MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT (FERC DOCKET NO. DI02-3-002)

APPLICATION FOR LICENSE FOR MINOR PROJECT AND PRELIMINARY DRAFT ENVIRONMENTAL ASSESSMENT

VOLUME II OF VI
PRELIMINARY DRAFT
ENVIRONMENTAL ASSESSMENT

AQUAENERGY GROUP, LTD.
Mercer Island, Washington

NOVEMBER 2006

MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT
(FERC DOCKET NO. DI02-3-002)

APPLICATION FOR LICENSE FOR MINOR PROJECT

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PRELIMINARY DRAFT ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Environmental and Engineering Review
Washington, D.C.

MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT

FERC DOCKET NO. DI02-3-002

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National Marine Fisheries Service (NMFS)
National Oceanic & Atmospheric Administration (NOAA)
National Park Service (NPS)
State of Washington Office of Financial Management (OFM)
U.S. Army Corps of Engineers (USACE)
U.S. Coast Guard (USCG)
U.S. Fish and Wildlife Service (USFWS)
U.S. Forest Service (USFS)
U.S. Geological Survey (USGS)
Washington Department of Fish and Wildlife (WDFW)
Washington Department of Natural Resources (WDNR)
Washington State Departments of Ecology (WDOE)

Other Entities

American Cetacean Society (ACS)
AquaEnergy Group, Ltd. (AquaEnergy)
Bonneville Power Authority (BPA)
California Energy Commission (CEC)
Devine Tarbell & Associates, Inc. (DTA)
Electric Power Research Institute (EPRI)
National Data Buoy Center (NDBC)
National Geographic Society (NGS)
North Olympic Peninsula Lead Entity (NOPLE)
Northwest Energy Innovation Center (NEIC)
Pacific Fishery Management Council (PFMC)
Public Interest Energy Research (PIER)
Public Utility District (PUD)
Thales GeoSolutions (Pacific), Inc. (TGPI)

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Olympic Coast National Marine Sanctuary (OCNMS)

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401 Water Quality Certification (401 WQC)
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Cultural Resources Management Plan (CRMP)
Environmental Impact Statement (EIS)
Hydraulic Project Approval (HPA)
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Exclusive economic zone (EEZ)
Global positioning system (GPS)
Habitat area of particular concern (HAPC)
Horizontal directional drilling (HDD)
Kilowatts (kW)
Kilowatt-hours (kWh)
Megawatt (MW)

Megawatt-hours (MWh)
Non-governmental organizations (NGOs)
Operation and maintenance (O&M)
Parts per million (ppm)
Pounds per square inch (PSI)
Priority Habitats and Species (PHS) information system
Rare, threatened, and endangered species (RTE)
Ready for Environmental Analysis (REA)
Revolutions per minute (rpm)
Vertical load anchor (VLA)

EXECUTIVE SUMMARY

AquaEnergy Group, Ltd. (AquaEnergy) proposes to develop and operate the Makah Bay Offshore Wave Energy Pilot Project (Makah Bay Project). The project will be located in the Pacific Ocean in Makah Bay, Clallam County, near the city of Neah Bay, Washington. The land portion part of the project is the property of the Makah Indian Nation. Part or all of the aquatic portion of the project is within Washington State waters, the Olympic Coast National Marine Sanctuary (OCNMS), and the Flattery Rocks National Wildlife Refuge. The Makah Bay Project, which is supported by a consortium of public and private agencies, the Makah Indian Nation, and a major university, does not occupy any federally-owned land, though the OCNMS is administered by the National Oceanic and Atmospheric Administration (NOAA) and the Flattery Rocks National Wildlife Refuge is administered by the U.S. Fish and Wildlife Service (USFWS).

The project represents the first of its kind pilot wave energy project in the nation to be developed and is based on a heaving buoy principle. The Proposed Action involves the design and construction of a pilot 1 megawatt (MW) offshore wave energy power plant, consisting of four wave energy conversion buoys, called AquaBuOYs. The portion of the buoys that are above water are similar in size to large navigational aids used to demarcate shipping lanes and identify obstructions. The AquaBuOYs will be placed 3.7 statute miles (3.2 nautical miles) offshore in water depths of approximately 150 feet. Each AquaBuOY will function as a floating wave energy converter, transforming wave energy into usable electrical energy. The closed loop hydraulic-to-electrical conversion takes place inside each AquaBuOY. The AquaBuOY technology is designed specifically for operation in an ocean wave environment and generates power from the substantial up-and-down kinetic motion of the offshore waves. Energy will be transported to a small shore station via an anchored transmission cable which will run along the sea floor, except near shore, where it will be buried using a horizontal directional drilling (HDD) technique.

AquaEnergy is developing the project to produce electricity for the Clallam County PUD service territory and to demonstrate the economic, environmental, and tribal benefits of wave energy conversion power plants in utilizing ocean resources to generate clean, renewable energy to coastal communities. AquaEnergy anticipates a 30-year license term for the project from the Federal Energy Regulatory Commission (FERC, the Commission). The OCNMS provides permits for three-year periods, and AquaEnergy plans to regularly renew the OCNMS permit over the term of the FERC license. The nearby community of Neah Bay and the Makah Nation will benefit from a reliable renewable energy source as power generation is lacking and needed on the western end of the Clallam County PUD service area. This energy source aligns with Clallam County PUD's objective to provide clean energy to customers and the Makah Tribe's interest in using energy derived from renewable resources. In fact, the Makah Nation chose to be an active participant in this project due to the environmental integrity and low impact of AquaEnergy's offshore buoy technology over competing onshore technologies.

AquaEnergy is following the Commission's alternative licensing procedures and is filing this preliminary draft environmental assessment (PDEA) with a final application for an original license. This is the first wave energy or tidal project in the nation required to undergo the FERC licensing process.

AquaEnergy's Proposed Action includes the following environmental measures:

- Use HDD to deploy transmission cable from the shore station, under the beach and intertidal area, out to a depth of 10 to 30 feet below mean lower low water (the depth to which HDD will occur will depend on the results of the eelgrass survey to be conducted prior to project construction and the suitability of the sediment for HDD);
- Design features to achieve a closed-loop system to prevent any marine life entering pressurized water flow;
- Utilize anti-fouling paints and materials on the equipment;
- Design features to minimize scale of anchor devices, project footprint on seafloor, and the chain/cable sweep of the seafloor;
- Design buoys to include a heavy-duty plastic conical attachment to be placed over the above-water portion of the buoy to prevent marine mammal haulout and seabird roosting;
- Install GPS transponders in each AquaBuOY for tracking purposes;
- Develop and implement a Cultural Resources Management Plan (CRMP) consisting of measures to protect cultural resources;
- Develop and implement an interpretive and education plan to provide information regarding the Makah Bay Plant and use of the area by the Makah;
- Develop, in conjunction with the permitting agencies, a schedule of regular system maintenance that minimizes site visits, disturbance to marine growth, and activity at the site; and
- Improve and maintain the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and develop design guidelines for future project improvements.

This PDEA analyzes the effects of development and operation of the project. In addition to the Proposed Action, we consider alternatives, including a no-action alternative. Based on our analysis, we recommend licensing the Makah Bay Offshore Wave Energy Pilot Project as proposed by AquaEnergy. We conclude that issuing an original license for the project, with the environmental measures that we propose, would not be a major federal action significantly affecting the quality of the human environment. The Energy Policy Act of 2005, which was signed into law on August 8, 2005, promotes the development of cleaner and more productive use of domestic energy sources as well as the diversification in energy supplies through greater use of alternative and renewable fuels. Given the national energy demands, supply limitations, and energy development goals, we recommend that development of new ocean technologies by AquaEnergy be encouraged and promoted to increase domestic energy production, especially from clean renewable sources.

PRELIMINARY DRAFT ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Environmental and Engineering Review
Washington, D.C.

MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT
FERC DOCKET NO. DI02-3-002

1. APPLICATION

AquaEnergy Group, Ltd. (AquaEnergy) is filing with the Federal Energy Regulatory Commission (FERC, the Commission) this preliminary draft environmental assessment (PDEA) and an application for an original license for the Makah Bay Offshore Wave Energy Pilot Project (Makah Bay Project), FERC Docket No. DI02-3-002.

The Proposed Action, which is supported by a consortium of public and private agencies, the Makah Indian Nation, and a major university, involves the design and construction of a pilot 1 megawatt (MW) offshore wave energy power plant, consisting of four wave energy conversion buoys, called AquaBuOYs. The portion of the buoys that are above water are similar in size to large navigational aids used to demarcate shipping lanes and identify obstructions. The AquaBuOYs will be placed 3.7 statute miles (3.2 nautical miles) offshore in water depths of approximately 150 feet. Energy will be transported to a small shore station via an anchored transmission cable which will run along the sea floor, except near shore, where it will be buried using a horizontal directional drilling (HDD) technique.

The project is located in the Pacific Ocean in Makah Bay, Clallam County, near the city of Neah Bay, Washington (latitude and longitude: 48º 19 min 53 sec N, 124º 44 min 18 sec W). The land portion of the project is the property of the Makah Indian Nation. Water area of the proposed project occurs in Washington State waters, the Olympic Coast National Marine Sanctuary (OCNMS), the Flattery Rocks National Wildlife Refuge, and the Makah Usual and Accustomed Grounds[1]. With regard to Washington State waters, the buoy anchors and underwater transmission cable would lie on state-owned bedlands/seafloor. The project does not occupy any federally-owned

[1] The Makah Usual and Accustomed fishing grounds extend along the northern Olympic Peninsula - north of 48°02'15" N to the U.S./Canada border and east of 125°44'00" (Pacific Fishery Management Council [PFMC] 2003). This area extends from about 20 miles south of the project area north to the middle of the Strait of Juan de Fuca and seaward to a maximum distance of about 50 miles (NOAA 2001).

land, though the OCNMS[2] is administered by NOAA and the Flattery Rocks National Wildlife Refuge[3] is administered by the USFWS (Figures 1-1, 1-2, and 1-3).

The project represents the first of its kind pilot wave energy project in the nation to be developed and to involve the FERC licensing process. AquaEnergy is developing the project to demonstrate the economic, environmental, and tribal benefits of wave energy conversion power plants in utilizing ocean resources to generate clean, renewable energy to coastal communities. The research and demonstration of the AquaBuOY pilot plant would also contribute to advances in the worldwide ocean energy industry. Offshore wave energy has experienced significant government support in Europe and Australia with UK, Denmark, Portugal, and Australia having provided funding to ocean developers. AquaEnergy and its partners are striving to develop methods of producing energy derived from an environmentally clean, safe and renewable source, which will help to reduce dependence on foreign oil and help to reduce CO_2 emissions, the main contributor to the global warming.

AquaEnergy has developed the PDEA using the Commission's alternative licensing process (ALP), which combines into a single process the pre-filing consultation and environmental review processes under the National Environmental Policy Act (NEPA).

[2] The OCNMS, stretches from the Olympic coast an average of 35 miles into the Pacific Ocean (NOAA 2005*a*). It includes the coastal strip of Olympic National Park, the offshore National Wildlife Refuge islands and the Usual and Accustomed fishing areas for four treaty tribes (the Makah, Quileute, Hoh and Quinault) (Bowlby et al. 2001).

[3] The Flattery Rocks National Wildlife Refuge extends from the northern tip of the Olympic Peninsula over 20 miles south, where it abuts the Quillayute Needles National Wildlife Refuge. These two National Wildlife Refuges, along with the Copalis National Wildlife Refuge, located along the southern end of the OCNMS, are referred to as the Washington Islands National Wildlife Refuge. These combined refuges consist of 870 islands, rocks, and reefs along over 100 miles of the Washington coast and extends more than 100 miles seaward (USFWS 2001, 2005).

FIGURE 1-1
MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT AREA MAP

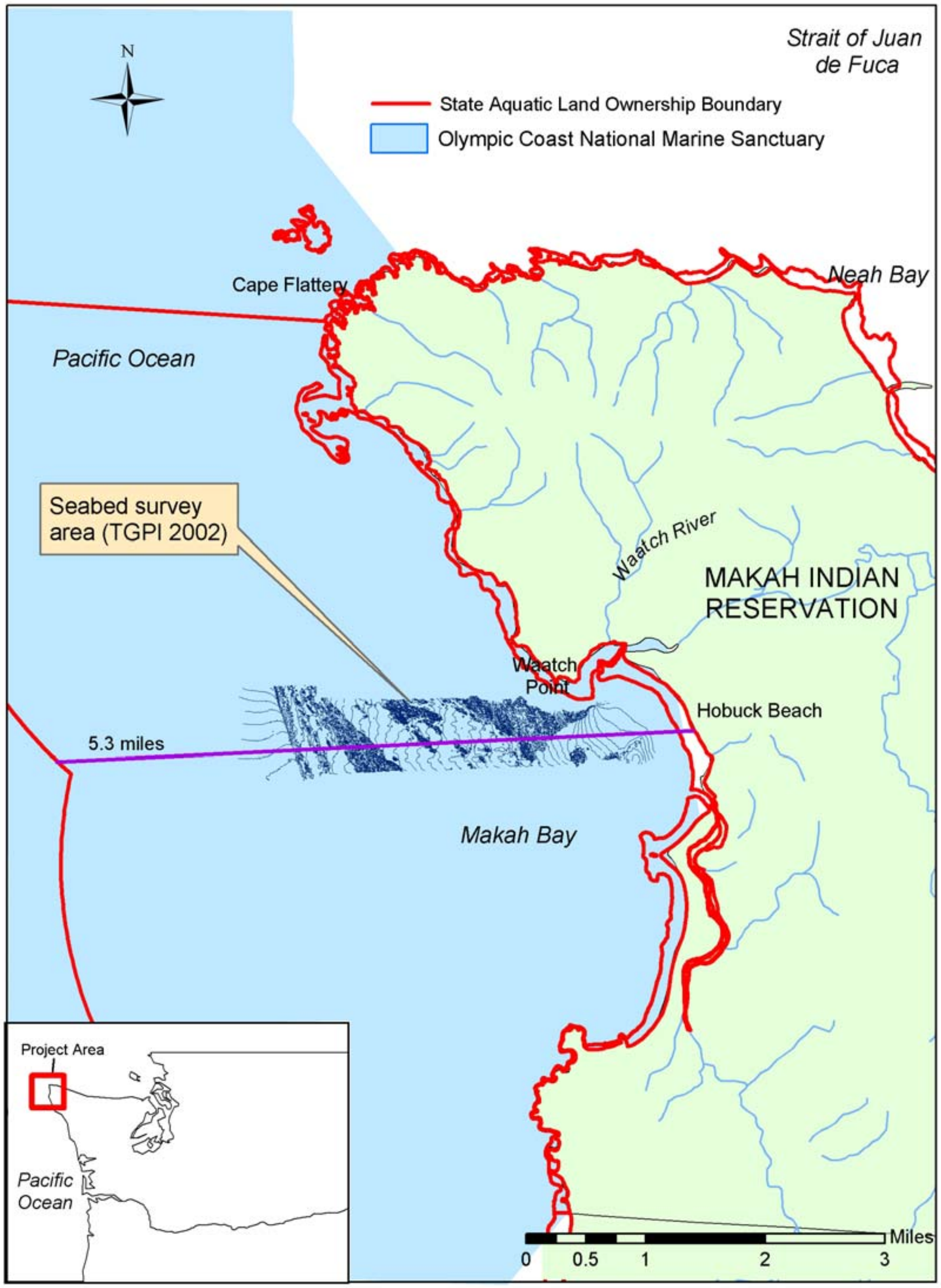


FIGURE 1-2
MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT SITE MAP

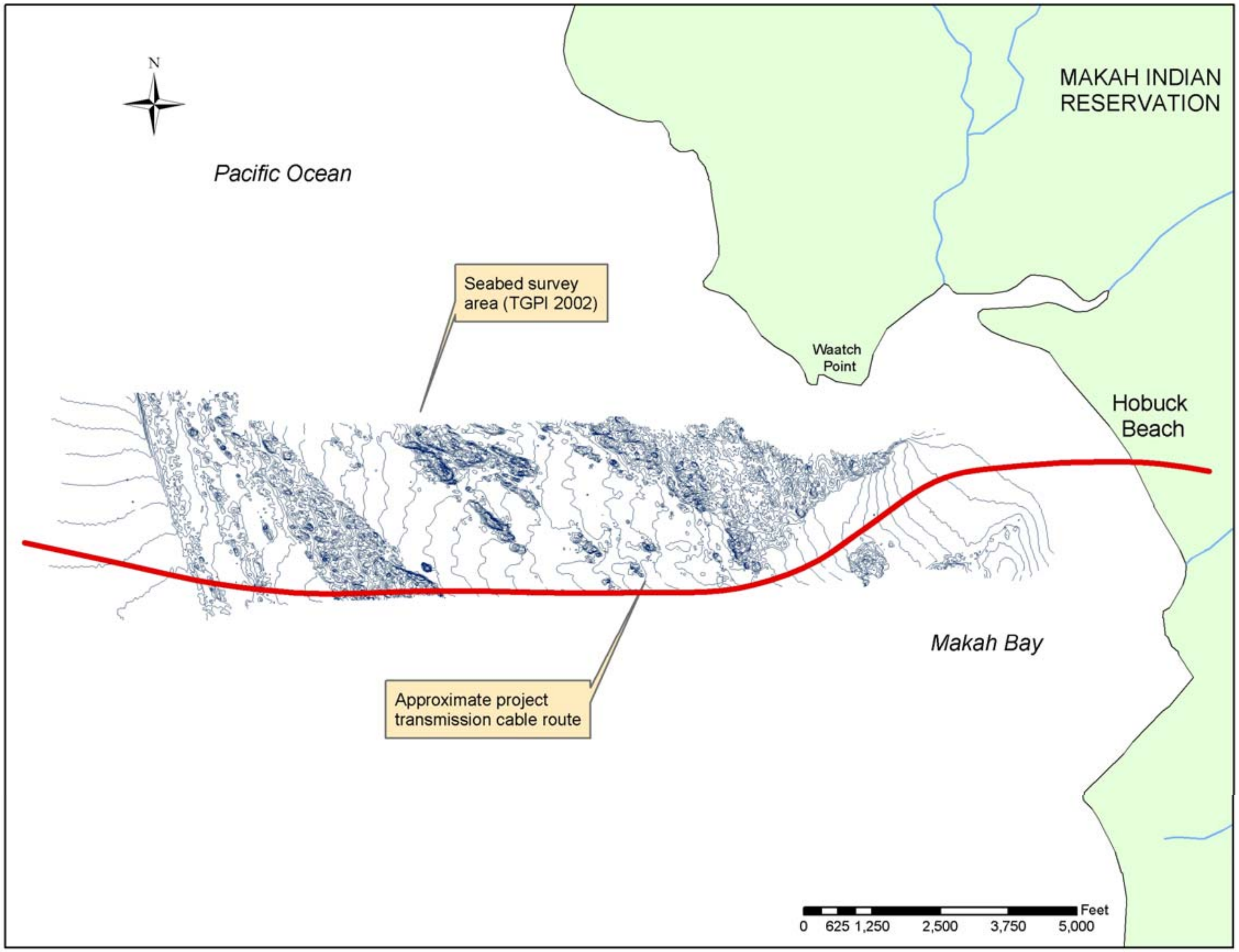
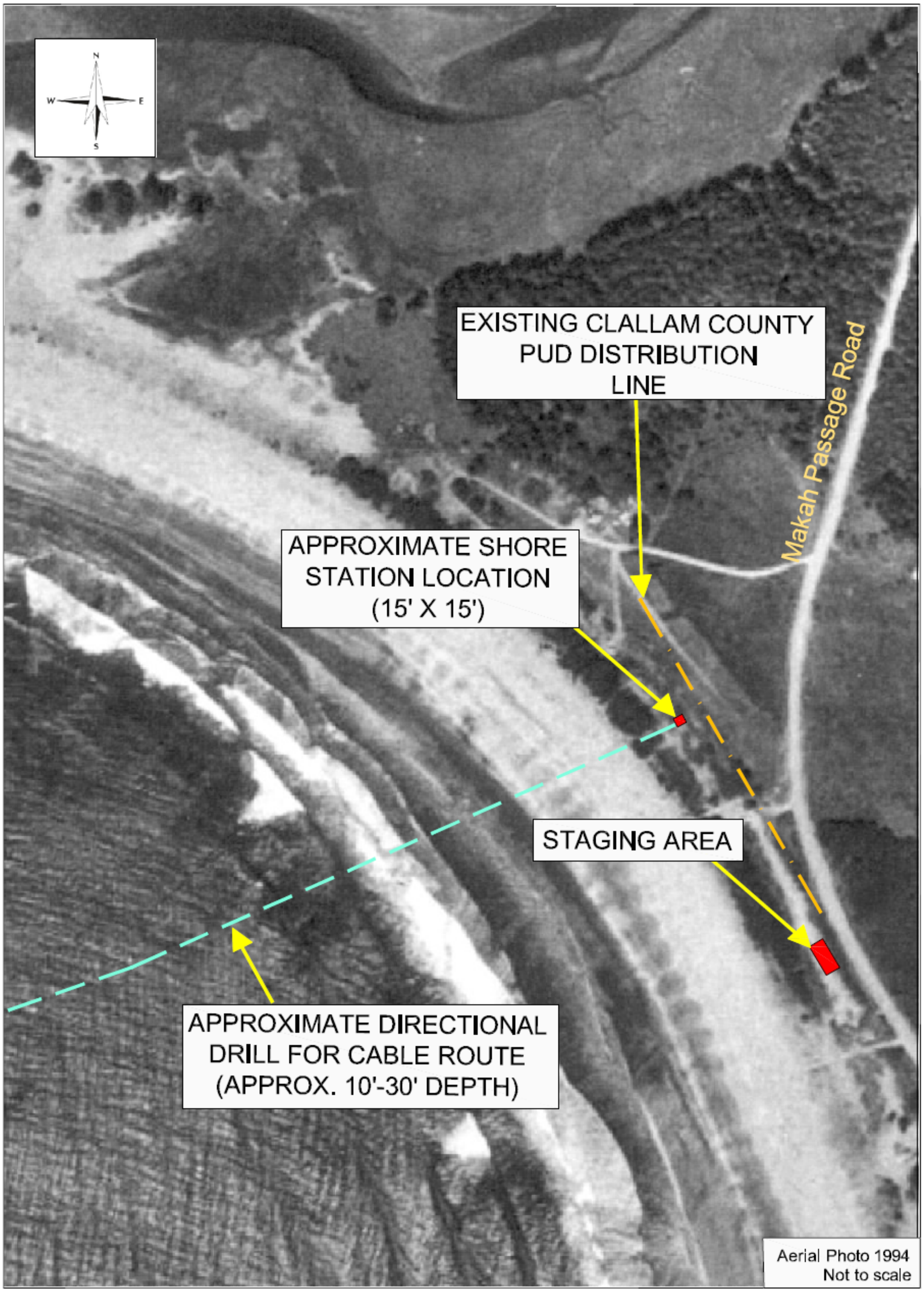


FIGURE 1-3
MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT SHORE STATION



2. PURPOSE AND NEED FOR POWER

A. Purpose of Action

The Commission must decide whether to license the proposed project, and what, if any, conditions should be placed in any license issued. Issuing a license for the Makah Bay Project would allow AquaEnergy to generate electricity at the project for the term of a new license, making electric power from ocean waves, a renewable resource, for the use of Washington residents.

In this PDEA, we analyze the environmental and economic effects associated with the proposed construction and operation of the Makah Bay Project. In addition to the power and developmental purposes for which a license is issued, the Commission must give equal consideration to: the purposes of energy conservation; the protection, mitigation of damage to, and enhancement of fish and wildlife; the protection of recreational opportunities; and the preservation of other aspects of environmental quality. This PDEA assesses the above considerations.

B. Need for Power

With a maximum output of 1 MW, the Makah Bay Project will provide approximately 1,500 megawatt-hours (MWh) annually of clean renewable ocean energy. Clallam County Public Utility District (PUD), based in Port Angeles, Washington will provide connection to its electrical distribution system and purchase the generated electricity for its delivery within the Clallam County PUD service territory[4], including the Makah Indian Nation. The ocean wave energy conversion power plant will help the utility meet its customers' power needs. From 2005 to 2015, Clallam County PUD expects an annual increase of one percent for both energy growth and net peak load, with the latter increasing from 144 MW in 2005 to 159 MW in 2015 (personal communication Fred Mitchell, Clallam County PUD, September 16, 2005). The total demand for the Indian Nation is approximately 5 MW. The Makah Tribal Council and the Clallam County Economic Development Council are project participants, and direct beneficiaries of the economic benefits of this project.

The renewable power produced by the project will contribute to diversification of the generation mix in the region. This energy source also aligns with Clallam County PUD's objective to provide clean energy to customers and the Makah Tribe's interest in using energy derived from renewable resources. In fact, the Makah Nation chose to be an active participant in this project due to the environmental integrity and low impact of AquaEnergy's offshore buoy technology over competing onshore technologies.

[4] The Clallam County PUD service area extends from the coast approximately 100 miles to Olympia.

The successful installation of the Makah Bay offshore power generating plant will herald the beginning of a new renewable energy industry segment, eventually bringing clean, competitively-priced electricity to commercial and residential consumers in Washington State and other coastal U.S. states. The future use of the project's power, its displacement of non-renewable fossil-fueled generation, and its contribution to a diversified generation mix, demonstrate that the project will help meet a need for power in the region, the Clallam County PUD service territory, and specifically, the Makah Indian Nation, during the short and long term.

Other factors that favor the development of alternative technologies like the Makah Bay Project include:

- The economic and environmental benefits of renewable energy over current polluting sources are well documented in the U.S.
- Clean energy technologies are expected to grow from $7 billion to $82 billion by 2010. U.S. renewable energy generation is projected to grow at a faster rate than all other sources except natural gas, continuing the nearly 30 percent growth rate seen in the 1990s.
- According to the U.S. Department of Energy, nationwide demand for power continues to grow at 2 percent per year without sufficient supply to meet it. Electrical generating capacity must double in the next 20 years to meet demand, resulting in an estimated $400 billion per year in revenue from domestic electricity sales.
- The Energy Policy Act of 2005 promotes renewable energy. Specifically, the act calls for the development of cleaner and more productive use of domestic energy sources as well as the diversification in energy supplies through greater use of alternative and renewable fuels. Further, the act recognizes ocean energy, including wave and tidal, as a renewable resource with a significant potential to benefit the U.S.
- Offshore wave energy projects promise to be "...one of the most environmentally benign electrical generation technologies" (Electric Power Research Institute [EPRI] 2004).
- The coastal states of the U.S. will be particularly hard hit by the energy shortages, since much of the country's population resides in these areas, yet most of the transmission and generation infrastructure lies away from these demand centers. Ocean energy contributes to easing the current transmission constraints already threatening the nation's electric grids, by locating dispersed energy sources connected to transmission lines near population centers at the coast.
- The Makah Indian Nation projects tribal benefit as a result of the proposed Makah Bay Project whereby the Makah will derive revenues from the pilot plant operation in accordance with the land lease agreement executed between AquaEnergy and the Makah Indian Nation.

The operation of the project is therefore needed from several perspectives. It provides clean energy to the local community, and it represents a major milestone for the wave energy industry in efforts to achieve practical commercial generation of this emission-free renewable energy source.

3. PROPOSED ACTION AND ALTERNATIVES

This section describes the Proposed Action, including the proposed project facilities and the proposed operation and environmental measures. In addition, this section describes the no-action alternative, and other operating scenarios evaluated by AquaEnergy in developing the Proposed Action, and alternatives considered but eliminated from further evaluation.

A. Proposed Action

1. Project Facilities and Operation

Project Facilities

The Makah Bay Project is supported by a consortium composed of the following members:

- Makah Tribal Council;
- Washington State University Energy Program;
- Clallam County Economic Development Center;
- Clallam County PUD;
- Washington Public Utility Districts Association; and
- AquaEnergy Group, Ltd.

Additional participants assisting on the project include:

- University of Washington;
- Pacific Northwest National Lab,
- Battelle Marine Sciences Lab;
- Evans-Hamilton, Inc.;
- Energy Northwest;
- Bonneville Power Administration;
- Fugro Pelagos (formerly Thales GeoSolutions (Pacific), Inc.);
- Devine Tarbell & Associates, Inc. (DTA);
- Snohomish Public Utility District; and
- Puget Sound Energy.

Although the proposed Makah Bay Project will function as a pilot project in the U.S., the power plant is based on the development of predecessor technologies, namely the IPS Buoy and the Technocean Hose-Pump. These predecessor technologies have successfully passed prototype ocean trials in the North Sea off the Swedish Coast. AquaBuOY is the next generation device, which combines these ocean-tested technologies and employs a reliable and simple design. The Makah Bay offshore pilot plant consists of patented wave energy converters, AquaBuOYs, based on heaving buoy point absorber and hose-pump technologies (Figure 3-1). The portion of the buoys that are above water are similar in size and shape to large navigational aids used to demarcate shipping lanes and identify obstructions. The mechanical portion of the Makah Bay Project will consist of four low-profile moored AquaBuOYs placed 3.7 statute miles (3.2 nautical miles) offshore in water depths of approximately 150 feet. The AquaBuOYs function as a closed loop of high-pressure freshwater system and floating wave energy converter, transforming wave energy into usable electrical energy. The hydraulic-to-electrical conversion takes place inside each AquaBuOY[5]. The AquaBuOY technology is designed specifically for operation in an ocean wave environment and generates power from the substantial up-and-down kinetic motion of the offshore waves.

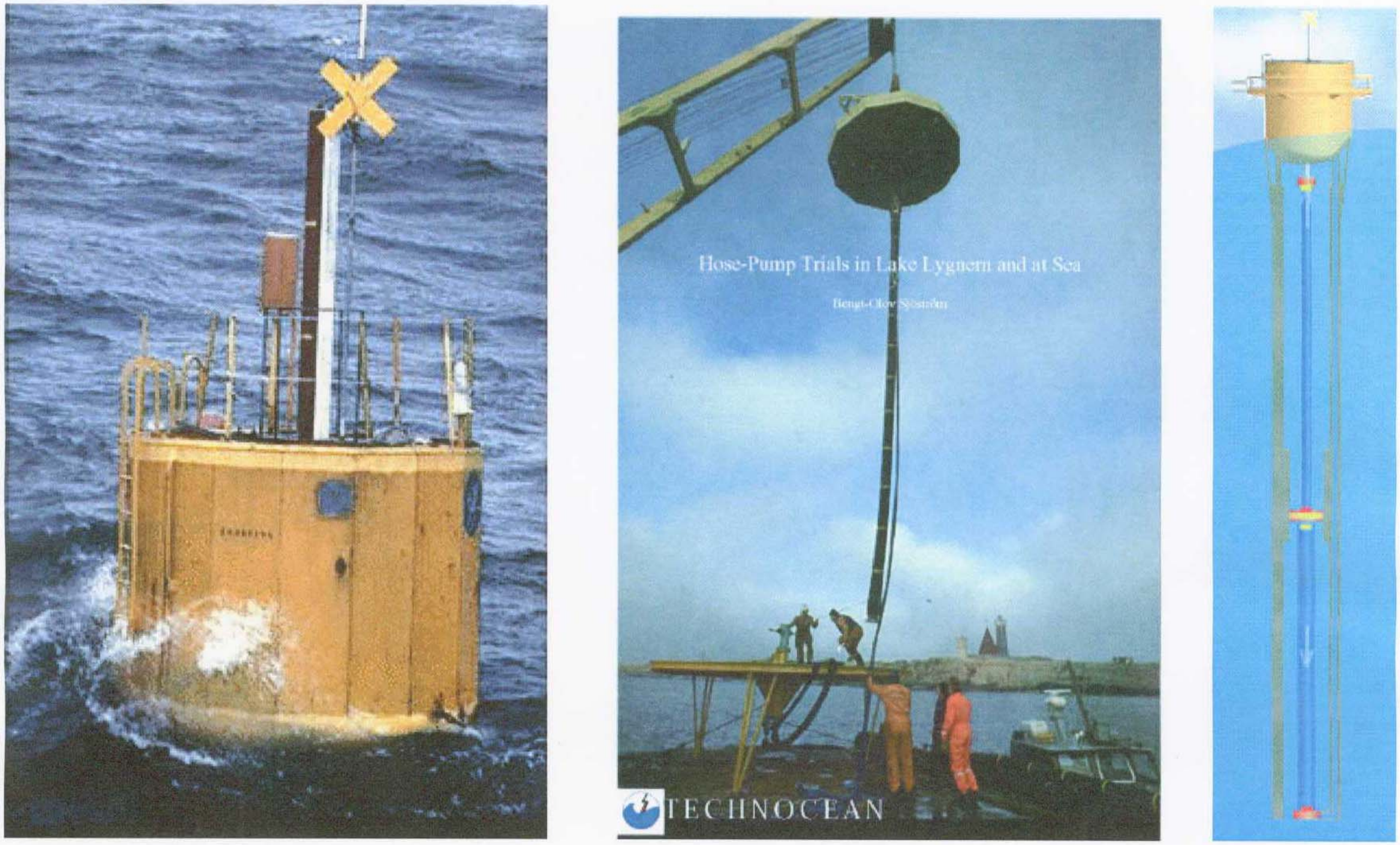
AquaBuOY is a vertical-axis two-body converter: (i) the buoy/acceleration tube assembly, and (ii) the piston, together with the water inside the acceleration tube, designed to deliver 80 to 250 kW of power. Dimensions of the AquaBuOY are tailored to the installation location with an average device having a 19.5-foot-diameter float with a 98-foot-long, 15-foot-diameter acceleration tube. Four devices installed in a cluster form the offshore power plant. All components of the power plant (including buoy hulls, anchors and mooring auxiliaries, energy converters, and turbine-generator housing) will be fabricated in off-site shipyards and machine shops. Members of the local community will participate in the pilot plant installation, monitoring and testing, similar as they have participated during oceanographic data collection. While in machine shops, buoys are fitted with internal systems, such as hose pumps, and hydraulic and electronic controls. The buoys will be spaced about 60 feet apart in a line approximately parallel to the wave front (Figure 3-2). The ocean surface occupied by the four AquaBuOYs and 10 surface floats is approximately 60 feet by 240 feet on the ocean surface. Generated electrical power is delivered to shore via a submarine cable installed on the ocean floor.

Pumped water is directed into a conversion system consisting of a Pelton turbine-driven generator. The hose pump used in the project is the most durable and effective transducer of the linear motion produced by a rising buoy. As the first body, the buoy/acceleration tube assembly, oscillates vertically as a function of surface waves it drives a set of hose pumps that are referenced to the second body — the piston together with the water in the acceleration tube. As the hose elongates, its internal volume decreases to create a pressurized flow of fluid. The flow of this pressurized fluid will be entirely closed-cycle. The working fluid is fresh water. The use of a turbine is simply a matter of internal efficiency and system durability[6]. The hydraulic-to-electrical power

[5] This represents a significant change from the original design where the hydraulic-to-electric conversion would have taken place in a sealed power habitat on the floor of Makah Bay. These changes were made primarily to address agency concerns about impacts to the floor of Makah Bay.

[6] Earlier wave energy buoy prototypes employed neither a hose pump nor turbine but instead an all-mechanical system with a geared shaft, flywheel, and escapement gearing.

FIGURE 3-1
AQUAENERGY AQUABUOY

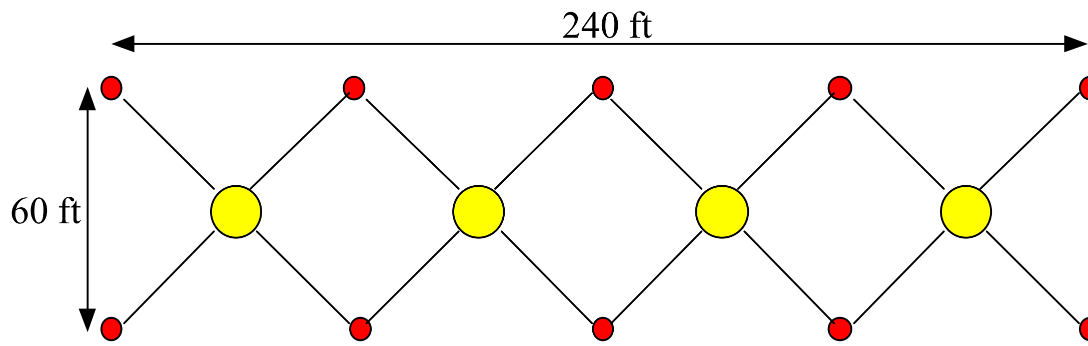


IPS Buoy during ocean testing

Hose Pump installation

AquaBuOY

FIGURE 3-2
PILOT PLANT SURFACE AREA

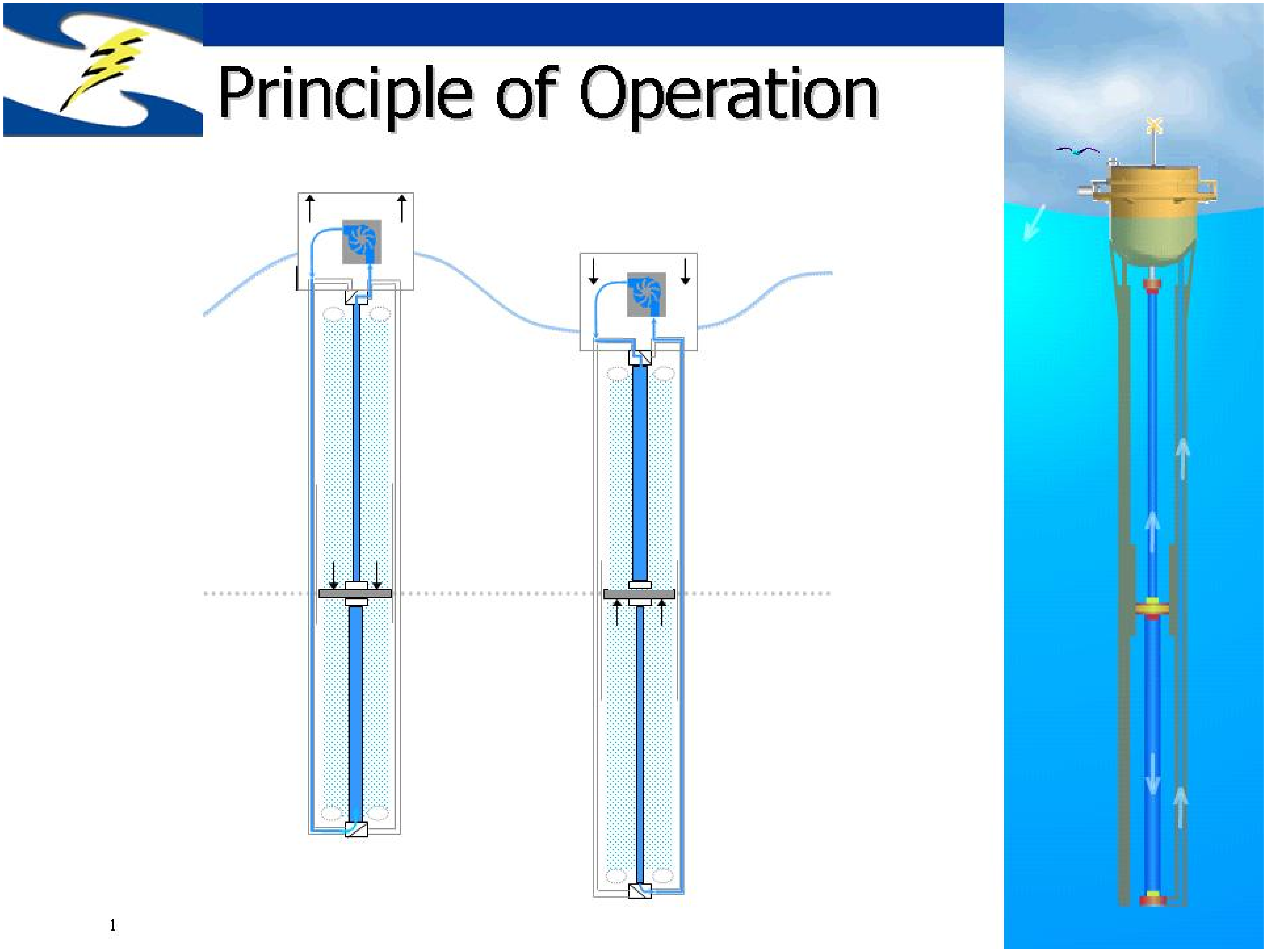


conversion takes place when the pressurized fluid is released through a nozzle to a Pelton turbine, coupled to an electrical generator (Figure 3-3). Pelton turbines are impulse turbines that operate at very high-efficiency rates, typically in the range of 85 percent.

Each AquaBuOY and collection buoy contains the following:

- Two single-acting hose pumps 35 feet in length with an inner diameter 16 to 18 inches, mounted vertically in the acceleration tube. The pumps will be working in a closed-loop hydraulic system filled with fresh water. The total volume of the fresh water hydraulic system is about 1,850 gallons. (There is no interaction between the closed-loop fresh water system and the outside seawater.) The maximum output from both hose pumps is 34 gallons/second (125 liters) at 215 PSI (1.5 Mpa).
- One 200- to 400-liter water accumulator connected to the hydraulic system on the pressure side, its role is to even out the pressure and flow rate of the water feeding into the Pelton turbine.
- One Pelton turbine with a maximum water capacity of 34 gallons/sec at 215 PSI. The turbine rotation speed (revolutions per minute [rpm]) will vary based on incoming water pressure. Pressure nozzles regulating the turbine will be automatic or remotely controlled via an electro hydraulic system.
- One 480V AC variable speed synchronic generator, with a maximum output of 250 kilowatt (kW). Estimated average output is 46 kW (with an average wave resource of 8.5 kW/ft [28 kW/m] wave front).

FIGURE 3-3
PRINCIPLE OF OPERATIONS



- Controls, sensors, RF data link, radar reflector, and sealed/foamed chambers to insure positive buoyancy. Sensing instruments will monitor: wave height and period; buoy heave; piston position in the acceleration tube; piston force; mooring forces; water flow (nozzle); water pressure in different parts of the hydraulic loop; turbine rpm; generator output, v and amp; accumulator pressure; and inside buoy temperature. All sensing equipment will be RF capable to allow for wireless internet connection. All instruments will be equipped with a battery backup system in the event of primary power failure.
- Navigational instruments: navigational light with battery backup and radar reflector; global positioning system (GPS) transmitter in case of break away.
- In addition to the equipment previously described for each AquaBuOY, the Collection Buoy will hold: (1) a 1 MW 480 V/12 kV transformer; and (2) a 1 MW, 12 kV rectifier.

Each AquaBuOY hull will be tethered by a tension cable to four surface floats, each approximately 4 feet in diameter. The surface floats will be connected to sub-surface mooring buoys, located just above the seafloor, by a cable fastened to a chain. The mooring system for each buoy terminates with a chain running from the sub-surface buoy to a connection to the sea-bed placed approximately in a square pattern on the ocean floor with the AquaBuOY approximately centered on the surface above. Heave forces acting on the surface floats and mooring buoys are dampened by lifting the chain slack between the two, which provides ample mooring in storm conditions. The sub-surface floats also serve to prevent chain scouring of the seafloor.

The original sea-bed connection consisting of concrete block has been re-assessed in favor of using a sea-bed connection that would assure that the pilot plant array stay fairly fixed in position and minimize the disturbance to the sea-bed. A conventional catenary mooring with drag anchor has been discounted because it allows quite large positional excursions and because it relies on heavy chain for the principal mooring forces which is expensive.

AquaEnergy intends to use vertical load anchors (VLAs, Figure 3-4) with a near vertical leg connection to the sub-surface mooring buoy that in turn is connected to the buoy array as illustrated in Figure 3-5 and 3-6. Vertical load anchors are a recent development in the off-shore industry, developed to withstand the major loads associated with floating offshore production systems. VLAs are frequently used for mooring oil drilling platforms when in vertical (normal) loading mode. VLAs can withstand both tremendous horizontal and vertical loads. Mooring system installation is achieved by installing opposed VLA pairs and pulling them together with the resulting configuration being a linear array of anchors. Each VLA is installed deep into the seabed with a low

FIGURE 3-4
VERTICAL LOAD ANCHOR

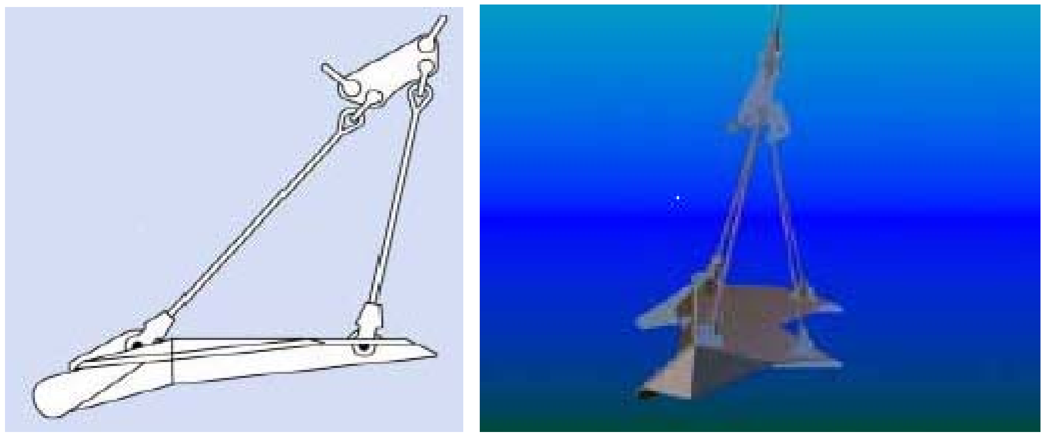


FIGURE 3-5
MAKAH BAY OFFSHORE WAVE ENERGY PILOT POWER PLANT - BLOCK DIAGRAM

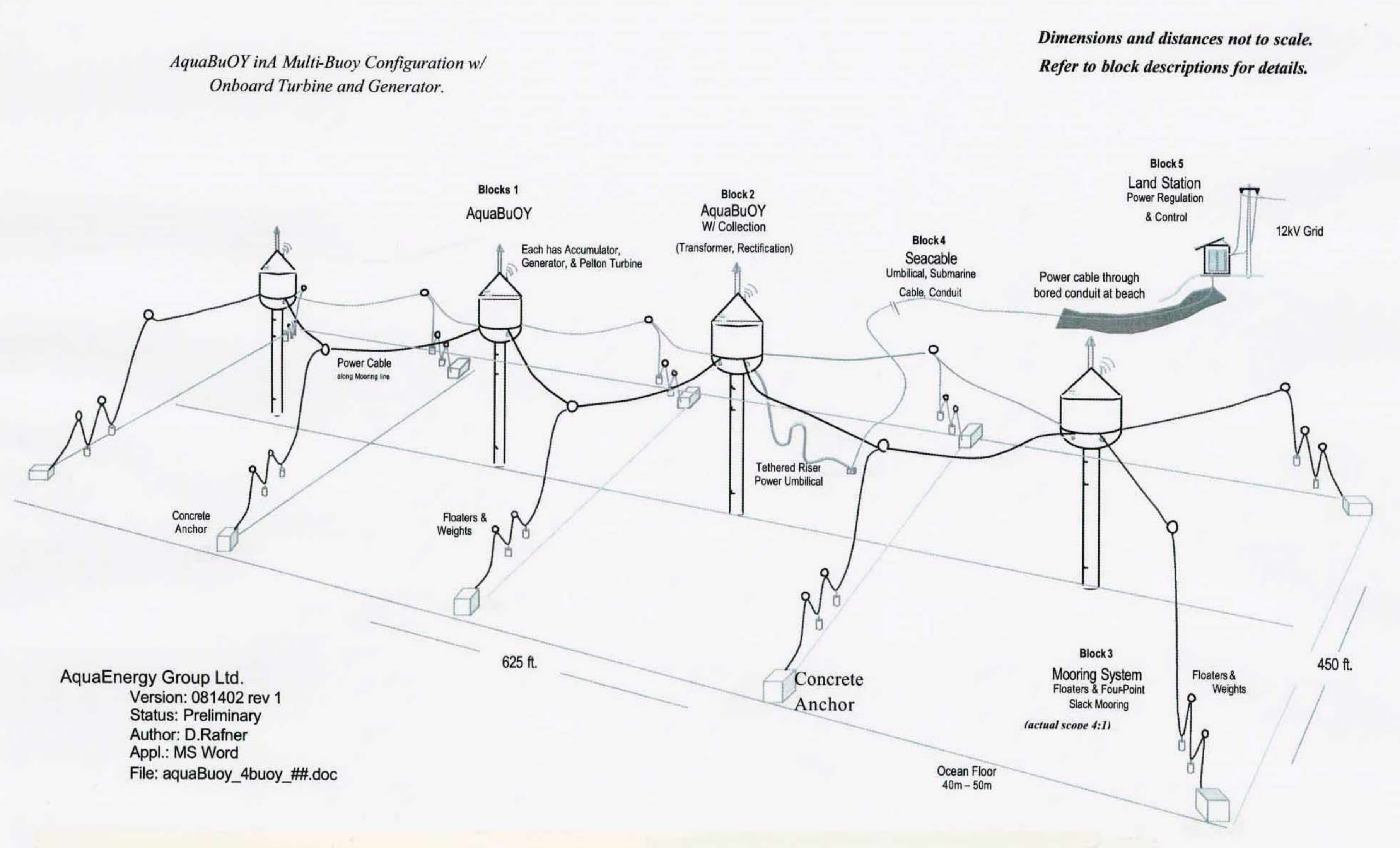


FIGURE 3-6
COLLECTOR AQUABUOY
(*CEII - NOT RELEASED TO THE PUBLIC - SEE VOLUME III OF VI*)

angle between the mooring line and the fluke. When the required installation load is reached, the anchor is triggered to the normal loading mode (the sub-sea tensioner is removed) and the mooring cables are connected loosely to the mooring buoy. In this configuration, the load from the mooring buoy is perpendicular to the fluke, which maximizes the pull-out resistance. The present design of the mooring system is projected to cover a rectangular area of approximately 625 by 450 feet on the ocean floor. The proposed mooring design is shown in Figure 3-5. It should be noted that the figure represents the mooring design that was used during earlier testing in the North Sea. AquaEnergy is considering the use of VLA, instead of concrete anchors as shown in the figure, to reduce the impact on the ocean floor.

It is anticipated that the footprint on the ocean floor area can be reduced with the use of VLAs. Details of the mooring design will be finalized and provided prior to the pilot plant installation with the explicit justification of the minimal ocean floor impact during installation and the subsequent plant operation.

The buoy closest to shore, referred to as the collector buoy, serves as a collector of electrical power, or the hub, receiving generated electricity from the other three buoys. From the hub, a tethered riser umbilical power cable — dimensioned to handle the maximum combined electric output of 1 MW at 12 kV — will deliver the energy to a seafloor DC transmission cable. The transmission cable, which is approximately 3.7 miles long, will lead from the tethered riser into the shore connection. Other than the portion that is HDD, the transmission cable will be anchored to the ocean floor.

From 10 to 30 feet in depth below mean low tide[7] to shore, the transmission cable will be buried using HDD, a technique frequently used for other cable projects[8]. HDD is often preferred to open trenching, especially in intertidal areas, because it does not expose the surface of the seabed and intertidal zone to wave action, thus minimizing erosion and suspension of sediment. No trenching will be required and impacts to the surf zone and Hobuck Beach can thus be eliminated.

The land-based facilities will be located on Hobuck Beach, and will consist of a small distribution station, or shore station (Figures 1-3 and 3-4). This station will be located on tribal lands owned by the Makah Tribe. The building will measure 15 feet by 15 feet and will house the electrical conditioning equipment necessary to connect to the utility grid. This equipment includes a 1 MW, 0.4 kV rectifier, 1 MW, 0.4 kV inverter, 0.4 kV/12 kV transformer, a 12 kV 50 amp switchgear with a connection to the

[7] The depth to which directional drilling will occur will be determined prior to construction and will depend on the results of the eelgrass survey and the suitability of the sediment for HDD.

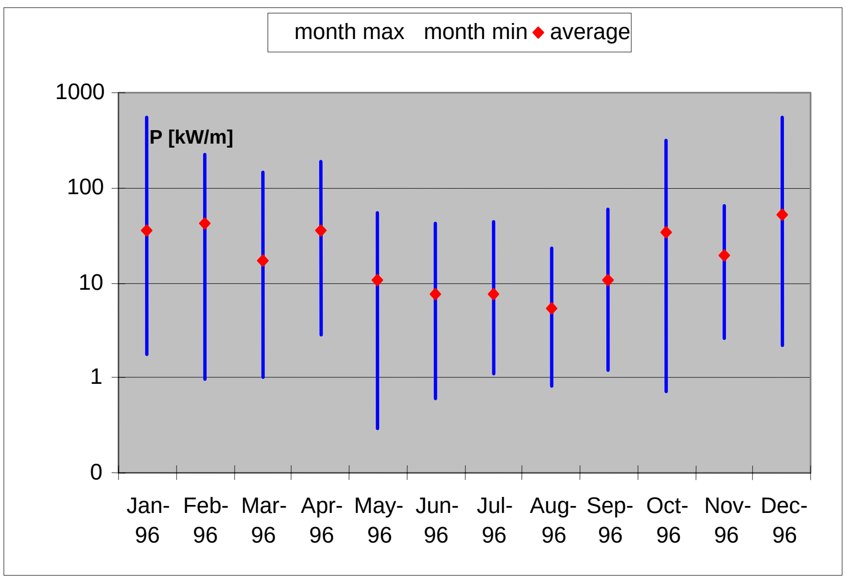
[8] For example, for the Monterey Accelerated Research System Cabled Observator, a 32-mile-long submarine cable currently being constructed in the Monterey Bay National Marine Sanctuary (MBNMS), HDD is being used for the portion of the cable within approximately one mile of shore (CA State Lands Commission and MBNMS 2005; Woods Hole Oceanographic Institution 2006).

transmission cable, and a 12 kV 50 amp switchgear with a connection to the primary distribution line. From this station, the power will be directly connected to the nearby existing Clallam County PUD 12 kV distribution line. The electrical interconnection will be located in close proximity to Makah Passage Road.

Project Operation

The Makah Bay pilot power plant is projected to deliver 1,500 MWh annually. The monthly projection of power is provided in Figure 3-7. The Makah Bay Project includes research, development and system integration of marine components with power delivery equipment for utility grid interconnection, and development and validation of numerical models simulating wave-to-wire system operation.

FIGURE 3-7
MONTHLY AVERAGE, MAXIMUM, AND MINIMUM POWER PROJECTED TO BE PRODUCED AT THE MAKAH BAY PROJECT (BASED ON 1996 DATA)



The power generated at the project will be used by Clallam County PUD in its distribution system to meet the energy needs of the county residents, including members of the Makah Indian Nation. Use of the Makah Bay Project for offshore wave energy generation will result in a substantial reduction in the amount of fossil fuels used (see Section 6.C).

The main objective of the pilot offshore power plant includes:

- Provide energy generated from a renewable source to the western end of the Clallam County PUD service area;

- Validate pilot plant energy generation predictions, its survivability and negligible environmental impacts;
- Research the performance of mechanical principles of wave energy conversion in the ocean (the optimum materials, buoy hull structure, weight characteristics) and electrical components (electronic controls and reliable grid interconnection);
- Validate wave-to-wire numerical models; and
- Collect field data for further studies and analysis of the pilot plant operational characteristics.

The project will operate passively. AquaEnergy intends to develop, in conjunction with the permitting agencies, a regular system maintenance schedule that minimizes site visits, disturbance to the project area marine community, and activity at the site. It is expected that the floating power plant would be visited two to five times per year by boat out of Neah Bay. Buoys will otherwise be monitored using online buoy telemetry equipment. The land-based station would be visited about six times per year by vehicle.

2. Project Construction

The AquaEnergy ocean wave offshore power plants use fabricated modular components. Any construction activities involving hazardous processes or materials (e.g., metal cutting, oil, or paint) are accomplished in existing shore-based shops and shipyards. Most of the system interconnections are preassembled. Using boats designed to deploy anchoring systems, placement of the seabed components (the VLA) is fairly straight forward and not hazardous to the environment. The VLA is a special design of drag embedment anchor that can be triggered so that the angle of the load line through the centroid of its fluke (the centroid angle) increases from about 65° to a final angle of 90° "vertical" to its fluke. When its final centroid angle is reached, the VLA is at its ultimate holding capacity for a given depth of embedment. In addition to its minimal ocean floor impact, VLAs are designed to be retrieved by use of an unlocking device, a chain shank, and a streamlined fluke.

Once buoys, anchors, hoses, and transmission cables are assembled, boats or barges will be used to ferry the buoys and other hardware to the site approximately 3.7 miles offshore where water depth is about 150 feet. The buoy launch is accomplished either by towing the buoys or transporting them to the site aboard crane-equipped buoy tender vessels.

Installing sea-to-shore transmission cable is a specialty job that will be subcontracted to a marine construction firm. The cable will be anchored securely to the ocean floor to prevent movement along the sea floor. The actual anchoring method will be determined with the cable installation company and agreed to prior to the installation with OCNMS and Washington Department of Natural Resources (WDNR). From 10 to 30 feet in depth below mean low tide to shore the transmission cable will be bored horizontally under the beach using HDD methodology. The transmission cable will continue through the surf zone, underground to the grid interconnection behind Hobuck Beach.

It is anticipated that the HDD contractor will use specialized equipment to drill in a substantial pipe conduit along the route of the transmission cable which is to be passed below the seabed. Boring is done with a track-based horizontal boring rig that incrementally adds sections of pipe as the shaft or “drill string” progresses into the ground. When the shaft comes out at its destination, the bit is removed from the end and the transmission cable is attached at that end. The shaft is then pulled back the way it came towards the drilling rig, pulling the cable or conduit back with it.

In many cases, water, mud, or gel is pumped into the drilling shaft while drilling. In the case of putting in an electrical or fiber cable through a beach or even in a suburban neighborhood, pressurized water can greatly speed the drilling process. With some rigs water is immediately recovered, filtered, and put back into a reservoir tank. The precise process that will be used for this project will be determined once a contractor specializing in HDD is selected.

Most of the shore station equipment is housed in a fabricated metal building (approximately 10 feet high with a floor plan measuring 15 feet by 15 feet) that can be erected with small equipment. The construction of the shore station will occur at the same time as the placement of the in-water components. Construction of the shore facilities requires some earthwork (foundation preparation); however, this work will not occur within 200 feet of a water line and no fill will be required. The shore station will be landscaped to blend with the local flora. The only impervious surface is about 200 square feet for the shore station.

It is anticipated that the ocean wave power plant will be deployed in phases. First, a single buoy would be launched and tested for survivability. Subsequently, three additional power buoys and the transmission cable will be deployed over a period of approximately two months. Once all subsystems are in place and interconnected, system integration and testing will commence and continue until the power plant is declared operational.

3. Proposed Environmental Measures

AquaEnergy proposes to operate the project as described above and to implement the following environmental measures:

- Use HDD to deploy transmission cable from shore station, under the beach and intertidal area, out to a depth of 10 to 30 feet below mean low tide (the depth at which HDD will occur will depend on the results of the eelgrass survey to be conducted prior to project construction and the suitability of the sediment for HDD);

- Design features to achieve a closed-loop system to prevent any marine life entering pressurized water flow;
- Utilize anti-fouling paints and materials on the equipment;
- Design features to minimize scale of anchor devices, project footprint on seafloor, and the chain/cable sweep of the seafloor;
- Design buoys to include a heavy-duty plastic conical attachment to be placed over the above-water portion of the buoy to prevent marine mammal haulout and seabird roosting;
- Install GPS transponders in each AquaBuOY for tracking purposes;
- Develop and implement a CRMP consisting of measures to protect cultural resources;
- Develop and implement an interpretive and education plan to provide information regarding the Makah Bay Plant and use of the area by the Makah;
- Develop, in conjunction with the permitting agencies, a schedule of regular system maintenance that minimizes site visits, disturbance to the project area marine community, and activity at the site; and
- Improve and maintain the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and develop design guidelines for future project improvements.

B. Alternatives Analysis

AquaEnergy completed wave resource assessments in key locations throughout the world. The wave energy resource analysis of the U.S. West Coast conducted by AquaEnergy indicated that good to excellent wave energy resource is available from San Francisco to Alaska. However, there were some areas where the combination of the resource/distance to depth was best. The locations considered by AquaEnergy in its analysis of alternative sites were northern California (Eureka/Arcada), southern Oregon, and Washington (Grays Harbor and Makah Bay). Criteria used for site selection included:

- Presence of wave energy resource greater than 6 kW/ft (20 kW/m);
- Distance to 165 feet (50 m) depth less than 2.5 miles (3 nautical miles);
- Power line location in close proximity to the shoreline, requiring no feeder lines to be constructed;
- Interested buyer; and
- Willing landowner.

Following is a summary of AquaEnergy's five site selection criteria and their applicability to the respective site. Only the Washington site meets the selection criteria for five elements.

	Criteria	WA	OR	CA
1	Presence of wave energy resource greater than 6 kW/ft (20 kW/m)	X	X	X
2	Distance to 165 ft (50 m) depth less than 2.5 mi (3 nautical miles)	X		X
3	Power line location in close proximity to the shoreline, requiring no feeder lines to be constructed	X	X	X
4	Interested buyer	X		
5	Willing landowner	X		

In 2001, AquaEnergy submitted a proposal to the California Energy Commission (CEC) for a 1 MW demonstration plant in Northern California under the Public Interest Energy Research (PIER) program. The project was rejected on the basis that CEC had not done the assessment of the California ocean energy resource and thus was not prepared to fund a demonstration project.

The wave energy resource analysis conducted by AquaEnergy indicated that the Oregon wave energy climate has significant seasonal extremes, demanding that the AquaBuOY device design will need to be overdesigned to withstand winter storm conditions. Because AquaEnergy was looking for a demonstration site that had reasonable conditions, i.e., wave resource, distance to depth, willing land owner and buyer, and close proximity of transmission lines to shore, the Oregon site was not pursued further.

On May 30 2001, AquaEnergy held an introduction meeting with Grays Harbor PUD, the Quinault Indian Nation, and the Grays Harbor Economic Development center. The meeting was set-up with the assistance of the then-existing Northwest Energy Innovation Center (NEIC) that included Bonneville Power Authority (BPA) and Energy Northwest. AquaEnergy proposed a demonstration plant to be located off the cost of Long Beach, or further north of the coast of the Quinault Indian Nation. Both proposed locations did not receive a positive reaction for the following reasons:

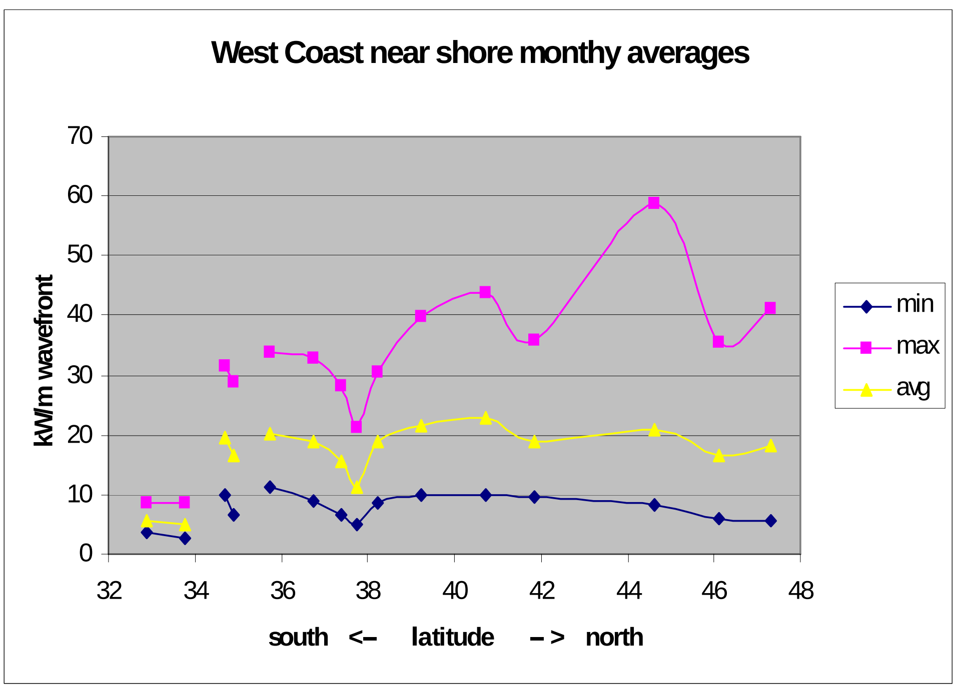
1. The continental shelf in the area is fairly shallow. AquaEnergy's wave energy conversion device, an AquaBuOY, requires a minimum 150 feet. The distance to appropriate depths at both locations was approximately 10 miles and both locations were close to shipping lanes. It was questionable whether a 10-mile-long cable, at a cost of approximately $500k/mile would be warranted for a 1 MW demonstration plant.
2. Grays Harbor PUD was not in need for any additional power. It was willing to wheel the power to BPA lines, but would have required BPA to purchase generated electricity. Since BPA is a federal agency, by law, they would have been required to prepare a full environmental impact statement. This was not feasible at the time as some of the required data would not yet be available and would be collected during the demonstration project. Furthermore, BPA

regulations did not provide for putting in place a power purchase agreement for a non-qualified, pre-commercial installation.

3. There were concerns that, if the above issues could be resolved, the demonstration plant might have an impact on the oyster industry located in the area.
4. The Quinault Indian Nation, though interested in the concept, did not express a desire to purchase generated power.

Results of the assessment of wave sites at different locations throughout the west coast and globally indicated that the waters offshore of the Olympic Peninsula are one of the best locations for a wave energy conversion project. Analysis further indicated that the Makah Bay site would be the ideal location for electrical power generation by means of wave energy conversion compared to other locations on the Pacific Coast of the U.S. (Figure 3-8). With the above issues related to the Grays Harbor site, it was decided by AquaEnergy and NEIC to look for another site in the state of Washington. In the fall of 2001, NEIC arranged a meeting between AquaEnergy, the Makah Indian Nation, the CCPUD and the BPA. All parties attending the meeting agreed to proceed towards a Memorandum of Agreement (MOA) that was signed later that year following a confirmation from Carol Bernthal, Superintendent of the OCNMS (telephone conversation, October 2001) that the demonstration plant can be permitted to be located in the OCNMS as long as it provides economic benefit to the Makah Indian Nation.

FIGURE 3-8
WAVE ENERGY ALONG THE WEST COAST OF THE U.S.



Source: AquaEnergy analysis using data collected from U.S. Coast Guard (USCG) buoys.

Additional factors that favored developing this project at Makah Bay include the following:

- Excellent wave energy potential (approximately 8.5 kW/ft [28 kW/m] wave front) - has good wave energy content and consistent annual wave height;
- Makah Bay site represents one of the better wave energy resources of sites evaluated in the lower 48 states;
- Sufficient water depths (at least 120 feet) within a reasonably close distance from shore (3.7 statute miles);
- Electrical distribution lines of a major utility in a close proximity to the shore;
- Participating land manager and electricity consumer in the Makah Indian Nation;
- Need for energy source on the west end of the Clallam County PUD distribution service territory (see Section 2.B, Need for Power); and
- Close proximity to the boating facilities of Neah Bay.

C. No-Action Alternative

Under the no-action alternative, the project would not be constructed and no economic benefit will be created to either the Makah Indian Nation or the Clallam County. No renewable energy would be generated, and the proposed environmental protection, mitigation, or enhancement measures would not be implemented. This alternative is used to establish baseline environmental conditions for the comparison with the alternatives.

D. Alternatives Considered but Eliminated from Detailed Study

A non-power license is not a realistic alternative to licensing in this circumstance. A non-power license is a temporary license that the Commission could issue whenever it determines that another governmental agency should assume regulatory authority and supervision over the lands and facilities covered by the non-power license. During the scoping process for the Makah Bay Project, no participant recommended or indicated they wanted a non-power license. Quite simply, the purpose of the project is to generate electricity; if a non-power license were issued for the project, it would not be built.

4. CONSULTATION AND COMPLIANCE

A. Consultation

The Commission's regulations (18 CFR §16.8) require applicants to consult with the appropriate resource agencies before filing an application for a license. This consultation is the first step in complying with the Fish and Wildlife Coordination Act (FWCA), the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), and other federal statutes. Pre-filing consultation must be completed and documented according to the Commission's regulations.

1. Scoping

On November 15, 2001, a Consortium was formed to install a pilot project to generate electricity from ocean wave energy. Leading the endeavor was AquaEnergy Group Ltd. of Mercer Island, Washington, owner and developer of ocean-tested technology to harvest power from ocean waves. The Makah Nation and Clallam County PUD are project participants, as was the then-existing Northwest Energy Innovation Center made up of the Bonneville Power Administration, Energy Northwest, Pacific Northwest National Lab and Washington State University[9]. Other project endorsers include Snohomish Public Utility District, EPRI, National Renewable Energy Laboratory, Seattle City Light, and Puget Sound Energy. Additional team members for marine, mechanical, or electrical research on the project include: University of Washington, Oregon State University, and Battelle Marine Sciences Lab.

Beginning in 2002, AquaEnergy initiated meetings with various state and federal agencies, including NOAA, FERC, the U.S. Army Corps of Engineers (USACE), the Washington State Departments of Ecology (WDOE), Washington Department of Fish and Wildlife (WDFW), and the Washington Department of Natural Resources (WDNR). On April 18, 2002, AquaEnergy held a project kick-off meeting in Port Angeles, Washington with these entities to explain the proposed project and identify the permits which needed to be obtained from these agencies for development of the Makah Bay Project. AquaEnergy worked with NOAA to identify the studies to be performed. From April to August 2002, AquaEnergy filed a number of preliminary permits, including a Joint Aquatic Resources Permit Application (JARPA), which was submitted to a number of resource agencies in May 2002. The JARPA served to coordinate environmental review of the project for issuance of other non-FERC-required permits, findings, and use authorizations[10]. A revised JARPA was submitted in March 2003.

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[9] The clean energy project continues to be supported by Consortium partners that have changed little from the time of its formation with the goal of demonstrating the economic, environmental, and tribal benefits of offshore wave energy in the U.S.

[10] The JARPA covered the following permits and use authorizations: a Section 404/Section 10 permit from the USACE, a Section 401 Water Quality Certificate from the WDOE, a Coastal Zone Management Act (CZMA)

Permits and use authorizations received to date include:

- USACE - Permit received for monitoring buoy deployment;
- WDNR - Land Lease Agreement executed;
- NOAA - Research and Education - Received two permits for oceanographic research;
- U.S. Coast Guard - Permit received for monitoring buoy deployment; and
- Submitted WDFW permit application for plant - permit pending.

On April 23, 2002, AquaEnergy filed a Declaration of Intention for the development of the project with FERC. In orders issued October 3, 2002 and February 28, 2003, FERC determined that the Makah Bay Project is required to be licensed under Part 1 of the FPA. Thus, AquaEnergy has formally engaged in the FERC licensing process in addition to the numerous other required federal, state, and local permitting and use authorization processes.

AquaEnergy also initiated discussions with the local community to explain the proposed project and garnered support for the project from the Makah Indian Tribe, the local utility, and the community at large for the Makah Bay Project. For example, the Clallam County PUD board meetings generally include an overwhelming majority of customers supportive of the project and over 800 signatures were collected in support of the project and provided to Washington elected officials.

As a result of scoping, AquaEnergy conducted a number of oceanographic and geophysical studies from October 2002 to February 2003 to collect the necessary environmental data for use in the preparation of the environmental assessment document. These studies are described further in Section 4.A.2 below.

On April 17, 2003, AquaEnergy contacted the resource agencies and other identified stakeholders and invited their participation in the FERC ALP and the development of a communications protocol. The communications protocol was developed through two teleconferences and preparation of six drafts incorporating the agencies' comments. The list of entities that expressed an interest in participating in the ALP are as follows:

- Makah Indian Nation;
- Clallam County Economic Development Council;
- NOAA;

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certification and consistency determination, a Hydraulic Project Approval (HPA) from the WDFW, an Aquatic Lands Lease from the WDNR, an Aid to Navigation Permit from the U.S. Coast Guard, and an Archaeological Evaluation from the Makah Tribal Council.

■ NOAA - OCNMS;
■ WDFW;
■ WDNR;
■ Washington State Office of Archaeology and Historic Preservation;
■ WDOE;
■ U.S. Coast Guard;
■ USFWS;
■ USACE; and
■ FERC.

As established in the communications protocol, AquaEnergy developed a secure server, available only to Participants for retrieval of all project documents, meeting minutes, meeting agendas, and other project information. AquaEnergy developed a project list serve, an email address, makah_permits@aeg-ltd.com, to distribute email to the following participants representing the above-listed entities:

■ Charlie White, Makah Tribal Council
■ John Arum, Makah Tribal Council
■ Charlene Andrade, WDFW
■ Martha Hurd, WDNR
■ Sally Toteff, WDOE
■ Wendy Bolender, WDOE
■ Carol Bernthal, OCNMS
■ Ed Bowlby, OCNMS
■ George Galasso, OCNMS
■ Liam Antrim, OCNMS
■ Mary Sue Brancato, OCNMS
■ David Bizot, NOAA
■ Molly Holt, NOAA
■ Pat Gearin, NOAA
■ Louellyn Jones, USFWS
■ Jessica Gramling, USACE
■ Olivia Romano, USACE
■ Tim Westcott, USCG
■ Nicholas Jayjack, FERC
■ Mary Jane Parks, AquaEnergy

Note: This list is current as of the date of this filing.

In lieu of AquaEnergy emailing attachments to the list serve, participants agreed to download project documents from AquaEnergy's secure server. In addition AquaEnergy provided project information on its company website at http://www.AquaEnergy Group.com.

On July 6, 2003, AquaEnergy submitted a request to the Commission to use the ALP to file a license application for the Makah Bay Project. The Commission approved the request on September 4, 2003. AquaEnergy sent the ALP participants Scoping Document 1 (SD1) (dated July 2003) on August 5, 2003 to enable resource agencies, Indian tribes, and other interested parties to effectively participate in and contribute to the scoping process. SD1 requested clarification of preliminary issues concerning the proposed project and the identification of new issues that needed to be addressed in AquaEnergy's PDEA.

On August 26 and 27, 2003, AquaEnergy held three scoping meetings in the project area in order for the public and participating government agencies to determine the issues associated with the project. Interested agencies, nongovernmental organizations (NGOs), and individuals were invited to attend one or all of the meetings and to assist in identifying the scope of environmental issues to be analyzed in the PDEA. The times and locations of these meetings were as follows:

- Public Scoping Meeting: Tuesday, August 26, 2003; 7:00 p.m. to 9:00 p.m.; Makah Tribal Community Center Neah Bay, Washington
- Agency Scoping Meeting: Tuesday, August 26, 2003; 5:00 pm to 6:00 pm; Makah Tribal Offices Neah Bay, Washington
- Public Scoping Meeting: Wednesday, August 27, 2003; 7:00 p.m. to 9:00 p.m.; Clallam County PUD, Port Angeles, Washington

AquaEnergy conducted a site visit to the project for interested parties on Tuesday, August 26, 2003. Scoping meetings were recorded, and all statements (oral and written) were included as part of the Commission's public record for the project. Stakeholders were invited to provide written comments to the Commission.

Following the three scoping meetings and public comment period for SD1, AquaEnergy revised SD1, as necessary, to reflect comments received during the scoping comment period, and issued Scoping Document 2 (SD2). The first draft of SD2 was issued to the participants October 2003. Written and oral comments were received throughout the scoping process, and a number of revised drafts of SD2 were produced and distributed to participants for their review. Ultimately, the final SD2 draft was issued May 2005 and addressed comments received during the scoping process. Comments were also received by numerous individuals at the scoping meetings. In 2004, support expanded to include the Washington State Public Utility Districts Association.

On June 27, 2005, AquaEnergy convened a technical meeting with stakeholders in Port Angeles, Washington. The purpose of the meeting was to review completed studies and discuss efforts to develop the PDEA and license application. Meeting minutes were distributed to stakeholders on July 12, 2005. At that meeting, all agency participants indicated a desire to see this project succeed.

AquaEnergy completed an initial draft of the PDEA and submitted it to the resource agencies for their informal preliminary review on December 6, 2005. Comments were received from OCNMS, WDFW, and WDNR in letters all dated January 3, 2006. OCNMS provided additional comments in emails dated January 6 and 16, 2006. AquaEnergy revised the PDEA in response to these comments, which are included along with AquaEnergy's disposition of the comments, in Appendix A.

Completion of the NEPA and State Environmental Policy Act (SEPA) reviews will culminate in FERC license and NOAA and other agencies environmental and use authorization permits including:

- Section 404/Section 10 Permit - USACE;
- Hydraulic Project Approval - WDFW;
- Aquatic Lands Use Authorization - WDNR;
- OCNMS Permit;
- NMFS consultation;
- USFWS consultation;
- Archeological evaluation - Makah Tribal Council; and
- Aid to Navigation Permit - U.S. Coast Guard.

In response to specific resource agency concerns and suggestions, the project, as described in Section 3.A.1, has gone through several extensive re-designs in the past year. Major modifications include:

- After an April 2002 permit review by the WDFW, AquaEnergy altered its 2002 project design to adopt a closed-loop hydraulic pump system that prevents entrainment of small fish and sea life[11].
- AquaEnergy, based on WDFW recommendation that the AquaBuOY hull prevent sea birds from nesting and landing on the buoys, re-designed the top of the AquaBuOY to a cone shaped-design.
- The WDFW further recommended the use of anti-fouling properties on the buoys and minimal maintenance on the habitat structure (housing the turbine and generator) that might be placed on the sea floor, to prevent habitat or artificial reef disturbance. In response to an OCNMS request, AquaEnergy agreed to evaluate different brands of antifouling paints to identify those that worked best.
- Subsequent to the initial OCNMS input, AquaEnergy removed the turbine-generator habitat structure from the sea floor.

[11] The turbine system was made entirely self contained by employing a closed-loop hose pump system, contact of seawater and potential entrainment of marine life with the Pelton turbine or project generating works is eliminated.

- OCNMS recommended that the anchor chain used to connect the AquaBuOYs to the concrete anchors on the sea floor be lifted in such a way as to prevent scouring of the sea floor. Based on these comments, AquaEnergy first redesigned the anchor and chain configuration to include an interim float to buoy the chain and prevent it from laying on the sea floor. As stated by AquaEnergy at the June 27, 2005 project technical meeting, AquaEnergy further modified the design to eliminate potential ocean floor scouring, reduce the ocean floor footprint, and to provide for anchors removal after the test period through the use of vertical load anchors.

Since initiation of the Makah Bay Project, AquaEnergy has consistently consulted with resource agencies and stakeholders in order to inform them about project status and to ensure that appropriate actions are taken to minimize any potential project impacts.

2. Studies

As a result of scoping, AquaEnergy conducted the following oceanographic and geophysical studies from October 2002 to February 2003 to collect the necessary environmental data for use in the preparation of the environmental assessment document:

- Current analysis (Evans-Hamilton 2006)
  - trawl-resistant profiling current meter bottom-mount Sontek 500 kHz Accoustic Doppler Profiler (ADP) current meter-mounted upward-looking in a trawl-resistant bottom mount
- Surface wind and wave analysis - wave height and period (Evans-Hamilton 2006)
- Sediment variation evaluation (Evans-Hamilton 2006)
  - eight Van Veen sediment samples
  - analysis of sediment grain size
- Geophysical survey - (Thales GeoSolutions (Pacific), Inc. [TGPI] 2002)
  - seafloor and vegetation mapping
  - bathymetric survey using a multibeam echo sounder
  - side-scan sonar survey
  - sub-bottom profile survey using methods approved for archeological investigations
- Seagrass survey - As was agreed during a telephone conversation between Alla Weinstein, AquaEnergy, and Bob Burkle, WDFW, on August 30, 2005, and summarized in a letter from Devine Tarbell & Associates, Inc. (DTA) to WDFW dated September 7, 2005, AquaEnergy will conduct a seagrass survey during summer months prior to the time of construction.

Data and available summary reports were made available to stakeholders starting in June 2003 on an FTP internet site that AquaEnergy established for the purpose of sharing project information. Study results were summarized at the technical meeting with stakeholders held in Port Angeles on June 27, 2005. Summaries of study results are also included in the PDEA under relevant resource areas in Section 5, Environmental Analysis.

B. Compliance

This section describes conditions and prescriptions filed under mandatory conditioning authorities, recommendations filed under Section 10(j) of the FPA, and the status of any related consultation.

1. Water Quality Certification (Clean Water Act)

AquaEnergy is required to apply to WDNR for Section 401 water quality certification (WQC), as required by the Clean Water Act (CWA).

2. Endangered Species Act

Section 7 of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species. AquaEnergy contacted National Marine Fisheries Service (NMFS) and USFWS and requested information regarding threatened or endangered species in the project area on May 14, 2002. Regarding other species, AquaEnergy was directed to WDFW's web site which lists threatened and endangered species for the State of Washington. Species listed under the ESA that could occur in the project area are presented in Table 4-1.

TABLE 4-1
FEDERALLY-LISTED THREATENED OR ENDANGERED SPECIES THAT MAY OCCUR IN THE PROJECT AREA

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Northern right whale	*Balaena glacialis*	Mammal	Endangered
Blue whale	*Balaenoptera musculus*	Mammal	Endangered
Fin whale	*Balaenoptera physalus*	Mammal	Endangered
Humpback whale	*Megaptera novaeangliae*	Mammal	Endangered
Sei whale	*Balaenoptera borealis*	Mammal	Endangered
Sperm whale	*Physeter macrocephalus*	Mammal	Endangered
Orca (killer whale)	*Orcinus orca*	Mammal	Endangered
Brown pelican	*Pelecanus occidentalis*	Bird	Endangered
Short-tailed albatross	*Phoebastria albatrus*	Bird	Endangered
Bald eagle	*Haliaeetus leucocephalus*	Bird	Threatened
Marbled murrelet	*Brachyramphus marmoratus*	Bird	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Reptile	Endangered
Steller sea lion	*Eumetopias jubatus*	Mammal	Threatened

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Green sea turtle	*Chelonia mydas*	Reptile	Threatened
Loggerhead sea turtle	*Caretta caretta*	Reptile	Threatened
Coho Salmon	*Oncorhynchus kisutch*	Fish	
Southern OR/Northern CA Coasts ESU			Threatened
Oregon Coast ESU			Threatened
Chinook Salmon	*O. tshawytscha*	Fish	
Snake River Fall-run ESU			Threatened
Snake River Spring/Summer-run ESU			Threatened
Puget Sound ESU			Threatened
Lower Columbia River ESU			Threatened
Upper Willamette River ESU			Threatened
Upper Columbia River Spring-run ESU			Endangered
Chum Salmon	*O. keta*	Fish	
Hood Canal Summer-run ESU			Threatened
Columbia River ESU			Threatened
Sockeye Salmon	*O. nerka*	Fish	
Snake River ESU			Endangered
Ozette Lake ESU			Threatened
Steelhead	*O. mykiss*	Fish	
Upper Columbia River ESU			Endangered
Snake River Basin ESU			Threatened
Lower Columbia River ESU			Threatened
Upper Willamette River ESU			Threatened
Middle Columbia River ESU			Threatened
Sea-run Cutthroat Trout	*O. clarki clarki*	Fish	
Umpqua River ESU			Endangered

Source: WDFW 2005*a*, NOAA 2005*c*.

As a result of this finding, on December 5, 2005, AquaEnergy filed a request to be designated the non-federal representative for Section 7 ESA consultation with the USFWS and NMFS to discuss these species and determine appropriate actions related to the presence of these species in the project area.

3. Section 10(j) Recommendations (Federal Power Act)

Under Section 10(j) of the FPA, each license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the appropriate agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency.

4. Coastal Zone Management Act

Under Section 307(c) (3) (A) of the Coastal Zone Management Act (CZMA), 16 U.S.C. § 1456(3) (A), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program. AquaEnergy is consulting with state agencies on CZMA consultation requirements.

5. National Marine Sanctuary Permit (National Marine Sanctuaries Act)

With the 1972 National Marine Sanctuaries Act (NMSA), Congress directed NOAA to identify, designate and manage National Marine Sanctuaries for the American people (OCNMS 2005). The OCNMS, created in 1994, stretches from the Olympic coast an average of 35 miles into the Pacific Ocean (NOAA 2005*a*). It is adjacent to or has jurisdiction that overlaps with the coastal strip of Olympic National Park, the offshore Washington Islands National Wildlife Refuge islands and the Usual and Accustomed fishing areas for four treaty tribes (the Makah, Quileute, Hoh and Quinault) (Bowlby et al. 2001). The Sanctuary is "... managed to protect its natural resources while encouraging compatible commercial and recreational uses", and it has many management partners, including tribal entities, state agencies, and the academic community (NOAA 2005*a*; Bowlby et al. 2001). A sanctuary permit will be required because OCNMS regulations cover seafloor disturbance and placement of structures. Furthermore, the OCNMS Management Plan provides for permitting of projects that carry economic benefits to Indian tribes located within OCNMS boundaries.

6. Marine Mammal Protection Act

The 1972 Marine Mammal Protection Act (MMPA) is the principal federal law that guides marine mammal conservation. Under the MMPA, on the West Coast, NMFS is responsible for the management of cetaceanns and pinnipeds, while the USFWS manages sea otters (NMFS 2005). The MMPA prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. It also prohibits the harassment of all marine mammal species.

7. State-Owned Aquatic Lands (As established by the Submerged Lands Act and Outer Continental Shelf Lands Act)

The state owns submerged lands out to 3 nautical miles (3.5 statute miles). These tidelands and bedlands are managed by the WDNR and are subject to leasing from the State of Washington.

5. ENVIRONMENTAL ANALYSIS

A. General Description of the Project Area

The Makah Bay Project is located 3.7 statute miles (or 3.2 nautical miles) offshore, generally west of Hobuck Beach and south of Waatch Point in Makah Bay, Clallam County, Washington (latitude and longitude: 48º 19 min 53 sec N, 124º 44 min 18 sec W) (Figures 1-1 and 1-2). The buoys will occupy an area of 60 feet by 240 feet on the ocean surface. The anchors will cover an area of approximately 450 feet by 625 feet or less resulting from the final mooring system design. The water depth at the buoy location is about 150 feet. Makah Bay is about 3¼ miles southwest of the community of Neah Bay (Figure 1-1). The in-water part of the project is in Washington State waters, the OCNMS, the Flattery Rocks National Wildlife Refuge and the Makah Usual and Accustomed Grounds, and the shore-based facilities are on tribal land of the Makah Indian Nation. The shore station location is Hobuck Beach. The sea-to-shore transmission cable will run from one of the four AquaBuOYs, called the hub buoy, to the interconnection station, along the seafloor and under the sandy beach slope. The proposed route of the transmission cable is presented in Figure 5-1.

The State of Washington's seaward boundary is nominally 3.5 statute miles (3 nautical miles) seaward of land; however, this distance can be greater depending on the presence of island, headlands, etc. In the proposed project area, the state aquatic land ownership boundary extends about 5.3 miles offshore. Consequently, the entire project, including the AquaBuOYs and underwater transmission cable will be on state-owned aquatic lands. The OCNMS is administered by NOAA and occurs along Washington's Olympic Peninsula from the Strait of Juan de Fuca (at the mouth of Puget Sound) 135 miles (OCNMS 2005) south to the Copalis River, located to the north of Grays Harbor. The Sanctuary extends 20 to 40 miles into the Pacific Ocean from the coast, covering 3,300 square miles. The Flattery Rocks National Wildlife Refuge is administered by the USFWS and extends from the northern tip of the Olympic Peninsula over 20 miles south, where it abuts the Quillayute Needles National Wildlife Refuge. These two National Wildlife Refuges, along with the Copalis National Wildlife Refuge, located along the southern end of the OCNMS, are referred to as the Washington Islands National Wildlife Refuge. These combined refuges consist of 870 islands, rocks, and reefs along over 100 miles of the Washington coast and extends more than 100 miles seaward (USFWS 2001, 2005).

FIGURE 5-1
PROJECT AREA BATHYMETRY (SHEET 1 OF 2).

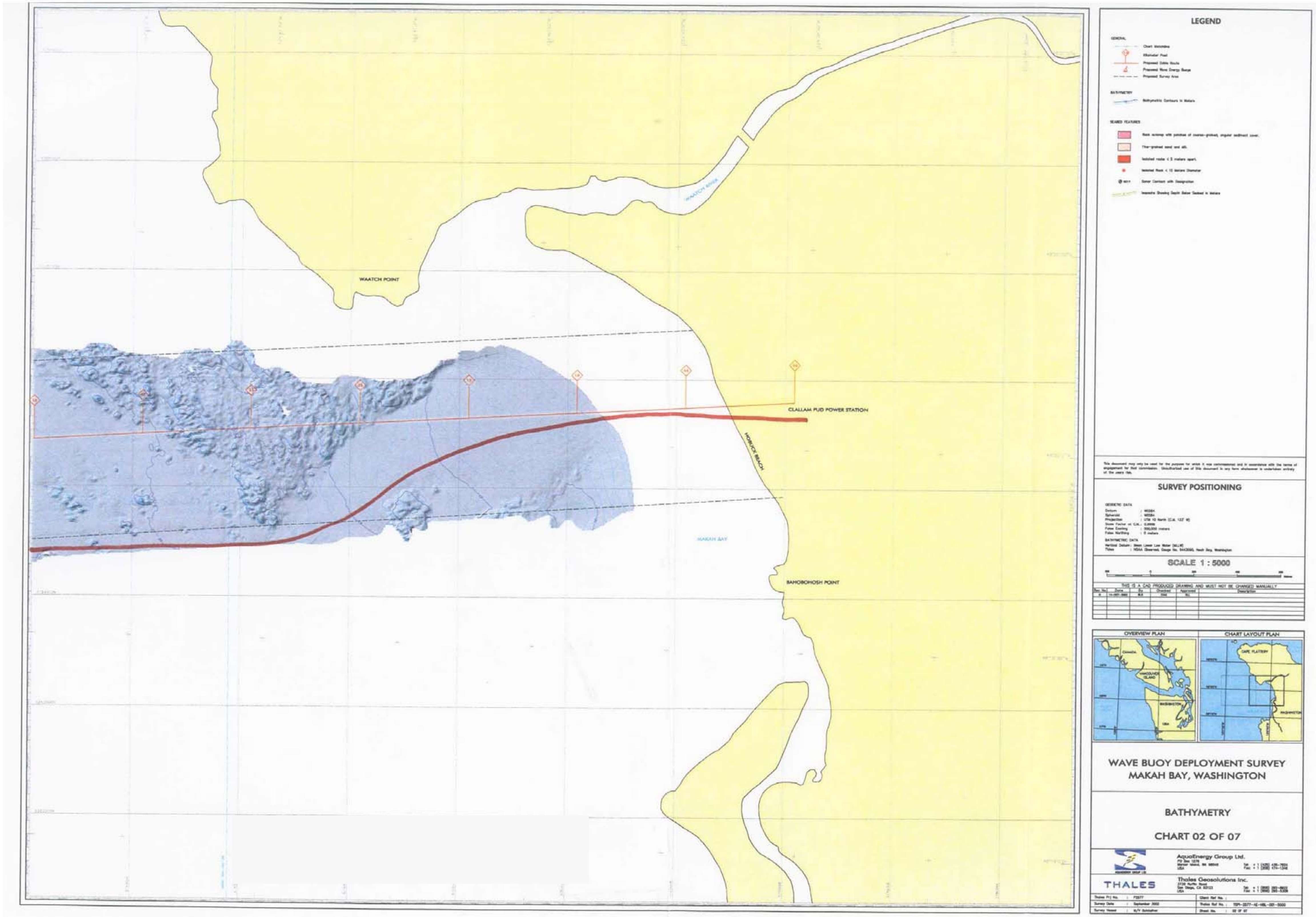
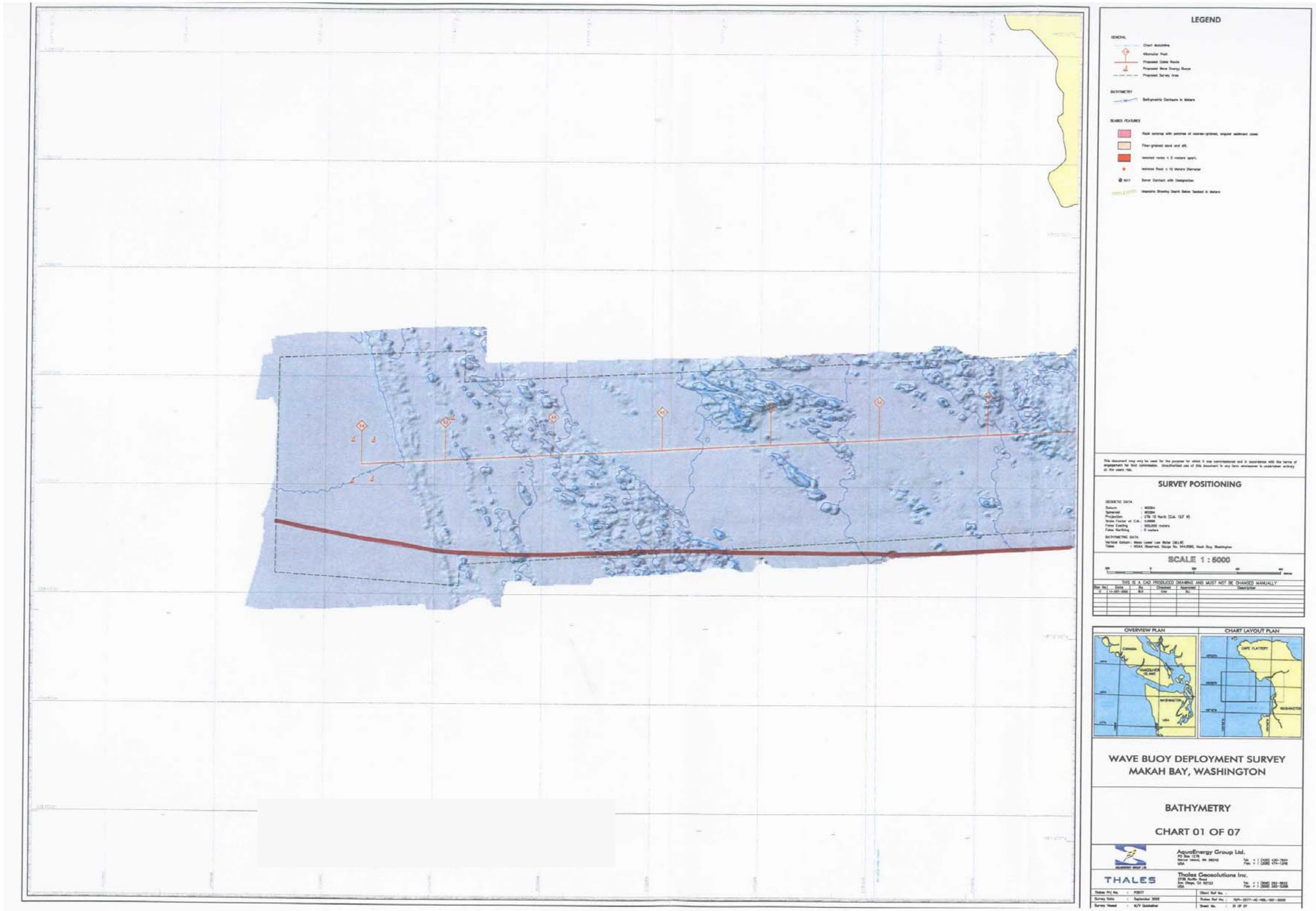


FIGURE 5-1
PROJECT AREA BATHYMETRY (SHEET 2 OF 2).



The Olympic coast is sparsely populated with almost the entire coastline being undeveloped (NOAA 2005*a*). Most of the Olympic Coast is either wilderness, part of the Olympic National Park (48 miles [NOAA 2005*a*]), or Tribal land. The Makah Indian Nation occupies 47 square miles on the tip of the Olympic Peninsula. Other Olympic Coast tribes, which are located to the south of the project site, are the Quileute, Hoh and Quinault. Exposed rocks, sea stacks, and islands that occur in the Sanctuary are part of the Washington Islands National Wildlife Refuge (NOAA 2005*a*).

In describing the OCNMS, NOAA (2001) stated:

> *The region's high biological productivity is fueled by seasonal enhanced upwelling along the edge of the continental shelf, especially at submarine canyons, during periods of high solar radiation and northwesterly winds.*
>
> *The diversity of habitats that make up the Sanctuary supports a great variety of biological communities. The unusually large range of habitat types include: offshore islands and rocks (most within the three National Wildlife Refuges: Flattery Rocks, Quillayute Needles, and Copalis); kelp beds; intertidal communities; erosional features such as rocky headlands, sea stacks, and arches; interspersed exposed beaches and protected bays; submarine canyons; the continental shelf, including a broad shallow plateau extending from the mouth of the Juan de Fuca canyon; and continental slope environments.*

Western Washington has relatively mild winters and dry cool summers. OCNMS (2005) further characterizes the project area climate as follows:

> *Most air masses reaching the coast originate over the Pacific Ocean and exert a moderating influence throughout the year. In late spring and summer, westerly to northwesterly winds associated with the North Pacific high pressure system produce a dry season. In late fall and winter, southwesterly and westerly winds associated with the then dominant Aleutian low pressure system provide ample moisture and cloud cover for the wet season which begins in October.*
>
> *The rising and cooling of moist air along the windward slopes of the Willapa Hills and Olympic Mountains produces an area of heavy precipitation from the coast to the crests. Annual amounts range from 70 to 100 inches over the southern coastal plains and from 125 to 200 inches in the "rain forest" area on the western slope of the Olympic Mountains (op. cit.). Afternoon temperatures near the coast during the summer are generally in the upper 60's (°F). In an average winter, maximum temperatures range from 38° to 45° and minimums from 28° to 35°.*

Ocean surface water temperature near the coast averages about 48° in February, 52° in May, 57° in August, and 50° in November. The temperature range offshore is slight throughout the year, thus inshore-offshore migrations of biota associated with seabed temperature changes do not occur.

Typically, rough seas and large waves occur off of the Olympic Coast. Wave heights ranging from 50 to 90 feet have been documented off of the continental shelf (OCNMS 2005).

B. Cumulative Effects

- **Pilot Project -** According to the Council on Environmental Quality's regulations for implementing NEPA (§1508.7), an action may cause cumulative impacts on the environment if its impacts overlap in time and/or space with the impacts of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time to include energy generation and other land and water development activities. Through scoping, agency consultation, and our independent analysis we have identified no resources that would be cumulatively affected by construction and operation of the Makah Bay Project. As described in the following sections, the project represents a very small footprint, has negligible environmental impacts, and is located in the OCNMS[12], which has little existing or planned future developmental activity.
- **Commercial-scale Project -** AquaEnergy is currently seeking to install only the four-buoy pilot project. There are no definitive plans for future activity. However, given that the purpose of this proposal is to demonstrate the commercial viability of the wave energy power generation technology, it is conceivable that the successful results of the project might lead to a desire for additional developments at sites with favorable characteristics and infrastructure. For a commercial-scale project, it is likely that some of the issues addressed in this PDEA would likely be more significant and require a more thorough analysis (i.e., potential effect to marine mammal movements, exclusion of other activities from the area, navigational concerns, etc.). If at some point in the future AquaEnergy chooses to consider expanding the project at this site, AquaEnergy would initiate a new round of acquiring necessary permits or amendments and would engage in additional environmental review.

[12] The OCNMS occurs along Washington's Olympic Peninsula from the Strait of Juan de Fuca (at the mouth of Puget Sound) 135 miles (OCNMS 2005) south to the Copalis River, located to the north of Grays Harbor. The Sanctuary extends 20 to 40 miles into the Pacific Ocean from the coast, covering 3,300 square miles.

C. Proposed Action and Action Alternatives

1. Geological Resources

a. Affected Environment

The seafloor within the project area consists primarily of fine-grained sand and silt surrounding large rock outcrops and smaller groups of scattered rock (TGPI 2002). TGPI conducted a seabed survey at the project area of Makah Bay on September 22 and 23, 2002. During the survey, multibeam bathymetry, including backscatter data, and shallow sub-bottom data were acquired. The primary purpose of the study was to aid in selection of a site for placement of the buoys and identify routes for transmission cables connecting the buoys to the shore station (TGPI 2002).

The seabed in the project area descends gently from the shore to approximately 150-foot water depth at the location of the buoy deployment site. Several rock outcrops cross the area, and the relief across these outcrops is very steep locally, with some pinnacles rising over five meters from the otherwise relatively flat seabed (TGPI 2002). This is exemplified by Figure 5-1, which shows the bathymetry of the project area.

The general slope of the marine portion of the project area is flat with the ocean bottom having a slope of approximately 1.5 percent. For the entire project area, sand- to silt-sized sediment covers approximately 60 percent of the seafloor; the remaining 40 percent consists of rock outcrop. The nearshore bottom surface is sandy out to a water depth of approximately 70 feet. Figure 5-2 shows seabed features of the project area. Multibeam backscatter data reveal large areas of modern sediment surrounding rock outcrop. Coarse-grained, angular sediment blankets much of the rock in a shallow layer and extends minimally beyond the edge of the outcrop. Sub bottom profiler data are consistent with this finding. Ripples are seen locally in the coarse-grained, angular sediment covering the rock. Their wavelength is less than 6.5 feet, and they occur in an area approximately 165 feet by 660 feet at 50 feet water depth (TGPI 2002).

Rock outcrops appear to be crystalline rock, probably mafic in nature based on the regional geology. Gabbro and diorite faulted against pillow basalts and Cretaceous sedimentary layers have been mapped immediately south of the survey area, a good indication as to the nature of the rocks seen here. Northwest trending layers in the rock have been fractured, creating the blocky appearance seen throughout the outcrops. The shape of the western rock outcrop combined with the overall northwest trend of the outcrops together would suggest that tectonic activity has occurred in the area. Straight, sharp contact between rock and sediment exists along the seaward edge of the rock (TGPI 2002).

FIGURE 5-2
PROJECT AREA SEABED FEATURES (SHEET 1 OF 2).

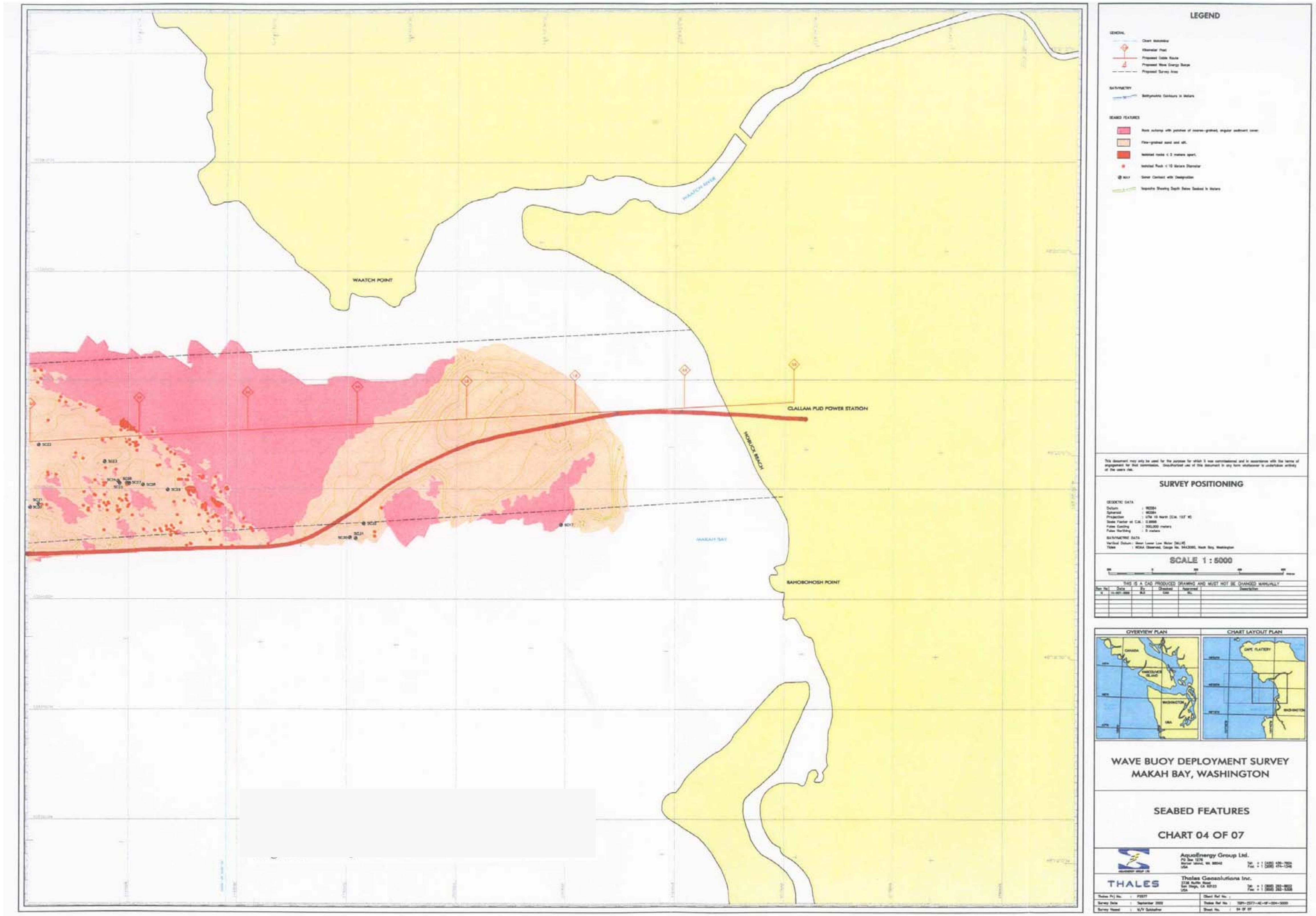
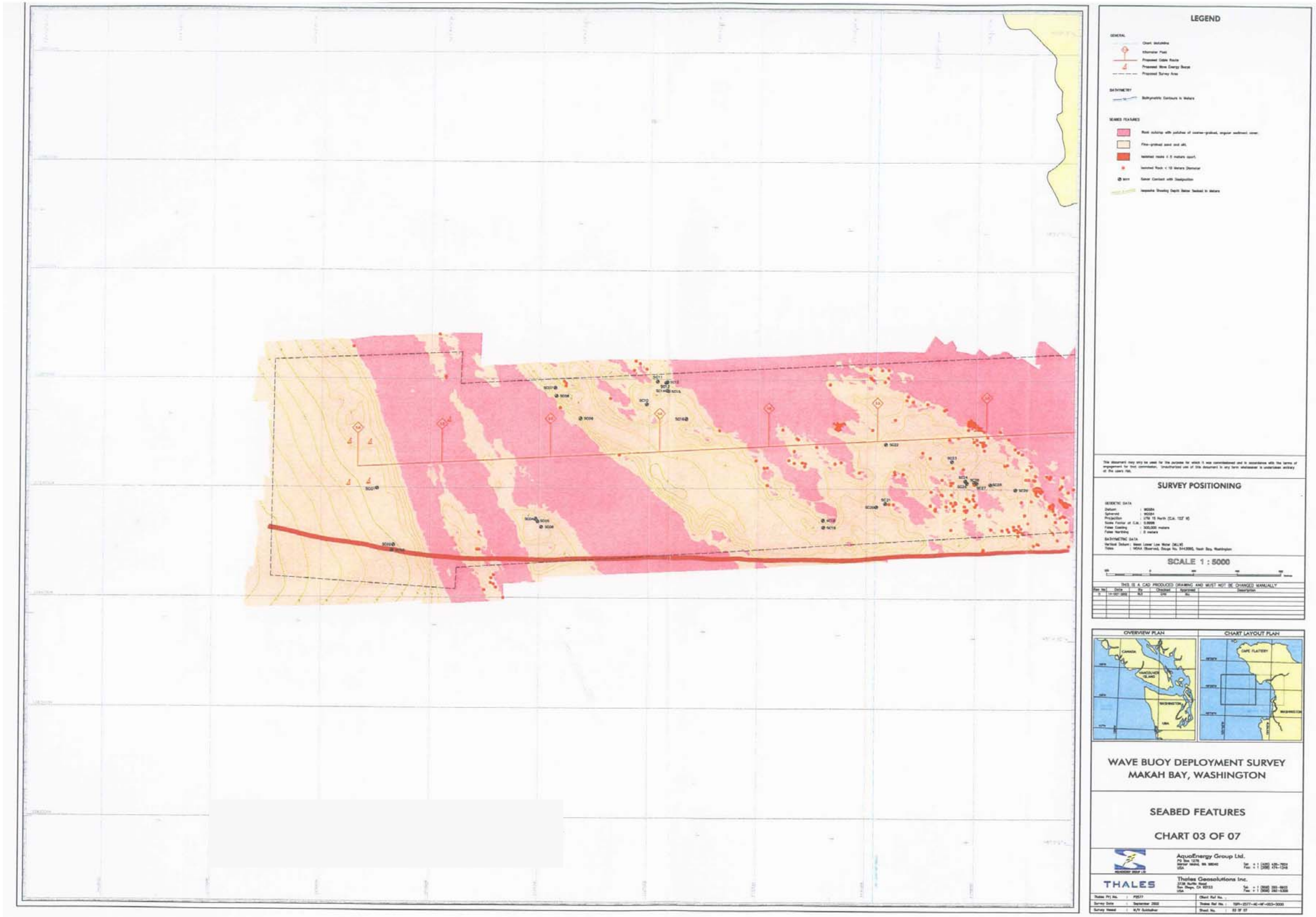


FIGURE 5-2
PROJECT AREA SEABED FEATURES (SHEET 2 OF 2).



The regional geology represents the unique end member of the Cascadia subduction zone, where the Juan de Fuca plate is sliding beneath the North American plate. Therefore, it is known that a large amount of folding and faulting has occurred in the rocks of this area and that a large accretionary complex exists offshore of northern Washington. The Callawah fault (left-slip) is a major fault that has been mapped both onshore and offshore, and trends northwest through the nearby Makah Reservation and Cape Flattery (TGPI 2002).

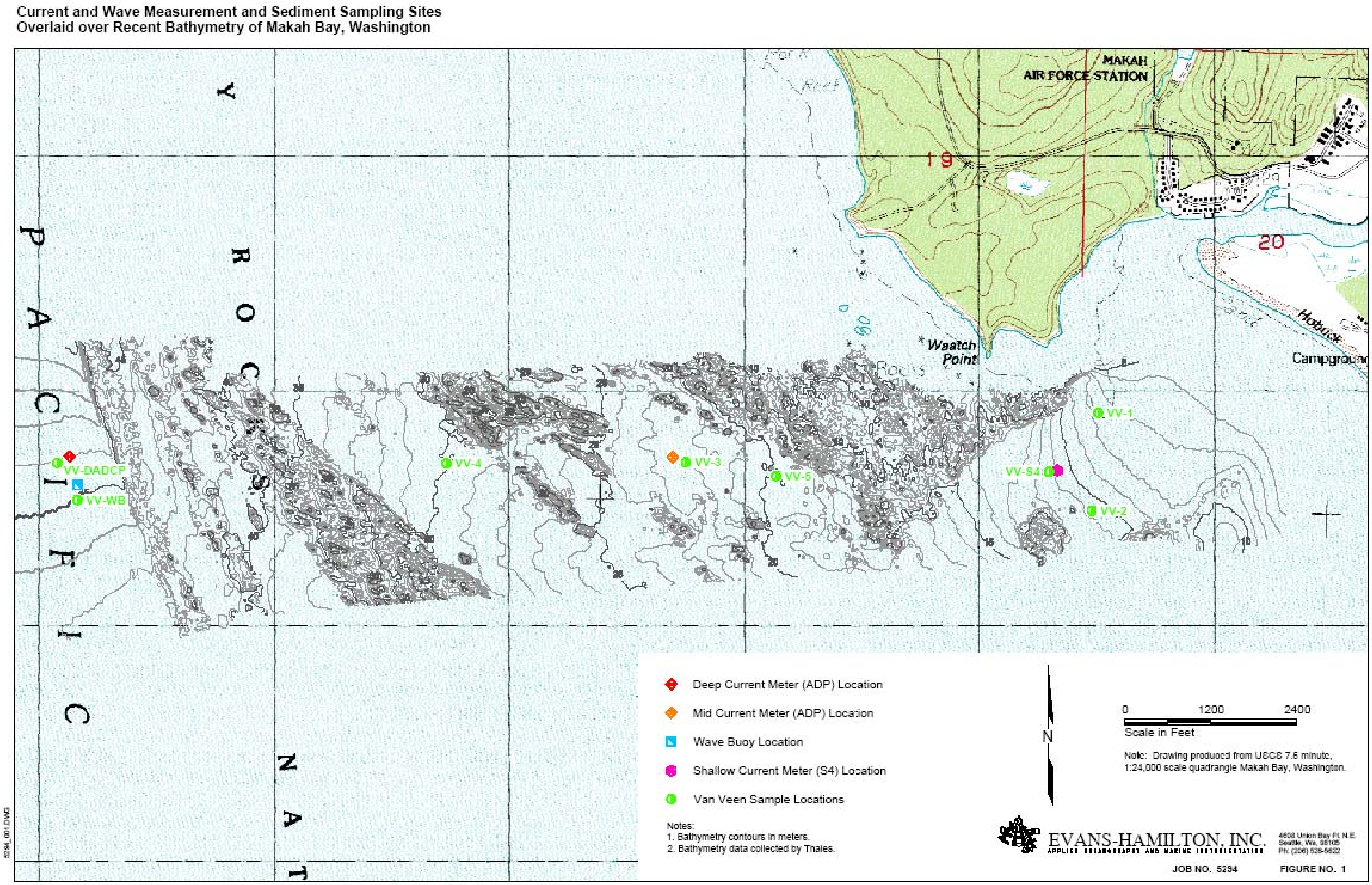
In 2002, Evans-Hamilton collected bottom sediment samples for analysis of grain size at eight locations in the project area, with locations extending from the proposed buoy placement site, having a depth of about 150 feet, towards shore to a depth of about 26 feet (Figure 5-3) (Evans-Hamilton 2006). The purpose of the sediment samples was to understand the bottom sediment conditions, and assess the potential for sediment resuspension and scouring around the buoy anchors and electrical cable to shore. Table 5-1 shows the grain size distribution results for the sediment samples at the eight sampling sites.

TABLE 5-1
PERCENT OF SEDIMENT WITHIN STANDARD SEDIMENT GRAIN SIZE CLASSIFICATIONS
(Station locations are shown in Figure 5-3)

PHI Size	Opening (mm)	Percent Retention							
		Deep ADCP Site	Wave Buoy	Station VV-4	Station VV-3	Station VV-5	S4 Site	Station VV-2	Station VV-1
	4.75	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	1.5
-2	4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.4
-1	2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
0	1	0.1	< 0.1	0.1	0.1	< 0.1	0.1	< 0.1	0.1
1	0.5	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.3
2	0.25	2.1	0.7	4	1.2	1.3	11.3	8.3	35.4
3	0.125	68.6	76.7	80.6	85.1	88.4	78	77.5	53.4
4	0.063	13.7	15.8	10.2	6.1	4.3	6.9	7.6	1.9
5	0.032	7.4	2.4	2.3	3.4	3	0.3	2.8	4.4
6	0.016	3	< 0.1	< 0.1	0.4	< 0.1	< 0.1	< 0.1	< 0.1
7	0.008	1.9	1.7	0.5	0.5	1	< 0.1	1.7	0.5
8	0.004	1.5	1	0.8	0.2	1	1.3	0.4	0.8
9	0.002	0.1	0.1	0.1	< 0.1	0.1	0.2	< 0.1	0.1
10	0.001	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
>+10	<0.001	1.3	1.4	1.3	2.9	0.7	1.4	1.4	1.3
Gravel: <-2 to -1 Phi		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	1.9
Sand: 0 to +4 Phi		**84.6**	**93.3**	**95**	**92.6**	**94.1**	**96.6**	**93.7**	**91.1**
Silt: +5 to +8 Phi		13.8	4.1	3.6	4.5	5	1.6	5.9	5.7
Clay: +9 to >+10 Phi		1.4	1.5	1.4	2.9	0.8	1.6	1.4	1.4

Source: Evans Hamilton, 2006.

FIGURE 5-3
SITE MAP: LOCATIONS OF DEPLOYED SEDIMENT GRAB SAMPLES AND CURRENT METERS (EVANS-HAMILTON 2006)



The grain size distribution showed that the area has a high sand concentration (greater than 85 to as high as 97 percent of the grain sizes) (Table 5-1). Silt was the second most prominent sediment, followed by clay. Gravel was negligible at all sites except for the near-shore site, where it was still less than two percent (Table 5-1) (Evans-Hamilton 2006).

Review of the multibeam backscatter data indicates there is no distinct boundary between the grain sizes. But the grain size and water depth (0.04 inches) together indicate that the boundary between the lower beach and inner shelf occurs within the survey area (most likely around 50 to 80 feet water depth) (TGPI 2002).

Sub-bottom profiler data reveal a sediment layer varying in thickness from less than 1.6 feet at edges of rock outcrop to 36 feet at the western extent of the survey area. At the eastern extent of the survey, sediment is thickest (23 feet) between northern and southern rock outcrops in a small, buried basin. The basin is asymmetrical, deepening steeply from the north and gently from the south. Further to the west, within the interior of the survey area where rock and scattered rock are abundant, sediment thickness is not greater than 6.5 feet. Further to the west sediment gently thickens to 16 feet, and then shoals steeply to the edge of another rock outcrop. At the westernmost edge of rock, sediment thickens sharply to approximately four meters, and then begins to thicken gradually to the west to a depth of 36 feet (TGPI 2002).

The geology of the terrestrial portion of the project areas consists of nonglacial deposits, including beach deposits along Hobuck Beach and alluvium inland of the beach. The beach deposits are Holocene in age, consists of sand and (or) gravel with minor shell fragments deposited along shorelines, and locally includes back-beach dune fields and minor estuarine deposits. Rock fragments are typically well rounded (Schasse 2003).

The alluvium is Holocene and Pleistocene in age and includes sorted combinations of silt, sand, and gravel deposited in stream and river beds. The surface is relatively undissected by streams and locally includes sand and gravel of low-lying river terraces, alpine drift, and lacustrine and landslide deposits (Schasse 2003).

b. Environmental Effects

AquaEnergy compiled resource agency concerns regarding potential project impacts and presented these in SD2 (AquaEnergy 2005). With regard to geological resources, resource agencies indicated concern about the sedimentation environment and transport rates for the buoy anchor area and transmission cable route, including annual and seasonal sediment cycles and engineering for cable stability, scour at anchors, and anchor stability (AquaEnergy 2005). In addition, in a letter dated August 25, 2003, the Surfrider Foundation expressed concern regarding potential wave-dampening effects of the buoys. AquaEnergy's proposed anchor outlay is described above in Section 3.A.1, Project Facilities and Operation (see Figure 3-5).

Our Analysis

■ **Buoy Anchor Area**

The offshore power plant will occupy a rectangular area of 60 feet by 240 feet on the water surface. The anchor system, consisting of a total of 10 VLAs and 10 surface floats, will cover a rectangular area of approximately 625 by 450 feet on the ocean floor (Figure 3-5). A main objective for designing a mooring system for the project was to reduce impact on the ocean floor and eliminate drag and scouring potential. The initial design used slack mooring with gravity anchors (concrete blocks)[13]. In response to agency concern about impacts of chain sweep from mooring lines on the benthic community around each anchor, AquaEnergy modified the buoy design to utilize VLAs. Each VLA is installed like a conventional drag embedment anchor, but penetrates much deeper. The resulting configuration will have minimal chance of chain sweep between mooring buoys and the surface floats. Because the VLAs are deployed completely below the seafloor, only the area of the seafloor surface equal to the diameter of the cables leading from the VLAs will be affected by the mooring system. The buoy anchor area will therefore not have any appreciable footprint on the sea floor.

The near-shore bottom surface is sandy out to a water depth of approximately 70 feet (Figure 5-2). Typically, the changes in depth of sand is greatest nearshore and diminishes farther offshore where cross-shore processes dominate the nearshore dynamics.

Evans-Hamilton (2006) conducted an analysis of the potential for the sediments at the site to become re-suspended, and which direction they would be transported if resuspended. To do this, researchers compared the grain size results of collected samples to published charts (Miller et al. 1977) that show the expected current speed at 1 m above the seabed needed to re-suspend unconsolidated grain sizes (Evans-Hamilton 2006).

Table 5-2 lists the top five grain sizes found in the sediment samples, and the associated current speeds required for resuspension. The +3 Phi size (sand) was used for comparison to these charts due to, as mentioned above, the dominance of this grain size in the sediment samples (at the buoy anchor area, 78 percent of the sediment was composed of this grain sand) (Tables 5-1 and 5-2). Comparison to the charts shows that current speeds of 35 cm/sec will resuspend this grain size. Current speeds near bottom (2.4 m above the seabed) exceeded this threshold speed 11 percent of the time. Of this time,

[13] Inter-buoy mooring had been tested in a wave tank at Aalborg University in Denmark.

4.3 percent was directed southward, while 6.1 percent of the time the currents would have carried the re-suspended sand northward (Table 5-2) (Evans-Hamilton 2006).

TABLE 5-2
SUMMARY OF PERCENT OCCURRENCE TABLES FOR THE SURFACE AND BOTTOM BINS WITH FOCUS ON CURRENT SPEEDS INDUCING SEDIMENT RESUSPENSION

Current speed	Sediment transported	Percent of sediment at buoy site	Bottom Currents (2.4 m above bottom)			
			Northward flow	Southward flow	Eastward flow	Westward flow
(cm/s)			(300°-20°)	(120°-200°)	(20°-120°)	(200°-300°)
<20	+6 phi (mud)	<0.1	16.6	19.5	12.2	8.6
>20	+5 phi (mud)	2.4	21.8	16.9	1.7	2.6
>25	+4 phi (sand)	15.8	15.5	11.4	<1	1.6
>35	+3 phi (sand)	76.7	6.1	4.3	<1	<1
>40	+2 phi (sand)	0.7	3.2	2.3	<1	<1

Certain characteristics related to sediment transport can also be estimated using wave data along with the sediment grain sizing data. Depth of closure relates to the depth in the nearshore zone below which major changes in bathymetry do not occur due to onshore/offshore sediment cycling. It is a calculated quantity that indicates the depth at which cross shore processes cease to modify the bottom profile. Typically, the vertical change is greatest nearshore and diminishes farther offshore. The depth of closure can be approximated using the relationship

$$d = 2.28\ He$$

where *He* is the largest wave occurring over a 12-hour duration in the nearshore (personal communication, Richard Sternberg, University of Washington, July 25, 2005). Upon review of the last two years of data from the Cape Elizabeth Station, the maximum wave height that occurs over a 12-hour duration is 25 feet. Therefore, the depth of closure based on this time period is approximately 56 feet.

The depth to which waves in the Makah Bay area erode or mobilize sediment extends to a much greater depth. Factors including wave height, wave period, wave length and depth are used to determine the threshold orbital velocity and the depth of erosion. Based on a review of existing data within Makah Bay, any waves with 15-second periods can mobilize sediment to 295 feet depth, and during individual storm periods, the erosion depths can be high. Therefore, existing wave conditions and storm events will likely result in erosion for the entire project region as the AquaBuOYs are proposed to be located in a depth of 150 feet. While shifting sands can occur to a great depth, substantial changes in bathymetry are unlikely at depths greater than the closure depth, because, as mentioned above, beyond this depth, cross shore processes cease to modify the bottom profile (personal communication, Richard Sternberg, University of

Washington, July 25, 2005). While some resuspension of sediment in the buoy anchor area will occur due to ocean currents (Table 5-2), because the anchors will be located at a depth beyond the closure depth (calculated to be about 56 feet at the project), substantial changes in bathymetry are not expected. Some impacts to the bottom sediment will be associated with deployment of the VLAs but these will be temporary.

The project also has a very low potential of affecting the movement of sediment along the shore or dampening waves because, as a wave energy buoy-type facility, "...any wave energy that is not absorbed will pass through the plant and continue to travel shoreward, where it can power the littoral drift. Furthermore, the undiminished wave energy that passes to either side of the plant will spread by diffraction into the lower-energy area immediately behind the plant" (EPRI 2004). In addition, because the project only consists of four buoys almost four miles offshore, the impact to shore processes and potential to dampen waves is expected to be negligible.

With regard to potential effects of the project on seabed sediments: 1) as opposed to a caisson-based device, the wave energy that is not absorbed will pass by the unit and thereby contribute to sea bed drift; 2) the approximately 150-foot depth at the site will minimize effects of the buoy on seabed sediment transport; and 3) because there will be only four buoys, peripheral influences on the seabed will likely negate any influence of each buoy on seabed sediment.

■ Transmission Cable Route

The power transmission cable installed from the AquaBuOY to the shore station will be anchored to the ocean floor, except for the nearshore section[14]. The portion of the transmission cable not buried by HDD will be anchored to the seafloor. The actual anchoring method will be determined with the cable installation company and agreed to with the OCNMS and WDNR prior to the installation. It is anticipated that anchoring the cable will not result in appreciable impacts to sediments. According to crab fishermen, off of northern Oregon sea floor sand levels at fishing locations (crab pots) fluctuate from 15 to 20 feet and can be expected to vary considerably within sandy zones inshore of 70 feet in depth (City of Rockaway Beach Ocean Outfall PER, personal communication from E. Gage, Brown and Caldwell, Portland, Oregon to G. Kaminsky, Washington Department of Ecology, April 19, 2004). As mentioned above, shifting sands can occur to a great depth, but substantial changes in bathymetry are not expected beyond the closure depth (personal communication, Richard Sternberg, University of Washington, July 25, 2005), calculated to be about 56 feet at the project. It is therefore likely that portions of the transmission cable will be naturally buried by sand or scoured, especially in areas of 56 feet or less of depth.

[14] The depth to which directional drilling will occur will depend on the results of the eelgrass survey to be conducted prior to HDD and the suitability of the sediment for HDD.

At a depth of 10 to 30 feet, the transmission cable will be buried using a HDD technique in order to eliminate impacts to the surf zone and Hobuck Beach. HDD is a common technique used in the area for transmission cable installation projects to minimize nearshore environmental impacts. Staff from OCNMS and WDFW agreed that HDD is becoming the preferred method to install cable in nearshore areas (June 27, 2005 project technical meeting, Port Angeles, Washington).

HDD is a trenchless method for installing a product that serves as a conduit for liquids, gasses, or as a duct for pipe, cable, or wire line products. It is a multi-stage process typically consisting of site preparation, equipment setup, and drilling a pilot bore along a predetermined path and then pulling the product back through the drilled space. When necessary, enlargement of the pilot bore hole may be necessary to accommodate a product larger than the pilot bore hole size. This process is referred to as back reaming and is done at the same time the product is being pulled back through the pilot bore hole.

It is anticipated that the HDD contractor will use specialized equipment to drill in a pipe conduit along the route of the cable which is to be passed below the seabed. Boring can be done with a track-based horizontal boring rig that incrementally adds sections of pipe as the shaft or “drill string” progresses into the ground along its predetermined alignment. When the shaft comes out at its destination, the bit is removed from the end and the cable is attached at that end. The shaft is then pulled back the way it came towards the drilling rig, pulling the cable or conduit back with it.

In many cases, water, mud, or bentonite is pumped into the drilling shaft while drilling to act as a drilling fluid. The primary purpose of the drilling fluid is to remove the cuttings from the borehole, stabilize the borehole, and act as a coolant and lubricant during the drilling process. In the case of putting in an electrical or fiber cable through a beach or even in a suburban neighborhood, pressurized water can greatly speed the drilling process. With some drill rigs, water is immediately recovered, filtered, and put back into a reservoir tank.

The drilling fluid is typically made up primarily of water and bentonite to act as the drilling lubricant. Bentonite is a naturally-occurring, non-toxic, inert substance and is frequently used for drilling potable water wells. Therefore, the environmental impacts of an inadvertent release of drilling fluid in a waterbody is a temporary increase in local turbidity until the drilling fluid dissipates with the current or is settled.

The HDD method has the potential for loss or seepage of drilling fluid into the geologic formation through which the drill passes. In some cases, the drilling fluid may be forced to the surface resulting in what is commonly referred to as inadvertent release of drilling lubricant or “frac-out”. Drilling fluid releases are typically caused by pressurization of the drill hole beyond the containment capability of the overburden material. Providing adequate depth of cover for the installation is a design consideration intended to mitigate this potential. In some cases, an inadvertent release of drilling fluid can be caused by existing conditions in the geologic materials (e.g., fractures) even if the downhole pressures are low.

Prevention of drilling fluid release is a major design consideration when determining the profile (or path) of a HDD crossing. Some of the driving factors in selecting the crossing profile are the type of subsurface material and the depth of cover material. Typically, cohesive soils, such as clays, dense sands, and competent rock are considered ideal materials for HDD. Based on the sub-bottom profile survey, the existing composition of sand and rock is favorable for the HDD technique.

HDD is a technically-advanced process involving skilled operators. The detection of drilling fluid seepage is highly dependant upon the skills and experiences of the drilling crew. Each drilling situation is unique in that the behavior of the subsurface material is highly variable and difficult to predict. There is no known in-hole monitoring equipment that can detect if drilling fluid is seeping into the surrounding formation. Instead, drilling experts use a combination of factors, which must be properly interpreted, and may indicate conditions that can have the potential for causing a frac-out. AquaEnergy and the drilling contractor will take all necessary preventative and responsive measures in case of a frac-out.

At a June 27, 2005 Makah Bay Project technical meeting, concerns were raised regarding the portion of the transmission cable laid on the seafloor could get caught by trawlers and could physically disturb the seafloor habitat. This is addressed in the discussion on tribal fishing in Section 5.C.7, Recreation Resources and Land Use.

Abrasions on rocks or rock outcrops could sever a cable (TGPI 2002). AquaEnergy has sited the transmission cable route so that rock outcroppings will be avoided to a depth of 75 feet (Figures 5-1 and 5-2).

Conclusion

The Makah Bay Project will not affect shoreline erosion or change sediment deposition patterns. The transmission cable will be anchored to the sea floor or buried by directional drilling (the transmission cable will be bored from 10 to 30 feet in depth below mean lower low tide[15] shoreward to and under the beach using HDD technology). Thus, the project will not impact the shore zone. Some impacts to the bottom sediment will be associated with installation of the VLAs but these will be temporary. Otherwise, the portions of the project that contact the bottom — the mooring anchors and the

[15] Depth to which HDD will be used will be determined based on results of the seagrass survey which will be completed prior to construction of the project.

transmission cable — will not affect the geological resources. Potential impacts to the benthic community are discussed below in Section 5.C.3, Aquatic Resources.

c. Unavoidable Adverse Impacts

Some impacts to the bottom sediment will be associated with installation of the VLAs and the transmission cable but these will be temporary. Otherwise, the proposed project will not result in unavoidable adverse impacts to the project area geological resources.

2. Water Resources

a. Affected Environment

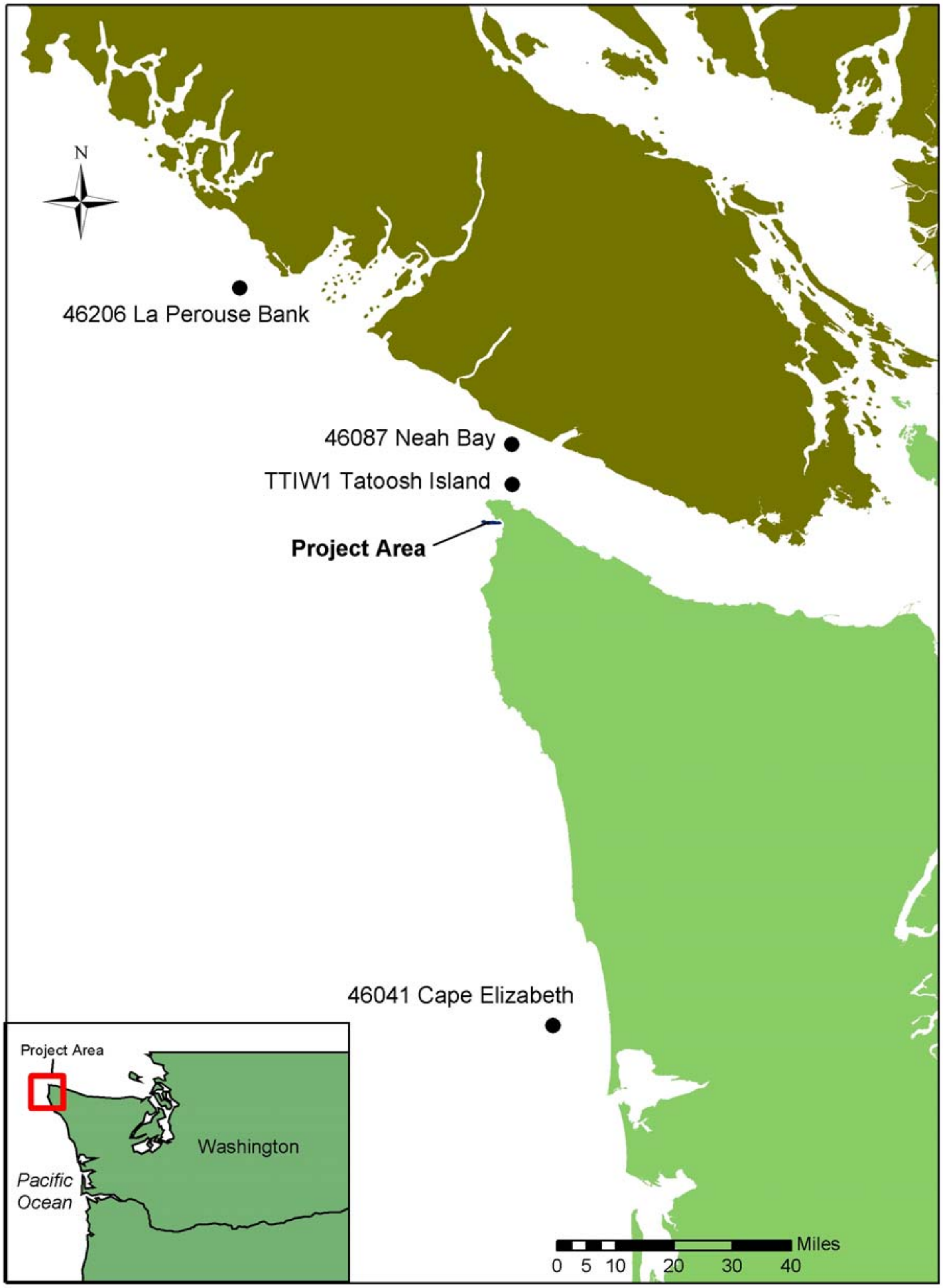
During consultation, agency staff requested meteorological data including tables of joint distribution of wave height and period by month and annually, extreme wave and wind conditions for the 5-, 10-, 25-, and 50-year intervals (AquaEnergy 2005, project technical meeting, June 27, 2005). There are several meteorological monitoring buoys located on the west coast that are used to collect wind and wave data. Some of the buoys are located in Washington or Canada but none of them are located in the immediate project vicinity except for Tatoosh Island station which monitors wind only. The three closest stations are described below and depicted in Figure 5-4.

■ **Station 46206 - La Perouse Bank -** Station 46206 consists of a moored meteorological weather buoy. The buoy is located in Canada approximately 70 miles from the project area and is owned and maintained by Environment Canada. The buoy was deployed in November 1988 and provides historical meteorological data to the present (Fisheries and Oceans Canada [FOC] 2005).

  Latitude/longitude: 48°50’2” N 126°0’0” W
  Site elevation: sea level
  Water depth: 73 m
  Relevant parameters monitored: wind speed (WS), wave height (WH), and wave period (WP)

■ **Station 46087 - Neah Bay, Washington (Traffic Separation Lighted Buoy “JA”) -** Station 46087 consists of a moored 3-meter discus meteorological weather buoy. The buoy is located to the north of Tatoosh Island in the Strait of Juan de Fuca approximately 11 miles from the project area and is owned and maintained by the National Data Buoy Center (NDBC). The buoy was recently deployed and only contains historical data from 2004 to present. Physical information for Station 46087 (NDBC 2005*a*) consists of the following:

FIGURE 5-4
METEOROLOGICAL MONITORING BUOYS LOCATED IN THE VICINITY OF THE MAKAH BAY PROJECT



Latitude/longitude: 48°29'38" N 124°43'38" W
Site elevation: sea level
Air temp height: 4 m above site elevation
Anemometer height: 5 m above site elevation
Barometer elevation: sea level
Sea temp depth: 0.6 m below site elevation
Water depth: 260.6 m
Watch circle radius: 233 m
Relevant parameters monitored: WS, WH, and WP

- **Station TTIW1 - Tatoosh Island, Washington -** Station TTIW1 consists of a Coastal Marine Automated Network (C-MAN) station located on Tatoosh Island just northwest of the project area. Station TTIW1 is owned and maintained by the NDBC. Station TTIW1 contains meteorological historical data from 1984 to present. Physical information for Station TTIW1 (NDBC 2005*b*) consists of the following:

  Latitude/longitude: 48°23'30" N 124°44'06" W
  Site elevation: 30.8 m above mean sea level
  Air temp height: 15.5 m above site elevation
  Anemometer height: 25.3 m above site elevation
  Barometer elevation: 47.5 m above mean sea level
  Relevant parameters monitored: maximum WS

- **Station 46041 - Cape Elizabet**h **-** Station 46041 consists of a moored 3-meter discus climatological weather buoy. The buoy is located approximately 45 nautical miles northwest of Aberdeen, Washington and is also owned and maintained by the NDBC. Station 46041 contains meteorological historical data from 1987 to present. Physical information for Station 46041 (NDBC 2005*c*) consists of the following:

  Latitude/longitude: 47°20'24" N 124°45'00" W
  Site elevation: sea level
  Air temp height: 4 m above site elevation
  Anemometer height: 5 m above site elevation
  Barometer elevation: sea level
  Sea temp depth: 0.6 m below site elevation
  Water depth: 132.0 m
  Watch circle radius: 154 m
  Relevant parameters monitored: WS, WH, and WP

Additionally, AquaEnergy deployed current meters provided by Evans-Hamilton at three sites within Makah Bay. Site 1 was deployed in the vicinity of the future project AquaBuOY locations in approximately 150 feet (46 m) of water depth. The meter was set to measure currents at approximately 1 m depth increments. The meter collected current data from approximately 2 m above the bottom to within approximately 5 m of the water surface, and it collected profiles every 20 minutes. Site 2 was located in approximately 75 feet (23 m) of water depth at a location approximately halfway along the proposed transmission cable corridor to the beach. To this date, the current meter cannot be retrieved. Site 3 was located in approximately 25 feet (8 m) of water depth (outside the anticipated surf zone) at a location near the beach along the proposed transmission cable corridor. This meter was also lost. Consequently, only data from Site 1 are available; this meter collected data for approximately four months, from October 30, 2002 through February 12, 2003.

Wind

Differential solar heating of the atmosphere produces winds, which in turn produce waves and surface currents (Sumich 1988). Because of this link to waves and surface currents, wind in the project area is assessed in the water resources section. AquaEnergy collected wind data from the existing stations listed above in order to assist with engineering and design of buoys, cables, and associated anchor mechanisms and to determine maximum wind speeds in the project area. A summary of the wind speed data from several stations is presented below (Table 5-3).

TABLE 5-3
SUMMARY OF THE MAXIMUMS FOR THE 5-, 10-, AND 25-YEAR INTERVALS FOR CAPE ELIZABETH, LA PEROUSE BANK, NEAH BAY STATION, AND TATOOSH ISLAND STATIONS

	Cape Elizabeth			La Perouse Bank			Neah Bay			TI*
	Max WS m/s	Max WH m	Max WP s	Max WS m/s	Max WH m	Max WP s	Max WS m/s	Max WH m	Max WP s	Max WS m/s
5-yr interval										
2001 – 2005	21.1	10.3	14.1	22.7	10.6	16	16.6	7.6	12.2	28.4
1996 – 2000	21.8	9.6	14.5	22.4	10.6	16				30.9
1991 – 1995	20.1	9.9	13.8	20.1	10.4	19.7				31.9
1986 – 1990	19	9.2	14.9	19.4	8.7	16				29.3
1981 – 1985										27.3
10-yr interval										
1996 – 2005	21.8	10.3	14.5	22.7	10.6	16				30.9
1986 – 1995	20.1	9.9	14.9	20.1	10.4	19.7				31.9
25-yr interval										
1980 – 2005	21.8	10.3	14.9	22.7	10.6	19.7				31.9

*Tatoosh Island

WS – Wind Speed in meters/second averaged over an eight-minute period for buoys and a two minute period for land stations. Reported hourly.

WH – Significant wave height in meters calculated as the average of the highest one-third of all of the wave heights during the 20-minute sampling period. Reported hourly.

WP – Dominant wave period in seconds is the period with the maximum wave energy. Reported hourly.

Waves

OCNMS (2005) characterized the wave environment off of the Olympic Coast as follows:

> *The Washington outer coast is known for its rough seas and large waves. Extremes of wave height ranging from 50 ft (15m) to 90 ft (29 m) have been recorded on and beyond the continental shelf.*
>
> *The height and direction of waves vary seasonally. During summer, waves are lower in height, predominately from the northwest. This results in longshore currents and sediment transport to the south. In winter, waves are generally higher and from the southwest, causing north-flowing currents and sediment transportation along the coast. The most severe wave conditions are caused by winter storms originating near Japan that move onto the U.S. Pacific coast. Storm winds ahead of warm fronts generate waves with wave heights up to 19-23 ft (6-7m); winds associated with cold fronts generate waves of 26-33 ft (8-10m).*

A comparison of the axis buoy data (AquaEnergy, Station 1) with the Cape Elizabeth data indicates that the maximum wave heights compare quite closely. A graph of the two data sets for the same time period is presented below in Figure 5-5.

A graph of the frequency distribution allows a comparison of the wave heights from each data set with the percentage of time that those wave heights exceed a specific height. A graph of the frequency distribution of the same data set is presented below in Figure 5-6.

This graph provides a better illustration of how the wave heights from the two locations compare. In general, it appears that higher waves occur more frequently at the Cape Elizabeth station than they do in the project area. For example, waves in excess of 4 meters occurred approximately 25 percent of the time at Cape Elizabeth, while waves in excess of 4 meters only occurred 10 percent of the time in Makah Bay.

A summary of the maximums for the 5-, 10-, and 25-year intervals from each station is summarized above in Table 5-3. The annual joint distribution of wave height and period data from the Cape Elizabeth station is presented below in Table 5-4.

FIGURE 5-5
GRAPH OF HOURLY MAXIMUM WAVE HEIGHT DATA FROM NOAA STATION 46041 VERSUS DATA FROM AXYS BUOY

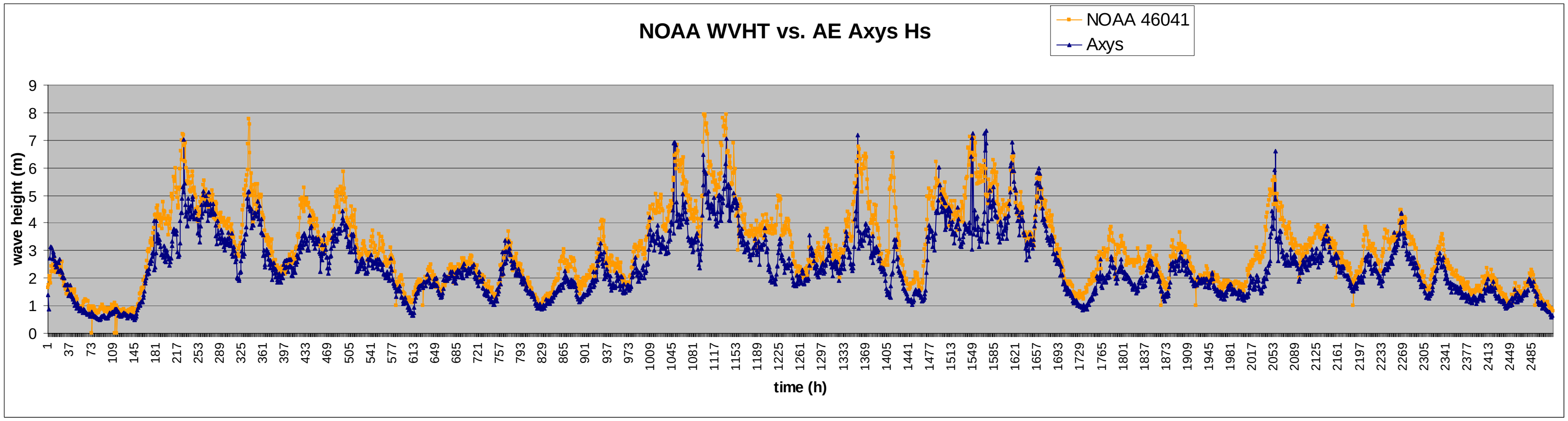


FIGURE 5-6
WAVE HEIGHT FREQUENCY ANALYSIS
(Comparison of NOAA Station to AXYS Buoy Data for 10/30/02 - 2/11/03)

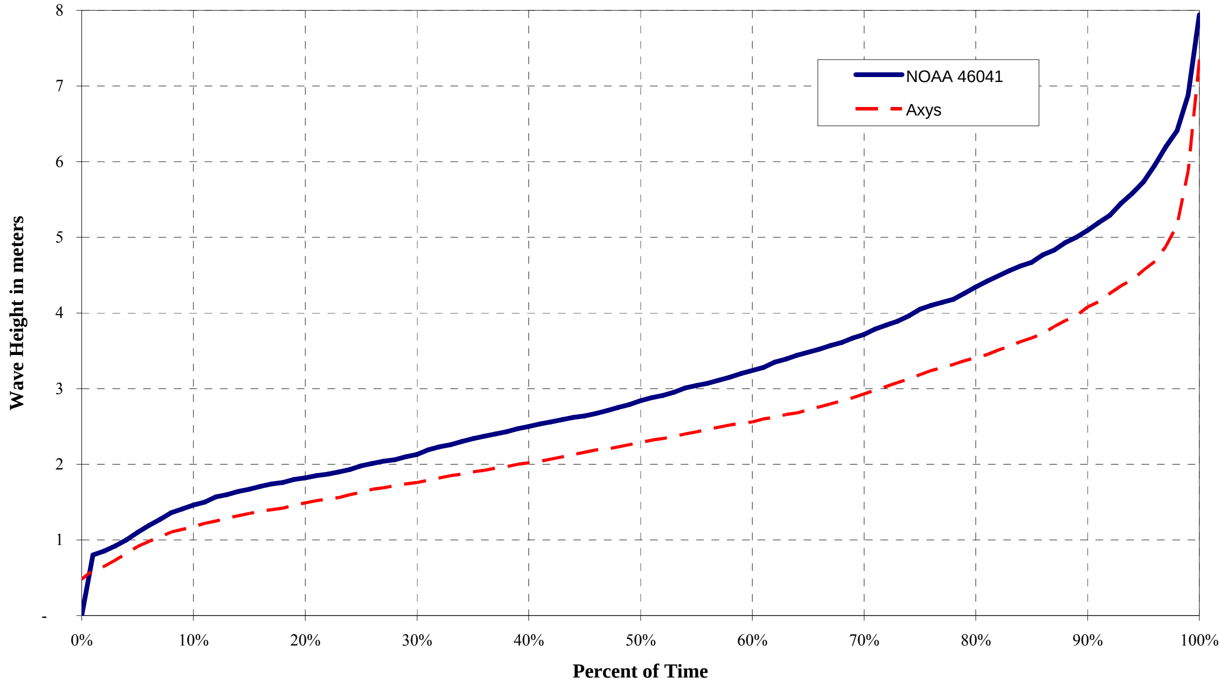


TABLE 5-4
ANNUAL JOINT DISTRIBUTION OF WAVE HEIGHT AND PERIOD DATA FROM THE CAPE ELIZABETH STATION

Year (Jan-Dec)	Wave Height (m)	Average Period (sec.)
1987		7.36
1988	2.22	7.42
1989	1.24	7.09
1990	1.78	7.14
1991	2.02	7.27
1992	2.05	7.16
1993	1.95	7.35
1994	2.13	7.37
1995	2.12	7.17
1996	2.02	7.03
1997	2.23	7.37
1998	1.89	6.77
1999	2.06	7.06
2000	2.18	7.20
2001	2.21	6.88
2002	2.30	7.22
2003	2.30	7.08
2004	2.21	7.15

The monthly joint distribution of wave height and period data from the Cape Elizabeth station is presented below in Table 5-5.

TABLE 5-5
MONTHLY JOINT DISTRIBUTION OF WAVE HEIGHT AND PERIOD DATA FROM THE CAPE ELIZABETH STATION

Month (1987-2004)	Wave Height (m)	Average Period (sec.)
J	2.87	7.87
F	2.58	8.27
M	2.54	7.85
A	2.19	7.33
M	1.72	6.71
J	1.54	6.32
J	1.31	6.02
A	1.31	6.15
S	1.63	6.93
O	2.22	7.61
N	2.86	7.74
D	3.09	8.12

Currents

OCNMS (2005) characterized the currents off of the Olympic Coast as follows:

The oceanic current system off the coast of Washington is comprised of the California Current, Davidson Current, and California Undercurrent. The California Current flows southward beyond the continental shelf throughout the year. This current is approximately 1,000 km wide with a typical velocity of 10 cm/second. It brings water low in temperature and salinity, with high oxygen and phosphate contents. The California Current is strongest in July and August in association with westerly to northwesterly winds. The California Undercurrent, a narrow (20 km) subsurface countercurrent, flows northward along the upper continental slope with its core at a depth of about 200m. This current is also strongest in the summer with a mean velocity of about 10 cm/second. It brings warmer water with more saline, and less oxygen and phosphate. An additional southward flowing bottom current (the Washington Undercurrent) flows deeper along the slope at about 400m depth during the winter. During winter, the California current either moves offshore or is replaced by the northward flowing Davidson Current. The Davidson Current flows during winter and early spring in association with southerly or southwesterly winds. It flows at a mean velocity of 20 cm/second and is associated with water masses with the same characteristics as the California Undercurrent. Currents over *the continental shelf tend to follow the seasonal pattern of the oceanic currents, but are also strongly influenced by*

- local winds
- bottom and shoreline configuration
- freshwater input

...Local currents are highly variable and are dependent on passing weather systems, or large scale weather effects such as El Niño. While currents are flowing south along the coast during spring and summer months, the forces of northwesterly winds and the earth's rotation combine to push the surface waters offshore. As these waters move offshore they are replaced from below by cold and nutrient-rich waters. This process is called upwelling. It introduces nitrates, phosphates, and silicates that are essential for high plant based plankton (phytoplankton) production that forms the basis for the oceanic food chain. The majority of this upwelling occurs within 20-50 miles (10-20 km) off the coast.

Downwelling, or sinking of surface waters, occurs along the coast during winter when southwest winds push surface waters onshore. Tides on the Washington coast and Strait of Juan de Fuca occur with two high and low tides each day. A highest high and a lowest low tide are followed by a moderate high tide and a moderate low tide. Tidal changes along the coast are large, averaging about 12 ft (3.5m). This ensures a rich intertidal community.

The *Makah Bay Offshore Wave Energy Pilot Project Report* was provided to AquaEnergy in March 2006 and includes results related to current measurements and sediments (Evans-Hamilton 2006). This report was posted to the AquaEnergy FTP site and made available to interested agencies and stakeholders. The following discussion summarizes the findings from this report.

Measurements of currents were attempted at three locations (150-, 75-, and 30-foot water depths) within Makah Bay, Washington. Due to the sediment movement and subsequent burial of the meters deployed, the current meter at a depth of 150 feet was the only meter recovered. Therefore, only data from this current meter was available for analysis.

At this location, a SonTek ADP profiling current meter measured currents throughout the water column by transmitting sound signals from three transducers, and measuring the Doppler shift of the returning sound signal. The meter measured currents at 1 m (3.3 feet) depth intervals from approximately 2 m (6.6 feet) above the seabed to near the water surface from October 29, 2002 through March 12, 2003.

The measurements provide an excellent data set of currents during winter conditions, which coincides with seasons of the largest tidal currents that occur in this area. The largest tide ranges, and tidal currents, normally occur during late December to January and June of each year. Tidal currents are strong, reaching 75 cm/sec near the surface and 50 cm/sec near the bottom during periods of weaker winds. The tidal currents are semi-diurnal, and vary in strength due to periods of spring and neap tides. Currents are generally uniform in direction with depth, and run predominantly north and south.

Table 5-6 presents information on the average, minimum, maximum, and net current speeds and associated directions versus depth at 5-meter intervals. These data represent current statistics of five different storm events within the data collection period. This table shows how the maximum and net current speeds were normally highest near the surface, and lowest near bottom. The maximum current speeds generated during the storms were 142 cm/sec near-surface headed northward. The net current speed reached 17 cm/sec near surface and 2 cm/sec near bottom, again directed generally northward.

TABLE 5-6
STATISTICS FROM CURRENT MEASUREMENTS DURING STORM EVENTS

Height Above Bottom (m)	Avg Spd (cm/s)	Max Spd (cm/s)	Dir of Max (deg wrtN)	Min Spd (cm/s)	Dir of Min (deg wrtN)	Net Spd (cm/s)	Net Dir (deg wrtN)
43.41	27.6	141.8	18.9	0.2	108.5	17.1	12.1
40.41	26.2	129.4	19.0	0.1	198.5	11.7	17.1
35.41	25.5	120.9	5.3	0.1	18.5	7.8	21.5
30.41	25.6	118.0	1.7	0.1	108.5	4.9	24.4
25.41	25.8	112.1	355.8	0.1	198.5	3.2	21.7
20.41	26.4	107.0	353.1	0.0	0.0	2.1	9.0
15.41	26.6	104.2	349.5	0.0	0.0	1.7	341.5
10.41	26.1	106.0	348.6	0.4	198.5	1.7	315.0
5.41	23.8	100.0	345.8	0.0	0.0	1.6	305.1

Storm events: Nov 6-20, 2002; Dec 12-19, 2002; Dec 25-27, 2002; Jan 2-6, 2003; Jan 22-28, 2003.

The current direction during storm events was also the predominant current direction during the entire measurement period. Surface flow was predominantly north-northeast (between 320° and 40°). For the entire study period, 45 percent of the time surface currents were greater than 25 cm/s, 10 percent of the time currents exceeded 50 cm/s, and 1.4 percent of the time currents exceeded 75 cm/s. Bottom flow was predominantly north-northwest and south-southeast. Twenty-eight percent of the time, currents were greater than 25 cm/s, and 1.3 percent of the time currents exceeded 50 cm/s.

Current speeds at the site are quite rapid, even near bottom, and especially when influenced by winter storms. The strongest currents were northward during the measurement period, as was the overall net current (Evans-Hamilton 2006).

Water Quality

The waters in the project area are classified as "AA (extraordinary)" by the WDNR. Washington water quality standards state that the designated uses of Class AA marine waters are salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning (Washington Administration Code [WAC] Chapter 173-201A and 201A-210).

b. Environmental Effects

The resource agencies indicated that their main concern with wind and wave information is with regard to potential loss of equipment under storm conditions, and any associated water quality impacts, and that wind direction was not a substantial issue from an environmental standpoint (project technical meeting, June 27, 2005, AquaEnergy 2005). The WDFW recommended the use of anti-fouling properties on the buoys. The resource agencies wanted AquaEnergy to consider water quality impacts of any lubricants associated with project facilities and antifouling agents (AquaEnergy 2005).

<u>Our Analysis</u>

In response to a scenario where an AquaBuOY separates from its mooring, a GPS transmitter that will have been installed in each AquaBuOY will allow tracking and retrieval.

With regard to fouling control, EPRI (2004) reports that

> *...it can be accomplished either by periodic cleaning (requires divers) or the use of antifouling coatings (requires drydocking). If the coating option is selected, then the use of an organotin compound, such as tri-butyl tin (TBT), would almost certainly be considered, since it entails a recoating interval of six to seven years compared with one or two years for copper-based paints. ...The typical legal limit for average TBT release rate is 5 micrograms per cm2 of hull wetted surface area per day. U.S. Navy experience has been that release rates well below this level (on the order of 0.1 micrograms/cm2/day) are fully effective in preventing fouling. Therefore, even if antifouling coatings are required for a wave energy device, an environmentally acceptable solution to the problem appears to exist.*

In discussions with OCNMS, AquaEnergy has agreed to try different brands of antifouling paints to identify those that work best.

The power plants represent a closed-loop hydraulic system filled with fresh water. The total volume of the fresh water in the hydraulic system is about 1,850 gallons. There is no interaction between the closed-loop fresh water system and the outside seawater. The system does not contain nor does it use hazardous materials such as biocides, corrosives, petroleum-based lubricants, or toxic hydraulic fluids. As such, the project operations will not affect water quality.

The Makah Bay Project will not alter currents or wave directions nor will it affect water quality.

c. Unavoidable Adverse Impacts

Implementation of the Proposed Action will not result in unavoidable adverse impacts to project area water resources.

3. Aquatic Resources

a. Affected Environment

The Pacific Ocean off of the Olympic Peninsula is characterized by a productive upwelling zone, which in turn provides rich habitat for a wealth of aquatic species including marine mammals, fish, seabirds, invertebrates, and algae (NOAA 2005*a*). The attraction to the area of foraging marine wildlife and important fisheries yields significant economic benefits to state and tribal economies (NOAA 2001).

WDFW Priority Habitats and Species (PHS) information system catalogs habitats and species considered to be priorities for conservation and management (WDFW 2005*c*). The PHS system listed the following within the Makah Bay Project area (Letter from WDFW to AquaEnergy, November 17, 2003; Letter and PHS resource maps from WDFW to DTA, October 4, 2005; AquaEnergy 2005):

- Bald Eagle (State Threatened);
- Dungeness crab (*Cancer magister*) (Priority Species);
- Hard shell subtidal clam (Priority Species);
- Marbled murrelet (State Threatened);
- Northern sea otter (State Endangered); and
- Rockfish (yelloweye [*Sebastes ruberrinus*]) (State Candidate).

Other species and habitats of concern to WDFW in the project vicinity include harbor seal haulouts, palustrine and marine wetland habitat, and kelp beds (Letter from WDFW to AquaEnergy, November 17, 2003; Letter and PHS resource maps from WDFW to DTA, October 4, 2005).

Marine Mammals

The Sanctuary represents one of the most diverse marine mammal assemblages in North America (NOAA 2005*a*). Twenty-nine species of marine mammals inhabit or pass through the OCNMS including cetaceans (both toothed and baleen whales), pinnipeds (seals and sea lions), and northern sea otters (*Enhydra latris kenyoni*) (OCNMS 2005). "All marine mammals in the area of the project receive federal protection under the MMPA with additional species (Steller sea lions and humpback whales) also covered by the ESA. Sea otters are MMPA protected (under USFWS jurisdiction) as well as being listed as a "State Endangered" species by WDFW…" (personal communication S. Jeffries, marine mammal biologist, WDFW to L. Vigue, WDFW, August 29, 2005). Federally-listed species are discussed in Section 5.C.5, Threatened and Endangered Species.

■ **Cetaceans**

Stakeholders have indicated that project impacts to gray whales (*Eschrichtius robustus*), minke whales (*Balaenoptera acutorostrata*), harbor porpoises (*Phocoena phocoena*), and ESA-listed whales, including orcas (or killer whales)[16] should be assessed (AquaEnergy 2005, letter from WDFW to AquaEnergy dated November 17, 2003; letter from Olympic Park Associates to FERC dated September 17, 2003). These species are further discussed below and in Section 5.C.5, Threatened and Endangered Species.

Gray whales are the most frequently seen cetacean off the Olympic Coast; humpback whales are also seen. Both of these whales are mysticetes or baleen whales. Harbor porpoise, Dall's porpoise (*Phocoenoides dalli*), Pacific white-sided dolphins (*Lagenorhynchus obliquidens*), and orcas are typical odontocetes or toothed whales found off the Olympic Coast (OCNMS 2005; NOAA 2001). OCNMS (2005) classifies the occurrence of only gray whales and harbor porpoise as common in the OCNMS while humpback whales, Dall's porpoise, and orcas are considered rare and Pacific white-sided dolphins are considered accidental in the OCNMS.

Gray whales are a success story for recovery of endangered species with current populations estimated to be approximately 27,000 whales (NOAA 2001). This population level is thought to be as great or greater than it was before commercial exploitation began around 1850 and may even be approaching carrying capacity. Gray whales migrate up and down the Pacific coast between their Alaskan feeding waters (summer) and Mexican breeding grounds (winter). This migration covers 10,000 to 14,000 miles for a round trip (WDOE 2005), and it represents the longest migration of

[16] Orcas were previously listed as threatened by the State of Washington (WDFW 2005*a*). The southern resident group, which visits Puget Sound every summer, was federally listed as endangered under the Endangered Species Act on November 15, 2005.

any mammal. The northbound migration occurs offshore of Washington from March through May and the southbound migration occurs in December and January (WDFW 1997). Some studies suggest that gray whales migrate farther offshore of Washington during the southward migration. Green et al. (1995) reported that the mean distance offshore for southbound migrants off Washington was 15.7 miles compared to 7.3 miles offshore during the northward migration. Shelden et al. (2000) reported southward migrating gray whales as far as 29 miles offshore of Washington. NOAA (2001) reports that “there has been relatively little effort off Washington to document the timing of the migration because ... during their southward migration, gray whales travel well offshore through this area....” A few gray whales are known to reside in nearshore waters off of Washington during the summer (WDFW 1997); these are referred to as the Pacific Coast feeding aggregation (Letter from OCNMS to Aqua Energy dated January 3, 2006). NOAA (2001) states that “...these whales 1) move widely within and between areas on the Pacific coast to feed in the summer and fall, 2) are not always observed in the same area each year, and 3) may have several year gaps between resightings in studied areas.”

In Washington and elsewhere on migratory routes, gray whales forage almost exclusively by benthic suction in areas having mud, sand, silt, or gravel bottoms. Amphipods are the primary component of their diet; however, their nonselective foraging ensures a varied diet (WDFW 1997).

NMFS (2005) describes minke whales as follows:

Minke whales… are one of the most widely distributed of baleen whales, ranging from South America to Alaska. For management, NMFS recognizes a California, Oregon, and Washington stock within the exclusive economic zone (EEZ). “The number of minke whales is estimated as 631 (CV = 0.45) based on ship surveys in 1991, 1993, and 1996 off California and in 1996 off Oregon and Washington” (Barlow 1997; Carretta et al. 2001). They are not endangered or threatened under the ESA nor depleted under the MMPA. The stock is not listed as strategic under the MMPA and total human-caused mortality (zero) is less than the four minke whales allowed under the Potential Biological Removal formula (Carretta et al. 2001). Little is known of their reproductive biology; presumably they calve in winter in tropical waters after about a ten-month gestation (Reeves et al. 2002). They are the smallest of the rorqual whales and only the pygmy right whale is smaller. Some migrate as far north as the ice edge in summer. The diet of Minke whales consists of plankton, krill, and small fish, including schools of sardines, anchovies and herring. They have occasionally been caught in coastal gillnets off California (Hanan et al. 1993), in salmon drift gillnet in Puget Sound, Washington, and in drift gillnets off California and Oregon (Carretta et al. 2001). There have been *no recent takes in groundfish fisheries off California, Oregon, or Washington (Carretta et al. 2001).*

Harbor porpoises are common along coastal Washington, with the exception of southern Puget Sound (NOAA 2001). They typically travel singly or in small groups ranging from two to 10 animals (American Cetacean Society [ACS] 2004*a*). This species frequents near-shore waters of depths less than 600 feet, with a preference for 25 fathoms (150 feet) or less. They are frequently seen in shallow bays, estuaries, and harbors (NOAA 2001). Harbor porpoises are present year-round, though seasonal changes in abundance occur along the state's west coast. This species is characterized by low movement and genetic analysis suggests that numerous stocks may occur (Carretta et al. 2005). Harbor porpoises give birth in Washington from May through July (NOAA 2001). The population for coastal Oregon, north of Cape Blanco and Washington was 39,586 in 1997 and 26,175 in 1991. The only known source of human-caused mortality to harbor porpoises is from the gillnet fishery, which was estimated to result in a mortality of 3.2 harbor porpoises per year for the Oregon/Washington coast stock. This level of mortality is considered insignificant (Carretta et al. 2005).

■ **Pinnipeds**

Seals and sea lions forage at sea, but come ashore for mating, birthing, nursing, and molting. Five pinniped species occur off of Washington: California sea lions (*Zalophus californianus*), Steller sea lions, and northern fur seals (*Callorhinus ursinus*) are otariids (eared seals), while harbor seals (*Phoca vitulina*) and elephant seals (*Miroung angustirostris*) are both phocids (earless or true seals) (OCNMS 2005; Jeffries et al. 2000).

California sea lions are seasonal inhabitants of Washington waters. The migrants consist mainly of adult and subadult males (greater than four to five years old) coming north from California and Mexico to feed (NOAA 2001; Jeffries et al. 2000). They start arriving in August following the summer breeding season, staying throughout the winter, and returning to California during May and June. Small numbers of California sea lions are sighted in Makah Bay with larger concentrations occurring in Neah Bay and off of Cape Flattery (NOAA 2001). The WDFW *Atlas of Seal and Sea Lion Haulout Sites in Washington* (Jeffries et al. 2000) indicate the California sea lion haulouts nearest to the project area are on Tatoosh Island and neighboring islands off of Cape Flattery (about five miles to the north of the project area); one site is used by up to 500 animals, the other two identified sites are used by less than 100 (Jeffries et al. 2000). Jeffries et al. (2000) state that prior to the 1950s, this species was rarely seen in Washington and today, peak numbers of 3,000 to 5,000 occur in the northwest. NOAA (2001) reports that groups numbering 50 to 100 are commonly sighted off of Cape Flattery and, off of Cape Alava (approximately 11 miles to the south of the project area), 4,000 to 5,000 California sea lions have been observed around the Bodelteh Islands, offshore of Cape Alava.

The Steller sea lion lives throughout the year in Washington with highest numbers present from late summer through winter (NOAA 2001). This species is listed as threatened under the ESA and is further discussed in Section 5.C.5, Threatened and Endangered Species.

The northern fur seal seasonally migrates through Washington waters an average of 10 miles and beyond offshore (NOAA 2001). Jeffries et al. (2000) do not identify any northern fur seal haulouts in Washington. Some northern fur seal have been observed in the Strait of Juan de Fuca and Puget Sound, but these instances are rare. Northern fur seal do not breed in the state, but rather in the Pibilof Islands in the Bering Sea with a lesser number breeding in the Channel Islands in California. Adult males stay in Alaska; females and juveniles will migrate as far south as southern California and northern Baja, Mexico. Most northern fur seals migrate northward in the middle of spring and reach the breeding ground in early summer (NOAA 2001). This species is considered to be rare in the OCNMS (OCNMS 2005), and consequently in the project area.

Harbor seals are the most common marine mammal in Washington and are frequently sited by boaters along the Washington coast. This non-migratory species lives year-round in Washington's coastal waters (NOAA 2001, Jeffries et al. 2000). The pupping season occurs from May through July along the Olympic Coast. Harbor seals use a variety of areas to rest or haulout. Harbor seal densities can vary from groups numbering a few animals on some intertidal rocks to thousand of animals congregating seasonally in estuaries (Jeffries et al. 2000). In the project vicinity, harbor seal numbers are variable with lowest numbers occurring along the western Strait of Juan de Fuca while the highest densities occur at Cape Alava (NOAA 2001). Jeffries et al. (2000) identify the following haulout areas each used by less than 100 harbor seals in the project vicinity: 1) rocks and reef areas off Waatch Point as a haulout area for harbor seals; 2) areas around Skagway Rocks and Fuca Pillar (about three miles north of the project); and 3) reef areas off Portage Head (about three miles south of the project).

Northern elephant seals are the largest pinniped found off Washington. Breeding occurs in winter in California and Mexico with individuals migrating along Oregon and Washington following the breeding season and annual molt cycles. Males typically migrate to feeding areas south of the Aleutian Island while females feed in deep offshore areas off of Oregon and California. The population of northern elephant seals has grown significantly in recent years and now numbers more than 100,000 animals (Jeffries et al. 2000). However, this species is considered to be rare in the OCNMS (OCNMS 2005).

■ **Northern Sea Otters**

Northern sea otters (*Enhydra lutris kenyoni*) spend their entire lives in the water. Overhunting led to extirpation of sea otters in the early 1900s. A successful reintroduction of Alaskan sea otters in 1969 and 1970 has allowed a sustaining population to develop. During annual surveys conducted from 2000 to 2004, counts ranged from 500 to 743 sea otters (Lance et al. 2004). The majority of otters occur off the Olympic Coast, though some have been observed in the Strait of Juan de Fuca and off of Vancouver Island (Lance et al 2004, OCNMS 2005). Most of the growth in the Washington sea otter population has occurred to the north of La Push, located about 30 miles south of the project area near the Clallam County and Jefferson County line, and around Destruction Island, located off the middle of the Jefferson County coast (Lance et al. 2004; NOAA 2001). WDFW reports that sea otters occur off of Waatch Point, with five reported during WDFW's 1999 survey (Letter and PHS resource maps from WDFW to DTA, October 4, 2005). The sea otter population is well established along the Olympic Coast and the range is slowly extending northward (NOAA 2001). In 1991, the range extended north to the proposed project area when a large group of sea otters established itself in Makah Bay (Jameson 1998). NOAA (2001) reports that:

> *Breeding and pupping sea otters generally occur from Point of Arches (about six miles south of the project area) to the south, with a large concentration of sea otters near Cape Alava. In addition, sea otters are generally concentrated in areas with large quantities of kelp and generally stay in water that is quite shallow, usually 20 feet or less. However, sea otters are seen in near-shore open water in the area between Point of Arches and Cape Alava, as there is no rocky substrate and therefore little kelp. Sea otters pup in late winter and early spring, and wean the pups in late summer and early fall. The Makah Tribe has expressed concerns about the effects of the expanding sea otter population on the Tribe's sea urchin fishery, but to date no actions have been taken.*

Reptiles

Sea turtles that may occur off Washington are the leatherback sea turtle, green sea turtle, loggerhead sea turtle, and Pacific olive ridley sea turtle (*Lepidochelys olivacea*) (NOAA 2001). In Washington, the leatherback sea turtle is federally listed as endangered, and the green sea turtle and loggerhead sea turtle are federally listed as threatened (WDFW 2005*a*). These species are further discussed in Section 5.C.5, Threatened and Endangered Species.

The Pacific olive ridley sea turtle may be the most numerous sea turtle in the Pacific Ocean; however, "...ocean temperature restricts olive ridleys to waters well south of Washington. The state has only a single olive ridley record, a turtle that was found dead in Grays Harbor County" (WDFW 2005*a*). It has been concluded that the olive ridley's range does not include Washington coastal waters (Richardson 1997). In fact, all of these sea turtle species prefer warmer waters, and their occurrence off Washington is uncommon, though higher numbers of sea turtles occur during El Niño periods when currents warm off the Northwest (NOAA 2001).

Fish

■ **Overview**

The cold waters of the Olympic Coast represent some of the most productive fish habitat in the world and contain an abundant and diverse assemblage of marine species (OCNMS 2005). NOAA (2001) reported that, along with shellfish, groundfish[17] and Pacific salmon are the most commercially-important species off the northern Washington coast.

The 2002 seabed survey conducted in Makah Bay (TGPI 2002, see Section 5.C.1, Geological Resources) helps characterize marine habitat in the project area. Extending from the sandy Hobuck Beach, the general slope of the marine portion of the project area is flat with the ocean bottom having a slope of approximately 1.5 percent. For the entire project area sand- to silt-sized sediment covers approximately 60 percent of the seafloor; the remaining 40 percent consists of rock outcrop. The nearshore bottom surface is sandy out to a water depth of approximately 70 feet. Figure 5-2 shows seabed features of the project area (TGPI 2002).

NOAA has characterized the fish community in the OCNMS by habitats (sandy intertidal, shallow rocky reefs/kelp beds and rocky intertidal) as well as general area (sublittoral and offshore) (OCNMS 2005). The species listed below could occur in the project area.

Fish that inhabit or use sandy intertidal habitats include starry flounder, staghorn sculpin (*Leptocottus armatus*), sand lance (*Ammodytes* spp.), sand sole (*Psettichthys melanostictus*), surf smelt (*Hypomesus pretiosus*), redtail surfperch (*Amphistichus rhodoterus*), and sanddab (*Citharichthys sordidus*) (OCNMS 2005).

Fish associated with shallow rocky reef areas and kelp beds include the numerous rockfish species as well as lingcod, kelp greenling (*Hexagrammos decagrammus*), cabezon (*Scorpaenichthys marmoratus*), kelp perch (*Brachyistius frenatus*), wolf eel (*Anarrhichthys ocellatus*), and red Irish lord (*Hemilepidotus hemilepidotus*) (OCNMS 2005).

Species inhabiting rocky intertidal areas include tidepool sculpin (*Oligocottus maculosus*), wolf eel, juvenile lingcod and greenling (*Hexagrammos* spp.), gunnels

[17] As the PFMC (2005) states, “groundfish are fish such as rockfish, sablefish, flatfish, and Pacific whiting that are often (but not exclusively) found on or near the ocean floor or other structures”.

(family *Pholidae*), eelpouts (family *Zoarcidae*), and pricklebacks, cockcombs and warbonnets (family *Stichaeidae*) (OCNMS 2005).

Typical species inhabiting the sublittoral areas off of the Olympic Coast include albacore tuna (*Thunnus alalunga*), Pacific halibut (*Hippoglossus stenolepis*), starry flounder (*Platichthys stellatus*), arrowtooth flouder (*Atheresthes stomias*), petrale sole (*Eopsetta jordani*), Dover sole (*Microstomus pacificus*), English sole (*Parophrys vetulus*), numerous rockfish species, Pacific cod (*Gadus macrocephalus*), Pacific hake (*Merluccius productus*), lingcod (*Ophiodon elongatus*), sablefish (*Anoplopoma fimbria*), thresher shark (*Alopias vulpinus*), Pacific herring (*Clupea pallasii*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), pollock (*Pollachius virens*), spiny dogfish (*Squalus acanthias*), green sturgeon (*Acipenser medirostris*), white sturgeon (*Acipenser transmontanus*), and Pacific salmon (chinook, sockeye, pink [*O. gorbuscha*], chum, and coho) (OCNMS 2005).

Offshore areas are inhabited by Pacific ocean perch (*Sebastes alutus*), lingcod, English sole, Dover sole, Pacific cod, and sablefish (these species represent 2/3 of the 1987 to 1988 annual harvest along the outer coast) (OCNMS 2005).

The OCNMS identifies salmon and groundfish species as being the most significant in the Sanctuary. The waters offshore of the northern Olympic Peninsula are potentially used by migrating salmon from British Columbia to California. Pacific salmon are further discussed in Section 5.C.5, Threatened and Endangered Species.

■ **Essential Fish Habitat**

As summarized by the Pacific Fishery Management Council (PFMC 2005), the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson Act) requires that regional management councils describe essential fish habitat (EFH) in their fishery management plans and that Councils minimize impacts on this essential habitat from fishing activities. Amendment 19[18] of the Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP), revises the definition of groundfish EFH, identifies habitat areas of particular concern (HAPC), and describes management measures intended to mitigate the adverse effects of fishing on EFH. The PFMC took final action to approve Amendment 19 and submitted it to NMFS for review on November 23, 2005.

EFH for groundfish is defined as “the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish, and for

[18] In December 2005, NMFS, in cooperation with the PFMC, completed a Final Environmental Impact Statement for Essential Fish Habitat Designation and Minimization of Adverse Impacts for the Pacific Coast Groundfish Fishery Management Plan (NMFS 2005*b*). The Groundfish FMP Amendment 19 language incorporates the appropriate elements of the EFH Designation and Minimization of Adverse Impacts EIS preferred alternative into the Groundfish FMP.

groundfish contributions to a healthy ecosystem" (PFMC 2005). The PFMC manages 82+ groundfish species that occur throughout the EEZ (on the west coast, it encompasses the area extending 200 miles offshore) (PFMC 2005; NMFS 2005). These species, and their various life stages, represent diverse life histories, and they consequently inhabit a variety of habitats. While some species travel great distances in the ocean, others, such as yelloweye rockfish, may spend their entire lifetime (up to 120 years) around one rockpile (PFMC 2005; WDFW 2005*a*). Under the current EFH identification and description, incorporated into the groundfish fisheries management plan (FMP) by Amendment 19, all waters from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, along the coast of Washington to the U.S. EEZ is EFH for groundfish (PFMC 2005). The offshore area (the EEZ) is also used to designate EFH for coastal pelagic[19] species and salmon (PFMC 2005). So, not only does EFH constitute a vast area (317,690 square miles [NMFS 2005]), but it also represents a vast number of species— some of which are fairly well understood while very little is known about others (PFMC 2005).

Amendment 19 to the Groundfish FMP (PFMC 2005) designates the following HAPC:

- Estuaries;
- Canopy Kelp;
- Seagrass;
- Rocky Reefs;
- Areas of Interest (includes all waters and sea bottom in Washington State waters shoreward from the three nautical mile boundary of the territorial sea shoreward to the mean higher high water line); and
- Oil Platforms.

Of these HAPC types, Rocky Reefs and Areas of Interest occur in the proposed project footprint. It has not yet been determined if Seagrass occurs along the proposed underwater transmission cable route. As discussed above in Section 5.C.1, Geological Resources, several rock outcrops cross the project area, and the relief across these outcrops is very steep locally, with some pinnacles rising over five meters from the otherwise relatively flat seabed (TGPI 2002) (Figure 5-1). Because the Areas of Interest HAPC designation is so broad in Washington, this HAPC cannot be avoided. AquaEnergy's consultation with WDFW regarding assessing the presence or absence of seagrass along the transmission cable route, is discussed further below in the Our Analysis section under Marine Vegetation.

[19] Pacific sardine, Pacific (chub) mackerel, northern anchovy, jack mackerel, and market squid.

While not located within the proposed project footprint, kelp is present along Waatch Point and to the north away from Makah Bay. Kelp within the project area is also further discussed in the Marine Vegetation section below.

Tribal/commercial and recreational fishing in the project area is described in Section 5.C.7 (Recreation Resources and Land Use). Under the proposed amendments to the Pacific Coast Groundfish FMP (NMFS 2005), NMFS does not intend any proposed alternatives to apply to tribal fisheries in Usual and Accustomed grounds. Instead, "NMFS will continue to work with the tribes to ensure that within the Usual and Accustomed grounds, adequate measures are in place to protect EFH and HAPCs" (NMFS 2005)[20].

Seabirds

NOAA (2001) reports that "The seabird colonies of Washington's outer coast, mostly breeding on the seastacks and islands of the National Wildlife Refuges, are among the largest in the continental United States". As characterized by the USFWS (2001, 2005), the project area is contained in the Flattery Rocks National Wildlife Refuge, which extends from the northern tip of the Olympic Peninsula over 20 miles south, where it abuts the Quillayute Needles National Wildlife Refuge. These two National Wildlife Refuges, along with the Copalis National Wildlife Refuge, located along the southern end of the OCNMS, are referred as the Washington Islands National Wildlife Refuge. These combined refuges consist of 870 islands, rocks, and reefs along over 100 miles of the Washington coast and extends more than 100 miles seaward. Fourteen species of seabirds nest and rear their young on refuge islands and over a million seabirds, waterfowl, and shorebirds use the refuge. The refuge islands, which represent habitat used by over 80 percent of the state's breeding seabirds, are closed to visitation to protect seabird nesting and other wildlife (USFWS 2001, 2005).

OCNMS (2005) states that nearly 100 species of marine birds and shorebirds use the OCNMS. Typical seabirds include blackfooted albatross (*Diomedea nigripes*), fork-tailed storm-petrel (*Oceanodroma furcata*), Leach's storm-petrel (*Oceanodroma leucorhoa*) rhinoceros auklets (*Cerorhinca monocerata*), Cassin's auklets (*Ptychoramphus aleuticus*), common murres (*Uria murre*), northern fulmars (*Fulmarus glacialis*), sooty shearwater (*Puffinus griseus*), tufted puffins (*Fratercula cirrhata*), and cormorants (*Phalacrocorax* spp.). Other than breeding, nesting, and rearing their young, these pelagic birds spend their entire lives at sea. Common gulls in the project vicinity include Bonaparte's (*Larus philadelphia*), mew (*L. canus*), ring-billed (*L. delawarensis*),

[20] The Makah Usual and Accustomed fishing grounds extend along the northern Olympic Peninsula - north of 48°02'15" N to the U.S./Canada border and east of 125°44'00" (PFMC 2003). This area extends from about 20 miles south of the project area north to the middle of the Strait of Juan de Fuca and seaward to a maximum distance of about 50 miles (NOAA 2001).

California (*L. californicus*), herring (*L. argentatus*), Thayer's (*L. thayeri*), western (*L. occidentalis*), and glaucous-winged (*L. glaucescens*).

Seabirds frequently nest on isolated and severe landscapes such as rocky islands, sea stacks, and cliff sides. For example, common murres and cormorants nest on exposed cliffs (they may forgo building a nest and just lay an egg on a rock surface) while rhinoceros auklets, Cassin's auklets and storm-petrels will excavate a burrow and lay their egg underground (OCNMS 2005). Common murres nest on Tatoosh Island, located offshore of Cape Flattery, and on White Rock, located about 15 miles south of the project (NOAA 2001). OCNMS (2005) reports that many of the seabird species nest in other parts of the world and only inhabit the Olympic Coast during summer. For example, the sooty shearwater, which is one of the most abundant seabirds in the area, nests off of South America, Australia, and New Zealand during the summer. Likewise, the black-footed albatross, the most common albatross in this region, nests between Hawaii and Japan. Northern fulmars breed to the north offshore of Alaska, but commonly are seen off the Olympic Coast (OCNMS 2005). Most marine birds are protected under the Migratory Bird Treaty Act (NOAA 2001).

Other birds that inhabit or pass through the project area are discussed in Section 5.C.4, Terrestrial Resources (e.g., shorebirds, waterfowl) and Section 5.C.5, Threatened and Endangered Species (bald eagle, marbled murrelet, brown pelican, and short-tailed albatross).

Invertebrates

The project area consists primarily of sandy intertidal, sandy/mud and rock sublittoral habitats as well as offshore/pelagic areas (Figure 5-2), in which a variety of invertebrates can be found. The sandy intertidal area is inhabited by razor clams (Siliqua), isopods, mysids (opossum shrimp), sand dollars, purple olive snails, several species of clam (e.g., Macoma secta and Tellina bodegensis), Dungeness and mole crabs, amphipods, and worms typically occur in sandy intertidal areas. In sublittoral soft sediments, mud shrimp (Upogebia), brittle stars, and several species of clams and polychaete worms typically occur. Barnacles, limpets, amphipods, isopods, sea snails (Lacuna and Tegula), several species of crabs, the sea squirt Clavelina, and various species of edible clams (butter clams, littleneck clams, and horse clams) live on or under sublittoral boulder and cobbles. Squid, octopi, jellyfish, salps, heteropods, shrimp, and euphausiids are species that typically occur in more pelagic areas (OCNMS 2005).

While the Makah harvest razor clams at Hobuck Beach, there is no commercial razor clam harvest in the project area (letter from OCNMS to AquaEnergy, January 3, 2006). WDFW has expressed particular interest in assessing project impacts to Dungeness crabs and hard shell subtidal clams, both listed as Priority Species in the

Makah Bay Project area[21] (Letter from WDFW to AquaEnergy dated November 17, 2003; AquaEnergy 2005). The Dungeness crab lives in bays, inlets, around estuaries, and on the continental shelf to depths of approximately 180 m. It is typically found on sand bottoms and frequently among eelgrass (NMFS 2005). WDFW marine resources maps indicate that the entire project area represents Dungeness crab habitat (habitat and species information provided by WDFW, October 4, 2005).

Hard shell subtidal clams refer to three species: butter clam (*Saxidomus giganteus*), littleneck clam (*Protothaca staminea*), and Japanese littleneck clam (*Tapes philippinarum*). Butter clams can live up to 20 years. They inhabit intertidal habitat to 40 m in depth, bury to 30 cm, and prefer quiet bays and estuaries having muddy sand or muddy/sandy gravel. Littleneck clams occur in intertidal areas inhabiting coarse sand though they may be found in cobble or coarse shell mixed with gravel mud or sand. They bury to depths of 80 mm and primarily occur in estuaries, but occasionally occur along the open coast. Japanese littleneck clams are an introduced species that occur in intertidal habitat to depths of 10 m. This species prefers shelly or gravely mud or sand in low energy, stable beach environments (Kegel 1998). WDFW marine resources maps indicate that hardshell subtidal clams occur in Makah Bay, but to the south of the project, within about one mile from shore (habitat and species information provided by WDFW, October 4, 2005).

Marine Vegetation/Algae

A variety of seaweeds occur in the OCNMS and the project vicinity including, black pine (*Neorhodomela larix*), bottlebrush algae (*Endocladia muricata*), bull kelp (*Nereocystis* leutkeana), coralline algae (Order: Corallinales), giant kelp (*Macrocystis pyrifera*), laver or nori (*Porphyra* sp.), rockweed (*Fucus* sp.), sea cauliflower (*Leathesia difformis*), sea lettuce (*Ulva* sp.), sea palms (*Postelsia palmaeformis*), sea staghorn or dead man's finger (*Codium Fragile*), surfgrass, (*Pyllospadix* sp - actually a true plant), and winged kelp (*Alaria Marginata*) (OCNMS 2005). The OCNMS (2005) described the algae off of the Olympic Peninsula as follows:

> *Both microalgae and macroalgae are abundant and diverse on the outer coast. Over 120 species of algae have been identified in the rocky intertidal areas of the outer coast of the Olympic National Park. Microalgae are primarily composed of benthic diatoms which are found as thin coatings on rocks or living within the sediment. These diatoms are an important part of the "algal film" forming diatom slicks on rocks and providing a principal food source for many grazing animals such as gastropods and chitons.*

[21] A list of WDFW Priority Species within the project area is presented in the following environemental affects section.

Marine lichens are found as thin veneers on rocks in the highest intertidal areas on exposed rocky areas.

Macroalgae are seaweed that grow attached to a firm substrate from the intertidal region down to as deep as 40 m. The seaweeds are composed of three main phyla: red algae (Rhodophyta), brown algae (Phaeophyta), and green algae (Chlorophyta). Kendrick and Moorhead (1987) present a summary of the algal species found, or expected to occur, at three intertidal sites along the coast of the Olympic National Park. ... The red algae are the most diverse of the macroalgae in terms of number of genera (about 115) and species (at least 265) in the Pacific Northwest (Waaland, 1977). In intertidal and shallow subtidal areas, red algae often occupy the understory of the larger kelps.

Less common in the exposed areas of the outer coast, green algae inhabit the more protected marine and estuarine areas in Washington. These algae reside primarily in tidepools and rocky intertidal areas.

Brown algae include the largest marine plants and are probably the most important macroalgal group in terms of primary productivity and direct economic value. Brown algae vary from the large kelps to the less conspicuous forms that encrust rocks or form filaments on other algae. The Pacific Northwest coast supports the highest diversity of kelps in the world. Two species of brown algae dominate the extensive kelp forests of the outer coast: the bull kelp ... which is found in relatively protected waters; and the giant kelp ... which prefers more exposed areas ….

OCNMS (2005) further states that kelp beds provide important habitat structure, associated with the canopy, stipes, and holdfast, throughout the water column. Kelp beds grow in dense aggregations, reach up to 60 feet or more in height, and are important habitat for rockfish and a variety of pelagic and demersal fish species, providing important nursery areas and spawning habitat for small fish. In fact, numerous fish species, as well as sea otter, closely associate with giant kelp forests (OCNMS 2005).

The dominant vegetation types along the Olympic Coast in Jefferson and Clallam Counties, are kelp habitats with eelgrass and surfgrass also locally abundant (North Olympic Peninsula Lead Entity [NOPLE] 2005). Areas of sea grass, which includes eelgrass, surfgrass, and kelp, are considered HAPC (PFMC 2005). Giant kelp and bull kelp are the primary species of kelp forests that extend from Alaska to northern California (OCNMS 2005). A review of the Washington State ShoreZone Inventory database (covers from the intertidal to a depth of a few meters) and Floating Kelp Inventory database indicates that kelp and surfgrass were present along Waatch Point and to the north away from Makah Bay, and absent along Hobuck Beach south to the outlet of the

Sooes River. Kelp beds do not occur along the proposed transmission cable route and power plant site (personal communication with Bob Burkle, WDFW, August 12, 2005; Letter and PHS resource maps from WDFW to DTA, October 4, 2005).

b. Environmental Effects

In SD2 (AquaEnergy 2005), AquaEnergy consolidated many comments received from resource agency staff and other stakeholders and presented aquatic issues that were identified for analysis in the PDEA. In general, stakeholders wanted the PDEA to analyze sealife in the project area including an overview description of invertebrates, fish, birds, and marine mammals (sea otter, pinnipeds, and cetaceans). It was requested that any project impacts on these resources should be assessed with special emphasis on any state- or federally-listed species, and any non-listed species, if any, that may be particularly impacted by the project. As discussed above, WDFW Priority Habitats and Species information system listed the following within the Makah Bay Project area (Letter from WDFW to AquaEnergy, November 17, 2003; Letter and PHS resource maps from WDFW to DTA, October 4, 2005; AquaEnergy 2005):

- Bald Eagle (State Threatened);
- Dungeness crab (Priority Species);
- Hard shell subtidal clam (Priority Species);
- Marbled murrelet (State Threatened);
- Northern sea otter (State Endangered); and
- Rockfish (yelloweye) (State Candidate).

Other species and habitats of concern to WDFW in the project area include palustrine and marine wetland habitat, kelp beds, and harbor seal haulouts (Letter from WDFW to AquaEnergy, November 17, 2003; Letter and PHS resource maps from WDFW to DTA, October 4, 2005).

Marine mammals that resource agency staff and other stakeholders thought could be potentially affected by the development of the study area include cetaceans (gray, humpback, minke, orcas, harbor porpoise), pinnipeds (seals, sea lions), and sea otters. The location of the project relative to the migration route of gray whales was of particular concern. Stakeholders expressed an interest that baseline information be summarized regarding seabirds and fish species present in the project area (AquaEnergy 2005).

AquaEnergy proposes to implement the following environmental measures to minimize impacts to the area marine resources:

- Use HDD to deploy transmission cable from the shore station, under the beach and intertidal area, out to a depth of 10 to 30 feet below mean lower low tide (the depth to which HDD will occur will depend on the results of the eelgrass survey to be conducted prior to project construction and the suitability of the sediment for HDD);

- Design features to achieve a closed-loop system to prevent any marine life entering pressurized water flow;
- Utilize anti-fouling paints and materials on the equipment;
- Design features to minimize scale of anchor devices, project footprint on seafloor, and the chain/cable sweep of the seafloor;
- Design buoys to include a heavy-duty plastic conical attachment to be placed over the above-water portion of the buoy to prevent marine mammal haulout and seabird roosting; and
- Develop, in conjunction with the permitting agencies, a schedule of regular system maintenance that minimizes site visits, disturbance to marine growth, and activity at the site.

Marine Mammals

Specific concerns raised by resource agencies regarding potential impacts of the project on marine mammals include potential impacts on harbor porpoise, minke whales, migrating gray whales, pinnipeds, and sea otter (including any take under the MMPA); assessment of entanglement risk; and acoustic and magnetic field impacts (AquaEnergy 2005; Letter from WDFW to AquaEnergy dated November 17, 2003; Letter from Olympic Park Associates to FERC dated September 17, 2003). In a letter to FERC dated September 25, 2003, the USFWS stated that the PDEA should consider potential impacts to foraging and rafting sea otters. Steve Jeffries of WDFW stated "Based on the project description I doubt any (marine mammals) will be impacted by this demonstration project although any buoy anchored in that area may be used as a haulout structure by California and/or Steller sea lions. ...Other than those issues, (I) don't see anything else that should be a marine mammal issue" (personal communication S. Jeffries, marine mammal biologist, WDFW to L. Vigue, WDFW, August 29, 2005).

<u>Our Analysis</u>

- **Cetaceans**

Migration and entanglement - Because gray whales migrate up and down the Pacific coast between their Alaskan feeding waters (summer) and Mexican breeding grounds (winter), resource agencies have indicated that their migration routes are of specific concern in regards to the project location and potential effect. Gray whales can become entangled in fishing gear, such as rope or net from crab pots or gillnets. In some cases, entanglement can be so severe as to cause death (WDFW 1997).

As discussed above, the northbound migration occurs offshore of Washington from March through May and the southbound migration occurs in December and January (WDFW 1997). Green et al. (1995) reports the mean distance offshore for southbound migrants off Washington was 15.7 miles compared to 7.3 miles offshore during the northward migration while Shelden et al. (2000) reported southward migrating gray whales as far as 29 miles offshore of Washington. NOAA (2001) reports that "there has been relatively little effort off Washington to document the timing of the migration because ... during their southward migration, gray whales travel well offshore through this area (Pike 1962; Green et al. 1995; Shelden et al. 2000)...."

The Makah Bay Project is located 3.7 statute miles offshore, and therefore the majority of migrating gray whales should not pass close to the AquaBuOY deployment site. Any gray whales migrating nearer to shore or some of the few (WDFW 1997) Pacific coast feeding aggregation that summer off the Washington Coast[22] could encounter the project. To assess the potential for entanglement, it is helpful to review the mooring system.

The mooring system for each AquaBuOY consists of four VLAs placed approximately in a square pattern on the ocean floor with the AquaBuOY approximately centered on the surface above (Figure 3-5). From buoy to anchor, each mooring consists of a tension cable attached to a surface float followed by a cable fastened to a chain, which is fixed to a float just above the seafloor to prevent chain scouring, followed by chain fixed to the VLA. Each AquaBuOY hull will be tethered to four floats used to lift the mooring chain from the seafloor to prevent harm to the seafloor. Floats are each approximately 4 feet in diameter. Heave forces acting on the surface floats and seafloor floats are damped by lifting the chain from the VLA. Each VLA is installed like a conventional drag embedment anchor, but penetrates much deeper. The anchor system, consisting of a total of 10 VLAs and 10 surface floats, will cover a rectangular area of approximately 625 by 450 feet on the ocean floor (Figure 3-5).

AquaEnergy's decision to use VLAs instead of concrete anchors eliminates excess cable associated with a concrete block anchoring system, which results in reduced potential for entanglement. In discussion of the VLA system design, WDNR and OCNMS staff stated that the reduction in cable length and number allowed by the anchors under consideration looks "very promising" from an environmental standpoint (project technical meeting, June 27, 2005).

[22] As discussed earlier, a few gray whales are known to reside in nearshore waters off of Washington during the summer (WDFW 1997; letter from OCNMS to AquaEnergy dated January 3, 2005). NOAA (2001) points out that Calambokidis and Quan (1999) and Quan (2000) found that "...these whales 1) move widely within and between areas on the Pacific coast to feed in the summer and fall, 2) are not always observed in the same area each year, and 3) may have several year gaps between resightings in studied areas."

While crab pot lines or gill nets are more likely to give way and potentially twist around a whale that has made contact with it, due to the mass of the AquaBuOYs and the VLAs combined with the strength/resistance of the mooring cables and chains, the mooring system is expected to have adequate tension to preclude forming loops or twisting around a passing animal. The spacing of the AquaBuOYs 60 feet apart from each other further minimizes the likelihood of entanglement by providing room for cetaceans (including minke whales, harbor porpoise, and orcas) and other marine life to pass between the buoys. It is unknown whether the slack mooring associated with the subsurface floats and weights may represent a possible point of entanglement for passing marine life. However, this mooring design is a commonly-used buoy configuration as it accommodates for additional cable lengths required with the varying tides and waves these systems encounter.

The portion of the transmission cable that is anchored to the seafloor will be deployed in such a way as to provide maximum contour to the seafloor to minimize spaces where marine mammals could become trapped. The actual cable anchoring method will be determined with the installation company and agreed to with the OCNMS and WDNR, prior to installation.

Construction of the project is anticipated to occur during the summer, when gray whales will not be migrating through the area. Therefore, no interference to migrating whales associated with the deployment of the buoys and laying of the transmission cable is expected.

Acoustic disturbance - Resource agencies have indicated concern regarding potential acoustic impacts of the project on cetaceans. Potential sources of noise resulting from project operation include operations of the hose pump and the turbine as well as waves impacting against the buoy. EPRI reports that "...noise from wave power plant machinery will generally increase in proportion to the ambient background noise associated with surface wave conditions, thus tending to minimize its noticeable effect" (EPRI 2004).

NOAA (2001) reports that "studies of short-term behavioral responses to underwater noise associated with aircraft, ships, and seismic explorations indicate a 0.5 probability that (gray) whales will respond to continuous broadband noise when sound levels exceed ca. 120 dB and to intermittent noise when levels exceed ca. 170 dB, usually by changing their swimming course to avoid the source." A Department of the Navy (2001) study detected some short-term behavioral responses of whales to sound levels of 120 to 155 dB. Noting that "short-term behavioral responses do not necessarily constitute significant changes in biologically important behaviors", the Department of the Navy (2001) concluded that the threshold for potential impact on biologically significant behaviors (level of potential concern) of whales is >145 dB.

AquaBuOYs are similar in size to large navigational aids, which are common along the nation's coastlines. Noise resulting from waves hitting the buoys is expected to have no significant impact on area marine life. Noise levels resulting from project operation, specifically the hose pump and the pressurized water hitting the Pelton turbine are expected to produce noise levels well below the ambient noise of the ocean and well below 145 dB. During the June 27, 2005 Makah Bay Project technical meeting, AquaEnergy staff stated, and resource agency staff agreed, that the high wave action associated with this area will, during most days, create more noise than the plant will. AquaEnergy anticipates noise associated with construction would be localized, intermittent, and of short duration. As such, neither project construction nor operation is expected to adversely affect gray whales or other cetaceans and marine mammals.

Electromagnetic radiation - Scott Wilson and Downie (2003) state that "The artificial magnetic and electric fields (associated with submarine electric cables) can cause interference and disturbance to orientation in migrating animals and with the feeding mechanisms of elasmobranchs (group of fishes which includes the sharks, rays, and skates). The emission of noise and vibrations into the water column can also impact on the behavior of fish species, and cause them stress." The Danish Institute for Fisheries Research (2000) concluded the following regarding effects to fish from underwater transmission cables associated with large offshore windmills:

> *Magnetic fields from cable (routes) ..., windmills, and the offshore transformer station may be expected to reach geomagnetic field-strength levels only in the immediate vicinity of these structures, at distances no more than 1 m. Cartilaginous fishes (sharks and rays) are, by way of their electro-receptive sense organs, able to detect magnetic fields, and they may use the geomagnetic field for navigation. For bony fish, a true magnetic sense has been proposed, but the evidence is much less compelling. Thus, the weak magnetic fields… are not expected to pose any serious problem for the local fish species. Furthermore it does not appear likely that the magnetic fields generated by the power transmission cables will have any detectable effects on the harbor porpoises and seals in the area.*

Transmission cables using an alternating current (AC) system, which is the primary system used in North America for electricity supply, would not result in measurable deflection of compasses or disruption of radio, GPS, or radio-beacon navigational equipment on ships passing over the cables (USACE 2004).

The number and strength of the transmission cables, the type of cable used and the type of cable sheathing, and the depth at which the cable is buried represent factors that will influence the degree to which sensitive species are affected by electro-magnetic fields (EMF) (ABPmer 2005). The proposed Cape Wind Energy Project underwater transmission cable system would contain grounded metallic shielding that would block any electric fields generated by transmission of electricity through the cable system. Thus, the USACE (2004) concluded that the project would not result in any adverse effects to the aquatic community from electric field effects. The USACE (2004) reported that "the actual magnitude of typical 60-Hz magnetic fields in the vicinity of the (proposed project) submarine cables is, in most locations, many fold below that of the steady geomagnetic field (~500 mG)" from the earth and the maximum exposure would occur over "...an extremely small space, and decrease rapidly within a few feet of such locations...". The USACE (2004) concluded that there were no anticipated adverse effects to fish species or the marine environment resulting from the 60-Hz magnetic fields that would result from the operation of the project.

The World Health Organization (2005) reports that while "some investigators have suggested that human-made EMF from undersea power cables could interfere with the prey sensing or navigational abilities of (electrosensitive fish such as sharks and rays) in the immediate vicinity of the sea cables... none of the studies performed to date to assess the impact of undersea cables on migratory fish (e.g., salmon and eels) and all the relatively immobile fauna inhabiting the sea seafloor (e.g., mollusks), have found any substantial behavioral or biological impact."

At the present time, it is not clear as to the significance or scale of these impacts. The transmission cable for the Kaneohe Bay Project was designed to carry 250 kW (Department of the Navy 2003). For that project, the Navy determined that "The small scale and limited area of disturbance indicate that impacts from electromagnetic radiation (EMR) on marine organisms would be minor and temporary. Impacts of EMR on marine organisms can be expected to range from no impact to avoidance (for bottom-dwelling organisms only) (in) the vicinity of the WEC cable" (Department of the Navy 2003).

The expected output from each AquaBuOY is 480V AC current with a nameplate capacity of 250 kW. Power levels from each unit are expected to range between 0 and 250 kW with an estimated average output of 46 kW (with an average wave resource of 28 kW/m wave front). The transmission cable leading from the hub buoy to the shore station would transmit direct current (DC) power which does not create high levels of electro magnetic radiation (EMR) as compared to the transmission of AC power. The cable will adhere to OSEA standards that prescribe the minimum size and weight of cable. The project cable will transfer range between 0 and 1,000 kW (1 MW) with an average of 184 kW. It is therefore expected that, as with the Kaneohe Bay Project, any EMR impacts of the Makah Bay Project would be minor and temporary ranging from no impact to avoidance for organisms inhabiting the seafloor near the transmission cable.

■ **Pinnipeds**

California sea lions, harbor seals, and other pinnipeds haulout on islands and rocky outcrops nearshore (NOAA 2001). There are some rocky outcrops in Makah Bay that are exposed at low tide and which could be used by pinnipeds as haulout areas. One of the primary impacts of wave energy projects on pinniped populations identified by EPRI (2004) in its report, *Offshore Wave Power in the U.S., Environmental Issues*, was that wave energy plants may provide artificial haulouts for seals and sea lions, and result in the growth of populations of these species greater than would otherwise occur in the absence of the project. In response to similar concerns raised by resource agencies (AquaEnergy 2005), AquaEnergy has designed the above-water surface portion of the buoys to be conical in shape to prevent marine mammal haulout on project equipment. As indicated above, Steve Jeffries of WDFW stated that other than potential use of project buoys by sea lions as haulouts, he doubted "... any (marine mammals) will be impacted by this demonstration project...." (personal communication S. Jeffries, marine mammal biologist, WDFW to L. Vigue, WDFW, August 29, 2005). Pinnipeds that are in the water will be able to maneuver around and between the project's moorings and for the reasons described above in the discussion regarding gray whales, it is unlikely that pinniped, or sea otters or seabirds, will become entangled in moorings.

During construction, possible disturbance to pinnipeds may result from buoy and transmission cable installation and noise of construction equipment. These impacts, as well as the presence of construction crews, will be short term and only occur during the initial construction phase of the project.

■ **Sea Otters**

NOAA (2001) reports that sea otters are typically found in very shallow waters in areas having high kelp concentrations. In the *Washington State Recovery Plan for the Sea Otter* (Lance et al 2004), WDFW reports that in state waters sea otters generally remain in nearshore waters (seldom more than 0.5 to 1.5 miles from shore) up to 20 fathoms deep. Habitat use by sea otters along the Washington coast has recently been described using radio telemetry and resight data collected from 68 individuals (Laidre et al. 2002). Adult males foraged deeper than juvenile males (52.5 and 46 feet, respectively), but the mean distance from shore for foraging was greater for juveniles than adults (0.9 and 0.7 miles, respectively). In contrast, juvenile females foraged deeper than adult females (12 and 10 m, respectively) and also foraged at mean distance from shore greater than adults (3,100 and 2,352 feet, respectively) (Lance et al. 2004).

Because the buoys will be placed offshore in water approximately 150 feet deep in an area not having kelp, and because the transmission cable running to shore will be either secured or buried along the ocean bottom along a route selected to avoid kelp beds, particularly the kelp beds around Waatch Point where sea otters have been documented, project operations are not expected to have any impact on sea otters.

Fish

Specific concerns raised by resource agencies regarding potential effects of the project on marine fish include potential impacts on rockfish, especially yelloweye rockfish, and their habitat; potential impacts to nearshore habitats for and other impacts to salmon and forage fish; assessment of attraction and predation, and fish passage (AquaEnergy 2005; Letter from WDFW to AquaEnergy dated November 17, 2003). Pacific salmon are discussed in Section 5.C.5, Threatened and Endangered Species.

Our Analysis

Over 64 species of rockfish, family Scorpaenidae, inhabit waters off the West Coast. Rockfish grow slowly, become sexually mature in six years, and have long life spans. Rockfish species settle in one location where they typically remain. They do not appear to migrate (PFMC 2005). WDFW has indicated particular concern with yelloweye rockfish, which is a state candidate species (AquaEnergy 2005; Letter from WDFW to AquaEnergy dated November 17, 2003). This species associates with rugged, rocky habitats and has been found at depths ranging from 50 to 1,800 feet. It was declared overfished in 2002. WDFW has prohibited the keeping of yelloweye rockfish in Washington recreational fisheries (PFMC 2005).

The power plant will occupy a relatively small area of the ocean surface (60 feet by 240 feet). Each AquaBuOY is a closed system, and as such, there is no chance that entrapment of fish or other marine life will occur. Because the VLAs are deployed completely below the seafloor, impacts to the benthos will primarily occur only when deploying the anchors and these impacts will occur only in a small area represented by the footprint of the anchors. Each VLA is installed like a conventional drag anchor, but penetrates much deeper. Following construction, only the area of the seafloor equal to the diameter of the cables leading from the VLAs to the mooring buoys, will be affected by the power plant. As such, there is practically no footprint on the seafloor under the power plant. The transmission cable that is anchored to the seafloor represents a small footprint and is the only part of the project that will sit on the seafloor. AquaEnergy proposes to locate the transmission cable along sand and silt substrate, avoiding all rock outcroppings out to a depth of 98 feet. Rocky reefs are considered HAPC, and the transmission cable is not expected to negatively affect these habitats. The portions of the transmission cable crossing over both rock and sand substrate may provide structure to invertebrates and macro algae, thus providing for development of small artificial reef areas. This in turn could improve fish habitat in the project area.

During construction, possible disturbance to the seabed may occur from anchoring of construction vessels and transmission cable installation; and noise of construction equipment will also occur. Where the transmission cable does pass over rocky substrate, there will be some impacts during laying of the transmission cable and securing it to the bottom. These impacts will be short term, very localized, and only occur during the initial construction phase of the project. At the June 27, 2005 Makah Bay Project technical meeting, WDFW staff said that 150 db/1 micropascal is a reasonable rule-of-thumb disturbance level for fish. Because this is the level that would occur during activities such as pile driving, which will not be required for this project, WDFW and OCNMS staff stated that it was doubtful that the project would have an acoustic effect on fish. During the June 27, 2005 technical meeting, AquaEnergy staff stated, and resource agency staff agreed, that the high wave action associated with this area will, during most days, create more noise than the plant will.

At the June 27, 2005 project technical meeting, WDFW staff stated that surf smelt are a concern to WDFW. Surf smelt are very widespread in Washington, occurring in nearshore areas and spawning "...at high tides on mixed sand-gravel substrates in the upper intertidal zone" (Bargmann 1998). The nearest documented surf smelt spawning grounds to the project area occurs just south of Makah Bay at Shishi Beach (personal communication Steve Fradkin, Olympic National Park), and about 30 miles south of Makah Bay, along the coast to the north of the mouth of the Quillayute River (Bargmann 1998). At the June 27, 2005 project technical meeting, WDFW staff stated that the HDD proposed by AquaEnergy will largely address their concern regarding surf smelt. WDFW staff stated that other fish using the area will probably not be affected by the project unless their habitat is disturbed.

AquaEnergy concludes that neither construction nor operation of the project will adversely affect rockfish, surf smelt, or other marine fish in the project area. Instead, project construction may result in a net gain for fish and other marine life that will benefit from the protection from fishing along and around the project footprint and potential development of small artificial reef areas along the transmission cable.

Seabirds

Resource agencies have requested assessment of potential impacts of the project on seabirds in general, and bald eagles and marbled murrelets in particular. Analysis of impacts to these latter two species is included in Section 5.C.5, Threatened and Endangered Species.

<u>Our Analysis</u>

It is expected that the floating power plant would be visited two to five times per year by boat out of Neah Bay. Any displacement associated with periodic boat activity at the project would be temporary and is unlikely to significantly disrupt non-listed seabirds using the project area.

One of the primary impacts of wave energy projects on seabird populations identified by EPRI (2004) in its report, Offshore Wave Power in the U.S., Environmental Issues, was that wave energy plants may provide artificial nesting space for seabirds, and result in the growth of populations of these species greater than would otherwise occur in the absence of the project. The likelihood of this occurring is increased because the buoys require only infrequent service visits. In response to agency concerns regarding this issue (AquaEnergy 2005), AquaEnergy has designed the buoys to prevent seabird roosting — a heavy-duty plastic conical attachment will be placed over the above-water portion of the buoy.

Invertebrates

Resource agencies have requested assessment of potential impacts of the project on the benthic community (AquaEnergy 2005).

Our Analysis

Each AquaBuOY is a closed system, and as such, there is no chance that entrapment of marine life will occur. The offshore power plant will occupy a rectangular area of 60 feet by 240 feet on the water surface. The anchor system, consisting of a total of 10 VLAs and 10 surface floats, will cover a rectangular area of approximately 625 by 450 feet on the ocean floor (Figure 3-5). In response to agency concern about impacts of chain sweep from mooring lines on the benthic community around each anchor, AquaEnergy modified the buoy design to utilize VLAs. Each VLA is installed like a conventional drag embedment anchor, but penetrates much deeper. The VLA will have minimal chance of chain sweep as it incorporates a slack mooring system, involving subsurface floats (Figure 3-5), to maintain suspension of the mooring chains and cables above the seafloor. As discussed above, the VLAs are deployed completely below the seafloor, and the primary impact to the benthos will occur during deployment of the anchors when the anchors are pushed through the sediment. This process will affect a very small area represented by the approximate area of each anchor, otherwise, only the area of the seafloor equal to the diameter of the cables leading from the VLAs to the mooring buoys, will be affected by the power plant.

AquaEnergy proposes that the transmission cable, transferring the power plant output to the shore station, will be anchored on the ocean floor, except for, from about 10 to 30 feet in depth from mean lower low water[23]. From this depth the transmission cable will be buried using a HDD technique frequently used for other transmission cable projects. AquaEnergy proposes to use HDD to eliminate impacts to the surf zone and Hobuck Beach. Staff from OCNMS and WDFW agreed that HDD is becoming the

[23] The depth at which directional drilling will occur to will depend on the results of the eelgrass survey and the suitability of the sediment for HDD. The survey will be completed prior to project construction.

preferred way to lay transmission cable in the nearshore areas (June 27, 2005 project technical meeting, Port Angeles, Washington).

The HDD process is presented above in Section 5.C.1, Geological Resources. As discussed in that section, the HDD method has the potential for loss or seepage of drilling fluid into the geologic formation through which the drill passes. In some cases, the drilling fluid may be forced to the surface resulting in what is commonly referred to as inadvertent release of drilling lubricant or “frac-out”. AquaEnergy and the drilling contractor will take all necessary preventative and responsive measures in case of a frac-out.

The portion of the transmission cable not buried by HDD will be anchored to the seafloor. By not burying this portion of the transmission cable, AquaEnergy will avoid the short-term impacts associated with trenching (e.g., suspended sediments resulting from dredging and associated dislodging of benthos). According to crab fishermen, off of the northern Oregon sea floor sand levels at fishing locations (crab pots) have changed from 15 to 20 feet, and these fluctuations can be expected within sandy zones inshore of 70 feet in depth (City of Rockaway Beach Ocean Outfall PER, personal communication from E. Gage, Brown and Caldwell, Portland, Oregon to G. Kaminsky, Washington Department of Ecology, April 19, 2004). As mentioned above, shifting sands can occur to a great depth, but changes in bathymetry are not expected beyond the closure depth (calculated to be about 56 feet at the project) (personal communication, Richard Sternberg, University of Washington, July 25, 2005). It is therefore likely that portions of the transmission cable will be naturally buried by sand or scoured, especially in areas of 56 feet or less of depth.

Other than the small area directly under the anchors, transmission cable, and cable anchoring devices, the benthic community, including Dungeness crabs and hard shell subtidal clams, will not be affected by the project operation. In fact, the anchors and transmission cable may likely provide structure to invertebrates and macro algae, thus providing for development of artificial reef structure in the project area (EPRI 2004; WDFW staff, June 27, 2005 project technical meeting) representing positive impacts of the project. Anti-fouling paints and materials will be used on the buoys to minimize growth of invertebrates and macroalgae on the project equipment; this was further discussed above in Section 5.C.2, Water Resources.

At a June 27, 2005 Makah Bay Project technical meeting, a WDNR staff member expressed concern that the portion of the transmission cable laid on the seafloor could get caught by trawlers and could physically disturb the seafloor habitat. This is addressed in the discussion on tribal fishing in Section 5.C.7, Recreation Resources and Land Use.

As previously mentioned, during construction, possible disturbance to the seabed may occur from anchoring of construction vessels and transmission cable installation and noise of construction equipment will also occur. These impacts will be short term and only occur during the initial construction phase of the project. AquaEnergy concludes that no significant impact will result to the benthic community from construction and operation of the project.

Marine Vegetation

At the June 27, 2005 Makah Bay Project meeting, WDFW biologists stated that kelp and other macroalgae are a principle issue for WDFW with respect to development of the proposed project. AquaEnergy proposes to locate the power plant and the transmission cable so as to avoid macro algae beds and sea grass communities.

<u>**Our Analysis**</u>

The power plant portion of the project will be located in approximately 150 feet of water. Because kelp and seagrass, both which are considered HAPC (PFMC 2005), do not grow at this depth, the power plant portion of the project, consisting of the buoy anchor array, is located well seaward of kelp bed areas and will not affect marine vegetation. As documented by the TGPI seabed survey (TGPI 2002), the seafloor within the project vicinity consists primarily of fine-grained sand and silt surrounding large rock outcrops and smaller groups of scattered rock. For the entire project area, sand- to silt-sized sediment covers approximately 60 percent of the seafloor; the remaining 40 percent consists of rock outcrop. Floating kelp and non-floating kelp are most common in rocky, high-energy environments (WDNR 2005); a review of the Washington State ShoreZone Inventory database and Floating Kelp Inventory database indicates that kelp and surfgrass were present along Waatch Point and to the north away from Makah Bay, and absent along Hobuck Beach south to the outlet of the Sooes River. AquaEnergy proposes to locate the transmission cable along sand and silt substrate, avoiding all rock outcroppings out to a depth of 30 meters. The transmission cable will therefore avoid rocky habitats at the depths preferred by kelp as well as many other species of macro algae (OCNMS 2005; Figures 5-1 and 5-2). WDFW agreed that the proposed project route would not affect kelp beds (personal communication, Bob Burkle, WDFW, August 12, 2005).

AquaEnergy plans to use HDD to pull the transmission cable underground from at least a depth of 10 feet. During consultation, WDFW staff indicated that the presence or absence of seagrass along the transmission cable route should be assessed from a depth of 10 to 30 feet below mean lower low tide (personal communication Bob Burkle, WDFW, August 12, 2005). Upon further consultation (personal communication, Bob Burkle, WDFW, August 30, 2005; letter from DTA to WDFW dated September 7, 2005), AquaEnergy and WDFW staff agreed that AquaEnergy would conduct this survey during summer months prior to the time of construction and that, if the presence of seagrass is confirmed, AquaEnergy will consult with WDFW as to the appropriate methods to minimize disturbance. AquaEnergy suggested that likely solutions would involve either modifying the transmission cable route so as to avoid seagrass communities or using HDD to a depth of 30 feet. AquaEnergy stated that their goal was to work with WDFW to ensure that any potential effects to area seagrass communities are minimized (personal communication, Bob Burkle, WDFW, August 30, 2005; letter from DTA to WDFW dated September 7, 2005).

The proposed use of HDD will minimize impacts to the beach, intertidal, and nearshore zones. AquaEnergy's plan to conduct a seagrass survey prior to project construction, and to coordinate with WDFW in routing the project transmission cable so as to avoid any identified seagrass beds, will ensure that impacts to marine vegetation are minimized. Consequently, the project will not represent a negative impact to the area's kelp beds and seagrass communities. At the June 27, 2005 project technical meeting, WDFW staff stated that project anchor cables may provide a new holdfast for kelp, rendering the project "partially self-mitigating".

Conclusions

The proposed project represents one of the most environmentally benign electrical generation technologies. Entanglement is of minimal concern to marine mammals and seabirds, and the taking of marine mammals protected under the MMPA is very unlikely. The potential growth of benthic organisms on the project cables and anchors represent a beneficial impact. AquaEnergy's proposed measures will help eliminate or minimize any potential negative impacts to marine fauna and flora resulting from project operation and construction.

c. Unavoidable Adverse Impacts

Unavoidable adverse impacts to the benthic community resulting from development of the proposed project will primarily occur only when deploying the anchors; these impacts will occur only in a small area represented by the footprint of the anchors. During construction, possible disturbance to the seabed may occur from anchoring of construction vessels and transmission cable installation and noise of construction equipment will also occur. These impacts, as well as the presence of construction crews, will be short term and only occur during the initial construction phase of the project.

4. Terrestrial Resources

a. Affected Environment

The terrestrial setting of the project is divisible into three vegetation zones or cover types that correspond to increased elevation above mean high water: 1) beach; 2) dune; and 3) wooded. The beach cover type includes areas periodically inundated by the tide along the gently sloping shoreline. This is the prevalent cover type within the project area. Although largely devoid of vegetation, beaches are nonetheless important foraging and resting habitat for shorebirds, gulls, crows, river otter, and other wildlife.

The following sections describe the existing vegetation and wildlife resources in the Makah Bay Project vicinity, including major cover types, general distribution of vegetation and wildlife, and special status species. Information about federally-threatened and -endangered species is presented in Section 5.C.5, Threatened and Endangered Species.

Plants

The land-based portion of the project is located on Hobuck Beach. This area is within the Pacific Northwest Coast Ecoregion, which includes much of the Olympic Peninsula of Washington, the coast mountain ranges extending down to central Oregon, and most of Vancouver Island in British Columbia (WDNR 2003). Events of both natural and human origin have modified the land in the Makah Bay Project area. Natural disturbance events include coastal storms and flooding. Human disturbance in the project area consists of an overhead transmission line.

As previously stated, land cover in the Makah Bay Project area is generally restricted to beach, dune, and wooded cover types. There is no urban development, and the most common vegetation is beach grass. In the vicinity of the proposed shore station, the most common cover types consist of dune and wooded lands. Below, we discuss each cover type including plant species identified during a site reconnaissance on June 26, 2005.

Cover Types

■ **Beach Cover Type**

The beach cover type is the primary cover type within the project area. Beaches furnish habitat for shorebirds, crows, gulls, and a host of other wildlife. "The coastline forms an important migratory pathway for millions of birds that pass through each year, guiding ducks, geese, cranes and raptors toward northern breeding areas during the spring and southward, as winter approaches" (OCNMS 2005). This cover type extends from mean high water to the aeolian[24] ramp (seaward side of the foredune). Common plant species occurring in this zone include Virginia glasswort (*Salicornia virginica*) and sea rocket (*Cakile edentula*). WDFW classifies Hobuck Beach as a marine wetland, which is considered a Priority Habitat (Letter and PHS resource maps from WDFW to DTA, October 4, 2005).

[24] A geomorphic process whereby soil forming material is transported and deposited by wind.

■ **Dune Cover Type**

The dune cover type includes the area from the aeolian ramp to the seaward edge of the wooded community. Plant species adapted to dunes must tolerate wind, sand burial, sand abrasion, salt spray, water deprivation, and salty shifting soils (WDOE 2005). The foredunes in the project area are dominated by European beachgrass (*Ammophila arenaria*), whereas a greater variety of species were observed on the landward side of the dunes, including: American dunegrass (*Elymus mollis*), large-headed sedge (*Carex macrocephala*), beach morning-glory (*Convolvulus soldanella*), yellow sand verbena (*Abronia latifolia*), northern dune tansy (*Tanacetum douglasii*), smooth cats-ear (*Hypochaeris glabra*), beach pea (*Lathyrus japonicus*), American glehnia (*Glehnia leiocarpa*), seaside plantain (*Plantago maritima*), Labrador-tea (*Rhododendron* [*Ledum*] *groenlandicum*), and western bracken fern (*Pteridium aquilinum*). The dune cover type is well vegetated, and no large areas devoid of vegetation were observed.

■ **Wooded Cover Type**

Woody vegetation begins to appear at slightly higher elevations on the landward side of the dune zone, first as scattered small shrubs, increasing to a low, shrubby thicket, and then small trees. Shrubs observed in this zone include wild blackberry (*Rubus ursinus*), Himalayan blackberry (*R. discolor*), salmonberry (*R. spectabilis*), small red alder (*Alnus rubra*), willow (*Salix* sp.), and rose (*Rosa* sp.). Sitka spruce (*Picea sitchensis*) is the dominant tree species, with occasional tree-sized red alder and red elderberry (*Sambucus racemosa*). A variety of herbaceous species were observed in this cover type roadside, including self-heal (*Prunella vulgaris*), orchard-grass (*Dactylis glomerata*), common horsetail (*Equisetum arvense*), bracken fern, and occasional tansy ragwort (*Senecio jacobaea*). Because the project area only extends to Makah Passage Road, it does not encompass any heavily forested areas.

Species of State Concern

DTA contacted WDNR to inquire about any plant species of state concern that occurred in the project vicinity. WDNR responded, in a letter dated September 13, 2005, that the following rare plants are currently or historically know to occur within one mile of the land portion of the project:

Common name	Scientific name	Status
Current species		
pink fawn-lilly	*Erythronium revolutum*	state sensitive
western yellow oxalis	*Oxalis suksdorfii*	state threatened
Historical species		
pink sandverbena	*Abronia umbellata ssp.*	possibly extirpated

None of these species were observed during the June 26, 2005 site reconnaissance.

Wildlife

This section describes the occurrence of wildlife species in the Makah Bay Project vicinity. The project vicinity supports over 100 species of marine bird and shorebirds (OCNMS 2005). In addition, numerous mammal species and various species of amphibians, reptiles, mollusks, and insects utilize the project area. The wildlife information in this section is based in part on visual observations that AquaEnergy biologists conducted during various site investigations and from various reference sources.

The OCNMS is a critical link in the Pacific flyway (NOAA 2005*a*). Common waterfowl in the project vicinity include Eurasian wigeon (*Anas penelope*), American wigeon (*A. americana*), oldsquaw (*Clangula hyemalis*), black scotor (*Melanitta nigra*), surf scoter (*M. perspicillata*), white-winged scotor (*M. fusca*), common goldeneye (*Bucephala clangula*), and barrow's goldeneye (*B. islandica*) (National Geographic Society [NGS] 1983).

Common shorebirds in the vicinity of the project area include black-bellied plover (*Pluvialis squatarola*), pacific golden plover (*P. fulva*), killdeer (*Charadrius vociferous*), black oystercatcher (*Haematopus bachmani*), ruddy turnstone (*Arenaria interpres*), black turnstone (*A. melanocephala*), red knot (*Calidris canutus*), sanderling (*C. alba*), least sandpiper (*C. minutilla*), rock sandpiper (*C. ptilocnemis*), dunlin (*C. alpina*), short-billed dowitcher (*Limnodromus griseus*), and common snipe (*Gallinago gallinago*) (NGS 1983). Other bird species that occur in the project vicinity include bald eagle (*Haliaeetus leucocephalus*), red-tailed hawk (Buteo jamaicensis), and peregrine falcon (*Falco peregrinus*).

Information on seabird species that inhabit and/or pass through the project area and bald eagles is presented in Section 5.C.3, Aquatic Resources while Section 5.C.5, Threatened and Endangered Species, provides additional information on the marbled murrelet and bald eagle.

Mammals likely to occur in the project vicinity include coyote (*Canis latrans*), black bear (*Ursus americanus*), Townsend's chipmunk (*Eutamias townsendii*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), mink (*Mustela vison*), little brown myotis (*Myotis lucifugus*), beaver (*Castor canadensis*), deer mouse (*Peromyscus maniculatus*), and Townsend's vole (*Microtus townsendii*) (The Audubon Society 1980).

b. Environmental Effects

In SD2 (AquaEnergy 2005), AquaEnergy consolidated many comments received from resource agency staff and other stakeholders, then presented issues that were identified for analysis in the PDEA. With regard to terrestrial resources, stakeholders wanted the PDEA to include an overview description of plants in the project area.

Under the applicant's Proposed Action, there will be minimal changes to the current condition of terrestrial resources at the site. Construction of the shore station equipment will be housed in a fabricated metal building (approximately 10 feet high with a floor plan measuring 15 feet by 15 feet) in the wooded cover type previously described. The structure will be erected using small equipment. Construction of the shore station, the driveway, and the parking area will coincide with the placement of the in-water components. Construction of the shore facilities will require some earthwork (foundation preparation); however, this work will not occur within 200 feet of the water line and no fill will be required to establish the foundation area. During the shore station construction phase, approximately 1,500 square feet of area will be used by the HDD contractor. A staging area located approximately ¼ mile southeast of the shore station (formerly used by Air Force) will be used for preparing the transmission cable, electrical equipment, and any other construction-related activities to minimize disturbances to the terrestrial resources at the site (see Figure 1-3). The proposed locations for these activities and access to these stations during the construction phase will avoid wetlands. Upon completion, the shore station will be landscaped to blend with the local flora. The only impervious surface measures approximately 200 square feet which is required for the onshore electrical equipment building. Section 3, Proposed Action and Alternatives, provides additional information regarding the shore station and its appurtenances.

Our Analysis

No work or structures will be placed within 200 feet of the water line. As previously discussed in Section 3, Proposed Action and Alternatives, the transmission cable will be installed underground by HDD, from a depth of 10 to 30 feet below mean lower low tide to the shore station. Use of HDD will ensure minimal disturbance to the beach zone. AquaEnergy concludes that the Proposed Action will not adversely affect terrestrial vegetation or wildlife communities.

c. Unavoidable Adverse Impacts

The 15-foot-by-15-foot footprint of the shore station, driveway, and parking area represents areas that will be permanently impacted by the project. Construction of the land portion of the project and the laydown area for the HDD represents temporary impacts.

5. Threatened and Endangered Species

a. Affected Environment

AquaEnergy contacted NMFS and USFWS and requested information regarding threatened or endangered species in the project area on May 14, 2002. Regarding other species, AquaEnergy was directed to WDFW's web site which lists threatened and endangered species for the State of Washington. Federally-listed threatened or endangered animal species that may occur in the project area are listed in Table 5-7.

TABLE 5-7
FEDERALLY-LISTED THREATENED OR ENDANGERED SPECIES THAT MAY OCCUR IN THE PROJECT AREA

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Northern right whale	*Balaena glacialis*	Mammal	Endangered
Blue whale	*Balaenoptera musculus*	Mammal	Endangered
Fin whale	*Balaenoptera physalus*	Mammal	Endangered
Humpback whale	*Megaptera novaeangliae*	Mammal	Endangered
Sei whale	*Balaenoptera borealis*	Mammal	Endangered
Sperm whale	*Physeter macrocephalus*	Mammal	Endangered
Orca (killer whale)	*Orcinus orca*	Mammal	Endangered
Steller sea lion	*Eumetopias jubatus*	Mammal	Threatened
Brown pelican	*Pelecanus occidentalis*	Bird	Endangered
Short-tailed albatross	*Phoebastria albatrus*	Bird	Endangered
Bald eagle	*Haliaeetus leucocephalus*	Bird	Threatened
Marbled murrelet	*Brachyramphus marmoratus*	Bird	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Reptile	Endangered
Green sea turtle	*Chelonia mydas*	Reptile	Threatened
Loggerhead sea turtle	*Caretta caretta*	Reptile	Threatened
Coho Salmon	*Oncorhynchus kisutch*	Fish	
Southern OR/Northern CA Coasts ESU			Threatened
Lower Columbia River ESU		Fish	Threatened
Chinook Salmon	*O. tshawytscha*	Fish	
Snake River Fall-run ESU			Threatened
Snake River Spring/Summer-run ESU			Threatened
Puget Sound ESU			Threatened
Lower Columbia River ESU			Threatened
Upper Willamette River ESU			Threatened
Upper Columbia River Spring-run ESU			Endangered
Chum Salmon	*O. keta*	Fish	
Hood Canal Summer-run ESU			Threatened
Columbia River ESU			Threatened
Sockeye Salmon	*O. nerka*	Fish	
Snake River ESU			Endangered
Ozette Lake ESU			Threatened
Steelhead	*O. mykiss*	Fish	
Upper Columbia River ESU			Threatened
Snake River Basin ESU			Threatened
Lower Columbia River ESU			Threatened

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Upper Willamette River ESU			Threatened
Middle Columbia River ESU			Threatened
Sea-run Cutthroat Trout	*O. clarki clarki*	Fish	
Umpqua River ESU			Endangered

Source: WDFW 2005*a*; NOAA 2005*c*; NOAA 2006.

Marine Mammals

ESA-listed marine mammals off northern Washington include the Steller sea lion and the large whales - humpback, sperm, fin, sei, blue, and northern right whales (NOAA 2001; WDFW 2005*a*) and orcas (the southern resident group of orcas were listed under the ESA on November 15, 2005). OCNMS (2005) classifies the occurrence of these species in the Sanctuary as follows:

- **Common** Steller sea lion
- **Rare** humpback whale and sperm whale
- **Accidental** northern right whale, fin whale, sei whale, blue whale, orca

Species listed as endangered under the ESA are automatically considered as depleted and strategic under the MMPA. The following descriptions of the ESA-listed whales, other than the northern right whale and orcas, are taken from NMFS (2005).

Humpback whales have a worldwide distribution and occur along Washington, Oregon, and California. NMFS recognizes the eastern North Pacific stock which is observed frequently in coastal areas. “The North Pacific total now almost certainly exceeds 6,000 humpback whales” (Calambokidis et al. 1997; Carretta et al. 2001). Annual human-caused mortality (>0.2 whales) is less than the 1.9 whales allowed under the Potential Biological Removal formula (Carretta et al. 2001). Male humpback whale songs are one of the most famous breeding behaviors of all the marine mammals. They breed during winter with a two- to three-year gestation and calving in the tropics (Reeves et al. 2002). Their migrations can be as long as 5,000 miles one way from the higher latitude feeding grounds to the tropics for breeding and calving. They feed on krill and pelagic schooling fish.

Sperm whales occur throughout the oceans and seas of the world near canyons and the continental slope. They are observed along the coasts of Oregon, and Washington (Carretta et al. 2001; Dohl et al. 1983). “Recently, a combined visual and acoustic line transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 24,000 (CV=0.46) sperm whales based on visual sightings, and 39,200 (CV=0.60) based acoustic detections and visual group size estimates” (Carretta et al. 2001). Annual human-caused mortality (1.7 whales) is less than the 2.1 sperm whales allowed under the Potential Biological Removal formula (Carretta et al. 2001). Mating occurs in the spring, and the calving interval is a minimum of four to six years. Combined with a gestation period of 18 months, this results in extremely low population growth rates (Reeves et al. 2002). All age classes and both sexes move throughout tropical waters, while males range farther and farther from the equator. Sperm whales feed near the ocean bottom, diving as deep as one mile to eat large squid (including giant squid), octopuses, rays, sharks, and fish (Reeves et al. 2002).

Fin whales occur in the major oceans of the world and tend to be more prominent in temperate and polar waters. The California, Oregon, and Washington stock was estimated at 1,851 fin whales, based on ship surveys in summer/autumn of 1993 and 1996 (Barlow and Taylor 2001). Annual human-caused mortality (1.5 whales) is less than the 3.2 whales allowed under the Potential Biological Removal formula (Carretta et al. 2001). Little is known of their reproductive behavior, breeding, or calving areas. The female calving cycle is two to three years with an 11- or 12-month gestation period following winter breeding. They probably do not make large-scale migrations and feed on krill and small pelagic fish such as herring (Reeves et al. 2002).

Sei whales occur in subtropical and tropical waters and into the higher latitudes, occupying both oceanic and coastal waters. “Seis are known worldwide for their unpredictable occurrences, with a sudden influx into an area followed by disappearance and subsequent absence for years or even decades” (Reeves et al. 2002). They are rare off Washington, Oregon, and California, and there are no estimates of abundance or population trends for this stock. Sei whales in the eastern North Pacific (east of 180° W longitude) are considered a separate stock and listed as endangered under the ESA (Carretta et al. 2001). Sei whales usually travel alone or in small groups and little is known of their behavior. They breed and calve in winter after an 11- to 12-month gestation. They forage on small fish, squid, krill, and copepods.

The blue whale is the largest animal ever to exist on this planet. They inhabit most oceans and seas of the world. The eastern north Pacific stock summers off California to feed and migrates as far south as the Costa Rica Dome. It has been estimated that there are about 2,000 whales in this stock(Carretta et al. 2001). Annual human-caused mortality (zero whales) is less than the 1.7 whales allowed under the Potential Biological Removal formula (Carretta et al. 2001). Blue whale mating is unknown but calving takes place in winter after an 11-month gestation. Calving interval is about two to three years. They feed on krill and possibly pelagic crabs (Reeves et al. 2002). There are no recent observations of blue whale incidental catches in West Coast groundfish fisheries.

The following description of the northern right whale is from NOAA (2005*b*). Right whales are the rarest of all large whale species. They are found in three general regions: the North Atlantic, the North Pacific, and the Southern Hemisphere. Recent genetic studies provide evidence that these are separate species. There are no reliable estimates of current abundance or trends for right whales in the North Pacific. Sightings have been reported as far south as central Baja California in the eastern North Pacific, as far south as Hawaii in the central North Pacific, and as far north as the sub-Arctic waters of the Bering Sea and sea of Okhotsk in the summer. Since 1996, right whales have been consistently observed in Bristol Bay, southeastern Bering Sea, during the summer months. Migratory patterns of the North Pacific population are unknown, although it is thought the whales spend the summer on high-latitude feeding grounds and migrate to more temperate waters during the winter. Over the past 40 years, most sightings in the eastern North Pacific have been of single whales. However, during the last few years, small groups of right whales have been sighted. Only one confirmed sighting of calves in the 20th century has occurred. In the North Pacific, ship strikes and entanglements may pose a threat to right whales. However, because of their rare occurrence and scattered distribution, it is impossible to assess the threat of ship strikes or entanglement to the North Pacific right whales at this time. Thus, the estimated annual rate of human-caused mortality and serious injury appears minimal for this species. The reasons for the apparent lack of recovery for right whales in this region are unknown.

Orcas, or killer whales, occur seasonally and year-round off of the Washington coast and are thought to be comprised of distinct population types: resident, transient, and offshore (Carretta et al. 2005; ACS 2003). Wiles (2004) described Washington's orcas as follows:

> *Killer whales are distributed throughout the marine waters of Washington. Four populations are recognized and are referred to as southern residents, northern residents, transients, and offshores. These populations rarely interact and do not interbreed despite having largely sympatric year-round geographic ranges that extend into British Columbia and other areas along the west coast of North America. Southern resident and transient killer whales are the only populations that regularly enter the state's coastal waters, whereas offshore whales mainly inhabit open ocean off the outer coast. Northern residents are rare visitors to the state. Resident killer whales are believed to feed almost exclusively on salmon, especially chinook, and other fish. They occur in small highly stable social units known as matrilines, in which all individuals are maternally related. Pods are larger social groups comprised of several matrilines and typically hold about 10 to 60 whales. In contrast, transient whales feed primarily on harbor seals and other marine mammals. They also travel in small matrilineal groups, which typically contain one to six animals. Although some matriline members maintain long-term bonds, the social organization of transients is generally more flexible than in residents. Few details are known about the biology of offshore killer whales, but they commonly occur in large groups of 20-75 individuals and are believed to be mainly fish-eaters.*

Little is known about orcas' breeding habits, and it is thought that they will breed throughout the year (ACS 2003). The southern resident population, which was listed as endangered on November 15, 2005 (NOAA 2005*c*), is thought to consist of three pods totaling between 80 to 100 animals. These pods have been seen in inland Washington waters and off the coast of Washington (as far south as Grays Harbor) and southern British Columbia. The minimum abundance estimate of all orcas, includes resident, transient, and offshore populations, occurring along the coasts of California, Oregon, and Washington is 1,038 (Carretta et al. 2005; Wiles 2004). During a 1994 observer program conducted by NFS, WDFW, and the Tribes, of 2,205 salmon fishery gillnet sets, no orcas were observed to be entangled. Researchers believe that the total fishery mortality and serious injury for the orca stock is zero (Carretta et al. 2005).

Due to the main potential threats of the: 1) historic declines in orcas' main prey, salmon; 2) documented bioaccumulation in orcas of PCBs, DDT, and other organochlorine pollutants; 3) increasing growth of whale watching in and around the San Juan Islands; and 4) threat of oil spills, WDFW recommended that the orca be listed as an endangered species in the state (Wiles 2004). This was done — Washington listed the species as state endangered (WDFW 2005*a*). The southern resident orcas were listed as endangered on November 15, 2005. NOAA reports that the southern resident population has experienced a 20 percent decline in the 1990s and that this population is at risk from "...vessel traffic, toxic chemicals and limits on availability of food, especially salmon. It has only a small number of sexually mature males. Because the population historically has been small, it is susceptible to catastrophic risks, such as disease or oil spills." (NOAA 2005*c*).

Steller sea lions live throughout the year in Washington, primarily along the outer coast, with highest numbers present from late summer through winter (NOAA 2001; Jeffries et al. 2000). Steller sea lions do not breed in the state though there are rookeries in northern British Columbia and central Oregon where pupping occurs in May and June. The population numbers have declined significantly during the last 15 years, and this species is listed as threatened under the ESA along the west coast of the U.S. (NOAA 2001; Jeffries et al. 2000). The reasons for the population decrease are unknown (North Pacific Universities 2005). Haulout sites include jetties, offshore rocks, and coastal islands (Jeffries et al. 2000). In the project area, Steller sea lions frequently use several haulout sites in the Makah Usual and Accustomed area (Gearin and Scordino 1995) with the haulout sites nearest the project area being on Tatoosh Island and neighboring islands off of Cape Flattery (Jeffries et al 2000). They are observed around Neah Bay throughout the year, but are most common from late August through April. Further to the south, off of Cape Alava (about 11 miles south of the project), more than 1,000 Steller sea lions have been seen on the Bodelteh Islands and on Guano Rock (NOAA 2001). This species is considered to be common in the OCNMS (OCNMS 2005).

Reptiles

In Washington, the leatherback sea turtle is federally listed as endangered and the green sea turtle and loggerhead sea turtle are federally listed as threatened (WDFW 2005*a*). These species of sea turtles prefer warmer waters and their occurrence off Washington is uncommon (NOAA 2001).

Birds

In a September 25, 2003 letter to FERC, the USFWS provided the following information regarding bald eagles in the project area:

> *Bald eagles are documented to nest on the shorelines adjacent to the project location and winter in the Waatch Valley, a drainage that enters Makah Bay. ...Bald eagles can occur in Western Washington throughout the year as both resident and wintering populations. According to WDFW, 2,223 nesting territories are currently documented throughout the state. Approximately 1,380 (62%) of these nesting territories are within one mile of marine water. Most territories have two to three nests.*
>
> *In western Washington some adult eagles stay in their nesting territories year round and territories have an average radius of 1.6 miles (2.5 km). Nesting activities can begin in January with nest establishment, pair bonding, and egg laying. Hatching and fledging occur from April to August. Resident bald eagles are monitored by WDFW. ...Wintering bald eagles tend to congregate around food sources, such as spawning salmon or large concentrations of waterfowl. They can be found along major salmon rivers, and along the Pacific Coast, including the Strait of Juan de Fuca and Puget Sound, during spawning seasons.*

According to the Makah Nation and WDFW, there are three potential eagle nesting sites within ½ mile of the project (personal communication R. McCoy, Makah Tribal Forestry Wildlife Division Manager, July 8, 2005; letter and PHS resource maps received from WDFW, October 4, 2005). One nest is consistently active and fledged young in 2005. Another nest was active in 2004 and 2005 but failed to produce young both years. The third nest has never been documented as active since the discovery of an old nest structure in 1998 (personal communication R. McCoy, Makah Tribal Forestry Wildlife Division Manager, July 8, 2005). None of the three sites are located within ½ mile of the proposed shore station (letter and PHS resource maps received from WDFW, October 4, 2005).

Marbled murrelets nest in inland old growth forests but feed offshore. NOAA (2001) characterizes marbled murrelet life history and status as follows:

In Washington the marbled murrelet is found in all nearshore marine areas (within 1.2 miles offshore), with the greatest concentrations in northern Puget Sound (Washington Department of Wildlife). The average distance from shore, 464 meters, is less than other seabirds ... . Marbled murrelets spend most of their lives on salt water feeding on fish or invertebrates, but fly inland to nest (Washington Department of Wildlife). The main causes of the population decline of the marbled murrelet is loss of older forests as a result of timber harvesting, but other threats include oil pollution, entanglement in gill nets, and the species' low reproductive rate (Washington Department of Wildlife). The population is estimated at no more than 5,000 animals (Washington Department of Wildlife). Murrelet populations are higher along the coasts of northern Washington than southern Washington, thought to be a result of the nearshore substrate being more conducive to the fish they are feeding on and the limited amount of mature forests south of Grays Harbor (Thompson, personal communication).

Brown pelicans inhabit the west coast from British Columbia to Central America. Historically, breeding colonies were found in California and Baja California, Mexico. Brown pelicans frequent coastal areas, including rocky shores and cliffs, sloughs, breakwaters, jetties, pilings, and sandbars. This species is still found throughout its original range; however, the breeding colonies are in decline. Following the banning of DDT in 1972 the population began to recover. The population is considered to be stable, thought the availability of preferred prey, including Pacific mackerel, Pacific sardine, and the northern anchovy, are of concern due to the effects of overfishing on these species. The primary threats to California brown pelicans are human development in coastal regions, entanglement in abandoned recreational fishing gear, and oil spills (NOAA 2005a). While brown pelicans nest on small islands along the coast, they are rarely sighted as far north as Makah Bay. In fact, there are no nesting sites documented in the state. In the summer, brown pelicans roost in high numbers at the mouth of the Columbia River and offshore of the town of Tahola (located at the mouth of the Quinault River approximately 70 miles south of the project area) (NOAA 2001).

Short-tailed albatross breeding grounds are located in Japan and possibly in Hawaii. "In Washington state sightings are extremely rare, with only three or four recent sightings, all occurring 20 to 30 miles offshore" (Thompson, personal communication in NOAA 2001).

Fish

ESA-listed species of fish that may occur in the project area include four species of Pacific salmon (coho, chinook, chum, and sockeye) as well as steelhead and sea-run cutthroat trout (both of which are also Oncorhynchus) (Table 5-3). A spawning run of 13,000 chinook salmon was reported in the Waatch River, which enters Makah Bay at the north end of Hobuck Beach (personal communication Jim Woods and Russ Svec, Makah Indian Nation, August 2, 2005). The OCNMS (2005) states that "The region is not only important for those salmon that spawn in streams adjacent to the OCNMS, but potentially encompasses the migration corridor of both juvenile and adult salmonids from California, Oregon, and British Columbia as well." The EEZ, which encompasses the area extending 200 miles off the continental west coast, is used to designate EFH for salmon (PFMC 2005). Chinook, coho, and chum salmon represent three of the top 10 fishes commercially harvested along the outer coast of Washington (OCNMS 2005), and along with shellfish and groundfish, and Pacific salmon are the most commercially-important species off the northern Washington coast (NOAA 2001). Like other anadromous species, Pacific salmon, steelhead, and sea-run cutthroat trout hatch and spend their early life stages in freshwater, then migrate to estuaries and the ocean to spend the rest of their adult lives prior to returning to their natal rivers to spawn and die.

b. Environmental Effects

AquaEnergy is pursuing the development of this project using its AquaBuOY technology because it allows for energy production with little to no environmental impacts. AquaEnergy has proposed the following environmental measures to minimize any potential impacts to ESA-listed species using the project area:

- Design features to minimize scale of anchor devices and project footprint on seafloor; and
- Design buoys to prevent marine mammal haulout (heavy-duty plastic conical attachment to be placed over the above-water portion of the buoy).

The USFWS and OCNMS have indicated that the PDEA should assess any project impacts on ESA-listed species that occur in the project area (AquaEnergy 2005). In a letter to FERC dated September 25, 2003, the USFWS specifically stated that the PDEA should consider potential impacts to nesting and wintering bald eagles and foraging, resting, and breeding marbled murrelets.

Marine Mammals

Steve Jeffries, marine mammal biologist, WDFW, stated "Based on the project description I doubt any (marine mammals) will be impacted by this demonstration project although any buoy anchored in that area may be used as a haulout structure by California and/or Steller sea lions. ...Other than those issues, (I) don't see anything else that should be a marine mammal issue" (personal communication S. Jeffries, WDFW to L. Vigue, WDFW, August 29, 2005). Steller sea lions haulout on islands and rocky outcrops nearshore (NOAA 2001). There are some areas in Makah Bay where rocks are exposed at low tide and that could provide haulouts for pinnipeds. AquaEnergy has designed the above-water surface portion of the buoys to be conical in shape to prevent marine mammal haulout on project equipment. Steller sea lions that are in the water will be able to maneuver around and between the project's moorings and for the reasons described above in the discussion regarding gray whales, it is unlikely that individuals will become entangled in moorings.

As discussed above in Section 5.C.3, Aquatic Resources, AquaEnergy concluded that construction and operation of the project will not affect gray whales, the most commonly seen whale in Washington coastal waters. For the same reasons, AquaEnergy also believes the proposed project is unlikely to affect any of the federally-listed whale species, many of which frequent more offshore waters (ACS 2004*b*, 2004*c*; Carretta et al. 2005) and all of which are considered to be either accidental (northern right whale, fin whale, sei whale, blue whale) or rare (humpback whale, sperm whale) in the OCNMS (OCNMS 2005).

As mentioned above, in a 1994 observer program conducted by NMFS, WDFW, and the Tribes, of 2,205 salmon fishery gillnet sets, no orcas were observed to be entangled. Researchers believe that the total fishery mortality and serious injury for the Orca stock is zero (Carretta et al. 2005). Considering these findings, it is expected that orcas will definitely be able to avoid entanglement in the project moorings.

Reptiles

Because leatherback, green, and loggerhead sea turtles rarely occur off of Washington (NOAA 2001), it is unlikely the project will affect these species.

Birds

The USFWS stated, in a September 25, 2003 letter to FERC, that "Construction and maintenance activities could disturb nesting or wintering bald eagles. In addition, forest clearing for buildings, transmission lines, or mobilization, could remove habitat important to nesting, wintering or roosting bald eagles." The Washington State Bald Eagle Protection Rule (WAC 232-12-292) requires a Bald Eagle Management Plan (BEMP) for proposed land-use activities, involving land containing or adjacent to an eagle nest or communal roost. However, any disturbance associated with construction activities or subsequent periodic boat activity, associated with project maintenance, would be temporary and is unlikely to significantly disrupt bald eagles visiting the project area. Construction will not damage or remove any large trees which would be used by eagles for resting or nesting. In addition, because bald eagles forage primarily near land and islands (NOAA 2001), they should not be affected by the project which is located 3.7 miles offshore and is not near any islands. Given the known activities related to the installation and operation of the project, AquaEnergy is not planning to implement a BEMP for this project.

The USFWS stated, in a September 25, 2003 letter to FERC, that “Construction, operation, maintenance, or demobilization of the project in the offshore could disturb foraging or resting murrelets. Disturbance that takes place during the breeding season can have a larger effect on murrelets than at other times. Turbidity caused by project construction could also potentially affect forage fish.” While crab pot lines or gill nets are more likely to give way and potentially twist around a passing animal that has made contact with it, due to the mass of the AquaBuOYs and the VLAs combined with the strength/resistance of the mooring cables and chains, the mooring system is expected to have adequate tension to preclude forming loops or twisting around a diving bird. It is therefore unlikely that individuals will become entangled in moorings. Once the site is developed, little boat activity is required for operations and maintenance. It is expected that the floating power plant would be visited two to five times per year by boat out of Neah Bay. The project is therefore unlikely to adversely affect marbled murrelets because any displacement associated with construction activities or subsequent periodic boat activity, associated with project maintenance, would be temporary and is unlikely to significantly disrupt normal feeding or resting behavior. NOAA (2001) reports that murrelets “...can readily move short distances away from vessels to less disturbed areas and continue feeding”.

Brown pelicans are rarely sighted as far north as Makah Bay (NOAA 2001). While some may occur off of northern Washington in the summer (NOAA 2001), as with marbled murrelets, any displacement associated with construction activities or subsequent periodic boat activity, associated with project maintenance, would be temporary and is unlikely to significantly disrupt brown pelicans visiting the project area. For the reasons described above, it is unlikely that brown pelicans will become entangled in moorings.

Short-tailed albatross infrequently occur off of northern Washington (NOAA 2001). Only three or four recent sightings, all 20 to 30 miles offshore, have been documented (Thompson, personal communication in NOAA 2001). While it may occur occasionally far off shore of Washington, it is a low priority because it has no habitat in the state (personal communication Derek Stinson, WDFW, August 19, 2005). The few sightings that have occurred are much farther offshore than the project. Consequently, it is unlikely that the proposed project will affect this species.

Fish

With regard to Pacific salmon, in its Nearshore Strategy for the North Olympic Peninsula, the NOPLE (NOPLE 2005) states that “Select nearshore habitats are defined as critical by WAC and federal regulation based on their documented use by juvenile salmonid for migration, smoltification, refuge, and feeding, and juvenile and adult forage fish for migration, refuge, feeding, and spawning. These include marine and estuarine riparian zones, estuarine marsh habitat, documented forage fish spawning areas, and kelp and eelgrass beds." NOPLE (2005) identifies the following as the important nearshore concerns for salmon restoration:

- juvenile stages of salmonid development;
- spawning habitat for prey species; and
- access for returning adults.

NOPLE states that "the working convention within the NOPLE TRG (technical review group), Elwha-Morse Management Team and Dungeness River Management Team has been that tidally influenced estuaries, including marsh and eelgrass habitats, and their role for nursery grounds for feeding and refuge, are the top priority for fish recovery. Habitats that provide an intact migratory corridor and forage fish spawning are an important-though slightly lower-priority than estuarine/tidal marsh habitats." The significant nearshore habitat types in this part of the Olympic Peninsula are lower rivers and estuaries, vegetated habitats, and sand and gravel beaches (spawning sites for some forage fish) (NOPLE 2005).

ESA-listed salmonids may pass through the project area. The enclosed nature of each AquaBuOY system ensures that no oils or pollutants will enter the water. The buoys are located well offshore, and the transmission cable will pass underground from a depth of 10 to 30 feet below mean lower low tide (depth to be determined by the results of the seagrass survey) to the shore station. AquaEnergy will coordinate with resource agencies to ensure that project routing avoids eelgrass beds. Thus, the project will not significantly affect nursery grounds and refuge area for juvenile salmonids, nor will it affect migrating salmon as they access coastal streams and rivers. The small area of disturbance to the benthos of the anchors and transmission cable will not significantly affect spawning habitat for potential prey species.

Conclusion

Because of the nature of the AquaBuOY technology, refinement in project design, and environmental measures proposed by AquaEnergy for construction and operation of the project, the Proposed Action will not negatively affect ESA-listed species.

c. Unavoidable Adverse Impacts

Implementation of the proposed project will not result in unavoidable adverse impacts to threatened and endangered species.

6. Cultural Resources

a. Affected Environment

Native Americans have inhabited the Olympic Coast for at least 6,000 years and possibly much longer. Archaeological investigations indicate human occupation along much of the coast (OCNMS 2005). The land portion of the project site is located within the tribal lands of the Makah Indian Nation. The offshore plant location is in the Makah Usual and Accustomed Grounds, the OCNMS, the Flattery Rocks National Wildlife Refuge, and Washington State waters. The Makah culture centered around hunting gray whales and use of other ocean resources. The Makah and other Olympic Coast Indian tribes have long fished the offshore waters using a variety of net and line techniques. The Makah hunted gray whales more than the other Washington tribes, and the Treaty of Neah Bay (1855) reserved their right to fish and hunt whales as well as seals (OCNMS 2005; WDFW 1997). NOAA (2001) reports that "The Tribe believes that continuing its whaling tradition will provide important subsistence and ceremonial benefits to the Makah community and will help the Tribe to reaffirm its traditions and cultural identity. The large tribal ceremonies and celebrations involving most members of the Tribe after the successful hunt on May 17, 1999, are indicative of the benefits of whaling to the Makah Tribe."

In August, the Makah Indian Nation holds their annual celebration in Neah Bay to celebrate their ancestral heritage and traditions. The celebration typically includes traditional dancing and singing as well as canoe races and Slahal[25] games. In addition, the festivities also include a grand parade, street fair, dancing, singing, feasting, and a spectacular fireworks show (Makah Nation 2005).

The Makah Cultural and Research Center (MCRC) located in Neah Bay, is recognized as the nation's finest tribal museum according to the Makah Tribe (2005). As described by the Makah Tribe (2005), the MCRC contains permanent exhibits including artifacts from the Ozette collection, uncovered from Makah village partially buried by a mudslide nearly 500 years ago. The museum contains a full-size replica long house, and four handcrafted cedar dug-out canoes. Whaling, sealing and fishing gear, basketry, and other tools are also on display (Makah Tribe 2005).

[25] According to the University of Waterloo (2005), a Slahal game consists of a visually impressive Pacific Northwest Coast Indian bone and stick gambling game. The play of the game is dependent upon two pieces of antler which are used like dice. The score keeping device consists of a colorful whale carved out of red cedar wood painted with typical Pacific Northwest Coast Indian tribal designs and sticks are inserted into the whale to aid in keeping score of the game. The game was made circa 1981 by Bill Kuhnely, Vancouver Island, British Columbia, Canada.

b. Environmental Effects

The Makah Indian Nation is participating in on-going consultation with AquaEnergy regarding the cultural and historical preservation of the project site. As part of the Proposed Action, AquaEnergy proposes to develop and implement a CRMP consisting of measures to protect cultural resources. As part of this process, AquaEnergy has initiated preliminary consultation with the tribal cultural resource specialist and the state archeologist.

Our Analysis

Although the small portion of the project that is on land will be sited on the Makah Indian Nation, the Makah, as an active participant in this project, have helped in the siting process. Through the tribe's involvement, they have been able to ensure that no sensitive cultural or historic sites will be affected by construction of this project.

c. Unavoidable Adverse Impacts

Implementation of the Proposed Action will not result in unavoidable adverse impacts to cultural resources.

7. Recreation Resources and Land Use

a. Affected Environment

The project area offers numerous water- and land-based recreational opportunities. In addition, tribal fishing represents an important land use. Some of the most popular water activities include surfing, fishing, pleasure boating, kayaking, whale and wildlife watching, and scuba diving. Some of the most popular land-based activities include bird watching, hiking, beachcombing, hunting, touring public parks and lands, and visiting the MCRC located in the heart of the Makah Nation, Neah Bay.

The in-water portion of the project area is a natural area used for fishing (mostly tribal and recreational), boating, and recreational marine activity. The onshore portion is located in an unoccupied portion of land of the Makah Indian Nation and is located adjacent to Hobuck Beach. There are no existing structures on the site. The offshore portion of the project is located in Washington State waters, the OCNMS, the Flattery Parks National Wildlife Refuge, and the Makah Usual and Accustomed Grounds. Other natural attractions in the project vicinity include the coastal portion of Olympic National Park, part of which is located directly south of and adjacent to the Makah Tribal

Reservation, and the Washington Islands National Wildlife Refuge[26]. The Flattery Rocks NWR is part of the Washington Islands NWR and includes Makah Bay (letter from OCNMS to AEG dated January 3, 2006.

Water-Based Recreation Opportunities and Uses

Sport fishing and pleasure boating opportunities are abundant in the project area. Sportfishing for salmon and fishing for bottom fish in the saltwater which surrounds the Makah Nation, is now considered to be the best in the contiguous U.S. (Makah Nation 2005). “Charter boats and private fishing and pleasure craft dot Neah Bay’s picturesque harbor during the busy summer months. Hobuck Lake and the Waatch and Sooes Rivers are located near the project and are popular fishing sites for rainbow and cutthroat trout. Steelhead can also be taken from the rivers when in season” (Makah Nation 2005). A spawning run of 13,000 chinook salmon was reported in the Waatch River, which enters Makah Bay at the north end of Hobuck Beach (personal communication Jim Woods and Russ Svec, Makah Indian Nation, August 2, 2005).

Surfing is very popular off of Hobuck Beach (Clallam Bay-Sekiu Chamber of Commerce 2003). There are both fresh water and salt water kayaking opportunities in the project area. “The Strait of Juan de Fuca from Pillar Point to Cape Flattery offers several places one can launch and kayak through kelp forests and off-shore sea stacks to view the variety of marine life while paddling” (Clallam Bay-Sekiu Chamber of Commerce 2003). Makah Bay offers an exciting location for experienced kayakers who are interested in kayak surfing (Clallam Bay-Sekiu Chamber of Commerce 2003).

With regard to whale watching, NOAA (2001) reports that gray whale watching occurs from March through May during the gray whale northward migration.[27] Most whale watching outfits operate out of Westport in the southern portion of the Washington coast. Whale watching has not developed significantly in Neah Bay and the project area because of the remote location and the unpredictable whale viewing associated with this area. Some trips occur out of Neah Bay and Sekiu, located further east in the Strait of Juan de Fuca from Neah Bay. The Neah Bay whale watching trips are available only by reservation during the summer (NOAA 2001).

Scuba diving in the vicinity of the project area is rated as superior. The location of the project in relation to the Strait of Juan de Fuca and the OCNMS offers a unique diving experience. “Rocky reefs and kelp forests offer a wide variety of large and colorful invertebrates, including fish-eating anemones, giant mussels and the world’s largest

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[26] Exposed rocks, islets, and islands that occur in the Sanctuary are part of the Washington Maritime National Wildlife Refuge (NOAA 2005).

[27] Thirty-four companies are known to offer killer whale watching and wildlife tours in Washington’s inland waters, primarily in Haro Strait to the west of the San Juan Islands (NOAA 2001).

octopus" (Clallam Bay-Sekiu Chamber of Commerce 2003). Fish species commonly observed while diving amongst these areas include wolf eels, lingcod, perch, and various species of rock fish.

The Washington Olympic coastline extends about 160 miles from Cape Flattery to the Columbia River mouth. The ocean off the Olympic coast is subject to commercial shipping, and commercial and tribal fishing represent primary uses.

Tribal/Commercial Fishing

The Makah's Neah Bay is one of only three north Washington Coast ports to host groundfish vessels. The Makah, along with three other Washington tribes, have treaty rights for ocean fishing, fish for a variety of species and have formal groundfish allocations for sablefish, black rockfish, and Pacific whiting. Twelve tribes, including the Makah, have and exercise treaty fishing rights to halibut. Access to historical fisheries is important for commercial, ceremonial, and subsistence purposes. Tribal fishing uses similar methods to non-tribal fishing and their catch is distributed through the same markets. The Makah are the only tribe that harvests whiting, as well as widow rockfish, yellowtail rockfish, and other groundfish, using mid-water trawl gear (Table 5-8). The Makah also use longline vessels, and their fleet is the biggest of the four treaty tribes. The Makah fishery is limited to their Usual and Accustomed area.[28] The Makah work with the PFMC to stay within the PFMC harvest limits for overfished and abundant stocks (NMFS 2005).

TABLE 5-8
MAKAH AT-SEA CATCH BY YEAR (UNITS ARE IN POUNDS)

	Year			
Species Aggregation	**2000**	**2001**	**2002**	**2003**
Other Fish	483,822	1,529,540	2,987,067	3,145,036
Pacific Whiting	13,781,245	13,404,002	48,045,527	51,706,192
Total	14,265,068	14,933,542	51,032,594	54,851,228

Source: NMFS 2005.

In total, the Makah have over 200 commercial and sport fishing vessels in Neah Bay. The Makah report that sport fishing for salmon and bottom fish around the reservation is considered to be the best in the mainland U.S. (Makah Nation 2005). NOAA (2005*a*) reports that "...the Makah (commercial) fleet is composed of 43 boats. Twenty-nine of the boats fish for salmon, sablefish, and halibut. These boats primarily fish from March to October. Ten of the boats are small bottom trawlers. The trawl

[28] NOAA (2005*a*) reports that "This results in immobile fisheries that cannot move to a new location if the resources or habitat are depleted. In addition, the Tribe and its fishermen have a view of ownership of their fishing grounds rooted in centuries of use and control of these grounds. This sense of ownership influences the fishing practices of the tribes. Because the tribes are limited in the areas they fish, they work to practice good stewardship".

fishery is open from January to December, but primarily the fishing is done from June to October. The mid-water whiting fleet is composed of four boats. Their season is from May to September" (NMFS 2005). Non-tribal commercial fishing using fixed gear and trawling is excluded within three miles of shore. Non-tribal recreational anglers and commercial crab and salmon (long line) fishermen are allowed to use waters in the project area. However, the Makah do not conduct bottom trawling in the vicinity of the project buoys or transmission cable because of the bottom rock outcrops and the relatively shallow depths of the area. The Makah typically fish for crabs at depths from 150 to 300 feet. As the project is planned to be located at a depths up to 150 feet, fishing for crabs within the project area will need to be avoided. The pink shrimp fishery, which is captured by bottom trawling, would not occur in the project area and currently the Makah do not have any commercial dive shellfish fisheries or commercially harvest bivalves in the area (personal communication with Brandon Bryant, Makah Groundfish Biologist, April 11, 2006).

Land-Based Recreation Opportunities and Uses

The adjacent forested lands and the shoreline of the area offer a variety of habitats for the bird species that live and migrate along this portion of the coastline. "A birder in Washington State could see up to 365 species of birds by visiting the Washington Coast. This represents almost 80 percent of the species that have been found in the state. With this many species, the Washington coast has become an attraction for birders and is considered one of the top ten best regions to bird in the United States. Many come to see the coastal specialties and hope for the rarity that occasionally appears" (Washington Hotspots 2002). The OCNMS is used by nearly 100 different species of marine birds and shorebirds (OCNMS 2005). Noteworthy bird species that can be observed in the area from land include: Pacific plover, black turnstone, sanderling, and red-necked phalarope. Noteworthy bird species that can be observed in the area from the water include: tufted puffin, Cassin's auklet, pigeon guillemot, and northern fulmar (Clallam Bay-Sekiu Chamber of Commerce 2003; NGS 1983).

There are many opportunities to explore a variety of habitats while hiking in the vicinity of the project area. Two of these areas are located on the Makah Indian Nation. The Makah Indian Tribe Cape Flattery Trail located in the most northwestern point in the lower U.S. offers beautiful views of the OCNMS (Makah Tribe 2005; Logan 2001). According to the Makah Tribe (2005), the Cape Flattery Trail is one of the preferred destinations for eco-tourists and hikers and is one of the most beautiful places on the Makah Indian Reservation. The trail is approximately ¾ mile long and consists of a wooden boardwalk, stone, and gravel steps. The trail contains four observation decks which offer breath-taking views of the OCNMS and Tatoosh Island (Makah Tribe 2005). Another popular hiking trail on the Makah Nation is the Shi Shi Trail, and it is also located in the northwestern tip of the North Olympic Peninsula. According to the Makah Tribe (2005), this trail is also one of the most spectacular trails in Washington State.

Beachcombing is very popular on Hobuck Beach and in the general vicinity of the project area. According to the Clallam Bay-Sekiu Chamber of Commerce (2003), Hobuck Beach is a favorite beach for local residents and is also very popular with families. Other popular beachcombing areas include the beaches within Olympic National Park and the beautiful Lake Ozette wilderness area located to the south of the project area (Clallam Bay-Sekiu Chamber of Commerce 2003). The Olympic National Park contains over 60 miles of wilderness coastline, representing the largest such stretch along the continental U.S. (EPRI 2004).

Waterfowl hunting on Washington State's Olympic Peninsula is some of the best and most unique in the Pacific Flyway. The region hosts a wide variety of local and migratory ducks and geese that spend the greater part of the fall and winter on the fields, inland waters, estuaries and bays of the Northern Puget Sound/Strait of Juan de Fuca region. The majority of the hunting in the area is centered on traditional diver and sea-duck hunting opportunities. Commonly hunted duck species include old squaw, long tailed ducks, scoters (white-wing, surf, black), harlequin duck, bufflehead, Barrows and common goldeneye, greater and lesser scaup, hooded, common, and red-breasted mergansers (Peninsula Sportsman 2005).

The Makah Indian Nation holds their annual celebration in Neah Bay to celebrate their ancestral heritage and traditions. The celebration typically includes traditional dancing and singing as well as canoe races and Slahal games. In addition, the festivities also include a grand parade, street fair, dancing, singing, feasting and a spectacular fireworks show. The celebration is held every year towards the end of August (Makah Nation 2005).

The MCRC located in Neah Bay, is recognized as the nation's finest tribal museum according to the Makah Tribe (2005). As described by the Makah Tribe (2005), the MCRC contains permanent exhibits including artifacts from the Ozette collection, uncovered from the Makah village partially buried by a mudslide nearly 500 years ago. The museum contains a full-size replica long house, and four handcrafted cedar dug-out canoes. Whaling, sealing and fishing gear, basketry, and other tools are also on display. The museum is open to the public and contains a gift shop (Makah Tribe 2005).

b. Environmental Effects

AquaEnergy is developing the Makah Bay Project as part of a consortium which also includes the Makah Nation, Washington State University Energy Program, Clallam County Economic Development Center, Clallam County PUD, and the Washington Public Utility Districts Association. Stakeholders have expressed interest in assessing impacts of the project on recreation fishing and other uses both for Makah Bay and Hobuck Beach, including access to the project area, and marine safety (e.g., buoy lighting, notice to mariners, coloration) (AquaEnergy 2005). As part of the Proposed Action, AquaEnergy proposes to develop and implement an interpretive and education plan to provide information regarding the Makah Bay Project to area residents and visitors.

The Sanctuary is "... managed to protect its natural resources while encouraging compatible commercial and recreational uses" (NOAA 2005*a*). NOAA (2001) explains that "Sanctuaries are managed under multiple objectives, including maintaining natural biological communities, enhancing public awareness, and the wise and sustainable use of the marine environment, but the primary objective is resource protection." At the time the Sanctuary was designated, an EIS was prepared (NOAA 1993) on the present and potential uses of the area including "...commercial and recreational fishing, research and education, subsistence uses, and other commercial, governmental, and recreational uses." The OCNMS management plan provides for permitting projects that are economically beneficial to Indian tribes located within the Sanctuary limits.

Our Analysis

The footprint of the land station is approximately 10 feet high with a floor plan measuring 15 feet by 15 feet and, other than the immediate building location, will not affect people's access to the Hobuck Beach area (project effects on area aesthetics are further discussed in Section 5.C.8, Aesthetic Resources). The offshore power plant will occupy a rectangular area of 60 feet by 240 feet on the water surface. The anchor system, consisting of a total of 10 VLAs and 10 surface floats, will cover a rectangular area of approximately 625 by 450 feet on the ocean floor (Figure 3-5). As discussed above, the anchors represent almost no footprint on the seafloor. The transmission cable may provide structure to invertebrates and macro algae, thus providing for development of a small artificial reef. This in turn could improve fish habitat in the project area. A fishing and navigation exclusion zone will need to be developed for project protection and human safety. Because bottom trawling does not occur in the project area, the presence of the project would only result in a curtailment of recreational, crab, and long-line fishing around the buoys. While this will result in decreased fishing in the immediate buoy area, fish and other marine life within the buoy anchor footprint will effectively be protected. This consequently will not result in significant impacts to recreational fishing in the area and may result in an overall improvement to the fish community in the project vicinity.

The buoy area will be located in about 150 feet of water over sand substrate. Because of the depth and lack of kelp beds/rocky habitat, it is unlikely that the power plant will limit scuba diving opportunities. Access to Hobuck Beach will not be diminished from current levels.

Most wave power plant schemes represent obstacles to marine navigation (EPRI 2004). However, the portion of the buoys that are above water are similar in size and shape to those used to demarcate shipping lanes and identify obstructions. As such, the buoys will not represent an onerous navigational restriction, other than the small restriction zone around the buoy field (Scott Wilson and Downie 2003). The nearest harbors to the project out of which shipping occurs, is Port Angeles, 56 miles east of Cape Flattery, and Grays Harbor, 93 miles south of Cape Flattery. The West Coast Offshore Vessel Traffic Risk Management Project, co-sponsored by the Pacific State/British Columbia Oil Spill Task Force and the U.S. Coast Guard Pacific Area, recommends that, unless other traffic management areas exist (such as near ports), vessels of 300 gross tons or larger should maintain a minimum distance of 25 nautical miles offshore along the entire west coast (EPRI 2004). The project area is listed as an Area to Be Avoided (ATBA), which advises operators of vessels carrying petroleum and hazardous materials to maintain a 25-mile buffer from the coast. The distance narrows as shipping lanes converge at the entrance of the Strait of Juan de Fuca (OCNMS 2005). This designation serves to direct larger vessels away from Makah Bay, but leave the area open to smaller vessels (Letter from OCNMS to AquaEnergy dated January 3, 2006). To minimize hazards to navigation, the seabed and buoy components of the project (anchors, turbine-generator housing, and transmission cable) will be posted on a USCG Notice to Mariners and the latter will be equipped with required USCG navigation lights for identification by boaters. AquaEnergy proposes to paint the buoys using non-reflective colors that blend with the background landscape in order to minimize buoy visibility from shore. Buoys will be made visible to boaters during the day and will likely aid navigation during periods of fog or low visibility and at night as boaters may take their bearings to/from the buoys. AquaEnergy will continue to consult and comply with the U.S. Coast Guard regarding navigation safety.

The project's location 3.7 statute miles offshore in approximately 150 feet of water will ensure minimal impacts on other forms of recreation including kayaking and scuba diving. In fact, the approval and construction of this project may likely result in the nation's first-of-its-kind wave energy project, and as such, will likely attract tourists and visitors to the project area. For instance, in the United Kingdom, a wave energy device has proven to be a tourist attraction (EPRI 2004). With this in mind, as a project environmental measure, AquaEnergy is proposing to develop and implement an interpretive and education plan to provide information regarding the Makah Bay Project to area residents and visitors. AquaEnergy anticipates developing, in coordination with the Makah Tribe, state, and OCNMS staff, some interpretive displays to be positioned in the vicinity of Hobuck Beach. These displays would provide information about: 1) how the wave energy project works; 2) the marine resources of the project area; 3) the participation with the Makah Tribe, how the Makah use the area, and how the project aligns with the tribe's values; 4) how diverse stakeholders have worked together to make the successful development of this groundbreaking project possible; and 5) developing wave energy technology projects can translate into minimizing the nation's dependence on foreign fossil fuels.

At the June 27, 2005 project technical meeting, a WDNR staff member expressed concern that the portion of the transmission cable laid on the seafloor could get caught by trawlers and could physically disturb the seafloor habitat. Other than tribal fishing, commercial fishing is prohibited in the project area. As discussed above in the affected environment, the Makah have a significant fishing fleet including 10 small bottom trawlers. The trawl fishery is open from January to December, but bottom trawling primarily occurs from June to October (NMFS 2005). The area encompassed by the buoys will be off limits to fishing. Bottom trawling along portions of the transmission cable route anchored to the seabed will be off limits to tribal fishing because of the possibility of damage to the transmission cable by trawling gear. This will result in reducing the area that can be fished by the Makah Tribe, but fish and other marine life may benefit from the protection from fishing pressure.

Conclusions

The project should have no detrimental impact on recreational opportunities within or adjacent to the project area, and the land use is compatible with existing designated and intended uses. In fact, this project could likely increase tourism in the project vicinity which could result in positive economic gains for the Makah Nation and surrounding communities. Use of the project area will continue in a similar manner to current conditions. While development of the project will represent a slight decrease in areas where tribal fishing can occur, the benefits to the Makah Nation, active participants in developing this project, as direct recipients of the power produced, will outweigh any negative impacts of reduced fishing grounds.

c. Unavoidable Adverse Impacts

The exclusions of recreational and commercial fishing around the buoy area and of commercial fishing along the transmission cable route represents an unavoidable impact in the project area. The decrease in recreational fishing opportunities around the buoy area represents a fairly small area (anchor footprint is 625 feet by 450 feet). The decrease in area for fishing by the Makah will be offset by the benefits of the project for which they are advocates.

8. Aesthetic Resources

a. Affected Environment

This section provides a general overview of aesthetic resources in the vicinity of the Makah Bay Project. The proposed project will be located in the Pacific Ocean in Makah Bay, near the city of Neah Bay, Washington. The land-based portion of the project is located in a rural setting and is the property of the Makah Indian Nation. Neah Bay, which has a population of approximately 800 people, is located approximately three miles to the northeast of the land-based portion of the project. The town of Forks, approximately 50 miles to the south, has a population of approximately 3,120 people (U.S. Census Bureau 2000). The marine portion of the project is within the OCNMS (Figures 1-1 and 1-2). The OCNMS is an important national resource with aesthetics as a core quality. The sea stacks, pillars, and islands are strong visual features that represent the remote and rugged character of the Olympic Peninsula's coastline. Many visitors from around the nation and from other countries are drawn to this area by the scenic beauty of these offshore islands. The majority of these islands are also part of the Washington Islands Wilderness Area, a designation that preserves these areas in their natural, undisturbed character (OCNMS 2005).

The primary aesthetic resource use associated with the area is a result of public viewing of the nearby islands, rocks, coastline, and sea stacks from the mainland or from private or commercial watercraft and airplanes. The dominant visual resource in the vicinity of the project area is the coastline of the Pacific Ocean. The beaches of the Olympic Peninsula provide an aesthetic resource that allows visitors to view offshore islands, rocks, and coastline features that comprise this area. These features appear in varying distances from the shoreline and can be seen to the south and north of the project area. The islands mostly appear as rock pillars and tables that rise directly out of the ocean in various sizes, shapes, and forms.

From the water, the view of the coastline generally includes "spectacular undeveloped shorelines" (OCNMS 2005). The land-based project facilities will be located on Hobuck Beach.

b. Environmental Effects

Resource agencies have indicated a desire to minimize aesthetic impacts of the project (AquaEnergy 2005). The Sanctuary is "... managed to protect its natural resources while encouraging compatible commercial and recreational uses" (NOAA 2005*a*).

The land-based project facilities will be located on Hobuck Beach, and will consist of a small distribution station, or shore station (Figure 1-3). This station will be located on tribal lands owned by the Makah Tribe. The shore station will measure 15 feet by 15 feet, and it will house the electrical conditioning equipment necessary to connect the project to the utility grid. The electrical interconnection will be located adjacent to Makah Passage Road and will connect to an existing Clallam County PUD 12 kV distribution line (Figure 1-3). AquaEnergy proposes to plant native vegetative landscaping around the shore station so that the facilities fit into the natural landscape associated with the project area.

As previously described in Section 3, Proposed Action and Alternatives, the mechanical portion of the Makah Bay pilot power plant will consist of four low-profile moored AquaBuOYs (a large part of the buoy/piston structure is located beneath the surface) placed 3.7 statute miles (3.2 nautical miles) offshore from Hobuck Beach. Each AquaBuOY that captures the wave energy is about 16 feet in diameter and floats approximately 6 feet above the water surface. The buoys will be spaced about 60 feet apart in a line approximately parallel to the wave front (Figures 3-2 and 3-5). The ocean surface, occupied by the four AquaBuOYs, measures approximately 60 feet by 240 feet. In accordance with U.S. Coast Guard requirements, navigation lights onboard the buoys will be used for marine safety. AquaEnergy proposes to paint the buoys using non-reflective colors that blend with the background landscape.

Our Analysis

The land-based project facilities would be visible from Makah Passage Road. However, since the shore-station will be located in proximity to a few residential dwellings and on Makah Nation property, it is expected that the majority of travelers using Makah Passage Road would be local residents of the Makah Nation or occasional recreationists. AquaEnergy's proposed planting of native vegetative landscaping around the shore station aid the facilities fitting into the natural landscape associated with the project area.

Offshore wave energy projects have less visual impact than nearshore or onshore projects. AquaEnergy proposed painting of the buoys using non-reflective colors that blend with the background landscape will minimize the visibility of the buoys. Buoys may be visible from a high cliff. From Hobuck Beach they may be visible as a small point on the horizon. The navigation lights on the buoys will likely be visible from other points on clear nights.

AquaEnergy's Proposed Action would maintain use of the project area similar to those under existing conditions. The exception to this would be the area occupied by the 15-foot-by-15-foot shore station adjacent to Hobuck Beach and also the area occupied by the AquaBuOYs. No changes in use of Hobuck Beach will result under the Proposed Action.

AquaEnergy's plan to maintain the aesthetic values of the project area through the selection of non-reflective colors for the AquaBuOYs that blend with the background landscape, native vegetative screening for the shore-station, and development of design guidelines for future project improvements will help to ensure that the project has negligible visual impacts.

c. Unavoidable Adverse Impacts

Deployment of the buoys and development of the shore station will represent a permanent aesthetic impact of the project. However, because of the small size of the shore station, distance of buoys from shore, and efforts to make the buoys and the station blend in with the surroundings, these impacts will not be significant.

9. Socioeconomic Resources

Typically, the Commission evaluates socioeconomic effects occurring from major new construction projects or retirement (FERC 2001). This project includes new construction; in addition, it will have a direct socioeconomic effect on the Makah Indian Nation. The following discussion highlights the baseline socioeconomic conditions in the Makah Bay Project area.

a. Affected Environment

Information on recent population trends, median household income, and housing units for Clallam County and the Makah Reservation is presented in Table 5-9. Clallam County covers approximately 1,739 square miles within northwest Washington (State of Washington Office of Financial Management [OFM] 2004). The Makah Reservation, located in the northwest portion of Clallam County, covers approximately 47 square miles of land at the northwest tip of Washington bounded by the Pacific Ocean and the Strait of Juan de Fuca to the north (Makah Indian Tribe 2003). The total population reported for Clallam County in 2000 was 64,525. The total population reported for the Makah Tribe in 2000 was 1,356 (approximately 2.1 percent of the county population) (U.S. Census Bureau 2000). From 1990 to 2000, the population of Clallam County and the Makah Reservation grew 14.3 percent and 11.7 percent, respectively (U.S. Census Bureau 2000).

TABLE 5-9
PROJECT AREA DEMOGRAPHIC INFORMATION

Item	Area	
	Clallam County	**Makah Reservation**
1990 Total Population	56,204	1,214
2000 Total Population	64,525	1,356
Percent Change in Population 1990 – 2000	14.3%	11.7%
Housing Units 2000	30,683	534
Area in Square Miles (Total)	1,739	47
2000 Total Population Density (People/Square Mile)	37	29
Median Household Income – 1999	36,449	24,091
Poverty Status – 1999 (% below poverty level)	8.9	26.8

Sources: U.S. Census Bureau 2000; Washington OFM 1990; and Makah Indian Tribe 2003.

The management, professional, and related occupations sector is the largest employment sector in Clallam County and the Makah Reservation providing over 28 percent of the jobs in Clallam County and 38 percent in the Makah Reservation, respectively. The fishing, farming, and forestry sector provides almost 13 percent of the jobs in the Makah Reservation, while only 3.6 percent of jobs in Clallam County rely on this sector for employment. The percentage of people below poverty level in 1999 for

Clallam County and the Makah Reservation were 8.9 and 26.8, respectively (U.S. Census Bureau 2000). The median income for Neah Bay is $21,635, which represents the lowest income of any of the Washington or Oregon coast ports surveyed (i.e., ports that are also census places) (NMFS 2005).

Much of the mainland adjacent to the project area consists of either sparsely populated areas or land under federal or Makah Nation management. The areas not contained within the Makah Reservation are protected either by the National Park Service (NPS), U.S. Forest Service (USFS), or administered by Clallam County.

The area economy is primarily resource-based in nature, with industries focusing on commercial fishing, timber, and some tourism. The rich biological productivity of the coastal and offshore waters off of the Olympic Coast sustain robust plankton and fish populations, which in turn attract a variety of foraging marine wildlife and important fisheries, which in turn yield significant economic benefits to state and tribal economies (NOAA 2001). The Makah Nation has a substantial commercial fishery which serves as a primary mainstay of its economy (Makah Nation 2005). While forestry resources continue to support the area economy, tourism is growing in importance, particularly nature-based tourism, such as recreational fishing. The emergence of Olympic National Park and the OCNMS as major regional tourist attractions bring thousands of visitors to the coastline and mainland directly adjacent to the project area every year (Clallam County Economic Development Council 2003).

Clallam County includes retirement communities in Sequim and innovative industrial water (Marine) and wood (Forest Resources) companies in Port Angeles and Forks. Technological advances, education, and research firms fuel these companies (Clallam County Economic Development Council 2003). While Neah Bay, the closest town to the project area and also the heartbeat of the Makah Reservation, focuses its economy on commercial fishing and related industries. Port Angeles, Clallam County's major commercial center and county seat, is located 75 miles from Neah Bay, and Seattle is located approximately 150 miles away. The closest town to Neah Bay, the Forks, is located approximately 60 miles away (Makah Indian Tribe 2003).

Many visitors come to Neah Bay to tour the MCRC and hike to the most northwestern point of the U.S., Cape Flattery. In 1970, tidal erosion uncovered an ancient whaling village in Ozette, parts of which had been covered by a mud slide hundreds of years ago. The subsequent artifacts which were found have now classified Ozette as one the most significant archaeological discoveries ever made in North America. In 1979, the MCRC opened to the public in order to share the resources discovered. This nationally-recognized museum features full-scale replicas of cedar log houses as well as whaling, sealing, and fishing canoes (Makah Indian Tribe 2003; Makah Nation 2005).

b. Environmental Effects

The Makah Tribal Council is participating with AquaEnergy in the development of the Makah Bay Project as part of a consortium which also includes Washington State University Energy Program, Clallam County Economic Development Center, Clallam County PUD, and the Washington Public Utility Districts Association. No resource agencies have raised any concerns regarding socioeconomic issues associated with this project.

The development of the project represents the main factor that will affect the socioeconomics of the region. In addition, the following proposed environmental measures may also affect the socioeconomics of the region: 1) development and implementation of an interpretive and education plan to provide information regarding the Makah Bay Plant; and 2) improving and maintaining the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and developing design guidelines for future project improvements.

Our Analysis

A key ingredient to the fishery industry and related services sector in the Makah Nation is that this area is generally dependant on its natural resources for economic sustainability. Renewable energy technology development projects are being conducted in several Indian nations and territories across the U.S. The Makah Tribal Council understands the economic, cultural, and historical significance of developing safe, renewable and clean electricity from natural resources. The Makah have looked to the sea for their livelihood for millennia, and this project is consistent with their history and traditions.

The ocean off the coast of the Makah Reservation is part of the rich aquatic heritage, culture, and economy of the Makah people. The use of this natural resource for the supply of food and electricity further strengthens this heritage. The Makah Indian Nation, by siting the project in Makah Bay, can demonstrate that the ocean resource can be used for energy generation in harmony with nature.

AquaEnergy understands the primary reason for performing any socioeconomic analysis was to identify the important socioeconomic resources of the region, particularly those of the Makah Indian Nation, and ensure that licensing proposals do not negatively impact these resources. The Makah Bay Project will provide 1 MW, or approximately 1,500 MWh, of clean renewable ocean energy to Clallam County PUD and the Makah Indian Nation. Power generation is lacking and needed on the western end of the Clallam

County PUD service area.[29] The ocean wave energy conversion power plant will help the utility meet its customers' power needs. The Clallam County Economic Development Center and Makah Tribal Council are ultimate project participants, and direct beneficiaries of the economic benefits of this project. The total demand for the Indian Nation is approximately 5 MW. This energy source aligns with Clallam County PUD's objective to provide clean energy to customers and the Makah Tribe's interest in using energy derived from renewable resources. In fact, the Makah Nation chose to be an active participant in this project due to the environmental integrity and low impact of AquaEnergy's offshore buoy technology over competing onshore technologies.

The installation of the AquaBuOY pilot plant in Makah Bay was initiated by the Makah Tribal Council after their assessment of various ocean energy conversion technologies, including offshore wind. AquaEnergy was selected in 2001 to demonstrate an economically-feasible method to supply clean, renewable energy from ocean waves. The project is consistent with federal support of renewable energy development on tribal lands across the U.S.

The Makah Indian Nation, as owners of the land and as active participants in the Makah Bay Project, plans to derive economic benefit from the proposed activities by leasing to AquaEnergy specified property for the land station. In 2001, AquaEnergy and the Makah Tribal Council entered into a MOA, "to develop and promote offshore wave power generation plants as one of the renewable energy technologies that contribute to non-polluting energy production, the efficient use of energy and which contribute to the preservation of wildlife habitat within the Pacific Northwest". The initial MOA has been replaced by a land lease agreement for a 1 MW pilot plant.

The Makah Tribal Council envisions that the pilot plant would provide enough clean energy to supply approximately 150 homes. To demonstrate the feasibility of the technology to the Makah, the Clallam County PUD, and the general public, the size of the pilot project is limited to minimum size providing meaningful field data.

The electrical output of this project will benefit the welfare of the Makah Indian Nation by deriving plant production revenues through the land lease agreement. Pilot plant installation, monitoring and research activities provide tribal welfare through the lease fees, employment opportunities presented to the Makah, as well as through the cultural and historical value of using the ocean to help meet community needs, as the Nation has done for centuries.

The major socioeconomic benefit is that local contractors will be used whenever possible for construction and maintenance activities. AquaEnergy's plan to develop an

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[29] EPRI (2004) states that wave energy can help provide power in remote coastal areas and reduce reliance on diesel or other fossil fuel stations.

interpretive and education plan to provide information regarding the Makah Bay Plant will highlight to residents and visitors to the Makah Nation who may have an interest in how the Makah Nation is obtaining power from this cutting edge, first-of-its-kind wave energy project. It is expected that the development and operation of this project in and of itself, will result in some increased tourism involving people who are interested in this new technology and what it represents.

Much of the Makah Nation economy is resource oriented and the aesthetic appeal of the Olympic coastline is itself a significant resource. AquaEnergy's plan to maintain the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and develop design guidelines for future project improvements will help to ensure that the project has the minimum impacts possible to the valued aesthetics of project area (see Section 5.C.8, Aesthetic Resources).

AquaEnergy concludes that the Proposed Action represents a definite positive effect on socioeconomic resources in the project area. Through its active participation with AquaEnergy, the Makah Nation will be able to achieve its goal of developing a source of renewable power near the reservation.

c. Unavoidable Adverse Impacts

There will be no unavoidable adverse impacts to socioeconomic resources in the project area from development and operation of the Makah Bay Project.

D. No-Action Alternative

Under the no-action alternative, the project would not be constructed. This pioneering commercial project using renewable wave energy to generate electricity would not be constructed, and the use of wave energy to meet energy demands in the U.S. would face a set back. No environmental protection, mitigation, or enhancement measures would be implemented. This alternative is used to establish baseline environmental conditions for the comparison of other alternatives.

6. DEVELOPMENTAL ANALYSIS

This section includes an analysis of the project's use of the available wave energy to generate power, estimate the economic benefits of the proposed project, estimate the cost of various environmental measures, and the effects of these measures on the project's operations. Table 6-1 lists the assumptions used in the economic analysis.

TABLE 6-1
ECONOMIC INFORMATION FOR NET BENEFIT ANALYSIS

Net Investment	$5,000,000[1]
Licensing Cost	$1,000,000
Annual Cost	
Annual Costs	$50,000
Inflation	3%
Cost of Money	10%
Period of Analysis	30 years
Energy Value	
Nominal Market Value of Power (average for the year)	$40 (peak MWh) $40 (off peak MWh)
Capacity Value	N/A

[1] Net investment is based upon AquaEnergy books as of December 31, 2005 and projections of the project constructions costs. Total investment to date of $1,000,000.

A. Power and Economic Benefits

The project is estimated to generate an average of 1,500 MWh annually. AquaEnergy used this average annual generation as the basis for analysis of project economic benefits and based the value of project power benefits on the current nominal market value of power generated by the Makah Bay Project. This represents a reasonable proxy of project value for the purpose of this evaluation, which provides a basis for measuring the economic benefit of continued project operation. Analysis of the project's net benefits is based on the following economic information included in Table 6-1.

Based on this information for the proposed project, the average project annual generation of 1,500 MWh of electricity represents an annual gross value of $60,000 based on the nominal energy and capacity values, and costs of $50,000 annually to operate, resulting in an annual net benefit of about $10,000.

B. Cost of Environmental Measures

Most of the measures contained in AquaEnergy's Proposed Action would affect project economics by requiring capital outlays, increasing annual operations and maintenance (O&M) costs, or affecting energy generation. Table 6-2 presents the estimated costs for the environmental measures considered in this PDEA consisting of the costs associated with AquaEnergy's Proposed Action.

TABLE 6-2
COST OF AQUAENERGY PROPOSED ACTION

Item	Capital Costs (2005 dollars)	Incremental O&M or Annual Cost (2005 dollars)	Annual Gross Value of Energy Gain/Loss	Net Present Value of Capital and / or Annual Cost / Benefit - 30-Year Term
Use HDD to deploy transmission cable from shore station, under beach and intertidal area, out to a depth of 10 to 30 feet below mean lower low tide.*	$500,000	$0	$14,000	$420,000
Design features to achieve a closed-loop system to prevent any marine life entering pressurized water flow.	$500,000	$20,000	$30,500	$915,000
Utilize anti-fouling paints and materials on the equipment;	$20,000	$20,000	$17,000	$510,000
Design features to minimize scale of anchor devices, project footprint on seafloor, and chain/cable sweep of seafloor;	$250,000	$0	$7,000	$210,000
Design buoys to prevent marine mammal haulout and seabird roosting;	$250,000	$0	$7,000	$210,000
Install GPS transponders in each AquaBuOY for tracking purposes;	$40	$400	$500	$15,000
Develop and implement a Cultural Resources Management Plan (CRMP) consisting of measures to protect cultural resources;	$2,500	$6,000	$5,000	$150,000
Develop an interpretive and education plan to provide timely information regarding the Makah Bay Plant;	$2,500	$6,000	$5,000	$150,000
Develop, in conjunction with the permitting agencies, a schedule of regular system maintenance that minimizes site visits, disturbance to marine growth, and activity at the site; and	$2,500	$500	$500	$15,000
Improve and maintain the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and develop design guidelines for future project improvements.	$5,000	$500	$500	$15,000

*The depth to which directional drilling will occur will depend on the results of the eelgrass survey and the suitability of the sediment for HDD.

C. Pollution Abatement

Continuing operation of the Makah Bay Project would benefit air quality and the environment in the Northwest because the need for fossil-fueled generation and the resulting pollutants would be avoided or minimized. In addition, generation energy from waves does not result in consumptive use of water.

The use of the ocean as an energy source helps to offset CO_2 and NO_X pollutants from our air that have contributed to pollution in our Nation's marine environment. The ocean energy resource has no carbon emissions as there are from gas and diesel cogeneration plants, the eutrophication effects of warm water from nuclear plants are absent, and unlike hydro dams, there is no impact on migratory marine life and fish. In a sense, this project uses the ocean to help alleviate the impact of pollutants on land as well as to protect the ocean and its estuaries.

7. COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a) (1) of the FPA require the Commission to give equal consideration to all uses of the waterway on which the project is located. When the Commission reviews a project, the recreational, fish and wildlife, and other non-developmental values of the waterway are considered equally with its electric energy and other developmental values. In determining whether, and under what conditions, to license a project, the Commission must weigh the various economic and environmental tradeoffs involved in the decision.

Under the Proposed Alternative, AquaEnergy would construct the proposed pilot project, and take a number of steps to minimize any impacts of plant construction and operation.

Based on our review of the alternatives for the project as documented in Section 5 of this PDEA, we recommend the Makah Bay Project with the various environmental measures included in the Proposed Action described because:

- Issuance of a license would provide benefits to the overall welfare of the Makah Indian Nation by providing a dependable and inexpensive source of electrical energy for the residents of the Makah Nation; jobs for the Makah tribe; and economic and cultural benefits.
- Makah Tribal fishing is expected to be protected if not enhanced by the navigation aids onboard the AquaBuOY in the vicinity of tribal fishing grounds.
- Issuance of a license would provide a beneficial, dependable, and inexpensive source of electrical energy for the residents of Clallam County.
- The project will allow continued promotion of the Makah's ethic of living in harmony with nature.
- The public benefits of this alternative would exceed those of the no-action alternative.
- Many potentially-affected resources were identified for this project and none were found to be significantly impacted. The AquaEnergy AquaBuOY technology represents one of the most environmentally-benign electrical generation technologies.
- The project will provide an incredible benefit to the scientific community by testing the first grid-connected, wave energy conversion power plant.
- The Energy Policy Act of 2005 promotes the development of cleaner and more productive use of domestic energy sources, and renewable energy supplies for federal government facilities, as well as the diversification in energy supplies through greater use of alternative and renewable fuels. The Makah Bay Project is the epitome of clean energy.

- This project will reduce the dependence of foreign oil on a local level, and as it demonstrates, viability for larger-scale projects.
- This operation of this project will help to reduce CO_2 emissions, which is arguably the main source of global warming.
- The Makah will have a direct revenue associated as a result of the land lease agreement.
- The fabrication of the power plant will be done locally, which will provide jobs for the Makah Nation.
- Eco-tourism will add to the local economy as the interest in the project will increase the number of eco-visitors to the area.

The preferred alternative includes the following environmental measures:

- Use HDD to deploy transmission cable from the shore station, under the beach and intertidal area, out to a depth of 10 to 30 feet below mean lower low tide (the depth to which HDD will occur will depend on the results of the eelgrass survey to be conducted prior to project construction and the suitability of the sediment for HDD);
- Design features to achieve a closed-loop system to prevent any marine life entering pressurized water flow;
- Utilize anti-fouling paints and materials on the equipment;
- Design features to minimize scale of anchor devices, project footprint on seafloor, and the chain/cable sweep of the seafloor;
- Design buoys to include a heavy-duty plastic conical attachment to be placed over the above-water portion of the buoy to prevent marine mammal haulout and seabird roosting;
- Install GPS transponders in each AquaBuOY for tracking purposes;
- Develop and implement a CRMP consisting of measures to protect cultural resources;
- Develop and implement an interpretive and education plan to provide timely information regarding the Makah Bay Plant;
- Develop, in conjunction with the permitting agencies, a schedule of regular system maintenance that minimizes site visits, disturbance to marine growth, and activity at the site; and
- Improve and maintain the aesthetic values of the project area through the selection of non-reflective colors that blend with the background landscape, and develop design guidelines for future project improvements.

In conclusion, we recommend licensing the Makah Bay Offshore Wave Energy Pilot Project as proposed by AquaEnergy for a term of 30 years. We conclude that issuing an original license for the project, with the environmental measures that we propose, would not be a major federal action significantly affecting the quality of the human environment. Given the national energy demands and supply limitations, we recommend that development of new technologies by AquaEnergy and other companies be encouraged and promoted to increase domestic energy production, especially from clean renewable sources.

8. CONSISTENCY WITH FISH AND WILDLIFE RECOMMENDATIONS

If Section 10(j) recommendations are submitted, then pursuant to the FPA, the Commission is required to make a determination that the recommendations of the federal and state fish and wildlife agencies are consistent with the purpose and requirements of Part I of the FPA and applicable law. Section 10(j) of the FPA states that whenever the Commission believes that a fish and wildlife agency recommendation may be inconsistent with the purposes and requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve any such inconsistency, giving due weight to recommendations, expertise, and statutory responsibilities of such agency.

9. CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a) (2) of the FPA requires the Commission to consider the extent to which a project is consistent with federal or state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the project. Under Section 10(a) (2), federal and state agencies filed a total of 73 comprehensive plans that address various resources in Washington. A list of these plans is provided in Appendix B. Of these, we identified and reviewed four plans relevant to the project[30]. No inconsistencies were found.

[30] Pacific coast salmon plan for commercial and recreational salmon fisheries off the coasts of Washington, Oregon, and California as revised through Amendment 14 (adopted March 1999) (PFMC 2003); An assessment of outdoor recreation in Washington State: A State Comprehensive Outdoor Recreation Planning (SCORP) Document 2002-2007 (Interagency Committee for Outdoor Recreation 2002); Northwest conservation and electric power plan (Northwest Power Planning Council 1986); and State of Washington natural heritage plan (WDNR 1987).

10. FINDING OF (NO) SIGNIFICANT IMPACT

On the basis of our analysis, we conclude that the issuance of an original license for the Makah Bay Project as proposed would not constitute a major federal action significantly affecting the quality of the human environment, and there will be no cumulative effects from the proposed project.

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APPENDICES

APPENDIX A

AGENCY COMMENT MATRIX

MAKAH BAY OFFSHORE WAVE ENERGY PILOT PROJECT
PRELIMINARY DRAFT ENVIRONMENTAL ASSESSMENT
COMMENTS AND SUMMARY MATRIX ON DECEMBER 5, 2005 DRAFT PDEA

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
1	WDFW	1/3/06	The Federal Power Act and the Federal Energy Regulatory Commission (FERC) defines enhancements as actions "in addition to" protection and mitigation measures to offset environmental impacts of the project. Listed in several areas of the PDEA AquaEnergy includes proposed actions for protection, mitigation and enhancement measures to minimize impacts to marine resources, and they are termed "enhancements". The project has been redesigned to meet environmental concerns, which are termed "protection measures". We recommend correction in the PDEA from "enhancement" to "protection" measures. AquaEnergy, at this time, is not proposing any mitigation for the project, since they believe there are minimal impacts to the marine environment with the current design of the facility.	Not all proposed actions are protection measures, for instance, development and implementation of an interpretive plan to provide information regarding the Makah Bay Plant and use of the area by the Mahak is an enhancement. In order to take into account this comment, AquaEnergy refers to these actions as environmental measures.
2	WDFW	1/3/06	In the Scoping Document Two (SD2) (May 2005) it states the operation of the facility will be for a term of three years. The PDEA does not indicate the duration of this project. What is the intended operation period for the project?	AquaEnergy anticipates a 30-year license term for the project from FERC. OCNMS has indicated it would grant a permit for three years. This would result in one year for project construction and two years of operation. AquaEnergy plans to regularly renew the OCNMS permit over the term of the FERC license. This information has been incorporated in the PDEA.
3	WDFW	1/3/06	The FERC requires "properly conducted environmental studies are those that provide the applicant, FERC, and reviewing resource agencies and tribes clear and substantial information." A list of the environmental studies is provided on pages 4-2, 4-5 and 4-6 of the PDEA. Have these studies been finalized into reports that can be referenced in the final environmental assessment? It would be to AquaEnergy's benefit to finalize these studies. These reports will provide important (existing conditions) baseline information on the project area, and will provide important scientific documentation to federal and state agencies including the FERC, which will ultimately make the determination on issuance of a license for this project.	Reports were produced for the oceanographic survey (included current analysis - conducted by Evans Hamilton) and the geophysical survey (conducted by Thales GeoSolutions Inc.). These reports have been finalized and the results are included in the PDEA. Copies of the report are being submitted to FERC along with the license application. As noted in the PDEA, the seagrass survey will be conducted during summer months prior to the time of construction.

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
4	WDFW	1/3/06	Under the Proposed Action and Alternative section of the PDEA, it states, "at the present time AquaEnergy is considering the use of vertical load anchors (VLA)." In the Environmental Analysis section of the document it is written with the intended use of the VLA system. If AquaEnergy is intending to use the VLA system, it should be consistently written in the PDEA.	Vertical load anchors are planned until the final design has been established. The final design may dictate that other anchoring systems will be required due to specific seabed composition. The final design will be submitted to agencies for their review prior to construction of the project.
5	WDFW	1/3/06	The PDEA does not include the final design for the sea-bed connection, mooring design, and location of the transmission cable. Since the final design cannot be reviewed during this environmental assessment process, it is important to have ongoing consultation with the state and federal agencies prior to the construction of the project. AquaEnergy should develop a final design plan for each of the items stated above and allow time for review from the state and federal agencies prior to construction of the first buoy.	AquaEnergy has developed a preliminary design for the project, which was provided in the PDEA. However, due to ongoing research and development, some design elements may be advanced as a result of AquaEnergy's research. Technology elements would be expected to be altered if they provide greater environmental protection and operational and cost efficiency. In the event of a final design change, AquaEnergy will develop a final design plan for each item (including, mooring sea-bed connection, location of transmission cable, interconnection with grid). AquaEnergy will allow time for the final design review by the state and federal agencies prior to deployment of the project.
6	WDFW	1/3/06	The Environmental Analysis section of the PDEA should include a description of the footprint of the anchor configuration on the sea floor bed. Please see pages 5-10, 5-11, 5-45 and 5-48. There is a description of the approximate dimensions of the anchor system on the ocean floor in the Cultural Resources section of the PDEA. This description should also be included in the environmental analysis.	AquaEnergy incorporated the description of the footprint of the anchor configuration on the seafloor bed in both the geological and aquatic resource sections, as suggested.
7	WDFW	1/3/06	The PDEA does not include the description of a generator on the seafloor bed. If this is still intended to be part of the project then a clear description of the facility needs to be presented in the PDEA. WDFW's concern is in regards to the attachment of marine organisms, which will be a benefit if left undisturbed, but disturbance during maintenance may be a problem, potentially interrupting life histories of juvenile rockfish and other species of concern that may take up residence in association with this new habitat. The maintenance plan should address this issue. WDFW did not propose anti-fouling paint on all equipment.	The preliminary plant design presented in the PDEA provides for one of the buoys to function as a collector of generated energy for the overall plant. Hence there will be no generator located on the ocean floor. This design change was implemented based on the preliminary comments received from WDFW. In addition, AquaEnergy and OCNMS have agreed to conduct a biofouling experiment on the buoys which will involve painting the buoys with various anti-

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			WDFW did not recommend TBT and/or any other organophosphate, as it is deadly and should never be used in the marine environment. For the generator, we recommend a housing that can be removed intact, sort of like a "hut" over the generator, water tight and inserted into the bottom a sufficient distance to seal it. Nothing will grow inside of it if there is no circulation. This could be lifted off with attachment organisms intact by a diver with an airbag so that the generator could be accessed. And as far as the buoys go, we recommend either designing them with enough buoyancy to operate fully fouled and forget about it, or putting them on a schedule of regular replacement with a spare buoy so that the fouled buoy can be hauled to an onshore marine maintenance yard for cleanup and repainting. Same thing with the anchor lines and intermediate buoys, it would be best if these could be designed to operate with attached fouling as well, but if not, then they need to be designed to be removable for cleaning. What we do not want is organisms scraped from galvanized or painted surfaces directly into the water, as these get ingested along with attached metals and other contaminates, and head up the food chain. Contaminants moving up the food chain result in toxic levels in animals higher up in the food chain (e.g. DDT in bald eagle, peregrine falcon, salmon and orca whale, as well as many other species). Paints used therefore need to be of the least toxic and contain nothing that can bioaccumulate.	biofouling paints to determine a) buoy operation with biofouling and b) which paint provides better protection in terms of reduced biofouling. Thus, no buoy scraping/biofouling removal will be performed during the two year demonstration and biofouling testing period.
8	WDFW	1/3/06	A comprehensive bibliography of the literature related to mooring impacts on the bottom from the mooring and VLA system was not done in this PDEA, will be included in the Final DEA? Has this configuration, or parts of it, been deployed in another part of the world? If so, what were the environmental impacts? In the SD2, the task list included conducting a review of the literature related to the impacts of similar mooring systems on the general marine environment.	AquaEnergy reviewed environmental impacts associated with different mooring systems. As a result of this review, and in response to agency concern about impacts of chain sweep from mooring lines on the benthic community around each anchor (concrete blocks were originally proposed in SD2), AquaEnergy modified the buoy design to utilize VLAs. As indicated in the PDEA, VLAs are frequently used for mooring oil drilling platforms and when in vertical (normal) loading mode, VLAs can withstand both tremendous horizontal and vertical loads. Each VLA is installed like a conventional drag embedment anchor, but penetrates much deeper. The resulting

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
				configuration will have minimal chance of chain sweep between mooring buoys and the surface floats, to maintain suspension of the mooring chains and cables above the seafloor. Because the VLAs are deployed completely below the seafloor, only the area of the seafloor surface equal to the diameter of the cables leading from the VLAs will be affected by the mooring system. The buoy anchor area will therefore not have any appreciable footprint on the sea floor.
9	WDFW	1/3/06	Since the Makah Bay Offshore Wave Energy Pilot Project is a new technology being deployed into the national marine sanctuary, the WDFW recommends AquaEnergy develop, in consultation with all the resource agencies, a comprehensive monitoring plan for the project. This monitoring plan would be set up to evaluate impacts to marine environment. Components of the plan would include: entanglement of marine mammals or seabirds, avoidance behavior from the acoustic disturbance or electromagnetic radiation and other impacts. As an example, sea otter populations in the state of Washington continue to grow and expand northward (Lance et al. 2004), and sea otters have overcome deep open waters barriers (Kenyon 1969).	AquaEnergy understands that there are limited environmental study data relating to the operation of a wave turbine project. However, as part of this PDEA, research has been conducted to identify potential effects and to incorporate design modifications in response to agency concerns. For example, the closed loop hydraulic-to-electrical conversion takes place inside each AquaBuOY, which is a significant design modification from the original design where the hydraulic-to-electrical conversion would have take place in a power habitat on the sea floor. Another design modification is the installation of a cone shaped cover on the buoy to avoid seabird roosting and pinniped haulout. These are just 2 of several design modifications that have been made as a result of agency concerns. As mentioned in Section 5 of the PDEA, Steve Jeffries, marine mammal biologist with WDFW, stated "Based on the project description I doubt any (marine mammals) will be impacted by this demonstration project although any buoy anchored in that area may be used as a haulout structure by California and/or Steller sea lions. ...Other than those issues, (I) don't see anything else that should be a marine mammal issue". Based on research conducted as part of the PDEA and the design changes made in response to resource agency concerns, AquaEnergy is not planning to implement a monitoring plan for this pilot project.

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
10	WDFW	1/3/06	Sea Otters, Page 5-42: The PDEA should be updated to include the following information from the WDFW Sea Otter Recovery Plan. In general, sea otters remain in nearshore waters of Washington (seldom more than 1-2 km from shore) up to 20 fathoms deep. Habitat use by sea otters along the Washington coast has recently been described using radio telemetry and resight data collected from 68 individuals (Laidre et al. 2002). Adult males foraged deeper than juvenile males (16 and 14 m, respectively), but the mean distance from shore for foraging was greater for juveniles than adults (1,382 and 1,163 m, respectively). In contrast, juvenile females foraged deeper than adult females (12 and 10, respectively) and also foraged at mean distance from shore greater than adults (945 and 717 m, respectively).	AquaEnergy has modified the PDEA to include this information.
11	WDFW	1/3/06	Surf smelt, Page 5-44: Please correct the PDEA to include surf smelt spawning just south of Makah Bay at Shishi Beach (Steve Fradkin, Personal Communication).	AquaEnergy has modified the PDEA to include this information.
12	WDFW	1/3/06	Page 3-8, Figure 3-4: should be updated with the current design of the offshore wave energy system.	The present figure is all we have at the present time. As plant design progresses, there will be design reviews to provide agencies an opportunity to comment on the final plant design.
13	WDFW	1/3/06	Page 3-13, alternative analysis: What was the period of time that the wave resource assessment was conducted? It would be helpful to include a map of the sites (Cape Elizabeth and the Canadian buoy) in reference to the project area.	This information is provided in Section 5.C.2.
14	WDFW	1/3/06	Page 4-4 and 4-5: NMFS and USFWS "review" should be changed to NMFS and USFWS "consultation".	AquaEnergy has made this change in the PDEA.
15	WDFW	1/3/06	Page 5-15, affected environment: please include a map in the PDEA of the sites of the meteorological buoys in relationship to the project.	A map has been included showing the location of the meteorological buoys.
16	WDFW	1/3/06	Page 5-52, please describe the location of the laydown area. How many acres will be impacted? This site should also be included on Figure 1-3. Palustrine wetlands are located just east of the proposed site for the housing facility on shore. Construction of both the housing facility and laydown area should avoid any environmentally sensitive areas.	AquaEnergy has updated the PDEA to describe the staging area location and area required during the construction phase of the shore station.
17	WDFW	1/3/06	Page 5-61, the heading "seabirds" should be changed to "birds".	AquaEnergy has revised the PDEA accordingly.

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
			Bald eagles are not considered seabirds.	
18	WDFW	1/3/06	Page 9-1, Consistency with Comprehensive Plans, the Final EA should include the list of FERC listed comprehensive plans.	AquaEnergy has modified the PDEA to include this information.
19	WDFW	1/3/06	In the PDEA it states that a Hydraulic Permit Application (HPA) will be issued for the project in other places it states otherwise. This inconsistency needs to be corrected. An HPA is required under state law and likely to be a requirement of the water quality certification issued by the Department of Ecology under the federal Clean Water Act.	AquaEnergy has modified the PDEA to take into account this comment.
20	WDFW	1/3/06	The appendix should include a copy of all correspondence that is referenced in the PDEA.	A record of project consultation is included in a separate volume of the license application.
21	WDFW	1/3/06	Overall, AquaEnergy has made significant changes to the design of the wave energy pilot project in order to meet the concerns raised by the resource agencies over the past three years. We applaud their efforts. It has been exciting for WDFW to be a part of this new technology in the State of Washington.	Comment noted.
1	WDNR	1/3/06	The most glaring omission is the lack of recognition and discussion of State owned aquatic lands that will be used by this project. That omission needs to be corrected throughout the document beginning from the first page (1-1) of the document and under general description of the project area on page 5-1, for example. The tidelands and bedlands over which the electric cable will be laid, HDD'd, or buried are lands owned by the State of Washington and managed by the Department of Natural Resources. The State of Washington owns the bedlands of the ocean out to 3 nautical miles. So depending on the final location of the buoys, a part or all of the buoy deployment may also be over or on state owned aquatic lands and subject to leasing from the State of Washington.	AquaEnergy has modified the PDEA to take into account this comment. Please note that in Section 4.A.1, it is mentioned that AquaEnergy filed a Joint Aquatic Resources Permit Application (JARPA) and that the JARPA, in part, covered an Aquatic Lands Lease from WDNR.
2	WDNR	1/3/06	Next, all references to permits should also add the words "use authorizations" or "easements" since the document to denote the difference between permits and the use authorization that will be entered into by AquaEnergy and the DNR. See pages 4-2 and 4-4 as two places where the text should be changed to: "Permits and "Easements" or Use Authorizations"…."	AquaEnergy has modified the PDEA to take into account this comment.
3	WDNR	1/3/06	Nowhere in the document did I find discussion for the need to do	The land survey will be performed prior to construction

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
			a land survey which will be a requirement of procuring a use authorization from the DNR. The DNR will also require a plan of operations. Both the survey and plan of operations become a part of the use authorization AquaEnergy will have with the DNR.	as required for WDNR use authorization. Because this PDEA is being developed for FERC licensing purposes, we do not address the WDNR use authorization requirements in this document.
4	WDNR	1/3/06	Other items I did not find noted in the document was the length of the FERC license being sought. The anticipated length of time for these fixtures to be deployed for the pilot project should be noted. Also, I did not find any information on the diameter of cable and whether it would be laid exposed or if it would be in some type of conduit.	AquaEnergy anticipates a 30-year license term for the project from FERC. OCNMS has indicated it would grant a permit for three years. This would result in one year for project construction and two years of operation. AquaEnergy plans to regularly renew the OCNMS permit over the term of the FERC license. This information has been incorporated in the PDEA. As indicated in the PDEA, the power transmission cable installed from the AquaBuOY to the shore station will be anchored to the ocean floor, except for the nearshore section. HDD will be used to deploy the transmission cable from the shore station, under the beach and intertidal area, out to a depth of 10 to 30 feet below mean low tide (the depth to which HDD will occur will depend on the results of the eelgrass survey to be conducted prior to project construction and the suitability of the sediment for HDD). The cable will adhere to OSEA standards that prescribe the minimum size and weight of cable. Cable anchoring will be contracted to a qualified cable installation firm. Prior to the plant installation agencies will be provided with an opportunity to review the proposed plan for the cable anchoring by the cable installation contractor.
5	WDNR	1/3/06	Finally, it would be beneficial to incorporate the recommended changes and edits to the document from the state and federal agencies you have contacted prior to the document being released to the public. It would then be helpful for the state and federal agencies to have one more chance to review that document before it goes out the public.	AquaEnergy has provided the resource agencies the opportunity to review the PDEA prior to submitting it to FERC. The comments provided by WDNR have been addressed here and in the revised draft PDEA. AquaEnergy welcomes any additional comments that resource agencies have on the draft PDEA submitted to FERC and other stakeholders. AquaEnergy believes

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
				that these opportunities to comment allow sufficient opportunity for resource agencies to review the PDEA while enabling the licensing process to move forward.
1	OCNMS	1/3/06	It should be noted that portions, if not all of the project is within Washington State waters, the sanctuary, and the Flattery Rocks National Wildlife Refuge. Also, it is relevant to state this later in the document, e.g., page 1-1. Please check the project location relative to the state's marine boundary (nominally 3 miles from shore but influenced by islands, headlands, etc.). This is important for p.5- 70 where fishing closures are suggested and the authority for closures is not clear. We can provide a GIS shapefile of the Washington sea boundary if you need this.	AquaEnergy has modified the PDEA to take into account this comment.
2	OCNMS	1/3/06	-p.l.l: this should mention that the cable would lie on state owned bedlands/seafloor. Please add the state waters boundary to figures.	AquaEnergy has modified the PDEA to take into account this comment.
3	OCNMS	1/3/06	-p.2-1: Minor points - while we agree that development of electrical energy from sustainable sources is an important development and power generation in western Clallam County is perhaps desirable, it is not "needed" given the distribution network of power lines. Also, it is not accurate to say this project will displace fossil fuel generated electricity because this is less than 5% of Clallam PUD's energy source. The technology, if applied at a commercial scale, could achieve this goal.	AquaEnergy has modified the PDEA to address this comment.
4	OCNMS	1/3/06	-p.3-l: the Northwest National Lab and Pacific Northwest National Lab are the same and deserve only one bullet. Minor point - it may be questionable to call this a design that is ocean-tested abroad because we understand that this buoy design is unique in its power generation components from what has been field tested. Are there reports of the North Sea prototype that can be referenced and findings that can be presented?	AquaEnergy has changed the text to reflect the correct name for the lab, Pacific Northwest National Lab. The predecessor technologies, namely the IPS Buoy and the Technocean Hose-Pump, were ocean tested in full. AquaBuOY is the next generation device, combining these ocean tested technologies. The PDEA has been modified to incorporate this information.
5	OCNMS	1/3/06	-p.3-2: a detailed graphic of the proposed AquaBuOY with labeled parts is desirable to understand the functional description provided on pages 3-2 and 3-5.	AquaEnergy has included the requested graphics.
6	OCNMS	1/3/06	p.3-5 and throughout: consistent units of measurement would help (e.g., meters, inches, miles, statute miles)	AquaEnergy has modified the PDEA to take into account this comment. Please note that in Section

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
				V.C.2, Aquatic Resources, meteorological buoy data remains in metric units because these are the units in which data were collected/presented.
7	OCNMS	1/3/06	-p.3-6: later design of the anchoring systems for the buoys and transmission cable makes a complete evaluation of the project impossible through the PDEA. There is an inconsistency where it is stated that AquaEnergy is considering vertical load anchors but the rest of the document implies this decision is finalized. Figure 3-4 should be refined to accurately reflect the project as proposed. Do you plan to use weights and floats on the cables as shown? At what height off the seafloor will the subsurface floats be placed? How much slack will be in the transmission cable between the float and the seafloor?	The use of vertical load anchors is under consideration with the final decision to be made during the plant detail design. As mentioned before, agencies will be provided with an opportunity to review and comment on the design prior to the plant construction. At this time the plant design drawing will be kept as is.
8	OCNMS	1/3/06	-p.3-9: the lands are owned by the Tribe, not the Council. The road is probably Makah Passage Road, not Hobuck Road. The footnote should say "will be determined" not "will be performed".	AquaEnergy has modified the PDEA to take into account this comment.
9	OCNMS	1/3/06	-p.3-l2: even if a decision is not made at this time, alternative methods for cable anchoring need some description, including different equipment used rock and sand seafloor, size and number of cable anchors, etc (see also p.5-l2, para.4). WDNR will require permitting for this as well as OCNMS.	Cable anchoring will be contracted to a qualified cable installation firm. Prior to the plant installation agencies will be provided with an opportunity to review the proposed plan for the cable anchoring by the cable installation contractor.
10	OCNMS	1/3/06	-p.3-l5: this wave energy analysis is not very comprehensive. The studies from the Axys buoy in Makah Bay are not provided or referenced, and studies along the U.S. west coast conducted by AquaEnergy are not presented in detail. Source data for Figure 3-6 should be provided. The values for Makah Bay provided in the text do not match the figure for 48 degrees north. Sites between 39 and 41 degrees appear to have better average wavefront values than Makah Bay. What wave data was used to characterize Grays Harbor? Grays Harbor is referenced as the primary alternative site; were there other alternative sites considered? Explanations for the site selection criteria (p. 3-13) are not provided to fortify the site selection.	*This wave energy analysis is not very comprehensive.* Based on the agency meeting that took place last June in Port Angeles, AquaEnergy understands that the primary purpose of the wave analysis is to ensure that the buoy and transmission cable anchoring design for the project accounts for the extreme wave conditions that are expected to occur within the project area. Based on this understanding the wave analysis provided in the PDEA satisfies the agency requested information. *The studies from the Axys buoy in Makah Bay are not provided or referenced, and studies along the U.S. west coast conducted by AquaEnergy are not presented in detail.* Data from the axys bouy were provided to Dr.

Comment No.	Stakeholder	Date of Letter	Comments	Response to Comments
				Sternberg to calculate the depth of sediment movement. A discussion relating to sediment movement is provided in 5.C.1.b. Further analysis relating to the potential for resuspension and scour is included in the March, 2006 report prepared by Evans Hamilton and available on the AEG ftp site. *Source data for Figure 3-6 should be provided.* This figure is based on analysis conducted by AquaEnergy of data collected by USCG buoys. In the revised document, this figure is now 3-8; this source information is referenced. *The values for Makah Bay provided in the text do not match the figure for 48 degrees north. Sites between 39 and 41 degrees appear to have better average wavefront values than Makah Bay.* AquaEnergy agrees that sites between 39 and 41 degrees north have slightly higher wave energy potential. The text has been revised accordingly. *What wave data was used to characterize Grays Harbor?* The Cape Elizabeth buoy. *Grays Harbor is referenced as the primary alternative site; were there other alternative sites considered? Explanations for the site selection criteria (p. 3-13) are not provided to fortify the site selection.* Additional discussion is provided in Section 3.B, Alternative Analysis.
11	OCNMS	1/3/06	-p.4-l, para. 3: also list Department of Natural Resources.	AquaEnergy has made this change in the PDEA.
12	OCNMS	1/3/06	-p.4-2: we suspect a JARP A permit application was submitted.	AquaEnergy has modified the PDEA to take into account this comment.
13	OCNMS	1/3/06	-p.4-4: the OCNMS Permit and NMFS review are separate.	AquaEnergy has modified the PDEA to take into account this comment.
14	OCNMS	1/3/06	-p.4-9: it is not correct to say the sanctuary includes the park, refuge, etc. It is better to say the sanctuary is adjacent to or has	AquaEnergy has modified the PDEA to take into account this comment.

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			jurisdiction that overlaps with other entities. Also mention that a sanctuary permit will be required because OCNMS regulations cover seafloor disturbance and placement of structures. Under the MMPA, harassment of all species is prohibited. The sentence on Makah Whaling is irrelevant to this document.	
15	OCNMS	1/3/06	-p.5-2-3:Figure 5-1 does not clearly identify bathymetry values. OCNMS now has sonar data covering all of outer Makah Bay and the project area which could provide AquaEnergy better information for cable routing than the limited swaths shown in Figures 5-2 and 3. Let us know if you would like these data.	The resolution of Figure 5-1 has been improved so that bathymetry values are legible. The bathymetric data used in the PDEA (Figure 5-1) is adequate for selecting a general cable route. Using these data, AquaEnergy was able to site the cable route so that it would run along sand and silt substrate, avoiding all rock outcroppings out to a depth of 30 meters. The transmission cable will therefore avoid rocky habitats at the depths preferred by kelp as well as many other species of macro algae. AquaEnergy is interested, however, in receiving the sonar data from OCNMS for all of outer Makah Bay. AquaEnergy will use these data for verification of AquaEnergy's analysis and cable siting, and finalization of the proposed cable route prior to project construction.
16	OCNMS	1/3/06	-p.5-10: the main objective of the mooring design is to hold the project in place; the main environmental objective in design of the system is as stated.	AquaEnergy did not claim that reducing impact to the ocean floor was "the" main objective, but as stated in the PDEA, it definitely was "a" main objective. That is why AquaEnergy proposed use of VLAs.
17	OCNMS	1/3/06	-p.5-11, para. 1: the point is that with VLAs the cables are under tension, with little slack and low potential for chain/cable sweep. The phrase "to maintain suspension of the mooring chains.. ." does not connect clearly with the rest of the sentence. An improved figure (Fig. 3-3 or another) accurately showing the mooring configuration from anchor to surface floats is needed. Are subsurface floats required with the VLA anchors? Throughout the document where it is cited, one keeps looking back to Figure 3-3 to see if mooring features are shown and finds only the VLAs shown. Although likely minimal, the impact on the seabed and area of the VLA at installation should be described (see also p.5-12, para. 2).	AquaEnergy has clarified the referenced sentence. Many of the references to Figure 3-3 (illustration of a VLA) should have been to Figure 3-4 (pilot project block diagram). The use of VLA will require different interconnection between the buoys, at the same time VLA result in less impact to the ocean floor. The mooring design provided in Figure 3-4 is based on what was used during earlier testing in the North Sea. However, AquaEnergy is considering the use of VLA to reduce the impact on the ocean floor. The PDEA has been changed to clarify this information.
18	OCNMS	1/3/06	-p.5-11, para. 3: is it data from Makah Bay that indicates that 15	Data from Makah Bay indicates that 15 second wave

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			sec. wave period can mobilize sediment to 90 meter depth or is this off a chart or formula?	periods exist within the project area. DTA consulted with Dr. Sternberg (Retired professor from University of Washington), who has studied sedimentation in Makah Bay. Using site-specific data, Dr. Richard Sternberg estimated (based on calculations) that for 15 second wave periods, sediment can mobilize to a 90 meter depth.
19	OCNMS	1/3/06	-p.5-12, para. 4: the method for cable anchoring needs to be defined, and also approved by WDNR. How will the cable anchor differ where sea floor is sand vs. bedrock?	Cable anchoring will be contracted to a qualified cable installation firm. Prior to the plant installation agencies will be provided with an opportunity to review the proposed plan for the cable anchoring by the cable installation contractor.
20	OCNMS	1/3/06	-p.5-15 onward: please list various relevant data types available from various stations and buoys.	AquaEnergy revised the PDEA to identify the relevant parameters monitored for each station.
21	OCNMS	1/3/06	-p. 5-18: is the Axys wave buoy the same as the Triaxys mentioned on p. 4-6?	AXYS Technologies, Inc. makes the TRIAXYS Directional Wave Buoy used in the study.
22	OCNMS	1/3/06	-p. 5-19: make line labels consistent in two graphs. Can you use this wave height and period data to estimate sediment movement at the project site?	AquaEnergy revised the line labels accordingly. Sediment movement at the project site has been estimated. See section 5.C.1.b
23	OCNMS	1/3/06	-p.5-22: is this missing a current summary because Evans Hamilton has not retrieved their instruments? If so, these data are assumed to be permanently lost. If not, when do you expect to have this analysis?	AquaEnergy has recently received the Evans Hamilton report and incorporated a summary into the PDEA.
24	OCNMS	1/3/06	-p.5-23: we are interested in how you would try different anti-fouling formulations to see what works best.	AquaEnergy and OCNMS have agreed to conduct a biofouling experiment on the buoys which will involve painting the buoys with various anti-biofouling paints to determine a) buoy operation with biofouling and b) which paint provides better protection in terms of reduced biofouling. Thus, no buoy scraping/biofouling removal will be performed during the two year demonstration and biofouling testing period.
25	OCNMS	1/3/06	-p.5-24 and onward: irregular provision of scientific names could be corrected. We suggest that you provide scientific names once with first use of common name. para. 2: the other species and habitats identified are best stated in the “vicinity”, not specifically in the project area.	AquaEnergy has modified the PDEA to take into account this comment.
26	OCNMS	1/3/06	-p.5-25: the phrase “summer residents” is now referenced as the	AquaEnergy has modified the PDEA to take into

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			"Pacific Coast feeding aggregation".	account this comment.
27	OCNMS	1/3/06	-p.5-28, para. 1: the number of harbor seal haulout sites in Makah U&A grounds is not relevant because this is a large area, but the subsequent description is appropriate. para.3: overhunting led to extirpation from Washington, not extinction for the species. Also, the more recent sea otter recovery plan (Dec. 2004) should be cited and is available at http://wdfw.wa.gov/wlrnldiverstv/soc/recoverv/seaotter/index.htm (although the web site lists 2001 as the publication date).	AquaEnergy has modified the PDEA to take into account this comment.
28	OCNMS	1/3/06	-p.5-30, para. 2: OCNMS website is not the best source for fish habitat classification; the habitats listed are not distinct types and perhaps require some definition. For example, sublittoral is everything from the beach to the continental shelf and it is an area, not a habitat type.	AquaEnergy has modified the PDEA to take into account this comment.
29	OCNMS	1/3/06	-p.5-32, para. 1: because EFH covers virtually the entire continental shelf, clearly state whether HAPC occurs in or near the project area. para. 4: there are only two species of storm petrels (correct spelling), so why not list both fork tailed and Leach's?	AquaEnergy has modified the PDEA to take into account this comment.
30	OCNMS	1/3/06	-p.5-34: small portions of the large quote are relevant and could be extracted for brevity. The "important" species one wonders about because the Pacific oyster does not occur in the project area, there is no commercial razor clam harvest in the area, and only Makah harvest razor clams at Hobuck Beach. In general, this section can be more specific and focused.	AquaEnergy has modified the PDEA to take into account this comment.
31	OCNMS	1/3/06	-p.5-35: provide information about Makah and other crabbing effort in Makah Bay, not off Grays Harbor many miles to the south. Are geoduck and horse clams not hard shell subtidal clams?	AquaEnergy included additional information about crabbing effort in Makah Bay in Section 5.C.7, Recreation Resource and Land Use. Horse clams are considered a hardshell subtidal clam however, geoduck are not. In its list of priority species, WDFW lists butter clams, littleneck clams, and Japanese littleneck clams, the three clam species listed in the PDEA, as being hardshell clam priority species, which is the focus of the referenced section. The PDEA was revised to clarify that these three species are the priority hardshell clam species listed by WDFW.
32	OCNMS	1/3/06	-p.5-37: clarify the area ShoreZone Inventory covers (intertidal	AquaEnergy clarified the area covered by the

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			to depth of a few meters subtidal), and note that future macro algae/vegetation studies will be performed following WDFW protocols (unless you are requesting a waiver). Again, a map with subtidal habitats identified (for categories see Dethier 1990, A Marine and Estuarine Habitat Classification System for Washington State. WA Natural Heritage Program, Dept. Natural Resources) and discussion focused on the immediate project area (including cable route) would be most appropriate.	ShoreZone inventory. Proposed marine vegetation studies are discussed in the Environmental Effects section. As discussed in Section 5.C.1 Geological Resources, Thales GeoSolutions (TGPI) conducted a seabed survey of the project area in 2002. TGPI developed a map of subtidal habitat, which was discussed in Section 5.C.1 and presented as Figure 5-2. This figure shows seabed features in the project area with the following subtidal habitats designated: 1) rock outcrop with patches of coarse-grained, angular sediment cover, 2) fine-grained sand and silt, and 3) isolated rock. The resolution on this figure in the PDEA was not sufficient and it has been improved so that this information can be better discerned. In response to your comment AquaEnergy has also included a map showing floating kelp beds in the project vicinity (from the state Floating Kelp Inventory Database).
33	OCNMS	1/3/06	-p.5-39: use consistent units-nautical miles or statute miles or km. This mooring system description is more detailed than that provided in Section 3 but a good diagram is still lacking. Key is greater cable tension and elimination of excess or slack cable in the water column. Details of the subsurface floats, the "slack mooring associated with..." [these] and the weights mentioned here are still unclear. Again, a description of alternative methods for cable anchoring would be helpful.	Units have been reviewed for consistency. Cable anchoring will be contracted to a qualified cable installation firm. Prior to the plant installation, agencies will be provided with an opportunity to review the proposed plan for the cable anchoring by the cable installation contractor.
34	OCNMS	1/3/06	-p.5-41: there appears to be a lack of information on anticipated noise levels associated with AquaBuOYs. A comparison of the mechanical similarities and differences between the Kaneohe Bay installation and AquaBuOYs would be helpful. If any more specifics about noise output were provided in the Navy's EA or subsequent monitoring for noise levels, this information would be helpful. Plus, the comparison to "ship traffic" is not well defined - what kind of ships? Is this a comparison to Navy vessel traffic at the entrance to a major facility hosting air craft carriers and large destroyer vessels? We are left wondering how noisy the mechanics of the buoys will be. The last sentence in	Noise levels resulting from project operation, specifically the hose pump and the pressurized water hitting the Pelton turbine, are expected to be well below the ambient noise of the ocean. During the June 27, 2005 Makah Bay Project technical meeting, AquaEnergy staff stated, and resource agency staff agreed, that the high wave action associated with this area will, during most days, create more noise than the plant will. AquaEnergy does not have sufficient information on

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			para. 2 belongs in the analysis section.	the Kaneohe Bay installation for comparison purposes. AquaEnergy acknowledges that the comparison to "ship traffic" is not well defined. Therefore this particular reference has been deleted. This referenced text *is* part of the analysis section.
35	OCNMS	1/3/06	-p.5-42: the numbers for the Makah Bay project are not clearly compared with the Kaneohe Bay project. It appears that the Makah Bay project has potential to produce 4 times the electrical output than Kaneohe but the estimated average for Makah Bay will be 184 kW. What's the estimated average for Kaneohe? Is the Kaneohe cable transmitting AC or DC power? What is the relative difference in EMR produced by DC vs. AC transmission cables? Do we know anything about the range or distance from the cable over which impacts can occur? para. 3: this paragraph belongs somewhere else.	It is true that the Makah Bay project has potential to produce 4 times the electrical output than Kaneohe but the estimated average for Makah Bay will be 184 kW. The Kaneohe cable would transmit AC current. The transmission cable leading from the hub buoy to the shore station would transmit direct current (DC) power which does not create high levels of electro magnetic radiation (EMR) as compared to the transmission of AC power. While we do not know the range or distance form the cable over which impacts can occur (assuming that there are impacts), we have included several different discussions relating to what is known about EMR from transmission cables. For example, as discussed in the PDEA, the USACE has responded to magnetic field concerns for the proposed Cape Wind Energy Project. The USACE (2004) reported that "the actual magnitude of typical 60-Hz magnetic fields in the vicinity of the (proposed project) submarine cables is, in most locations, many fold below that of the steady geomagnetic field (~500 mG)" from the earth and the maximum exposure would occur over "...an extremely small space, and decrease rapidly within a few feet of such locations...". The USACE (2004) concluded that there were no anticipated adverse effects to fish species or the marine environment resulting from the 60-Hz magnetic fields that would result from the operation of the project.
36	OCNMS	1/3/06	-p.5-43 and 5-44: recommend stopping at minimal footprint and avoiding statements about improved fish habitat. Also, there are not separate "Our Analysis" sections for pinnipeds, sea otters,	AquaEnergy provided analysis of potential cable effects of the underwater transmission cable in addition to the buoy anchor area. As indicated in the PDEA, the

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			acoustic disturbance, etc. which would be best for consistency. Some documentation for the 150 db/l value suggested by WDFW is required and also real data for pile drivers for comparison. As presented, this is mostly a speculative analysis.	additional structure provided by the transmission cable may result in positive effects to the marine community by providing "structure to invertebrates and macro algae" which may in turn benefit other marine organisms.
				
				The Environmental Effects for the Aquatic Resources of the PDEA is organized as follows:
				
				Marine Mammals
				    Our Analysis
				        Cetaceans
				        Pinnipeds
				        Sea Otters
				Fish
				    Our Analysis
				Seabirds
				    Our Analysis
				Invertebrates
				    Our Analysis
				Marine Vegetation
				    Our Analysis
				
				Pile driving is a common activity in marine settings, WDFW has considerable experience associated with permitting these activities. Given their experience with this topic, AquaEnergy believes citing their statements during the June 2005 technical meeting as sufficient documentation of this statement. Also, given the associated discussion by WDFW and OCNMS at the meeting, AquaEnergy believes the depth of this discussion in the PDEA is appropriate for this type of activity, which has been practiced for many years.

37	OCNMS	1/3/06	-p.5-45: please mention what design features would prevent bird nesting or reference earlier report section that does this. An approximate size for each VLA would provide more information on the area impacted by their deployment.	A heavy-duty plastic conical attachment will be placed over the above-water portion of the buoy to prevent seabird roosting. The PDEA has been modified to incorporate this information.
38	OCNMS	1/3/06	-p.5-46: "all necessary preventative and responsive measures in	The HDD will be contracted to a qualified cable

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			case of frac-out" is quite subjective as to what may be necessary. You might benefit from more thorough discussion of what materials might be released to the water and their environmentally benign nature (including bentonite, if it is indeed benign), or note that nothing other than water or bentonite will be used unless agreed to by resource agencies. The meaning of the statement that "sand levels.. .ranged from 15 to 20 feet..." is not clear. Does this mean bottom depths have changed this much in sandy, nearshore areas. A different phrasing could clear this up. Until we know what the cable anchors will be, it's inappropriate to state they will enhance benthic habitat. Also, throughout it would be good to clarify that HDD (to 10 ft or 30 ft) to whatever depth is referenced to mean lower low water. A cable surfacing at 10ft depth at high tide off Hobuck Beach would be intertidal and would have severe stress and pull in waves (probably even at 10ft MLLW off Hobuck).	installation firm. Prior to the plant installation, agencies will be provided with an opportunity to review the proposed plan for the HDD by the cable installation contractor. AquaEnergy will clarify the referenced text in the PDEA to say sand levels on the bottom at fishing locations (crab pots) have changed from 15 to 20 feet and changes of this magnitude can be expected within sandy zones inshore of 70 feet in depth. AquaEnergy specified in the PDEA that while the area directly under the cable anchors my be affected by the project, the hard structure on the seabed that they will represent may serve to enhance aquatic habitat. WDFW reached similar conversations as indicated during the June 2005 technical meeting, when WDFW staff noted that project anchor cables may provide a new holdfast for kelp, rendering the project "partially self-mitigating". The PDEA has been modified to reference 10 to 30 ft depth from mean lower low water.
39	OCNMS	1/3/06	-p.5-48: here and throughout, benthic impacts of the cable anchors need to be mentioned, including as an unavoidable impact. As mentioned earlier, you should provide an option or two for cable anchoring to pre-empt concerns raised by the uncertainty of what this will entail on sandy vs. rocky bottom areas in terms of equipment, installation technique, numbers.	The final transmission cable design will be based on consultation with the contractor selected for this effort. Prior to plant installation, AquaEnergy will provide the final design to the agencies and allow them to comment.
40	OCNMS	1/3/06	-p.5-50: for clarity, you could mention that the species listed were identified during a site survey rather than a generic list from this habitat type, and comment that none of the species of state concern were found during the survey.	AquaEnergy has modified the PDEA to take into account this comment.
41	OCNMS	1/3/06	-p.5-52: mention the driveway in the Environmental Effects paragraph in addition to the Unavoidable Adverse Impacts section.	AquaEnergy has modified the PDEA to take into account this comment.
42	OCNMS	1/3/06	-p.5-54 onward: to support conclusions made in the	AquaEnergy has modified the PDEA to include this

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			environmental effects section, it would be valuable to mention frequency of occurrence for each species in the sanctuary or Makah Bay area.	information.
43	OCNMS	1/3/06	-p.5-60: also mention design features to prevent seabird nesting? This is not adequately described in the document. Decouple OCNMS/NMFS.	A heavy-duty plastic conical attachment will be placed over the above-water portion of the buoy to prevent seabird roosting. The PDEA has been modified to incorporate this information.
44	OCNMS	1/3/06	-p.5-62: restate reasons why murrelets not effected because comparison with gray whales not appropriate.	AquaEnergy has modified the PDEA to take into account this comment.
45	OCNMS	1/3/06	-p.5-60 onward: note that offshore plant is in Makah U&A as well as the Flattery Rocks or Washington Islands National Wildlife Refuge [mention of the Refuge is also missing other places throughout the document]. Consultation with tribal cultural resource specialist (?) rather than a biologist seems appropriate.	AquaEnergy has modified the PDEA so as to mention that the offshore plant is in the Makah U&A as well as the Flattery Rocks or Washington Islands National Wildlife Refuge. AquaEnergy is in consultation with the tribal cultural resource specialist; the PDEA has been corrected to state this.
46	OCNMS	1/3/06	-p.5-65: mention surfing, probably the most popular recreation in the waters of the bay. The most accurate name is probably the Washington Islands National Wildlife Refuge, which includes the Flattery Rocks NWR that includes Makah Bay.	AquaEnergy has modified the PDEA to take into account this comment.
47	OCNMS	1/3/06	-p.5-67: it is not accurate to say only tribal commercial fishers can operate in the project area. This is repeated on p. 5-71. Correct would be only tribal trawlers can operate in this area, but non-tribal salmon and other mid-water fisheries as well as those after crab, shrimp, and other things can work the area if they want. This should be confirmed through the Makah Fisheries Department and WDFW. It is unlikely that this is a preferred trawl area, which could be stated after it is confirmed by Makah Fisheries.	AquaEnergy contacted the Makah groundfish biologist in April 2006. He stated that non-tribal fixed gear and trawling is excluded within 3 miles of shore and that tribal fishermen would not be bottom trawling in the vicinity of the project buoys or transmission cable. Non-tribal recreational anglers and commercial crab and salmon (long line) fishermen can use waters in the project area. The Makah fisheries biologist stated that the fishery for pink shrimp are captured by bottom trawling and would not occur in the project area.
48	OCNMS	1/3/06	-p.5-70: under who's authority will fishing be "off limits"? This designation will likely require significant consultation and process with WDFW and the Makah Tribe, possibly NOAA Fisheries and the Pacific Fisheries Management Council, depending on the species and locations. Later on the page, you mention a restricted zone around the buoy field - again, under who's authority will this be restricted? For vessel traffic, you should list the sanctuary-promoted Area To Be Avoided	AquaEnergy will consult with WDFW, the Makah, NOAA, and other appropriate entities to evaluate the appropriateness and process for developing exclusion zones around the project buoys and transmission cable in order to minimize damage to the project, passing ships, and fishing gear. AquaEnergy incorporated information about the Area

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			(information is available on our web site) and the established vessel traffic lanes at the mouth of the Strait. These both direct larger vessels away from Makah Bay, but leave the area open to smaller vessels.	To Be Avoided in the PDEA.
49	OCNMS	1/3/06	-p.5-71: The buoys (surface floats as well as AquaBuOYs) should be posted in the USCG notice, and the surface buoys should have navigation lights if they are sizeable. Are there USCG regulations or consultations that will specify when lights are required?	AquaEnergy has modified the PDEA to take into account this comment.
50	OCNMS	1/3/06	-p.5- 72: the sanctuary is an important national (not statewide) resource, with aesthetics as a core quality. The area receives international visitation.	AquaEnergy has modified the PDEA to take into account this comment.
51	OCNMS	1/3/06	-p.5- 74: unless you are sure buoys will not be visible at all, it might be better to describe their visibility potential as small points on the horizon or similar minimal visibility.	We have modified the PDEA to state that buoys may be visible from a high cliff and that they may be visible as a small point on horizon when standing on the Hobuck.
52	OCNMS	1/3/06*	A couple of issues not included in the letter: the latitude and longitude for the project and the anticipated duration of the pilot project were not provided in the PDEA.	The latitude and longitude of the project is: 48º 19 min 53 sec N 124º 44 min 18 sec W AquaEnergy anticipates a 30-year license term for the project from FERC. OCNMS has indicated it would grant a permit for three years. This would result in one year for project construction and two years of operation. AquaEnergy plans to regularly renew the OCNMS permit over the term of the FERC license. This information has been incorporated in the PDEA.
53	OCNMS	1/5/06*	It would be appropriate to briefly acknowledge that some of the issues addressed in the PDEA would likely be more significant and require a more thorough analysis (i.e., impedance to marine mammal movements, exclusion of other activities from the area, navigational concerns, etc.) if a commercial scale project were proposed.	AquaEnergy has modified the PDEA to take into account this comment.
54	OCNMS	1/6/06*	Basically, we need clear justification for why the pilot project needs to occur within the sanctuary. You have provided essential criteria for project siting but did not clearly provide a	The PDEA has been modified to incorporate this discussion.

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			comparison of all these criteria for Grays Harbor. Also, at the June meeting you provided information for a site in Oregon, but did not include this in the PDEA. Northern California seems to have appropriate wave energy (from the data in the PDEA), but no sites from this area were included. So, I recommend at least two alternative sites and evaluation of all project siting criteria you list for each of the sites.	

*Email from OCNMS to AquaEnergy.

APPENDIX B

REVISED LIST OF COMPREHENSIVE PLANS, MARCH 2005

FEDERAL ENERGY REGULATORY COMMISSION
REVISED LIST OF COMPREHENSIVE PLANS
MARCH 2005
WASHINGTON STATE

- Bureau of Land Management. 1985. Spokane resource area management plan and final environmental impact statement. Department of the Interior, Spokane, Washington. August 1985. 202 pp.
- Forest Service. 1988. Colville National Forest land and resource management plan. Department of Agriculture, Colville, Washington.
- Forest Service. Undated. Decision Notice and Finding of No Significant Impact for the Inland native fish strategy. Department of Agriculture, Colville, Washington.
- Forest Service. 1989. Okanogan National Forest land and resource management plan. Department of Agriculture, Okanogan, Washington. 167 pp. and appendices.
- Forest Service. 1990. Mt. Baker-Snoqualmie National Forest land and resource management plan. Department of Agriculture, Seattle, Washington. June 1990. 396 pp. and appendices.
- Forest Service. 1990. Olympic National Forest land and resource management plan. Department of Agriculture, Olympia, Washington. July 1990. 232 pp. and appendices.
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- Interagency Committee for Outdoor Recreation. 1995. Voices of Washington. November 1995. 20 pp.
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- Mason County. 1997. Mason County Skokomish River comprehensive flood management plan. Shelton, Washington. February 1997.
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fisheries off the coasts of Washington, Oregon, and California commencing in 1978. Department of Commerce. March 1978. 157 pp.

- National Park Service. 1988. General management plan: North Cascades National Park, Ross Lake National Recreation Area, and Lake Chelan National Recreation Area. Department of the Interior, Sedro Woolley, Washington. June 29, 1988. 77 pp.
- Northwest Power Planning Council. 1984. Columbia River Basin fish and wildlife program. Portland, Oregon. October 1984. 138 pp., maps, and appendices.
- Northwest Power Planning Council. 1986. Northwest conservation and electric power plan. Portland, Oregon. Two volumes.
- Northwest Power Planning Council. 1987. Columbia River Basin fish and wildlife program. Portland, Oregon. February 1987. 246 pp.
- Northwest Power Planning Council. 1994 Columbia River Basin fish and wildlife program. Portland, Oregon. December 14, 1994. 409 pp. and appendices.
- Northwest Power Planning Council. 1988. Protected areas amendments and response to comments. Document 88-22. Portland, Oregon. September 14, 1988. 21 pp.
- Pacific Fishery Management Council. 1988. Eighth amendment to the fishery management plan for commercial and recreational salmon fisheries off the coasts of Washington, Oregon, and California commencing in 1978. Portland, Oregon.
- January 1988.
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