Canadian Coast Guard Foreshore Biophysical Survey

Public Works and Government Services Canada

Final Report

Submitted to:
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February 2013

Suggested Citation:

G3 Consulting Ltd. (G3). 2013. Canadian Coast Guard Port Hardy Foreshore Biophysical Survey. Prepared for Public Works and Government Services Canada by G3 Consulting Ltd., Surrey, BC. 21pp + Appendices.

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1.0 INTRODUCTION

At the request of Public Works and Government Services Canada (GEPSC), on behalf of Fisheries and Oceans Canada (DFO) under the Standing Offer (Ref # EZ899-102579) Call Up Process, G3 Consulting Ltd. (G3) was retained to conduct a marine biophysical assessment of the foreshore and subtidal zone for a proposed pier and dock structure as part of a new Canadian Coast Guard (CCG) facility in Port Hardy, BC. Pre-field planning and field assessments were conducted in December, 2012 and included reconnaissance assessments around the proposed dock location, SCUBA dive operations and biophysical habitat assessments along terrestrial, intertidal and subtidal areas of the proposed site and bathymetric mapping of subtidal areas within the water lot boundary.

1.1 Project Overview

The Objectives of this project were to:

1. Conduct a marine assessment of the proposed water lot boundary and describe physical and biological characteristics of the site;
2. Conduct a risk assessment of the proposed works and characterize risk to fish and fish habitat using the Fisheries and Oceans Canada *Risk Management Framework* (DFO 2009) as a guide; and,
3. Determine the suitability of proposed construction works and provide recommendations and mitigation measures to minimize any potential residual effects.

Construction is to consist of the installation of:

- abutment for a new trestle consisting of lock block walls and abutment;
- trestle (pipe pilings), grated to enable light infiltration;
- gangway without pilings, attached above the high, high, water mark (HHWM);
- concrete float (4m by 25m), foam filled and anchored with pilings (which would not be concrete); and,
- two (2) floating trimaran breakwaters (48.8 m x 9.1 m and 24.4 m x 9.1 m). The method of anchoring has yet to be specified.

G3 conducted a marine biological assessment of the entire proposed water lot, employing methods outlined in the DFO standardized *Marine Foreshore Environmental Assessment Protocol* (Northrup and Cowan, 2002). Activities undertaken included:

1. development of an *Operational Work Plan* (OWP) to direct field work. Concurrent with design of this plan was the development of an *Emergency Action Plan* (EAP), to be employed in the event of a field accident or dive emergency;
2. project start-up, mobilization and travel, which involved preparation of field logistics, forms, equipment and travel to and from the project site and consultation with regulatory agencies including a Notice of Project to Workers Compensation Board (WCB);
3. preliminary on-site reconnaissance of the water lot boundary;
4. extensive biophysical assessments of sub-tidal (and intertidal) habitat through establishment of survey transects within the water lot boundary. Work was sufficient to enable representation of baseline site condition, including intertidal areas to high water mark. Work included physical site descriptions, flora and fauna relative abundance, substrate, potential habitat identification; and,
5. a bathymetric survey of the site.

Subsequent to field assessments, data was synthesized, summarized and used to assess and report site suitability. DFO's *Risk Management Framework* (DFO, 2008) was used to assess risk to fish habitat at each the site. This report includes survey methodology, biophysical results and a risk assessment analysis. Site figures (including site schematics and a bathymetric map), site photos and biophysical tables, are provided in Appendix 1, 2 and 3 respectively.

1.2 Study Area & Background

The proposed development site was located adjacent to an existing Canadian Coast Guard facility on Seagate Warf in Hardy Bay, Port Hardy, BC. A previous design for a proposed CCG pier and dock was assessed by Pacificus Biological Services Ltd. in 2010. During the previous survey no anadromous streams were identified within 100 m of the site but Eelgrass beds were observed in areas adjacent to the current dock (Pacificus, 2010). Since then, the design has been altered so that the CCG dock will be located farther east (in deeper water).

2.0 METHODOLOGY

The following methods were employed to complete project objectives as outlined in Section 1.0.

2.1 Operational Work Plan & Emergency Action Plan

The statement of work was used as the basis for the development of an *Operational Work Plan*. This plan was used to oversee project planning, logistics and activities as well as dictate data objectives, reporting and safety and contingency planning.

Separately, yet concurrent with this work, was the development of an Emergency Action Plan (EAP). Given that diving is inherently dangerous, it is critical that project specific emergency action plans be developed to expedite emergency response and to ensure all field personnel are conversant in those emergency procedures. In addition, a Notice of Project regarding the dive work was made to the Workers' Compensation Board (WCB).

2.2 Project Start-Up, Mobilization & Travel

Planning included assimilation and testing of all relevant equipment, contingency planning, preparation of water proof dive and field forms, travel and support vessel arrangements, diver air and safety supplies arrangements and project personnel procedures, QA/QC and safety review meetings.

A field crew mobilized from Vancouver to Port Hardy (via driving) with equipment and supplies on December 17, 2012. A stable work platform, dive tendering, marine site access and bathymetric soundings, was facilitated through the use of a 7 m aluminum work vessel. This vessel is registered with Transport Canada and had all necessary safety equipment. Boat operators were qualified and certified as required by Transport Canada. On December 19, two WCB representatives attended the survey site to review procedures and safety with the field crew.

2.3 Site Reconnaissance

Upon arrival at the project site, a preliminary reconnaissance of the site was conducted. This reconnaissance identified the water lot boundary, location of proposed marine facilities, potential regions of sensitivity, presence of any stream/creek discharges, breadth of intertidal areas, general terrain and underwater topography, confounding influences, high high water mark (HHWM), potential upland confounding activities and general orientation of the site. Subsequently, field personnel measured out linear survey distances along the shore and marked Points of Commencement (POCs) with permanent wooden site markers. Each transect marker was georeferenced and survey sites photographed.

An initial reconnaissance was then conducted to assess general habitat and dive quality of proposed sites and to identify any sensitive habitat, such as eelgrass or abalone beds. Eelgrass beds were noted at this time, in the vicinity of proposed works.

2.4 Biophysical Survey Methods

2.4.1 Transect Layout

Areas of the proposed facility were assessed, as well as areas adjacent to the site, to determine the potential for cumulative effects on the environment associated with facility construction and operation. Transects were established perpendicular to shore at regular intervals (approximately 12 m apart) along the linear site foreshore length. A total of five (5) transects encompass the entire water lot width (~50 m wide). Transects ranged from 155 m to 210 m in length (T1 to T5, respectively) and extended to the edge of the water lot boundary. Incremental lead-line transect procedures were employed as described by Northrup and Cowan (2002) and further refined by G3 (as summarized below):

- Point of Commencements (POC) for each transect were located at the highest high water mark (HHWM) covering both intertidal and sub-tidal areas for characterization;

- transects were individually numbered and permanently marked (GPS and wooden field marker);
- depth was correlated to Mean Sea Level (MSL) chart datum;
- start and end time and compass bearings were then recorded for each transect; and,
- transect data collected occured every 5-10 m (linear distance) along the transect line. Collections incorporated visual estimates, quadrat enumeration and photographed or videotaped (if underwater) for biophysical characteristics (as described below).

2.4.2 Sub-tidal & Intertidal Procedures

Transect Assessment

Three WCB certified Unrestricted SCUBA divers conducted transect surveys collecting biophysical and underwater video data. Divers started transect assessments from the Point of Termination (POT) at the edge of the water lot boundary and worked toward the POC to the edge of the water line. Transects were individually numbered and permanently marked (GPS and wooden field marker). Each transect received comprehensive biophysical dive assessments and uninterrupted video footage. Transect data collection occurred every 5 to 10 m (linear distance) along the transect line and incorporated visual estimates, quadrat enumeration and underwater video and photographic documentation of biophysical characteristics (as described below).

Qualitative methods were used to describe biophysical attributes of each transect. Methods described by DFO (Northrup and Cowan, 2002) were utilized to describe and estimate percent (%) cover of substrate, flora and fauna. Divers described marine plant and animal distribution qualitatively and quantitatively. Marine vegetation was described as being ‘dominant’ or ‘subdominant’, based on observed abundance and percentage (%) cover. Animal abundance was recorded as approximate percent (%) cover for sessile organisms (e.g. barnacles). Motile organisms were counted where feasible.

Project specific field forms were used to detail observations and maintain data consistency and descriptors between sites and observations. Depth was correlated (corrected) to Mean Sea Level (MSL) chart datum. Start and end time, compass bearing and water current condition were recorded for each transect. Each 10 m transect segment received independent assessment of the following biophysical site attributes:

- substrate (types and percent [%] cover). Substrate type was recorded using the following categories:

-Bedrock	>2,000 mm diameter
-Boulder	>256 mm diameter
-Cobble	64-256 mm diameter
-Gravel	2-64 mm diameter
-Sand	0.0625-2 mm diameter
-Silt/Mud/Clay	<0.0625 mm diameter

- marine flora (descriptions of plant communities and abundance in percent [%] cover);
- sessile fauna (descriptions of organisms and abundance in percent cover, or quadrat data correlation);
- potential as salmonid habitat (spawning, foraging, cover, rearing, etc.);
- motile fauna (descriptions of organisms and abundance in percent (%) cover, or through individual enumeration); and,

- video and photographic documentation (complete transect video footage with select photos of relevant organisms, physical features, or representative habitat types).

Terrestrial-based Intertidal Assessments

Given that transects extended to the HHWM, regions of the foreshore were often above the waterline at the time of assessment. These regions underwent a terrestrial based biophysical evaluation, similar to that of underwater surveys; except data collection occurred every 5 m (linear distance) along the transect line (rather than the 10 m distance under water). Photographs were taken of each quadrat (examples in Appendix 2). Data was recorded on field forms in a manner similar to that used for SCUBA transect assessments.

2.5 Bathymetric Survey

The bathymetric survey of the water lot was facilitated through use of a digital Lowrance LCX-15MT depth sounder interfaced directly to an Omnistar Differentially-corrected DGPS receiver (measured in UTM coordinates, NAD83). This technology enabled real-time, sub-meter spatial positioning accuracy. Sounding and positional equipment were mounted on the aluminum vessel to enable shallow, near-shore and open water areas to be surveyed. Sonar depth and positional data was logged directly to the sounder as a downloadable file. To ensure preservation of collected data, information was downloaded to a laptop computer in the field and backed-up on conventional media (e.g., external hard drive) each evening.

2.6 Post Field Assessment

2.6.1 Bathymetric Mapping & Corrections

Upon return from the field, sonar and positional bathymetric data was converted to appropriate georeferenced datum files and uploaded into bathymetry rendering software to interpolate spatial and depth data to create a connected surface layer from which contour lines and bathymetric relief was depicted. To adjust for potential tidal and seasonal fluctuations field data was corrected to a Mean Sea Level (MSL) datum to correspond with engineered drawings provided.

Data from bathymetric surveys was then overlaid on previously created maps of the water lot to display shore contour data. Figure 5 (Appendix 1) provides a schematic of subtidal bathymetry for the project site.

2.6.2 Transect Review

Site assessments were aided by field guides by Lamb and Edgell (1986), Sept (1999), Kozloff (1993) and Druehl (2000) for scientific nomenclature of marine organisms. Observed species were tabulated according to observed occurrence or estimates of populations (Appendix 3). Plant and animal distribution was then described as “abundant”, “moderate” or “trace”.

‘‘Abundant'' was used to describe organisms distributed as the primary flora or fauna of the region. For predominantly sedentary organisms (e.g., anemones, barnacles, and plants), "abundant" described distribution that covered an area >60% of available suitable habitat. For more motile organisms (e.g., finfish, crabs and shrimp) "abundant" distribution described a concentration of the subject organism. This classification was subjective for motile animals, as regional and temporal conditions influenced distribution. As an example, along a transect within a particular habitat zone, five to eight non-schooling finfish of the same species or approximately 30 to 50 schooling fin fish would be described as "abundant".

“Moderate” distribution described organisms in either clustered groups or sporadic within the habitat zone. For predominantly sedentary organisms, overall distribution covering approximately 25% to 59% of apparently suitable habitat was considered moderate. Distribution of more motile organisms was subjectively assessed. For example, three to five non-schooling finfish or fewer than 30 schooling finfish along a transect within a particular zone would be described as moderate distribution.

“Trace” distribution described organisms observed either singly (e.g., a solitary finfish) or a relatively small cluster of colonizing organisms (e.g., encrusting sponges) comprising <10% to 25% of assessed area. “Trace” generally described observations of single or few organisms observed within each intertidal or subtidal zone.

2.6.3 Site Schematics

Site schematics and bathymetric maps were developed using Mean Sea Level (MSL) corrected bathymetry data, GPS coordinates of site features and select site photos. Information assembled within biophysical data tables were used to produce site maps. Scales, legends, and directional arrows were included on each map.

3.0 RESULTS

Transects were surveyed on December 18 to 20, 2012, with five (5) transects used to represent the area of the proposed water lot boundary. Assessment of the foreshore intertidal and sub-tidal areas at the proposed site included dive and terrestrial-based assessment of marine foreshore, intertidal and subtidal habitat (Figure 3, Appendix 1). Upon review of biophysical site data collected during the field survey, the site was divided into four (4) distinct habitat zones based on physical and biological factors (e.g. tidal range, submergence time, substrate type and water depth and subsequently used to describe substrate, flora/fauna at the site. Habitat zones included:

1. Upper Intertidal Zone (UIZ);
2. Mid-Intertidal Zone (MIZ);
3. Lower Intertidal Zone (LIZ); and,
4. Subtidal Zone (SZ).

For definitions of technical terms used in this section to describe species abundances and substrate classes refer to the methods section of this report. Tables 1 through 5 (Appendix 3) summarize field observations of the biophysical surveys conducted on Transects 1 through 5 over the four above-mentioned zones. Figures 4 (Appendix 1) show depth contour profiles of each transect.

Figure 3 (Appendix 1) depicts the study locations and associated transect layout. Photographs of each Transect POC and underwater observations are provided in Appendix 2. Video footage accompanies this report and includes footage from each transect.

3.1 Site Description & Habitat Assessment

The survey area covered approximately 50 m of shoreline (representing the water lot boundary) in a location approximately 100 m south of the current Seagate Warf and Canada Coast Guard station, directly in front of the current CCG accommodation building at the end of Shipley Street in Hardy Bay.

Five (5) transect lines were laid out at the High High Water Mark (HHWM) and spaced apart at 12 m intervals. Each transect extended out over the foreshore and to the end of the site at a 55° angle over transect line distances ranging from 155 m (T1) to 210 m (T5) to cover the water lot boundary area and proposed placement of pier and dock structure.

Table 1: General Survey Data

Transect	GPS Coordinates		Length (m)	Terrestrial Survey Distance (m)	SCUBA Survey Distance (m)	Maximum Depth (m)[1]	Tide Height (m)[1]
	POC	POT					
1	0606649 E 5619929 N	0606787 E 5620007 N	155	0 – 30	155 – 40	8.0	2.7
2	0606655 E 5619915 N	0606797 E 5620009 N	176	0 – 10	176 – 20	9.7	4.1
3	0606659 E 5619905 N	0606812 E 5620013 N	183	0 – 50	183 – 60	10.8	1.8
4	0606661 E 5619898 N	0606825 E 5620015 N	200	0 – 50	200 – 60	11.7	3.4
5	0606669 E 5619897 N	0606843 E 5620012 N	210	0 – 70	210 – 80	12.9	2.1

[1] Depths and tide heights corrected to Mean Sea Level (MSL)

The HHWM was located at the top of a sloped riprap wall (~1.5 m high) with terrestrial grasses interspersed between the rip rap boulders (Photo 32, Appendix 2). Large woody debris (logs) was noted as part of the wall at the south end of the site, near Transect 5 (Photo 55, Appendix 2). At the top of the riprap wall the ground leveled out with the Canadian Coast Guard accommodation building located behind the POC at Transect 3 (Photo 32, Appendix 2). Between the accommodation building and the top of the riprap wall there was small patch of lawn and a gravel path extending along the entire site.

A small stream was noted approximately 5 m south of Transect 5. The stream flowed from a culvert (1 m wetted width at mouth of culvert) near Transect 5 POC, into a dense patch of grass, then onto the beach (Photo 66, Appendix 2).

Transects 1 to 5 had similar physical characteristics. The site encompassed a gently sloping sandy beach (~5° slope) with large areas of flat bedrock, cobble and boulder, extending through the intertidal and subtidal areas of the site.

3.1.1 Upper Intertidal Zone (UIZ)

The Upper Intertidal Zone (UIZ) was established in areas of 'highest high water level' (HHWL) where marine algae were limited in distribution and abundance and vegetation consisted mostly of vascular plants, including grass. When observed within quadrats, biota covered <5% of the area and substrate was predominantly sand with shell hash. The UIZ was similar between all transects and comprised the region extending from 0 m to 19 m of the site as measured from the HHWM.

Substrate

The first 0 m to 5 m from the HHWM included a steep boulder and riprap slope with terrestrial grasses protruding from between the boulders. Cobble and gravel substrates were also dominant directly adjacent to the boulder slope. Extending towards the water from the boulder wall substrates were dominated by sand and shell hash with occasional boulder or cobble patches. Between 15 m and 19 m from the HHWM, intermittent sections of flat bedrock were noted as the dominant substrate (Photos 7, 8, 20, 32, 44 and 56, Appendix 2).

Flora & Fauna

The Upper Intertidal Zone was generally barren of observable flora and fauna. Marine plants observed were filamentous green algae (5% ground cover) noted on portions of bedrock substrate at the edge of the zone (Transect 1). Barnacles (*Balanus glandula)* were sparsely observed (5% ground cover) on boulder and cobble substrate on Transect 1.

3.1.2 Mid Intertidal Zone (MIZ)

The Mid Intertidal Zone (MIZ) experiences periods of inundation and exposure each day and comprised an area 20 m to 79 m from the HHWM. As with the Upper Intertidal Zone the slope remained low (~5°).

Substrate

Bedrock and sand substrate dominated the MIZ. Flat bedrock outcroppings covered large portions of the site within this zone and were noted as the only substrate type in several quadrats. Where bedrock was not observed to be dominant, sand was dominant and also found to be the only substrate in several quadrats. Gravel, cobble and boulder were noted as subdominant substrate in a few areas.

Flora & Fauna

Flora was more abundant in the Mid Intertidal Zone than the Upper Intertidal Zone. Rockweed (*Fucus gardneri)* was the most abundant flora in most quadrats within this zone and generally over the entire zone, occurring in highest abundance when bedrock was the dominant substrate. *Analipus sp.* was the dominant flora in a few quadrats and was observed as abundant (60% cover) and moderate (40% cover). Sea moss (*Cladophora sp.)* and filamentous brown and green algaes were noted within the zone (20 m to 35 m from the HHWM) and also associated with bedrock and substrate. Wrack kelp (*Laminaria saccharina)*, sea sacs (*Halosaccion glandiforme*) and encrusting coralline algae (*Lithothamnion sp.*) were only noted closer to the Lower Intertidal Zone (>60 m from the HHWM) and in trace concentrations. Other flora found in trace amounts throughout the Mid Intertidal Zone included sea lettuce (*Ulva sp.), Analipus sp*. and *Desmarestia sp.*

Marine fauna was limited in diversity in the Mid Intertidal Zone; however, dominant species provided abundant substrate coverage in some places. Barnacles (*Balanus grandula)* were the most abundant organism found in the Mid Intertidal Zone, providing 1% to 95% surface cover and covering over 90% cover in several locations. Barnacles were principally found in areas with higher percentage (%) cover of bedrock and boulder substrate and were found throughout the entire zone. Other noted organisms included the aggregating anemone (*Anthopleura elegantissima),* burrowing anemone (Anthopleura artemisia), thatched barnacle (Semibalanus cariosus) and hermit crabs (*Pagurus sp.)* found in the lower half of the Mid Intertidal Zone (>50 m from the HHWM).

3.1.3 Lower Intertidal Zone (LIZ)

The Lower Intertidal Zone comprised the area 80 m to 119 m from the HHWM.

Substrate

A diverse array of substrate types were present in the Lower Intertidal Zone with Bedrock and boulder substrate was dominant in most areas. Large sections were also dominated by sand and silt substrate, especially along Transect 1. Silt, gravel and cobble filled in the areas between boulders and overlayed bedrock. Substrate remained gently sloped.

Flora & Fauna

A wide variety of marine flora was present in the LIZ. Rockweed (*Fucus gardneri)* remained present but reduced in coverage compared to the Mid Intertidal Zone (5% and 20% of quadrat surface area) and found to a maximum distance of 90 m from the HHWM. Eelgrass beds were observed along all transects within this zone and extended into the Subtidal Zone along Transect 1. Within the LIZ, eelgrass was noted along a band running southeast between 80 m and 110 m from the HHWM and a separate bed on Transect 1 located between 100 and 119 m from the HHWM. Eelgrass was the dominant species in certain areas (maximum coverage of 40%). Other common species of algae included *Desmarestia sp*. and *Analipus sp*. Encrusting coralline algae (*Lithothamnion sp.)* and feather coralline algae (*corallina sp.)* were also moderately (from 2% to 50% coverage) attached to boulders and bedrock outcroppings. Other species of algae noted in the Lower Intertidal Zone included turkish towel (*Chondracanthus exasperatus*), *Macrocystis sp.* and wrack kelp (*Laminaria saccharina).*

The LIZ exhibited a diverse composition of fauna though the density of organisms remained low within sampling quadrats. Barnacles (*Balanus grandula)* were present on boulders and bedrock from (1% to 20% cover). Bedrock and boulder substrates provided habitat for a variety of species including aggregating anemones (*Anthopleura elegantissima)* and trace observations of whelks (*Lirabuccinum dirum)*, limpits (*Lottiidae*), hermit crabs (*Pagurus*) and encrusting sponges (*Desmospondiae)*. Other trace organisms taking advantage of the diverse marine algae and substrate types included sunstar (*Pycnopodia helianthoides*), purple star (*Pisaster ochraceus),* porcelin crab (*Porcellanidae),* decorator crab (*Majoidea)* and dorid species (*Doridoidea sp.)*. Trace observations of fish species noted resting between boulders and kelp included a red irish lord (*Hemilepidotus hemilepidotus)*, buffalo sculpin (*Enophrys bison*) and a gunnel (*Pholidae)*. Fish eating anemone (*Urticina piscivora*), burrowing anemone (*Anthopleura artemisia*) and giant pink seastar (*Pisaster brevispinus*) were noted on the more sandy sections.

Other trace organisms noted by the divers included kelp crab (*Pugettia productus*), dungeness crab (*Metacarcinus magister)* and kelp greenling (*Hexagrammos decagrammus)* just above substrates, between the kelp. At the edge of the LIZ and entering the Upper Subtidal Zone, hooded nudibranchs (*Melibe leonina)* were noted in abundance covering eelgrass.

3.1.4 Sub-tidal Zone (SZ)

The Sub-tidal Zone was defined as the area comprising 120 m+ from the HHWM.

Substrate

Substrate in the Subtidal zone was generally homogenous with silt and sand substrate being dominant size classes for most of the zone. Boulder, cobble and bedrock substrates were also seen throughout the Subtidal Zone and dominant along Transect 2 and 3. Boulder and bedrock sections provided areas for algae to attach and excellent habitat for more sessile organisms. A small overhanging bedrock wall (~1 m in height) was noted parallel to shore at the 130 m to 150 m distance across Transect 1 to 4. Another small overhanging bedrock wall was also noted at 170 m to 175 m across Transect 3, 4 and 5. These areas, along with other boulder patches, showed a more diverse array of organisms.

A pipeline was noted running across the site at 183 m on Transect 3 and 190 m on Transect 4 and 5 (Photos 42 and 65, Appendix 2).

Flora & Fauna

Dominant marine algae included wrack kelp (*Laminaria saccharina*) and (*Desmarestia sp.)* and found relatively consistently (2% to 20% cover) across the Subtidal Zone (120 m to 210 m from the HHWM). Turkish towel (*Chondracanthus exasperatus*), feather coralline algae (*corallina sp.*) and encrusting coralline algae (*Lithothamnion sp.)* were also noted in a few quadrats (<10 % cover). Within the Subtidal Zone, eelgrass was noted along Transect 4 between 130 m to 140 m from the HHWM and between 130 m and 135 m from the HHWM along transect 5. Overall, eelgrass was noted running in an intermittent band along all transects, crossing over both the Lower Intertidal and Subtidal Zones.

Fauna in the Subtidal Zone was most diverse of all zones observed; however density of organisms remained low within sampling quadrats (<10 individual organisms observed for any one species within this zone). A giant Pacific octopus (*Enteroctopus dofleiniwas*) was observed beneath a bedrock overhang on Transect 3 at 170 m from HHWM. Several kelp crabs (*Pugettia productus*) were observed in areas with boulder substrate and higher abundance of marine algae.

Other trace species included lemon peel nudibranch (*Tochuina gigantea*), pacific sea peach (*Halocynthia aurantium*), yellow dorid (*Doris montereyensis*), leopard dorid (*Diaulula sandiegensis*), whelk (*Lirabuccinum dirum*), encrusting sponge (*Desmospondiae*), spot prawn (*Pandalus platyceros*), hermit crab (*Pagurus*), coonstripe shrimp (*Pandalus danae*), black tail shrimp (*Crago nigricauda*), decorator crab (*Majoidea*), shrimp (*Pandalus*), chiton (*Polyplacophora*), orange feather duster (*Eudistylia*), and an orange sponge (Desmospondiae). Two species of seastar (*Pycnopodia helianthoides* and *Pisaster brevispinus)*, burrowing anemones (*Anthopleura artemisia*), fish eating anemones (*Urticina piscivora*) and california seacucumbers (*Parastichopus californicus*) were also noted.

Trace observations of fish species included longfin sculpin (*Jordania zonope*), goby (*Gobiidae*), giant sculpin (*Scorpaenichthys marmoratus*) and copper rockfish (*Sebastes caurinus*).

3.1.5 General Wildlife

General wildlife observed during the survey includes stellar sea lions (*Eumetopias jubatus)*, harbour seals (*Phoca vitulina)*, pacific loons (*Gavia pacifica)*, wester grebes (*Aechmophorus occidentalis)*, common mergansers (*Mergus merganser)* and herring gulls (*Larus smithsonianus)*.

4.0 RISK MANAGEMENT FRAMEWORK

Potential effects and associated risks to the marine environment, associated with the proposed CCG facility project in Hardy Bay, were assessed using DFO's *Risk Management Framework* (DFO 2009). This method incorporates an Aquatic Effects Assessment and applies *Pathways of Effects* to assess mitigation and identify any potential negative residual effects. Risk Assessment was also undertaken to categorize any risk based on an analysis of identified negative effects, along with Risk Management, to identify overall risks and any required regulatory input or decision.

4.1 Aquatic Effects Assessment

An Aquatic Effects Assessment is a process used to identify potential effects that proposed work may have on fish and fish habitat. To determine what the potential effects may be, Pathways of Effects diagrams were employed to analyze the proposed development as a series of specific and definable activities, types of stress these activities might have on the environment and how identified stressors may ultimately lead to effects in the aquatic environment (based on cause-effect relationships). Potential land- and water-based activities were first identified for both the construction and operational phases of the project.

Table 2: Proposed Development Potential Activities

Proposed Development	Phase of Work	Activities	
		Water-based	Land-based
Proposed development and operation of a marine pier with pilings, gangway and floating dock	Construction	• Marine vessel(s) use to facilitate construction • Placement of materials in water (anchoring structures, pilings and dock)	• Vegetation clearing, excavation adjacent to water and installation of riprap on foreshore • Use of industrial equipment (excavators, trucks, etc.) in foreshore areas
	Operation	• Marine vessel maintenance, operation, fueling, loading/ unloading activities	• Vehicle/ foot traffic

Potential stressors and effects were subsequently outlined in connection to specific activities associated with the development. Potential effects on fish and fish habitat represent an area where mitigation may be applied to reduce potentially negative effects. Stressors that cannot be fully addressed could result in remaining residual effects.

Table 3: Construction & Design (Aquatic Effects Assessment)					
Activity		Stressor	Cause & Effect Relationship	Mitigation Measures	Anticipated Residual Effect(s)
Water-based	Marine vessel use to facilitate construction	Floating Structure (Barge)	Pile driving may require use of floating structures which could ground in shallow areas. Potential mortality of fish/eggs/ova may result	Sufficient operational water depths, favorable tidal and weather conditions must be present to prevent barges or floats from grounding on the foreshore. Minimize use of barge stabilizing spuds	None
		Visual and Acoustic	Pile driving, vessel use and other work in and above water may cause behavioral changes to biota	Work should be conducted within appropriate Fisheries Timing Windows to minimize impact(s)	Potential visual and acoustic disturbance during Fisheries Window (low)
		Oil, Grease and Fuel Leaks From Equipment	Release of potentially toxic compounds may cause fatality to organisms, alteration of the ecosystem through changes in the abundance, composition, and diversity of communities and habitats	Operations should follow Best Management Practices (BMPs) for equipment use. Operators should follow appropriate fuel handling and emergency spill procedures and have spill containment equipment/ materials present to prevent and contain discharge of deleterious substances to the marine environment	Fuel Spill Potential (low)
	Placement of Materials in Water (anchoring structures, pilings and dock)	Movement of Materials and Installation	Sediment generation may be created through the installation of pilings and anchors. Increased sediment may reduce water clarity (reducing visibility and light penetration), damage fish gills and reduce the availability and quality of spawning/rearing habitat (through infilling). Compaction and abrasion of substrate may result from movement of site materials.	Areas for anchor or piling placement should be pre-determined with installation occurring only at those areas and within Timing Windows to minimize areas affected	Impacted Zone (minimal and localized to specific areas)
		Material Type	Treated lumber or other materials containing volatile compounds may release compounds to environment on contact with water	Use inert or untreated materials as supports for structures that are to be on or submerged in water	Minimal or None
		Solar Input(s)	Floating structure and walkway may cause reduction in light penetration resulting in reduced productivity	Minimize shading from access ramps or walkways by elevating them above the surface of the water. Grating, spaced boards or large spaces in decking to enable light penetration. Follow applicable design BMPs	Shading Effects (low)
		Change of Habitat (addition of structures)	Addition of stable structure may offer attachment for marine organisms and potential cover	Installation of structure should be sited in areas with moderate to low habitat quality	Flora/fauna encrusting marine structures (positive effect)
		Grounding	Potential for grounding of floating structures during low tides	Bottom of floats should be a minimum of 1.5 m above the sea floor during lowest recorded water level	None

Table 3: Construction & Design (Aquatic Effects Assessment; Con'd)

Activity		Stressor	Cause & Effect Relationship	Mitigation Measures	Anticipated Residual Effect(s)
Land-based	Vegetation clearing, excavation adjacent to water and installation of riprap along foreshore	Bank Stability and Sediment Mobilization	Vegetation clearing may result in reduced bank stability and exposed soils which can cause sediment erosion and surface runoff	Minimal onshore excavation required. Construction should take place during Fish Timing Windows to avoid excessive run-off and erosion. Employ BMPs for work in and around water. Design and follow appropriate Erosion Sediment Control Plan	Minimal
Land-based	Marine vessel use to facilitate construction	Oil, Grease and Fuel Leaks From Equipment	Increases in toxic compounds may cause effect that can range from fatality to organisms, alteration of the ecosystem structure through changes in the abundance, composition, and diversity of communities and habitats	Operations should follow Best Management Practices (BMPs) for equipment use. Operators should employ appropriate fuel handling and emergency spill procedures and have spill containment equipment/ materials present to prevent discharge of deleterious substances to the marine environment	Fuel Spill Potential (low)

Table 4: Operational (Aquatic Effects Assessment)

Activity		Stressor	Cause & Effect Relationship	Mitigation Measures	Anticipated Residual Effect(s)
Water-based	Marine vessel maintenance, use, fueling, loading/ unloading activities	Oil, Grease and Fuel Leaks from equipment and bilge water	Increases in toxic compounds may cause effect that can range from fatality to organisms, alteration of the ecosystem structure through changes in the abundance, composition, and diversity of communities and habitats	Operators should employ appropriate fuel handling and emergency spill procedures to prevent discharge of deleterious substances to the marine environment	Fuel Spill Potential (low)
		Visual and Acoustic	Use of propellers and other machinery in or near water may cause behavioral changes to biota	Minimize use in shallow areas	Potential visual and acoustic disturbances (low)
		Grounding/ Substrate Disturbance	Potential for prop scour or disturbance of substrate caused by prop wash/grounding of vessels	Ensure elevated structures extend a sufficient distance offshore from the water to prevent grounding of floating sections; design minimum clearance below a floating structure at low water to be 1.5 m to avoid the wash from propellers disturbing the substrate	None

4.2 Risk Assessment

Subsequent to determination of any potential residual effects, the scale of negative and positive effects was assessed in the context of fish and fish habitat potentially being affected (i.e. habitat sensitivity) to enable a characterization of the potential Level of Risk the development poses to the productive capacity of the habitat. Both the scale of effects and sensitivity of fish and fish habitat were ranked as 'Low', 'Medium', or 'High' then incorporated into the *Risk Assessment Matrix* to categorize and convey the 'level of risk'.

To assess the scale of effect, three attributes were evaluated (extent, duration, and intensity). *Extent* refers to the direct footprint of the development proposal and any indirectly affected areas. *Duration* refers to the amount of time that the residual effect is likely to persist and *Intensity* refers to the estimated amount of change from the assessed baseline condition.

Table 5: Scale of Negative Effects

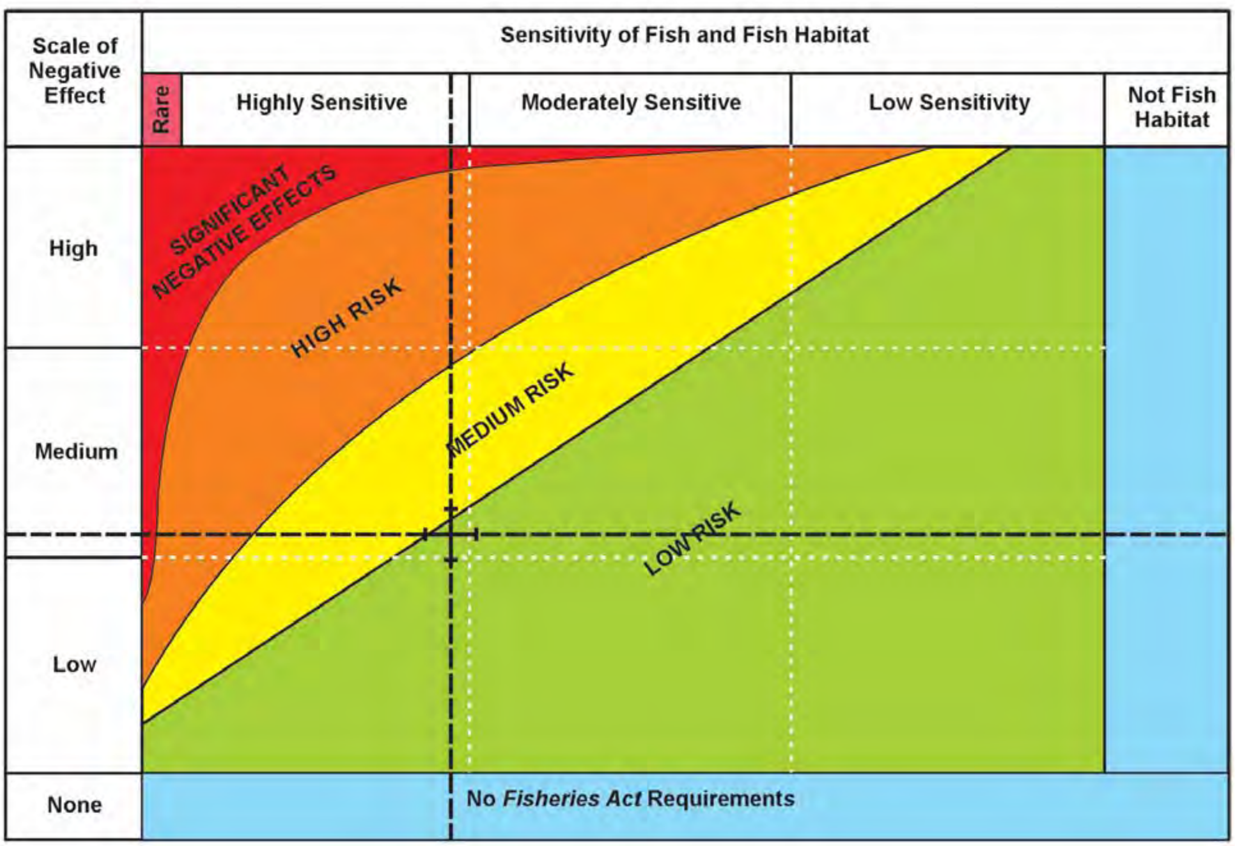
	Anticipated Residual Effect(s)	Extent	Duration	Intensity	Rank (L, M, H)
Construction & Design	Visual and Acoustic Disturbance During Construction	Areas below and near dock placement	Temporary	Timing of work will decrease intensity	L
	Possibility of Fuel/ Oil Spill/ Leak During Construction	Area around site potentially affected during spill	Temporary	Unknown	L
	Substrate Impacted From Placement of Materials in Water (anchoring structures, pilings and dock)	Confined to placement	Long term (however, if done correctly, will encrust and create potential good habitat in long term)	Position of structures over lower quality habitat will reduce intensity	L - M
	Upland Vegetation Clearing and Excavation	Little to no clearing required	Weeks to months, riparian vegetation will grow back	Habitat still suitable, productivity likely not affected	L
	Shading Effects	Limited to areas below dock	Long term	Habitat still suitable below dock. Intensity of effects may be minimal depending on mitigation measures employed and depth of water	L
Operation	Visual and Acoustic Disturbance From Vessel Use Around New Structure	Limited to areas below and near dock	Individual occurrences (Temporary)	Position of dock in lower quality habitat and sufficiently deep water will reduce intensity	L - M
	Possibility of Fuel Spill From Ongoing Vessel Use and Refueling	Area around site potential affected during spill	Temporary – Longer Term (depending on size of spill)	Unknown	L
	Vehicle Grounding and Prop Wash	Area near dock placement	Individual occurrences (Temporary)	Position of dock in sufficiently deep water will reduce intensity	L
				Overall Rank	**L to M**

To assess the sensitivity of fish and fish habitat, four attributes were used that included 1) species sensitivity; 2) species' dependence on habitat; 3) rarity; and, 4) habitat resiliency. *Species Sensitivity* is the susceptibility of a given species to changes in environmental conditions. *Dependence on Habitat* describes the use and requirements of a given species on the habitat. *Rarity* refers to the relative abundance and frequency of a given population or habitat type. *Habitat Resiliency* refers to the ability of an aquatic ecosystem to resist change and recover from any changes in environmental condition.

Table 6: Sensitivity of Fish and Fish Habitat

Species Sensitivity	Species' Dependence on Habitat	Rarity	Habitat Resiliency	Overall Rank (L, M, H)
Eelgrass is considered sensitive marine habitat and ran along all transects running in an intermittent band between 110 m and 80 m from the HHWM, to 120 m along Transect 1 and 2, 135 m along transect 5, and to 140 m from the HHWM along transect 4	Eelgrass plays an important role in the ecological function and biophysical structuring of nearshore marine environments by filtering the water column, stabilizing sediment, buffering shorelines and providing valuable habitat (refuge, rearing and feeding habitat) Eelgrass meadows have high levels of primary production. Several organisms were observed using the eelgrass habitat including hooded nudibranchs (in abundance at several locations)	No rare or protected species were observed in the area	Structures may have initial physical impacts on eelgrass habitat where pilings are installed. Eelgrass may be affected by reduced solar inputs beneath the installed dock Habitat would be very sensitive to any spills or grounding effects	H

Figure 1: Risk Assessment Matrix with Overall Risk to Fish and Fish Habitat



5.0 DISCUSSION

5.1 Biophysical Assessment Summary

Biophysical habitat data (substrate, flora and fauna) and video footage was collected along five transects surveyed on December 18 to 20, 2012. Transects extended from the High High Water Mark (HHWM) over intertidal to subtidal zones (distances ranging from 155 m to 210 m) of the proposed water lot boundary. The area surveyed included approximately 50 m of shoreline directly in front of the current CCG accommodation, building at the end of Shipley Street in Hardy Bay, and provided a comprehensive assessment of habitat quality in the area.

Transects 1 to 5 had similar biophysical characteristics. The site encompassed a gently sloping sandy beach (~5° slope) with large areas of flat bedrock, cobble and boulder, extending through the intertidal and subtidal areas of the site. Areas of boulder, cobble and gravel substrate exhibited the most abundant and diverse communities, with areas of sand and fine sediment exhibiting less diverse and less abundant biota, with the exception of areas where eelgrass was noted growing over sandy substrate. Areas of the Lower Intertidal and Upper Subtidal Zones comprised the more diverse and productive marine habitat, while areas of the Upper Intertidal and Mid Intertidal Zones exhibited less species diversity and limited species abundance.

Several species of flora provided substantial cover for a variety of marine organisms. Rockweed was observed in abundance in the Mid Intertidal Zone and in moderation in the Lower Intertidal Zone. Common species within the Lower Intertidal Zone included *Desmarestia sp*., *Analipus sp*., encrusting coralline algae (*Lithothamnion sp.)* and feather coralline algae (*corallina sp.)* attached to boulders and bedrock outcroppings. Eelgrass beds were observed along all transects within the LIZ and in higher quantities in the deeper sections (90 m to 119 m from the HHWM) and into the Upper Subtidal Zone. In the Subtidal Zone dominant marine algae included wrack kelp (*Laminaria saccharina*) and (*Desmarestia sp.)* and found relatively consistently across the Subtidal Zone.

Marine fauna was limited in diversity in the Mid Intertidal Zone; however, barnacles provided abundant substrate coverage in places with bedrock and boulder substrate. The LIZ and SZ exhibited a diverse composition of fauna though the density of organisms remained low within sampling quadrats. Bedrock and boulder substrates provided habitat for a variety of species including a variety of anemones, sea stars, crabs, dorids, prawns, shrimp, sponges, sea cucumbers and fish. A giant Pacific octopus (*Enteroctopus dofleiniwas*) was observed beneath a bedrock overhang on Transect 3 at 170 m from HHWM. At the edge of the LIZ and entering the Upper Subtidal Zone, hooded nudibranchs (*Melibe leonina)* were noted in abundance covering eelgrass.

5.2 Risk Assessment Summary

Construction for the proposed works is to consist of the installation of pipe pilings (without concrete infilling), gangway, a pre-cast concrete float, anchored with pilings and floating trimaran breakwaters. Activities associated with the development and operation of the proposed works were identified and the potential effects and associated risks to the marine environment described using the DFO's *Risk Management Framework* (DFO 2009). The main site activites are to include marine vessel use for construction (e.g. barge) and installation of materials (anchoring structures, pilings and dock). Once construction is complete, potential operational activies will include marine vessel maintenance, fueling, loading etc. Potential environmental stressors and negative effects associated with these activities could include potential visual and acoustic disturbance to biota, potential prop scour and prop wash during low tides and potential for fuel spills during both construction and operation phases. Other potential effects may include impacts from movement and installation of materials (compaction of areas for anchoring and piling placement), grounding of floating structures (i.e. barge and dock) and shading effects from the addtion of floating structures. Positive effects may result from flora/fauna encrusting over time on the stable marine structures. Most of the potential effects identified for fish and fish habitat represent issues where mitigation could be applied to reduce most potentially negative effects. Mitigation measures described in Tables 3 and 4 (above) and Best Management Practices described below (Section 5.3) should be employed to reduce any potential negative effects on fish and fish habitat.

While the habitat in the area of the proposed water lot boundary is generally considered to be of 'High' quality and supports a diverse array of marine flora and fauna, the scale of potential negative effects that the project poses on fish and fish habitat is generally ranked 'Low to Medium'. The design of the proposed construction is such that the zone directly impacted by the installation of anchoring structures, pilings and dock is limited in extent. If installed using appropriate mitigation measures and BMPs the extent, duration and intensity of most potential effects can be reduced. Substrate impacted from direct placement of materials will encrust and create habitat when installed correctly, grounding of vehicles and floating structures can be avoided if dock is positioned in sufficiently deep water and shading effects limited if sufficient grating and spacing is incorporated into ramps and walkways. The highest potential for negative impacts would likely result from direct substrate impacts from placement of materials and vessel use around the dock structure (visual and acoustic disturbance and potential for prop wash), given the shallow water depths at the site.

The sensitivity of the habitat is ranked 'High' given the presence of eelgrass within the water lot boundary. Eelgrass plays an important role in the ecological function and biophysical structuring of nearshore marine environments by filtering the water column, stabilizing sediment, buffering shorelines and providing valuable habitat (refuge, rearing and feeding habitat). Areas with eelgrass have high levels of primary production. Eelgrass was observed within the entire site in the Lower Intertidal and Upper Sub Tidal Zones covering distances of 140 m to 80 m from the High High Water Mark (HHWM). Several organisms were observed using the eelgrass habitat including hooded nudibranchs (in abundance at several locations). Eelgrass habitat may be affected from physical impacts where pilings and anchors are installed, reduced solar inputs beneath the installed dock and would be very sensitive to any spills or grounding effects.

Although the sensitivity of the habitat was given a ranking of 'High', the overall project risk to fish and fish habitat, based on this Risk Assessment of proposed works, and use of the Risk Assessment Matrix, was assessed as 'Low' to 'Medium', assuming appropriate management practices are employed to eliminate any potential effects to fish habitat and specifically eelgrass. The project design as proposed would have limited direct impact to the substrate and low to moderate risk to eelgrass. Potential effects to eelgrass could include some loss due to shading, damage during construction, installation of pilings and/or boat wake damage. Specific design features can be installed to mitigate this risk and reduce or eliminate potential effects on eelgrass. These include installation of pilings and installation of docks, ramps and gangways away from eelgrass beds. If avoidance of eelgrass is not feasible or there is transition of structures across eelgrass beds, impacts may be mitigated through use of grated decking materials and elevated access ramps to enable greater light penetration and prevent grounding of structures.

As part of the biophysical survey, eelgrass was identified and the approximate location of eelgrass beds were mapped (Figure 3 and Figure 4; Appendix 1). As proposed, the CCG float may be situated over a small portion of eelgrass. Figure 4 (Appendix 1) provides a possible alternate siting alignment for the float, moving its location further to the northeast to avoid the eelgrass beds.

5.3 Mitigation & BMPs

Best Management Practices (BMPs) are methods used to help ensure that a project minimizes potential impacts to fish and fish habitat and to provide a standard level of protection to the aquatic and terrestrial environment potentially affected by the project. The following Best Management Practices were selected from the Guidebook on *Standards and Best Practices for Instream Works for Wharf, Pier, Dock, Boathouse & Mooring* (MOE, G3 2013).

Design BMPs

1. ensure General BMPs and Standard Project Considerations area appropriately applied prior to, during and after commencement of work;
2. ensure works adhere to Regional Timing Windows to prevent disruption of fish and wildlife habitat;
3. design and construct structures using Qualified Professional(s) (QP), dependent on scale and scope of the project;

4. design and locate structures to avoid the need for future maintenance dredging;
5. ensure elevated structures extend a sufficient distance offshore from the water body High Water Mark (HWM) to prevent grounding of floating sections;
6. design minimum clearance below a floating structure at low water to be 1.5 m to reduce or eliminate wash from propellers disturbing the sea floor;
7. design structures to have a minimum of 50 m (undisturbed shoreline) between other in-water structures;
8. prevent interruption of water currents and reduce potential for altered patterns of erosion or sediment deposition by leaving the site in as natural a condition as possible and installing a minimum number of well-spaced pilings;
9. ensure existing rocks and logs in the aquatic environment remain where they are and are not used as building materials;
10. construct elevated decks and walkways so they are spaced to allow light penetration to the foreshore;
11. do not use rubber tires as floatation system components for proposed floating dock sections as they are known to produce extracts that are toxic to fish and aquatic invertebrates; and,
12. minimize shading from access ramps or walkways by elevating them as high as possible above the surface of the water and designing them to be as narrow as possible.

Operational BMPs

13. minimize disruption to habitat by ensuring construction or maintenance activities do not include dredging, blasting and/or placement of fill below the waterbody high water mark (HWM);
14. conduct pile driving from a floating structure (i.e. a barge) so that disturbance to the waterbody bottom is prevented, if required for construction or maintenance, where feasible;
15. if pile driving activities are required to be conducted from a barge, ensure activities adhere to the following:
    - sufficient water must be present to prevent the barge from grounding on the foreshore;
    - minimize the use of barge stabilizing spuds and their disturbance to the foreshore;
    - fully restore any foreshore areas disturbed by barge stabilizing spuds by hand, in the dry, and during low water; and,
    - during maintenance or construction prop scour of the foreshore must not occur from tending vessel(s). This may require maneuvering of barges in shallow water with ropes tied to shore and/or pilings.
16. ensure construction activities involving pile driving are monitored on a full-time basis by an appropriately Qualified Professional (QP). Fish exclusion should be employed at the discretion of the QP;
17. replace or relocate rocks, stumps or logs required to be moved from the waterbody bottom or foreshore during construction to an area of similar depth. Do not remove materials altogether from the bottom or foreshore;
18. use inert or untreated materials (e.g. fir, cedar, hemlock) as supports for structures that are to be submerged in water. Treated lumber must not be used as it may contain compounds that can be released into the water and become toxic to the aquatic environment;
19. cut, seal and stain (non-toxic) all lumber away from the water and ensure it is completely dry before used near water;
20. ensure plastic barrel floats are free of any chemicals inside and outside of the barrel before they are placed in water;

21. install concrete abutments entirely on land above the high water mark (HWM) if required to secure structures; and,
22. prevent deleterious substances such as uncured concrete, grout, paint, sediment and preservatives from entering the waterbody foreshore areas or stormdrains.

6.0 CONCLUSIONS

G3 Consulting Ltd. (G3) was retained to conduct a marine biophysical assessment of the foreshore and subtidal zone of a proposed pier and dock structure as part of a new Canadian Coast Guard (CCG) facility in Port Hardy, BC. In addition, a risk assessment of the proposed works on the marine habitat was conducted to determine the suitability of the selected site. Five (5) transects were established at the High High Water Mark (HHWM) and extended out, perpendicular to the foreshore, to the end of the water lot to cover the water lot boundary area (Figure 3, Appendix 1).

Biophysical habitat data (substrate, flora and fauna) and video footage was collected, reviewed and provided a comprehensive assessment of habitat quality in the area. The site encompassed a gently sloping sandy beach with large areas of flat bedrock, cobble and boulder, extending through the intertidal and subtidal areas of the site. Areas of boulder, cobble and gravel substrate exhibited the most abundant and diverse communities, with areas of sand and fine sediment exhibiting less diverse and less abundant biota, with the exception of areas where eelgrass was noted growing over sandy substrate.

A Risk Assessment was conducted for proposed construction and an overall Project Risk assigned based on potential effects from the project to the marine environment. The scale of potential effects and the sensitivity of fish and fish habitat were then assigned. While the habitat in the area of the proposed water lot boundary was considered to be of high quality and supported a diverse array of marine flora and fauna, the scale of potential negative effects posed by the project on fish and fish habitat was generally ranked Low to Medium given the minimal extent, duration and intensity of perceived effects. The sensitivity of the habitat was given a rank of High due to the presence of eelgrass, a sensitive and important marine habitat.

Risk to the marine habitat could be potentially further reduced through selection and application of appropriate mitigation measures. The proposed project design would have limited direct impact to the substrate, and risk to impacting eelgrass from shading, or direct damage could be reduced if designed and installed considerate of avoiding and protecting sensitive habitat by employing appropriate BMPs. Installation of pilings and anchors should avoid eelgrass beds. Eelgrass beds were noted along all transects surveyed during this assessment along a band running southeast so transition of structures across these areas should be feasible. The proposed design potentially positions the CCG float above patches of eelgrass. If possible the float should be relocated further to the northeast to avoid the eelgrass (Figure 4, Appendix 1). Design and installation should take all precautions necessary to reduce potential shading or grounding impacts. If damage to eelgrass beds cannot be avoided, potential compensation for potential short or longer term habitat loss should be considered.

The project, as proposed, includes a site with highly sensitive habitat and low risk of impact, where implemented in accordance with BMPs/mitigation strategies identified in this report. Based on the criteria used in the Risk Assessment Framework, an overall project risk of ‘Low to Medium’ was assigned.

7.0 LITERATURE SOURCES

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Appendices

Appendix 1 – Figures
Appendix 2 – Photos
Appendix 3 – Tables

Appendix 1

Figures

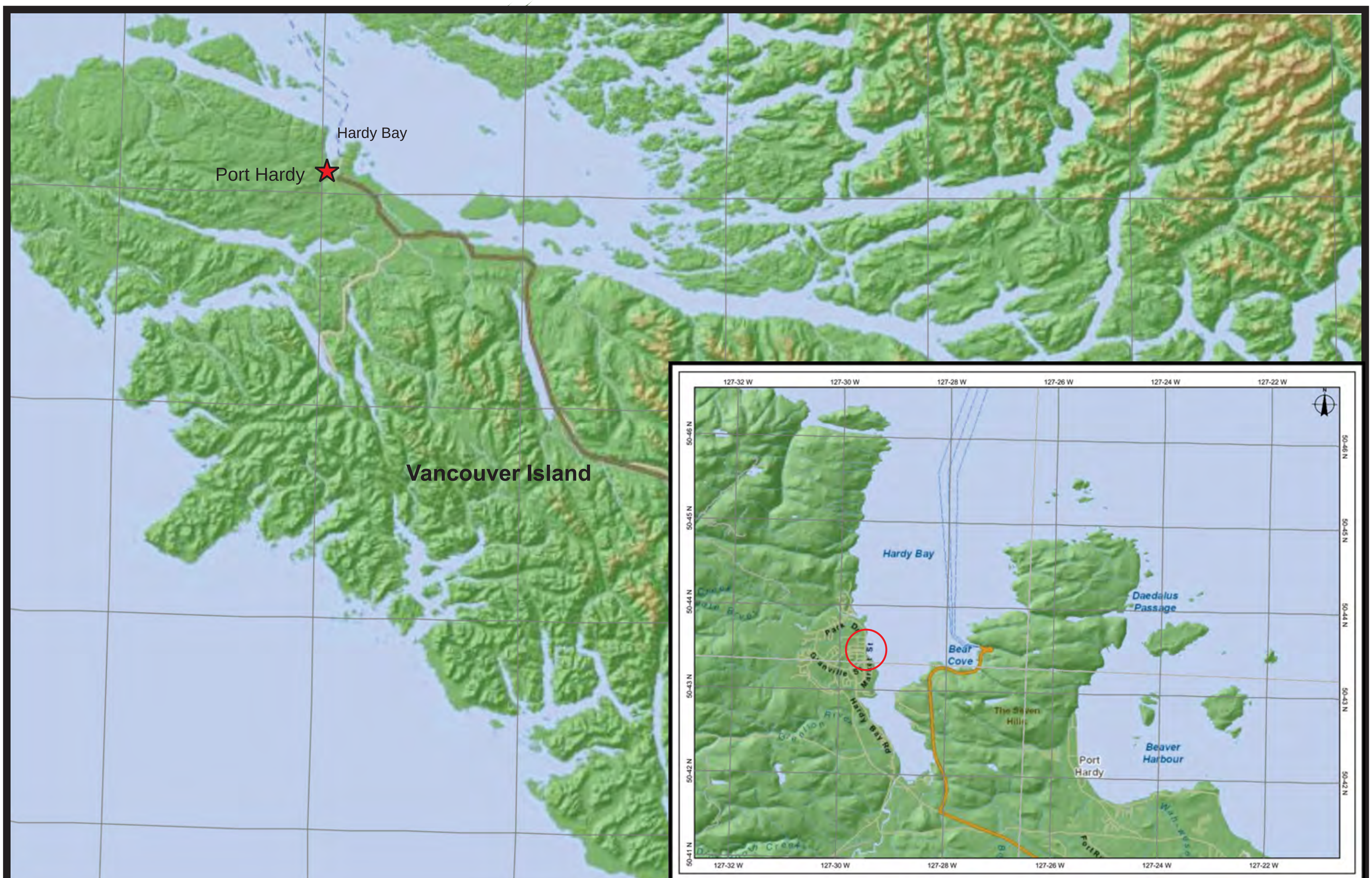

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Figure 1: Proposed Development Site Overview
Imagery Source: iMapBC; Basemap 1:1,000,000; Insert 1:60,000
Created: January, 2013
Created by AC
Datum: NAD83

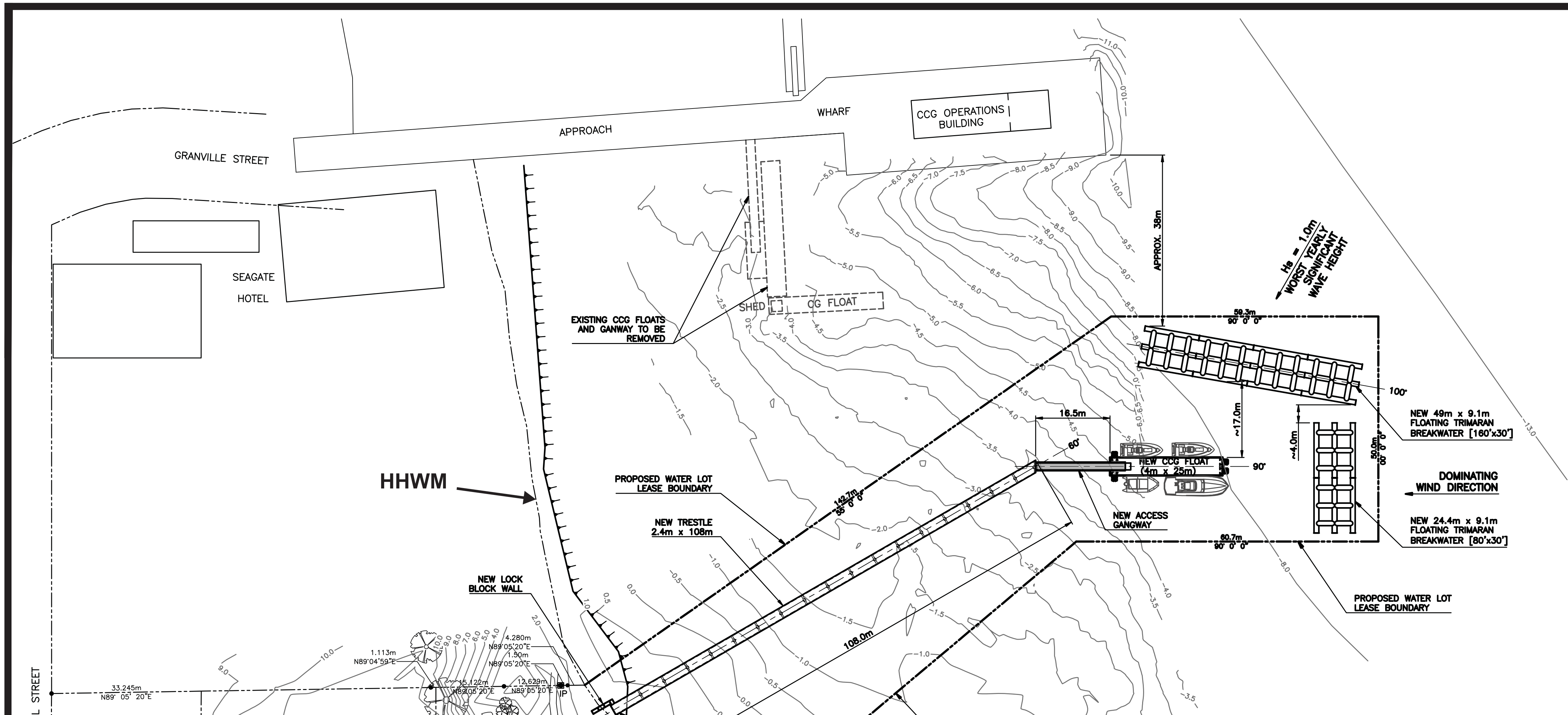

Photo 1: Looking northeast at existing CCG facility

Photo 2: Looking south at foreshore and Transect 5 POC marker from HHWM

Photo 3: Looking north at foreshore and existing CCG building from Transect 5 POC marker

Photo 4: Looking northeast at survey area from Transect 5 POC marker

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Figure 2: Site Schematic

Created: January, 2013
Created By: AC
Datum: NAD83
Depth (m corrected to Mean Sea Level [MSL] chart datum)

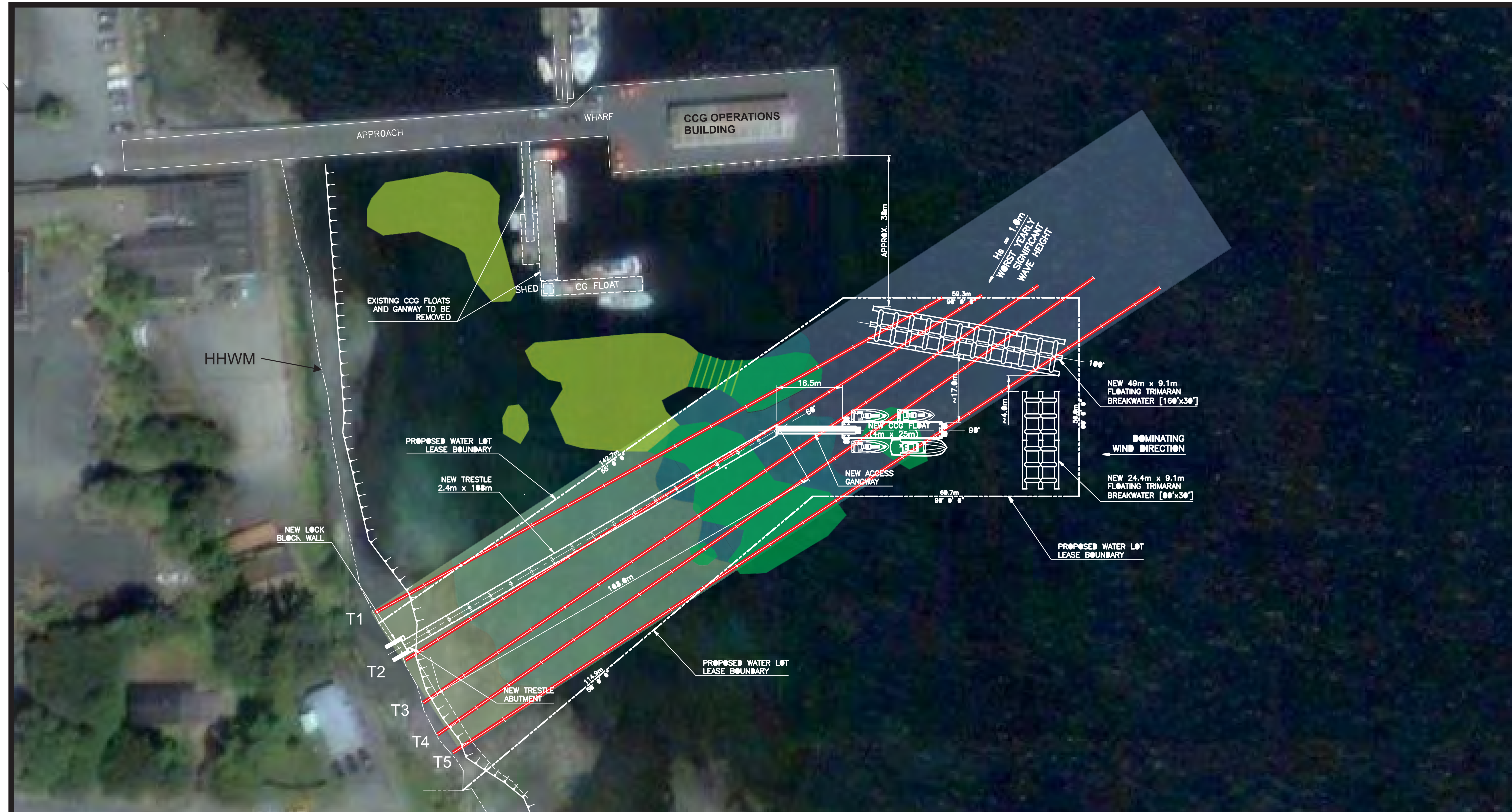

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Figure 3: Transect Observations

Created: January, 2013
Created By: AC
Datum: NAD83

Legend:
- Approximate Zone of Eelgrass (2012 observations)
- Eelgrass (2010 observations) (Pacificus 2010)
- Suspected zone of Eelgrass
- Upper Intertidal Zone
- Mid Intertidal Zone
- Lower Intertidal Zone
- Subtidal Zone
- Transects
- Water Lot Boundary
- HHWM

0 25 50 100
Meters

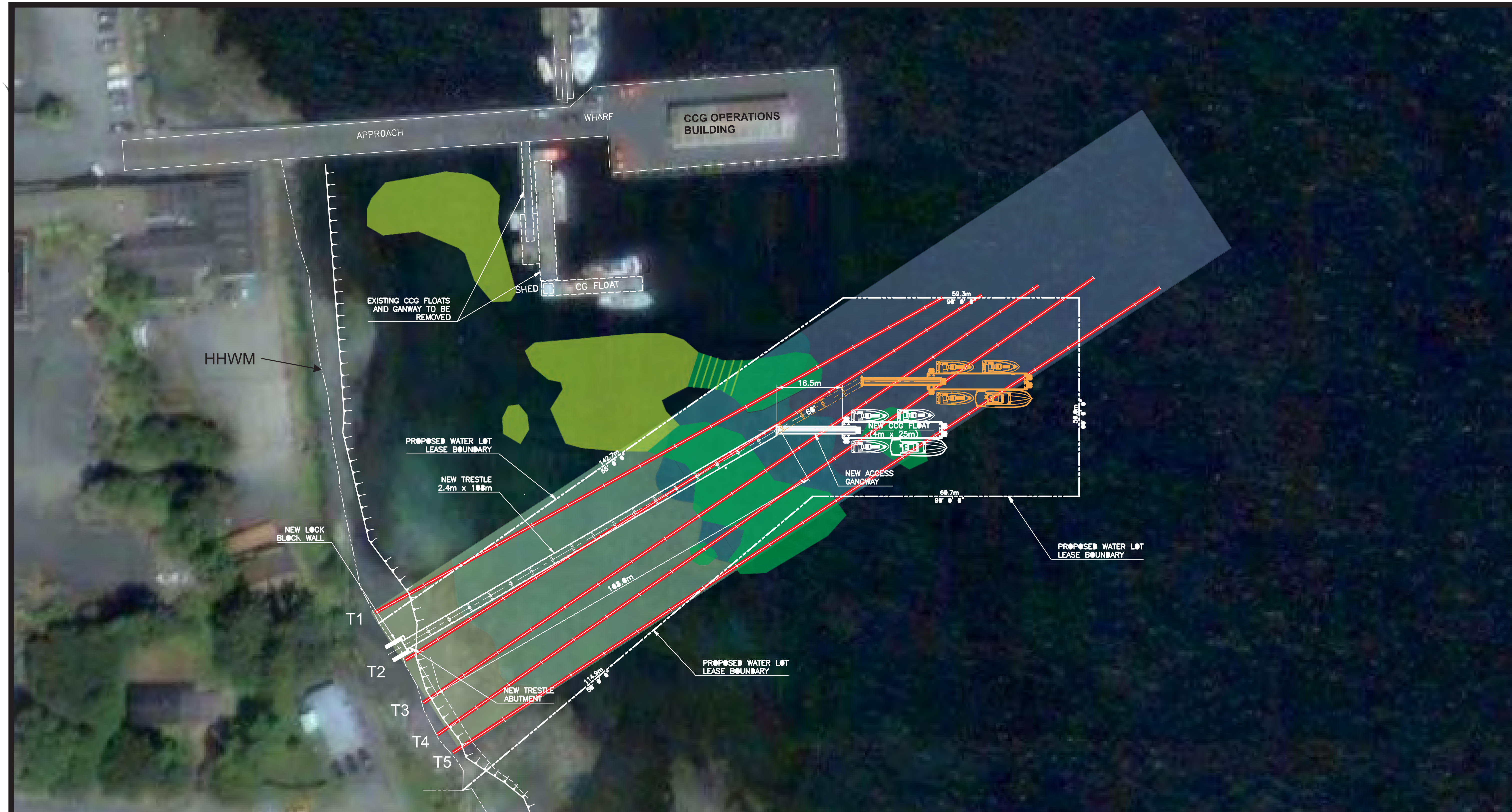

Figure 4: Alternate Siting Alignment

Created: February, 2013
Created By: AC
Datum: NAD83

Legend:

- Approximate Zone of Eelgrass (2012 observations)
- Eelgrass (2010 observations) (Pacificus 2010)
- Suspected zone of Eelgrass
- Upper Intertidal Zone
- Mid Intertidal Zone
- Lower Intertidal Zone
- Subtidal Zone
- Transects
- Water Lot Boundary
- HHWM

0 25 50 100
Meters

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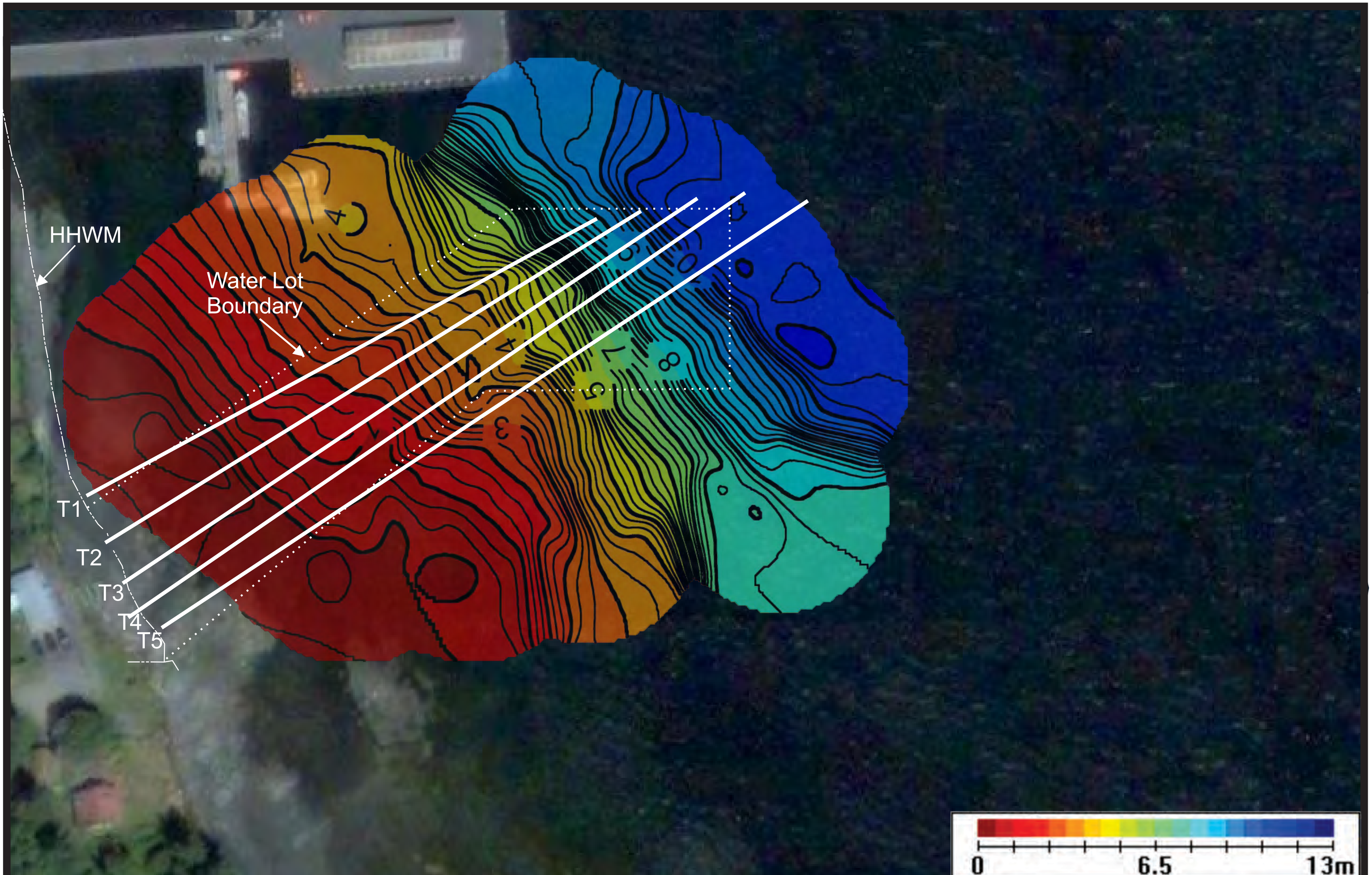

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Figure 5: Bathymetry
Created: January, 2013
Created by AC
Datum: NAD83

Appendix 2

Photos

Appendix 2-1: Site Overview

Photo 1: Looking northeast from foreshore towards existing Canadian Coast Guard (CCG) dock and Seagate Warf (December 18, 2012)

Photo 2: Looking north at foreshore of site from Transect 3 (December 19, 2013)

Photo 3: Looking northeast at the water lot boundary and Transect 3 layout (December 19, 2012)

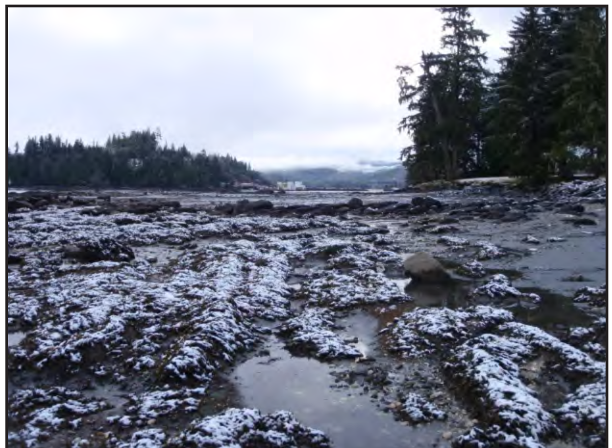

Photo 4: Looking south at foreshore of water lot boundary from Transect 3 (December 19, 2013)

Photo 5: Looking southwest at foreshore and current CCG accommodation building from Transect 3 (December 19, 2012)

Photo 6: Looking southwest at water lot boundary from current CCG dock (December 20, 2012)

Appendix 2-2: Transect 1 Overview

Photo 7: Transect 1 (0 m); looking northeast at transect foreshore and SCUBA survey vessel (December 18, 2012)

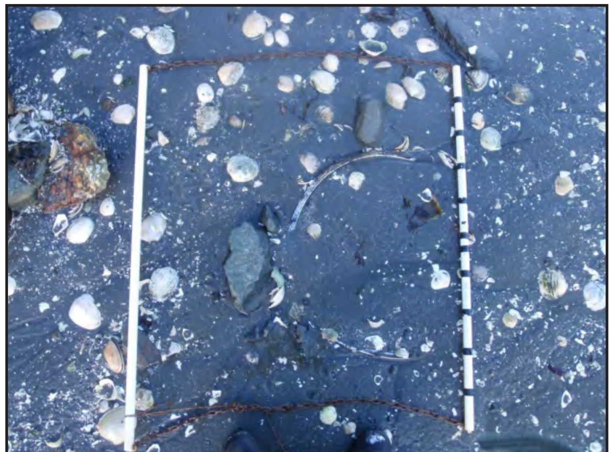

Photo 8: Transect 1 (10 m); Upper Intertidal Zone; looking at sand and shell hash substrate (December 18, 2012)

Photo 9: Transect 1 (30 m); Mid Intertidal Zone; looking southwest at foreshore from waters edge (December 18, 2012)

Photo 10: Transect 1 (30 m); Mid Intertidal Zone; looking at quadrat with rockweed (December 18, 2012)

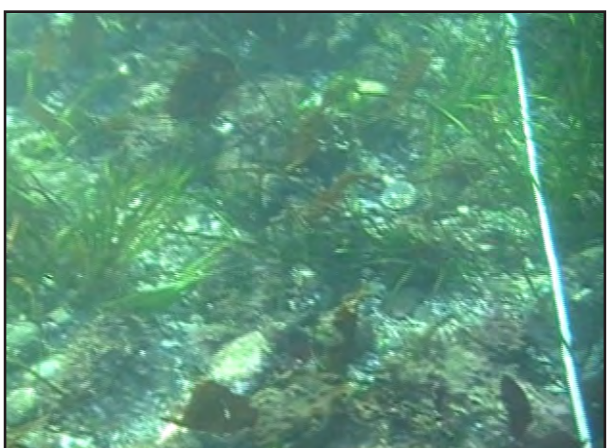

Photo 11: Transect 1 (90 m); Lower Intertidal Zone; looking at substrate with eelgrass present (December 18, 2012)

Photo 12: Transect 1 (95 m); Lower Intertidal Zone; looking at kelp directly south of transect line (December 18, 2012)

Appendix 2-2: Transect 1 Overview

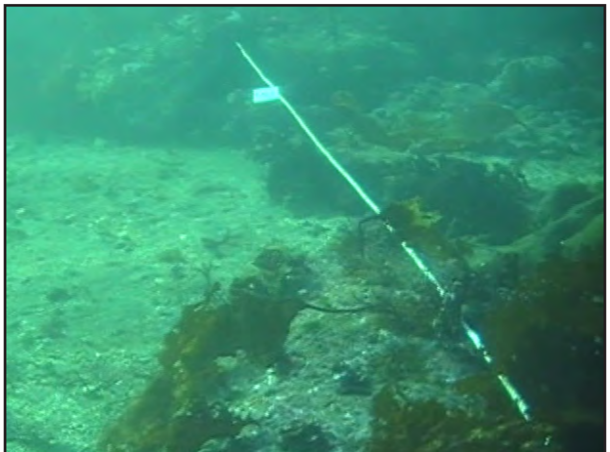

Photo 13: Transect 1 (135 m); Subtidal Zone; looking at silt/sand and boulder substrate (December 18, 2012)

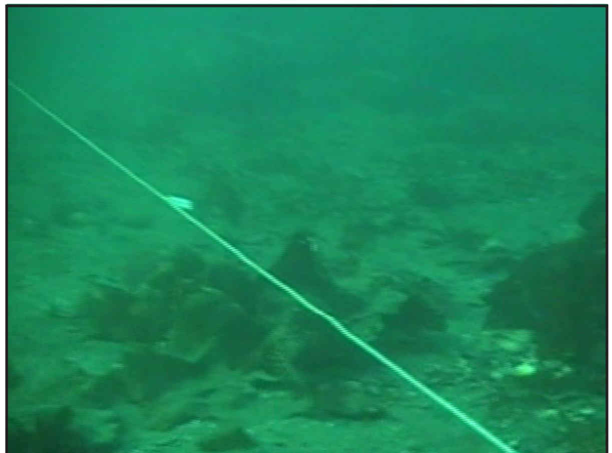

Photo 14: Transect 1 (150 m); Subtidal Zone; looking at silt substrate (December 18, 2012)

Photo 15: Transect 1 (140 m); Subtidal Zone; looking at small (~1 m tall) rock wall (December 18, 2012)

Photo 16: Transect 1 (95 m); Subtidal Zone; looking at rock crabs observed along transect (December 18, 2012)

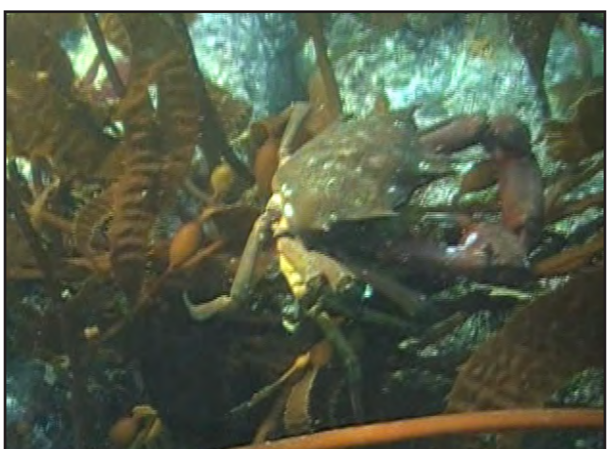

Photo 17: Transect 1 (95 m); Subtidal Zone; looking at kelp crab observed along transect (December 18, 2012)

Photo 18: Transect 1 (125 m); Subtidal Zone; looking at frosted nudibranch observed along transect (December 18, 2012)

Appendix 2-2: Transect 2 Overview

Photo 19: Transect 2 (0 m); looking at area above HHWM and transect HHWM marker (December 18, 2012)

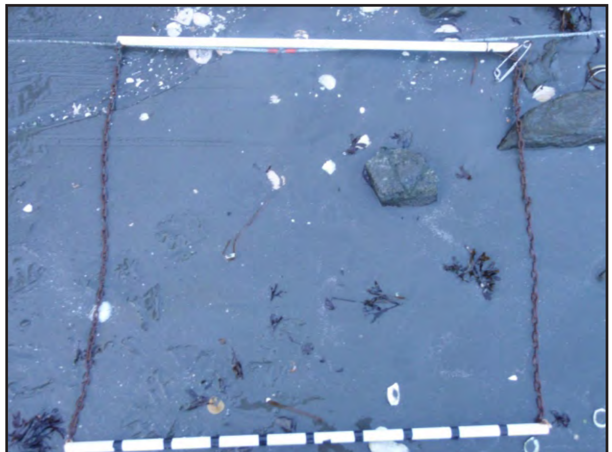

Photo 20: Transect 2 (10 m); Upper Intertidal Zone; looking at sand substrate (December 18, 2012)

Photo 21: Transect 2 (30 m); Mid Intertidal Zone; looking at rockweed covering substrate (December 18, 2012)

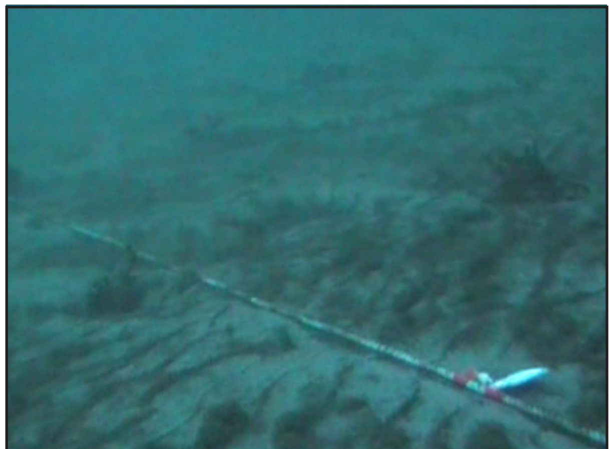

Photo 22: Transect 2 (70 m); Mid Intertidal Zone; looking at silt substrate (December 18, 2012)

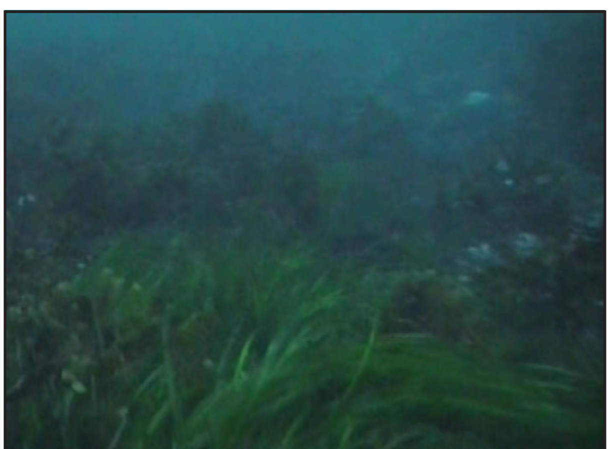

Photo 23: Transect 2 (85 m); Lower Intertidal Zone; looking at eelgrass covering substrate (December 18, 2012)

Photo 24: Transect 2 (105 m); Lower Intertidal Zone; looking at eelgrass covering substrate (December 18, 2012)

Appendix 2-2: Transect 2 Overview

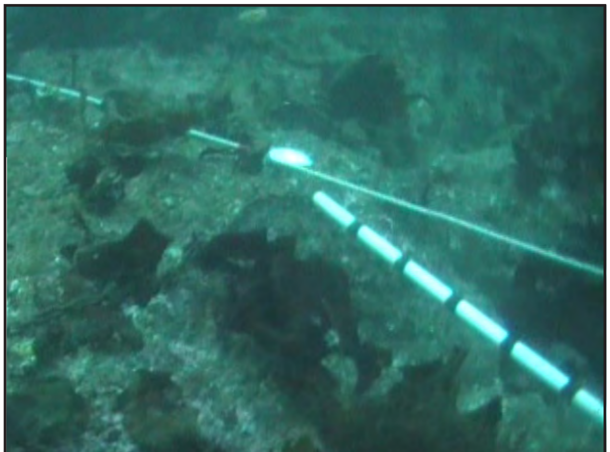

Photo 25: Transect 2 (120 m); Subtidal Zone; looking at boulder substrate (December 18, 2012)

Photo 26: Transect 2 (150 m); Subtidal Zone; looking at small (~1 m) rock wall (December 18, 2012)

Photo 27: Transect 2 (~180 m); Subtidal Zone; looking at boulder substrate (December 18, 2012)

Photo 28: Transect 2 (120 m); Subtidal Zone; looking at kelp growing near transect line (December 18, 2012)

Photo 29: Transect 2 (150 m); Subtidal Zone; looking at giant pink seastar observed along transect (December 18, 2012)

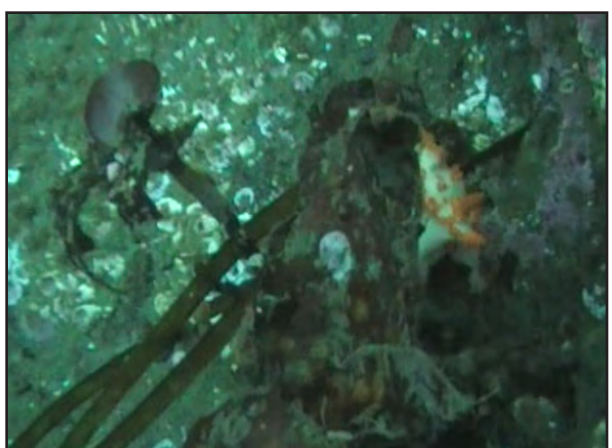

Photo 30: Transect 2 (130 m); Subtidal Zone; looking at clown nudibranch observed along transect (December 18, 2012)

Appendix 2-2: Transect 3 Overview

Photo 31: Transect 3 (0 m); Upper Intertidal Zone; looking at foreshore and transect marker from HHWM (December 19, 2012)

Photo 32: Transect 3 (5 m); Upper Intertidal Zone; looking at riprap wall and CCG building behind HHWM (December 19, 2012)

Photo 33: Transect 3 (20 m); Mid Intertidal Zone; looking at bedrock substrate (December 19, 2012)

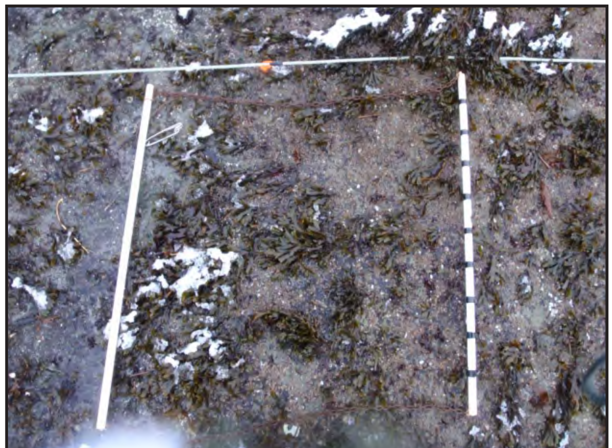

Photo 34: Transect 3 (35 m); Upper Intertidal Zone; looking at bedrock substrate and rockweed (December 19, 2012)

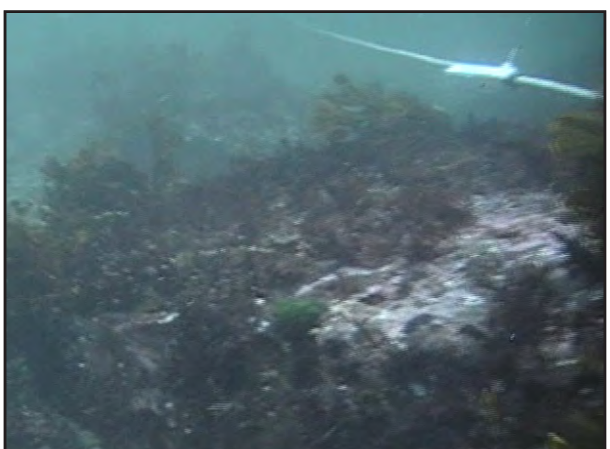

Photo 35: Transect 3 (80 m); Lower Intertidal Zone; looking at boulder substrate and various flora (December 19, 2012)

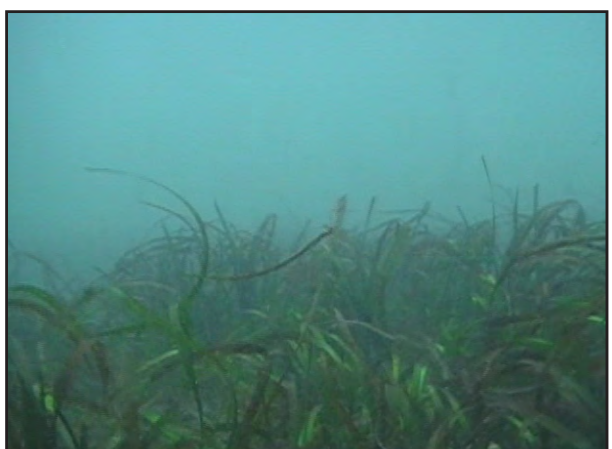

Photo 36:Transect 3 (105 m); Lower Intertidal Zone; looking at eelgrass covering substrate (December 19, 2012)

Appendix 2-2: Transect 3 Overview

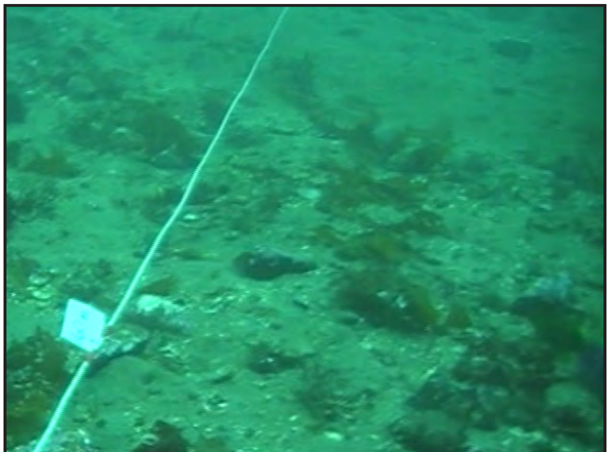

Photo 37: Transect 3 (160 m); Subtidal Zone; looking at silt and boulder substrate (December 19, 2012)

Photo 38: Transect 3 (180 m); Subtidal Zone; looking at silt substrate and giant pink seastar (December 19, 2012)

Photo 39: Transect 3 (90 m); Subtidal Zone; looking red Irish Lord hiding amongst boulder and eelgrass (December 19, 2012)

Photo 40: Transect 3 (120 m); Subtidal Zone; looking at lemon peel nudibranch on boulder substrate (December 19, 2012)

Photo 41: Transect 3 (150 m); Subtidal Zone; looking at bedrock wall (December 19, 2012)

Photo 42: Transect 3 (183 m); Subtidal Zone; looking at end of transect and pipeline (December 19, 2012)

Appendix 2-2: Transect 4 Overview

Photo 43: Transect 4 (0 m); Upper Intertidal Zone; looking northeast at transect foreshore (December 19, 2012)

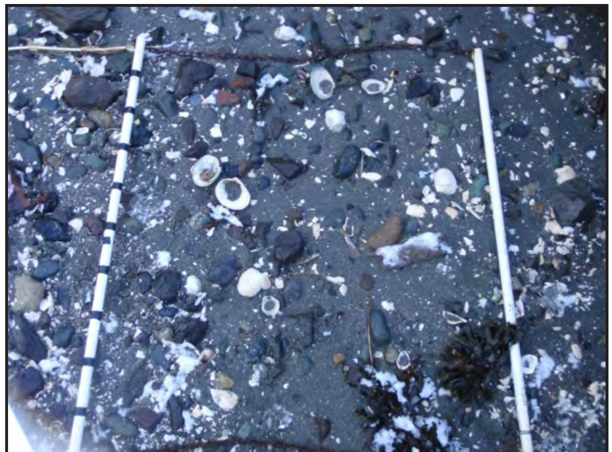

Photo 44: Transect 4 (10 m); Upper Intertidal Zone; looking at sand and cobble substrate (December 19, 2012)

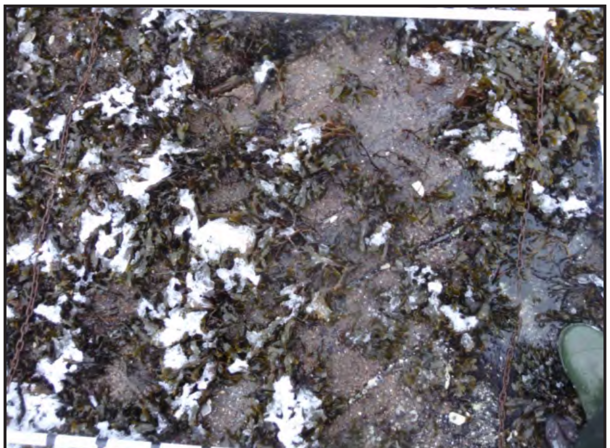

Photo 45: Transect 4 (35 m); Mid Intertidal Zone; looking at bedrock substrate and rockweed (December 19, 2012)

Photo 46: Transect 4 (50 m); Mid Intertidal Zone; looking at bedrock substrate (December 19, 2012)

Photo 47: Transect 4 (80 m); Lower Intertidal Zone; looking at bedrock substrate (December 19, 2012)

Photo 48: Transect 4 (110 m); Lower Intertidal Zone; looking at eelgrass covering substrate (December 19, 2012)

Appendix 2-2: Transect 4 Overview

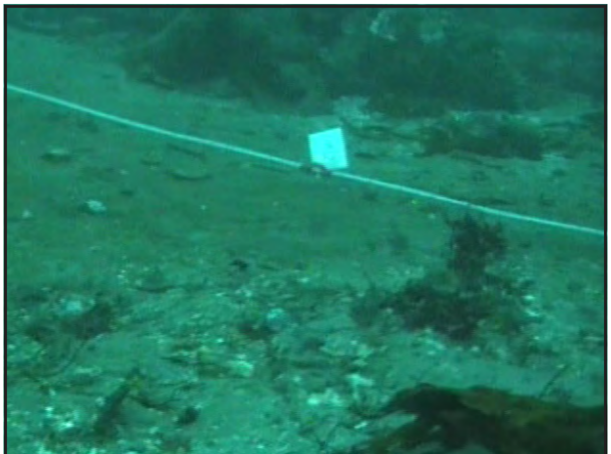

Photo 49: Transect 4 (160 m); Subtidal Zone; looking at silt substrate (December 19, 2012)

Photo 50: Transect 4 (200 m); Subtidal Zone; looking at silt and cobble substrate (December 19, 2012)

Photo 51: Transect 4 (120 m); Subtidal Zone; looking at sculpin hiding in boulder substrate (December 19, 2012)

Photo 52: Transect 4 (150 m); Subtidal Zone; looking at sandrose anemone (December 19, 2012)

Photo 53: Transect 4 (140 m); Subtidal Zone; looking at hooded nudibranchs covering eelgrass (December 19, 2012)

Photo 54: Transect 4 (145 m); Subtidal Zone; looking at small (~1 m tall) rockwall (December 19, 2012)

Appendix 2-2: Transect 5 Overview

Photo 55: Transect 5 (0 m); Upper Intertidal Zone; looking at transect foreshore from HHWM (December 20, 2012)

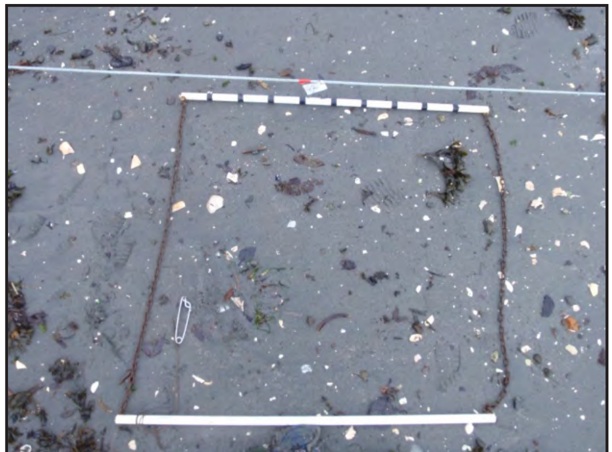

Photo 56: Transect 5 (10 m); Upper Intertidal Zone; looking at sand substrate (December 20, 2012)

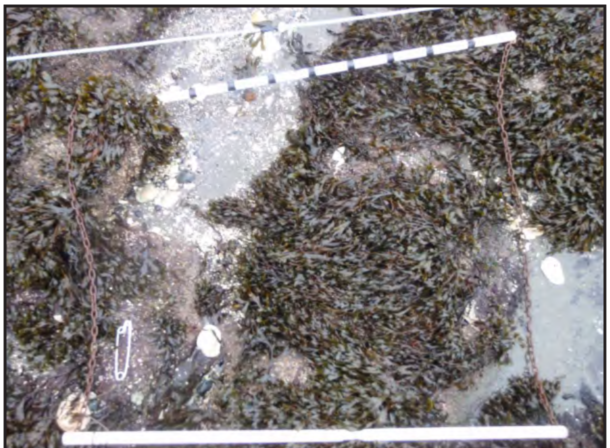

Photo 57: Transect 5 (30 m); Mid Intertidal Zone; looking at bedrock substrate and rockweed (December 20, 2012)

Photo 58: Transect 5 (70 m); Mid Intertidal Zone; looking southwest at foreshore (December 20, 2012)

Photo 59:Transect 5 (80 m); Lower Intertidal Zone; looking at bedrock substrate covered in various flora (December 20, 2012)

Photo 60: Transect 5 (110 m); Lower Intertidal Zone; looking at eelgrass covering substrate (December 20, 2012)

Appendix 2-2: Transect 5 Overview

Photo 61: Transect 5 (135 m); Subtidal Zone; looking at kelp and anemone observed along transect (December 20, 2012)

Photo 62:Transect 5 (200 m); Subtidal Zone; looking at silt substrate (December 20, 2012)

Photo 63: Transect 5 (165 m); Subtidal Zone; looking at giant pacific octopus beneath bedrock overhang (December 20, 2012)

Photo 64: Transect 5 (115 m); Lower Intertidal Zone; looking at kelp crab in coralline algae (December 20, 2012)

Photo 65: Transect 5 (190 m); Subtidal Zone; looking at pipeline running accross transect (December 20, 2012)

Photo 66:Transect 5 (0 m); looking at culvert and mouth of small (1 m wetted width) stream south of transect 5, adjacent to HHWM (December 20, 2012)

Appendix 3

Tables

TABLE 1: Transect 1 Biophysical Observations

TRANSECT 1		Upper Intertidal Zone				Mid Intertidal Zone							Lower Intertidal Zone				Sub Tidal Zone				
	Distance (m)	0	5	10	15	20	25	30	40	50	60	70	80	90	100	110	120	130	140	150	155
	Time	12:50	12:55	13:00	13:05	13:10	13:15	13:25	13:27	13:25	13:22	13:20	13:17	13:12	13:08	13:05	13:02	12:58	12:53	12:48	12:45
	Corrected Depth (m)	0	0	0	0.0	0.0	0.0	0.0	0.7	1.0	1.3	1.3	2.2	2.2	2.8	2.8	3.5	4.4	5.9	7.1	8.0
Substrate	Silt													20	100	100	100	100		100	100
	Sand			90	10	40		10		70	90	70	100								
	Gravel		50	10				10													
	Cobble		40			10				20	10	30									
	Boulder		10							10				80					5		
	Bedrock				90	50	100	80	100										95		
Flora	Rockweed					40	10	60	70												
	Sea lettuce						10	2		30	15	20									
	Sea moss						2														
	Sea sacs																				
	Eelgrass beds													5	20	10	10				
	Encrusting coralline algae													5							
	flamentous green algae				5	15	10	2													
	filamentous brown algae						10														
	analipus sp.						40														
	Stringy Algae												5		10	30	10				
	Wrack kelp										10			5				5	5		5
	feather coraline algae													5							
	turkish towel													5							
	Macrocystis integrifolia																				
Fauna	Acorn barnacle		5			30	5	70	10%		5%	5%					5%		10%		
	Thatched barnacle																				
	Aggregating anemone								5	15	6										
	limpit																				
	kelp crab																				
	lemon peel nudibranch																				
	whelk																				
	encrusting sponge																				
	pacific sea peach																				
	spot prawn																				
	burrowing anemone												1	1							
	fish eating anemone																				
	pychnopodia																				
	purple star																				
	hermit crab									1		1			1					1	1
	porcelin crab																				
	copper rockfish																				
	giant pacific octopus																				
	california seacucumber																				
	yellow dorid																				
	leopard dorid																				
	unid. Dorid																				
	longfin sculpin																				
	coonstripe shrimp																				
	goby																		1		
	black tail shrimp																				
	decorator crab																		1		
	red irish lord																				
	giant pink starfish																				
	chiton																1				
	unid. Orange sponge																				
	feather duster worm																				
	shrimp																	1	1	1	1
	giant sculpin																				
	buffalo sculpin																				
	gunnel															1					

TABLE 2: Transect 2 Biophysical Obersvations

TRANSECT 2		Upper Intertidal Zone			Mid Intertidal Zone						Lower Intertidal Zone				Sub Tidal Zone						
	Distance (m)	0	5	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	176
	Time	15:50	16:00	16:03	16:36	16:33	16:31	16:29	16:27	16:26	16:23	16:20	16:16	16:13	16:09	16:06	16:02	15:59	15:55	15:53	15:50
	Corrected Depth (m)	0	0	0	-1.0	-0.7	-0.7	0.2	0.8	0.8	1.4	1.4	2.1	2.7	3.3	3.9	4.8	6.6	7.5	8.8	9.7
Substrate	Silt										60				20	70	5	100	60	75	90
	Sand		100	95	100					100											
	Gravel																				
	Cobble			5							40			10						25	
	Boulder												80		80	30			40		10
	Bedrock					100	100	100				100	20	90			95				
Flora	Rockweed					70	20	15	10		20	5									
	Sea hair																				
	Sea moss																				
	Sea sacs																				
	Eelgrass beds											40	15								
	Encrusting coralline algae											5								10	10
	flamentous green algae																				
	filamentous brown algae																				
	analipus sp.																				
	Stringy Algae						10				5	5	20	15	10	10					
	Wrack kelp												10	15	10	10	5		10	10	10
	feather coraline algae												20	2							
	turkish towel																				
	Macrocystis integrifolia																				
Fauna	Acorn barnacle					10%	1%	5%	1%		1%				1%						
	Thatched barnacle																				
	Aggregating anemone																				
	limpit																				
	kelp crab														1					1	
	lemon peel nudibranch																			1	
	whelk															1			1		
	encrusting sponge													1	1	1			1		
	pacific sea peach																		1		
	spot prawn														1				1		
	burrowing anemone							1	20							1					
	fish eating anemone														1						
	pychnopodia													1							
	purple star												1								
	hermit crab												1								
	porcelin crab												1								
	copper rockfish																				
	giant pacific octopus																				
	california seacucumber																				
	yellow dorid																				
	leopard dorid																				
	unid. Dorid																				
	longfin sculpin																				
	coonstripe shrimp																				
	goby																				
	black tail shrimp																				
	decorator crab																				
	red irish lord																				
	giant pink starfish																				
	chiton																				
	unid. Orange sponge																				
	feather duster worm																				
	shrimp																				
	giant sculpin																				
	buffalo sculpin																				
	gunnel																				

TABLE 3: Transect 3 Biophysical Observations																										
TRANSECT 3		Upper Intertidal Zone				Mid Intertidal Zone									Lower Intertidal Zone				Subtidal Zone							
	Distance (m)	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120	130	140	150	160	170	180	183
	Time	12:20	12:25	12:28	12:30	12:32	12:36	12:40	12:43	12:45	12:51	13:01	12:57	12:54	12:52	12:49	12:45	12:41	12:36	12:33	12:29	12:26	12:24	12:21	12:15	12:12
	Corrected Depth (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.6	1.6	1.6	2.2	2.2	2.8	3.4	3.4	4.7	6.8	8.0	8.9	10.1	10.8
Substrate	Silt																		15	35	25	10	75	10	75	90
	Sand		95	95		30	30	90		60	50		60	100	15	5										
	Gravel			5	5		20																			
	Cobble						10			5			40		60											10
	Boulder		5				30	10		5					25		20		85	65			25	90	25	
	Bedrock				95	70	10		100	30	50	100				90	80	100			75	90				
Flora	Rockweed					5	30	10	60	10	2		5													
	Sea hair									2	5	10														
	Sea moss																									
	Sea sacs											5														
	Eelgrass beds														15	15	10									
	Encrusting coralline algae																		5		5					
	flamentous green algae					2	2																			
	filamentous brown algae					5	2																			
	analipus sp.									2	2	60			15	15										
	Stringy Algae																			10					10	15
	Wrack kelp																	25	10	10	5		10	5	15	20
	feather coraline algae																10	25	10	10	2					
	turkish towel																10		10							
	Macrocystis integrifolia																									
Fauna	Acorn barnacle						10	5	90	10			5%		5%	5%	5%	10%	5%	5%			5%		5%	
	Thatched barnacle																									
	Aggregating anemone																									
	limpit																1									
	kelp crab																			1			1			
	lemon peel nudibranch																									
	whelk																									
	encrusting sponge																						1		1	
	pacific sea peach																									
	spot prawn																							1		1
	burrowing anemone													3								1				
	fish eating anemone																1									
	pychnopodia																		1							
	purple star																									
	hermit crab																								1	
	porcelin crab																									
	copper rockfish																									1
	giant pacific octopus																							1		
	california seacucumber																							1		
	yellow dorid																							1		
	leopard dorid																						1			
	unid. Dorid																	1								
	longfin sculpin																				1					
	coonstripe shrimp																				2					
	goby																				1					
	black tail shrimp																			1						
	decorator crab																	1								
	red irish lord															1										
	giant pink starfish																									
	chiton																									
	unid. Orange sponge																									
	feather duster worm																									
	shrimp																									
	giant sculpin																									
	buffalo sculpin																									
	gunnel																									

TABLE 4: Transect 4 Biophysical Observations																											
	TRANSECT 4	Upper Intertidal Zone				Mid Intertidal Zone									Lower Intertidal Zone				Subtidal Zone								
	Distance (m)	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
	Time		14:45	14:30	13:21	13:24	13:22	13:20	13:18	13:15	13:12	13:08	16:12	16:10	16:07	16:03	16:01	15:59	15:56	15:53	15:50	15:47	15:45	15:43	15:39	15:36	15:33
	Depth Corrected (m)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	1.3	1.6	2.9	2.9	4.1	4.7	6.5	7.7	8.6	9.6	10.8	11.7
Substrate	Silt													90			20	50	20	70	100	95	100	100	80	100	90
	Sand			80	90	50	70	70		10		30	100														
	Gravel																										
	Cobble			20	10							10				40	40								20		10
	Boulder									10				10			40	50	80	30		5					
	Bedrock					50	30	30	100	80	100	60			100	60											
Flora	Rockweed						30	50	70	20	5	30			10	5											
	Sea hair										2																
	Sea moss																										
	Sea sacs																										
	Eelgrass beds																10			5							
	Encrusting coralline algae														10		10	10	5								
	flamentous green algae									5	10																
	filamentous brown algae																										
	analipus sp.							10		10	50	50			10	5											
	Stringy Algae																10				5	5	5			20	
	Wrack kelp																	10		5				5	10	5	5
	feather coraline algae																	10	10	5							
	turkish towel																										
	Macrocystis integrifolia																	10									
Fauna	Acorn barnacle							30	80	10		5		5%	10%			10%	10%	5%						5%	
	Thatched barnacle																										
	Aggregating anemone													3													
	limpit															5											
	kelp crab																										
	lemon peel nudibranch																										
	whelk																1										
	encrusting sponge																								1	1	
	pacific sea peach																										
	spot prawn																					1					1
	burrowing anemone																							1			
	fish eating anemone																										
	pychnopodia																										
	purple star																										
	hermit crab																							1			
	porcelin crab																										
	copper rockfish																										
	giant pacific octopus																										
	california seacucumber																								1		
	yellow dorid																										
	leopard dorid																										
	unid. Dorid																										
	longfin sculpin																										
	coonstripe shrimp																										
	goby																					1					
	black tail shrimp																										
	decorator crab																										
	red irish lord																										
	giant pink starfish														1												1
	chiton																									1	
	unid. Orange sponge																					1					
	feather duster worm																					1					
	shrimp																			1							
	giant sculpin																		1								
	buffalo sculpin																										
	gunnel																										

TABLE 5: Transect 5 Biophysical Observations

	TRANSECT 5	Upper Intertidal Zone				Mid Intertidal Zone										Lower Intertidal Zone				Subtidal Zone									
	Distance (m)	0	5	10	15	20	25	30	35	40	45	50	55	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210
	Time		11:04	11:06	11:09	11:11	11:13	11:16	11:20	11:25	11:26	11:28	11:31	11:37	11:40	11:39	11:37	11:34	11:31	11:27	11:25	11:22	11:19	11:16	11:14	11:11	11:08	11:06	11:04
	Corrected Depth (m)	0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.8	1.3	1.3	1.9	2.5	3.1	4.4	6.2	7.1	8.3	8.9	10.5	11.1	12.0	12.9
Substrate	Silt																			85	100	100	100	95	90	75	100	90	85
	Sand		100	100	60	40	40	10	40		80	20		10															
	Gravel						20	5						80															
	Cobble											40				30	30												
	Boulder										20	40		10			25			15				5	10	25		10	15
	Bedrock				40	60	40	85	60	100			100			70	45	100	100										
Flora	Rockweed					5	40	70	20	90	20	20	20	10	40		20												
	Sea hair						2																						
	Sea moss								2																				
	Sea sacs																												
	Eelgrass beds																10		40		2								
	Encrusting coralline algae														10	30	20												
	flamentous green algae							2	2																				
	filamentous brown algae																												
	analipus sp.							2	40							30	10	15											
	Stringy Algae																	5				5	5		2	10		5	
	Wrack kelp																		5	2	2	5	5		2	10	2	5	5
	feather coraline algae																	50	50	2									
	turkish towel																								2				
	Macrocystis integrifolia																												
Fauna	Acorn barnacle						20	70	10	90	10	40	95	10			20%					5%							
	Thatched barnacle												2		60														
	Aggregating anemone												2			40													
	limpit												2			1	1												
	kelp crab																			1								1	
	lemon peel nudibranch																												
	whelk																												
	encrusting sponge																						1			1			1
	pacific sea peach																			1									
	spot prawn																												
	burrowing anemone																					1						1	
	fish eating anemone																							1		1			
	pychnopodia																								1				
	purple star																1												
	hermit crab															1					1							1	
	porcelin crab																												
	copper rockfish																												
	giant pacific octopus																												
	california seacucumber																												
	yellow dorid																												
	leopard dorid																			1									
	unid. Dorid																												
	longfin sculpin																										1		
	coonstripe shrimp																										1		
	goby																												
	black tail shrimp																												
	decorator crab																												
	red irish lord																												
	giant pink starfish																							1					
	chiton																												
	unid. Orange sponge																					1							
	feather duster worm																												
	shrimp																												
	giant sculpin																												
	buffalo sculpin																		1										
	gunnel																												

TABLE 6: Complete Transect Observations Species List		
	Common Name	**Scientific Name**
Flora	Rockweed	*Fucus gardneri*
	Sea lettuce	*Ulva sp.*
	Sea moss	*Cladophora sp.*
	Sea sacs	*Halosaccion glandiforme*
	Eelgrass beds	*Zostera marina*
	Encrusting coralline algae	*Lithothamnion sp.*
	flamentous green algae	N/A
	filamentous brown algae	N/A
	analipus sp.	*analipus sp.*
	Stringy Algae	*Desmarestia sp.*
	Wrack kelp	*Laminaria saccharina*
	feather coraline algae	*corallina sp.*
	turkish towel	*Chondracanthus exasperatus*
	Macrocystis integrifolia	*Macrocystis integrifolia*
Fauna	Acorn barnacle	*Balanus glandula*
	Thatched barnacle	*Semibalanus cariosus*
	Aggregating anemone	*Anthopleura elegantissima*
	limpit	*Lottiidae*
	kelp crab	*Pugettia productus*
	lemon peel nudibranch	*Tochuina gigantea*
	whelk	*Lirabuccinum dirum*
	encrusting sponge	Desmospondiae
	pacific sea peach	*Halocynthia aurantium*
	spot prawn	*Pandalus platyceros*
	burrowing anemone	*Anthopleura artemisia*
	fish eating anemone	*Urticina piscivora*
	pychnopodia	*Pycnopodia helianthoides*
	purple star	*Pisaster ochraceus*
	hermit crab	Pagurus
	porcelin crab	Porcellanidae
	copper rockfish	*Sebastes caurinus*
	giant pacific octopus	*Enteroctopus dofleini*
	california seacucumber	*Parastichopus californicus*
	yellow dorid	*Doris montereyensis*
	leopard dorid	*Diaulula sandiegensis*
	unid. Dorid	Doridoidea
	longfin sculpin	*Jordania zonope*
	coonstripe shrimp	*Pandalus danae*
	goby	*Gobiidae*
	black tail shrimp	*Crago nigricauda*
	decorator crab	*Majoidea*
	red irish lord	*Hemilepidotus hemilepidotus*
	giant pink starfish	*Pisaster brevispinus*
	chiton	*Polyplacophora*
	orange sponge	Desmospondiae
	feather duster worm	Eudistylia
	shrimp	Pandalus
	giant sculpin	*Scorpaenichthys marmoratus*
	buffalo sculpin	*Enophrys bison*
	gunnel	Pholidae

TABLE 7: Other Incidental Observations		
	Common Name	**Scientific Name**
Fauna	Mottled sea star	*Evasterias troschelii*
	Sand rose anemone	*Urticina columbiana*
	Dungeness crab	*Metacarcinus magister*
	Red rock crab	*Cancer productus*
	crenate barnacles	*Balanus crenatus*
	painted greenling	*Oxylebius pictus*
	kelp greenling	*Hexagrammos decagrammus*
	frosted nudibranch	*Dirona albolineata*
	sandrose anemone	*Urticina columbiana*
	rock scallop	*Crassadoma gigantea*
	morning sun star	*Solaster dawsoni*
	blood star	*Henricia leviuscula*
	painted star	*Orthasterias koehleri*
	red sea urchin	*Strongylocentrotus franciscanus*
	blue branching seaweed	*Fauchea laciniata*
	giant keyhole limpit	*Megathura crenulata*
	hooded nudibranch	*Melibe leonina*
	dawson star	*Solaster dawsoni*
	clown nudibranch	*Triopha catalinae*

TABLE 8: Other Observed Wildlife		
	Common Name	**Scientific Name**
Fauna	stellar sea lion	*Eumetopias jubatus*
	pacific loon	*Gavia pacifica*
	western grebe	*Aechmophorus occidentalis*
	common merganser	*Mergus merganser*
	herring gull	*Larus smithsonianus*
	harbour seal	*Phoca vitulina*