December 14, 2012

REPORT ON

Sampling, Testing and Development of Preliminary Acid Rock Drainage (ARD) and Metal Leaching (ML) Monitoring Program, Coastal Construction Aggregates, Tasu Quarry, Haida Gwaii

Submitted to:
Coastal Construction Aggregates Inc.
15041 Owens Road
Smithers, BC
V0J 2N1

Report Number: 1214760060-001-R-Rev0

Distribution:

2 Copies - Coastal Construction Aggregates Inc.

2 Copies - Golder Associates Ltd.

REPORT

Golder Associates

Table of Contents

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Coastal Construction Aggregates Inc. (CCAI) retained Golder Associates Ltd. (Golder) to conduct a limited geological review of the Tasu Iron Ore Mine Site (Tasu Quarry), Tasu Sound, Haida Gwaii (see Figures 1 and 2), and prepare a draft monitoring plan to assess acid rock drainage (ARD) and metal leaching (ML) potential during the production of industrial rock products. CCAI plans to produce a variety of rock products through a combination of extraction of material from existing waste rock piles and quarrying of in-situ bedrock.

The Terms of Reference (ToR) and a Request for Proposals (RFP) for the work were transmitted to Golder by CCAI on August 28, 2012. Within the ToR it was identified that the work to be conducted was a requirement of the BC Ministry of Energy and Mines within permit G-8-345 issued under the British Columbia *Mines Act*.

This report must be read in conjunction with **"Important Information and Limitations of this Report",** which is appended following the text. The reader's attention is specifically drawn to this information for the proper use and interpretation of this report.

2.0 SCOPE OF WORK

The scope of work conducted by Golder for this assignment is contained in our proposal dated September 12, 2012 (Golder Reference No. P2-14470222-001-L-Rev0). The proposed scope of work consisted of the following tasks:

- Conduct initial field visit and surface grab sampling from Cobber reject rock stockpile;
- Review available test data and recommendations for testing of grab samples from site visit;
- Conduct petrographic examination of thin sections (if required);
- Conduct ARD/ML testing of samples collected;
- Provide interpretation and report findings; and
- Develop a draft ARD/ML monitoring program.

3.0 BACKGROUND

3.1 Location and Historical Operations

Based on information provided within CCAI's mining plan (2011)[1] submitted as part of the application for a mine permit, the following background information is provided.

- The Tasu Quarry is located on the southwestern coast of South Moresby Island, approximately 55 km southwest of Sandspit, which is the closest community to the proposed quarry site (see Figure 1).
- Mineral exploration at the Tasu Quarry site began in the late 1950's and early 1960's.

[1] Coastal Construction Aggregates Ltd.; 2011; "Tasu Aggregate Quarry Mine Plan;" submitted to BC Ministry of Energy and Mines, February 18, 2011.

- Mining started approximately 1967 and continued through to closure in late 1983.
- Over 12 million tons of iron ore were shipped from the site and 27 million tons of ore was processed.
- Excavation of the Cobber reject rock stockpile is being proposed to produce various rock products. The stockpile rises approximately 50 m above Hunger Harbour on Tasu Sound and is estimated to contain approximately 1,400,000 m^3 of material (see Figure 2).
- Excavation and processing of the material in Pit #1 for clean fill material will occur first at the quarry, with blasting of in-situ bedrock to occur as necessary for production of larger rock products (e.g. rip rap, rock armour, clean marine fill).

3.2 Bedrock Geology

Bedrock geology within the area of the Tasu Quarry site has been mapped by J.W. Haggart, on two 1:50,000 scale map sheets as follows:

- Haggart, J.W.; 2002; "Geology, Ramsay Island, Darwin Sound, and Tasu Head (103C09), British Columbia;" Geological Survey of Canada, Open File 4418 (scale – 1:50,000).
- Haggart, J.W.; 2002; "Geology, Moore Channel (103C16), British Columbia;" Geological Survey of Canada, Open File 4423 (scale – 1:50,000).

Within the previously mined area there are four distinct bedrock formations identified by Haggart (2002), which are shown in Figure 3. These formations include:

- TJK – Kunga Group – undifferentiated shale, calcareous shale, massive limestone, fine-grained sandstone.
- TS – Sadler Limestone – massive, grey crystalline limestone; with lesser chert.
- TK – Karmutsen Formation – basalt flows; flow breccias; pillow lavas; tuff; grey limestone lenses; minor siltstone.
- MJS – San Cristoval Plutonic Suite – medium-grained, equigranular, mafic inclusion-bearing (biotite-) hornblende quartz diorite, quartz monzodiorite and diorite; foliated inclusions and prismatic hornblende are characteristic; includes local migmatite and agmatite complexes.

3.3 Rock Products

Based on information provided to Golder by CCAI, it is proposed that the material in the Cobber reject rock stockpile and possibly blasted rock material from elsewhere in the quarry area will be used to make the following rock products:

- Riprap and armour stone;
- Clean marine fill;
- Aggregates for Super-pave and other asphalt products;
- Aggregates for concrete production; and
- Railway ballast material.

Production of these rock products may require sorting, washing, processing (crushing and sieving), stockpiling and loading. The processing of the rock products is proposed to occur on a flat, cleared area at the northwest end of Hunger Harbour. The flat area having been constructed during the original mine operations by infilling (with mine waste rock) into Hunger Harbour and closing off of the original open channel. This now provides an opportunity for a sheltered barge loading site if required.

4.0 PREVIOUS ARD/ML TESTING RESULTS

4.1 Acid Base Accounting (ABA) Testing

As part of the mine permit application and mine plan, CCAI conducted acid base accounting (ABA) testing on five samples collected from the Cobber reject rock stockpile. Rock from the Cobber reject rock stockpile was collected and sieved to a 1" (25 mm) minus gradation. This material was then visually separated into various rock types including; andesite, diorite and marble. In general, the five samples were further sieved to particle sizes varying from 25 mm (<1") to 9.5 mm (3/8"), which included the production of fine material referred to within the mine plan report as "Tasu Fines." The three separated rock type samples, a composite sample (Tasu 1" minus) and a sample of the Tasu Fines were sent to SGS Canada Inc. (SGS) laboratory in Burnaby, BC for ABA testing and total metals analysis (methodology not reported). A duplicate sample of the Tasu 1" minus was also tested for paste pH (Sobek), total inorganic carbon (TIC), total sulphur (S(T)), sulphate sulphur ($S(SO_4)$), neutralization potential (NP) and Fizz Test (Sobek)

Laboratory results provided in the CCAI's mine plan are reproduced in Table 1 below:

Table 1: Laboratory Results from ABA Testing – SGS-CEMI

Sample ID/Test	LOD	Method Code	Tasu 1" Minus	Tasu Andesite	Tasu Diorite	Tasu Marble	Tasu Powder	Tasu 1" Minus Duplicate
Paste pH	1.01	Sobek	7.86	8.12	8.52	8.10	7.53	7.90
TIC %	0.02	HCL Leach	2.79	0.27	0.6	11.6	0.91	2.83
$CaCO_3$ NP	#N/A	Calc.	232.5	22.5	50.0	966.7	75.8	-
S(T) %	0.02	Leco	0.93	0.11	0.06	0.09	1.32	0.95
$S(SO_4)$ %	0.01	HCL Leach	0.05	0.04	0.04	<0.01	0.07	0.05
S(S-2) %	#N/A	Calc.	0.88	0.07	0.02	0.09	1.25	-
AP	#N/A	Calc.	27.5	2.2	0.6	2.8	39.1	-
Sobek NP	0.1	Modified NP	239.5	36.9	33.0	968.2	81.1	235.8
Net NP	#N/A	Calc.	212.0	34.7	32.4	965.4	42.0	-
Sobek NP/AP Ratio	#N/A	Calc.	8.7	16.9	52.8	344.2	2.1	-
Carbonate NP (kg $CaCO_3$/Tonne)	-	-	63.5	6.1	13.6	263.7	20.7	64.4
Carbonate NP/AP Ratio	-	-	2.3	2.8	22.7	94.2	0.5	-
Fizz Test	#N/A	Sobek	Moderate	Moderate	Moderate	Strong	Moderate	Moderate

Total metals analysis was also conducted on each of the five samples submitted for testing. The results of those tests are compiled in the table provided in Appendix A. The results indicate high levels of copper (549.3 ppm) and manganese (1636 ppm) in the samples tested.

4.2 Surface Water Quality Testing

CCAI conducted water quality testing on two samples of surface water in June 2010. The samples were collected from the main portal that drains Pit No. 1 and from surface flow from the old thickener site. The samples were tested for total metals using the ICPMS method and compared to the BC Water Quality Guidelines (BCWQG) for Drinking Water and aesthetic objectives. The test results for the two samples indicated that none of the parameters (metals) exceeded the BCWQG (see Appendix A for results).

5.0 VISUAL SITE ASSESSMENT

A site visit was conducted at the Tasu Quarry site on September 17, 2012, which consisted of a 6 hour visual assessment of the Cobber reject rock stockpile, Pit No. 1, the proposed processing site, and a potential marine terminal site. The site visit was conducted by Mr. Jeff Kyba, a geologist from the BC Ministry of Energy and Mines (MEM), Mr. Colin Richardson, Chair of the First Nations Solutions Table, the Owner and the author. Annotated photos taken during the visual site assessment are compiled in Appendix B.

5.1 Site Access

Access to the Tasu Quarry site was by helicopter, which was provided by Helijet Helicopters stationed in Sandspit, Haida Gwaii, BC. The quarry site is not currently accessible by road. Access during commercial quarrying operations is expected to be generally by boat or ship.

The visual site assessment was carried out by hiking along roads that had been constructed as part of the original mine operations. The roads were generally in fair to good condition, with small trees and shrubs overgrowing portions of the road. Some of the roads had been eroded by surface runoff, but none were found to be inaccessible by foot. The visual assessment was limited to the operating areas near sea level and up to the Pit No. 1 level, where it is understood that most operations will take place.

The potential site of the marine berth that will be used for shipping materials by Panamax or Handi-max class ships is located on the northwest side of the proposed production area. It is assumed that the marine berth for the previous mine operations was within an open channel at the north end of Hunger Harbour and has been infilled to form a causeway across the channel. There is evidence that this site was likely used as a shipping berth previously and that it might be possible to reconstruct portions of the berth for use as a loading facility for the propose quarry.

5.2 Bedrock

Bedrock in the area of the Tasu Quarry site was observed to be highly variable in composition. Residual materials produced during the previous mining operations were present in the form of magnetite-rich fines, large blocks of magnetite and iron ore-rich rock. Based on the visual site assessment it was estimated by MEM geologist and the author that the rock types and proportions present at the quarry site generally were as follows:

- 45% calc-silicate skarn assemblage;
- 15% marble;
- 10% magnetite/ironstone;
- 15% intrusives (quartz diorite, diorite);
- 12-15% volcanics (basalt); and
- 0-3% copper/iron sulphide rich rocks.

Exposures of limestone were observed on exposed bedrock faces upslope of Pit No. 1. Calcite veins were observed in the rock at several outcrops in and around Pit No. 1. Staining on outcrops was limited to small patches of brown, iron oxide. The bulk of the iron ore appears to have been removed during the previous mining operations and remaining ore consists of small, isolated remnant piles.

5.3 Cobber Reject Rock Stockpile

Rock in the Cobber reject rock stockpile is inferred to be a mixture of the rock types indicated above. The pile has variable fines content (10-20% estimated) based on observations of the exposed slope on the stockpile. Small surface failures along the top and middle portions of the stockpile slope allowed visual assessment of the material composition and an estimate of fines content.

5.4 Surface Drainage

Surface drainage at the Site was limited due to a long dry period that occurred prior to the visual site assessment. Surface water was observed to be flowing in a small stream on the west side of the Cobber reject rock stockpile. The inferred source of the surface flow was the old thickener site located above and behind the stockpile. The water was observed to be clear, with no iron staining or discoloration detected. A second surface water flow was identified on the southeast side of the road access to Pit No. 1, where a light greenish-blue stain was evident on the bedrock surface along which the water was flowing. Surface water was also observed to be seeping over a bedrock exposure within Pit No. 1. It was assumed that the flow originated within one of the limestone deposits that were visible within the exposed pit faces in and above Pit No. 1.

No other surface water flows were observed during the visual site assessment. Notably, no water was observed in the base of Pit No. 1 during the visual site assessment and no ponding was observed in the area of the old thickener site, although a dry stream channel was apparent on one side of the site.

5.5 Groundwater

No groundwater wells were identified by CCAI and no evidence of groundwater wells was observed during the visual site assessment. The Cobber reject rock stockpile is in direct contact with the marine waters and therefore is unlikely to be influencing local groundwater. No surface water ponding was observed in the bottom of Pit No. 1

6.0 SAMPLING AND LABORATORY TESTING

A single grab sample was collected from the slope of the Cobber reject rock stockpile and submitted to SGS Canada Inc. (SGS) laboratory in Burnaby, BC. Laboratory tests requested were ABA and SFE analysis. The SGS laboratory reports are provided in Appendix C.

6.1 Testing Methodologies

ABA and SFE testing are "static" testing methods used to assess ARD and ML potential, respectively (MEND, 2009)[2]. ABA testing provides quantitative information on the sulphide sulphur concentration and other sulphur species in a rock sample. ABA testing was conducted using the Modified Sobek method which derives acid potential (AP) from oxidation of sulphide sulphur and neutralization potential (NP) using an ambient temperature digestion at pH 2.0-2.5 and a titration endpoint of 8.3. The oxidation of sulphide sulphur is the chemical process responsible for generation of ARD and the release of metals in site drainage (ML). Laboratory "fizz testing" to assess apparent carbonate mineral content was conducted using a 25% HCl solution.

For the test conducted by SGS the rock submitted was ground to 2 mm minus material and then subjected to the prescribed test methodology.

SFE testing information provides quantitative information on total and dissolved metals in leachate generated from a rock sample screened to a 6.35 mm minus gradation (rock pulp) and agitated with a 3:1 ratio of de-ionized water to rock pulp for 24 hrs. Fine particles in the SFE leachate were allowed to settle for 3 hrs before the leachate was decanted and analyzed.

6.2 ARD/ML and Surface Water Quality Guidelines

Methods for assessing and predicting ARD and ML in sulphidic geological materials at mine sites have been developed by MEND (2009). These guidelines can be used as a screening tool in assessing ARD and ML potential for non-mining projects, recognizing the limitations in applying these guidelines to non-mining projects. The results of the laboratory testing of metal leaching potential were compared with the British Columbia Water Quality Guidelines (BCWQG; Working 2006 and Approved 2010) criteria for freshwater aquatic life. The BCWQG are used for comparative purposes only, and are not used to assess the actual quality of drainage or potential exceedances in surface water or groundwater associated with the Cobber reject rock stockpile or local bedrock.

Total and dissolved metal parameters in SFE leachate were compared to the BCWQG criteria for freshwater aquatic life to assess relative magnitudes of the concentrations of chemical parameters of potential environmental concern. Total metals (multi-element) analysis of the rock sample was carried out to measure the solid-phase concentrations of various metals in the rock that might have an effect on surface water quality.

6.2.1 ABA Test Results

ABA test results on the Cobber reject rock sample submitted from the Tasu Quarry are summarized in Table C-1 in Appendix C. Laboratory (paste) pH of the rock sample was 7.79, which indicates that the rock sample has an initial basic (alkaline) chemical tendency. Total inorganic carbon (TIC) was 2.55%. The fizz test rating reported by the laboratory was moderate.

[2] MEND; 2009; "Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials": MEND Report 1.20.1, prepared by William A. Price, CANMET – Mining and Mineral Sciences Laboratories, Smithers, BC., Natural Resources Canada.

Total sulphur concentration in the rock sample was 0.47% by mass. Sulphate sulphur reported in the ABA results was less than the laboratory detection limit (<0.01%). The calculated acid generation potential (AP) for the sample was 14.7 tonnes $CaCO_3$ equivalent per 1,000 tonnes of material. The bulk acid neutralization potential (Modified Sobek NP) was 210.8 tonnes $CaCO_3$ equivalent per 1,000 tonnes of material. The carbonate neutralization potential (Carbonate NP) was 58.0 tonnes $CaCO_3$ equivalent per 1,000 tonnes of material, calculated from the TIC concentration. The Modified Sobek NP method assumes that the reactive carbonates in a sample include calcite and/or highly reactive silicates that could be available to neutralize AP, whereas the Carbonate NP assumes that the reactive carbonates are in the form of calcite (MEND, 2009). Therefore, Modified Sobek NP results are typically higher than Carbonate NP results.

Neutralization potential ratio (NPR) is defined as the ratio of NP to AP and can be used to classify sulphide-bearing rocks according to the ARD screening criteria (MEND, 2009). The rock sample tested had a Sobek NP/AP ratio of 14.34 and carbonate NPR of 3.95.

6.2.2 Shake Flask Extraction (SFE) Results

Shake flask extraction (SFE) testing was conducted on the single grab sample. The laboratory results for the SFE leachates were compared to the BCWQG criteria for freshwater aquatic life. The SFE analytical results are provided in Table C-2, Appendix C.

Key leachate quality parameters of interest included pH, sulphate, alkalinity, and metals (total and dissolved). The pH of the SFE leachate was 7.73, which is slightly basic. Sulphate concentration was low (7 mg/L) and alkalinity concentration was 46.1 mg $CaCO_3$/L.

Results from the SFE test are provided in Tables C-3 (Dissolved Metals) and C-4 (Total Metals), Appendix C. The results are compared to the BCWQG in each table.

Comparison of the SFE dissolved metal results with the BCWQG criteria indicated that dissolved aluminum (0.184 mg/L vs guideline 0.1 mg/L) and dissolved copper (0.0053 mg/L vs guideline 0.004 mg/L) exceeded the BCWQG criteria in the test leachate. Comparison of the SFE total metals test results for aluminum (1.23 mg/L vs 0.1 mg/L), copper (0.0942 mg/L vs guideline 0.004 mg/L) and total iron (2.32 mg/L vs guideline 0.3 mg/L) indicate they exceeded the BCWQG criteria in the test leachate.

6.2.3 Conclusions

Based on the static testing results from the single sample, the material assessed can be classified as *not potentially acidic drainage generating* (Non-PAG) according to the ARD screening criteria used in evaluation of mine rock and waste (MEND, 2009). Review of the data provided by CCAI supports the conclusion that the material in the Cobber reject rock stockpile is not potentially acidic drainage generating.

SFE testing results indicated that the pH of the leachate produced was slightly alkaline, with some potential for metal leaching (i.e. total and dissolved). Dissolved metals in SFE leachates were analyzed to provide information on readily soluble components as indicated in MEND (2009). The leaching of metals associated with placement of the materials produced from the Cobber reject rock stockpile in the environment is expected to be mitigated by the anticipated large particle sizes (i.e. gravel to rip rap sizes) of the materials that will be produced. Rock products with smaller particle sizes such as aggregate and granular fill would be expected to have a higher potential for leaching metals given the larger surface area available for leaching associated with smaller particle size materials. CCAI is developing plans to screen the fines out of the cobber reject pile and either process or landfill these materials on site. This will further mitigate the potential for leachable metals in the products that will be shipped from site for construction purposes.

7.0 PROPOSED MONITORING PROGRAM

7.1 Basis for Monitoring Program

The International Network for Acid Prevention (INAP) has produced a Global Acid Rock Drainage Guide (GARD Guide 2009, last updated Dec. 2010) which can be used as a basis for a proposed monitoring program.

7.1.1 Monitoring Objectives

Monitoring objectives for ARD/ML at mine sites are generally as follows (taken from Figure 8.2: Steps in the Development of an ARD Monitoring Program, GARD 2009):

- Characterize current climatic, hydrological, hydro-geologic, biological and geochemical conditions;
- Assess ARD/ML Potential;
- Detect Onset of ARD/ML by continuous monitoring of drainage water quality;
- Predict Onset of ARD/ML using monitoring data and through use of predictive model(s);
- Assess effects/impacts of ARD/ML on drainage water quality and the receiving environment; and
- Assess engineered ARD/ML controls.

Bedrock chemistry and water quality for the existing rock and surface water conditions are described within the Mine Plan submitted by CCAI. Baseline data on existing water quality and contaminants (metals) within Hunger Harbour will be required to establish a pre-operation baseline condition against which future monitoring and/or testing can be compared (current conditions survey). Based on static test results of rock from the Cobber reject rock stockpile, the potential for acidic drainage from the Cobber reject rock stockpile or from Pit No. 1 is likely to be low, assuming drainage, mineralogical and chemical (rock) conditions remain similar to those observed during the visual site assessment. The proposed monitoring program will provide the methodology for detection of ARD/ML in future. The impacts of ARD/ML, should it occur, would be to marine life and vegetation within Tasu Sound.

7.1.2 Quarry Rock and Product Assessment Monitoring

Rock materials tested to date from the Cobber reject rock stockpile are classified as "not potentially acidic drainage generating" (Non-PAG) according to comparison of testing results with ARD screening criteria. The rock types and mineralogy of materials in the Cobber reject rock stockpile and from Pit No. 1 should be expected to vary as further excavation and blasting occurs. Therefore, the monitoring program must consider these potential changes as rock is removed and rock products produced. The following monitoring program for rock products is proposed.

Table 2: Monitoring Program for Existing Stockpile and Blasted Rock Products

Operation	Location of Tests	Frequency of Tests	Purpose
When loading directly from Cobber reject rock stockpile or material from Pit No. 1.	Samples collected from active excavation face	■ 1 ABA and 1 SFE test per 1000 m^3 for first 10,000 m^3 produced= ■ 1 ABA and 1 SFE test for every 5,000 m^3 after first 10,000, m3 up to 100,000 m^3 produced ■ 1 ABA and 1 SFE test for every 10,000 m^3 produced after first 100,000 m^3 have been produced	■ To verify rock is Non-PAG and provides client with QC data on product supplied ■ To monitor potential changes in rock mineralogy and verify rock is Non-PAG ■ To monitor potential changes in rock mineralogy and verify rock is continuing to be Non-PAG
When crushing or screening product for loading at the processing area.	Samples collected from crusher or screen operations	Same as above	Same as above
When blasting and producing large rock products from Pit No. 1.	Samples collected at exposed bedrock face	■ Minimum 3 samples for ABA and SFE testing prior to start of blasting operations ■ 1 ABA and 1 SFE test for every 2000 m^3 produced up to 20,000 m^3 ■ 1 ABA and 1 SFE test for every 10,000 m^3 produce after first 20,000 m^3	■ To assess intact rock for potential to cause acidic drainage ■ To verify rock is Non-PAG and provides client with QC data on product supplied ■ To monitor potential changes in rock mineralogy and verify rock is continuing to be Non-PAG
When producing materials from sites other than the Cobber reject rock stockpile or Pit No. 1.	Samples to be collected at exposed bedrock face or from stockpile	As per 1, 2 or 3 above depending on operational method and product to be produced	As per 1, 2 or 3 above depending on operational method and product to be produced

Continuous testing of the bedrock and rock products will allow for the detection of the onset of ARD/ML should geological conditions change as stockpiled materials are removed and existing pits are expanded. Data collected will need to be analyzed to assess if trends occur which could lead to the prediction of ARD/ML conditions as quarrying operations progress. The high number of tests during start-up of each operational site is to verify that the rock types being processed are consistent with the prediction that the rock being processed is not potentially acidic drainage generating. The frequency of subsequent testing should provide data on ARD/ML potential in advance of potential environmental damage.

7.1.3 Surface Water Monitoring

Surface water monitoring should be conducted in close proximity to where potential ARD or water discharges are likely to occur. At the Tasu Quarry site, the main stream on the northwest end of the Cobber reject rock stockpile should be a primary sampling location. It is assumed that during development of the quarry, other streams or seepages will become evident or will be directed into concentrated flows. Where these flows are in contact with potential ARD then sampling points should be established on these drainages.

Based on the visual assessment, the stream flows are concentrated into narrow and shallow flow patterns, therefore multiple samples across the width of the flows is not likely required. For wider streams multiple samples would be collected to test for variance across the stream (vertically and horizontally) and to assess the degree of mixing that was taking place. Flow monitoring should take place on the main stream on the northwest end of the Cobber reject rock stockpile so that calculation of chemical loading may be conducted, particularly so that baseline data may be developed to evaluate operational impact to water quality.

The Cobber reject rock stockpile currently extends into the marine waters of Hunger Harbour. Biological monitoring of the kelp and sea plants in Hunger Harbour may be the most effective method for evaluating ARD impacts. CCAI has indicated that it will be unlikely that subsurface extraction of the Cobber reject rock stockpile will be undertaken, therefore, the primary means of change to the marine environment will be through the introduction of ARD and metals in drainage which enter into Hunger Harbour. Bio-accumulation assessment is a means to assess risks to aquatic-dependent wildlife and human health associated with exposure to bioaccummulative substances[3].

[3] MacFarlane, M.; 2003; “A Guidance Manual to Support the Assessment of Contaminated Sediments in Freshwater, Estuarine and Marine Ecosystems in British Columbia – Volume IV – Supplemental Guidance on the Design and Implementation of Detailed Site Investigations in Marine and Estuarine Ecosystems; BC Ministry of Water, Land and Air Protection, Pollution Prevention and Remediation Branch, November, 2003

From conditions observed during the visual site assessment and proposed operations at the Tasu Quarry, the following surface water monitoring program is proposed:

Table 3: Proposed Surface Water Monitoring Program

Source	Frequency of Testing	Purpose
Main Creek on northwest end of Cobber Reject Rock Stockpile	■ Sample should be taken weekly during first month of operations at the site. ■ Samples should be taken once per month thereafter and frequency increased if water quality is observed to deteriorate.	■ Purpose is to monitor surface water quality during site operations and to provide a potential tool for predicting the impacts of site operations on water quality over time.
Other surface water drainages	■ Surface flows in contact with active operations within the Tasu Quarry should be sampled once per week during the start up of operations. ■ Samples should be taken once per month thereafter and frequency increased if water quality is observed to deteriorate.	■ Purpose is to monitor surface water quality during site operations and to provide a potential tool for predicting the impacts of site operations on water quality over time.
Hunger Harbour and Tasu Sound	■ Vegetation sampling for biological analysis should be conducted once per season for the first year in Hunger Harbour and Tasu Sound. ■ Vegetation sampling should be conducted once per year thereafter, assuming the site is active.	■ Biological analysis of the vegetation in Hunger Harbour will provide a method for assessing impacts to marine life and changes to the marine environment during and after site operations.

7.1.4 Groundwater

No groundwater wells were observed on the Tasu Quarry site and none have been reported by CCAI. Monitoring wells would be difficult and expensive to install within the proposed quarry operations. It would be difficult to site wells which could be used to effectively identify impacts of operations solely from the Cobber reject rock stockpile and Pit No. 1 and not be impacted by old mining conditions in other areas. It is therefore recommended that groundwater monitoring wells not be installed at this time but consideration be given to installation of wells in the future when blasting and quarrying operations begin to take place higher on the slopes above Tasu Sound and the Cobber reject rock stockpile has been removed.

7.1.5 Testing Parameters for Rock Products and Surface Water

Monitoring of the rock products produced from the Tasu Quarry will be for the prediction of ARD and ML resulting from site operations and for potential purchasers for their receiving environments. It is proposed that the following tests and test parameters be included in monitoring of ARD and ML potential at the Tasu Quarry unless geological conditions should change significantly.

Monitoring of ARD/ML potential in rock products:

- Acid base accounting (ABA) test (Modified Sobek Method) which provides the following test parameters:
  - Paste pH
  - Total inorganic carbon (TIC)
  - Calcium carbonate neutralization potential ($CaCO_3$ NP)
  - Total sulphur
  - Sulphate sulphur
  - Sulphide sulphur
  - Calculated acid potential (AP)
  - Neutralization potential (NP)
  - Net neutralization potential (Net NP)
  - Fizz Test.

- Shake Flask Extraction Test (SFE) test with following test parameters:
  - pH
  - Redox
  - Conductivity
  - Hardness $CaCO_3$
  - Total acidity
  - Alkalinity
  - Sulphate
  - Major Anions (meq/L) (Calculated)
  - Major Cations (meq/L) (Calculated)
  - Dissolved Metals (mg/L)
  - Total Metals (mg/L)

Monitoring of Surface Water Quality for ARD/ML:

- Metals in Water using ICP-MS:
  - pH
  - Redox
  - Conductivity
  - Alkalinity
  - Sulphate
  - Major Anions
  - Major Cations
  - Hardness
  - Dissolved Metals (mg/L)
  - Total Metals (mg/L)

7.1.6 Data Analysis and Interpretation

Assessment of ARD test results (data) derived from the monitoring should refer to Chapter 14; "*Acid Base Accounting and Criteria Used to Predict Potential For Acidic Drainage;"* as provided in the MEND, 2009, document to assess variations or changes in the ARD/ML potential. The laboratory water quality results for surface water from the Tasu Quarry site should be compared to British Columbia (Approved and Working) Water Quality Guidelines (BCWQG)[4,5] for freshwater aquatic life and marine aquatic life. The metals analyses as part of the SFE testing should also be compared to these guidelines.

7.1.7 Quality Control and Quality Assurance

A quality control (QC) and quality assurance (QA) plan should be prepared so that the collection of data is of known and defensible quality. The QC/QA plan should identify the project management team on site and particularly those people responsible for sample collection, analysis and action in the event that conditions change. The plan should also contain sample collection methods, handling and custody methods, analytical testing requirements, field and laboratory control methods (e.g. field blanks, duplicates, replicates) criteria for data review and validation and response actions for deficiencies and non-conforming activities.

The analysis of the samples should be conducted by a certified laboratory familiar with the required tests and who can perform the tests at the detection limits required for direct comparison to the guidelines identified. The laboratory must be able to demonstrate their internal quality control and quality assurance programs including instrument calibration, maintenance and data management.

---

[4] BC Ministry of Environment, "Approved Water Quality Guidelines", updated January 2010.
[5] BC Ministry of Environment, "A Compendium of Working Water Quality Guidelines for BC", updated August 2006.

8.0 CLOSURE

We trust that this report is sufficient for your immediate requirements. If you have any questions about the contents of this report, please do not hesitate to contact the undersigned.

GOLDER ASSOCIATES LTD. **REVIEWED BY:**

Rob Buchanan, M.A., P.Geo.
Senior Geoscientist

Jeff Fillipone, Ph.D., P.Geo.
Principal, Senior Geologist

RB/JF/smh

n:\final\2012\1476\12-1476-0060 ccal tasu quarry haida gwaii\1214760060-001-r-rev0-ard ml 14dec_12\1214760060-001-r-rev0 ard ml tasu quarry haida gwaii 14dec_12.docx

9.0 LIMITATIONS

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

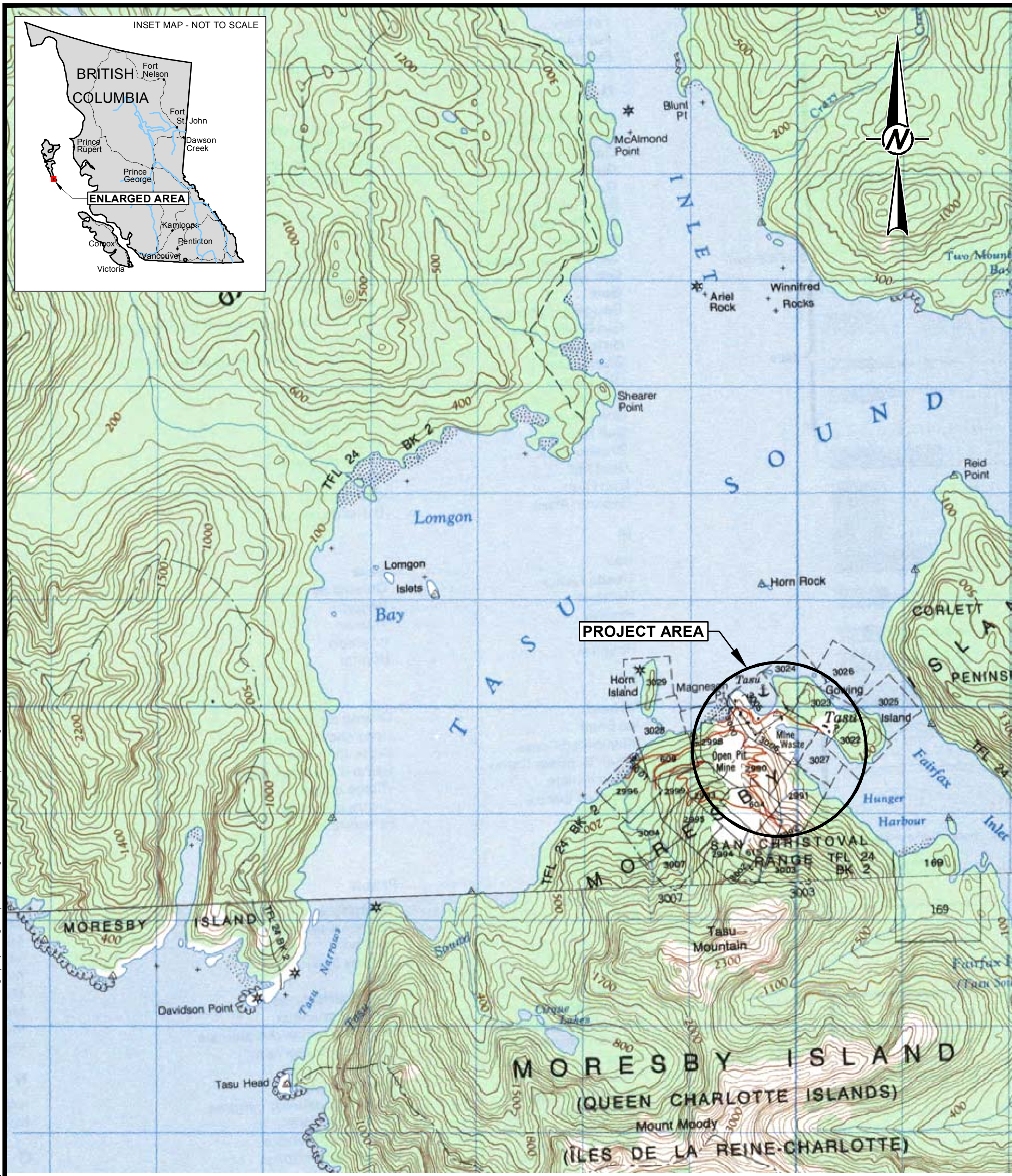
Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.



0 1,000 2,000 3,000 m

SCALE

PROJECT

COAST CONSTRUCTION AGGREGATES
TASU QUARRY
HAIDA GWAII, BC

TITLE

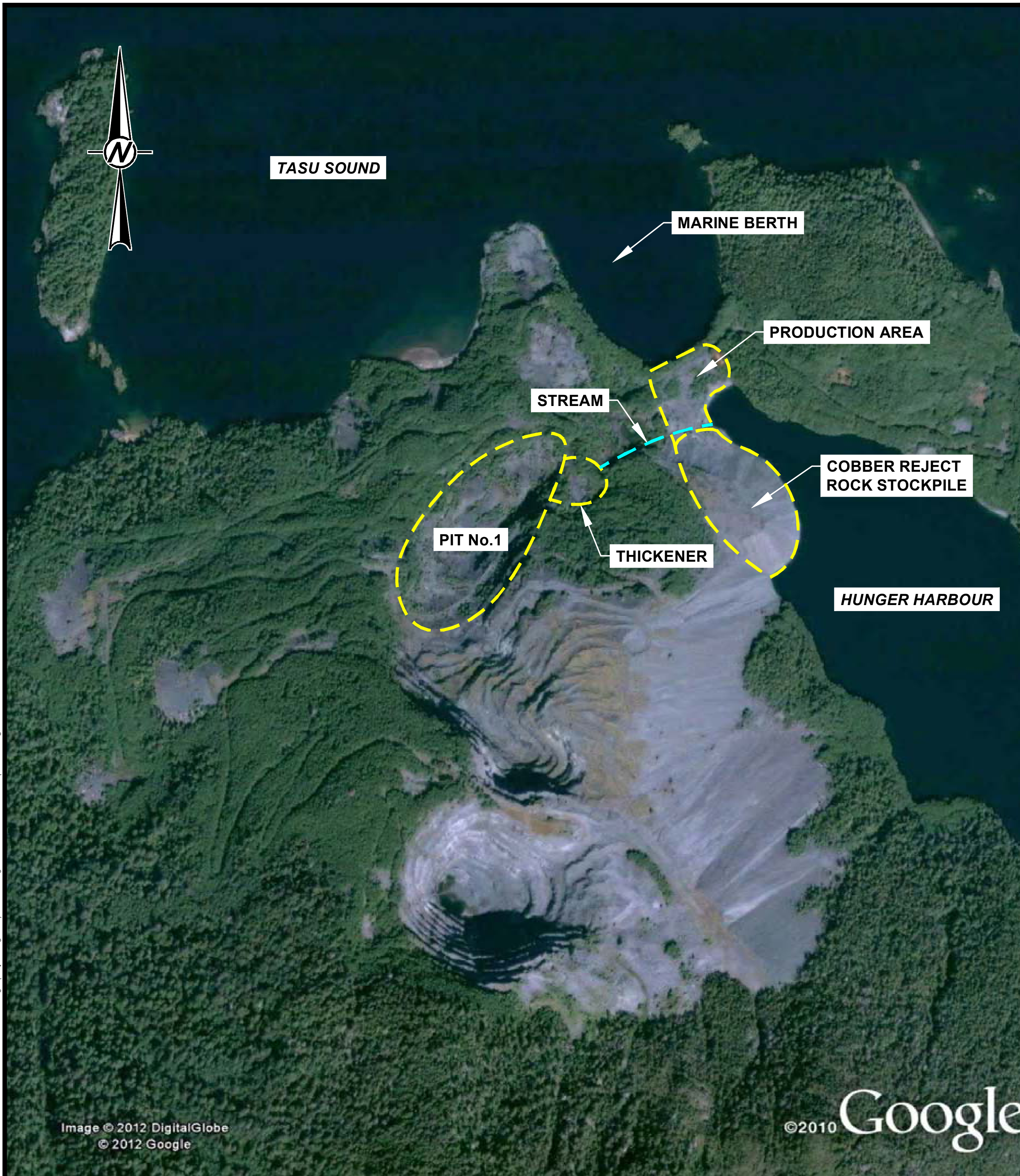
KEY PLAN

REFERENCE

 PROJECTION: TRANSVERSE MERCATOR DATUM: NAD83 COORDINATE SYSTEM: UTM ZONE 8.

Golder Associates

PROJECT No.		12-1476-0060	FILE No.	12147600602000-1
DESIGN	RB	25OCT12	SCALE	AS SHOWN
CADD	JEF	26OCT12	FIGURE 1	
CHECK	RB	04DEC12		
REVIEW	JF	04DEC12		



0 200 400 600 m

SCALE

REFERENCES

IMAGERY OBTAINED FROM GOOGLE EARTH PRO, USED UNDER LICENSE.
IMAGERY DATE AUGUST 7, 2005. GOOGLE EARTH IMAGE IS NOT TO SCALE.

PROJECT

COAST CONSTRUCTION AGGREGATES
TASU QUARRY
HAIDA GWAII, BC

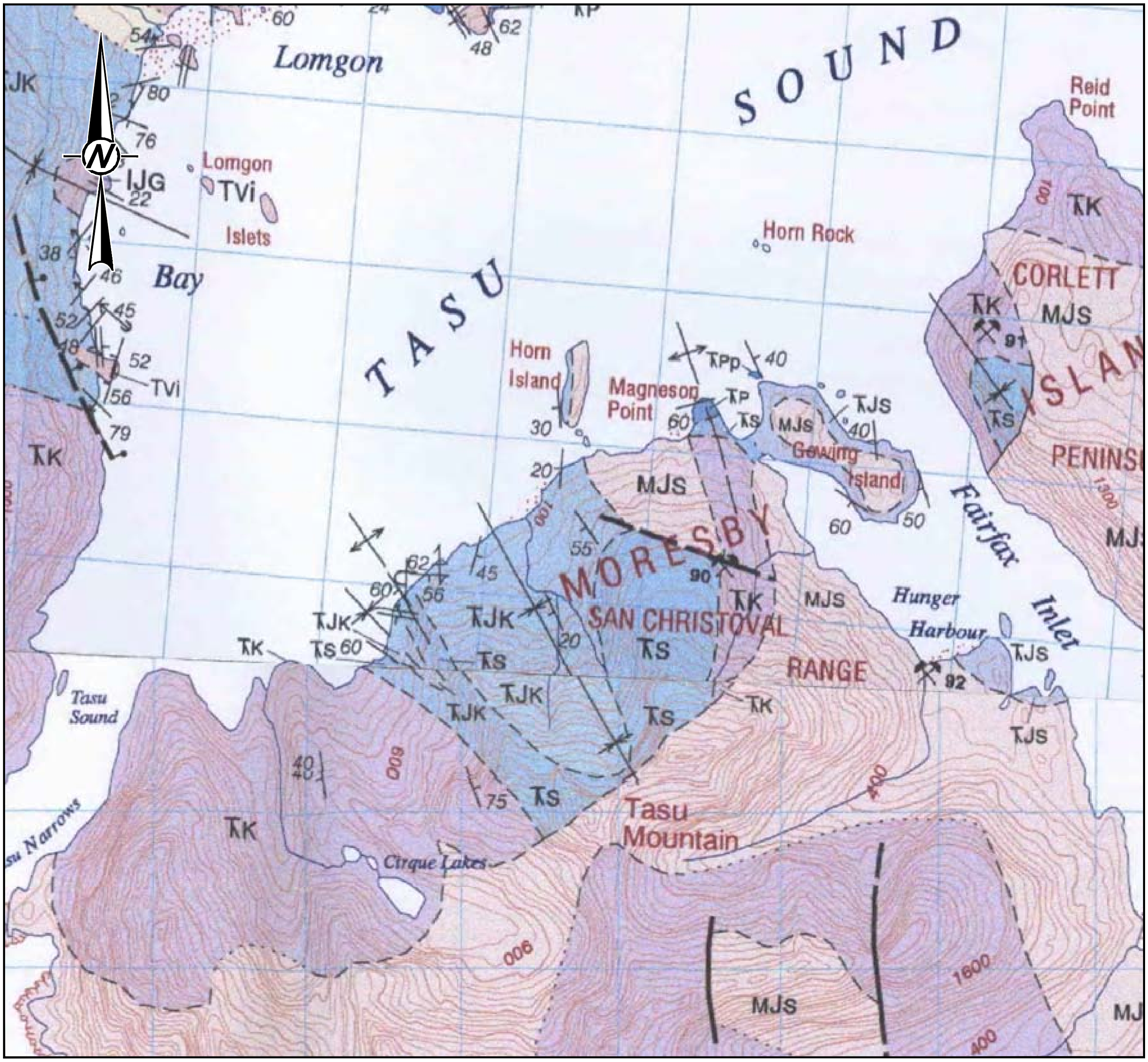
TITLE

SITE PLAN

Golder Associates

PROJECT No.		12-1476-0060	FILE No. 12147600602000-2
DESIGN	RB	25OCT12	SCALE AS SHOWN
CADD	JEF	26OCT12	FIGURE 2
CHECK	RB	04DEC12	
REVIEW	JF	04DEC12	

\\golder.gds\gal\Victoria\Active\2012\1476\12-1476-0060 CCAL Tasu Quarry Haida Gwaii\09 CAD\Phase 2000\12147600602000-2.dwg | Layout: Figure 2 | Modified: tstgelais 11/09/2012 10:14 AM | Plotted: tstgelais 12/05/2012



JURASSIC

UPPER TRIASSIC TO LOWER JURASSIC

KUNGA GROUP

ꞆJK	*KUNGA GROUP, undifferentiated (ꞆS - ꞆJS): shale; calcareous shale; massive limestone; fine-grained sandstone*

UPPER NORIAN(?) TO TOARCIAN

ꞆJS	*SANDILANDS FORMATION: shale; fine-grained sandstone, locally tuffaceous*

TRIASSIC

UPPER CARNIAN TO MIDDLE NORIAN

ꞆP	*PERIL FORMATION: dark grey, medium-bedded calcareous shale; minor grey limestone; rare local peperite (ꞆPp; in Tasu Sound)*

UPPER CARNIAN

ꞆS	*SADLER LIMESTONE: massive, grey crystalline limestone; lesser secondary chert*

CARNIAN

ꞆK	*KARMUTSEN FORMATION: basalt flows; flow breccias; pillow lavas; tuff; grey limestone lenses; minor siltstone*

MIDDLE JURASSIC TO LATE JURASSIC

MJS	*San Christoval Plutonic Suite (U-Pb: 171-172 Ma; K-Ar: 145-192 Ma): medium-grained, equigranular, mafic inclusion-bearing (biotite-) hornblende quartz diorite, quartz monzodiorite and diorite; foliated inclusions and prismatic hornblende are characteristic; includes local migmatite and agmatite complexes*

0 800 1,600 2,400 m

SCALE

REFERENCES

BEDROCK GEOLOGY MAPS OPEN FILE NO. 4423, TITLED *MOORE CHANNEL,* AND OPEN FILE NO. 4418, TITLED *RAMSAY ISLAND, DARWIN SOUND, AND TASU HEAD,* © 2002 HER MAJESTY THE QUEEN IN RIGHT OF CANADA. DEPARTMENT OF NATURAL RESOURCES. ALL RIGHTS RESERVED. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD83 COORDINATE SYSTEM: UTM ZONE 10

PROJECT

COAST CONSTRUCTION AGGREGATES
TASU QUARRY
HAIDA GWAII, BC

TITLE

BEDROCK GEOLOGY

Golder Associates

PROJECT No.		12-1476-0060	FILE No. 12147600602000-3
DESIGN	RB	06NOV12	SCALE AS SHOWN
CADD	TMS	08NOV12	
CHECK	RB	04DEC12	**FIGURE 3**
REVIEW	JF	04DEC12	

APPENDIX A

Surface Water Test Results From CCAI

l"	<0.05	1	1.72	21.1	17	<1	0.3	7.96	0.4	7	37	22	0.3	607.3	9.83	6	0.2	0.2
ite	<0.05	0.3	2.84	0.5	12	<1	0.1	2.1	0.1	15	24.8	44	0.5	99.3	6.17	10	0.2	0.5
.	<0.05	0.5	2.34	<0.5	23	<1	0.3	2.28	0.1	12	17.9	49	0.4	44	4.52	9	0.1	0.2
e	<0.05	0.2	0.03	<0.5	7	<1	0.1	>25.00	0.1	1	1.4	2	<0.1	7.7	0.17	<1	<0.1	<0.1
er	<0.05	3.3	0.6	40.8	20	<1	0.4	2.3	0.9	4	70.6	16	0.3	1948	30.9	5	0.6	0.1
cate																		
l"	<0.05	1	1.64	18.9	15	<1	0.3	8.18	0.4	7	35.7	21	0.3	549.3	9.33	6	0.2	0.2

le ID	**In**	**K**	**La**	**Li**	**Mg**	**Mn**	**Mo**	**Na**	**Nb**	**Ni**	**P**	**Pb**	**Rb**	**Re**	**S**	**Sb**	**Sc**	**Se**
	ppm	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppb**	**%**	**ppm**	**ppm**	**ppm**
	0.01	0.01	1	0.1	0.01	1	0.1	0.01	0.1	0.1	0.001	0.1	0.1	5	0.05	0.1	0.1	0.5
l"	0.14	0.05	3	6.8	0.75	1728	3.4	0.03	0.4	20.2	0.038	9.8	2.1	<5	0.84	0.2	3.7	<0.5
ite	0.05	0.04	6	11.2	1.37	914	1.7	0.16	0.3	31.4	0.111	7.2	1.9	<5	0.09	0.2	6.9	<0.5
.	0.04	0.08	5	10.9	1.42	942	0.7	0.07	0.1	19.9	0.061	20.6	3.5	<5	<0.05	0.2	9	<0.5
e	0.01	0.01	<1	0.4	0.05	578	0.2	<0.01	0.3	8.3	0.002	9.9	0.3	<5	<0.05	0.1	0.2	<0.5
er	0.25	0.02	2	3	0.34	1117	2.3	0.02	1.1	25.5	0.015	9.5	1.4	<5	0.74	0.3	1.6	<0.5
cate																		
l"	0.13	0.05	3	6.6	0.73	1636	2.9	0.03	0.3	18.5	0.037	11.6	1.9	<5	0.87	0.2	3.6	<0.5

le ID	**Sr**	**Ta**	**Te**	**Th**	**Ti**	**Tl**	**U**	**V**	**W**	**Y**	**Zn**	**Zr**
	ppm	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
	1	0.1	0.1	0.1	0.005	0.1	0.1	2	0.1	0.1	1	0.1
l"	174	<0.1	0.1	0.5	0.13	<0.1	0.7	45	1	7.8	74	7.1
ite	50	<0.1	<0.1	0.4	0.442	<0.1	0.1	125	0.2	24.6	95	16.2
.	46	<0.1	<0.1	0.6	0.21	<0.1	0.2	85	0.2	15.8	81	5
e	631	<0.1	0.1	<0.1	0.034	<0.1	0.8	<2	0.4	0.5	7	0.6
er	54	<0.1	0.2	0.2	0.048	<0.1	0.7	23	3.5	4	86	3.6
cate												
l"	166	<0.1	0.1	0.5	0.122	<0.1	0.6	44	1	7.4	70	6.4

ardness 03)	mg/L	192	111	0.5		
Metals by S						
luminum (Al)	ug/L	20.0	6.3	0.2	200	100
ntimony (Sb)	ug/L	0.06	0.13	0.02	4300	20
rsenic (As)	ug/L	0.18	0.71	0.02	25	5
arium (Ba)	ug/L	1.49	1.67	0.02		5
eryllium (Be)	ug/L	<0.01	<0.01	0.01	4	5.3
ismuth (Bi)	ug/L	<0.005	<0.005	0.005		
oron (B)	ug/L	<50	<50	50	5000	1200
admium (Cd)	ug/L	0.033	0.059	0.005		0.04
hromium (Cr)	ug/L	<0.1	0.4	0.1		1
obalt (Co)	ug/L	0.341	0.143	0.005		110
opper (Cu)	ug/L	4.09	3.98	0.05	500	16
ron (Fe)	ug/L	9	4	1		1000
ead (Pb)	ug/L	0.022	0.088	0.005	50	137
ithium (Li)	ug/L	<0.5	<0.5	0.5		870
anganese (Mn)	ug/L	0.43	0.37	0.05		22000
ercury (Hg)	ug/L	<0.01	<0.01	0.01	1	
olybdenum	ug/L	3.03	3.38	0.05	250	2000
ickel (Ni)	ug/L	0.59	0.35	0.02		110
elenium (Se)	ug/L	1.01	0.80	0.04		2
ilicon (Si)	ug/L	1430	1090	100		
ilver (Ag)	ug/L	<0.005	<0.005	0.005		3
trontium (Sr)	ug/L	122	121	0.05		
hallium (Tl)	ug/L	<0.002	<0.002	0.002	0.5	0.3
in (Sn)	ug/L	<0.01	<0.01	0.01		
itanium (Ti)	ug/L	<0.5	<0.5	0.5		4600
ranium (U)	ug/L	0.289	0.760	0.002		300
anadium (V)	ug/L	<0.2	<0.2	0.2		6
inc (Zn)	ug/L	2.3	3.9	0.1	5000	78
irconium (Zr)	ug/L	<0.1	<0.1	0.1		
alcium (Ca)	mg/L	73.6	42.6	0.05		
agnesium (Mg)	mg/L	2.08	1.10	0.05		
otassium (K)	mg/L	0.30	0.19	0.05		
odium (Na)	mg/L	2.82	2.98	0.05		
ulphur (S)	mg/L	42	10	10		
Reportable Detection						

eportable Detection Limit

APPENDIX B

Site Photographs Taken During Visual Site Assessment

Photograph 1: Profile of Cobber reject rock stockpile showing small failures which expose areas of higher fines content in the stockpile. Rock is estimated to approximately 150 mm minus material (visual assessment).

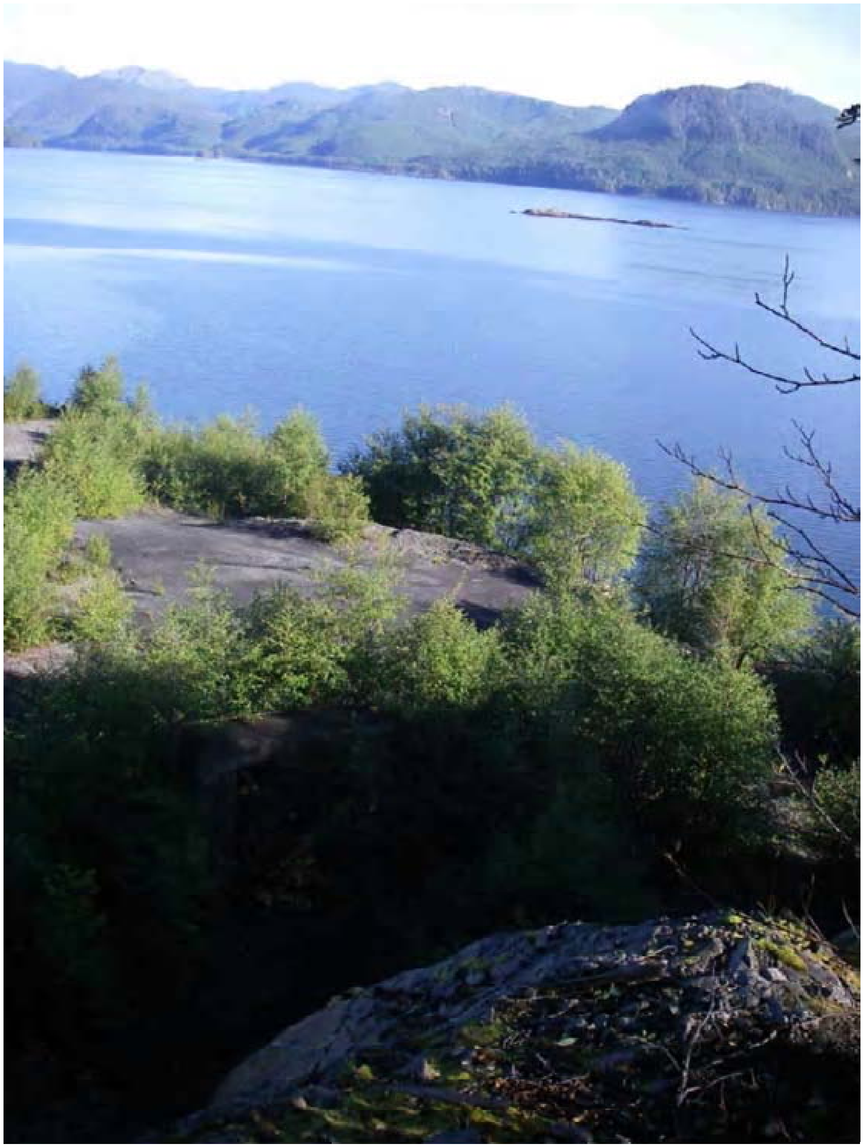
Photograph 2: Profile of northwest portion of the Cobber reject rock stockpile. Slope is approximately 30 m in height and stockpile volume was estimated at over 1,000,000 m3 in total.

Photograph 3: Shows stream flowing on the northwest end of the Cobber reject rock stockpile.

Photograph 4: View looking north at Magneson Point. Ramp on left leads to old storage shed for concentrate. Area to the right in photo is old stockpile site and where marine berth facilities would be located.

Photograph 5: Shows old bedrock face that has been blasted below Pit No. 1 on road access. Seepage over the face is forming a carbonate rich coating on the rock.

Photograph 6: Copper rich precipitate has formed on bedrock face where seepage is occurring. This is located on rock face above access road up to Pit No. 1.



Photograph 7: View looking north over Tasu Sound. Marine area to front of shoreline in photo is area where marine berthing is being considered.

Photograph 8: View of Tasu Sound from old loading facility foundation along access road to Pit No. 1.

Photograph 9: Looking upslope from Pit No. 1 area at old mine workings in Pit No. 2 area. This is flat area with 15 m deep excavation immediately in front of photo location.

Photograph 10: Typical rock found in Pit No. 1 area with calcite veins in basaltic rock.

Photograph 11: View into bottom of Pit No. 1. Old underground opening is to the left of photo but has been buried under waste rock to prevent entrance into the workings.

Photograph 12: Typical bedrock formation in walls of Pit No. 1(basalt with some limestone lenses).

Photograph 13: Flat area at north end of Cobber reject rock stockpile is proposed to be processing site for production of rock products from the stockpile and Pit No. 1.

Photograph 14: View looking southeast at Hunger Harbour from the proposed processing site.

Photograph 15: Remnant marine berthing facilities on Tasu Sound, northwest of proposed processing site.

Photograph 16: Foundation walls for old concentrate storage building near proposed marine berthing location.

Photograph 17: Beach area to the west of the old concentrate storage building and looking north at Tasu Sound.

APPENDIX C

Laboratory Results From SGS-CEMI For ABA and SFE Tests

Table C-1: Analytical Results From ABA Test
Tasu Quarry - Haida Gwaii

CLIENT : Golder Associates Ltd.
Golder Project# : 09-1476-0060 Tasu Quarry
SGS Project # : 1111
Test : Modified Acid-Base Accounting
Date : September 27, 2011

Sample ID	Paste pH	TIC %	CaCO3 NP	S(T) %	S(SO4) %	S(S-2) %	AP	NP	Net NP	Fizz Test
Method Code	Sobek	CSA04V	Calc.	CSA06V	CSA07V	Calc.	Calc.	Modified	Calc.	Sobek
LOD	0.20	0.05	#N/A	0.01	0.01	#N/A	#N/A	0.5	#N/A	#N/A
02447-01 **Duplicate**	7.79	2.55	212.5	0.47	<0.01	0.47	14.7	210.8	196.1	Moderate

Parameter	Method	Units		
Volume Nanopure water		mL	750	750
Sample Weight		g	250	-
pH	meter		7.73	7.46
Redox	meter	mV	364	-
Conductivity	meter	uS/cm	92	1
Acidity (to pH 4.5)	titration	mg CaCO3/L	#N/A	-
Total Acidity (to pH 8.3)	titration	mg CaCO3/L	2.8	-
Alkalinity	titration	mg CaCO3/L	46.1	-
Sulphate	Turbidity	mg/L	7	-
Ion Balance				
Major Anions	Calc	meq/L	1.07	#N/A
Major Cations	Calc	meq/L	0.97	#N/A
Difference	Calc	meq/L	0.10	#N/A
Balance (%)	Calc	%	4.9%	#N/A
Dissolved Metals				
Hardness CaCO3		mg/L	43.8	-
Aluminum Al	ICP-MS	mg/L	0.184	-
Antimony Sb	ICP-MS	mg/L	< 0.0002	-
Arsenic As	ICP-MS	mg/L	0.0003	-
Barium Ba	ICP-MS	mg/L	0.00077	-
Beryllium Be	ICP-MS	mg/L	< 0.00002	-
Bismuth Bi	ICP-MS	mg/L	< 0.00001	-
Boron B	ICP-MS	mg/L	0.0080	-
Cadmium Cd	ICP-MS	mg/L	< 0.000003	-
Calcium Ca	ICP-MS	mg/L	16.6	-
Chromium Cr	ICP-MS	mg/L	< 0.0005	-
Cobalt Co	ICP-MS	mg/L	0.000088	-
Copper Cu	ICP-MS	mg/L	0.0053	-
Iron Fe	ICP-MS	mg/L	< 0.003	-
Lead Pb	ICP-MS	mg/L	< 0.00002	-
Lithium Li	ICP-MS	mg/L	< 0.001	-
Magnesium Mg	ICP-MS	mg/L	0.582	-
Manganese Mn	ICP-MS	mg/L	0.0122	-
Mercury Hg	ICP-MS	ug/L	0.01	-
Molybdenum Mo	ICP-MS	mg/L	0.00194	-
Nickel Ni	ICP-MS	mg/L	0.0002	-
Phosphorus P	ICP-MS	mg/L	0.010	-
Potassium K	ICP-MS	mg/L	0.896	-
Selenium Se	ICP-MS	mg/L	0.00039	-
Silicon Si	ICP-MS	mg/L	0.67	-
Silver Ag	ICP-MS	mg/L	0.00009	-
Sodium Na	ICP-MS	mg/L	1.05	-
Strontium Sr	ICP-MS	mg/L	0.0518	-
Sulphur (S)	ICP-MS	mg/L	11.5	-
Thallium Tl	ICP-MS	mg/L	< 0.00002	-
Tin Sn	ICP-MS	mg/L	0.00006	-
Titanium Ti	ICP-MS	mg/L	0.0006	-
Uranium U	ICP-MS	mg/L	0.000038	-
Vanadium V	ICP-MS	mg/L	0.00017	-
Zinc Zn	ICP-MS	mg/L	0.002	-
Zirconium Zr	ICP-MS	mg/L	0.00001	-
3 h quescent settling prior to sampling.				
Total Metals				
Hardness CaCO3		mg/L	70.4	-
Aluminum Al	ICP-MS	mg/L	1.23	-
Antimony Sb	ICP-MS	mg/L	< 0.0002	-
Arsenic As	ICP-MS	mg/L	0.0016	-
Barium Ba	ICP-MS	mg/L	0.00590	-
Beryllium Be	ICP-MS	mg/L	< 0.00002	-
Bismuth Bi	ICP-MS	mg/L	0.00002	-
Boron B	ICP-MS	mg/L	0.0086	-
Cadmium Cd	ICP-MS	mg/L	< 0.000003	-
Calcium Ca	ICP-MS	mg/L	26.5	-
Chromium Cr	ICP-MS	mg/L	0.0007	-
Cobalt Co	ICP-MS	mg/L	0.00238	-
Copper Cu	ICP-MS	mg/L	0.0942	-
Iron Fe	ICP-MS	mg/L	2.32	-
Lead Pb	ICP-MS	mg/L	0.00053	-
Lithium Li	ICP-MS	mg/L	< 0.001	-
Magnesium Mg	ICP-MS	mg/L	1.02	-
Manganese Mn	ICP-MS	mg/L	0.0952	-
Mercury Hg	ICP-MS	ug/L	0.01	-
Molybdenum Mo	ICP-MS	mg/L	0.00203	-
Nickel Ni	ICP-MS	mg/L	0.0013	-

Sample ID			0247-01	Blank	Water Aquatic Life Freshwater (mg/L)
Parameter	**Method**	**Units**			
Volume Nanopure water		mL	750	750	
Sample Weight		g	250	-	
pH	meter		7.73	7.46	**6.5 to 9.0**
Redox	meter	mV	364	-	
Conductivity	meter	uS/cm	92	1	
Acidity (to pH 4.5)	titration	mg CaCO3/L	#N/A	-	
Total Acidity (to pH 8.3)	titration	mg CaCO3/L	2.8	-	
Alkalinity	titration	mg CaCO3/L	46.1	-	
Sulphate	Turbidity	mg/L	7	-	
Ion Balance					
Major Anions	Calc	meq/L	1.07	#N/A	
Major Cations	Calc	meq/L	0.97	#N/A	
Difference	Calc	meq/L	0.10	#N/A	
Balance (%)	Calc	%	4.9%	#N/A	
Dissolved Metals					
Hardness CaCO3		mg/L	43.8	-	
Aluminum Al	ICP-MS	mg/L	**0.184**	-	**0.1**
Antimony Sb	ICP-MS	mg/L	< 0.0002	-	
Arsenic As	ICP-MS	mg/L	0.0003	-	**0.005**
Barium Ba	ICP-MS	mg/L	0.00077	-	
Beryllium Be	ICP-MS	mg/L	< 0.00002	-	
Bismuth Bi	ICP-MS	mg/L	< 0.00001	-	
Boron B	ICP-MS	mg/L	0.0080	-	
Cadmium Cd	ICP-MS	mg/L	< 0.000003	-	**0.000017**
Calcium Ca	ICP-MS	mg/L	16.6	-	
Chromium Cr	ICP-MS	mg/L	< 0.0005	-	**0.001**
Cobalt Co	ICP-MS	mg/L	0.000088	-	
Copper Cu	ICP-MS	mg/L	**0.0053**	-	**0.004**
Iron Fe	ICP-MS	mg/L	< 0.003	-	**0.3**
Lead Pb	ICP-MS	mg/L	< 0.00002	-	**0.001**
Lithium Li	ICP-MS	mg/L	< 0.001	-	
Magnesium Mg	ICP-MS	mg/L	0.582	-	
Manganese Mn	ICP-MS	mg/L	0.0122	-	
Mercury Hg	ICP-MS	ug/L	0.01	-	**0.026**
Molybdenum Mo	ICP-MS	mg/L	0.00194	-	**0.073**
Nickel Ni	ICP-MS	mg/L	0.0002	-	**0.025**
Phosphorus P	ICP-MS	mg/L	0.010	-	**narrative**
Potassium K	ICP-MS	mg/L	0.896	-	
Selenium Se	ICP-MS	mg/L	0.00039	-	**0.001**

Sample ID			0247-01	Blank	Water Aquatic Life Freshwater (µg/L)
Parameter	**Method**	**Units**			
Silicon Si	ICP-MS	mg/L	0.67	-	
Silver Ag	ICP-MS	mg/L	0.00009	-	**0.0001**
Sodium Na	ICP-MS	mg/L	1.05	-	
Strontium Sr	ICP-MS	mg/L	0.0518	-	
Sulphur (S)	ICP-MS	mg/L	11.5	-	
Thallium Tl	ICP-MS	mg/L	< 0.00002	-	**0.0008**
Tin Sn	ICP-MS	mg/L	0.00006	-	
Titanium Ti	ICP-MS	mg/L	0.0006	-	
Uranium U	ICP-MS	mg/L	0.000038	-	
Vanadium V	ICP-MS	mg/L	0.00017	-	

CLIENT : Golder Associates Ltd.
Golder Project# : 09-1476-0060 Tasu Quarry
SGS Project # : 1111
Test : 24 Hour Nanopure Water Leach Extraction Test at 3:1 Liquid to Solid Ratio
Date : September 27, 2011

Leachate Analysis

Sample ID			0247-01	Blank	Water Aquatic Life Freshwater (mg/L)
Parameter	**Method**	**Units**			
Volume Nanopure water		mL	750	750	
Sample Weight		g	250	-	
pH	meter		7.73	7.46	6.5 to 9.0
Redox	meter	mV	364	-	
Conductivity	meter	uS/cm	92	1	
Acidity (to pH 4.5)	titration	mg CaCO3/L	#N/A	-	
Total Acidity (to pH 8.3)	titration	mg CaCO3/L	2.8	-	
Alkalinity	titration	mg CaCO3/L	46.1	-	
Sulphate	Turbidity	mg/L	7	-	
Ion Balance					
Major Anions	Calc	meq/L	1.07	#N/A	
Major Cations	Calc	meq/L	#REF!	#N/A	
Difference	Calc	meq/L	#REF!	#N/A	
Balance (%)	Calc	%	#REF!	#N/A	
3 h quescent settling prior to sampling.					
Total Metals					
Hardness CaCO3		mg/L	70.4	-	
Aluminum Al	ICP-MS	mg/L	**1.23**	-	0.1
Antimony Sb	ICP-MS	mg/L	< 0.0002	-	
Arsenic As	ICP-MS	mg/L	0.0016	-	0.005
Barium Ba	ICP-MS	mg/L	0.00590	-	
Beryllium Be	ICP-MS	mg/L	< 0.00002	-	
Bismuth Bi	ICP-MS	mg/L	0.00002	-	
Boron B	ICP-MS	mg/L	0.0086	-	
Cadmium Cd	ICP-MS	mg/L	< 0.000003	-	0.000017
Calcium Ca	ICP-MS	mg/L	26.5	-	
Chromium Cr	ICP-MS	mg/L	0.0007	-	0.001
Cobalt Co	ICP-MS	mg/L	0.00238	-	
Copper Cu	ICP-MS	mg/L	**0.0942**	-	0.004
Iron Fe	ICP-MS	mg/L	**2.32**	-	0.3
Lead Pb	ICP-MS	mg/L	0.00053	-	0.001
Lithium Li	ICP-MS	mg/L	< 0.001	-	
Magnesium Mg	ICP-MS	mg/L	1.02	-	
Manganese Mn	ICP-MS	mg/L	0.0952	-	
Mercury Hg	ICP-MS	ug/L	0.01	-	0.026
Molybdenum Mo	ICP-MS	mg/L	0.00203	-	0.073
Nickel Ni	ICP-MS	mg/L	0.0013	-	0.025
Phosphorus P	ICP-MS	mg/L	0.036	-	narrative
Potassium K	ICP-MS	mg/L	1.10	-	
Selenium Se	ICP-MS	mg/L	0.00037	-	0.001
Silicon Si	ICP-MS	mg/L	3.22	-	
Silver Ag	ICP-MS	mg/L	0.00009	-	0.0001
Sodium Na	ICP-MS	mg/L	1.27	-	
Strontium Sr	ICP-MS	mg/L	0.0739	-	
Sulphur (S)	ICP-MS	mg/L	5.81	-	
Thallium Tl	ICP-MS	mg/L	< 0.00002	-	0.0008
Tin Sn	ICP-MS	mg/L	0.00019	-	
Titanium Ti	ICP-MS	mg/L	0.0519	-	
Uranium U	ICP-MS	mg/L	0.000152	-	
Vanadium V	ICP-MS	mg/L	0.00254	-	
Zinc Zn	ICP-MS	mg/L	0.010	-	0.03
Zirconium Zr	ICP-MS	mg/L	0.00039	-	

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
www.golder.com

Golder Associates Ltd.
2nd floor, 3795 Carey Road
Victoria, British Columbia, V8Z 6T8
Canada
T: +1 (250) 881 7372

SEABULK SYSTEMS INC.
Integrated Shipping Solutions

Suite 150 – 10271 Shellbridge Way
Richmond, B.C. V6X 2W8
Canada
Telephone: (604) 273-1378
Facsimile: (604) 273-1358
E-mail: sbs@seabulk.com

Ref: 820-01-201300142

January 7, 2013

Coastal Construction Aggregates
15041 Owens Road
Smithers, British Columbia
V0J 2N1

Attention: Ray Carrier, Director

Dear Ray:

Re: Tasu Sound Aggregate Load-out Facility
Design Concept Study

Further to our recent correspondence and teleconference, we are pleased to present this draft study report for design concepts for aggregate load-out to barges at Tasu Sound on the west coast of Moresby Island.

1. Site Description

The proposed load-out facility is located at Hunger Harbour (52° 45' N, 132° 02' W), Tasu Sound on the west coast of Moresby Island. Hunger Harbour is formed by a rock fill causeway between Gowing Island and Moresby Island built during the development of the Tasu mine site. The site, ***Figure 1***, is shadowed by 3,065 foot high Mount Tasu to the south, Gowing Island and Fairfax Inlet to the east, Moresby Island to the west and the fill causeway to the north. Hunger Harbour is sheltered from direct exposure to wind generated waves and has a 4.5 metre tidal range, ***Table 1***. The tidal range at the site is less than the tidal range that occurs in other north coast locations such as Prince Rupert where a tidal of 7.6 metres occurs. The site's tidal range is about the same at that on south coastal British Columbia making it possible to relocate used ramps designed for the south coastal tidal range to the project site.

Table 1: Tasu Sound, Hunger Harbour, Tidal Information

Tide Description	Elevation (m – CHS)	Elevation (ft – CHS)
HHW Large Tide	4.5	14.9
HHW Mean Tide	3.7	12.0
Mean Water Level	2.3	7.6
LLW Mean Tide	0.7	2.4
LLW Large Tide	0.0	-0.1

Navigation within Tasu Sound to Hunger Harbour is in deep and sheltered water. Horn Rock at the entrance to Fairfax Inlet is a minor obstacle to navigation that is well marked on the charts. Hunger Harbour is deep and about 80 metres wide enabling barges up to 5,000 tonne capacity and possibly larger to be navigated into the site.

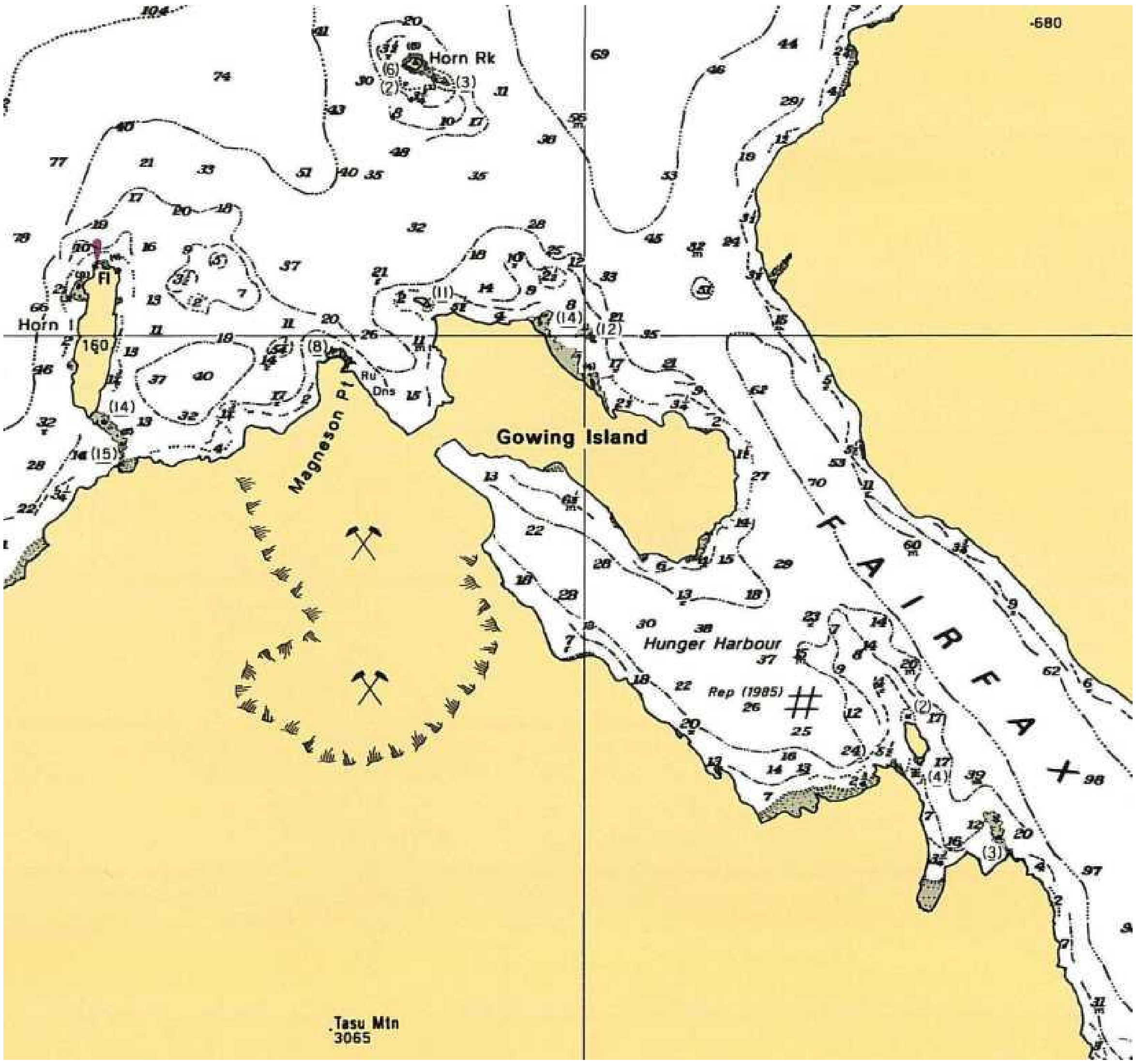


Figure 1: Excerpt from CHS Chart 3859 Showing Hunger Harbour, Tasu Sound.

2. Products

Two products are proposed for load-out from Tasu Sound:

2.1 Aggregate

Aggregate would be processed from material recovered from the cobber reject pile at the Tasu Sound mine site. The material's market is construction projects planned for the north coast including waterfront projects in Prince Rupert harbour such as the Fairview-Ridley Island connector road.

The aggregate is to be processed to a coarse angular stone with a gradation and qualities similar to railway ballast. The angle of repose of the material is estimated to be 35 degrees based on analysis of photographs of the cobber reject pile. The material is deemed conveyable using belt conveyors.

2.2 Armour Rock

The armour rock is described as select massive single units intended for use as surface armour stone in shore protection, coastal and river engineering projects in the Pacific Northwest. Individual pieces could range in weight up to 25 to 30 tonnes each. The armour stone would be handled individually using a large front end loader with rock forks.

3.0 Load-out Facilities

The design concept has been developed with the remoteness of the project site in mind. A minimalist approach has been sought to mitigate installation and decommissioning costs and expedite construction schedule.

3.1 Aggregate Load-out

Load-out of aggregate at Hunger Harbour using a radial stacker is deemed a practical solution, ***Appendix 1 and 2***. The steep foreshore at Hunger Harbour and 4.5 m tide range enables barges to be moored close enough to shore to enable to a 25 m reach radial stacker operating on a runway deck to build a pile in a 5,000 tonne capacity barge. The infrastructure design has been simplified to two basic elements to construct the barge berth and support the radial stacker:

- Steel pipe piles are used to berth and moor the barge and support a runway for the radial stacker; and
- Steel HP section runway deck elements support the radial stacker at the barge berth.

Review of photographs of the shoreline at the project site shows five inch minus surface materials that would not preclude pile driving, ***Figure 2***, however, the size of material at depth is unknown. The feasibility of installing steel pipe piles to the required penetration by conventional methods such as impact or vibro-hammer is likely but not assured. Contractors undertaking to install the piles should also have other contingencies for advancing the pipe in case of obstructions. Other means might include an under-reamer hammer or churn for example. A minimum of three steel pipe piles would be required to create the berth face and one steel pipe pile would be required for a stop dolphin on the shoreward end of the berth. Five piles would be required to support the runway deck.

Figure 2: Upper Foreshore in the Area of the Proposed Stacker Runway.

For the barge berth steel pipe 610 mm (24") in diameter is assumed for preliminary design and cost estimation purposes. The steel pipes comprising the berth are typically 25 to 30 metres in length and would be subject to lateral loading and require penetrations on the order of 10 to 12 metres, ***Appendix 1***.

It is deemed the pile supported stacker runway would be simpler and quicker to build than a bulkhead or retaining wall for the same purpose. A 25 m reach stacker should be able to build a pile on a 5,000 tonne flat deck barge without having to warp the barge.

For the stacker runway steel pipe 610 mm (24") in diameter is assumed for preliminary design and cost estimation purposes. Piles in the stacker runway are typically 15 metres in length and would experience mostly vertical loading. The piles would be open ended and develop resistance through skin friction between the steel pipe wall and coarse rock fill. These piles would be driven to practical refusal and a pile penetration of 10 to 12 metres has been assumed for cost estimation purposes.

The stacker assumed is a Telestack model 1550 radial stacker, ***Appendix 2***, which has about a 25 metre reach enabling coverage of a 5,000 tonne barge deck without warping. Other stackers are possible at this location but the runway geometrics would have to be adjusted to fit the machine.

3.2 Rock Load-out

A floating RO-RO ramp is proposed for armour rock load-out. A large front end loader such as a Caterpillar 988 with rock forks would be required for the job. Use of crane with an orange peel grapple was investigated but it was found the reach and capacity requirements would preclude practical crane sizes at this site. The 4.5 m tidal range at Hunger Harbour suggests a RO-RO ramp length on the order of 20 m or longer would be required to keep the ramp at an acceptable slope most of the time. The ramp would require a high load capacity to handle the loads imposed by the loaded machines. The imposed axle loads are estimated to be on the order of 100 tonnes. The existing floating RO-RO ramp at Fairview Terminals in Prince Rupert is an example of a high capacity ramp although it is much longer than would be required for RO-RO operations at Tasu Sound. The Fairview Terminals ramp is illustrative of a floating ramp design comprised of dual plate girders with buoyancy tanks, ***Figure 3***.

Figure 3: Example of a High Capacity Floating RO-RO Ramp, Fairview Terminals.

A floating ramp is proposed as it is deemed to be practical to implement at the site. A floating ramp can hoist itself using buoyancy tanks to meet the barge deck. Hydraulic cylinders are typically deployed in these ramps and are powered by an HPU on the ramp or the shore. Noting the remoteness of the site, electrical power for the HPU could be provided from a generator set either on the ramp or in the shore. The alternative ramp hoisting methods require a hoisting tower which is deemed to be a more costly option to implement at this site. In addition, the floating ramp is simpler to decommission and would have resale value. The RO-RO ramp would be supported on the shore by a pile supported abutment beam. For cost estimation purposes a steel abutment beam on two 610 mm diameter piles is assumed. The abutment would require some fill placement and grading to create a smooth transition to the ramp deck.

4. Construction

The scope of work will require pile driving capability from both the sea and the land. After completing marine based pile driving, the derrick would have to be landed and run ashore for driving piles for the stacker runway. Pile driving capability should include impact and vibro-hammers and a means of advancing piling in case of obstruction. Qualified marine contractors include Vancouver Pile Driving, Fraser River Pile & Dredge, Ruskin Construction and Broadwater Industries.

It is assumed proposed work would be phased to construct the aggregate load-out (stacker) and armour rock load-out (RO-RO ramp) separately, implementing each phase as required by pending supply contracts.

There are a number of possibilities for building the RO-RO ramp from an existing ramp or bridge sections that are available in contractor yards around the south coast. Enquiries were made and some possibilities identified including:

- Former Mitchell Island Ferry Ramp in FRPD's yard;
- Former Lynn Term Ramp in Van Pile's yard;
- Former Delta Port Ramp in Ruskin's yard;
- Former BC Ferries Ramp in FRPD's No. 5 Road yard; and
- Former Pitt River Bridge fixed spans in Amix Salvage's yard.

The existing ramps are unlikely to have sufficient capacity for the intended loads and will require strengthening. The fixed span sections from the Pitt River Bridge would have ample load capacity but would require trimming down to obtain manageable geometrics and weight for the intended application. New buoyancy tanks and hydraulic systems would have to be fabricated. An example application of a marine access ramp using a section of the former Pitt River Bridge fixed steel span is presented in ***Figure 4***.

The remoteness of the site and navigation through the North Eastern Pacific to the entrance of Tasu Sound directs one to plan this project for implementation during the summer months from June through August.

Amix Heavy Lift is supposed to commence regular runs to Skidegate Inlet during 2013 so they would be a candidate for transporting any heavy items to the project site such as the RO-RO ramp.

Figure 4: Example of Pitt River Bridge girder deployed in an access ramp application.

6. Schedule

Indicative project schedules are outlined for the barge berth and stacker runway and RO-RO ramp assuming separate implementation, ***Tables 2 and 3***. The time frame is estimated to be about 14 for the aggregate load-out and 20 weeks for the RO-RO Ramp although the actual on site construction would be on the order of weeks.

Table 2: Indicative Project Schedule – Barge Berth and Stacker Runway

Description	**Time Frame (weeks)**
Engineering Design and Drawings	3
Contractor Quotation, Evaluation and Award	3
Contractor Preparations and Mobilization	3
Transit to Site (Summer, from South Coast)	1
Installation 12 Piles for Berth, Stacker Runway	2
Stacker Runway Deck Installation	1
Transit from Site (Summer, to South Coast)	1
Approximate Total Time Frame	14

Table 3: Indicative Project Schedule – RO-RO Ramp

Description	Time Frame (weeks)
Procure Used RO-RO Ramp	3
Engineering Condition Survey and Analysis	3
Shop Refurbishment, Buoyancy Tank, Hydraulic System	11
Summer Transit to Site from South Coast	1
Ramp Abutment and Ramp Installation	1
Summer Transit from Site to South Coast	1
Approximate Total Time Frame	20

The time frame for the RO-RO ramp assumes an existing ramp or bridge section is obtained that requires only minor modification and new fabrication is mostly in the buoyancy tank and hydraulic system.

7. Cost

Indicative project cost estimates have been prepared assuming the aggregate load-out with a radial stacker and armour rock load-out over a RO-RO ramp are implemented as separate projects, ***Tables 4 and 5***. At this site for the aggregate load-out, about half of the costs are materials and installation and about half are related costs and allowances including towing, LOA, weather risk and engineering. The estimated $850,000 for the barge berth and stacker runway does NOT include the cost of the stacker.

Table 4: Indicative Maritime Infrastructure Cost: Aggregate Load-out Facility

Description	Amount	Distribution
Material Supply – Piling, Deck Panels, Walkway	$200,000	24%
Installation – Pile Driving, Welding	$200,000	24%
Contractor Mob/ Demob	$100,000	12%
Towing and Standby Tug Charges	$200,000	24%
Living Out Allowances and Travel Costs	$70,000	8%
Weather Risk Allowance	$20,000	2%
Engineering, Drawings, Management	$60,000	7%
Total	**$850,000**	

Seabulk obtained a quotation for a Telestack 1550 radial stacker in early 2011 and the price delivered dockside in five containers at an Irish port for a basic new machine was about £345,000 ($547,000 CDN) and for a full featured new machine about £392,000 ($621,000 CDN). The delivery time frame for the Telestack machine was 18 to 22 weeks following receipt of order.

In the case of the RO-RO Ramp, about 70% of the costs are in materials and installation and the balance in related costs and allowances including towing, LOA, weather risk and engineering. The RO-RO Ramp should be a comparatively quick installation. The RO-

RO ramp's cost assumes a section bridge section is obtained and modified in a shop and buoyancy tanks and a hydraulic hoisting system are added.

Table 5: Indicative Maritime Infrastructure Cost: RO-RO Ramp

Description	Amount	Distribution
Material Supply – Piling, Abutment, Ramp	$800,000	62%
Installation – Pile Driving, Welding, Ramp	$100,000	8%
Contractor Mob/ Demob	$100,000	8%
Towing and Standby Tug Charges	$180,000	14%
Living Out Allowances and Travel Costs	$40,000	3%
Weather Risk Allowance	$10,000	1%
Engineering, Drawings, Management	$90,000	7%
Total	**$1,320,000**	

8. Summary

Loading out processed aggregate and armour stone to barges at Hunger Harbour, Tasu Sound is technically feasible.

A 25 m reach radial stacker supported on a runway deck is proposed for loading aggregate onto flat deck 5,000 tonne capacity barges. Barges this size would be covered by the stacker thereby avoiding warping and facilitating rapid dispatch. A RO-RO ramp with capacity to handle axle loads on the order of 100 tonnes is proposed for loading out heavy armour rock at the site. Indicative maritime infrastructure project costs assuming them to be built separately are $850,000 for the aggregate load-out facility and $1,320,000 for the RO-RO ramp. The details of the design are dependent upon the stacker design and the RO-RO ramp girder selected for use.

Implementation of the project in 2013 would require decisions to be made soon as the construction season for the region is brief and starts in June.

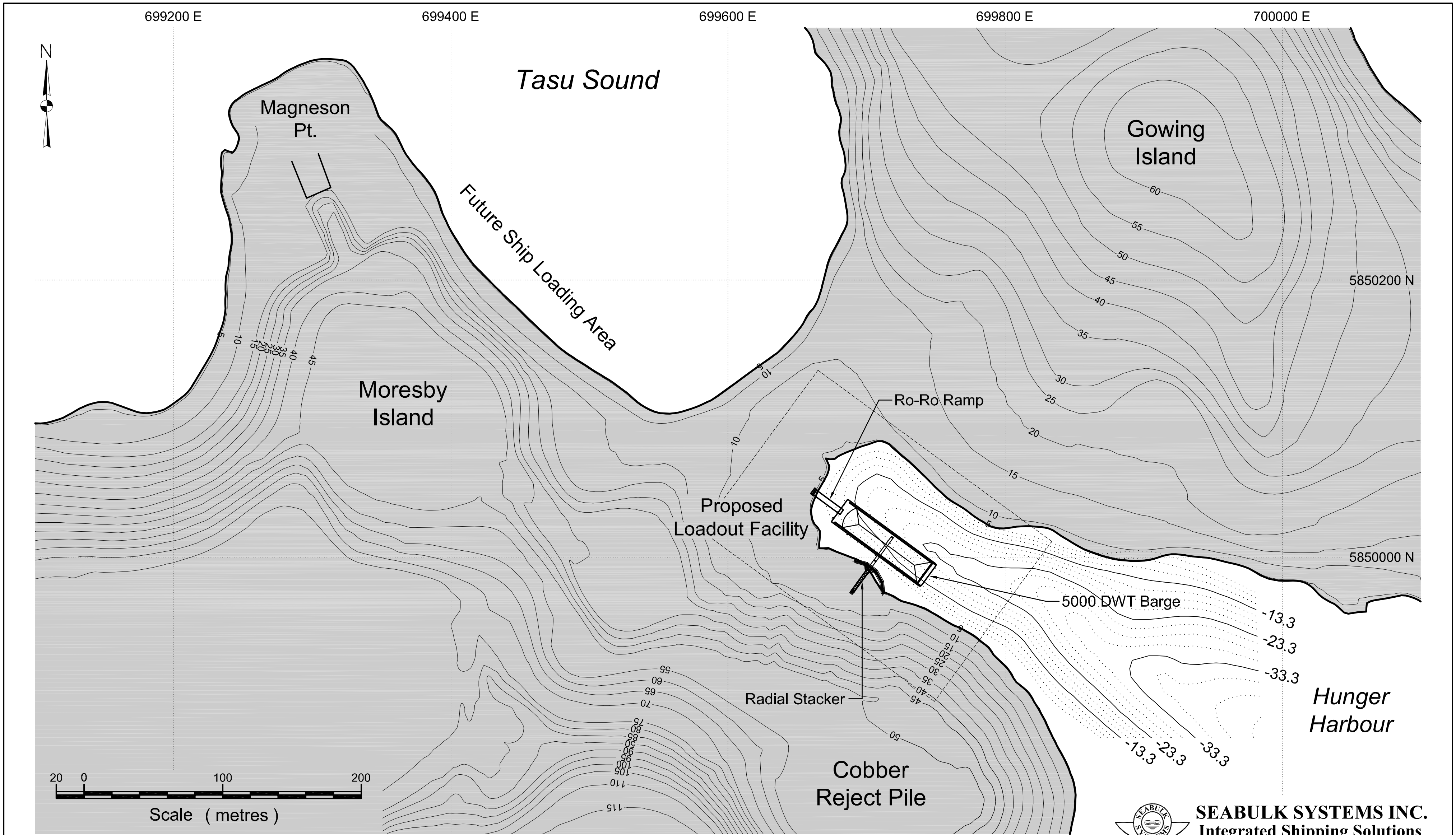
We trust that this brief report provides useable ideas for developing the proposed load-out facilities further. We are prepared to continue as required on the development of this project and look forward to meeting soon and continuing to work together.

Sincerely,

SEABULK SYSTEMS INC.

Carlos Johansen, P.Eng.
Vice-President Marine

Appendix 1
Tasu Sound Loadout Facilities
General Arrangement Diagrams

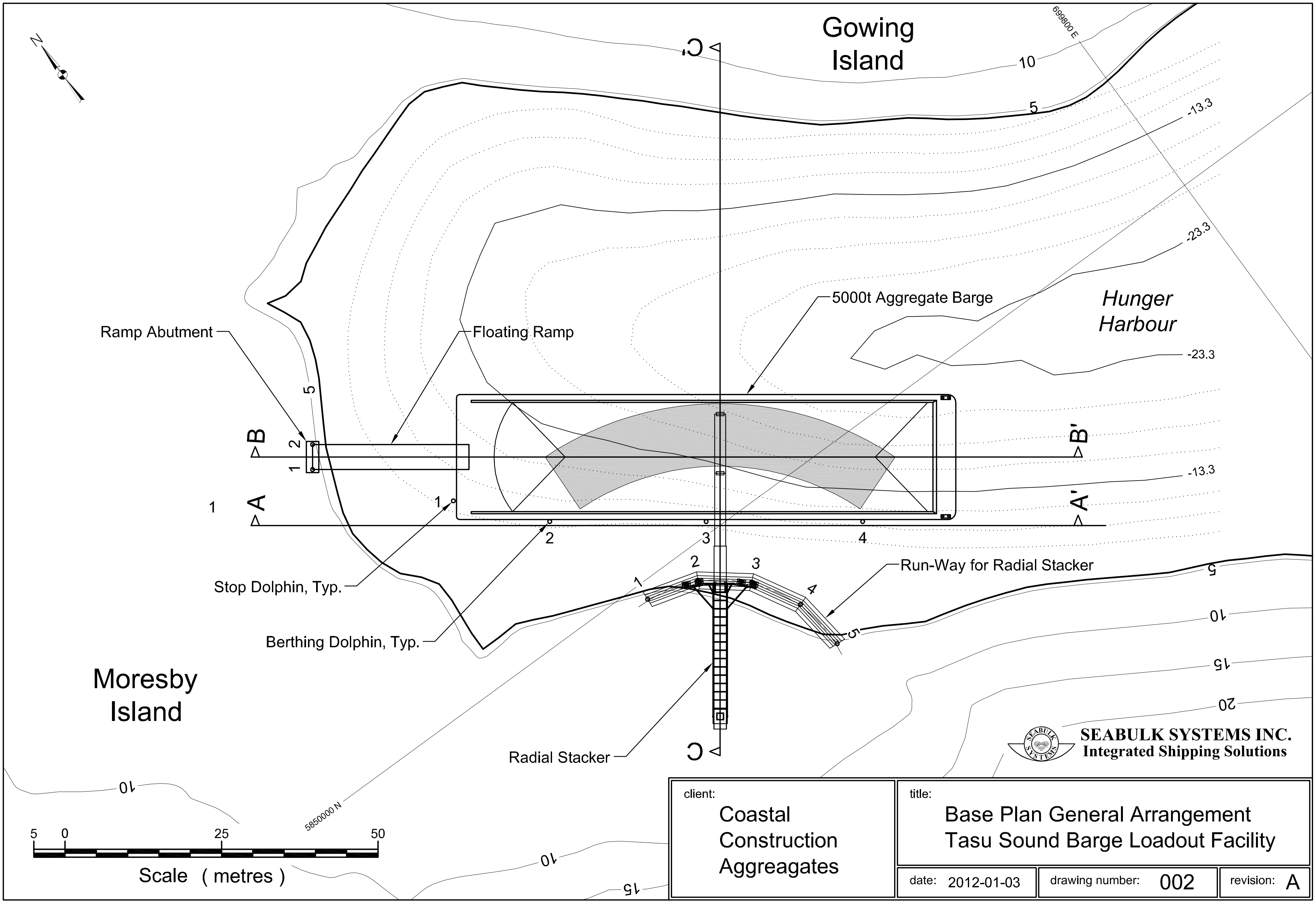


Notes:

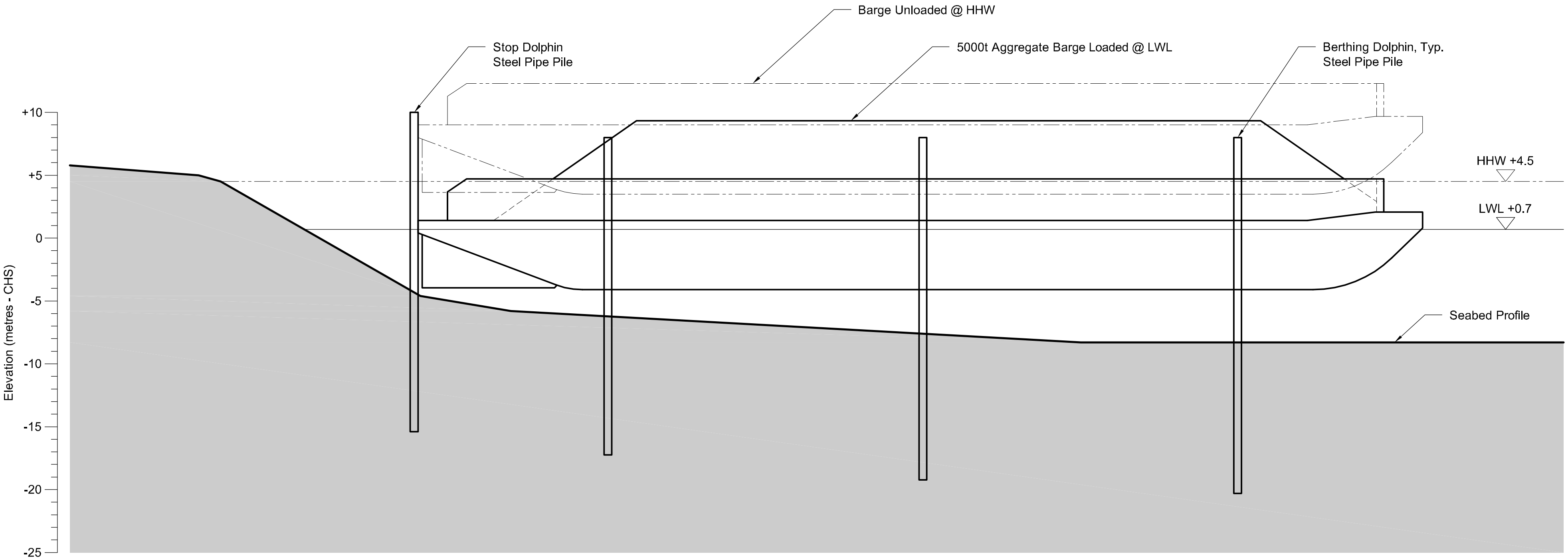
1. CHS chart 3859 and topographic mapping was referenced in the preparation of this figure.
2. Horizontal are approximate and in metres with reference to UTM NAD 83 Zone U8.
3. Seabed bathymetry is in metres relative to Canadian Hydrographic Service datum and measured on 19-Sep-2012.

client: Coastal Construction Aggreagates	title: Site General Arrangement Tasu Sound Barge Loadout Facility

date:	drawing number:	revision:
2012-01-03	001	A

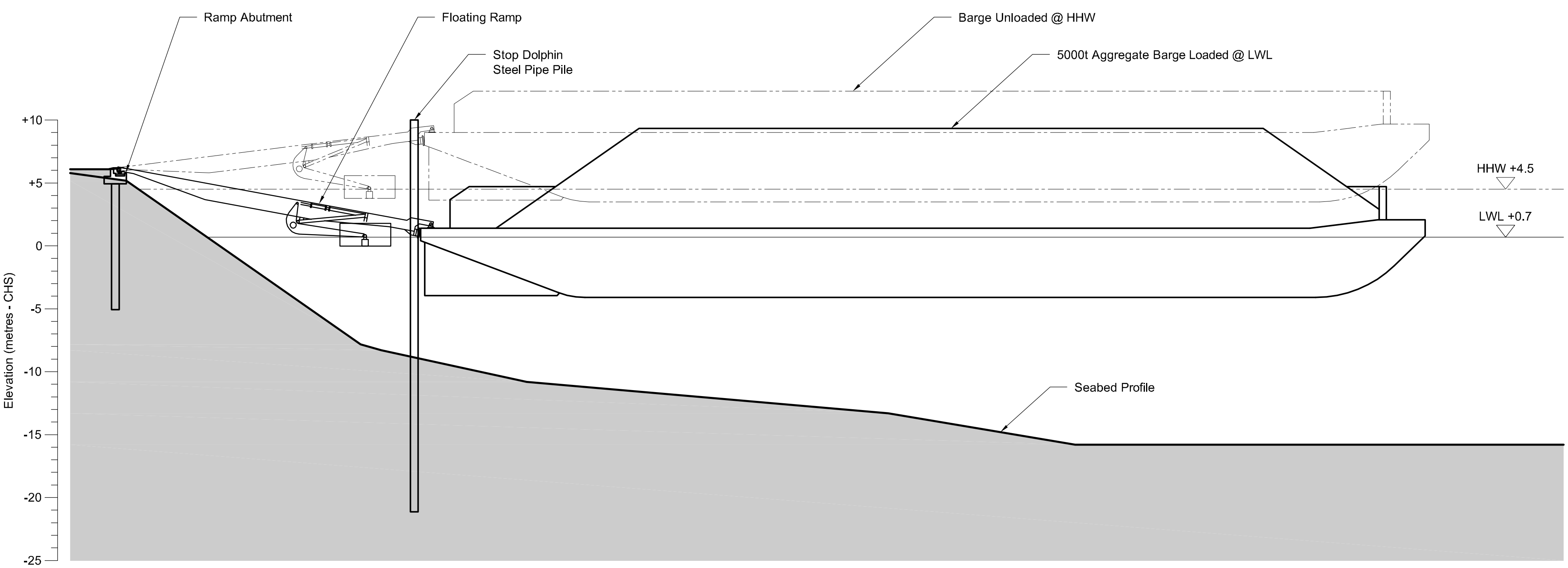


client:	title:		
Coastal Construction Aggregates	Base Plan General Arrangement Tasu Sound Barge Loadout Facility		
	date: 2012-01-03	drawing number: 002	revision: A



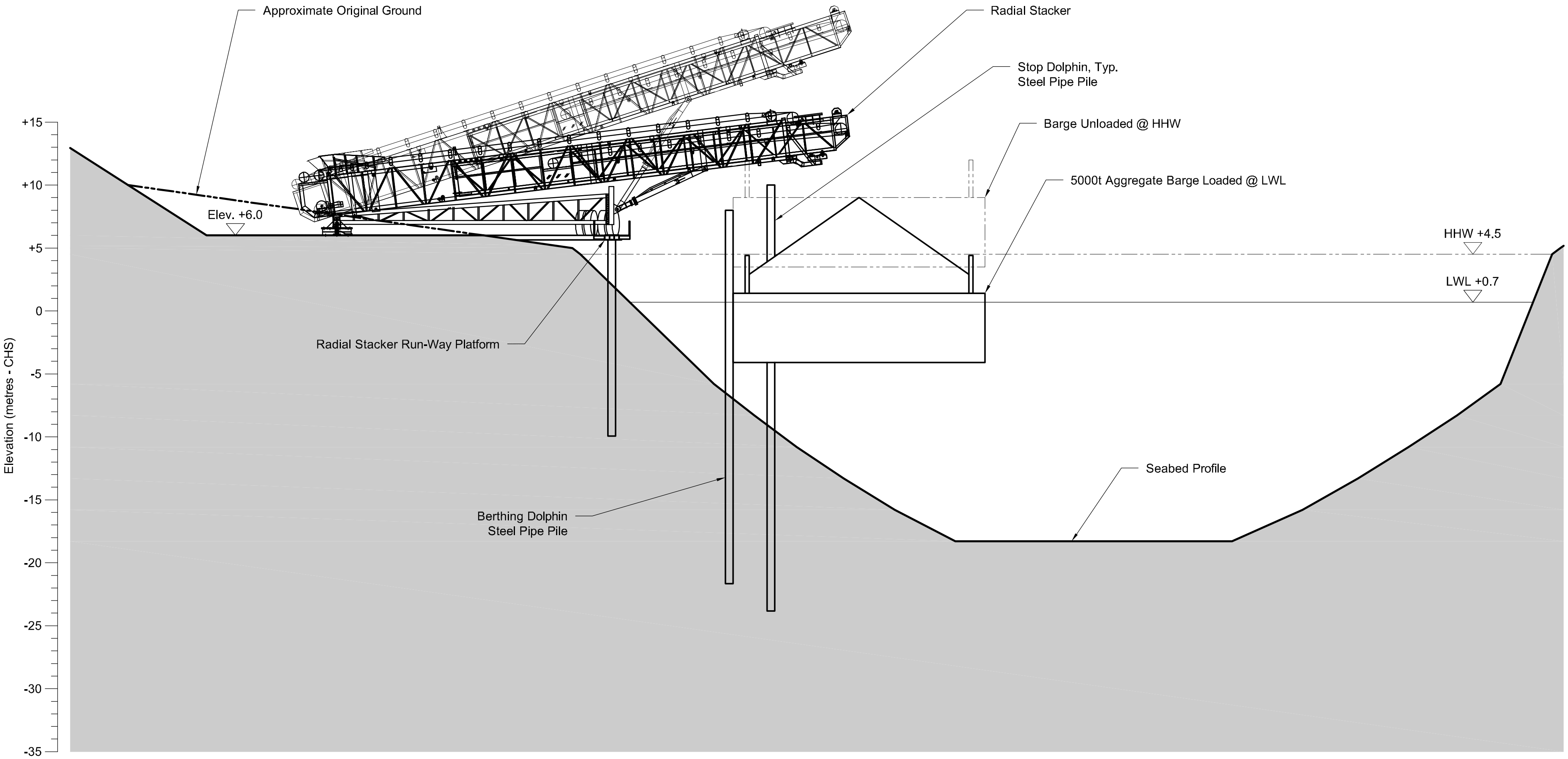
SEABULK SYSTEMS INC.
Integrated Shipping Solutions

client: Coastal Construction Aggreagates	title: Section A-A' General Arrangement Tasu Sound Barge Loadout Facility
date: 2012-01-03	drawing number: 003
revision: A	



SEABULK SYSTEMS INC.
Integrated Shipping Solutions

client:	title:		
Coastal Construction Aggreagates	Section B-B' General Arrangement Tasu Sound Barge Loadout Facility		
	date: 2012-01-03	drawing number: 004	revision: A



SEABULK SYSTEMS INC.
Integrated Shipping Solutions

client:	title:
Coastal Construction Aggreagates	Section C-C' General Arrangement Tasu Sound Barge Loadout Facility

date: 2012-01-03	drawing number: 005	revision: A

Appendix 2
Radial Stacker
Telestack Model 1550

Telestack Limited
Bankmore Way East,
Omagh, Co Tyrone
Northern Ireland
BT 79 0NZ

Phone: 00 44 (0) 2882251100
Fax: 00 44 (0) 2882252211
Website: www.telestack.com
Email: info@telestack.com

Specialists in the Design, Manufacture, Delivery, Installation and Commissioning of an extensive range of Mobile Material Handling Solutions

TECHNICAL SPECIFICATIONS

Telestack TS 1550 Radial Telescopic Conveyor

TS 1550 Radial Telescopic - Technical Specification

Features and Performance Benefits

The TS 1550 radial telescopic conveyor offers a unique material handling solution for the Ports (Ship / Barge Loading and Unloading), Quarrying, Mining and Rail Transportation industries. The flexibility and efficiency of this equipment ensures:

- Increased production capacities
- Lower capital investment
- Flexible and reliable mobile material handling equipment
- Reduced labour and operator costs
- Reduced energy consumption
- Eliminate segregation, degradation, contamination and compaction
- Minimal civil's and planning permission required

- Radial wheel drive (movement left – right) ensures that an area of 270 degree can be reached from a single feed-in point, without moving the equipment. The telescopic inner conveyor action allows for unrivalled movement and flexibility while in operation.

- 2 x Hydraulic luffing rams (up – down) allow for a maximum discharge height of 17.4 metres (56' 7"). Also, electric direct drives as standard.

- Can be packed into standard 40ft containers, which ensures easy and cost effective transport around the globe. On site assembly less than 1 week.

- All sections are easily bolted together on site, with electrical 'plugs and sockets' which eliminates wiring and ensures safety

- Integrated self diagnostic panel allows for all major functions to be operated and monitored from this single point.

- Can be transportable on the road via the fifth wheel coupling for site to site transport *(Depending on local road regulations)*

- Conveying material reduces dust levels, noise levels and carbon footprint.

- Conveying material eliminates the high cost of dump truck or shovel haulage and is the most cost-efficient and environmentally sound method of material transfer.

Technical Specifications

TS 1550 Specification (Standard Machine)	
Machine Weight	47 Tonnes (52.6 Ton)
Tonnes per hour	1500TPH @ 1.6 t/m3
Maximum lump size	200mm (8”)
Feed in Height	4.04 metres (13’ 2”)
Maximum Discharge height	17.40 metres (56’ 7”)
Total Length (Fully extended)	51.60 metres (170’)
Total Length (Fully retracted)	33.60 metres (110’)
Operating Width	11.27 metres (37’)

Stockpile Capacities	Tonne (Metric)	M3 (Metric)	Ton (Imperial)	Yrds 3 (Imperial)
Conical Stockpile	13,900	8,688	15,290	11,364
Conical Telescopic	16,600	10,375	18,260	13,571
Radial Stockpile capacity increase per degree	626	391	689	511
@ 90 degrees	72,800	45,500	80,080	59,514
@ 120 degrees	91,500	57,188	100,650	74,802
@180 degrees	129,000	80,625	141,900	105,458
@ 270 degrees	185,300	115,813	203,830	151,483

1. Structural Specification

- Main “outer” frame is constructed from 150 x 150 x 12mm heavy structural angle.

- The telescopic extendible “inner” lattice truss is constructed using 200x100x6mm and 150x100x6mm Rectangular Hollow Section (RHS).

- The forward support frame ("Hydraulic Under Carriage") is constructed of 250 x 250 x 10mm hollow section and the rear support frame ("Under Carriage") is fabricated from 200 x 200 x 8mm heavy structural angle. The forward support is hydraulically raised and lowered.

- King, pin, counterweight and side plate assemblies are designed to allow ample turning clearance for most 5th wheel tractors. Safety guards at all pinch points are standard.

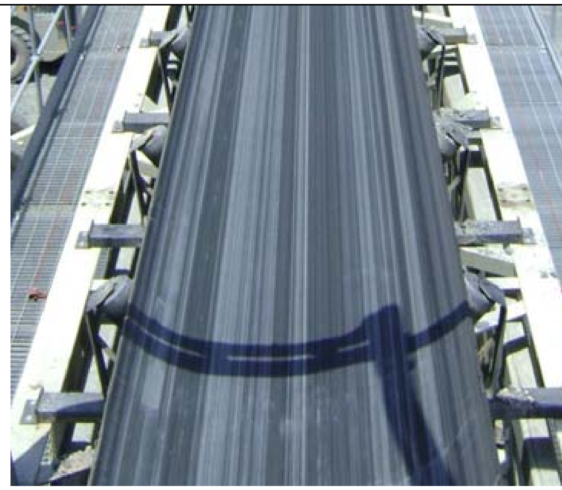
- Standard accessories include loading hopper, (stone box, or tapered chute) 1900mm (6' 2") wide x 2120mm (6' 11") long, fabricated from 8mm (1/3") plate with rubber skirting.

- The conveyor mid section is hydraulically raised to allow the wheels to swing from travel mode to radial position. Wide wheelbase in radial position offers great stability during operation while the closed travel position allows for safe transportation.

- Telescopic action is activated by a 325mm (1') dia drum (3.0 KW motor) and 16mm (5/8") cable winch package, which moves the conveyor, approximately 14 ft/min (0.07 m/s) (5252Nm, 3.1 Tonnes pull).	

2. Component Specification

Belting – 1200mm (48") - Outer conveyor – EP630 / 4ply, 6mm top 2mm bottom cover - Inner conveyor – EP630 / 4ply, 6mm top 2mm bottom cover Belting is premium quality, high tensile strength, to support the load and the designed horsepower. Standard covers are 6mm x 2mm 4 ply EP630 with vulcanised splice (if available in local area) or clipped belt for container transport	 ***Belt Speed :*** ***Outer Conveyor 492 ft/min (2.5 m/s)*** ***Inner Conveyor 531 ft/min (2.7 m/s)***

Rollers	
- Troughing Rollers 133mm (5”) dia troughing at 50 degrees 4 roll set - Return Rollers Spiral rollers 102mm (4”) dia 1200mm (40”) belt 1 of at head and Tail of conveyor 102mm (4”) plain rollers between spiral rollers - Both the main conveyor and the telescopic conveyor utilise 133mm (5”) steel idlers with 50 degree troughs;	

Drums and Shafts	
- Outer conveyor head drum and shaft 520mm (21”) x 1280mm (50”) drum, 120mm (5”) x 2625mm (103”) shaft - Outer conveyor tail drum and shaft 520mm (21”) x 1280mm (50”) drum, 120mm (5”) x 1818mm (72”) shaft - Inner conveyor head drum and shaft 457mm (18”) x 1280mm (50”) drum, 100mm (4”) x 2625mm (103”) shaft - Inner conveyor tail drum and shaft 457mm (18”) x 1280mm (50”) drum, 100mm (4”) x 1818mm (72”) shaft. All end drums are welded steel, crowned faced, secured by Fenlock hubs on high strength (EN8) steel shafts. All head drums are diamond lagged. (50”) shaft	

Gearboxes

- Outer conveyor direct drive

  14.61:1 shaft mounted gearbox

- Inner conveyor direct drive

  13.45:1 shaft mounted gearbox

- Winch direct drive

  348.91:1 shaft mounted gearbox

Belt Scraper

Carbite tungsten tipped finger scraper to suit 1200mm (48") belt.

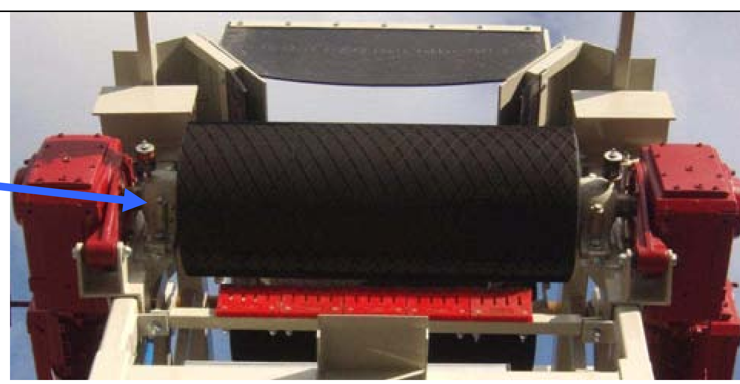
Belt cleaners are situated at the discharge end on both conveyors, cleaning the drive drums below the tangent point of the head pulley.

Bearings

- Head drum bearings 115mm (4½") pillow block bearing

- Tail drum bearings 75mm (3") pillow block bearing

(Includes greasing canisters on each bearing as standard)



Electrics and Controls Electrical Panel is mounted in weather proof enclosure with 415V/380V, 3 phase, 50 Hz, Allen Bradley starters with Allen Bradley SLC 500 processor allowing the unit to be fully automated or manually operated. Includes full fault diagnostics and monitoring indicating LED's for monitoring and maintenance.	

Electric Motors - Outer conveyer motor - 2 x 37 kw IP 55 rating - Inner conveyer motor - 2 x 30 kw IP 55 rating - Winch drive motor - 3.0 kw IP 55 rating **Power Consumption (Approx)** - Unit requires 210 Amps of Supply (Based on operating @ 18 degrees on full load – Note: This will vary depending on angle of operation)	

Hydraulics

- Jack leg cylinders 112mm bore 400mm stroke

- Telescopic lift cylinders 152mm bore 1830mm stroke fitted with safety check valve

- 11 Kw 4 station Hydraulic Power Pack with 125 lts reservoir Powers a 8.6 litres/min gear pump at 4000psi

- Wheel drive utilises two hydraulic torque hubs

Note: Electric hydraulic power pack used for all hydraulic functions – Raise / lower conveyor sections, raise / lower under-carriage, radial left / right

Wheels and Axles

The axle is a specially designed outrigger style framework with 8 x 425 / 65 /22.5 super single wheels mounted onto standard 10 stud hubs.

This includes 2 x Internal wheels hub drives fro radial left / right.

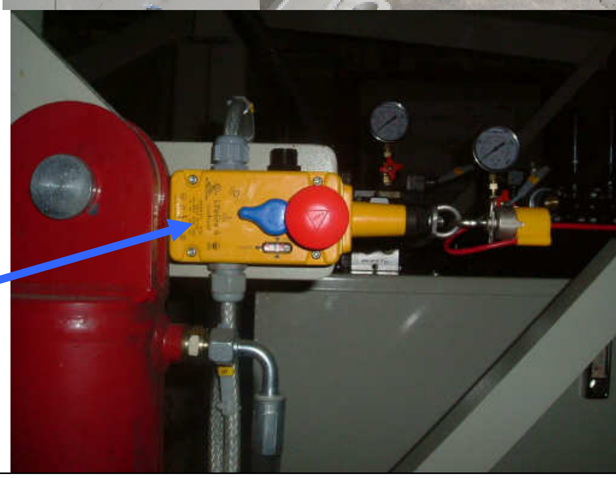
3. Safety and Paint Finish

Safety

All Telestack machines are safety guarded to BS 7300 as standard, for extra walkways, handrails and safety solutions see options. All machines are fitted with safety grab wire

- Safety grab wire as standard around undercarriage of unit.

- 2 x Emergency stops on pull cords located on each side of the undercarriage.

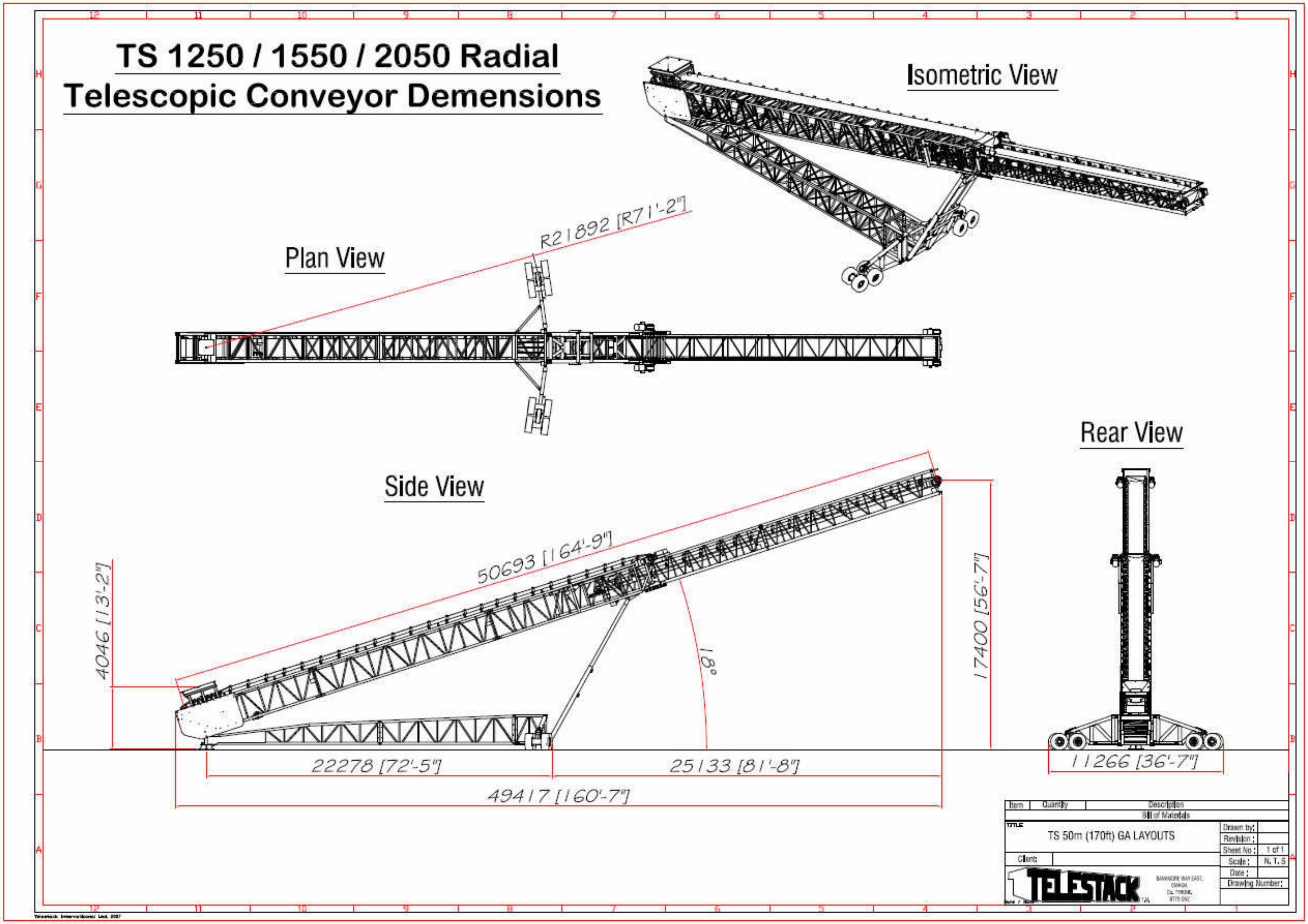


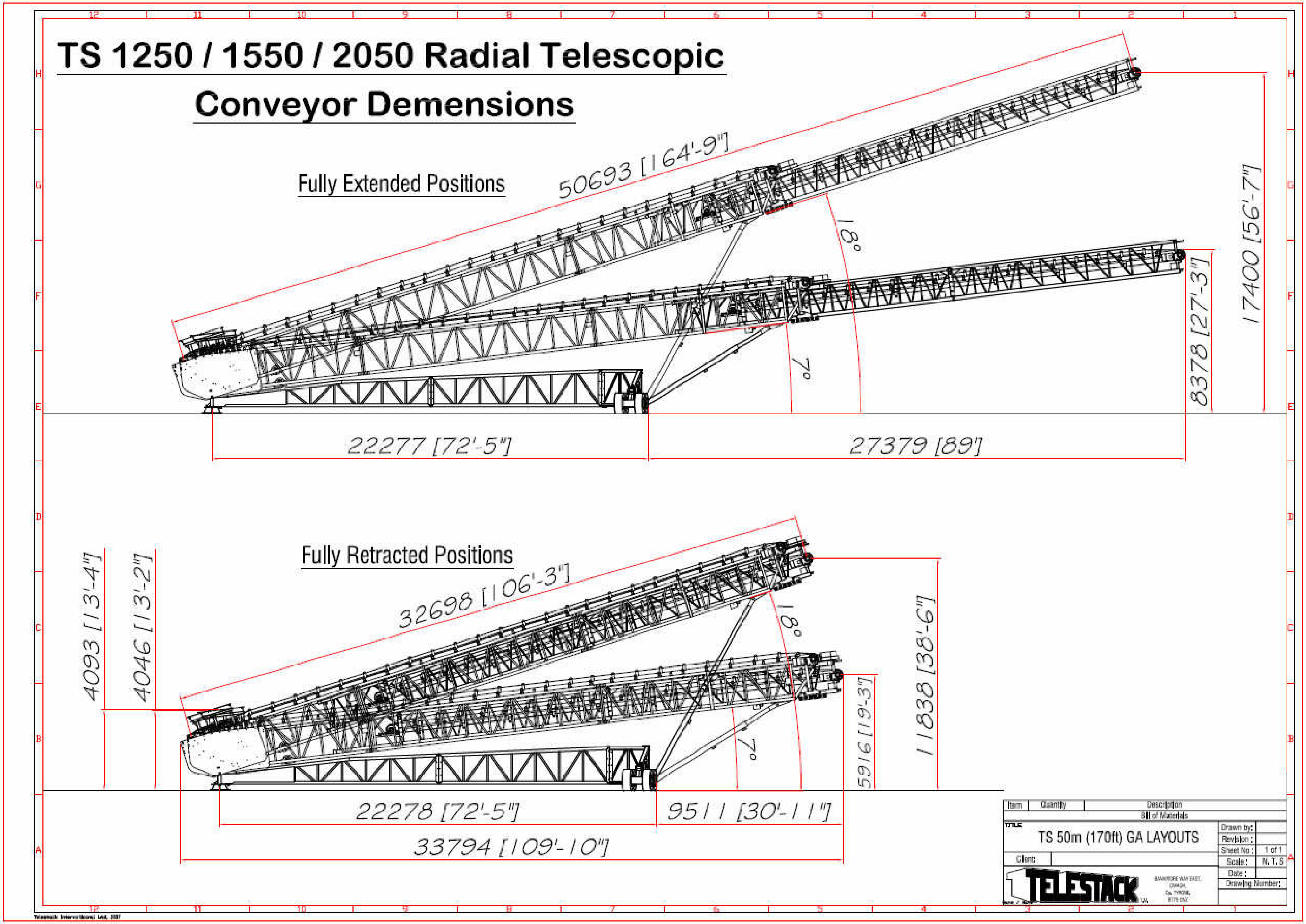
Paint Finish

Two Pak Epoxy Primer paint to ADT 60 microns

Two pak Epoxy top coat to ADT 60 microns

Total Average Dry Thickness of 160 microns.


TS 1250 / 1550 / 2050 Radial
Telescopic Conveyor Demensions
Isometric View
Plan View
R21892 [R71'-2"]
Side View
Rear View
50693 [164'-9"]
4046 [13'-2"]
17400 [56'-7"]
18°
22278 [72'-5"]
25133 [81'-8"]
49417 [160'-7"]
11266 [36'-7"]
TS 50m (170ft) GA LAYOUTS
TELESTACK

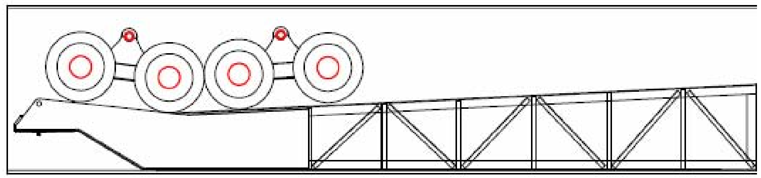

TS 1250 / 1550 / 2050 Radial Telescopic
Conveyor Demensions
Fully Extended Positions
50693 [164'-9"]
18°
7°
17400 [56'-7"]
8378 [27'-3"]
22277 [72'-5"]
27379 [89']
Fully Retracted Positions
32698 [106'-3"]
18°
7°
4093 [13'-4"]
4046 [13'-2"]
5916 [19'-3"]
11838 [38'-6"]
22278 [72'-5"]
9511 [30'-11"]
33794 [109'-10"]
Item
Quantity
Description
Bill of Materials
TITLE
TS 50m (170ft) GA LAYOUTS
Client:
Drawn by:
Revision:
Sheet No: 1 of 1
Scale: N.T.S
Date:
Drawing Number:
TELESTACK

TS 1250 / 1550 / 2050 Radial Telescopic Conveyor – Transport Requirements

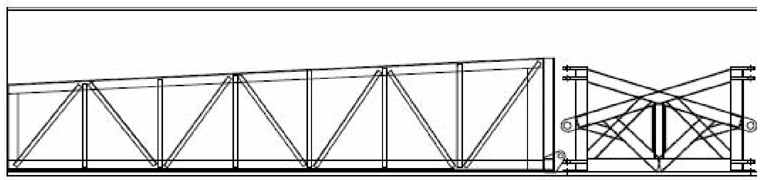
5 x Std 40ft ‘High Cube’ Containers or Euro-liners

Typical Dimensions – 40ft x 8ft x 9ft 6”

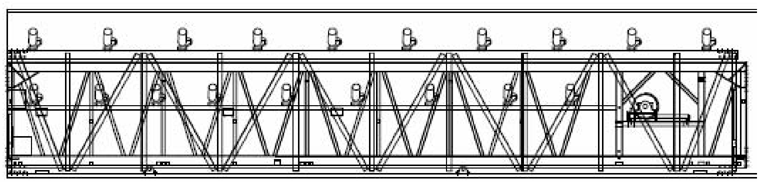
Container One



Container Two

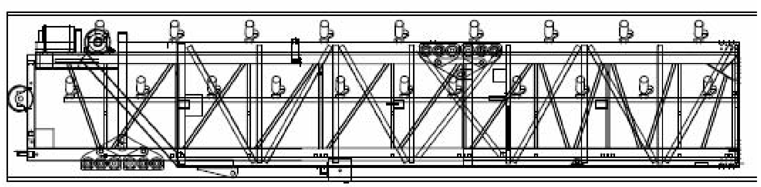


Container Three

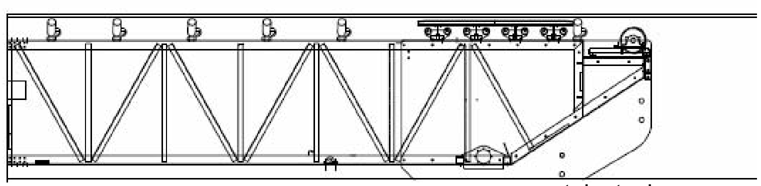


Note: **Optional Tracks, Gen-set or walkways needs extra 1 x 40ft ‘High Cube’ Container**

Container Four



Container Five



Foreshore Fish Habitat Assessment for Southeast Tasu Mine Site

September 2012

prepared for:

Ray Carrier
Coastal Construction Aggregates Inc.
15041 Owens Road
Smithers, B.C.
V0J 2N1

prepared by:

Eric White, RPBio, FABP
3093 Heddle Road
Nelson, BC
V1L 6M2
telephone/FAX: 250.825.4392
E-Mail: eric_white@shaw.ca

October 22, 2012

Foreshore Fish Habitat Assessment for Southeast Tasu Mine Site in Tasu Sound: September 2012

Executive Summary

Coastal Construction Aggregates Inc. proposes to re-develop the Tasu Iron Mine site on Morseby Island, Haida Gwaii to produce construction aggregate materials. The mine was active from 1967 to 1983, milling some 22.7 million tonnes of ore to produce iron, copper, silver and gold.

The site is highly modified. There are large piles of waste rock that have intruded into the pre-existing foreshore and a causeway was built between the mine site and Gowing Island.

Coastal Construction Aggregates Inc. proposes to re-work the existing waste rock piles and to generate large rock materials by drilling and blasting. Proposed uses are fill, construction aggregates (i.e. concrete) and marine armour.

The purpose of this report is to document the existing state of inter-tidal habitats and provide an initial overview of sub-tidal habitats at the site pursuant to Coastal Construction Aggregates Inc. application for a foreshore license.

The fieldwork for this assessment was done on September 17 & 18, 2012. That fieldwork consisted of an on-the-ground assessment of the site and inspecting the sub-tidal parts of the bay with towed video. Information gathered included substrate character, and animal and plant species observed.

The existing inter-tidal shoreline consists largely of waste rock of cobble and smaller sizes with protrusions of native rock. The waste rock habitats are colonized with barnacles, mussels and rockweed. Biota on waste rock substrates appears to be reduced, whereas biota on native rock substrates appears to be more robust and diverse.

A similar situation was observed sub-tidally. The waste rock substrates extend approximately halfway across the bay. Seaweeds observed on waste rock substrates were sparse, while there were areas with robust blade kelp growth – which appeared to be associated with bedrock outcrops. Industrial debris was observed in the harbour.

The author makes the following conclusions:

1. The site is highly modified as a result of historic mining activities.

2. The proposed development includes an initial ramp barge landing site (which is usable without modification) and two permanent barge-loading facilities (which will require minor modifications to the shoreline).
3. The proposed processes will take place well removed from the shore other than the actual loading of the barges.
4. The materials to be exported (i.e. loaded onto barges) are virtually the same as the material forming the shoreline now and so any minor spillage should have no affect on the shoreline habitats.
5. The biota observed on site are reduced in both abundance and diversity from what one could expect on similar shorelines in Haida Gwaii.
6. There are a number of possible contributing factors to the observed reduction in biota. These include the nature of the substrates and water quality – in terms of both groundwater flow into the bay and the reduced water circulation in the bay.

Foreshore Fish Habitat Assessment for Souteast Tasu Mine Site in Tasu Sound: September 2012

Table of Contents

List of Figures

List of Photographs

Acknowledgements

The author would like to extend his thanks to the following people in appreciation for their help during this work:

- **Ray Carrier** of Coastal Construction Aggregates Inc. for providing insight into on the project, background information and the company's goals with the project.

Foreshore Fish Habitat Assessment for Souteast Tasu Mine Site in Tasu Sound: September 2012

Introduction

Coastal Construction Aggregates Inc. proposes to re-develop the Tasu Iron Mine site on Morseby Island, Haida Gwaii to produce construction aggregate materials. The location of the site is shown in **Figure 1**. The mine was active from 1967 to 1983, milling some 22.7 million tonnes of ore to produce some 12.3 million tonnes of iron, copper, silver and gold (Tasu Global Resources Inc., 2012). These figures suggest that about 10.4 million tonnes of waste rock and/or tailings were generated as part of ore producing operations. Additionally, mine works development (i.e. pit and underground works) have been estimated to generate a further 30 million tons of shot-rock that remain on the property, in various dumps. It is the shot rock and waste rock which are the focus of the proposed export operations (R. Carrier, pers.com,. 2012).

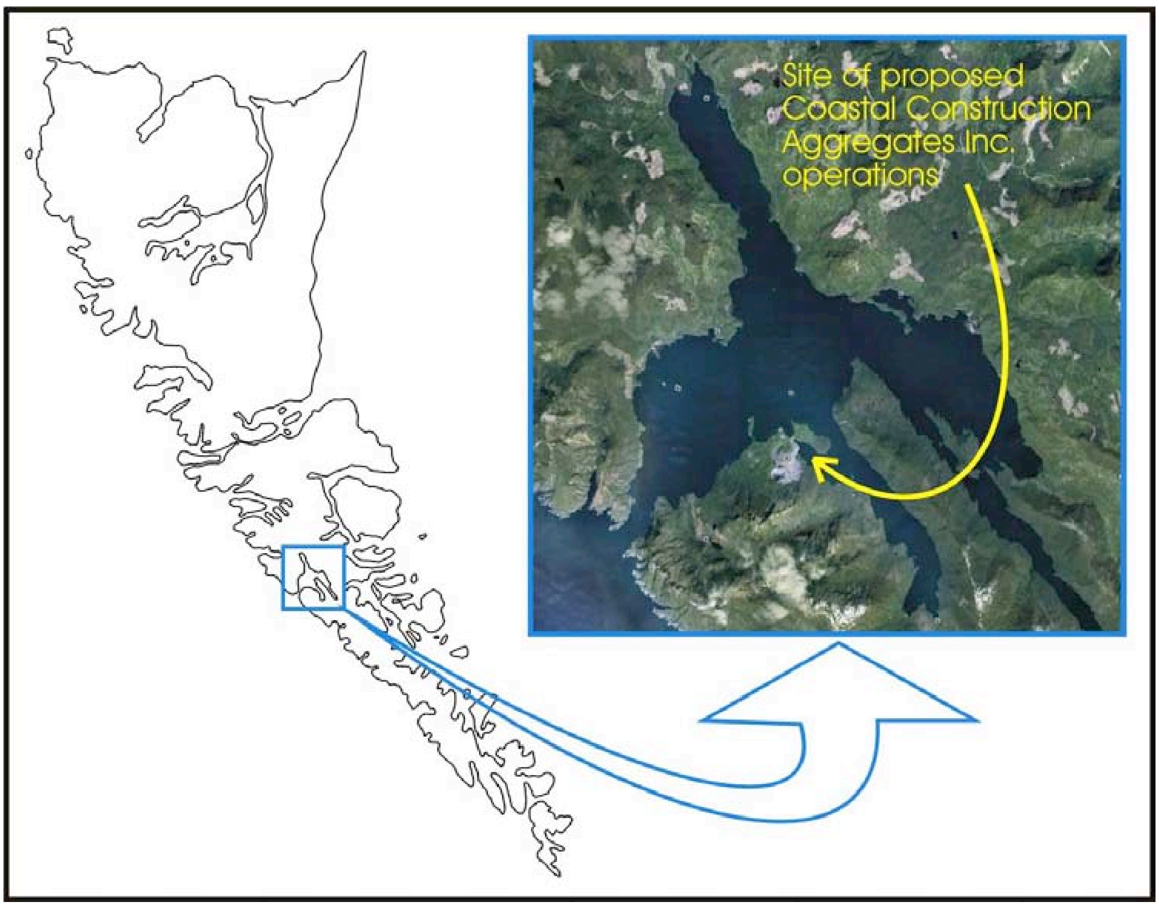


Figure 1: Location of the proposed Coastal Construction Aggregates Inc. site in Tasu Sound.

Coastal Construction Aggregates Ltd. is proposing to use the site to generate and export construction aggregates and is currently pursuing both a License of Occupation for roughly 90 ha of land and a foreshore license for 13.2 ha in the bay. These tenures would allow the company to process existing waste rock piles to produce construction aggregates, to load and unload barges, and to possibly moor a floating camp for workers in bay.

The existing site is conducive to the proposed operations in that:

- There is limited infrastructure on site. The roads are in very good condition and there is plenty of level ground where materials can be processed and sorted.
- The previous mining operation generated significant volumes of shot rock and crushed rock that is essentially ready to ship. Other products being considered could be screened and processed from the waste rock.
- The bay in which these operations would take place is very sheltered, which will minimize the chances of operational upsets in bad weather.
- The site has been severely disturbed as a result of the historic mining operations. There may be opportunities to improve the ecological performance of the site in the long term if the project goes ahead.

The components of the proposed development that will affect the foreshore are the initial barge loading site, a permanent barge-loading site and a conveyor-assisted barge-loading site (see **Figure 2**). On-site discussions suggest that the installation of these will have minimal effect on the existing foreshore (Ray Carrier, pers.com., 2012). The reader is advised that no detailed engineering drawings have been drawn at this time. The following comments are made on the basis of on-site discussions with Ray Carrier.

The bay between the mine site itself and Gowing Island is approximately 80m (262’) wide at its most constricted point. The largest barges envisioned for this work are 30m (100’) wide by 122m (400’) long. Dead-man anchors will be buried in the crushed rock on the mine side of the bay, and rock-bolt anchors would be installed in the bedrock of Gowing Island. It is anticipated that all four corners of the barge will be secured and the materials will be conveyed to the barge by rubber-tired loaders or mobile conveyors.

The initial ramp barge-loading site will be situated at the center of the head of the bay. Subsequently, once the operation is reasonably established, a permanent barge facility would be developed on the north-east side of the head of the bay. The initial ramp barge-loading site will require no alteration of the foreshore and the permanent barge facility should require minimal physical alteration of the existing foreshore. Future development would include a conveyor assisted barge facility on the south side of the bay, which should require minimal physical alterations to the foreshore.

The purpose of this report is to document the existing state of inter-tidal habitats and provide an initial overview of sub-tidal habitats pursuant to Coastal Construction Aggregates Inc. application for a foreshore license.

Figure 2: The site of Coastal Construction Aggregates Inc. showing the locations of the proposed foreshore facilities and the foreshore lease application area.

Methods

The fieldwork was done on the afternoon of September 17 and the morning of September 18, 2012. The on-site work included walking the potentially affected foreshore areas, and viewing the sub-tidal habitats in the bay with towed video.

Three transects were established at each of the proposed barge facility sites – one being down the centre and two more 5m to either side. All transects were perpendicular to shore with the origin at the extreme high tide line. The centre transects were surveyed and the map coordinates are given in **Table 1**. Transect data are presented in **Appendix I**.

Table 1: GPS coordinates for centre transects of proposed barge facility sites		
Site	**easting**	**northing**
Initial barge landing site	699663	5850067
Permanent barge facility site	699697	5850086
Future conveyor barge loading facility site	699690	5849994

All transect locations and the approximate towed video tracks are shown in **Figure 3**. Transects were documented with still photographs. Note: Ray Carrier documented facility sites with video imagery, which is not included here but is available from Coastal Construction Aggregates Inc. directly. Procedures used follow Northrup & Cowan, 2002.

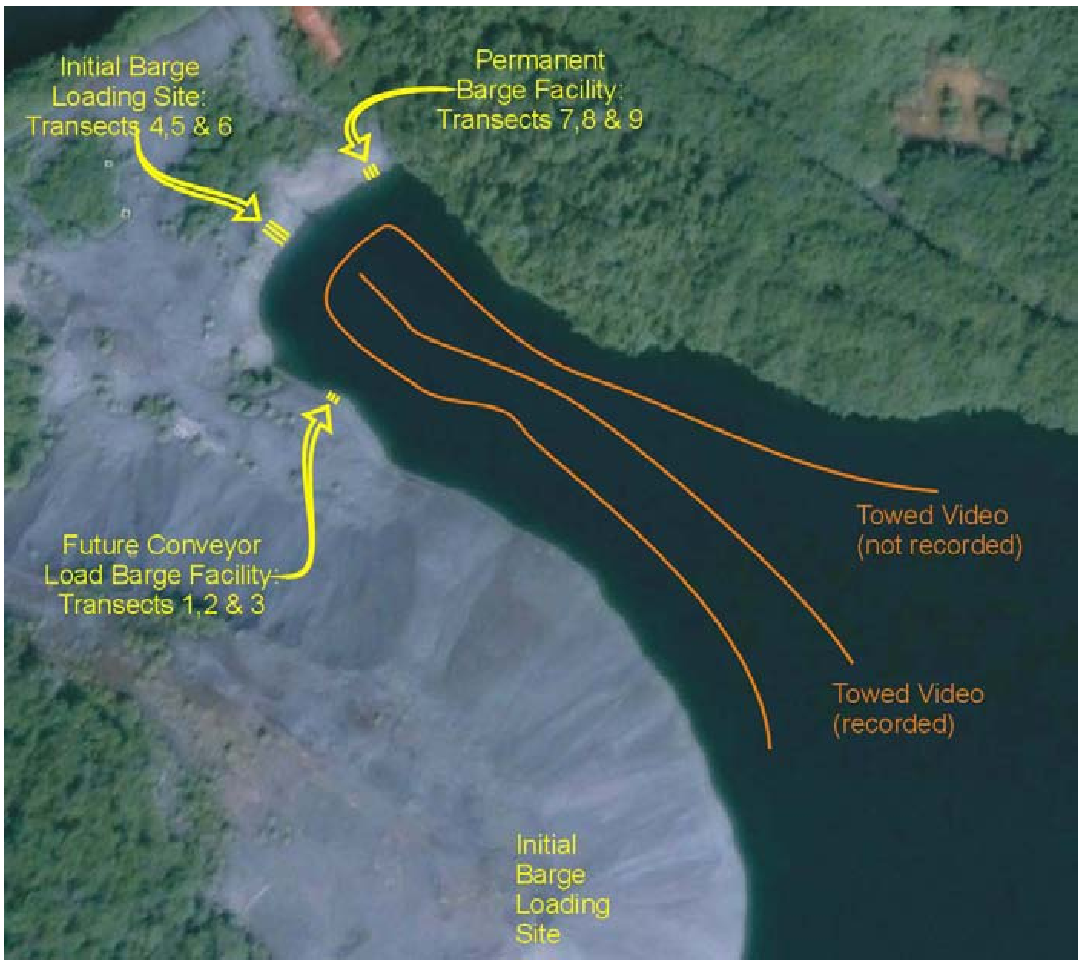


Figure 3: The proposed Coastal Construction Aggregates Inc. site showing the locations of foreshore transects and the towed video surveys

Predicted tides for September 17, 2012 were 3.8m @ 02:27, 1.0 m @ 8:29 and 4.1 m @ 14:38; and for September 18, they were 3.7 @ 03:13, 1.1 @ 09:06 and 4.2 @ 15:16. (Canadian Hydrographic Service, 2012)

There was a computer storage problem with the initial towed video file, however the second tow was visually similar to the first and the author is confident that the imagery presented is characteristic of the bottom in the bay. Due to the bathymetry of the bottom the depth of both tows varied between depths of 30 and 60 feet. The towed video file is presented in **Appendix II**.

The figures presented in this report have been derived from images from Google Earth. Biological nomenclature follows *Marine Life of the Pacific Northwest* (Lamb and Hanby, 2005).

Foreshore Habitats

Inter-tidal habitats

Photograph 1 shows the inter-tidal slope at the head of the bay. This is the east shore of the causeway and it appears that most of the material on the foreshore here is waste rock from the mine workings.

Notes: The photograph is taken from the north end of the causeway (the proposed permanent barge facility location) looking across the initial barge site.

Photograph 1: The inter-tidal foreshore at the head of the bay.

Biota observed included barnacles (*Balanus glandula*), rockweed (*Fucus gardineri*), little rockweed (*Pelvetiopsis limitata*) and mussels (*Mytelis edulis*). All the mussels were small and appeared to be juvenile or 1st year. There were some amphipods. There were very few periwinkles (*Littorina sitkana*) and limpets (*Tectura persona*) found on most of the beach.

Photograph 2: A typical view of the mid inter-tidal zone boulder/cobble substrate at the head of the bay.

The only place I saw large mussels (i.e. multi-year) was on a single large boulder near the north east end of the causeway (**Photograph 3**). Also observed were hairy hermit crabs (*Pagurus hirsutiusculus*), red rock crabs (*Cancer productus*) and polyclad flatworms (likely *Notoplana sanguinea*).

Notes: This boulder is situated near the proposed permanent barge facility site, on the north east side of the causeway.

Photograph 3: A single large boulder with rockweed and mussels in the lower inter-tidal zone.

There were small sculpins (*Oligocottus maculosus*) near the waters edge and the occasional gunnel or prickleback (possibly *Xiphister atropurpureus*) under rocks in the lower inter-tidal zone.

The substrate was often comprised of uniform material in the cobble/gravel size range with some fines. **Photograph 1** shows that there are large areas that are sparsely colonized but there are also areas where the degree of colonization is more typical of unaffected shorelines in Haida Gwaii. These better-colonized areas often (but not always) appear to be associated with larger substrate material (**Photograph 4**).

Notes: there was relatively luxuriant growth of rockweed on cobble substrate in the center of the photograph as compared with the limited growth on similar substrates to either side.

Photograph 4: Looking towards the proposed conveyor-assisted barge-loading facility site.

At the waters edge there were often mats and clumps of a filamentous brown growth, this could have been colonial diatoms or brown tuft algae. Other plants observed in the water included cornrow sea lettuce (*Ulva intestinalis*) and the occasional drift eelgrass frond.

Sub-tidal Habitats

The sub-tidal habitats follow the character described above – there are large areas of the bottom of the bay, i.e. all of the south side, where the substrate is waste rock from the mine. These areas are sparsely colonized with seaweeds, mostly the filamentous brown mats discussed above. In places where there were bedrock outcrops there was a noticeable increase in the abundance and diversity of blade kelps.

Some rockfish (likely *Sebastes* spp.) were observed these did not appear to be associating with any particular bottom substrate.

There were many pieces of industrial scrap or debris observed, such as large (~0.5 m thick) I beams, tires, as well as one ore car carcass (?) and other non-descript metal pieces.

Implications of Proposed Development

As noted previously the site is highly degraded as a result of the past mining activities. The proposed industrial processes discussed include re-handling existing cobble/gravel sized rocks and creating large rock pieces for use as marine rip rap by blasting. These processes will be done well removed from the shoreline and should have no affect on it. The only part of the process that would affect the marine environment is the loading of materials onto barges for export. The materials to be loaded are the same as the material forming the shoreline now, so it is reasonable to conclude that no further environmental degradation would result from minor spillage.

That said, the biota observed on the shoreline is reduced in both abundance and diversity from what one would expect on similar but undisturbed sites in Haida Gwaii. There are a number of possible explanations and/or contributing factors that spring to mind for this.

One is that the material is mobile and continuous slumping is precluding the development of biological community. This may well be happening in some parts of the site – such as on the face of the waste rock piles themselves – but does not seem likely on the face of the causeway where the shoreline is less steep and the rocks appear stable.

Another is that there may well be a water quality issue that is inhibiting marine life. The leachate from the rock piles contains low levels of copper (R. Carrier; pers. com., 2012). Cuprous oxide is the biocide used in a common antifouling paint so it is reasonable that the copper in the leachate coming off site could be a contributing factor.

And, finally, the reduced tidal circulation in the bay, resulting from the causeway construction, may be another factor. If the area were subject to more tidal flow then any leachate would be and dispersed. Currently, the bay has no through current and, therefore groundwater flow (which would contain the leachate) is confined in the bay.

Conclusions

The author makes the following conclusions:

1. The site is highly modified as a result of historic mining activities.
2. The proposed development includes an initial ramp barge landing site (which is usable without modification) and two permanent barge-loading facilities (which will require minor modifications to the shoreline).
3. The proposed processes will take place well removed from the shore other than the actual loading of the barges.
4. The materials to be exported (i.e. loaded onto barges) are virtually the same as the material forming the shoreline now and so any minor spillage should have no affect on the shoreline habitats.

5. The biota observed on site are reduced in both abundance and diversity from what one could expect on similar shorelines in Haida Gwaii.
6. There are a number of possible contributing factors to the observed reduction in biota. These include the nature of the substrates and water quality – in terms of both groundwater flow into the bay and the reduced water circulation in the bay.

Sources of Information

References

Canadian Hydrographic Service, 2012. Website accessed September 8, 2012; Website address: **http://www.waterlevels.gc.ca/eng/find/region/1**

Lamb, A. and **Bernard P. Hanby. 2005.** *Marine Life of the Pacific Northwest; A Photographic Encyclopaedia of Invertebrates, Seaweeds and Selected Fishes.* Harbour Publishing. Madeira Park. BC. 398 pages.

Northrop, S. and **A. Cowan. 2002.** Marine Foreshore Environmental Assessment Procedure. Department of Fisheries and Oceans, Pacific Region. 4 pages.

Tasu Global Resources Inc., 2012. *Tasu Global Presentation v01 web* (web address: tasuglobalresources.com); accessed Oct 20, 1012. 15 pages

Personal Communications

Ray Carrier, principal, Coastal Construction Aggregates Inc., various September – October, 2012

Appendices

Appendix I: Transect data

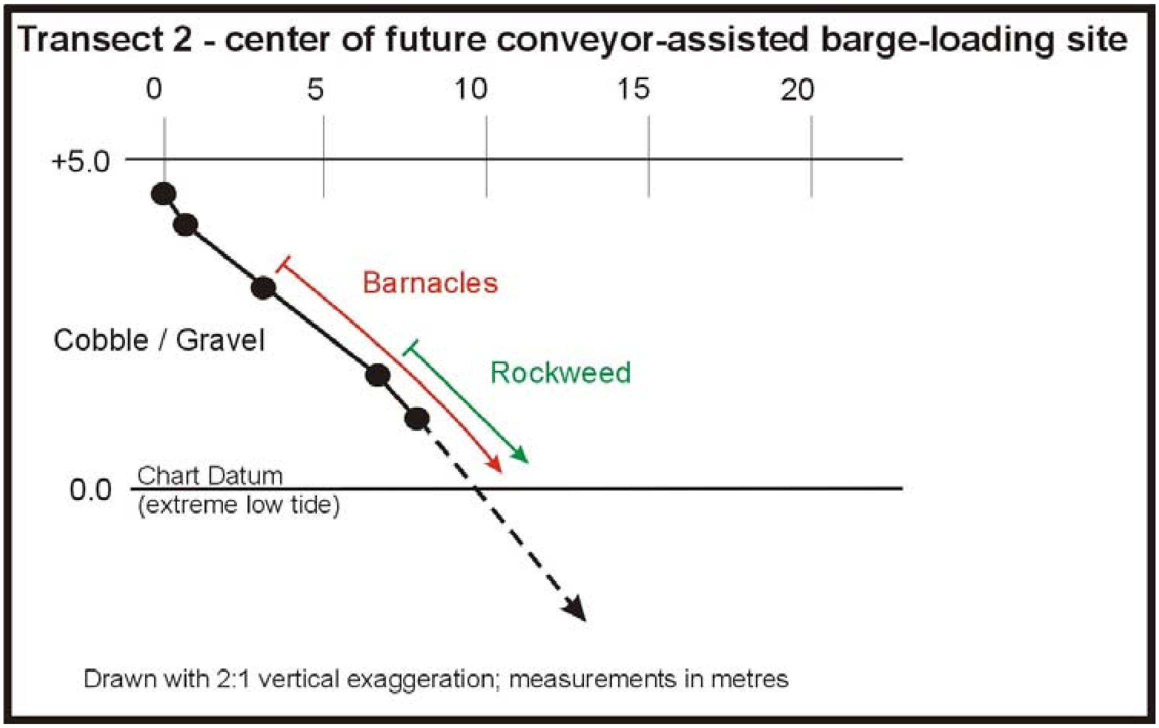
Three transects were established at each of the proposed barge facility sites – one being down the centre and two more 5m to either side. All transects were perpendicular to shore with the origin at the extreme high tide line. Only the centre transects were surveyed.

All data were gathered on September 17, 2012

Future conveyor-assisted barge-loading facility

UTM coordinates for origin of center transect: Easting: 699690 / Northing: 5849994

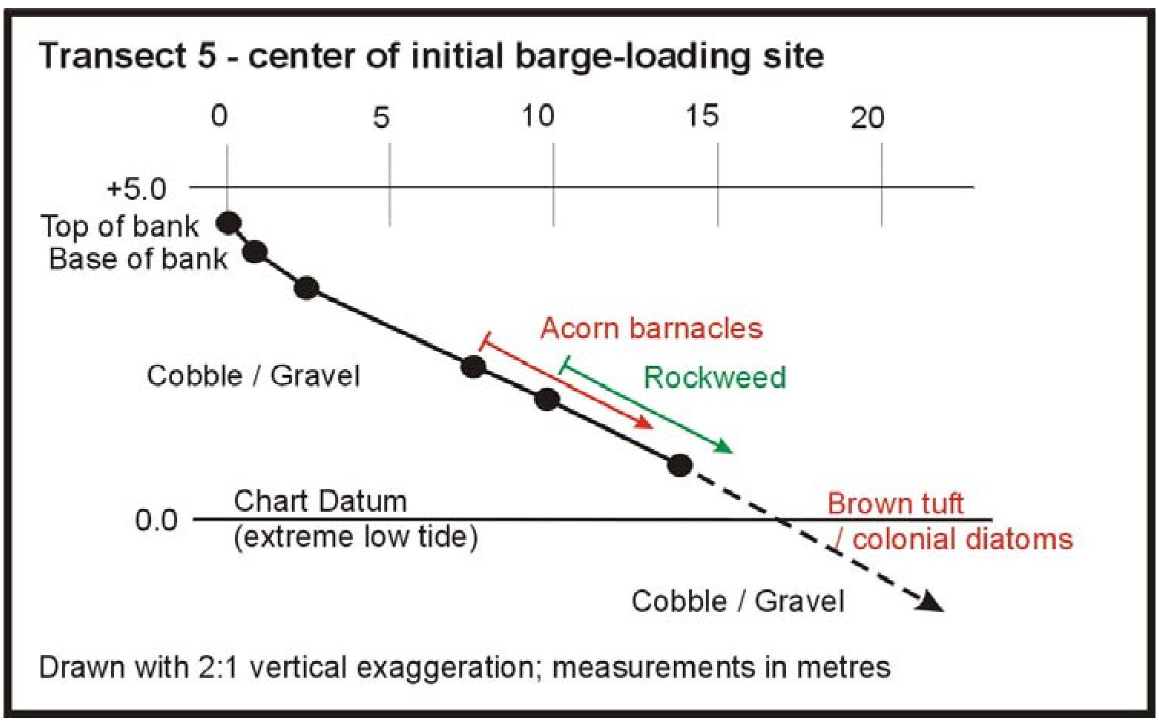
Transect Number	Slope Distance	Chart Depth	Geodetic Elevation	Notes
1	0			Extreme high water
	1.4			Afternoon tide (+4.1 m)
	3.3			Start acorn barnacles
	5.0			Start rockweed
	7.4			Waters edge; brown tuft and/or colonial diatoms visible in water
2	0	+4.5	2.2	Extreme High Water
	0.85	+4.0	1.7	Afternoon tide
	3.45	+3.1	0.8	Start acorn barnacles
	7.15	+1.7	-0.6	Break in slope; occasional rockweed
	8.45	+1.0	-1.3	Waters edge
3	0			Extreme High Tide
	1.1			Afternoon tide
	3.9			Start acorn barnacles
	7.3			Start small tufts of rockweed
	9.2			Waters edge; brown tuft and/or colonial diatoms visible in water; angel hair seaweed; leather star



Initial barge-loading site

UTM coordinates for origin of center transect: Easting: 699663 / Northing: 5850067

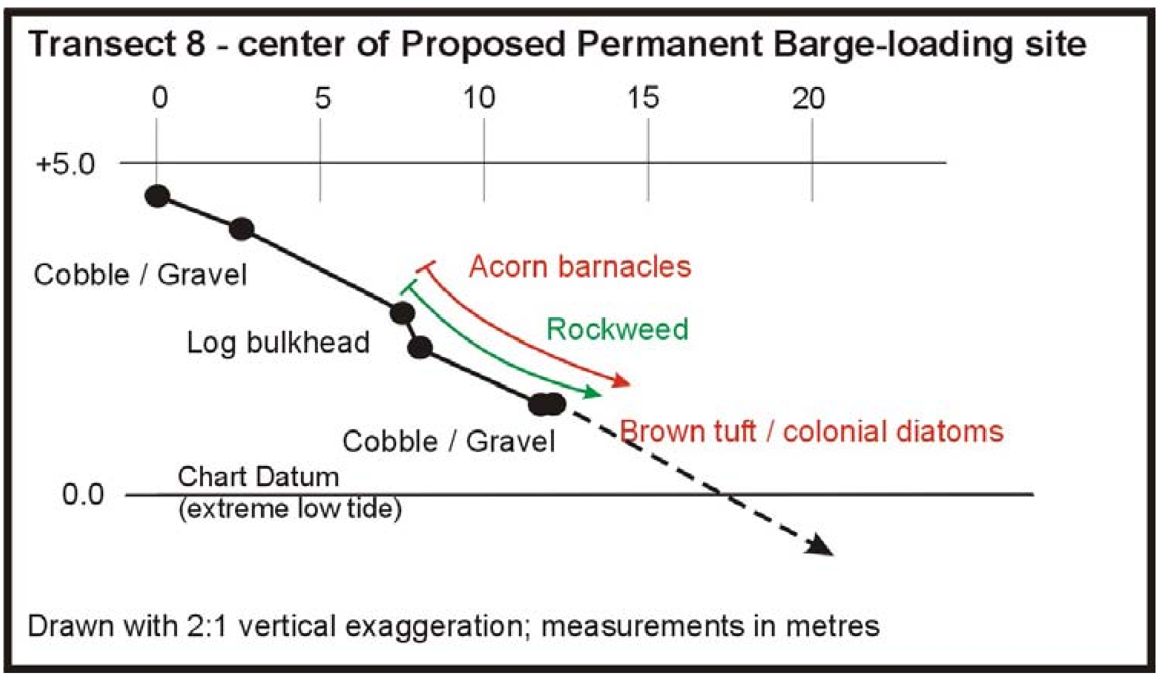
Transect Number	Slope Distance	Chart Depth	Geodetic Elevation	Notes
4	0			Extreme high water; below 0.4 m cut bank
	2.0			Afternoon tide (+4.1 m)
	5.4			Acorn barnacles on boulder
	6.1			Start acorn barnacles on cobbles
	6.8			Start periwinkles
	7.9			Start rockweed on boulders (only on boulders, not on cobbles)
	13.7			Water's edge; green scum; amphipods and hermit crab
5	0	+4.5	2.2	Extreme High Water / top of cut bank
	0.93	+4.1	1.8	Base of cut bank
	2.56	+3.5	1.2	Afternoon tide
	7.8	+2.3	0.0	Start acorn barnacles
	10.2	+1.8	-0.5	Start rockweed
	14.3	+0.8	-1.3	Waters edge
6	0			Extreme High Tide
	1.2			Afternoon tide
	6.7			Start acorn barnacles, periwinkles
	10.9			Start rockweed
	16.4			Waters edge; brown tuft and/or colonial diatoms visible in water



Permanent barge-loading site

UTM coordinates for origin of center transect: Easting: 699697 / Northing: 5850086

Transect Number	Slope Distance	Chart Depth	Geodetic Elevation	Notes
7	0			Extreme high water; below 0.4 m cut bank
	5.8			Start acorn barnacles, periwinkles
	7.3			Start rockweed
	11.1			Limpets amongst the rockweed
	12.6			Water's edge, start diatom scum
8	0	+4.5	2.2	Extreme High
	2.6	+4.0	1.7	Afternoon tide
	7.64	+2.8	0.5	Top of sill log
	8.4	+2.2	-0.1	Bottom of sill log; start acorn barnacles, rockweed
	12.2	+1.3	-1.0	Continuous barnacles
	12.5	+1.3	-1.0	Waters edge, start diatom scum
9	0			Extreme High Tide
	2.2			Afternoon tide
	5.1			Start acorn barnacles
	6.2			Sill log; barnacles, rockweed, periwinkles
	11.0			Waters edge; diatom scum on rocks



Appendix II: Towed Video Imagery

This DVD shows imagery gathered with towed video up the center (more or less) of the bay. It is un-edited. The viewer is advised that there are portions that do not show the bottom – because of changes in bathymetry or attempts to avoid obstacles. There is, however, enough viewable imagery to give the viewer a general sense of the sub-tidal situation.

Water depth varies between 30 and 60 feet.