



# Study Plans for the Reedsport Wave Energy project

NOAA Fisheries  
Northwest Region  
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# 1. Study: Local Wave Environment

- **Justification:** Characterization of the wave environment is necessary to model array effects on wave height, period and energy. This information is also necessary to optimize the efficiency of the deployed equipment.
- **Existing Information:** Numerous NOAA buoys offshore Oregon record wave direction, amplitude and frequency/period.
- **Needed Information:** Wave amplitude and frequency/period measurements at the proposed site are needed over at least an annual cycle.
- **Proposed Study:** Applicant will deploy instrumentation to record wave amplitude, frequency/period and direction for a period of one year. Results would be compared to NOAA buoy output to determine the existing buoys' skill at predicting site conditions.
- **Methodology:** In situ buoy deployment with needed instrumentation.
- **Cost Factors:** Factors include cost of buoy deployment, recovery, data downloads and analysis.

## 2. Study: Ocean Currents

- **Justification:** Ocean currents, along with waves, drive the littoral transport system. Additionally, ocean currents act as the transport system for some biological properties and for any accidental spills. Information on currents, especially seasonal and episodic meteorological responses, will be needed to support transport models.
- **Existing Information:** Information about Oregon's ocean currents is general. There have been some high resolution studies of waves and currents on the central Oregon coast, but none are presently known for the project site.
- **Needed Information:** Surface currents at the project site need to be documented, especially with respect to seasonal and meteorological cycles/episodes.
- **Proposed Study:** Applicant will characterize ocean currents in the vicinity of the littoral sub-cell (and larger cell, if necessary).
- **Methodology:** One option is to deploy current meters (acoustic Doppler current profilers or ADCPs) at the site for a year; the other may be to deploy high-resolution radar at the site to study both waves and currents.
- **Cost Factors:** Cost factors depend on method, but current meters will require at-sea deployment and recovery; radar methodology will be deployed from shore. Both require sophisticated data analysis. This may be a good area for partnering with Oregon State University.

# 3. Study: Local Littoral Transport

- **Justification:** A wave energy park will likely modify both the wave energy and the ocean currents. Models used to predict effects on the littoral transport cell will require information on local littoral processes, especially areas likely to develop erosive or depositional environments.
- **Existing Information:** Existing information describes each littoral cell. There is no existing site-specific information.
- **Needed Information:** This Study might be addressed, in part, with a high-resolution HF study of the local waves and currents, before and after the array deployment. Oregon State University's College of Oceanic and Atmospheric Sciences (COAS) has this capability in-house.
- **Proposed Study:** Modeling.
- **Methodology:** Wave and current data from other studies can be assimilated in the appropriate model(s).

## 4. Study: Bathymetry and Surficial Geology

- **Justification:** Deployment of anchoring systems will require a high resolution profiling of the sediment layer and sub-bottom (i.e., underlying hard substrate or basement) to assure adequate sediment depth. Any cultural resources (i.e., shipwrecks) will also need to be identified, if present.
- **Existing Information:** Existing information is very coarse in spatial resolution. There is general bathymetry and bottom type information to support the hypothesis that the site is fine sand throughout.
- **Needed Information:** The water depth and sediment depth and type need to be documented with appropriate resolution over the entire site.
- **Proposed Study:** Acoustic sub-bottom profiling and depth sonar can be combined in a single survey of the site. Side-scan sonar can be used to estimate sediment type from reflectivity. Sediment samples will be needed to ground truth the side-scan sonar results; they will be provided by the next study
- Study. The applicant will provide
- **Methodology:** High -resolution acoustic sub-bottom profiling, bathymetry and side-scan sonar surveys.
- **Cost Factors:** It may be possible and desirable to conduct this study concurrently with the characterization of background EMF with a magnetometer.

## 5. Study: Physical Characterization of Benthic Habitat

- **Justification:** The grain size, homogeneity, and amount of organic material in the sediment are prime determinants of habitat for the biota. These characteristics are likely to change as energy is removed from the wave train and deposition of finer sediments is possible. Additionally, more organics may be supplied by the higher density of organisms inhabiting the hard substrates.
- **Existing Information:** As in other cases, data of this type exist, but they are quite coarse in spatial resolution, and none are known at the site. Recent data collected by EPA's EMAP program (2003) gives a general idea of sediment characteristics at similar depths on the shelf.
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide characterizations of the grain size, homogeneity, and amount of organic material in the native sediment.
- **Methodology:** Any common grab device, including corer, Van Veen, Shipek, Smith-Macintyre will suffice. A larger piece of gear will also provide enough sample for characterization of the Infauna as well. Suggested transects: one transect along the 50m isobath (center of deployment); and three transects normal to 50m isobath, at both ends and center of deployment.
- **Cost Factors:** These samples can be used to ground truth the reflectivity information from the side-scan sonar survey.

## 6. Study: Characterization of Benthic Infauna

- **Justification:** The benthic Infauna are in large part the basis of the demersal food web. Changes in the physical benthic habitat will likely lead to changes in the infauna.
- **Existing Information:** Recent data collected by EPA's EMAP program (2003) gives a general idea of benthic infaunal characteristics at similar depths on the shelf.
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide identification and enumeration of adequate sediment samples to characterize the study area; this should include some analysis of the meiofauna (usually passes through a 1.0 mm sieve).
- **Methodology:** Grab sampler such as box corer, Van Veen, Smith-Macintyre, with enough area/volume to yield statistically relevant sample sizes. A random stratified sample plan may be appropriate for this study. Possible transects: one transect along the 50m isobath (center of deployment); and three transects normal to 50m isobath, at both ends and center of (14 or 200) buoy deployment.

## 7. Study: Characterization of Epibenthic Macrofauna

- **Justification:** The benthic epifauna are a large part the basis of the demersal food web. Changes in the physical benthic habitat and infauna will likely lead to changes in the epifauna.
- **Existing Information:** Recent data collected by EPA's EMAP program (2003) gives a general idea of epibenthic macrofaunal characteristics at similar depths on the shelf.
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide
- **Methodology:** Bottom trawl such as try-net, otter trawl or beam trawl. The trawl should dig into the sediment enough to assure capture of Pacific Sandlance, or they should be sampled by other means. An ROV survey might complement the trawl data.

## 8. Study: Characterization of Pelagic Nekton

- **Justification:** The pelagic nekton (swimming fish and invertebrates inhabiting the water column) are expected to change in distribution and abundance due to project effects, especially the provision of physical structure in historically open water.
- **Existing Information:** The resident nektonic biota of Oregon are well known, though there were apparently northward range extensions of some warmer water species during the 1996 El Niño (e.g., blue marlin, chub mackerel).
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide
- **Methodology:** Mid-water trawl and purse seine; other capture or census methods as applicable.

## 9. Study: Characterization of Key Forage Plankton (Euphausiids and Mysids)\*

- **Justification:** Vertically migrating species of relatively large planktonic crustaceans (especially euphausiids, and in some cases mysids) form an important source of food for many key groups, including fish, seabirds and whales. The creation of a wave energy park in previously open water will likely have some effect on the availability of this group as forage in the water column. Measurements of presence/absence of forage plankton can provide an indication of change in the area/system while species composition measurements can provide an indication of predators likely present.
- **Existing Information:** There is general information on the distribution and abundance of euphausiids and Mysids on the Oregon continental shelf. NOAA's triennial (now biennial) West Coast groundfish surveys have traditionally collected acoustics data on the "deep scattering layer".
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide
- **Methodology:** Tucker Trawl or large zooplankton net (50 cm or larger opening). This approach could be augmented by using acoustic surveys with appropriate ground truthing.

# 10. Study: Site Use by/Presence of Salmonids (Smolts and Spawners)\*

- **Justification:** Wild salmonid stocks in the Pacific Northwest are largely diminished, and many evolutionarily significant units (ESUs) are under ESA protection. Hence, any predicted salmon takings by the project will come under great scrutiny. Since this project lies just north and west of the Umpqua River, any outmigrating wild stocks will be of special interest.
- **Existing Information:** General information exists on the ocean ecology of Pacific salmon, including general paths of migration of smolts and spawners.
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide
- **Methodology:** ESA species are a problem, as takings are kept to an absolute minimum. Hence, the study should use any tools available that do not injure fish, smolts or spawners.

# 11. Study: Characterization of Background Electrical and Magnetic Fields

- **Justification:** Any electromagnetic fields emanating from the buoys and transmission system will be superimposed on the background of the earth's magnetic field and induced electrical field generated by the seawater flowing through it. Animals with the EMF sensory capability use it to sense animal motion within the context of this dynamic background.
- **Existing Information:** There may be enough general information applicable to the site to obviate the need for data collection as a baseline.
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide
- **Methodology:** Magnetometer survey, if needed.
- **Cost Factors:** It may be possible to conduct the geophysical (acoustic and EMF) surveys together. The magnetometer may also help to find any more recent shipwrecks that would be of either cultural interest or a possible source of toxic chemicals.

## 12. Study: Characterization of Acoustic Background

- **Justification:** Any sound emanating from the buoys and transmission system will be superimposed on the background of the ambient sound field generated by wind and waves, animals and man's activities. Animals with the acoustic sensory capability use it within the context of this background noise.
- **Existing Information:**
- **Needed Information:** Need site-specific information.
- **Proposed Study:**
- **Methodology:** In situ hydrophone deployment.

# 13. Study: Site Use by/Presence of Seabirds

- **Justification:** Use of the site by the various groups of seabirds needs to be documented prior to buoy deployment, in order to provide a baseline for effects evaluation. Seabird use is expected to be strongly seasonal. This study will need a control site and will need to be of multi-year duration.
- **Existing Information:**
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide seabird surveys, performed at appropriate time and space scales.

## 14. Study: Site Use by/Presence of Cetaceans

- **Justification:** Use of the site by cetaceans needs to be documented prior to buoy deployment, in order to provide a baseline for effects evaluation. Cetacean use is expected to be strongly seasonal, especially the spring and fall migrations of gray whale. This study will need a control site and will also need to be of multi-year duration.
- **Existing Information:** There is general information on cetacean distribution and abundance on the Oregon Shelf.
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide

## 15. Study: Site Use by/Presence of Pinnipeds

- **Justification:** Use of the site by the various species of seals and sea lions needs to be documented prior to buoy deployment, in order to provide a baseline for effects evaluation. Pinniped use is expected to be strongly seasonal. This study will need a control site and will need to be of multi-year duration.
- **Existing Information:**
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will provide

# 16. Study: Neuston Survey/Presence of Invasive Species

- **Justification:** There is concern that providing hard substrates in an open-water environment may have consequences in the distribution of invasive species. There is also concern that the deployment of many structures in previously open water could affect the recruitment of meroplankton, especially if those surfaces are coated with toxic compounds.
- **Existing Information:** There are general neuston surveys related to numerous projects on the Oregon Shelf (e.g., Rumrill work on *McArthur* offshore Coos Bay). Marine invasive species surveys are not known at this time.
- **Needed Information:** Need site-specific information.
- **Proposed Study:** Applicant will conduct a meroplankton survey or deploy settling plates during peak recruitment period (late spring through early summer?).

# 17. Study: Presence of Toxic Chemicals in Water Column and Sediment

- **Justification:** The applicant will want to make sure that the sediment at the site is devoid of any prior chemical contamination prior to its activities. This study will need a control site and will need to be of multi-year duration for later effects evaluation.
- **Existing Information:** Recent data collected by EPA's EMAP program (2003) gives a general idea of the relative rarity of sediment toxicity at similar depths on the shelf, based on a random stratified sampling scheme of 50 stations between 20 and 120 m water depth on the Oregon shelf. Water column values are generally known.
- **Needed Information:** Characterization of sediment chemistry for EPA priority pollutants, including organics and metals; also documentation of water column values of metals.
- **Proposed Study:** Applicant will provide

# 18. Study: Background Turbidity

- **Justification:** Turbidity is one of the water quality standards likely to be applicable to this activity in both the deployment and operational stages. Turbidity is a major factor in the effectiveness of visual predation, or conversely, prey escape.
- **Existing Information:**
- **Needed Information:** The near-bottom turbidity at the site needs to be documented prior to deployment.
- **Proposed Study:** Applicant will provide
- **Methodology:** In situ transmissiometer or nephelometer deployment. This could be deployed along with an ADCP string.

# 19. Study: Beach Gradient Profile

- **Justification:** Beach gradient (depth with distance from shore) is a key expression and characteristic of the littoral system, and also a critical factor in defining tsunami run-up risk.
- **Existing Information:** Some Oregon beaches (mainly north end) have recently been profiled by the Oregon Department of Geology and Mineral Industries (DOGAMI).
- **Needed Information:** Profiles of beaches in project vicinity.
- **Proposed Study:** The applicant will provide profiling of beaches onshore of project area.

## 20. Study: Survey of Nontoxic Water Quality Parameters

- **Justification:** Applicant will likely want to document existing values of classical water quality parameters at site prior to project implementation; this also may be a requirement for ODEQ's Clean Water Act § 401 certification.
- **Existing Information:** General information exists for salinity, temperature, pH, dissolved oxygen concentration, and other water column parameters on the Oregon shelf. There is a long history at the so-called *Newport Line*, along which these types have been collected since the 1960s.
- **Needed Information:** Seasonal documentation of water quality parameters at the site. It may be possible to argue that no project influence will ever be expressed on these largely advectively controlled parameters, but they may be required for certification under the Clean Water Act.
- **Proposed Study:**
- **Methodology:** *In situ* sensor deployment; water samples from bottles if necessary.
- **Cost Factors:** It may make sense to combine any turbidity sampling using an *in situ* transmissiometer or nephelometer with the water column survey; it can likely be deployed on the same instrument.

# **Adaptive Management: Key Characteristics**

- **Cannot meet mandates to assess impacts without more information**
- **Studies are designed to obtain baseline; monitoring for effects**
- **Management decisions are left to future adaptive management team**
- **Agencies continue to retain authorities**