October 29, 2010

Project No. 09-1475-0026/6000
E/10/439

Mr. Andrew Mylly, B.Sc, PMP
Public Works and Government Services Canada
641-800 Burrard Street
Vancouver, BC
V6Z 2V8

LETTER REPORT ON 2010 ASSESSMENT OF NORTH LANDING WHARF GABION STRUCTURE, ESQUIMALT GRAVING DOCK, ESQUIMALT, BC

Dear Mr. Mylly,

Public Works and Government Services Canada (PWGSC) retained Golder Associates Ltd. (Golder) to conduct an assessment of submerged, stone-filled wire-basket erosion protection mats (gabion mats) along the North Landing Wharf at the Esquimalt Graving Dock (EGD) in Esquimalt, British Columbia. The mats are connected together with wire ties to create a single gabion structure that extends along most of the North Landing Wharf at EGD.

This letter summarises the findings of this work. Accompanying the letter are two (2) digital video disks (DVDs) of underwater video, including an audio record of diver observations. This work was carried out on February 26, 2010, March 3 to 5, 2010, and March 10 and 11, 2010 (inclusive), under PWGSC Standing Offer No. E0276-040048/006/XSB “Remediation Consultants”.

1.0 BACKGROUND

Stone-filled wire baskets (gabion mats) were installed along the North Landing Wharf for scour protection in 2002. The mats were wired together to create a continuous scour protection blanket. These mats were repaired in 2005 after a section was dislodged during a Coast Guard bollard pull test. The gabions were installed and repaired by Advance Subsea Services Ltd. of Sidney, BC.

“As-built” drawings are not available. The specifications for the gabion mat structure, as outlined in a 2005 document supplied by PWGSC[1], indicate that it was designed to be approximately 0.23 metres (m) thick, 3 m wide and approximately 250 m long. According to the specifications, the gabion mats were positioned atop

[1] Specifications for North Landing Wharf – Scour Protection at Esquimalt Graving Dock, Esquimalt, B.C., PWGSC Project Number 861229, August 2005

“filter cloth” (min. 0.45 millimetre (mm) thickness, 125 grams/m^2). The gabion mats were specified to be constructed using 2.2 mm diameter galvanised and PVC-coated wire in a double-twist hexagonal mesh with 80 mm by 100 mm openings. The wire mesh was to be filled with minimum 100 mm to maximum 200 mm clean stone (measured in the largest dimension). Individual mats were specified to be approximately 3 m wide by 6 m long.

Based on the specifications, video of a previous inspection provided by PWGSC from December 9, 2008, and discussion of this video with the dive supervisor who supervised the survey (Pat Thompson, President/General Manager of South Coast Diving Ltd.), a current gap of 150 mm to 300 mm was anticipated between the toe of the south landing wharf wall and the crest of the mats.

Based on the specifications and drawings, the crest of the gabions was expected to be approximately 14.14 m below the wharf surface, (*i.e.,* approximately 13 m below the high water mark or 9.75 m below the low-low water level). Based on hydrographic survey data provided with the specifications (Canadian Hydrographic Services, 2000), the gabions were expected to slope slightly downward away from the toe of the wall at approximately 1:3 (vertical:horizontal, equivalent to 18 degrees).

PWGSC is currently planning remediation of the EGD water lot, and requires an assessment of the as-built layout of the gabion mat structure, as well as additional information on sediment chemistry in the vicinity of the gabion mat structure. PWGSC does not wish to remove or damage the mats for investigation purposes, and is deliberately avoiding drilling through or cutting the structure.

PWGSC authorised Golder on February 22, 2010, via electronic mail, to conduct an assessment of the existing gabion mat structure, as per the Golder letter “*2010 Assessment of North Landing Wharf Gabion Mats, Esquimalt Graving Dock, Esquimalt, BC*”, dated February 19, 2010 (Golder Ref. 10-1475-0001, E/10/068). During the course of this field work, Anchor QEA, a consulting company separately employed by PWGSC on remedial options assessment for the Esquimalt Graving Dock water lot, commented on the advisability of probing in the vicinity of the gabions to measure the thickness of soft sediment. Golder subsequently obtained authorisation from PWGSC, via electronic mail on March 7, 2010, to proceed with a modified scope of work, described in the Golder letter “*2010 Assessment of North Landing Wharf Gabion Mats, Esquimalt Graving Dock, Esquimalt, BC*” dated March 9, 2010 (ref. 10-1475-0001, E/10/093).

2.0 SCOPE OF WORK AND METHODOLOGY

Golder worked with South Coast Diving Ltd. to conduct a brief diver-based assessment of gabion conditions and sediment conditions in the vicinity of the gabions. The scope of work included the following tasks:

- **Task 1000**: Control Points - Establish vertical and horizontal control points for diver measurements.
- **Task 2000**: Reconnaissance Video– Conduct a video survey of the gabions, with limited hand probing.
- **Task 3000**: Gabion Measurement – Diver measurement of gabion thickness and width.
- **Task 4000**: Sediment Coring – Diver-based coring at the toe of the gabions.
- **Task 5000**: Surficial Sediment Sampling – Diver-based collection of surficial grab samples, for example, between the wall toe and gabion crest, where diver-coring was not feasible on the basis of hand-probe results.

- **Task 6000**: Analytical Testing – Submission of sediment samples to an analytical laboratory for select chemical analysis.
- **Task 7000**: Data Processing – Data tabulation, the calculation of approximate gabion edge positions based on diver measurements, and the preparation of an updated Base Map in CAD (DXF) showing the inferred current measurements of the gabions.
- **Task 8000**: Reporting – Preparation and submission of a concise summary of the investigation methodology and findings.
- **Task 9000**: Project Management - Management of staff, subcontracting, health and safety and coordination with PWGSC.

As discussed in Section 1, an additional task (Task 10,000: Overburden Probing) was added at PWGSC's request on March 7, 2010. Task 10,000 comprised diver probing with a fixed probe and/or water lance ("jet probe") on up to four transects perpendicular to the North Landing Wharf wall at up to 10 metres from the base of the wall.

Key tasks are described in more detail below.

2.1 Control Points

Prior to mobilising divers, Focus Geomatics (Focus) of Victoria, BC, installed eleven (11) reference points along the edge of the North Landing Wharf. The survey data from Focus is attached in Appendix A. The reference locations were surveyed in the UTM coordinate system. These above-water reference points were surveyed using standard land survey methods. The survey locations were marked using nails installed into the wooden toe rail along the edge of the North Landing Wharf. Flagging tape was attached to the nails and the location number was marked with paint to identify the locations. Surveying of the reference point locations was completed on Friday, February 16, 2010. The survey points were numbered 1 to 11, with number 1 located at the west end of the North Landing Wharf.

2.2 Reconnaissance Video

Golder dropped weighted lines (lead lines) from the established control points. The lead lines were individually marked with different combinations of coloured flagging tape. Each lead line had a series of four "flags" tied to the line, spaced approximately 0.4 m apart. The flags were attached to each lead line in order to distinguish between the different locations during the dive survey. The reference flagging system for the lead lines is attached in Appendix A. The depth to the harbour bottom was measured at each lead line using a fibreglass tape measure with a lead weight on the end. The elevation, measured depth and calculated geodetic depth at each lead line location are listed in Table 1.

Table 1. Depth at each reference location

Lead Line Location	Reported Depth (m) below pin	Measured Elevation (m geodetic)	Measured Elevation (m chart)	Measured Elevation (m facility datum)
1 (west end)	13.01	-10.49	-8.62	-8.74
2	14.33	-11.49	-9.62	-9.74
3	14.27	-11.38	-9.51	-9.63
4	14.89	-12.05	-10.18	-10.30
5	14.86	-11.98	-10.11	-10.23
6	13.85	-10.93	-9.06	-9.18
7	15.05	-12.12	-10.25	-10.37
8	14.48	-11.52	-9.65	-9.77
9	14.04	-11.06	-9.19	-9.31
10	13.73	-10.76	-8.89	-9.01
11 (east end)	14.46	-11.48	-9.61	-9.73

A surface-supply diver from South Coast Diving Ltd. of Esquimalt, BC, was deployed to conduct a video survey of the gabions.

The diver began the survey at the east end of the North Landing Wharf, at the entrance to the Dry Dock. Specifically, recording was started when the diver reached the first caisson stop, the outermost sealing surface for the dock mouth caisson. At the time the video was filmed, the dock mouth caisson was located at Stop No. 2, slightly inboard.

During the video survey the diver carried visible indicators of scale and inclination. A scale bar was carried in order to show the scale of objects and features observed and an inclinometer was carried to measure the approximate angle of the gabions. A video record of this reconnaissance accompanies this letter. This video includes audio commentary of diver observations on the following:

- The gap between the Stop #1 Sill and the beginning of the gabions;
- The wire mesh on gabion mats;
- The toe of the wall at the crest of the gabion mats and crest of the gabion mats relative to the lead lines;
- The size of the gap between the wall and gabion structure crest;
- The toe of the gabions including the height and thickness of the gabion structure toe;
- Sediment accumulation on the gabion mats;

- Slope of the gabion mats;
- Debris material in the vicinity of the gabion mats;
- Surface conditions at the far (west) end of the gabion mat structure; and,
- Location and extent of exposed geotextile.

Information collected during the dive survey was tabulated and is attached in Appendix B.

During the video survey, the diver gently probed areas of accumulated sediments including sediment–filled depressions in the gabions, sediment-obscured gabion edges, wall defects and/or the gap between the crest of the gabions and the toe of the wall by hand to assess the suitability of areas for diver coring.

2.3 Gabion Measurement

Following the video survey, the dive team made a second pass along the gabion mat structure to measure the width of the gabion mats and carry out preliminary probing. Measurements and probing was carried out at each end of the gabion mat structure and at nine of the eleven lead lines. The gabion mat structure did not extend as far west as lead line 1 or as far east as lead line 11 (*i.e.*, is less than 242.5 m in length). Measurement of the gabion mat included the length from the wall of the north landing wharf to the toe of the gabions using a fibre glass tape measure. A 0.4 m long steel probe was used to probe the sediments between the crest of the gabions and the north landing wharf and sediments at the toe of the gabions. Measurements taken during the second pass are summarized in Appendix B. The inferred current gabion layout is shown in Figure 1.

2.4 Sediment Coring

Following assessment of the extent and condition of the gabions, a proprietary diver-based piston corer and expert oversight for South Coast Diving Ltd. was obtained from Research Support Services (RSS) of Bainbridge Island, Washington (Photograph 1, Appendix C).

Diver piston coring was repeatedly attempted on March 4 and 5, 2010 along the outer edge of the gabion mats. Divers reported that surficial material included cobbles and/or gravel, and were unable to recover core, with the exception of a relatively short core (80 cm) on the eastern end of the gabions (Photo 2, Appendix C), close to the mouth of the dry dock (sample DC10-01 and field duplicate DC10-06).

A sediment probe (Core Probe) was improvised to resemble the diver piston corer in order to assess if conditions were suitable for piston coring. The probe was constructed on-site by RSS personnel using a PVC core liner, a core cutter/catcher and slide hammer. Probing at the toe of the Gabions at lead lines 1, 2, 6 8 and between lead lines 10 and 11, determined that sediments were unsuitable for coring and that sediment collection would require a grab sampler.

2.5 Surficial Sediment Sampling

Based on observations made during sediment coring and probing attempts using the Core Probe, divers used a 0.2 m diameter, 0.31 m high, 9.7 litre (L) cylindrical stainless steel grab sampler provided by RSS (Photograph 3, Appendix C) to collect surficial sediment for grain size and chemical analysis. Diver collected material from five locations near the toe of the gabion mat structure. Due to the small volume of the core sample collected at the eastern end of the gabions, one of these grab samples was collected at the same location as the core (DC10-01). At the DC10-01 location, sediments from the core sample were submitted for chemical analysis and sediments from the grab sample were submitted for grain size analysis.

The locations of the five samples collected are listed in Table 2

Table 2. Grab Samples Collected and Location

Sample	Location
DC10-01	At the gabion structure toe between lead lines 10 and 11.
DC10-02	At the gabion structure toe at lead line 8
DC10-03	At the gabion structure toe at lead line 6
DC10-04	At the gabion structure toe at lead line 2
DC10-05	At the gabion structure toe at lead line 1

2.6 Analytical Testing

Based on observed lithology, visual indications of potential contamination and olfactory indications of potential contamination, six samples (five field samples and one duplicate, DC10-06) were processed by Golder, loaded into laboratory-provided pre-cleaned sample containers and transported under chain-of-custody procedures to ALS Laboratory Group (ALS) of Burnaby, BC. ALS is a certified analytical laboratory under the Canadian Association of Analytical Laboratories (CALA) system.

The samples were analysed for the following parameters:

- Moisture Content;
- pH;
- Sodium and Chloride by Saturated Paste Method;
- Canadian Council of Ministers of the Environment (CCME) Total Metals;
- Total Polychlorinated Biphenyls (PCBs); and,
- Tributyltin (TBT).

Tabulated laboratory data and the laboratory certificate of analysis are included in Appendix D.

Additionally, two samples (DC10-01 and DC10-05) were submitted to Golder's Canadian Standards Association (CSA) Certified Geotechnical Laboratory in Victoria, BC, for grain-size (sieve) analysis (Appendix F; ASTM C 136/CSA A23.2-2A).

2.7 Overburden Probing

Sediment thickness probing was conducted on March 10 and 11, 2010. This allowed for the prior scheduled facility sill clearing which took place on Tuesday, March 9, 2010, to be completed beforehand. During sill cleaning, divers used a water jet to blow accumulated sediment away from the concrete structure at Stop No. 1. Divers did not observe significant new deposition on the gabion mats on March 10th or 11th, 2010.

Based on the potential for relatively hard and/or rocky substrate, Golder provided the dive team with means for both hand probing and water lancing (jet probing). The jet probe consists of a water pump operated at surface to supply water under pressure to a “lance” carried by the diver (Photo 4, Appendix C). Pressurized water is discharged through end of the lance allowing the diver to more easily advance the probe into the sediment. The length of the lance can be adjusted to meet the needs of a particular program. For this project the lance was operated at 3.7 m in length. The hand probe consisted of a 2.53 m length of iron rebar with a tapered end and a welded “T” handle. Penetration was measured using a tape measure secured to the upper end of the probe to assess exposed probe length before penetration and again at maximum penetration.

Probing was carried out along four transects oriented perpendicular to the north landing wharf. Probing transects were between 9 and 10 m long and were aligned with lead lines 2, 5, 7 and 10. The location of the transects and probing sites is indicated on Figure 1. Probing information relayed by the working diver to the surface was recorded by Golder on field forms. Three probing locations were selected along each transect with up to two probes conducted at each location. Probing was conducted on both sides of the transects at a maximum distance of 1 m from the transect line. The position, depth and penetration depth of probes at each location was tabulated and are included in Appendix E.

3.0 RESULTS

3.1 Schedule

As mentioned previously, field work was completed on March 11, 2010. Analytical data with the exception of TBT was received from ALS on March 16, 2010. TBT data was not received before Monday, March 29. As arranged for in the proposal dated March 9, 2010 (ref. 10-1475-0001, E/10/093), TBT data will be forwarded when received.

Geotechnical analysis of sediment samples was received on March 25, 2010.

3.2 Gabion Assessment

The gabion mat structure substantially covers the area immediately along the toe of the North Landing Wharf. The nature of the substrate under the gabions is not known. The east end of the gabions was measured to be located approximately 3.0 metres west of lead line 11. The west end of the gabions is located approximately 1.2 m east of lead line 1. Lead line 1 marked the west corner of the north landing wharf. This implies an overall gabion mat structure lateral extent of approximately 238.3 m (1.7 metres less than the level end-to-end length of 40 individual 6 m mats).

The gabions are constructed of a plastic coated hexagonal wire mesh similar in appearance to chain-link fencing. The mesh apertures were measured during the dive survey to be approximately 80 mm, which is consistent with the specifications. The rocks inside the gabions were measured to have an average diameter of approximately 170 mm, consistent with the specification. The mats were measured to be approximately 3 m wide. Individual mats of approximately 6 m in length have been wired together. In several locations along the gabions, filter cloth was observed to protrude from beneath the gabions at the crest and toe.

The gap between the gabion crest and the wall was measured at each lead line; the measurements are included in Appendix B. The gap was measured to range between approximately 0.2 to 0.6 m. The width of the gabions from the north landing wharf wall was measured at each lead line; the measurements are included in Appendix B. The distance between the wall and the toe of the gabions was measured to be between approximately 2.8 and 3.4 m. The height of the gabions above the sediment at the toe was measured at each lead line; the measurements are included in Appendix B. The exposed height of the toe of the gabions was measured to range between approximately 0.00 (buried) and 0.25 m.

The toe of the gabions was observed by the dive crew to be buried in the sediment in some areas and slightly undermined in others, indicating locally variable net erosion and accretion of sediment. Observations by the divers, including probing, suggests that the area between the crest of the gabion mats and the wall of the north landing wharf is substantially underlain by concrete, rip-rap or similar hard substrate. Probing indicated a hard substrate under not more than 10 cm of sediment at the crest of the gabions in most locations.

3.3 Chemical Characterisation

The results from sediment chemistry analysis are presented in Appendix D. Samples from all five locations (DC10-01 through DC10-05) exceeded the CCME Probable Effects Limit (PEL) criteria for marine sediments.

Sample exceedences are as follows:

- Sample DC10-01 exceeded the PEL for arsenic, copper, lead, mercury, zinc, PCB-1254 (arochlor) and exceeded 10x the PEL for total polychlorinated biphenyls (PCBs).
- Sample DC10-02 exceeded the PEL for arsenic, copper, lead, mercury, PCB-1254 (arochlor) and exceeded 10x the PEL for zinc.
- Sample DC10-03 exceeded the PEL for cadmium and exceeded 10x the PEL for arsenic, copper, lead and zinc.
- Sample DC10-04 exceeded the PEL for cadmium, lead and mercury and exceeded 10x the PEL for arsenic, copper and zinc.
- Sample DC10-05 exceeded the PEL for copper, lead, mercury, zinc and total PCBs and exceeded 10x the PEL for arsenic.

3.4 Geotechnical Characterisation

Two samples (DC10-01 and DC10-05) were submitted for grain size analysis at the Golder geotechnical lab in Victoria, BC. The results of the grain size analysis indicate sediments near the gabion toe are composed primarily of gravel size (DC10-05) and/or sand size (DC10-01) particles. Sieve analysis tables and grain size distribution figures are included in Appendix F. The coarse nature of the sediments in the vicinity of the gabion mats creates a relatively unsuitable environment for diver piston cores.

3.5 Overburden Probing

Divers probed 14 locations in total. Penetration depths for the overburden probing are included in Appendix E. Probing locations are illustrated on Figure 1. Probing attempts at the gabion crest resulted in refusal of the probe at a maximum penetration depth of 0.05 m.

At approximately 5 probe locations, divers reported hitting what they believed to be solid rock. In most cases, divers found it difficult to determine the source of probe refusal. Refusal due to hard substrate and gravel were also reported by divers. Additional probes within 1 m of the original probe location were carried out to check the penetration depth of the refusal.

A summary table of overburden probe penetration results is presented in Table 3.

Table 3: Overburden Probe Penetration Summary

Location	Maximum penetration (m)	Minimum Penetration (m)	Average Penetration (m)
Gabion toe (Approximately 3 m from gabion crest)	1.81	0.15	0.88
6 m (along transect from gabion crest)	2.02	0.2	1.14
9 m (along transect from gabion crest)	1.23	0.23	0.87

Penetration depth was calculated by subtracting the exposed length of probe at refusal (a direct measurement using a fibreglass tape measure) from the initial probe length (also a direct measurement using a fibreglass tape measure).

Maximum and minimum probe penetration depths along the gabion toe were 1.81 m and 0.15 m, respectively with an average probe penetration of 0.88 m. Penetration depths at a distance of 6 m from the gabion crest (along transect) were 2.02m (maximum) and 0.2 m (minimum) with an average probe penetration of 1.14 m. The maximum and minimum probe penetration at a distance of 9 m the gabion crest were 1.23 m and 0.23 m, respectively, with an average penetration of 0.87 m.

Based on diver observations and the varied depth of refusal, it is inferred that the subgrade contains cobbles or boulders that prevent probe penetration. Overall, on the order of one metre of penetration was achieved towards the east (the dock mouth). Probe results from the transect at lead line 2 (to the west) indicate somewhat less penetration (on the order of 0.2 to 0.8 m).

4.0 DISCUSSION

Figure 1 summarises the assessment of gabion position and probing locations.

Based on diver observations, the gabions appear to be substantially consistent with the terms of the specifications provided to Golder for review. They are approximately 3 metres wide, and are relatively gently sloped downwards away from the toe of the wall (10 to 35 degrees, typically 15 to 20 degrees). The crest of the gabions is at an average elevation of about -9.52 m (relative to chart datum). The gap between the crest of the gabion mats and the North Landing Wharf wall was measured to range between approximately 0.2 to 0.6 m. The total measured lateral extent of the gabion structure along the North Landing Wharf was approximately 238.3 metres. No major areas of damage or displacement were visually apparent. Although areas are covered with up to approximately 0.1 m of soft sediments, the gabions' upper surface remains substantially exposed.

Diver observations and probing results indicate the space between the gabions and the wall of the North Landing Wharf is filled with hard material, possibly concrete, under a thin (5 to 10 cm) veneer of loose material.

Contamination in sediments around the gabions is consistent with waterlot contamination described elsewhere. Individual exceedences of 10 times the CCME PEL for substances such as arsenic, copper, lead, zinc and PCBs were detected in sediment samples.

Sediment in the vicinity of the gabions appears to be substantially gravels and sands. Probe penetration was limited by hard substrate, potentially either rubble or bedrock. The achieved penetration was variable throughout the site, to a maximum of approximately 2 m.

The observation of gravel and rubble is consistent with the account of North Landing Wharf construction given in the article "*The New Esquimalt Drydock*" by J.P. Forde, published in the Journal of the engineering Institute of Canada in December of 1925:

> *"…The site for this wharf was dredged to the rock bottom of the harbour, which lies at an average depth of 54*[2] *feet below low water level. Along this dredged area was built a rubble mound to a height of 32 feet below low water level*[3]*. The upper 12 inches of this mound consists of fine spawls and gravel and was levelled by means of a heavy steel beam dragged over it at the proper level by tugs. After an inspection by a diver and very close soundings indicated had shown that the top of the mound was level and that no low spots had been left, timber cribs with reinforced concrete outer surfaces were placed and ballasted with gravel…"*

With regard to measurement accuracy, note that the underwater use of fibreglass tape measures is prone to more error than top-side work under more amenable conditions. Based on studies of underwater archaeological surveys[4], Golder anticipates that a standard error of 25 mm or more is possible, and that up to 20% of diver reported measurements may be substantially in error (*i.e.*, diver may read off the wrong numeral). The inclinometer used for underwater work was selected for visibility and for ease of use wearing cold water gloves. It is estimated to be accurate to within +/- 5 degrees. Diver depth measurements by pneumofathometer using the KMACS air control box are accurate to within approximately +/- 150 mm.

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[2] 16.46 metres

[3] *i.e.*, about 9.75 metres below low-low water.

[4] Holt, Peter. 2003. "An Assessment of Quality in Underwater Archaeological Surveys Using Tape Measurements". The International Journal of Nautical Archaeology (2003) 32.2: 246-25 1

Golder compared measurements, referred to the video survey and plotted results to attempt to identify outlying data. Based on this assessment, the interpolation between measurement points, the roughness of the paths traversed by the tape, and the potential positional error related to simultaneous error in length, depth and/or slope, Golder suggests that recorded positions should be considered approximate. For example, for probe points 9 metres from the North Landing Wharf Wall, simultaneous bearing, inclinometer and tape measure errors could lead to a lateral error on the order of 1 meter. Overall, the potential lateral error at the gabion toe is on the order of 0.3 meters. For operations with a risk of gabion mat damage, such as excavation, a design safety margin of 0.5 metres or more may be advisable at the indicated gabion toe. In light of potential positional error and the documented historic movement of the gabions because of extreme propwash, local soundings or diver inspection should be considered shortly before beginning potentially destructive operations.

5.0 CLOSURE

We trust that the above meets your requirements and sincerely appreciate the opportunity to be of service. Please do not hesitate to contact the undersigned with any questions or comments.

Yours very truly,

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Rachael Jones, B.Sc.
Environmental Scientist

ORIGINAL SIGNED

Pete Craig, M.Sc.
Environmental Scientist

Reviewed By:

ORIGINAL SIGNED

Tim Whalen, M.Sc., P.Eng.
Associate

RJ/RPC/TW/kar/smh

Attachments Figures, Appendices

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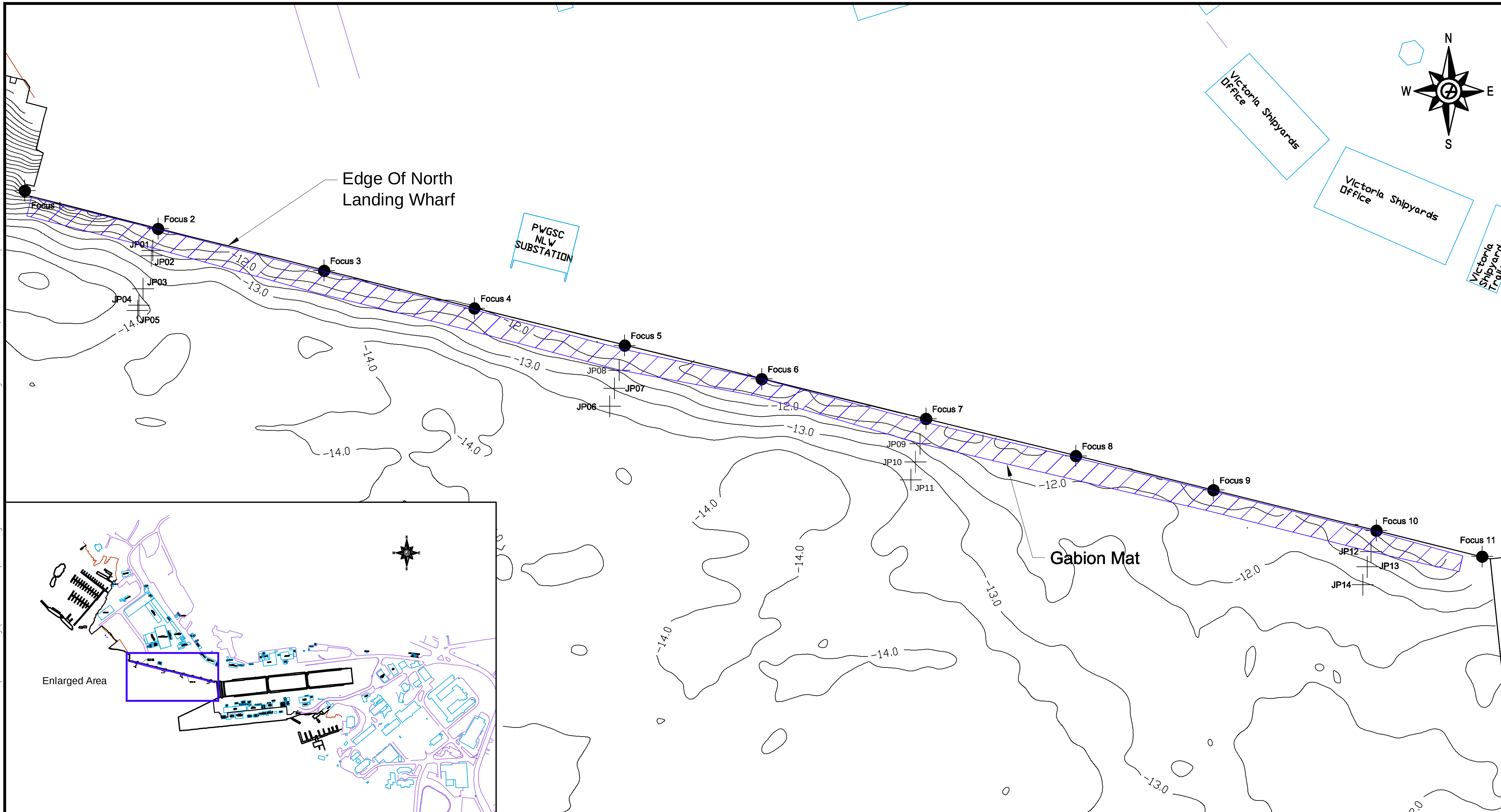
FIGURES



LEGEND

Focus x — Control Points (Focus 2010)

JPxx — Jet Probes (Golder 2010)

—1.0— Bathymetric Contours (Geodetic)

REFERENCE

Base map provided by Public Works and Government Services Canada

10 0 10

SCALE METRES

PROJECT

PWGSC
GABION SURVEY
ESQUIMALT GRAVING DOCK, ESQUIMALT, B.C.

TITLE

GABION MAT AND JET PROBE LOCATION PLAN

Golder Associates
Victoria, BC

PROJECT No. 09-1475-0026			FILE No. P09147500266000-02
DESIGN	NG	22 MAR 10	SCALE AS SHOWN REV. 0
CADD	CLF	26 MAR 10	
CHECK	SEM	27 OCT 10	FIGURE 1
REVIEW	JF	27 OCT 10	

N:\Active\2009\1475\09-1475-0026 PWGSC EGD Waterlot PSI DSI\Vic Drafting\Phase 6000\ Drawing file: P09147500266000-01.dwg Oct 28, 2010 - 1:48pm

APPENDIX A

Reference Locations Surveyed by Focus
Esquimalt Graving Dock, Esquimalt, B.C

Focus Location	Northing	Easting	Elevation (geodetic)	Flagging	Measured Depth (m) below pin	Measured Elevation (m geodetic)	Measured Elevation (m chart)	Measured Elevation (m facility datum)
1	5364971.329	468153.449	2.52	4 X black and yellow	13.01	-10.49	-8.62	-8.74
2	5364965.189	468174.961	2.84	2 X red and 2X black and yellow	14.33	-11.49	-9.62	-9.74
3	5364958.430	468201.748	2.89	4 X red	14.27	-11.38	-9.51	-9.63
4	5364952.356	468226.012	2.84	1 X yellow and 3 X red	14.89	-12.05	-10.18	-10.30
5	5364946.363	468250.267	2.88	2 X yellow and 2 X red	14.86	-11.98	-10.11	-10.23
6	5364940.945	468272.376	2.92	3 X yellow and 1 X red	13.85	-10.93	-9.06	-9.18
7	5364934.527	468298.897	2.93	4 X yellow	15.05	-12.12	-10.25	-10.37
8	5364928.532	468323.083	2.96	1 X red and white and 3 X yellow	14.48	-11.52	-9.65	-9.77
9	5364923.030	468345.285	2.97	2 X red and white and 2 X yellow	14.04	-11.06	-9.19	-9.31
10	5364916.494	468371.578	2.97	3 X red and white and 1 X yellow	13.73	-10.76	-8.89	-9.01
11	5364912.300	468388.651	2.97	4 X red and white	14.46	-11.48	-9.61	-9.73

Notes:
Chart Elevation = Geodetic Elevation + 1.87 m
Facility Datum Elevation = Geodetic Elevation + 1.75 m
Significant figures are as reported in field notes and subcontractor deliverables
Tape measure measurement using lead ball weight on varying bottom conditions on wall of varying plumbness introduces additional error

APPENDIX B

Summary of Diver Measurements from Diver Video Survey
Esquimalt Graving Dock, Esquimat, B.C.

Lead Line	Diver Depth pneumo (metres / feet)	Gap between gabion and wall (metres / inches)	Slope of Gabions (deg)	Toe height, off harbour floor (metres / inches)	Notes
1	-	-	-	-	
West End	11.0 m / 36'	0.2 m / 8"	30 - 35 (south)	0.23 m / 9"	west end of gabions, approximately 1.2 m east of Lead Line 1
2	10.5 m / 34.5'	0.18 m / 7"	10 - 15 (south)	0.18 m / 7"	
3	10.5 m / 34.5'	0.25 - 0.3 m / 10" to 12"	10 - 15 (south)	0.18 m / 7"	
4	11.0 m / 36'	0.3 m / 24"	10 - 15 (south)	0.15 m / 6"	
5	10.7 m / 35'	0.76 m / 30"	20 (north)	0.25 m / 10"	gabion mats are lower in the middle
6	9.9 m / 32.5'	0	10 - 15 (south)	0.13 m / 5"	
7	10.7 m/ 35'	0.61 m / 24"	20 (north), 10 (south)	0.18 m / 7"	gabion mats are higher in the middle
8	10.1 m / 33'	0.36 m / 14"	5 (south)	0	toe flush with sediment or buried
9	9.8 m/ 32'	0.2 m / 8"	10 - 15 (south)	0.18 m / 7"	
10	9.6 m/ 31.5'	0.25 m / 10"	10 - 15 (south)	0.18 m / 7"	
East End	-	0.61 m / 24"	15 - 20 (south)	0.1 m / 4"	Gabion measures at east end of gabions, approximately 3 m west of 11
11	-	-	-	-	

Notes:
Significant figures are as reported in field notes and subcontractor deliverables

Gabion Video Survey Observations
Esquimalt Graving Dock, Esquimalt, B.C.

Date	Time	Lead Line Reference	Surface Marker	Length to Marker (m)	Gabion Width (m)	Probe Penetration at Gabion Toe (metres / inches)	Notes on Probing at Toe	Probe Penetration between Wall and Gabions (metres / inches)	Notes on Probing at Wall
3-Mar-10	13:20	West End of Gabions	1	15.23	3.28	0.15 m / 6"	some rocks encountered with probe, some full penetration	full penetration	some full penetration, some shallow sediment over concrete, filter cloth againts wall with poured cement underneath
			2	26.38		0.66 m / 26"		0.02 m / 1"	
			3	51.41				0	
			Gabion Assessment Comments	At station 2 gap between gabion and wall is 0.17 metres (7 inches), slope of gabion is 10-15 degrees down and away from wall, toe of gabion is 0.17 metres (7 inches) thick; west of station 2 is a wired seam between two gabions, toe is exposed with filter cloth showing; further west is another 2 wired seams; further west - the end of the gabions with filter cloth showing, gabions stop approx 1.2 metres (4 feet) before end of wall, gap between the gabion and the wall is 0.2 metres (8 inches), slope is 30-35 degrees down and away from wall, gabion is 0.22 metres (9 inches) thick on side of gabion, filter cloth extends past last gabion and wraps overtop at the toe of the last gabion; around corner of wall no gabions are visible, large rocks and debris past the gabions and around the corner of the wall.					
	13:45	2	1	27	3	0.25m / 10"	feels rocky, filter cloth along the wall, not full penetration	0	filter cloth overtop of cement
			2	14.9		0.2m / 8"		0.05 m / 2"	gabion mat wires are plastic coated
			3	31.23					
			Gabion Assessment Comments	At station 3 gap between the gabion and the wall is 0.25 to 0.3 metres (10 to 12 inches), slope of the gabion is 10-15 degrees down and away from wall, toe of the gabion is 0.17 metres (7 inches), further west from station 3 a seam between two gabions has been wired together and rocks have been placed between the two gabions, top mesh of gabion is mounded in the centre, sloping down on either side towards the wall and towards the harbour; further west - another seam between two gabions wired together.					
	14:00	3	2	31.08	3.42	0.2 m/ 8"	some large stones on surface	solid	few inches of seidment over concrete, not so much filter cloth at this location but does come up over concrete
			3	14.935		0.12m/ 5"		min. penetration	
			4	29.44		0.33 m/ 13"			
						0.66 m/ 26"			
			Gabion Assessment Comments	At station 4 the mesh wire of the gabion is covered with sediment, gabion is approx 0.3 metres (12 inches) from wall, gabion is sloping down and away from wall at 10-15 degrees, toe of gabion is exposed 0.15 metres (6 inches), possible old ship fenders just past toe of the gabions with large stones in front of the fenders, toe of the gabion is undercut; further west, near station 3 - the top mesh of the gabion is exposed.					
	15:12	4	3	29.58	3.1	0.35 m / 14"	solid bottom, possibly rocks	0.07 m / 3"	mud with rocks under the mud
			4	15.48		0.07 m / 3"		0.3 m / 12"	
			5	29.42					
			Gabion Assessment Comments	At station 5, filter cloth exposed near wall, a gap of 0.76 metres (2.5 feet) covered with sediment between gabion and wall, gabion is sloping down and into wall at 20 degrees, gabion is undercut at toe with filter cloth exposed - 0.25 metres (10 inches) from sea floor to top of gabion - gabion is 0.17 metres (7 inches) thick at toe; further west - two gabions stitched together with wire and minor undercutting in the area of the seam, filter cloth is exposed; further along - gabion is buried near the wall and at the toe.					
	15:36	5	4	29.9	2.9	0.66 m / 26"	no resistance	0	filter cloth comes up by the wall, concrete as been poured between the wall and the gabions
			5	14.93					
			6	27.14					
			Gabion Assessment Comments	At station 6 - 10" gap between gabion and wall filled with concrete, 10-15 degree slope of gabion down and away from wall, toe of gabion is exposed 6", gabions slightly covered with sediment but toe is still visible; further west - gap between gabion and wall is filled with sediment; further west - a seam between two gabions- coated wire has come loose near the toe but still intact near wall.					
	15:46	6	5	27.02	3	0.66 m / 26"	full penetration, some rocks	min. penetration	small layer of sediment over concrete
			6	14.7		0.15 m / 6"			
			7	31.09					
			Gabion Assessment Comments	Rebar frame at station 7 near wall is not connected to gabion mesh (Could be a separate bar), approx 0.6 metres (2 feet) between gabion and wall, gabion has a peak at the centre with a slope of 10 degrees down and away from wall, and 20 degrees down and into wall, toe of gabion is 0.17 metres (7 inches); approximately midway between Station 7 and 6 - space between gabion and wall is filled in with concrete with sediment above concrete, filter cloth is visible against wall, top of gabion and rocks fully exposed; further along a seam stitched together connecting two gabions.					

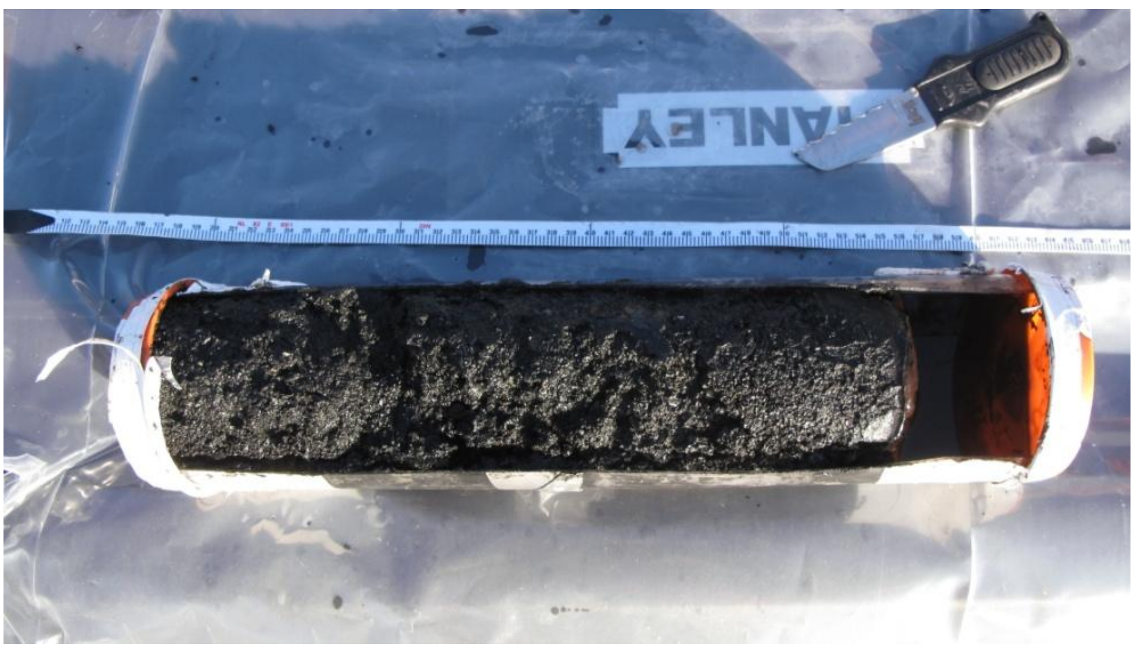
Notes:
Significant figures are as reported in field notes and subcontractor deliverables

Date	Time	Lead Line Reference	Surface Marker	Length to Marker (m)	Gabion Width (m)	Probe Penetration at Gabion Toe (metres / inches)	Notes on Probing at Toe	Probe Penetration between Wall and Gabions (metres / inches)	Notes on Probing at Wall
4-Mar-10	9:45	7	6	30.85	3.02	0.25 m	full penetration (1.0 m)	0.1 m	solid underneath, cement?
			7	15.15		1.0 m			
			8	29.52					
			Gabion Assessment Comments	At Station 8 gabion is buried near wall, approx 0.35 metre (14 inch) gap between gabion and wall, slope of gabion is 5 degrees down and away from wall, toe of gabion is buried; midway between Station 8 and 7 - concrete poured over gabion into a gap within the gabion, toe of gabion is exposed, gap between gabion and wall is 0.3 metres (12 inches); further west - another seam between gabions approx 0.2 metres (8 inches) wide, coated wire used to stitch gabion in place, gabion near wall is buried; furhter west - gabions are sloped into the wall.					
	-	8	7	29.13	3.16	1.0 m	some gravel felt	0	no penetration
			8	15.19		0.74 m			
			9	27.53		0.87 m			
		From Station 9 to Station 8	Gabion Inspection Comments	At station 9 slope of gabion is 10 to 15 degrees down and awy from wall, gap between gabion and wall is 0.2 metres (8 inches), sediment and shell debris filling in gabion, gabion toe is 0.17 metres (7 inches); midway between station 9 and 8 seam between two gabions, no gap between gabions at seam, filter cloth exposed between gabions, gabion toe is at same level as sea floor and/or buried in spots.					
	-	9	8	27.25	3.12	0.15 m	probe at 1 m offshore of gabion toe : 0.83 m, 0.8 m, 0.85 m	0	no penetration
			9	14.9		0.03 m			
			10	30.93		0.6 m			
			Gabion Inspection Comments	At station 10 there is a 0.25 metre (10 inch) gap between the gabion and wall, gabion toe height is approximately 0.05 metre (2 inch), slope is 15 degrees down and away from wall, rock inside gabion is approx 0.17 metrea (7 inches) in diameter, mesh opening is 3" in diameter; midway between station 10 and 9 there is a 0.25 to 0.3 metre (10-12 inch) gap between gabion and wall, iron rebar at toe and inner edge of gabion acting as frame of gabion, gabion covered with sediment.					
	-	10	9	30.55	3.11	0.32 m	probe at 1 m offshore of gabion toe : 0.46 m, 0.35 m, probe at 2m out from gabion toe : 0.5 m, 0.5 m	0.05 m	-
			10	14.6		0.22 m			
			11	23.9		0.35 m			
			Gabion Assessment Comments	At east end of gabion there is a 0.6 metre (2 foot) gap between gabion and wall, 15-20 degree slope down and away from wall; at midway point between station 11 and 10 gabion toe height is approx 0.1 metres (4 inches).					
	-	east end of gabions, 3.04 m west of location 11	9	43.95	2.77	-	-	-	-
			10	20.28					
			11	14.61					
	-	11	9	47.84	-	-	no gabions at this location	-	no gabions at this location
			10	22.47					
			11	14.53					

Notes:
Significant figures are as reported in field notes and subcontractor deliverables

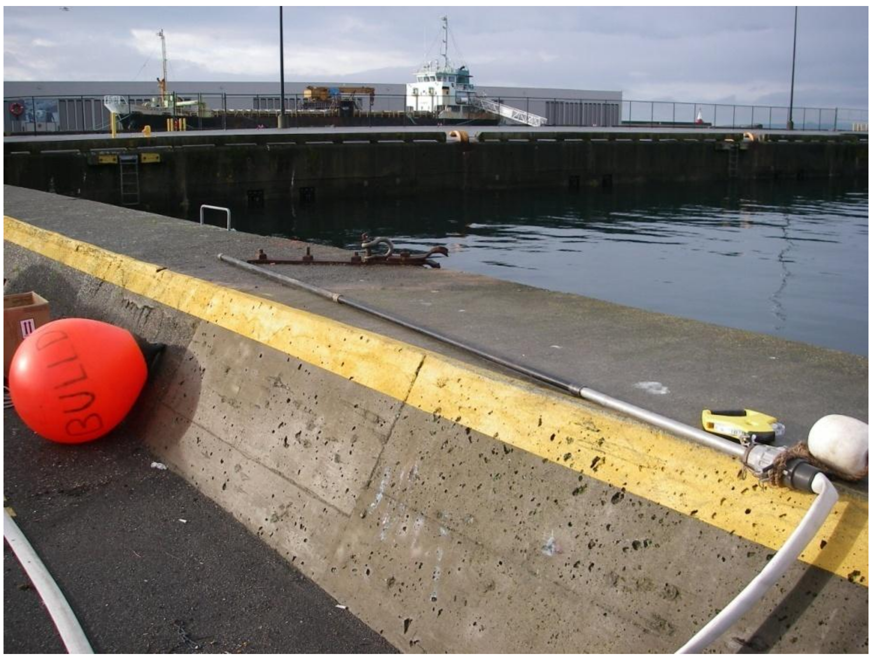
APPENDIX C

Photograph 1: Diver based piston core provided by RSS.



Photograph 2: 80 cm core retrieved using diver operated piston core.

Photograph 3: Stainless steel grab sampler provided by RSS.



Photograph 4: Jet Probe "lance" supplied by Golder Associates.

APPENDIX D

Sample Location	CCME[4] Sediment Marine PEL[5]	CSR Standards for Marine / Estuarine Sediment[2] Typical[3]	10 x PEL	DC10-01	DC10-02	DC10-03	DC10-04	DC10-05	DC10-06
Study									
Sample Control Number				21537-01	21537-02	21537-03	21537-04	21537-05	21537-06
Depth Interval below mudline (m)				0.8	0.27	0.25	0.25	0.26	0.8
Date Sampled				5-Mar-10	5-Mar-10	5-Mar-10	5-Mar-10	5-Mar-10	5-Mar-10
Sample Type				Core	Grab	Grab	Grab	Grab	Core
QA/QC									Dup
Physical Parameters									
moisture (%)				30.8	31.8	25.7	19.9	34.6	29.2
pH (pH units)				8.22	8.13	8.40	8.37	8.21	8.34
Saturated Paste Extractables									
Chloride (Cl)				5200	8900	6200	8000	7800	4930
% Saturation				38.0	44.8	32.0	38.3	47.4	50.0
Sodium (Na)				3150	4990	3270	4280	4220	2850
Total Metals									
antimony				43	114	1630	492	224	72
arsenic	**41.6**	*50.0*	416	***73.0***	***309***	***3240***	***1310***	***450***	***111***
barium				185	235	370	356	280	166
beryllium				<0.50	<0.50	0.95	0.51	<0.50	<0.50
cadmium	**4.2**	*5.0*	42	0.65	2.54	***5.16***	**4.37**	1.64	0.95
chromium (total)	**160**	*190.0*	1600	41.0	75.0	143	133	61.7	42.3
cobalt				13.0	34.8	157	67.9	33.3	15.6
copper	**108**	*130.0*	1080	***423***	***1060***	***1980***	***1660***	***603***	***447***
lead	**112**	*130.0*	1120	***219***	***319***	***2180***	***900***	***368***	***272***
mercury	**0.7**	*0.84*	7.0	***1.50***	***5.67***	0.360	**0.713**	***1.13***	***2.13***
molybdenum				8.1	22.2	139	112	46.7	13.8
nickel				25.9	32.2	52.1	75.0	33.6	30.4
selenium				<2.0	<6.0	<6.0	<4.0	<2.0	<2.0
silver				<2.0	<2.0	2.1	<2.0	<2.0	<2.0
thallium				<1.0	<1.0	1.3	<1.0	<1.0	<1.0
tin				13.9	34.8	255	102	41.4	21.1
Uranium				1.13	3.92	4.98	5.85	2.14	1.10
vanadium				73.9	59.9	64.7	62.3	53.9	72.1
zinc	**271**	*330.0*	2710	***375***	***3150***	***10000***	***4720***	***2050***	***471***
Polychlorinated Biphenyls									
PCB-1016				<0.050	<0.056	<0.050	<0.050	<0.060	<0.050
PCB-1221				<0.050	<0.056	<0.050	<0.050	<0.060	<0.050
PCB-1232				<0.050	<0.056	<0.050	<0.050	<0.060	<0.050
PCB-1242				0.063	0.138	<0.050	<0.050	<0.060	0.518
PCB-1248				<0.050	<0.056	<0.050	<0.050	<0.060	<0.050
PCB-1254 (arochlor)	**0.709**		7.09	**2.07**	**0.976**	0.069	<0.050	0.431	**1.41**
PCB-1260				<0.050	0.705	0.054	<0.050	0.094	0.626
PCB-1262				<0.050	<0.056	<0.050	<0.050	<0.060	<0.050
PCB-1268				<0.050	<0.056	<0.050	<0.050	<0.060	<0.050
polychlorinated biphenyls (PCB-total)[6]	**0.189**	*0.23*	1.89	**2.14**	*1.82*	*0.123*	<0.050	***0.525***	***2.56***

Notes:
1. Results are expressed in micrograms per gram (ug/g), unless otherwise indicated.
2. Sediment Quality Criteria (SEDQC) shown are from the BC Contaminated Sites Regulation (CSR) (B.C. Reg. 375/96, O.C. 1480/96 and M271/2004, including amendments up to B.C. Reg. 343/2008, updated January 1, 2009) standards listed for marine sediments. Criteria shown are from Schedule 9 - Generic Numerical Sediment Criteria.
3. Typical contaminated site (TCS) means a sediment site which is not a sensitive sediment site.
4. Canadian Council of Ministers of the Environment (CCME). (1999). Canadian Environmental Quality Guidelines [Update 2002]. Guidelines listed are for marine sediments.
5. PEL = Probable Effects Limit
6. PCB-total means the sum of four to seven aroclor mixtures (1016, 1221, 1232, 1242, 1248, 1254 and/or 1260) or the sum of >= 20 individual PCB congeners.

Certificate of Analysis

GOLDER ASSOCIATES LTD.
ATTN: PETE CRAIG
2640 DOUGLAS STREET
VICTORIA BC V8T 4M1

Report Date: 07-APR-10 13:34 (MT)
Version: FINAL

Lab Work Order #: L867711 **Date Received:** 09-MAR-10

Project P.O. #: NOT SUBMITTED
Job Reference: 10-1475-0001
Legal Site Desc:
CofC Numbers: 21537

Other Information:

Comments:

Dean Watt
Account Manager

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L867711-1	L867711-2	L867711-3	L867711-4	L867711-5
	Description					
	Sampled Date	05-MAR-10	05-MAR-10	05-MAR-10	05-MAR-10	05-MAR-10
	Sampled Time					
	Client ID	21537-01	21537-02	21537-03	21537-04	21537-05
Grouping	**Analyte**					
SOIL						
Physical Tests	% Moisture (%)	30.8	31.8	25.7	19.9	34.6
	pH (pH)	8.22	8.13	8.40	8.37	8.21
Saturated Paste Extractables	Chloride (Cl) (mg/kg)	5200	8900	6200	8000	7800
	% Saturation (%)	38.0	44.8	32.0	38.3	47.4
	Sodium (Na) (mg/kg)	3150	4990	3270	4280	4220
Metals	Antimony (Sb) (mg/kg)	43	114	1630	492	224
	Arsenic (As) (mg/kg)	73.0	309	3240	1310	450
	Barium (Ba) (mg/kg)	185	235	370	356	280
	Beryllium (Be) (mg/kg)	<0.50	<0.50	0.95	0.51	<0.50
	Cadmium (Cd) (mg/kg)	0.65	2.54	5.16	4.37	1.64
	Chromium (Cr) (mg/kg)	41.0	75.0	143	133	61.7
	Cobalt (Co) (mg/kg)	13.0	34.8	157	67.9	33.3
	Copper (Cu) (mg/kg)	423	1060	1980	1660	603
	Lead (Pb) (mg/kg)	219	319	2180	900	368
	Mercury (Hg) (mg/kg)	1.50	5.67	0.360	0.713	1.13
	Molybdenum (Mo) (mg/kg)	8.1	22.2	139	112	46.7
	Nickel (Ni) (mg/kg)	25.9	32.2	52.1	75.0	33.6
	Selenium (Se) (mg/kg)	<2.0	<6.0	<6.0	<4.0	<2.0
	Silver (Ag) (mg/kg)	<2.0	<2.0	2.1	<2.0	<2.0
	Thallium (Tl) (mg/kg)	<1.0	<1.0	1.3	<1.0	<1.0
	Tin (Sn) (mg/kg)	13.9	34.8	255	102	41.4
	Uranium (U) (mg/kg)	1.13	3.92	4.98	5.85	2.14
	Vanadium (V) (mg/kg)	73.9	59.9	64.7	62.3	53.9
	Zinc (Zn) (mg/kg)	375	3150	10000	4720	2050
Polychlorinated Biphenyls	PCB-1016 (mg/kg)	<0.050	<0.056	<0.050	<0.050	<0.060
	PCB-1221 (mg/kg)	<0.050	<0.056	<0.050	<0.050	<0.060
	PCB-1232 (mg/kg)	<0.050	<0.056	<0.050	<0.050	<0.060
	PCB-1242 (mg/kg)	0.063	0.138	<0.050	<0.050	<0.060
	PCB-1248 (mg/kg)	<0.050	<0.056	<0.050	<0.050	<0.060
	PCB-1254 (mg/kg)	2.07	0.976	0.069	<0.050	0.431
	PCB-1260 (mg/kg)	<0.050	0.705	0.054	<0.050	0.094
	PCB-1262 (mg/kg)	<0.050	<0.056	<0.050	<0.050	<0.060
	PCB-1268 (mg/kg)	<0.050	<0.056	<0.050	<0.050	<0.060
	Total Polychlorinated Biphenyls (mg/kg)	2.14	1.82	0.123	<0.050	0.525

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L867711-6				
	Description					
	Sampled Date	05-MAR-10				
	Sampled Time					
	Client ID	21537-06				
Grouping	**Analyte**					
SOIL						
Physical Tests	% Moisture (%)	29.2				
	pH (pH)	8.34				
Saturated Paste Extractables	Chloride (Cl) (mg/kg)	4930				
	% Saturation (%)	50.0				
	Sodium (Na) (mg/kg)	2850				
Metals	Antimony (Sb) (mg/kg)	72				
	Arsenic (As) (mg/kg)	111				
	Barium (Ba) (mg/kg)	166				
	Beryllium (Be) (mg/kg)	<0.50				
	Cadmium (Cd) (mg/kg)	0.95				
	Chromium (Cr) (mg/kg)	42.3				
	Cobalt (Co) (mg/kg)	15.6				
	Copper (Cu) (mg/kg)	447				
	Lead (Pb) (mg/kg)	272				
	Mercury (Hg) (mg/kg)	2.13				
	Molybdenum (Mo) (mg/kg)	13.8				
	Nickel (Ni) (mg/kg)	30.4				
	Selenium (Se) (mg/kg)	<2.0				
	Silver (Ag) (mg/kg)	<2.0				
	Thallium (Tl) (mg/kg)	<1.0				
	Tin (Sn) (mg/kg)	21.1				
	Uranium (U) (mg/kg)	1.10				
	Vanadium (V) (mg/kg)	72.1				
	Zinc (Zn) (mg/kg)	471				
Polychlorinated Biphenyls	PCB-1016 (mg/kg)	<0.050				
	PCB-1221 (mg/kg)	<0.050				
	PCB-1232 (mg/kg)	<0.050				
	PCB-1242 (mg/kg)	0.518				
	PCB-1248 (mg/kg)	<0.050				
	PCB-1254 (mg/kg)	1.41				
	PCB-1260 (mg/kg)	0.626				
	PCB-1262 (mg/kg)	<0.050				
	PCB-1268 (mg/kg)	<0.050				
	Total Polychlorinated Biphenyls (mg/kg)	2.56				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-PASTE-COLOR-VA	Soil	Chloride in paste by Colourimetric	SOIL SAMPLING AND METHODS OF ANALYSIS

This analysis is adapted from the methods outlined in "Soil Sampling and Methods of Analysis" by M. Carter. In summary, 200 to 500 grams of sample is extracted for a minimum of 4 hours with an amount of deionized water as required to create a saturated paste. The sample is then filtered or centrifuged and decanted to produce an extract that is ready for analysis.

HG-CCME-CVAFS-VA	Soil	CVAFS Hg in Soil (CCME)	BCMELP CSR SALM METHOD 8/EPA 245.7

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry (EPA Method 7000 series).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MET-CSR-FULL-ICP-VA	Soil	Metals in Soil by ICPOES (CSR SALM)	BCMELP CSR SALM METHOD 8

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MOISTURE-VA	Soil	Moisture content	ASTM METHOD D2974-00

This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.

PCB-SE-ECD-VA	Soil	PCB by Extraction with GCECD	EPA 3630/8082 GCECD

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Methods 3500, 3620, 3630, 3660, 3665 & 8082, published by the United States Environmental Protection Agency (EPA). The procedure involves a solid-liquid extraction of a subsample of the sediment/soil using a mixture of hexane and acetone. Water is added to the extract and the resulting hexane extract undergoes one or more of the following clean-up procedures (if required): florisil clean-up, silica gel clean-up, sulphur clean-up and/or sulphuric acid clean-up. The final extract is analysed by capillary column gas chromatography with electron capture detection (GC/ECD).

PH-1:2-VA	Soil	CSR pH by 1:2 Water Leach	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

SAR-CALC-MGKG-ICP-VA	Soil	Saturated Paste Extraction (ICPOES)	BCMELP/EPA SW-846 6010B

Saturated paste sediment extracts are analyzed for metals by inductively coupled plasma optical emission spectrophotometry (EPA Method 6010B). Reported metals results have been converted into milligrams per dry kilogram. Sodium Adsorption Ratio (SAR) is calculated from the Sodium, Calcium, and Magnesium concentrations in the saturated paste extract of a sediment sample. The SAR calculation is described in "Soil Sampling and Methods of Analysis" by M. Carter.

TL-CSR-MS-VA	Soil	ICPMS Tl in Soil by CSR SALM	BCMELP CSR SALM Method 8

This analysis is carried out using procedures from CSR Analytical Method 8 "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, Lands and Parks, 26 June 2001, and procedures adapted from "Test Methods for Evaluating Solid Waste", SW-846 Method 3050B United States Environmental Protection Agency (EPA). The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 90 degrees Celsius for 2 hours by either hotplate or block digester using a 1:1 ratio of concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

U-200.2-MS-VA	Soil	Uranium in Soil by ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may

Reference Information

be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS LABORATORY GROUP - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

21537

GLOSSARY OF REPORT TERMS

Surrogate A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg milligrams per kilogram based on dry weight of sample.
mg/kg wwt milligrams per kilogram based on wet weight of sample.
mg/kg lwt milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L milligrams per litre.
< - Less than.
D.L. The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as receieved by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Laboratory Group Quality Control Report

Workorder: L867711 Report Date: 07-APR-10

Client: GOLDER ASSOCIATES LTD.
2640 DOUGLAS STREET
VICTORIA BC V8T 4M1

Contact: PETE CRAIG

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-PASTE-COLOR-VA	**Soil**							
Batch R1210605								
WG1077919-1 MB								
Chloride (Cl)			<10		mg/L		10	16-MAR-10
WG1079260-1 MB								
Chloride (Cl)			<10		mg/L		10	16-MAR-10
HG-CCME-CVAFS-VA	**Soil**							
Batch R1209421								
WG1077231-3 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			108		%		70-130	15-MAR-10
WG1077231-4 CRM		**VA-NRC-PACS2**						
Mercury (Hg)			113		%		70-130	15-MAR-10
WG1077231-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	15-MAR-10
WG1077231-2 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	15-MAR-10
Batch R1209682								
WG1077231-10 CRM		**VA-NRC-PACS2**						
Mercury (Hg)			112		%		70-130	15-MAR-10
WG1077231-9 CRM		**VA-CANMET-TILL1**						
Mercury (Hg)			103		%		70-130	15-MAR-10
WG1077231-8 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	15-MAR-10
Batch R1210612								
WG1077231-7 DUP		**L867711-3**						
Mercury (Hg)		0.360	0.404		mg/kg	11	30	16-MAR-10
MET-CSR-FULL-ICP-VA	**Soil**							
Batch R1209429								
WG1077231-10 CRM		**VA-NRC-PACS2**						
Arsenic (As)			26.6		mg/kg		13.3-33.3	12-MAR-10
Barium (Ba)			71		%		70-130	12-MAR-10
Cadmium (Cd)			2.16		mg/kg		0.98-2.98	12-MAR-10
Chromium (Cr)			106		%		70-130	12-MAR-10
Cobalt (Co)			8.3		mg/kg		4.8-12.8	12-MAR-10
Copper (Cu)			114		%		70-130	12-MAR-10
Lead (Pb)			100		%		70-130	12-MAR-10
Molybdenum (Mo)			5.2		mg/kg		0-12.6	12-MAR-10
Nickel (Ni)			97		%		70-130	12-MAR-10

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-CSR-FULL-ICP-VA	**Soil**							
Batch R1209429								
WG1077231-10 CRM		**VA-NRC-PACS2**						
Tin (Sn)			18.3		mg/kg		9.1-29.1	12-MAR-10
Vanadium (V)			108		%		70-130	12-MAR-10
Zinc (Zn)			98		%		70-130	12-MAR-10
WG1077231-9 CRM		**VA-CANMET-TILL1**						
Arsenic (As)			17.3		mg/kg		5.4-25.4	12-MAR-10
Barium (Ba)			118		%		70-130	12-MAR-10
Beryllium (Be)			0.51		mg/kg		0-1.54	12-MAR-10
Chromium (Cr)			108		%		70-130	12-MAR-10
Cobalt (Co)			105		%		70-130	12-MAR-10
Copper (Cu)			112		%		70-130	12-MAR-10
Nickel (Ni)			18.5		mg/kg		7.4-27.4	12-MAR-10
Vanadium (V)			108		%		70-130	12-MAR-10
Zinc (Zn)			99		%		70-130	12-MAR-10
WG1077231-7 DUP		**L867711-3**						
Antimony (Sb)		1630	1680		mg/kg	2.9	30	12-MAR-10
Arsenic (As)		3240	3470		mg/kg	6.9	30	12-MAR-10
Barium (Ba)		370	422		mg/kg	13	30	12-MAR-10
Beryllium (Be)		0.95	0.92	J	mg/kg	0.03	2	12-MAR-10
Cadmium (Cd)		5.16	5.65		mg/kg	9.0	30	12-MAR-10
Chromium (Cr)		143	180		mg/kg	23	30	12-MAR-10
Cobalt (Co)		157	167		mg/kg	6.4	30	12-MAR-10
Copper (Cu)		1980	2130		mg/kg	7.4	30	12-MAR-10
Lead (Pb)		2180	2590		mg/kg	17	30	12-MAR-10
Molybdenum (Mo)		139	164		mg/kg	16	30	12-MAR-10
Nickel (Ni)		52.1	60.6		mg/kg	15	30	12-MAR-10
Selenium (Se)		<6.0	<6.0	RPD-NA	mg/kg	N/A	30	12-MAR-10
Silver (Ag)		2.1	2.3	J	mg/kg	0.2	8	12-MAR-10
Tin (Sn)		255	275		mg/kg	7.7	30	12-MAR-10
Vanadium (V)		64.7	62.9		mg/kg	2.7	30	12-MAR-10
Zinc (Zn)		10000	10600		mg/kg	5.7	30	12-MAR-10
WG1077231-8 MB								
Antimony (Sb)			<10		mg/kg		10	12-MAR-10
Arsenic (As)			<5.0		mg/kg		5	12-MAR-10
Barium (Ba)			<1.0		mg/kg		1	12-MAR-10
Beryllium (Be)			<0.50		mg/kg		0.5	12-MAR-10

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-CSR-FULL-ICP-VA	**Soil**							
Batch R1209429								
WG1077231-8 MB								
Cadmium (Cd)			<0.50		mg/kg		0.5	12-MAR-10
Chromium (Cr)			<2.0		mg/kg		2	12-MAR-10
Cobalt (Co)			<2.0		mg/kg		2	12-MAR-10
Copper (Cu)			<1.0		mg/kg		1	12-MAR-10
Lead (Pb)			<30		mg/kg		30	12-MAR-10
Molybdenum (Mo)			<4.0		mg/kg		4	12-MAR-10
Nickel (Ni)			<5.0		mg/kg		5	12-MAR-10
Selenium (Se)			<2.0		mg/kg		2	12-MAR-10
Silver (Ag)			<2.0		mg/kg		2	12-MAR-10
Tin (Sn)			<5.0		mg/kg		5	12-MAR-10
Vanadium (V)			<2.0		mg/kg		2	12-MAR-10
Zinc (Zn)			<1.0		mg/kg		1	12-MAR-10
Batch R1209538								
WG1077231-3 CRM		**VA-CANMET-TILL1**						
Arsenic (As)			17.2		mg/kg		5.4-25.4	12-MAR-10
Barium (Ba)			108		%		70-130	12-MAR-10
Beryllium (Be)			0.49		mg/kg		0-1.54	12-MAR-10
Chromium (Cr)			114		%		70-130	12-MAR-10
Cobalt (Co)			108		%		70-130	12-MAR-10
Copper (Cu)			108		%		70-130	12-MAR-10
Nickel (Ni)			18.0		mg/kg		7.4-27.4	12-MAR-10
Vanadium (V)			109		%		70-130	12-MAR-10
Zinc (Zn)			100		%		70-130	12-MAR-10
WG1077231-4 CRM		**VA-NRC-PACS2**						
Arsenic (As)			25.8		mg/kg		13.3-33.3	12-MAR-10
Barium (Ba)			106		%		70-130	12-MAR-10
Cadmium (Cd)			2.30		mg/kg		0.98-2.98	12-MAR-10
Chromium (Cr)			105		%		70-130	12-MAR-10
Cobalt (Co)			9.0		mg/kg		4.8-12.8	12-MAR-10
Copper (Cu)			108		%		70-130	12-MAR-10
Lead (Pb)			103		%		70-130	12-MAR-10
Molybdenum (Mo)			5.3		mg/kg		0-12.6	12-MAR-10
Nickel (Ni)			102		%		70-130	12-MAR-10
Tin (Sn)			17.6		mg/kg		9.1-29.1	12-MAR-10
Vanadium (V)			109		%		70-130	12-MAR-10

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-CSR-FULL-ICP-VA	**Soil**							
Batch R1209538								
WG1077231-4 CRM		**VA-NRC-PACS2**						
Zinc (Zn)			101		%		70-130	12-MAR-10
WG1077231-1 MB								
Antimony (Sb)			<10		mg/kg		10	12-MAR-10
Arsenic (As)			<5.0		mg/kg		5	12-MAR-10
Barium (Ba)			<1.0		mg/kg		1	12-MAR-10
Beryllium (Be)			<0.50		mg/kg		0.5	12-MAR-10
Cadmium (Cd)			<0.50		mg/kg		0.5	12-MAR-10
Chromium (Cr)			<2.0		mg/kg		2	12-MAR-10
Cobalt (Co)			<2.0		mg/kg		2	12-MAR-10
Copper (Cu)			<1.0		mg/kg		1	12-MAR-10
Lead (Pb)			<30		mg/kg		30	12-MAR-10
Molybdenum (Mo)			<4.0		mg/kg		4	12-MAR-10
Nickel (Ni)			<5.0		mg/kg		5	12-MAR-10
Selenium (Se)			<2.0		mg/kg		2	12-MAR-10
Silver (Ag)			<2.0		mg/kg		2	12-MAR-10
Tin (Sn)			<5.0		mg/kg		5	12-MAR-10
Vanadium (V)			<2.0		mg/kg		2	12-MAR-10
Zinc (Zn)			<1.0		mg/kg		1	12-MAR-10
WG1077231-2 MB								
Antimony (Sb)			<10		mg/kg		10	12-MAR-10
Arsenic (As)			<5.0		mg/kg		5	12-MAR-10
Barium (Ba)			<1.0		mg/kg		1	12-MAR-10
Beryllium (Be)			<0.50		mg/kg		0.5	12-MAR-10
Cadmium (Cd)			<0.50		mg/kg		0.5	12-MAR-10
Chromium (Cr)			<2.0		mg/kg		2	12-MAR-10
Cobalt (Co)			<2.0		mg/kg		2	12-MAR-10
Copper (Cu)			<1.0		mg/kg		1	12-MAR-10
Lead (Pb)			<30		mg/kg		30	12-MAR-10
Molybdenum (Mo)			<4.0		mg/kg		4	12-MAR-10
Nickel (Ni)			<5.0		mg/kg		5	12-MAR-10
Selenium (Se)			<2.0		mg/kg		2	12-MAR-10
Silver (Ag)			<2.0		mg/kg		2	12-MAR-10
Tin (Sn)			<5.0		mg/kg		5	12-MAR-10
Vanadium (V)			<2.0		mg/kg		2	12-MAR-10
Zinc (Zn)			<1.0		mg/kg		1	12-MAR-10

ALS Laboratory Group Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MOISTURE-VA	**Soil**							
Batch R1207386								
WG1077122-2 DUP		**L867711-4**						
% Moisture		19.9	18.4		%	7.8	30	10-MAR-10
PCB-SE-ECD-VA	**Soil**							
Batch R1209583								
WG1077208-2 CRM		**VA-CRM911-050**						
Total Polychlorinated Biphenyls			77		%		65-130	10-MAR-10
PCB-1254			77		%		65-130	10-MAR-10
WG1077208-1 MB								
Total Polychlorinated Biphenyls			<0.050		mg/kg		0.05	10-MAR-10
PCB-1016			<0.050		mg/kg		0.05	10-MAR-10
PCB-1221			<0.050		mg/kg		0.05	10-MAR-10
PCB-1232			<0.050		mg/kg		0.05	10-MAR-10
PCB-1242			<0.050		mg/kg		0.05	10-MAR-10
PCB-1248			<0.050		mg/kg		0.05	10-MAR-10
PCB-1254			<0.050		mg/kg		0.05	10-MAR-10
PCB-1260			<0.050		mg/kg		0.05	10-MAR-10
PCB-1262			<0.050		mg/kg		0.05	10-MAR-10
PCB-1268			<0.050		mg/kg		0.05	10-MAR-10
PH-1:2-VA	**Soil**							
Batch R1207811								
WG1077231-7 DUP		**L867711-3**						
pH		8.40	8.30		pH	1.2	20	14-MAR-10
SAR-CALC-MGKG-ICP-VA	**Soil**							
Batch R1210622								
WG1077919-1 MB								
Sodium (Na)			<5.0		mg/L		5	16-MAR-10
WG1079260-1 MB								
Sodium (Na)			<5.0		mg/L		5	16-MAR-10
TL-CSR-MS-VA	**Soil**							
Batch R1209334								
WG1077231-10 CRM		**VA-NRC-PACS2**						
Thallium (Tl)			0.4		mg/kg		0.2-0.6	13-MAR-10
WG1077231-3 CRM		**VA-CANMET-TILL1**						
Thallium (Tl)			0.1		mg/kg		0-0.3	13-MAR-10
WG1077231-4 CRM		**VA-NRC-PACS2**						

Test		Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TL-CSR-MS-VA		**Soil**							
Batch	**R1209334**								
WG1077231-4	**CRM**		**VA-NRC-PACS2**						
Thallium (Tl)				0.4		mg/kg		0.2-0.6	13-MAR-10
WG1077231-9	**CRM**		**VA-CANMET-TILL1**						
Thallium (Tl)				0.1		mg/kg		0-0.3	13-MAR-10
WG1077231-7	**DUP**		**L867711-3**						
Thallium (Tl)			1.3	1.3	J	mg/kg	0.0	4	13-MAR-10
WG1077231-1	**MB**								
Thallium (Tl)				<1.0		mg/kg		1	13-MAR-10
WG1077231-2	**MB**								
Thallium (Tl)				<1.0		mg/kg		1	13-MAR-10
WG1077231-8	**MB**								
Thallium (Tl)				<1.0		mg/kg		1	13-MAR-10
U-200.2-MS-VA		**Soil**							
Batch	**R1209334**								
WG1077231-10	**CRM**		**VA-NRC-PACS2**						
Uranium (U)				91		%		70-130	13-MAR-10
WG1077231-3	**CRM**		**VA-CANMET-TILL1**						
Uranium (U)				125		%		70-130	13-MAR-10
WG1077231-4	**CRM**		**VA-NRC-PACS2**						
Uranium (U)				101		%		70-130	13-MAR-10
WG1077231-9	**CRM**		**VA-CANMET-TILL1**						
Uranium (U)				97		%		70-130	13-MAR-10
WG1077231-7	**DUP**		**L867711-3**						
Uranium (U)			4.98	5.07		mg/kg	1.8	39	13-MAR-10
WG1077231-1	**MB**								
Uranium (U)				<0.050		mg/kg		0.05	13-MAR-10
WG1077231-2	**MB**								
Uranium (U)				<0.050		mg/kg		0.05	13-MAR-10
WG1077231-8	**MB**								
Uranium (U)				<0.050		mg/kg		0.05	13-MAR-10

ALS Laboratory Group Quality Control Report

Legend:

Limit	99% Confidence Interval (Laboratory Control Limits)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

SAMPLE RECEIPT FORM / CHEMICAL ANALYSIS FORM

FILE #: PR100288

CLIENT: ALS Environmental
1988 Triumph Street
Vancouver, B.C.
V5L 1K5

Phone – 604-253-4188
Email: selam.worku@alsenviro.com

RECEIVED BY: J. delPozo **DATE/TIME:** March 10, 2010 (8:30 a.m.)

CONDITION: okay, 4°C

# of Containers	Sample Type	Sample (Client Codes)	Lab Codes	Test Requested
1	Sediment	L867711-1 / 21537-01	PR100288	TBT
1	Sediment	L867711-2 / 21537-02	PR100289	TBT
1	Sediment	L867711-3 / 21537-03	PR100290	TBT
1	Sediment	L867711-4 / 21537-04	PR100291	TBT
1	Sediment	L867711-5 / 21537-05	PR100292	TBT
1	Sediment	L867711-6 / 21537-06	PR100293	TBT

STORAGE: stored at < -10°C

ANALYTES: HRGC/HRMS analysis for tributyltin (TBT)

SPECIAL INSTRUCTIONS:

METHODOLOGY
Reference Method: TBT: in house, SOP LAB04

Data summarized in Data Report Attached

Data emailed to: Selam Worku Date: April 6, 2010

Comments: Results relate only to items tested.

____
David Hope PChem, CEO

DATA REPORT

Client: ALS Environmental
Contact: Selam Worku

Date Extracted: 15-Mar-10
Date Analysed: 1-Apr-10

	Client ID:	**L867711-1 / 21537-01**	**L867711-2 / 21537-02**	**L867711-3 / 21537-03**	**L867711-4 / 21537-04**	**L867711-5 / 21537-05**
	PRL ID:	PR100288	PR100289	PR100290	PR100291	PR100292
Compound	**DL µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**
Tributyltin Chloride	0.001	4.84	3.22	3.54	0.647	3.10
Dibutyltin dichloride	0.001	0.438	0.477	0.269	0.132	0.265
Monobutyltin trichloride	0.001	0.071	0.074	0.078	0.055	0.040

Compound	**DL µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**	**µg/g**
TBT^{+}	0.001	4.32	2.87	3.15	0.577	2.76
DBT^{++}	0.001	0.335	0.366	0.206	0.101	0.203
MBT^{+++}	0.001	0.045	0.046	0.049	0.035	0.025
Surrogate Recoveries (%)						
Tributyltin - d27		97	84	89	59	85

ND - none detected

Patrick Pond, CTO

Form Name: DOC14 Data Report TBT 11-Dec-09 DGH

DATA REPORT

Client: ALS Environmental
Contact: Selam Worku

Date Extracted: 15-Mar-10
Date Analysed: 1-Apr-10

	Client ID:	**L867711-6 / 21537-06**	
	PRL ID:	PR100293	PR100293D
			Duplicate
Compound	**DL**		
	µg/g	**µg/g**	**µg/g**
Tributyltin Chloride	0.001	3.02	3.36
Dibutyltin dichloride	0.001	0.636	0.546
Monobutyltin trichloride	0.001	0.088	0.115

Compound	**DL**		
	µg/g	**µg/g**	**µg/g**
TBT^{+}	0.001	2.69	2.99
DBT^{++}	0.001	0.488	0.419
MBT^{+++}	0.001	0.055	0.072
Surrogate Recoveries (%)			
Tributyltin - d27		92	83

ND - none detected

Patrick Pond, CTO

Form Name: DOC14 Data Report TBT 11-Dec-09 DGH

Pacific Rim Laboratories Inc. #103 - 19575 55A Avenue, Surrey, B.C. V3S 8P8
Tel: +604-532-8711 Fax: +604-532-8712 Email: info@pacificrimlabs.com

QC REPORT

Client: ALS Environmental
Contact: Selam Worku

Date Extracted: 15-Mar-10
Date Analysed: 1-Apr-10

	Client ID:	blank			Spike	LOF	Recovery
	PRL ID:	TB10185B			TB10186S		
Compound	**DL**						
	µg/g	**µg/g**			**µg/g**	**µg/g**	
Tributyltin Chloride	0.001	ND			0.024	0.025	97%
Dibutyltin dichloride	0.001	ND			0.010	0.025	39%
Monobutyltin trichloride	0.001	ND			0.018	0.025	71%

Compound	**DL**						
	µg/g	**µg/g**					
TBT^{+}	0.001	ND					
DBT^{++}	0.001	ND					
MBT^{+++}	0.001	ND					
Surrogate Recoveries (%)							
Tributyltin - d27		56			51		

ND - none detected

Patrick Pond, CTO

Acronyms used in reporting organotins:

TBT = Tributyltin	TBTCl = Tributyltin chloride
DBT = Dibutyltin	DBTCl = Dibutyltin dichloride
MBT = Monobutyltin	MBTCl = Monobutyltin trichloride

This method analyzes organotin derivatives in water, sediment and biota. The method cannot determine which organotin salt is present in the sample, therefore all data is quantified in terms of organotin chlorides and expressed as cation equivalents (TBT^{+}, DBT^{++}, MBT^{+++}).

In sea water and under normal conditions, TBT exists as three species (hydroxide, chloride, and carbonate), which remain in equilibrium. At pH values less than 7.0, the predominate forms are $Bu_3SnOH_2^{+}$ and Bu_3SnCl, at pH 8, they are Bu_3SnCl, Bu_3SnOH, and $Bu_3SnCO_3^{-}$, and at pH values above 10, Bu_3SnOH and $Bu_3SnCO_3^{-}$ predominate. Source: http://www.inchem.org/documents/ehc/ehc/ehc116.htm#SectionNumber:1.1

TBT data has been reported in many conventions over the years. To convert to other units, use the multipliers below.

To convert	To:	Multiply by:
Tributyltin chloride	As Sn	0.3647
Tributyltin chloride	As TBTO	0.9760
Tributyltin chloride	As TBT^{+}	0.8911
Dibutyltin dichloride	As Sn	0.3907
Dibutyltin dichloride	As TBTO	0.9110
Dibutyltin dichloride	As DBT^{++}	0.7666
Dibutyltin dichloride	As TBT^{+}	0.9546
Monobutyltin trichloride	As Sn	0.4207
Monobutyltin trichloride	As TBTO	0.8461
Monobutyltin trichloride	As MBT^{+++}	0.6231
Monobutyltin trichloride	As TBT^{+}	1.0279
As Sn	As TBTO	2.8097

Acceptable recoveries for Tributyltin surrogate standards

Sediment/biota	TBT d_{27}	20-150%
Water	TBT d_{27}	10-130%

CHAIN-OF-CUSTODY RECORD/ANALYSIS REQUEST

Nº 21537 page 1 of 1

Golder Associates

500–4260 Still Creek Drive
Burnaby, British Columbia, Canada V5C 6C6
Telephone: 604-298-6623 Fax: 604-298-5253

Project Number: 10-1475-0001	Laboratory Name: ALS Environmental
[redacted]	Address: 8081 Lougheed Hwy Suite 100, Burnaby ~~MA980 Triumph St. Vancouver BC V5L 1S~~
Golder Contact: PETE CRAIG / Golder E-mail Address: PCRAIG@golder.com	Tel/Fax: 1-800-665-0243 / Contact: Amber Springer

Office the final reports should be sent to:

- ☐ 500–4260 Still Creek Drive, Burnaby, BC V5C 6C6, Tel: 604-298-6623, Fax: 604-298-5253
- ☐ 202–2790 Gladwin Road, Abbotsford, BC V2T 4S8, Tel: 604-850-8786, Fax: 604-850-8756
- ☒ 2640 Douglas Street, Victoria, BC V8T 4M1, Tel: 250-881-7372, Fax: 250-881-7470

L867711

Sample Control Number (SCN)	[redacted]	Sample Matrix (over)	Date Sampled (D/M/Y)	[redacted]	Number of Containers	CCME METALS	LOW LEVEL TBT	TOTAL PCB	NA + CL BY SAT PASTE						RUSH	Remarks (over)
21537-01		SOIL	5/03/10		6	X	X	X	X							
21537-02		↓	↓		6	X	X	X	X							
21537-03		↓	↓		6	X	X	X	X							
21537-04		↓	↓		8	X	X	X	X							
21537-05		↓	↓		8	X	X	X	X							
21537-06		↓	↓		6	X	X	X	X							
-07																
-08																
-09																
-10																
-11																
-12																

Sampler's Signature: Michelle Spani	Relinquished by: Signature: [signature]	Company: Golder	Date: March 8 2010	Time: 09:30	Received by: Signature	Company
Sample Storage (°C)	Relinquished by: Signature	Company	Date	Time	Received by: Signature	Company
Comments:	Method of Shipment: DHL	Waybill No.: D013331530	Received for Lab by: HD		Date: 10 03 09	Time: 8:15
	Shipped by: Michelle Spani	Shipment Condition: / Seal Intact:	Temp (°C): 2	Cooler opened by:	Date	Time

WHITE: Golder copy YELLOW: Lab copy PINK: Lab returns with Final Report

APPENDIX E

Jet Probing Field Data

Esquimalt Graving Dock, Esquimalt, BC

Date:	3/10/2010
Transect:	TR # 1 at Station # 2
Bearing:	308°
Probe length:	3.7m (2 Rods)
Diver:	Dave
Water depth	2.19m @ 11:04:40pm
(from nail to water line)	2.29m @ 11:26:15pm

Probe Location	Attempt #	Depth pneumo m / ft**	Probe depth (m) distance to mudline	Penetration depth (m)*	Distance along transect (m)	Time (hh:mm:ss)	Type of refusal
Base of Wall @ 0m along transect	1			0			Hit concrete, no penetration; probing not possible
JP-01 @ toe of gabion	1	11.9 / 39	3.55	0.15	3.5	14:20	Hit solid substrate
within 1m	2		3.05	0.65			Hit solid substrate
JP-02 (4m mark along transect)	1	12.2 / 40	3.55	0.15	4	14:35	Hit solid rock
within 1m	2		3.35	0.35			Hit solid rock
within 1m	3		3.53	0.17			Hit solid rock
JP-03 @ 6m along transect	1	12.5 / 41	3.38	0.32	6	14:43	Hit solid substrate
within 1m	2		3.5	0.2			Hit solid substrate
JP-04 @ 9m along transect	1	14.0** / 46**	2.9	0.8	9	10:50**	Hit solid substrate
within 1m	2		3.43	0.27			Hit solid substrate
within 1m	3		3.47	0.23			Hit solid substrate
JP-05 @ 10m along transect	1	14.6** / 48**	3.05	0.65	10	11:00* *	Hit solid substrate
within 1m	2		3.11	0.59	10		Hit solid substrate
10.5m along transect	3		3	0	10.5		Hit solid substrate

* Penetration Depth = (probe length - probe depth (m) distance to mudline)

** Values were approximated based on dive records

Date:	10/03/2010 and 11/03/2010	
Transect:	TR # 2 at Station #5	
Bearing:	186°	
Probe length:	2.53m (hand probe)	Hand probe used for these locations as the pump for the jet probe broke and needed to wait for repair person to fix it.
Diver:	Ian	
Water depth	2.19m @ 11:04:40pm	
(from nail to water line)	2.29m @ 11:26:15pm	

Probe Location	Attempt #	Depth pneumo m / ft**	Probe depth (m) distance to mudline	Penetration depth (m)*	Distance along transect (m)	Time (hh:mm:ss)	Type of refusal
Probe attempt at base of wall	1			0.04	0		Probe penetrated 4-5 cm then hit something hard, likely concrete; probing not possible at this location
JP-08 @ toe of gabion	1	12.5 / 41	1.37	1.16	2.64m (edge of gabions) Probe location at 3.0 m - positioned to avoid filter cloth	10:16**	Hit solid rock
within 1m	2		1.45	1.08	0.25 m from left side of transect		Hit solid rock
JP-07 @ 6m	1	11.9 / 39	2	1.7	6	16:22	Hit hard substrate (gravel)
within 1m	2		1.9	1.8			Hit gravel - can't push probe in any further
JP-06 @ 9m from wall	1	12.2 / 40	2.48	1.22	9	16:05	Substrate appears to be mainly silt on surface- hit solid substrate
within 1m	2		2.62	1.08			Hit solid substrate

* Penetration Depth = (probe length - probe depth (m) distance to mudline)
** Values were approximated based on dive records

Date:	3/11/2010
Transect:	TR # 3 at Station #7
Bearing:	172°
Probe length:	3.7m (2 Rods)
Diver:	Dave
Water depth	2.50m @ 12:47pm
(from nail to water line)	2.615m @ 1:19pm

Probe Location	Attempt #	Depth pneumo m / ft**	Probe depth (m) distance to mudline	Penetration depth (m)*	Distance along transect (m)	Time (hh:mm:ss)	Type of refusal
Base of wall	1	n/a		0.05		12:24:45	5 cm penetration; no probing possible at this location
JP-09 @ toe of gabion	1	12.3 / 40.5	2.73	0.97	3	12:47:45	Solid Rock
within 1m	2		1.89	1.81			Hit solid but with more force could push probe further
JP-10 @ 6m along transect	1	12.9 / 42.5	3.17	0.53	6	12:58:50	Solid rock
within 1m	2		1.68	2.02			Not solid but can't push past material
JP-11 @ 9m along transect	1	13.6 / 44.5	2.58	1.12	9	13:09:35	Solid Rock
within 1m	2		2.47	1.23			Solid rock

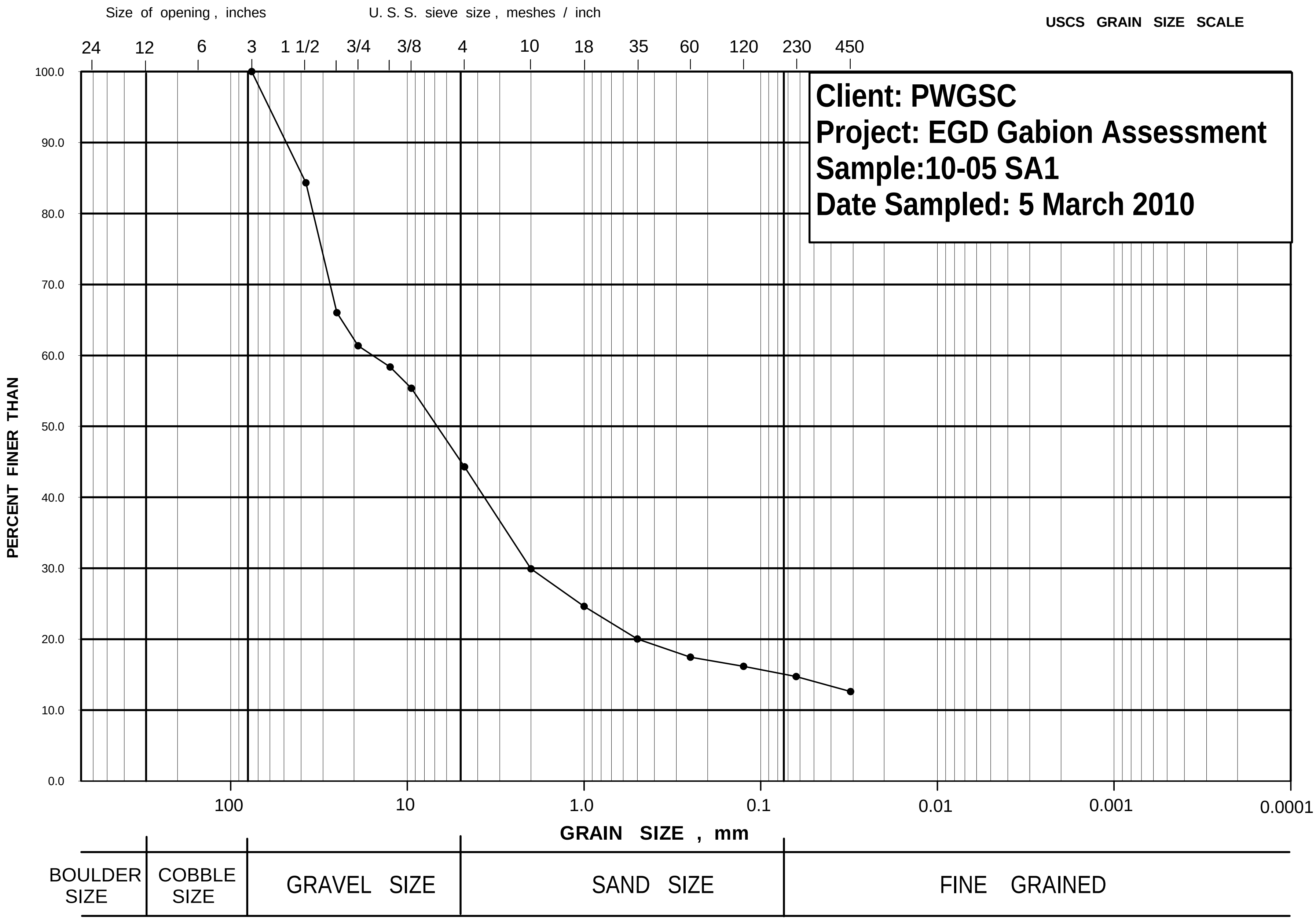
* Penetration Depth = (probe length - probe depth (m) distance to mudline)
** Values were approximated based on dive records

Date:	3/11/2010
Transect:	TR # 4 at Station #10
Bearing:	170°
Probe length:	3.7m (2 Rods)
Diver:	Steve
Water depth	3.28m @ 15:52pm
(from nail to water line)	3.33m @ 16:16pm

Probe Location	Attempt #	Depth pneumo m / ft**	Probe depth (m) distance to mudline	Penetration depth (m)*	Distance along transect (m)	Time (hh:mm:ss)	Type of refusal
Base of wall	1	n/a		0	0		no penetration, hit solid concrete
JP-12 @ toe of gabion	1	11.1 / 36.5	3.15	0.55	3.5	15:41:05	water pressure on jet probe low possibly because intake in too low -hit something solid (gravel), diver could not push past
within 1 m	2		3.06	0.64			Hit hard substrate (gravel) couldn't push past
JP-13 @ 6m along transect	1	11.6 / 38	2.54	1.16	6	15:53:15	Hit hard substrate
within 1m	2		2.3	1.4			Hit rock, could not push past
JP-14 @ 9m along transect	1	11.9 / 39	2.73	0.97	9	16:02:15	Hit solid rock
within 1m	2		2.8	0.9			Hit solid rock
within 1m	3		2.85	0.85			

* Penetration Depth = (probe length - probe depth (m) distance to mudline)
** Values were approximated based on dive records

APPENDIX F



Project No. 09-1475-0026-6000 Drawn DGM Reviewed PC Date 25 Mar 10	Golder Associates	**GRAIN SIZE DISTRIBUTION**	**Figure F-1**

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

ASTM C 136

Project #: 09-1475-0026 Phase: 6000

Short Title: 2010 ASSESSMENT OF NORTH LANDING WHARF GABION MATS

Tested by: DGM Date: 25/03/2010

Source: Esquimalt Harbour

Visual Description of Sample: Marine Sediments

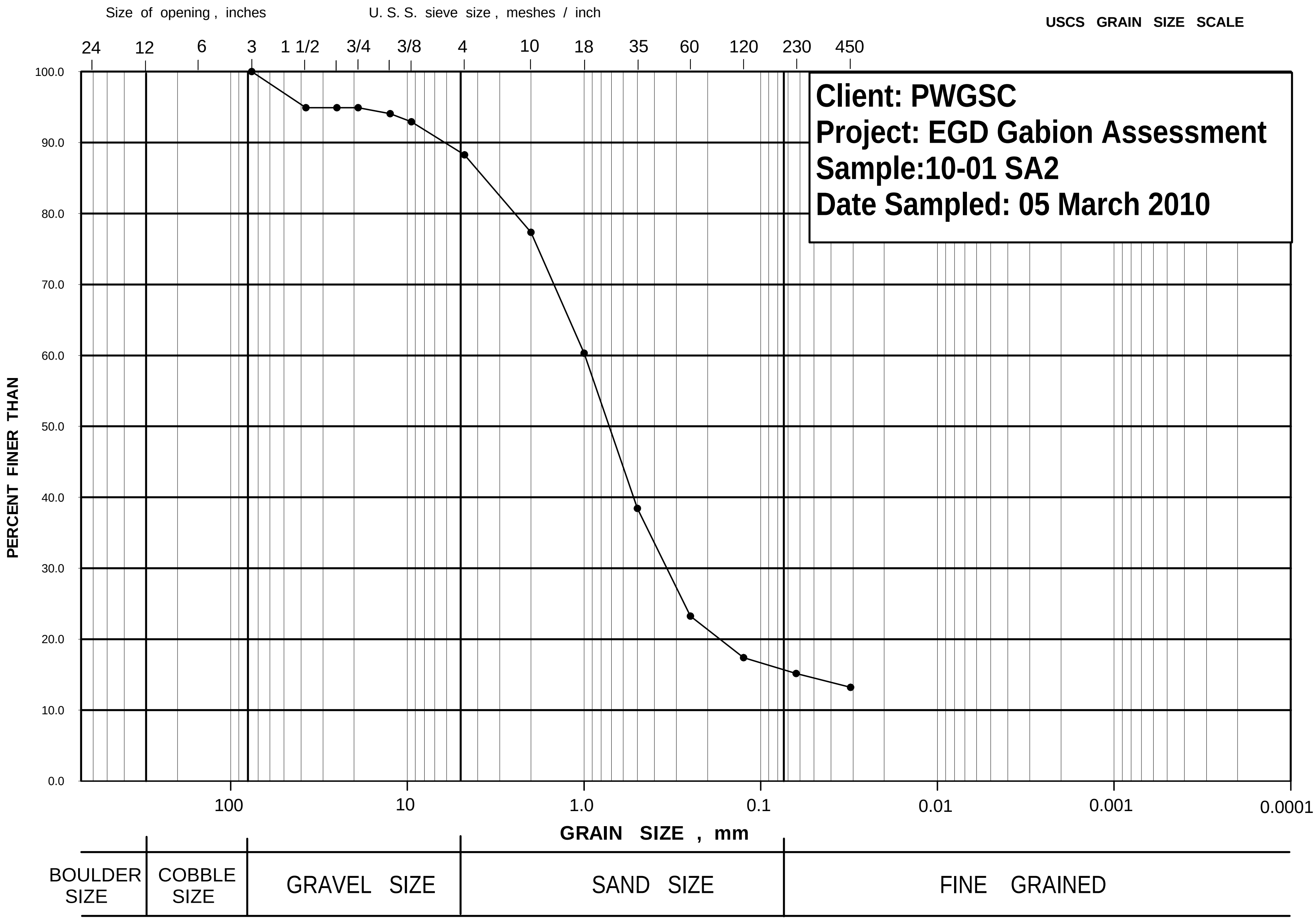
Auger Hole		Sample :	10-05 SA1		Depth :		
	1st SIEVING		2nd SIEVING		Wash Sieving		
	Weight before sieving		Weight before sieving		Weight after wash		2445.5
	Total weight	2791.8	1/4 Pass #4		Residual #200		6.3
	Pass #4				Minus #200		352.6
Sieve (CAN)	**Weight Retained**	**% Retained**	**Weight Retained**	**% Retained**	**% Retained of Total**	**Diameter (mm)**	**% Passing**
3"	0	0.0			0	**76.0**	**100**
1 1/2"	437.7	15.7			15.7	**37.5**	**84.3**
1"	511.0	18.3			18.3	**25.0**	**66.0**
3/4"	130.2	4.7			4.7	**19.0**	**61.4**
1/2"	83.3	3.0			3.0	**12.5**	**58.4**
3/8"	84.0	3.0			3.0	**9.5**	**55.4**
#4	309.2	11.1			11.1	**4.8**	**44.3**
#10	400.9	14.4			14.4	**2.0**	**29.9**
#18	148.2	5.3			5.3	**1.0**	**24.6**
#35	128.5	4.6			4.6	**0.5**	**20.0**
#60	71.1	2.5			2.5	**0.250**	**17.5**
#120	36.2	1.3			1.3	**0.125**	**16.2**
#230	39.6	1.4			1.4	**0.063**	**14.8**
#450	59.7	2.1			2.1	**0.031**	**12.6**
Pan	352.6	12.6			12.6		

REMARKS :

Reported by: ____________________ Reviewed by: ____________________

Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other zones/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 2640 Douglas St. Victoria, BC, V8T 4 M1, Tel: 250-881-7372 Fax: 250-881-7470



Project No. 09-1475-0026-6000 Drawn DGM Reviewed PC Date 25 Mar 10	Golder Associates	**GRAIN SIZE DISTRIBUTION**	**Figure F-2**

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE

ASTM C 136

Golder Associates

Project #: 09-1475-0026 Phase: 6000

Short Title: 2010 ASSESSMENT OF NORTH LANDING WHARF GABION MATS

Tested by: DGM Date: 25/03/2010

Source: Esquimalt Harbour

Visual Description of Sample: Marine Sediments

Auger Hole		Sample :	10-01 SA2		Depth :		
	1st SIEVING		2nd SIEVING		Wash Sieving		
	Weight before sieving		Weight before sieving		Weight after wash		2090.2
	Total weight	2403.9	1/4 Pass #4		Residual #200		3.8
	Pass #4				Minus #200		317.5
Sieve (CAN)	**Weight Retained**	**% Retained**	**Weight Retained**	**% Retained**	**% Retained of Total**	**Diameter (mm)**	**% Passing**
3"		0.0			0.0	**76.0**	**100**
1 1/2"	122.1	5.1			5.1	**37.5**	**94.9**
1"	0.0	0.0			0.0	**25.0**	**94.9**
3/4"	0.0	0.0			0.0	**19.0**	**94.9**
1/2"	20.4	0.8			0.8	**12.5**	**94.1**
3/8"	27.5	1.1			1.1	**9.5**	**92.9**
#4	111.9	4.7			4.7	**4.8**	**88.3**
#10	262.3	10.9			10.9	**2.0**	**77.4**
#18	409.8	17.0			17.0	**1.0**	**60.3**
#35	526.0	21.9			21.9	**0.5**	**38.4**
#60	364.9	15.2			15.2	**0.250**	**23.3**
#120	140.8	5.9			5.9	**0.125**	**17.4**
#230	53.6	2.2			2.2	**0.063**	**15.2**
#450	47.1	2.0			2.0	**0.031**	**13.2**
Pan	317.5	13.2			13.2		

REMARKS :

Reported by: ____________________ Reviewed by: ____________________

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