June 9, 2011
File: 1108-006.01

Squamish Oceanfront Development Corporation
37321 Galbraith Road, P.O. Box 468
Squamish, BC V0N 3G0

Attn: Heather Dunham

Dear Ms. Dunham,

Re: Mamquam Blind Sediment Quality Investigation

1.0 INTRODUCTION

Squamish Oceanfront Development Corporation (SODC) retained Hemmera to evaluate the in-situ quality of sediment proposed to be dredged from the Mamquam Blind Channel. This dredging will be completed in accordance with the Department of Fisheries and Oceans (DFO) letter to the District of Squamish dated August 22, 2008, regarding 'Proposed Dredging of Navigation Channel in Mamquam Blind Channel', as amended by DFO on October 26, 2010. This letter and amendment are provided in **Appendix A**. SODC is a wholly owned subsidiary of the District of Squamish.

The location of the Squamish Oceanfront Lands and Mamquam Blind Channel are shown on **Figure 1**. The proposed dredge footprint and study area are shown on **Figure 2**, and extend from north of the former Food Machinery and Chemical Corporation (FMC)/Nexen salt docks to the government wharf at Vancouver Street.

2.0 WORK PROGRAM

On April 13, 2011, Hemmera worked with ConeTec Investigations Ltd. and Mud Bay Drilling Company Ltd. advanced 15 boreholes to characterize sediment quality in the proposed dredge footprint. Sediment sampling locations are shown on **Figure 2**. Drilling was completed with the use of a barge, where a track-mounted sonic drill rig was set-up on board the barge and drilled through an opening in the deck. Boreholes were each 0.2 m in diameter. Boreholes were advanced to a maximum depth of 3.5 m below sediment surface (mbss), and the sediment cores were extruded into clear plastic bags and placed on the deck of the barge to allow measuring and logging of the sediment properties. The cores were logged with respect to their geologic properties; specifically colour, moisture, density, grain size, and soil type.

Hemmera Envirochem Inc.
Suite 250, 1380 Burrard Street
Vancouver, BC V6Z 2H3

Telephone 604.669.0424
Facsimile 604.669.0430
www.hemmera.com

Sediment samples were collected according to established procedures outlined in the BC Ministry of Environment's (BC MOE) British Columbia Field Sampling Manual. Samples were collected and placed into large stainless steel bowls and homogenized prior to being placed into sample containers. Samples were placed into two-250 mL glass jars, two-125 mL glass jars, one Ziploc® bag, and one-50 mL plastic vial supplied by ALS Laboratory Group of Burnaby, BC (ALS) and sealed. All jarred samples were filled with no headspace to prevent oxidation and loss of volatile organic compounds, while the vials were only filled ¾ full to prevent breakage due to expansion during freezing and were placed on dry ice supplied by Praxair Inc. of Vancouver, BC.

Water was collected from the Mamquam Blind Channel after the completion of the sediment investigation for possible Dredgeate Elutriate Test (DRET) analysis. The water was collect into five 20 L inflatable carboys from a boat in the middle of the Mamquam Blind Channel.

Sample jars and carboys were labeled, noting the sample name and project number. The sample jars were then temporarily stored in insulated coolers to minimize chemical alteration prior to laboratory analysis. The coolers were delivered to ALS via Hemmera field staff the following day, April 14, and submitted for analysis.

The proposed work plan included a step-wise analytical approach, with up to two rounds of analysis to be conducted on the samples collected. The first round of analysis was conducted to characterize the main constituents of potential concern (COPCs) suspected in Mamquam Blind sediments. A second round of analysis was proposed for lower likelihood COPCs, but was only to be completed if the results of the first round indicated that the lower likelihood COPCs might be present.

3.0 RESULTS

The compiles analytical results are presented on **Table 1**, attached. The following subsections provide a summary of the results.

3.1 SOIL STANDARDS

As outlined in the DFO dredging permit, "as the upland placement of dredged material is planned, the upland dredged material must comply with the BC *Environmental Management Act* and its regulations, such as the Contaminated Sites and Hazardous Waste regulations." For that reason, the analytical results for the sediment samples were compared to the following British Columbia Contaminated Sites Regulation (CSR) Soil standards:

- The CSR Generic Numerical Soil standards, Urban Park Land Use (PL), as presented in Schedule 4 of the CSR;

- The CSR Matrix Numerical Soil standards, Column III, Urban Park (PL), as presented in Schedule 5 of the CSR:
  - Intake of contaminated soil standard
  - Groundwater used for drinking water standard
  - Toxicity to soil invertebrates and plants standard
  - Groundwater flow to surface water used by marine aquatic life standard;
- The CSR Standards Triggering Contaminated Soil Relocation Agreements, Column II, Soil Relocation to Non-agricultural Land (SRNL), as presented in Schedule 7 of the CSR; and
- The CSR Generic Numerical Soil and Water Standards, Column III, Agricultural, Urban Park, Residential Soil standards, as presented in Schedule 10 of the CSR.

Results indicated that of the 49 samples submitted for analysis, 12 samples and one duplicate exceeded the applicable CSR soil standards. Constituents of concern measured at concentrations above the CSR standards are presented in **Table A**, below.

Table A Samples and Duplicates Exceeding CSR Soil Standards

Sediment Station	Samples	Sample Depth Interval (mbss)	Constituent Of Concern	Standards Exceeded
SED1	SED11-1A SED11-1B	0.0-0.38 0.38-0.97	Sodium and Chloride Ions	PL and SRNL
SED3	SED11-3A	0.0-0.46	Copper	SRNL
SED5	SED11-5A (SED11-5G) SED11-5B	0-0.50 0.50-1.00	Sodium and Chloride Ions	PL and SRNL
	SED11-5C	1.00-1.50	Copper	PL and SRNL
SED7	SED11-7A	0.0-0.46	Sodium and Chloride Ions	PL and SRNL
SED8	SED11-8A	0.0-0.50	Sodium and Chloride Ions	PL and SRNL
SED9	SED11-9A	0.0-0.57	Sodium and Chloride Ions	PL and SRNL
SED11	SED11-11A	0.0-0.42	Sodium and Chloride Ions	PL and SRNL
SED13	SED11-13A	0.0-0.15	Sodium and Chloride Ions	PL and SRNL
SED15	SED11-15A	0.0-0.34	Sodium and Chloride Ions	PL and SRNL

Notes: mbss = metres below sediment surface ( ) = duplicate sample
PL = BC CSR Urban Park Land Standards
SRNL = BC CSR Schedule 7 Soil Relocation to Non-Agricultural Land

3.2 SEDIMENT CRITERIA

The analytical results for the sediment samples were also compared to the following BC CSR sediment criteria:

- The CSR Generic Numerical Sediment Criteria, Column IV and V, Marine and Estuarine Sediment Sensitive ($SedQC_{SS}$) and Typical ($SedQC_{TS}$) as presented in Schedule 9 of the CSR.

This comparison is intended to provide an indication of sediment quality that may be left in place after dredge materials are removed, but is only relevant for those sediment samples collected below the proposed 1 mbss depth of dredging. Results indicated that of the 49 samples submitted for analysis, 14 samples and two duplicates exceeded the applicable criteria. However, of these 14, only three samples were collected from below 1 mbss, and would potentially indicate sediment quality left in place after dredging. Constituents of concern measured at concentrations above the CSR sediment criteria are presented in **Table B,** below. Those locations indicated in bold are the ones that are situated below the proposed 1 m depth of dredging.

Table B Samples and Duplicates Exceeding CSR Sediment Criteria

Sediment Station	Samples	Sediment Depth Interval (mbss)	Constituent Of Concern	Criteria Exceeded
SED2	SED11-2A	0.0-0.45	Copper	$SedQC_{SS}$
	SED11-2B	0.45-0.91	Mercury	$SedQC_{SS}$
	SED11-2C	**0.91-1.36**	Mercury	$SedQC_{SS}$ and $SedQC_{TS}$
SED3	SED11-3A SED11-3B (SED11-3G)	0.0-0.46 0.46-0.92	Copper	$SedQC_{SS}$
SED4	SED11-4A	0.0-0.56	Copper	$SedQC_{SS}$
SED5	SED11-5A (SED11-5G) SED11-5B **SED11-5C**	0.0-0.50 0.50-1.00 **1.00-1.50**	Copper	$SedQC_{SS}$
	SED11-5B	0.50-1.00	Acenaphthene, Anthracene, Fluoranthene, Fluorene	$SedQC_{SS}$
SED6	SED11-6A SED11-6B	0.0-0.48 0.48-0.96	Copper	$SedQC_{SS}$
SED7	**SED11-7C**	**0.93-1.64**	Acenaphthene	$SedQC_{SS}$ and $SedQC_{TS}$
SED11	SED11-11A SED11-11B	0.0-0.42 0.42-0.85	Copper	$SedQC_{SS}$

Notes: mbss = metres below sediment surface ( ) = duplicate sample
$SedQC_{SS}$ = BC CSR Schedule 9 Sensitive Sediment $SedQC_{TS}$ = BC CSR Schedule 9 Typical sediment.

3.3 FURTHER ANALYSES

At each of the sediment sampling locations SED2, SED3, SED5 and SED7, the deepest sample analysed during the first round of analysis measured at least one constituent above the CSR sediment criteria. Based on this, a deeper sample from each of these locations was submitted for analysis to vertically delineate the impacts identified during the first round of analysis.

Results indicate that of the four samples submitted for vertical delineation, three were less than the CSR sediment criteria, and vertical delineation was achieved. Only one sample exceeded the CSR sediment criteria, as shown in **Table C,** below, and vertical delineation was not achieved at this location.

Table C Round Two Analysis Results

Sediment Station	Samples	Sediment Depth Interval (mbss)	Constituent Of Concern	Criteria Exceeded
SED5	SED11-5D	1.50-2.17	Copper	$SedQC_{SS}$

Notes: mbss = metres below sediment surface $SedQC_{SS}$ = BC CSR Schedule 9 Sensitive criteria

3.4 QUALITY ASSURANCE / QUALITY CONTROL

Hemmera's field quality assurance/quality control program (QA/QC) included practicing standard soil sampling protocols to minimise the potential for cross contamination between samples. The field QA/QC procedure also included the collection and analysis of field duplicates. Four field duplicate sediment samples (SED11-3G, SED11-1G, SED11-5G, and SED11-6G) were submitted for analysis as part of the sediment quality investigation.

The QA/QC methods were evaluated by determining the relative percent differences (RPD) between characterization samples and their field duplicates. RPD values are determined by the following equation:

RPD = Absolute Value [A-B X 100/((A-B)/2)]
where A = field sample and B = duplicate sample

In cases where the concentration of a parameter is less than five times the reportable laboratory detection limit, the RPD is not calculated since concentrations near the laboratory detection limit are not typically precise. The RPD data quality objectives (DQO) used for this investigation were[1]:

- 50% for PAHs in sediment;
- 40% for EPH in sediment; and
- 30% for metals in sediment.

One sample (SED11-5A) and its duplicate (SED11-5G) exceeded the appropriate DQO for lead, with an RPD of 117%. This result does not affect the integrity of the results reported, as both the characterisation sample and its field duplicate were below the applicable standards. Based on the above, the sediment analytical results were maintained for discussion and the data quality was considered to be acceptable.

[1] British Columbia Environmental Laboratory Manual, 2009 edition, prepared and published by Water and Air Monitoring Reporting Section, Environmental Quality Branch, Ministry of Environment, Province of British Columbia with the assistance of The British Columbia Environmental Laboratory technical Advisory Committee.

4.0 DISCUSSION

4.1 ANALYTICAL RESULTS

As discussed above, some of the samples submitted for analysis exceeded either the applicable CSR soil standards and/or the applicable CSR sediment criteria. These exceedances are discussed below.

4.1.1 Copper

Copper was found to exceed the CSR Schedule 7 SRNL soil standard and CSR Schedule 9 Sensitive sediment criteria in two samples, and exceeded only the Schedule 9 Sensitive sediment criteria in 13 samples.

Although some of the Mamquam Blind sediment samples exceeded CSR soil standards and CSR sediment criteria for copper, if viewed as a whole, sediment from this area was not contaminated with copper according to the BC MOE *Technical Guidance on Contaminated Sites #2: Statistical Criteria for Characterizing a Volume of Contaminated Material* (TG 2) (2009). A statistical evaluation of the data has shown that this material is below the soil standards, as:

- The upper 90th percentile of the sample concentrations is less than the applicable soil standards (83.6 µg/g versus the CSR PL standard of 150 µg/g, and the SRNL standard of 90 µg/g);
- The upper 95% confidence limit of the average concentration of the samples is less than the applicable standards (60.54 µg/g versus the CSR PL standard of 150 µg/g, and the SRNL standard of 90 µg/g), as calculated by the US EPA ProUCL statistical software package with non-parametric data and the Chebyshev inequality using the sample mean and sample standard deviation; and
- No sample within the data set has a concentration exceeding two times the standards (maximum copper concentration is 110 µg/g versus two times the CSR PL standard of 150 µg/g, and the SRNL standard of 90 µg/g).

Furthermore, a 2004 report by Environment Canada titled *Nearshore Contaminated Sediment Investigations at Britannia Beach, British Columbia*, indicates that the copper associated with the former Britannia Mine more than likely migrated up Howe Sound to Squamish, and that copper was found in subtidal sediment at Watts Point in high concentrations. Therefore, copper impacts associated with the Mamquam Blind sediments may be a result of the former Britannia Copper Mine operation located about 10 km down towards the head of Howe Sound.

Therefore, given the statistical argument presented by TG 2, and the fact that Howe Sound shows elevated copper concentrations due to the former Britannia Mine, copper is not considered to be a constituent of concern in the Mamquam Blind Channel.

4.1.2 Mercury

Mercury was found to exceed the CSR Sensitive sediment criteria at sediment sample location SED2 (between 0.45 – 0.91 mbss), while a deeper sample at the same location exceeded the Sensitive and Typical sediment criteria (from 0.91 – 1.36 mbss). A subsequently deeper sample at SED2 was shown to be below the criteria (from 1.92 – 2.27 mbss), and vertical delineation was achieved.

The concentrations of mercury detected in the sediment samples did not exceed the applicable CSR PL or SRNL soil standards (in fact, the maximum mercury concentration was measured at 2.28 µg/g, which is only 15% of the CSR PL/SRNL soil standards (15 µg/g)). As such mercury is not considered to be a constituent of concern if the dredgeate is used as soil.

4.1.3 Sodium and Chloride Ions

Sodium and Chloride Ions are not regulated by CSR sediment criteria. These constituents, however, were found to exceed the CSR PL soil and SRNL standards. Elevated sodium and chloride concentrations were anticipated as the sediment samples were collected from a marine/estuarine environment.

Depending on where and how the dredged sediments from the Mamquam Blind Channel are placed/used, these sodium and chloride concentrations may result in certain conditions being imposed on the selection of a placement site. This may include the requirement for a Contaminated Soil Relocation Agreement under BC MOE *Technical Guidance 20*. As such, the sodium and chloride ions are considered to be potential constituents of concern if the dredgeate is used as soil.

4.1.4 PAHs

PAH impacts (specifically Acenaphthene, Anthracene, Fluoranthene, and Fluorene) were found in concentrations in excess of the CSR Sensitive sediment criteria in one sample, while Acenaphthene exceeded the Sensitive and Typical sediment criteria in another sample. These two sample locations (SED5 and SED7) were both found within the vicinity of the log booming operations found in the Mamquam Blind Channel, and these impacts are likely to be associated with creosote pilings used in these operations. Vertical delineation was achieved at these locations and the PAH impacts did not extend beyond 1.64 mbss.

Because the concentrations of PAHs detected in the sediment samples did not exceed the applicable CSR PL or SRNL soil standards, PAHs are not considered to be a constituent of concern if the dredgeate is used as soil.

4.2 EXCLUSION OF LOW LIKELIHOOD COPCS

Based on the history of the site, the following lower likelihood COPCs were identified:

- Methyl mercury;
- Hexachlorobenzene; and
- Dioxins/Furans.

Based on the results of the first round of analysis from this sediment sampling program, these lower likelihood COPCs were not analysed during the second round of analysis. The rationale for not analysing these constituents is discussed in **Appendix B**.

4.3 EXCLUSION OF ANALYTICAL METHODS

The following additional analytical methods were also considered as part of this program:

- Dredgeate Elutriate Test (DRET);
- Toxicity Characteristic Leaching Procedure (TCLP); and
- BC Ministry of Energy and Mines Method (BCMEM).

However, based on the results of the first round of analysis from this sediment sampling program, these additional analytical methods were not considered to be necessary. The rationale for not applying these analytical methods is also discussed in **Appendix B**.

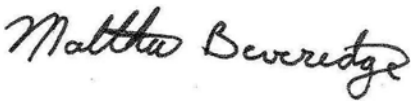
5.0 CONCLUSIONS

The results of this sediment investigation indicate the following:

- Elevated copper concentrations identified in the Mamquam Blind sediments are not considered to be a constituent of concern based on a statistical evaluation of the data and regional concentrations of copper in sediment;
- Elevated concentrations of mercury were measured at only one of fifteen sediment sampling locations. These mercury concentrations did not exceed the applicable CSR soil standards; therefore mercury is not considered to be a constituent of concern if the dredgeate is used as soil;
- Sodium and chloride exceedances measured during this sediment sampling program may result in certain conditions being imposed on the selection of the dredgeate placement site. This may include the requirement for a Contaminated Soil Relocation Agreement, under BC MOE *Technical Guidance 20*. Therefore, the sodium and chloride ions are considered to be potential constituents of concern if the dredgeate is used as soil; and
- Elevated concentrations of PAHs measured at two sample locations are likely to be associated with creosote pilings used by log booming operations in the area. These PAH concentrations did not exceed the applicable CSR soil standards; therefore PAHs are not considered to be a constituent of concern if the dredgeate is used as soil.

We have appreciated the opportunity of working with you on this project and trust that this report is satisfactory to your requirements. Please feel free to contact the undersigned at 604.669.0424 regarding any questions or further information that you may require.

Report prepared by:
Hemmera



Matthew Beveridge, EIT
Environmental Specialist
604.669.0424 (247)
mbeveridge@hemmera.com

Report peer reviewed by:
Hemmera

James Mair, AScT, PMP
Project Manager
604.669.0424 (199)
jmair@hemmera.com

Greg Quandt, B.Sc,
Business Leader
604.669.0424 (168)
gquandt@hemmera.com

6.0 STATEMENT OF LIMITATIONS

This report was prepared by Hemmera, based on fieldwork conducted by Hemmera, for the sole benefit and exclusive use of Squamish Oceanfront Development Corporation. The material in it reflects Hemmera's best judgment in light of the information available to it at the time of preparing this Report. Any use that a third party makes of this Report, or any reliance on or decision made based on it, is the responsibility of such third parties. Hemmera accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this Report.

Hemmera has performed the work as described above and made the findings and conclusions set out in this Report in a manner consistent with the level of care and skill normally exercised by members of the environmental science profession practicing under similar conditions at the time the work was performed.

This Report represents a reasonable review of the information available to Hemmera within the established Scope, work schedule and budgetary constraints. It is possible that the levels of contamination or hazardous materials may vary across the Site, and hence currently unrecognised contamination or potentially hazardous materials may exist at the Site. No warranty, expressed or implied, is given concerning the presence or level of contamination on the Site, except as specifically noted in this Report. The conclusions and recommendations contained in this Report are based upon applicable legislation existing at the time the Report was drafted. Any changes in the legislation may alter the conclusions and/or recommendations contained in the Report. Regulatory implications discussed in this Report were based on the applicable legislation existing at the time this Report was written.

In preparing this Report, Hemmera has relied in good faith on information provided by others as noted in this Report, and has assumed that the information provided by those individuals is both factual and accurate. Hemmera accepts no responsibility for any deficiency, misstatement or inaccuracy in this Report resulting from the information provided by those individuals.

The liability of Hemmera to Squamish Oceanfront Development Corporation shall be limited to injury or loss caused by the negligent acts of Hemmera. The total aggregate liability of Hemmera related to this agreement shall not exceed the lesser of the actual damages incurred, or the total fee of Hemmera for services rendered on this project.

7.0 REFERENCES

British Columbia Ministry of Environment. *Environmental Management Act, 2004, Contaminated Sites Regulation*, B.C. Reg. 375/96.

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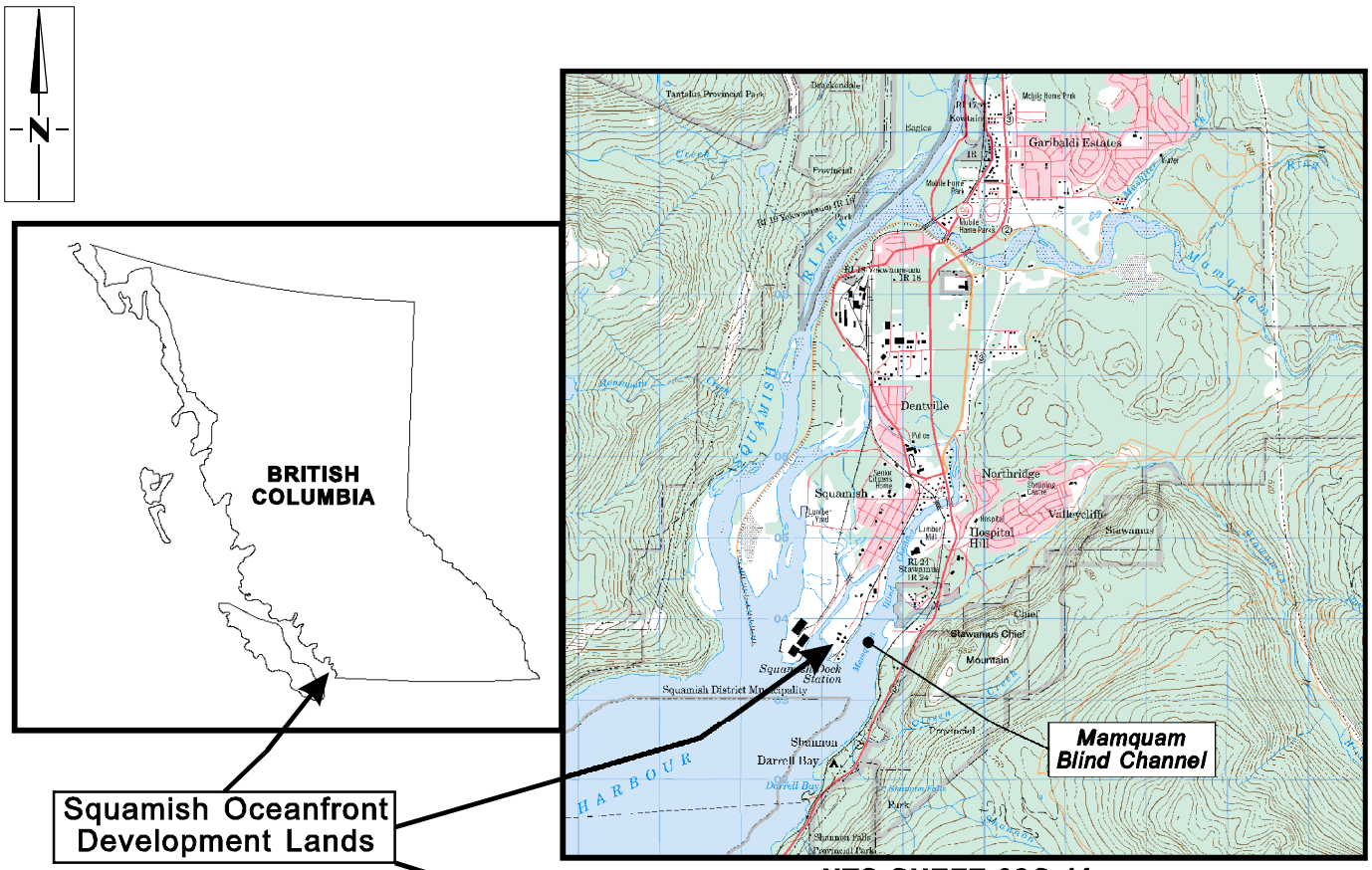
URS Norecol Dames & Moore Inc. April 2001. Off-Site Waterbodies Detailed Site Investigation FMC/Nexen Chlor Alkali Plant, Squamish, BC. Prepared for Nexen Inc.

FIGURES



NTS SHEET 92G-11

AERIAL VIEW (GOOGLE EARTH 2008)

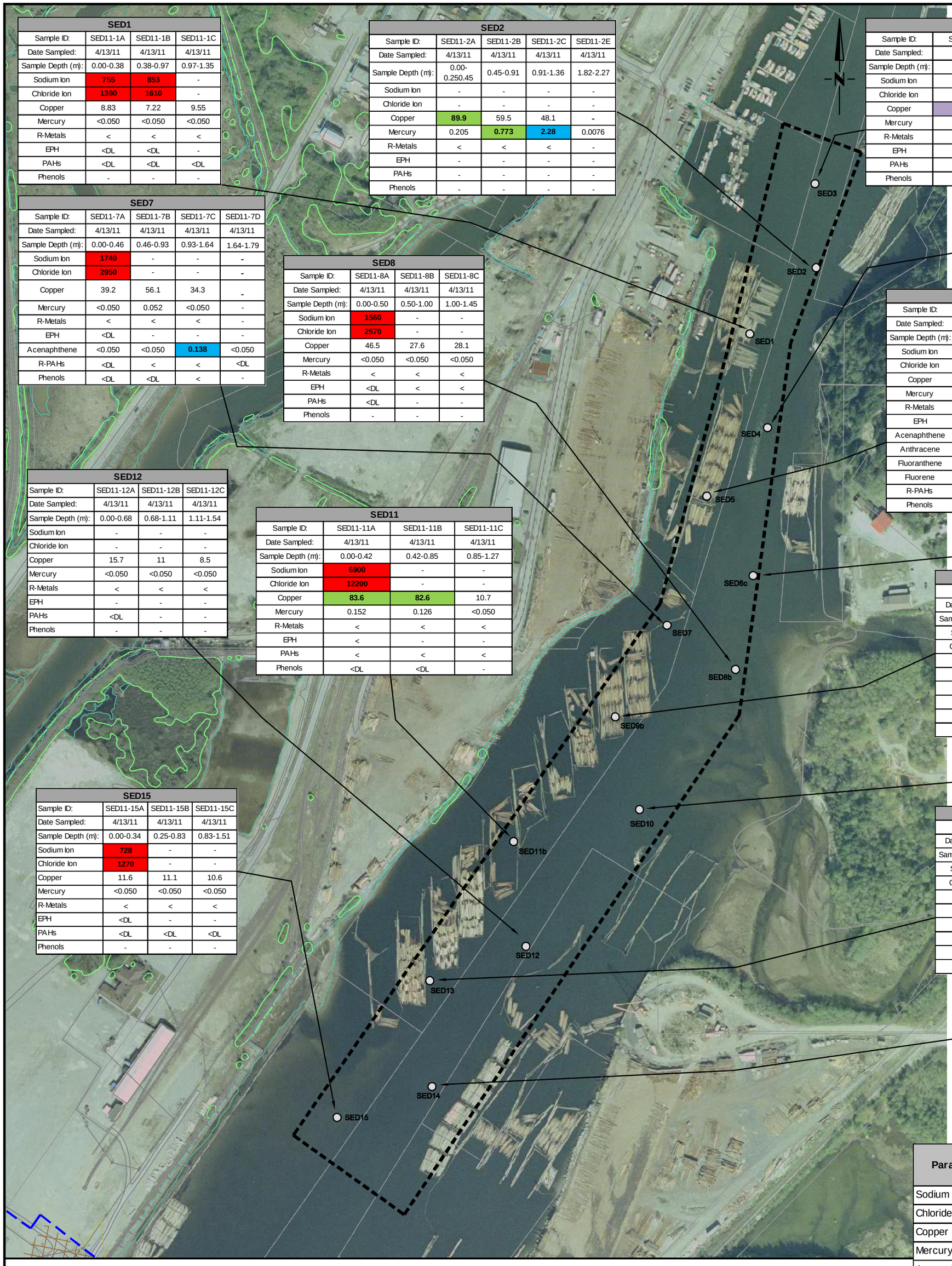
HEMMERA

CLIENT: SQUAMISH OCEANFRONT DEVELOPMENT CORPORATION

MAMQUAM BLIND CHANNEL SEDIMENT QUALITY INVESTIGATION

SITE LOCATION MAP & AERIAL VIEW

PROJECT No.		
1108-006.01	June 2011	FIGURE 1



SED1			
Sample ID:	SED11-1A	SED11-1B	SED11-1C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.38	0.38-0.97	0.97-1.35
Sodium Ion	**755**	**853**	-
Chloride Ion	**1390**	**1610**	-
Copper	8.83	7.22	9.55
Mercury	<0.050	<0.050	<0.050
R-Metals	<	<	<
EPH	<DL	<DL	-
PAHs	<DL	<DL	<DL
Phenols	-	-	-

SED2				
Sample ID:	SED11-2A	SED11-2B	SED11-2C	SED11-2E
Date Sampled:	4/13/11	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.250.45	0.45-0.91	0.91-1.36	1.82-2.27
Sodium Ion	-	-	-	-
Chloride Ion	-	-	-	-
Copper	**89.9**	59.5	48.1	-
Mercury	0.205	**0.773**	**2.28**	0.0076
R-Metals	<	<	<	-
EPH	-	-	-	-
PAHs	-	-	-	-
Phenols	-	-	-	-

SED3				
Sample ID:	SED11-3A	SED11-3B	SED11-3C	SED11-3D
Date Sampled:	4/13/11	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.0-0.46	0.46-0.92	0.92-1.27	1.27-2.12
Sodium Ion	-	-	-	-
Chloride Ion	-	-	-	-
Copper	**110**	**67.1**	39.9	-
Mercury	0.267	0.321	0.279	0.026
R-Metals	<	<	<	-
EPH	-	-	-	-
PAHs	<	<	<	-
Phenols	-	-	-	-

SED4			
Sample ID:	SED11-4A	SED11-4B	SED11-4C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.56	0.56-1.05	0.76-1.58
Sodium Ion	-	-	-
Chloride Ion	-	-	-
Copper	**83.6**	11.2	11.5
Mercury	0.181	<0.050	<0.050
R-Metals	<	<	<
EPH	-	-	-
PAHs	<	-	-
Phenols	-	-	-

SED7				
Sample ID:	SED11-7A	SED11-7B	SED11-7C	SED11-7D
Date Sampled:	4/13/11	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.46	0.46-0.93	0.93-1.64	1.64-1.79
Sodium Ion	**1740**	-	-	-
Chloride Ion	**2950**	-	-	-
Copper	39.2	56.1	34.3	-
Mercury	<0.050	0.052	<0.050	-
R-Metals	<	<	<	-
EPH	<DL	-	-	-
Acenaphthene	<0.050	<0.050	**0.138**	<0.050
R-PAHs	<DL	<	<	<DL
Phenols	<DL	<DL	<	-

SED8			
Sample ID:	SED11-8A	SED11-8B	SED11-8C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.50	0.50-1.00	1.00-1.45
Sodium Ion	**1560**	-	-
Chloride Ion	**2570**	-	-
Copper	46.5	27.6	28.1
Mercury	<0.050	<0.050	<0.050
R-Metals	<	<	<
EPH	<DL	<	<
PAHs	<DL	-	-
Phenols	-	-	-

SED5				
Sample ID:	SED11-5A	SED11-5B	SED11-5C	SED11-5D
Date Sampled:	4/13/11	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.50	0.50-1.00	1.00-1.50	1.50-2.17
Sodium Ion	**6980**	**7920**	-	-
Chloride Ion	**11700**	**13600**	-	-
Copper	**70.5**	**81.4**	**91.6**	73.4
Mercury	0.131	0.08	0.143	0.186
R-Metals	<	<	<	<
EPH	<	-	-	-
Acenaphthene	<0.050	**0.071**	<0.050	-
Anthracene	<0.050	**0.212**	0.098	-
Fluoranthene	0.263	**1.14**	0.609	-
Fluorene	<0.050	**0.101**	<0.050	-
R-PAHs	<	<	<	-
Phenols	<DL	<DL	<DL	-

SED6			
Sample ID:	SED11-6A	SED11-6B	SED11-6C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.48	0.48-0.96	0.96-1.44
Sodium Ion	-	-	-
Chloride Ion	-	-	-
Copper	**70.5**	**86.7**	53.1
Mercury	0.113	0.103	0.06
R-Metals	<	<	<
EPH	<DL	-	-
PAHs	<	-	-
Phenols	-	-	-

SED12			
Sample ID:	SED11-12A	SED11-12B	SED11-12C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.68	0.68-1.11	1.11-1.54
Sodium Ion	-	-	-
Chloride Ion	-	-	-
Copper	15.7	11	8.5
Mercury	<0.050	<0.050	<0.050
R-Metals	<	<	<
EPH	-	-	-
PAHs	<DL	-	-
Phenols	-	-	-

SED11			
Sample ID:	SED11-11A	SED11-11B	SED11-11C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.42	0.42-0.85	0.85-1.27
Sodium Ion	**6900**	-	-
Chloride Ion	**12200**	-	-
Copper	**83.6**	**82.6**	10.7
Mercury	0.152	0.126	<0.050
R-Metals	<	<	<
EPH	<	-	-
PAHs	<	<	<
Phenols	<DL	<DL	-

SED9			
Sample ID:	SED11-9A	SED11-9B	SED11-9C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.57	0.57-1.15	1.15-1.72
Sodium Ion	**1780**	-	-
Chloride Ion	**3100**	-	-
Copper	35.5	54.7	41.2
Mercury	<0.050	<0.050	<0.050
R-Metals	<	<	<
EPH	<DL	-	-
PAHs	<	<	<
Phenols	<DL	<DL	-

SED10			
Sample ID:	SED11-10A	SED11-10B	SED11-10C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.55	0.55-1.10	1.10-1.65
Sodium Ion	-	-	-
Chloride Ion	-	-	-
Copper	29.7	22.1	35.1
Mercury	<0.050	<0.050	<0.050
R-Metals	<	<	<
EPH	-	-	-
PAHs	<DL	-	-
Phenols	-	-	-

SED15			
Sample ID:	SED11-15A	SED11-15B	SED11-15C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.34	0.25-0.83	0.83-1.51
Sodium Ion	**728**	-	-
Chloride Ion	**1270**	-	-
Copper	11.6	11.1	10.6
Mercury	<0.050	<0.050	<0.050
R-Metals	<	<	<
EPH	<DL	-	-
PAHs	<DL	<DL	<DL
Phenols	-	-	-

SED13			
Sample ID:	SED11-13A	SED11-13B	SED11-13C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.15	0.15-0.64	0.64-1.22
Sodium Ion	**5420**	-	-
Chloride Ion	**9600**	-	-
Copper	54.9	9.06	8.48
Mercury	0.117	<0.050	<0.050
R-Metals	<	<	<
EPH	<DL	-	-
PAHs	<	<DL	<DL
Phenols	<DL	<DL	-

SED14			
Sample ID:	SED11-14A	SED11-14B	SED11-14C
Date Sampled:	4/13/11	4/13/11	4/13/11
Sample Depth (m):	0.00-0.33	0.33-0.95	0.95-1.45
Sodium Ion	-	-	-
Chloride Ion	-	-	-
Copper	43.3	10.7	9.28
Mercury	0.158	<0.050	<0.050
R-Metals	<	<	<
EPH	-	-	-
PAHs	<DL	-	-
Phenols	-	-	-

Parameter	BCCSR PL	BCCSR SedQC(SS) Marine	BCCSR SedQC(TS) Marine	BCCSR SRNL
Sodium Ion	200	-	-	200
Chloride Ion	35	-	-	35
Copper	90-150	67	130	90
Mercury	15	0.43	0.84	15
Acenaphthene	-	0.055	0.11	-
Anthracene	-	0.15	0.29	-
Fluoranthene	-	0.93	1.8	-
Fluorene	-	0.089	0.17	-

LEGEND

- Dredge Study Area (1m depth, area ~ 100,000m2)
- Sediment Sample Location (ConeTec, April 13, 2011)
- R Remaining metals/PAHs
- < Result is less than applicable standards
- <DL Result is less then laboroatory detection limit

- Greater than BC CSR Sediment Quality Standards - Sensitive Sediment
- Greater than BC CSR Sediment Quality Standards - Sensitive and Typical Sediment
- Greater than BC CSR Soil Relocation to Nonagricultural Land and BC CSR PL
- Greater than BC CSR Soil Relocation to Nonagricultural Land and BC CSR Sensitive Sediment Quality

SCALE 1:3,200
metres
0 65 130

HEMMERA

CLIENT: SQUAMISH OCEANFRONT DEVELOPMENT CORPORATION

MAMQUAM BLIND CHANNEL SEDIMENT QUALITY INVESTIGATION

DREDGE STUDY AREA & SEDIMENT SAMPLE ANALYTICAL RESULTS

PROJECT No. 1108-006.01 | June 2011 | FIGURE 2

TABLE

Table 1
Sediment Analytical Results - Round 1 Analysis

				Location ID:	Sed-1					Sed-2				Sed-3					
				Sample ID:	SED11-1A	SED11-1B	SED11-1C	SED11-1G	*RPD %*[19]	SED11-2A	SED11-2B	SED11-2C	SED11-2E	SED11-3A	SED11-3B	SED11-3G	*RPD %*[19]	SED11-3C	SED11-3D
				Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011
				Sample Depth (m):	0.00-0.38	0.38-0.97	0.97-1.35	0.97-1.35		0.00-0.45	0.45-0.91	0.91-1.36	1.82-2.27	0.0-0.46	0.46-0.92	0.46-0.92		0.92-1.27	1.27-2.12
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]															
Physical Tests																			
Hardness, Total (CaCO3) (%)	-	-	-	-	-	<0.70	-	-	-	1.09	-	-	-	-	-	-	-	-	-
Moisture (%)	-	-	-	-	14.8	18.6	15.1	20.5	*30.34*	-	-	-	-	52.2	38.2	42.7	*11.12*	31.1	-
pH	-	-	-	-	8.32	8.76	8.68	8.66	*0.23*	7.60	7.80	8.00	-	7.56	7.76	7.70	*0.78*	8.09	-
Saturation (%)	-	-	-	-	28.8	29.4	-	-	-	-	-	-	-	-	-	-	-	-	-
Grain Size																			
Clay (<0.004 mm) (%)	-	-	-	-	-	0.71	-	-	-	18.7	-	-	-	-	-	-	-	-	-
Silt (0.004-0.063 mm) (%)	-	-	-	-	-	0.43	-	-	-	67.3	-	-	-	-	-	-	-	-	-
Sand (0.063-2.00 mm) (%)	-	-	-	-	-	89.1	-	-	-	13.2	-	-	-	-	-	-	-	-	-
Gravel (>2.00 mm) (%)	-	-	-	-	-	9.76	-	-	-	0.77	-	-	-	-	-	-	-	-	-
Total Inorganics																			
Total Inorganic Carbon (%)	-	-	-	-	-	<0.10	-	-	-	0.13	-	-	-	-	-	-	-	-	-
Organics																			
Total Carbon by Combustion (%)	-	-	-	-	-	<0.10	-	-	-	4.8	-	-	-	-	-	-	-	-	-
Total Organic Carbon (%)	-	-	-	-	-	<0.10	-	-	-	4.68	-	-	-	-	-	-	-	-	-
Saturated Paste Extractables																			
Chloride Ion	90 [8]	-	-	35	***1390***	***1610***	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodium Ion	200 [9]	-	-	200	***755***	***853***	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals																			
Antimony	20 [10]	-	-	20	<0.10	<0.10	<0.10	<0.10	*nc*	0.17	0.13	0.11	-	0.18	0.15	0.16	*nc*	<0.10	-
Arsenic	15 [8]	26	50	15	0.552	0.518	0.481	0.439	*9.13*	5.53	4.16	3.05	-	5.99	4.29	4.45	*3.66*	2.57	-
Barium	400 [8]	-	-	400	33.7	34.5	25.2	28.4	*11.94*	135	121	113	-	148	138	141	*2.15*	125	-
Beryllium	4 [10]	-	-	4	<0.20	<0.20	<0.20	<0.20	*nc*	0.22	<0.20	<0.20	-	0.25	<0.20	<0.20	*nc*	<0.20	-
Cadmium	1.5-70 [11]	2.6	5	1.5	0.053	<0.050	<0.050	<0.050	*nc*	0.439	0.323	0.229	-	0.583	0.414	0.405	*2.20*	0.15	-
Chromium	60 [8]	99	190	60	4.73	5.69	7.51	8.35	*10.59*	18.3	15.8	14.3	-	19.7	18.1	18.9	*4.32*	15.3	-
Cobalt	50 [10]	-	-	50	2.97	3.38	2.63	2.67	*1.51*	10.3	8.6	7.59	-	10.9	9.43	9.62	*1.99*	8.14	-
Copper	90-150 [12]	67	130	90	8.83	7.22	9.55	8.07	*16.80*	***89.9***	59.5	48.1	-	***110***	***67.1***	***69.6***	*3.66*	39.9	-
Lead	100-500 [13]	69	130	100	0.77	0.61	0.68	0.65	*nc*	7.44	6.14	4.93	-	7.68	6.96	6.79	*2.47*	4.13	-
Mercury	15 [14]	0.43	0.84	15	<0.050	<0.050	<0.050	<0.050	*nc*	0.205	***0.773***	***2.28***	0.0076	0.267	0.321	0.31	*3.49*	0.279	0.026
Molybdenum	10 [10]	-	-	10	<0.50	<0.50	0.67	0.58	*nc*	2.94	2.38	1.51	-	3.31	2.08	2.11	*nc*	1.33	-
Nickel	100 [10]	-	-	100	3.45	3.73	3.2	3.62	*12.32*	11.6	9.83	8.69	-	12.3	11.7	11.9	*1.69*	9.56	-
Selenium	3 [10]	-	-	3	<0.20	<0.20	<0.20	<0.20	*nc*	0.35	0.26	<0.20	-	0.4	0.26	0.27	*nc*	<0.20	-
Silver	20 [10]	-	-	20	<0.10	<0.10	<0.10	<0.10	*nc*	0.12	<0.10	<0.10	-	0.13	0.11	0.11	*nc*	<0.10	-
Thallium	-	-	-	-	<0.050	<0.050	<0.050	<0.050	*nc*	0.209	0.156	0.12	-	0.261	0.19	0.194	*nc*	0.112	-
Tin	50 [10]	-	-	50	<2.0	<2.0	<2.0	<2.0	*nc*	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	*nc*	<2.0	-
Uranium	16 [15]	-	-	-	0.134	0.966	0.192	0.109	*nc*	1.77	1.31	1.03	-	1.88	1.3	1.28	*1.55*	0.831	-
Vanadium	200 [10]	-	-	200	22.5	25.2	22.1	23.9	*7.83*	64.6	57	53.6	-	71.1	62.2	63.2	*1.59*	57.3	-
Zinc	150-450 [16]	170	330	150	18.1	18.1	15.5	15.5	*0.00*	97.4	73.9	61.4	-	108	87.8	89.7	*2.14*	59	-

Table 1
Sediment Analytical Results - Round 1 Analysis

				Location ID:	Sed-1					Sed-2				Sed-3					
				Sample ID:	SED11-1A	SED11-1B	SED11-1C	SED11-1G	*RPD %*[19]	SED11-2A	SED11-2B	SED11-2C	SED11-2E	SED11-3A	SED11-3B	SED11-3G	*RPD %*[19]	SED11-3C	SED11-3D
				Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011
				Sample Depth (m):	0.00-0.38	0.38-0.97	0.97-1.35	0.97-1.35		0.00-0.45	0.45-0.91	0.91-1.36	1.82-2.27	0.0-0.46	0.46-0.92	0.46-0.92		0.92-1.27	1.27-2.12
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]															
EPH																			
EPH10-19	1000 [17]	-	-	1000 [17]	<200	<200	-	-	-	-	-	-	-	-	-	-	-	-	-
EPH19-32	1000 [17]	-	-	1000 [17]	<200	<200	-	-	-	-	-	-	-	-	-	-	-	-	-
LEPH	1000 [10]	-	-	1000	<200	<200	-	-	-	-	-	-	-	-	-	-	-	-	-
HEPH	1000 [10]	-	-	1000	<200	<200	-	-	-	-	-	-	-	-	-	-	-	-	-
PAH																			
2-Methylnaphthalene	-	0.12	0.24	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Acenaphthene	-	0.055	0.11	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Acenaphthylene	-	0.079	0.15	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Anthracene	-	0.15	0.29	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Benzo(a)anthracene	1 [10]	0.43	0.83	1	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	0.054	0.074	*nc*	<0.050	-
Benzo(a)pyrene	1 [9]	0.47	0.92	1	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Benzo(b)fluoranthene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	0.101	0.067	0.091	*nc*	<0.050	-
Benzo(g,h,i)perylene	-	-	-	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Benzo(k)fluoranthene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Chrysene	-	0.52	1	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	0.101	<0.050	*nc*	<0.050	-
Dibenz(a,h)anthracene	1 [10]	0.084	0.16	1	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Fluoranthene	-	0.93	1.8	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	0.065	0.228	0.321	*nc*	<0.050	-
Fluorene	-	0.089	0.17	-	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Indeno(1,2,3-c,d)pyrene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Naphthalene	5 [10]	0.24	0.47	5	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Phenanthrene	5 [10]	0.34	0.65	5	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	<0.050	<0.050	<0.050	*nc*	<0.050	-
Pyrene	10 [10]	0.87	1.7	10	<0.050	<0.050	<0.050	<0.050	*nc*	-	-	-	-	0.251	0.215	0.313	*nc*	0.07	-
Total PAHs	-	10	20	-	<0.050	<0.050	<0.050	<0.050	*nc*				-	0.316	0.598	0.708	-	0.07	-
Phenols, Chlorinated																			
2,3,4-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,3,5-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,3,6-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,6-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,3,4,5-Tetrachlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,3,4,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,3,5,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	0.15-20 [18]	0.36	0.69	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 1
Sediment Analytical Results - Round 1 Analysis

					Location ID:	Sed-4			Sed-5						Sed-6				
					Sample ID:	SED11-4A	SED11-4B	SED11-4C	SED11-5A	SED11-5G	*RPD %*[19]	SED11-5B	SED11-5C	SED11-5D	SED11-6A	SED11-6B	SED11-6C	SED11-6G	*RPD %*[19]
					Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	
					Sample Depth (m):	0.00-0.56	0.56-1.05	0.76-1.58	0.00-0.50	0.00-0.50		0.50-1.00	1.00-1.50	1.50-2.17	0.00-0.48	0.48-0.96	0.96-1.44	0.96-1.44	
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]															
Physical Tests																			
Hardness, Total (CaCO3) (%)	-	-	-	-	-	0.88	-	-	-	-	-	-	-	-	-	-	-	-	-
Moisture (%)	-	-	-	-	46.8	-	-	55	56.6	*2.87*	55.1	51.7	-	49.5	-	-	-	-	
pH	-	-	-	-	7.51	8.50	8.32	7.18	7.27	*1.25*	7.19	7.20	7.46	7.56	7.63	8.00	8.09	*1.12*	
Saturation (%)	-	-	-	-	-	-	-	96.4	96.9	*0.52*	127	-	-	-	-	-	-	-	
Grain Size																			
Clay (<0.004 mm) (%)	-	-	-	-	-	0.89	-	-	-	-	-	-	-	-	-	-	-	-	
Silt (0.004-0.063 mm) (%)	-	-	-	-	-	1.95	-	-	-	-	-	-	-	-	-	-	-	-	
Sand (0.063-2.00 mm) (%)	-	-	-	-	-	84.1	-	-	-	-	-	-	-	-	-	-	-	-	
Gravel (>2.00 mm) (%)	-	-	-	-	-	13.1	-	-	-	-	-	-	-	-	-	-	-	-	
Total Inorganics																			
Total Inorganic Carbon (%)	-	-	-	-	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	
Organics																			
Total Carbon by Combustion (%)	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	
Total Organic Carbon (%)	-	-	-	-	-	<0.10	-	-	-	-	-	-	-	-	-	-	-	-	
Saturated Paste Extractables																			
Chloride Ion	90 [8]	-	-	35	-	-	-	***11700***	***12200***	*4.18*	***13600***	-	-	-	-	-	-	-	
Sodium Ion	200 [9]	-	-	200	-	-	-	***6980***	***7040***	*0.86*	***7920***	-	-	-	-	-	-	-	
Total Metals																			
Antimony	20 [10]	-	-	20	0.17	<0.10	<0.10	0.48	0.14	*nc*	0.12	0.17	0.16	0.13	0.14	0.1	<0.10	*nc*	
Arsenic	15 [8]	26	50	15	4.68	0.766	0.751	4.12	4.19	*1.68*	3.49	6.25	4.47	4.15	4.23	3.24	2.92	*10.39*	
Barium	400 [8]	-	-	400	101	31.6	44.5	93.8	76.4	*20.45*	80.4	105	79.3	87.9	92.2	108	101	*6.70*	
Beryllium	4 [10]	-	-	4	<0.20	<0.20	<0.20	<0.20	<0.20	*nc*	0.21	0.24	<0.20	<0.20	0.21	<0.20	<0.20	*nc*	
Cadmium	1.5-70 [11]	2.6	5	1.5	0.404	<0.050	<0.050	0.328	0.331	*0.91*	0.373	0.383	0.357	0.262	0.337	0.155	0.124	*nc*	
Chromium	60 [8]	99	190	60	16.3	6.19	9.33	18	14.2	*23.60*	14.7	17.1	14.2	14.5	15.2	14.5	13.7	*5.67*	
Cobalt	50 [10]	-	-	50	9.04	3.49	3.96	8.22	8.47	*3.00*	9.19	10.2	8.06	8.49	8.68	8.78	7.95	*9.92*	
Copper	90-150 [12]	67	130	90	***83.6***	11.2	11.5	***70.5***	***69.3***	*1.72*	***81.4***	***91.6***	***73.4***	***70.5***	***86.7***	53.1	45.8	*14.76*	
Lead	100-500 [13]	69	130	100	6.71	0.72	0.98	25.3	6.63	***116.94***	8.47	9.99	8.36	6.13	6.38	4.83	4.05	*17.57*	
Mercury	15 [14]	0.43	0.84	15	0.181	<0.050	<0.050	0.131	0.095	*nc*	0.08	0.143	0.186	0.113	0.103	0.06	0.058	*nc*	
Molybdenum	10 [10]	-	-	10	3.39	0.68	0.57	3.69	3.25	*12.68*	4.54	4.27	3.7	2.24	2.98	2.05	1.8	*nc*	
Nickel	100 [10]	-	-	100	10.6	4.63	5.25	10.5	8.68	*18.98*	9.2	11.8	10.6	8.84	9.38	8.91	8.15	*8.91*	
Selenium	3 [10]	-	-	3	0.34	<0.20	<0.20	0.32	0.31	*nc*	0.36	0.41	0.32	0.28	0.33	0.23	<0.20	*nc*	
Silver	20 [10]	-	-	20	<0.10	<0.10	<0.10	<0.10	<0.10	*nc*	<0.10	0.13	<0.10	<0.10	<0.10	<0.10	<0.10	*nc*	
Thallium	-	-	-	-	0.165	<0.050	<0.050	0.114	0.116	*nc*	0.127	0.149	0.141	0.122	0.13	0.103	0.09	*nc*	
Tin	50 [10]	-	-	50	<2.0	<2.0	<2.0	<2.0	<2.0	*nc*	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	*nc*	
Uranium	16 [15]	-	-	-	2	0.379	0.286	2.9	2.82	*2.80*	3.66	3.08	2.39	2.03	2.24	1.66	1.34	*nc*	
Vanadium	200 [10]	-	-	200	59.7	25.5	29.5	53.5	54.2	*1.30*	56.4	61.8	52.3	57.5	56.8	54.6	52.3	*4.30*	
Zinc	150-450 [16]	170	330	150	94.2	20.6	23.5	100	82	*19.78*	86.8	98	83.4	77.9	88	62.7	52.5	*17.71*	

Table 1
Sediment Analytical Results - Round 1 Analysis

				Location ID:	Sed-4			Sed-5						Sed-6				
				Sample ID:	SED11-4A	SED11-4B	SED11-4C	SED11-5A	SED11-5G	*RPD %*[19]	SED11-5B	SED11-5C	SED11-5D	SED11-6A	SED11-6B	SED11-6C	SED11-6G	*RPD %*[19]
				Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	
				Sample Depth (m):	0.00-0.56	0.56-1.05	0.76-1.58	0.00-0.50	0.00-0.50		0.50-1.00	1.00-1.50	1.50-2.17	0.00-0.48	0.48-0.96	0.96-1.44	0.96-1.44	
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]														
EPH																		
EPH10-19	1000 [17]	-	-	1000 [17]	-	-	-	<200	<230	*nc*	-	-	-	<200	-	-	-	-
EPH19-32	1000 [17]	-	-	1000 [17]	-	-	-	290	660	*nc*	-	-	-	<200	-	-	-	-
LEPH	1000 [10]	-	-	1000	-	-	-	<200	<230	*nc*	-	-	-	<200	-	-	-	-
HEPH	1000 [10]	-	-	1000	-	-	-	290	660	*nc*	-	-	-	<200	-	-	-	-
PAH																		
2-Methylnaphthalene	-	0.12	0.24	-	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	<0.050	-	<0.050	-	-	-	-
Acenaphthene	-	0.055	0.11	-	<0.050	-	-	<0.050	<0.050	*nc*	***0.071***	<0.050	-	<0.050	-	-	-	-
Acenaphthylene	-	0.079	0.15	-	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	<0.050	-	<0.050	-	-	-	-
Anthracene	-	0.15	0.29	-	<0.050	-	-	<0.050	<0.050	*nc*	***0.212***	0.098	-	<0.050	-	-	-	-
Benzo(a)anthracene	1 [10]	0.43	0.83	1	<0.050	-	-	0.05	0.065	*nc*	0.108	0.144	-	<0.050	-	-	-	-
Benzo(a)pyrene	1 [9]	0.47	0.92	1	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	0.06	-	<0.050	-	-	-	-
Benzo(b)fluoranthene	1 [10]	-	-	1	0.066	-	-	0.058	0.084	*nc*	0.099	0.159	-	<0.050	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	<0.050	-	<0.050	-	-	-	-
Benzo(k)fluoranthene	1 [10]	-	-	1	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	0.053	-	<0.050	-	-	-	-
Chrysene	-	0.52	1	-	<0.050	-	-	<0.050	0.083	*nc*	0.127	0.21	-	0.056	-	-	-	-
Dibenz(a,h)anthracene	1 [10]	0.084	0.16	1	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	<0.050	-	<0.050	-	-	-	-
Fluoranthene	-	0.93	1.8	-	<0.050	-	-	0.263	0.308	*15.76*	***1.14***	0.609	-	0.112	-	-	-	-
Fluorene	-	0.089	0.17	-	<0.050	-	-	<0.050	<0.050	*nc*	***0.101***	<0.050	-	<0.050	-	-	-	-
Indeno(1,2,3-c,d)pyrene	1 [10]	-	-	1	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	<0.050	-	<0.050	-	-	-	-
Naphthalene	5 [10]	0.24	0.47	5	<0.050	-	-	<0.050	<0.050	*nc*	<0.050	<0.050	-	<0.050	-	-	-	-
Phenanthrene	5 [10]	0.34	0.65	5	<0.050	-	-	<0.050	<0.050	*nc*	0.079	0.061	-	<0.050	-	-	-	-
Pyrene	10 [10]	0.87	1.7	10	0.146	-	-	0.182	0.213	*nc*	0.707	0.42	-	0.09	-	-	-	-
Total PAHs	-	10	20	-	0.146			0.495	0.669	-	2.545	1.602	-	0.258	-	-	-	-
Phenols, Chlorinated																		
2,3,4-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
2,3,5-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
2,3,6-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
2,4,6-Trichlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
2,3,4,5-Tetrachlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
2,3,4,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
2,3,5,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-
Pentachlorophenol	0.15-20 [18]	0.36	0.69	0.15	-	-	-	<0.020	<0.020	*nc*	<0.020	-	-	-	-	-	-	-

Table 1
Sediment Analytical Results - Round 1 Analysis

				Location ID:	Sed-7				Sed-8			Sed-9			Sed-10				
				Sample ID:	SED11-7A	SED11-7B	SED11-7C	SED11-7D	SED11-8A	SED11-8B	SED11-8C	SED11-9A	SED11-9B	SED11-9C	SED11-10A	SED11-10G	***RPD %*** [19]	SED11-10B	SED11-10C
				Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011
				Sample Depth (m):	0.00-0.46	0.46-0.93	0.93-1.64	1.64-1.79	0.00-0.50	0.50-1.00	1.00-1.45	0.00-0.57	0.57-1.15	1.15-1.72	0.00-0.55	0.00-0.55		0.55-1.10	1.10-1.65
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]															
Physical Tests																			
Hardness, Total (CaCO3) (%)	-	-	-	-	-	-	1.07	-	-	-	<0.70	0.91	-	-	0.72	0.71	*1.40*	-	-
Moisture (%)	-	-	-	-	32.5	43.4	40.6	16.3	35	-	-	26.9	28.9	23.2	18.3	-	-	-	-
pH	-	-	-	-	7.87	7.86	7.35	-	7.05	7.15	7.47	8.10	7.92	7.74	7.41	-	-	6.99	7.61
Saturation (%)	-	-	-	-	43	-	-	-	41.2	-	-	41.7	-	-	-	-	-	-	-
Grain Size																			
Clay (<0.004 mm) (%)	-	-	-	-	-	-	3.61	-	-	-	0.62	2.6	-	-	0.51	0.67	*27.12*	-	-
Silt (0.004-0.063 mm) (%)	-	-	-	-	-	-	19.2	-	-	-	0.98	11.4	-	-	0.26	0.3	*14.29*	-	-
Sand (0.063-2.00 mm) (%)	-	-	-	-	-	-	72.3	-	-	-	40.7	84.2	-	-	65	72.2	*10.50*	-	-
Gravel (>2.00 mm) (%)	-	-	-	-	-	-	4.99	-	-	-	57.7	1.78	-	-	34.3	26.8	*24.55*	-	-
Total Inorganics																			
Total Inorganic Carbon (%)	-	-	-	-	-	-	0.13	-	-	-	<0.10	0.11	-	-	<0.10	<0.10	*nc*	-	-
Organics																			
Total Carbon by Combustion (%)	-	-	-	-	-	-	5.5	-	-	-	0.6	1.2	-	-	<0.10	<0.10	*nc*	-	-
Total Organic Carbon (%)	-	-	-	-	-	-	5.4	-	-	-	0.64	1.05	-	-	<0.10	<0.10	*nc*	-	-
Saturated Paste Extractables																			
Chloride Ion	90 [8]	-	-	35	***2950***	-	-	-	***2570***	-	-	***3100***	-	-	-	-	-	-	-
Sodium Ion	200 [9]	-	-	200	***1740***	-	-	-	***1560***	-	-	***1780***	-	-	-	-	-	-	-
Total Metals																			
Antimony	20 [10]	-	-	20	<0.10	0.14	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	<0.10	<0.10
Arsenic	15 [8]	26	50	15	1.95	2.8	1.66	-	2.32	1.27	1.36	1.84	3.05	2.05	1.41	-	-	1.76	1.89
Barium	400 [8]	-	-	400	28.6	45.8	33.8	-	36.5	21.2	25	31.9	43.1	36.9	31	-	-	17	25.7
Beryllium	4 [10]	-	-	4	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	-	-	<0.20	<0.20
Cadmium	1.5-70 [11]	2.6	5	1.5	0.076	0.173	0.121	-	0.077	<0.050	0.053	0.069	0.127	0.084	<0.050	-	-	<0.050	0.056
Chromium	60 [8]	99	190	60	8.79	14.8	7.81	-	9.76	8.05	7.23	8.49	10.3	8.33	4.87	-	-	9.19	7.83
Cobalt	50 [10]	-	-	50	5.24	6.84	4.85	-	5.67	3.92	5.06	5.22	6.62	6.63	4	-	-	4.68	4.53
Copper	90-150 [12]	67	130	90	39.2	56.1	34.3	-	46.5	27.6	28.1	35.5	54.7	41.2	29.7	-	-	22.1	35.1
Lead	100-500 [13]	69	130	100	3.76	4.64	3.13	-	4.7	2.47	2.4	3.42	5.27	3.87	2.56	-	-	2.73	3.14
Mercury	15 [14]	0.43	0.84	15	<0.050	0.052	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050
Molybdenum	10 [10]	-	-	10	1.1	2.2	1.6	-	1.73	0.62	1.63	1.14	1.75	1.23	0.88	-	-	0.68	1.42
Nickel	100 [10]	-	-	100	5.7	8.11	5.32	-	6.62	5.4	5.27	6.33	7.52	6.31	4.53	-	-	5.5	5.45
Selenium	3 [10]	-	-	3	<0.20	<0.20	<0.20	-	<0.20	<0.20	<0.20	<0.20	0.22	<0.20	<0.20	-	-	<0.20	<0.20
Silver	20 [10]	-	-	20	<0.10	<0.10	<0.10	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	<0.10	<0.10
Thallium	-	-	-	-	<0.050	0.066	<0.050	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050
Tin	50 [10]	-	-	50	<2.0	<2.0	<2.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	-	-	<2.0	<2.0
Uranium	16 [15]	-	-	-	1.6	1.69	1.33	-	1.74	0.507	0.799	1.04	1.75	1.38	0.509	-	-	1	1.04
Vanadium	200 [10]	-	-	200	36.4	45.4	34.1	-	43	28	30.3	35.8	43.2	37.3	23.7	-	-	30.7	30
Zinc	150-450 [16]	170	330	150	50.7	61.7	43.3	-	54.6	41.5	42.6	49.2	60.8	48.5	42	-	-	42.5	44.1

Table 1
Sediment Analytical Results - Round 1 Analysis

				Location ID:	Sed-7				Sed-8			Sed-9			Sed-10				
				Sample ID:	SED11-7A	SED11-7B	SED11-7C	SED11-7D	SED11-8A	SED11-8B	SED11-8C	SED11-9A	SED11-9B	SED11-9C	SED11-10A	SED11-10G	***RPD %*** [19]	SED11-10B	SED11-10C
				Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011		4/13/2011	4/13/2011
				Sample Depth (m):	0.00-0.46	0.46-0.93	0.93-1.64	1.64-1.79	0.00-0.50	0.50-1.00	1.00-1.45	0.00-0.57	0.57-1.15	1.15-1.72	0.00-0.55	0.00-0.55		0.55-1.10	1.10-1.65
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]															
EPH																			
EPH10-19	1000 [17]	-	-	1000 [17]	<200	-	-	-	<200	-	-	<200	-	-	-	-	-	-	-
EPH19-32	1000 [17]	-	-	1000 [17]	<200	-	-	-	<200	-	-	<200	-	-	-	-	-	-	-
LEPH	1000 [10]	-	-	1000	<200	-	-	-	<200	-	-	<200	-	-	-	-	-	-	-
HEPH	1000 [10]	-	-	1000	<200	-	-	-	<200	-	-	<200	-	-	-	-	-	-	-
PAH																			
2-Methylnaphthalene	-	0.12	0.24	-	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Acenaphthene	-	0.055	0.11	-	<0.050	<0.050	***0.138***	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Acenaphthylene	-	0.079	0.15	-	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Anthracene	-	0.15	0.29	-	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Benzo(a)anthracene	1 [10]	0.43	0.83	1	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Benzo(a)pyrene	1 [9]	0.47	0.92	1	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Benzo(b)fluoranthene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Benzo(g,h,i)perylene	-	-	-	-	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Benzo(k)fluoranthene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Chrysene	-	0.52	1	-	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Dibenz(a,h)anthracene	1 [10]	0.084	0.16	1	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Fluoranthene	-	0.93	1.8	-	<0.050	0.12	0.317	<0.050	<0.050	-	-	0.074	0.067	0.055	<0.050	-	-	-	-
Fluorene	-	0.089	0.17	-	<0.050	<0.050	0.083	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Indeno(1,2,3-c,d)pyrene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Naphthalene	5 [10]	0.24	0.47	5	<0.050	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Phenanthrene	5 [10]	0.34	0.65	5	<0.050	<0.050	0.062	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	-	-
Pyrene	10 [10]	0.87	1.7	10	<0.050	0.083	0.202	<0.050	<0.050	-	-	0.059	<0.050	<0.050	<0.050	-	-	-	-
Total PAHs	-	10	20	-	<0.050	0.203	0.802	<0.050	<0.050	-	-	0.133	0.067	0.055	<0.050		-	-	-
Phenols, Chlorinated																			
2,3,4-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
2,3,5-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
2,3,6-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
2,4,5-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
2,4,6-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
2,3,4,5-Tetrachlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
2,3,4,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
2,3,5,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-
Pentachlorophenol	0.15-20 [18]	0.36	0.69	0.15	<0.020	<0.020	-	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-

Table 1
Sediment Analytical Results - Round 1 Analysis

				Location ID:	Sed-11			Sed-12			Sed-13			Sed-14			Sed-15		
				Sample ID:	SED11-11A	SED11-11B	SED11-11C	SED11-12A	SED11-12B	SED11-12C	SED11-13A	SED11-13B	SED11-13C	SED11-14A	SED11-14B	SED11-14C	SED11-15A	SED11-15B	SED11-15C
				Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011
				Sample Depth (m):	0.00-0.42	0.42-0.85	0.85-1.27	0.00-0.68	0.68-1.11	1.11-1.54	0.00-0.15	0.15-0.64	0.64-1.22	0.00-0.33	0.33-0.95	0.95-1.45	0.00-0.34	0.34-0.83	0.83-1.51
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]															
Physical Tests																			
Hardness, Total (CaCO3) (%)	-	-	-	-	-	-	-	0.91	-	-	-	<0.70	-	-	0.83	-	<0.70	-	-
Moisture (%)	-	-	-	-	54.5	45.7	12.8	21.1	-	-	49.7	15.5	19.3	36.1	-	-	21.3	13.8	14.4
pH	-	-	-	-	7.55	7.79	8.54	7.69	7.63	7.95	7.43	7.60	7.44	7.34	7.37	7.55	7.27	7.46	7.20
Saturation (%)	-	-	-	-	114	-	-	-	-	-	67.9	-	-	-	-	-	32.9	-	-
Grain Size																			
Clay (<0.004 mm) (%)	-	-	-	-	-	-	-	0.91	-	-	-	0.5	-	-	0.68	-	0.73	-	-
Silt (0.004-0.063 mm) (%)	-	-	-	-	-	-	-	2.2	-	-	-	0.38	-	-	0.81	-	1.14	-	-
Sand (0.063-2.00 mm) (%)	-	-	-	-	-	-	-	78.5	-	-	-	55.5	-	-	85.8	-	92.1	-	-
Gravel (>2.00 mm) (%)	-	-	-	-	-	-	-	18.4	-	-	-	43.7	-	-	12.7	-	6.05	-	-
Total Inorganics																			
Total Inorganic Carbon (%)	-	-	-	-	-	-	-	0.11	-	-	-	<0.10	-	-	0.1	-	<0.10	-	-
Organics																			
Total Carbon by Combustion (%)	-	-	-	-	-	-	-	0.2	-	-	-	<0.10	-	-	0.1	-	0.1	-	-
Total Organic Carbon (%)	-	-	-	-	-	-	-	0.1	-	-	-	<0.10	-	-	<0.10	-	0.1	-	-
Saturated Paste Extractables																			
Chloride Ion	90 [8]	-	-	35	***12200***	-	-	-	-	-	***9600***	-	-	-	-	-	***1270***	-	-
Sodium Ion	200 [9]	-	-	200	***6900***	-	-	-	-	-	***5420***	-	-	-	-	-	***728***	-	-
Total Metals																			
Antimony	20 [10]	-	-	20	0.17	0.16	<0.10	<0.10	<0.10	<0.10	0.14	<0.10	<0.10	0.15	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic	15 [8]	26	50	15	4.95	5.28	0.696	0.887	0.747	0.461	3.44	0.651	0.436	3.29	0.755	0.41	0.94	0.851	0.588
Barium	400 [8]	-	-	400	103	89.2	31.2	32.5	33.6	33.7	80.9	27.5	31.4	71.5	28.5	30.5	19.1	17.1	15.4
Beryllium	4 [10]	-	-	4	0.21	0.23	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Cadmium	1.5-70 [11]	2.6	5	1.5	0.299	0.225	<0.050	<0.050	<0.050	<0.050	0.194	<0.050	<0.050	0.178	<0.050	<0.050	<0.050	<0.050	<0.050
Chromium	60 [8]	99	190	60	16.3	15.1	5.54	6.94	6.65	5.96	12.4	4.97	6.43	11.1	5.39	6.24	6.51	6.57	5.8
Cobalt	50 [10]	-	-	50	10.1	10	3	3.57	3.22	3.12	6.99	3.93	2.81	6.82	3.24	3.09	3.27	3.45	3.43
Copper	90-150 [12]	67	130	90	***83.6***	***82.6***	10.7	15.7	11	8.5	54.9	9.06	8.48	43.3	10.7	9.28	11.6	11.1	10.6
Lead	100-500 [13]	69	130	100	7.9	8.67	1.1	1.29	0.91	0.55	4.3	0.77	0.55	3.94	0.93	0.66	1.3	1.34	1.31
Mercury	15 [14]	0.43	0.84	15	0.152	0.126	<0.050	<0.050	<0.050	<0.050	0.117	<0.050	<0.050	0.158	<0.050	<0.050	<0.050	<0.050	<0.050
Molybdenum	10 [10]	-	-	10	2.9	3.18	<0.50	0.81	0.89	<0.50	2.1	<0.50	0.51	3.8	0.54	<0.50	<0.50	<0.50	<0.50
Nickel	100 [10]	-	-	100	11.1	10.7	4.04	5.04	4.45	4.25	8.62	4.62	3.57	7.8	4.33	4.61	5.78	5.45	6.21
Selenium	3 [10]	-	-	3	0.36	0.39	<0.20	<0.20	<0.20	<0.20	0.21	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver	20 [10]	-	-	20	<0.10	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Thallium	-	-	-	-	0.136	0.101	<0.050	<0.050	<0.050	<0.050	0.097	<0.050	<0.050	0.095	<0.050	<0.050	<0.050	<0.050	<0.050
Tin	50 [10]	-	-	50	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium	16 [15]	-	-	-	2.56	3.11	0.249	0.459	0.38	0.138	1.47	0.232	0.254	1.75	0.29	0.294	0.329	0.291	0.263
Vanadium	200 [10]	-	-	200	63.1	61.8	25.9	31.1	27.9	25.4	50.9	25	21.9	44.6	25.9	26.8	34.1	32.7	33
Zinc	150-450 [16]	170	330	150	93.3	86.6	19.3	23.2	21.9	16.6	62.8	21.5	15.8	53.5	20.3	22.6	25.6	28.2	27.5

Table 1
Sediment Analytical Results - Round 1 Analysis

				Location ID:	Sed-11			Sed-12			Sed-13			Sed-14			Sed-15		
				Sample ID:	SED11-11A	SED11-11B	SED11-11C	SED11-12A	SED11-12B	SED11-12C	SED11-13A	SED11-13B	SED11-13C	SED11-14A	SED11-14B	SED11-14C	SED11-15A	SED11-15B	SED11-15C
				Date Sampled:	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011	4/13/2011
				Sample Depth (m):	0.00-0.42	0.42-0.85	0.85-1.27	0.00-0.68	0.68-1.11	1.11-1.54	0.00-0.15	0.15-0.64	0.64-1.22	0.00-0.33	0.33-0.95	0.95-1.45	0.00-0.34	0.34-0.83	0.83-1.51
Parameter	***BCCSR PL*** [3,4]	**BCCSR SedQC(SS) Marine** [3,5]	**BCCSR SedQC(TS) Marine** [3,6]	***BCCSR SRNL*** [3,7]															
EPH																			
EPH10-19	1000 [17]	-	-	1000 [17]	<200	-	-	-	-	-	<200	-	-	-	-	-	<200	-	-
EPH19-32	1000 [17]	-	-	1000 [17]	210	-	-	-	-	-	<200	-	-	-	-	-	<200	-	-
LEPH	1000 [10]	-	-	1000	<200	-	-	-	-	-	<200	-	-	-	-	-	<200	-	-
HEPH	1000 [10]	-	-	1000	210	-	-	-	-	-	<200	-	-	-	-	-	<200	-	-
PAH																			
2-Methylnaphthalene	-	0.12	0.24	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Acenaphthene	-	0.055	0.11	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Acenaphthylene	-	0.079	0.15	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Anthracene	-	0.15	0.29	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Benzo(a)anthracene	1 [10]	0.43	0.83	1	0.061	0.053	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Benzo(a)pyrene	1 [9]	0.47	0.92	1	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Benzo(b)fluoranthene	1 [10]	-	-	1	0.085	0.075	<0.050	<0.050	-	-	0.051	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Benzo(g,h,i)perylene	-	-	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Benzo(k)fluoranthene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Chrysene	-	0.52	1	-	0.051	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Dibenz(a,h)anthracene	1 [10]	0.084	0.16	1	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Fluoranthene	-	0.93	1.8	-	0.356	0.221	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Fluorene	-	0.089	0.17	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Indeno(1,2,3-c,d)pyrene	1 [10]	-	-	1	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Naphthalene	5 [10]	0.24	0.47	5	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Phenanthrene	5 [10]	0.34	0.65	5	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050	<0.050	-	-	<0.050	<0.050	<0.050
Pyrene	10 [10]	0.87	1.7	10	0.263	0.277	<0.050	<0.050	-	-	0.107	<0.050	<0.050	0.055	-	-	<0.050	<0.050	<0.050
Total PAHs	-	10	20	-	0.731	0.551	<0.050	<0.050	-	-	0.107	<0.050	<0.050	0.055	-	-	<0.050	<0.050	<0.050
Phenols, Chlorinated																			
2,3,4-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
2,3,5-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
2,3,6-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
2,4,6-Trichlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
2,3,4,5-Tetrachlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
2,3,4,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
2,3,5,6-Tetrachlorophenol	0.5 [10]	-	-	0.5	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-
Pentachlorophenol	0.15-20 [18]	0.36	0.69	0.15	<0.020	<0.020	-	-	-	-	<0.020	<0.020	-	-	-	-	-	-	-

Table 1
Sediment Analytical Results - Round 1 Analysis

(1) All values are reported as µg/g unless otherwise noted
(2) - = No standard or not analyzed
(3) BCCSR = BC Environmental Management Act, Contaminated Sites Regulation, B.C. Reg. 375/96, including amendments up to B.C. Reg. 112/2010, effective May 1, 2010
(4) BCCSR PL = Schedules 4 (Generic) and/or 5 (Matrix), Column III Urban Park, and/or Schedule 10, Column III, Agricultural, Urban Park, Residential Soil Standard
(5) BCCSR SedQC(SS) Marine = Schedule 9, Column IV, Marine and Estuarine Sediment, Sensitive Site
(6) BCCSR SedQC(TS) Marine = Schedule 9, Column V, Marine and Estuarine Sediment, Typical Site
(7) BCCSR SRNL = Schedule 7, Standards Triggering Contaminated Soil Relocation Agreements, Column II, Soil Relocation to Nonagricultural Land
(8) Schedule 5, Human Health Protection, Groundwater used for drinking water
(9) Schedule 5, Environmental Protection, Toxicity to soil invertebrates and plants
(10) Schedule 4, Generic Numerical Soil Standards
(11) Cadmium varies with pH as follows for BCCSR PL, Schedule 5, Human Health Protection, Groundwater used for drinking water:
- 1.5 if pH<6.5
- 3 if pH>=6.5 and pH<7
- 15 if pH>=7 and pH<7.5

Cadmium varies with pH as follows for BCCSR PL, Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life, Freshwater:
- 2 if pH<7
- 2.5 if pH>=7 and pH<7.5
- 25 if pH>=7.5 and pH<8

Cadmium varies with pH as follows for BCCSR PL, Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life, Marine:
- 3.5 if pH>=7 and pH<7.5
- 35 if pH>=7.5 and pH<8

Otherwise, Schedule 5, Environmental Protection, Toxicity to soil invertebrates and plants applies (70 ug/g).

(12) Copper varies with pH as follows for BCCSR PL, Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life:
- 90 if pH<5
- 100 if pH>=5 and pH<5.5

Otherwise, Schedule 5, Environmental Protection, Toxicity to soil invertebrates and plants applies (150 ug/g).

(13) Lead varies with pH as follows for BCCSR PL, Schedule 5, Human Health Protection, Groundwater used for drinking water:
- 100 if pH<6
- 250 if pH>=6 and pH<6.5

Lead varies with pH as follows for BCCSR PL, Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life:
- 150 if pH<5.5
- 250 if pH>=5.5 and pH<6

Otherwise, Schedule 5, Human Health Protection, Intake of contaminated soil applies (500 ug/g).

(14) Schedule 5, Human Health Protection, Intake of contaminated soil
(15) Schedule 10, Generic Numerical Soil and Water Standards, Column III, Agricultural, Urban Park, Residential Soil Standard
(16) Zinc varies with pH as follows for BCCSR PL, Schedule 5, Human Health Protection, Groundwater used for drinking water:
- 150 if pH<5
- 200 if pH>=5 and pH<5.5
- 300 if pH>=5.5 and pH<6

Zinc varies with pH as follows for BCCSR PL, Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life, Freshwater:
- 150 if pH<6
- 300 if pH>=6 and pH<6.5

Zinc varies with pH as follows for BCCSR PL, Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life, Marine:
- 150 if pH<6.5
- 300 if pH>=6.5 and pH<7

Otherwise, Schedule 5, Environmental Protection, Toxicity to soil invertebrates and plants applies (450 ug/g).

(17) BC Ministry of Water, Land and Air Protection, Director of Waste Management, May 23, 2003, Update on Contaminated Sites, Clarification on Hydrocarbon Analytical Methods and Standards; the Director has extended the EPH to LEPH/HEPH equivalency indefinitely; therefore, EPH concentrations not corrected for PAHs have been conservatively compared to the LEPH/HEPH standards

(18) Pentachlorophenol varies with pH as follows for BCCSR PL, Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life:

0.15	if	pH>=6.5 and pH<7.5
0.2	if	pH>=7.5 and pH<8
0.3	if	pH>=6 and pH<6.5
0.35	if	pH>=8
2.5	if	pH>=5.5 and pH<6

Pentachlorophenol varies with pH as follows for BCCSR PL, Schedule 5, Human Health Protection, Groundwater used for drinking water:

1	if	pH>=7.5
1.5	if	pH>=7 and pH<7.5
2	if	pH>=6.5 and pH<7
6.5	if	pH>=6 and pH<6.5

Otherwise, Schedule 5, Environmental Protection, Toxicity to soil invertebrates and plants applies (20 ug/g).

(19) RPD = Relative Percent Difference

nc RPD is not calculated as one or both results are less than five times the reportable detection limit

RPD Value If the RPD value is bold and italicized for a sample and its duplicate this indicates that the RPD is above the applicable BC MOE Data Quality Objective as outlined in the BC Environmental Laboratory Manual, 2009 Edition

APPENDIX A

Fisheries and Oceans Canada
Pêches et Océans Canada

Oceans, Habitat and Enhancement
Lower Fraser Area
Unit 3 - 100 Annacis Parkway (Annacis Island)
Delta, BC V3M 6A2

October 26, 2010

District of Squamish
37955 2nd Avenue
PO Box 310
Squamish, BC V8B 0A3

Attention: M. Gottardi, Community Development Manager

RE: Proposed Dredging of Navigation Channel in Mamquam Blind Channel & Placement of Dredged Material on Former Nexen Lands

Dear Mick:

Reference is made to the August 22, 2008 Squamish Estuary Review Committee (SERC) letter sent to you regarding the subject proposal. This August 22, 2008 SERC letter had an expiry date of December 31, 2009 but was extended to a new expiry date of December 31, 2010.

As December 31, 2010 is approaching, SERC is being proactive and has reviewed whether the expiry date of the August 22, 2008 can be extended beyond its current December 31, 2010 expiry date.

Based upon this review, Fisheries and Oceans Canada (DFO) has determined that an amendment needs to be made to the timing restrictions for the project. The original timing restrictions stated that the dredging works only be conducted during the period of January 1 to February 15 of any given year or during the period of September 15 to October 1 of any given year.

However, in recent years, herring have appeared in Mamquam Blind Channel in early February in preparation for spawning. In order to protect herring, DFO is amending the timing restrictions for the project so that the dredging works can only be conducted during the period of December 1 of any given year to February 1 of the following year or during the period of September 15 to October 1 of any given year.

Subject to the above amended timing restriction, SERC hereby amends the expiry date of the August 22, 2008 SERC letter to a new expiry date of December 31, 2011.

Please note that all understandings and mitigation measures specified in SERC's August 22, 2008 letter as amended above are still applicable to the subject proposal.

Should the dredging need to be delayed until after December 31, 2011, please contact me as soon as possible so that SERC can review your request for another extension to the expiry date of the SERC August 22, 2008 letter.

.../2

Should you have any questions or require further information, please do not hesitate to contact the undersigned at Tel: (604) 666-8190.

Sincerely,

Brian Naito
on behalf of SERC

Fisheries and Oceans Canada
Oceans, Habitat and Enhancement
Lower Fraser Area
Unit 3 - 100 Annacis Parkway (Annacis Island)
Delta, BC V3M 6A2

August 22, 2008

District of Squamish
37955 2nd Avenue
PO Box 310
Squamish, BC V8B 0A3

Attention: M. Gottardi, Director of Community Development

RE: Proposed Dredging of Navigation Channel in Mamquam Blind Channel & Placement of Dredged Material on Former Nexen Lands

Dear Mick:

Reference is made to the following documents sent to SERC for review:

i) the letter to P. Woods of the District of Squamish from T. Finnbogason of Envirochem Services Inc. dated July 23, 2008 and attachments regarding "District of Squamish – SERC Application for Dredging the Stawamus Bar within Mamquam Blind Channel"and;

ii) the letter to P. Woods of the District of Squamish from T. Finnbogason of Envirochem Services Inc. dated June 11, 2008 and attachments regarding "District of Squamish – SERC Application for Sampling in Support of Dredging the Stawamus Bar within Mamquam Blind Channel".

iii) the email to P. Woods of the District of Squamish from T. Finnbogason of Envirochem Services Inc. sent August 6, 2008 and attachment regarding "SERC Application for Dredging Stawamus Bar (Mamquam Blind Channel) – Location of Suction Dredge Lines".

From the information provided, it is SERC's understanding that the District of Squamish is proposing to dredge a portion of the navigation channel in Mamquam Blind Channel near the mouth of the Stawamus River. The dredging will restore the navigation channel depth to -3.5 metres LLW. In addition, a "catch basin" area at the mouth of the Stawamus River will be dredged to a depth of -3.5 metres LLW. The total volume of material to be dredged is approximately 80,000 cubic metres. SERC also understands that hydraulic suction dredging will be used to undertake the works and that the dredged material will be placed on the upland at the former Nexen lands site.

Please be advised that, on the understanding that the foregoing points accurately reflect the subject proposal, it is the opinion of SERC that the potential adverse environmental impacts resulting from the works to dredge a portion of the navigation channel (to a depth of -3.5 metres LLW) and a "catch basin" (to a depth of -3.5 metres LLW) in Mamquam Blind Channel near and at the mouth of the Stawamus River can be mitigated through the application of appropriate criteria. In addition to those measures set out in the information provided, the following measures are intended to prevent or avoid any potentially harmful effects on the environment:

1. District of Squamish acknowledges that all plans and specifications relating to the works have been duly prepared and reviewed by appropriate professionals working on its behalf. District of Squamish further acknowledges that it is solely responsible for all design, safety and workmanship aspects of the works.

2. The works shall be as described above and as described and shown in the above referenced documents.

3. District of Squamish shall ensure that all work complies with the requirements of the *Fisheries Act* and any other applicable laws and regulations.

4. The works shall adhere to the "Squamish Estuary Maintenance Dredging Guidelines" with respect to those specific sections titled "Disposal of Dredgeate", "Deleterious Substances", and "Timing Restrictions" (attached).

5. Pumps for hydraulic suction dredging shall only operate when the suction-head is within one and one half metres (1.5 m) of the seabed.

6. Water-based machinery or equipment (e.g., barges, etc.) shall be located and firmly moored in deep water, far enough offshore to prevent any grounding on the intertidal foreshore or bed of Mamquam Blind Channel. The only exception to this condition is that use may be made of vertical spuds to hold barge(s) in place.

7. All works must be carried out in a manner that minimizes the direct or indirect release of sediment or sediment laden water onto the intertidal foreshore of or into the waters of Mamquam Blind Channel. In this regard, reference should be made to the water quality criteria for turbidity and suspended solids as described in the British Columbia Water Quality Guidelines (Criteria): 2006 Edition produced by BC Ministry of Environment.

8. If the dredging is conducted by hydraulic suction dredge and the dredge and return water pipes will cross the foreshore of Mamquam Blind Channel, please note the following requirements:

   Upland Areas: The dredge and return water pipes are to be placed/removed in a manner that avoids the disturbance to upland trees and minimizes the disturbance to shrub and grass vegetation at the top of and on the bank down to the high water mark (inclusive). Any shrub or tree vegetation that is removed or significantly disturbed is to be replaced by replanting at or near the disturbance site.

   Intertidal Areas: The dredge and return water pipes are to be placed/removed in a manner that does not disturb any intertidal mud or sand flat or intertidal vegetation on the Mamquam Blind Channel foreshore.

9. If the dredging is conducted by hydraulic suction dredge, the return water from the dredged material placed on the upland must be discharged directly into Howe Sound and the return water must be discharged via pipe that extends far enough offshore so that **the return water discharge is submerged to near the seabed and is below the sea water surface at all times**.

10. As the upland placement of dredged material is planned, the upland dredge material placement site and the dredged material must comply with the BC *Environmental Management Act* and its

regulations, such as the Contaminated Sites and Hazardous Waste regulations. Should contamination of sediments be a possibility due to present or historical activities at, or adjacent to, the proposed dredging area, the Ministry of Environment (BCE), Contaminated Sites Program, recommends assessment of sediment quality prior to dredging to ensure proper off-site management of dredged sediments. Section 55 of the *Environmental Management Act* and Part 8 of the Contaminated Sites Regulation should be referred to in conjunction with the results of any pre-dredge sediment quality assessment to determine whether a Contaminated Soil Relocation Agreement is required prior to commencing dredging. If site sediments are under provincial jurisdiction, the BCE Contaminated Sites Program recommends that results of in-situ sediment quality assessments be compared to the appropriate Contaminated Sites Regulation sediment quality criteria for marine and estuarine sediment.

11. There should be no fuelling on or immediately landward of the foreshore associated with the proposed works. All petroleum products (e.g., fuel, oil, lubricants), used in association with the construction of the subject works should be stored and handled at an appropriate upland location and in compliance with all applicable legislation, guidelines, and Best Management Practices.

12. District of Squamish shall ensure that an appropriate fuel and oil spill prevention/contingency plan is in place prior to work commencing and that appropriate spill containment and cleanup supplies are at hand whenever the subject dredging is underway.

13. District of Squamish should be reminded of its obligation to comply at all times with Section 36 of the *Fisheries Act*, which specifically prohibits the discharge of substances deleterious to fish or other aquatic life onto the intertidal foreshore of or into fish-bearing waters such as Mamquam Blind Channel. Due diligence is required at all times to prevent such discharges, and adherence to the terms and conditions of this letter does not of itself relieve District of Squamish of this ongoing obligation.

14. The works shall be carried out in such a manner so as to avoid any adverse impact on fish or fish habitat. If the harmful alteration, disruption or destruction of fish habitat occurs, the works will be in contravention of Section 35 of the *Fisheries Act*. If any such alteration occurs Fisheries & Oceans Canada reserves the right to immediately suspend or alter operations and the proponent and/or their agent(s) or contractor(s) shall undertake, at their own expense, any remedial works deemed necessary by Fisheries & Oceans Canada to ensure a "no net loss" in the productive capacity of local fish habitat.

15. The Fisheries & Oceans Canada Conservation & Protection Field Supervisor in Squamish, B.C. (Ph: 604-892-3230 / Facs. 604-892-2378) shall be notified at least five (5) days in advance of the start of the proposed works.

16. A copy of this letter must be kept on-site during the works.

17. This letter of advice is valid until December 31, 2009. After this time, if the subject works have not been completed, this letter will be void. This will ensure that the proposed works will conform to current habitat management policy, guidelines, and legislation.

18. It is understood that by proceeding with these works, District of Squamish and/or its agent(s) and/ or contractor(s) shall have indicated that they understand and have agreed to the foregoing conditions.

Please note that this letter of advice should not be taken to imply approval of the subject works in accordance with the habitat protection provisions of the *Fisheries Act* or any other federal or provincial legislation. If harmful alteration, disruption or destruction of fish habitat occurs as a result of a change in the plans for the subject proposed works, or failure to implement the measures specified above, contravention of subsection 35(1) of the *Fisheries Act* could occur.

Please note that the above measures are based upon the anticipated potential environmental issues associated with the works based on the project information supplied. For non-environmental issues or approvals, or in cases where unforeseen issues not addressed above or elsewhere may arise during the course of the work, the responsible authority(ies) must be contacted directly. For example, for matters concerning navigation, Transport Canada Navigable Waters Protection Division must be contacted

Should you have any questions or require further information, please do not hesitate to contact the undersigned at Tel: (604) 666-8190.

Sincerely,

Brian Naito
on behalf of SERC

cc: D. Lee, Environment Canada
M. Willcox, BC Ministry of Environment
P. Woods, District of Squamish
Fisheries and Oceans Canada, C&P Squamish
R. Lewis, Squamish Nation
Squamish Public Library

J. Schellenberg, Transport Canada, Navigable Waters Protection

APPENDIX B

1.0 EXCLUSION OF LOW LIKELIHOOD COPCS

Based on the history of the site, the following lower likelihood constituents of potential concern were identified:

- Methyl mercury;
- Hexachlorobenzene; and
- Dioxins/Furans.

Based on the results of the first round of analysis from this sediment sampling program, these lower likelihood constituents were not analysed during the second round of analysis. The rationale for not analysing these constituents is discussed below.

1.1 METHYL MERCURY

Based on the low total mercury concentrations measured in the first round of analysis of this sediment sampling program, and past sediment results from the 2001 *Off-Site Waterbodies Detailed Site Investigation* conducted by URS, methyl mercury concentrations are likely to be low in the Mamquam Blind Channel sediments. Therefore methyl mercury was not analyzed as part of this sediment sampling program.

1.2 HEXACHLOROBENZENE

Hexachlorobenzene is a constituent of potential concern (COPC) related to the past FMC/Nexen plant operations. Based on results from the 2001 *Off-Site Waterbodies Detailed Site Investigation* conducted by URS, hexachlorobenzene was only found in very small concentrations in the sediments around the former FMC/Nexen Plant. In fact, concentrations of other COPCs associated with the plant were all generally found with concentrations less than the CSR Sediment criteria. Therefore, hexachlorobenzene was not analyzed as part of this program.

1.3 DIOXINS AND FURANS

The constituents 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF) are COPCs related to the past FMC/Nexen plant operations. These COPCs would potentially be present where elevated mercury levels are present, and would represent older sediment formerly contaminated by plant operations.

Historic sampling as part of the *Off-Site Waterbodies Detailed Site Investigation (DSI)* measured a maximum TCDD/TCDF concentration of 28 pg/g Toxic Equivalency (TEQ) for the Squamish Estuary as a whole (21 samples collected). That value is considerably below the present CSR PL soil standard (350 pg/g TEQ) and CSR $SedQC_{SS}$ (130 pg/g TEQ). The maximum concentration historically measured in Mamquam Blind sediments (from 6 samples) was 18 pg/g.

The Off-Site Receiving Environment Risk Assessment evaluated the dioxin and furan fingerprint of sediments around the plant site, as well as within Old Lagoon sludge and Plant Site Landfill soil. The TCDD/TCDF present in South Beach sediments in proximity to the Old Lagoon discharge contained predominantly furans which was similar to the signature of Old Lagoon sludge and Landfill soil. This suggested that the site was likely a contributor of TCDF in this immediate area, i.e. the South Beach. However, the TCDD/TCDF signature of sediments elsewhere in the estuary (including Mamquam Blind) contained predominantly dioxins, and was thought to be more attributed to regional sources such as Municipal Landfill burning or Woodfibre pulp mill.

Dioxins and furans were only retained as COPCs in the Off-Site Receiving Environment Risk Assessment based on a wildlife bioaccumulation criteria of 2 pg/g TEQ, that BCMOE had published in its 1999 Draft Criteria for Managing Contaminated Sediment in BC. That value was used as a Toxicity Reference Value (TRV) to calculate wildlife hazard quotients for sediment. Hazard Quotients (HQs) did exceed a value of one; however, to our knowledge this 2 pg/g TEQ benchmark has since never been incorporated into the CSR or the Technical Appendix for the sediment criteria.

Therefore, it is highly unlikely that the sediments within Mamquam Blind contain levels of dioxins and furans exceeding either soil standards or sediment criteria, and dioxins and furans (including TCDD and TCDF) were not analysed as part of this program.

2.0 EXCLUSION OF ANALYTICAL METHODS

The following additional analytical methods were also considered as part of this program:

- Dredgeate Elutriate Test (DRET);
- Toxicity Characteristic Leaching Procedure (TCLP); and
- BC Ministry of Energy and Mines Method (BCMEM).

However, based on the results of the first round of analysis from this sediment sampling program, these additional analytical methods were not considered to be necessary. The rationale for not applying these analytical methods is discussed below.

2.1 DRET TEST

The USEPA/US Army Corps of Engineers (USACOE) has a Dredgeate Elutriate Test (DRET) for estimating the degree of contaminants released from sediments due to re-suspension at the time of dredging.

The results of the first round of analysis showed that the concentrations of the COPCs were generally below the CSR Sediment criteria. The marginal copper exceedences found in the sediments are not an issue with respect to water column effects, and previous work with mercury impact sediments from around the former FMC/Nexen Chlor-Alkali Plant in the 2004 *Plan for Management of Mercury Contaminated Sediment at the Former Chlor-Alkali Plant* by URS showed that sediment with a mercury concentration of 20 µg/g was found to re-suspend less than 1% of its total mercury concentration to the surrounding seawater.

Results from the first round of analysis of this sediment sampling program had a maximum mercury concentration of 2.28 µg/g. Based on historical re-suspension analysis, this is unlikely to impact the water of the Mamquam Blind Channel during any dredging operations. Therefore, based on historical and current results it was deemed that the DRET test was not necessary.

2.2 TCLP/BCMEM

To address the potential of the dredgeate to leach contaminants to groundwater once in a terrestrial setting, a toxic characteristic leaching procedure (TCLP) analysis, or analysis via an alternate method such as the BCMEM method, could be conducted on the sediments samples.

However, given that the concentration of COPCs that will leach is a portion of the total concentration, and that based on the first round of analysis, the total concentrations of COPCs were generally below the CSR Sediment Criteria (or only marginally above), they are unlikely to leach based on their low concentrations. Therefore, the analysis of the sediment samples using the TCLP or BCMEM analytical methods was not considered to be necessary.