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January 23, 2006

Chris Blondeau
Seafront Coordinator
Pearson College
650 Pearson College Drive
Victoria, BC V9C 4H7

Dear Mr. Blondeau,

RE: Second Interim Report : Environmental Monitoring at Race Rocks Ecological Reserve related to the Pearson College – Encana - Clean Current Tidal Power Demonstration Project at Race Rocks

This report summarizes the environmental monitoring tasks completed August 1 to January 13, 2006 related to the Tidal Demonstration Project at Race Rocks Ecological Reserve. These tasks included a) three site visits (Oct.-Nov., 2005) to document biotic features along the cable route (subtidal portion) and at the turbine site prior to construction and, b) preparation and remote monitoring (via Race Rocks web linked cameras) of the marine construction phase between December 2005 and January 13, 2006. Direct communication with yourself (primarily) and Garry Fletcher (regarding video imagery and some species ID) was maintained throughout this phase of the monitoring period, as well as with the drilling company (Robin Pederson – Construction Drilling Inc.) prior to the onset of marine construction. Observations of the upland construction activity between the boathouse and the battery room were made during the last site visit in November.

Towed Underwater Video and Dive Survey

Methodology

The documentation of species and community assemblages along the cable route and at the turbine site prior to the sub-marine construction phase was completed using a combination of towed underwater video (SIMS-Subtidal Imagery and Mapping System) and diving. The majority of the cable route was surveyed using SIMS (375m of a total 450m or 83%) with the exception of the area of dense bull kelp (*Nereocystis leutkeana*) east of middle rocks (Figure 1). Video imagery was collected using both methodologies, with SIMS imagery geo-referenced using an onboard dGPS at a fix rate of one data point per second.

The SIMS survey was conducted October 6, 2005 over a 2hr period around the afternoon slack tide. Water depths ranged from 2mCD at the jetty (Photo A) to 19.8mCD at the turbine site. Boat tow speed was approximately 1knot, however the current did influence the speed at both ends of the slack window. Depth of the towfish above the seabed ranged between 0.5m and 1.5m (with the exception of the occasional entanglement with bull kelp) with most of the imagery collected at 1.0m above the bottom. The depth of the towfish (relative to CD) and trackline location data (UTM northing and easting, Zone 10) was burned on the imagery. Two copies of the SIMS imagery (burned on DVD) were provided to Pearson College.

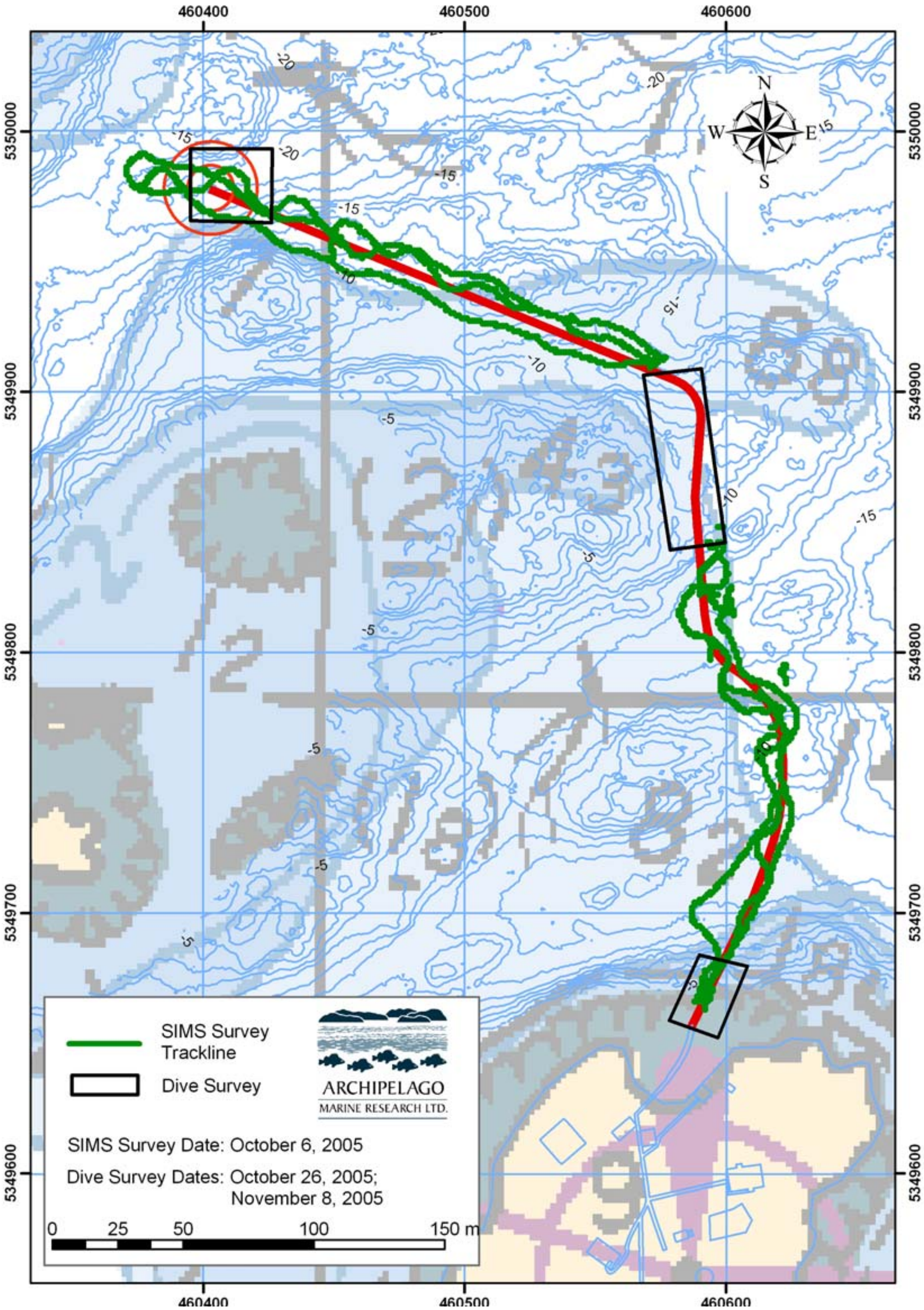


Figure 1. Towed underwater video and dive survey locations along the proposed cable route and at the turbine site.

Following the collection and review of the SIMS imagery, three dives were conducted in the following locations:

1. The turbine site: on October 26, 2005, four divers (two from Archipelago and one student and one instructor from Pearson), using a float and small anchor block marking the location of the turbine (at 19.8mCD), collected information on the invertebrate, algal and fish community within an approximate 25x25m area at the turbine site (see Figure 1). Archipelago compiled a list of species and collected video imagery while the Pearson divers collected video imagery and specimens. Sea lions were present throughout the dive and on occasion, "nibbled" on the student divers fins and video camera.
2. The northeast end of middle rocks: on the same day as the turbine dive (Oct. 26, 2005), two divers from Archipelago collected species information and video imagery along the 75m portion of the cable route (12.5m to 9.5mCD, north to south) that was not filmed using the towed underwater system. At the same time, several divers from Pearson examined an alternative route along the north edge of the bedrock. Sea lions were also present during this dive and had minor interactions with Pearson divers (as above).
3. The jetty: on November 8, 2005, species information was collected from the base of the concrete encasement alongside the western edge of the jetty to the end of the bull kelp (+0.2m to 6.8mCD depth). While the SIMS imagery provided very good spatial coverage of the canopy forming kelps (*N. leutkeana* and *Pterygophora*) and megafauna (including sea urchins, anemones, fish, demosponges, hydroids) the focus of this dive was to document the understory species (in particular Northern abalone, which have been documented in this area previously) obscured by dense vegetation in the shallowest portion of the cable route.

Video imagery collected during all three dives was provided to Pearson College in DVD format. All dive work required to document the biotic community along the cable route and at the turbine site prior to construction was completed using the Pearson vessel Second Nature as a dive platform. Efforts were made to combine the environmental monitoring tasks with other tidal turbine work conducted by Pearson staff and students. Fieldwork was completed in an atmosphere of mutual learning, professionalism and attention to high safety standards.

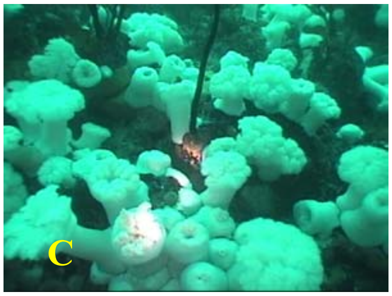
On October 17, prior to the dive work, a brief conference call between Clean Current (Russell Stothers, Turbine Project Manager), Encana (David Lye, Team Leader Environmental Health and Safety Coordinator), Pearson College (yourself and Garry Fletcher, Ecological Reserve Warden) and myself was held. The purpose was to review environmental aspects of the project to date and discuss any concerns related to the upcoming construction activity planned for November. There were no major environmental issues identified.

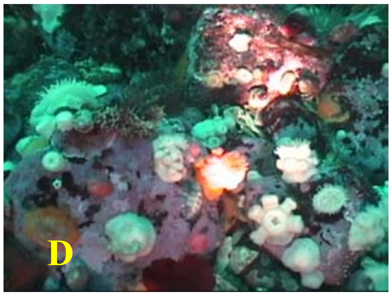
Biotic Features

General

A preliminary list of flora and fauna observed during both the SIMS and dive survey is provided in Appendix Table 1. No soft corals, Northern abalone (listed as Threatened under SARA) or other rare or endangered marine invertebrates, fish or vegetation were noted. Although abalone have been documented in the vicinity of the jetty where suitable habitat exists (particularly to the immediate northeast), none were observed during the dive survey. Dominant invertebrate species observed include sea urchins (primarily *Strongylocentrotus*

franciscanus, Photo B), anemones (*Metridium giganteum,* Photo C, brooding and other anemones, Photo D), demosponges (various encrusting and erect species including *Isodictya* sp., Photo E), hydroids (including erect and encrusting hydrocoral), and ascidians (including the lobed compound ascidian *Cystodytes lobatus*, Photo F). There are large urchin barrens at depths greater than 8mCD between the jetty and middle rocks. Fish species observed along the proposed cable route include kelp greenlings (both male and female), lingcod and rockfish (Quillback and copper) with kelp greenlings most abundantly noted.





Generally, the substrate along the cable route between middle rock and the turbine site is dominated by gravel (cobble and boulder predominantly, limited shell hash and pebble) and bedrock/outcrops. More bedrock outcrops, with pockets of shell hash and fewer boulders on bedrock, characterize the cable route between middle rocks and the jetty. The predominantly hard bottom provides substrate for diverse marine vegetation, which includes the bladed kelps *Laminaria* spp., (*Laminaria saccharina/bondgardiana* in the shallow subtidal zone *Laminaria setchelli* >12m depth, Photo G), *Costaria costata* (dominant between 10-12mCD range), *Cymathere triplicata*, and *Pleurophycus gardneri*. *Pterygophora* (Photo H) and *Nereocystis* are the dominant canopy kelps at depths less than 9m in the vicinity of the jetty. Foliose and filamentous red alga is present at all depth ranges.

It is important to note that vegetation typically dies back in the winter months, usually between late October and February. As a result, identification of some species can be problematic (e.g. stipes only), and density or seabed cover will be less than during the spring and summer months. Seasonal variability becomes important when comparing pre and post construction video. Urchin grazing can also greatly affect vegetation density (creation of urchin “barrens” on one extreme) and often it is difficult to determine whether a short woody stipe is the result of urchin grazing or winter (perennial/annual growing cycle, storms) die back.

Upland Construction

Construction of the cable pathway between the boathouse and engine room commenced in early November. A discussion with the construction foreman (Roma Construction) took place enroute to the dive site November 8, 2005, and included a review of the work schedule (activity and timing). Photos and observations of the upland construction were undertaken following the completion of the dive in the shallow subtidal zone north of the jetty.

Although a large portion of the area along the sidewalk was fertile soil, it was anticipated that there would be a need to break up some concrete and bedrock immediately beside the sidewalk to accommodate the cables. Photo I shows the construction path immediately west of the sidewalk, while Photos J and K show close views of the bedrock and concrete demolition areas. Most of the concrete that was demolished alongside the sidewalk was placed back into the fill area while some will be hauled away with other constructions spoils.

Observations on bird behaviour (gulls and cormorants) in the vicinity of the construction work were completed over a 45-minute period on November 8, 2005. Observations were made prior to, during (Photo L), and after jackhammer activity. There appeared to be little to no adverse effect on bird behaviour in that individuals and/or groups did not take flight immediately after work with the jackhammer started. Photo M shows both gulls and cormorants perched on the rock (immediately east of the construction area) during the onset of jackhammer use. A smaller, quieter and more mobile jackhammer than the one used for demolition work at the engine room, was employed.

Marine Construction

Pile Construction – November 2005

Prior to the onset of pile construction at the turbine site scheduled to start mid November, direct contact with the drilling company (Robin Pederson – Construction Drilling Inc.) was made to discuss details of planned construction methodology. It was confirmed that oil/chemical spill response kits (with extra booms and padding) would be provided by the barge company (Fraser River Pile and Dredge). A description of the vegetable based drill oil (Matex R.D.O. 302 E.S.) and MSDS information was provided along with the MSDS information for the Terresolve hydraulic oil (EnviroLogic 146).

Components of proposed construction activity included:

- positioning the drill platform (barge) at the turbine site through the use of six anchor blocks (from surface),
- cleaning the overburden (boulder/cobble) in an approximate 2m x 2m area to locate the underlying bedrock (by diver),
- bolting a metal template to the bedrock (by diver) to guide the drill casing,
- lowering the casing to interface with the bedrock (mostly from surface), and,
- drilling (from surface).

It was anticipated that an approximate volume of $5m^3$ of drill cuttings would be air lifted to the surface into a cyclone, which is used to separate the water from the cuttings. The drill cuttings would then be taken off site for disposal while the drill effluent (water and fines, see below) would be discharged on site. Although considered a closed system, it was anticipated that

- approximately $0.5m^3$ of fine material (powder and fines < 1mm diameter) may still be present in the drilling effluent (discharged either from the surface or 6m depth, to be determined).
- the seal between the casing and bedrock would not be perfect, and as a result, approximately $0.5m^3$ of drill cuttings (estimated to be in the size range of ¾" – to 1" in diameter) may be deposited around the base of the drill casing.

Environmental concerns associated with drill cutting escape and fines in the discharge plume are direct smothering of benthic marine organisms in a localized area and dispersion of fine sediments causing direct smothering of marine organisms and/or increased turbidity in the water column. Given the volume of predicted fines in the drill effluent and the strong currents and mixing that occurs at Race Rocks, suspension of fine material in the water column will be short term (one tidal cycle) and will not result in any significant accumulation of material on the seabed. Appendix 2 provides an estimate on dispersion rates based on reasonable assumptions of the operation and physical conditions of the site.

Although there will be direct impacts to benthic organisms in the immediate area of the drill site, all efforts are being made to minimize these impacts. The purpose of monitoring the seabed prior to construction is to be able to assess impacts post construction. It is anticipated that impacts will be localized (between 2-3m around the turbine site) and that re-colonization of benthic organisms will occur and will be monitored by Pearson College over at least a 5-year period.

On November 29, 2005, the barge and drill rig were on site to start with the pile construction (Photo N). Planned monitoring activity included observations on i) marine mammal and bird behaviour, ii) construction equipment positioning and, iii) dispersion of the drill effluent plume. LGL's report on marine mammal and bird behaviour and disturbances at Race Rocks (Demarchi and Bentley 2004) was reviewed and the marine mammal observer (Rhonda Reidy, Archipelago) was prepped and ready to deploy.


N

Due to weather and associated safety concerns, a decision was made to postpone construction activity until January 2006.

Template Installation – January 2006
Between January 10 – 13, 2006, divers from Can-Pac, supported by Pearson College and a local tug (Blue Water Contracting, Photo O) attempted to install the drill template. Due to a thick layer of overburden material (<1m), the template was not successfully installed and the work crew left the site.


O

<u>Work to be Completed</u>
Drilling activity is planned to resume in the next few weeks. The drill company will proceed without the use of a diver positioned template. Direct contact with the drill operator needs to be made in order to review estimated volume of drill cutting escape given drilling will now occur through the boulder/cobble overlay. Further environmental monitoring will include i) marine mammal and effluent discharge observations during drilling and cable laying activity and, ii) a post construction dive inspection immediately following drilling activity (24 – 48 hours) in order to assess impacts.

Please let me know if you require any further detail for this second interim report.

Sincerely,

Pam Thuringer, M.Sc., R.P. Bio.
Project Biologist
Archipelago Marine Research Ltd.

Appendix Table 1. Preliminary list of invertebrate, algal and fish species observed along the proposed cable route and turbine site. The list was compiled from observations made in the subtidal zone (0.0mCD to 19.8mCD) in October and November, 2005.

Invertebrates

Scientific Name	**Common Name**
Sea Stars	
Crossaster papposus	Rose star
Evasterias troschelli	Mottled star
Stylasterias forreri	Long-rayed star
Henricia sp.	
Pycnopodia helianthoides	Sunflower star
Solaster stimpsoni	Striped sun star
Orthasterias koehleri	Rainbow star
Dermasterias imbricata	Leather star
Sea Urchins	
Strongylocentrotus franciscanus	Red sea urchin
Strongylocentrotus droebachiensis	Green sea urchin
Sea Cucumbers	
Psolus chitonoides	Creeping pedal sea cucumber
Cucumaria miniata	Orange sea cucumber
Brittle Stars	
Ophiura sp. (likely *lutkeni* , arms only)	Brittle star
Anemones, Cup corals, Zoanthids	
Metridium giganteum	Giant plumose anemone
Metridium senile	Short plumose anemone
Epiactus sp.	Brooding anemone
Urticina crassicornis	Painted anemone
Urticina sp.	Anemone
Cribrinopsis fernaldi	Crimson anemone
Unidentified anemone	
Balanophyllia elegans	Orange cup coral
Sponges	
Encrusting/erect demosponges including:	
Isodictya sp.	Erect sponge
Myxilla lacunosa	Sulphur sponge
Unknown encrusting red spnge	Red sponge
Hydroids including:	
Plumularia spp.	Glassy plume hydroids
Abietinaria spp.	hydroid
Aglaophenia spp.	hydroid
Ectopleura (*Tubularia*)	hydroid
Thuiaria spp.	Sea fir hydroid

Invertebrates

Scientific Name	**Common Name**
Hydrocorals (erect/encrusting) including:	
Stylantheca (Allopora) spp.	hydrocoral
Stylaster spp.	hydrocoral
Ascidians	
Cystodytes lobatus	Lobed compound tunicate
Metandrocarpa taylori	Orange social ascidian
Unidentified compound and solitary ascidians	Unidentified compound and solitary ascidians
Bryozoans including:	
Heteropora sp.	Staghorn bryozoan
Membranipora sp.	Encrusting bryozoan (on *Desmarestia*)
Snail, Limpet, Nudibranch	
Acmaea mutra	Whitecap limpet
Diodora aspera	Keyhole limpet
Fusitriton oregonensis	Oregon Triton
Calliostoma sp. (likely *ligatum)*	Topsnail
Unidentified snails	Unidentified snails
Chlamys sp.	Swimming scallop
Crassadoma gigantea	Rock scallop
Tonicela lineata	Lined chiton
Cryptochiton stelleri	Gumboot chiton
Unidentified dorid nudibranch	Nudibranch
Tube Dwelling Worm	
Myxicolla infundibulum	Slime tube worm
Unidentified Serpulidae	Calcareous tube worms
Dodecaceria sp.	Clustering tube worms
Unidentified Saballidae	Parchment tube Worms
Crab, Shrimp, Barnacle	
Pandalus danae	Coonstripe shrimp
Pagurus spp.	Hermit crab
Balanus nubilus	Giant acorn barnacle

Fish

Scientific Name	**Common Name**
Sebastes maliger	Quillback rockfish
Sebases caurinus	Copper rockfish
Ophiodon elongatus	Lingcod
Hexagrammos decagrammus (male and female)	Kelp greenling
Scorpaenichthys marmoratus	Cabezon
Family Cottidae	Unidentified Sculpin

Vegetation

Scientific Name	Common Name
Brown Algae	
*Pterygophora californica**	Woody-stemmed kelp
*Laminaria setchellii**	Sugar kelp
Laminaria saccharina	Stiff-stiped kelp
Laminaria bongardiana (groenlandica)	Split kelp
Laminaria sp. (stipes)	
Nereocystis leutkeana	Bull kelp
Alaria sp. (*marginata* morph)	Winged kelp
Pleurophycus gardneri	Sea spatula
Cymathere triplicata	Three-ribbed kelp
Costaria costata	Seersucker
Agarum fimbriatum	Fringed sieve kelp
Desmarestia sp. (foliose + filamentous)	Acid kelp
Cystosiera geminata (stipes only)	Bladder leaf
Filamentous/foliose red algae including:	
Opunteilla californica	Red opuntia
Odonthalia sp.	Rockweed brush
Polysiphonia sp.	Filamentous red algae
Cryptopleura ruprechtiana	Hidden rib
Mazzaella splendens	Splendid iridescent seaweed
Coralline red algae (erect and encrusting):	
Lithothamnion sp.	Rock crust
Bossiella spp./*Calliarthron* spp.	Erect coralline red algae
Green Algae	
Ulva spp.	Sea lettuce

*Both these species were documented at 19m depth, growing beside one another on rock near the turbine site. These species can be found in association with one another at depths to 20m at high energy sites (wave or current) (Emmett *et al.* 1995).

Emmett, B., L. Burger and J. Carolsfeld. 1995. An inventory and mapping of subtidal biophysical features of the Goose Islands, Hakai Recreational Area, British Columbia. BC Parks Occassional Paper No. 3. 55pp + Appendices.

Appendix 2. Estimate of dispersion of drill effluent released at the water surface at Race Rocks

To estimate the dispersion of material released at the water* surface and its impact at the seabed we calculated the sinking rates of particles of various sizes and estimated their distance of travel given the current speeds at Race Rocks. The range of particle travel distances (in the predominant directions of ebb and flood) from their release point is given below.

Particle size	Distance from release point
1mm dia.	= +/-130m
0.5mm dia	= +/- 530m
0.3mm dia	= +/- 1,475m
0.2mm dia	= +/- 3,320m
0.1mm dia	= +/-13,275m

Assumptions:
Water depth = 20m
Range of current speed = 0 to 1.5 m/s in both ebb and flood directions
Volume of material released = 0.5m^3 (provided by drill operator)

If we assume all 0.5 m^3 is deposited within a 3km x 10m area, the height of the sediment deposition layer would be 0.017mm, or less than 1 average particle size high.

Given the seabed sediment grain size present at Race Rocks is very coarse (primarily cobble and boulder with sparse amounts of pebble and coarse sand), the currents would likely continue to disperse any fine particles from the drill effluent once they have reached the seabed; therefore it is highly unlikely any sediment accumulation within the Race Rocks area will result from the release of drilling effluent at the water surface.

*drill effluent may be released subsurface at 6m depth