Acoustic Effects of Tidal Energy: Research Plan

March 17, 2010

Snohomish Public Utility District

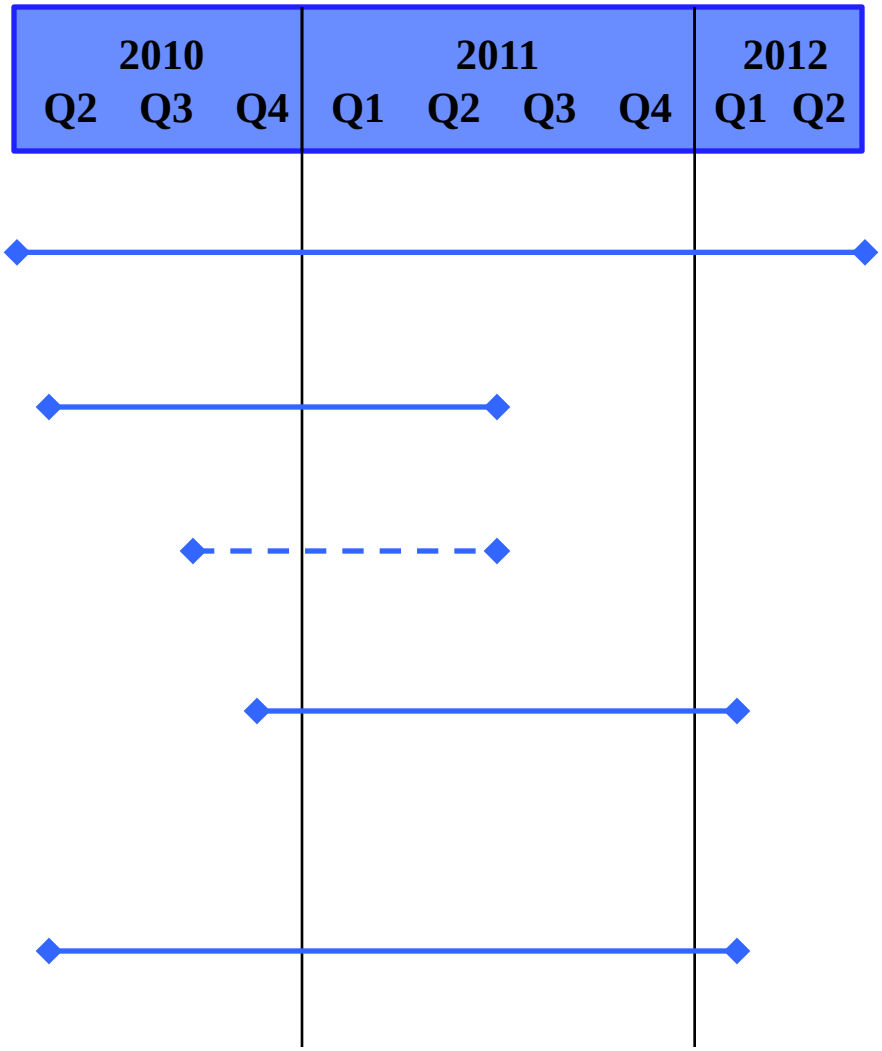
University of Washington NNMREC

Sea Mammal Research Unit, Ltd.

Pacific Northwest National Laboratory

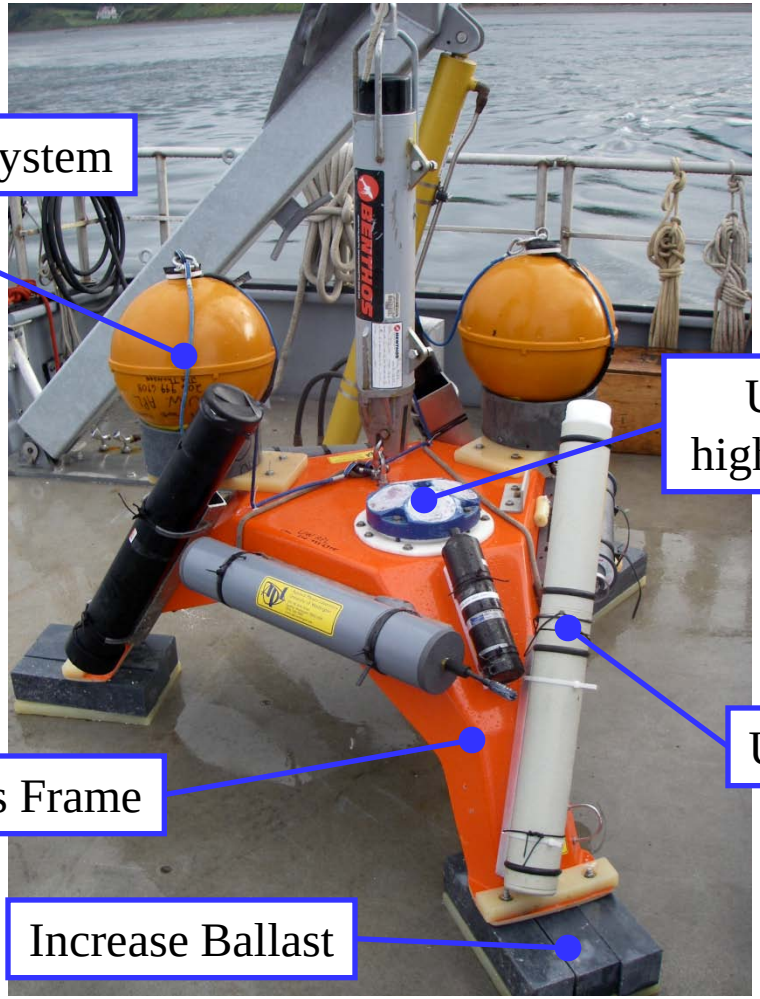
Tasks and Partners

Task	Task Lead
Project Management	Snohomish County PUD
I. Site Monitoring	UW
II. Turbine Noise Simulation	UW
III. Interpretation of Marine Mammal Behavior	SMRU
IV. Effects of Noise on Aquatic Species	Pacific Northwest National Laboratory



Instrumentation Tripod v. 2

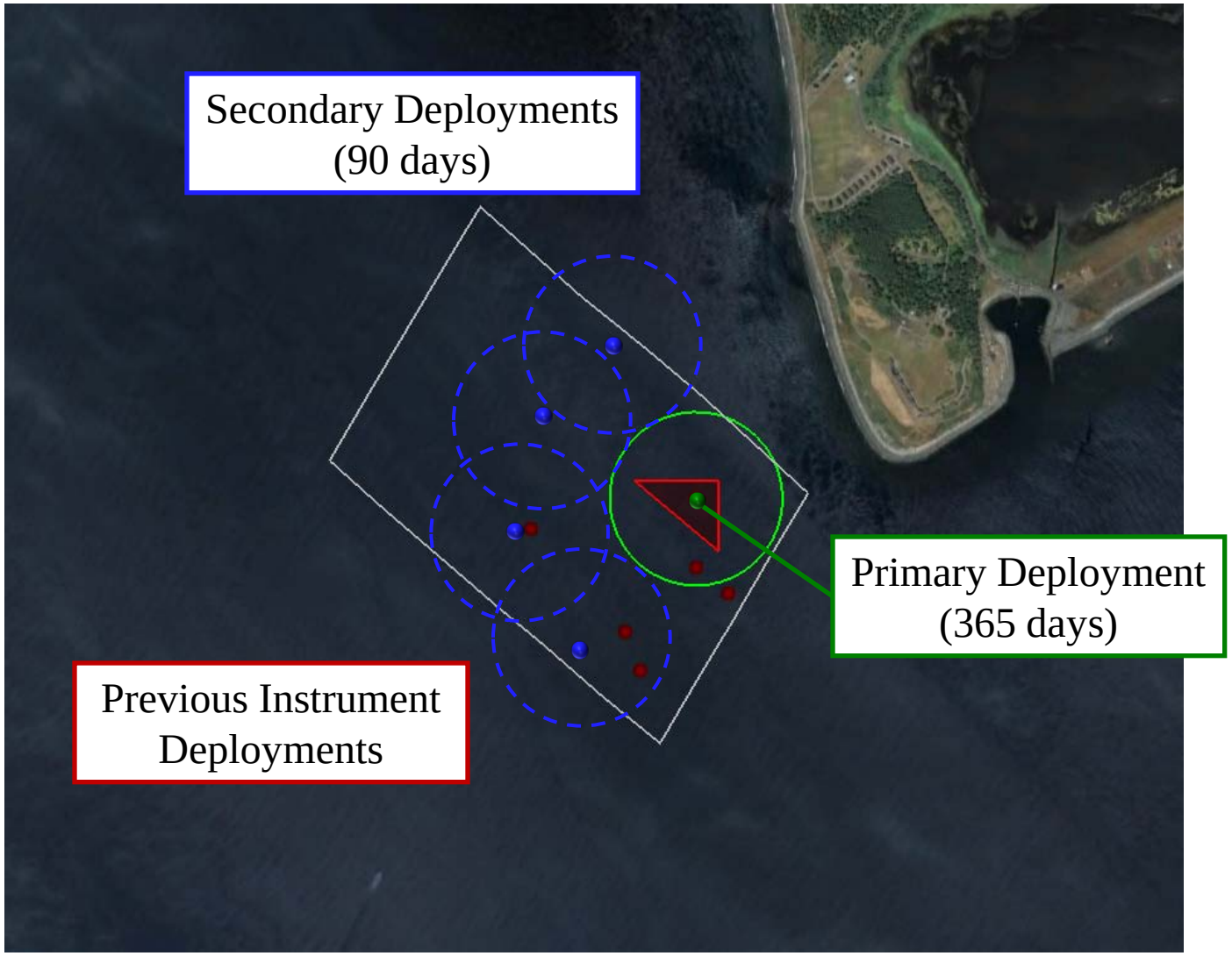
Task 1



Programmed for 3 month deployments

Data Collection Plan

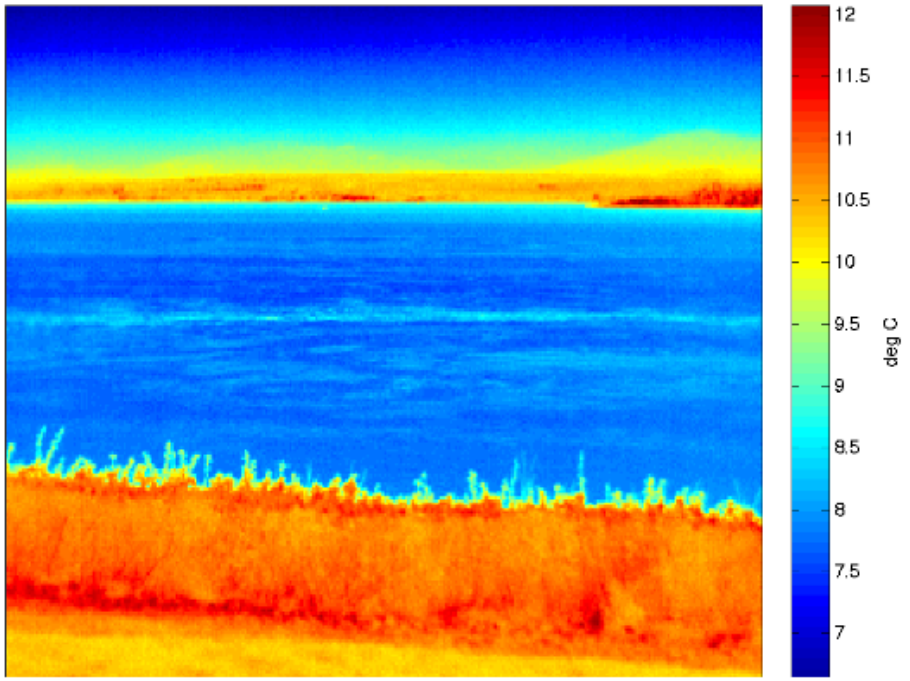
Task 1



Infrared Camera

Task 1

Assess potential to detect marine mammals on surface

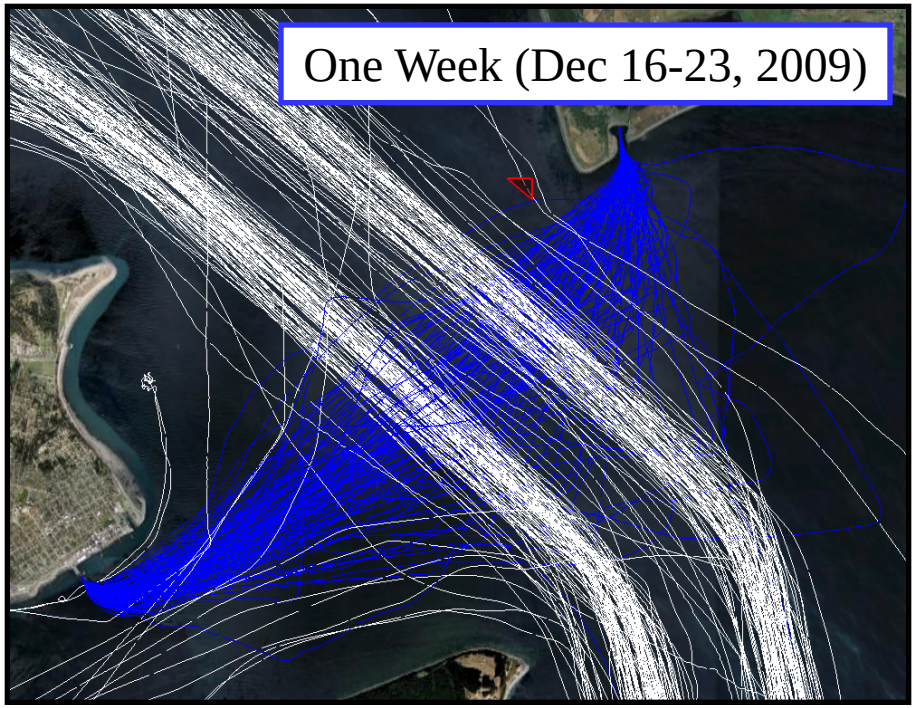


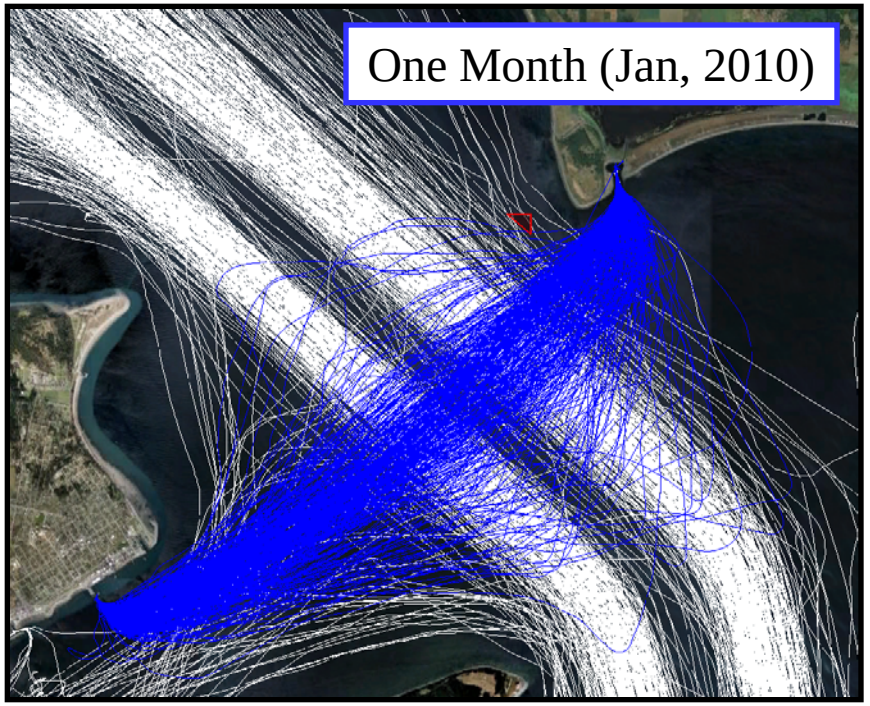
Install on Admiralty Head lighthouse – moderate field of view

Automatic Information System

Task 1

Understand contribution of ship traffic to ambient noise





Installed on Admiralty Head lighthouse

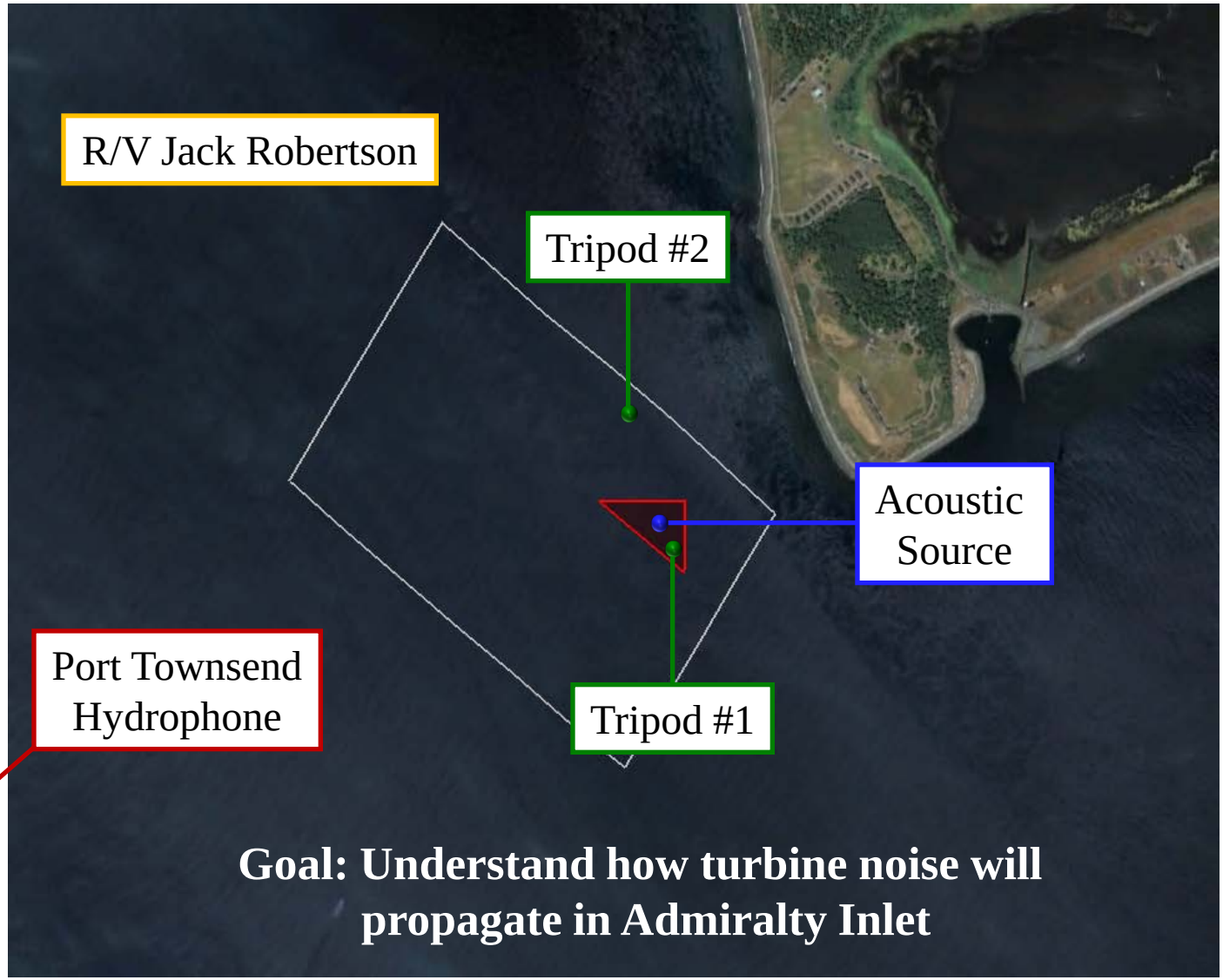
Task Outcomes

Task 1

- **Characterize sources of background noise**
  - Shipping traffic
  - Ferry traffic
  - Wind and waves (sea state)
  - Rainfall
  - Flow over rough bathymetry
- **Collect data describing physical environment**
- **Collect data describing biological environment**

Turbine Noise Simulation

Task 2



Test Plan

Task 2

Timing

- August, 2010 (pending)
- May, 2011 (pending)

Duration

- Four total experiments
- 2 hours playback each experiment

Source

- Recordings from OpenHydro turbine in Bay of Fundy
- Anticipate ~160 dB re 1µPa - broadband

Marine Mammal Safeguards

Task 2

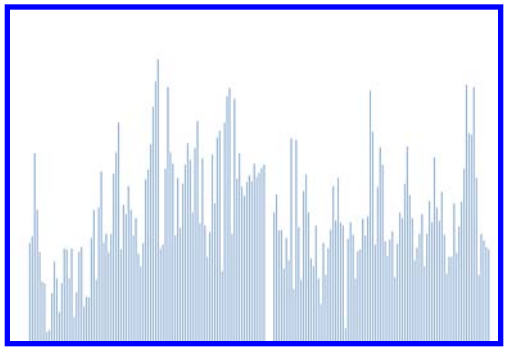
- **Southern Resident Killer Whales**
  - Schedule tests during May and August, when usage of Admiralty Inlet is at annual minimum
  - Do not conduct test if SRKW are present (verify by OrcaNetwork hydrophone and observers)
  - Ramp up turbine source to maximum intensity
- **Harbor porpoises and seals**
  - Observe behavior during test
  - Monitor echolocation activity with CPod
- **Pursuing Incidental Harassment Authorization from NMFS**

Marine Mammals: Interpreted Presence and Behavior

Task 3

- **Echolocations from CPods (primarily harbor porpoise)**
  - Assess correlations with time of day, season, and tidal state

- **Synthesize data from multiple sources to interpret marine mammal presence and behavior**
  - Click trains from CPods
  - Vocalizations from recording hydrophones
  - Land-based marine mammal observers
  - Infrared camera images



Effect of Noise on Aquatic Species

Task 4

1. **Estimate acoustic "dose" for OpenHydro turbine**
   - Measurements from EMEC and Bay of Fundy
   - Sound propagation study from Admiralty Inlet (ideally)
2. **Expose juvenile Chinook salmon to "dose" in laboratory environment**
   - Model species
3. **Evaluate response to dose**
   - Hearing threshold shift
   - Necropsy for barotrauma