbara Meyer President

Aquamarine Power

- Theresa Wisner Consultant

Beachcombers

- Guy DiTorrice

Central Oregon Coast Association

- Rebecca Morris Director

Columbia Power Technologies

- Ken Rhinefrank Vice President of Research

Depoe Bay Whale Watch Center

- Morris Grover Volunteer Coordinator and Team Leader

Economic Development Alliance of Lincoln County

- Caroline Bauman Executive Director

Fisherman Interested in Natural Energy

- Bob Eder Member
- Bob Jacobson Chair
- Wayne Belmont Member
- Rob Bovett Member

Friends of Yaquina Bay

- Bridget Wolfe President

Marine Discovery Tours

M-3 Wave Energy Systems

- Mike Morrow Chief Technology Officer

Ocean Power Technologies

- George Wolff Business Development Manager

Oregon Coast Aquarium

- Carrie Lewis President and CEO
- Kerry Morgan Director of Public Programs
- Tina Smith Interpretive Coordinator

Oregon Shores Conservation Coalition

- Robin Hartmann Ocean Program Director

Our Ocean

- Susan Allen Coalition Director

Pacific Energy Ventures

- Justin Klure Partner

Pacific Power and Light

- Kevin Putnam Operations Manager

Southern Oregon Resource Coalition

- Julie Keil Interim President

Surfrider Foundation

- Charlie Plybon Oregon Field Coordinator
- Gus Gates Oregon Policy Coordinator

Yaquina Birders & Naturalists

- Range Bayer President

Individuals

- Richard Johnson
- Yvonne Weiland
- John Sherman

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6.2 Personal Communications

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Henkel, Sarah. Assistant Professor. Hatfield Marine Science Center. Newport, OR. August 2, 2010—Email message.

Miller, John. Administrative Officer. U.S. Bureau of Land Management. Newport, OR. June 8, 2010—Telephone conversation.

Nielsen, Gina. Manager. Port of Newport-South Beach Marina. Newport, OR. June 1, 2010—Telephone conversation; June 3, 2010—Email message.

Schindler, Eric. Ocean sampling project leader. Oregon Department of Fish and Wildlife. Newport, OR. June 7, 2010—Telephone conversation.