A BIOPHYSICAL INVENTORY OF AND HABITAT ASSESSMENT FOR THE INTERTIDAL AND SUBTIDAL FORESHORE OF THE PROPOSED NEW MOORING FACILITY FOR THE CANADIAN NATIONAL RAILWAY ALASKA FERRY SLIP AT PRINCE RUPERT B.C.

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INTRODUCTION

This Habitat Assessment was requested by Canadian National Railway for Department of Fisheries and Oceans. As stated by C.N., in their communication of 23 April, 1996, "the Canadian National Railway owns a ferry slip in Prince Rupert, B.C. which is used to load 45 to 50 rail cars onto a barge for Alaska. The existing mooring wall to which the barge is secured during loading and unloading operations, is in a deteriorated condition and requires rebuilding. Furthermore, to increase car capacity on the barge, it will be necessary to move the mooring wall approximately 28 feet toward the shore." Following the initial habitat survey, the proposed design for the new berthing structure was reviewed and redesigned by C.N. Rail, in order to reduce the overall impact on the marine habitat. The new plan proposes the replacement of the existing creosoted pile and timber structure with a steel pile dolphin structure approximately 7 meters inshore from the face of the existing mooring wall.

The location of the existing mooring wall is shown on Drawing #1 of the enclosed drawing package. The proposed replacement of the existing mooring wall with a steel pile structure and dredging to properly accommodate barges will inevitably lead to disruption of existing intertidal and subtidal habitat and therefore a habitat assessment with a like-for-like habitat replacement plan is required by the Department of Fisheries and Oceans. The area of the intertidal and subtidal foreshore that would be altered by this work is clearly outlined in Drawing #1.

PROPOSED DEVELOPMENT AREA

The existing mooring wall is in need of rebuilding. In addition, in order to make efficient use of the mooring facility C. N . Railway requires more loading space to accommodate more rail cars on the barge. The alignment of the barge relative to the loading ramp is currently off center, due to the location of the current mooring wall. The result of this is poor barge loading space utilization. To correct the alignment, C.N. proposes to build the new steel pile dolphin mooring facility approximately 7 meters shoreward from the existing mooring wall. Some dredging to allow barge mooring at the new facility at all tides is also proposed as described below. The new mooring facility will service the adjoining existing loading ramp and C.N. Rail link and is a necessary improvement for the safety and continued viability of this Alaska Rail Ferry link.

Several designs for the proposed new mooring structure have been considered in detail by C.N. Rail utilizing the space occupied by the existing mooring wall and the adjoining intertidal foreshore (Drawing #1). As stated the design for the proposed new mooring facility has been modified to limit both the area of impact and the degree of impact imposed on the area due to the proposed improvements. The new footprint of the 'impact area' is shown on Drawing # 1. The toe of the proposed development, is clearly outlined and indicates the extent of the proposed intertidal and subtidal foreshore operations.

PROPOSED DEVELOPMENT PLAN

As has already been stated, C.N. has reviewed several designs for the proposed new mooring structure. The current proposal which utilizes a steel pile dolphin structure was considered to be the design which best limits the impact on the marine habitat. The details of the design and construction of the proposed new facility will be provided separately by C.N. However a number of aspects of the proposed development potentially affect the marine habitat and the following discussion reflects our understanding of how these will be dealt with.

The planned improvements include:

- Demolition of the existing timber piled mooring wall and dolphins
- Dredging and excavation to accommodate barge berthing further inshore
- Construction of a new berthing structure further inshore
- Reconstitution of the foreshore (rip rap)

The new berthing structure will be comprised of steel piled dolphins and fenders with interconnecting catwalks. The steel piles will be percussion driven into the sub soils and core drilled into the underlying rock where necessary to achieve appropriate bearing pressures. (see C.N. drawings for details)

The foreshore will be dredged to elevation -2.29 meters below hydrographic datum adjacent to the new dolphins. In shore of the new dolphins, the foreshore will be trimmed to a slope of 1 to 1.5 through most of the area (see insert Drawing # 4) and reinstated with a 1 meter thick capping layer of rip rap rock of minimum 300 mm diameter.

Habitat Impact Analysis of Development Plan

1. Demolition of the Timber Mooring Wall:

The existing mooring wall is a creosoted timber pile structure with treated timber framing and mooring wall. This type of structure diffuses toxic leachates into the water column over time. Its removal and subsequent replacement with a steel piled structure will ultimately be beneficial to the local marine environment.

The removal process will be carefully planned and controlled to prevent debris from this demolition polluting the surrounding beach and sea bed. This may involve installation of a containment boom and or net as necessary.

The demolition waste will be taken to an approved disposal site and disposed off in an approved manner. Creosoted piles will be afforded special attention. The demolition and waste disposal plan will be submitted for approval prior to any work commencing on site.

2. Dredging and Embankment Excavation:

The dredging program will be undertaken within the window of least impact to migratory fish as laid out by Fisheries. The dredging method will be carefully planned in order to limit potential increases in suspended solids in the local marine environment. Site marine sediment sampling and analysis has been carried out separately by Levelton Associates. If barge dumping is the preferred method for substrate disposal, an ocean dumping permit will be obtained from the Canadian Coastguard prior to the commencement of this work. If shore dumping is utilized, the disposal site and the methodology to be used will be submitted to Waste Management Division for approval, as appropriate. Landing sites for the barges and loaders will be carefully chosen to avoid impact to foreshore in another location.

In addition to dredging, the proposed work involves excavation and trimming of the existing foreshore embankment, beyond the high water mark, to prevent slippage into the dredged area. This work will affect a large area of foreshore. However the impact of the proposed dredging and excavation will be substantially reduced by virtue of the rip rap slope re-instatement for seaweeds and sea bed re-instatement for clam habitat. The following Habitat Assessment details this issue.

3. Piling:

The proposed steel pile dolphins will have a minimal impact on the surrounding marine habitat. Their footprint on the foreshore is minimal and is substantially less than the footprint of the existing creosoted wood pile and timber mooring wall. The net impact of the replacement of the existing structure with the steel pile structure should be a positive one.

BIOPHYSICAL INVENTORY

PROCEDURES AND METHODS

Parameters for the Assessment and Mapping of the Foreshore (Refer to Drawings #1, #2, #3,)

The following parameters were used in order to accurately map the foreshore affected by the proposed new mooring facility for the Alaska Ferry slip belonging to the Canadian National Railway .

1) All foreshore elevations were determined in meters above hydrographic datum (observed).

2) The physical nature of the foreshore was mapped according to elevation above datum, slope, and substrate composition (Appendix 1 - Transects, Drawing #2). The following classification was used: Intertidal mud, silt(<5mm); coarse sand/gravel(5 to 150 mm); small rock & cobbles (300mm minus); large boulders(> 300 mm diameter) and bedrock.

3) The fauna and flora were mapped according to zones of abundance (dominant species) and elevation above datum (Appendix 1-Transects, Drawing #3).

4) Species data was recorded and tabulated with respect to abundance and general intertidal elevation (upper intertidal, mid intertidal, lower intertidal) (see Table 2)

Site Assessment

The introductory site survey was carried out on Sunday, May 26, 1996 between 1:00 p.m. and 6:00 p.m. There was a low tide during this site visit of 2.3 meters above hydrographic datum at 3:00 p.m. The zero chainage line was established and from it the chainages to be used for the transects were established and marked above the high high water line and on the overhead walkway of the mooring wall. Parallel chainage lines were marked at 8 meter intervals from the zero meter chainage line. Transects were then established on these chainage lines starting from the 24 meter chainage (Drawing #1). On Monday, May 27, between 3:00 p.m. and 5:30 p.m. a second site visit was carried out. During this visit there was a low tide of 2.3 meters at 4:00 p.m. The 2.3 meter above datum elevation was established and marked. Distances and elevations were checked and some modifications to the existing drawing were made. Further elevations were established and some site survey work carried out.

On Tuesday, May 28, 1996 during a low tide of 2.3 meters above datum, the 2 meter elevation was verified and other elevations were established. At this time, the upper to mid intertidal portions of a number of the transects was documented utilizing the previously established chainage lines.

On Thursday, May 30, a site visit was carried out between 5:30 am and 7:30 am. During this visit there was a low tide of 1.2 meters above datum at 6:30 am. This allowed the establishment of the 1 meter above datum line which was marked for reference. Further documentation of the transects was done at this time. On the same day, during a high tide of 5.6 meters above datum, the 5.5 meter above datum line was clearly established.

On three consecutive days: Sunday, June 2, between 7:30 am and 10:30 am; Monday June 3, between 8:30 am and 11:30 am; and Tuesday, June 4, between 9:30 and 11:30 am; site work was carried out during the low tide of 0.2 meters on each of these days. The zero meter tide line was clearly established and referenced to the supporting wood piles of the existing mooring wall. The documentation of the transects was completed down to the zero meter tide line and by snorkeling further below this line down to the face of the existing mooring wall on the shoreward side. The starting point for each transect was the top of the existing embankment. The biophysical details along the length of each

transect line were recorded from the 0 meter point at the top of the existing embankment, through the high water line then down across the intertidal and subtidal area as shown on Drawing #1.(see results of Transects in Appendix 1). The subtidal portion of the transects which was seaward of the face of the existing mooring wall was surveyed separately as described below.

Test digs in the intertidal area were carried out where ever substrate was mud or sand/gravel including areas where these substrates were covered by small surface rocks. The test digs were approximately 1/4 meter square and were carried out randomly and also along the line of several of the transects. Locations of these digs are shown on Drawing #1 and results were recorded in Table # 3.

The subtidal survey was carried out in two stages. First, a series of bottom grab samples was taken and second a visual survey was made by scuba diving. On Monday, June 10, in conjunction with sediment sampling by Levelton Associates, bottom grab samples were taken from the subtidal portion of the area both within the predicted area of impact and beyond this area. The grabs were taken from a barge using a crane with a clam shell bucket, and were variable in size. The sediment obtained was manually sifted to reveal flora and fauna and the results were recorded in Table # 4. The approximate location of these grab samples is shown on Drawing # 1. The results of the grab samples were used to supplement the visual information of the affected subtidal area obtained by means of scuba diving on Monday, June 24, during a low tide of 2.2 meters at 2:00 PM.

A series of short dives, one along the subtidal portion of each of the transect lines, was made and the visual information was relayed to an assistant on shore and recorded prior to the next dive. The on shore assistant was also able to ensure that the dives covered the appropriate area of the transects. Finally a dive was made along the bottom by the seaward face of the existing mooring wall.

An inventory of species of macrofauna and flora of the affected intertidal and subtidal foreshore was maintained throughout the site investigations and is presented in Table #2. Due to the wide variety of organisms encountered, this list can not be considered all inclusive.

A further site visit was made on Tuesday, June 25, 1996 to complete the field work and site mapping.

A photographic record was maintained throughout the site visits and is presented in Appendix # 2.

Additional site visits were made in the company of C.N. Rail representatives to discuss habitat areas and the proposed berthing structure designs.

Mapping of Current Habitat Areas and Calculation of Impacted Habitat Areas

Careful mapping of the intertidal substrates and macrobiota within the footprint of the proposed new mooring facility made the calculation of distinct habitat areas possible (Drawing #3, Table #1).

The major considerations with respect to habitat impact as a result of the proposed rebuilding and movement shoreward of the C.N. ferry slip mooring facility are the disruption of Fucus and other seaweed habitat and the loss of intertidal and subtidal mud which is clam habitat. Following the initial findings of this study, the proposed design of the new mooring structure was altered to have a reduced 'affected area' (drawing # 1). Further, it is proposed that the entire area be reinstated either as seaweed or clam habitat.

The footprint of the new 'Affected Area' is clearly outlined on Drawing #1. The habitat areas for unicellular green algae / bare rock, sparse barnacles, Fucus/barnacles, Mussels/barnacles/Fucus, filamentous brown algae, filamentous red algae, mixed red/green (Ulva) algae, rock/kelp and clams are also shown on Drawing #3 and the 'affected areas' calculated and tabulated in Table #1.

The current habitat for Fucus (see Drawing #3), that falls within the footprint of the proposed development impact area was mapped and measured, (Drawing # 3), and the affected area it occupies recorded in Table #1. The Fucus zone (photo # 7, 21, 24, 26, 30, 35, 40, 43, 45, 51) occupies certain portions of the mid intertidal area normally falling within the 2.5 to 5.5 meter above datum range.

The extreme upper intertidal area, above the barnacle zone, in most cases the area above the 6 meter above datum line, is an area which is predominantly bare rock but with scattered unicellular green algae on the rock surface (Photographs #3, #4, #9, #21, #24, #30, #37, #43, & # 45). This entire area has been identified as 'Unicellular Green Algae' habitat as shown and calculated on Drawing #3, and recorded in Table #1.

Just above the 5.5 meter contour .A Barnacle zone was identified between the 'Fucus/barnacle' zone and the 'unicellular Green Algae' zone. This is a zone of fairly sparse barnacle growth falling mainly between the 5.5 meter contour and the 6 meter contour. This zone was identified, mapped, (Drawing #3), and affected areas calculated and recorded (Table #1).

Below the Fucus/barnacle zone and extending down to the toe of the rock of the existing rock embankment there are a couple of relatively narrow habitat bands. The first is a mussel/barnacle zone (photo # 43, 45) which also often includes some sparse Fucus. As the elevation dips towards the 2 meter above datum line, there is a zone in which the predominant macrobiota is Filamentous brown algae (photo # 22, 26). Both these zones were identified, mapped (Drawing #3), and the affected areas calculated and tabulated in Table # 1. Where the bands overlapped or were too narrow to show with any accuracy they were recorded jointly under mussel/barnacles/Fucus.

The area below the toe of the rock embankment down to the zero meter above datum line which is at, or between the supporting piles of the existing mooring wall is an area of diverse surface macroflora and fauna. Areas of small rocks support green(Ulva) and red algae as well as occasional small kelp specimens on their surface where light is sufficient and where there is suitable rock for attachment (photos # 17 & 18). Crabs, whelks and worms are often found underneath the rocks. A variety of other organisms including starfish, plume worms, sponges, anemones, jingle shell etc were found on and among the supporting piles of the existing mooring wall (photos # 48, 46, 42, 41, 36). The main surface seaweed in the shadow of the mooring wall structure is a very small, fine, filamentous red algae (photo # 4,31) which appears as a film on rocks as they are uncovered by the retreating tide.

Random Benthic digs (see locations on Drawing #1) in areas with no surface rocks produced clams and assorted marine worms (photos # 49, 50). Further digs in areas where loose rocks did cover the surface revealed that the subsurface substrate was fairly uniform throughout this area and some clams were found in most digs. Since clam habitat is of particular interest, the entire area covered by these digs, where any clams were found, has been classified as 'Clam Habitat'. This 'Clam Habitat' has been identified and mapped on Drawing #3, and the area falling within the potential impact area calculated and recorded in Table #1. In one area between the piles, no appreciable subsurface mud was found, and the small rocks appeared to continue for some depth. No evidence of clams was found in this area and it was mapped and identified according to the most consistent macrobiota which was the' red filamentous seaweed' described above (Drawing # 3).

Below the zero meter above datum line but within the 'area of Impact' the substrate is silty sand/mud with scattered rock and the dominant benthic macrobiotic organisms are clams and polychaete worms. (Drawing # 3, Table #4).This area includes other macrobiota (starfish) as recorded in the transects and photographic survey (photos # 55 & 56), but has been classified as clam habitat, since this is the most consistent macrobiota. This area has been identified, mapped (Drawing #3), and the area falling within the impact area has been identified, calculated and recorded (Table #1).

A small sub tidal area of larger rocks on the seaward side of the mooring wall (Drawing # 2) was identified. Small kelp specimens (Nereocystis) were identified here. This area was classified as Kelp / rock, and was mapped, the area calculated (Drawing # 3), and recorded (Table 1).

Table 1 summarizes the results of the mapping and area calculations for all of the areas within the 'Affected Area'.

The following format is utilized for Table 1:

1) Affected Habitat - The area of the current habitat that falls within the footprint of the area of disturbance for the proposed work. (from Drawing #3)

2) Reinstated Area: - The area of the habitat that will be reinstated or created on completion of the proposed work.

3) Net Habitat Balance - The "Reinstated Area" minus the "Affected Habitat" provides a net habitat balance figure for each habitat after the proposed work is completed.

* Suitable Mitigation, where required, must be decided through consultation with D.F.O. before suitable compensation areas can be identified.

Results

General Description of Site

The proposed development is for: the removal of the existing deteriorated creosoted wood pile mooring wall and dolphins servicing the Canadian National Railways Alaska rail ferry slip at Prince Rupert, B.C.; the replacement of the old timber mooring wall and dolphins by a steel pile dolphin structure to the shoreward side of the existing mooring wall face; the dredging of the seaward side of the new mooring structure to the 2.29 meter below hydrographic datum contour; on the shoreward side of the new dolphin structure, trimming of the foreshore (slope of 1 to 1.5, or 1 to 2, see insert Drawing # 4) and reconstitution of the trimmed foreshore with a 1 meter thick capping of rip rap rock (Drawing # 4). The proposed new steel pile mooring structure would be in the same general foreshore area as the old mooring wall but would have a much reduced permanent footprint.

This proposed development would be positioned as shown on the location drawing (Drawing #1). It would be accessed by the existing rail line, loading ramp and access road that services the existing Ferry Slip.

The site is situated within Prince Rupert Harbour. The proposed area for the new mooring facility is, as previously stated, the site of the existing mooring wall but to the shoreward side of this existing wall face (Drawing # 4). The proposed affected area consists of an existing rock fill (rip rap) embankment leading down to an area of silty mud with some small surface rocks. The pile structure of the existing mooring wall is embedded in the silty mud below the rock fill. (Appendix #1 - Transects: Appendix #2 - Photographs: Drawings #2 and # 3).
The subtidal area that falls within the proposed 'affected area' is basically an extension of the silty mud area dominating the lower intertidal zone (Drawing # 2).

Biophysical Inventory

The proposed 'affected area' occupies a total intertidal area of 2115 m^2 as shown on Drawing #3. Details of the physical characteristics of the site including elevation and slope contours are shown on Drawing #2. Predominant substrate composition was mapped and is presented on Drawing #2.

The location of "Benthic Test Digs" and "Benthic Grabs" to determine subsurface substrates and benthic organisms are shown on Drawing # 1. The results of these digs and grabs are given in Tables 3 and 4.

The location of the transects is shown on Drawing #3. The details of the transects are given in Appendix 1 and these results support the mappings of substrate and habitat areas as shown on Drawings # 2 and # 3.

All of the results reported are supported by the Photographic survey presented in Appendix 2. Where relevant, references are made to these photographs in the text.

A macrobiota species list is presented in Table 2. The mapping of dominant species zones within the proposed development area, relative to elevation above datum, is presented in drawing #3. The areas of each of the respective dominant species zones are also calculated on this drawing. The results of these calculations are tabulated in Table 1.

The main horizontal dominant species zones for macrobiota within the intertidal and subtidal portions of the proposed development footprint area are as follows:

Upper Intertidal (5.5 to 7.3m above datum)	- Bare Rock/ Unicellular Green Algae - Sparse Barnacles
Mid Intertidal (2.0 to 5.5m above datum)	- Fucus/barnacles - Mussels/barnacles/Fucus - Filamentous Brown Algae
Lower Intertidal (0 to 2 m above datum)	- mixed Ulva/Porphyra/small kelp - filamentous red algae - clams
Sub tidal (below datum)	- clams - kelp/rock

Discussion and Habitat Reinstatement Plan for the Rebuilding and Relocation of the Mooring Facility for the C.N. Alaska Rail Ferry Link

This habitat survey deals with the direct impact on the foreshore intertidal and subtidal areas of the proposed replacement and relocation shoreward of the C.N. Rail Alaska ferry mooring structure. Sensitive aspects of the demolition process for the existing structure and of the construction procedures themselves are discussed under the title "Development Plan" and its impact, at the beginning of this report.

As already noted, the intertidal area that would be directly affected by this new mooring wall construction, is an area of rock fill embankment leading down to a silty mud area in the lower intertidal zone. Small surface rocks and sand /gravel often cover the surface of the silty mud. The silty mud area is an area of relatively low slope which continues down into the subtidal zone.

The habitat areas that are of most concern in this proposed development area are the Fucus/barnacle habitat, other rock habitats that constitute seaweed habitat, and the areas that constitute clam habitat. The Department of Fisheries and Oceans requires "like for like" replacement for any lost fisheries habitat.

For the proposed replacement and relocation shoreward of the C.N. Rail Alaska ferry mooring structure, a number of factors have been taken into account when assessing 'lost' habitat.

1) The new design for the mooring structure is a steel pile dolphin structure with access walkways. This structure, once constructed, will only occupy a very small area of the subtidal bottom, that is, the area occupied by the piles for the dolphins, (see C.N. Rail design details).

2) The old creosoted timber piles, dolphins and mooring wall will be removed (Drawing # 4). Extreme care must be taken during the removal process (see 'Development Plan'), but once this demolition is completed, there should be a number of positive effects on the local marine environment as follows:

a) Creosoted timbers are known over time to leach toxins into the marine environment. The existing mooring wall, a large creosoted timber structure, will have been permanently removed, removing this source of toxins from the environment.

b) The permanent footprint of the current mooring wall structure on the foreshore is large due to the large number of creosoted wood piles required to support the mooring wall and its access structures. This footprint area will be permanently restored by the removal of the existing structure. * It should be noted that no deduction to habitat areas was made in Table 1 for the footprint area occupied by the existing piles themselves.

c) The removal of the creosoted timber piles and mooring wall will also result in a substantial increase in the incident light available to the local intertidal and shallow sub tidal marine habitats. The current structure creates large shaded areas which means that much of the "affected" rocky habitat falls within the shadow of this structure (see photos # 1, 2, 6, 7,). Since the proposed new structure would have an almost negligible shadow effect, this shading problem will be virtually eliminated by the removal of the existing mooring wall structure. This is particularly important for the seaweed habitats (Fucus, kelp, etc).

As stated above, the removal of the existing C.N. timber pile mooring wall structure and its replacement with the proposed steel pile dolphin structure can be considered as a positive improvement for the local marine environment. The negative aspects of this proposed development are predominantly associated with the construction of the new mooring facility. Disruption of the existing marine habitats would occur mainly as a result of the proposed dredging and embankment excavation activities (see 'Habitat Impact Analysis of the Development Plan'). The embankment excavation activities required to lessen the embankment slope and prevent slippage from the embankment will affect the existing rocky intertidal habitats (Drawing # 3, Table 1).

1). The dredging operations required to correct the alignment of barges relative to the loading ramp and efficiently utilize barge space (see 'Proposed Development Area') will affect the existing intertidal and subtidal mud, or 'clam habitat' within the dredged area (Drawing # 3, Table 1). As shown on Drawing # 3, a total of 2115.1 M^2 of intertidal and subtidal habitat will be affected by these operations.

In order to mitigate for this disruption of marine habitat, C.N. Rail is proposing to 'reinstate' the entire affected area including the area gained through removal of the existing creosoted timber piles, and a small area trimmed from above the HHW line (drawing # 4). The only area not reinstated, will be the small area occupied by the steel piles, and a very small portion of the upper intertidal zone (5 M^2) required for the concrete footing for the interconnecting walkways. The total intertidal and sub tidal area after "reinstatement" would be 2257 M^2. To achieve reinstatement, the area shoreward of the dredged area, including the "trimmed" rock embankment, will be capped to a depth of approximately 1 meter with large rock (> 300 mm). This will create a new rocky intertidal embankment at a slope of 1:5 to 1 through most of the area and 2:1 at the lowest elevations (see C.N. design details). The total area of rocky intertidal and shallow subtidal habitat that will be created in this way is calculated to be 1533.8 M^2 an increase of 803.2 M^2 (see Table 1 & Drawing # 4).

For Table 1, it has been assumed that:
a) Since it is proposed that all tidal elevations above the dredge line will receive this 'rock capping' and the slope of the proposed embankment is constant, all rocky intertidal habitats within the affected area would be proportionately replaced by new rock.
b) Since the proposed new slope would be gentler than the slope of existing rock embankment, the area (plan) of each habitat band, or between each tidal elevation, would be slightly greater. Drawing # 4 and Table 1, reflect this slight increase.
c) Since the proposed new rock embankment would be continued below the level of the existing rock (~ 2 M above datum) down to the dredge line (-2.29 m above datum), new rock habitat will be formed at these elevations (Drawing # 4, Table 1).

d) Since the shadow effect of the existing mooring wall structure will have been removed, the major seaweed habitats should benefit. In particular, the new rock in the 2 M above to -2.29 meter below datum elevations, will form both a suitable substrate for and an area of suitable light level for the growth of the larger seaweeds (Kelp). For this reason the "new" rock habitat areas that would be produced have been allocated either to Ulva/Porhyra/small kelp (2 M to .5M above datum; +256.7 M^2) or to Kelp (e.g. Nereocystis, .5 M to 2.29 M elevation; + 480.2 M^2). These figures are summarized in Table 1. This reasoning is supported by the fact that these seaweeds are found in the existing habitat area in small areas where there is suitable light and rock for attachment at the appropriate elevations. (photos # 17 & 18).

e) Since the light level throughout the 'affected area' will be higher, it is likely that the less productive 'low light' algal species (filamentous red) would be replaced by the larger, more productive species (Kelp), when recolonization of the area occurs. Table 1, does not reflect this further potentially positive effect on kelp habitat.

The proposed capping of the 'trimmed' embankment with large rock as described above would result in an increase in rocky intertidal and subtidal area, but a decrease in intertidal and subtidal mud. The dredging process itself would affect 1384 M^2 of intertidal and subtidal mud/clam habitat. The proposal by C.N. rail is that all of the area below the dredge line will be reinstated as clam habitat Drawing # 4, Table 1). C.N. Rail has had the area tested to determine the depth of the sediment over the existing bedrock. This study indicates that the depth of sediment is far in excess of the required dredging depth. C.N. will ensure that there is at least 1 meter of sediment (mud) suitable for clam habitat over the whole of the dredged area indicated (Drawing # 4) after dredging is complete. This would mean that despite the removal of a layer of intertidal mud, a sufficient depth of mud would remain to provide habitat for all types of clams. This intertidal mud could provide 'reinstated' clam habitat at -2.29 M. below datum. The clams that would colonize this area would likely be clams that are normally found at this depth. Of the clams that were identified in the original habitat areas, the Butter clams (Saxidomas giganteus), Gaper clams (Tresus capax), and Cockles (Clinocardium nutalli), are all species that are found depths at depths from the lower intertidal zone to below -2.29 meters below datum. It is therefor

assumed that they could all form part of the recolonization of this area. The littleneck clams (Protothaca staminea) that were identified on the original site (Table 3, Drawing # 3), at elevations as high as 2 meters above datum are unlikely to thrive at the new elevation of -2.29 above datum. When this 'reinstated' mud/clam area (723.1 M^2)is taken into account the net balance for intertidal/subtidal mud for clam habitat is - 661.4 M^2.

In summary, the proposed demolition and removal of the old creosoted timber mooring wall and its replacement with a new steel pile dolphin structure would affect 2115 M^2 of intertidal and sub tidal habitat. This would be due mainly to the trimming of the rock embankment and dredging activities. Proposed habitat reinstatement procedures would result in 2257 M^2 of reinstated habitat, a net gain of 142 M^2. This would include a net loss of mud / clam habitat of 661.4 M^2 and a net gain of 803.2 M^2 of rock for seaweed habitat.

At this stage discussion on the suitability of the reinstatement measures described above and / or of other mitigation proposals should be carried out with the Department of Fisheries and Oceans.

TABLES

List of Tables

TABLE 1:
SUMMARY OF CALCULATIONS FOR HABITAT BALANCE
REVISED TOTAL AFFECTED AREA: 2115.1 M^2 from DR#3

HABITAT	AREA OF HABITAT AFFECTED (M^2)	AREA OF NEW AND REINSTATED HABITAT ON COMPLETION (M^2)	NET HABITAT BALANCE ON COMPLETION (M^2)
UNICELLULAR GREEN ALGAE	116.4	128.0	+11.6
SPARCE BARNACLES	55.9	61.5	+5.6
FUCUS / BARNACLES	234.9	258.4	+23.5
MUSSELS / FUCUS / BARNACLES	71.7	78.9	+7.2
FILAMENTOUS BROWN ALGAE	80.4	88.4	+8.0
FILAMENTOUS RED ALGAE	108.5	119.3	+10.3
ULVA / PORPHYRA	53.0	309.3	+256.3
KELP	9.8	490.0	+480.2
CLAMS	1384.5	723.1	- 661.4 *
TOTAL AREA	2115.5	2256.9	+142

EXPLANATION FOR TABLE 1

1) Affected Habitat: The area of the current habitat that falls within the footprint of the area of disturbance for the proposed work. (from Drawing #3)

2) Reinstated Area: Area of the habitat that will be reinstated or created on completion of the proposed work. (see Drawing #4 and discussion)

3) Net Habitat Balance: The "Reinstated Area" minus the "Affected Habitat" provides a net habitat balance figure for each habitat after the proposed work is completed.

*Suitable Mitigation, where required, must be decided through consultation with D.F.O. before suitable compensation areas can be identified

TABLE 2
MACROBIOTA SURVEY OF THE INTERTIDAL REGION

SPECIES	DENSITY
Upper Intertidal Zone (5.5M to 7.4 M above datum)	
Unicellular green algae	moderate
Barnacles (Balanus species)	moderate
Plate Limpet (Notoacmaea scutum)	low
Periwinkles (Littorina sp.)	low
Shore Crabs (Hemigrapus nudus)	low
Mid Intertidal Zone (2.5M to 5.5M above datum)	
Barnacles (Balanus sp)	moderate/high
Rockweed (Fucus sp.)	moderate/high
Ulva sp	low
Shore Crabs (Hemigrapus nudus)	low
Periwinkles (Littorina sp.)	low
Filamentous brown algae	moderate
Mussels (Mytilus edulis)	moderate
Mid to Lower Intertidal Zone (1.5 to 2.5 M above Datum)	
Ulva	moderate
Porhyra	moderate
Halosccion glandiforme	low
Microcladia	low
Dogwinkle (Nucella lamellosa)	low
Shore Crabs (Hemigrapus nudus)	low
Gunnels (Apodichthys flavidus) - under rocks	low
Little neck clams (Protothaca staminea)	low

TABLE 2 (continued)
MACROBIOTA SURVEY OF THE INTERTIDAL REGION
Lower Intertidal Zone and on Piles
(0 to 1.5 M above Datum)

Ulva	low
Porphyra	low
Alaria	low
Plume worms (Schizobrznchia)	high
Anemones (Telia crassicornis)	low
Anemones (Metridium senile)	high
Dogwinkle (Nucella lamellosa)	low
Red Algae (Hollenbergia sp)	high
Jingle Shells(Pododesmus cepio)	high
Chitons (Mopalia lignosa)	low
Clam Worm (Nereis virens)	low
Small polychaetes (unidentified)	moderate in mud
Shrimp (Pandalus danae)-in water around piles	moderate
Butter clams (Saxidomus gigantus)	moderate
Little neck clams (Protothaca staminea)	moderate
Gaper Clams (Tresus nuttallii)	low
Cockles (Clinocardium nuttallii)	low
Bent nose Macoma (Macoma nasuta)	low
Sponges (Halichondria sp.)	moderate
Nudibranchs (Archidoris montereyensis)	low
Ascidians (unidentified on piles)	low
Fish eggs (unidentified on piles)	low
Black clawed crab (Lothopanopeus dellus)	low
Dungeness crab (Cancer magister)	moderate
Hermit Crabs (unidentified)	low
Spider Crabs (Libinia sp.)	low
Blood stars (Henricia leviuscula)	low
Sunstars (Solaster sp.)	low
Starfish (Asterias)	low

Subtidal Zone
(Below 0 M above Datum)

Butter clams (Saxidomus gigantus)	moderate
Gaper Clams (Tresus nuttallii)	low
Cockles (Clinocardium nuttallii)	low
Bent nose Macoma (Macoma nasuta)	low
Starfish	
Dungeness crab (Cancer magister)	moderate
Red Algae (Hollenbergia sp)	high
Jingle Shells(Pododesmus cepio)	high
Bull Kelp (Nereocystis sp.)	low

TABLE 3
RESULTS OF BENTHIC "TEST DIGS"

DIG #	SUBSTRATE	MACROBIOTA	# FOUND
TD1	SMALL ROCKS OVER SILTY MUD	CLAMS, MACOMA	2
		WORMS	6
		CLAMWORMS (NEREIS)	1
		BUTTER CLAMS (SAXIDOMAS)	4
		DOG WHELKS	1
TD2	SMALL ROCKS OVER SILTY MUD	GAPER CLAMS	1
		CLAMWORMS (NEREIS)	2
		MACOMA	2
		SMALL POLYCHAETES	3
TD3	SMALL ROCKS OVER SILTY MUD	WORMS, (MIXED)	2
		CLAMS, MACOMA	1
		BUTTER CLAMS, (SAXIDOMAS)	2
TD4	GRAVEL / SAND OVER SILTY MUD	CLAMS, MACOMA	1
		WORMS	8
		BUTTER CLAMS (SAXIDOMAS)	4
TD5	SMALL ROCKS OVER SILTY MUD	COCKLES, (CLINOCARDIUM)	1
		WORMS (MIXED)	4
		BUTTER CLAMS (SAXIDOMAS)	2
TD6	SMALL ROCKS OVER SILTY MUD	BUTTER CLAMS (SAXIDOMAS)	4
		WORMS (MIXED)	6
		DOG WHELKS	1
TD7	SMALL ROCKS OVER SILTY MUD	CLAMS, MACOMA	2
		WORMS	6
		CLAMWORMS (NEREIS)	1
		BUTTER CLAMS (SAXIDOMAS)	4
TD8	GRAVEL/SAND OVER SILTY MUD	WORMS (MIXED)	2
		LITTLENECK CLAMS (PROTOTHACA)	2
TD9	GRAVEL/SAND OVER SILTY MUD	LITTLENECK CLAMS, (PROTOTHACA)	1
		WORMS (MIXED)	5
TD10	GRAVEL/SAND OVER SILTY MUD	LITTLENECK CLAMS, (PROTOTHACA)	2
		WORMS	1
TD11	GRAVEL/SAND OVER SILTY MUD	LITTLE NECK CLAMS, (PROTOTHACA)	1
		BUTTER CLAMS, (SAXIDOMAS)	1
TD12	SMALL ROCKS OVER SILTY MUD	BUTTER CLAMS,(SAXIDOMAS)	1
		WORMS	3
		CLAMWORMS (NEREIS)	1
		COCKLE (CLINOCARDIUM)	1

TABLE 3 (CONTINUED)
RESULTS OF BENTHIC "TEST DIGS"

DIG #	SUBSTRATE	MACROBIOTA	# FOUND
TD13	SMALL ROCKS OVER SILTY MUD	CLAMS, MACOMA	1
		WORMS, (MIXED)	8
		BUTTER CLAMS (SAXIDOMAS)	2
TD14	SAND/GRAVEL OVER SILTY MUD	BUTTER CLAMS, (SAXIDOMAS)	2
		WORMS, (MIXED)	3
TD15	SAND/GRAVEL OVER SILTY MUD	LITTLENECK CLAMS,(PROTOTHACA)	1
		WORMS	1
TD16	SAND/GRAVEL OVER SILTY MUD	LITTLENECK CLAMS,(PROTOTHATCA)	2
		WORMS	3
TD17	SMALL ROCK	UNABLE TO DIG- ROCKY SUBSTRATE NO BENTHIC MACROFAUNA FOUND	
TD18	SAND/GRAVEL OVER SILTY MUD	LITTLENECK CLAMS,(PROTOTHACA)	1
		WORMS(MIXED)	2
TD19	SAND/GRAVEL OVER SILTY MUD	LITTLENECK CLAMS, (PROTOTHACA)	2
		WORMS	6
TD20	SMALL ROCK	UNABLE TO DIG- ROCKY SUBSTRATE NO BENTHIC MACROFAUNA FOUN	
TD21	SMALL ROCKS/SAND/ GRAVEL/SILTY MUD	BUTTER CLAMS, (SAXIDOMAS)	1
		WORMS	1

TABLE 4
RESULTS OF BENTHIC SUBTIDAL "TEST GRABS"

GRAB #	SUBSTRATE	MACROBIOTA	# FOUND
TG1	BLACK SILTY MUD SOME SHELL	COCKLE, CLINOCARDIUM	1
		WORMS	6
		CLAMWORMS (NEREIS)	1
TG2	SANDY MUD SHELLS	GAPER CLAMS	1
		CLAMWORMS (NEREIS)	1
		DUNGENESS CRAB	1
		SMALL POLYCHAETES	2
		SCULPIN	1
TG3	SAND/SHELLS/ MUD	WORMS - NEMERTINES	8
TG4	BLACK SILTY MUD	CLAMWORM (NEREIS)	1
		DOGWINKLES	1
		BUTTER CLAMS	3
TG5	SANDY MUD OLD SHELLS	GAPER CLAM	1
		WORMS (NEMERTINES)	3
		CLAMWORMS (NEREIS)	2
TG6	BLACK SILTY MUD	WORMS - MIXED - NUMEROUS	
		BUTTER CLAMS	2
TG7	SANDY MUD	COCKLES (CLINOCARDIUM)	2
		WORMS - MIXED	6
TG8	BLACK SILTY MUD	DUNGENESS CRAB	1
		GAPER CLAM	2
		WORMS - MIXED	5
		POLYCLAD	1
TG9	SANDY MUD OLD SHELLS	CLAM (MACOMA)	1
		WORMS (NEMERTINES)	3
		CLAMWORMS (NEREIS)	1
		GAPER CLAMS	3
		BLOOD STAR	1
		STARFISH	1

BATTERY, BOAT PROPELLER, OTHER MISC.

TABLE 4 (CONTINUED)
RESULTS OF BENTHIC SUBTIDAL "TEST GRABS"

GRAB #	SUBSTRATE	MACROBIOTA	# FOUND
TD10	BLACK SILTY MUD	WORMS - MIXED -	NUMEROUS
TD11	SANDY MUD OLD SHELLS	BUTTER CLAM	2
		WORMS (MIXED)	8
		GAPER CLAMS	1
		CHAIN, PIECE OF A BOAT,	OTHER MISC
TD12	BLACK SILTY MUD	WORMS (MIXED)	NUMEROUS
		GAPER CLAMS	3
TD13	SILT, SAND, SHELL MIX	BUTTER CLAMS	2
		WORMS (MIXED)	7
TD14	SMALL ROCKS, SILTY MUD	BUTTER CLAMS	1
		WORMS (MIXED)	1
		COCKLE	1

DRAWINGS

APPENDIX 2

PHOTOGRAPHIC SURVEY

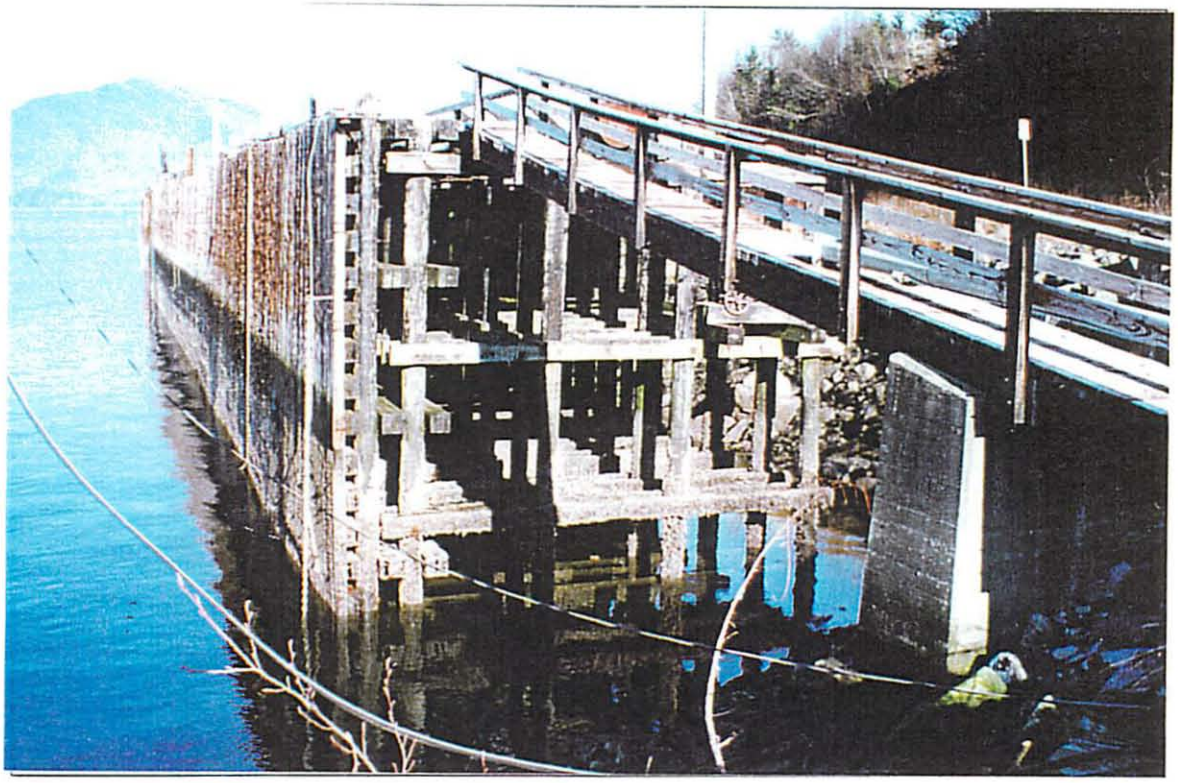


Photo #1: Looking toward the mooring wall from the ramp.

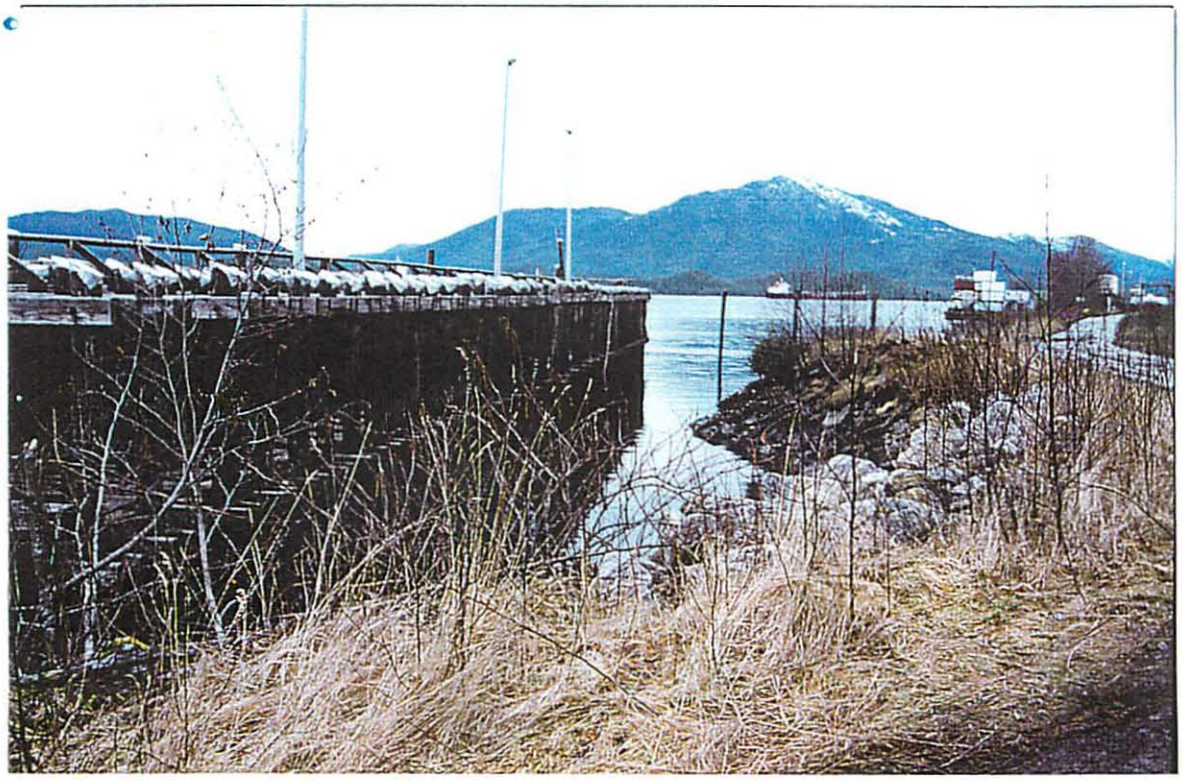


Photo #2: Viewing the back of the mooring wall. Looking North.

Photo #3: Looking at the south end of the mooring wall.

Photo #4: Looking at the south end of the mooring wall.

Photo #5: Looking north along the back of the mooring wall.

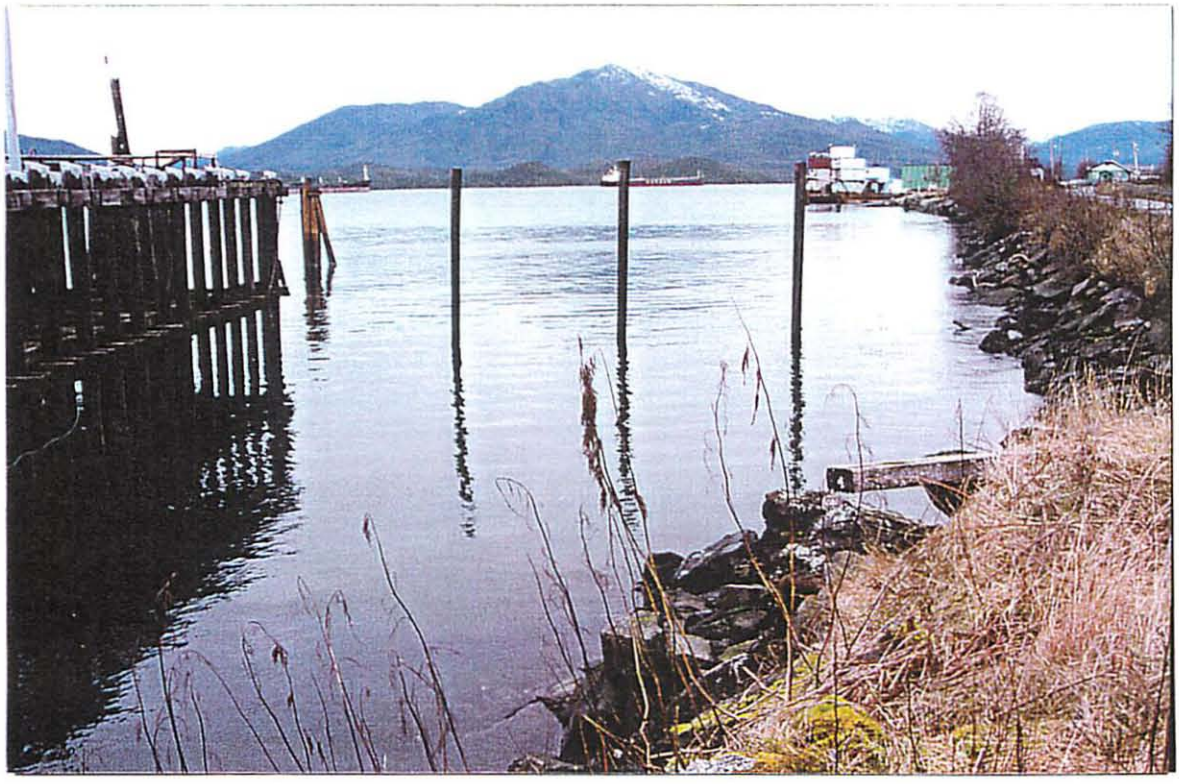


Photo #6: Looking north near the north end of the mooring wall.

Photo #7: Looking north near the north end of the mooring wall.

Photo #8: Looking south at the back of the mooring wall.

Photo #9: Looking south at the back of the mooring wall.

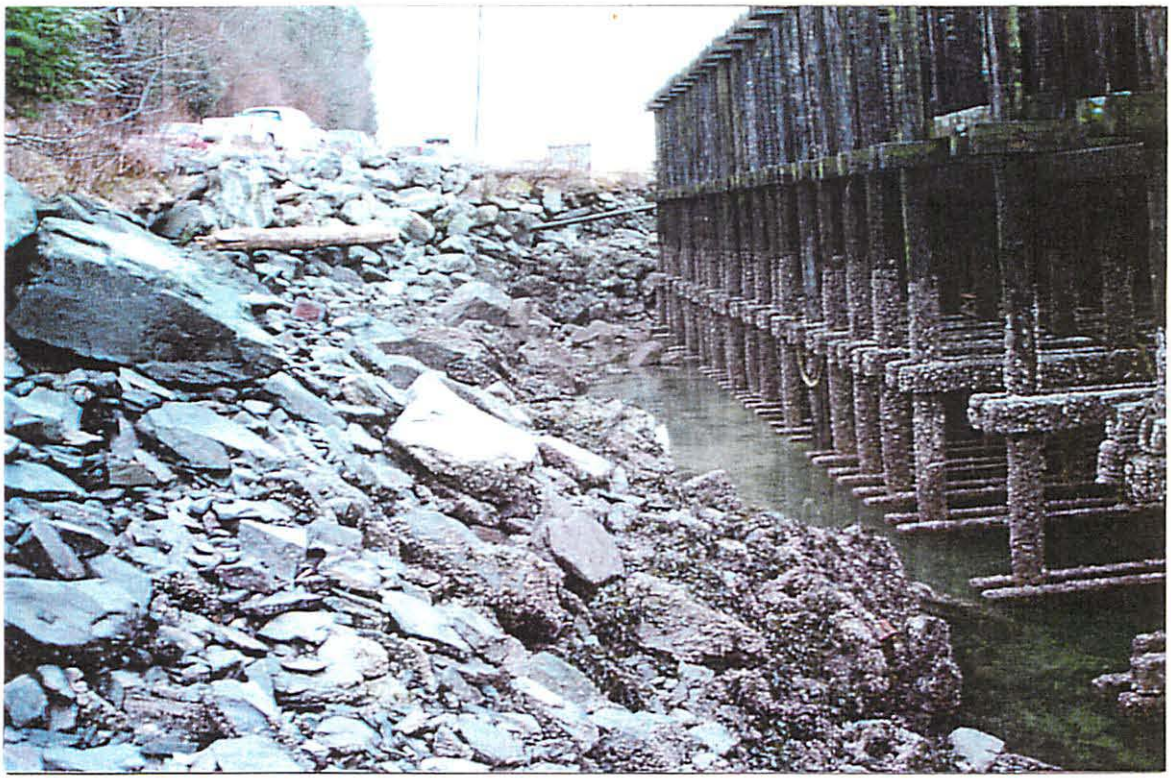


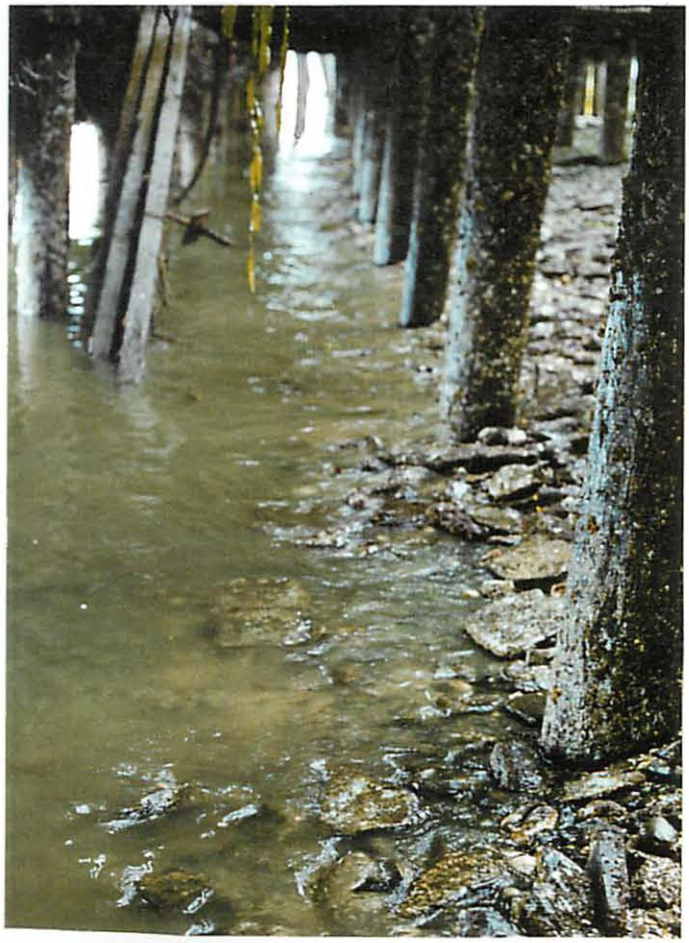
Photo #10: Looking south at the back of the mooring wall.

Photo 11:
View looking south along the lower intertidal along the back of the mooring wall. This view taken from chainage 120 meters. View shows water level at the base of the first pile (chainage 112) on a o.2 meter Tide.

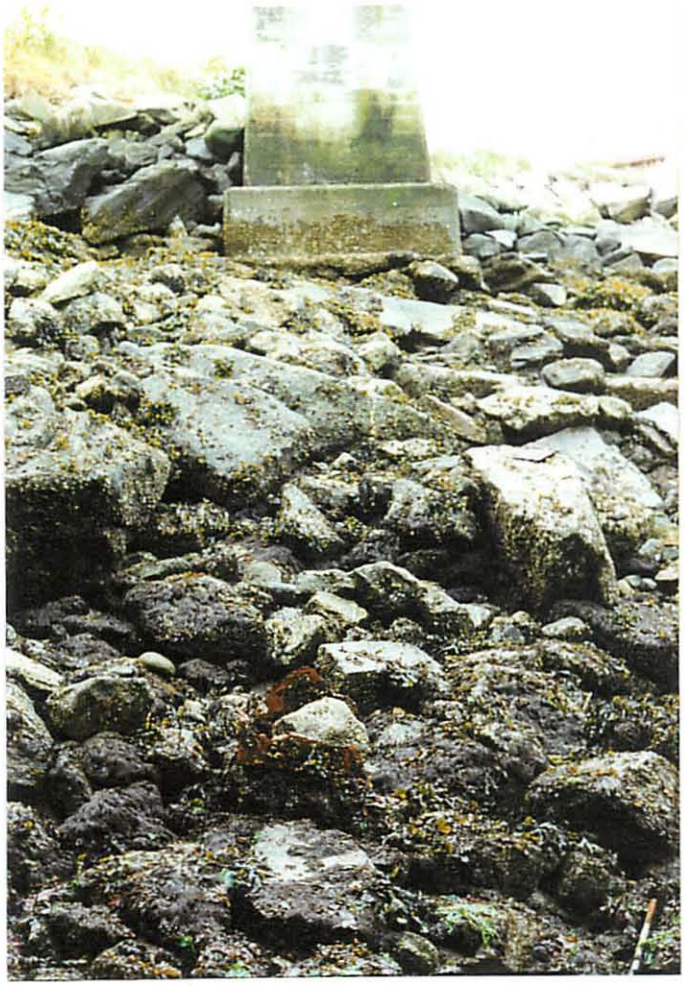
Photo 12:
View of the existing mooring wall from the Northeast on a low tide of .2 meters above hydrographic datum. Foreground shows area of rock and cobble over sandy silt stretching from the toe of the intertidal rock down to the zero tide level through most of the area.

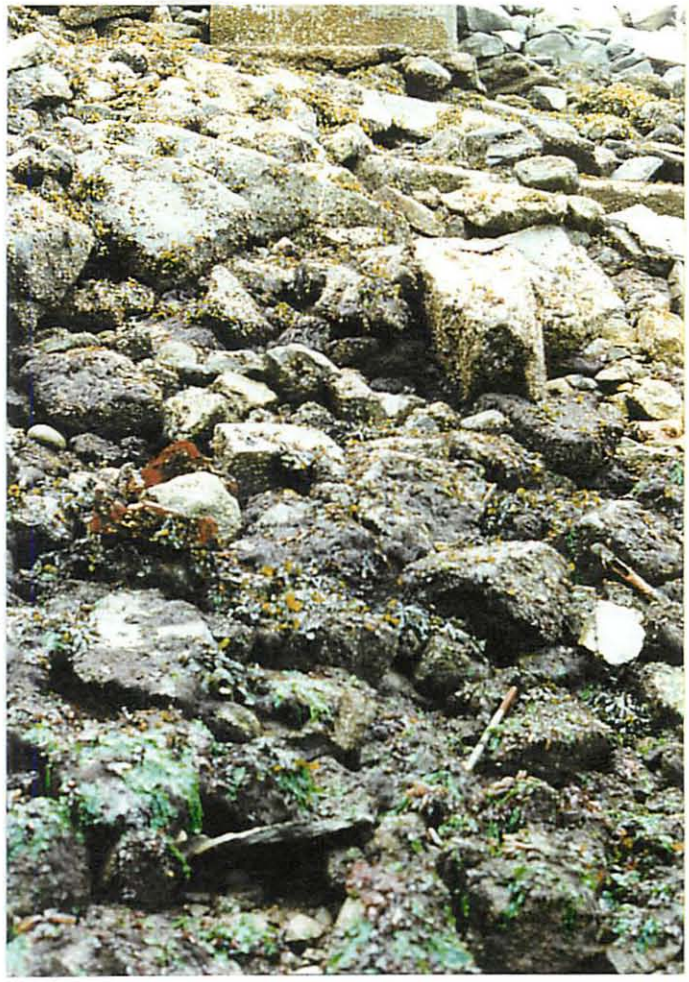
Photo # 3:
View of area between the piles of the existing mooring wall. This photo was taken from Transect # 10 (chainage 96), and shows the water level at the third pile of the mooring wall on a low tide of .2 meters above datum. The photo shows the area between Transect # 10 and transect # 6.

Photo #4:
This photo shows the same area as photo # 3, but looks north from transect # 6 towards transect # 10.



Photos #15 & 16:
Views of upper and mid intertidal portions of transect # 0.





Photographs 17 & 18: Close ups of seaweeds in lower mid intertidal and lower intertidal portions of transect # 0.

Photograph #19 and 20:
View of the lower intertidal area of transects # 0, 1 and 2 on a low tide of .2 meters above hydrographic datum.

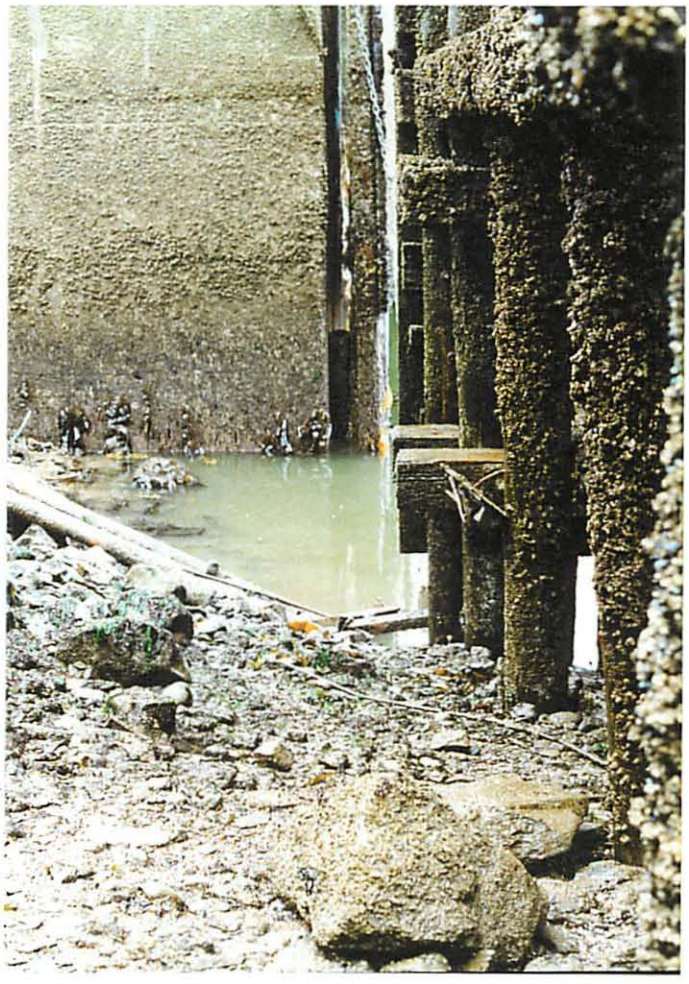


Photo #21: This is a view of transect # 2 (chainage 32) showing the upper and mid intertidal areas.
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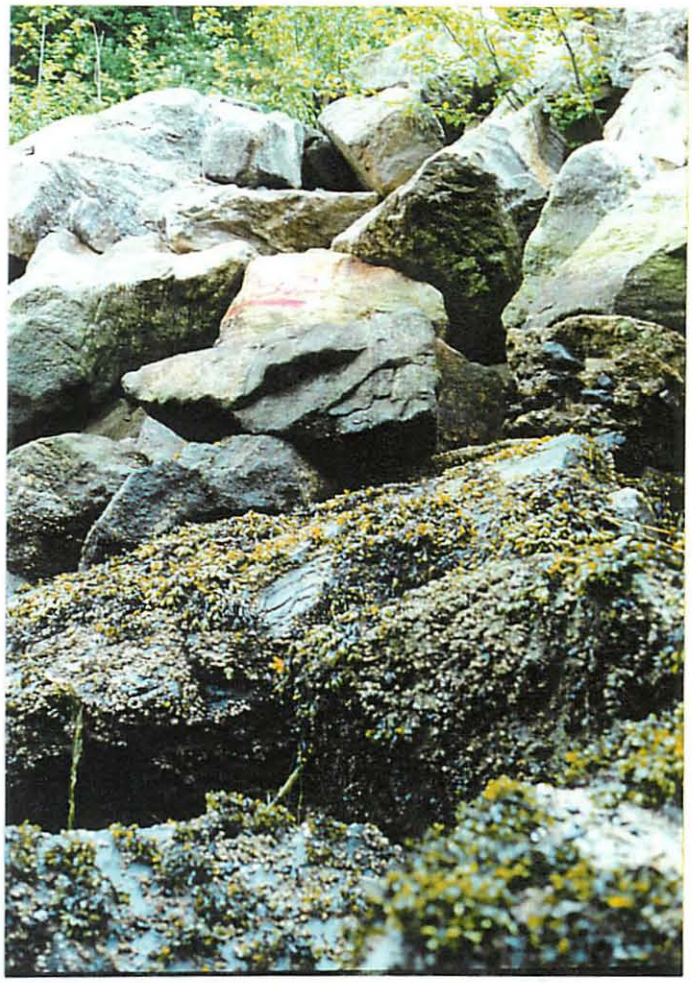
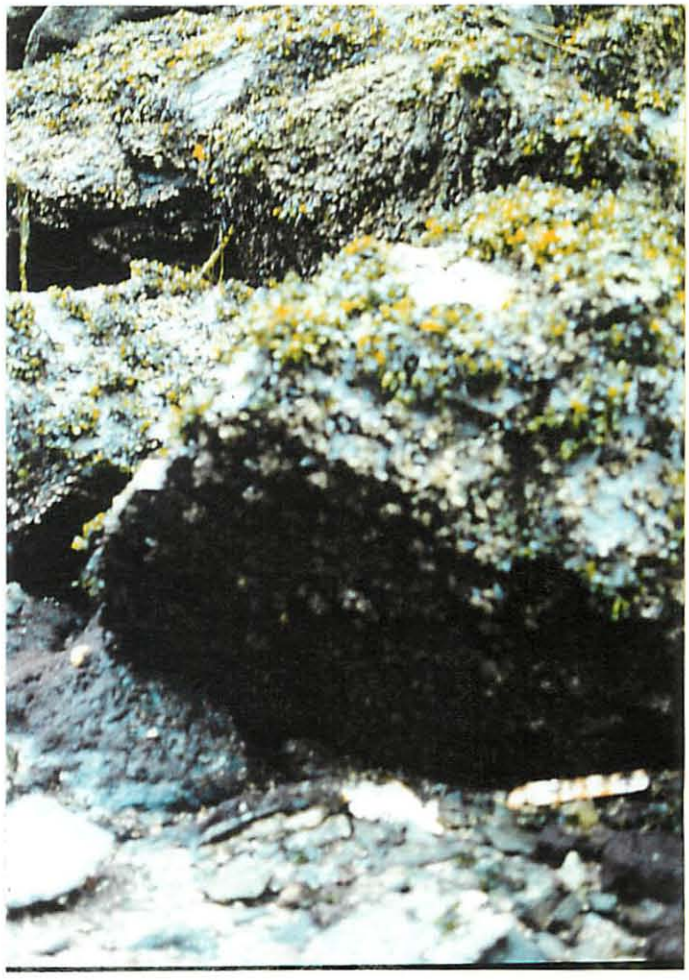
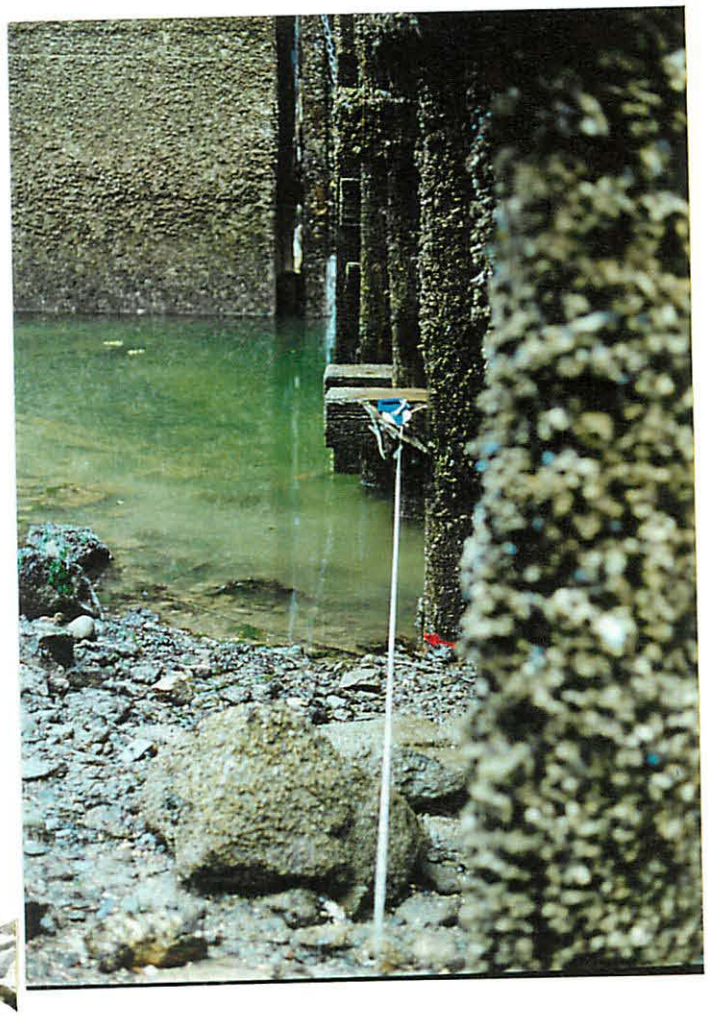
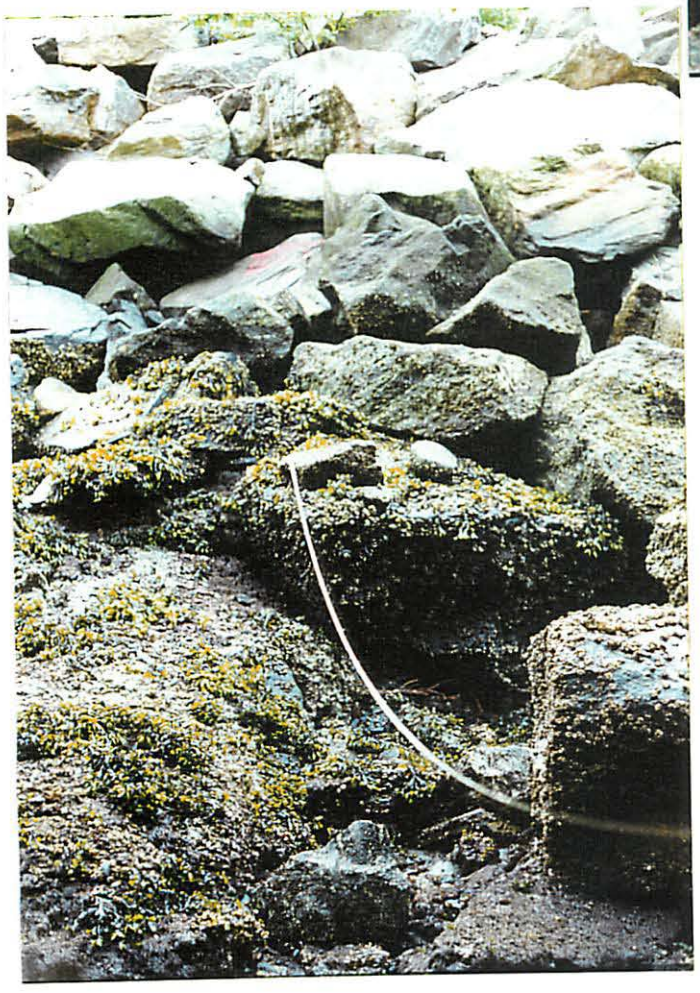


Photograph # 22:
View of Transect # 2 showing the lower mid intertidal area. Bulkhead.



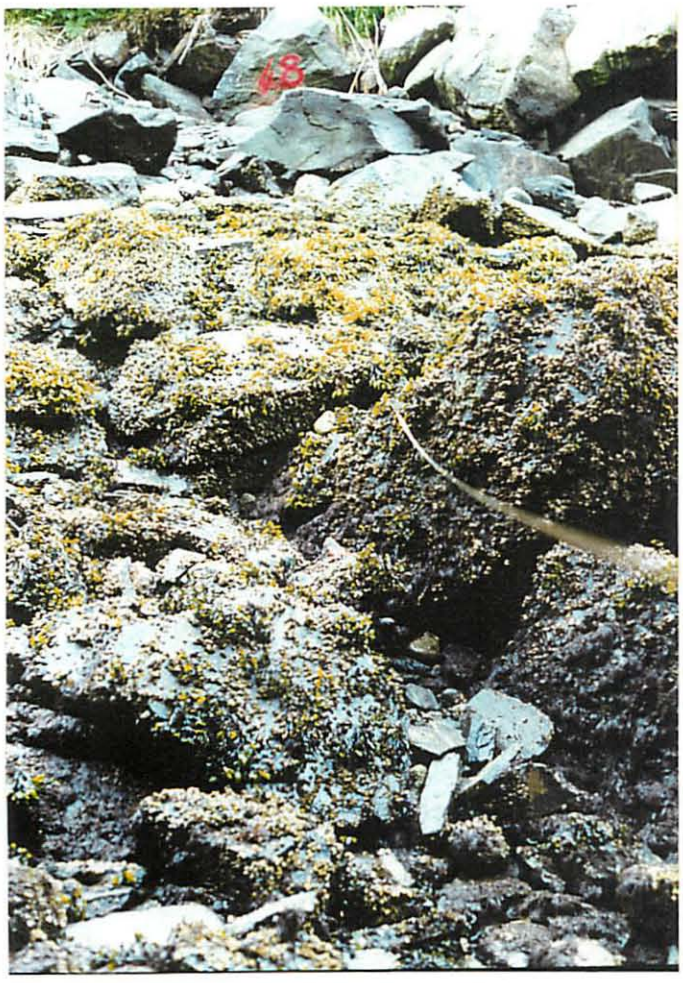


Photograph #23:
Lower intertidal portion of transect # 2. This view shows the water level at the base of the third pile on a low tide of 1.2 meters above datum.



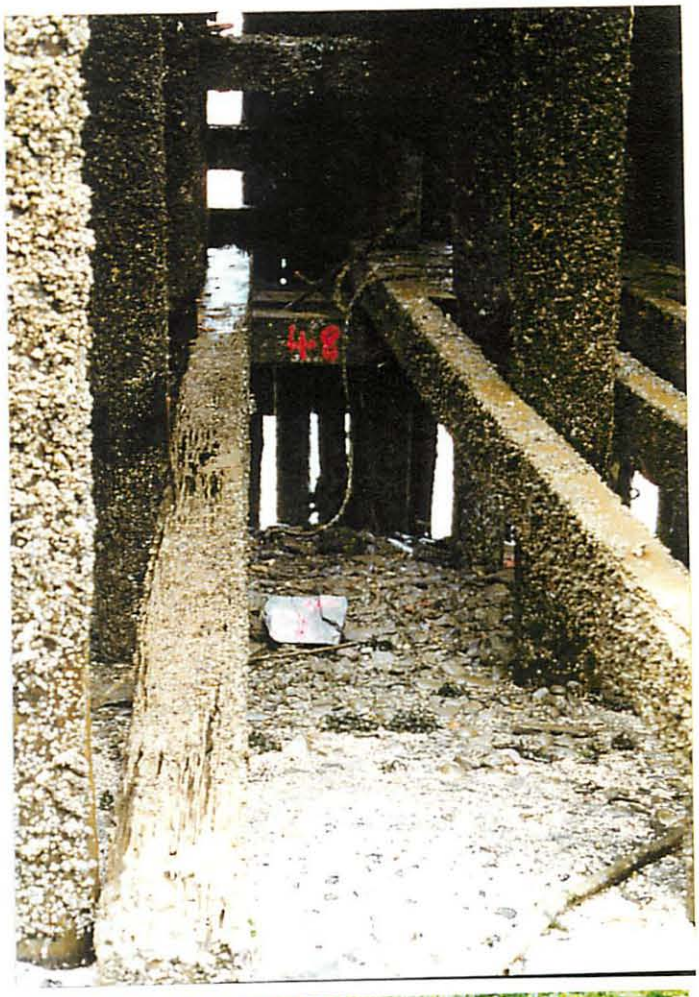
Photograph # 24:
View of the upper intertidal portion of Transect # 3 (chainage 40).

Photographs #25:
View of the lower intertidal portion of transect #3 on a low tide of 1.2 meters.

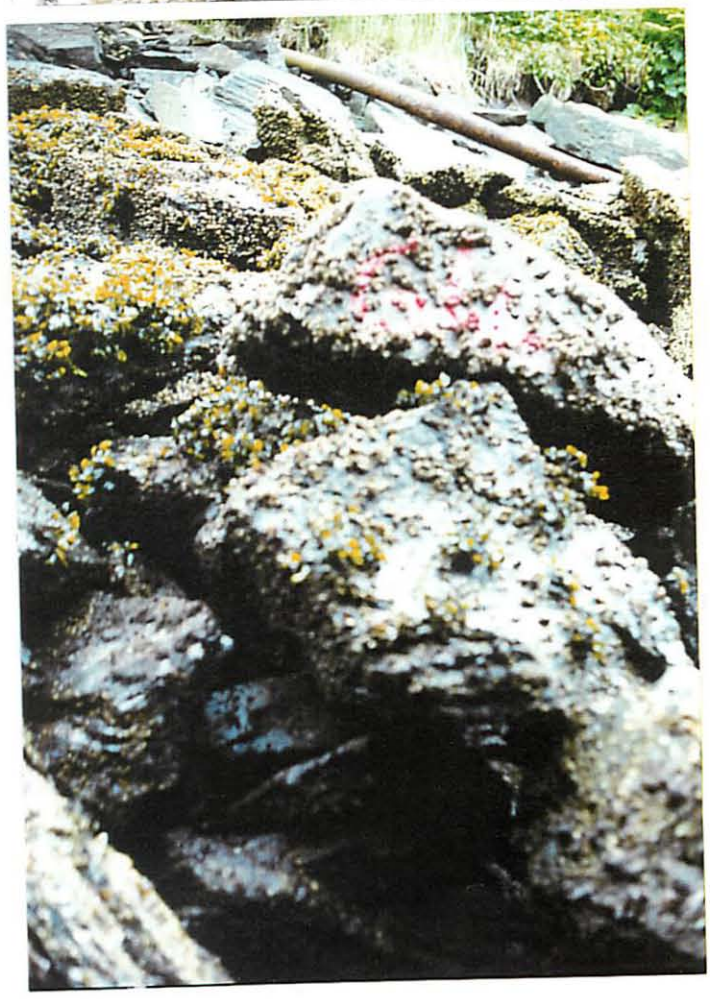


Photograph # 26:
View of Transect # 4, showing the upper and mid intertidal regions.

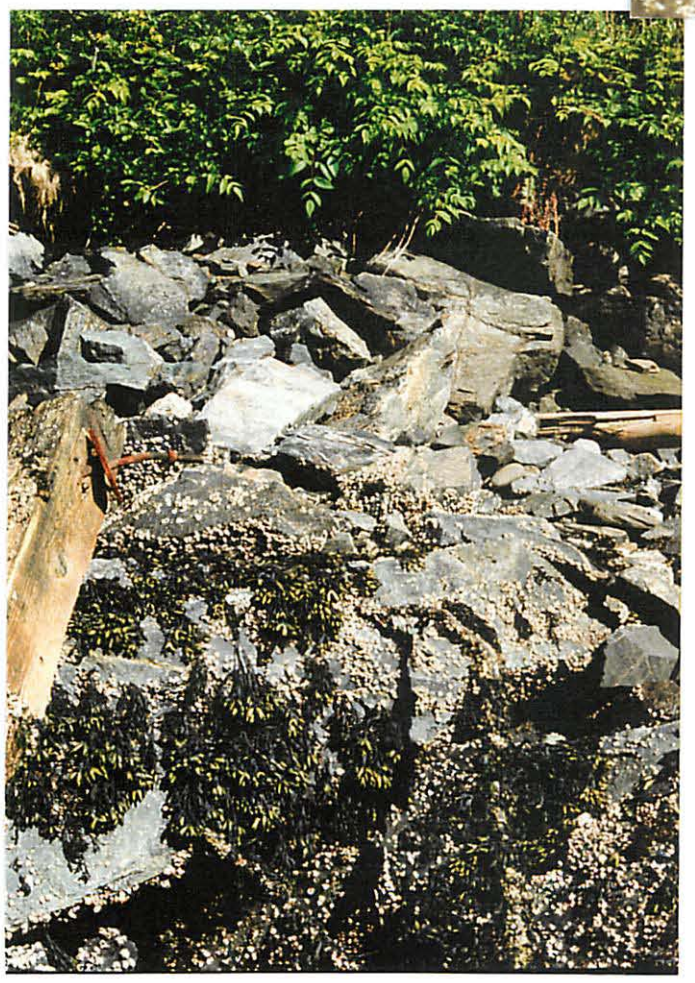
Photographs #27:
View of the lower intertidal portion of transect #4 (chainage 48). This shows the water level during a low tide of 0.2 meters.



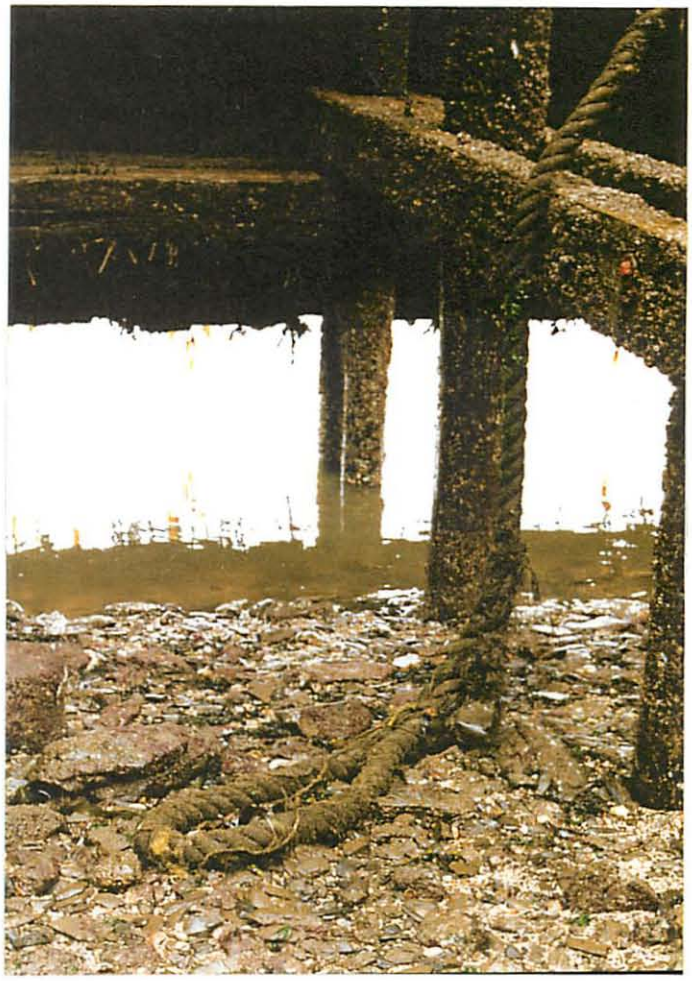
Photograph # 28:
This is a view of the upper and mid intertidal portions of transect # 5 (chainage 56).



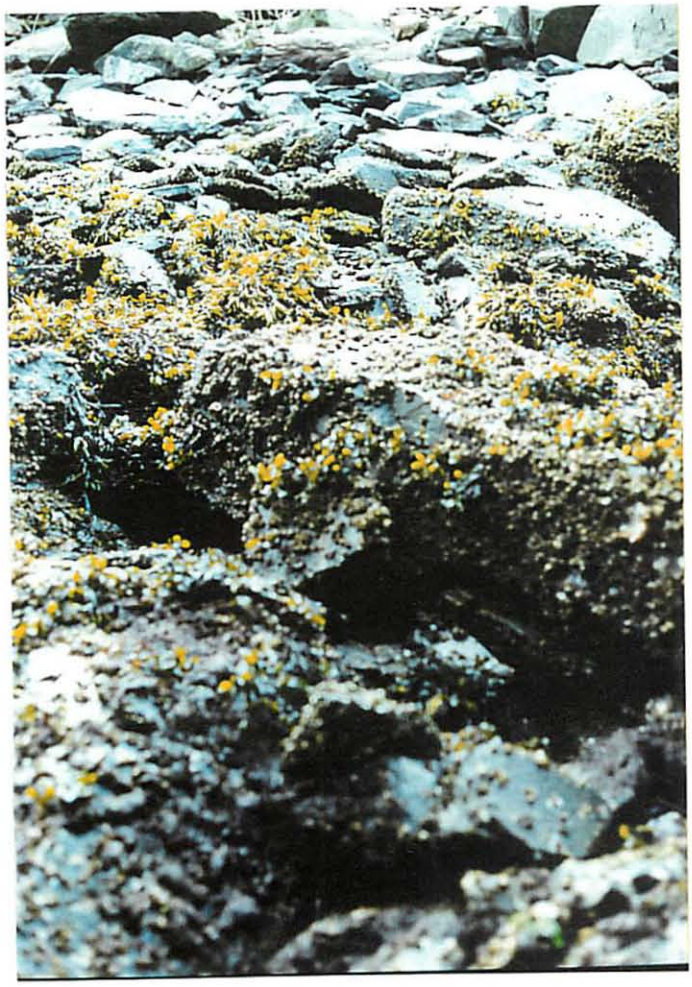
Photograph # 29:
View of transect # 5, in the extreme lower intertidal region. This shows the water line at the fourth pile during a low tide of .2 meters.



Photograph # 30:
This view shows the upper to mid intertidal zones of transect # 6, chainage 64.



Photographs #31
View of transect #6:
This is the lower intertidal region of this transect, showing the water line just below the third pile on a low tide of .2 meters above datum.

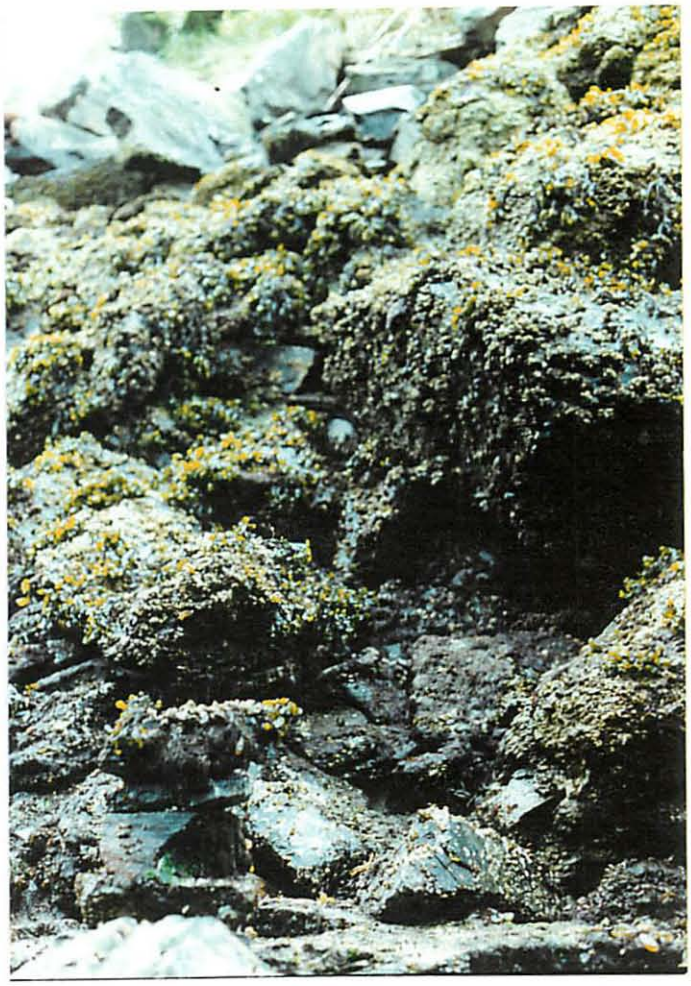


Photograph # 32:
Transect # 7, chainage 72:
This is a view of the upper and mid intertidal regions of this transect from the mussel/ barnacle zone back towards the HWL.

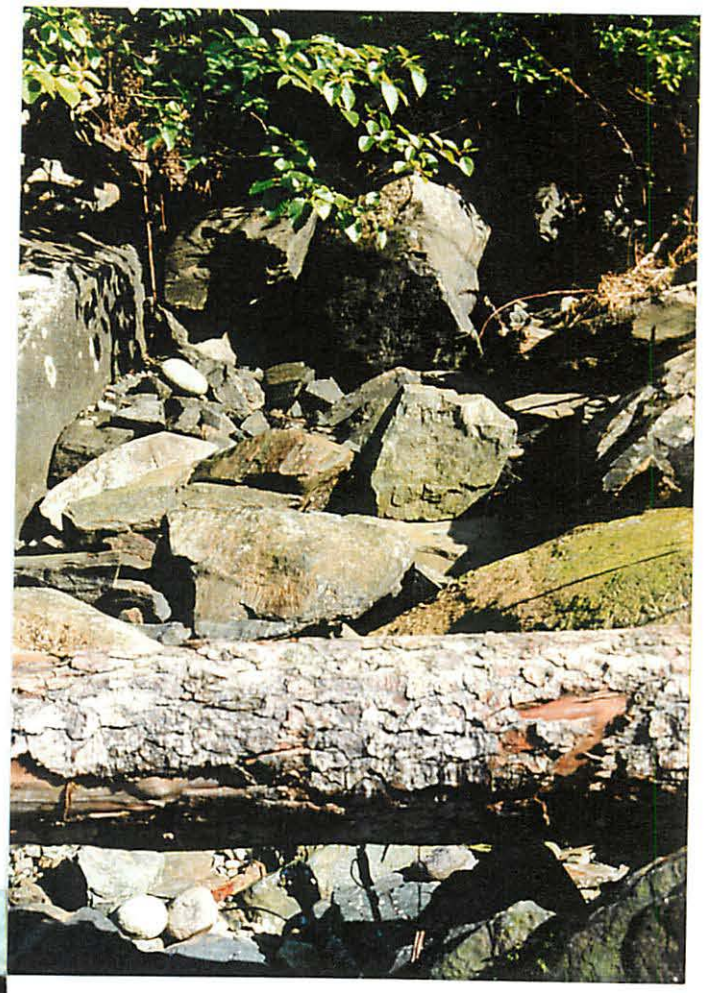
Photograph # 33:
View of the lower intertidal zone of transect # 7 on a 1.2 meter low tide.

Photograph # 34:
View of the lower intertidal zone of transect # 7 on a 0.2 meter low tide.

Photograph # 35:
View of Transect #8 chainage 80 meters from mussel/barnacle zone back to HWL.



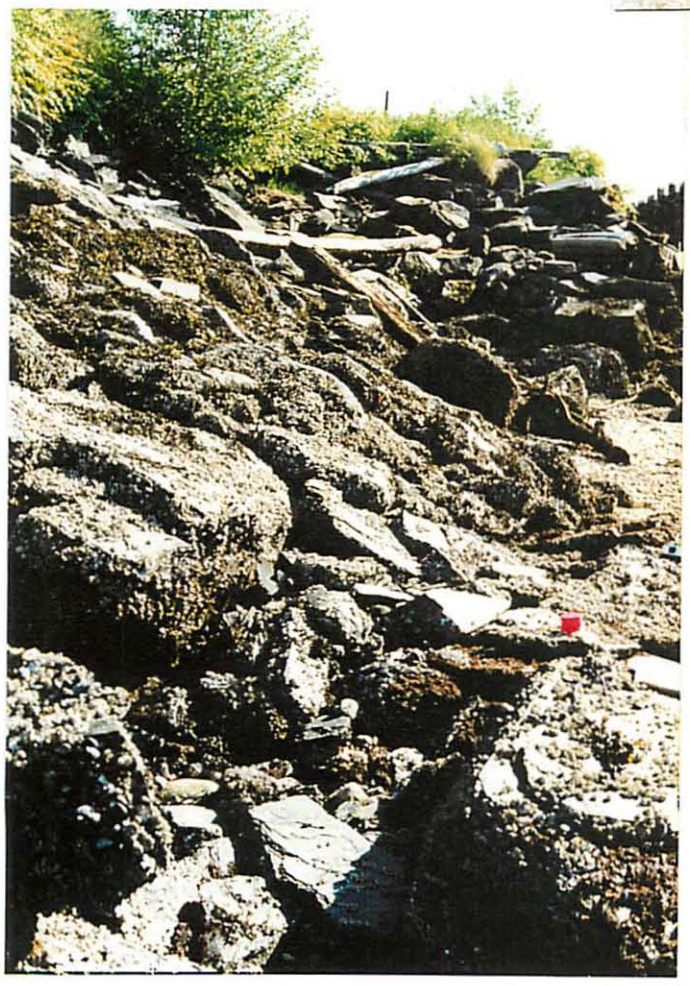
Photograph # 36:
View of Transect #8, showing the lower intertidal zone on a 0.2 meter above datum low tide. The water line is at the base of the third pile.



Photographs 37:
View of Transect #9, chainage 88, showing the extreme upper intertidal zone and above.

Photograph # 38:
Transect # 9, showing the mid intertidal zone.

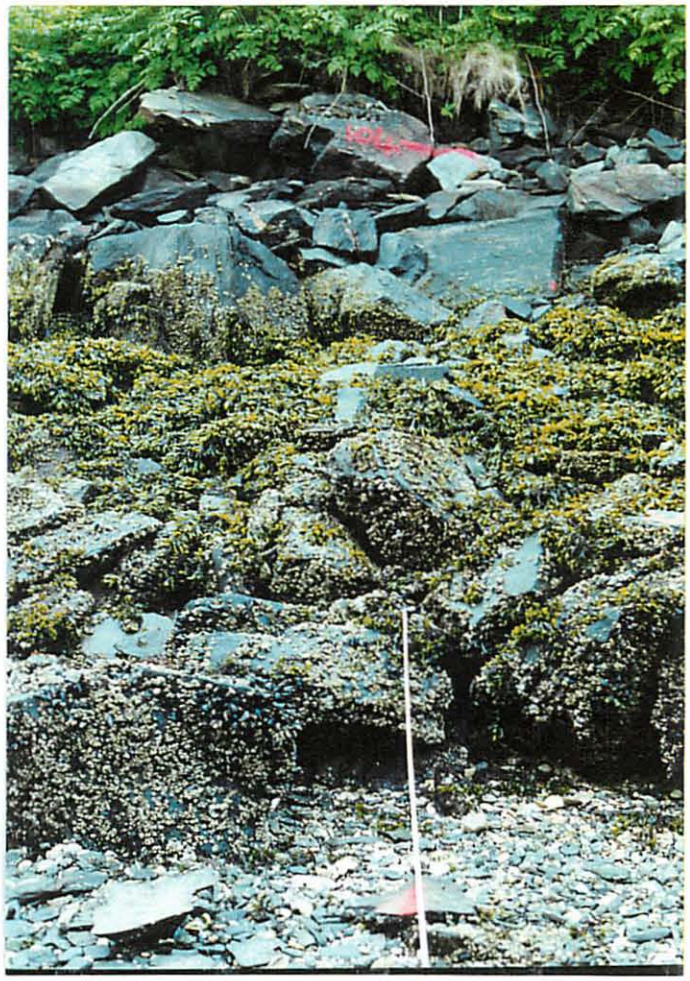
Photograph # 39:
View of Transect # 9, showing the lower intertidal area on a 0.2 meter tide.



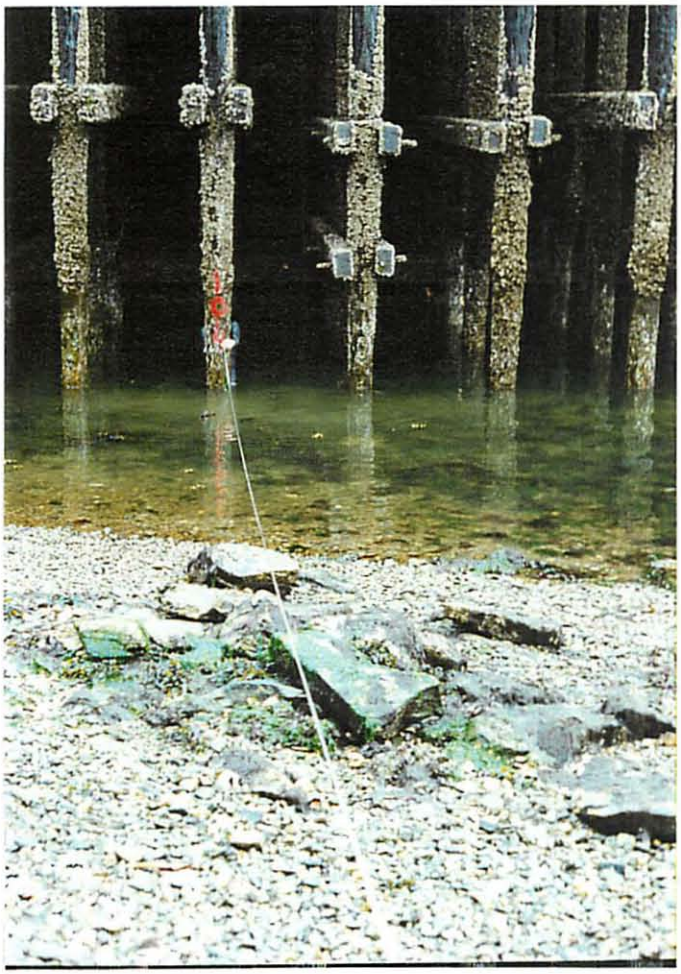
Photograph # 40:
View of the upper and mid intertidal areas looking south from chainage 120 through to chainage 88.

Photograph # 41:
View of the lower intertidal zone in the region of transect # 10, taken on a low tide of 1.2 meters above datum.

Photograph # 42:
Close up of plume worms on piles at transect # 10.

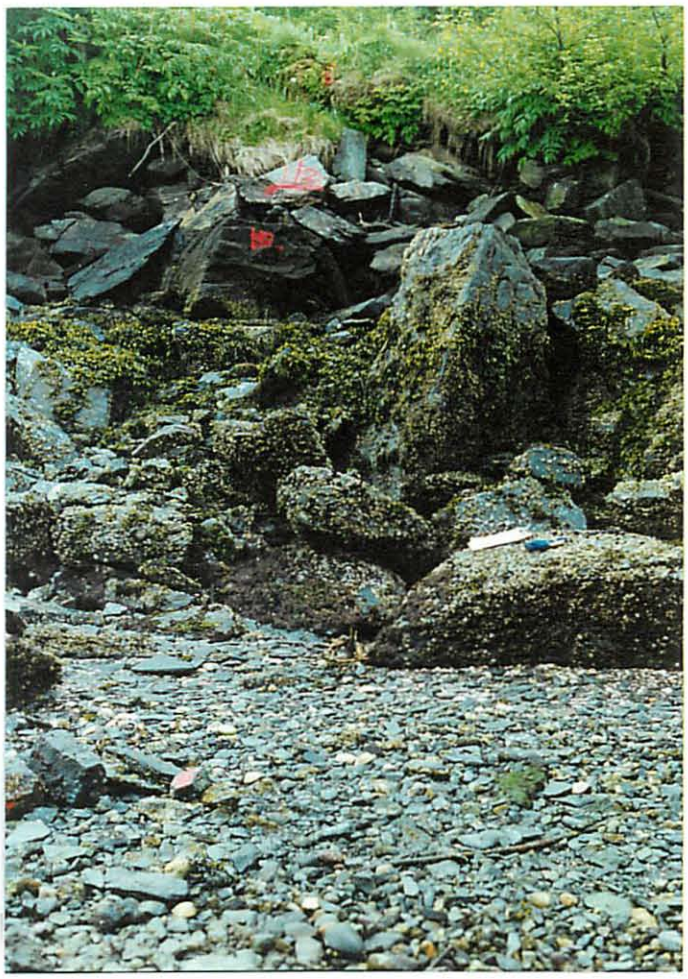


Photograph # 43:
Upper and mid intertidal area of transect # 11, chainage 104, showing the mid and upper intertidal portions of this transect.



Photograph # 44:
View of lower intertidal region of transect #11, showing the surface substrate and water level on a 1.2 meter above datum low tide.

Photograph # 45:
View from the lower mid intertidal region through to the High Water line and above for transect # 12, chainage 120.



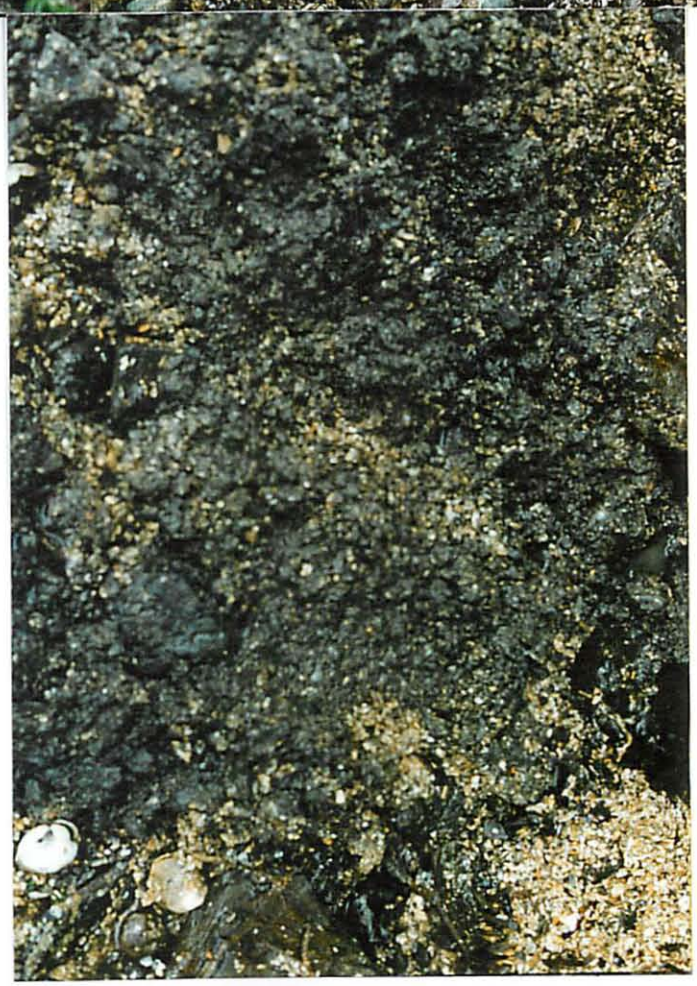
Photograph # 46:
This is a view of the lower intertidal portion of transect # 12, taken during a low tide of .2 meters above datum.

Photograph # 47:
Close up of rocky surface substrate and red and green seaweeds in the lower intertidal portion of transect # 12.

Photograph # 48:
View of the under surface of a typical small rock from the lower intertidal area between the piles supporting the mooring wall.

Photograph # 49:
Typical substrate and organisms (clams and worms) from 'typical' Benthic digs.

Photograph # 50:
Close up of silty mud typically found in the benthic digs.



Photograph # 50:
This photograph shows the sandy area with scattered rocks between the existing rock embankment and the first pile of the mooring wall in the region of transects # 2 to # 5. Small clams were found in this area.

Photograph # 51:
This view shows the existing rock embankment in the region of transect # 6, where the toe of the rock reaches down to the first row of piles for the mooring wall.

Photograph # 52:
This photograph shows the equipment for and relative sample size of the subtidal Benthic grabs.

Photograph # 53:
This photograph is an example of the sediment found in grabs taken very close to the existing mooring wall.

Photograph # 54:

This photograph is an example of the sediment found in grabs taken about 16 meters out from the existing mooring wall along a line parallel to the loading ramp.

Photograph # 55 & 56:

These two photographs are illustrative examples of the types of epiphytic growth revealed in the various grabs.

APPENDIX 1

RESULTS OF TRANSECTS

TRANSECT #0

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 3:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
3 to 5:	Extreme upper intertidal area from HHW point. This area consists of large rock (rip rap) boulders. (photograph # 15). The only visible life in this area is unicellular green algae on some areas of the boulders.
5 to 6:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 5 meter point marks the beginning of a sparse barnacle zone. (see photograph # 15).
6 to 11.6:	This is a continuation of the large rock boulders (rip rap) forming the existing embankment. The 6 meter point along this transect marks the beginning of the Fucus/barnacle zone. (see photographs # 15 & 16).
11.6 to 14:	This is a continuation of the large rock boulders (rip rap) of the existing embankment. This is an area which is predominantly filamentous brown algae. (see photographs # 15 & # 16).
14 to 17.6 :	This is a continuation of the rock embankment reaching to the toe of the rock. This is an area of mixed seaweed. Red algae (Porphyra), green algae (Ulva) and some small kelp specimens (Alaria) predominate on surface of these rocks. Under rocks there are small shore crabs.
17.6 to 20:	This is an area of scattered rocks on the surface in the lower intertidal area. There is a mixture of organisms here including some small kelp specimens on rocks near the zero meter tide line at the mooring wall piles.

TRANSECT #1 (CHAINAGE 24)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1.5:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1.5 to 4:	Extreme upper intertidal area from HHW point. This area consists of large rock (rip rap) boulders. (photograph # 21). The only visible life in this area is unicellular green algae on some areas of the boulders.
4 to 6:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 6 meter point marks the beginning of a sparse barnacle zone. (see photograph # 21).
6 to 11:	This is a continuation of the large rock boulders (rip rap) of the existing embankment. The 6 meter point along this transect marks the beginning of the Fucus/barnacle zone. This transect cuts diagonally across this zone. (see photograph # 21 & 22).
12 to 19 :	This is a continuation of the large rock boulders (rip rap) forming the existing rock embankment. This transect runs diagonally across this area from this point. The area is dominated by filamentous brown algae on the rocks.
19 to 25:	This is an area of smaller rocks and mixed seaweed. It includes Filamentous brown algae, mixed red algae and green algae (Ulva) on the surface of these rocks.

TRANSECT #2 (CHAINAGE 32)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1 to 1.8:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 21). The only visible life in this area is unicellular green algae on some areas of the boulders.
1.8 to 2.4:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 1.8 meter point marks the beginning of the barnacle zone. (see photograph # 21).
2.4 to 4.8:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 2.4 point marks the beginning of the Fucus/barnacle zone. (see photographs # 21 & # 22)
4.8 to 6.8:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 5 meter point marks the beginning of the barnacle/mussel/Fucus zone (see photograph # 22).
6.8 to 8:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 6.8 meter point marks the beginning of the filamentous brown algae zone (see photograph # 22). The toe of the existing rock marks the end of this zone.
8 to 11:	Area of sand/shell over a mud and silt base in the lower intertidal zone. No visible surface macrofauna or macroflora in this area, but benthic digs revealed small clams. (see Results of Benthic Digs, Table 3 and photograph # 50)
11 to 18.4:	This is a region of rocks over a mud/silt base in the lower intertidal area from the 1.2 meter line down to the 0 meter line and below. Benthic digs were carried out randomly but it was difficult to dig in this area. The rocks continued for some depth down through the mud/silt here. No sign of clams was found in this area. Red filamentous algae predominates on surface rocks. Starfish, Polychaete worms and anemones are abundant on the piles.
18.4 to: 27	Below the 0 meter above datum line. The zero meter line is very close to the existing mooring wall. The bottom substrate below the zero meter above datum point is a continuation of the sandy, shell mixture with some scattered rocks occur on the bottom. Benthic digs revealed that the subsurface substrate is dark silty mud.

TRANSECT #3 (CHAINAGE 40)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 0.8:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
0.8 to 2:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 24). The only visible life in this area is unicellular green algae on some areas of the boulders.
2 to 2.5:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 2 meter point marks the beginning of the barnacle zone. (see photograph # 24).
2.5 to 5:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 2.5 meter point marks the beginning of the Fucus/barnacle zone (see photograph # 24).
5 to : 6.5	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 5 meter point marks the beginning of the barnacle/mussel/Fucus zone (see photograph # 24).
6.5 to 10.4:	This is a region of fine sand and broken shells with occasional rocks on the surface in the lower intertidal area from the toe of the rock down to the first pile for the mooring wall. Digs in the sand were carried out randomly and clams and marine worms were found in all digs. Substrate in digs is a silty mud. (photographs # 25 & # 50)
10.4 to 19.0:	This is a region of rocks over a mud/silt base in the lower intertidal area from the first pile down to the 0 meter line and below. Benthic digs were carried out randomly but it was difficult to dig in this area. The rocks continued for some depth down through the mud/silt here. No sign of clams was found in this area. Red filamentous algae predominates on surface rocks. Barnacles are the main life on the piles (photograph # 25).
19.4 to 24:	Below the 0 meter above datum line. The zero meter line is very close to the existing mooring wall. The bottom substrate below the zero meter above datum point is a continuation of the sandy, shell mixture found above the zero meter line. Scattered rocks occur on the bottom and an occasional piece of kelp was found on rocks in this area. Benthic grabs in this area produced a black silty sub surface mud containing occasional cockles and marine worms.

TRANSECT #4 (CHAINAGE 48)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1 to 3:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 26). The only visible life in this area is unicellular green algae on some areas of the boulders.
3 to 3.5:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3 meter point marks the beginning of the barnacle zone. (see photograph # 26).
3.5 to 7:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3.5 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 26).
7 to 8:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 7 meter point marks the beginning of the barnacle/mussel/Fucus zone (see photograph # 26).
8 to 9:	This is a small area near the toe of the rock embankment where there is mixed seaweed as well as barnacles and mussels where the dominant life is filamentous brown algae. (see photograph # 26).
9 to 12.5:	This is a region of fine sand and broken shells with occasional rocks on the surface in the lower intertidal area from the toe of the rock down to the first pile for the mooring wall. Digs in the sand were carried out randomly and clams and marine worms were found in all digs. Substrate in digs is a silty mud. (photograph # 50)
12.5 to 20.5:	This is a region of rocks over a mud/silt base in the lower intertidal area from the first pile down to the 0 meter line and below. Benthic digs were carried out randomly but it was difficult to dig in this area. The rocks continued for some depth down through the mud/silt here. Some small clams were found in this area. Red filamentous algae predominates on surface rocks. Barnacles are the main life on the piles (photograph # 27).
20.5 to 23.5	Below the 0 meter above datum line. The zero meter line is 0.8 meter from the existing mooring wall. The bottom substrate below the zero meter above datum point is a continuation of the sandy, shell mixture found above the zero meter line. Scattered small rocks occur on the bottom with some small red algae on the surface of the rocks in this area. Benthic grabs in this area produced a oily black silty sub surface mud containing occasional clams, dog whelks and marine worms. (see Results of Benthic Grabs, Table 4)

TRANSECT #5 (CHAINAGE 56)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1 to 3.5:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 28). The only visible life in this area is unicellular green algae on some areas of the boulders.
3.5 to 4:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3.5 meter point marks the beginning of the barnacle zone. (see photograph # 28).
4 to 8:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 4 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 28).
8 to 9:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. This is a mixed area of barnacles, mussels, Fucus, and filamentous brown algae.
9 to 12.4:	This is a region of fine sand and broken shells with occasional rocks on the surface in the lower intertidal area from the toe of the rock down to the first pile for the mooring wall. Digs in the sand were carried out randomly and clams and marine worms were found in all digs. Substrate in digs is a silty mud. (photograph # 50) See results of Benthic Digs.
12.4 to 19.4:	This is a region of rocks over a mud/silt base in the lower intertidal area from the first pile down to the 0 meter line and below. Benthic digs were carried out randomly in this area. Some small clams were found in this area. Red filamentous algae predominates on surface rocks. Barnacles are the main life on the piles (photograph # 29).
19.4 to 27:	Below the 0 meter above datum line. The zero meter line is 1.8 meter from the existing mooring wall. The bottom substrate below the zero meter above datum point is a continuation of the sandy, shell mixture found above the zero meter line. Scattered small rocks occur on the bottom with some small red algae on the surface of the rocks in this area. Benthic grabs in this area produced a oily black silty sub surface mud containing occasional clams and marine worms. (see Results of Benthic Grabs, Table 4)

TRANSECT #6 (CHAINAGE 64)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1 to 3 :	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 30). The visible life in this area is sparse unicellular green algae on some areas of the boulders.
3 to 4:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3 meter point marks the beginning of the barnacle zone. (see photograph # 30).
4 to 8.4:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 4 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 30).
8.4 to 10 :	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 8.4 meter point marks the beginning of a mixed area of barnacles, mussels, and filamentous brown algae. This area ends at the toe of the rock embankment which is also at the first row of piles for the mooring wall on this transect (photograph #52).
10 to 17:	This is a region of rocks over a mud/silt base in the lower intertidal area from the first pile down to the 0 meter line and below. Benthic digs were carried out randomly in this area. Some small clams were found in this area. Red filamentous algae predominates on surface rocks. Barnacles and plume worms are the main life on the piles. Starfish are abundant. (photograph # 31).
17 to 25:	Below the 0 meter above datum line. The zero meter line is 2.5 meters from the existing mooring wall. The surface substrate below the zero meter above datum point is a continuation of the sandy, shell mixture found above the zero meter line. Scattered rocks occur on the bottom and there are numerous empty clam shells occurring in this area. Benthic grabs in this area produced a oily black silty sub surface mud containing occasional clams and marine worms. (see Results of Benthic Grabs, Table 4)

TRANSECT #7 (CHAINAGE 72)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 0.8:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
.8 to 2.5 :	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 32). The only visible life in this area is unicellular green algae on some areas of the boulders.
2.5 to 3.5:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 2.5 meter point marks the beginning of the barnacle zone. (see photograph # 32).
3.5 to 7.5:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3.5 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 32 & # 52).
7.5 to 8.5 :	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 7.5 meter point marks the beginning of the barnacle/mussel/Fucus zone. (see photographs # 32 & 52).
8.5 to 9.5 :	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 8.5 meter point marks the beginning of the filamentous brown algae zone (see photograph # 52).
9.5 to 10.5:	Large boulders with barnacle growth extending between the supporting piles of the mooring wall.
10.5 to 16:	This is a region of rocks over a mud/silt base in the lower intertidal area from the rock boulder down to the 0 meter line and below. Benthic digs were carried out randomly in this area. Clams were found in this area. Red filamentous algae predominates on surface rocks. Barnacles and plume worms are the main life on the piles. Starfish are abundant. Almost all surface rocks had jingle shells and anemones as well as dog welks on their lower surface.
16 to 24:	Below the 0 meter above datum line. The zero meter line is 2.5 meters from the existing mooring wall. The surface substrate below the zero meter above datum point is a continuation of the sandy, shell mixture found above the zero meter line. Scattered rocks occur on the bottom. Dungeness crabs and starfish were seen in this area.

TRANSECT #8 (CHAINAGE 80)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1.5:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1.5 to 3:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. The only visible life in this area is unicellular green algae on some areas of the boulders.
3 to 4:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3 meter point marks the beginning of the barnacle zone.
4 to 7:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. The 4 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 35).
7 to 8.5:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. The 7 meter point marks the beginning of the barnacle/mussel/Fucus zone (see photograph # 35).
8.5 to 11.5:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. The is an area of mixed algae including filamentous brown algae, mixed red algae (Porphyra) and green algae (Ulva) on the surface of the rocks. (Photographs # 35, # 11, # 12).
11.5 to 18.5:	This is a region scattered small rocks on the surface in the lower intertidal area from the toe of the existing rock down to the 0 meter line. Filamentous Red Algae dominates on the surface of the small rocks. Loose Fucus covers the surface rocks near the first pile. Benthic digs were carried out after removal of the surface rocks and clams and marine worms were found. Starfish, Polychaete worms and anemones are abundant on the piles and in the sand. Almost all surface rocks near the zero meter tide line had jingle shells and anemones as well as dog welks on their lower surface.
18.5 to 29:	Below the 0 meter above datum line. The zero meter line is 2.5 meters from the existing mooring wall. The surface substrate below the zero meter above datum point is a continuation of the sandy, shell mixture found above the zero meter line. A number of starfish were seen in this area. Benthic grabs were carried out in this area (see Results of Benthic Grabs, Table 4).

TRANSECT #9 (CHAINAGE 88)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1.2:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1 to 5 :	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 37). The only visible life in this area is unicellular green algae on some areas of the boulders.
5 to 5.8:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 5 meter point marks the beginning of the barnacle zone.
5.8 to 13.4:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. The 5.8 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 38).
13.4 to 14.8:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. This is a mixed area of the barnacles, mussels, sparse Fucus, and filamentous brown algae. (see photograph # 38 & # 7)
14.8 to 16.5:	This is an area of mixed shell and gravel below the toe of the rock of the existing embankment. Small clams were found in Benthic digs in this area.
16.5 to 19:	Area of smaller rocks and cobbles over a sand/shell base in the lower intertidal zone. Mixed Red (Porphyra) and green algae (Ulva) predominates on surface of these rocks. Under rocks there are small crabs and worms. Loose Fucus on the surface limit the seaweed growth on the rocks. When surface rocks were removed and benthic digs carried out clams were found in this area. See Results of Benthic Digs and Photograph # 11.
19 to 26:	This is a region scattered small rocks on the surface in the lower intertidal area extending down to the 0 meter line. Filamentous Red Algae dominates on the surface of the small rocks. Benthic digs were carried out after removal of the surface rocks and clams and marine worms were found. Starfish, plume worms and anemones are abundant on the piles and in the mud. Almost all surface rocks near the zero meter tide line had jingle shells and anemones as well as dog welks on their lower surface. (photograph # 39)
26 to 34:	Below the 0 meter above datum line. The zero meter line is 3 meters from the existing mooring wall. The surface substrate is a sand, gravel mixture. Red seaweed sunstars, a Dungeness crab and assorted human garbage was seen in this area . Benthic crabs revealed black silty mud containing worms and gaper clams.

TRANSECT #10 (CHAINAGE 96)

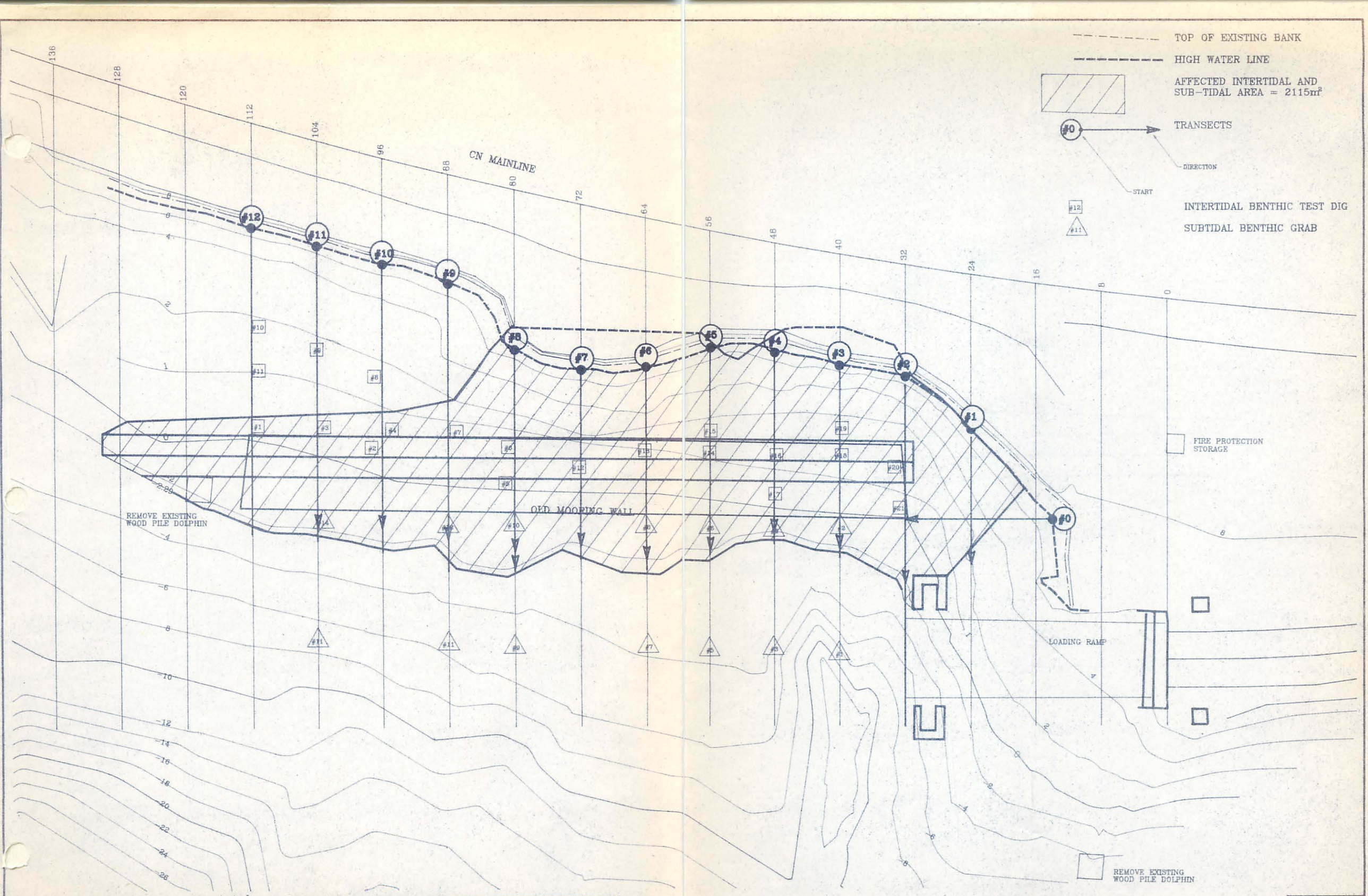
Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to 1:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
1 to 3:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 40). The visible life in this area is unicellular green algae on some areas of the boulders.
3 to 4:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3 meter point marks the beginning of the barnacle zone. (see photograph # 40).
4 to 6:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. The 4 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 40 & # 7).
6 to 7:	This is a continuation of the large rock boulders (rip rap) forming the existing embankment. The 6 meter point marks the beginning of the barnacle/mussel/Fucus zone (see photograph # 40).
7 to 18 :	Area below the toe of the existing rock embankment and sloping gently down to the zero meter above datum line. The surface substrate is mainly a gravel and shell mix. Benthic digs in this area produced some small clams. (see results of Benthic digs).(Photograph # 11)
18 to 22:	This is a continuation of the gently sloping area below the existing rocky embankment. This is the lower intertidal portion of this area, from approximately 1 meter above datum to the mooring wall piles. The surface substrate is a gravel/shell mix with some very small rocks. Some loose Fucus has accumulated near the mooring wall piles and some red (Porphyra) and green algae (Ulva) can be seen on surface rocks. Under rocks there are small crabs and worms. Clams were found in Benthic digs.See Results of Benthic Digs and Photographs # 11 & 41.
22 to 27:	This is a continuation of the previous zone in the shaded area between the mooring wall piles. The piles support starfish, plume worms, sponges and anemones. Almost all surface rocks near the zero meter tide line had jingle shells and anemones as well as dog welks on their lower surface. Clams and worms were found in Benthic digs. (photograph # 42).
27 to 35:	Below the 0 meter above datum line. The zero meter line is 4 meters from the existing mooring wall. The surface substrate is a sand, gravel mixture. A small pile of rocks about 3 feet in diameter has fallen through from behind the mooring wall here. A number of starfish and crabs were seen in this area.

TRANSECT #11 (CHAINAGE 104)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to .8:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
.8 to 2.8:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 43). The visible life in this area is sparse unicellular green algae on some areas of the boulders.
2.8 to 3.8:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3.8 meter point marks the beginning of the barnacle zone. (see photograph # 43).
3.8 to 5.8:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. The 3.8 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 43).
5.8 to 7.8:	This is a continuation of the large rock boulders (rip rap) forming the existing embankment. The 5.8 meter point marks the beginning of the barnacle/mussel/Fucus zone (see photograph # 43).
7.8 to 14:	Area below the toe of the existing rock embankment and sloping gently down to the zero meter above datum line. The surface substrate is mainly large gravel and shell mix. Benthic digs in this area produced some small clams. (see results of Benthic digs).(Photograph # 11)
14 to 24:	This is a continuation of the gently sloping area below the existing rocky embankment. This is the lower intertidal portion of this area, from approximately 1.5 meter above datum to the mooring wall piles. The surface substrate is a gravel/shell mix with some small rocks. Mixed small seaweeds including Red (Porphyra) and green algae (Ulva) can be seen on surface rocks. Under rocks there are small crabs and worms. Clams were found in Benthic digs. See Results of Benthic Digs and Photographs # 11 & 44.
24 to 26.4:	This is a continuation of the previous zone in the shaded area between the mooring wall piles. The piles support starfish, plume worms, sponges and anemones. Almost all surface rocks near the zero meter tide line had jingle shells and anemones as well as dog welks on their lower surface. Clams and worms were found in Benthic digs. Filamentous Red Algae dominates on the surface of the small rocks.
26.4 to 37:	Below the 0 meter above datum line. The zero meter line is 6.5 meters from the existing mooring wall. The surface substrate is a sand, gravel mixture. A number of starfish were seen in this area. A couple of large rocks occurred in this area.

TRANSECT #12 (CHAINAGE 112)

Distance from TOP OF THE EXISTING EMBANKMENT (ABOVE HHW) (in meters)	Description
0 to .8:	Area from top of the existing embankment down to the HHW line. This is an area of mixed vegetation.
.8 to 2:	Extreme upper intertidal area from HHW point. This area consists of large rock boulders. (photograph # 45). The visible life in this area is sparse unicellular green algae on some areas of the boulders.
2 to 3:	This is a continuation of the large rock boulders (rip rap) in the upper intertidal zone. The 3 meter point marks the beginning of the barnacle zone. (see photograph # 45).
3 to 6:	This is a continuation of the large rock boulders (rip rap) in the intertidal zone. The 3.8 meter point marks the beginning of the Fucus/barnacle zone. (see photograph # 43).
6 to 7.5:	This is a continuation of the large rock boulders (rip rap) forming the existing embankment. The 5.8 meter point marks the beginning of the barnacle/mussel/Fucus zone (see photograph # 43).
7.5 to 15.5:	Area below the toe of the existing rock embankment and sloping gently down to the zero meter above datum line. The surface substrate is mainly large gravel and rock mix. Barnacles and filamentous brown algae occur on the surface of some of the rocks in this area. Benthic digs in this area produced some small clams. (see results of Benthic digs).(Photograph # 11 & 45)
15.5 to 26:	This is a continuation of the gently sloping area below the existing rocky embankment. This is the lower intertidal portion of this area, from approximately 1.5 meter above datum to the mooring wall piles. The surface substrate is a gravel and small rocks. Mixed small seaweeds including Red (Porphyra) and green algae (Ulva) can be seen on surface rocks. Under rocks there are small crabs and worms. Clams were found in Benthic digs. See Results of Benthic Digs and Photographs # 11 & 46.
26 to 26.8:	This is a continuation of the previous zone in the shaded area between the mooring wall piles. The piles support starfish, plume worms, sponges and anemones. Almost all surface rocks near the zero meter tide line had jingle shells and anemones as well as dog welks on their lower surface. Clams and worms were found in Benthic digs. Filamentous Red Algae dominates on the surface of the small rocks. (photograph # 46, # 47, # 48)
26.8 to 37:	Below the 0 meter above datum line. The zero meter line is 8.3 meters from the existing mooring wall. The surface substrate is a sand, gravel mixture. A number of starfish were seen in this area. (Photograph # 46)



No.	Date	Description	Dr.	Ch
2	10/04	revised impact area	ps	
1	07/10	revised contours as per semple	ps	

Table of Revisions

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BERTHING WALL RECONSTRUCTION
PRINCE RUPERT, B.C.

DRAWING TITLE: SITE PLAN
AFFECTED INTERIDAL AND SUBTIDAL AREAS

Designed		Job No.	CN-03
Drawn	PRS	Scale	~~1:200~~ 1:400
Checked	PRS	Date	96/10/04

Drawing No. 01 of 4

SUBSTRATES

- ROCKY INTERTIDAL (RIPRAP)
- SMALL ROCK (100mm MINUS) OVER SILTY MUD
- GRAVEL / SAND (50mm MINUS) OVER SILTY MUD
- SMALL ROCK (200mm MINUS)

- TOP OF EXISTING BANK
- HIGH WATER LINE
- TRANSECTS (#0 → DIRECTION; START)

CN MAINLINE

#12 #11 #10 #9 #8 #7 #6 #5 #4 #3 #2 #1 #0

SAND GRAVEL

OLD MOORING WALL

REMOVE EXISTING WOOD PILE DOLPHIN

FIRE PROTECTION STORAGE

LOADING RAMP

REMOVE EXISTING WOOD PILE DOLPHIN

No.	Date	Description	Dr.	Ch.
2	10/04	revised impact area	ps	
1	07/10	revised contours as per semple	ps	

Smyth Engineering Services
Survey – Design – Inspection
385 – 309 2nd Avenue West
Prince Rupert, B.C., V8J 3T1
Telephone / FAX : (604) 624-3021

SEAL :

CLIENT : SEMPLE ASSOCIATES PRINCE RUPERT, B.C.

PROJECT : AQUATRAIN BERTH BERTHING WALL RECONSTRUCTION PRINCE RUPERT, B.C.

DRAWING TITLE : SUBSTRATES FOR AFFECTED INTERTIDAL AND SUBTIDAL AREAS

Designed		Job No.	CN-08
Drawn	PRS	Scale	1:200 | 1:400

Drawing No. 02

HABITAT ZONE	AREAS
UNICELLULAR GREEN ALGAE	116.4m2
SPARCE BARNACLES	55.9m2
FUCUS / BARNACLES	234.9m2
MUSSELS / FUCUS / BARNACLES	71.7m2
FILAMENTOUS BROWN ALGAE	80.4m2
FILAMENTOUS RED ALGAE	108.5m2
ULVA / PORPHYRA	53.0m2
CLAMS	1384.5m2
ROCK / KELP	9.8m2
TOTAL AFFECTED AREA	2115.1m2

TOP OF EXISTING BANK

HIGH WATER LINE

#0 TRANSECTS

DIRECTION

START

CN MAINLINE

#12 #11 #10 #9 #8 #7 #6 #5 #4 #3 #2 #1 #0

FIRE PROTECTION STORAGE

OLD MOORING WALL

REMOVE EXISTING WOOD PILE DOLPHIN

LOADING RAMP

REMOVE EXISTING WOOD PILE DOLPHIN

2	10/04 revised impact area	ps

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Drawing No. 03

NEW & RE-INSTATED HABITAT ZONES

	AREAS (M^2)
UNICELLULAR GREEN ALGAE	128.0
SPARSE BARNACLES	61.5
FUCUS / BARNACLES	258.4
MUSSELS / FUCUS / BARNACLES	78.9
FILAMENTOUS BROWN ALGAE	88.4
FILAMENTOUS RED ALGAE	119.3
ULVA / PORPHYRA / SMALL KELP	309.3
ROCK / KELP	490.0
NEW & RE-INSTATED ROCK HABITAT	1533.8
TOTAL RE-INSTATED CLAM HABITAT, EL-2.29	723.1
TOTAL AREA OF RE-INSTATEMENT	2256.9

TOP OF EXISTING BANK

HIGH WATER LINE

AREA RE-INSTATED WITH RIP-RAP ROCK, >300mm DIA.

TRANSECTS

DIRECTION

START

AFFECTED AREA PERIMETER

RE-INSTATED CLAM HABITAT

CN MAINLINE

NEW DOLPHINS

OLD MOORING WALL

REMOVE EXISTING WOOD PILE DOLPHIN

FIRE PROTECTION STORAGE

LOADING RAMP

REMOVE EXISTING WOOD PILE DOLPHIN

TIMBER PILE FACING

EL. 10.250

EL. 8.750

H. H. W. L.

EXISTING GROUND

ARMOUR ROCK MIN 1m THICKNESS MIN 300mm DIA

1 : 1.5

DREDGE LINE

L. L. W. L.

1 : 2

-2.29m

1:200
1:400

2	10/04	revised impact area	ps

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SCALE 1

Drawing No. 04