Resort Municipality of Whistler Landfill Annual Monitoring Report – 2012

Whistler, BC

Presented to:

James Hallisey
Manager of Environmental Projects

Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, BC V0N 1B4

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1. INTRODUCTION

This annual report incorporates landfill monitoring data collected in 2012. The Resort Municipality of Whistler (RMOW) site is located approximately 8 km west of Whistler, and is accessed off Highway 99 on Cheakamus Lake Road. The location of the site is illustrated in Figure 1.

The Whistler landfill opened in 1977 and accepted residential, industrial, commercial and institutional waste. In 1988, the permit was amended to accept construction and demolition waste. The landfill site was closed in October 2005, to accommodate plans to use the area east of the site as the location of the Athletes' Village for the 2010 Winter Olympic Games. Between 1977 and 2005 approximately 350,000 tonnes of waste was disposed of at the Whistler Landfill (CH2M Hill, 2008a).

Construction of residential and commercial buildings in the area commenced in 2007, following the installation of a cover system and landfill gas (LFG) collection system in 2006.

Morrison Hershfield was retained by RMOW to complete the annual environmental monitoring and fulfill reporting requirements as set out in Section 3.31 of the 2005 Whistler Landfill Operational Certificate (MR-04693) and the Whistler Landfill Closure Plan (CH2M Hill, 2006a).

Results of the 2011 monitoring program and recommendation for the future monitoring requirements at the landfill were documented in the Whistler Landfill Annual Monitoring Report – 2011 & Revised Monitoring Program Recommendations (Morrison Hershfield, 2012) and submitted to the Ministry of Environment in June 2012.

The current report documents the 2012 monitoring program and presents a summary of the findings.

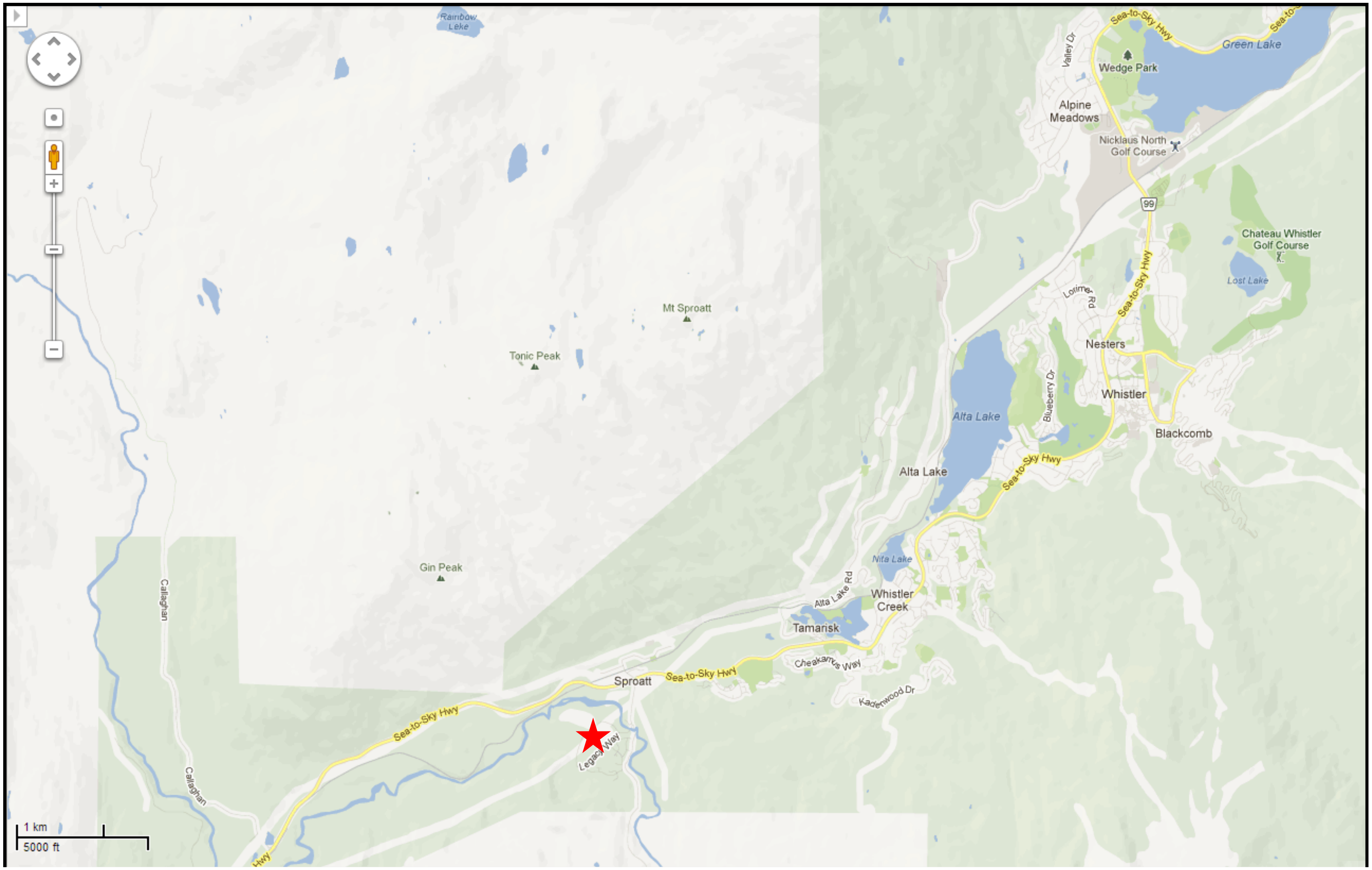

Figure 1. Whistler landfill location (Google Maps, 2013).

1.1 Program Objectives

The overall objective of the Whistler landfill monitoring program is to monitor post-closure impacts of the closed landfill on the surrounding environment.

The objectives of the Surface Water and Groundwater Monitoring Program are to:

- Determine if the landfill is negatively affecting local groundwater and surface water quality; and
- Apply corrective measures as necessary to minimize landfill effects on groundwater and surface water.

The objectives of the LFG monitoring program are as follows:

- Monitor levels of LFG migration offsite;
- Assess the overall collection performance of the Landfill Gas Collection System (LFGCS)
- Identify the presence of potentially unsafe concentrations of LFG within the soil at monitoring probe locations; and
- Adjust LFGCS as necessary based on monitoring data results, to minimize gas migration.

As outlined in the Closure Plan (CH2M Hill, 2006a), the monitoring program was to be re-evaluated following the completion of monitoring over a 2-year period; this evaluation was conducted in 2011. The recommendations from the Morrison Hershfield report (2012) and Ministry of the Environment response (Appendix A) have been incorporated into this report.

1.2 Report Purpose

The purpose of this report is to address the following requirements included in the Whistler Landfill Closure Plan:

- Annual reporting of monitoring data collected (2012); and
- Summary of maintenance activities competed on site in 2012 and planned objectives in 2013.

2. SITE DESCRIPTION

2.1 Landfill

There are three cells within the landfill which were developed at different times over the life span of the landfill:

- The northeast cell was initiated in 1977 and contains residential and industrial, commercial and institutional (ICI) waste. This is not in a lined cell and it relies on natural attenuation and a perimeter collection system to manage the leachate.
- The southwest cell was opened in 1988 to accept only construction and demolition waste (C & D). This cell also relies on natural attenuation and a perimeter collection system to manage the leachate.
- In 1998 a central cell was developed between the northeast and southwest cells for residential and ICI waste. This area was developed with high-density polyethylene (HDPE) liner with a leachate collection system.

In addition, a biosolids storage area was located at the south end of the landfill covering a portion of the old southwest cell. Based on CH2M Hill (2006a) preliminary survey information from 2005, there was an estimated 6,000 m^3 of biosolids stockpiled there.

2.2 Hydrological Conditions

The site is located within the Cheakamus watershed. The Cheakamus River is located approximately 300 m north of the waste mass and flows along the eastern boundary of the Athletes' Village (CH2M Hill, 2006a). The surface water features are concentrated mainly to the perimeter of the site. This is due to a combination of the natural and constructed topography in the area.

2.3 Geological Conditions

The following description of geological conditions associated with the site is described by CH2M Hill (2008a).

In general, the site topography slopes from south to north. As described in the Whistler Landfill Closure Plan, within areas on the site and within adjacent lands, aggregate extraction activities have removed much of the natural overburden materials for use as industrial aggregates and replaced them with imported fill materials. As a result, the present ground surface associated with the landfill has likely been altered by industrial activities. As part of historical aggregate extraction activities conducted at the site, much of the natural overburden materials had been removed from the area and replaced with imported fill, resulting in a disturbance of the natural topography of the site. Exposed bedrock surface, characterized by glaciated surfaces and steep inclines, are present throughout the site. Areas between the exposed bedrock are infilled by coarse and medium grain sediments.

Based on the results of the borehole investigation conducted by CH2M Hill in January 2006, the top layer of the site stratigraphy is composed of sand, gravel, cobbles, and boulders (fill material), followed by a gravel-sand layer. The subsurface includes a poorly graded fine sand layer with some silt, followed by still sandy silt located above the bedrock (green basalt) (CH2M Hill, 2006a).

Overburden at the site was generally found to be consistent across the advanced boreholes and is characterized by progressively finer particle size of the sediments with increasing depth. Overburden thickness is highly variable, ranging from 0 to greater than 21 m. The overburden is consistent with fluvial or near-shore lacustrine deposition environments.

2.4 Hydrogeological Conditions

The following description of hydrogeological conditions associated with the site is described by CH2M Hill (2006a) as follows:

A single unconfined aquifer is within the overburden on the site. The saturated zone in most locations extends from the bedrock surface at depth to within less than one metre of the ground surface. Bedrock in the area was found to be relatively dry and presented no visual indication of water bearing fractures. Groundwater flow is generally in a south to north direction, consistent with the surface topography.

Interpreted groundwater flow at the site is illustrated in Figure 2 (from CH2M Hill, 2006a).

2.5 Climate

The long-term average climatic conditions (1971 – 2000) recorded at the Whistler meteorological station (approximately 8 km from the site) indicate the daily average annual temperature in the area is 6.3^{o}C, and the mean annual precipitation is 1229.1 mm. The precipitation can be further divided into an average of 850.1 mm of rainfall, and 411.2 cm of snowfall.

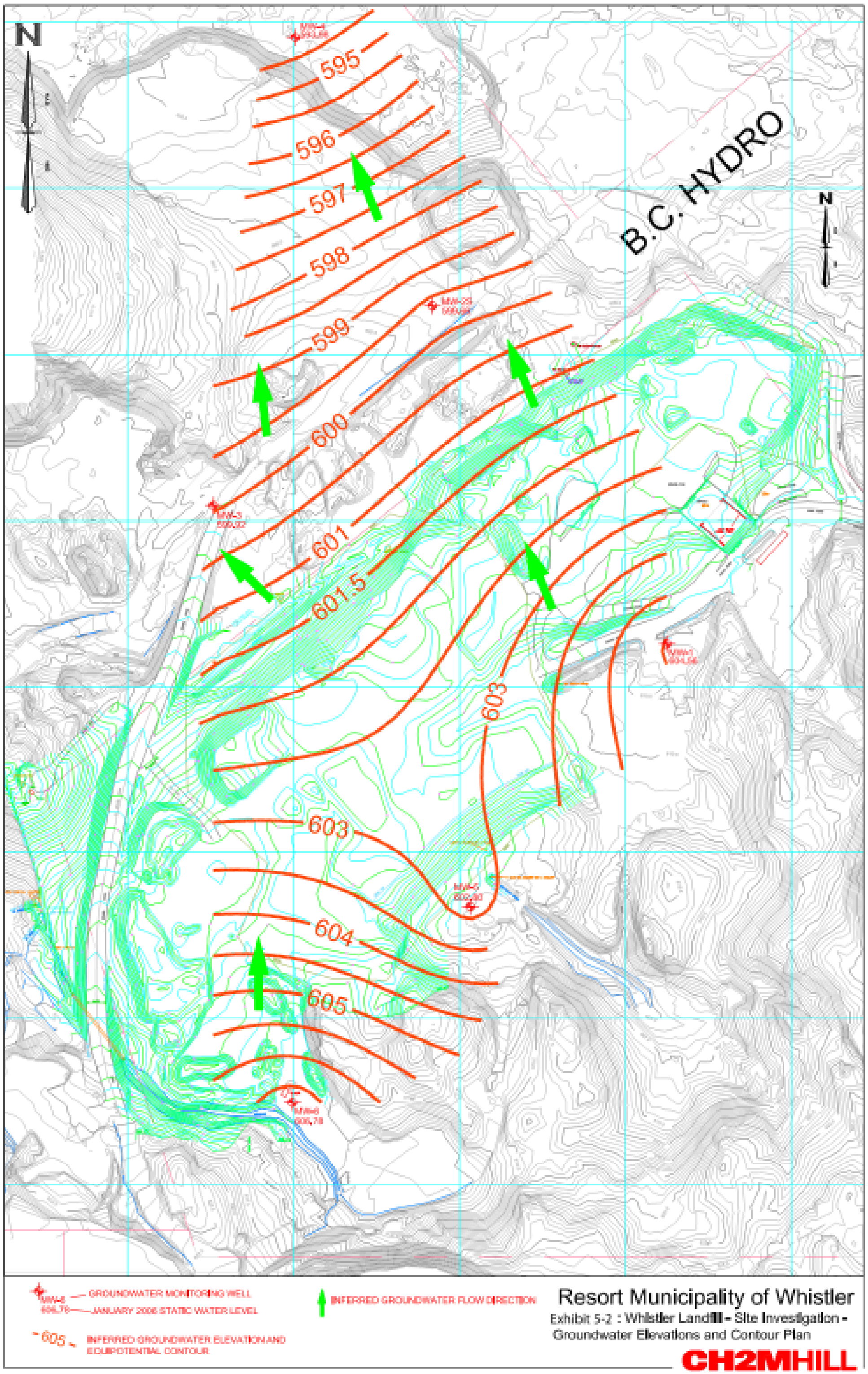

Figure 2. Groundwater elevations and flow pattern at the Whistler landfill site (from CH2M Hill. 2006a).

3. MONITORING REQUIREMENTS

The following documents form the basis of the post-closure monitoring program and associated requirements, including parameters to be monitored. They are frequently referenced throughout this report.

- *Whistler Landfill Closure Plan, Final Report (CH2M HILL, 2006a)*
- *Whistler Landfill Gas Pre-Design Memorandum (CH2M HILL, 2006b)*
- *Landfill Operational Certificate MR-04692 (B.C. Ministry of Environment, 2005)*
- *Mitigation and Safety Measures for Reduction of Landfill Gas Migration Risks (CH2M HILL, 2008a)*
- *Landfill Gas Collection System Operation and Maintenance Manual (CH2M HILL, 2008b)*
- *Monitoring and Reporting Requirements (CH2M HILL, 2008c)*
- *Resort Municipality of Whistler Landfill Annual Monitoring Report – 2011 & Revised Monitoring Program Recommendations (Morrison Hershfield, June 2012).*

The monitoring and reporting requirements are included as Appendix B.

4. METHODOLOGY

4.1 Sample Locations

Leachate, groundwater, surface water and landfill gas (LFG) monitoring locations are shown in Figure 3. Groundwater monitoring locations are identified as MW (monitoring well) followed by a number or number / letter combination (e.g. MW-3, MW-2S), a letter is added when both a shallow (S) and a deep (D) well were installed within a single borehole. Surface water sample locations are identified as SFC (surface), followed by a number or number / letter combination (e.g. SFC-2, SFC-2B), where the letter is used to indicate a second surface water sample on the same watercourse. L1 is the single leachate collection point.

The LFG collection system consists of the following components:

- Thirteen vertical LFG extraction wells connected to horizontal LFG collection trenches covering the landfill cell footprint;
- A 200mm diameter header approximately 800m in length that carries the LFG from the vertical well and horizontal trench network to a flare station;
- A LFG abstraction plant on the north side of the property that burns the collected LFG in a candle-stick flare;
- Twenty-one monitoring probes (MP) located around the perimeter of the landfill cell; and
- Approximately 91 test ports within selected buildings and residences in close proximity to the landfill.

The landfill gas monitoring probes around the circumference of the landfill mass are identified as MP followed by a number (e.g. MP14). Also identified in Figure 3 are several components of the LFG collection system, including: thirteen LFG extraction wells (labeled as "W" followed by a number (e.g. W11)), the flare station, and header valves.

As per the requirements outlined in CH2M Hill (2008c), groundwater and surface water monitoring have been conducted quarterly. Quarterly monitoring is tracked and reported based on a calendar year. The sampling frequency will be adjusted in 2013 to reflect the Ministry of the Environment recommendations (see Appendices C and D).

A new monitoring probe was installed in November 2012 to the west of MP17, it is identified as MP17A. As of December 2012 sampling commenced at MP17A and was omitted at MP17. Further information on the purpose and installation method for MP17a is provided in section 5.4.

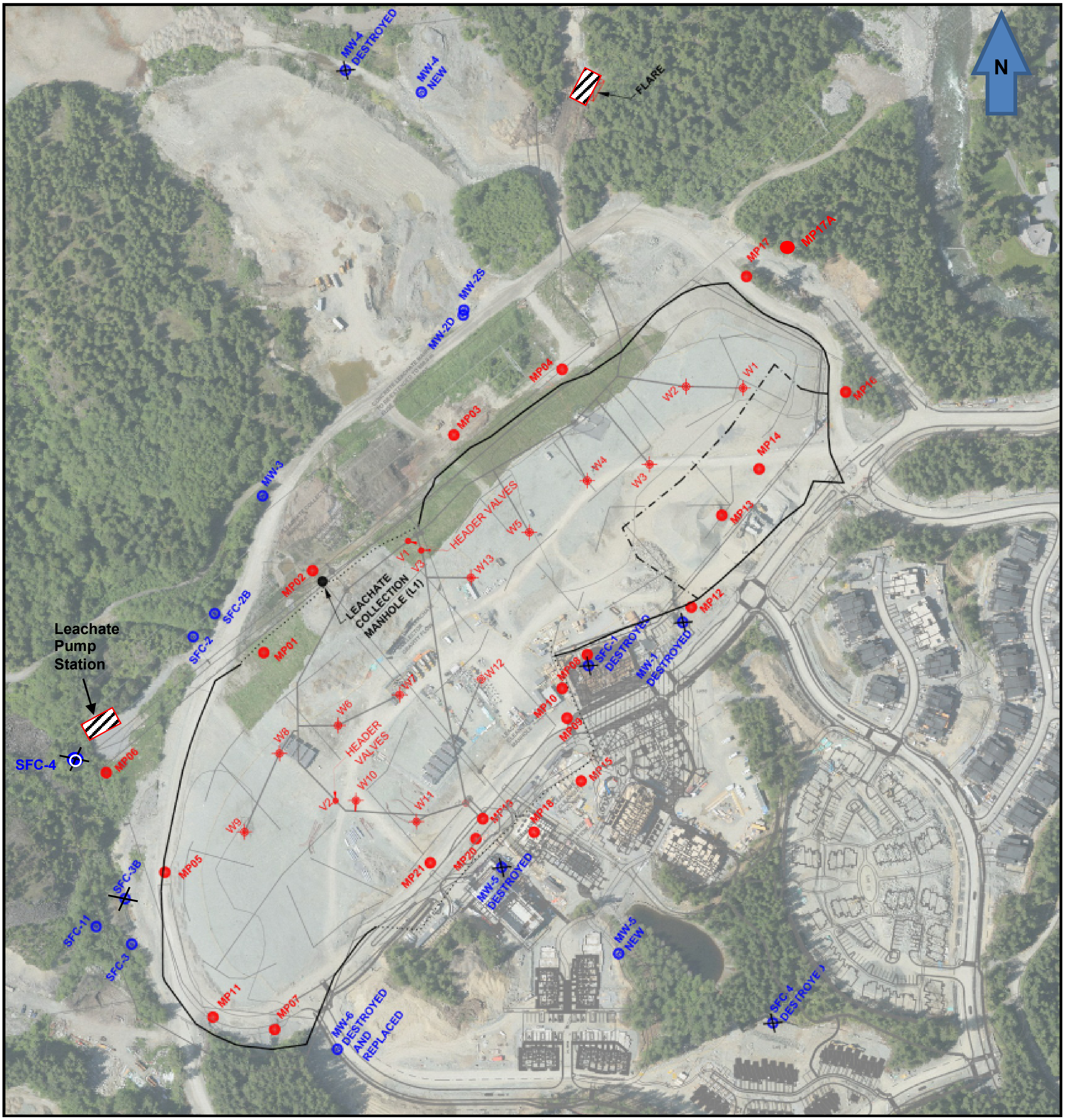

Figure 3. Post-closure monitoring sites at Whistler landfill.

Table 1. Monitoring dates during 2012.

Monitoring dates 2012	
Quarter 1 (Q1 2012)	January 26, 2012
Quarter 2 (Q2 2012)	May 16, 2012
Quarter 3 (Q3 2012)	September 26, 2012
Quarter 4 (Q4 2012)	December 12, 2012

The leachate, groundwater and surface water monitoring program was completed by Morrison Hershfield for quarter 1 and 2, and was then completed by the Whistler Waste Water Treatment Plant staff under the direction of Morrison Hershfield for the last two quarters.

The LFG monitoring program has been in effect since 2009. LFG data are collected by Norseman Engineering Ltd. on a minimum monthly basis. During the winter months monitoring occurs on a weekly basis when there is snow cover on the landfill or frozen ground (i.e. conditions that could facilitate subsurface LFG migration).

4.2 Leachate Monitoring

A single leachate collection point located on the down gradient side of the landfill mass (Figure 2 and Figure 3) was sampled to provide an indicator of the elevated concentration of target parameters within the landfill cell. Leachate samples were obtained using a plastic pail rinsed three times with the leachate water.

A leachate sample was collected during each quarterly sampling event. Appendix E includes the analytical parameters associated with leachate quality monitoring. In addition to the samples for laboratory analysis, standard leachate quality parameters were collected and measured during sampling events. The parameters measured include: pH, temperature (^{o}C), dissolved oxygen (mg/L), and conductivity (µS/cm). Field parameters were measured using an YSI model 556 multi-probe meter.

Leachate quality monitoring results were compared to Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the Contaminated Sites Regulation B.C. (Reg. 375/96), as required by the Closure Plan. Following Ministry of the Environment recommendations (Appendix A), the results have also been compared to the B.C. Working and Approved Water Quality Guidelines in Appendix F.

4.3 Groundwater Monitoring

CH2M Hill originally installed six monitoring wells (MW-1 to MW-6), one of which (MW-2) was constructed with a shallow and a deep screen, for a total of seven monitoring points. Monitoring wells were constructed with 50 mm (2”) diameter new PVC pipe. Screen intervals were constructed with 50 mm (2”) diameter #10 slot PVC screen. The depth and screen length of each well was selected in the field based on observations made during drilling. Bentonite seals were installed (as required) to prevent infiltration of surface water into the well (CH2M Hill, 2006a).

The groundwater monitoring locations are situated both up- and down-gradient of the landfill to monitor the potential migration of any leachate and to be able to separate groundwater impacts of residential and commercial development from impacts of the landfill. MW-6(New) is up-gradient of the landfill mass, while all of the other wells are down-gradient.

The installation of these wells by CH2M Hill was conducted prior to the extensive grading that occurred preceding construction on the Athlete's Village. During grading and construction operations four of the existing wells were destroyed: MW-1, MW-4, MW-5 and MW-6. The four destroyed wells are indicated in Figure 3 with the monitoring well name followed by "destroyed" (i.e. MW-1 DESTROYED).

Three of the four destroyed monitoring wells (MW-4, MW-5, and MW-6) were replaced prior to 2010 sampling to prevent data gaps in the monitoring program. However, due to insufficient groundwater levels since 2010, MW-5 (New) has been omitted from the sampling program.

Table 2 provides a summary of groundwater wells monitored in 2012.

Table 2. Groundwater monitoring events in 2012.

Site	Q1	Q2	Q3	Q4
Year	**2012**			
MW-2S and 2D	✔	✔	✔	✔
MW-3	✔	✔	✔	✔
MW-4 (New)	✔	✔	✔	✔
MW-6 (New)	✔	✔	✔	

During the fourth quarter of 2012 a sample was not collected at MW-6 due to snow cover obscuring the location of the well.

Groundwater samples were collected using dedicated HDPE tubing and foot valves. The procedure for the collection of all groundwater samples follows that described in CH2M Hill (2008c) (provided in Appendix B). Laboratory analysis for all of the samples was performed by ALS Laboratory Group (ALS) in Vancouver, B.C. Appendix E includes the analytical parameters associated with groundwater quality monitoring. ALS follows a quality control program (ISO 17025) to ensure a high degree of accuracy and precision in their results. Appendix G includes the chain of custody for all samples collected in 2012 including the QA/QC samples (travel blanks and replicates).

All groundwater samples collected for dissolved metals analysis were filtered and preservative was added in the field. In addition to the samples for laboratory analysis, standard water quality parameters were collected at each sample location during sampling events. The parameters measured include: pH, temperature (^{o}C), dissolved oxygen (mg/L), and conductivity (µS/cm).

Field parameters were measured using an YSI model 556 multi-probe meter. The depth to static water level was also recorded for each monitoring well using a Solinst water level meter.

Groundwater quality monitoring results were compared to Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the Contaminated Sites Regulation B.C. Reg. 375/96, as required by the Closure Plan and the Revised Monitoring Program Recommendations (Morrison Hershfield, 2012). Following Ministry of the Environment recommendations (Appendix A), the results have also been compared to the B.C. Working and Approved Water Quality Guidelines in Appendix H. These guidelines provide element and compound concentrations to prevent detrimental effects in water bodies that support aquatic life. Unlike the B.C. Contaminated Sites Regulation there is no dilution factor incorporated; therefore the values represented in the B.C. Ambient Water Quality guidelines are more stringent for many parameters.

4.4 Surface Water Monitoring

Table 3 provides a summary of the surface water sites sampled in 2012. Sample station SFC-11 is located cross-gradient from the landfill and the tributary extends southwest away from the landfill; therefore the watershed for this tributary does not include the landfill area (Figure 3). Sample station SFC-2B is located in a watercourse which originates in the wetland feature immediately adjacent to the leachate collection point. It is also located immediately down-gradient of the lined ICI and Residential Waste Cell and the historic biosolids and wood chip storage area. SFC-2 is located approximately 10 m downstream of SFC-2B. The source of the water in SFC-2 is from a culvert extending from the Athlete's Village that collects surface water runoff. SFC-3 is located in a perimeter watercourse.

Table 3. Surface water monitoring in 2012.

Site	Q1	Q2	Q3	Q4
Year	2012			
SFC-2	✔	✔	✔	✔
SFC-2B	✔	✔	✔	✔
SFC-3	✔	✔	✔	✔
SFC-11	✔	✔	✔	✔

Surface water samples were collected using the techniques outlined in CH2M Hill (2008c) (Appendix B). Standard water quality parameters were measured in the field during sampling events. The parameters measured include: pH, temperature (^{o}C), dissolved oxygen (mg/L), and conductivity (µS/cm). An YSI model 556 multi-probe meter was used to measure the field parameters.

Similar to the groundwater samples, all surface water samples were sent to ALS in Vancouver, B.C. for analysis. Appendix E includes the analytical parameters associated with surface water quality monitoring. In Q1 2012 metals were sampled for dissolved, not total metals. This error was corrected for Q2 – Q4 in 2012.

Surface water quality results were compared to Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the Contaminated Sites Regulation B.C. Reg. 375/96. Following Ministry of the Environment recommendations, the results have also been compared to the B.C. Working and Approved Water Quality Guidelines in Appendix I. The guidelines provide element and compound concentrations to prevent detrimental effects in water bodies that support aquatic life. Unlike the B.C. Contaminated Sites regulation there is no dilution factor incorporated; therefore the values represented in the BC Ambient Water Quality guidelines are more stringent for many parameters.

4.5 Landfill Gas Monitoring

Landfill gas monitoring was completed by Norseman Engineering Ltd. on a weekly (winter months) to monthly basis from April 2009 to present. LFG was monitored at the 21 monitoring probes and approximately 91 test ports within selected buildings and residences in close proximity to the landfill.

Standard monitoring procedures were followed for LFG monitoring.

The following data has been collected:

- Methane content at the subsurface probes;
- Methane and oxygen contents, flow rate, and inlet suction at the flare station; and
- Valve position (percent open), methane content and suction at each of the extraction wells (monitored for assessing the operational efficiency of the LFG collection system).

Pressure at the wells is measured using 0 – 5” water column (w.c.) or 0 – 0.5” w.c. magnahelic pressure gauges. Methane content, as percent of the Lower Explosive Limit (LEL), is detected using a Gastech device, model NP204[1]. Other parameters measured at the flare station are obtained from the programmable logic controller associated with the LFG collection system. The data gathered are important for assessing the overall function of the LFG collection system, particularly the concentration of methane present in the landfill for flaring, and to determine if the gas is escaping into the atmosphere or migrating off-site.

Triggers levels for LFG monitoring results which indicate when additional action is required are based on the B.C. Environmental Monitoring Guidelines. They are provided in the Operation and Maintenance Manual for the project (CH2M Hill, 2008b) and are as follows:

- Methane gas concentrations in excess of, or predicted to exceed 10% LEL in subsurface soils at the eastern and southern property boundaries of the Whistler Landfill (MP 8 through MP 21, excluding MP 11)
- Methane gas concentrations in excess of, or predicted to exceed, 25% LEL in soils at the western and northern property boundaries (MP1 through MP7, and MP 11).

[1] A concentration of 5% methane in the air is "the lower explosive limit" (LEL), and concentrations equal to or greater than the LEL are considered hazardous (BC MOE, 1996)

As per Morrison Hershfield (2012), the frequency of LFG monitoring should increase from monthly or weekly to daily in the event of LFG collection system malfunction or maintenance requirements, or if detection of methane in excess of the trigger level (10% LEL) are observed. Morrison Hershfield (2012), notes that, following detection of methane in excess of the trigger levels, monitoring should be increased to daily at all of the monitoring probes and any buildings within 100 m of the MP which exceeded the trigger level will be monitored until there are two consecutive days of undetectable methane content in the monitoring probes. If gas concentrations at the property boundaries remain above recommended trigger limits for more than 2 days, additional measures are outlined in the revised LFG monitoring program (Appendix D).

4.6 Sample Analysis and Quality Control

In addition to using an accredited laboratory, Quality Assurance/Quality Control (QA/QC) samples were collected to certify the accuracy and precision of the field sampling and the laboratory testing procedures. For each surface and groundwater sampling event a sample replicate and a travel blank were submitted for analysis. Replicate samples are collected from a single monitoring location and are identified on the sample containers with the addition of a “Rep” at the end of the station name. Travel blanks are used to confirm that the primary samples have not been contaminated during transportation. They are transported in the same manner as monitoring sample bottles to and from the site, remain closed and are only reopened in the laboratory for analysis.

5. RESULTS & INTERPRETATION

The results section includes a comparison of the laboratory results for leachate, groundwater and surface water to Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the B.C. Contaminated Sites Regulation. These are the standards specified for comparison in the Landfill Closure Plan. Following Ministry of the Environment recommendations, in addition to the standards, the results were compared to the B.C. Working and Approved Water Quality Guidelines and the Contaminated Site Regulation Schedule 6, Column II Numerical Water Standards for Aquatic Life, these are provided in Appendix F, H and I for leachate, groundwater and surface water respectively.

5.1 Leachate

A tabulated summary of the results is provided in Appendix F including a comparison to the standards and guidelines, and the complete laboratory results are provided in Appendix G. Leachate field measurements are presented in Appendix J. Trends for key leachate parameters in the data collected from 2010 to 2012 are presented in Appendix K.

5.1.1 Results

Table 4 highlights those parameters that exceed Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the B.C. Contaminated Sites Regulation which is expressed as dissolved concentrations for metals. Since the leachate is being treated at the Whistler waste water treatment plant the standards do not apply to the raw leachate. However, the raw leachate data has been compared to these standards for illustrative purposes. Leachate will continue to be collected and treated until all parameters are below the standards.

Table 4. Summary of elevated leachate results 2010 – 2012.

Analyte	Units	BCCSR Sched. 6 for Aquatic Life	2010			2011				2012			
			Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
			June 22/10	Sept. 27/10	Dec. 21/10	March 9/11	June 1/11	Aug. 19/11	Nov. 25/11	Jan.26/ 12	May 16/12	Sept. 26/12	Dec. 12/12
Nitrite (as N)	mg/L	0.2	-	**0.743**	-		-		-	-	-	-	
Ammonia (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	-	**24 (pH = 7.17)**	NS	**117 (pH = 7.09)**	NS	-	-	-	**157 (pH = 7.77)**	**87.3 (pH = 7.73)**
LEPH	mg/L	0.5	-	-	**0.82**		-		-	-	-	**0.84**	**0.58**

Notes: Values in bold and red indicate concentrations that are higher than the B.C. Contaminated Sites Schedule 6, Aquatic Life standards.
NS – Not Sampled.

5.1.2 Summary

Of the 135 parameters monitored in 2012 there are 57 that have set acceptable values in Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the Contaminated Sites Regulation B.C. (Reg. 375/96). In 2012 there were only two parameters (ammonia and light extractable petroleum hydrocarbons (LEPH)) that were above the standards, these exceedances were limited to the last two quarters of 2012. The leachate is treated in the Whistler wastewater treatment plant prior to eventual discharge; collection and treatment will continue until leachate is found to be within the standards.

5.2 Groundwater

A tabulated summary of the laboratory results are presented in Appendix H including a comparison to standards and guidelines, and the complete laboratory results are provided in Appendix G. Field measurements are presented in Appendix J. Trends for key groundwater parameters in the data collected from 2010 to 2012 are presented in Appendix L.

5.2.1 Results

The results from the quarterly sampling for groundwater were compared to Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the B.C. Contaminated Sites Regulation (as required in the Closure Plan). Those standards assume a minimum 1 to 10 dilution factor is available prior to the groundwater reaching any water body that supports aquatic life. Where a replicate sample was collected at a groundwater monitoring location the average of the sample results was compared to the standards.

During the 2012 sampling only ammonia exceeded the standards. The exceedance is discussed further below.

5.2.1.1 Ammonia

Ammonia concentration can be used as an indicator of groundwater contamination. In natural groundwater, concentrations of ammonia are typically below 0.2 mg / L and in anaerobic groundwater, concentrations are up to 3 mg / L (WHO, 2003). Leachate in older landfills, such as the Whistler Landfill, typically have high concentrations of ammonia in the leachate due to the fermentation and degradation of nitrogenous wastes. The ammonia concentrations for the groundwater wells are presented in Table 5, with exceedances of the aquatic life standards from the B.C. Contaminated Sites Regulation highlighted. The standards vary between 1.31 to 18.4 mg / L based on the sample pH. The aquatic life standards give an indication of the potential environmental impacts when the groundwater daylights in surface water features such as the Cheakamus River. The trends from 2010 to 2012 for ammonia concentrations in the leachate and at the monitoring wells are presented in Figure 4. The standards have not been plotted on the graph due to the range of threshold values which are based on the pH of the sample.

Ammonia concentrations in the leachate are highly variable, but consistently higher than background levels at MW-6 (New). The concentrations at MW-6 (New) and MW-3 are within the range of natural levels. At MW-2D, MW-2S, and MW-4 (New), the ammonia concentrations appear elevated relative to the background (MW-6). However only concentrations at MW-2D and MW-2S exceed the standards.

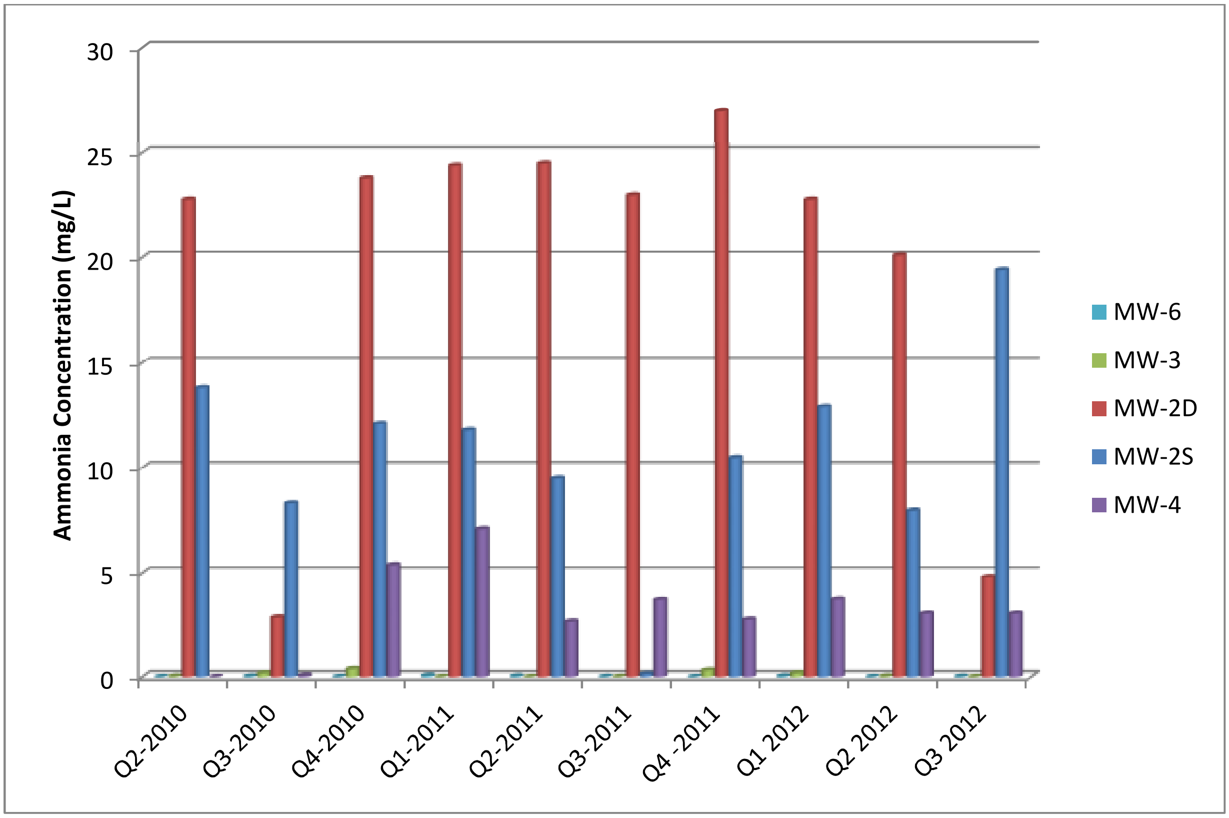

Figure 4. Graphic representation of the ammonia concentrations in groundwater and leachate (2010-2012).

Table 5. Ammonia concentrations in groundwater and leachate (2010-2012).

Sample Date	Units	Ammonia Concentrations										
		Q2-2010	Q3-2010	Q4-2010	Q1-2011	Q2-2011	Q3-2011	Q4-2011	Q1-2012	Q2-2012	Q3-2012	Q4-2012
MW-6	mg/L	NS	0.0207	NS	0.0578	0.029	0.0072	<0.0050	0.0299	<0.0050	0.0122	NS
MW-3	mg/L	0.023	0.182	0.378	NS	0.00402	0.0067	0.313	0.185	0.0254	<0.0050	0.173
MW-2D	mg/L	**22.8**	2.83	**23.8**	**24.4**	**24.5**	**23**	**27**	**22.8**	**20.1**	4.81	18.2
MW-2S	mg/L	13.8	8.28	12.1	11.8	9.46	0.138	10.5	12.9	7.94	**19.4**	10.7
MW-4	mg/L	NS	0.0693	5.39	7.07	2.64	3.67	2.73	3.69	3.02	3.02	1.6
L1	mg/L	13	4.69	24	NS	117	NS	7.5	0.402	0.491	**157**	**87.3**

Notes: Values in bold and red indicate concentrations that are higher than the B.C. Contaminated Sites Schedule 6, Aquatic Life standards.
MW-6 is up-gradient of the landfill, all other wells are down-gradient
NS – Not Sampled.

5.2.2 Summary

During the 2012 sampling year there were fewer parameters that exceeded the standards than 2011. Of the 57 parameters sampled with set acceptable values in Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the Contaminated Sites Regulation B.C. (Reg. 375/96), only ammonia was regularly above the standards at MW-2D and MW-2S in 2012. The remaining 56 parameters were all within the acceptable limits set by the standards.

As discussed in the 2011 annual report (Morrison Hershfield, 2012), MW-2D and MW-2S were considered impacted by leachate. At MW-2D and 2S the concentrations of ammonia were much higher than the up-gradient results from MW-6 (see Appendix I). The ammonia concentrations confirm the findings in the 2011 annual report; it is likely that the concentrations of ammonia at wells MW-2D and MW-2S is the result of leachate migration. There were no exceedences of any standards (including ammonia) at the monitoring well located furthest down gradient (MW-4).

5.3 Surface Water

A summary of the laboratory results are presented in Appendix I with a comparison to standards and guidelines, and the complete laboratory results are provided in Appendix G. Field measurements are presented in Appendix J. Trends for key surface water parameters in the data collected from 2010 to 2012 are presented in Appendix M.

5.3.1 Results

All surface water quality results have been compared to Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the B.C. Contaminated Sites Regulation. These standards for metals are only applicable to total concentrations of metals measured in surface water. Prior sampling in 2010 and 2011 measured dissolved metal concentrations. In 2012 sampling the Q1 samples were analyzed for dissolved metals. All subsequent analysis (Q2-Q4) were completed for total metal concentrations.

If a replicate sample was collected at a surface water monitoring location the average of the sample results were used to compare to the standards.

In 2012 there were no confirmed exceedances of the standards. The one potential exceedance was for copper in the second quarter at SFC-2B. This is discussed further in the following section.

5.3.1.1 Copper

In 2012 there were no confirmed exceedances of the standards. The one potential exceedance was for copper in the second quarter at SFC-2B. The standard for copper is a function of the sample hardness, which was not provided for this sample in the laboratory results. As a point of comparison the hardness for Q2-2011 (142 mg/L $CaCO_3$) was considered as well as the values in Q1-2012 (225 mg/L $CaCO_3$) and Q3-2012 (270 mg/L $CaCO_3$) at SFC-2B. The average of these hardness values is 212 mg/L $CaCO_3$. Using this hardness value, the standard is 0.08

mg/L of copper. The sample concentration in Q2 at SFC-2B of 0.0705mg/L is slightly below the standards assuming an average hardness value.

Copper concentrations are depicted in Figure 5, and Table 6 contains the numerical concentration values. During 2011 and 2012 there were elevated copper concentrations with one exceedence at SFC-2B.

Table 6. Copper concentrations in surface water (2010-2012).

Sample Location	Q2 - 2010	Q3 - 2010	Q4 - 2010	Q1 - 2011	Q2 - 2011	Q3 - 2011	Q4 - 2011	Q1 - 2012	Q2 - 2012	Q3 - 2012	Q4 - 2012
SFC-3	<0.0010	0.0436	0.0038	0.0017	0.00205	0.0012	0.0077	0.0022	0.0044*	0.0224*	0.0056*
SFC-11	<0.0010	0.0013	<0.0010	<0.0010	0.0014	<0.0010	0.0012	<0.0010	0.0029*	<0.0010*	0.0023*
SFC-2	0.0012	0.0151	0.0131	0.0022	0.006	<0.0010	0.0175	0.0014	0.0106*	0.0193*	0.0028*
SFC-2B	0.013	0.0857	0.0676	0.022	0.0311	0.0122	***0.145***	0.0158	0.0705*	<0.0010*	0.0011*
SFC-4B	1.3*	3.7*	12.5*	0.0047	0.0014	<0.0010	0.0123	0.0055	0.0032*	0.001*	0.0116*

Notes: 1) Values in bold and red indicate concentrations that are higher than the B.C. Contaminated Sites Schedule 6, Aquatic Life standards.
2) SF-3 and SFC-11 are up-stream of the landfill, all other sampling locations are down-stream.
*3) Samples with an * are for total metal concentrations, others are dissolved.*
4) Results for SFC-4B in 2010 are anomalously high and QA/QC data are not available for that period to validate results.

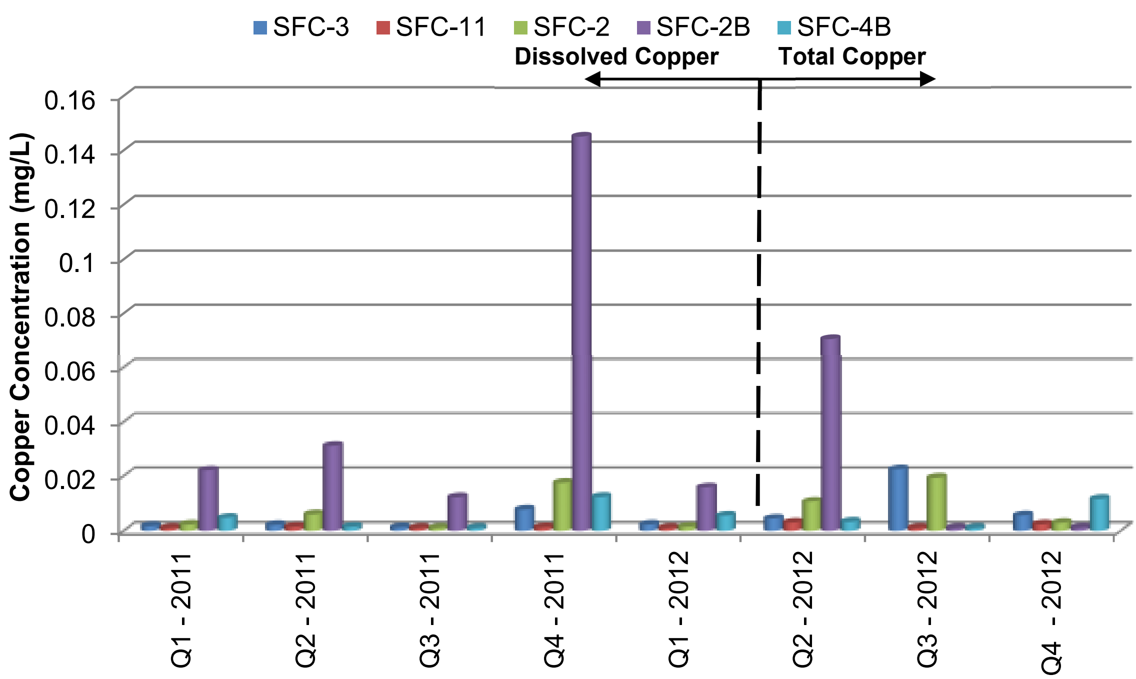

Figure 5. Graphic representation of the copper concentrations in surface water (2011-2012).

5.3.2 Summary

As indicated in the 2011 annual report (Morrison Hershfield, 2012) SFC-2B is considered to be influenced by leachate as a result of leachate overflow into a wetland upstream of the collection point in 2011. However, the sample results for 2012 seem to indicate that the impacts from this event are dissipating. Of the 75 parameters that are sampled, there are 41 with set acceptable standards in Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the Contaminated Sites Regulation B.C. (Reg. 375/96). In 2012, only copper was potentially above the standards in the second quarter of 2012; the remaining 40 parameters were below the standards. Parameters that have exceeded standards in previous years (ammonia, cadmium and cobalt) are well below the respective standards in 2012 (see Appendix I for detailed results).

5.4 Landfill Gas

Methane measurements obtained from perimeter monitoring probes post-closure are summarized in Table 7. Monitoring dates where there was no methane detected at any of the monitoring probes are not presented in the table.

5.4.1 Landfill Gas Collection System Adjustments

Well Installation

During the past two years of LFG monitoring at the Whistler Landfill, monitoring probe 17 (MP17) has frequently had levels of methane that exceed the trigger levels. It is thought that the exceedances of methane may be the result of pockets of waste that are in the area surrounding MP17. Based on discussions with the RMOW, Norseman Engineering and Morrison Hershfield Ltd. it was decided that a new probe should be installed near MP17 but outside the potential waste footprint area. The new probe would serve to determine if there is any methane migration in the northern area of the site.

On November 5, 2012 Josephine Gilson from Morrison Hershfield Ltd. was present on site with Sonic Drilling to install a new monitoring probe. The probe was installed using a truck mounted drill rig on the north-west side of Jane's Lake Road between the PVR Building and the BC Hydro corridor (Figure 3); location drawings for the monitoring probe are provided in Appendix N. The new monitoring probe is identified in all new maps and reports as monitoring probe 17A (MP17A). The total depth of the probe is 26 ½ feet (8.07 m), with a screen that was installed from 26 ½ feet (8.07 m) to 11 ½ feet (3.51 m) below ground surface. Sand pack was used to fill the borehole and a bentonie plug was used to seal the hole. A stick-up metal well casing was installed to protect the monitoring probe and a slip-cap cover was used on the top of the well with a metal fitting for methane monitoring. A borehole log for the monitoring probe is provided in Appendix O. Since the installation of MP17A, monitoring at MP17 has been discontinued.

5.4.2 Results

During 2012 there were some methane concentrations in the perimeter monitoring probes that exceeded the trigger levels. These exceedances were recorded during the winter when there was snowpack on the landfill. Excluding MP17, which is not considered an accurate indicator of LFG migration, thee monitoring probes exceeded trigger levels during 2012. The dates and methane concentrations of these exceedances are illustrated in Table 7. A complete summary of monitoring probe dates and results are provided in Appendix P.

Table 7. Monitoring probe exceedances of methane trigger level concentrations* during 2012

Date	Methane Concentration (%)		
	MP 7	**MP 13**	**MP 14**
January 3 /12	0	0	**4**
Oct. 30 /12	**3**	**23**	**37**
Oct. 31 /12	**2**	0	0

Notes: Values in bold and red indicate concentrations that are higher than the trigger levels specified in the Revised Landfill Gas Monitoring Program and Operation & Maintenance Manual (June 2012).
**Trigger levels are 10% of the Lower Explosive Limit (LEL) which is 5%, therefore the trigger levels are 0.5% methane concentrations.*

5.4.3 Summary

Throughout 2012 there were sporadic exceedances of the methane trigger levels during months with snowpack on the landfill, at monitoring probes along the south east perimeter of the landfill; MP 7, MP13 and MP14 (see Figure 3 for a map of the locations). Methane concentrations were recorded at all three of these locations on October 30. Consistent exceedances were also recorded at MP17 throughout the year that did not correspond to adjustments to the LFG system. Since monitoring commenced at the new MP17A (in December 2012) there have not been any detected methane concentrations in this area of the site (see Appendix P for complete results).

6. SUMMARY OF ENVIRONMENTAL ISSUES AND ACTIONS TAKEN

6.1 Leachate

Elevated concentrations of ammonia and light extractable petroleum hydrocarbons (LEPH) exceeding the corresponding standards were measured during the last two quarters in 2012. No actions were taken since leachate is currently treated at the Whistler wastewater treatment plant.

6.2 Groundwater

The applicable standards for groundwater at the site (as defined in the Closure Plan) are Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the B.C. Contaminated Sites Regulation. The only groundwater parameter that exceeded these standards in 2012 was ammonia in monitoring wells MW-2S and MW-2D. Ammonia levels in the farthest down gradient monitoring well (MW-4) were consistently below the respective standard. No actions were recommended or taken as a 20112 groundwater monitoring results.

6.3 Surface Water

The applicable standards for surface water at the site (as defined in the Closure Plan) are Schedule 6, Column II (Generic Numerical Water Standards for Aquatic Life) of the B.C. Contaminated Sites Regulation. There were no confirmed exceedances of standards in all surface water samples collected in 2012.

6.4 Landfill Gas

Throughout 2012 there were sporadic exceedances of the methane trigger levels in perimeter monitoring probes during months with snowpack on the landfill, at MP 7, MP13 and MP14. Subsequent adjustments were made to optimize the LFG collection to reduce opportunities for LFG migration.

Methane concentrations were consistently recorded at MP17 throughout the year that were not influenced by adjustments to the LFG system. It is postulated that MP17 may be located within a waste pocket outside the influence of the LFG collection system. A new monitoring probe, MP17A, has been installed to better detect the potential for LFG migration in the northern area of the site. Since monitoring commenced at MP17A there have not been any methane detections in this area of the site.

6.5 Revised Monitoring Program

Based on landfill monitoring results from 2010 and 2011 and recommendations made by the Ministry of the Environment (Appendix A), a revised monitoring program was developed in 2012 for implementation in 2013. Refer to Appendices C and D for more details on the revised program.

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APPENDIX A: Ministry of Environment's Response to Proposed Revised Monitoring Program (Dated October 5, 2012)

RECEIVED
NOV 27 2012
RESORT MUNICIPALITY OF WHISTLER

BRITISH COLUMBIA
The Best Place on Earth

RECEIVED
NOV 27 2012
RESORT MUNICIPALITY OF WHISTLER

Date: November 21, 2012

File: MR-04692

Manager of Environmental Projects
Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, BC V0N 1B4

Dear Mr. Hallisey,

RE: Municipality of Whistler Landfill Annual Monitoring Report - 2011

Thank you for the Resort Municipality of Whistler Landfill Annual Monitoring Report - 2011, received on September 07, 2012. The report was reviewed by the Environmental Management and the Environmental Quality Sections.

The Environmental Quality Section compiled a memorandum and has proposed changes to the environmental monitoring programme. Please find the memorandum enclosed. The Ministry requires that the listed items below be incorporated into the environmental monitoring programme;

1: See comments & conclusions on pages 2 and 3,

2: See recommendations made in relation to ground water and surface water analysis, pages 3 and 4.

Please employ all memorandum recommendations into your current environmental monitoring programme.

If you have any questions about this letter, please contact the undersigned at (604) 582-5307 or Tracy Henderson at (604) 582-5277.

Sincerely,

David O' Malley

David O'Malley M.Sc.
Environmental Protection Officer
Environmental Management Section

BRITISH COLUMBIA
Ministry of Environment

MEMORANDUM
File #: MR-04692

October 5, 2012

Attn: David O'Malley
Environmental Protection Officer

RE: Environmental Quality Review of the Resort Municipality of Whistler Landfill Annual Monitoring Report – 2011 & Revised Monitoring Program Recommendations, Report Dated: 06/12

I have reviewed the Whistler Landfill Annual Monitoring Report (submitted by Masse Morrison Hershfield) prepared as required in the 2005 Whistler Landfill Operation Certificate. My comments on the report and proposed changes to the environmental monitoring program are included below.

Background
The landfill opened in 1977 and accepted industrial, commercial, and institutional waste. In 1988, additional permitting was received to accept construction and demolition waste. The landfill is divided into three cells; two that rely on natural attenuation and one with a liner/leachate collection system. The landfill site was closed in October 2005 and a final cover system was installed in 2006. Approximately 350,000 tonnes of waste was disposed of at the Whistler Landfill.

The landfill is located within the Cheakamus watershed and based on hydrogeological studies, groundwater flows from south to north in direction. Sampling results were compared to Contaminated Site Regulations[1] (CSR) for drinking water and aquatic life. For both the groundwater and surface water monitoring components, the report states that exceedance of compliance criteria for more than two consecutive sampling events will trigger contingency plans as stated in the closure plan. The details of the contingency plans are not included in this annual report. This summary addresses contaminants of concern in groundwater and surface water attributable to the land filling waste at the Whistler Landfill.

Water Quality Monitoring Program
The water quality monitoring program for the landfill consists of leachate, groundwater, surface water, and gas sampling. For purpose of this memorandum, landfill gas monitoring was not reviewed. The monitoring program for the landfill is conducted to determine if leachate management is negatively affecting groundwater and surface water quality.

[1] http://www.bclaws.ca/

Samples from monitoring wells (MW), surface water, and a leachate collection point were obtained and analysed for general chemistry, nutrients, dissolved metals, volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH), and hydrocarbons. When possible, sampling was done on a quarterly basis. Groundwater and surface water was also monitored up gradient of the landfill to provide a basis for evaluation of water quality downgradient of the landfill.

Parameters that are generally associated with landfill leachate are: ammonia, chloride, iron, manganese, and sodium as they are typically found at elevated levels, inclined to migration and linked with leachate plume evolution. Chloride is known as a tracer of landfill leachate as it's subject to negligible attenuation, does not react or degrade, and is usually found at higher levels. Conductivity and metal levels are also normally found at elevated concentrations.

Results

Results provided in the report were reviewed and compared to Contaminated Site Regulations for drinking water (groundwater) and aquatic life (surface water).

Groundwater parameters that exceeded CSR drinking water guidelines in 2010 to 2012 were iron, manganese, arsenic, sulphate, and benzo(a)pyrene. The two most impacted wells from leachate contamination are: MW-2D and MW-2S (downgradient of the unlined portion of the landfill). These wells also had elevated ammonia levels, as well as frequently detected levels of PAHs, VOCs, and hydrocarbons.

Surface water parameters that exceeded CSR aquatic life guidelines in 2010 to 2012 were ammonia, cadmium, copper, and cobalt. Since CSR guidelines are higher than BC Ambient Water Quality Guidelines[2] for aquatic life, the frequency and magnitude of the surface water exceedances would be greater and for more parameters. The most impacted surface water site from leachate contamination is: SFC-2B (adjacent to the leachate collection point).

Comments and Conclusion

General comments and recommendations for the report:

- Groundwater (iron and manganese) and surface water (all parameters) data over time (2010 to 2012) for the monitoring locations were not graphed. Current and previous monitoring data needs to be illustrated to ensure that longer term trends are captured, while providing valuable information on the leachate plume evolution.

- Guidelines should be included on graphs to highlight magnitude of exceedances and these graphs should have monitoring locations moving from background to furthest downgradient.

- Groundwater sampling results were not compared to BC Ambient Water Quality Guidelines for aquatic life (only compared to CSR guidelines for drinking water). While these aquatic life

[2] http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html

- Site SFC-2B should be monitored quarterly instead of bi-annually because this site is connected to a wetland that was influenced by leachate flooding. Continued quarterly monitoring is required as the leachate was retained in the wetland and may be slowly released over time.

- Surface water analyses should not include PAHs or other organics, because PAHs partition to sediments rapidly.

- Due to elevated ammonia levels and sometimes elevated nitrate/nitrite levels in surface water, the landfill monitoring plan should consider conducting regular visual observations of surface water drainages near the closed landfill to document whether excessive algal growths and subsequent die-off is occurring. Heavy algal blooms directly affect aquatic integrity by smothering habitat, promoting accumulation of additional sediments and promoting excessive bacterial decomposition that leads to low dissolved oxygen vital for most aquatic species.

Overall the report appears to be thorough. The proposed receiving environment monitoring program looks adequate with a few clarifications necessary on schedule and parameters. If you have any questions and/or concerns about the above discussion of the monitoring program, please call me at (604) 582-5277.

Sincerely,

T. Henderson

Tracy Henderson
Water Technician

guidelines do not specifically apply directly to groundwater, they are important to be used as a "flag" to identify possible risks to aquatic life if groundwater intercepts nearby surface waters, such as the Cheakamus River. If sampling results were compared to BC Ambient Water Quality Guidelines, actual exceedances may be higher and for a larger number of parameters.

- Surface water data analyses were conducted for dissolved rather than total metals. Using only dissolved concentrations may underestimate the potential toxicity as this omits metals that may be weakly adsorbed onto particulates that are retained in filter; therefore, actual exceedances may be higher and for a larger number of parameters. Ensure future surface water samples include total metals analysis.

- The report did not mention whether the groundwater discharged to the Cheakamus River was ever confirmed. Based on the direction of groundwater flow, from south to north, the final discharge location would likely be into the Cheakamus River. Since monitoring wells downgradient of the landfill are impacted by leachate, an additional surface water monitoring site may need to be established on Cheakamus River. Investigate the landfill leachate groundwater plume interception with the Cheakamus River and whether this is a potentially meaningful monitoring location.

- The report could be strengthened if downstream aquatic and terrestrial ecological values were identified.

General comments and recommendations for the proposed changes to the environment monitoring program (pg 41):

- Leachate: I agree to all the terms listed.

- Groundwater: I agree to the terms listed, except for:

    - All sites should be monitored quarterly instead of bi-annually because many parameters were frequently found at elevated levels and/or exceeded guidelines. The annual report stated that these elevated levels are mainly caused by leachate contamination, specifically MW-2D and MW-2S (downgradient of the unlined portion of the landfill). Continuing to monitor groundwater sites will aid in understanding the leachate plume development and provide valuable information on whether mitigation efforts are effective.

    - Due to minor and infrequent exceedances, volatile organic compounds, polycyclic aromatic hydrocarbons, and hydrocarbons can be sampled bi-annually (spring and fall).

- Surface water: I agree to the terms listed, except for:

    - Surface water quality data should also be compared to the BC Approved and Working Criteria for Water Quality to highlight other potential parameters of concern.

Ministry of Environment

Environmental Protection
Regional Operations
Lower Mainland Region

Mailing/Location Address:
10470 152 Street
SURREY BC V3R 0Y3

Telephone: (604) 582-5200
Facsimile: (604) 584-9751
http://www.gov.bc.ca/
http://www.gov.bc.ca/env/

APPENDIX B: Monitoring and Reporting Requirements (CH2M Hill, 2008)

Return to : J.P.

Volume 2

Monitoring and Reporting Requirements

Prepared for

WHISTLER

Resort Municipality of Whistler
British Columbia

January 2008

Prepared by

CH2MHILL

Metrotower II, Suite 2100 – 4720 Kingsway
Burnaby, BC V5H 4N2
Phone: 604.684.3282

Contents

Exhibits

Appendices

1. Background

1.1 Introduction

This manual describes the environmental monitoring requirements for the Resort Municipality of Whistler's (RMOW's) Whistler Landfill (the Site). The environmental monitoring program is based on the Whistler Landfill Closure Plan (CH2M HILL, 2006), which was approved by the British Columbia (BC) Ministry of Environment (MoE) in its letter, dated January 10, 2007. This site monitoring manual encompasses monitoring and reporting procedures for ground water, surface water, leachate, landfill gas (LFG), and cover system integrity.

Operation and maintenance (O&M) requirements and procedures for the landfill gas collection system (LFGCS) are presented under a separate document.

This monitoring manual describes the site-specific monitoring requirements for post-closure monitoring, including:

- Sampling and monitoring location (groundwater, surface water, LFG)
- Sampling protocols (collection techniques, equipment, preservatives, sample storage, and chain of custody)
- Laboratory analysis requirements
- Quality assurance and quality control (QA/QC)
- Data Interpretation and Reporting Requirements

LFG migration monitoring and O&M requirements and procedures for the LFGCS are presented in Volume 1 - Landfill Gas Collection System Operation and Maintenance Manual and this, Volume 2 - Monitoring and Reporting Requirements.

1.2 Safety

Safety is a very serious concern in a landfill environment; many potential life-threatening hazards are present. O&M of the system may involve exposure to refuse, leachate (water that has come into contact with waste and may contain a wide variety of contaminants that may be harmful to human health or the environment), LFG, and LFG condensate. O&M of the system may also require confined space entry.

Before undertaking work, a written health and safety plan (HASP) must be prepared to address task-specific hazards associated with the work. The HASP should be based on the Occupational Health and Safety Regulations, BC Regulation 296/97, published by the Workers Compensation Board of British Columbia.

2. Site Location and History

The RMOW owns and operates the Site, which is located approximately 8 km west of Whistler and accessed via Highway 99 and the Cheakamus Lake Road, see Exhibit A-1 (Appendix A). The Site was initially permitted in 1977 for the disposal of refuse from residential and Industrial, Commercial, and Institutional (ICI) sources. In 1988, a second permit was issued to authorize the discharge of construction and demolition (C&D) waste in a separate cell of the Site. In 2005, the RMOW decided to close the landfill to accommodate development of the adjacent land to serve as the Athletes' Village during the 2010 Winter Olympic Games. Disposal at the landfill ceased in October 2005.

The landfill closed, and a final cover system was installed in 2006. During construction of the final cover, an active LFG collection and flare system was installed to manage LFG generated by the waste and to control emissions. Development of commercial and residential buildings on the lands directly east of the landfill footprint began in 2007.

3. Site Hydrology and Hydrogeology

Details of the hydrogeology are provided in the Closure Plan (CH2M HILL, 2006). A single, unconfined aquifer was identified within the overburden. The saturated zone in most locations extended from the bedrock surface at depth to within less than 1 m of the ground surface. Detailed description of the stratigraphy and groundwater monitoring well details are presented in Appendix B.

Groundwater elevations measured during a single water level monitoring event ranged between 606.78 and 593.98 m above mean sea level (AMSL). Flow generally follows the topography approximately south to north toward the Cheakamus River, Exhibit C-1 (Appendix C).

Small surface streams are present within the landfill limits and surrounding the landfill. Small streams located downgradient from the landfill likely receive some base flow as a result of seasonal groundwater discharge. Locations of the surface water features are shown in Exhibit D-1 (see Appendix D).

4. Groundwater Monitoring Program

The groundwater monitoring well locations are shown in Exhibit D-1 (Appendix D), and hydraulic location, monitoring frequency, and field measurements as well as IDs of the wells to be monitored, are presented in Exhibit 4-1.

EXHIBIT 4-1
Well Location IDs and Parameters to be Analyzed

Location ID	Hydraulic Location Relative to Waste	Monitoring Frequency	Field Measurements	Laboratory Analysis
MW-1 (destroyed) MW06-16	Upgradient	Spring, Fall	Water level Temperature pH Conductivity Oxidation Reduction Potential (ORP) Dissolved Oxygen	See Exhibit E-1 (Appendix E)
MW-2s MW-2d MW-3 MW-4	Downgradient	Spring, Fall	Water level Temperature pH Conductivity ORP Dissolved Oxygen	See Exhibit E-1 (Appendix E)

The groundwater monitoring network includes monitoring wells located upgradient and downgradient of the landfill cell. These wells are utilized to monitor groundwater levels and groundwater quality.

Groundwater levels will be monitored at all wells available at the Site to allow assessment of groundwater flow and seasonal variation of the groundwater table elevation.

Groundwater quality will be assessed upgradient of the landfill to determine the baseline water quality and provide a basis for the evaluation of groundwater quality downgradient of the landfill. Downgradient groundwater quality will be assessed to determine if the landfill is resulting in impacts to groundwater quality.

5. Surface Water

Surface water will be collected from four locations within flowing water courses. The surface water monitoring locations are shown in Exhibit D-1 (Appendix D) and are relative to the presence of surface water. In the case that surface water is not available, field staff will seek for other sources that cover the studied area.

Surface water quality data will be compared to Schedule 6, Column I (Generic Numerical Standards for Aquatic Life) of the Contaminated Sites Regulation BC Regulation 375/96 to determine the quality of surface water at the Site and to identify if unacceptable impacts are present.

Surface water quality will be assessed upstream of the landfill to determine the baseline surface water quality and provide a basis for the evaluation of surface water quality downstream of the landfill. Due to the direct exposure of surface water to potential sources of contamination other than the leachate derived from the landfill, surface water quality results based on a single round of samples should be interpreted with caution.

It must be noted that surface water flow rates will not be measured during this investigation.

Surface water sampling locations and their specific conditions are described as follows and detailed in Exhibit 5-1:

- SFC-4 is located upstream of the Site, within a stream that flows towards the eastern side of the landfill and runs under the waste. At SFC-4, water flows towards the north and discharges at SFC-2B, north of the waste footprint.
- SFC-2 is located downstream of SFC-4. The water course runs under the waste mass through a culvert between the two sampling locations. SFC-2 is situated at the discharge point of the culvert. The culvert was installed along the approximate alignment of the natural watercourse prior to the development of the Site. In the absence of leakage into the culvert underlying the landfill, SFC-2 is not connected to surface water overland flow that is generated within the waste footprint. It should be noted that the condition of the culvert has not been assessed. Discharged groundwater may contribute to the stream base flow.
- SFC2-B is located within the stream north of the waste footprint. It receives water from the SFC-2 sampling location from overland flow generated by the surrounding lands south of the waste footprint, and likely from some groundwater discharge. High topographic relief isolates SFC2-B from the surface water that is generated within the waste footprint. Based on comparison of the elevations of surface water in the creek and of static groundwater measured at nearby groundwater wells, groundwater discharge may represent a significant portion of the stream's base flow.
- SFC-3 is located within a stream flowing west of the former compost and biosolids storage area.

Exhibit 5-1 presents the hydraulic location of the sample, the frequency for sampling, and the parameters analyzed on the field and by the laboratory.

EXHIBIT 5-1
Surface Water Sampling Information

Location ID	Hydraulic Location Relative to Waste	Monitoring Frequency	Field Measurements	Laboratory Analysis
SFC-1 (dry) SFC-4	Upstream	Spring, Fall	Temperature pH Conductivity ORP Dissolved Oxygen Total water depth at sample location	See Exhibit E-2 (Appendix E)
SFC-2 SFC-2b SFC-3	Downstream	Spring, Fall	Temperature pH Conductivity ORP Dissolved Oxygen Total water depth at sample location	See Exhibit E-2 (Appendix E)

6. Leachate

One borehole was advanced at the highest point of the Site within the oldest waste during the field investigation. The leachate observation well was designed not to reach the groundwater table to prevent accidental contamination of groundwater.

A leachate observation well (LW-1, shown in Exhibit 6-1) was installed within the waste to permit leachate sampling. Monitoring performed to-date suggests that the waste is not continuously saturated throughout the year at this location. As a result, sufficient leachate is not always available to provide a sample. Since the well was installed, the landfill cap has been constructed and is expected to reduce leachate generation at the site. This reduction in leachate availability may result in less frequent sample collection requirements in the future.

The leachate level in the well should be monitored as scheduled, and sample collection should be undertaken when sufficient leachate accumulation is detected. See Exhibit 6-1 for parameters.

EXHIBIT 6-1
Leachate Sampling Point and Parameters

Location ID	Hydraulic Location Relative to Waste	Monitoring Frequency	Field Measurements	Laboratory Analysis
LW-1	Leachate	Spring, Fall	Water level Temperature pH Conductivity	See Exhibit E-2 (Appendix E)

7. Maintenance of Monitoring Wells

The structural integrity of the groundwater monitoring well system must be maintained in such a way as to prevent surface water and contaminant from entering the well. Prior to sampling, a visual inspection of the exterior monitoring well must be conducted that includes the following observations:

- Well labelling
- Damage to protective casing
- Settling and cracking of surface seal

If a groundwater monitoring well becomes damaged and requires more than just replacement of a well cap or lock, then a new replacement monitoring well must be installed.

8. Monitoring and Sampling Procedures

The following section details the procedures that are to be followed for undertaking surface water, groundwater, and leachate sampling programs at the Site.

8.1 Personnel

Team members must be familiar with the sampling and handling procedures included in this document and with health and safety procedures applicable to the sampling work (in accordance with Provincial and Federal regulations) prior to commencement of activities. All team members should be aware of potential site hazards and proper emergency procedures before sampling begins. A task-specific health and safety plan should be developed by a qualified professional familiar with the monitoring program.

8.2 Preparations for Sampling

Preparations for sampling include coordination with the laboratory and facility personnel, procuring field equipment, and calibrating field instruments.

8.2.1 Procuring Field Equipment

Gather equipment to be used for sampling and appropriate health and safety equipment. Field personnel should check to ensure that all equipment functions properly. Check well maintenance records or field logs generated during previous field investigations to determine the condition of wells and identify additional operational requirements.

8.2.2 Calibrating Field Equipment

Calibration requirements for field instruments are instrument-specific. The manufacturer's instructions must be followed for all calibration requirements.

At a minimum, equipment should be calibrated daily. A calibration check using standard reference solutions of known composition should be conducted more frequently to confirm that calibration is maintained throughout the working day. Calibration and calibration check results will be recorded in the field notes. Additional periodic calibration checks will occur if meter readings appear to drift or batteries require replacement.

Field measurement equipment that is out of calibration and cannot be calibrated or that malfunctions during use will be removed from service and repaired by a qualified technician. Field equipment conditions will be recorded in the field notes and should describe the following: dates and types of equipment malfunction and type, location, and dates of repairs.

The field meters and water-level indicator operate on batteries that will be checked routinely for integrity. Some meters with rechargeable batteries have a battery check function for convenient determination of the battery charge level. Battery replacement dates will be recorded on the field equipment log.

8.3 Pre-sampling Inspection

Prior to undertaking sampling, each of the wells and surface water stations will be inspected to provide an assessment of the condition of the sampling location. Record observations regarding the condition including, but not limited to, the following inspection items:

- Groundwater Well Inspection
  - Condition of the protective casing and lock, including evidence of tampering
  - Condition of the surface seal
  - Any obstructions in the well
  - Condition of dedicated sampling equipment in the well
- Surface Water Station Inspection
  - Tampering, litter, or debris near the sample location
  - Presence or absence of flow
  - Approximate flow depth

8.4 Groundwater and Leachate Level Measurements

Discrete water levels are to be recorded following the pre-sampling inspection. Water levels in each of the wells will be measured as the initial step in sampling to calculate the volume of water to be evacuated. Exhibit F-1 (Appendix F) shows the water/leachate level readings taken during sampling visits.

Water levels should be measured at all wells within 24 hours of the measurement at the first well.

8.4.1 Equipment and Materials

The following equipment is required:

- Electronic water-level meter (Solinst or equivalent) with a minimum 50-m tape; the tape should have graduations in increments of 0.01 m or less
- Distilled water for decontamination
- Gloves – powderless Nitrile

8.4.2 Procedure

1. Verify that the unit is turned on and functioning properly.
2. Slowly lower the probe on its cable into the well until the probe makes contact with the water's surface; the unit will respond with a tone and/or light signal.
3. Measure the depth to the water level to within 0.01 m with an electronic water-level indicator from the reference point on the top of the casing indicated by a mark on the casing

- *Optional measurements:*
  1) The depth of the well
  2) The distance from the reference point to the top of the protective casing
  3) The distance to the surface of the concrete pad or to ground.

  These measurements are useful for assessing changes to the condition of the well and verifying the well's identification through comparison to the as-constructed measurements, should the well's ID tag be illegible.

4. Record the time, date, and water level measurements in the field log.

5. Thoroughly spray or wash portions of the instrument that were inserted into the well with distilled water after the measurements are performed and prior to coiling the line back onto the spool.

8.5 Groundwater and Leachate Well Purging and Sampling

Prior to sample collection, each well will be purged to remove stagnant water within the well and provide samples that are more representative of *in situ* conditions. The volume of water to be evacuated from each well prior to its sampling will be calculated in the field and recorded on the groundwater sampling form.

8.5.1 Equipment and Materials

The following equipment is required for well purging and sampling:

- Sampling pump:
  - Waterra inertial pump (foot valve) with tubing or equal
    - Pump and tubing are to be dedicated to each well
- Graduated bucket
- Water quality instrument:
  - Portable instrument capable of measuring
    - Temperature
    - pH
    - Specific conductance
    - Oxidation/reduction potential
  - distilled water for instrument decontamination
  - flow-through cell (optional)
- Sample containers
- Groundwater field filter 0.45 μ (single-use filter – Waterra or equal)
- Gloves – Nitrile, disposable, powderless

8.5.2 Purging and Field Parameter Measurement

The following procedures are to be followed while purging each well:

1. Record the well number, site, date, and condition in the field logbook.

2. Confirm that the water level has been recorded.

3. Confirm that a dedicated pump is installed in the well and that it is functional. Install a new pump if no pump is present or damage is suspected.
4. Ensure that instruments are calibrated according to the manufacturer's instructions.
5. Calculate the total depth of water in the well based on the water level measurement and total well depth. The depth of water is calculated as follows:

   Depth of water (m) = Depth to water (m) – Total Depth of Well (m)

6. Calculate the volume of water to be purged using the water level data collected. The volume in litres of water in the well casing is calculated as follows:

   $(\pi r^2 h)/1000$ = *Volume in litres*

   where: $\pi = 3.14$
   r = Radius of the well pipe in mm
   h = Height of water in well in m

   The volume of water in typical well casings may be calculated as follows:

   50-mm-diameter (2-inch) diameter well:
   2 L/m x Depth of water (m) = litres

7. Purge sufficient water from the well to allow the initial field parameters to be measured and recorded in the field logbook.
   - Capture and measure the volume of the purge water in the graduated bucket to determine the volume purged from the well.
   - Measure the field parameters, and record the results in the field logbook. Field parameters are listed in Exhibit 4-1 of this plan.
     - It is preferred to measure field parameters using a flow-through cell to minimize contact of the water with atmosphere. Follow the manufacturer's recommendations for use of the flow-through cell. The purged groundwater is directed through the flow-through cell, allowing measurements to be collected before the water contacts the atmosphere.
     - Alternatively, field parameters may be measured directly from the graduated bucket.
8. Continue purging well for 3 to 6 well volumes.
   - Measure and record field parameters after each well volume at a minimum.
   - Purge the well until field parameters have stabilized over three consecutive well volumes or parameters stabilize to with 10% of the previous readings. In general, field parameters are considered stabilized when pH measurements agree within 0.1 units, specific conductance measurements agree within 10%, ORP measurements agree within 10 mV, and turbidity is as low as practicable given sampling conditions.
   - Record the stabilized readings in the field logbook.

8.5.3 Sample Collection

The following procedures are to be followed for collection of groundwater samples immediately following well purging:

1. Put on new, clean Nitrile gloves.
2. Operate the pump in a smooth, consistent manner to achieve an appropriate flow rate that does not result in excessive turbidity or aeration of the water. Reduce the pumping rate to the extent possible to reduce sample turbidity.

   Note: *Alternatively, Waterra High Density Polyethylene (HDPE) tubing can be used, along with a foot valve mounted at the bottom of tubing.*

3. Collect sample directly from the pump tubing to the sample container. Care must be taken not to introduce contaminants from the sampler, surface, or atmosphere during sample collection. Handle the sample container lids with caution during sampling.
   - Samples should be collected in a particular order to assure that those samples most likely to change rapidly when exposed to the atmosphere are collected first. Exhibit D-1 (Appendix D) presents the parameters to be analyzed.
   - Care must be taken to minimize sample disturbance when collecting volatile organic compound (VOC) samples. Each VOC bottle will be filled such that a positive meniscus is established and will be checked for the presence of air bubbles after the bottle is capped. If air bubbles appear, the bottle cap will be removed, water from the pump will be added so that the bottle overflows slightly, and the bottle will be recapped. All samples will be collected using dedicated Waterra pumps or another engineering-approved sampling device.
   - Samples for total dissolved metals analysis must be filtered during collection using a 0.45 µ disposable groundwater field filter.
     - Remove new filter from packaging.
     - Insert filter into sample tubing in the proper flow orientation.
     - Record filter lot number in the field notes, and dispose of filter.
4. Ensure the sample is preserved per the laboratory's requirements for each analyte.
5. Ensure the sample is labelled appropriately, including: sample ID, date, time, and project/site reference.
6. Place samples in a cooler containing ice immediately after they are collected. Samples should be maintained at approximately 4°C and must be maintained under chain-of-custody procedures from the time of collection through delivery to a laboratory for analysis (see Appendix G for Chain-of-Custody forms). The cooler temperature should be monitored to ensure the internal temperature does not exceed 10°C.
7. Record date, time, field measurements, and additional observations in the field logbook.

9. Surface Water Sample Collection

9.1 Equipment and Materials

The following equipment is required for sampling:

- Water quality instrument:
  - Portable instrument capable of measuring
    - Temperature
    - pH
    - Specific conductance
    - Oxidation/reduction potential
- Sample containers
- Gloves – Nitrile, disposable, and powderless

9.2 Sample Collection

The following procedure is to be followed for collection of surface water samples:

1. Put on new, clean Nitrile gloves.
2. Select the location for water sampling. Location should have flowing water deep enough to allow collection of surface water without entraining bottom sediments.
3. Approach the location from downstream in a manner that avoids disturbance of bottom sediments as much as possible.
4. Using a clean sample bottle with no preservative, gently submerge the bottle, with the mouth pointed upstream, and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle.
5. When the bottle is full, gently remove it from the water. If sample preservatives are required, transfer the sample to a bottle pre-charged with preservative, or add preservatives to the sample bottle.
6. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.
7. Record date, time, field measurements, and additional observations in the field logbook. Record depth of flow and approximate stream width at sample location.

10. QA/QC Samples

A field QA/QC protocol is necessary to verify the precision and accuracy of the combined field sampling/handling and laboratory procedures and to assess reproducibility of the sampling and analytical procedures. QA/QC samples will include the following:

- Blind replicate sample (split sample):
  - Frequency: 1 Blind replicate per 10 samples
  - Analytical Parameters: Same as samples
  - Collection technique:
    - Collect identical field samples by equally splitting collected sample between two bottle sets.
    - Label one bottle set with the well ID and the second set with a unique identifier.
    - Record the date and sample identifications of the collected samples in the field logbook.
- Field blank samples:
  - Frequency: 1 field blank per 10 samples
  - Analytical Parameters: Same as samples
  - Collection technique:
    - Laboratory reagent (deionized) water will be carried through sample collection and handling (including preservation) to check for contamination, purity of preservatives, and other systematic errors occurring from time of sampling.

A total of two QA/QC samples are expected per sampling event.

11. Sample Handling

The following section provides an overview of the sample handling procedures.

11.1 Sample Parameters, Containers, Holding Times, and Methods

Exhibit 11-1 summarizes the bottle requirements, holding times, analytical methods, and preservation requirements for samples to be collected during sampling events. The analytical laboratory should be consulted to ensure that the requirements meet current standards and recommended practices.

EXHIBIT 11-1
Sample Handling Information

Parameters	(#) Containers	Preservation	Holding Times	Comments
VOCs	(2) 40 ml VOA	Pre-treated with HCl. Cool to 4°C.	14 days	USEPA Method 8240 or 624
PCBs, Chlorinated Phenols, PAHs	(3) 1 L amber glass	Cool to 4°C.	14 days	PCBs – Method 628 Chlorinated phenols – 604 PAHs – 625
General Water Quality Parameters[1]	(1) 1 L polyethylene	Pre-treat with H_2SO_4. Cool to 4°C.	28 days	ITAP Standard Methods, APHA 18th Ed.
Major Ions[2]	(1) 250 ml polyethylene	Cool to 4°C.	6 months	ITAP Standard Methods, APHA 18th Ed.
Dissolved Metals[3]	(1) 250 ml polyethylene	Acid-washed, field filter, cool to 4°C.	6 months	ITAP Standard Methods, APHA 18th Ed. – ICP
Coliform	(1) 100 ml polyethylene, wide-mouth	Pre-sterilized, cool to 4°C.	6 hours (24 hours max.)	USEPA and APHA Methods 9222 and 9223B

[1] COD, hardness, fluoride, nitrite (as N), nitrate (as N), ammonia (as N), phosphorus, alkalinity (as $CaCO_3$), sulphate

[2] Magnesium, chloride, bicarbonate

[3] Aluminum, beryllium, barium, chromium, copper, lead, manganese, molybdenum, silver, arsenic, boron, cadmium, cobalt, iron, magnesium, nickel, zinc, calcium, potassium

Should chemical preservative be needed, the laboratory will provide bottles with appropriate preservatives already added. Bottles prepared with preservatives will be prelabelled and identified as "preserved" in order to distinguish them from nonpreserved bottles.

11.2 Sample Packaging and Shipping

Samples and empty sample containers will be packaged and shipped in conformance with International Air Transportation Association (IATA) and Transport of Dangerous Goods regulations, as applicable. The following procedures for sample packaging and shipping will be followed to maintain sample quality and to minimize container breakage during transport to the laboratory.

Before packaging samples, the exterior of the sample container will be checked to verify that it is clean and that the sample identification number is legible. The sample packaging and shipping containers will be constructed and packed to meet the following requirements:

- There will be no release of materials to the environment. Inner containers that are breakable must be packaged to prevent breakage.
- Only waterproof ice chests and coolers are acceptable shipping containers and must be packaged to prevent breakage and leakage.

After documentation, samples will be handled as follows:

1. Seal drain plug in cooler.
2. Place vermiculite (cushioning and absorbent material) in bottom.
3. Wrap glass bottles with bubble wrap, and place in cooler that is partially filled with vermiculite or other inert packing material. If bubble wrap is not available, place the containers in Ziploc-type plastic bags, and set in waxed cardboard holders that have been set up inside the cooler.
4. Fill space between bottles with vermiculite or other inert packing material.
5. Add ice in plastic bags.
6. Place the chain-of-custody form in plastic bag attached to inside of cooler lid.
7. Attach chain-of-custody seals at both the front and back of container so that the seals must be broken if the cooler is opened.
8. Place name and address of receiving laboratory in a position clearly visible on the outside of the cooler.
9. Secure the lid with fibre tape.

Samples will be delivered directly by the sampling team or shipped via overnight courier to the contracted laboratory for analysis. All air bills should be kept on file as part of chain-of-custody documentation, and the laboratory will be informed by telephone each time samples are shipped.

11.3 Sample Custody

The management of samples collected in the field must follow specific procedures to assure sample integrity. The possession of samples must be traceable from the time they are collected through the time that they are analyzed in the laboratory. All groundwater samples will be collected under chain-of-custody procedures. Chain-of-custody forms are provided by the laboratory for this purpose. An example chain-of-custody form is shown in Appendix G.

Custody of a sample is defined by the following criteria:

- The sample is in a person's view while in his/her possession.
- Any sample in a person's possession and not in view is locked up or transferred to a designated secure area.

Each time the samples change hands, both the sender and receiver sign and date the chain-of-custody form and specify what item has changed hands. When a sample shipment is sent to the laboratory, the top signature copy is enclosed in plastic and secured to the inside of the cooler lid. The second copy of the chain-of-custody form must be retained in the project files. A chain-of-custody record must be completed for each shipping container, and the information must be consistent with the sample identification matrix (see Appendix G, page 2).

The following information is to be included in the chain-of-custody form:

- Sample number
- Signature of sampler
- Date and time of collection
- Place of collection
- Type of sample
- Sample identification number
- Type of container
- Inclusive dates of possession
- Signature or initials of the receiver

In addition to the labels, seals, and chain-of-custody form, other components of sample tracking include the field data sheets, sample shipment receipt, and laboratory logbook.

11.4 Field Documentation

Specific information and observations should be recorded on the groundwater sampling field data sheets during sampling. At minimum, the following information is to be documented on the data sheet:

- Sampling team personnel and their designated responsibilities (for example, team leader or assistant).
- The make, model number, serial number, and calibration information for each meter used in the field (that is, temperature, specific conductance, pH, and all health and safety monitoring equipment).
- Well evacuation data (including evacuation rate, total volume removed during evacuation, and water levels at the beginning and end of well evacuation).

- Field parameters (temperature, pH, and specific conductance).
- Management of purge water (for example, discharge onto the ground or into drums for holding and future analysis).
- Sampling data, including: sample identification, types of bottles filled, and analyses to be performed on each bottle; method of collection (pump or bailer); visual description of the water; and the date and time the samples were collected.

Decontamination procedures and times when specific equipment where required should be recorded, although it may be convenient to keep a log of decontamination activities in a separate log book.

11.5 Decontamination of Groundwater Sampling Equipment

Any wells that do not contain dedicated sampling equipment will be sampled with disposable polyethylene or Teflon bailers or will have a dedicated foot valve pump installed during the monitoring event. No decontamination of groundwater sampling equipment is expected.

11.6 Management of Purge Water and Field-derived Wastes

Field-derived wastes generated during the groundwater sampling effort will include purge water and disposable personal protection and sampling equipment. All purge water will be discharged onto the ground. Disposable equipment will be disposed of at the onsite waste transfer station or, alternatively, bagged and disposed of properly.

12. Landfill Gas

An active LFGCS has been installed at the Site. However, subsurface landfill migration monitoring probes have not yet been installed.

Detailed description of the system and the O&M requirements are presented in Volume 1 - Landfill Gas Collection System Operation and Maintenance Manual.

13. Reference List

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APPENDIX A
SITE LOCATION

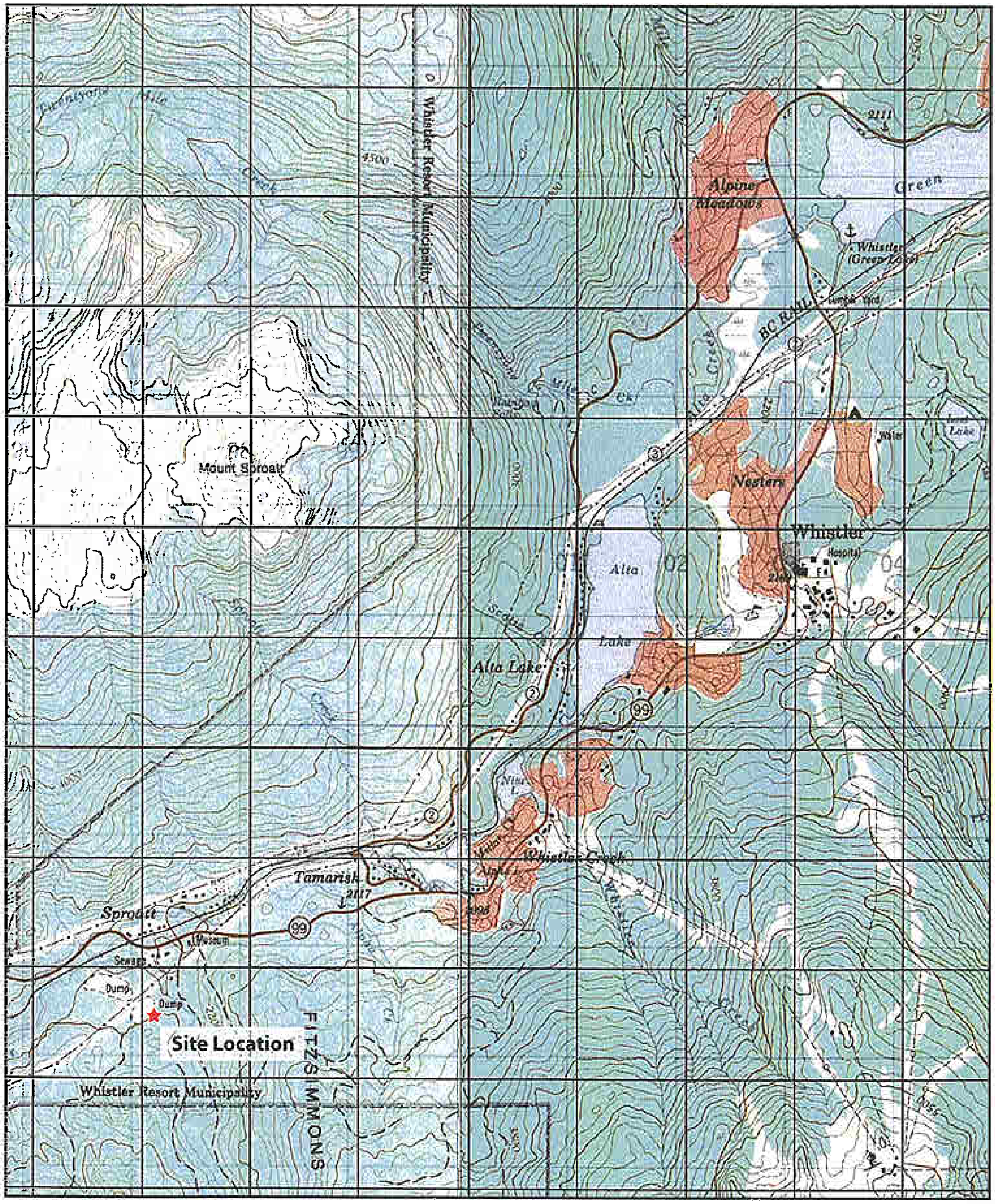

Exhibit A-1
Site Location Map
Whistler Landfill Closure Plan

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APPENDIX B

BOREHOLE LOGS AND MONITORING WELL DETAILS

CH2MHILL

RECORD OF BOREHOLE: BH 1-06

LOCATION: Landfill
PROJECT NUMBER: 335612
DRILLER: Sonic Drilling
DATE DRILLED:
BORING METHOD: HSA/HQ-CORE
LOGGED BY: PP
GROUND ELEVATION:
DATUM:

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	BOREHOLE BACKFILL DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 20 40 60 80
	195			sandy **SOIL (FILL)**				
1								
2								
	61			**ROCK**: Fine grain basalt		2.07		
3				End of borehole at 3.05 mbgs		3.05		
4								
5								

CH2MHILL

SHEET 1 OF 1

RECORD OF BOREHOLE: BH 2-06

LOCATION: Landfill | PROJECT NUMBER: 335612 | DRILLER: Sonic Drilling
DATE DRILLED: | BORING METHOD: HSA/HQ-CORE
LOGGED BY: PP | GROUND ELEVATION: | DATUM:

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	BOREHOLE BACKFILL DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 20 40 60 80
	122			sandy **SOIL**: Brown				
1				**ROCK**: Fine grain basalt		0.91		
2	30							
3	18							
4				End of borehole at 3.96 mbgs		3.96		
5								

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CH2MHILL

RECORD OF BOREHOLE: BH 3-06

LOCATION: Landfill
PROJECT NUMBER: 335612
DRILLER: Sonic Drilling
DATE DRILLED:
BORING METHOD: HSA/HQ-CORE
LOGGED BY: PP
GROUND ELEVATION:
DATUM:

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	BOREHOLE BACKFILL DETAILS	ORGANIC VAPOUR READINGS PID (ppm) 20 40 60 80
	170			gravelly **SAND (FILL)**: Brown			
1							
				silty **SAND**: Grey and brown	1.22		
2							
	55			**SAND and GRAVEL**: Cobbles and boulders, poor recovery	2.13		
3				**ROCK**: Fine grain basalt	3.05		
				End of borehole at 3.35 mbgs	3.35		
4							
5	30			**ROCK**: Coarse grained granite boulder	4.88		

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RECORD OF BOREHOLE: BH 3-06

LOCATION: Landfill
PROJECT NUMBER: 335612
DRILLER: Sonic Drilling
DATE DRILLED:
BORING METHOD: HSA/HQ-CORE
LOGGED BY: PP
GROUND ELEVATION:
DATUM:

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	BOREHOLE BACKFILL DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 20 40 60 80
7								
8								
9								
10								
11								

CH2MHILL

RECORD OF MONITORING WELL: LW1-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 615.42 mASL
LOGGED BY: PP	GROUND ELEVATION: 614.54 mASL	Datum: X 496996.58 Y 5547611.001

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	201	1		GRANULAR (FILL): Grey, black			Concrete seal	
1							Bentonite pellet seal	
2								
3								
	195	2		Mixed waste, dry		611.19 / 3.35		
4							10/20 Sand	
							2" diameter PVC, Sch. 40, No. 10 slot well screen	
5								
6	122	3						
				GRANULAR (FILL): Black, damp		608.14 / 6.40		
7								
	0	4						
8				Mixed waste with granular fill, wet		606.61 / 7.93		
9								

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RECORD OF MONITORING WELL: LW1-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 614.54 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 615.42 mASL
Datum: X 496996.58 Y 5547611.001

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	146	5						
10								
11						603.26 / 11.28		
12				gravelly **SAND**: Black, wet				
13								
14						600.52 / 14.02		
				End of borehole at 14.02 mbgs				
15								
16								
17								
18								

CH2MHILL

SHEET 1 OF 2

RECORD OF MONITORING WELL: MW 1-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 607.99 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 608.81 mASL
Datum: X 497024.932 Y 5547525.992

SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)
sandy **SOIL**: Some roots, brown	607.38 / 0.61
gravelly **SAND**: Some cobbles, some silt, trace clay, brown/orange, sub-rounded grain shape roots and wood throughout Grey mottling for 20 cm	605.59 / 2.40
sandy **SOIL**: A lot of wood, brown/black	605.12 / 2.87
silty **SAND**: Grey	605.07 / 2.92
gravelly **SAND**: Well graded, rounded/sub-rounded grain, orange some cobbles throughout Brown/grey	604.03 / 3.96
gravelly **SAND**: Poorly graded, medium sand, small rounded gravel	603.63 / 4.36
fine silty **SAND**: Some small gravel, brown/grey, some orange mottling, poorly graded	603.11 / 4.88
Boulder, coarse grained	602.50 / 5.49
gravelly **SAND**: Well graded, some cobbles, medium sand, small rounded/sub-rounded grains, orange/grey	601.44 / 6.55
ROCK: Fine grained	

DEPTH (mbgs): 1, 2, 3, 4, 5, 6, 7, 8, 9

SAMPLES: RECOVERY(cm) | TYPE | BLOWS/0.15 m

STRATA PLOT

WELL CONSTRUCTION DETAILS:
- Concrete seal
- Bentonite pellet seal
- Sand
- Bentonite pellet seal
- 10/20 Sand
- 2" diameter PVC, Sch. 40, No. 10 slot well screen
- Water level measured at 4.25 mbgs
- Bentonite pellet seal

⊕ ORGANIC VAPOUR READINGS PID (ppm): 30, 60, 90, 120

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CH2MHILL

RECORD OF MONITORING WELL: MW 1-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 607.99 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 608.81 mASL
Datum: X 497024.932 Y 5547525.992

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
				End of borehole at 9.6 mbgs	+ + +	598.39 / 9.60		
10								
11								
12								
13								
14								
15								
16								
17								
18								

CH2MHILL

RECORD OF MONITORING WELL: MW 2D-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.9 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.84 mASL	Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	244	1		sandy **GRAVEL**: Brown		Concrete seal	
1						Bentonite pellet seal	
				medium **SAND**: Poorly graded, brown/orange laminations for 0.61m	602.32 / 1.52		
2							
3	305	2					
4							
5							
				SILT: Grey, soft, thin orange laminations	598.11 / 5.73	Water level measured 5.77 mbgs	
6	305	3		gravelly **SAND**: Well graded coarse sand to fine gravel, sub-rounded to round, grey	597.96 / 5.88		
7							
				Orange			
8							
				Grey, fine Silt, some fine, angular gravel, some sand, soft for 5 cm			
9							
	146	4					

CH2MHILL

RECORD OF MONITORING WELL: MW 2D-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP
PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 603.84 mASL
DRILLER: Sonic Drilling
TOP OF PIPE: 604.9 mASL
Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS
10						
11						
12						
13	305	5				
14						
15						10/20 Sand
16	183	6				2" diameter PVC, Sch. 40, No. 10 slot well screen
17				**SILT**: Stiff	587.07 / 16.77	
18				**ROCK**: Fine grain basalt	585.85 / 17.99	
	36	7				

⊕ ORGANIC VAPOUR READINGS PID (ppm): 30 60 90 120

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 2D-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.9 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.84 mASL	Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
20						583.72		
				End of borehole at 20.12 mbgs		20.12		
21								
22								
23								
24								
25								
26								
27								
28								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 2S-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 603.84 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 604.94 mASL
Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	244	1		sandy **GRAVEL**: Brown			Concrete seal	
1							Bentonite pellet seal	
				medium **SAND**: Poorly graded, brown/orange laminations for 0.61m		602.32 / 1.52		
2								
3	305	2						
4								
5							Water level measured 5.28 mbgs	
				SILT: Grey, soft, thin orange laminations		598.11 / 5.73		
6	305	3		gravelly **SAND**: Well graded coarse sand to fine gravel, sub-rounded to round, grey		597.96 / 5.88		
7							10/20 Sand	
				Orange			2" diameter PVC, Sch. 40, No. 10 slot well screen	
8				Grey, fine				
9	146	4						

CH2MHILL

SHEET 2 OF 2

RECORD OF MONITORING WELL: MW 2S-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.94 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.84 mASL	Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
10								
11								
12								
	305	5						
13								
14								
15								
	36	6						
16								
				End of borehole at 16.77 mbgs		587.07 / 16.77		
17								
18								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

SHEET 1 OF 2

RECORD OF MONITORING WELL: MW 3-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 601.47 mASL
LOGGED BY: PP	GROUND ELEVATION: 600.61 mASL	Datum: X 496751.391 Y 5547609.577

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS
	170	1		**COBBLE and GRAVEL (FILL)**: Grey	600.00 / 0.61	Concrete patch
1				??	599.39 / 1.22	Slough
				gravelly **SAND**: Well graded coarse sand to fine gravel, sub-rounded particles	598.62 / 1.99	
2	305	2		sandy **GRAVEL**: Well graded, sub-rounded particles		Bentonite pellet seal
				Cobble		
3				Cobble	596.95 / 3.66	10/20 Sand
4				medium **SAND**: Poorly sorted, Brown, occasional pebble		2" diameter PVC, Sch. 40, No. 10 slot well screen
5	305	3		Cobble		
6						
7				Orange		
8	305	4		Grey		
9						Slough/cave bottom of hole

⊕ ORGANIC VAPOUR READINGS PID (ppm): 30 60 90 120

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 3-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 601.47 mASL
LOGGED BY: PP	GROUND ELEVATION: 600.61 mASL	Datum: X 496751.391 Y 5547609.577

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	305	5						
10								
11								
12								
	305	6						
13								
14								
15								
				End of borehole at 15.24 mbgs		585.37 / 15.24		
16								
17								
18								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

SHEET 1 OF 2

RECORD OF MONITORING WELL: MW 4-06

LOCATION: Landfill | PROJECT NUMBER: 335612 | DRILLER: Sonic Drilling
DATE DRILLED: | BORING METHOD: HSA/HQ-CORE | TOP OF PIPE: 595.48 mASL
LOGGED BY: PP | GROUND ELEVATION: 594.60 mASL | Datum: X 496800.883 Y 5547890.701

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS
	1.22	1		sandy **GRAVEL (FILL)**: Brown	593.99 / 0.61	Concrete seal
1	53	2		**SILT, SAND, GRAVEL, COBBLE (FILL)**: Grey	592.77 / 1.83	Bentonite pellet seal; Water level measured: 1.497 mbgs
2	15	3		**ROCK, COARSE GRAIN GRANITE**		
	24	4		Soft to 3.2 mbgs		
3	61	5				
4					590.03 / 4.57	
	122	6		gravelly **SAND**: Well graded, medium sand to medium gravel, brown	589.18 / 5.42	
5				**SAND and GRAVEL (FILL)**: Brown		
6	305	7				
7						10/20 Sand
8					586.29 / 8.31	2" diameter PVC, Sch. 40, No. 10 slot well screen
				sandy **GRAVEL**: Well graded, rounded gravel to medium sand Oxidation	585.66 / 8.94	
9	305	8		**SAND**: Medium to fine, poorly graded, grey Thin oxidation lamination to 13.11 mbgs		

⊕ ORGANIC VAPOUR READINGS PID (ppm): 30 60 90 120

CH2MHILL

RECORD OF MONITORING WELL: MW 4-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 594.60 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 595.48 mASL
Datum: X 496800.883 Y 5547890.701

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
10								
11								
12	305	9						
13				sandy **SILT**: Grey		581.49 / 13.11		
				SAND: Fine End of borehole at 13.21 mbgs		581.39 / 13.21		
14								
15	305	10						
16								
17								
18						576.60 / 18.00		

CH2MHILL

RECORD OF MONITORING WELL: MW 5-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.65 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.98 mASL	Datum: X 496906.423 Y 5547367.257

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)
	305	1		**SAND and GRAVEL (FILL)**: Some cobble, some silt	
	305	2		sandy **GRAVEL**: Well graded, coarse sand to medium gravel, some cobble, rounded to sub-rounded partcles, some silt orange/brown	601.31 / 2.67
	152	3		**SAND**: Coarse, well graded, grey	598.85 / 5.13
				SAND: Medium to fine, some silt, occasional gravel, grey, some oxidation zones	598.80 / 5.18
	206	4		sandy **SILT**: Fine angular gravel, stiff, grey, with some oxidation mottling	597.38 / 6.60
				sandy **GRAVEL**: Silty, brown	597.05 / 6.93
				Boulder	596.93 / 7.05
	8	5		sandy, gravelly **SILT**: Stiff	596.30 / 7.68
				ROCK: Fine grain basalt	596.11 / 7.87

Depth scale (mbgs): 1, 2, 3, 4, 5, 6, 7, 8, 9

STRATA PLOT

WELL CONSTRUCTION DETAILS

- Concrete seal
- Bentonite pellet seal
- 10/20 Sand
- Water level measured 1.855
- Bentonite pellet seal
- 10/20 Sand
- 2" diameter PVC, Sch. 40, No. 10 slot well screen

⊕ ORGANIC VAPOUR READINGS PID (ppm)

30 60 90 120

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CH2MHILL

RECORD OF MONITORING WELL: MW 5-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 603.98 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 604.65 mASL
Datum: X 496906.423 Y 5547367.257

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
10						593.88 / 10.10		
				End of borehole at 10.2 mbgs				
11								
12								
13								
14								
15								
16								
17								
18								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

SHEET 1 OF 1

RECORD OF MONITORING WELL: MW 6-06

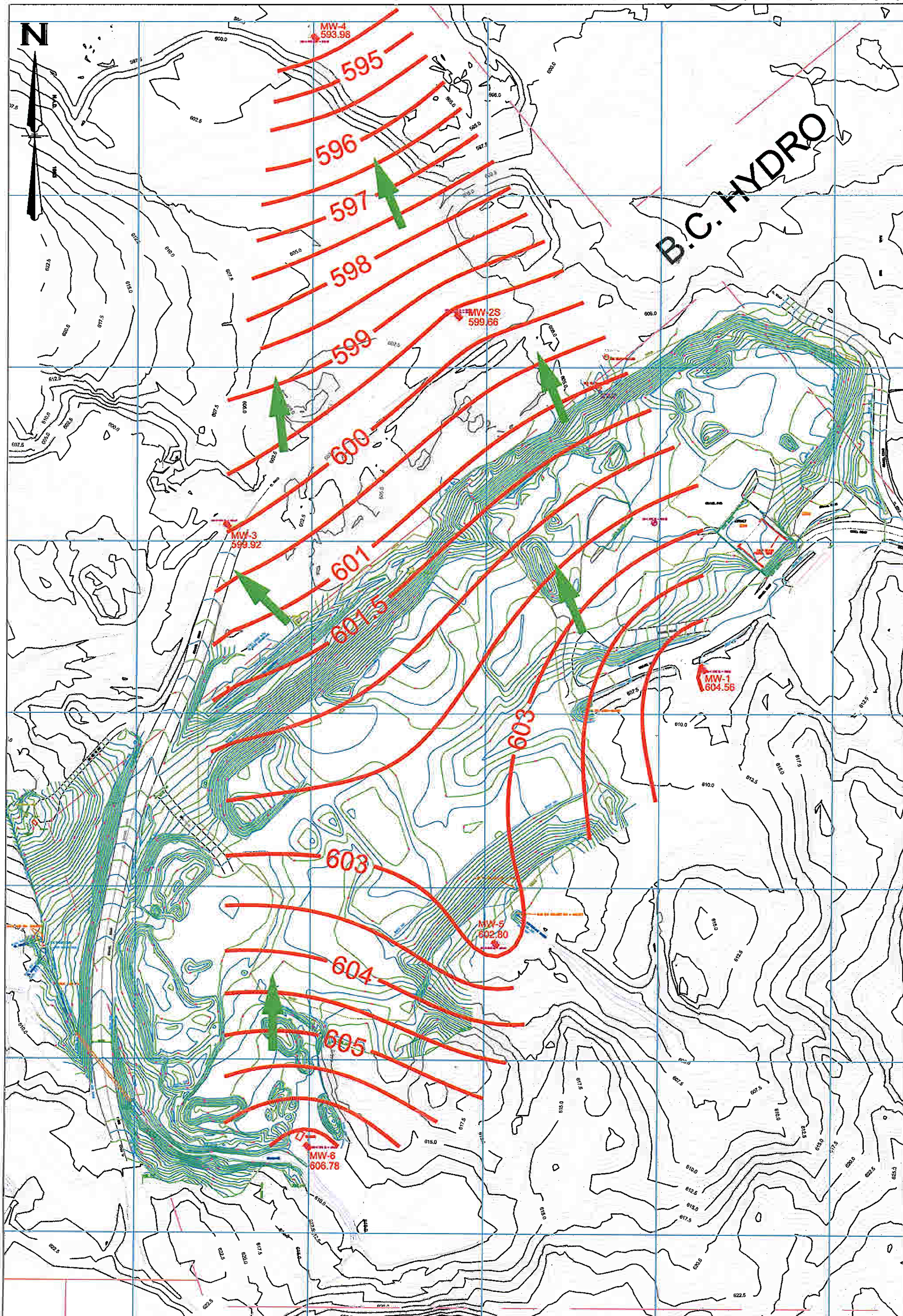
LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 610.05 mASL
LOGGED BY: PP	GROUND ELEVATION: 609.3 mASL	Datum: X 496799.226 Y 5547249.454

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	1.82			**SAND, GRAVEL, COBBLE**			Concrete seal	
1				**ORGANIC SOIL**: Black, wood fragments		608.39 / 0.91	Bentonite pellet seal	
2	305							
3							Water level measured 3.271 mbgs	
4							10/20 Sand 2" diameter PVC, Sch. 40, No. 10 slot well screen	
5	305			**SAND**: Occasional gravel, well graded, some silt		604.25 / 5.05		
6								
7				gravelly, silty **SAND**: Fine, dense, orange to 8.23 mbgs		602.59 / 6.71		
8	122			Grey to bottom				
9				End of borehole at 9.15 mbgs		600.15 / 9.15		

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

APPENDIX C

GROUNDWATER FLOW



MW-6 — GROUNDWATER MONITORING WELL
606.78 — JANUARY 2006 STATIC WATER LEVEL

INFERRED GROUNDWATER FLOW DIRECTION

-605- INFERRED GROUNDWATER ELEVATION AND EQUIPOTENTIAL CONTOUR

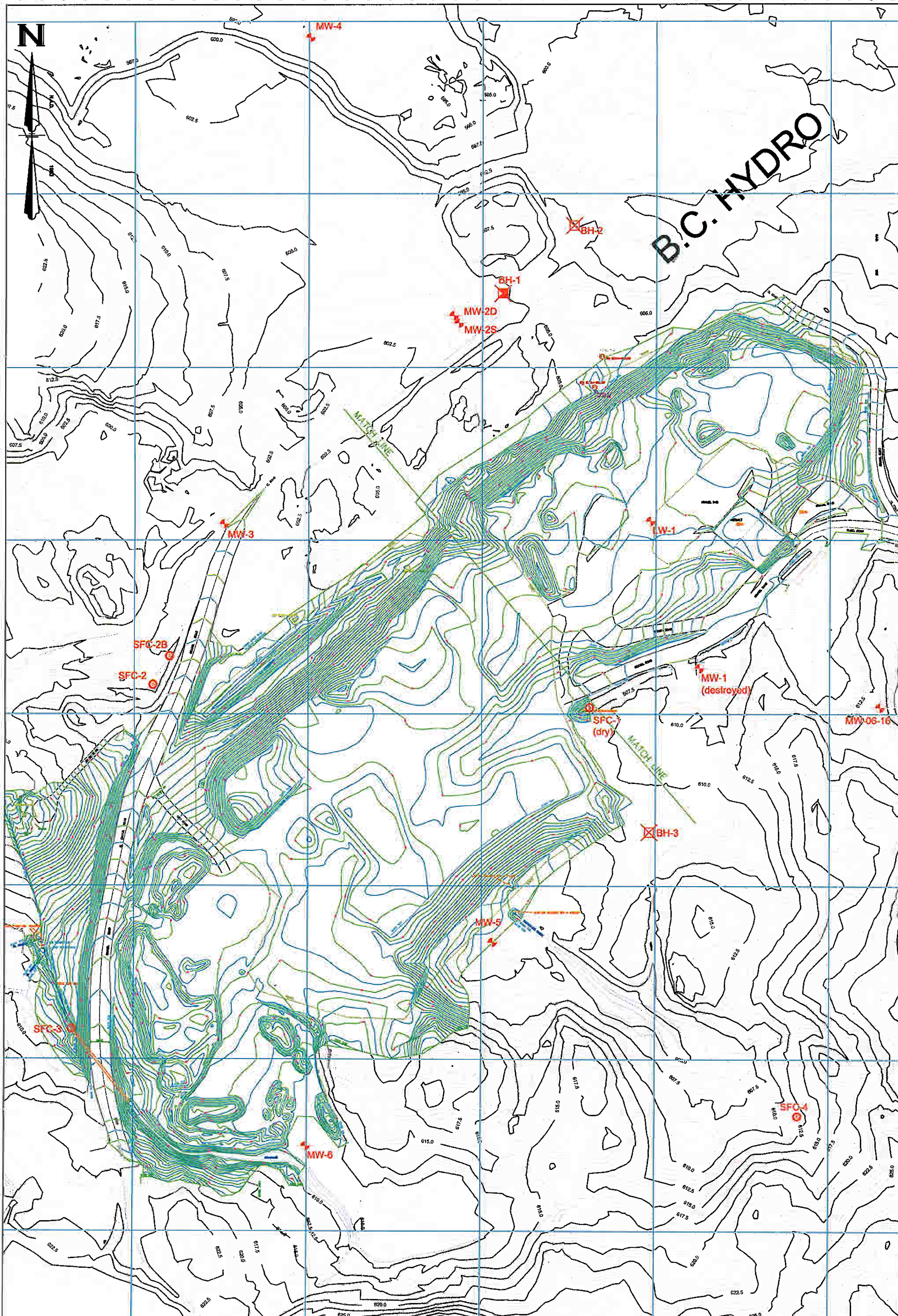
Resort Municipality of Whistler

Exhibit C-1: Groundwater Flow

CH2MHILL

Appendix D

Sampling Location



MW-4 GROUNDWATER MONITORING WELL

LW-1 LEACHATE MONITORING WELL

SFC-4 SURFACE WATER MONITORING LOCATION

BH-3 BOREHOLE LOCATION

Resort Municipality of Whistler

Exhibit D-1: Whistler Landfill - Sampling Location

CH2MHILL

APPENDIX E

PARAMETERS TO BE ANALYZED

EXHIBIT E-1

Groundwater – Parameters to be Analyzed

General Chemistry	Volatiles	Polycyclic Aromatics Hydrocarbons	Dissolved Metals
Misc. Inorganics	Purgeable VPH (VHW6 to 10 - BTEX)	Low Molecular Weight PAHs	**Misc. Inorganics**
Bromide (Br)	CSR VH C6-C10	High Molecular Weight PAHs	Dissolved Hardness ($CaCO_3$)
Anions	**Chlorobenzenes**	Total PAH	**Dissolved Metals by ICP**
Nitrite (N)	1,2-dichlorobenzene	Naphthalene	Dissolved Barium (Ba)
Calculated Parameters	1,3-dichlorobenzene	Quinoline	Dissolved Beryllium (Be)
Nitrate (N)	1,4-dichlorobenzene	2-Methylnaphthalene	Dissolved Bismuth (Bi)
Misc. Inorganics	Chlorobenzene	Acenaphthylene	Dissolved Boron (B)
Alkalinity (Total as $CaCO_3$)	**Monocyclic Aromatics**	Acenaphthene	Dissolved Calcium (Ca)
Alkalinity (PP as $CaCO_3$)	Benzene	Fluorene	Dissolved Iron (Fe)
Bicarbonate (HCO_3)	Ethylbenzene	Phenanthrene	Dissolved Magnesium (Mg)
Carbonate (CO_3)	m & p-Xylene	Anthracene	Dissolved Manganese (Mn)
Hydroxide (OH)	o-Xylene	Acridine	Dissolved Molybdenum (Mo)
Anions	Styrene	Fluoranthene	Dissolved Nickel (Ni)
Dissolved Sulphate (SO_4)	Toluene	Pyrene	Dissolved Phosphorus (P)
Dissolved Chloride (Cl)	Xylenes (Total)	Benzo(a)anthracene	Dissolved Potassium (K)
Nutrients	**Parameter**	Chrysene	Dissolved Silicon (Si)
Total Kjeldahl Nitrogen (Calc)	4-Methyl-2-pentanone (MIBK)	Benzo(b&j)fluoranthene	Dissolved Sodium (Na)
Ammonia (N)	**Volatiles**	Benzo(k)fluoranthene	Dissolved Strontium (Sr)
Nitrate plus Nitrite (N)	1,1,1,2-tetrachloroethane	Benzo(a)pyrene	Dissolved Sulphur (S)
Total Nitrogen (N)	1,1,1-trichloroethane	Indeno(1,2,3-cd)pyrene	Dissolved Tin (Sn)
Total Phosphorus (P)	1,1,2,2-tetrachloroethane	Dibenz(a,h)anthracene	Dissolved Titanium (Ti)
Physical Properties	1,1,2-trichloroethane	Benzo(g,h,i)perylene	Dissolved Vanadium (V)
Conductivity	1,1-dichloroethane		Dissolved Zinc (Zn)
pH	1,1-dichloroethene	HEPH (C19-C32 less PAH)	Dissolved Zirconium (Zr)
	1,2-dichloroethane	LEPH (C10-C19 less PAH)	**Dissolved Metals by ICPMS**
	1,2-dichloropropane	**Ext. Pet. Hydrocarbon**	Dissolved Aluminum (Al)
	2-Butanone (MEK)	EPH (C10-C19)	Dissolved Cadmium (Cd)
	Acetone	EPH (C19-C32)	Dissolved Antimony (Sb)
	Bromodichloromethane		Dissolved Arsenic (As)
	Bromoform		Dissolved Chromium (Cr)
	Bromomethane		Dissolved Cobalt (Co)
	Carbon tetrachloride		Dissolved Copper (Cu)
	Chlorodibromomethane		Dissolved Lead (Pb)
	Chloroethane		Dissolved Lithium (Li)
	Chloroform		Dissolved Selenium (Se)
	Chloromethane		Dissolved Silver (Ag)
	cis-1,2-dichloroethene		Dissolved Thallium (Tl)
	cis-1,3-dichloropropene		Dissolved Uranium (U)
	Dibromoethane		**Mercury by CVAA**
	Dichloromethane		Dissolved Mercury (Hg)
	Methyl-tert-butylether (MTBE)		
	Tetrachloroethene		
	trans-1,2-dichloroethene		
	trans-1,3-dichloropropene		
	Trichloroethene		
	Trichlorofluoromethane		
	Vinyl chloride		

EXHIBIT E-2

Surface Water and Leachate – Parameters to be Analyzed

General Chemistry	Volatiles	Polycyclic Aromatics Hydrocarbons	Total Metals
Misc. Inorganics	Purgeable VPH (VHW6 to 10 - BTEX)	Low Molecular Weight PAHs	**Misc. Inorganics**
Bromide (Br)	CSR VH C6-C10	High Molecular Weight PAHs	Total Hardness ($CaCO_3$)
Anions	**Chlorobenzenes**	Total PAH	**Total Metals by ICP**
Nitrite (N)	1,2-dichlorobenzene	Naphthalene	Total Barium (Ba)
Calculated Parameters	1,3-dichlorobenzene	Quinoline	Total Beryllium (Be)
Nitrate (N)	1,4-dichlorobenzene	2-Methylnaphthalene	Total Bismuth (Bi)
Misc. Inorganics	Chlorobenzene	Acenaphthylene	Total Boron (B)
Alkalinity (Total as $CaCO_3$)	**Monocyclic Aromatics**	Acenaphthene	Total Calcium (Ca)
Alkalinity (PP as $CaCO_3$)	Benzene	Fluorene	Total Iron (Fe)
Bicarbonate (HCO_3)	Ethylbenzene	Phenanthrene	Total Magnesium (Mg)
Carbonate (CO_3)	m & p-Xylene	Anthracene	Total Manganese (Mn)
Hydroxide (OH)	o-Xylene	Acridine	Total Molybdenum (Mo)
Anions	Styrene	Fluoranthene	Total Nickel (Ni)
Total Sulphate (SO_4)	Toluene	Pyrene	Total Phosphorus (P)
Total Chloride (Cl)	Xylenes (Total)	Benzo(a)anthracene	Total Potassium (K)
Nutrients	**Parameter**	Chrysene	Total Silicon (Si)
Total Kjeldahl Nitrogen (Calc)	4-Methyl-2-pentanone (MIBK)	Benzo(b&j)fluoranthene	Total Sodium (Na)
Ammonia (N)	**Volatiles**	Benzo(k)fluoranthene	Total Strontium (Sr)
Nitrate plus Nitrite (N)	1,1,1,2-tetrachloroethane	Benzo(a)pyrene	Total Sulphur (S)
Total Nitrogen (N)	1,1,1-trichloroethane	Indeno(1,2,3-cd)pyrene	Total Tin (Sn)
Total Phosphorus (P)	1,1,2,2-tetrachloroethane	Dibenz(a,h)anthracene	Total Titanium (Ti)
Physical Properties	1,1,2-trichloroethane	Benzo(g,h,i)perylene	Total Vanadium (V)
Conductivity	1,1-dichloroethane		Total Zinc (Zn)
pH	1,1-dichloroethene	HEPH (C19-C32 less PAH)	Total Zirconium (Zr)
	1,2-dichloroethane	LEPH (C10-C19 less PAH)	**Total Metals by ICPMS**
	1,2-dichloropropane	**Ext. Pet. Hydrocarbon**	Total Aluminum (Al)
	2-Butanone (MEK)	EPH (C10-C19)	Total Cadmium (Cd)
	Acetone	EPH (C19-C32)	Total Antimony (Sb)
	Bromodichloromethane		Total Arsenic (As)
	Bromoform		Total Chromium (Cr)
	Bromomethane		Total Cobalt (Co)
	Carbon tetrachloride		Total Copper (Cu)
	Chlorodibromomethane		Total Lead (Pb)
	Chloroethane		Total Lithium (Li)
	Chloroform		Total Selenium (Se)
	Chloromethane		Total Silver (Ag)
	cis-1,2-dichloroethene		Total Thallium (Tl)
	cis-1,3-dichloropropene		Total Uranium (U)
	Dibromoethane		**Mercury by CVAA**
	Dichloromethane		Total Mercury (Hg)
	Methyl-tert-butylether (MTBE)		
	Tetrachloroethene		
	trans-1,2-dichloroethene		
	trans-1,3-dichloropropene		
	Trichloroethene		
	Trichlorofluoromethane		
	Vinyl chloride		

APPENDIX F

GROUNDWATER AND LEACHATE LEVELS

EXHIBIT F-1
Groundwater/Leachate Levels
Whistler Landfill

Date	MW-1		MW-2S		MW-2D		MW-3		MW-4		MW-5		MW-6		MW06-16		LW-1	
	Ground Elev. =	607.99	Ground Elev. =	603.84	Ground Elev. =	603.84	Ground Elev. =	600.61	Ground Elev. =	594.60	Ground Elev. =	603.98	Ground Elev. =	609.30	Ground Elev. =	613.89	Ground Elev. =	614.54
	Riser Elev. =	608.81	Riser Elev. =	604.94	Riser Elev. =	604.90	Riser Elev. =	601.47	Riser Elev. =	595.48	Riser Elev. =	604.65	Riser Elev. =	610.05	Riser Elev. =	614.34	Riser Elev. =	615.42
dd-mmm-yy	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)
27-Jan-06	4.25	604.56	5.28	599.66	5.77	599.13	1.55	599.92	1.50	593.98	1.86	602.80	3.27	606.78	NM	-	9.61	605.81
20-Apr-06	4.80	604.01	6.12	598.82	6.88	598.02	1.58	599.89	2.54	592.94	1.97	602.68	3.43	606.62	3.23	611.11	NM	-
1-Nov-06	DRY	-	6.83	598.11	6.79	598.11	2.10	599.37	1.87	593.61	DEC	-	DEC	-	NM	-	8.13	607.29
21-Jun-07	1.89	606.93	6.56	598.38	6.53	598.37	5.43	596.04	**2.57**	592.91	DEC	-	DEC	-	NM	-	7.79	607.63
15-Aug-07	DRY	-	6.80	598.14	6.77	598.14	2.12	599.36	**2.34**	593.14	DEC	-	DEC	-	NM	-	9.31	606.11
12-Dec-07	DEC	-	6.41	598.53	6.27	598.63	1.70	599.77	**2.70**	592.78	DEC	-	DEC	-	2.48	611.86	NM	-

mBTR – Metres Below Top of Riser
mASL – Metres Above Sea Level (Mean Sea Level)
NM – Not Measured
DEC – Decommissioned
DRY – Well Dry at Bottom
2.34 Riser (0.88m) trimmed to ground surface, inferred water table

EXHIBIT F-1
Groundwater/Leachate Levels
Whistler Landfill

Date	MW-1		MW-2S		MW-2D		MW-3		MW-4		MW-5		MW-6		MW06-16		LW-1	
	Ground Elev. = 607.99		Ground Elev. = 603.84		Ground Elev. = 603.84		Ground Elev. = 600.61		Ground Elev. = 594.60		Ground Elev. = 603.98		Ground Elev. = 609.30		Ground Elev. = 613.89		Ground Elev. = 614.54	
	Riser Elev. = 608.81		Riser Elev. = 604.94		Riser Elev. = 604.90		Riser Elev. = 601.47		Riser Elev. = 595.48		Riser Elev. = 604.65		Riser Elev. = 610.05		Riser Elev. = 614.34		Riser Elev. = 615.42	
dd-mmm-yy	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)	Depth to Water (mBTR)	Static Water Level (mASL)
27-Jan-06	4.25	604.56	5.28	599.66	5.77	599.13	1.55	599.92	1.50	593.98	1.86	602.80	3.27	606.78	NM	-	9.61	605.81
20-Apr-06	4.80	604.01	6.12	598.82	6.88	598.02	1.58	599.89	2.54	592.94	1.97	602.68	3.43	606.62	3.23	611.11	NM	-
1-Nov-06	DRY	-	6.83	598.11	6.79	598.11	2.10	599.37	1.87	593.61	DEC	-	DEC	-	NM	-	8.13	607.29
21-Jun-07	1.89	606.93	6.56	598.38	6.53	598.37	5.43	596.04	**2.57**	592.91	DEC	-	DEC	-	NM	-	7.79	607.63
15-Aug-07	DRY	-	6.80	598.14	6.77	598.14	2.12	599.36	**2.34**	593.14	DEC	-	DEC	-	NM	-	9.31	606.11
12-Dec-07	DEC	-	6.41	598.53	6.27	598.63	1.70	599.77	**2.70**	592.78	DEC	-	DEC	-	2.48	611.86	NM	-

mBTR – Metres Below Top of Riser
mASL – Metres Above Sea Level (Mean Sea Level)
NM – Not Measured
DEC – Decommissioned
DRY – Well Dry at Bottom
2.34 Riser (0.88m) trimmed to ground surface, inferred water table

APPENDIX G

CHAIN-OF-CUSTODY FORMS

A7U1928

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC, V5A 4N5
www.maxxamanalytics.com

Phone: (604) 444-4808
Fax: (604) 444-4511
Toll Free: 1-800-440-4808

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

PAGE 1 OF 1

ANALYSIS REQUEST F 91533

COMPANY NAME: CH2M Hill

PH. #: 604-439-2368
E-mail: mbudzik@ch2m.com
FAX #: 604-684-3292

COMPANY ADDRESS: Suite 2100 - 4720 Kingsway Burnaby BC V5H 4N2

CLIENT PROJECT ID: (#) 367242.A1.01

SAMPLER NAME (PRINT): Cristofor Ursache

PROJECT MANAGER: Mike Budzik

#	FIELD SAMPLE ID	MAXXAM LAB # (Lab Use Only)	MATRIX: GROUND WATER	MATRIX: SURFACE WATER	MATRIX: SOIL	MATRIX: OTHER	# CONTAINERS	SAMPLING: DATE DD/MM/YY	SAMPLING: TIME	HEADSPACE VAPOUR	General chemistry	VOC/BTEX	EPH	Dissolved Metals	Total Metals	PAH	Alkalinity	Anions	Phosphorus Total	LAB USE ONLY
1	MW-2S		X				6	12/12/07	9am			X	X	X		X	X	X	X	
2	MW-2D		↓				7	↓	9:30		X	X	↓	↓		↓	↓	↓	↓	
3	MW-3		↓				7	↓	10am		X	X	↓	↓		↓	↓	↓	↓	No. Preserves.
4	MW-4		↓				7	↓	10:30		X	X	↓	↓		↓	↓	↓	↓	
5	MW06-16		↓				7	↓	3pm		X	X	↓	↓		↓	↓	↓	↓	
6	1972		↓				7	↓	3pm		X	X	↓	↓		↓	↓	↓	↓	
7	SFC-2			X			6	↓	1pm				↓		X	↓	↓	↓	↓	
8	SFC-2B			↓			6	↓	1:30				↓		↓	↓	↓	↓	↓	
9	SFC-3			↓			6	↓	2:30				↓		↓	↓	↓	↓	↓	
10	SFC-4			↓			6	↓	2:45				↓		↓	↓	↓	↓	↓	
11	LW-1 (Pump)					X	5	↓	3:30			X	↓		↓	↓	↓	↓	↓	
12																				

TAT (Turnaround Time)

<5 DAY TAT MUST HAVE PRIOR APPROVAL

*some exceptions apply please contact lab

- STANDARD 5 BUSINESS DAYS ☐
- RUSH 3 BUSINESS DAYS ☐
- RUSH 2 BUSINESS DAYS ☐
- URGENT 1 BUSINESS DAY ☐

OTHER BUSINESS DAYS ____

CUSTODY RECORD

P.O. NUMBER / QUOTE NUMBER: 367242.A1.01

SPECIAL DETECTION LIMITS / CONTAMINANT TYPE: LW-1 (Pump) = Leachate

☐ CCME
☒ CSR DW/AW
☐ ALBERTA TIER 1
☐ OTHER

ACCOUNTING CONTACT: Resort Municipality of Whistler: 604-935-8109

SPECIAL REPORTING OR BILLING INSTRUCTIONS: Billing Resort Municipality of Whistler

JARS USED:

LAB USE ONLY
ARRIVAL TEMPERATURE °C: 10, 7, 6 / 3, 10, 7
DUE DATE:
LOG IN CHECK:

RELINQUISHED BY SAMPLER: CGU	DATE: DD/MM/YY 13/12/07	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME: 10:25	RECEIVED BY LABORATORY: A. M

COCFORM - BC - 05/06

ORIGINAL - MAXXAM YELLOW - MAXXAM PINK - CLIENT

Maxxam Analytics Inc

8577 Commerce Court
Burnaby, BC V5A 4N5
www.maxxamanalytics.com

Phone: (604) 444-4808
Fax: (604) 444-4511
Toll Free: 1-800-440-4808

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

PAGE ____ OF ____

ANALYSIS REQUEST F 88365

LAB USE ONLY

COMPANY NAME:	PH. #: E-mail: FAX #:
COMPANY ADDRESS:	CLIENT PROJECT ID: (#)
SAMPLER NAME (PRINT):	PROJECT MANAGER:

FIELD SAMPLE ID	MAXXAM LAB # (Lab Use Only)	MATRIX: GROUND WATER	MATRIX: SURFACE WATER	MATRIX: SOIL	MATRIX: OTHER	# CONTAINERS	SAMPLING: DATE DD/MM/YY	SAMPLING: TIME	SAMPLING: HEADSPACE VAPOUR	ANALYSIS REQUEST
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

TAT (Turnaround Time)

<5 DAY TAT MUST HAVE PRIOR APPROVAL

*some exceptions apply please contact lab

- STANDARD 5 BUSINESS DAYS ☐
- RUSH 3 BUSINESS DAYS ☐
- RUSH 2 BUSINESS DAYS ☐
- URGENT 1 BUSINESS DAY ☐

OTHER BUSINESS DAYS ____

CUSTODY RECORD

P.O. NUMBER / QUOTE NUMBER:	SPECIAL DETECTION LIMITS / CONTAMINANT TYPE:	☐ CCME ☐ CSR ☐ ALBERTA TIER 1 ☐ OTHER
ACCOUNTING CONTACT:	SPECIAL REPORTING OR BILLING INSTRUCTIONS:	# JARS USED:

LAB USE ONLY

ARRIVAL TEMPERATURE °C:	DUE DATE:	LOG IN CHECK:

RELINQUISHED BY SAMPLER:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME:	RECEIVED BY:
RELINQUISHED BY:	DATE: DD/MM/YY	TIME:	RECEIVED BY LABORATORY:

COCFORM - BC - 06/06

ORIGINAL - MAXXAM YELLOW - MAXXAM PINK - CLIENT

APPENDIX C: Revised Groundwater, Surface Water and Leachate Monitoring Program

MORRISON HERSHFIELD

REPORT

Revised Groundwater, Surface Water and Leachate Monitoring Program

Whistler, BC

Presented to:

James Hallisey
Manager of Environmental Projects

Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, BC V0N 1B4

Report No. 510401602 January 4, 2013

M:\PROJ\5104016\02\PHASE 04 REVISED MONITORING PROGRAM\REVISED MONITORING PROGRAM\GW_SW_L\GW_SW_L_JANUARY2013.DOCX

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

1. INTRODUCTION

The following document outlines the proposed monitoring program for the Resort Municipality of Whistler, Whistler Landfill site (the Site) for the next two years. This updated program is based on a review of the following documents:

- Whistler Closure Plan, CH2M Hill, 2006;
- Monitoring and Reporting Requirements, CH2M Hill, 2008;
- Mitigation and Safety Measures for Reduction of Landfill Gas Migration Risks, CH2M Hill, 2008; and
- Landfill Gas Collection System Operation and Maintenance Manual, CH2M Hill, 2008.

The updated monitoring program encompasses monitoring and reporting requirements and procedures for groundwater, surface water, and leachate. It describes the site specific requirements including:

- Sampling locations;
- Sampling frequency;
- Sample collection techniques, equipment, and sample handing instructions;
- Laboratory analysis requirements;
- Quality assurance and quality control (QA / QC) measures ; and
- Data reporting requirements.

The updated landfill gas (LFG) operation, maintenance and monitoring program has been developed as a separate document (*Landfill Gas Collection System Operation and Maintenance Manual*, Morrison Hershfield, 2012); however, a summary of this program is provided at the end of this report.

The monitoring program described within this document is intended to replace the program developed by CH2M Hill in 2008, based on the results of monitoring data collected overall a 2-year period (2010 – 2011). It is anticipated that this new program will direct monitoring efforts over the next two years (2012 – 2013). Following this two-year period, the monitoring program will be reviewed to determine if any adjustments are required to maintain the integrity and purpose of the monitoring program.

Figure 1 and Figure 2 depict the landfill footprint along with all of the current and historic surface water, groundwater, leachate and landfill gas monitoring locations.

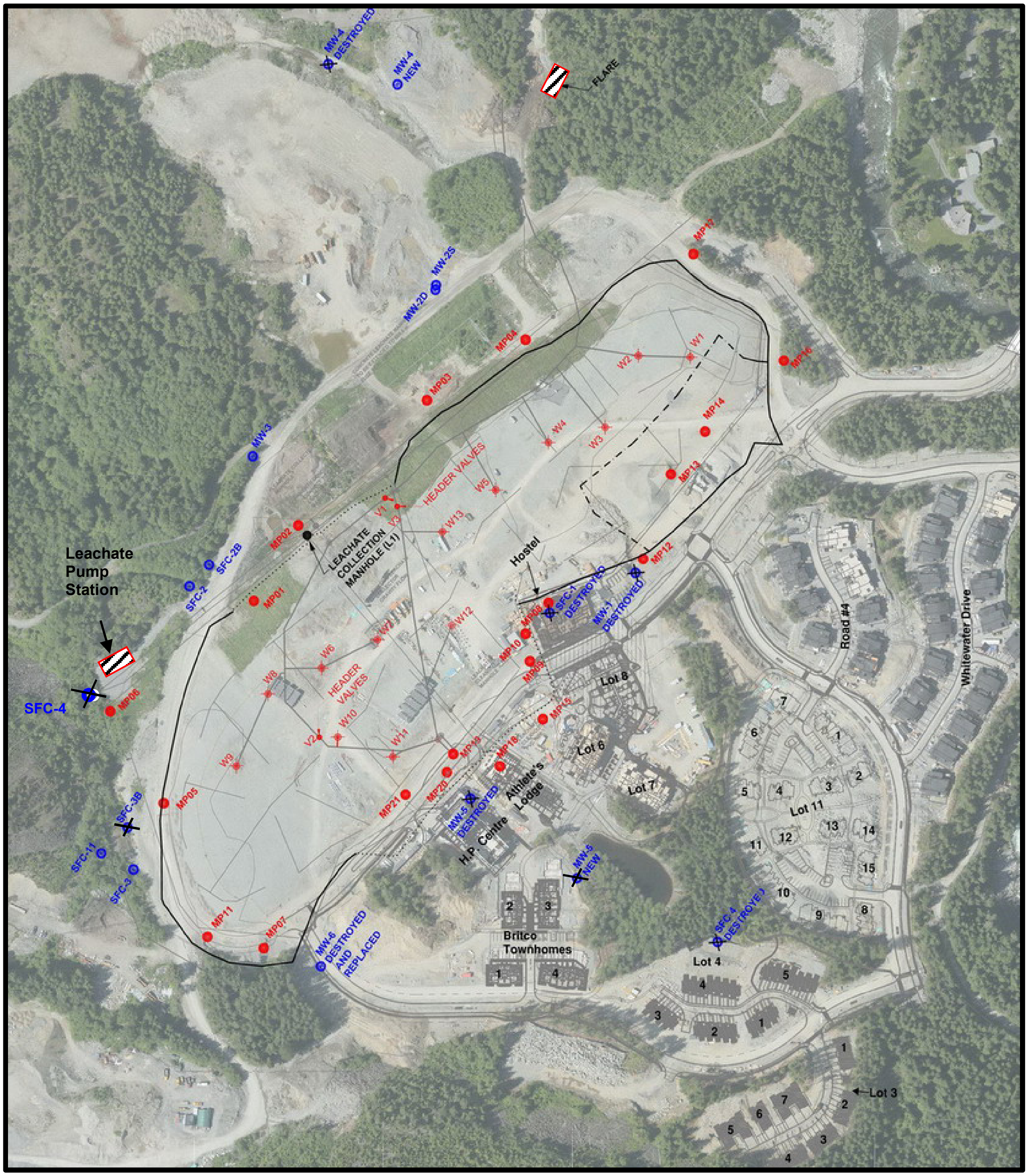


Figure 1. Whistler Landfill with Groundwater, Surface Water, and Leachate Sampling Locations, and LFG Monitoring Probes, LFG Wells and Buildings, Identified.

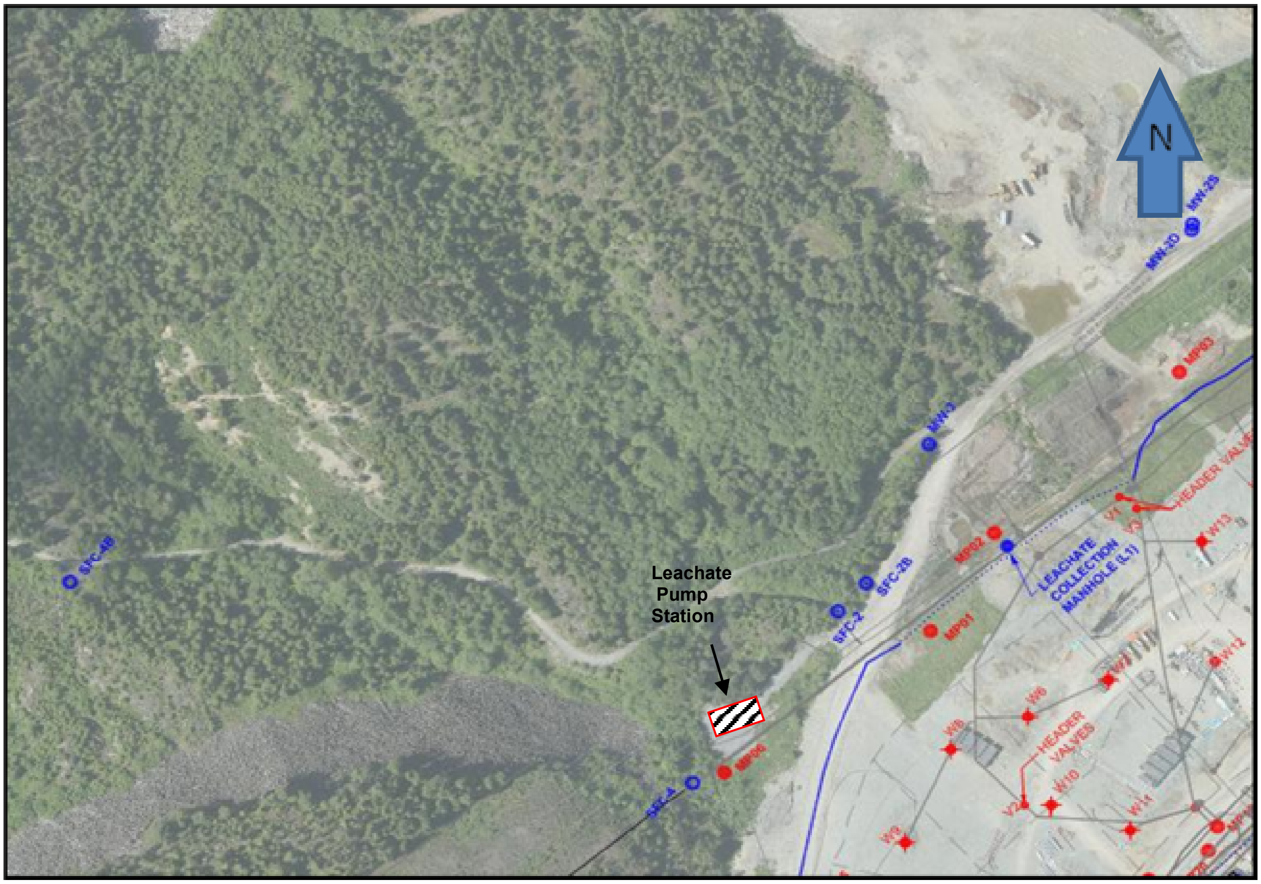


Figure 2. Whistler Landfill Sample Locations East of the Landfill site.

2. PROGRAM SUMMARY

An overview of the proposed groundwater, surface water and leachate monitoring program is provided in Table 1.

Table 1. Monitoring Program Summary for Groundwater, Surface Water, Leachate

Monitoring Program	Sampling Locations	Parameters for Analysis				Standards for Results Comparison (as per the requirements of the Landfill Closure Plan)	Guidelines for Results Discussion Comparison	Reporting Requirements
		First Quarter (Spring)	Second Quarter (Summer)	Third Quarter (Fall)	Fourth Quarter (Winter)			
Groundwater	MW-2D MW-2S MW-3 MW-4 New MW-6 New	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP. *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Dissolved Metals, **VOCs, PAHs, and Hydrocarbons**.	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP. *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Dissolved Metals.	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP. *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Dissolved Metals, **VOCs, PAHs, and Hydrocarbons**.	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP. *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Dissolved Metals.	BC Contaminated Sites Regulation, Column II, Freshwater Aquatic Life	BC Approved and Working Criteria for Water Quality	Annually
Surface Water	SFC-2 SFC-2B SFC-3 SFC-4B SFC-11	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Total Metals. *Visual Assessment:* Assess the algal moss growth in the surface water streams.	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Total Metals. *Visual Assessment:* Assess the algal moss growth in the surface water streams.	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Total Metals. *Visual Assessment:* Assess the algal moss growth in the surface water streams.	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Total Metals. *Visual Assessment:* Assess the algal moss growth in the surface water streams.	BC Contaminated Sites Regulation, Column II, Freshwater Aquatic Life	BC Approved and Working Criteria for Water Quality	Annually
Leachate	L1 (Leachate Collection Manhole)	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Dissolved Metals, VOCs, PAHs, and Hydrocarbons	Sampling is not required.	*Field Measurements:* Temperature, pH, D.O., Conductivity, and ORP *Laboratory Analysis:* Physical parameters, Anions & Nutrients, COD, Dissolved Metals, VOCs, PAHs, and Hydrocarbons	Sampling is not required.	BC Contaminated Sites Regulation, Column II, Freshwater Aquatic Life	BC Approved and Working Criteria for Water Quality	Annually

3. PERSONNEL

All field team members must be familiar with the sampling and handling procedures included within this document, as well as the health and safety procedures applicable to the sampling work prior to the commencements of activities. All team members should be aware of the potential site hazards and proper emergency procedures before sampling begins. A site-specific health and safety plan should be developed by a qualified professional familiar with the monitoring program.

4. GROUNDWATER MONITORING PROGRAM

4.1 Background

Previous hydrogeological investigations undertaken at the site identified a single unconfined aquifer within the overburden. The saturated zone extended in most regions of the landfill from bedrock to within less than 1 m from the ground surface. The borehole logs from the installation of the groundwater monitoring wells are provided in Appendix A.

Groundwater levels range from 597 to 607 m ASL (meters above sea level). Flow generally follows the topography flowing approximately south to north towards the Cheakamus River. See Appendix B for mapping of the groundwater flow.

A groundwater monitoring program was initiated at the Whistler Landfill in 2010 and is on-going.

Since the development of the first monitoring program some of the wells were destroyed during construction activities in the area. Table 2 provides a summary of all of the wells that were decommissioned, the active wells on the property, and the locations of the wells in relation to the landfill mass.

Table 2. Groundwater Monitoring Well Locations

Monitoring Well Identification	Location Related to the Landfill Mass	UTM Coordinates
Active Wells		
MW-2S	Down- gradient, nested well with MW-2D	10 U 0496823 5547354
MW-2D	Down -gradient, nested well with MW-2S	10 U 0496823 5547354
MW-3	Down-gradient	10 U 496751 5547611
MW-4 New	Down-gradient, closest to Cheakamus Rv.	10 U 0496856 5547877
MW- 6 New	Up-gradient	10 U 0496800 5547234
Decommissioned Wells		
MW -1 (Destroyed)	Up-gradient	10 U 497033 5547520
MW-4 Old (Destroyed)	Down-gradient	10 U 496818 5547874
MW – 5 Old (Destroyed)	Up-gradient	10 U 496905 5547369
MW-5 New (Dry)	Up-gradient	10 U 0496982 5547303
MW-6 Old (Destroyed)	Up-gradient	10 U 0496800 5547234

Groundwater monitoring occurs only at the five active sites identified in Table 3. Refer to Figure 1 for the location of the groundwater monitoring wells.

4.2 Monitoring Frequency and Chemical Parameters

Groundwater monitoring at the active sampling stations should be undertaken on a quarterly basis for the following parameters:

- General physical parameters;
- Anions & Nutrients,
- COD, and
- Dissolved metals.

Groundwater monitoring will also include the following parameters bi-annually during the spring and fall sample events:

- Volatile Organic Compounds (VOCs);
- Polycyclic Aromatic Hydrocarbons (PAHs); and
- Hydrocarbons.

A complete list of the specific analytes to be tested is provided in Appendix C.

4.3 Field Measurements

During each monitoring event the following field measurements will be recorded:

- Date, weather and team members participating in the sampling event;
- Well number;
- Well depth (m);
- Well water level (m);
- Volume of water in the well (L);
- Volume of water purged (L);
- Any notes on the station condition, evidence of erosion or sediment issues in the area; and
- Make, model and calibration information for all field equipment used.

Analytical parameters to be measured in the field:

- Temperature (°C);
- pH;
- Conductivity (µs/cm);
- Dissolved Oxygen (mg/L); and
- Oxidation reduction potential.

4.4 Equipment

Prior to heading out to the site, field personnel should check to ensure that all equipment is functioning properly; equipment should also be calibrated prior to use in the field.

Equipment required for groundwater monitoring includes:

- Electronic water level meter, with minimum 50 m tape. The tape should have graduation in increments of 0.01 m or less.
- Water quality multi-probe (e.g. YSI 556) with capacity to measure: temperature, pH, conductivity, dissolved oxygen and oxidation reduction potential (ORP).
- Nitrile gloves
- Distilled water
- Graduated bucket
- Sample containers
- Field book.

Calibration of Field Equipment

Calibration requirements for field instruments are instrument-specific. The manufacturer's instructions must be followed for all calibration requirements.

At minimum equipment should be fully calibrated daily during sampling. A calibration check using standard reference solutions of known composition should be conducted more frequently to confirm is properly calibrated throughout the working day. Calibration and calibration check results will be recorded in the field notes. Additional periodic calibration will occur if meter readings appear to drift or batteries require replacement.

All field meters and water-level indicators operate on batteries that will be replaced as needed to ensure proper operation of the equipment.

4.5 Procedure

Pre-sampling Inspection

The structural integrity of the groundwater monitoring well system must be maintained so as to prevent surface water and contaminants from entering the well. Prior to sampling, a visual inspection of the exterior of the monitoring well will be conducted to assess the following:

- Condition of the protective casing;
- Condition of surface seal;
- Any obstructions in the well;
- Condition of dedicated sampling device in the well; and
- Any additional observations that may impact the water quality on site.

All pre-sampling observations will be recorded in the field notes.

Sampling Procedures

Initial Measurements

1. Record the well number, date, weather conditions and time in the field notes.
2. Verify that the water-level meter is on and functioning properly.
3. Slowly, lower the water-level probe into the well until the probe makes contact with the water's surface; the unit will emit a tone and / or light signal.
4. Measure the depth to the water level within 0.01 m on the water – level indicator tape from the reference point at the top of the casing (indicated by a mark on the well casing).
5. Turn off the water-level meter and lower the probe until the bottom of the well is reached (i.e. when the tape goes slack).
6. Measure the depth of the well within 0.01 m on the water-level indicator tape from the reference point on the well casing.
7. The height of the well casing from the reference point to the ground surface should be measured within 0.01 m to make known of any settlement that may be occurring.
8. Record the water level, well depth and height of the well casing above the ground in the field notes.
9. Thoroughly spray or wash portions of the instruments that were inserted into the well with distilled water after the measurements are performed and prior to coiling the tape back onto the spool.

Purging and Field Parameter Measurement

1. Confirm that the dedicated pump is present in the well and that it is functional. Install a new pump if no pump is present or damage is suspected.
2. Ensure that the instruments are calibrated as per the manufacturer's instructions.
3. Calculate the total depth of water in the well based on the water level measurement and the well depth measurement. The depth of water is calculated as follows:
4. Depth of water (m) = Depth to water level (m) from Step 4 – Total depth of well (m) from Step 6
5. Calculate the volume of water to be purged from the well. The volume of the well should be purged 3 to 6 times from the well. The calculation is as follows:

   $\pi\, r^2 / 1000$ = *Volume in litres*

   where: $\pi = 3.14$

   r = Radius of the well pipe in mm

   h = height of water in the well in m

The volume of water in a 50 mm diameter (2 inch) well casing may be calculated as follows:

2 L/m x depth of water (m) = litres of water in the well

The volume in litres calculated above is then multiplied by a minimum of three, and a six times to determine the total volume that is to be purged. All calculations and volumes will be recorded in the field notes.

Purge the well until field parameters have stabilized over three consecutive well volumes of parameters stabilize to within 10% of the previous reading. In general, field parameters are considered stabilized when pH measurements agree within 0.1 units, specific conductance measurements agree within 10%, ORP measurements are within 10mV, and turbidity is as low as practicable given the sampling conditions.

1. Capture and measure the volume of the purge water in a graduated bucket to determine the volume purged from the well. Purge water can be discharged onto the ground when the bucket is filled.
2. Measure and record the field parameters after the purging of the well is complete. The field parameters include: temperature, pH, conductivity, dissolved oxygen, and ORP.

Sample Collection

1. Put on new, clean nitrile gloves.
2. Operate the pump in a smooth consistent manner to achieve an appropriate flow rate that does not result in excessive turbidity or aeration of the water.
3. Collect samples directly from the pump tubing to the sample container. Care must be taken to not introduce contaminants from the sampler, surface, or atmosphere during sample collection. Handle the sample container lids so as to avoid contamination during sampling.
4. Install the single use filter only for the collection of the dissolved metals sample (unless specified otherwise by the laboratory). Discard the filter after collection of the sample. All used filter should be bagged and disposed of properly.
5. Ensure the samples are preserved as per the laboratory’s requirements.
6. Ensure the sample label is completed and accurate.
7. Place samples in a cooler containing ice immediately after they are collected. Samples should be maintained at approximately 4°C and must be maintained under a chain-of-custody procedure from the time of collection through to delivery to a laboratory for analysis. Use the chain-of-custody forms provided by the laboratory. The cooler temperature should be monitored to ensure that the internal temperature does not exceed 10°C.

5. SURFACE WATER MONITORING PROGRAM

5.1 Background

Small surface streams are present within the landfill limits and surrounding the landfill. Small streams located down-gradient of the landfill are likely to receive some base flow as a result of seasonal groundwater discharge; however the majority of the flow appears to be from surface water runoff.

A surface water monitoring program was initiated at the Whistler Landfill in 2010 and is on-going.

Since the initiation of the monitoring on-site the surface water monitoring locations have been adjusted slightly. One sample station was removed as it was redundant. Table 3 provides a list of the current and past monitoring locations for surface water.

Table 3. Surface Water Monitoring Locations

Surface Water Monitoring Station	Location Related to the Landfill Mass	UTM Coordinates
Active Sites		
SFC-2	Down-gradient (receives water from Athletes Village up-gradient of landfill)	10 U 496703 5547520
SFC-2B	Down-gradient	10 U 496713 5547523
SFC-3	Cross-gradient	10 U 496650 5547359
SFC-4B	Down-gradient	10 U 0496303 5547318
SFC-11	Up-gradient	10 U 496643 5547363
Decommissioned Sites		
SFC-3B	Cross-gradient	10 U 496647 5547372
SFC-4	Down-gradient	10 U 496621 5547448°

Surface water monitoring occurs at the five active sites identified in Table 3. Refer to Figure 1 and Figure 2 for the location of the surface water monitoring stations.

5.2 Monitoring Frequency and Chemical Parameters

Monitoring at the active surface water monitoring should be undertaken on a quarterly basis. The parameters for analysis shall include the following:

- General physical parameters;
- Anions & Nutrients;

- COD, and
- Total metals.

A complete list of the specific analytes to be measured is provided in Appendix D.

5.3 Field Measurements

During each quarterly monitoring event the following field measurements will be recorded:

- Date, weather and team members;
- Station number;
- Any notes on the station condition, evidence of erosion or sediment issues in the area;
- Observations of any algal blooms or moss in the surface water stream; and
- Make, model and calibration information for all field equipment used.

Field parameters

- Temperature (°C);
- pH;
- Conductivity (µs/cm);
- Dissolved Oxygen (mg/L); and
- Oxidation reduction potential.

5.4 Equipment

Gather equipment to be used for sampling and appropriate health and safety equipment. Field personnel should check to ensure that all equipment functions properly and perform calibration of the equipment prior to use in the field.

Equipment for surface water monitoring includes:

- Water quality multi-probe (e.g. YSI 556) with capacity to measure: temperature, pH, conductivity, dissolved oxygen and oxidation reduction potential (ORP).
- Nitrile gloves
- Sample containers
- Field book

Calibration of Field Equipment

Refer to the groundwater monitoring section for details on calibration of field equipment.

5.5 Procedure

Pre-Sampling Procedure

Prior to undertaking sampling, assess the condition of the monitoring site. Record observations regarding the conditions such as:

- Litter or debris near the sample site;
- Flow (presence / absence); and
- Approximate flow depth.

Record all pre-sampling observation in field notes.

Sampling Procedures

1. Record the date, time, weather, and station number in the field notes.
2. Put on new, clean nitrile gloves.
3. At the surface water station, select a location in the watercourse to collect the sample. The location should have flowing water deep enough to allow collection of surface water without entraining bottom sediments.
4. Approach the sample location from downstream in a manner that avoid disturbance of bottom sediments as much as possible.
5. Using clean sample bottles with no preservative gently submerge the bottle, with the mouth pointed upstream, and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle.
6. When the bottle is full gently remove it from the water. If sample preservatives are required, transfer the sample to a bottle pre-charged bottle with preservative, or add preservative as required to the sample bottle.
7. Measure and record the field parameters at the sample location. The field parameters include: temperature, pH, conductivity, dissolved oxygen, and ORP.
8. Ensure the sample label is completed and accurate.
9. Place samples in a cooler containing ice immediately after they are collected. Samples should be maintained at approximately 4°C and must be maintained under a chain-of-custody procedure for the time of collection through delivery to a laboratory for analysis. Use the chain-of-custody forms provided by the laboratory. The cooler temperature should be monitored to ensure that the internal temperature does not exceed 10°C.

6. LEACHATE MONITORING PROGRAM

6.1 Background

The Whistler Landfill is equipped with a leachate collection system that is collected on site and pumped or gravity fed to the waste water treatment plant adjacent to the landfill. The collection point is at a manhole on the north side of the landfill mass on a line that travels to the pump station.

Monitoring leachate was incorporated into the water monitoring programs at the Whistler Landfill and is on-going since 2010.

6.2 Monitoring Frequency and Chemical Parameters

Leachate monitoring will be undertaken bi-annually (during the spring and fall) and will include the following parameters for analysis:

- General physical parameters;
- Anions & Nutrients,
- COD,
- Dissolved metals;
- Volatile Organic Compounds (VOCs);
- Polycyclic Aromatic Hydrocarbons (PAHs), and
- Hydrocarbons.

A complete list of the specific analytes is provided in Appendix C.

6.3 Field Measurements

- During each bi-annual monitoring event the following field measurements will be recoded:
- Date, weather and team members;
- Station number;
- Any notes on the station condition, evidence of erosion or sediment issues in the area; and
- Make, model and calibration information for all field equipment used.

Parameters to be measured in field:

- Temperature (°C);
- pH;
- Conductivity (μs/cm);
- Dissolved Oxygen (mg/L); and

- Oxidation reduction potential.

6.4 Equipment

Gather equipment to be used for sampling and appropriate health and safety equipment. Field personnel should check to ensure that all equipment functions properly and perform calibration of the equipment prior to use in the field.

Equipment for groundwater monitoring includes:

- Water quality multi-probe (e.g. YSI 556) with capacity to measure: temperature, pH, conductivity, dissolved oxygen and oxidation reduction potential (ORP).
- Nitrile gloves
- Distilled water
- Graduated bucket
- Single-use HDPE bailer
- Rope
- Metal bar / rod to remove manhole cover
- Sample containers
- Field book.

Calibration of Field Equipment

See the groundwater monitoring section for details on calibration of field equipment.

6.5 Procedure

Pre-Sampling Procedure

Prior to undertaking sampling, assess the condition of the monitoring site. Record observations regarding the conditions such as:

- Approximate depth of leachate in the manhole;
- Flow (e.g. trickle); and
- Evidence of leachate collection system blockage (e.g. leachate overflow from manhole).

Record all pre-sampling observation in field notes.

Sampling Procedure

1. Record date, time, weather and station.
2. Remove manhole cover.
3. Put on new, clean nitrile gloves.

4. Based on the depth of the water in the manhole, lower in the bucket for shallow leachate levels, or the bailer for deeper leachate levels.

   (a) If using the bucket, lower into the manhole and collect some leachate, raise the bucket, slosh the water around in the bucket to rinse it thoroughly and pour leachate back into the manhole. Repeat this process two more times.

5. Collect leachate from the manhole in the bailer or bucket.
6. Pour leachate into the sample bottles.
7. Measure and record the field parameters at the sample location. The field parameters include: temperature, pH, conductivity, dissolved oxygen, and ORP.
8. Ensure the sample label is completed and accurate.
9. Place samples in a cooler containing ice immediately after they are collected. Samples should be maintained at approximately 4°C and must be maintained under a chain-of-custody procedure for the time of collection through delivery to a laboratory for analysis. Use the chain-of-custody forms provided by the laboratory. The cooler temperature should be monitored to ensure that the internal temperature does not exceed 10°C.

7. QUALITY ASSURANCE /QUALITY CONTROL

A field QA / QC protocol is necessary to verify the precision and accuracy of the combined field sampling / handling and laboratory procedures. It is also necessary to confirm the reproducibility of the sampling and analytical procedures. QA / QC samples during groundwater, surface water and leachate sampling will include the following:

Replicate sample (split sample):

Frequency:	1 replicate sample per monitoring event
Analytical Parameters:	Same as samples
Collection technique:	Collect identical field samples by equally splitting a collected sample between two bottle sets. Label one bottle set with the station ID and the second with a unique identifier.

Field Blank sample:

Frequency:	1 replicate sample per monitoring event
Analytical Parameters:	Same as samples
Collection technique:	Laboratory reagent (deionized) water will be carried though the sample collection and handling (including preservation) to check for contamination, purity of preservatives, and other systematic errors occurring from the time of sampling.

A total of two QA / QC samples are expected per sampling event.

7.1 Sample Handling

The laboratory selected to perform the analysis on the groundwater, surface water and leachate samples should be an accredited laboratory with experience in environmental analytical testing.

All sample bottles should be clean, sealed bottles from the laboratory. Any jars that are not clean, or are cracked or unsealed shall not be used for the collection of a sample.

Should chemical preservative be required, the laboratory will provide bottles with the appropriate preservatives already added or the preservative will be sent with the sample bottles to be added immediately after the sample is collected. Ensure that the label indicates if the sample has been preserved.

Sample Packaging and Shipping

Samples and empty containers will be packaged and shipped in conformance with International Air Transportation Association (LATA) and Transport of Dangerous Goods regulations, as applicable. The follow procedures for sample packaging and shipping will be followed to maintain sample quality and to minimize container breakage during transport to the laboratory.

Before packing samples, the exterior of the sample container will be checked to verify that it is clean and the identification label is complete and legible. The sample packaging and shipping containers will be constructed and packed to meet the following requirements:

- There will be no release of materials to the environment. Inner containers that are breakable must be packaged to prevent breakage.
- Only waterproof ice chests and coolers are acceptable shipping containers and mist be packaged to prevent breakages and leaks.

The samples will be packed as follows:

1. Seal the drain plug in the cooler.
2. Place vermiculite (cushioning and absorbent material) in bottom.
3. Wrap glass bottles with bubble wrap, and place in cooler that is partially filled with vermiculite or other inert packing material. If bubble wrap is not available, place the containers in plastic bags and set in waxed cardboard holders that have been set up inside the cooler.
4. Fill space between bottles with vermiculite or other inert packing material.
5. Add ice in plastic bags.
6. Place the completed chain-of-custody form in a plastic bag attached to the inside of the cooler lid.
7. Place name and address of receiving laboratory in a position clearly visible on the outside of the cooler.
8. Secure lid with tape.

Samples should be delivered to the laboratory within one day of sampling.

Sample Custody

The management of samples collected in the field must follow specific procedures to assure sample integrity. The possession of the samples must be traceable from the time they are collected through the times that they are analyzed in the laboratory. All groundwater, surface water, and leachate samples will be collected under chain-of-custody procedures. Chan-of-custody forms are provided by the laboratory for this purpose. An example chain-of-custody is provided in Appendix E.

Custody of a sample is defined by the following criteria:

- The sample is in a person’s view while in his / her possession.
- Any sample in a persons’ possession and not in view is locked up or transferred to a designated secure area.

8. REPORTING REQUIREMENTS

The results from the monitoring events for groundwater, surface water, and leachate will be summarized in an annual report. The report will include all of the field measurements, laboratory analytic results, and analysis of the results to determine if there are impacts from the landfill on the environment. All groundwater, surface water, and leachate samples will be compared to the BC Contaminated Sites Regulation, Column II, Freshwater Aquatic Life.

9. LANDFILL GAS MONITORING PROGRAM

Due to the potential for gas to migrate to adjacent properties, networks of subsurface monitoring probes (MP) were installed around the perimeter of the landfill. Monitoring at these probes for gas migration was initiated in 2009 and been on-going since initiation. In addition, the LFG wells and the flare have also been monitored since 2009 for a measure of performance of the system. The *Landfill Gas Collection System Operation and Maintenance Manual* (Morrison Hershfield, 2012) contains the detailed information for monitoring including the equipment, procedures and maintenance activities. A summary of the LFG monitoring program is presented in Table 4.

Table 4. Monitoring Program Summary for LFG

Monitoring Program	Landfill Gas			
	Monitoring Probes	**Collection Wells**	**Building Ports**	**Flare**
Location	MP-01 to MP-16, and MP-18 to MP-21	W01 to W13	Road #4 Whitewater Road Lot 11 Lot 3 Lot 4 Lots 6 -8 Britco Homes Hostel Athletes Village High Performance Centre	Flare Station
Frequency	- Weekly during months with snowpack on the landfill. - Monthly months with no snow pack. - Daily if there is an exceedance of the trigger levels until there are 2 consecutive days with 0% methane.	- Monthly all parameters excluding water level and temperature. -Quarterly for water level and temperature.	- Twice per year collected during the winter months when there is snow pack. - If trigger levels are exceeded at a monitoring probe, building monitoring shall occur at any buildings within 100 m of that monitoring probe.	- Weekly during months with snow pack on the landfill. - Monthly months with no snow pack.
Parameters for Analysis	- Methane (% by volume) -The following will be measured only if methane is detected for greater than 2 consecutive samples: - - Carbon dioxide (% by volume) - Oxygen (% by volume) - Hydrogen sulphide (% by volume)	- Methane (% by volume) - Carbon dioxide (% by volume) - Oxygen (% by volume) - Static Pressure (kPa or inches of WC) - Differential Pressure (kPa or inches of WC) - Temperature - Water level	- Methane (% by volume)	- Methane (% by volume) - Oxygen (% by volume) Flow (cfm) - Vacuum (kPa or inches of WC) - Temperature
Reporting Requirements	Immediately contact the RMOW and lead consultant if MP exceeds trigger level Immediately contact to RMOW, lead consultant and building manager methane is detected in the buildings Daily Field Reports (within 12 hours of data collection) to RMOW and lead consultant Monthly Reports to RMOW and lead consultant Annual Reports to MoE (only for MP and Building Port data)			

10. REPORTING

10.1 Daily Reports

During regular monitoring, daily reports will be generated by the Contractor within 12 hours of collecting field data and provided to the RMOW and the lead consultant. The daily reports will include the measurements collected from the wellfield, monitoring probes and flare.

10.1.1 Daily Reports – Monitoring Probe Exceeds Trigger Level

In the event that a monitoring probe exceeds the trigger level, the Contractor will immediately contact the RMOW and the lead consultant to inform them of the exceedance. The daily reports in the event of an exceedance will include:

- Field measurements from all of the monitoring probes;
- Field measurements from the building ports within 100 m of the monitoring probe which exceeded the trigger level; and
- Summary of the management actions to prevent off-site migration.

10.2 Monthly Reports

Monthly reports will be generated and will include all field measurements collected for the month. At a minimum this will include:

- Wellhead measurements;
- Flare measurements;
- Monitoring probe measurements; and
- Any notes or observations made during fieldwork.

The following information should also be recorded if they occurred within the month:

- Summary of exceedances and management actions;
- LFGCS adjustments or optimization efforts;
- Repairs; and
- Shut-downs.

The report will also provide conclusions and recommendations based on the field measurements.

These reports will be provided to the RMOW and the lead consultant for the landfill closure monitoring program within 1 week of the last day of the month to which the report applies.

10.3 Annual Reports

An annual report will be generated for the Ministry of the Environmental that includes the following:

- Methane content at the monitoring probes; and
- Any exceedances of the trigger levels and management activities.

APPENDIX A: Borehole Logs for All Monitoring Wells

MORRISON HERSHFIELD

WELL NUMBER MW-4

CLIENT Regional Municipality of Whistler

PROJECT NAME RMOW Landfill Management and Monitoring

PROJECT NUMBER 510404600

PROJECT LOCATION Whistler, British Columbia

DATE STARTED 16/8/10 **COMPLETED** 16/8/10

GROUND ELEVATION 596.53 m **HOLE SIZE** 0.15 m

DRILLING CONTRACTOR Sonic Drilling Ltd.

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger 2"

AT TIME OF DRILLING ---

LOGGED BY S. Black **CHECKED BY**

AT END OF DRILLING ---

NOTES 5547877.45 E, 496856.42 N

AFTER DRILLING 3.05 m / Elev 593.48 m

DEPTH (m)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev. (m)	WELL DIAGRAM (Casing Top Elev: 596.53 (m), Casing Type: PVC)
0 – 1.52		GP		(GP) Coarse Gravel Cobbles	595.01	
1.52 – 3.05		SP		(SP) Coarse Sand	593.48	
3.05 – 5.49		GP		(GP) Cobble/Gravel Zone with Coarse Sand	591.04	Bentonite Seal
5.49 – 6.10		CL		(CL) Fine-grained Sand	590.43	
6.10 – 7.32		SP		(SP) Medium Coarse Sand (Wet)	589.21	
7.32 – 8.53		CL		(CL) Fine/Medium Sand	588.00	
8.53 – 11.89		SP		(SP) Medium Sand to Sandy Gravel	584.64	Sand Fill; 2"-15' Screen, Shed 40, 10 Slot, 10/20 Sand

Bottom of hole at 11.89 m.

MORRISON HERSHFIELD

WELL NUMBER MW-5

CLIENT Regional Municipality of Whistler
PROJECT NAME RMOW Landfill Management and Monitoring
PROJECT NUMBER 510404600
PROJECT LOCATION Whistler, British Columbia
DATE STARTED 17/8/10 **COMPLETED** 17/8/10
GROUND ELEVATION 610.82 m **HOLE SIZE** 0.15m
DRILLING CONTRACTOR Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY S. Black **CHECKED BY**
AT END OF DRILLING ---
NOTES 496982.68 E, 5547303.76 N
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION			WELL DIAGRAM Casing Top Elev: 610.82 (m) Casing Type: PVC
		GP		(GP) Clean Granular Fill	1.52	609.30	Bentonite Seal
2		GP		(GP) Rocky	3.05	607.77	Sand Fill
		SM		(SM) Coarse Sand (Wet)	3.96	606.86	2"-15' Screen, Shed 40, 10 Slot, 10/20 Sand

Bottom of hole at 3.96 m.

WELL NUMBER MW-6

MORRISON HERSHFIELD

CLIENT Regional Municipality of Whistler
PROJECT NAME RMOW Landfill Management and Monitoring
PROJECT NUMBER 510404600
PROJECT LOCATION Whistler, British Columbia
DATE STARTED 17/8/10 **COMPLETED** 17/8/10
GROUND ELEVATION 610.88 m **HOLE SIZE** 0.15
DRILLING CONTRACTOR Sonic Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger 2"
AT TIME OF DRILLING ---
LOGGED BY S. Black **CHECKED BY**
AT END OF DRILLING ---
NOTES 496771.95 E, 5547262.6 N
20hrs AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION		WELL DIAGRAM (Casing Top Elev: 610.88 (m); Casing Type: PVC)
0 – 3.05		GP		(GP) Clean Granular Fill	607.83	Bentonite Seal
3.05 – 3.66		SP		(SP) Organic Material (dark brown/black/dump)	607.22	
3.66 – 4.27		SW		(SW) Medium Sand (reddish)	606.61	
4.27 – 6.25		GP		(GP) Cobbles/Coarse Sand (clay lenses-reddish orange)	604.63	
6.25 – 8.23		SP		(SP) Brown/Grey Poorly Graded Sand, Gravelly and Silty Zones (Wet)	602.65	Sand Fill; 2"-15' Screen, Shed 40, 10 Slot, 10/20 Sand
8.23 – 8.53		GW		(GW) Gravel	602.35	
8.53 – 9.15		SP		(SP) Brown/Grey Poorly Graded Sand	601.73	

Depth scale: 2, 4, 6, 8

Bottom of hole at 9.15 m.

CH2MHILL

RECORD OF MONITORING WELL: MW 1-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 607.99 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 608.81 mASL
Datum: X 497024.932 Y 5547525.992

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS
				sandy **SOIL**: Some roots, brown	607.38 / 0.61	Concrete seal
1				gravelly **SAND**: Some cobbles, some silt, trace clay, brown/orange, sub-rounded grain shape roots and wood throughout Grey mottling for 20 cm		Bentonite pellet seal Sand
2					605.59 / 2.40	
				sandy **SOIL**: A lot of wood, brown/black	605.12 / 2.87	Bentonite pellet seal
3				silty **SAND**: Grey	605.07 / 2.92	
				gravelly **SAND**: Well graded, rounded/sub-rounded grain, orange some cobbles throughout Brown/grey	604.03 / 3.96	10/20 Sand 2" diameter PVC, Sch. 40, No. 10 slot well screen
4				gravelly **SAND**: Poorly graded, medium sand, small rounded gravel	603.63 / 4.36	Water level measured at 4.25 mbgs
				fine silty **SAND**: Some small gravel, brown/grey, some orange mottling, poorly graded	603.11 / 4.88	
5				Boulder, coarse grained	602.50 / 5.49	Bentonite pellet seal
6				gravelly **SAND**: Well graded, some cobbles, medium sand, small rounded/sub-rounded grains, orange/grey	601.44 / 6.55	
7				**ROCK**: Fine grained		
8						
9						

ORGANIC VAPOUR READINGS PID (ppm): 30 60 90 120

CH2MHILL

RECORD OF MONITORING WELL: MW 1-06

LOCATION: Landfill
PROJECT NUMBER: 335612
DRILLER: Sonic Drilling
DATE DRILLED:
BORING METHOD: HSA/HQ-CORE
TOP OF PIPE: 608.81 mASL
LOGGED BY: PP
GROUND ELEVATION: 607.99 mASL
Datum: X 497024.932 Y 5547525.992

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
				End of borehole at 9.6 mbgs	+ + +	598.39 / 9.60		
10								
11								
12								
13								
14								
15								
16								
17								
18								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 2D-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.9 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.84 mASL	Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	244	1		sandy **GRAVEL**: Brown			Concrete seal	
1							Bentonite pellet seal	
				medium **SAND**: Poorly graded, brown/orange laminations for 0.61m		602.32 / 1.52		
2								
3	305	2						
4								
5								
				SILT: Grey, soft, thin orange laminations		598.11 / 5.73	Water level measured 5.77 mbgs	
6	305	3		gravelly **SAND**: Well graded coarse sand to fine gravel, sub-rounded to round, grey		597.96 / 5.88		
7								
				Orange				
8								
				Grey, fine Silt, some fine, angular gravel, some sand, soft for 5 cm				
9								
	146	4						

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 2D-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.9 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.84 mASL	Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS
10						
11						
12						
	305	5				
13						
14						
15						10/20 Sand
	183	6				2" diameter PVC, Sch. 40, No. 10 slot well screen
16						
				SILT: Stiff	587.07 / 16.77	
17						
18				**ROCK**: Fine grain basalt	585.85 / 17.99	
	36	7				

⊕ ORGANIC VAPOUR READINGS PID (ppm): 30 60 90 120

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

SHEET 3 OF 3

RECORD OF MONITORING WELL: MW 2D-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 603.84 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 604.9 mASL
Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
20						583.72		
				End of borehole at 20.12 mbgs		20.12		
21								
22								
23								
24								
25								
26								
27								
28								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

SHEET 1 OF 2

RECORD OF MONITORING WELL: MW 2S-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 603.84 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 604.94 mASL
Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	RECOVERY(cm)	TYPE	BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS
	244	1		sandy **GRAVEL**: Brown		Concrete seal
1						Bentonite pellet seal
				medium **SAND**: Poorly graded, brown/orange laminations for 0.61m	602.32 / 1.52	
2						
3	305	2				
4						
5						Water level measured 5.28 mbgs
				SILT: Grey, soft, thin orange laminations	598.11 / 5.73	
6	305	3		gravelly **SAND**: Well graded coarse sand to fine gravel, sub-rounded to round, grey	597.96 / 5.88	
7						10/20 Sand
				Orange		2" diameter PVC, Sch. 40, No. 10 slot well screen
8				Grey, fine		
9	146	4				

ORGANIC VAPOUR READINGS PID (ppm): 30 60 90 120

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

SHEET 2 OF 2

RECORD OF MONITORING WELL: MW 2S-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.94 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.84 mASL	Datum: X 496883.455 Y 5547729.553

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
10								
11								
12								
	305	5						
13								
14								
15								
	36	6						
16								
				End of borehole at 16.77 mbgs		587.07 / 16.77		
17								
18								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 3-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 600.61 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 601.47 mASL
Datum: X 496751.391 Y 5547609.577

DEPTH (mbgs)	SAMPLES: RECOVERY(cm)	SAMPLES: TYPE	SAMPLES: BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	170	1		**COBBLE and GRAVEL (FILL)**: Grey	600.00 / 0.61	Concrete patch	
1				??	599.39 / 1.22	Slough	
				gravelly **SAND**: Well graded coarse sand to fine gravel, sub-rounded particles	598.62 / 1.99		
2	305	2		sandy **GRAVEL**: Well graded, sub-rounded particles Cobble		Bentonite pellet seal	
3				Cobble	596.95 / 3.66	10/20 Sand	
4				medium **SAND**: Poorly sorted, Brown, occasional pebble		2" diameter PVC, Sch. 40, No. 10 slot well screen	
5	305	3		Cobble			
6							
7				Orange			
8				Grey			
9	305	4				Slough/cave bottom of hole	

CH2MHILL

RECORD OF MONITORING WELL: MW 3-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 601.47 mASL
LOGGED BY: PP	GROUND ELEVATION: 600.61 mASL	Datum: X 496751.391 Y 5547609.577

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	305	5						
10								
11								
12								
	305	6						
13								
14								
15								
				End of borehole at 15.24 mbgs		585.37 / 15.24		
16								
17								
18								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 4-06

LOCATION: Landfill | PROJECT NUMBER: 335612 | DRILLER: Sonic Drilling
DATE DRILLED: | BORING METHOD: HSA/HQ-CORE | TOP OF PIPE: 595.48 mASL
LOGGED BY: PP | GROUND ELEVATION: 594.60 mASL | Datum: X 496800.883 Y 5547890.701

SAMPLES: RECOVERY(cm)	TYPE	BLOWS/0.15 m
1.22	1	
53	2	
15	3	
24	4	
61	5	
122	6	
305	7	
305	8	

SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)
sandy **GRAVEL (FILL)**: Brown	593.99 / 0.61
SILT, SAND, GRAVEL, COBBLE (FILL): Grey	592.77 / 1.83
ROCK, COARSE GRAIN GRANITE Soft to 3.2 mbgs	590.03 / 4.57
gravelly **SAND**: Well graded, medium sand to medium gravel, brown	589.18 / 5.42
SAND and GRAVEL (FILL): Brown	586.29 / 8.31
sandy **GRAVEL**: Well graded, rounded gravel to medium sand Oxidation	585.66 / 8.94
SAND: Medium to fine, poorly graded, grey Thin oxidation lamination to 13.11 mbgs	

DEPTH (mbgs): 1, 2, 3, 4, 5, 6, 7, 8, 9

WELL CONSTRUCTION DETAILS:
- Concrete seal
- Bentonite pellet seal
- Water level measured: 1.497 mbgs
- 10/20 Sand
- 2" diameter PVC, Sch. 40, No. 10 slot well screen

⊕ ORGANIC VAPOUR READINGS PID (ppm): 30 60 90 120

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 4-06

LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 594.60 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 595.48 mASL
Datum: X 496800.883 Y 5547890.701

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
10								
11								
12	305	9						
13				sandy **SILT**: Grey		581.49 / 13.11		
				SAND: Fine End of borehole at 13.21 mbgs		581.39 / 13.21		
14								
15	305	10						
16								
17								
18						576.60 / 18.00		

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 5-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.65 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.98 mASL	Datum: X 496906.423 Y 5547367.257

DEPTH (mbgs)	SAMPLES: RECOVERY(cm)	SAMPLES: TYPE	SAMPLES: BLOWS/0.15 m	SOIL DESCRIPTION	ELEV. (masl) / DEPTH (mbgs)
	305	1		**SAND and GRAVEL (FILL)**: Some cobble, some silt	
1					
2					
				sandy GRAVEL: Well graded, coarse sand to medium gravel, some cobble, rounded to sub-rounded partcles, some silt orange/brown	601.31 / 2.67
3	305	2			
4					
5	152	3			
				SAND: Coarse, well graded, grey	598.85 / 5.13
				SAND: Medium to fine, some silt, occasional gravel, grey, some oxidation zones	598.80 / 5.18
6					
	206	4		**sandy SILT**: Fine angular gravel, stiff, grey, with some oxidation mottling	597.38 / 6.60
7				**sandy GRAVEL**: Silty, brown	597.05 / 6.93
				Boulder	596.93 / 7.05
	8	5		**sandy, gravelly SILT**: Stiff	596.30 / 7.68
8				**ROCK**: Fine grain basalt	596.11 / 7.87
9					

WELL CONSTRUCTION DETAILS

- Concrete seal
- Bentonite pellet seal
- 10/20 Sand
- Water level measured 1.855
- Bentonite pellet seal
- 10/20 Sand
- 2" diameter PVC, Sch. 40, No. 10 slot well screen

⊕ ORGANIC VAPOUR READINGS PID (ppm)

30 60 90 120

CH2MHILL

RECORD OF MONITORING WELL: MW 5-06

LOCATION: Landfill	PROJECT NUMBER: 335612	DRILLER: Sonic Drilling
DATE DRILLED:	BORING METHOD: HSA/HQ-CORE	TOP OF PIPE: 604.65 mASL
LOGGED BY: PP	GROUND ELEVATION: 603.98 mASL	Datum: X 496906.423 Y 5547367.257

DEPTH (mbgs)	SAMPLES RECOVERY(cm)	SAMPLES TYPE	SAMPLES BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
10						593.88 / 10.10		
				End of borehole at 10.2 mbgs				
11								
12								
13								
14								
15								
16								
17								
18								

SCANMW 335612LANDFILL.GPJ CG&S.GDT 28/2/06

CH2MHILL

RECORD OF MONITORING WELL: MW 6-06

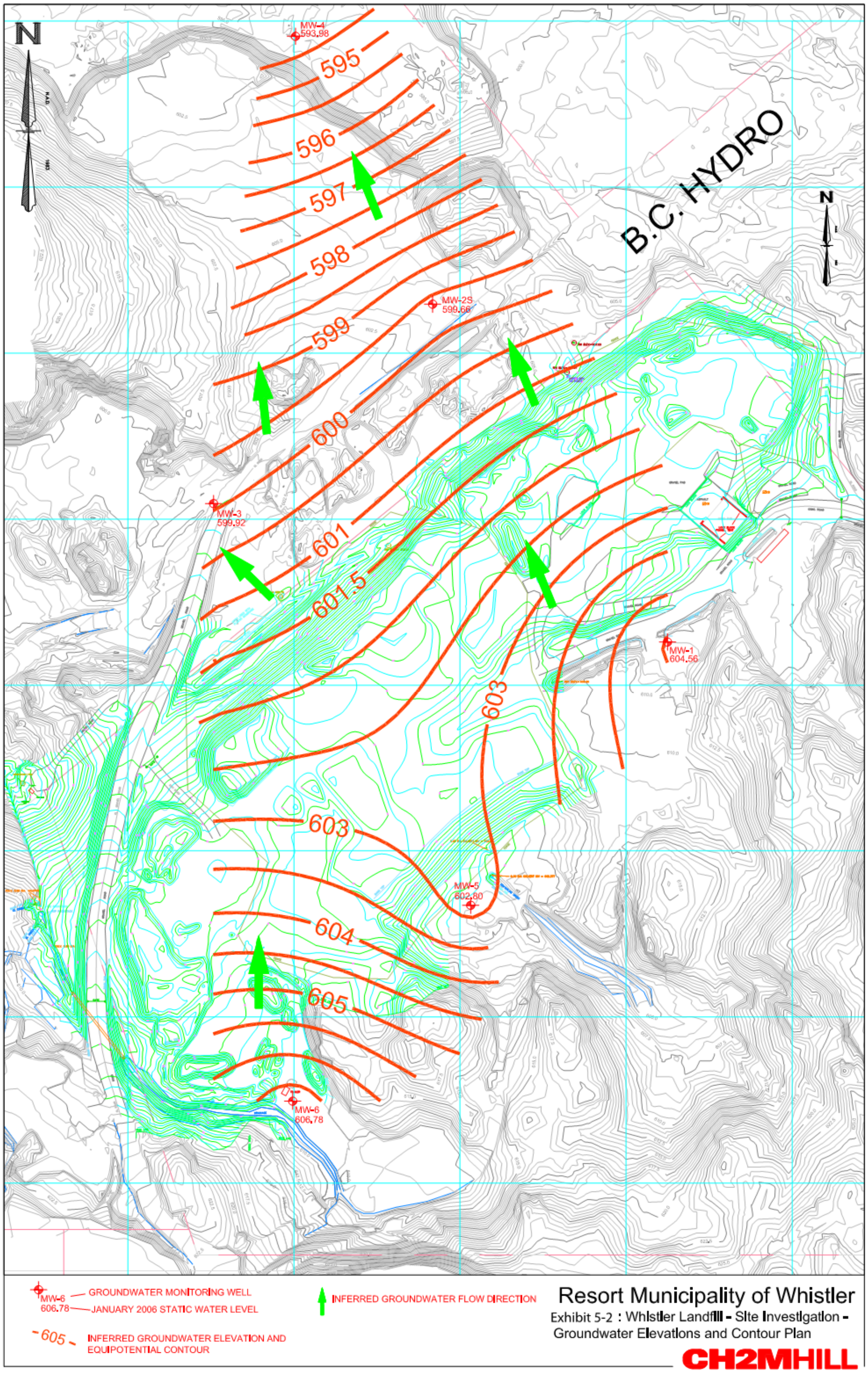
LOCATION: Landfill
DATE DRILLED:
LOGGED BY: PP

PROJECT NUMBER: 335612
BORING METHOD: HSA/HQ-CORE
GROUND ELEVATION: 609.3 mASL

DRILLER: Sonic Drilling
TOP OF PIPE: 610.05 mASL
Datum: X 496799.226 Y 5547249.454

DEPTH (mbgs)	SAMPLES: RECOVERY(cm)	SAMPLES: TYPE	SAMPLES: BLOWS/0.15 m	SOIL DESCRIPTION	STRATA PLOT	(masl) ELEV. / DEPTH (mbgs)	WELL CONSTRUCTION DETAILS	⊕ ORGANIC VAPOUR READINGS PID (ppm) 30 60 90 120
	1.82			**SAND, GRAVEL, COBBLE**			Concrete seal	
1				**ORGANIC SOIL**: Black, wood fragments		608.39 / 0.91	Bentonite pellet seal	
2								
	305							
3							Water level measured 3.271 mbgs	
4							10/20 Sand	
							2" diameter PVC, Sch. 40, No. 10 slot well screen	
5				**SAND**: Occasional gravel, well graded, some silt		604.25 / 5.05		
	305							
6								
7				gravelly, silty **SAND**: Fine, dense, orange to 8.23 mbgs		602.59 / 6.71		
8	122			Grey to bottom				
9								
				End of borehole at 9.15 mbgs		600.15 / 9.15		

APPENDIX B: Groundwater Flow



CH2M Hill. 2006a. Whistler Landfill Closure Plan. Final Report prepared for the Regional Municipality of Whistler.

APPENDIX C: Groundwater and Leachate Sample Analytes List

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Physical Tests			
Conductivity	APHA 2510 Auto. Conduc.	2.0	uS/cm
Hardness (as CaCO3)	APHA 2340B	0.50	mg/L
pH	APHA 4500-H pH Value	0.10	pH
Water - Anions and Nutrients			
Alkalinity, Bicarbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Carbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Hydroxide (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Total (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC	0.0050	mg/L
Bromide (Br)	APHA 4110 B.	0.050	mg/L
Chloride (Cl)	APHA 4110 B.	0.50	mg/L
Fluoride (F)	APHA 4110 B.	0.020	mg/L
Nitrate (as N)	EPA 300.0	0.0050	mg/L
Nitrite (as N)	EPA 300.0	0.0010	mg/L
Phosphorus (P)-Total	APHA 4500-P Phosphorous	0.0020	mg/L
Sulfate (SO4)	APHA 4110 B.	0.50	mg/L
Total Kjeldahl Nitrogen	APHA 4500-NORG D.	0.050	mg/L
Total Nitrogen	BC MOE LABORATORY MANUAL (2005)	0.050	mg/L
Water - Dissolved Metals			
Aluminum (Al)-Dissolved	EPA SW-846 3005A/6020A	0.01	mg/L
Antimony (Sb)-Dissolved	EPA SW-846 3005A/6020A	0.0005	mg/L
Arsenic (As)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Barium (Ba)-Dissolved	EPA SW-846 3005A/6010B	0.02	mg/L
Beryllium (Be)-Dissolved	EPA SW-846 3005A/6010B	0.005	mg/L
Bismuth (Bi)-Dissolved	EPA SW-846 3005A/6010B	0.2	mg/L
Boron (B)-Dissolved	EPA SW-846 3005A/6010B	0.1	mg/L
Cadmium (Cd)-Dissolved	EPA SW-846 3005A/6020A	0.00005	mg/L
Calcium (Ca)-Dissolved	EPA SW-846 3005A/6010B	0.1	mg/L
Chromium (Cr)-Dissolved	EPA SW-846 3005A/6020A	0.0005	mg/L
Cobalt (Co)-Dissolved	EPA SW-846 3005A/6020A	0.0005	mg/L
Copper (Cu)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Iron (Fe)-Dissolved	EPA SW-846 3005A/6010B	0.03	mg/L
Lead (Pb)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Lithium (Li)-Dissolved	EPA SW-846 3005A/6010B	0.05	mg/L
Magnesium (Mg)-Dissolved	EPA SW-846 3005A/6010B	0.1	mg/L
Manganese (Mn)-Dissolved	EPA SW-846 3005A/6010B	0.01	mg/L
Mercury (Hg)-Dissolved	EPA SW-846 3005A & EPA 245.7	0.0002	mg/L
Molybdenum (Mo)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Nickel (Ni)-Dissolved	EPA SW-846 3005A/6020A	0.005	mg/L
Phosphorus (P)-Dissolved	EPA SW-846 3005A/6010B	0.3	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Dissolved Metals			
Potassium (K)-Dissolved	EPA SW-846 3005A/6010B	2	mg/L
Selenium (Se)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Silicon (Si)-Dissolved	EPA SW-846 3005A/6010B	0.05	mg/L
Silver (Ag)-Dissolved	EPA SW-846 3005A/6020A	0.00005	mg/L
Sodium (Na)-Dissolved	EPA SW-846 3005A/6010B	2	mg/L
Strontium (Sr)-Dissolved	EPA SW-846 3005A/6010B	0.005	mg/L
Thallium (Tl)-Dissolved	EPA SW-846 3005A/6020A	0.0002	mg/L
Tin (Sn)-Dissolved	EPA SW-846 3005A/6010B	0.03	mg/L
Titanium (Ti)-Dissolved	EPA SW-846 3005A/6010B	0.05	mg/L
Uranium (U)-Dissolved	EPA SW-846 3005A/6020A	0.0002	mg/L
Vanadium (V)-Dissolved	EPA SW-846 3005A/6010B	0.03	mg/L
Zinc (Zn)-Dissolved	EPA SW-846 3005A/6010B	0.005	mg/L
Water - Aggregate Organics			
COD	APHA 5220 D. CHEMICAL OXYGEN DEMAND	20	mg/L
Water - Volatile Organic Compounds			
1,1,1,2-Tetrachloroethane	EPA8260B, 5021	0.0010	mg/L
1,1,1-Trichloroethane	EPA8260B, 5021	0.0010	mg/L
1,1,2,2-Tetrachloroethane	EPA8260B, 5021	0.0010	mg/L
1,1,2-Trichloroethane	EPA8260B, 5021	0.0010	mg/L
1,1-Dichloroethane	EPA8260B, 5021	0.0010	mg/L
1,1-Dichloroethylene	EPA8260B, 5021	0.0010	mg/L
1,1-Dichloropropylene	EPA 8260B, 5012A	0.0010	mg/L
1,2,3-Trichlorobenzene	EPA 8260B, 5012A	0.0010	mg/L
1,2,3-Trichloropropane	EPA 8260B, 5012A	0.0010	mg/L
1,2,3-Trimethylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,2,4-Trichlorobenzene	EPA 8260B, 5012A	0.0010	mg/L
1,2,4-Trimethylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,2-Dibromo-3-chloropropane	EPA 8260B, 5012A	0.0010	mg/L
1,2-Dichlorobenzene	EPA8260B, 5021	0.00070	mg/L
1,2-Dichloroethane	EPA8260B, 5021	0.0010	mg/L
1,2-Dichloroethane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,2-Dichloropropane	EPA8260B, 5021	0.0010	mg/L
1,3,5-Trimethylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,3-Butadiene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,3-Dichlorobenzene	EPA8260B, 5021	0.0010	mg/L
1,3-Dichloropropane	EPA 8260B, 5012A	0.0010	mg/L
1,3-Dichloropropene (cis & trans)	EPA8260B, 5021	0.0010	mg/L
1,4-Dichlorobenzene	EPA8260B, 5021	0.0010	mg/L
1,4-Difluorobenzene (SS)	EPA8260B, 5021	1	%

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Volatile Organic Compounds			
2,2-Dichloropropane	EPA 8260B, 5012A	0.0010	mg/L
2-Chlorotoluene	EPA 8260B, 5012A	0.0010	mg/L
2-Hexanone	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
4-Bromofluorobenzene (SS)	EPA8260B, 5021	1	%
4-Chlorotoluene	EPA 8260B, 5012A	0.0010	mg/L
4-Isopropyltoluene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Methyl isobutyl carbinol (MIBC)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Acetone	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Benzene	EPA8260B, 5021	0.00050	mg/L
Bromobenzene	EPA 8260B, 5012A	0.0010	mg/L
Bromochloromethane	EPA 8260B, 5012A	0.0010	mg/L
Bromodichloromethane	EPA8260B, 5021	0.0010	mg/L
Bromoform	EPA8260B, 5021	0.0010	mg/L
Bromomethane	EPA 8260B, 5012A	0.0010	mg/L
Carbon Disulfide	EPA8260B, 5035A, 5021, BC MELP	0.0050	mg/L
Carbon Tetrachloride	EPA8260B, 5021	0.00050	mg/L
Chlorobenzene	EPA8260B, 5021	0.0010	mg/L
Dibromochloromethane	EPA8260B, 5021	0.0010	mg/L
Chloroethane	EPA8260B, 5021	0.0010	mg/L
Chloroform	EPA8260B, 5021	0.0010	mg/L
Chloromethane	EPA8260B, 5021	0.0050	mg/L
cis-1,2-Dichloroethylene	EPA8260B, 5021	0.0010	mg/L
cis-1,3-Dichloropropylene	EPA8260B, 5021	0.0010	mg/L
Decane (nC10)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Dibromomethane	EPA 8260B, 5012A	0.0010	mg/L
Dichlorodifluoromethane	EPA 8260B, 5012A	0.0010	mg/L
Ethylbenzene	EPA8260B, 5021	0.00050	mg/L
1,2-Dibromoethane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
n-Heptane (nC7)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Hexachlorobutadiene	EPA 8260B, 5012A	0.0010	mg/L
n-Hexane (nC6)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Isopropylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
meta- & para-Xylene	EPA8260B, 5021	0.00050	mg/L
Methyl ethyl ketone (MEK)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Methyl isobutyl ketone (MIBK)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Methyl t-butyl ether (MTBE)	EPA8260B, 5021	0.00050	mg/L
Methylcyclohexane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Dichloromethane	EPA8260B, 5021	0.0050	mg/L
n-Butylbenzene	EPA 8260B, 5012A	0.0010	mg/L
n-Propylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Volatile Organic Compounds			
Naphthalene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
n-Octane (nC8)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
ortho-Xylene	EPA8260B, 5021	0.00050	mg/L
n-Pentane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
sec-Butylbenzene	EPA 8260B, 5012A	0.0010	mg/L
Styrene	EPA8260B, 5021	0.00050	mg/L
tert-Butylbenzene	EPA 8260B, 5012A	0.0010	mg/L
Tetrachloroethylene	EPA8260B, 5021	0.0010	mg/L
Toluene	EPA8260B, 5021	0.00050	mg/L
trans-1,2-Dichloroethylene	EPA8260B, 5021	0.0010	mg/L
trans-1,3-Dichloropropylene	EPA8260B, 5021	0.0010	mg/L
Trichloroethylene	EPA8260B, 5021	0.0010	mg/L
Trichlorofluoromethane	EPA8260B, 5021	0.0010	mg/L
Vinyl Chloride	EPA8260B, 5021	0.0010	mg/L
Xylenes	CALCULATION	0.00075	mg/L
Water - Hydrocarbons			
3,4-Dichlorotoluene (SS)	B.C. MIN. OF ENV. LAB. MAN. (2009)	1	%
EPH10-19	BCMOE EPH GCFID	0.3	mg/L
EPH19-32	BCMOE EPH GCFID	0.3	mg/L
HEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
LEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
Volatile Hydrocarbons (VH6-10)	B.C. MIN. OF ENV. LAB. MAN. (2009)	0.10	mg/L
VPH (C6-C10)	BC MOE LABORATORY MANUAL (2005)	0.10	mg/L
Water - Polycyclic Aromatic Hydrocarbons			
Acenaphthene	EPA 3510, 8270	0.000050	mg/L
Acenaphthene d10	EPA 3510, 8270	1	%
Acenaphthylene	EPA 3510, 8270	0.000050	mg/L
Acridine	EPA 3510, 8270	0.000050	mg/L
Acridine d9	EPA 3510, 8270	1	%
Anthracene	EPA 3510, 8270	0.000050	mg/L
Benz(a)anthracene	EPA 3510, 8270	0.000050	mg/L
Benzo(a)pyrene	EPA 3510, 8270	0.000010	mg/L
Benzo(b)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Benzo(g,h,i)perylene	EPA 3510, 8270	0.000050	mg/L
Benzo(k)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Chrysene	EPA 3510, 8270	0.000050	mg/L
Chrysene d12	EPA 3510, 8270	1	%
Dibenz(a,h)anthracene	EPA 3510, 8270	0.000050	mg/L
Fluoranthene	EPA 3510, 8270	0.000050	mg/L
Fluorene	EPA 3510, 8270	0.000050	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Polycyclic Aromatic Hydrocarbons			
Indeno(1,2,3-c,d)pyrene	EPA 3510, 8270	0.000050	mg/L
Naphthalene	EPA 3510, 8270	0.000050	mg/L
Naphthalene d8	EPA 3510, 8270	1	%
Phenanthrene	EPA 3510, 8270	0.000050	mg/L
Phenanthrene d10	EPA 3510, 8270	1	%
Pyrene	EPA 3510, 8270	0.000050	mg/L
Quinoline	EPA 3510, 8270	0.000050	mg/L

Methodology

Product	Matrix	Product Description	Analytical Method Reference
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)".

Methodology

Product	Matrix	Product Description	Analytical Method Reference

Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-SF-FID-VA	Water	EPH in Water by GCFID	BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

FUELS-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure

Methodology

Product	Matrix	Product Description	Analytical Method Reference

involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA	Water	Dissolved Metals in Water by ICPMS(Low)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PAH-SF-MS-VA	Water	PAH in Water by GCMS	EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SAMPLE-DISPOSAL-VA	Misc.	Sample Handling and Disposal Fee	
TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

Methodology

Product	Matrix	Product Description	Analytical Method Reference
VH-HSFID-VA	Water	VH in Water by Headspace GCFID	B.C. MIN. OF ENV. LAB. MAN. (2009)

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.

VH-SURR-FID-VA	Water	VH Surrogates for Waters	B.C. MIN. OF ENV. LAB. MAN. (2009)
VOC-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC-M-HSMS-VA	Water	Volatile Organic Compounds - GC-MS	EPA 8260B, 5012A

Water samples, with reagents, are heated and an aliquot of the headspace at equilibrium is analysed by GC-MS.

VOC-M2-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA	Water	BTEX/MTBE/Styrene by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Water	VOC7 and/or VOC Surrogates for Waters	EPA8260B, 5021
VPH-CALC-VA	Water	VPH is VH minus select aromatics	BC MOE LABORATORY MANUAL (2005)

These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).

XYLENES-CALC-VA	Water	Sum of Xylene Isomer Concentrations	CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

APPENDIX D: Surface Water Sample Analytes List

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Physical Tests			
Conductivity	APHA 2510 Auto. Conduc.	2.0	uS/cm
Hardness (as CaCO3)	APHA 2340B	0.50	mg/L
pH	APHA 4500-H pH Value	0.10	pH
Total Suspended Solids	APHA 2540 D - GRAVIMETRIC	3.0	mg/L
Water - Anions and Nutrients			
Alkalinity, Bicarbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Carbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Hydroxide (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Total (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC	0.0050	mg/L
Bromide (Br)	APHA 4110 B.	0.050	mg/L
Chloride (Cl)	APHA 4110 B.	0.50	mg/L
Fluoride (F)	APHA 4110 B.	0.020	mg/L
Nitrate (as N)	EPA 300.0	0.0050	mg/L
Nitrite (as N)	EPA 300.0	0.0010	mg/L
Phosphorus (P)-Total	APHA 4500-P Phosphorous	0.0020	mg/L
Sulfate (SO4)	APHA 4110 B.	0.50	mg/L
Total Kjeldahl Nitrogen	APHA 4500-NORG D.	0.050	mg/L
Total Nitrogen	BC MOE LABORATORY MANUAL (2005)	0.050	mg/L
Water - Total Metals			
Aluminum (Al)-Total	EPA SW-846 3005A/6020A	0.01	mg/L
Antimony (Sb)-Total	EPA SW-846 3005A/6020A	0.0005	mg/L
Arsenic (As)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Barium (Ba)-Total	EPA SW-846 3005A/6010B	0.02	mg/L
Beryllium (Be)-Total	EPA SW-846 3005A/6010B	0.005	mg/L
Bismuth (Bi)-Total	EPA SW-846 3005A/6010B	0.2	mg/L
Boron (B)-Total	EPA SW-846 3005A/6010B	0.1	mg/L
Cadmium (Cd)-Total	EPA SW-846 3005A/6020A	0.00005	mg/L
Calcium (Ca)-Total	EPA SW-846 3005A/6010B	0.1	mg/L
Chromium (Cr)-Total	EPA SW-846 3005A/6020A	0.0005	mg/L
Cobalt (Co)-Total	EPA SW-846 3005A/6020A	0.0005	mg/L
Copper (Cu)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Iron (Fe)-Total	EPA SW-846 3005A/6010B	0.03	mg/L
Lead (Pb)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Lithium (Li)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Magnesium (Mg)-Total	EPA SW-846 3005A/6010B	0.1	mg/L
Manganese (Mn)-Total	EPA SW-846 3005A/6010B	0.01	mg/L
Mercury (Hg)-Total	EPA 245.7	0.0002	mg/L
Molybdenum (Mo)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Nickel (Ni)-Total	EPA SW-846 3005A/6020A	0.005	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Total Metals			
Phosphorus (P)-Total	EPA SW-846 3005A/6010B	0.3	mg/L
Potassium (K)-Total	EPA SW-846 3005A/6010B	2	mg/L
Selenium (Se)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Silicon (Si)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Silver (Ag)-Total	EPA SW-846 3005A/6020A	0.00005	mg/L
Sodium (Na)-Total	EPA SW-846 3005A/6010B	2	mg/L
Strontium (Sr)-Total	EPA SW-846 3005A/6010B	0.005	mg/L
Thallium (Tl)-Total	EPA SW-846 3005A/6020A	0.0002	mg/L
Tin (Sn)-Total	EPA SW-846 3005A/6010B	0.03	mg/L
Titanium (Ti)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Uranium (U)-Total	EPA SW-846 3005A/6020A	0.0002	mg/L
Vanadium (V)-Total	EPA SW-846 3005A/6010B	0.03	mg/L
Zinc (Zn)-Total	EPA SW-846 3005A/6010B	0.005	mg/L
Water - Aggregate Organics			
COD	APHA 5220 D. CHEMICAL OXYGEN DEMAND	20	mg/L
Water - Hydrocarbons			
EPH10-19	BCMOE EPH GCFID	0.3	mg/L
EPH19-32	BCMOE EPH GCFID	0.3	mg/L
HEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
LEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
Water - Polycyclic Aromatic Hydrocarbons			
Acenaphthene	EPA 3510, 8270	0.000050	mg/L
Acenaphthene d10	EPA 3510, 8270	1	%
Acenaphthylene	EPA 3510, 8270	0.000050	mg/L
Acridine	EPA 3510, 8270	0.000050	mg/L
Acridine d9	EPA 3510, 8270	1	%
Anthracene	EPA 3510, 8270	0.000050	mg/L
Benz(a)anthracene	EPA 3510, 8270	0.000050	mg/L
Benzo(a)pyrene	EPA 3510, 8270	0.000010	mg/L
Benzo(b)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Benzo(g,h,i)perylene	EPA 3510, 8270	0.000050	mg/L
Benzo(k)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Chrysene	EPA 3510, 8270	0.000050	mg/L
Chrysene d12	EPA 3510, 8270	1	%
Dibenz(a,h)anthracene	EPA 3510, 8270	0.000050	mg/L
Fluoranthene	EPA 3510, 8270	0.000050	mg/L
Fluorene	EPA 3510, 8270	0.000050	mg/L
Indeno(1,2,3-c,d)pyrene	EPA 3510, 8270	0.000050	mg/L
Naphthalene	EPA 3510, 8270	0.000050	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Polycyclic Aromatic Hydrocarbons			
Naphthalene d8	EPA 3510, 8270	1	%
Phenanthrene	EPA 3510, 8270	0.000050	mg/L
Phenanthrene d10	EPA 3510, 8270	1	%
Pyrene	EPA 3510, 8270	0.000050	mg/L
Quinoline	EPA 3510, 8270	0.000050	mg/L

Methodology

Product	Matrix	Product Description	Analytical Method Reference
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

Product	Matrix	Product Description	Analytical Method Reference
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Product	Matrix	Product Description	Analytical Method Reference
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

Product	Matrix	Product Description	Analytical Method Reference
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

Methodology

Product	Matrix	Product Description	Analytical Method Reference

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-SF-FID-VA	Water	EPH in Water by GCFID	BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-TOT-CVAFS-VA	Water	Total Mercury in Water by CVAFS	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA	Water	Total Metals in Water by ICPMS(Low)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Methodology

Product	Matrix	Product Description	Analytical Method Reference
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PAH-SF-MS-VA	Water	PAH in Water by GCMS	EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SAMPLE-DISPOSAL-VA	Misc.	Sample Handling and Disposal Fee	
TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

APPENDIX E: Example Completed Chain of Custody Form

10-169118

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To		**Report Format / Distribution**	
Company:	MORRISON HERSHFIELD	Standard: ✓	Other (specify):
Contact:	JOSIE GILSON	Select: PDF ✓ Excel ✓ Digital Fax	
Address:	310-4321 STILL CREEK DRIVE BURNABY, BC	Email 1:	jgilson@morrisonhershfield.com
Phone: 604-454-0402	Fax:	Email 2:	
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	5104016
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	26448
Lab Work Order # (lab use only)		ALS Contact: Sdam Worku	Sampler: J. Gilson

Service Request: (Rush subject to availability - Contact ALS to confirm TAT)

- ✓ Regular (Standard Turnaround Times - Business Days)
- Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
- Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
- Same Day or Weekend Emergency - Contact ALS to confirm TAT

Analysis Request

(Indicate Filtered or Preserved, F/P)

Sample #	**Sample Identification** (This description will appear on the report)	**Date** (dd-mmm-yy)	**Time** (hh:mm)	**Sample Type**	COD/TKN/NH3	ORGANICS (LEPH/HEPH)	VOCs (BTEX)	PHYSICAL PARAM.	METALS - TOTAL	METALS - DISSOLVED							Number of Containers
				F/P	P	P	P		P	F P							
	MW-2D	04-04-12		GW	✓	✓	✓	✓		✓							
	MW-2S			GW	✓	✓	✓	✓		✓							
	MW-3			GW	✓	✓	✓	✓		✓							
	MW-4(New)			GW	✓	✓	✓	✓		✓							
	MW-6(New)			GW	✓	✓	✓	✓		✓							
	L1			GW	✓	✓	✓	✓		✓							
	SFC-2			SW	✓	✓		✓	✓								
	SFC-2B			SW	✓	✓		✓	✓								
	SFC-3			SW	✓	✓		✓	✓								
	SFC-4B			SW	✓	✓		✓	✓								
	SFC-11			SW	✓	✓		✓	✓								
	MW-3 Rep.			GW	✓	✓	✓	✓		✓							

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

VOCs - Pls. include Acetone, dibromomethane, bromomethane, 1-3 butadiene, MIBK, MEK.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

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APPENDIX D: Revised Landfill Gas Monitoring Program and Operation & Maintenance Manual

REPORT

Revised Landfill Gas Monitoring Program and Operation & Maintenance Manual

Whistler, BC

Presented to:

James Hallisey
Manager of Environmental Projects

Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, BC V0N 1B4

Report No. 5104016 June 11, 2012

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This document is adapted from the original document titled *Landfill Gas Collection System Operation and Maintenance Manual* (CH2MHill, 2008).

This document has maintained the intent of the original document with some adjustments to the monitoring requirements after a trigger level is exceeded at the monitoring probes.

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1. OVERVIEW

1.1 Background

This manual describes the operation, maintenance and monitoring requirements of the landfill gas control system (LFGCS) at the Resort Municipality of Whistler (RMOW) Landfill located in Whistler, British Columbia. The LFGCS is designed to capture and incinerate landfill gas (LFG) produced by the decomposing refuse and to prevent offsite migration of the gas.

1.1.1 Landfill Gas

LFG is produced by biological decomposition of putrescible wastes under anaerobic conditions within a landfill and consists primarily of carbon dioxide and methane with trace constituents such as hydrogen sulphide, mercaptans, vinyl chloride, and numerous other volatile organic compounds (VOCs). LFG is a moist gas that typically contains approximately 50 percent (%) methane and 50 % carbon dioxide by volume. The exact composition and proportions of the components of LFG varies over time, and from landfill to landfill.

The term “landfill gas” is generally used to refer to the entire mixture of methane, carbon dioxide, and other trace compounds as generated by decomposition of wastes placed in a landfill.

The environmental and human health impacts related to LFG depend on the exposure pathways and include the following:

- Air:
  - odours
  - degradation of local air quality
  - release of greenhouse gases to the atmosphere

- Soil:
  - explosion, asphyxiation, and toxicity hazards in enclosed areas on, or near landfills
  - vegetation stress on, or near landfills

Methane concentrations ranging from 5 to 15 % by volume in air are explosive. The 5% methane by volume in air is referred to as the lower explosive limit (LEL) of methane and the 15% the upper explosive limit (UEL). The risk of a LFG explosion is generally associated with subsurface migration of LFG into structures and enclosed areas located on or near landfill sites. If LFG is allowed to accumulate in these areas, explosive concentrations of methane can develop. When combined with a source of ignition, an explosion could result. Accumulation of LFG within an enclosure can also create an environment that is toxic and oxygen deficient, and therefore hazardous to humans.

Release of LFG into the air can contribute to odours in the vicinity of the site. LFG odours are caused primarily by hydrogen sulphide and mercaptans that are often found at trace quantities in LFG. These compounds may be detected by smell at very low concentrations (i.e. 0.005 ppmv and 0.001 ppmv). In addition to the potential odour, air quality, and health impacts, methane and carbon dioxide are greenhouse gases (GHG's) that contribute to global climate change when introduced into the atmosphere.

1.1.2 Safety

Safety is a very serious concern in a landfill environment; many potential life-threatening hazards are present. O & M of the system may involve exposure to refuse, leachate (water that has come into contact with refuse and may contain a wide variety of contaminants that may be harmful to human health or the environment), LFG, and LFG condensate. Operation and maintenance (O&M) of the system may also require confined space entry.

Prior to undertaking work, a written health and safety plan (HASP) must be prepared to address task-specific hazards associated with the work. The HASP should be based on the of the Occupational Health and Safety Regulations, BC Regulation 296/97, published by the Workers Compensation Board of British Columbia.

1.1.3 Basis of Design

LFGCSs are designed to actively collect LFG from a closed landfill area. LFG recovery wells (gas wells) are installed in the refuse layer and connected to a blower via a network of subsurface piping installed within the landfill final cover system. The blower creates suction in the gas wells, inducing a vacuum pressure gradient within the refuse towards the extraction wells. LFG generated in the refuse zones is collected through the gas wells. The captured LFG is conveyed via a transmission pipeline to a flare system for incineration.

1.1.4 Relationship of Gas Collection System to Other Landfill Systems

The LFGCS is designed to work in conjunction with the other environmental control systems at the site. These systems include the landfill cover and drainage system and the leachate collection system.

One of the primary functions of the landfill cover and drainage system is to limit infiltration of precipitation into the refuse layer. With an active gas collection system installed, the cover also isolates the waste from the atmosphere to limit air intrusion into the waste and LFGCS when vacuum is applied to the waste. The LFGCS gas wells penetrate the landfill cover, so it is essential that the landfill cover be in good condition to create an air-tight seal directly around the penetration and between each of the wells. The drainage system is designed to direct water away from the refuse.

The function of the leachate collection system is to collect leachate (water that has mixed with waste) present in the refuse layer and convey it offsite. The cover and leachate collection system reduce accumulation of leachate within the waste. Excessive accumulation of leachate may result in reduced gas collection efficiencies by limiting the area of vacuum influence within the waste. In addition, LFG condensate (water) accumulated within the LFGCS is drained through condensate traps into the leachate collection system.

1.1.5 Components and Operation

Major components of the LFGCS system include the following:

Collection Field:

- Vertical LFG recovery wells with control valves and monitoring points for measuring LFG composition, flow rate, pressure, and temperature
- Horizontal LFG collection trench, running centrally across the site immediately below the geosynthetic cover system,

Transmission Piping:

- High Density Polyethylene (HDPE) main header system
- HDPE branch lines (laterals)
- LFG condensate management sumps

LFG Management Plant:

- Skid Mounted Blower and open flare unit
- System monitoring and control centre
- LFG demister and condensate knock-out tank

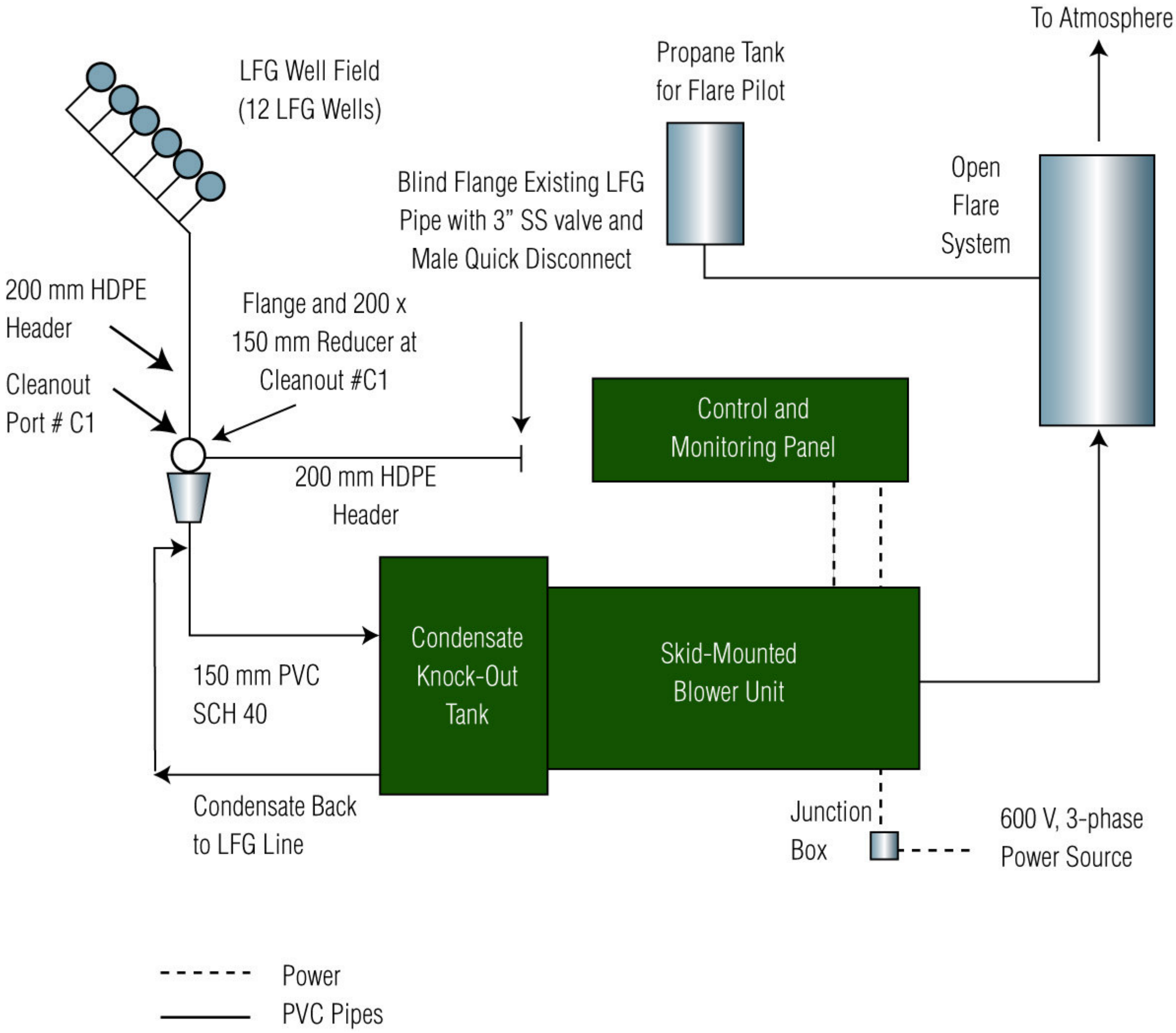
Appendix A – Drawing L1 illustrates the LFGCS and its components. Details of these components are discussed within subsequent sections of this manual.

1.1.6 System Operation Principles

The LFGCS for the Whistler Landfill is designed to collect LFG by applying vacuum to the refuse through the LFG collection wells installed throughout the landfill. Vacuum exerted at the gas wells is generated by the blowers located at the blower/flare station. The vacuum induces a pressure gradient within the refuse, resulting in LFG flow from the waste to the wells. Gas wells are spaced such that the maximum expected radius of influence of each well slightly overlaps adjacent wells to provide a continuous zone of influence (vacuum) throughout the refuse. As the vacuum is increased, the area of influence increases. In some cases, wells are positioned such that the maximum zone of influence may extend beyond the limit of refuse. If vacuum is increased too much, the influence may extend beyond the landfill cover and air may intrude the LFGCS. If insufficient vacuum is applied, the maximum flow of LFG may not be captured, and fugitive emissions may occur. The network of gas wells is commonly referred to as the "wellfield". The horizontal zone of influence of each well is expected to range between 0 and 30 m, depending on the level of vacuum applied and the conditions within the waste. Gas collected at the wells is conveyed to the blower/flare station through the header and lateral piping system, where it is incinerated by a flare. Figure 1 shows a process diagram with major system equipment.

Overall control of the collection and flaring process is provided by the programmable logic controller (PLC) at the system control centre. The PLC continuously monitors process variables to ensure safe operation of the system and successful incineration of the collected LFG. The system operates continuously, resulting in steady, safe removal and incineration of LFG (Appendix B – System Operation Information). The wellfield is adjusted (balanced) during startup and routine operations to provide the optimum, sustainable flow rate of LFG to the blower flare station, without over-drawing the wellfield and introducing air into the LFGCS. Monitoring at wellhead locations and the blower/flare system is crucial to the effective operation of the system. Monitoring data will be used to make adjustments to the system in order to optimize removal and incineration of LFG. Monitoring and adjustment are discussed in Section 2.

Figure 1. Process Flow Diagram with Major System Equipment



2. COLLECTION SYSTEM OPERATION AND MAINTENANCE

2.1 System Description

The Whistler LFGCS wellfield consists of 12 vertical gas recovery wells and 1 shallow horizontal gas collection trench. The vertical wells are installed from the landfill surface and extend to within a few meters of the landfill base. The single shallow horizontal collection trench was installed directly below the geosynthetic cover system. Each well is equipped with below-grade wellhead controls. Drawing L1 (Appendix A) shows the locations and identifications of each well.

The vertical gas wells were constructed of HDPE pipe within a borehole drilled from the landfill surface following waste placement. The well consists of a perforated screen section extending approximately two-thirds of the total well depth from the bottom of the borehole. A section of solid Polyvinyl Chloride (PVC) well riser with a telescoping joint connects the well screen to the collection piping via a wellhead assembly at the landfill surface. The telescoping joint is designed to compensate for settlement of the waste around the well and also to reduce physical stress on the rigid recovery well components. The screened interval of the well is backfilled with clean drain gravel to provide a permeable connection to the waste in order to maximize efficiency. A bentonite plug installed within the borehole above the screen interval provides a seal, reducing the potential for air intrusion from the surface. Each well is outfitted with a below-grade wellhead assembly to allow monitoring and control of well performance. The well head assemblies include the following components:

- Protective concrete vault and lid
- Removable access cap that allows unobstructed access to the bottom of the well for measuring water levels within the well, as needed
- Orfice plate for measuring the volumetric flow rate of LFG being collected
- Sample port / labcock for measurement of temperature
- Quick-disconnect sample ports for measuring the following:
  - LFG composition
  - LFG flow rate
  - Pressure (vacuum)
- Gate valve for control (throttling) and isolation

2.1.1 Subheader / Header Pipe Network

Each wellhead is connected to the flare by a network of pipelines, including laterals and header pipelines, as shown in Appendix A – Drawing L2. All pipeline types are constructed of HDPE pipe, with varying diameters, depending on the type and location of the pipe within the system. Laterals from the wellheads connect to the header pipeline. The laterals and portions of the header are buried in shallow trenches under the landfill. Another portion of the header is buried outside of the landfill, connecting the lateral pipes to the blower / flare system.

To facilitate condensate drainage, the laterals and subheader pipes are sloped at minimum 2%. The header pipe is sloped at 0.5% or greater in the same direction of gas flow, or 1.5% if condensate drainage is required to drain in the opposite direction of gas flow. Pipe slope for laterals and subheaders installed within the waste footprint are installed at the maximum slope achievable to compensate for unpredictable waste settlement.

The header is fitted with header control (isolation) valves, which are butterfly valves. Monitoring ports are available on the header at the valves to allow monitoring of pressure and gas composition. The ports are quick-connect fittings connected to a sampling hose similar to the fittings on the wellheads.

2.1.2 Condensate Drainage System

LFG is a moist gas, typically saturated when it leaves the waste. As the gas cools and changes pressure within the pipeline, condensation accumulates within the pipeline system. The function of the condensate drainage system is to allow condensate produced by the LFG to drain from the pipelines, which prevents the condensate from blocking gas flow. The system consists of condensate traps, which are located along the header pipeline, and at the blower/flare system, as indicated in Appendix A – Drawing L1. The condensate traps are designed to isolate the system vacuum from the atmosphere, preventing the intrusion of air into the system. This is accomplished by establishing a liquid seal within the trap. Two condensate trap-type drains have been installed in the system. Accumulated condensate is discharged from the condensate traps to the leachate collection system.

Note: *Condensate may contain contaminants; therefore, it cannot be discharged to the ground surface. It must be managed as leachate and disposed of appropriately.*

2.1.2.1 North Condensate Drain

The north condensate drain is connected to the system at the location shown in Appendix A – Drawing L2 with a branch saddle mounted at 90 degrees. The HDPE (100 mm [4 inches]) is connected to a reducer, which is connected to a 50-mm -diameter well. A valve is installed in the pipe to allow isolation of the trap. The valve is accessible through the valve stem riser, shown in Appendix A – Drawing L2 (Detail U-L1).

The piping is connected by a 50-mm tee to an HDPE well. Condensate collected in the pipes fills the well to the level of the discharge piping. Excess condensate drains from the well to the leachate ditch. The blind flange at the condensate trap may be used as an access point to inspect and clean the trap.

It is critical that, following repairs, the trap is primed with water and that it remains flooded during system operations. Failure to provide a liquid seal in the trap may result in air intrusion into the LFGCS.

2.1.2.2 South Condensate Trap

The south condensate trap is connected to the subheader pipe at locations shown in Appendix A – Drawing L2 (Detail X-L1) with a branch saddle. The trap is constructed of HDPE and incorporates a U-shaped design that prevents water or air from being drawn up into the pipe by the suction induced by the extraction system. Condensate from these traps drains to the leachate ditch via a 50-mm (2-inch) HDPE pipe. The blind flange at the condensate trap may be used as an access point to inspect and clean the piping. See Appendix A – Drawing L2 (Detail X-L1). It is critical that, following repairs, the U-shaped trap is primed with water and that it remains flooded during operation. Failure to provide a liquid seal in the trap may result in air intrusion into the LFGCS.

2.2 Wellfield Monitoring Procedures

The performance of the LFGCS is monitored at the wellhead and the flare skid. In general, monitoring and balancing are not required at the header valve locations. These header valve monitoring points may be used to troubleshoot operational problems and confirm monitoring data collected at the wellheads and flare skid. The following subsections describe the gas well monitoring and balancing procedures recommended for optimal operation of the LFGCS.

2.2.1 Monitoring Frequency and Termination

Monitoring and adjustment of operation parameters should continue at all wellheads on a monthly basis, at a minimum, and as necessary to ensure there is optimal operation of the LFGCS and no migration of gas off-site.

Note: *Monitoring procedures are outlined in Section 2.2.3. Wellhead should be balanced as described in Exhibit C-1 (Appendix C).*

For wells that have been adjusted, monitoring should be performed on a weekly basis until the readings have stabilized. Appendix D provides a summarized schedule of O&M tasks and frequency.

The wellfield must continue to be monitored as long as the LFGCS is operational. The LFGCS will no longer be needed when these conditions exist:

- It is impossible for the gas extraction system to maintain a sustained gas flow rate because of low gas production.
- No significant air emissions or gas migration are occurring.

Monitoring may be terminated after the LFGCS is longer deemed necessary.

2.2.2 Monitoring Equipment

The following equipment is generally necessary to perform routine wellfield monitoring and tuning operations:

- Portable landfill gas analyzer: CES-Landtec GEM 2000 or similar instrument(s) capable of measuring:

- Methane concentration (as % by volume). Methane measurement device must be designed for methane concentration greater than 100 % of the lower explosive limit (% LEL).
- Carbon dioxide concentration (as % by volume)
- Oxygen concentration (as % by volume)
- Temperature (°C)
- Static pressure (kPa or inches of water column [WC])
- Differential pressure (kPa or inches of WC)

▪ Valve operator arm attachment

▪ Tool to open valve vaults

▪ Water level measurement device: electronic water level indicator (Solinst or equal)

***CAUTION**: Due to the combustible and potentially corrosive composition of LFG, any equipment that will come into direct contact with landfill gas must be design for, or compatible with LFG. Consult equipment manufacturer to ensure compatibility.*

2.2.3 Monitoring Procedures

During routine monitoring events, each well must be checked for gas flow, pressure, methane content, carbon dioxide and oxygen content. The following steps describe the monitoring procedures to be performed at the wellheads. Similar measurements should also be made at the blower/flare station to check overall system performance.

1. Ensure that monitoring instrument(s) are calibrated properly (as per manufacturer's recommendations).
2. Remove the vault cover.
3. Follow the GEM2000 instructions for taking LFG wellhead readings. Ensure the GEM2000 unit is purged and pressures are zeroed prior to attaching sample hoses and temperature probe to the wellhead.
4. Select the proper well ID number from the menu for the wellhead being measured.
5. Attach the GEM2000 "static" pressure (which is also the sample inlet) hose to the quick-disconnect downstream (valve side) of the orifice plate.
6. Attach the GEM2000 "impact" pressure hose (also the differential hose) to the quick-disconnect upstream (well side) of the orifice plate.
7. Take readings for methane content, carbon dioxide, oxygen, pressure, and flow rate. At quarterly monitoring events also take readings for temperature. The GEM 2000 will automatically compute the flow rate, providing the well data has been input and uploaded into the unit. For complete instructions on how to use the Landtec GEM 2000, consult the unit's user manual.
8. When the readings are outside the normal operating range defined in Section 2.2.4, repeat the readings at least twice to eliminate the possibility of error.
9. If the measurements are outside the acceptable range, adjust control valve position to achieve required effect, following procedures described in Section 2.2.4.

10. After readings have been taken, replace sample port covers (if installed) and the vault cover.
11. When water level readings are taken during a scheduled quarterly monitoring event, remove the slip cap at the top of the wellhead. Measure the water level from the top of the well using an electric water level indicator. .

Data should be stored electronically in the Landtec GEM 2000 or in field notes and downloaded into a permanent record.

2.2.4 Acceptable Ranges

Operating ranges have been established for the wellfield. The following primary operating parameters must be recorded:

- Methane content,
- Oxygen content,
- Flow rate,
- Pressure,
- Temperature, and
- Carbon dioxide to methane ratio

Water levels within the gas wells and the LFG temperature should be monitored quarterly as an indicator of conditions within the refuse.

2.2.4.1 Methane Content

Methane content will be measured at gas wellheads and at the header isolation valves between the wells and at the flare system inlet. Operators may either store the readings in a gas analyzer such as the GEM2000, or record them in a field book.

Methane content at wellheads should be maintained above 40 % by volume. If low methane content is encountered in an extraction well, excessive vacuum may be causing the well to pull air through the landfill cover system from the surface. Adjust the well as instructed in Exhibit C-1 (Appendix C) to maintain methane concentrations, while maximizing flow from the extraction well. Methane concentrations at the wells are highly variable depending on their location; wells W01 – W06 and W11 – W13 are typically 15 – 60% methane, whereas wells W07 – W09 are typically between 1 and 5% methane content. These ranges are only typically values and may vary based on the changing conditions at the landfill. If unusually low concentrations are observed, before adjusting the well, confirm the instrument is connected to the monitoring fittings properly and that there are no leaks from the monitoring ports or fittings.

2.2.4.2 Oxygen

Oxygen concentration in LFG should be maintained below 2% by volume. Since LFG does not contain oxygen, oxygen above this level generally indicates air intrusion into the well and should be monitored closely. The vacuum pressure applied, and ultimately the LFG flow rate, should be decreased from a well with oxygen concentrations above 2%. Oxygen concentrations above 2% by volume may also be the result of a leaking monitoring port or fitting. If unusually high concentrations are observed, before adjusting the well, confirm the instrument is connected to the monitoring fittings properly and that there are no leaks from the monitoring ports or fittings.

2.2.4.3 Gas Well Pressure

Gas well static pressure should be monitored on the upstream side of the orifice plate. Normal operating range for vacuum (negative pressure) for the gas wells is between 0 and 3.5 kPa (0 to 14 inches WC, or 0 to 0.5 psi). The operator will review the well readings for instances where acceptable ranges have been exceeded. A reading of 0 with the gate valve open indicates a potential problem within the header or lateral piping and should be investigated further.

Vacuum greater than recommended maximum does not generally improve LFG capture and may result in intrusion of air into the LFGCS through the landfill cover or well seals. Highly unstable pressure readings may indicate partially obstructed header or lateral piping resulting from accumulated liquid. Highly unstable readings should be investigated further. If a well is outside its target range, make the necessary adjustments (according to the procedures in Exhibit C-1 (Appendix C) to bring the well into the appropriate range.

2.2.4.4 Flow Rate

Volumetric flow rate is calculated by measuring the differential pressure across the wellhead orifice plate. Pressure differential is measured at the quick-connect fittings installed on the upstream and downstream sides of the wellhead orifice plate. The measured pressure differential can then be used to calculate the gas velocity. Knowing the pipe diameter and the gas velocity, the gas flow rate can then be calculated. This calculation is performed automatically by the GEM2000 but can be undertaken manually if the differential pressure is measured using an alternative instrument. The flare system is set to accept the following flow rate: minimum 16 scfm and maximum 160 scfm.

The well flow rate is generally related to the vacuum pressure applied to the well and the LFG generation rate of the refuse within the zone of influence for a given vacuum pressure exerted at the well. If the zone of influence extends beyond the limit of refuse, air from the surface may contribute to the total flow rate. Due to these relationships, there are no recommended ranges for wellhead flow rates, however typical range for flow is between 0 to 20 scfm per well.

Flow rates are measured primarily to provide a guide for adjusting the wellhead valve. The valve will be adjusted to achieve the appropriate well pressure that results in gas flow composition within the acceptable ranges presented in Appendix C (Exhibit C-1). Normal operating ranges for individual well flow rates will vary from well to well because of localized variability within the refuse, local LFG generation characteristics, and landfill cover characteristics.

2.2.4.5 Temperature

Temperature should be monitored on a seasonal basis (quarterly). LFG temperature typically ranges from 25°C (77°F) to 50°C (122°F) when measured at the wellhead. LFG temperature is independent of ambient air temperature. Never allow the temperature of gas from gas extraction wells to exceed 54°C (130°F). If this occurs, close the gate valve by 75 % and monitor daily until the temperature is below 54°C (130°F). Readjust, as necessary, during the normal monitoring schedule.

High temperatures may indicate aerobic reactions in the landfill, which can potentially lead to a landfill fire. If the temperature exceeds the recommended range, the vacuum applied to the well should be reduced. Reducing the vacuum applied to the well will reduce the well's zone of influence and may help limit air intrusion and restore anaerobic degradation of the waste. Gas temperatures below 20°C may indicate air intrusion or measurement error. If gas temperature is below 20°C, confirm oxygen concentrations meet the recommended range.

2.2.4.6 Water Level

Quarterly water level measurements should be made in the spring, summer, fall and winter to track seasonal variation. Additional monitoring may be undertaken to investigate potential operational issues such as unusually high vacuum and low methane content encountered in a well. If these conditions occur, the water level should be monitored and compared to the top of screen elevation to see if the gas inlet screen has been occluded by rising water.

Water level in the gas extraction wells is measured from wellheads. Water levels may fluctuate between monitoring rounds. The water level should be recorded on monitoring rounds and compared to previous readings. If there is a large amount of water present in the well, shut down the well by closing the gate valve until the water level subsides to previous readings. If the slotted part of the well is full of water, then there will be no vacuum applied to it, so the gate valve needs to be closed.

If high water levels persist, the operator should increase the capture of LFG from nearby wells to compensate for the shutdown, watered-in well.

2.2.4.7 Carbon Dioxide to Methane Ratio

The ratio of carbon dioxide to methane should not be allowed to exceed a 1 to 2 ratio. Excessive carbon dioxide to methane ratio indicates air infiltration and aerobic reactions in the landfill, which can lead to overheating and potentially to a landfill fire. If the carbon dioxide to methane ratio observed falls outside the recommended range, the vacuum applied to the well should be reduced this will reduce the well's zone of influence and may help limit air intrusion.

Carbon dioxide to methane ratio is calculated as follows:

Carbon dioxide as % by volume / Methane content as % by volume

2.2.4.8 Supplementary Analysis

To supplement the analysis completed during routine monitoring using the portable instrumentation, third-party laboratory analysis test may be run to provide more detailed composition assessment of the LFG. Common analysis parameters include the following:

- Volatile Organic Compounds (VOCs), measured using U.S. Environmental Protection Agency (USEPA) Method TO-14
- Methane
- Hydrogen sulphide and Total Reduced Sulphur
- USEPA Method TO-X for totat organic halides
- Oxygen
- Carbon Dioxide
- Nitrogen
- Carbon Monoxide

These tests are commonly used to assess the accuracy of portable monitoring equipment used in field operations and may be conducted as needed.

Samples must be collected following analysis –specific procedures and using the proper sample collection vessel. Consult with the analytical laboratory during development of sample plans to determine appropriate methodology and testing requirements.

2.2.5 Reporting Requirements

Reports will be generated monthly with all of the field measurements and any recommendations or observations that were noted during the monitoring event(s). This information will also be included in an annual report. The reporting requirements are provided in greater detail in Section 8.

2.3 Wellfield Balancing Procedures

Periodic adjustments to the gas well are required to balance and optimize gas collection while minimizing air intrusion. Balancing the gas wells requires monitoring, as described in Section 2.2, and adjusting the position of each wellhead gate valve (also referred to as the wellhead throttling valve). The parameters discussed in Section 2.2.4 are monitored to assess the performance of the well and determine an appropriate valve adjustment, if required.

The procedure describes how to adjust the wellheads to provide a well-balanced field.

1. Each wellhead has a gate valve to throttle the vacuum exerted by the well. Closing the valve reduces the vacuum, while opening the valve increases the vacuum to the maximum available vacuum. The maximum vacuum that can be exerted on the well is equal to the vacuum directly downstream of the throttling valve.
2. Optimal vacuum is applied to the well when the following conditions exist:

- Gas flow quality characteristics meet the values recommended in Section 2.2.4
- Application of greater vacuum results in degradation of slow quality characteristics to values below the acceptable range.

3. Balancing the wellheads is an iterative process. The following list describes the key principles to be considered when balancing the system:
   - During monitoring, determine if the well is outside the normal operation ranges.
   - Estimate the amount of valve throttling (or opening) that would be necessary to achieve the normal operating range (e.g. close by 10% or open by 10%). Operator judgment is used to estimate the appropriate adjustment.
   - Rule of Thumb:

   Avoid large adjustments to the valve position unless obviously necessary. Dramatic adjustments at a single or multiple locations may cause un-balancing or instability within other portions of the wellfield.

   Opening valves will tend to decrease the methane content and increase the vacuum and flow rate by increasing the zone of influence. Closing valves will tend to increase the methane content and decrease the vacuum and flow rate by decreasing the zone of influence.

   - Adjust the valve to increase or reduce the vacuum exerted on the well (directly measured by pressure differential, velocity, or flow) by the estimated percentage.
   - In the next monitoring round, note how much the adjustment changed the operating parameter, and make additional adjustments in proportion necessary to achieve the acceptable operating range. Wells that have been adjusted should be monitored weekly (while other wells on a monthly schedule) until readings stabilize within the normal operating range.
4. It is good practice to record valve position and monitoring data before and immediately following, a valve adjustment. This will provide insight into the unique performance characteristics of each well over time.
5. Operators must monitor the effect of well adjustment on nearby wells. Check the nearby wellheads for reduced flow, increased oxygen, or other indicators of air intrusion.
6. The extent of the underground area influenced by an extraction well depends on the strength of the vacuum, waste density, leachate level, and a number of other factors, and will vary from well to well even if the same vacuum is applied. During normal operation, monitoring results from all extraction wells should be reviewed together. This will make it easier to detect when the system is out of balance. See Exhibit C-1 (Appendix C) of the Balance Guide for more information on the potential cause and actions required for various conditions observed at the wells.

2.4 Gas Well / Wellhead Maintenance

A conscientious, preventative maintenance program combined with prompt corrective action will reduce system downtime and improve operating efficiency. Frequent system inspections are the main type of preventative maintenance for the gas control system.

Anyone performing maintenance on wellheads below grade must be aware of the dangers of working in a confined space as defined by British Columbia Workers Compensation Board (BC WCB), Part 9. Follow appropriate health and safety procedures while undertaking all maintenance activities. Repairs generally fall into one of the categories discussed below.

NOTE: *All wellhead repairs must be made with gas flow shut off or isolated to prevent uncontrolled discharge of LFG and foreign debris from entering the well or piping system. Close the gate valve at the wellhead to block the flow of gas from the well, and cap open-ended gas collection pipes to prevent LFG from escaping and causing potential health and safety concerns.*

Where possible, always replace or repair components with the same material described in the design drawings. If material substitutions are required, a qualified Engineer should be consulted to determine appropriate material compatibility. Materials selected must be compatible with LFG and other applicable environmental considerations. Avoid use of silicone-based sealants or compounds during maintenance of the LFGCS. Silicone based materials may produce vapours that can damage the sensor of portable LFG monitoring instruments, reducing the lifespan of the equipment.

CAUTION: *Repairs to the LFG piping in the system may involve fusing HDPE pipe. There is an inherent danger of fire or explosion when doing any work on a LFG collection/piping system. Anyone performing maintenance on the system should develop task specific safety procedures.*

2.4.1 Leaking Pipe Joints

Small air leaks may develop at the wellhead pipe joints over time. Pay close attention to monitoring data for unusual oxygen concentrations that may indicate air leakage through a leaky pipe joint rather than excessive vacuum overdrawing the well.

Small leaks should be sealed with an appropriate material, based on the location and nature of the leak. Ensure the material used is compatible with LFG and the monitoring instrumentation. Some materials that contain silicone-based compounds are harmful to portable gas analyzers, and use should be avoided.

2.4.2 Monitoring Port Repair / Replacement

The most common repair conducted at the wellheads is replacement of the labcock valve, quick connect monitoring ports, and sample tubing. Since these fittings having moving parts and are used during routine monitoring and well balancing activities, they tend to be subjected to the greatest wear and may require replacement periodically. The rest of the well head components are relatively static and are not subject to wear. The sample train should be inspected and repaired if anomalous concentrations of oxygen are detected during wellhead monitoring.

During each monitoring event the tubing should be inspected for moisture before attaching the portable gas analyzer. Small accumulations of condensate within the tubing are common during normal operation of the system. The condensate can be easily drained back to the well by opening the monitoring port briefly to allow the moisture to be pulled back towards the wellhead by the system vacuum.

If a monitoring port is malfunctioning, inspect all gaskets and valve components for wear or damage and the tubing connections for leakage at fittings before replacing the fitting. Both male and female quick-connect fittings have small o-ring gaskets that create a seal when a connection is created during sampling. Dirt and moisture may accumulate in quick- connect fittings which may prevent proper sealing during use, resulting in intrusion of air into the sample collected.

Labcock valves and monitoring ports are tapped (i.e. threaded) directly into the PVC or HDPE materials. Flexible tubing is clamped to the piping system. If a valve or port is suspected of leaking - commonly indicated by an audible hissing noise - or anomalous oxygen concentrations measured when monitoring, take the following measures:

1. Close the gate valve at the wellhead.
2. Remove the faulty item, and inspect the threading on the valve and pipe.
3. If the threading is in good condition, Teflon tape or pipe compound may be used to reinforce the seal. Wrap the labcock threading with the Teflon tape, or apply compound and re-install the labcock. Make sure not to overtighten the connection.

Note : *Teflon thread sealant may be used on the labcock threads to provide an airtight seal and reinforce bonding. Apply sealant according to the manufacturers' recommendations.*

4. If the threading on the pipe is badly damaged, the pipe may need to be retapped at a new location and the old tap sealed.
    - Overdrill hole and tap with to a slightly larger diameter, and tap to match next available National Pipe Taper (NPT) diameter. Install a solid threaded plug using Teflon tape or pipe tread compound to achieve an airtight seal. Be careful to not over tighten the plug
    - If damage to HDPE pipe is significant, repair the pipe using a fusion patch. Clean the surface around the original tap. Fuse a patch of HDPE pipe of the same diameter to the exterior of the wellhead piping at the hole location. This step involves pipe fusion.

CAUTION: *Repairs to the LFG piping in the system may involve fusing HDPE pipe. There is inherent danger of fire or explosion when doing any work on an LFG collection / piping system. Anyone performing maintenance on the system should develop task-specific safety procedures.*

- Redrill and tap the pipe at a location approximately 5 cm upstream from the original tap for the static port, and 5 cm downstream for the test port (see Appendix A – Drawing L3 [Detail W-L1]). The tap must be one size smaller than the diameter of the labcock valve. Do not move orifice plate monitoring ports further away from the orifice plate without consulting the manufacturer's installation directions. Inappropriate monitoring port locations may affect the accuracy of the instrument.
- Reinsert the valve into the new tapped hole. To prevent stripping, make sure not to overtighten the connection.

2.4.3 Wellhead Major Component Replacement

It is important to minimize the air intrusion into the collection system during part replacement. This may be accomplished by shutting off the gate valve to stop the flow of gas from the wellhead. Alternately, a blind flange or pipe plug may be installed downstream of the repair to prevent air intrusion to the system.

There is no prescriptive replacement schedule for parts in the wellfield. It is recommended that a sufficient supply of replacement parts be kept onsite for repairs, as needed. Appendix F includes a list of parts vendors for replacement and restocking.

In addition to labcock valves and pipe supports, wellheads contain the following components: a gate valve, orifice plate, and flex hose. Any of these components should be replaced if damage is suspected. The following procedures should be used:

Gate Valve Replacement: Gate valves are mounted in the wellhead piping with a bolted flange. To remove the gate valve, loosen the bolts, and slide the valve out. Replace the new valve and re-tighten. It is recommended to install new gaskets be installed each time the orifice flange union is separated or dismantled.

Orifice Plate Replacement: Orifice plates are mounted in the wellhead piping with flanges. To remove the plate, close the gate valve, and make certain the pipeline is not under vacuum. Ensure positive gas pressure has been drained by opening the labcock valve to alleviate accumulation gas in the well. Loosen and remove all studs and nuts on the flange union. Spread flange union by turning jackscrews clockwise (if available). Remove existing plate and gaskets, and replace with new orifice plate and new gaskets. Make sure the centre of the orifice is aligned with the centre of the pipe. It is recommended that new gaskets be installed each time orifice flange union is separated.

Flex-hose Replacement: The flex hose is connected to the wellhead piping with flex-hose clamps. Using a Philips-head screwdriver, loosen the clamps (four in total), and slide the tubing from the pipe. Replace only with 50 mm flex hose of the same length. Tighten the hose clamps until the connection is snug. Do not overtighten, as this may cause damage to the hose.

2.4.4 Wellhead Replacement

In some cases, a damaged wellhead will require complete replacement. It is recommended to have a supply of replacement wellhead parts on hand to reduce system downtime during replacement. If parts are not kept on hand, maintain a list of local vendors that supply each components of the wellhead. Because this procedure requires cutting and welding HDPE, all work in this section must be performed by a skilled technician.

CAUTION: *Repairs to the LFG piping in the system may involve fusing HDPE pipe. There is inherent danger of fire or explosion when doing any work on an LFG collection / piping system. Anyone performing maintenance on the system should develop task-specific safety procedures.*

The following equipment is necessary to replace the wellhead. For information on replacement part vendors see Appendix F:

- Wellhead parts and piping
- HDPE pipe coupling
- Pipe cutting equipment
- HDPE fusion welder

The following procedure may be used to replace a damaged wellhead:

1. Close off vacuum to the well.
2. Disconnect the flex hose from the pipe lateral.
3. Decide where to sever the HDPE. Cut the pipe at a clean right angle, and remove the damaged section of the wellhead. Please refer to the fitting pipe manufacturer recommendation when cutting HDPE. Ensure the cut is cleaned and deburred. The damaged wellheads can be repaired, if possible, and used in the future.
4. Attach the pipe coupling to the wellhead piping using a fusion welder. Position the new wellhead and fuse the coupling to the HDPE portion of the wellhead.
5. Reattach the flex hose to the wellhead, leaving 5 cm slack in the hose.
6. When the wellhead has been replaced, it should be brought online as instructed in the Commissioning and Training Plan (Appendix G).

To undertake temporary repair if pipe fusion equipment cannot be undertaken immediately, mechanical couplers can be used to join the pipe temporarily. Mechanical couplers just as Fernco, Vitaulic or other joining system may be used. Always follow manufacturer's installation recommendations. Ensure there are no air leaks at the coupler following installation using visual leak detection compound or soapy water solution.

2.5 Header Operational Procedures

The header does not generally require monitoring or adjustment under normal operating conditions. The normal valve position is fully open during routine operation of the system. The valves may be closed to allow isolation of portions of the system during wellfield maintenance activities. If differential settlement occurs that causes condensate to collect and block gas flow, it may be necessary to excavate the pipe and re-install on a proper grade. Damage to the pipe may be repaired in accordance with HDPE pipe repairs procedures.

2.5.1 Isolating and Venting Header Pipe

CAUTION: *The procedure discussed below involves potential exposure to LFG. Repairs to the LFG piping in the system may involve exposure to LFG and may include fusion of HDPE pipe. There is an inherent danger of fire, explosion or asphyxiation when doing any work on a LFG collection / piping system. Anyone performing maintenance on the system should develop task-specific safety procedures.*

During repairs to the system it may be necessary to isolate the header from the well heads and vent the header pipe. Follow these steps to isolate and vent the header:

1. Completely shut down the Blower/Flare system (refer to Appendix H, Blower/Flare system control panel for how to turn the system OFF).
2. Close the Header Control Valves. The locations of the valves are shown in Appendix A - Drawing L1.
3. If required to undertake necessary repairs, vent the header by removing the blind flange assembly provided at the condensate traps.

2.5.2 Maintaining Header

Maintenance of the header includes identifying blockages in the header and subheaders and making the necessary repairs. Maintenance should be carried out by personnel trained in working on landfill sites.

It is good practice to periodically operate the header isolation valves to ensure proper operation and to exercise the valve seals. The valve should be briefly moved from *fully open* to *fully closed* positions to ensure the valve has a full operation range of operation.

2.5.3 Identifying Blockages and Leaks in Piping System

Measuring pressure, methane, oxygen, and pressure at the wellheads and header valve locations will help identify obstructions or leaks in the system.

Readings that indicate a leak include:

- Reduced methane concentration
- Elevated oxygen readings
- Reduced vacuum
- Increased flow readings at the blower/flare system

A leak typically indicates short-circuiting. In other words, ambient air is being drawn into the well due to a defective seal or a fractured surface condition. A leak in a header pipe could result from a puncture or a defective weld.

- Readings that indicate an obstruction include the following:
- Reduced velocity
- Increased or highly unstable vacuum
- Increased methane concentration
- Reduced flow readings at the blower/flare system
- Audible liquid movement within the piping

Possible causes of flow restrictions are partially-closed valves, condensate accumulation in the pipe, or ice formation in the pipe. If condensate build-up is suspected, the nearest downslope condensate trap should be inspected (see Section 2.6) to confirm proper operation.

2.5.4 Repairing Header Pipe

Typically, most repairs will be performed with the system offline, and personnel must be properly equipped. This section may involve pipe fusion.

CAUTION: *Repairs to the LFG piping in the system may involve fusing HDPE pipe. There is inherent danger of fire or explosion when doing any work on an LFG collection / piping system. Anyone performing maintenance on the system should develop task-specific safety procedures.*

Repairs to pipes below grade will require excavation and replacement,. Engineering approval should be obtained to determine the requirements of such pipe repairs; therefore, it is not covered in this manual.

2.5.5 Replacing Header Valves

Header isolation valve stations contain a hand-operated butterfly valve Replacement of the butterfly valve should be completed, as follows.

1. Make sure the system is offline and the valve is closed.
2. Check the pipeline for accumulation of LFG by measuring pressure in the pipeline.

Caution: Check the pipeline for accumulation of LFG by measuring pressure in the pipeline. If positive pressure is observed LFG will escape the pipe as soon as the flange is loosened. This may result in a hazardous atmosphere within the protective vault. Appropriate health and safety procedures must be followed.

1. Loosen the flange by removing the hex nuts on the bolts.
2. Carefully remove the valve from the pipe.
3. Replace with the new valve and gaskets, and retighten the bolts accruing to the manufacturer’s recommended torque values.
4. When the valve has been replaced, the system should be brought online as instructed in the Commissioning and Training Plan (Appendix G).
5. Check the flange assembly for leakage using visual leak indicator compound or soapy water.

2.6 Condensate Drainage System Operational Procedures

Operation of the condensate traps is fully automatic under normal operating conditions. Inspection should be conducted during each round of wellfield monitoring to ensure proper operation. Periodic adjustment or isolation of the condensate traps may be required. The following subsections provide procedures for adjustment and isolation of the traps.

2.6.1 Adjustments

The North Condensate trap is equipped with a gate valve, accessible via a PVC casing. The valve consists of a 25-mm (1-inch) nut at the level of the piping. A long-arm wrench must be used to turn the valve on and off. The valve is used to isolate the vacuum in the LFG system if the condensate drain needs to be cleaned or repaired while the LFG system is still operating, in which case the valve is closed while the cleaning/repairs are done. However, the valve cannot be closed for too long (more than a few hours) while gas continues to flow through the adjoining gas pipe, or condensate may back up into the manifold. Section 2.6.2 describes procedures in case of damage or leakage of the condensate traps / drainage.

2.6.2 Inspection and Maintenance

Maintenance of the condensate traps includes periodic check of liquid level, cleaning the outlet piping, and replacing parts, as necessary. Maintenance of the condensate drainage system can be accomplished with the following steps:

1. For the North Condensate trap, examine the 100mm (~4 inch) slip cap at the top of the condensate well casing monthly for leaks and damage. Because the system is under negative pressure, a leaky slip cap can cause oxygen to enter the system. Oxygen can present a significant fire and explosion hazard in an LFG environment. If damage is found, replace the slip cap with the trap valve closed.
2. For both trap types, make a quarterly examination of the liquid level in the trap, using a water-level-measuring device. The liquid level should be maintained at the invert elevation of the outlet drain pipe under normal circumstances. Higher liquid levels may indicate downstream blockages. Lower levels may indicate a break in the condensate trap piping or that the condensate trap has dried out, allowing air to enter the gas collection system. For a condensate trap that has dried out, fill the trap with water and observe whether leakage occurs. The leakage in the condensation traps can be observed by measuring the water level in the condensate traps at different time intervals. If, after filling the traps with water, the level drops, than there may be leakage. If leakage is suspected, investigate further to determine the source, and repair appropriately.
3. For both trap types, examine the blind flange(s) monthly for any signs of leaking. Replace any faulty flanges with the trap valve closed.
4. Discharge lines may be cleaned. If there is blockage at the point of discharge, remove the blockage so that condensate can flow freely from the discharge pipe.

3. BLOWER / FLARE SYSTEM OPERATION AND MAINTENANCE

The blower/flare system was manufactured by Perennial Energy Inc. (PEI). See the Perennial Energy; Operation and Maintenance Manual for a 160 SCFM Candlestick Flare Station, Whistler Landfill, Whistler, B.C., Canada, Open Candlestick Flare Unit 16.5' with Control Panel, Gas Handling System; January 2007, for a detailed description of the blower/flare system and all necessary operations and maintenance procedures. System shut down and startup procedures are also described in the PEI O&M manual. Additional information is provided in the Commissioning and Training Plan in Appendix G of this document. Review the training plan before starting the system.

Note: *The operational limitation of the flare system presented in the PEI O&M manual should not be exceeded under any circumstance.*

4. MAINTENANCE SCHEDULE

The maintenance schedule is provided by PEI and presented in Appendix D.

5. LANDFILL GAS PERIMETER MIGRATION MONITORING

5.1 Description

Due to the potential for gas migration to adjacent properties, a network of subsurface gas probes have been installed to monitor the soil gas quality surrounding the landfill (Figure 2). Data collected from the soil gas probes should be used to assess the overall collection performance of the LFGCS and identify the presence of potentially unsafe concentrations of LFG within the soil at the probe locations.

In addition to soil gas monitoring probes, monitoring ports have been installed in numerous buildings surrounding the site.

5.2 Equipment for Monitoring

The following equipment is generally necessary to perform subsurface migration monitoring at the monitoring probes or building ports:

- Portable LFG analyzer: CES-Landtec GEM2000 or similar instrument(s) capable of measuring:
  - Methane concentration
  - Static pressure (kPa or inches of WC)
  - Differential pressure (kPa or inches of WC)

5.3 Procedure

During monitoring events, each monitoring probe must be monitored using the following steps.

1. Ensure that the monitoring instrument(s) are calibrated properly (as per the manufacturer's recommendations).
2. Follow the instrument instruction for taking a LFG monitoring probe reading. If using the GEM2000, ensure the unit is purged and pressures are zeroed before attaching sample hoses.
3. If the instrument has logging capability, select the proper monitoring probe ID.
4. Attach the pressure measurement hose to the probe sample port.
5. Take the probe pressure reading.
6. Using the instrument pump, purge between 1 and 3 probe casing volumes to provide a sample of soil gas more representative of *in situ* conditions. In general, readings should be stable within 1% by volume to be considered representative. Take readings for methane content. The time required to purge the probe varies, based on the total depth of the probe and local soil conditions.
7. After readings have been taken, re-install port covers (if installed) and any other protective casings (i.e. vault covers).

Data collected in the field electronically or field notes should be downloaded into a permanent record.

5.4 Trigger Levels

Trigger levels have been established for determining when additional action is required based on the results of soil gas monitoring program.

The following combustible gas trigger limits for the site are recommended, based on the BC Environmental Monitoring Guidelines and other conservative regulatory criteria:

- Methane gas concentrations in excess of, or predicted to exceed, 10 percent LEL in subsurface soils at the eastern and southern property boundaries of the Whistler Landfill. The 10% LEL trigger level is applicable to the following monitoring probes:

MP08	MP14	MP19
MP09	MP15	MP20
MP10	MP16	MP21
MP12	MP18	
MP13		

- Methane gas concentrations in excess of, or predicted to exceed, 25 percent LEL in soils at the western and northern property boundaries. The 25% LEL trigger level is applicable to the following monitoring probes:

MP01	MP04	MP07
MP02	MP05	MP11
MP03	MP06	

Monitoring probe MP17 is an exception to the protocol described below; please refer to section 5.4.1 for further information on this probe.

Measurement of methane concentration in excess of the trigger levels require immediate action as described below to ensure the LFGCS is fully optimized.

In the event that a monitoring probe exceeds the trigger levels the RMOW and the lead consultant will be notified immediately by the Contractor.

A full round of wellfield balancing shall be conducted if a trigger level is exceeded. The maximum vacuum, to the extent possible, should be applied to the wells in the vicinity of the monitoring probe that exceeded the trigger level. The Contractor shall remain on site until a differential pressure is achieved at the wells in the vicinity of the monitoring probe that exceeded the trigger level. The maximum vacuum that can be applied to the wells should not result in exceedances of the trigger levels at other monitoring probes or degradation of the gas quality below the acceptable range described in Section 2.2.4.

Monitoring shall be performed daily at all of the monitoring probes and any buildings within 100 m of the monitoring probe that exceeded the trigger level. If any methane is detected in the buildings within 100 m of the probe, all of the building ports will be monitored. Monitoring of the probes and building ports will continue until there are 2 consecutive days with undetectable methane content in the monitoring probes. Reporting during the daily monitoring shall be provided to the RMOW and lead consultant within 12 hours of collection and will include the monitoring field data as well as a summary of the management actions to prevent / control the off-site gas migration.

If gas concentrations at the property boundaries remain above the recommended trigger limits for greater than 2 days, additional parameters will be measured at the MP including: carbon dioxide, oxygen, and hydrogen sulphide. This information will be used to assist in determining the source of the issue and follow-up actions. Management actions will be coordinated with the on-site contractor, lead consultant and the RMOW in the event that trigger limits are exceeded for greater than 2 consecutive days.

5.4.1 Monitoring Probe MP17

MP17 is located on the north west end of the landfill. During landfill closure this area was found to contain large volumes of waste that were not within the lined perimeter of the landfill. The RMOW used an excavator to remove the waste from the area around MP17 and further to the west of the probe (Personal communication, May 14, 2012, James Hallisey and Paul Bencharski, Resort Municipality of Whistler).

Since monitoring commenced on the LFGCS, MP17 has frequently exceeded the 10% LEL trigger level. Unlike exceedances at other perimeter monitoring probes, adjustments on the collection system have been unsuccessful at controlling the methane at MP17. Based on the site history of the area surrounding MP17, it is highly likely that MP17 has an isolated methane source from the waste that was previously dumped in the area.

Within approximately a 100 m radius of MP17 there is one potential receptor, which is a non-residential building that houses works for the municipal sanitary sewer lines. To ensure that the municipal building is not impacted by migration of LFG, an additional monitoring probe is proposed for the area immediately between the landfill and the building.

Since MP17 is not adjacent to any residential receptors and the probe is not felt to accurately represent the potential for off-site gas migration **the trigger levels do not apply for MP17.**

5.5 Monitoring Locations and Frequency

Regular monitoring occurs on two schedules that are dependent on the snow conditions. During the months when there is snow pack over the landfill, regular monitoring is to be conducted weekly at the monitoring probes and flare. The rest of the year when there is no snow pack regular monitoring is to be undertaken monthly. Monitoring at the building ports will be conducted twice per year during months when there is snow pack; the monitoring dates should be at least a month apart.

If an exceedance of the monitoring probe trigger levels is detected, the monitoring program is increased to manage the off-site migration of LFG.

Following the detection of methane in excess of the trigger levels, monitoring should be increased to daily at all of the monitoring probes and any building ports within 100 m of the monitoring probe which exceeded the trigger levels, until there are two consecutive days of undetectable methane concentrations recorded at the monitoring probes. In the event that methane is detected at the building ports the RMOW must be notified immediately as well as the building manager. The building port monitoring will be increased to include all of the buildings in the event that methane is detected in any of the building ports.

The following map displays the location of the gas collection wells, monitoring probes, and buildings that are equipped with monitoring ports.

Gas collection wells are labeled W01 to W13, and the monitoring probes are identified as MP01 – MP21. All of the building complexes that have monitoring ports are also identified, this includes; Road #4, Whitewater Road, Lot 11, Lot 3, Lot 4, Britco Homes, Lots 6 -8, Hostel, Athletes Village, and High Performance Centre.

Table 1 provides the monitoring parameters that should be recorded during each monitoring event.

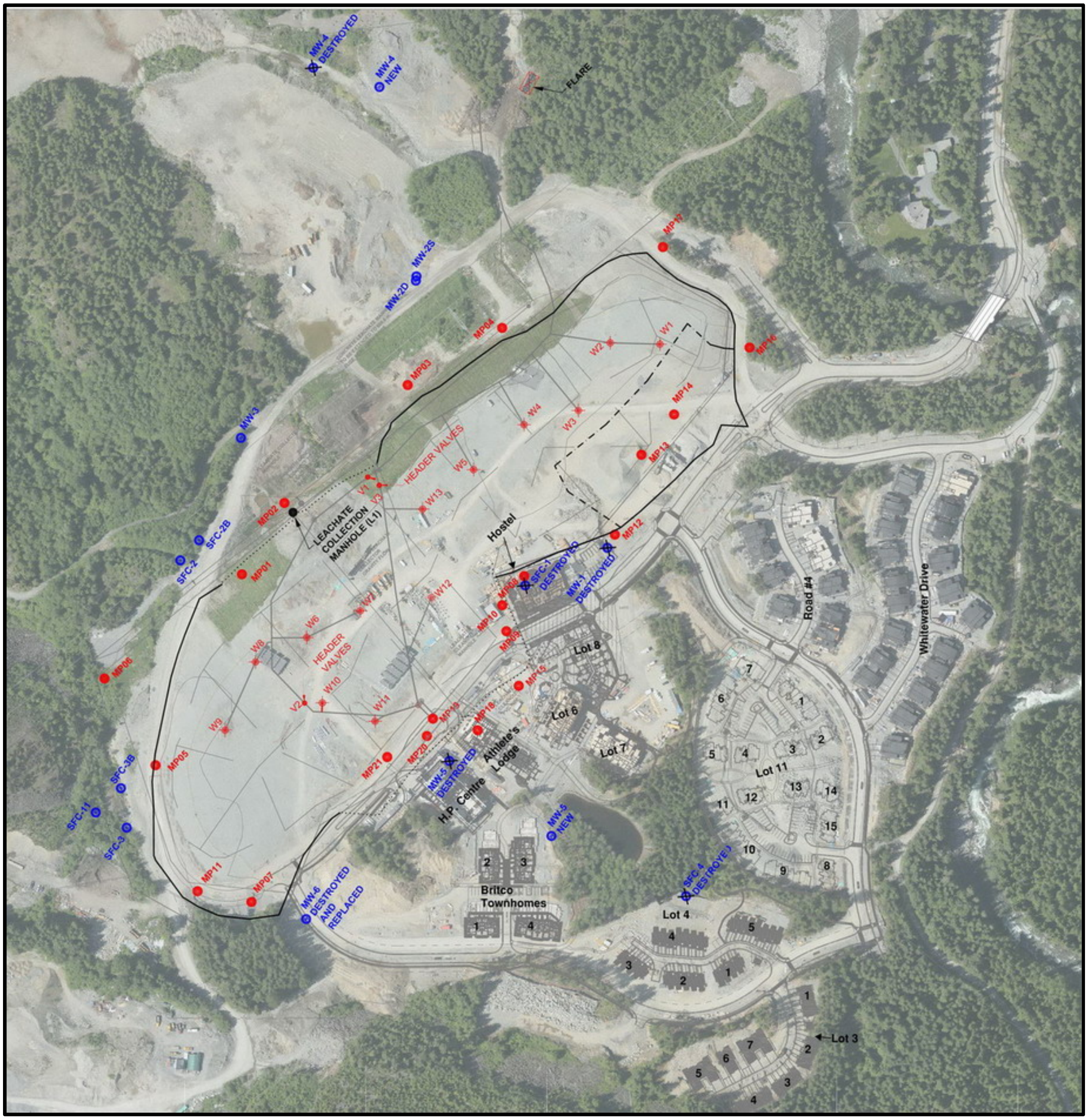


Figure 2. Whistler LFG Gas Well, Monitoring Probe and Building Port Location Map

Table 1. Summary of Monitoring for the LFGCS at the RMOW Landfill.

<table>
<tr><th rowspan="2">Monitoring Program</th><th colspan="4">Landfill Gas</th></tr>
<tr><th>Monitoring Probes</th><th>Collection Wells</th><th>Building Ports</th><th>Flare</th></tr>
<tr><td>Location</td><td>MP-01 to MP-16, and
MP-18 to MP-21</td><td>W01 to W13</td><td>Road #4
Whitewater Road
Lot 11
Lot 3
Lot 4
Lots 6 -8
Britco Homes
Hostel
Athletes Village
High Performance Centre</td><td>Flare Station</td></tr>
<tr><td>Frequency</td><td>- Weekly during months with snowpack on the landfill.

- Monthly months with no snow pack.

- Daily if there is an exceedance of the trigger levels until there are 2 consecutive days with 0% methane.</td><td>- Monthly all parameters excluding water level and temperature.

-Quarterly for water level and temperature.</td><td>- Twice per year collected during the winter months when there is snow pack.

- If trigger levels are exceeded at a monitoring probe, building monitoring shall occur at any buildings within 100 m of that monitoring probe.</td><td>- Weekly during months with snow pack on the landfill.

- Monthly months with no snow pack.</td></tr>
<tr><td>Parameters for Analysis</td><td>- Methane (% by volume)

-The following will be measured only if methane is detected for greater than 2 consecutive samples:

- - Carbon dioxide (% by volume)

- Oxygen (% by volume)

- Hydrogen sulphide (% by volume)</td><td>- Methane (% by volume)

- Carbon dioxide (% by volume)

- Oxygen (% by volume)

- Static Pressure (kPa or inches of WC)

- Differential Pressure (kPa or inches of WC)

- Temperature

- Water level</td><td>- Methane (% by volume)</td><td>- Methane (% by volume)

- Oxygen (% by volume)

Flow (cfm)

- Vacuum (kPa or inches of WC)

- Temperature</td></tr>
<tr><td>Reporting Requirements</td><td colspan="4">Immediately contact the RMOW and lead consultant if MP exceeds trigger level
Immediately contact to RMOW, lead consultant and building manager methane is detected in the buildings
Daily Field Reports (within 12 hours of data collection) to RMOW and lead consultant
Monthly Reports to RMOW and lead consultant
Annual Reports to MOE (only for MP and Building Port data)</td></tr>
</table>

5.6 Reporting Requirements

Reports will be generated daily and monthly with all of the regular field measurements. Monthly reports will also include any recommendations or observations that were noted during the monitoring event(s).

In the event of an exceedance at the monitoring probes daily monitoring reports will include the field measurements as well as management actions to prevent LFG migration.

The reporting requirements are provided in greater detail in Section 8.

6. RECORDS AND DATA FORMS

6.1 Records for Operating Costs

Records should be kept for all operating costs, including power supplied to the system, manpower, and maintenance expenses. Operators may use operating records to establish an acceptable range of operating costs. Maintenance records should be kept to track the overall status of the system. Although maintenance cost will fluctuate over time, a record should be kept to track maintenance cost trends.

6.2 Emergency Reports

Emergency reports should be filed for any of the following reasons:

- Injury sustained by anyone working on the system
- Any condition resulting in emergency evacuation and/or system shutdown

A report should be submitted to WorkSafeBC and copies filed permanently with system records.

6.3 Personnel and Maintenance Records

Personnel records should be maintained for anyone performing operations and maintenance of the LFGCS. All maintenance undertaken on the system should be recorded to provide a permanent record. Any modification to the system that differs from the as-constructed condition should be recorded in the drawing set (Appendix A) and this O&M manual (Using Systems Modification Log, provided in Appendix M). This record should include time and date, problems encountered in the field, and actions taken. Records should be kept in a permanent, sequential file.

7. CONTINGENCY PLAN FOR POTENTIAL FAULT CONDITIONS

7.1 Pollution Release Prevention

The blower/flare system shutdown will occur automatically for fault conditions, as described in the Blower / Flare Troubleshooting Guide (Appendix J). When this occurs, the wellfield will no longer be under vacuum, resulting in potential LFG migration to the surface. LFGCS downtime must be minimized to control LFG.

7.2 Additional Resources in Event of Failure

For long-term shutdowns of the flare system that last longer than 24 hours, the wellfield may need to be valved off. If fault conditions affect only a certain portion of the LFGCS, this area may be isolated by closing the appropriate valves using the following procedure.

- Close each individual wellhead gate valve.
- Once all valves have been closed, slowly close the valves at the manifold valve stations, starting with the station closest to the wellfield and moving down the header pipe toward the flare system.
- Close the manual header valves at the flare skid.

7.3 Corrective Action

Corrective actions may be required to address equipment failure and system alarm conditions resulting in system shutdowns. Corrective action should be undertaken as soon as possible to limit downtime and ensure LFG control. All corrective actions undertaken should be recorded in the operation log for the system. The procedures for shutting down and restarting the system are described in the PEI O&M manual. The Commissioning and Training Plan (Appendix G) outlines procedures for restarting the wellfield following required corrective action, as well as additional information. ThisTraining Plan will be reviewed before re-starting the system.

8. REPORTING REQUIREMENTS

8.1 Daily Reports

During regular monitoring, daily reports will be generated by the Contractor within 12 hours of collecting field data and provided to the RMOW and the lead consultant. The daily reports will include the measurements collected from the wellfield, monitoring probes and flare.

8.1.1 Daily Reports – Monitoring Probe Exceeds Trigger Level

In the event that a monitoring probe exceeds the trigger level, the Contractor will immediately contact the RMOW and the lead consultant to inform them of the exceedance. The daily reports in the event of an exceedance will include:

- Field measurements from all of the monitoring probes;
- Field measurements from the building ports within 100 m of the monitoring probe which exceeded the trigger level; and
- Summary of the management actions to prevent off-site migration.

8.2 Monthly Reports

Monthly reports will be generated and will include all field measurements collected for the month. At a minimum this will include:

- Wellhead measurements;
- Flare measurements;
- Monitoring probe measurements; and
- Any notes or observations made during fieldwork.

The following information should also be recorded if they occurred within the month:

- Summary of exceedances and management actions;
- LFGCS adjustments or optimization efforts;
- Repairs; and
- Shut-downs.

The report will also provide conclusions and recommendations based on the field measurements.

These reports will be provided to the RMOW and the lead consultant for the landfill closure monitoring program within 1 week of the last day of the month to which the report applies.

8.3 Annual Reports

An annual report will be generated for the Ministry of the Environmental that includes the following:

- Methane content at the monitoring probes; and
- Any exceedances of the trigger levels and management activities.

9. OPERATING PERMITS

The Ministry of the Environment Lands and Parks issued Operation Certificate (OC) MR-04693 (Appendix K) under the *Waste Management Act*. The Whistler Landfill must operate as per the conditions of the above-mentioned OC. The conditions for managing Whistler LFG are set out under Section 2.16 of the OC.

Air emission permitting is administered by the Squamish-Lillooet Regional District (SLRD). Based in discussions between RMOW and SLRD before the design and construction of the LFG control system, the RMOW determined that an air emission permit would not be required.

10. REFERENCE LIST

CH2MHill. 2007 Landfill Gas Mitigation and Safety Measures for Reduction of Landfill Gas Migration Risks. Prepared for Whistler 2020 Development Corporation.

Conestoga-Rovers & Associates. 1999. Final Report Vancouver Landfill Gas Management System Project I. September.

Workers Compensation Board of British Columbia. 1998. Occupational Health and Safety Regulations, BC Regulation 296/97. http://www2.worksafebc.com/Publications/OHSRegulation/Regulation.asp Accessed on February 1, 2012.

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APPENDIX A: Landfill Gas Collection System Components

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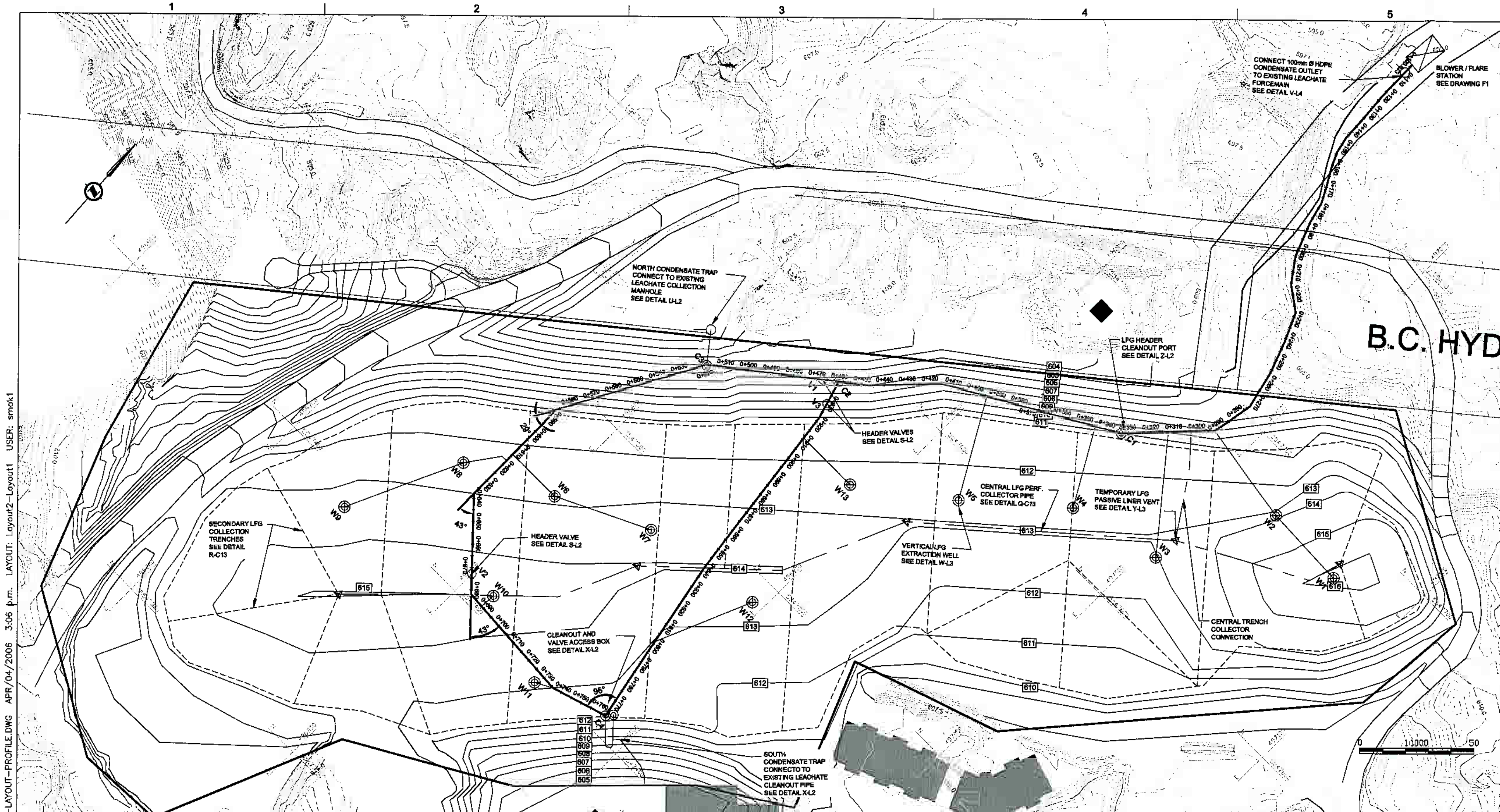

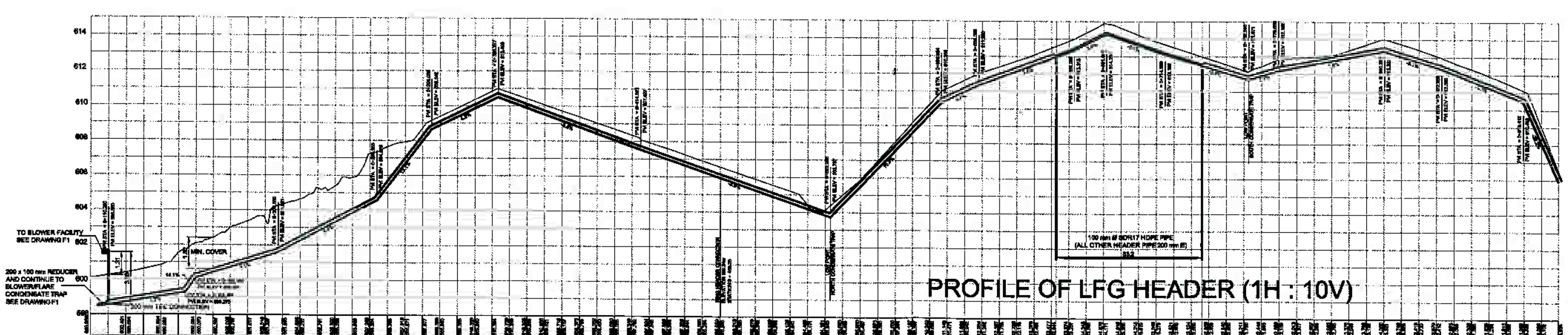

PROFILE OF LFG HEADER (1H : 10V)

LFG COLLECTION SYSTEM INFORMATION TABLE					
ITEM	CONNECTION STATION (m)	X COORDINATE (UTM 10)	Y COORDINATE (UTM 10)	BOTTOM WELL ELEVATION (m)	TOP OF CREST GRAVEL (m)
W1	FROM W2	497066.6013	5547677.3797	606.0	617.0
W2	0 + 292.1	497029.4712	5547676.6126	606.0	614.5
W3	0 + 312.8	497005.4739	5547628.4184	606.0	614.0
W4	0 + 344.8	496964.7547	5547619.0619	609.0	613.7
W5	0 + 384.3	496926.9112	5547584.5429	606.5	613.5
W6	0 + 614.0	496801.4737	5547460.0693	603.0	613.9
W7	FROM W6	496841.6913	5547479.8073	602.0	614.5
W8	0 + 617.8	496762.9923	5547442.0047	606.0	613.5
W9	FROM W8	496739.8880	5547381.2238	606.0	614.4
W10	0 + 688.7	496813.3606	5547410.8216	605.0	616.0
W11	0 + 736.0	496852.7904	5547396.7363	605.5	614.2
W12	0 + 600.9	496895.0567	5547486.0806	603.5	614.4
W13	0 + 510.6	496965.8967	5547555.3420	606.0	613.6
CLEANOUT 1 (C1)	0 + 333.0				
CLEANOUT 2 (C2)	0 + 480.3				
CLEANOUT 3 (C3)	0 + 519.2				
CLEANOUT 4 (C4)	0 + 782.1				
N. CONDENSATE	0 + 519.2				
S. CONDENSATE	0 + 782.1				
VALVE 1 (V1)	0 + 467.2				
VALVE 2 (V2)	0 + 672.9				
VALVE 3 (V3)	0 + 928.0				

NOTES:

- CONTOURS REPRESENT TOP OF GEOMEMBRANE.
- CREST WILL BE COVERED WITH 1,000 mm OF GRAVEL AND 300 mm TOPSOIL.
- SLOPES WILL BE COVERED WITH 600 mm OF GRAVEL AND 300 mm OF TOPSOIL.
- LANDFILL GAS HEADER PIPE WILL BE BURIED 450 mm MIN. BELOW THE TOP OF THE GEOMEMBRANE AND COVERED WITH APROPRIATE FILL.
- LFG WELLS, HEADER VALVES, CONDENSATE TRAPS AND CLEANOUT PORTS MUST PENETRATE LINER USING APPROPRIATE BOOT SEALS AND BE ACCESSIBLE FROM THE AS PER THE DETAILS.
- CONTRACTOR MUST RESPECT THE PIPE SLOPES AND ALIGNMENT.

- CLEANOUT PORT
- LFG EXTRACTION WELL
- LFG HEADER VALVE
- CONDENSATE TRAP
- TEMPORARY PASSIVE LINER VENT

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — M. S. BUDZIK

DSGN	M. PITRE						
DR	S. MAK	C	04-06-06	ISSUED FOR TENDER	MP	--	
CHK	M. BUDZIK	B	03-27-06	90% COMPLETION	MP	--	
		A	03-03-06	50% COMPLETION	MP	--	
APVD	C. SMITH	NO.	DATE	REVISION	BY	APVD	

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LANDFILL CLOSURE AND
LANDFILL GAS CONTROL SYSTEM

CIVIL

LFG EXTRACTION WELL LOCATIONS AND COLLECTION TRENCH LAYOUT

SHEET	17
DWG	L1
DATE	APR 2006
PROJ	335612

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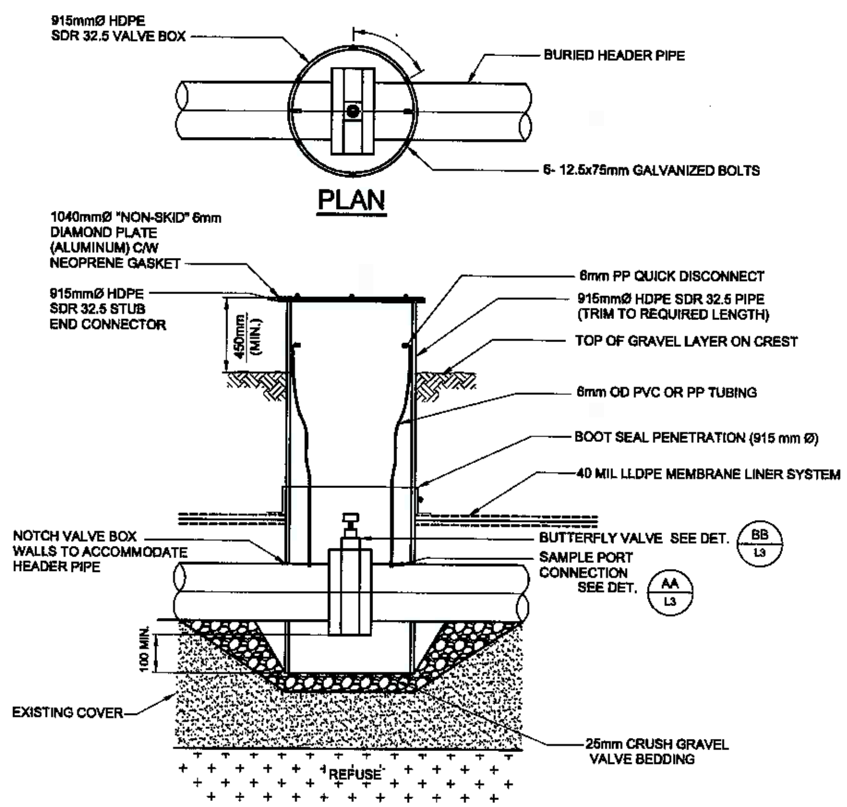
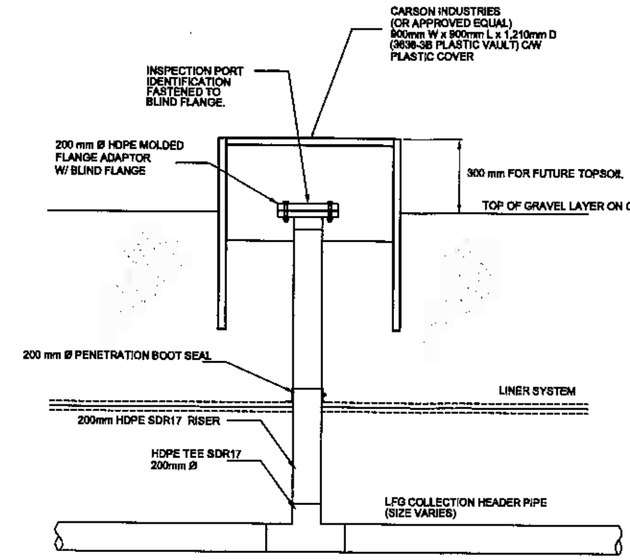


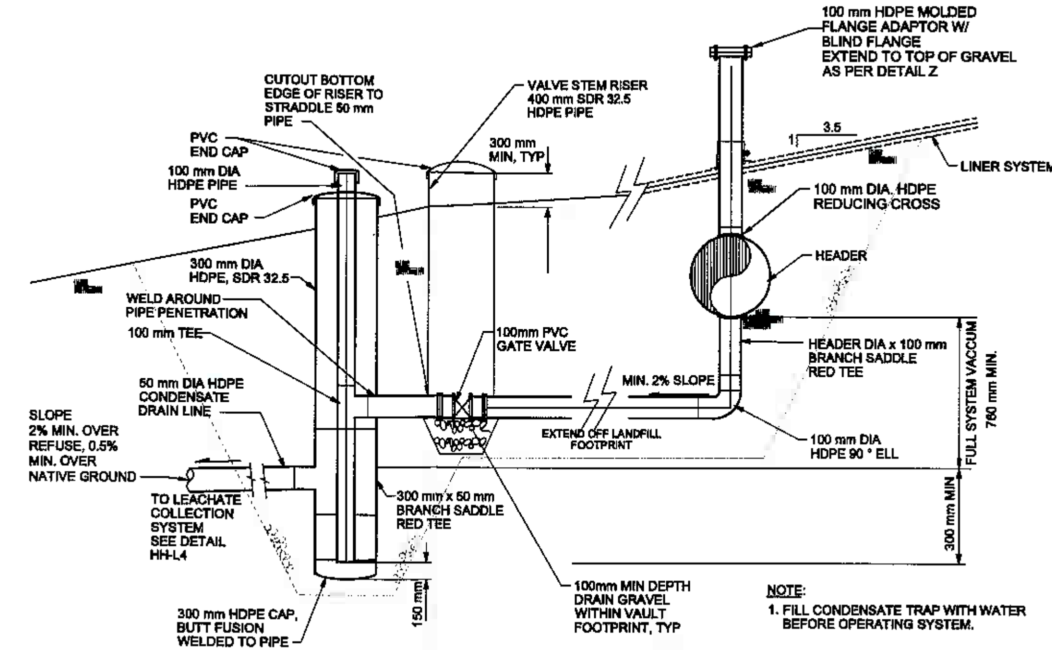
HEADER CONTROL VALVE SECTION (S / L1)

SCALE NTS



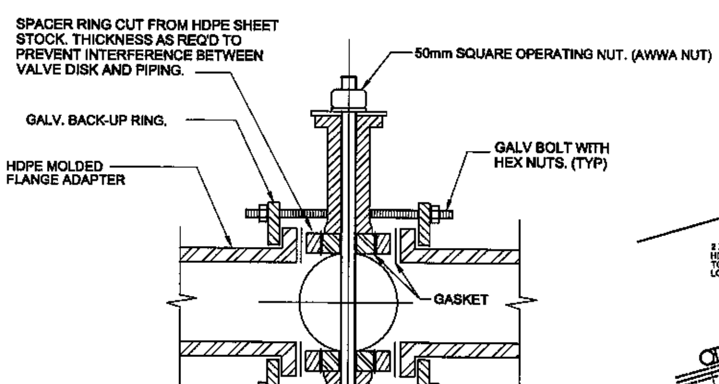
INSPECTION / CLEANOUT PORT (Z / L1)

SCALE NTS



NORTH CONDENSATE TRAP A DETAIL (U / L1)

NTS

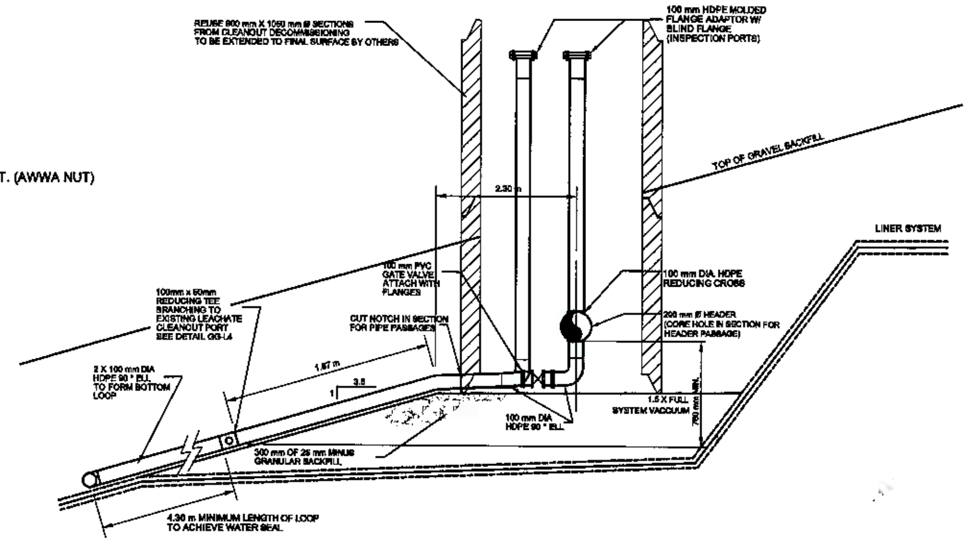


NOTES:

1. PROVIDE SPACER RINGS AS NECESSARY BETWEEN VALVE FACE AND MOLDED FLANGE ADAPTER SO THAT PIPE WALL DOES NOT INTERFERE WITH VALVE OPERATION.

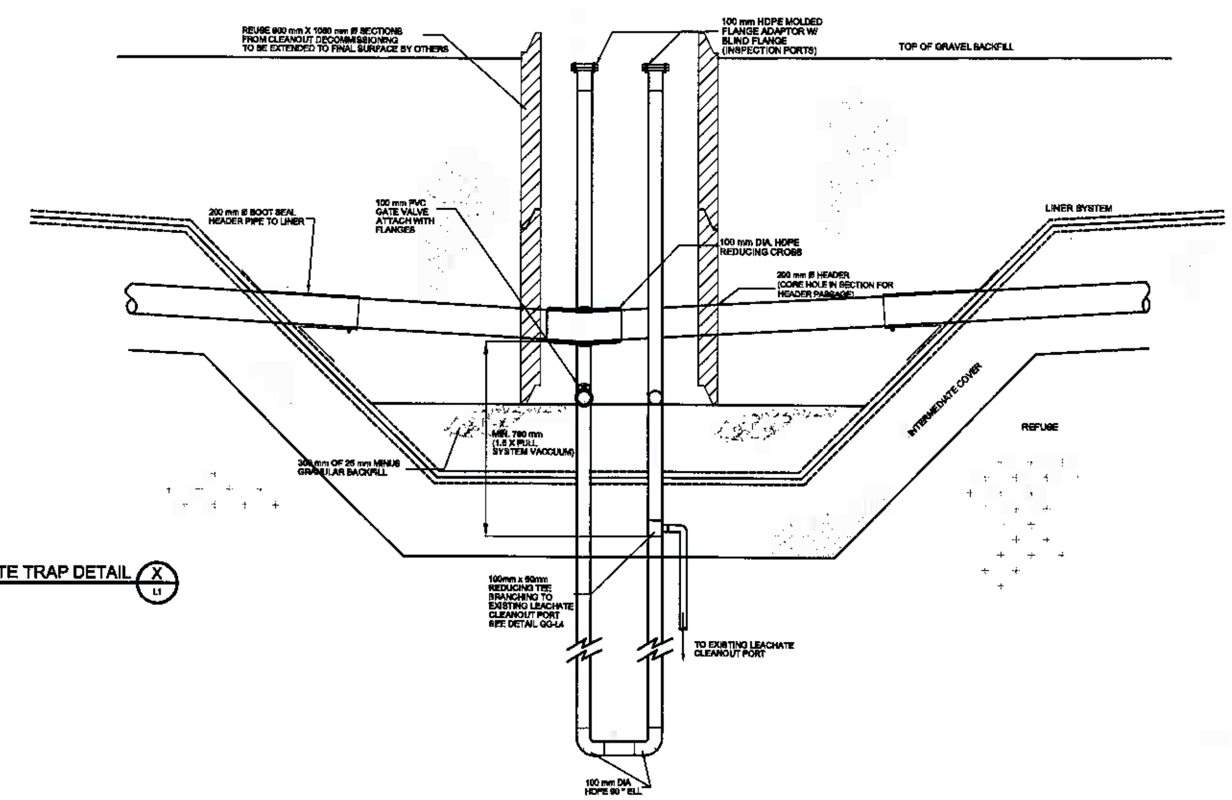
BUTTERFLY VALVE INSTALLATION (BB / -)

SCALE NTS



SOUTH CONDENSATE TRAP DETAIL (X / L1)

SCALE NTS



DSGN	M. PITRE					
DR	S. MAK	C	04-06-06	ISSUED FOR TENDER	MP	..
CHK	M. BUDZIK	B	03-27-06	90% COMPLETION	MP	..
		A	03-03-06	50% COMPLETION	MP	..
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LANDFILL GAS CONTROL SYSTEM

MECHANICAL

LFG SYSTEM DETAILS

SHEET	18
DWG	L2
DATE	APR 2006
PROJ	335612

PROFESSIONAL PROVINCE OF BRITISH COLUMBIA M. S. BUDZIK ENGINEER

P:\WHISTLERRESORTMUNIOF\335612LANDFILCLOSURE\001-CAD\TENDER-WORKING\DETAILS-MP.DWG APR/04/2006 3:05 p.m. LAYOUT: LFG SYSTEM_1 USER: smak1

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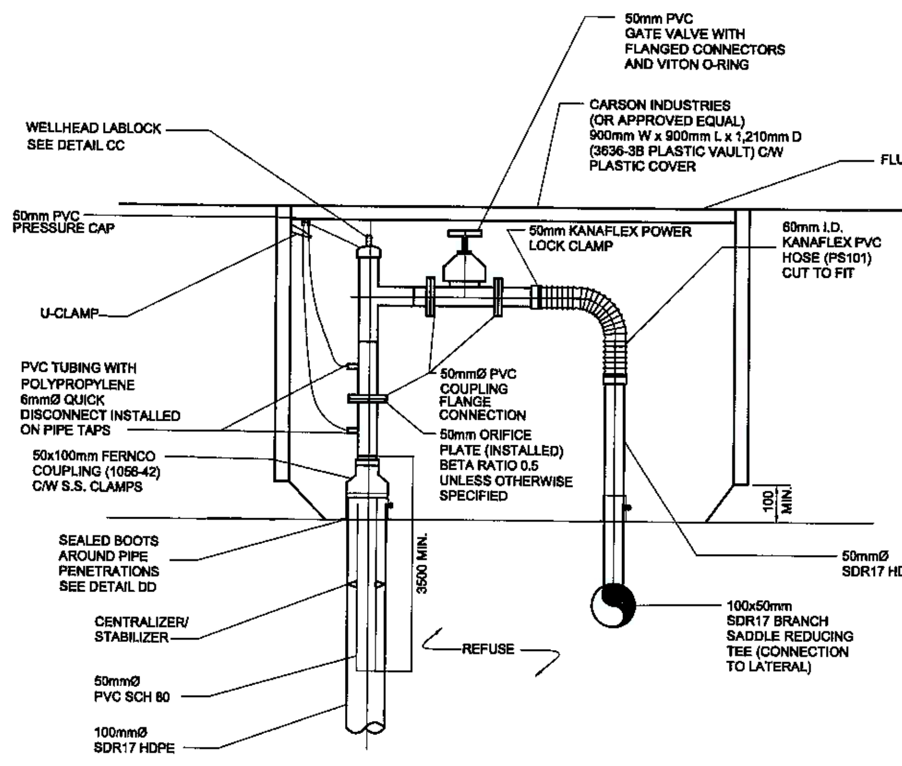


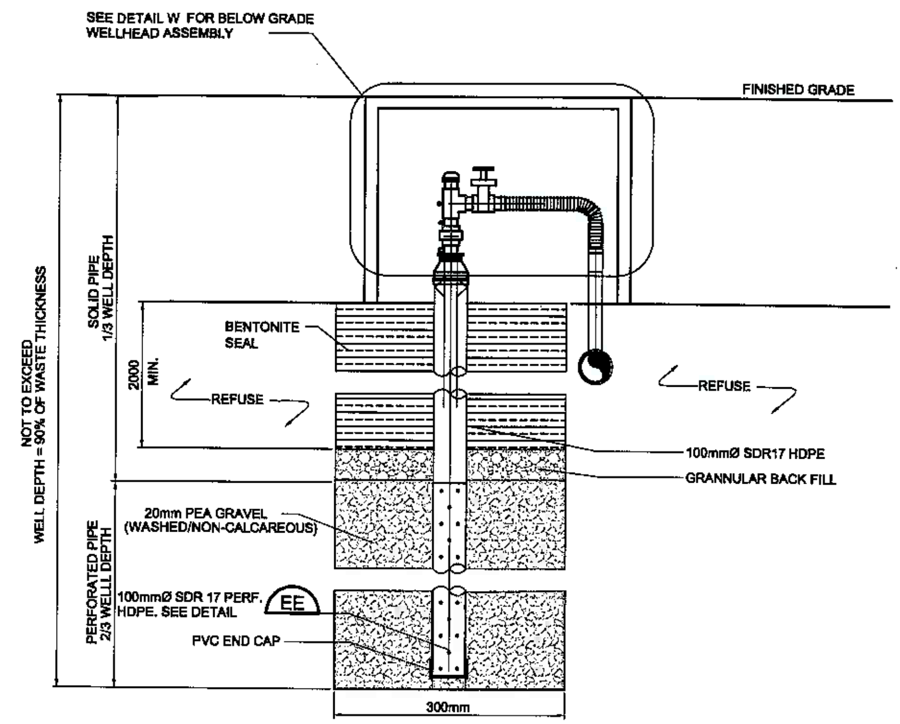
NOTES:
1. WARNING LABEL ON HATCH.

DANGER
COMBUSTIBLE GAS
HYDROGEN SULPHIDE GAS
OXYGEN DEFICIENCY

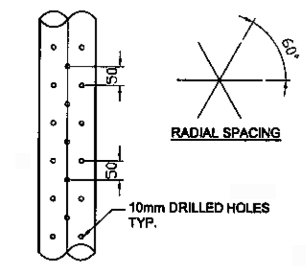
2. PIPE INSULATION NOT SHOWN FOR CLARITY. INSULATE ALL PIPING TO TOP OF MEMBRANE.
3. WELL LABEL ON HATCH

WELL ID
X-XX

BELOW GRADE WELLHEAD DETAIL TYPE B (W / L1)
N.T.S.

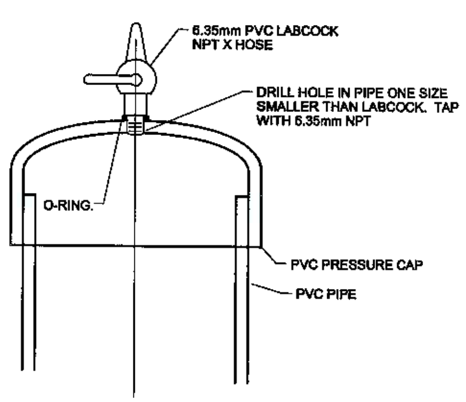


LFG COLLECTION WELL (W / L1)
N.T.S.



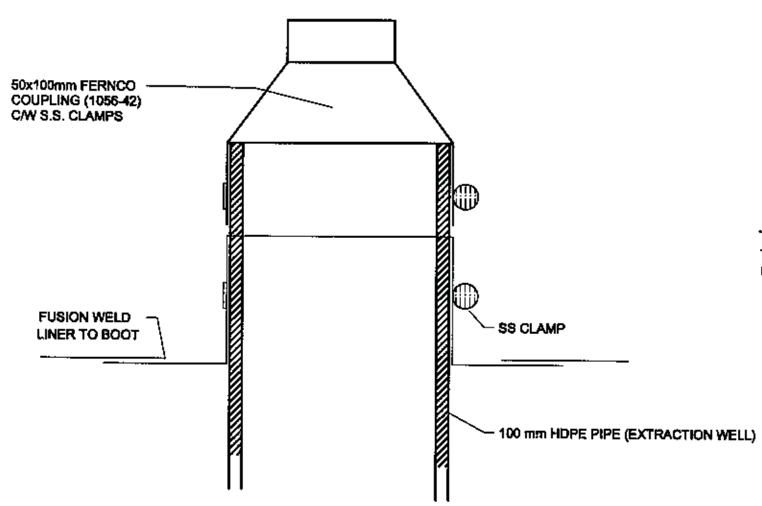
NOTE: NO FIELD CUTTING ALLOWED. PIPE SHOULD BE PERFORATED BY MANUFACTURER OR CONTRACTOR BEFORE DELIVERED TO SITE.

PERFORATION DETAIL (EE / -)
SCALE N.T.S.



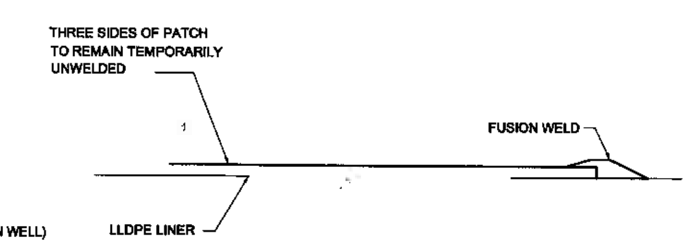
WELLHEAD LABCOCK DETAIL (CC / -)
SCALE N.T.S

NOTES:
1. USE TYPICAL 100 mm Ø BOOT AS PER LINER SUPPLIER.
2. BOOT TO BE FUSION WELDED TO MEMBRANE.
3. PIPE TO BE SECURED TO BOOT USING STAINLESS STEEL CLAMPS.



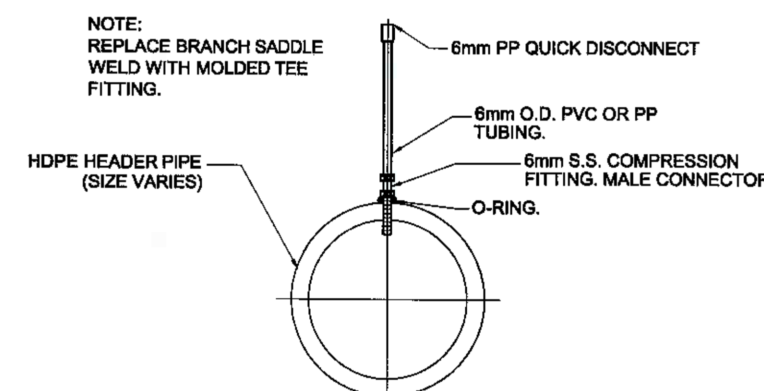
SEALED BOOT DETAIL (DD / -)
SCALE N.T.S.

NOTES:
1. CUT 100 mm Ø HOLE IN LINER SYSTEM WHERE INDICATED.
2. INSTALL TEMPORARY FLAP BY FUSION WELDING ONE SIDE ONLY.
3. ONCE EXTRACTION SYSTEM COMPLETE, FUSION WELD REMAINING SIDES TO CREATE PATCH, COVER WITH NON WOVEN GEOTEXTILE AND BACKFILL WITH APPLICABLE MATERIAL.

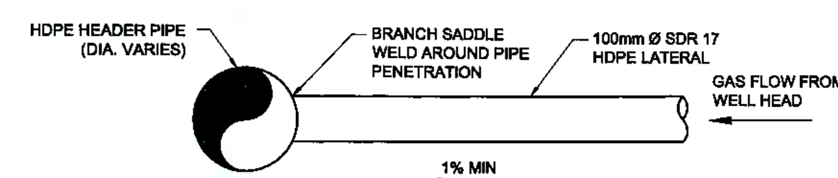


TEMPORARY PASSIVE VENT DETAIL (Y / L1)
SCALE N.T.S.

NOTE:
REPLACE BRANCH SADDLE WELD WITH MOLDED TEE FITTING.



SAMPLE PORT CONNECTION (AA / L2)
SCALE NTS



TYPICAL LATERAL TIE-IN TO HEADER
SCALE N.T.S.

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CHK	M. BUDZIK	B	03-27-06	90% COMPLETION	MP	..
		A	03-03-06	50% COMPLETION	MP	..
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LANDFILL GAS CONTROL SYSTEM

MECHANICAL
LFG SYSTEM DETAILS

SHEET	19
DWG	L3
DATE	APR 2006
PROJ	335612

P:\WHISTLERRESORTMUNIOF\335612LANDFILCLOSURE\001-CAD\TENDER-WORKING\DETAILS-MP.DWG APR/04/2006 3:05 p.m. LAYOUT: LFG SYSTEM_2 USER: smak1

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APPENDIX B: System Operating Information

SYSTEM OPERATION INFORMATION

A. FLARE START SEQUENCE

Turn the System on in "AUTO" mode. To do this, turn the SYSTEM, PILOT, BLOWER, SHUTDOWN VALVE, and SURGE CONTROL VALVE switches to "AUTO". The PLC first checks to see that the Run Clock is enabled. If so, it delays 3 seconds and then the Pilot lights. As the Pilot is started, the Blower delay timer starts. After the respective delay timers time out, the Blower starts and the Shutdown Valve opens. The Valve open delay timer should be set to let the Blower build some pressure before the valve opens. This timer should be adjusted to produce a quiet and smooth Flare startup. After the Landfill Gas starts burning, the Flare thermocouple will recognize the flame. Once the temperature exceeds the low flare temperature Setpoint, usually 200 °F, the system will be running in automatic mode. Should the temperature ever drop below this Setpoint after the pilot times out, the Flare will shut down. The Flare will then restart after the downtime timer times out. If the Flare does not restart, the restart process will repeat until the relight counter reaches its Setpoint. If this Setpoint is reached, the system will shut down on flame fail. Whenever the temperature exceeds the low temperature Setpoint, the relight counter is reset to zero.

B. DEMISTER

When the system is first started up, the demister should be inspected every couple of days. Isolate the demister, remove the inspection plate, and inspect the bottom for debris to help protect the condensate drain line from plugging. When the system Is running at its normal flow rate, make note of the pressure drop across the demister pad. As time goes on and the pad gets dirty, this pressure drop will rise. When the pressure drop reaches twice the original value, the demister pad must be cleaned. Isolate the demister from the gas, remove the top plate, and spray the pad with high-pressure water from the top. If high-pressure water is not available at the site, the pad can be removed out the top of the demister. Spray the pad with high-pressure water in the direction opposite of gas flow. This pad should not have to be replaced.

C. MAINTAINING GAC TEMPERATURE AND PRESSURE

The Gas Analysis Cabinet (GAC) is designed to maintain the sample gas at a constant temperature and pressure. The internal pressure is controlled at 0.2 In WC (+/- 0.2 In WC) across the oxygen-sensing element via two regulators (upstream & downstream). Pressure may be checked at the sample port directly below the oxygen sensor with a suitable manometer. This pressure is factory set and is not adjustable by the end user.

GAC temperature is controlled by the PLC via Setpoints entered in the Touchscreen along with a manual rheostat in the control cabinet. The rheostat provides a constant current to the GAC heater that prevents on/off cycling to increase heating element service life. It is important for cabinet temperature to remain constant year round. If the GAC temperature exceeds the Setpoint value in the summer months turn the rheostat knob to a lower value (counterclockwise). If the GAC temperature still remains above Setpoint, raise the Setpoint to a reasonable value above maximum ambient temperature for your region and re-calibrate the oxygen sensor at that temperature. If the GAC temperature remains below the Setpoint value in the winter months, turn the rheostat to a higher value (clockwise). Make rheostat value changes in small increments and allow sufficient time between changes for GAC temperature to stabilize (typically 30 minutes).

D. GAC CALIBRATION

Your Gas Analysis Cabinet is equipped to allow calibration of the oxygen sensor with relative ease. If you have changed the operating temperature of the GAC or reached a specified calibration interval, then perform the following procedure to ensure the oxygen reading on your system touchscreen and recorder are accurate.

Initial Conditions:

1. Gas Handling System is operating with flow through system (blower running, shutdown and inlet valves open).

2. Operating Manual with Flare Station P&ID at hand for reference.

3. Ensure pilot propane tanks are full and valved in.

4. Oxygen Calibration Setpoint touchscreen is selected to perform the calibration.

Oxygen Sensor Calibration:

1. Turn the GAC Calibrate switch on main control panel to ON position.

2. Isolate the oxygen sensor by closing the blower outlet sample valve (HVP-304) at the blower discharge pipe.

3. Open the GAC calibration valve (HVP-303) to let air draw through the sensor. Once the "Oxygen Sensor Input" stabilizes, push the "20.9% O2" calibrate button (the right one) to record the sensor's input at 0.0% O2.

4. Now connect a propane sample hose from HVP-309 to the calibration sample valve HVP-303 and open HVP-309 to allow propane to flow through the sensor. Allow sufficient time for the propane to fill the GAC lines and the reading to stabilize on the touchscreen. Push the 0.0% O2 calibrate button (the left one) and your sensor is now calibrated.

E. MASS FLOW

The specific gravity can be manually entered on the Touchscreen or calculated by the PLC. When calculating, the PLC uses the elevation, the inlet gas temperature, and the vacuum analog signals to calculate the %H_2O in the LFG. Then the PLC uses the analog or manual input values for %CO_2, %O_2, and %CH_4 values and assumes the rest of the LFG is N_2. If the N_2 calculates to be negative, the PLC will use the manual input of Specific Gravity in the calculation of flow rate (SCFM), and N_2 will read "0.0". This will create a Specific Gravity Calculation Error Alarm on the Touchscreen. If this system does not include a Gas Analysis Cabinet, obtain the manual input values for %CO_2, %O_2, and %CH_4 from a GEMS instrument. Also, in lieu of analog signals, use the various pressure and temperature gauges on the skid and at the Flare for the manual inputs on the Touchscreen.

F. RUN CLOCK

To run the system continuously, the Start Time must be set to "00.00" and the On Cycle Duration to "1440". When set at these Setpoints, the Off Cycle Duration and Number of Cycles are not used. If the On Cycle Duration is set to less than "1440", the system will cycle on and off according to the settings. Unless the system is set to run continuously, the system will never run between midnight and the Start Time of Day.

APPENDIX C: Balancing Guide

Considerations:

- Methane content is to be measured at gas extraction wellheads, manifold valve and flow stations, and the flare system inlet using a Landtec GEM2000 gas analyzer
- Oxygen concentration in LFG should be maintained below 2%

EXHIBIT C-1
Balancing Guide

Condition Observed[1]	Possible Cause of Condition	Desired Outcome	Action to Undertake[2]	Effect of Action
Low methane (<40%) High oxygen (>2%)	Air intrusion, zone of influence extends beyond the refuse	Decrease oxygen	Throttle wellhead valve back.	Reduces well pressure and zone of influence
High methane (>55%) Very low oxygen (<0.2%)	Influence of well may not be maximized	Increase zone of influence	Open wellhead throttle valve.	Increases vacuum at well and zone of influence collecting more gas
Vacuum and gas flow surging at wellhead	Liquid accumulation in header or lateral piping	Reduce liquid accumulations to restore consistent vacuum application and steady gas flow	Identify location of liquid accumulation. Re-grade effected portion of pipeline, or install additional condensate management traps.	Restores proper drainage of condensate
No vacuum available, no gas flow measured at wellhead	Header isolation valve may be closed or possible obstruction in the header or lateral pipelines	Restore vacuum and gas flow	Verify all header isolation valves are open; identify potential location of blockage.	Removes flow obstruction

Notes:

1. Low Methane: less than 40% by volume
   High Oxygen: concentration of more than 2%
   High Methane: more than 55%
   Very Low Oxygen: less than 0.2%
2. Refer to Appendix A for valve locations and details

APPENDIX D: Blower / Flare Maintenance Schedule

MAINTENANCE SCHEDULE

FREQUENCY		CHECK
Daily	A.	Fill out the Flare Station Data Log.
	B	Visually inspect unit - repair any breaks, leaks, and loose wires.
	C.	Follow all Manufacturers' Recommendations in Section 7.
	D.	Test Lamps by pushing the RUN Lamp and the ALARM/SHUTDOWN Lamp.
Two Months	A.	Lubricate Blower(s) per Blower Manufacturer's instructions.
Three Months		Turn flare off and perform the following procedures:
	A.	Check ignitor gap - Verify that the ignitor gap is 0.100". Regap as necessary. Verify that the spark is at the tip of the ignitor.
	B.	Inspect Ignitor Wiring - Examine the wire which runs between the ignition transformer on the flare and the ignitor in the pilot for frayed, heat damaged, or worn insulation.
	C.	Check Pilot - With the SYSTEM switch in the "ON" position turn the PILOT switch to the "TEST" position. Verify that the pilot lights and does not blow out. Return the PILOT switch to the "AUTO" position.
	D.	Check Thermocouple Voltage - After the flare has been off for at least 1 hour, open the breaker, then open the control panel and the swing panel. Locate the appropriate Thermocouple Input Module. Measure the voltage between the red and yellow wires of FLR-TE-501 and convert that voltage to temperature using the Type K Thermocouple Chart in Section 6. The readings should be within 25 °F of ambient temperature. Call PEI if a greater discrepancy exists. Close the swing panel and the enclosure door, then close the disconnect.
	E.	Check Flare Shutdown Valve FV-301 - With the SYSTEM switch in the "ON" position, turn the SHUTDOWN VALVE switch to the "TEST" position. As the valve opens, verify the "OPEN" lamp lights on the Touchscreen. After the valve has reached the full open position, turn the FLARE SHUTDOWN VALVE switch to the "CLOSED" or "AUTO" position and verify that the valve closes in less than 2 seconds. Return the valve switch to the "AUTO" position.
	F.	Check Blower(s) - Turn the BLOWER switch to the "TEST" position. Verify that the selected blower starts smoothly and operates properly. After the blower has ramped to maximum speed, turn the BLOWER switch to the "AUTO" position and verify that the blower stops properly. Turn the BLOWER SELECT switch to the other blower and repeat test.

G. Zero out the pressure, delta pressure, and vacuum gauges by closing off the valves in the gas lines to the gauges and opening the valves in the tees to atmosphere. Adjust the zeroing screw until the needle points to zero.

H. Remove the blind flange inspection port on the demister and remove any debris that has collected.

I. If the pressure drop across the demister reaches two times it's original value, open up the top of the demister and pull out the element. There is a handle at the top that is attached to the demister element. Hose the element down opposite of landfill gas flow with high pressure water and put it back in the demister container.

J. Test the pilot fail shutdown by turning off the propane and starting the system. The system should shut down after the Pilot On Timer Setpoint times out.

K. Test the flame fail shutdown by closing the manual inlet valve while the system is running and after the pilot has turned off. The system should shut down in a few seconds.

Annually Shut the Flare down and perform the following checks:

A. Check for loose bolts on the structure and at the flanges.

B. Check the configuration sheets for the Chart Recorder against the actual settings to make sure they have not been altered.

APPENDIX E: Landfill Gas Collection System Information Table

EXHIBIT E-1
Landfill Gas Collection System Information Table

Item	Connection Station (m)	X Coordinate (UTM 10)	Y Coordinate (UTM 10)	Bottom Well Elevation (m)	Top of Crest Gravel (m)
W1	From W2	497066.6013	5547677.3797	606.0	617.0
W2	0 + 292.1	497029.4712	5547678.6126	606.0	614.5
W3	0 + 312.6	497005.4739	5547628.4184	606.0	614.0
W4	0 + 344.8	496964.7547	5547618.0819	606.0	613.7
W5	0 + 394.3	496926.9112	5547584.5429	606.5	613.5
W6	0 + 614.0	496801.4737	5547460.0563	603.0	613.9
W7	From W6	496841.6913	5547479.8073	602.0	614.5
W8	0 + 617.8	496762.9923	5547442.0047	606.0	613.5
W9	From W8	496739.9690	5547391.2239	605.0	614.4
W10	0 + 688.7	496813.3906	5547410.5215	605.0	616.0
W11	0 + 736.0	496852.7904	5547396.7363	605.5	614.2
W12	0 + 800.9	496895.0557	5547489.0906	603.5	614.4
W13	0 + 910.8	496888.5957	5547555.3420	605.0	613.6
Cleanout 1 (C1)	0 + 333.0				
Cleanout 2 (C2)	0 + 460.3				
Cleanout 3 (C3)	0 + 518.2				
Cleanout 4 (C4)	0 + 762.1				
N. Condensate	0 + 518.2				
S. Condensate	0 + 762.1				
Valve 1 (V1)	0 + 467.2				
Valve 2 (V2)	0 + 672.9				
Valve 3 (V3)	0 + 929.0				

APPENDIX F: Vendor Data List

EXHIBIT F-1
Vendor Data List

Equipment	Details	Address	Telephone
Suction Flex Hose	Spiralite 125	Pacific Echo, Inc 23540 Telo Avenue Torrance, CA 90505	800.421.5196
		Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
	PVC Pipe Size Spiralite 124-PS	Kanaflex Corporation 750 West Manville Compton, CA 90220	310.637.1616
Gate Valves - PVC	Spears Model 2032-020	Spears Manufacturing Co. 3902 B Street Auburn, WA 98002	253.939.4433
		Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
TVI Butterfly Valve Gear-Operated	BFPXOVVWMG	Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
TVI Butterfly Valve Lever Handle	BFPXOVVWML	Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
Ball valves -- SS316	K-150 UTBZM 2", Class 150 Stainless Steel 316	Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
Labcocks Universal StopCocks	Hayward LC12 1/4" PVC	Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
Utility Box Extra Large Utility Box	Ametek 195103	Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
Silicon tubing	MasterFlex 96410-17 (platinum-cured) wall thickness 1.5mm (MasterFlex 96410-24 has 3.5 mm wall thickness)	LabCor - Cole Parmer	800.363.5900
		Fred Surridge 11871 Machrina Way Richmond, BC V7A 4V3	604.271.1341 Gord
Cable chordgrip for holding pitot tubes (for mounting pitot tubes)	Hubbell cordgrip Model SHC1022CR (catalogue 2000, page L-92) 0.25 - 0.38 inches Colour code - white	Nedco 4455 No 6 Road Richmond, BC V6V 1P8	604.273.2244

EXHIBIT F-1
Vendor Data List

Equipment	Details	Address	Telephone
Pitot Tubes	ERW SS316 instr tubing wall thickness 0.010" radius of bend <1" See Figure 2-5	Marcon Metalfab Inc. 12371 No 2 Road Richmond, BC V7E 2G3	604.275.0114 Airie
Epoxy-Coated Backup Flanges	3M ScotchKote 206N can supply 2-part paint	Robar Industries Ltd 12945-78 Avenue Surrey, BC V3W 2X8	604.591.8811 Blair
HDPE Pipe and Fittings	Various	Pacific Poly Pipe 9515 - 195th Street Surrey, BC V4N 4G3	604.513.8197 Gord Carver
PVC Pipe and Fittings	Various	Pacific Poly Pipe 9515 - 195th Street Surrey, BC V4N 4G3	604.513.8197 Gord Carver
PVC Pipe and Fittings	Alternate	BCG Services (International Plastics) 2691 No 5 Road Richmond, BC V6X 2S8	604.273.4987
Wellhead Supports	PowerStrut	Mueller Flow Control 7168 Progress Way Delta, BC V4G 1H2	604.940.1449 Jason
Touch Up Paint for flare combustors	Sandblast to SSPC-SP6 Sherwin Williams Flametrol 850 (2-3 mils DFT) Colour grey, black on top (drawing DG-00562-301)	Sherwin Williams #7 - 7047 Venture Delta, BC	604.940.9868
Skid Flare System	Blowers Candlestick flare components	Perennial Energy 1375 County Road 8690 West Plains, MO 65775	417.256.2002 417.256.2801
Landfill Gas Monitors	GEM™2000 Plus gas hose fittings	CES - Landtec 850 South Via Lata, Suite 112 Colton, CA 92324	301.391.6545 201.651.9669
Environmental Equipment	Multi-Gas Monitors Groundwater sampling supplies	Pine Environmental Services Inc. #117 – 3989 Henning Drive Burnaby, BC V5C 6N5	1-877-678-8383 604-678-8300 604-678-8302

APPENDIX G: Commissioning and Training Plan

Commissioning and Training Plan

Commissioning Plan

Final Inspection

Final inspection of the landfill gas control system (LFGCS) shall include the following:

- **Blower/Flare Station:** Inspection of the blower/flare station will take place with the assistance of a Perennial Energy Inc. (PEI) consultant. Operation and maintenance (O&M) personnel should be present during the initial blower/flare station inspection to ask questions about equipment and any other concerns related to the blower/flare station.
- **Removable cap** that allows unobstructed access to the bottom of the well for measuring water levels (optional)
- **Quick-disconnect ports** that measures temperature and pressure in the
- The **gate valve**
- The **flex hose** connecting the wellhead to the collection lateral

Pre-Startup Safety Meeting

A startup meeting shall be convened to discuss the following items related to startup of the system:

- **Emergency Equipment Locations:** Fire extinguishers, first-aid kit.
- **Resources, Communications:** Location of telephones, telephone numbers, alarm sounds/signals, pre-determined assembly area in the event of evacuation.
- **Protective Gear:** Dispense all necessary equipment, including: hard hat, reflective vest, footwear (if necessary), etc.

Initial Wellfield Adjustments and Monitoring

NOTE: For startup of the system, a PEI technician must be on hand to assist in determining process settings. A range of operations will be explored during performance testing. The following procedure is suggested as a start point to adjust the wellfield for initial operation. Monitoring will need to take place during the initial adjustment to ensure that operating parameters have been achieved prior to startup of the blower/flare station.

1. There is one flow control port and several monitoring ports located along the header pipe. Make sure that the gate valves at these locations are closed.
2. Beginning with South Area, open the gate valves at wellhead locations (W13, W12, W11, W10, W7, W6, and W8) to 50%, and fill the condensate trap with water (North and South Condensate Trap C3 and C4). Several qualified operators may perform this task at once to minimize start-up time. Monitoring at this point shall consist of measuring pressure

and temperature at the location of the flow control and monitoring port (located at the southern area). Operating parameters are given below. Allow 30 minutes for the system to reach equilibrium, then measure the following parameters:

- **Pressure:** Pressure should be less than 80 kPa (10 psi) for all parts of the system before initial start of the blower/flare station.
- **Temperature:** Temperature must be maintained below 54°C (130°F)
- **Methane Content:** Methane should be greater than 40%.

If operating parameters have stabilized, proceed to the next step. If parameters have not stabilized, test again in about 1 hour. If the well is still not within range, close the well.

3. Proceed to the North Area, and open the gate valves at wellhead locations W5, W4, W3, W2, and W1 to 50%. The procedure for monitoring is the same as with the South Area. The flow control and monitoring port for this area is located at the Blower/Flare station adjacent to the header pipe
4. Return to the flow control and monitoring port on the Flare System, and open the hand-operated butterfly valve 50%. Perform monitoring tasks described in Step 2.

Blower/Flare System Startup

Once the system has stabilized, the next step is to throttle the butterfly valves at the inlet to the blower to provide a steady stream of LFG to the Blower/Flare Station. This procedure requires coordination with the Blower/Flare Station startup. It is recommended that two teams perform these duties: one team led by the PEI consultant at the Blower/Flare Station, and another team of qualified operators monitoring the operating parameters along the header pipe.

The PEI technician will determine whether operating parameters and conditions are favorable for system start-up. Several relevant items include:

- Initial settings
- Adjustments during startup
- Troubleshooting

As part of the agreement with PEI, performance testing shall be conducted onsite over a continuous 48-hour period. During this time, both the system operators and a PEI technician will identify successful process settings that can accommodate normal variability in the input. These items should be recorded for inclusion in the O&M Manual.

Blower/Flare System Failure Mode Testing

Failure mode testing should be conducted at the conclusion of the 48-hour test period. Testing of failsafe devices will be performed at the discretion of the PEI technician. All failure modes must be tested before the conclusion of the test period.

Commissioning Records

Records should be kept for all adjustments made to the system during the first 48 hours of operation. Valve throttling should be recorded, along with corresponding operating parameters. These records should be kept in a permanent file and for use in updating the O&M Manual, as necessary.

Post-commissioning Operation and Maintenance

After wellfield commissioning and blower startup, the wellfield will require monitoring and adjustment, as described in the O&M Manual, Section 2.1. Daily monitoring and wellfield adjustment for the first 3 days of operation should be conducted to balance the wellfield.

Training Plan

Training Session Curriculum and Personnel

One-day Wellfield Adjustment Training

To be administered by CH2M HILL prior to initial startup, the wellfield training shall cover the following topics:

- Wellhead components
- Valve throttling
- Monitoring velocity and flow
- Balancing wellhead for primary operating parameters

One-day Blower/Flare System Training

To be administered by a PEI consultant prior to initial startup, the blower/flare system training shall cover the following topics:

- Control panel basics
- Startup/shutdown procedures
- Failsafe mechanisms
- System maintenance

Landfill Gas Fundamentals

O&M personnel must have a good understanding of LFG, including basic chemical properties and safety precautions.

LFG is normally composed of (ref., Solid Waste Association of North America [SWANA]):

- Approximately 45 to 58% methane
- Approximately 32 to 45% carbon dioxide
- 10 to 200 parts per million (ppm) of hydrogen sulfide
- Trace amounts of Volatile Organic Compounds (VOCs) and other organic and inorganic gases

Methane is combustible and explosive at concentrations of 5 to 15% by volume in air. Some of the trace gases, including VOCs, are toxic. The U.S. Environmental Protection Agency

(EPA) characterizes methane concentrations above 25% of methane's lower explosive limit (LEL), around 1.75% by volume, as dangerous.

Other constituents have been found in the LFG at the Whistler Landfill. These include hydrogen sulfide, tetrachloroethene, ethyl benzene, toluene, and xylenes. Exhibit G-1 presents information on exposure to these chemicals.

EXHIBIT G-1
Chemical Exposure Information
(Data Source: Final Report Vancouver Landfill Gas Management System Project I; Conestoga-Rovers & Associates, September 1999)

Contaminant	Exposure Limit[1]	IDLH[2]	Symptoms and Effects of Exposure	PIP[3] (eV)
Hydrogen Sulfide	10 ppm[4]	100 ppm	Irritation of the eyes and respiratory system; shortness of breath, coma, convulsions, conjunctivitis, eye pain, tearing, photosensitivity, corneal vesiculation; dizziness, headache, fatigue, irritability, insomnia, gastrointestinal disturbances	10.46
Ethyl Benzene	100 ppm	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Tetrachloroethylene (PCE)	25 ppm	150 CA	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
Toluene	50 ppm	500	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82
Xylene	100 ppm	900	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56

[1] Lowest value of WorkSafe BC Exposure Limit (EL), Occupational Safety & Health Administration (OSHA) Permissible EL (PEL), or Threshold Limit Value (TLV) listed.

[2] IDLH = Immediately Dangerous to Life and Health (units are the same as specified exposure limit units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[3] PIP = photoionization potential

[4] 10 ppm is a ceiling limit concentration of a substance in air that may not be exceeded at any time during the work period.

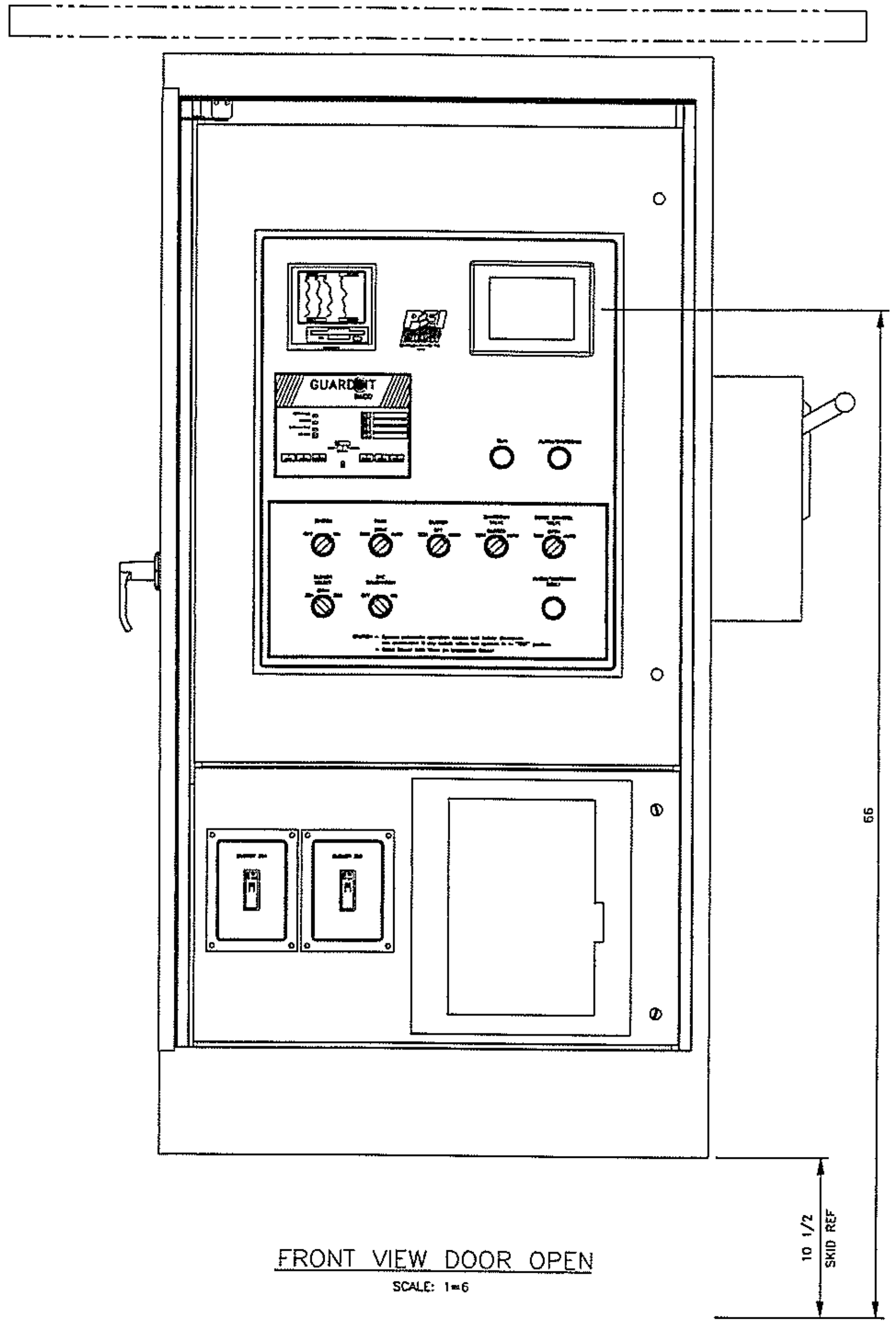
Safety During Training

Safety during training consists of the following topics:

- **Wellfield Training Safety:** In addition to LFG fundamentals, topics to be discussed include: confined space entry, lifting, electrical, biological hazards and controls, cold stress, and heat stress (if applicable).

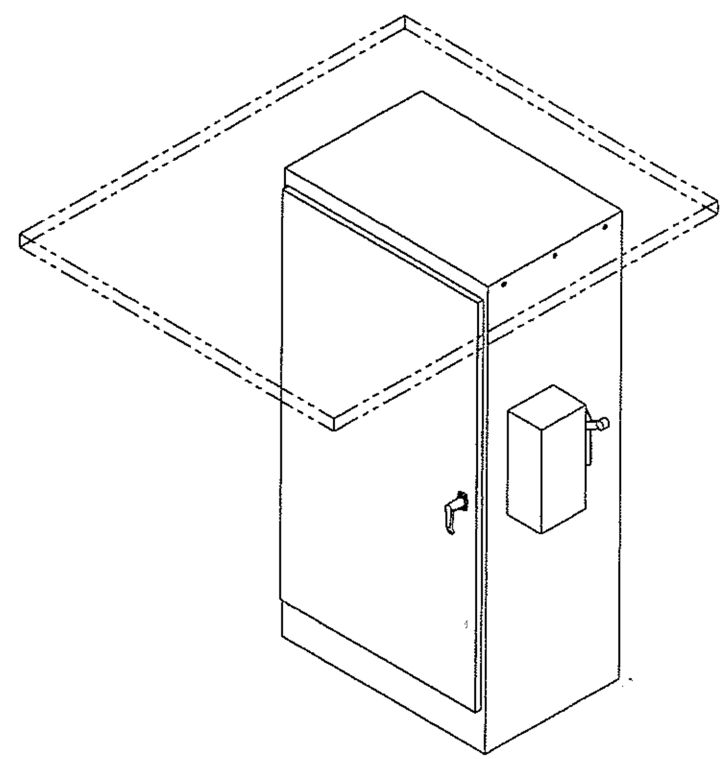
- **Blower/Flare Training Safety:** In addition to LFG fundamentals, topics to be discussed include: electrical hazards, biological hazards, and controls.

APPENDIX H: Control Panel Layout



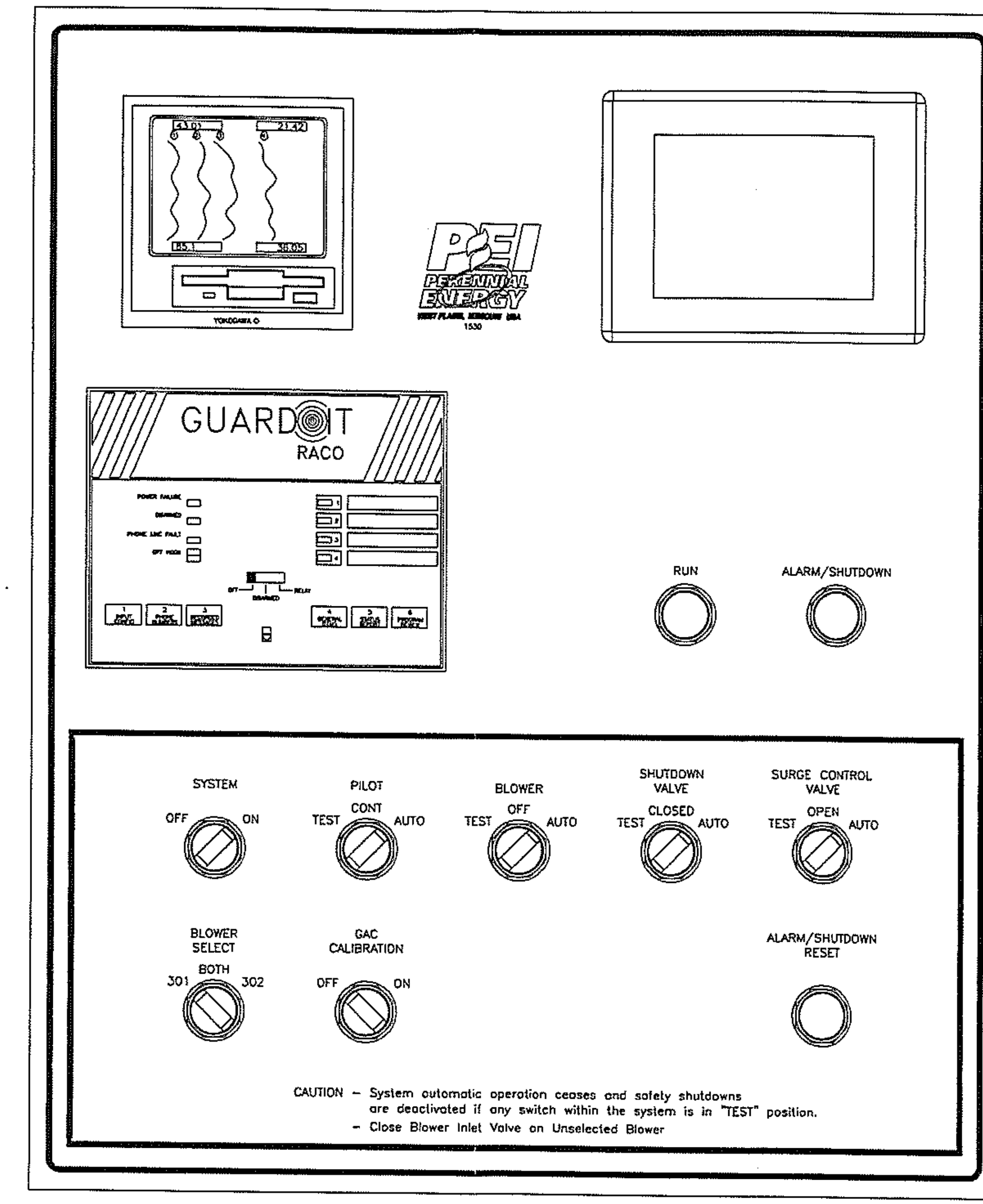
FRONT VIEW DOOR OPEN

SCALE: 1=6



ISOMETRIC VIEW DOOR CLOSED

SCALE: 1=12



LEGEND

SCALE: 1=2

(XX) REFERENCED PARTS

Part ID	Section	Drawing ID	RefDes	RefDesQty	UnitQty	TotalQty	Component	MFG / Material / Type	Description
5061	CP	PA-002-0250	CP-ENC-1	1 ea	1 ea	1 ea	Enclosure	Schaefer	SPFS-SS-72-36-24-SWB, per PEI dwg. # PP-025-0025, Stainless Steel enclosure
5045	CP	PA-002-0250	CP-LEG-1	1 ea	1 ea	1 ea	Legend Set	Metal Photo	PA-018-0253, Per spec #1530

(XX) REFERENCED DRAWINGS

Drawing ID	RefDes	RefDesQty	Component
PP-025-0051		1 ea	Sun/Rain Shield- 56" x 68" one piece

REDUCED FROM ORIGINAL SIZE

LTR	DESCRIPTION	DATE	APPROVED
1	AS BUILT (3/8/07)	7-3-07	KW

REVISIONS

APPLICABLE JOB NO(S). 1530
WHISTLER

PEI PERENNIAL ENERGY
1375 COUNTY ROAD 8090
WEST PLAINS, MO 65775
www.PerennialEnergy.com

This Drawing Contains Proprietary Data and May Not Be Duplicated, Copied, Reproduced or Otherwise Used in Any Manner Not in the Best Interest of Perennial Energy, Inc. All Ideas and Concepts Remain the Property of Perennial Energy, Inc.

ENGINEERING SIGNATURES

	DATE
DESIGNED BY: K.WADE	8/8/06
DRAWN BY: T.HAVILAND	8/8/06

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
FRACT ±1/16 .XX ±.03 ANGLES ±0°30

MATERIAL: AS NOTED

TITLE: CONTROL PANEL

SIZE: D (34x22)

DWG. NO. PA-002-0250

SCALE AS NOTED

FILE NO. PA-002-0250 R1 S0.DWG

SHEET 1 OF 1

I:\ACADF\1530\PA-002-0250 R1 S1.dwg, 7/3/2007 2:53:23 PM, Printed from CAD-2

APPENDIX I: Flare Station Data Log

FLARE STATION DATA LOG

Project # 1530 Project Name: Whistler LF (Min 16 SCFM, Max 160 SCFM)

Tester	E R				
Date	1/18/07				
Time	3:40				
Sky Conditions	TEST BAY				
Ambient Temperature, deg F	49°				
Inlet Temperature, deg F (GHS-TI-301)	49°				
Demister Inlet Valve Position, % Open (GHS-HV-301)	100				
LFG Vacuum, In WC (GHS-PI-301)	2 inch				
Demister Filter Delta P (GHS-PDI-301)	.325				
Blower 301 Inlet Pressure, In WC (GHS-PI-302)	60 inch				
Blower 301 Inlet Valve Position, % Open (GHS-FCV-301)	1/4 open				
Blower 301 Discharge Valve Position, % Open (GHS-HV-302)	100				
Blower 301 Discharge Temperature, deg F (GHS-TI-302)	110°				
Blower 302 Inlet Pressure, In WC (GHS-PI-303)	54				
Blower 302 Inlet Valve Position, % Open (GHS-FCV-302)	1/8				
Blower 302 Discharge Valve Position, % Open (GHS-HV-303)	100				
Blower 302 Discharge Temperature, deg F (GHS-TI-303)	52°				
Discharge Header Pressure, In WC (GHS-PI-304)	2				
Propane Pilot Supply Pressure, In WC (FLR-PI-101)	N/A				
Flame Arrester Inlet Pressure, In WC (FLR-PI-301)	N/A				
Flame Arrester Outlet Pressure, In WC (FLR-PI-301)	N/A				
Flame Arrester Delta P, In WC (FLR-PI-301)	N/A				

* *PUSH BUTTON*

FLARE STATION DATA LOG

Project # 1530 Project Name: Whistler LF (Min 16 SCFM, Max 160 SCFM)

YIC-1 From Main Menu Screen					
ANALOG DATA MENU					
* **PROCESS OVERVIEW**					
Flare Flow, SCFM	71				
Flare Temperature, °F	1265				
Flame Arrester Temperature, °F	49				
Blower 301, Amps	2.7				
Blower 302, Amps	stop				
* **BACK**					
* **BLOWER DATA**					
Blower 301 Status, Run/Stop	Run				
Blower 301 Hour Meter	2				
Blower 301 Current, Amps	2.7				
Blower 301 Vibration, In/Sec	.12				
Blower 302 Status, Run/Stop	stop				
Blower 302 Hour Meter	N/A				
Blower 302 Current, Amps	N/A				
Blower 302 Vibration, In/Sec	N/A				
* **BACK**					
* **FLARE FLOW DATA**					
Flow Delta P, In WC	1.28				
Flow Rate, SCFM	71				
Today's Total Flow, SCF	7726				
Total Flow, SCF	7925				
* **7 DAY FLOW HISTORY**					
Yesterday's Flow, SCF	199				
2 Day's Ago Flow, SCF	0				
3 Day's Ago Flow, SCF	0				
4 Day's Ago Flow, SCF	0				

* ***PUSH BUTTON***

FLARE STATION DATA LOG

Project # 1530 Project Name: Whistler LF (Min 16 SCFM, Max 160 SCFM)

5 Day's Ago Flow, SCF	0				
6 Day's Ago Flow, SCF	0				
7 Day's Ago Flow, SCF	0				
* **BACK**					
* **RESETTABLE FLOW**					
Resettable Total Flow, SCF	8069				
Reset Time	N/A				
Reset Date	N/A				
* **BACK**					
* **BACK**					
* **GAC DATA**					
Oxygen, %	20.9				
Methane, %	.2				
LEL, %	0				
GAC Temperature, °F	107				
* **BACK**					
* **CONTROL PANEL TEMPERATURE**					
Panel Temperature, °F	68				
* **BACK**					
* **BACK**					

* ***PUSH BUTTON***

Form 5-3 Blower/Flare Maintenance Log

NOTE: For task frequency see Section 4 Operation and Maintenance Schedule

Date/Time:__________________________

Maintenance Task	Completed	Problem Encountered	Action Taken
Check duty blower (blover in operation) for noise, heat, vibration			
Calibrate oxygen analyser			
Calibrate methane analyser			
Check panel heater is working			
Switch duty blower			
Check PLC battery is charged			
Inspect/Lubricate Purge Blower Fan			
Check Flame Scanner			
Lubricate Blower Bearings			
Check Shaft Alignment on Blower Motor			
Check/Adjust Tension of Blower Motor Belts			
Lubicate Motor Bearings			
Check Bank Sheets on Flame Arrestors-Flare # 1 and Flare #2			
Check Drain Ports			
Check Drainage/Filter at Knockout Pot (KOP)			
Check Flare Stack Finish			
Inspect wiring for signs of wear			
Check/clean pilot nozzle			
Check piping connection seals			
Check flare alignment			
Alarm testing			

INSTRUCTIONS FOR THE DAILY FLARE STATION DATA LOG, ALARM & SHUTDOWN REPORTS, & OTHER GENERAL INFORMATION

1. Optimum operating efficiency of your system and health of the gas field is maintained by diligent recording and use of the information contained on the Flare Station Data Log.

2. Two (2) sets of blanks for establishing this procedure as well as those for Safety Alarm and Shutdown Reports are provided immediately following these instructions. **These are your <u>MASTER COPIES;</u> you should make copies of these reports as they are needed.**

   1. Complete lines 1 through 3 with your Name, the Date, and the Time that you started taking the readings.

   2. Sky conditions - Write in the sky cover (clear, cloudy, raining, windy, etc.)

   3. Ambient Temperature - Write down the outside temperature. Either use a thermometer on site or call a local source for the information.

   4. Record all the gauges and meters in the order that they are listed.

3. Although this system has been factory tested prior to shipment, variable, site-specific conditions mandate various Setpoint changes to achieve optimum operation and will be made and documented by PEI's Service Representative during his visit for Start-Up and Operator Training.

4. Consistent monitoring, recording, and analyzing changes affecting gas quality from the Flare Station Data Log and the Alarm and Shutdown Reports will provide the operator with reliable information with which to make Setpoint adjustments, optimizing system performance to changing conditions.

5. The Setpoint, range, configuration, and other operating parameters for the major control devices incorporated into the design of the system are found in the Operational, Alarm, and Shutdown Setpoints information contained later in this section, with space provided to document any Setpoint changes or adjustments.

6. By dating and initialing all Setpoint changes in the space provided, you will be able to correlate the affect of your changes with the changing conditions noted in the Flare Station Data Log, assuring optimum equipment performance while maintaining the health of the gas field.

7. If you are not familiar with the procedure for making Setpoint changes to the above devices, please consult the applicable manufacturer's literature before proceeding.

Whistler Landfill Gas Control System - Wellfield Monitoring Data

Enter field data in the appropriate fields. Columns with bold headings represent calculated values. Out-of-range value are automatically flagged with red background.

Date:____________________ **Start Time:**________________ **End Time:**________________

Weather Conditions:________________ **Barometric Pressure:**__________ **Barometric Pressure:**__________

*Maximum Value** →				>1:2			>150 CFM		>130 °F	>14 in WC		
Well #	CH_4 %vol	CO_2 %vol	O_2 %vol	**CO_2:CH_4**	Total Pressure Differential (in WC)		**Flow (cfm)****		Temp (°F)	Pressure (in WC)		Comments
					Initial Reading	After Adjustment				Initial Reading	After Adjustment	
Manifold Valve & Flow Station ("MFV" on System Drawings)												
FLARE												
W01												
W02												
W03												
W04												
W05												
W06												
W07												
W08												
W09												
W10												
W11												
W12												

***Maximum Valules are for well locations only--exception is maximum temperature, which applies to all locations**

****Velocity and Flow based on T=70°F**

Whistler Landfill Gas Control System - Wellfield Monitoring Data

Enter field data in the appropriate fields. Columns with bold headings represent calculated values. Out-of-range value are automatically flagged with red background.

Date:________________ **Start Time:**____________ **End Time:**____________

Weather Conditions:____________ **Barometric Pressure:**________ **Barometric Pressure:**________

*Maximum Value** →				>1.2			>150 CFM		>130 °F	>14 in WC		
Well #	CH_4 %vol	CO_2 %vol	O_2 %vol	**CO_2:CH_4**	Total Pressure Differential (in WC)		**Flow (cfm)****		Temp (°F)	Pressure (in WC)		Comments
					Initial Reading	After Adjustment				Initial Reading	After Adjustment	
Manifold Valve & Flow Station ("MFV" on System Drawings)												
FLARE												
W01												
W02												
W03												
W04												
W05												
W06												
W07												
W08												
W09												
W10												
W11												
W12												

***Maximum Valules are for well locations only--exception is maximum temperature, which applies to all locations**
****Velocity and Flow based on T=70°F**

APPENDIX J: Flare / Blower Troubleshooting Guide

EXHIBIT J-1
Alarm Testing Checklist and Recommended Testing Frequency

	Alarm Condition	Items to Check	How?	Recommended Frequency
1	Flame failure flare #1	• Signal from flame scanner	• Remove sensor from flare stack and cover sensor to block UV. Flare should shut down.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
2	Flame failure flare #2	• Signal from flame scanner	• Remove sensor from flare stack and cover sensor to block UV. Flare should shut down.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
3	High temperature (>1100°C) flare #1	• Signal from thermocouple	• Lower high temperature set point on Honeywell controller.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel	• Weekly
4	High temperature (>1100°C) flare #2	• Signal from thermocouple	• Lower high temperature set point on Honeywell controller.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
5	High oxygen (>1.5%)	• Signal from oxygen analyzer	• Lower high oxygen set point on PLC controller.	• Weekly
		• Autodialer notification	• See above.	• Monthly

EXHIBIT J-1
Alarm Testing Checklist and Recommended Testing Frequency

	Alarm Condition	Items to Check	How?	Recommended Frequency
6	Low temperature (<875°C) flare #2	• Signal from thermocouple	• Raise low temperature set point on Honeywell controller.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
7	Blower failure #1 or #2	• Autodialer notification	• Pull coil wire.	• NOT Recommended
		• Alarm indicator light (on blower panel)	• Push buttons on blower panel.	• Weekly
8	High temperature @ flame arrestor #1 (>150°C)	• Signal from thermocouple	• Lower high temperature set point on flame arrestor controller.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
9	High temperature @ flame arrestor #2 (>150°C)	• Signal from thermocouple	• Lower high temperature set point on flame arrestor controller.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
10	Low pilot gas pressure	• Automatic shutdown and autodialer notification	• Shut supply valves and bleed pressure from system to cause auto shutdown.	• Monthly
		• Alarm indicator light on control panel	• Push buttons on blower panel.	• Weekly
11	Inlet valve failure --flare #1	• Alarm indicator light on control panel	• Pull wire 147A (hot).	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly

EXHIBIT J-1
Alarm Testing Checklist and Recommended Testing Frequency

	Alarm Condition	Items to Check	How?	Recommended Frequency
12	Inlet valve failure --flare #2	• Alarm indicator light on control panel	• Pull wire 267A (hot).	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
13	Low temperature (<875°C) flare #1	• Signal from thermocouple	• Raise low temperature set point on Honeywell controller.	• Monthly
		• Automatic shutdown	• See above.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
14	High oxygen (> 2%)	• Signal from oxygen analyzer	• Check calibration of oxygen analyzer.	• Weekly
		• Automatic shutdown	• Lower high oxygen set point on PLC controller.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly
15	Low methane (< 30%)	• Signal from methane analyzer	• Check calibration of methane analyzer.	• Weekly
		• Autodialer notification	• Input 8.8 mA using current signal generator.	• Monthly
16	Low low methane (< 20%)	• Signal from methane analyzer	• Check calibration of methane analyzer.	• Weekly
		• Automatic shutdown	• Input 7.26 mA using current signal generator.	• Monthly
		• Autodialer notification	• See above.	• Monthly
		• Alarm indicator light on control panel	• Push button on control panel.	• Weekly

EXHIBIT J-2
Troubleshooting Alarm and Shutdown Annunciation

Problem	Cause	Solution
Flare Flame Fail Shutdown	1. Low methane quality.	1. Tune landfill.
	2. Restriction of flow.	2. Check valves for proper positioning or check condensate blockage in lines.
Flare SD Valve Fail to Close	1. Shutdown valve not closing properly.	1. Valve sticking or blocked open.
	2. Limit switches out of range.	2. Adjust limit switches.
	3. Actuator linkage failed.	3. Replace if adjustment doesn't work.
High Demister 301 Condensate Level Shutdown	1. Condensate is at or above these levels.	1. Blockage. Clean out bottom of demister or piping.
	2. Faulty level switches.	2. Replace faulty level switches.
Low Flare Flow Alarm and Shutdown	3. Flare flow rate below system's "Low Flow Setpoints".	1. Adjust flow to higher flow rate or lower "Low Flow Setpoints". (Do not operate below manufacturer's designed flow rate.)
	4. Restriction of flow.	2. Check valving for proper positioning or condensate blockage.
Low Control Panel Temperature Alarm	1. Breaker is off or tripped.	1. Reset breaker. Turn on.
	2. Heater is faulty.	2. Replace heater.
High Control Panel Temperature Alarm	1. Heater setting is too high.	1. Setting needs to be turned down during summer months.
	2. Air conditioner thermostat setting too high.	2. Setting needs to be turned down during summer months.
	3. Breaker is off or tripped.	3. Reset breaker. Turn on.
Blowers High Current Differential	1. Blower inlet valving.	1. Adjust the blower valves by closing the inlet valve on blower with the higher current reading.
Blower 301..2 Low Amperage Alarm and Shutdown	1. Setpoint is not adjusted properly.	1. Lower alarm and shutdown setpoints just above blower surge point.
Blower 301..2 High Amperage Alarm and Shutdown	1. Bearings/impellers.	1. Grease bearings or replace if needed. Debris in blower housing or warped impeller. Consult manufacturer.
High GAC Temperate Alarm	1. Rheostat setting is too low.	1. Rheostat needs to be turned up during winter months.
	2. Breaker is off or tripped.	2. Reset breaker. Turn on.
	3. Heater is faulty.	3. Replace heater.
	4. Relay #1 is faulty.	4. Replace relay #1.

EXHIBIT J-2
Troubleshooting Alarm and Shutdown Annunciation

Problem	Cause	Solution
High GAC % LEL Alarm and Shutdown	1. Leakage.	1. Check area for loose flanges, open valves, or damaged equipment.
	2. Defective methane sensor.	2. Replace methane sensor.
	3. High LEL setpoint set too low.	3. Adjust this setpoint to the system specifications.
Run Clock Off Alarm	1. System START/STOP parameters set to operate on a timed schedule.	1. System START/STOP parameters have been modified for ON/OFF operations. Refer to the Touchscreen (Help menu under Run Clock operations) or Section 4 in this manual under System Operation Information, Section F.
Specific Gravity Calculation Error Alarm	1. Operator input value out of range.	1. Check your input selections. The total of all inputs cannot exceed 100%.
Blower 301 and 302 Run Signal Fail Shutdown	1. No power to motor starter.	1. Verify breaker is on and not tripped.
	2. Defective starter aux contacts.	2. Check auxiliary contacts for continuity/wiring faults.
Flare 1 Thermocouple Fail Shutdown	1. Selected controlling thermocouple or input module failure.	1. Check thermocouple wire for correct voltage. Replace faulty device. Change to different controlling thermocouple. Then change temperature value setpoint.
Blower 301..2 High Vibration Alarm and Shutdown	1. Blower/motor coupling alignment.	1. Check alignment, correct as necessary.
	2. Blower/motor bearings.	2. Refer to Section 7-2 in this manual for manufacturer's troubleshooting literature.
	3. Blower/motor.	3. Make sure that devices are mounted securely to base frame.
LFG High % Oxygen Alarm and Shutdown	1. Alarm and shutdown setpoint set too low.	1. Adjust setpoints.
	2. Broken pipe/loose flanges.	2. Repair piping, tighten flanges.
	3. Overdrawing wellfield.	3. Adjust wells.
LFG Low % CH_4 Alarm and Shutdown	1. Alarm and shutdown setpoint set too low.	1. Adjust setpoints.
	2. Broken pipe/loose flanges.	2. Repair piping, tighten flanges.
	3. Overdrawing wellfield.	3. Adjust wells.

SECTION VII
Troubleshooting Guide

PROBLEM: Low Air Flow or Loss of Pressure

1. Incorrect machine rotation
   - Check arrow on inlet

2. Restricted inlet piping
   - Valve not fully open
   - Dirty filters
   - Shipping covers not removed

3. Partially blocked outlet piping
   - Open all outlet valves
   - Check valve installed properly
   - Clogged diffusers

4. Instrumentation not reading accurately

5. Verify motor wiring
   - Incorrect voltage
   - Incorrect phasing

6. Increased inlet temperature

7. Increased inlet pressure

8. Improper design or assembly of the piping system

9. Foreign material in machine

PROBLEM: Excessive Vibration

1. Baseplate must never be bolted down or grouted in

2. Isolation pads
   - Positioned incorrectly
   - Improperly sized
   - Poor condition

3. Expansion joints
   - Machine must be isolated from system piping by flexible sleeves or expansion joints. **NEVER** bolt piping directly to blower.

4. Misalignment
   - The number one cause of excessive vibration in Gardner Denver equipment.

5. Foundation
   - The blower shall rest on a solid, level, flat surface such that it will support the weight of the unit.

6. Unsupported piping
   - The piping system must be adequately supported above the flexible connections.

7. Loose hold-down bolts
   - The motor and machine hold-down bolts may have loosened.

8. Foreign material in machine
   - Liquids (such as water, etc.)
   - Hardware (such as bolts, filter pieces, etc.)

9. Surge
   - Operating in the surge range
   - Blocked inlet or outlet piping

10. Motor vibration
    - Improper voltage
    - Failing motor bearings
    - Imbalance within motor (such as broken fan, etc.)

11. Blower/Exhauster bearings
    - Damaged during replacement
    - Over-lubrication or wrong type of lubricant
    - Wrong type of bearings
    - Inadequate storage maintenance

12. Coupling
    - Improper lubrication
    - Incorrect shaft spacing
    - Imbalance (such as damaged coupling or wrong size key)
    - Loosened set screws

13. Imbalance
    - Motor (due to rotor, bearings or fan)
    - Coupling
    - Rotor (due to impellers, shaft or bearings)

PROBLEM: Oil Leakage

1. Oil level too high
   - Operator or maintenance personnel overfilling reservoir
   - Improper oil level adjustment

2. Wrong type of oil (use recommended oils ONLY)

3. Breather vent clogged or vent hose clogged or pinched

4. Labyrinth or carbon ring seal leaking excessively

5. Incorrect bearing assembly
   - Oil slinger bent or not positioned properly
   - Housing gasket loosened or damaged
   - Gasket blocking oil return hole
   - Brass labyrinth seal oil drain holes not at bottom
   - Labyrinth loose in bearing housing

6. Oil reservoir glass cracked

7. Loose connections to oiler

8. Oilers located on wrong side of machine

9. Oil return holes plugged

10. Machine not level

PROBLEM: Overheating

1. Overheating Machine
   - Surge
   - Inadequate air flow
   - Clogged intake air filters
   - Incorrect use of discharge valve to control flow

2. Overheating Bearings
   - Damaged bearings
   - Excessive lubrication or wrong type
   - Incorrect class of bearings
   - Improper assembly procedure
   - High ambient temperatures
   - Worn housing
   - Worn retainer

3. Overheating Motor
   - High ambient temperatures
   - Incorrect voltage
   - Unbalanced voltage supply
   - Restricted air flow (for cooling)
   - Motor overloaded – motor too small for system
   - Improperly tensioned belts on v-belt drive systems
   - Bearing failure
   - Too frequent starting
   - Motor fan rotation incorrect

PROBLEM: Repeated Bearing Failures

1. Not using Gardner Denver bearings

2. Not using Gardner Denver recommended lubricant

3. Excessive lubrication or lack of lubrication

4. Improper assembly
   - Correct number of bearing shims
   - Wavy washer positioned properly
   - Oil and grease slingers positioned properly
   - All gaskets to original thickness specs

5. Bearing housings worn excessively, shaft journal worn

6. Coupling alignment
   - Coupling manufacturer specs followed for:
     a) hub-to-hub spacing
     b) shaft-to-shaft axial clearance
     c) lubrication (if required)

7. Shafts not rotated weekly on idle units

8. NOTE: Many non-mechanical problems can lead to frequent or repeated bearing failure. They may include improper installation, application or operation of machine.

PROBLEM: Surge

1. Restricted inlet piping

2. Blocked outlet piping

3. Increased fluid level in aeration tank or process differential pressure

4. System imbalance

5. Incorrect valving or valve timing.

SAFETY ALARM & SHUTDOWN TEST REPORT

Job # 1530 Tester Jaime Lawrence Date 1-23-07

Items	Alarm	Shutdown	Comments
GAC High % LEL	✓ (C22)		Changed SP Below PV
GAC High Temperature	✓ (C24)		Changed SP Below PV
LFG High Oxygen %	✓ (C25)	✓ (C125)	Changed SP Below PV
LFG Low % Methane	✓ (C26)	✓ (C126)	Changed SP Above PV
Blowers High Current Differential	✓ (C43)	✓ (C143)	Changed SP Below PV
Demister 301 High Condensate Level	✓ (C52)	✓ (C152)	Filled demister with water
Blower 301 Low Amperage	✓ (C54)	✓ (C154)	Changed SP Above PV
Blower 301 High Amperage	✓ (C55)	✓ (C155)	Inrush 18.2 for 30 sec.
Blower 301 High Vibration	✓ (C56)	✓ (C156)	Changed Sp Below PV
Blower 301 Run Signal Fail	✓ (C57)		~~[illegible]~~ lifted run sig wire
Flare 1 Low Temperature	✓ (C67)		MV Injected Sig = 65°F
Flare 1 Low Flow Rate	✓ (C71)	✓ (C171)	Changed Sp Above PV
Control Panel High Temperature	✓ (C73)		~~[illegible]~~ Lowered SP below PV
Flare 1 Flame Arrestor High Temperature		✓ (C174)	Lowered SP Below PV
Run Clock Off	✓ (C75)		Adjusted to time off
Flare 1 shutdown Valve Fail To Close		✓ (C175)	Changed cam position
Flare 1 Flame Fail		✓ (C177)	After low Flr. temp Alarm counts end up
Specific Gravity Calculation Error	✓ (C76)		Changed CH4 % to 100 %

Flare 1 Thermocouple Fail Shutdown		✓ (C112)	
GAC High % LEL Shutdown	✓ (C222)		Changed SP Below PV
Blower 302 Low Amperage	✓ (C254)	✓ (C354)	Changed SP above PV
Blower 302 High Amperage	✓ (C255)	✓ (C355)	Inrush 18.8 For 30 sec
Blower 302 High Vibration	✓ (C256)	✓ (C356)	Changed SP below PV
Blower 302 Run Signal Fail	✓ (C257)		Lifted Run Signal wire
Control Panel Low Temperature	✓ (C273)		Raised SP Above PV

APPENDIX K: Operational Certificate

FILE: 602

BRITISH COLUMBIA
The Best Place on Earth

File: MR-04692

February 2, 2007

Resort Municipality of Whistler
4325 Blackcomb Way
Whistler, British Columbia V0N 1B4

Re: Notice of Intent to Issue Operational Certificate No. MR-04692 Under the Provisions of the *Environmental Management Act* in the name of Resort Municipality of Whistler

Pursuant to Sections 28(4) & (5) of the *Environmental Management Act* and Sections 4(6) & 7 of the Public Notification Regulation, and as indicated in the enclosed notice, the Director intends to issue an operational certificate to you a minimum of 30 days after publication of the notice. Also enclosed is a copy of the draft operational certificate.

In accordance with the Public Notification Regulation, you are requested to publish a copy of the enclosed notice in one issue of the Whistler Question newspaper. The published notice must:

(a) be at least 10 centimetres in width,

(b) be at least 100 square centimetres in area,

(c) be entitled "ENVIRONMENTAL PROTECTION NOTICE" in a minimum type size of 12 points, and

(d) have the text of the notice in a minimum type size of 8 points.

Proof of publication, the full pages on which the notice appeared, must be sent within thirty days after the date of publication to the Regional Manager, Environmental Protection, Ministry of Environment, 10470 - 152 Street, Surrey, BC, V3R 0Y3. We suggest that the notice be published as soon as possible, so that if republishing is necessary for any reason, processing will not be delayed. Failure to comply with the regulations may delay the issuing of an operational certificate.

Any comments regarding the draft operational certificate must be sent to the Regional Manager, Environmental Protection, Ministry of Environment, at 10470 - 152 Street, Surrey, BC, V3R 0Y3, within 30 days of the date the notice is published.

As indicated on the notice, opportunity for any person to view the enclosed draft operational certificate at the Resort Municipality of Whistler office must also be provided.

If you have any questions, please contact Ashley Smith at telephone (604) 582-5358.

Yours truly,

Barb McGrenere - 250-387-0839

Barb McGrenere
Environmental Management Branch

enclosure

BRITISH COLUMBIA

The Best Place on Earth

NOTICE OF INTENT TO ISSUE OPERATIONAL CERTIFICATE
MR-04692 UNDER THE PROVISIONS OF THE
ENVIRONMENTAL MANAGEMENT ACT

Take notice that the Director intends, a minimum of 30 days after the date of this publication, to issue Operational Certificate MR-04692 to the Resort Municipality of Whistler for the existing Whistler Landfill located near Function Junction in Whistler. The terms of the draft operational certificate are consistent with the Resort Municipality of Whistler's approved Solid Waste Management Plan and establish the minimum operating requirements for the facility.

A copy of the draft operational certificate may be viewed at the Resort Municipality of Whistler office located at 4325 Blackcomb Way, Whistler, (604) 932-5535 during normal business hours.

Any comments regarding the draft operational certificate must be sent to the Regional Manager, Environmental Protection, Ministry of Environment, 10470 - 152 Street, Surrey, BC, V3R 0Y3, within 30 days of the date of this publication. A copy of any comments should also be sent to the Resort Municipality of Whistler.

Dated at Surrey, British Columbia on February 2, 2007

BRITISH COLUMBIA

MINISTRY OF ENVIRONMENT

Environmental Protection
10470 – 152 Street
Surrey, British Columbia
V3R 0Y3
Telephone: (604) 582-5200
Fax: (604) 584-9751

OPERATIONAL CERTIFICATE
MR-04692

Under the Provisions of the *Environmental Management Act* and
in accordance with the Squamish-Lillooet Regional District
Solid Waste Management Plan

RESORT MUNICIPALITY OF WHISTLER

4325 Blackcomb Way

Whistler, British Columbia

V0N 1B4

shall operate the Whistler Landfill, located near Function Junction in Whistler, British Columbia, subject to the conditions listed below. Contravention of any of these conditions is a violation of the *Environmental Management Act* and may result in prosecution.

1. AUTHORIZED FACILITIES

1.1 This section applies to the **discharge of municipal solid waste and contaminated soil from contaminated sites to a sanitary landfill** from sources within the **Squamish-Lillooet Regional District.** The site reference number for this discharge is E208303.

1.1.1 The discharge is authorized by the Squamish-Lillooet Regional District's approved solid waste management plan at a rate and for the duration specified in the plan.

1.1.2 The characteristics of the discharge shall be typical municipal solid waste, contaminated soil relocated from contaminated sites and other materials as specifically authorized by the director. Waste asbestos may be discharged in accordance with the *Hazardous Waste Regulation*.

Materials prohibited from discharge are Hazardous Waste (excluding asbestos), liquids, semi-solid waste, untreated biomedical waste and the following recyclable materials:

- used white goods,
- auto hulks and other large metallic waste,
- used tires,
- used lead acid batteries,
- gypsum wallboard exceeding 2% of any individual load,
- corrugated cardboard originating from institutional and commercial sources,
- other materials banned by the Regional District in implementing the Squamish-Lillooet Regional District's solid waste management plan, and
- other materials which may be designated by the director when alternative disposal become available.

1.1.3 Waste shall not be discharged into water or within a buffer zone as identified in **Section 2.7**. The burning of waste is prohibited.

1.1.4 The authorized works common to this section and **Section 1.2** are a locking gate to control access by the public, weigh scale and fire protection equipment, approximately located as shown on attached **Site Plan A**. These works shall be maintained while municipal solid waste is being actively managed (disposed, transferred and/or recycled) at the site.

1.1.5 The authorized works specific to this section are those associated with a landfill operation and include berms, covering material, electrified bear fence, surface water diversionary works, leachate collection works, environmental monitoring systems and a temporary transfer station, approximately located as shown on attached **Site Plan A**. The transfer station will be decommissioned during the implementation of the landfill closure plan required in **Section 2.16**.

1.1.6 The location of the point of discharge is District Lot 8065, Group 1, N.W.D.

1.2 This section applies to a **recycling facility** for the management of recyclable materials from sources within the **Squamish-Lillooet Regional District**.

1.2.1 The quantity of recyclable materials that may be stored is limited to the maximum that can be properly managed at the facility.

1.2.2 The authorized works are those associated with a recycling depot and include a building, bins and storage areas, approximately located as shown on attached **Site Plan A**.

1.2.3 The location of the facility is the same location as described in **Section 1.1.6**.

2. GENERAL REQUIREMENTS

2.1 Definitions

"contaminated soil" means soil that has a concentration of a substance that is greater than the concentration specified for that substance in column II of Schedule 7 of the *Contaminated Sites Regulation* but does not include hazardous waste soil;

"director" means the Director or a person delegated to act on behalf of the Director, as defined in the *Environmental Management Act*;

"hazardous waste soil" means soil that is classified as a hazardous waste in the *Hazardous Waste Regulation*;

"manager" means Regional Manager, Environmental Protection;

"qualified professional" means an applied scientist or technologist specializing in a particular applied science including, but not necessarily limited to, agrology, biology, chemistry, engineering, geology, or hydrogeology and

- who is registered in British Columbia with their appropriate professional organization, acting under that association's Code of Ethics and subject to disciplinary action by that association, and
- who, through suitable education, experience, accreditation and knowledge, may be reasonably relied on to provide advice within their area of expertise;

"suitable cover" means soils utilized in accordance with **Section 2.4** of this operational certificate or other material acceptable to the director;

"urban park quality soil" means soil which does not contain any substance with a concentration exceeding the lowest applicable numerical soil standard for urban park land (PL) as set forth in the *Contaminated Sites Regulation*.

2.2 Emergency Procedures

In the event of an emergency which prevents compliance with a requirement of this operational certificate, that requirement will be suspended for such time as the emergency continues or until otherwise directed by the director provided that:

a. Due diligence was exercised in relation to the process, operation or event which caused the emergency and that the emergency occurred notwithstanding this exercise of due diligence;

b. The manager is immediately notified of the emergency; and

c. It can be demonstrated that everything reasonably possible is being done to restore compliance in the shortest possible time.

Notwithstanding (a), (b), and (c) above, the director may require the authorized discharge to be suspended or reduced to protect the environment while the situation is corrected.

2.3 Inspections

The operational certificate holder shall inspect the authorized works regularly and maintain them in good working order. Notify the manager of any malfunction of these works.

The operational certificate holder shall inspect the property boundaries regularly and notify the manager of any visual evidence of environmental impacts on adjacent properties.

2.4 Soil Management

Contaminated soil meeting urban park quality may be utilized for berm construction, intermediate and final cover, top dressing and landscaping. Soil with any substance with a concentration exceeding the lowest applicable numerical soil standard for urban park land may only be used for internal berms or intermediate cover. The utilization or discharge of hazardous waste soil is prohibited.

Soils utilized for berm construction, intermediate and final cover, top dressing and landscaping shall not be included in determining the rate of discharge specified in **Section 1.1.1.**

2.5 Waste Compaction and Covering

All waste shall be placed in cells of a size determined by a qualified professional. The working face shall be confined to the smallest practical area. Waste shall be discharged in layers of 0.6 metres or less and compacted to the smallest practical volume. Side slopes shall be a maximum of 1:3 (vertical:horizontal). Daily cover consisting of a minimum of 0.15 metres of suitable cover material or alternate cover, acceptable to the director, shall be applied to the working face at the end of each operating day. If alternate cover is utilized, then the working face shall be covered with a minimum of 0.15 meters of suitable cover at least once every week. Intermediate cover, consisting of a minimum 0.30 metre of suitable cover material shall be applied within thirty (30) days to any area of the landfill which will not receive any further waste for thirty (30) days. The director may vary the frequency of covering when freezing conditions adversely affect normal operation.

2.6 Completed Areas of the Landfill

The operational certificate holder shall apply final cover to any area of the landfill which will not receive any further waste. Final cover shall be applied in accordance with the closure plan required in **Section 2.16**.

Final cover shall consist of a minimum of 1.0 metre of low permeability ($<1 \times 10^{-5}$ cm/s) compacted soil (or equivalent) cap plus a minimum of 0.15 metre of topsoil and suitable vegetative cover. Soil shall be utilized in accordance with **Section 2.4**. Final cover shall be sloped to promote surface water runoff. Surface water runoff shall be directed away from the landfill footprint.

2.7 Buffer Zones

Where possible, the operational certificate holder shall maintain a minimum 15 metre buffer zone around the perimeter of the landfill. The buffer zone shall include an adequate firebreak. The firebreak shall be maintained free of combustibles.

2.8 Wildlife Management

The operational certificate holder shall install and maintain an electrified bear fence around the active area of the landfill that will prevent bears from entering that part of the site. The fence shall be energized during the active bear season. The fence shall be maintained until implementation of the landfill closure plan required in **Section 2.16**.

Additional works may be required or other operating instructions may be issued by the director should a wildlife nuisance or hazard arise.

2.9 Fire Prevention and Control

The operational certificate holder shall take all reasonable measures necessary to prevent fires from occurring at the site and is responsible for complying with all local fire safety requirements. The operational certificate holder shall provide and maintain fire fighting equipment and materials as required. In the event of a landfill fire, immediately notify the local fire department, the Ministry of Forests, the Provincial Emergency Program and the manager.

2.10 Posting of Signs

The operational certificate holder shall post a sign, to the satisfaction of the director, at the entrance of the landfill site with the following current information:

- site name,
- owner and operator,
- contact telephone number and address for the owner and operator,
- telephone number in case of emergency,
- hours of operation,
- materials and wastes accepted for recycling and landfilling,
- prohibited materials and wastes, and
- tipping fees.

2.11 Management of Recyclable Materials

Recyclable materials shall be managed in a manner so as not to cause pollution and in accordance with the *Environmental Management A*ct and its regulations.

2.12 Leachate Management

The operational certificate holder shall, to the satisfaction of the director, take measures to minimize leachate generation, including but not limited to, providing effective covering and surface water runoff. Should it be demonstrated, through monitoring or any other information, that leachate is having an adverse impact on the receiving environment, then the operational certificate holder shall prepare a leachate management plan acceptable to the director.

2.13 Landfill Operation

The operational certificate holder shall operate the landfill authorized in **Section 1.1** in accordance with sound engineering principles and **Section 7** of the *Landfill Criteria for Municipal Solid Waste* (June 1993). Should there be a conflict between the criteria and other sections of this operational certificate, the requirements of the operational certificate shall prevail.

A copy of the criteria is available for viewing on the ministry's web page (http://wlapwww.gov.bc.ca/epd/epdpa/mpp/lcmsw.html) and at all Environmental Protection offices.

2.14 Site Decommissioning

In accordance with **Section 40** of the *Environmental Management Act* and **Part 2** of the *Contaminated Sites Regulation*, the operational certificate holder shall submit a site profile to the manager not less than 10 days prior to decommissioning the facilities authorized in **Section 1.**

2.15 Legal Survey

The operational certificate holder shall, upon closure of the landfill, register a charge against the property title, or provide other legal notification acceptable to the director, that the property described in **Section 1.1.6** was used for the purpose of waste disposal. Notify the manager of the registration of the charge or legal notification.

2.16 Landfill Closure Plan

The operational certificate holder shall submit a closure plan for the facilities authorized in **Section 1** prior to the closure of the landfill to the director for approval. The landfill shall be closed in accordance with the approved plan. The plan shall be prepared by a qualified professional and include, but not limited to, information regarding:

- estimated total waste volumes and tonnage and the closure date;
- a topographical plan showing the final elevation contours of the landfill, the extent of buffer zones, access roads and surface water diversion and drainage controls;
- design of the final cover including the thickness and permeability of barrier layers and drainage layers and information on topsoil, vegetative cover and erosion prevention controls;
- a geotechnical evaluation of the landfill to identify any slope stability, settlement and erosion issues. Remedial actions recommended as a result of the evaluation shall be implemented as part of the landfill closure;
- a landfill gas assessment to assess the potential generation of non-methane organic compounds (NMOC). Should the assessment indicate that the NMOC will exceed 150 tonnes/year then landfill gas collection and beneficial utilization or treatment shall be implemented as part of the landfill closure;
- a procedure for notifying the public about the closure and alternative waste disposal facilities;
- rodent and nuisance wildlife control procedures;
- proposed end use of the property after closure;
- a post-closure monitoring program for leachate, groundwater, surface water, landfill gas, erosion and settlement for a minimum period of 25 years. Monitoring shall be carried out in accordance with the monitoring procedures outlined in **Section 3.2**;
- post-closure operation of pollution abatement engineering works such as leachate and landfill gas collection/treatment systems for a minimum period of 25 years; and
- contingencies to address environmental impact concerns which may arise during the minimum post-closure period of 25 years.

3. MONITORING AND REPORTING REQUIREMENTS

3.1 Waste and Recyclable Materials Recording

While municipal solid waste is being actively managed (disposed, transferred and/or recycled) at the site, the operational certificate holder shall record the quantity, in tonnes, of waste received at the landfill and recycling facility. Also, the quantity of recyclable materials removed from the facility shall be recorded. This information shall be included in the annual report required in **Section 3.3**.

3.2 Monitoring Procedures

3.2.1 Sampling and Flow Measurement

Sampling and flow measurement shall be carried out in accordance with the procedures described in *British Columbia Field Sampling Manual for Continuous Monitoring plus the Collection of Air, Air-Emission, Water, Wastewater, Soil, Sediment and Biological Samples*, 1996 Edition (Permittee), 312 pp., or by suitable alternative procedures as authorized by the director.

Copies of the above manuals are available for viewing on the ministry's web page (http://www.publications.gov.bc.ca) and at all Environmental Protection offices.

3.2.2 Chemical Analyses

Analyses are to be carried out in accordance with procedures described in the latest version of *British Columbia Environmental Laboratory Manual for the Analysis of Water, Wastewater, Sediment and Biological Materials*, (March 1994 Permittee Edition), or by suitable alternative procedures as authorized by the director.

A copy of the above manual is available for viewing on the ministry's web page (http://www.publications.gov.bc.ca) and at all Environmental Protection offices.

3.2.3 Quality Assurance

All data analyses required to be submitted by the operational certificate holder shall be conducted by a laboratory acceptable to the director. At the request of the manager, the operational certificate holder shall provide the laboratory quality assurance data, associated field blanks, and duplicate analysis results along with the submission of data required under **Section 3.2** of the operational certificate.

3.3 Reporting

3.3.1 Annual Report

The operational certificate holder shall prepare an annual report which shall include the following:

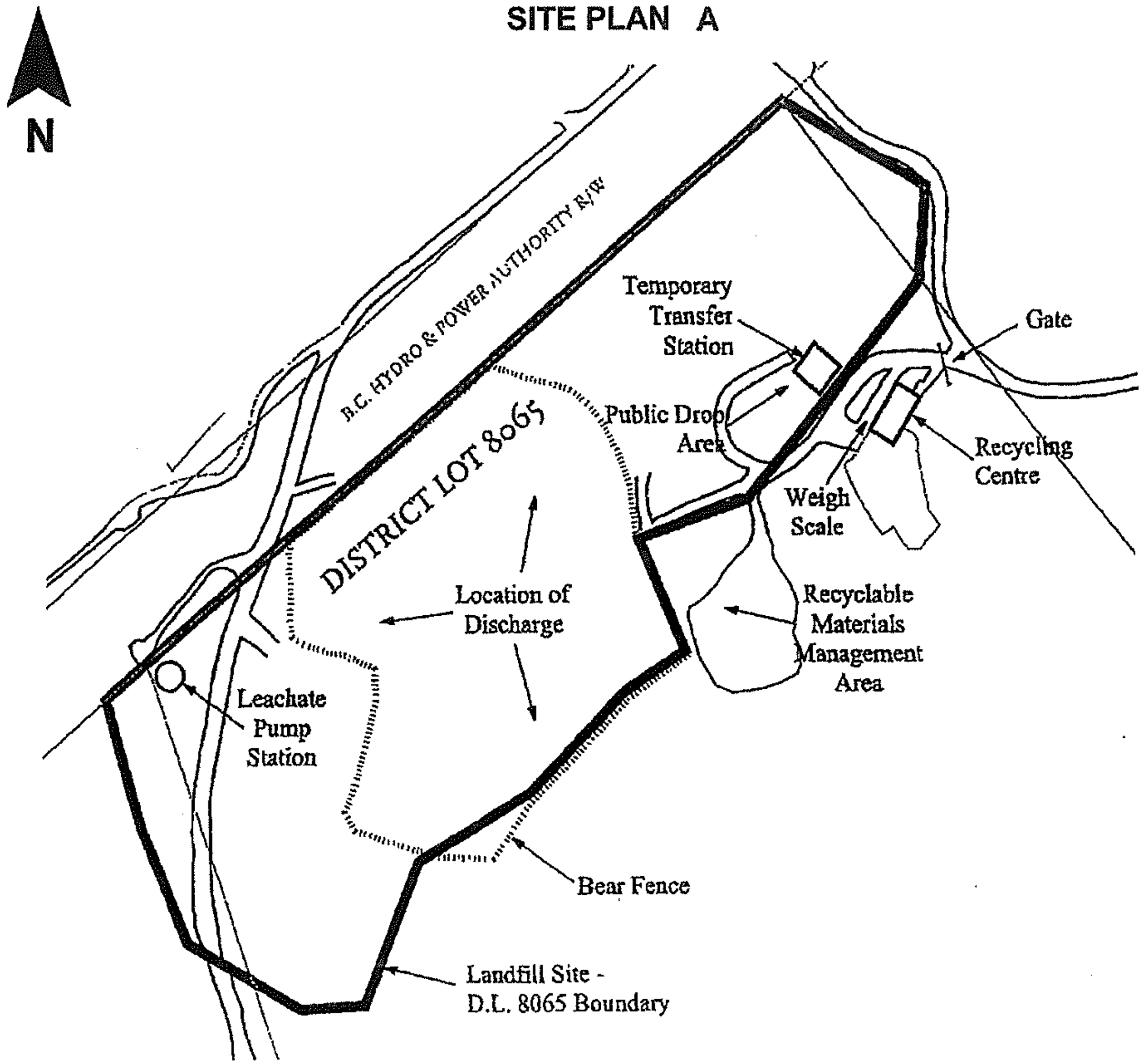
- summaries of waste and recyclable material records in accordance with **Section 3.1**.
- a review and interpretation of the analytical data resulting from post closure monitoring;
- a summary of post-closure maintenance carried out at the site during the year and any planned maintenance for the upcoming year; and
- identification of any environmental issues and corrective actions taken;

The annual report shall be submitted to the manager on or before March 31^{st} of the following year.

PROVINCE OF
BRITISH COLUMBIA

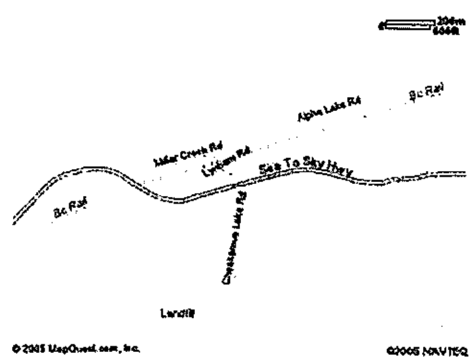
Environmental Protection

SITE PLAN A



Legal Description: District Lot 8065, Group 1, N.W.D.

Location Map



Scale: Not to Scale

OPERATIONAL CERTIFICATE: **MR-04692**

Date:

J. L. McGuire
For Director, Environmental Management Act

APPENDIX L: Operational and Alarm-Shutdown Setpoints

Operational Setpoints

	Element	Status	Edits
1	V4237		15
2	V4311		30
3	V5404 Minute Set Clock		
4	V5405 Hour Set Clock		
5	V5406 Day Set Clock		
6	V5407 Month Set Clock		11
7	V5410 Year, 00 Set Clock		6
8	V13140		40
9	V13141		100
10	V13142		1
11	V13143		20
12	V13144		10
13	V13150		300
14	V13151		5
15	V13152		30
16			
17			
18			
19			
20			
21			
22			

Alarm - Shutdown Setpoints

	Element	Status	Edits
1	V4035		5
2	V5035		30
3	V4056 Secs Blower 301 High Vibration Alarm Timer Setpoint		55
4	V5056 0.00 In/S Blower 301 High Vibration Alarm Setpoint		30
5	V4064		33
6	V5064		30
7	V4065		45
8	V5065		30
9	V4073 Secs Control Panel High Temperature Alarm Timer Setpoint		120
10	V5073 Deg F Control Panel High Temperature Alarm Setpoint		30
11	V4273 Secs Control Panel Low Temperature Alarm Timer Setpoint		35
12	V5273 Deg F Control Panel Low Temperature Alarm Setpoint		30
13			
	V4152 Secs Demister 301		120

	Element	Status	Edits
14	V4152 Secs Demister 301 High Condensate Level Shutdown Timer Setpoint		120
15	V4156 Secs Blower 301 High Vibration Shutdown Timer Setpoint		60
16	V5156 0.00 In/S Blower 301 High Vibration Shutdown Setpoint		30
17	V4157		30
18	V5157		
19			

APPENDIX M: System Modification Log

EXHIBIT M-1
System Modification Log

Date	Time	Issue/Problem Encountered	Action Taken	Contact Details

Notes:

Attach additional sheets if necessary

APPENDIX E: Analytical Parameters Associated with Leachate / Groundwater/ Surface Water Quality Monitoring

APPENDIX

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Physical Tests			
Conductivity	APHA 2510 Auto. Conduc.	2.0	uS/cm
Hardness (as CaCO3)	APHA 2340B	0.50	mg/L
pH	APHA 4500-H pH Value	0.10	pH
Water - Anions and Nutrients			
Alkalinity, Bicarbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Carbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Hydroxide (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Total (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC	0.0050	mg/L
Bromide (Br)	APHA 4110 B.	0.050	mg/L
Chloride (Cl)	APHA 4110 B.	0.50	mg/L
Fluoride (F)	APHA 4110 B.	0.020	mg/L
Nitrate (as N)	EPA 300.0	0.0050	mg/L
Nitrite (as N)	EPA 300.0	0.0010	mg/L
Phosphorus (P)-Total	APHA 4500-P Phosphorous	0.0020	mg/L
Sulfate (SO4)	APHA 4110 B.	0.50	mg/L
Total Kjeldahl Nitrogen	APHA 4500-NORG D.	0.050	mg/L
Total Nitrogen	BC MOE LABORATORY MANUAL (2005)	0.050	mg/L
Water - Dissolved Metals			
Aluminum (Al)-Dissolved	EPA SW-846 3005A/6020A	0.01	mg/L
Antimony (Sb)-Dissolved	EPA SW-846 3005A/6020A	0.0005	mg/L
Arsenic (As)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Barium (Ba)-Dissolved	EPA SW-846 3005A/6010B	0.02	mg/L
Beryllium (Be)-Dissolved	EPA SW-846 3005A/6010B	0.005	mg/L
Bismuth (Bi)-Dissolved	EPA SW-846 3005A/6010B	0.2	mg/L
Boron (B)-Dissolved	EPA SW-846 3005A/6010B	0.1	mg/L
Cadmium (Cd)-Dissolved	EPA SW-846 3005A/6020A	0.00005	mg/L
Calcium (Ca)-Dissolved	EPA SW-846 3005A/6010B	0.1	mg/L
Chromium (Cr)-Dissolved	EPA SW-846 3005A/6020A	0.0005	mg/L
Cobalt (Co)-Dissolved	EPA SW-846 3005A/6020A	0.0005	mg/L
Copper (Cu)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Iron (Fe)-Dissolved	EPA SW-846 3005A/6010B	0.03	mg/L
Lead (Pb)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Lithium (Li)-Dissolved	EPA SW-846 3005A/6010B	0.05	mg/L
Magnesium (Mg)-Dissolved	EPA SW-846 3005A/6010B	0.1	mg/L
Manganese (Mn)-Dissolved	EPA SW-846 3005A/6010B	0.01	mg/L
Mercury (Hg)-Dissolved	EPA SW-846 3005A & EPA 245.7	0.0002	mg/L
Molybdenum (Mo)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Nickel (Ni)-Dissolved	EPA SW-846 3005A/6020A	0.005	mg/L
Phosphorus (P)-Dissolved	EPA SW-846 3005A/6010B	0.3	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Dissolved Metals			
Potassium (K)-Dissolved	EPA SW-846 3005A/6010B	2	mg/L
Selenium (Se)-Dissolved	EPA SW-846 3005A/6020A	0.001	mg/L
Silicon (Si)-Dissolved	EPA SW-846 3005A/6010B	0.05	mg/L
Silver (Ag)-Dissolved	EPA SW-846 3005A/6020A	0.00005	mg/L
Sodium (Na)-Dissolved	EPA SW-846 3005A/6010B	2	mg/L
Strontium (Sr)-Dissolved	EPA SW-846 3005A/6010B	0.005	mg/L
Thallium (Tl)-Dissolved	EPA SW-846 3005A/6020A	0.0002	mg/L
Tin (Sn)-Dissolved	EPA SW-846 3005A/6010B	0.03	mg/L
Titanium (Ti)-Dissolved	EPA SW-846 3005A/6010B	0.05	mg/L
Uranium (U)-Dissolved	EPA SW-846 3005A/6020A	0.0002	mg/L
Vanadium (V)-Dissolved	EPA SW-846 3005A/6010B	0.03	mg/L
Zinc (Zn)-Dissolved	EPA SW-846 3005A/6010B	0.005	mg/L
Water - Aggregate Organics			
COD	APHA 5220 D. CHEMICAL OXYGEN DEMAND	20	mg/L
Water - Volatile Organic Compounds			
1,1,1,2-Tetrachloroethane	EPA8260B, 5021	0.0010	mg/L
1,1,1-Trichloroethane	EPA8260B, 5021	0.0010	mg/L
1,1,2,2-Tetrachloroethane	EPA8260B, 5021	0.0010	mg/L
1,1,2-Trichloroethane	EPA8260B, 5021	0.0010	mg/L
1,1-Dichloroethane	EPA8260B, 5021	0.0010	mg/L
1,1-Dichloroethylene	EPA8260B, 5021	0.0010	mg/L
1,1-Dichloropropylene	EPA 8260B, 5012A	0.0010	mg/L
1,2,3-Trichlorobenzene	EPA 8260B, 5012A	0.0010	mg/L
1,2,3-Trichloropropane	EPA 8260B, 5012A	0.0010	mg/L
1,2,3-Trimethylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,2,4-Trichlorobenzene	EPA 8260B, 5012A	0.0010	mg/L
1,2,4-Trimethylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,2-Dibromo-3-chloropropane	EPA 8260B, 5012A	0.0010	mg/L
1,2-Dichlorobenzene	EPA8260B, 5021	0.0010	mg/L
1,2-Dichloroethane	EPA8260B, 5021	0.0010	mg/L
1,2-Dichloroethane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,2-Dichloropropane	EPA8260B, 5021	0.0010	mg/L
1,3,5-Trimethylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,3-Butadiene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
1,3-Dichlorobenzene	EPA8260B, 5021	0.0010	mg/L
1,3-Dichloropropane	EPA 8260B, 5012A	0.0010	mg/L
1,3-Dichloropropene (cis & trans)	EPA8260B, 5021	0.0010	mg/L
1,4-Dichlorobenzene	EPA8260B, 5021	0.0010	mg/L
1,4-Difluorobenzene (SS)	EPA8260B, 5021	1	%

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Volatile Organic Compounds			
2,2-Dichloropropane	EPA 8260B, 5012A	0.0010	mg/L
2-Chlorotoluene	EPA 8260B, 5012A	0.0010	mg/L
2-Hexanone	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
4-Bromofluorobenzene (SS)	EPA8260B, 5021	1	%
4-Chlorotoluene	EPA 8260B, 5012A	0.0010	mg/L
4-Isopropyltoluene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Methyl isobutyl carbinol (MIBC)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Acetone	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Benzene	EPA8260B, 5021	0.00050	mg/L
Bromobenzene	EPA 8260B, 5012A	0.0010	mg/L
Bromochloromethane	EPA 8260B, 5012A	0.0010	mg/L
Bromodichloromethane	EPA8260B, 5021	0.0010	mg/L
Bromoform	EPA8260B, 5021	0.0010	mg/L
Bromomethane	EPA 8260B, 5012A	0.0010	mg/L
Carbon Disulfide	EPA8260B, 5035A, 5021, BC MELP	0.0050	mg/L
Carbon Tetrachloride	EPA8260B, 5021	0.00050	mg/L
Chlorobenzene	EPA8260B, 5021	0.0010	mg/L
Dibromochloromethane	EPA8260B, 5021	0.0010	mg/L
Chloroethane	EPA8260B, 5021	0.0010	mg/L
Chloroform	EPA8260B, 5021	0.0010	mg/L
Chloromethane	EPA8260B, 5021	0.0050	mg/L
cis-1,2-Dichloroethylene	EPA8260B, 5021	0.0010	mg/L
cis-1,3-Dichloropropylene	EPA8260B, 5021	0.0010	mg/L
Decane (nC10)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Dibromomethane	EPA 8260B, 5012A	0.0010	mg/L
Dichlorodifluoromethane	EPA 8260B, 5012A	0.0010	mg/L
Ethylbenzene	EPA8260B, 5021	0.00050	mg/L
1,2-Dibromoethane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
n-Heptane (nC7)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Hexachlorobutadiene	EPA 8260B, 5012A	0.0010	mg/L
n-Hexane (nC6)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Isopropylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
meta- & para-Xylene	EPA8260B, 5021	0.00050	mg/L
Methyl ethyl ketone (MEK)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Methyl isobutyl ketone (MIBK)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Methyl t-butyl ether (MTBE)	EPA8260B, 5021	0.00050	mg/L
Methylcyclohexane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Dichloromethane	EPA8260B, 5021	0.0050	mg/L
n-Butylbenzene	EPA 8260B, 5012A	0.0010	mg/L
n-Propylbenzene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Volatile Organic Compounds			
Naphthalene	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
n-Octane (nC8)	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
ortho-Xylene	EPA8260B, 5021	0.00050	mg/L
n-Pentane	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
sec-Butylbenzene	EPA 8260B, 5012A	0.0010	mg/L
Styrene	EPA8260B, 5021	0.00050	mg/L
tert-Butylbenzene	EPA 8260B, 5012A	0.0010	mg/L
Tetrachloroethylene	EPA8260B, 5021	0.0010	mg/L
Toluene	EPA8260B, 5021	0.00050	mg/L
trans-1,2-Dichloroethylene	EPA8260B, 5021	0.0010	mg/L
trans-1,3-Dichloropropylene	EPA8260B, 5021	0.0010	mg/L
Trichloroethylene	EPA8260B, 5021	0.0010	mg/L
Trichlorofluoromethane	EPA8260B, 5021	0.0010	mg/L
Vinyl Acetate	EPA8260B, 5035A, 5021, BC MELP	0.0010	mg/L
Vinyl Chloride	EPA8260B, 5021	0.0010	mg/L
Xylenes	CALCULATION	0.00075	mg/L
Water - Hydrocarbons			
3,4-Dichlorotoluene (SS)	B.C. MIN. OF ENV. LAB. MAN. (2009)	1	%
EPH10-19	BCMOE EPH GCFID	0.3	mg/L
EPH19-32	BCMOE EPH GCFID	0.3	mg/L
HEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
LEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
Volatile Hydrocarbons (VH6-10)	B.C. MIN. OF ENV. LAB. MAN. (2009)	0.10	mg/L
VPH (C6-C10)	BC MOE LABORATORY MANUAL (2005)	0.10	mg/L
Water - Polycyclic Aromatic Hydrocarbons			
Acenaphthene	EPA 3510, 8270	0.000050	mg/L
Acenaphthene d10	EPA 3510, 8270	1	%
Acenaphthylene	EPA 3510, 8270	0.000050	mg/L
Acridine	EPA 3510, 8270	0.000050	mg/L
Acridine d9	EPA 3510, 8270	1	%
Anthracene	EPA 3510, 8270	0.000050	mg/L
Benz(a)anthracene	EPA 3510, 8270	0.000050	mg/L
Benzo(a)pyrene	EPA 3510, 8270	0.000010	mg/L
Benzo(b)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Benzo(g,h,i)perylene	EPA 3510, 8270	0.000050	mg/L
Benzo(k)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Chrysene	EPA 3510, 8270	0.000050	mg/L
Chrysene d12	EPA 3510, 8270	1	%
Dibenz(a,h)anthracene	EPA 3510, 8270	0.000050	mg/L
Fluoranthene	EPA 3510, 8270	0.000050	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Polycyclic Aromatic Hydrocarbons			
Fluorene	EPA 3510, 8270	0.000050	mg/L
Indeno(1,2,3-c,d)pyrene	EPA 3510, 8270	0.000050	mg/L
Naphthalene	EPA 3510, 8270	0.000050	mg/L
Naphthalene d8	EPA 3510, 8270	1	%
Phenanthrene	EPA 3510, 8270	0.000050	mg/L
Phenanthrene d10	EPA 3510, 8270	1	%
Pyrene	EPA 3510, 8270	0.000050	mg/L
Quinoline	EPA 3510, 8270	0.000050	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Physical Tests			
Conductivity	APHA 2510 Auto. Conduc.	2.0	uS/cm
Hardness (as CaCO3)	APHA 2340B	0.50	mg/L
pH	APHA 4500-H pH Value	0.10	pH
Total Suspended Solids	APHA 2540 D - GRAVIMETRIC	3.0	mg/L
Water - Anions and Nutrients			
Alkalinity, Bicarbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Carbonate (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Hydroxide (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Alkalinity, Total (as CaCO3)	APHA 2320 Alkalinity	1.0	mg/L
Ammonia, Total (as N)	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC	0.0050	mg/L
Bromide (Br)	APHA 4110 B.	0.050	mg/L
Chloride (Cl)	APHA 4110 B.	0.50	mg/L
Fluoride (F)	APHA 4110 B.	0.020	mg/L
Nitrate (as N)	EPA 300.0	0.0050	mg/L
Nitrite (as N)	EPA 300.0	0.0010	mg/L
Phosphorus (P)-Total	APHA 4500-P Phosphorous	0.0020	mg/L
Sulfate (SO4)	APHA 4110 B.	0.50	mg/L
Total Kjeldahl Nitrogen	APHA 4500-NORG D.	0.050	mg/L
Total Nitrogen	BC MOE LABORATORY MANUAL (2005)	0.050	mg/L
Water - Total Metals			
Aluminum (Al)-Total	EPA SW-846 3005A/6020A	0.01	mg/L
Antimony (Sb)-Total	EPA SW-846 3005A/6020A	0.0005	mg/L
Arsenic (As)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Barium (Ba)-Total	EPA SW-846 3005A/6010B	0.02	mg/L
Beryllium (Be)-Total	EPA SW-846 3005A/6010B	0.005	mg/L
Bismuth (Bi)-Total	EPA SW-846 3005A/6010B	0.2	mg/L
Boron (B)-Total	EPA SW-846 3005A/6010B	0.1	mg/L
Cadmium (Cd)-Total	EPA SW-846 3005A/6020A	0.00005	mg/L
Calcium (Ca)-Total	EPA SW-846 3005A/6010B	0.1	mg/L
Chromium (Cr)-Total	EPA SW-846 3005A/6020A	0.0005	mg/L
Cobalt (Co)-Total	EPA SW-846 3005A/6020A	0.0005	mg/L
Copper (Cu)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Iron (Fe)-Total	EPA SW-846 3005A/6010B	0.03	mg/L
Lead (Pb)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Lithium (Li)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Magnesium (Mg)-Total	EPA SW-846 3005A/6010B	0.1	mg/L
Manganese (Mn)-Total	EPA SW-846 3005A/6010B	0.01	mg/L
Mercury (Hg)-Total	EPA 245.7	0.0002	mg/L
Molybdenum (Mo)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Nickel (Ni)-Total	EPA SW-846 3005A/6020A	0.005	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Total Metals			
Phosphorus (P)-Total	EPA SW-846 3005A/6010B	0.3	mg/L
Potassium (K)-Total	EPA SW-846 3005A/6010B	2	mg/L
Selenium (Se)-Total	EPA SW-846 3005A/6020A	0.001	mg/L
Silicon (Si)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Silver (Ag)-Total	EPA SW-846 3005A/6020A	0.00005	mg/L
Sodium (Na)-Total	EPA SW-846 3005A/6010B	2	mg/L
Strontium (Sr)-Total	EPA SW-846 3005A/6010B	0.005	mg/L
Thallium (Tl)-Total	EPA SW-846 3005A/6020A	0.0002	mg/L
Tin (Sn)-Total	EPA SW-846 3005A/6010B	0.03	mg/L
Titanium (Ti)-Total	EPA SW-846 3005A/6010B	0.05	mg/L
Uranium (U)-Total	EPA SW-846 3005A/6020A	0.0002	mg/L
Vanadium (V)-Total	EPA SW-846 3005A/6010B	0.03	mg/L
Zinc (Zn)-Total	EPA SW-846 3005A/6010B	0.005	mg/L
Water - Aggregate Organics			
COD	APHA 5220 D. CHEMICAL OXYGEN DEMAND	20	mg/L
Water - Hydrocarbons			
EPH10-19	BCMOE EPH GCFID	0.3	mg/L
EPH19-32	BCMOE EPH GCFID	0.3	mg/L
HEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
LEPH	BC MOE LABORATORY MANUAL (2005)	0.25	ug/mL
Water - Polycyclic Aromatic Hydrocarbons			
Acenaphthene	EPA 3510, 8270	0.000050	mg/L
Acenaphthene d10	EPA 3510, 8270	1	%
Acenaphthylene	EPA 3510, 8270	0.000050	mg/L
Acridine	EPA 3510, 8270	0.000050	mg/L
Acridine d9	EPA 3510, 8270	1	%
Anthracene	EPA 3510, 8270	0.000050	mg/L
Benz(a)anthracene	EPA 3510, 8270	0.000050	mg/L
Benzo(a)pyrene	EPA 3510, 8270	0.000010	mg/L
Benzo(b)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Benzo(g,h,i)perylene	EPA 3510, 8270	0.000050	mg/L
Benzo(k)fluoranthene	EPA 3510, 8270	0.000050	mg/L
Chrysene	EPA 3510, 8270	0.000050	mg/L
Chrysene d12	EPA 3510, 8270	1	%
Dibenz(a,h)anthracene	EPA 3510, 8270	0.000050	mg/L
Fluoranthene	EPA 3510, 8270	0.000050	mg/L
Fluorene	EPA 3510, 8270	0.000050	mg/L
Indeno(1,2,3-c,d)pyrene	EPA 3510, 8270	0.000050	mg/L
Naphthalene	EPA 3510, 8270	0.000050	mg/L

Quoted Parameters with Detection Limits

Parameter	Method Reference	Report D.L.	Units
Water - Polycyclic Aromatic Hydrocarbons			
Naphthalene d8	EPA 3510, 8270	1	%
Phenanthrene	EPA 3510, 8270	0.000050	mg/L
Phenanthrene d10	EPA 3510, 8270	1	%
Pyrene	EPA 3510, 8270	0.000050	mg/L
Quinoline	EPA 3510, 8270	0.000050	mg/L

Methodology

Product	Matrix	Product Description	Analytical Method Reference
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

Methodology

Product	Matrix	Product Description	Analytical Method Reference

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-SF-FID-VA	Water	EPH in Water by GCFID	BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-TOT-CVAFS-VA	Water	Total Mercury in Water by CVAFS	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA	Water	Total Metals in Water by ICPMS(Low)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Methodology

Product	Matrix	Product Description	Analytical Method Reference
NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

Product	Matrix	Product Description	Analytical Method Reference
P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

Product	Matrix	Product Description	Analytical Method Reference
PAH-SF-MS-VA	Water	PAH in Water by GCMS	EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Product	Matrix	Product Description	Analytical Method Reference
PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

Product	Matrix	Product Description	Analytical Method Reference
PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

Product	Matrix	Product Description	Analytical Method Reference
SAMPLE-DISPOSAL-VA	Misc.	Sample Handling and Disposal Fee	
TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

Product	Matrix	Product Description	Analytical Method Reference
TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

Product	Matrix	Product Description	Analytical Method Reference
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

APPENDIX F: Laboratory Results for Leachate Quality Monitoring Compared to Standards and Guidelines

Q1 - 2012 Leachate Results		BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	L1 REP	L1
Analyte	Units			1/26/2012	1/26/2012
Physical Parameters					
Conductivity	uS/cm	-	-	693	688
Hardness (as CaCO3)	mg/L	-	-	318	315
pH	pH	-	9	7.12	7.03
Nutrient & Anions					
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	119	118
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	119	118
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	0.397	0.407
Bromide (Br)	mg/L	-	-	<0.25	<0.25
Chloride (Cl)	mg/L	1500	150	7.3	7.6
Fluoride (F)	mg/L	2	0.4	<0.10	<0.10
Nitrate (as N)	mg/L	400	32.8	24.5	24.5
Nitrite (as N)	mg/L	0.2	0.06	0.0148	0.0184
Total Kjeldahl Nitrogen	mg/L	-	-	1.36	0.977
Total Nitrogen	mg/L	-	-	25.9	25.5
Phosphorus (P)-Total	mg/L	-	-	0.011	0.0099
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	145	144
Dissolved Metals					
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	0.028	0.027
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050	<0.00050
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	<0.0010	<0.0010
Barium (Ba)-Dissolved	mg/L	10	1	0.049	0.053
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	<0.10	<0.10
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	0.00022	0.000227
Calcium (Ca)-Dissolved	mg/L	-	-	109	108
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.00149	0.00171
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 150 - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	0.027	0.027
Iron (Fe)-Dissolved	mg/L	-	0.35	<0.030	0.032
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	10.9	10.9
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	1.6	1.62
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	<0.0010	<0.0010
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	<0.0050
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	-	373	5	5
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010	<0.0010
Silicon (Si)-Dissolved	mg/L	-	-	11.4	11.4
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	17.9	18.2
Strontium (Sr)-Dissolved	mg/L	-	-	0.425	0.428
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020	<0.00020
Tin (Sn)-Dissolved	mg/L	-	-	<0.030	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	<0.00020	<0.00020

Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030	<0.030
Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	0.0282	0.028
Aggregate Organics					
COD	mg/L	-	-	39	40
VOCs					
Acetone	mg/L	-	-	<0.0010	<0.0010
Benzene	mg/L	4	0.04	<0.00050	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010	<0.0010
Bromoform	mg/L	-	-	<0.0010	<0.0010
Bromomethane	mg/L	-	-	<0.0010	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010	<0.0010
Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	<0.0010	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010	<0.0010
Chloroethane	mg/L	-	-	<0.0010	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010	<0.0010
Chloromethane	mg/L	-	-	<0.0050	<0.0050
Dibromomethane	mg/L	-	-	<0.0010	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070	<0.00070
1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010	<0.0010
1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050	<0.00050
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.010	<0.010
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00050	<0.00050
Styrene	mg/L	0.72	0.072	<0.00050	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0020	<0.0010
Toluene	mg/L	0.39	0.0005	<0.00050	<0.00050
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050	<0.00050
Xylenes	mg/L	-	0.03	<0.00075	<0.00075
Hydrocarbons					
EPH10-19	mg/L	5	-	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10	<0.10
PAHs					
Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q2 - 2012 Leachate Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	L1 5/16/2012
Physical Parameters				
Conductivity	uS/cm	-	-	623
Hardness (as CaCO3)	mg/L	-	-	289
pH	pH	-	9	7.42
Nutrient & Anions				
Alkalinity, Total (as CaCO3)	mg/L	-	-	155
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	0.491
Bromide (Br)	mg/L	-		0.083
Chloride (Cl)	mg/L	1500	150	10.6
Fluoride (F)	mg/L	2	0.4	<0.10
Nitrate (as N)	mg/L	400	32.8	11.3
Nitrite (as N)	mg/L	0.2	0.06	0.0406
Total Kjeldahl Nitrogen	mg/L	-	-	1.46
Total Nitrogen	mg/L	-	-	12.8
Phosphorus (P)-Total	mg/L	-	-	0.0258
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	123
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	0.02
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	<0.0010
Barium (Ba)-Dissolved	mg/L	10	1	0.053
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	<0.10
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	0.000213
Calcium (Ca)-Dissolved	mg/L	-	-	99.5
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.00116
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	0.0208
Iron (Fe)-Dissolved	mg/L	-	0.35	<0.030
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	9.73
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	1.86
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	<0.0010
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30
Potassium (K)-Dissolved	mg/L	-	373	5.4
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010
Silicon (Si)-Dissolved	mg/L	-	-	8.78
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	16.5
Strontium (Sr)-Dissolved	mg/L	-	-	0.381
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020
Tin (Sn)-Dissolved	mg/L	-	-	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	<0.00020
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030

Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	0.0175
Aggregate Organics				
COD	mg/L	-	-	34
VOCs				
Acetone	mg/L	-	-	<0.020
Benzene	mg/L	4	0.04	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Bromomethane	mg/L	-	-	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010
Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010
Chloromethane	mg/L	-	-	<0.0050
Dibromomethane	mg/L	-	-	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070
1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010
1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.010
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00050
Styrene	mg/L	0.72	0.072	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0010
Toluene	mg/L	0.39	0.0005	<0.0030
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050
Xylenes	mg/L	-	0.03	<0.00075
Hydrocarbons				
EPH10-19	mg/L	5	-	<0.25
EPH19-32	mg/L	-	-	<0.25
LEPH	mg/L	0.5	-	<0.25
HEPH	mg/L	-	-	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10
PAHs				
Acenaphthene	mg/L	0.06	0.006	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050
Chrysene	mg/L	0.001	-	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q3 - 2012 Leachate Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	L1 9/26/2012
Physical Parameters				
Conductivity	uS/cm	-	-	3870
Hardness (as CaCO3)	mg/L	-	-	1430
pH	pH	-	9	7.77
Nutrients & Anions				
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	1430
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	1430
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	**157**
Bromide (Br)	mg/L	-	-	1.9
Chloride (Cl)	mg/L	1500	150	382
Fluoride (F)	mg/L	2	0.4	<0.40
Nitrate (as N)	mg/L	400	32.8	22.8
Nitrite (as N)	mg/L	0.2	0.06	**0.516**
Total Kjeldahl Nitrogen	mg/L	-	-	232
Total Nitrogen	mg/L	-	-	286
Phosphorus (P)-Total	mg/L	-	-	25.6
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	160
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	<0.050
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.0025
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	<0.0050
Barium (Ba)-Dissolved	mg/L	10	1	0.526
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	3.64
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	<0.00025
Calcium (Ca)-Dissolved	mg/L	-	-	479
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.0025
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.006
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	0.0072
Iron (Fe)-Dissolved	mg/L	-	0.35	0.352
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0050 *
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	56.4
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	9.6
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	<0.0050
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.025
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30
Potassium (K)-Dissolved	mg/L	-	373	164
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0050
Silicon (Si)-Dissolved	mg/L	-	-	11
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.00025
Sodium (Na)-Dissolved	mg/L	-	-	395
Strontium (Sr)-Dissolved	mg/L	-	-	3.47
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.0010
Tin (Sn)-Dissolved	mg/L	-	-	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	<0.0010
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030

Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	0.0975
Aggregate Organics				
COD	mg/L	-	-	161
VOCs				
Acetone	mg/L	-	-	<0.020
Benzene	mg/L	4	0.04	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Bromomethane	mg/L	-	-	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010
Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010
Chloromethane	mg/L	-	-	<0.0050
Dibromomethane	mg/L	-	-	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070
1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010
1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.0050
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00070
Styrene	mg/L	0.72	0.072	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0010
Toluene	mg/L	0.39	0.0005	<0.00050
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050
Xylenes	mg/L	-	0.03	<0.00075
Hydrocarbons				
EPH10-19	mg/L	5	-	0.84
EPH19-32	mg/L	-	-	0.5
LEPH	mg/L	0.5	-	**0.84**
HEPH	mg/L	-	-	0.5
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10
PAHs				
Acenaphthene	mg/L	0.06	0.006	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050
Chrysene	mg/L	0.001	-	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q4 - 2012 Leachate Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	L1 12/12/2012
Physical Parameters				
Conductivity	uS/cm	-	-	2500
Hardness (as CaCO3)	mg/L	-	-	500
pH	pH	-	9	7.73
Nutrients & Anions				
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	963
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	963
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	**87.3**
Bromide (Br)	mg/L	-	-	<1.0
Chloride (Cl)	mg/L	1500	150	173
Fluoride (F)	mg/L	2	0.4	<0.40
Nitrate (as N)	mg/L	400	32.8	4.53
Nitrite (as N)	mg/L	0.2	0.06	<u>0.122</u>
Total Kjeldahl Nitrogen	mg/L	-	-	97.5
Total Nitrogen	mg/L	-	-	102
Phosphorus (P)-Total	mg/L	-	-	0.49
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	<u>162</u>
Dissolved Metals				
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	<0.010
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	<0.0010
Barium (Ba)-Dissolved	mg/L	10	1	0.109
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	<u>2.24</u>
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	<0.000050
Calcium (Ca)-Dissolved	mg/L	-	-	156
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<u>0.0019</u>
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.00712
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	0.0097
Iron (Fe)-Dissolved	mg/L	-	0.35	0.085
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	27
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	3.42
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	0.0023
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	0.009
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30
Potassium (K)-Dissolved	mg/L	-	373	92.2
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010
Silicon (Si)-Dissolved	mg/L	-	-	8.06
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	191
Strontium (Sr)-Dissolved	mg/L	-	-	0.833
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020
Tin (Sn)-Dissolved	mg/L	-	-	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	0.00028
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030
Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	0.0248
Aggregate Organics				
COD	mg/L	-	-	174

VOCs				
Acetone	mg/L	-	-	0.011
Benzene	mg/L	4	0.04	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010
Bromoform	mg/L	-	-	<0.0010
Bromomethane	mg/L	-	-	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010
Carbon Disulfide	mg/L	-	-	<0.0050
Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010
Chloroethane	mg/L	-	-	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010
Chloromethane	mg/L	-	-	<0.0050
2-Chlorotoluene	mg/L	-	-	<0.0010
4-Chlorotoluene	mg/L	-	-	<0.0010
Decane (nC10)	mg/L	-	-	<0.0010
1,2-Dibromoethane	mg/L	-	-	<0.0010
Dibromomethane	mg/L	-	-	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070
1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010
1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050
n-Heptane (nC7)	mg/L	-	-	<0.0010
n-Hexane (nC6)	mg/L	-	-	<0.0010
2-Hexanone	mg/L	-	-	<0.0010
Isopropylbenzene	mg/L	-	-	<0.0010
4-Isopropyltoluene	mg/L	-	-	<0.0010
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.010
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010
Methylcyclohexane	mg/L	-	-	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00050
Naphthalene	mg/L	0.01	-	<0.0010
n-Octane (nC8)	mg/L	-	-	<0.0010
n-Propylbenzene	mg/L	-	-	<0.0010
Styrene	mg/L	0.72	0.072	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0010
Toluene	mg/L	0.39	0.0005	<0.00050
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010
1,2,3-Trichloropropane	mg/L	-	-	<0.0010
1,2,4-Trimethylbenzene	mg/L	-	-	<0.0010
1,3,5-Trimethylbenzene	mg/L	-	-	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050
Xylenes	mg/L	-	0.03	<0.00075
Hydrocarbons				
EPH10-19	mg/L	5	-	0.58
EPH19-32	mg/L	-	-	0.41
LEPH	mg/L	0.5	-	**0.58**
HEPH	mg/L	-	-	0.41
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10
PAHs				
Acenaphthene	mg/L	0.06	0.006	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050
Chrysene	mg/L	0.001	-	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.00020
Phenanthrene	mg/L	0.003	0.0003	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000080

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the
gudielines are in **bold and underlined**.

APPENDIX G: Analytical Laboratory Results for Leachate, Groundwater & Surface Water Results

MORRISON HERSHFIELD GROUP INC.
ATTN: Josie Gilson
310 - 4321 Still Creek Drive
Burnaby BC V5C 6S7

Date Received: 27-JAN-12
Report Date: 13-FEB-12 17:34 (MT)
Version: FINAL

Client Phone: 604-454-0402

Certificate of Analysis

Lab Work Order #: L1108173

Project P.O. #: NOT SUBMITTED
Job Reference: 5104016
C of C Numbers: 10-196598
Legal Site Desc:

Selam Worku
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1108173-1	L1108173-2	L1108173-3	L1108173-4	L1108173-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12
	Sampled Time					
	Client ID	MW2S	MW2D	MW3	MW4	MW6
WATER						
Physical Tests	Conductivity (uS/cm)	644	1610	377	600	673
	Hardness (as CaCO3) (mg/L)	173	614	98.8	158	144
	pH (pH)	7.27	7.12	6.81	6.99	6.35
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	182	293	40.8	183	10.1
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	182	293	40.8	183	10.1
	Ammonia, Total (as N) (mg/L)	12.9	22.8	0.185	3.69	0.0299
	Bromide (Br) (mg/L)	DLM <0.25	DLM <1.0	0.162	0.099	DLM <0.25
	Chloride (Cl) (mg/L)	30.5	44	74.9	50.7	111
	Fluoride (F) (mg/L)	DLM <0.10	DLM <0.40	0.032	DLM <0.10	DLM <0.10
	Nitrate (as N) (mg/L)	DLM <0.025	DLM <0.10	0.298	<0.0050	DLM <0.025
	Nitrite (as N) (mg/L)	DLM <0.0050	DLM <0.020	<0.0010	<0.0010	DLM <0.0050
	Total Kjeldahl Nitrogen (mg/L)	12.6	20.7	0.261	3.57	0.351
	Total Nitrogen (mg/L)	12.6	20.7	0.559	3.57	0.351
	Phosphorus (P)-Total (mg/L)	0.565	0.382	<0.0020	0.178	2.12
	Sulfate (SO4) (mg/L)	106	611	28.0	59.5	137
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Bismuth (Bi)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-6	L1108173-7	L1108173-8	L1108173-9	L1108173-10
	Description	LEACHATE	WATER	WATER	WATER	WATER
	Sampled Date	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12
	Sampled Time					
	Client ID	L1	WET WELL	SFC 2	SFC 2B	SFC 3
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	688	882	381	681	253
	Hardness (as CaCO3) (mg/L)	315	316	129	225	56.0
	pH (pH)	7.03	6.96	7.22	6.96	7.52
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	118	156	78.8	85.4	34.6
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	118	156	78.8	85.4	34.6
	Ammonia, Total (as N) (mg/L)	0.407	1.74	1.60	6.75	0.0095
	Bromide (Br) (mg/L)	<0.25 DLM	<0.50 DLM	<0.050	<0.25 DLM	<0.050
	Chloride (Cl) (mg/L)	7.6	72.6	23.2	37.6	33.8
	Fluoride (F) (mg/L)	<0.10 DLM	<0.20 DLM	0.069	<0.10 DLM	0.039
	Nitrate (as N) (mg/L)	24.5	<0.050 DLM	1.28	8.08	0.257
	Nitrite (as N) (mg/L)	0.0184	<0.010 DLM	0.0076	0.0576	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.977 TKNI	1.81	1.51	3.52	0.057
	Total Nitrogen (mg/L)	25.5	1.81	2.80	11.7	0.315
	Phosphorus (P)-Total (mg/L)	0.0099	0.0183	0.0020	0.0137	0.0024
	Sulfate (SO4) (mg/L)	144	214	74.5	175	36.3
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Bismuth (Bi)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-11	L1108173-12	L1108173-13		
	Description	WATER	LEACHATE	WATER		
	Sampled Date	26-JAN-12	26-JAN-12			
	Sampled Time					
	Client ID	SFC 11	L1 REP	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	100	693	<2.0		
	Hardness (as CaCO3) (mg/L)	32.5	318	<0.50		
	pH (pH)	7.49	7.12	5.65		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	24.0	119	2.4		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	24.0	119	2.4		
	Ammonia, Total (as N) (mg/L)	<0.0050	0.397	<0.0050		
	Bromide (Br) (mg/L)	<0.050	<0.25 DLM	<0.050		
	Chloride (Cl) (mg/L)	7.11	7.3	<0.50		
	Fluoride (F) (mg/L)	0.046	<0.10 DLM	<0.020		
	Nitrate (as N) (mg/L)	0.413	24.5	<0.0050		
	Nitrite (as N) (mg/L)	<0.0010	0.0148	<0.0010		
	Total Kjeldahl Nitrogen (mg/L)	0.079	1.36 TKNI	<0.050		
	Total Nitrogen (mg/L)	0.492	25.9	<0.0025		
	Phosphorus (P)-Total (mg/L)	0.0047	0.0110	<0.0020		
	Sulfate (SO4) (mg/L)	13.9	145	<0.50		
Total Metals	Aluminum (Al)-Total (mg/L)			<0.010		
	Antimony (Sb)-Total (mg/L)			<0.00050		
	Arsenic (As)-Total (mg/L)			<0.0010		
	Barium (Ba)-Total (mg/L)			<0.020		
	Beryllium (Be)-Total (mg/L)			<0.0050		
	Bismuth (Bi)-Total (mg/L)			<0.20		
	Boron (B)-Total (mg/L)			<0.10		
	Cadmium (Cd)-Total (mg/L)			<0.000050		
	Calcium (Ca)-Total (mg/L)			<0.10		
	Chromium (Cr)-Total (mg/L)			<0.00050		
	Cobalt (Co)-Total (mg/L)			<0.00050		
	Copper (Cu)-Total (mg/L)			<0.0010		
	Iron (Fe)-Total (mg/L)			<0.030		
	Lead (Pb)-Total (mg/L)			<0.0010		
	Lithium (Li)-Total (mg/L)			<0.050		
	Magnesium (Mg)-Total (mg/L)			<0.10		
	Manganese (Mn)-Total (mg/L)			<0.010		
	Mercury (Hg)-Total (mg/L)			<0.00020		
	Molybdenum (Mo)-Total (mg/L)			<0.0010		
	Nickel (Ni)-Total (mg/L)			<0.0050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1108173-1 WATER 26-JAN-12 MW2S	L1108173-2 WATER 26-JAN-12 MW2D	L1108173-3 WATER 26-JAN-12 MW3	L1108173-4 WATER 26-JAN-12 MW4	L1108173-5 WATER 26-JAN-12 MW6
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)					
	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silicon (Si)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Strontium (Sr)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	<0.010	<0.010	0.019	0.115	0.084
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	0.0011	0.0020	<0.0010	<0.0010	<0.0010
	Barium (Ba)-Dissolved (mg/L)	0.137	0.043	0.107	0.214	0.049
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	0.23	0.40	<0.10	0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	0.000064	<0.000050	0.000289	0.000143	0.000402
	Calcium (Ca)-Dissolved (mg/L)	58.0	206	31.1	50.8	46.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	0.00306	0.0245	0.00667	0.0356	0.0330
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	0.0033	0.0033	0.0035
	Iron (Fe)-Dissolved (mg/L)	19.9	55.7	0.040	30.8	0.313
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Dissolved (mg/L)	6.92	24.5	5.15	7.63	6.57
	Manganese (Mn)-Dissolved (mg/L)	2.24	2.81	2.88	3.40	1.64
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Dissolved (mg/L)	0.0035	0.0127	<0.0010	0.0072	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	0.0074	<0.0050	<0.0050	<0.0050
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	14.3	29.1	3.7	8.1	3.7
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)-Dissolved (mg/L)	8.32	12.9	7.54	9.83	7.75

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-6	L1108173-7	L1108173-8	L1108173-9	L1108173-10
	Description	LEACHATE	WATER	WATER	WATER	WATER
	Sampled Date	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12
	Sampled Time					
	Client ID	L1	WET WELL	SFC 2	SFC 2B	SFC 3
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)					
	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silicon (Si)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Strontium (Sr)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.027	<0.010	<0.010	<0.020 DLA	0.035
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010 DLA	<0.00050
	Arsenic (As)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0020 DLA	<0.0010
	Barium (Ba)-Dissolved (mg/L)	0.053	0.099	0.060	0.077	0.024
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	<0.10	0.22	<0.10	<0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	0.000227	<0.000050	0.000074	0.00026	<0.000050
	Calcium (Ca)-Dissolved (mg/L)	108	108	44.1	72.0	18.8
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010 DLA	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	0.00171	0.00287	0.00963	0.0317	<0.00050
	Copper (Cu)-Dissolved (mg/L)	0.0270	<0.0010	0.0014	0.0158	0.0022
	Iron (Fe)-Dissolved (mg/L)	0.032	11.8	1.49	2.41	0.049
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0020 DLA	<0.0010
	Lithium (Li)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Dissolved (mg/L)	10.9	11.2	4.72	11.0	2.21
	Manganese (Mn)-Dissolved (mg/L)	1.62	3.17	1.95	5.99	0.024
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010	0.0019	<0.0020 DLA	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	0.011	<0.0050
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	5.0	7.3	4.9	10.3	<2.0
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0020 DLA	<0.0010
	Silicon (Si)-Dissolved (mg/L)	11.4	8.01	4.25	6.75	6.26

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-11	L1108173-12	L1108173-13		
	Description	WATER	LEACHATE	WATER		
	Sampled Date	26-JAN-12	26-JAN-12			
	Sampled Time					
	Client ID	SFC 11	L1 REP	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)			<0.30		
	Potassium (K)-Total (mg/L)			<2.0		
	Selenium (Se)-Total (mg/L)			<0.0010		
	Silicon (Si)-Total (mg/L)			<0.050		
	Silver (Ag)-Total (mg/L)			<0.000050		
	Sodium (Na)-Total (mg/L)			<2.0		
	Strontium (Sr)-Total (mg/L)			<0.0050		
	Thallium (Tl)-Total (mg/L)			<0.00020		
	Tin (Sn)-Total (mg/L)			<0.030		
	Titanium (Ti)-Total (mg/L)			<0.050		
	Uranium (U)-Total (mg/L)			<0.00020		
	Vanadium (V)-Total (mg/L)			<0.030		
	Zinc (Zn)-Total (mg/L)			<0.0050		
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.045	0.028			
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050			
	Arsenic (As)-Dissolved (mg/L)	<0.0010	<0.0010			
	Barium (Ba)-Dissolved (mg/L)	<0.020	0.049			
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.0050			
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20			
	Boron (B)-Dissolved (mg/L)	<0.10	<0.10			
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	0.000220			
	Calcium (Ca)-Dissolved (mg/L)	10.1	109			
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050			
	Cobalt (Co)-Dissolved (mg/L)	<0.00050	0.00149			
	Copper (Cu)-Dissolved (mg/L)	<0.0010	0.0270			
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030			
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.0010			
	Lithium (Li)-Dissolved (mg/L)	<0.050	<0.050			
	Magnesium (Mg)-Dissolved (mg/L)	1.74	10.9			
	Manganese (Mn)-Dissolved (mg/L)	<0.010	1.60			
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.00020			
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010	<0.0010			
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	<0.0050			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30			
	Potassium (K)-Dissolved (mg/L)	<2.0	5.0			
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010			
	Silicon (Si)-Dissolved (mg/L)	7.46	11.4			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-1	L1108173-2	L1108173-3	L1108173-4	L1108173-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12
	Sampled Time					
	Client ID	MW2S	MW2D	MW3	MW4	MW6
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)-Dissolved (mg/L)	17.3	35.8	22.3	20.8	68.6
	Strontium (Sr)-Dissolved (mg/L)	0.311	0.891	0.236	0.322	0.388
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Dissolved (mg/L)	<0.00020	0.00039	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aggregate Organics	COD (mg/L)	72	83	<20	23	36
Volatile Organic Compounds	Acetone (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Benzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bromodichloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromoform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Butadiene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chlorobenzene (mg/L)	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
	Dibromochloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Dibromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichlorobenzene (mg/L)	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
	Dichloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	trans-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-6	L1108173-7	L1108173-8	L1108173-9	L1108173-10
	Description	LEACHATE	WATER	WATER	WATER	WATER
	Sampled Date	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12
	Sampled Time					
	Client ID	L1	WET WELL	SFC 2	SFC 2B	SFC 3
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	DLA <0.00010	<0.000050
	Sodium (Na)-Dissolved (mg/L)	18.2	43.0	15.7	27.1	24.6
	Strontium (Sr)-Dissolved (mg/L)	0.428	0.722	0.253	0.376	0.145
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	DLA <0.00040	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	DLA <0.00040	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Zinc (Zn)-Dissolved (mg/L)	0.0280	0.0225	0.0094	0.0319	<0.0050
Aggregate Organics	COD (mg/L)	40	<20	<20	33	<20
Volatile Organic Compounds	Acetone (mg/L)	<0.0010	<0.0010			
	Benzene (mg/L)	<0.00050	<0.00050			
	Bromodichloromethane (mg/L)	<0.0010	<0.0010			
	Bromoform (mg/L)	<0.0010	<0.0010			
	Bromomethane (mg/L)	<0.0010	<0.0010			
	1,3-Butadiene (mg/L)	<0.0010	<0.0010			
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050			
	Chlorobenzene (mg/L)	<0.0010	<0.0010			
	Dibromochloromethane (mg/L)	<0.0010	<0.0010			
	Chloroethane (mg/L)	<0.0010	<0.0010			
	Chloroform (mg/L)	<0.0010	<0.0010			
	Chloromethane (mg/L)	<0.0050	<0.0050			
	Dibromomethane (mg/L)	<0.0010	<0.0010			
	1,2-Dichlorobenzene (mg/L)	<0.00070	<0.00070			
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010			
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010			
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010			
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010			
	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010			
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010			
	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010			
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014	<0.0014			
	Dichloromethane (mg/L)	<0.0050	<0.0050			
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010			
	cis-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010			
	trans-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-11	L1108173-12	L1108173-13		
	Description	WATER	LEACHATE	WATER		
	Sampled Date	26-JAN-12	26-JAN-12			
	Sampled Time					
	Client ID	SFC 11	L1 REP	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000050			
	Sodium (Na)-Dissolved (mg/L)	5.6	17.9			
	Strontium (Sr)-Dissolved (mg/L)	0.108	0.425			
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020			
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.030			
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.050			
	Uranium (U)-Dissolved (mg/L)	<0.00020	<0.00020			
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.030			
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	0.0282			
Aggregate Organics	COD (mg/L)	<20	39	<20		
Volatile Organic Compounds	Acetone (mg/L)		<0.0010	<0.0010		
	Benzene (mg/L)		<0.00050	<0.00050		
	Bromodichloromethane (mg/L)		<0.0010	<0.0010		
	Bromoform (mg/L)		<0.0010	<0.0010		
	Bromomethane (mg/L)		<0.0010	<0.0010		
	1,3-Butadiene (mg/L)		<0.0010	<0.0010		
	Carbon Tetrachloride (mg/L)		<0.00050	<0.00050		
	Chlorobenzene (mg/L)		<0.0010	<0.0010		
	Dibromochloromethane (mg/L)		<0.0010	<0.0010		
	Chloroethane (mg/L)		<0.0010	<0.0010		
	Chloroform (mg/L)		<0.0010	<0.0010		
	Chloromethane (mg/L)		<0.0050	<0.0050		
	Dibromomethane (mg/L)		<0.0010	<0.0010		
	1,2-Dichlorobenzene (mg/L)		<0.00070	<0.00070		
	1,3-Dichlorobenzene (mg/L)		<0.0010	<0.0010		
	1,4-Dichlorobenzene (mg/L)		<0.0010	<0.0010		
	1,1-Dichloroethane (mg/L)		<0.0010	<0.0010		
	1,2-Dichloroethane (mg/L)		<0.0010	<0.0010		
	1,1-Dichloroethylene (mg/L)		<0.0010	<0.0010		
	cis-1,2-Dichloroethylene (mg/L)		<0.0010	<0.0010		
	trans-1,2-Dichloroethylene (mg/L)		<0.0010	<0.0010		
	1,3-Dichloropropene (cis & trans) (mg/L)		<0.0014	<0.0014		
	Dichloromethane (mg/L)		<0.0050	<0.0050		
	1,2-Dichloropropane (mg/L)		<0.0010	<0.0010		
	cis-1,3-Dichloropropylene (mg/L)		<0.0010	<0.0010		
	trans-1,3-Dichloropropylene (mg/L)		<0.0010	<0.0010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1108173-1 WATER 26-JAN-12 MW2S	L1108173-2 WATER 26-JAN-12 MW2D	L1108173-3 WATER 26-JAN-12 MW3	L1108173-4 WATER 26-JAN-12 MW4	L1108173-5 WATER 26-JAN-12 MW6
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	Ethylbenzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Methyl ethyl ketone (MEK) (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Styrene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Tetrachloroethylene (mg/L)	<0.0030	<0.0020	<0.0010	<0.0020	<0.0020
	Toluene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vinyl Chloride (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	ortho-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	93.4	91.2	90.3	88.9	93.1
	Surrogate: 1,4-Difluorobenzene (SS) (%)	101.8	101.7	101.9	100.7	100.9
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	VPH (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	81.0	78.2	83.9	74.8	SURR-ND 67.8
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1108173-6	L1108173-7	L1108173-8	L1108173-9	L1108173-10
	Description	LEACHATE	WATER	WATER	WATER	WATER
	Sampled Date	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12
	Sampled Time					
	Client ID	L1	WET WELL	SFC 2	SFC 2B	SFC 3
WATER						
Volatile Organic Compounds	Ethylbenzene (mg/L)	<0.00050	<0.00050			
	Methyl ethyl ketone (MEK) (mg/L)	<0.010	<0.010			
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010	<0.0010			
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	<0.00050			
	Styrene (mg/L)	<0.00050	<0.00050			
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010			
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010			
	Tetrachloroethylene (mg/L)	<0.0010	<0.0010			
	Toluene (mg/L)	<0.00050	<0.00050			
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010			
	1,1,2-Trichloroethane (mg/L)	<0.0010	<0.0010			
	Trichloroethylene (mg/L)	<0.0010	<0.0010			
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010			
	Vinyl Chloride (mg/L)	<0.0010	<0.0010			
	ortho-Xylene (mg/L)	<0.00050	<0.00050			
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050			
	Xylenes (mg/L)	<0.00075	<0.00075			
	Surrogate: 4-Bromofluorobenzene (SS) (%)	91.3	91.3			
	Surrogate: 1,4-Difluorobenzene (SS) (%)	100.9	100.3			
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10	<0.10			
	VPH (C6-C10) (mg/L)	<0.10	<0.10			
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	84.9	81.1			
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	0.000785	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-11	L1108173-12	L1108173-13		
	Description	WATER	LEACHATE	WATER		
	Sampled Date	26-JAN-12	26-JAN-12			
	Sampled Time					
	Client ID	SFC 11	L1 REP	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	Ethylbenzene (mg/L)		<0.00050	<0.00050		
	Methyl ethyl ketone (MEK) (mg/L)		<0.010	<0.010		
	Methyl isobutyl ketone (MIBK) (mg/L)		<0.0010	<0.0010		
	Methyl t-butyl ether (MTBE) (mg/L)		<0.00050	<0.00050		
	Styrene (mg/L)		<0.00050	<0.00050		
	1,1,1,2-Tetrachloroethane (mg/L)		<0.0010	<0.0010		
	1,1,2,2-Tetrachloroethane (mg/L)		<0.0010	<0.0010		
	Tetrachloroethylene (mg/L)		<0.0020	<0.0020		
	Toluene (mg/L)		<0.00050	<0.00050		
	1,1,1-Trichloroethane (mg/L)		<0.0010	<0.0010		
	1,1,2-Trichloroethane (mg/L)		<0.0010	<0.0010		
	Trichloroethylene (mg/L)		<0.0010	<0.0010		
	Trichlorofluoromethane (mg/L)		<0.0010	<0.0010		
	Vinyl Chloride (mg/L)		<0.0010	<0.0010		
	ortho-Xylene (mg/L)		<0.00050	<0.00050		
	meta- & para-Xylene (mg/L)		<0.00050	<0.00050		
	Xylenes (mg/L)		<0.00075	<0.00075		
	Surrogate: 4-Bromofluorobenzene (SS) (%)		91.3	93.9		
	Surrogate: 1,4-Difluorobenzene (SS) (%)		100.6	101.3		
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	0.35		
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25		
	LEPH (mg/L)	<0.25	<0.25	0.35		
	HEPH (mg/L)	<0.25	<0.25	<0.25		
	Volatile Hydrocarbons (VH6-10) (mg/L)		<0.10	<0.10		
	VPH (C6-C10) (mg/L)		<0.10	<0.10		
	Surrogate: 3,4-Dichlorotoluene (SS) (%)		86.8	97.5		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acridine (mg/L)	<0.000050	<0.000050	DLM <0.000060		
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010		
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1108173-1 WATER 26-JAN-12 MW2S	L1108173-2 WATER 26-JAN-12 MW2D	L1108173-3 WATER 26-JAN-12 MW3	L1108173-4 WATER 26-JAN-12 MW4	L1108173-5 WATER 26-JAN-12 MW6
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	94.0	90.1	95.8	101.4	87.8
	Surrogate: Acridine d9 (%)	100.7	93.9	102.7	92.6	89.2
	Surrogate: Chrysene d12 (%)	92.4	96.7	99.9	98.0	80.2
	Surrogate: Naphthalene d8 (%)	91.0	80.7	87.4	93.0	88.6
	Surrogate: Phenanthrene d10 (%)	91.6	88.1	92.0	87.7	87.3

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-6	L1108173-7	L1108173-8	L1108173-9	L1108173-10
	Description	LEACHATE	WATER	WATER	WATER	WATER
	Sampled Date	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12	26-JAN-12
	Sampled Time					
	Client ID	L1	WET WELL	SFC 2	SFC 2B	SFC 3
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	0.000114	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	0.000249	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	0.000059	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	84.5	84.4	86.0	85.7	87.7
	Surrogate: Acridine d9 (%)	87.2	85.7	87.5	86.0	83.7
	Surrogate: Chrysene d12 (%)	77.0	78.0	77.2	76.6	77.3
	Surrogate: Naphthalene d8 (%)	82.8	86.6	87.7	86.0	88.5
	Surrogate: Phenanthrene d10 (%)	80.9	82.2	84.4	82.1	82.9

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1108173-11	L1108173-12	L1108173-13		
	Description	WATER	LEACHATE	WATER		
	Sampled Date	26-JAN-12	26-JAN-12			
	Sampled Time					
	Client ID	SFC 11	L1 REP	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050		
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Fluorene (mg/L)	<0.000050	<0.000050	0.000085		
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050		
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Quinoline (mg/L)	<0.000050	<0.000050	DLM <0.000060		
	Surrogate: Acenaphthene d10 (%)	85.2	82.5	91.0		
	Surrogate: Acridine d9 (%)	86.1	84.8	99.5		
	Surrogate: Chrysene d12 (%)	74.6	85.0	92.8		
	Surrogate: Naphthalene d8 (%)	85.6	79.8	91.5		
	Surrogate: Phenanthrene d10 (%)	82.3	72.8	91.8		

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SFPL	Sample was Filtered and Preserved at the laboratory - samples # 1-12 - Dissolved Metals
SR:COC	Sample Received, Not Listed on Submitted Chain of Custody / Analytical Request Form - sample # Travel Blank - extra not on CoC

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bromide (Br)	DLM	L1108173-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1108173-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Method Blank	Benzo(a)pyrene	MB-LOR	L1108173-10, -11, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.
SURR-ND	Surrogate recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
TKNI	TKN result is likely biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ALS Test Code	Matrix	Test Description	Method Reference**
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ALS Test Code	Matrix	Test Description	Method Reference**
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

ALS Test Code	Matrix	Test Description	Method Reference**
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

ALS Test Code	Matrix	Test Description	Method Reference**
EPH-SF-FID-VA	Water	EPH in Water by GCFID	BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and

Reference Information

Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

FUELS-HSMS-VA | Water | VOCs in water by Headspace GCMS | EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

HARDNESS-CALC-VA | Water | Hardness | APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA | Water | Dissolved Mercury in Water by CVAFS | EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA | Water | Total Mercury in Water by CVAFS | EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA | Water | LEPHs and HEPHs | BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-DIS-ICP-VA | Water | Dissolved Metals in Water by ICPOES | EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA | Water | Dissolved Metals in Water by ICPMS(Low) | EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-ICP-VA | Water | Total Metals in Water by ICPOES | EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA | Water | Total Metals in Water by ICPMS(Low) | EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA | Water | Ammonia in Water by Fluorescence | J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA | Water | Total P in Water by Colour | APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PAH-SF-MS-VA | Water | PAH in Water by GCMS | EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA | Water | PAH Surrogates for Waters | EPA 3510, 8270

Reference Information

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

VH-HSFID-VA	Water	VH in Water by Headspace GCFID	B.C. MIN. OF ENV. LAB. MAN. (2009)

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.

VH-SURR-FID-VA	Water	VH Surrogates for Waters	B.C. MIN. OF ENV. LAB. MAN. (2009)
VOC-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC-M-HSMS-VA	Water	Volatile Organic Compounds - GC-MS	EPA 8260B, 5012A

Water samples, with reagents, are heated and an aliquot of the headspace at equilibrium is analysed by GC-MS.

VOC-M2-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA	Water	BTEX/MTBE/Styrene by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Water	VOC7 and/or VOC Surrogates for Waters	EPA8260B, 5021
VPH-CALC-VA	Water	VPH is VH minus select aromatics	BC MOE LABORATORY MANUAL (2005)

These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).

XYLENES-CALC-VA	Water	Sum of Xylene Isomer Concentrations	CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** 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 ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

10-196598

Reference Information

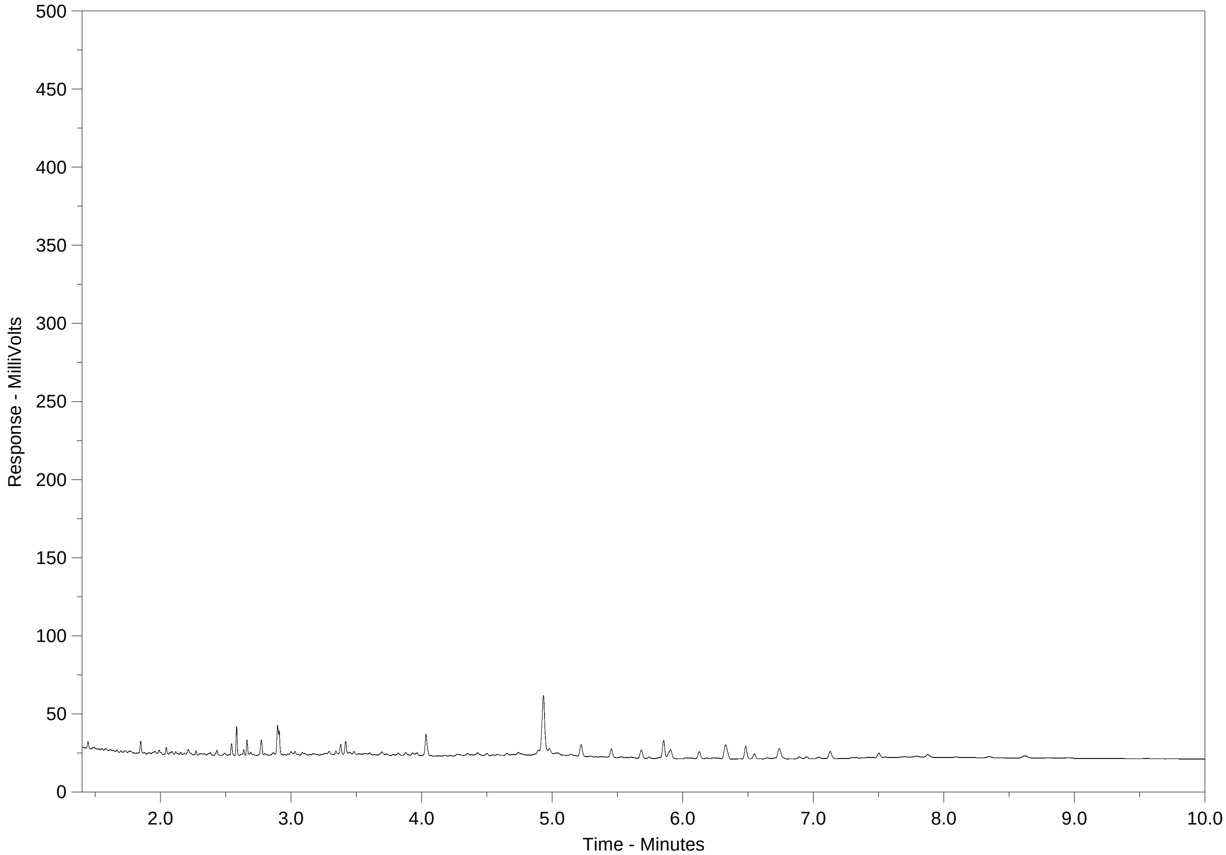
GLOSSARY OF REPORT TERMS

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 received 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.

Hydrocarbon Distribution Report

ALS Sample ID: L1108173-1
Client Sample ID: MW2S



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

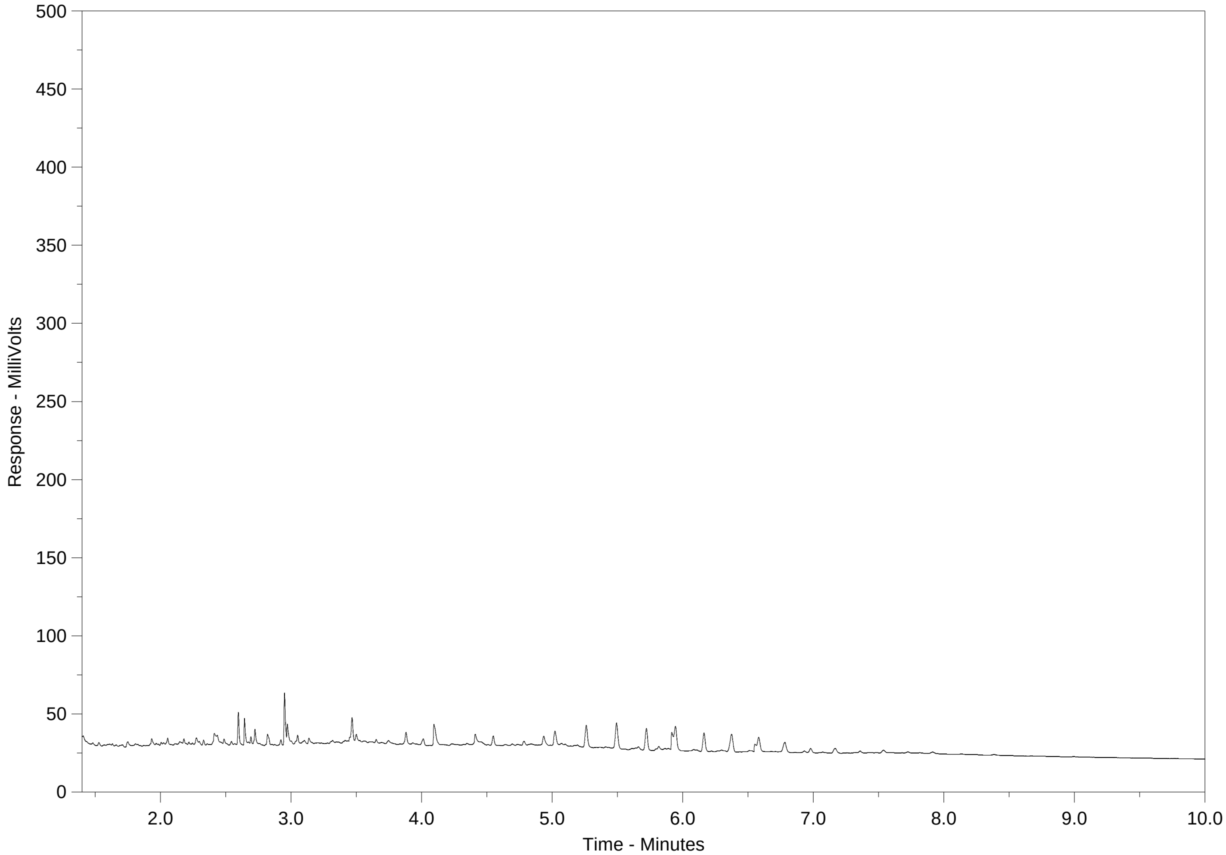
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1108173-2
Client Sample ID: MW2D



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

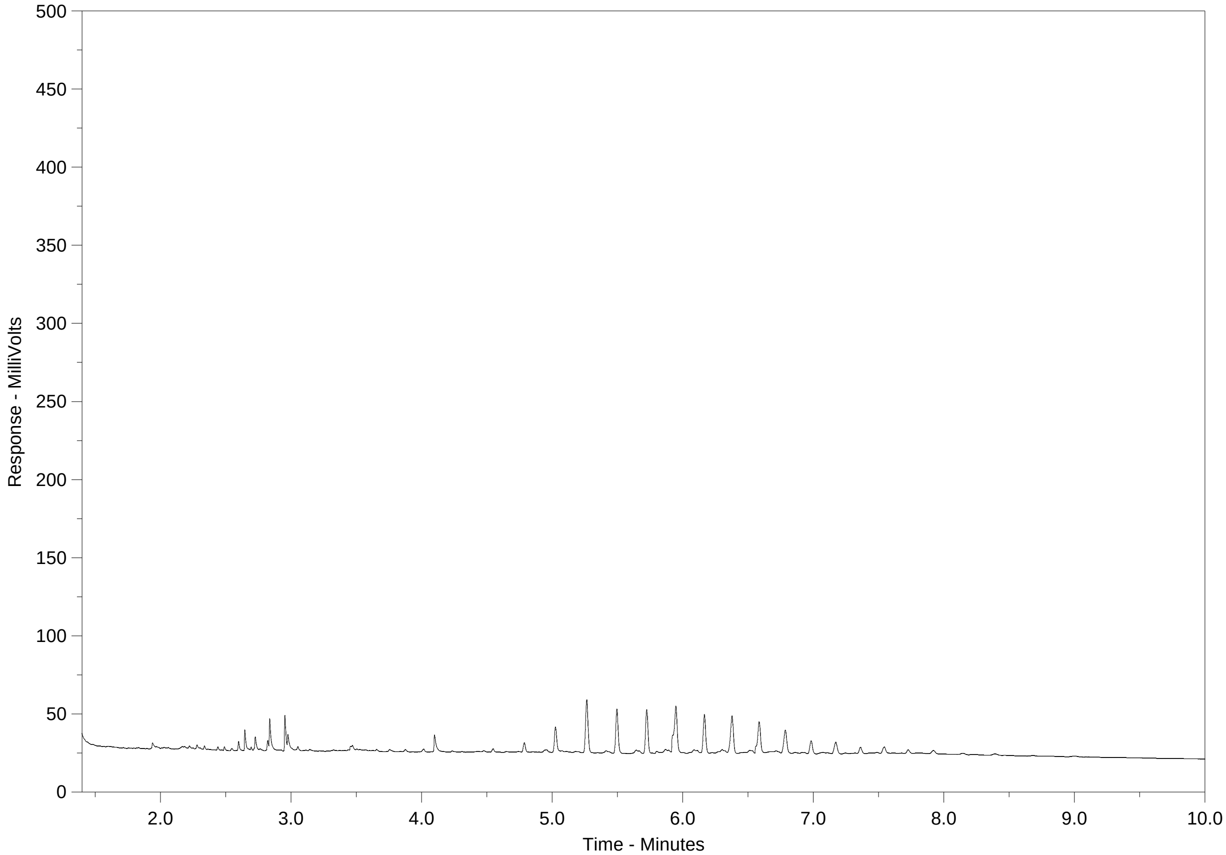
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1108173-4
Client Sample ID: MW4



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

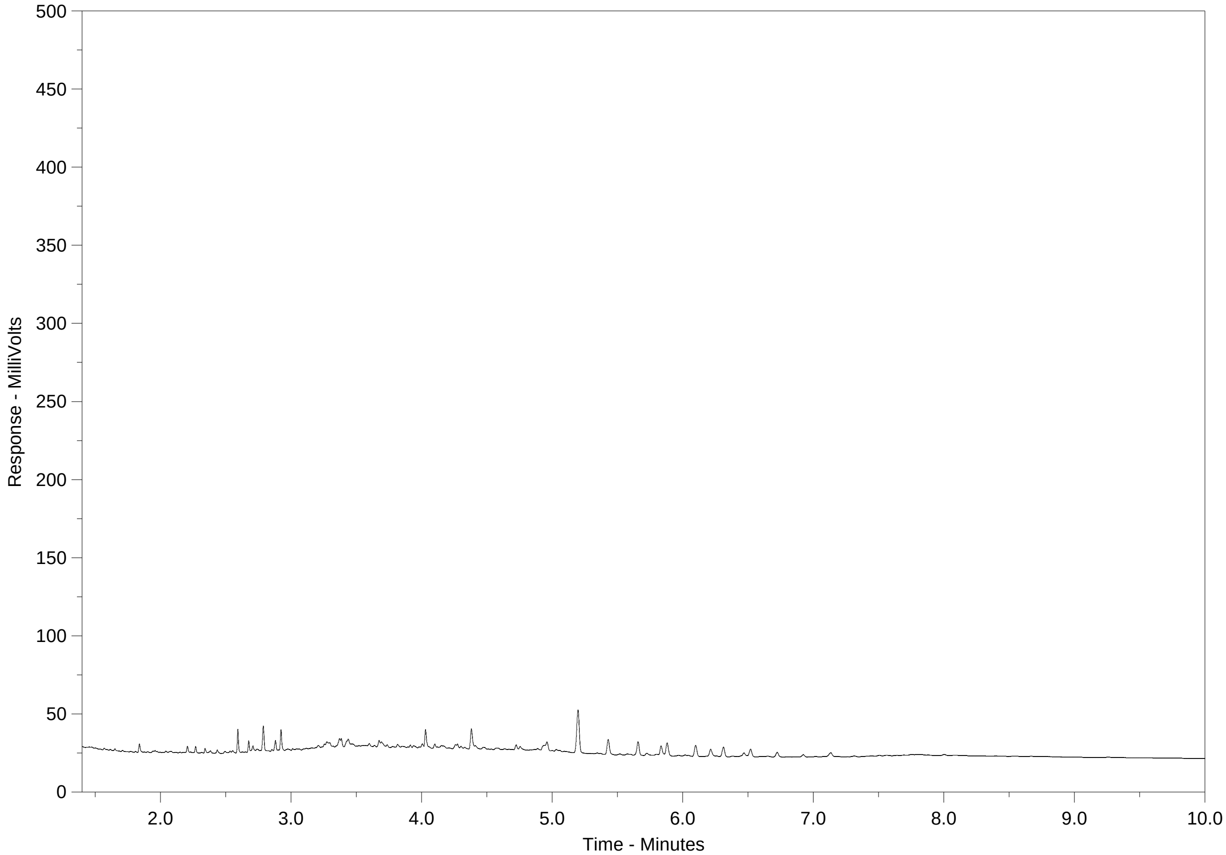
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1108173-6
Client Sample ID: L1



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

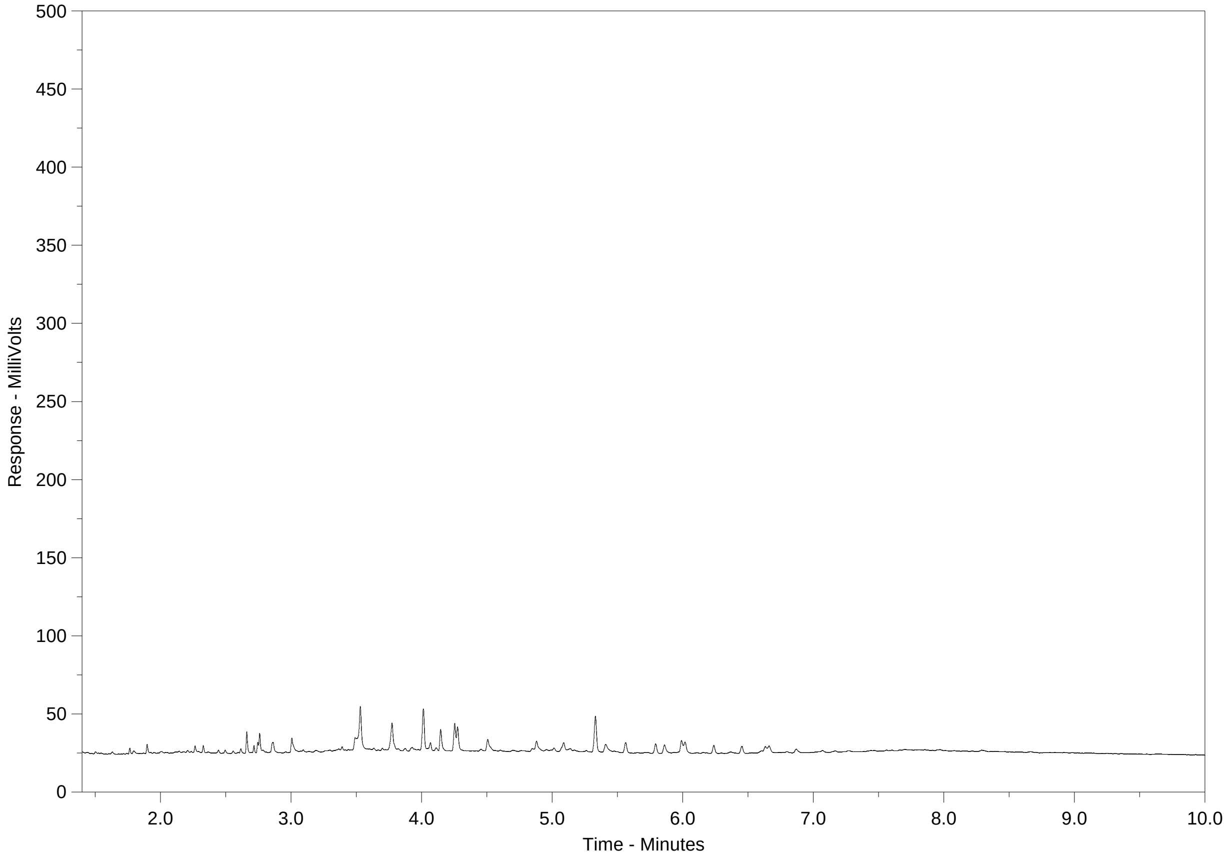
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1108173-7
Client Sample ID: WET WELL



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

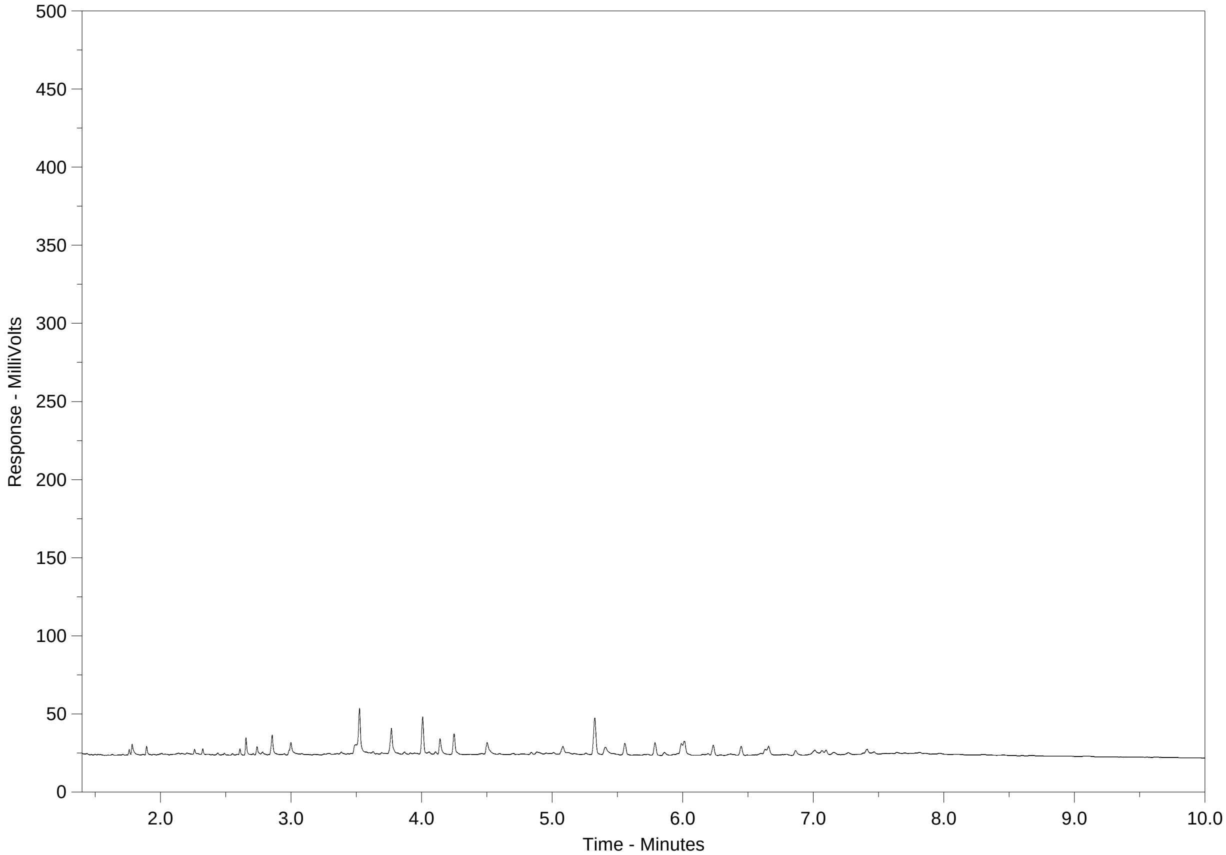
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1108173-8
Client Sample ID: SFC 2



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

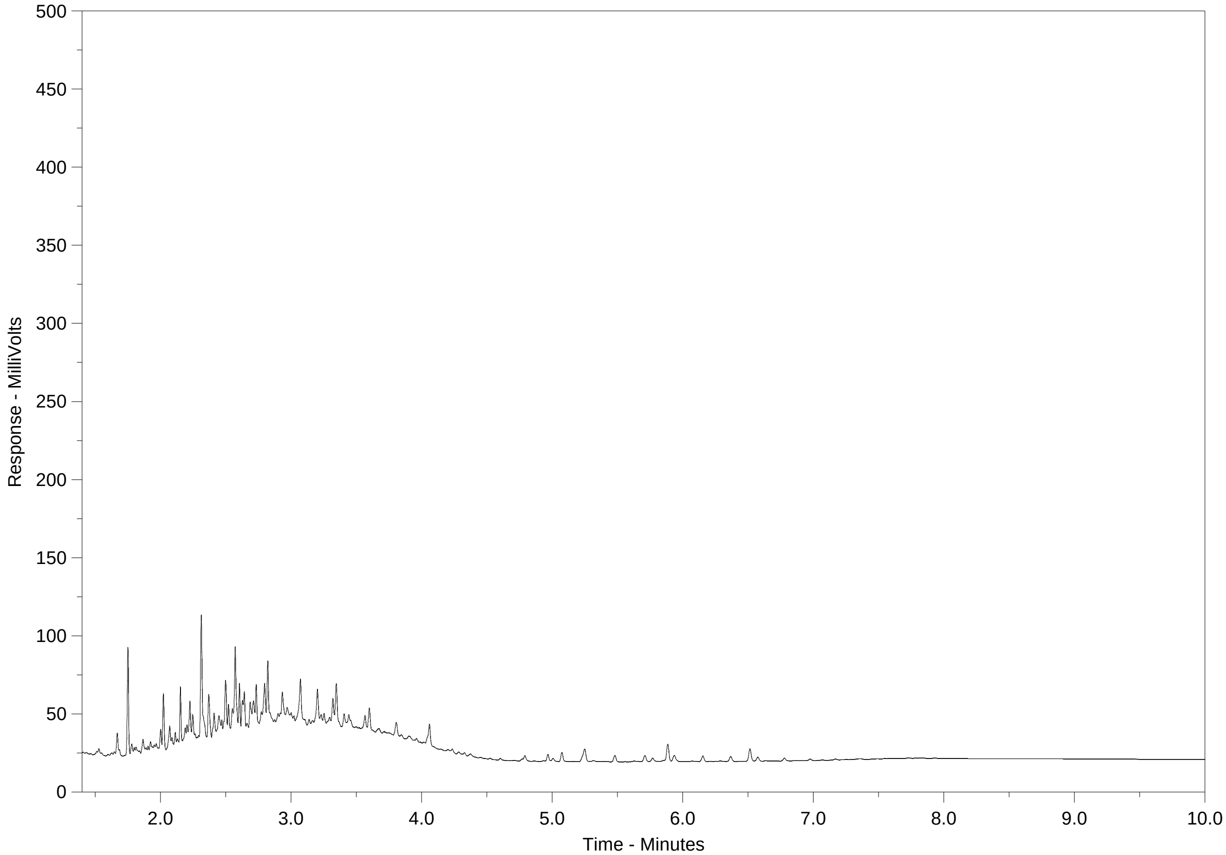
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1108173-13
Client Sample ID: TRAVEL BLANK



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

10-196598

ALS Environmental L1108173

C *L1108173-COFC*

Page 1 of 1

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company:	MORRISON HERSHFIELD (MH)	Standard: ✓ Other (specify):		✓ Regular (Standard Turnaround Times - Business Days)
Contact:	JOSEPHINE GILSON	Select: PDF ✓ Excel ✓ Digital Fax		Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	4321 STILL CREEK DR. SUITE 310 BURNABY, BC	Email 1: jgilson@morrisonhershfield.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:		Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	604-454-0402 Fax: 604-454-0403			Analysis Request
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information		(Indicate Filtered or Preserved, F/P)
	Copy of Invoice with Report? (circle) Yes or No	Job #:	5104016	
Company:		PO / AFE:		
Contact:		LSD:		
Address:	Short Holding Time			
Phone:		Quote #:	Q26448	
Lab Work	Rush Processing	ALS Contact: SELAM W.	Sampler: J.GILSON	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TKN/COD/NH3 NUTRIENTS + ANIONS (P)	DISSOLVED METALS	PAH /EPH	General	VOC'S	Number of Containers
	MW 2S	JAN. 26/12		GW	✓	✓	✓	✓	✓	
	MW 2D	↓		GW	✓	✓	✓	✓	✓	
	MW 3			GW	✓	✓	✓	✓	✓	
	MW4			GW	✓	✓	✓	✓	✓	
	MW6			GW	✓	✓	✓	✓	✓	
	L1			Leachate	✓	✓	✓	✓	✓	
	Wet Well			GW	✓	✓	✓	✓	✓	
	SFC 2			SW	✓	✓	✓	✓		
	SFC 2B			SW	✓	✓	✓	✓		
	SFC 3			SW	✓	✓	✓	✓		
	SFC 11			SW	✓	✓	✓	✓		
	L1 Rep			Leachate	✓	✓	✓	✓	✓	

Metals NOT preserved or filtered. Preservative wasn't + bottle shipment!

Missing 1 set of VOC's. Pls use the 1 of LEPH/HEPH BOTTLES FOR VOCS.

Special Instructions / Regulation with water or land use (CCME-Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

VOC'S – Pls. include → Acetone, dibromomethane, bromomethane, 1,3-Butadiene, MIBK, MEK

METALS → ~~only ... are~~ NO PRESERV~~ed ... preserved~~.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: [signature]	Date: JAN 27 2012	Time: 9Am	Received by: BP	Date: Jan. 27/12	Time: 9:00	Temperature: 4.5 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY GENF 18.01 Front

MORRISON HERSHFIELD GROUP INC.
ATTN: Josie Gilson
310 - 4321 Still Creek Drive
Burnaby BC V5C 6S7

Date Received: 16-MAY-12
Report Date: 01-JUN-12 14:10 (MT)
Version: FINAL

Client Phone: 604-454-0402

Certificate of Analysis

Lab Work Order #: **L1148551**
Project P.O. #: NOT SUBMITTED
Job Reference: 5104016
C of C Numbers: 10-253206
Legal Site Desc:

Selam Worku
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-1	L1148551-2	L1148551-3	L1148551-4	L1148551-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	MW-2D	MW-2S	MW-3	MW4	MW6
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1550	541	292	412	616
	Hardness (as CaCO3) (mg/L)	677	186	91.1	168	119
	pH (pH)	7.15	7.16	7.00	7.40	6.56
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	197	119	38.0	128	10.7
	Ammonia, Total (as N) (mg/L)	20.1	7.94	0.0254	3.02	<0.0050
	Bromide (Br) (mg/L)	<0.50 DLM	<0.050	0.058	<0.050	<0.050
	Chloride (Cl) (mg/L)	64.5	19.5	46.4	22.9	112
	Fluoride (F) (mg/L)	<0.20 DLM	<0.10 DLM	0.022	<0.10 DLM	0.123
	Nitrate (as N) (mg/L)	<0.050 DLM	<0.0050	1.03	0.0607	0.0325
	Nitrite (as N) (mg/L)	<0.010 DLM	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	20.5	9.42	0.073 TKNI	2.84	0.433
	Total Nitrogen (mg/L)	20.5	9.42	1.10	2.90	0.465
	Phosphorus (P)-Total (mg/L)	0.369	0.431	<0.0020	0.899	2.14
	Sulfate (SO4) (mg/L)	616	120	25.4	45.2	107
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Bismuth (Bi)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					
	Phosphorus (P)-Total (mg/L)					
	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID / Description / Sampled Date / Sampled Time / Client ID		L1148551-6 LEACHATE 16-MAY-12 LI	L1148551-7 SW 16-MAY-12 SFC2	L1148551-8 SW 16-MAY-12 SFC2 REP	L1148551-9 SW 16-MAY-12 SFC2B	L1148551-10 SW 16-MAY-12 SFC3
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	623	314	316	542	192
	Hardness (as CaCO3) (mg/L)	289	120	118		44.9
	pH (pH)	7.42	7.50	7.44	7.03	7.55
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	155	71.7	66.9	39.7	28.4
	Ammonia, Total (as N) (mg/L)	0.491	0.73	0.87	2.87	<0.0050
	Bromide (Br) (mg/L)	0.083	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	10.6	21.4	21.4	26.8	21.8
	Fluoride (F) (mg/L)	<0.10 DLM	0.056	0.058	0.149	0.048
	Nitrate (as N) (mg/L)	11.3	0.328	0.329	2.31	0.0949
	Nitrite (as N) (mg/L)	0.0406	0.0020	0.0018	0.0174	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	1.46	0.825	0.749	2.99	0.056
	Total Nitrogen (mg/L)	12.8	1.16	1.08	5.32	0.150
	Phosphorus (P)-Total (mg/L)	0.0258	<0.0020	0.0021	<0.020	0.0042
	Sulfate (SO4) (mg/L)	123	56.1	56.1	173	28.5
Total Metals	Aluminum (Al)-Total (mg/L)		0.435	0.447	2.20	0.106
	Antimony (Sb)-Total (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
	Barium (Ba)-Total (mg/L)		0.056	0.054	0.065	0.022
	Beryllium (Be)-Total (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050
	Bismuth (Bi)-Total (mg/L)		<0.20	<0.20	<0.20	<0.20
	Boron (B)-Total (mg/L)		<0.10	<0.10	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)		0.000056	0.000053	0.000255	<0.000050
	Calcium (Ca)-Total (mg/L)		41.2	40.7	65.1	14.7
	Chromium (Cr)-Total (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total (mg/L)		0.00608	0.00606	0.0307	<0.00050
	Copper (Cu)-Total (mg/L)		0.0105	0.0107	0.0705	0.0044
	Iron (Fe)-Total (mg/L)		3.89	4.15	14.5	0.184
	Lead (Pb)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)		<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Total (mg/L)		4.12	3.89	10.7	1.98
	Manganese (Mn)-Total (mg/L)		1.43	1.38	4.28	0.019
	Mercury (Hg)-Total (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Total (mg/L)		0.0032	0.0033	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)		<0.0050	<0.0050	0.0121	<0.0050
	Phosphorus (P)-Total (mg/L)		<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)		4.6	4.3	8.0	<2.0
	Selenium (Se)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-11	L1148551-12	L1148551-13		
	Description	SW	SW	SW		
	Sampled Date	16-MAY-12	16-MAY-12			
	Sampled Time					
	Client ID	SFC11	SFC-4	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	71.0	154	<2.0		
	Hardness (as CaCO3) (mg/L)	24.5	51.1	<0.50		
	pH (pH)	7.52	7.65	5.73		
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	19.1	27.6	<2.0		
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0617	<0.0050		
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050		
	Chloride (Cl) (mg/L)	4.51	13.6	<0.50		
	Fluoride (F) (mg/L)	0.057	0.053	<0.020		
	Nitrate (as N) (mg/L)	0.118	0.228	<0.0050		
	Nitrite (as N) (mg/L)	<0.0010	0.0011	<0.0010		
	Total Kjeldahl Nitrogen (mg/L)	0.065	0.128	<0.050		
	Total Nitrogen (mg/L)	0.184	0.357	<0.0025		
	Phosphorus (P)-Total (mg/L)	0.0115	0.0066	<0.0020		
	Sulfate (SO4) (mg/L)	8.29	23.7	<0.50		
Total Metals	Aluminum (Al)-Total (mg/L)	0.397	0.214	<0.010		
	Antimony (Sb)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Arsenic (As)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Barium (Ba)-Total (mg/L)	<0.020	<0.020	<0.020		
	Beryllium (Be)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
	Bismuth (Bi)-Total (mg/L)	<0.20	<0.20	<0.20		
	Boron (B)-Total (mg/L)	<0.10	<0.10	<0.10		
	Cadmium (Cd)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Calcium (Ca)-Total (mg/L)	7.55	17.0	<0.10		
	Chromium (Cr)-Total (mg/L)	<0.00050	<0.00050	<0.00050		
	Cobalt (Co)-Total (mg/L)	<0.00050	0.00078	<0.00050		
	Copper (Cu)-Total (mg/L)	0.0029	0.0032	<0.0010		
	Iron (Fe)-Total (mg/L)	0.200	0.305	<0.030		
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Lithium (Li)-Total (mg/L)	<0.050	<0.050	<0.050		
	Magnesium (Mg)-Total (mg/L)	1.37	2.11	<0.10		
	Manganese (Mn)-Total (mg/L)	<0.010	0.155	<0.010		
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010		
	Nickel (Ni)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	<2.0	<2.0	<2.0		
	Selenium (Se)-Total (mg/L)	<0.0010	<0.0010	<0.0010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-1	L1148551-2	L1148551-3	L1148551-4	L1148551-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	MW-2D	MW-2S	MW-3	MW4	MW6
Grouping	**Analyte**					
WATER						
Total Metals	Silicon (Si)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Strontium (Sr)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.020 DLA	<0.010	0.020	<0.010	0.282
	Antimony (Sb)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	0.0165	0.0079	<0.0010	0.0064	<0.0010
	Barium (Ba)-Dissolved (mg/L)	0.041	0.129	0.096	0.258	0.051
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	0.38	0.19	<0.10	0.10	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	0.000228	0.000168	0.000364
	Calcium (Ca)-Dissolved (mg/L)	225	59.6	28.9	54.2	38.5
	Chromium (Cr)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	0.0227	0.00178	0.00438	0.0368	0.0189
	Copper (Cu)-Dissolved (mg/L)	<0.0020 DLA	<0.0010	0.0035	<0.0010	0.0051
	Iron (Fe)-Dissolved (mg/L)	89.3	45.6	<0.030	61.1	0.109
	Lead (Pb)-Dissolved (mg/L)	<0.0020 DLA	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Dissolved (mg/L)	28.2	8.98	4.62	7.85	5.48
	Manganese (Mn)-Dissolved (mg/L)	3.15	2.54	1.97	3.29	0.883
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Dissolved (mg/L)	0.0162	0.0042	<0.0010	0.0149	<0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.010 DLA	<0.0050	<0.0050	0.0052	<0.0050
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	27.1	12.0	3.5	8.7	3.8
	Selenium (Se)-Dissolved (mg/L)	<0.0020 DLA	<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)-Dissolved (mg/L)	14.1	9.39	7.44	11.3	7.80
	Silver (Ag)-Dissolved (mg/L)	<0.00010 DLA	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)-Dissolved (mg/L)	34.9	15.1	14.5	26.0	75.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-6	L1148551-7	L1148551-8	L1148551-9	L1148551-10
	Description	LEACHATE	SW	SW	SW	SW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	LI	SFC2	SFC2 REP	SFC2B	SFC3
Grouping	**Analyte**					
WATER						
Total Metals	Silicon (Si)-Total (mg/L)		4.34	4.07	7.26	6.49
	Silver (Ag)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)-Total (mg/L)		16.0	15.3	22.2	20.5
	Strontium (Sr)-Total (mg/L)		0.246	0.239	0.371	0.124
	Thallium (Tl)-Total (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Total (mg/L)		<0.030	<0.030	<0.030	<0.030
	Titanium (Ti)-Total (mg/L)		<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Total (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Total (mg/L)		<0.030	<0.030	<0.030	<0.030
	Zinc (Zn)-Total (mg/L)		0.0067	0.0068	0.0229	0.0053
Dissolved Metals	Dissolved Metals Filtration Location	LAB				
	Aluminum (Al)-Dissolved (mg/L)	0.020				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.0010				
	Barium (Ba)-Dissolved (mg/L)	0.053				
	Beryllium (Be)-Dissolved (mg/L)	<0.0050				
	Bismuth (Bi)-Dissolved (mg/L)	<0.20				
	Boron (B)-Dissolved (mg/L)	<0.10				
	Cadmium (Cd)-Dissolved (mg/L)	0.000213				
	Calcium (Ca)-Dissolved (mg/L)	99.5				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050				
	Cobalt (Co)-Dissolved (mg/L)	0.00116				
	Copper (Cu)-Dissolved (mg/L)	0.0208				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	<0.0010				
	Lithium (Li)-Dissolved (mg/L)	<0.050				
	Magnesium (Mg)-Dissolved (mg/L)	9.73				
	Manganese (Mn)-Dissolved (mg/L)	1.86				
	Mercury (Hg)-Dissolved (mg/L)	<0.00020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0050				
	Phosphorus (P)-Dissolved (mg/L)	<0.30				
	Potassium (K)-Dissolved (mg/L)	5.4				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				
	Silicon (Si)-Dissolved (mg/L)	8.78				
	Silver (Ag)-Dissolved (mg/L)	<0.000050				
	Sodium (Na)-Dissolved (mg/L)	16.5				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-11	L1148551-12	L1148551-13		
	Description	SW	SW	SW		
	Sampled Date	16-MAY-12	16-MAY-12			
	Sampled Time					
	Client ID	SFC11	SFC-4	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Total Metals	Silicon (Si)-Total (mg/L)	7.33	6.11	<0.050		
	Silver (Ag)-Total (mg/L)	<0.000050	<0.000050	<0.000050		
	Sodium (Na)-Total (mg/L)	5.0	9.3	<2.0		
	Strontium (Sr)-Total (mg/L)	0.0853	0.154	<0.0050		
	Thallium (Tl)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Tin (Sn)-Total (mg/L)	<0.030	<0.030	<0.030		
	Titanium (Ti)-Total (mg/L)	<0.050	<0.050	<0.050		
	Uranium (U)-Total (mg/L)	<0.00020	<0.00020	<0.00020		
	Vanadium (V)-Total (mg/L)	<0.030	<0.030	<0.030		
	Zinc (Zn)-Total (mg/L)	<0.0050	<0.0050	<0.0050		
Dissolved Metals	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-1	L1148551-2	L1148551-3	L1148551-4	L1148551-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	MW-2D	MW-2S	MW-3	MW4	MW6
Grouping	**Analyte**					
WATER						
Dissolved Metals	Strontium (Sr)-Dissolved (mg/L)	0.895	0.316	0.248	0.332	0.359
	Thallium (Tl)-Dissolved (mg/L)	<0.00040 DLA	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Dissolved (mg/L)	<0.00040 DLA	<0.00020	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	0.0098	0.0067	0.0111	0.0066
Aggregate Organics	COD (mg/L)	62	45	<20	<20	51
Volatile Organic Compounds	Acetone (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Benzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bromodichloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromoform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Butadiene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chlorobenzene (mg/L)	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
	Dibromochloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Dibromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichlorobenzene (mg/L)	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
	Dichloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	trans-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Ethylbenzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Methyl ethyl ketone (MEK) (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-6	L1148551-7	L1148551-8	L1148551-9	L1148551-10
	Description	LEACHATE	SW	SW	SW	SW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	LI	SFC2	SFC2 REP	SFC2B	SFC3
Grouping	**Analyte**					
WATER						
Dissolved Metals	Strontium (Sr)-Dissolved (mg/L)	0.381				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.030				
	Titanium (Ti)-Dissolved (mg/L)	<0.050				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.030				
	Zinc (Zn)-Dissolved (mg/L)	0.0175				
Aggregate Organics	COD (mg/L)	34	<20	20	24	<20
Volatile Organic Compounds	Acetone (mg/L)	<0.020				
	Benzene (mg/L)	<0.00050				
	Bromodichloromethane (mg/L)	<0.0010				
	Bromoform (mg/L)	<0.0010				
	Bromomethane (mg/L)	<0.0010				
	1,3-Butadiene (mg/L)	<0.0010				
	Carbon Tetrachloride (mg/L)	<0.00050				
	Chlorobenzene (mg/L)	<0.0010				
	Dibromochloromethane (mg/L)	<0.0010				
	Chloroethane (mg/L)	<0.0010				
	Chloroform (mg/L)	<0.0010				
	Chloromethane (mg/L)	<0.0050				
	Dibromomethane (mg/L)	<0.0010				
	1,2-Dichlorobenzene (mg/L)	<0.00070				
	1,3-Dichlorobenzene (mg/L)	<0.0010				
	1,4-Dichlorobenzene (mg/L)	<0.0010				
	1,1-Dichloroethane (mg/L)	<0.0010				
	1,2-Dichloroethane (mg/L)	<0.0010				
	1,1-Dichloroethylene (mg/L)	<0.0010				
	cis-1,2-Dichloroethylene (mg/L)	<0.0010				
	trans-1,2-Dichloroethylene (mg/L)	<0.0010				
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014				
	Dichloromethane (mg/L)	<0.0050				
	1,2-Dichloropropane (mg/L)	<0.0010				
	cis-1,3-Dichloropropylene (mg/L)	<0.0010				
	trans-1,3-Dichloropropylene (mg/L)	<0.0010				
	Ethylbenzene (mg/L)	<0.00050				
	Methyl ethyl ketone (MEK) (mg/L)	<0.010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-11	L1148551-12	L1148551-13		
	Description	SW	SW	SW		
	Sampled Date	16-MAY-12	16-MAY-12			
	Sampled Time					
	Client ID	SFC11	SFC-4	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Strontium (Sr)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
Aggregate Organics	COD (mg/L)	<20	<20	<20		
Volatile Organic Compounds	Acetone (mg/L)			<0.020		
	Benzene (mg/L)			<0.00050		
	Bromodichloromethane (mg/L)			<0.0010		
	Bromoform (mg/L)			<0.0010		
	Bromomethane (mg/L)			<0.0010		
	1,3-Butadiene (mg/L)			<0.0010		
	Carbon Tetrachloride (mg/L)			<0.00050		
	Chlorobenzene (mg/L)			<0.0010		
	Dibromochloromethane (mg/L)			<0.0010		
	Chloroethane (mg/L)			<0.0010		
	Chloroform (mg/L)			<0.0010		
	Chloromethane (mg/L)			<0.0050		
	Dibromomethane (mg/L)			<0.0010		
	1,2-Dichlorobenzene (mg/L)			<0.00070		
	1,3-Dichlorobenzene (mg/L)			<0.0010		
	1,4-Dichlorobenzene (mg/L)			<0.0010		
	1,1-Dichloroethane (mg/L)			<0.0010		
	1,2-Dichloroethane (mg/L)			<0.0010		
	1,1-Dichloroethylene (mg/L)			<0.0010		
	cis-1,2-Dichloroethylene (mg/L)			<0.0010		
	trans-1,2-Dichloroethylene (mg/L)			<0.0010		
	1,3-Dichloropropene (cis & trans) (mg/L)			<0.0014		
	Dichloromethane (mg/L)			<0.0050		
	1,2-Dichloropropane (mg/L)			<0.0010		
	cis-1,3-Dichloropropylene (mg/L)			<0.0010		
	trans-1,3-Dichloropropylene (mg/L)			<0.0010		
	Ethylbenzene (mg/L)			<0.00050		
	Methyl ethyl ketone (MEK) (mg/L)			<0.010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-1	L1148551-2	L1148551-3	L1148551-4	L1148551-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	MW-2D	MW-2S	MW-3	MW4	MW6
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Styrene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Tetrachloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Toluene (mg/L)	DLM <0.0050	DLM <0.0030	DLM <0.0030	DLM <0.0030	DLM <0.0040
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vinyl Chloride (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	ortho-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	98.9	96.3	94.6	96.6	94.1
	Surrogate: 1,4-Difluorobenzene (SS) (%)	99.4	100.0	98.8	98.9	99.5
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	VPH (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	SURR-ND 155.5	96.0	101.4	108.3	SURR-ND 131.3
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-6	L1148551-7	L1148551-8	L1148551-9	L1148551-10
	Description	LEACHATE	SW	SW	SW	SW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	LI	SFC2	SFC2 REP	SFC2B	SFC3
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010				
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050				
	Styrene (mg/L)	<0.00050				
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010				
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010				
	Tetrachloroethylene (mg/L)	<0.0010				
	Toluene (mg/L)	<0.0030 DLM				
	1,1,1-Trichloroethane (mg/L)	<0.0010				
	1,1,2-Trichloroethane (mg/L)	<0.0010				
	Trichloroethylene (mg/L)	<0.0010				
	Trichlorofluoromethane (mg/L)	<0.0010				
	Vinyl Chloride (mg/L)	<0.0010				
	ortho-Xylene (mg/L)	<0.00050				
	meta- & para-Xylene (mg/L)	<0.00050				
	Xylenes (mg/L)	<0.00075				
	Surrogate: 4-Bromofluorobenzene (SS) (%)	92.9				
	Surrogate: 1,4-Difluorobenzene (SS) (%)	98.4				
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10				
	VPH (C6-C10) (mg/L)	<0.10				
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	92.5				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID / Description / Sampled Date / Sampled Time / Client ID		L1148551-11 SW 16-MAY-12 SFC11	L1148551-12 SW 16-MAY-12 SFC-4	L1148551-13 SW TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	Methyl isobutyl ketone (MIBK) (mg/L)			<0.0010		
	Methyl t-butyl ether (MTBE) (mg/L)			<0.00050		
	Styrene (mg/L)			<0.00050		
	1,1,1,2-Tetrachloroethane (mg/L)			<0.0010		
	1,1,2,2-Tetrachloroethane (mg/L)			<0.0010		
	Tetrachloroethylene (mg/L)			<0.0010		
	Toluene (mg/L)			DLM <0.0030		
	1,1,1-Trichloroethane (mg/L)			<0.0010		
	1,1,2-Trichloroethane (mg/L)			<0.0010		
	Trichloroethylene (mg/L)			<0.0010		
	Trichlorofluoromethane (mg/L)			<0.0010		
	Vinyl Chloride (mg/L)			<0.0010		
	ortho-Xylene (mg/L)			<0.00050		
	meta- & para-Xylene (mg/L)			<0.00050		
	Xylenes (mg/L)			<0.00075		
	Surrogate: 4-Bromofluorobenzene (SS) (%)			92.8		
	Surrogate: 1,4-Difluorobenzene (SS) (%)			99.2		
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25		
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25		
	LEPH (mg/L)	<0.25	<0.25	<0.25		
	HEPH (mg/L)	<0.25	<0.25	<0.25		
	Volatile Hydrocarbons (VH6-10) (mg/L)			<0.10		
	VPH (C6-C10) (mg/L)			<0.10		
	Surrogate: 3,4-Dichlorotoluene (SS) (%)			96.0		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050		
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010		
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050		
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-1	L1148551-2	L1148551-3	L1148551-4	L1148551-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	MW-2D	MW-2S	MW-3	MW4	MW6
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	98.5	92.9	102.8	95.5	90.4
	Surrogate: Acridine d9 (%)	109.7	105.5	107.5	108.9	95.8
	Surrogate: Chrysene d12 (%)	95.8	86.1	87.8	91.1	85.9
	Surrogate: Naphthalene d8 (%)	96.8	94.6	101.1	94.8	87.3
	Surrogate: Phenanthrene d10 (%)	100.4	99.0	104.6	100.9	90.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-6	L1148551-7	L1148551-8	L1148551-9	L1148551-10
	Description	LEACHATE	SW	SW	SW	SW
	Sampled Date	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12	16-MAY-12
	Sampled Time					
	Client ID	LI	SFC2	SFC2 REP	SFC2B	SFC3
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	89.8	95.1	96.7	97.3	96.0
	Surrogate: Acridine d9 (%)	100.9	100.9	98.8	107.5	99.3
	Surrogate: Chrysene d12 (%)	84.0	88.1	85.8	87.3	83.9
	Surrogate: Naphthalene d8 (%)	90.9	94.7	96.4	94.9	95.1
	Surrogate: Phenanthrene d10 (%)	92.1	97.4	97.9	98.9	98.5

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1148551-11	L1148551-12	L1148551-13		
	Description	SW	SW	SW		
	Sampled Date	16-MAY-12	16-MAY-12			
	Sampled Time					
	Client ID	SFC11	SFC-4	TRAVEL BLANK		
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050		
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050		
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050		
	Surrogate: Acenaphthene d10 (%)	97.6	98.8	107.6		
	Surrogate: Acridine d9 (%)	103.9	100.8	108.3		
	Surrogate: Chrysene d12 (%)	85.0	86.7	94.5		
	Surrogate: Naphthalene d8 (%)	99.4	96.7	109.5		
	Surrogate: Phenanthrene d10 (%)	101.0	101.4	110.1		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bromide (Br)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Chloride (Cl)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Sulfate (SO4)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Bromide (Br)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrate (as N)	DLM	L1148551-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1148551-2, -4, -6
Laboratory Control Sample	trans-1,3-Dichloropropylene	LCS-ND	L1148551-1, -13, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1148551-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
LCS-ND	Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
SURR-ND	Surrogate recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
TKNI	TKN result is likely biased low due to Nitrate interference. Nitrate-N is > 10x TKN.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	EPA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-SF-FID-VA	Water	EPH in Water by GCFID	BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the

Reference Information

entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

FUELS-HSMS-VA Water VOCs in water by Headspace GCMS EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA Water Dissolved Mercury in Water by CVAFS EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PAH-SF-MS-VA Water PAH in Water by GCMS EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

Reference Information

PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

VH-HSFID-VA	Water	VH in Water by Headspace GCFID	B.C. MIN. OF ENV. LAB. MAN. (2009)

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.

VH-SURR-FID-VA	Water	VH Surrogates for Waters	B.C. MIN. OF ENV. LAB. MAN. (2009)
VOC-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC-M-HSMS-VA	Water	Volatile Organic Compounds - GC-MS	EPA 8260B, 5012A

Water samples, with reagents, are heated and an aliquot of the headspace at equilibrium is analysed by GC-MS.

VOC-M2-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA	Water	BTEX/MTBE/Styrene by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Water	VOC7 and/or VOC Surrogates for Waters	EPA8260B, 5021
VPH-CALC-VA	Water	VPH is VH minus select aromatics	BC MOE LABORATORY MANUAL (2005)

These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).

XYLENES-CALC-VA	Water	Sum of Xylene Isomer Concentrations	CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** 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 ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

10-253206

Reference Information

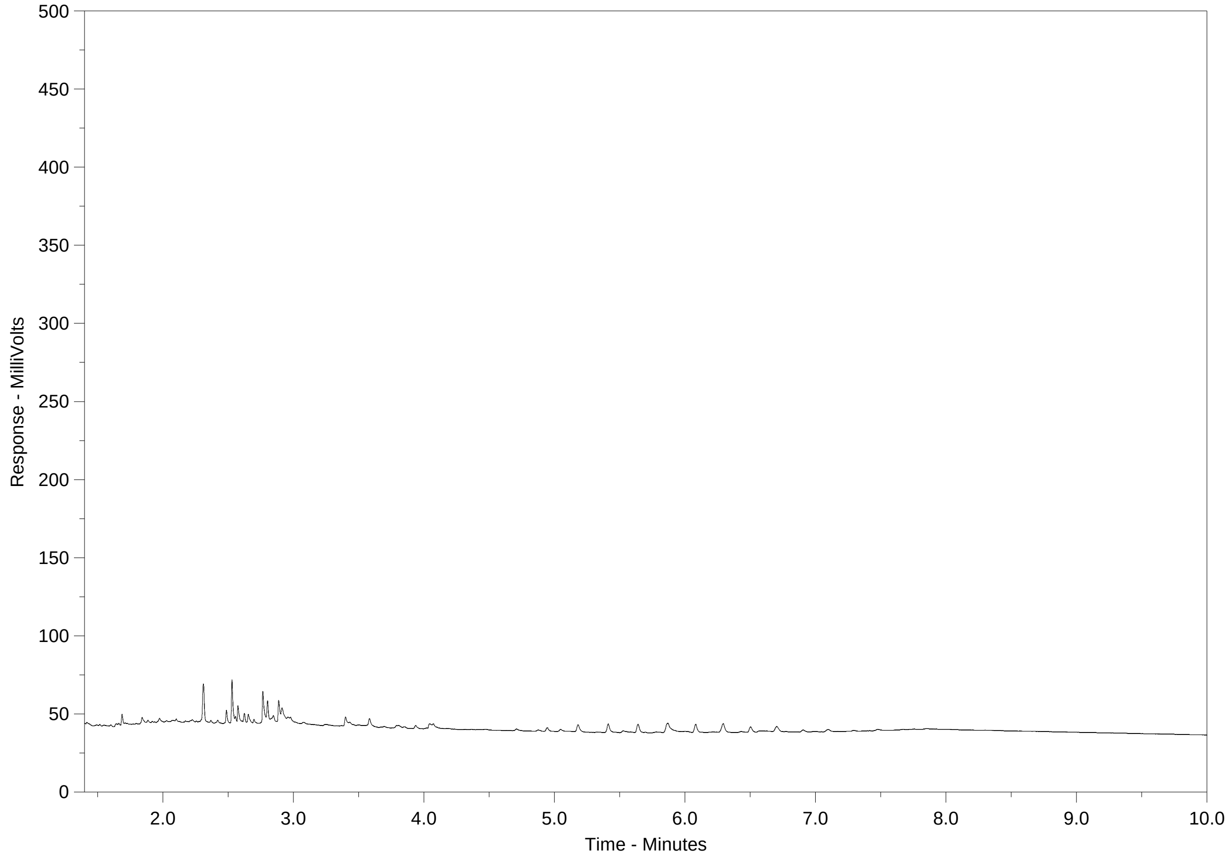
GLOSSARY OF REPORT TERMS

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 received 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.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-1
Client Sample ID: MW-2D



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline →   ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

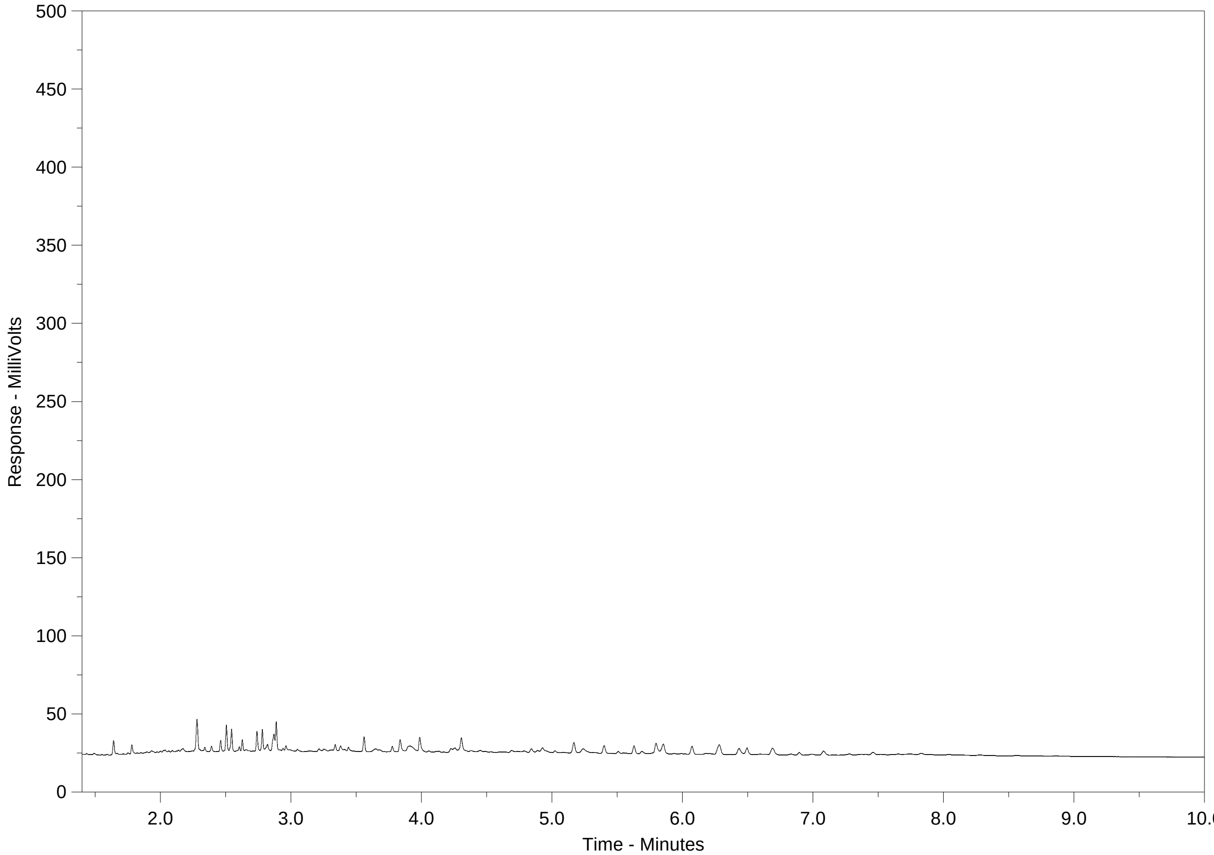
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-2
Client Sample ID: MW-2S



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

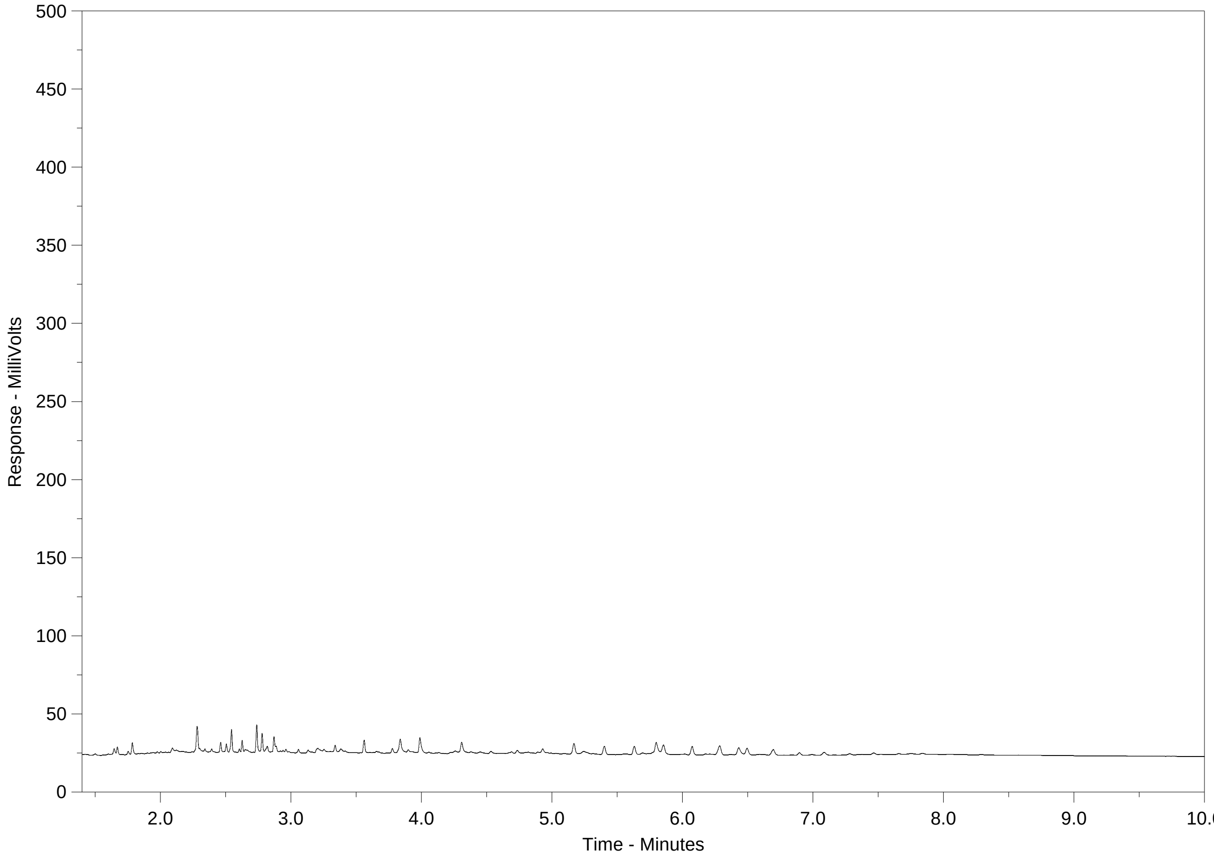
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-3
Client Sample ID: MW-3



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

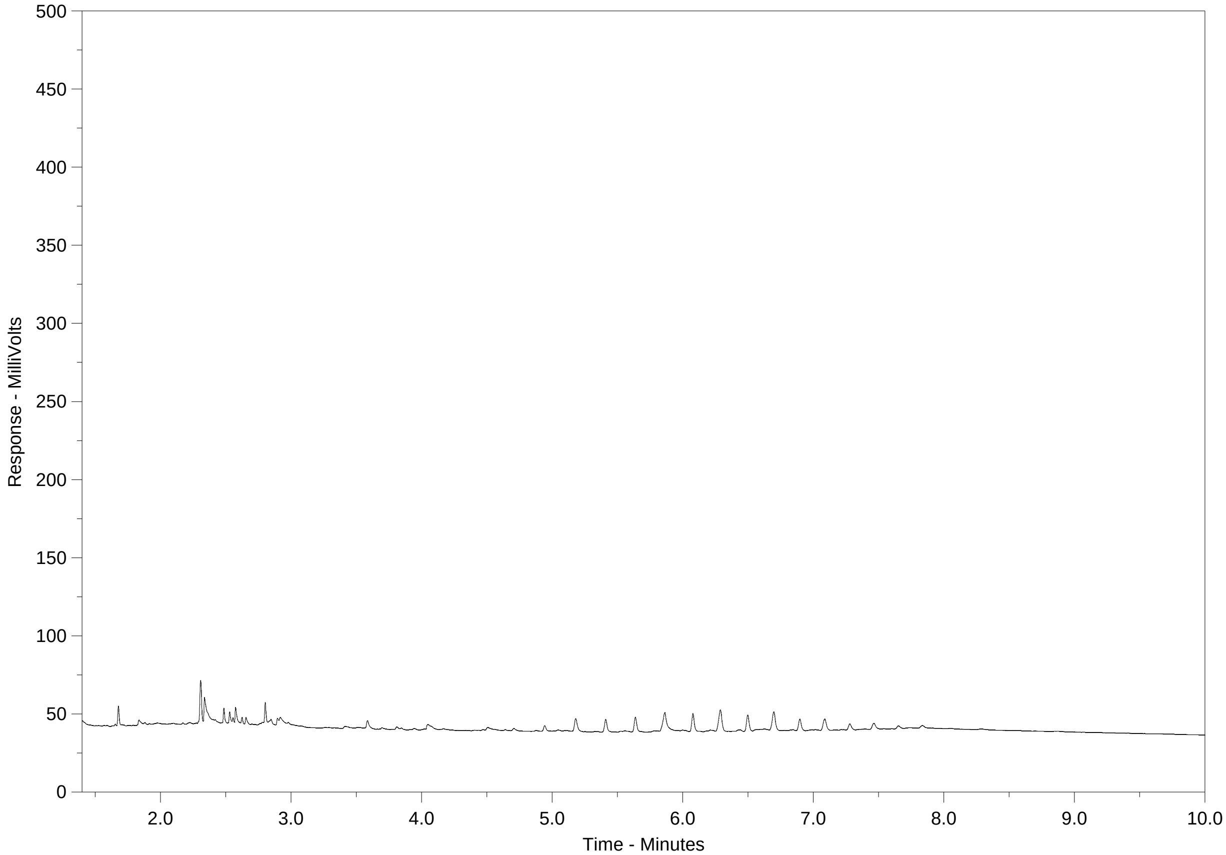
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-4
Client Sample ID: MW4



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

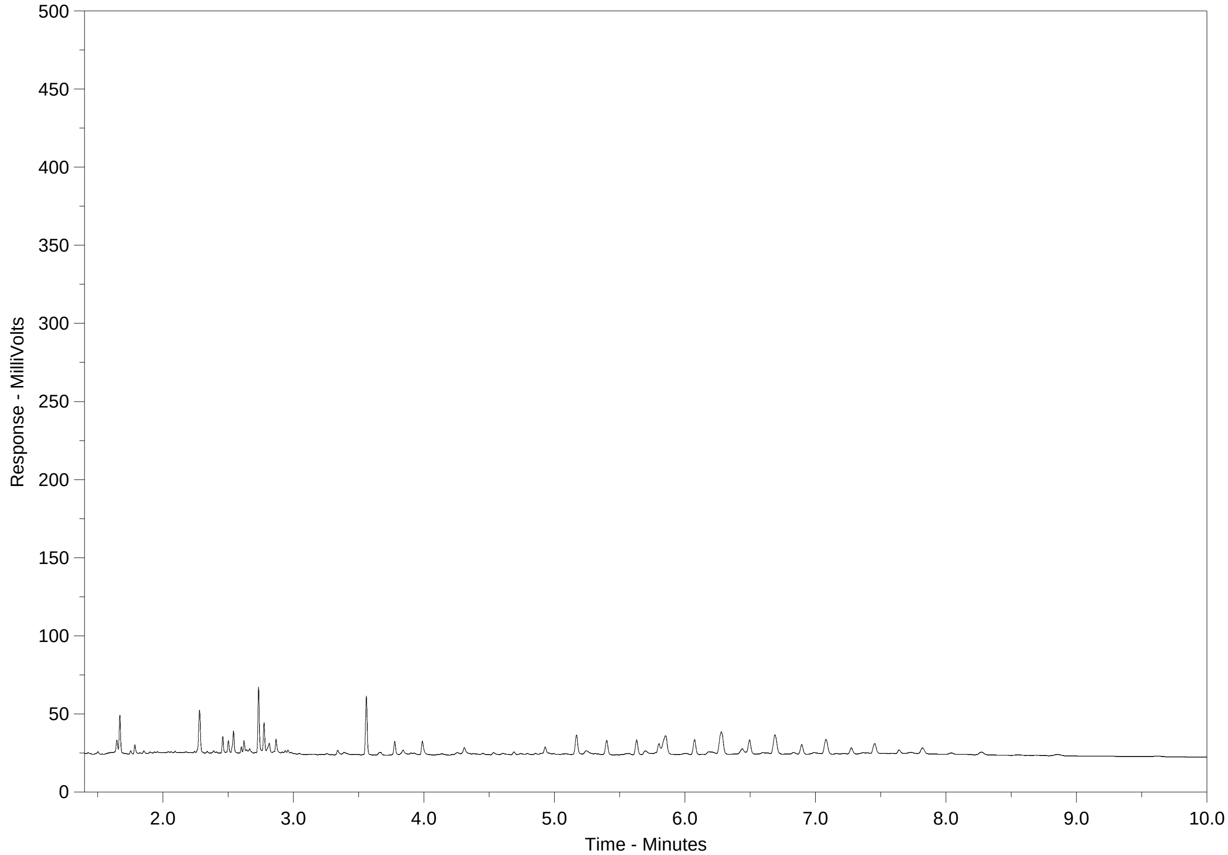
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-5
Client Sample ID: MW6



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

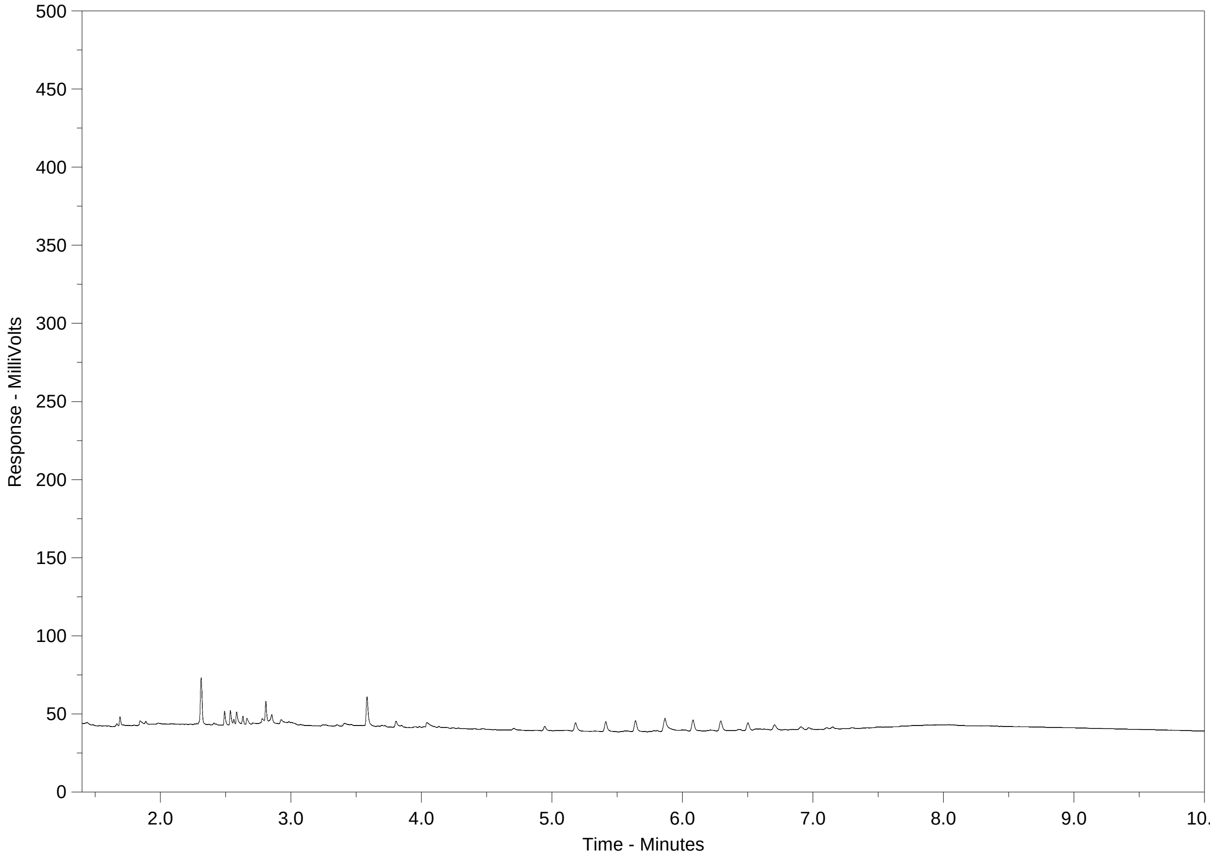
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-6
Client Sample ID: LI



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

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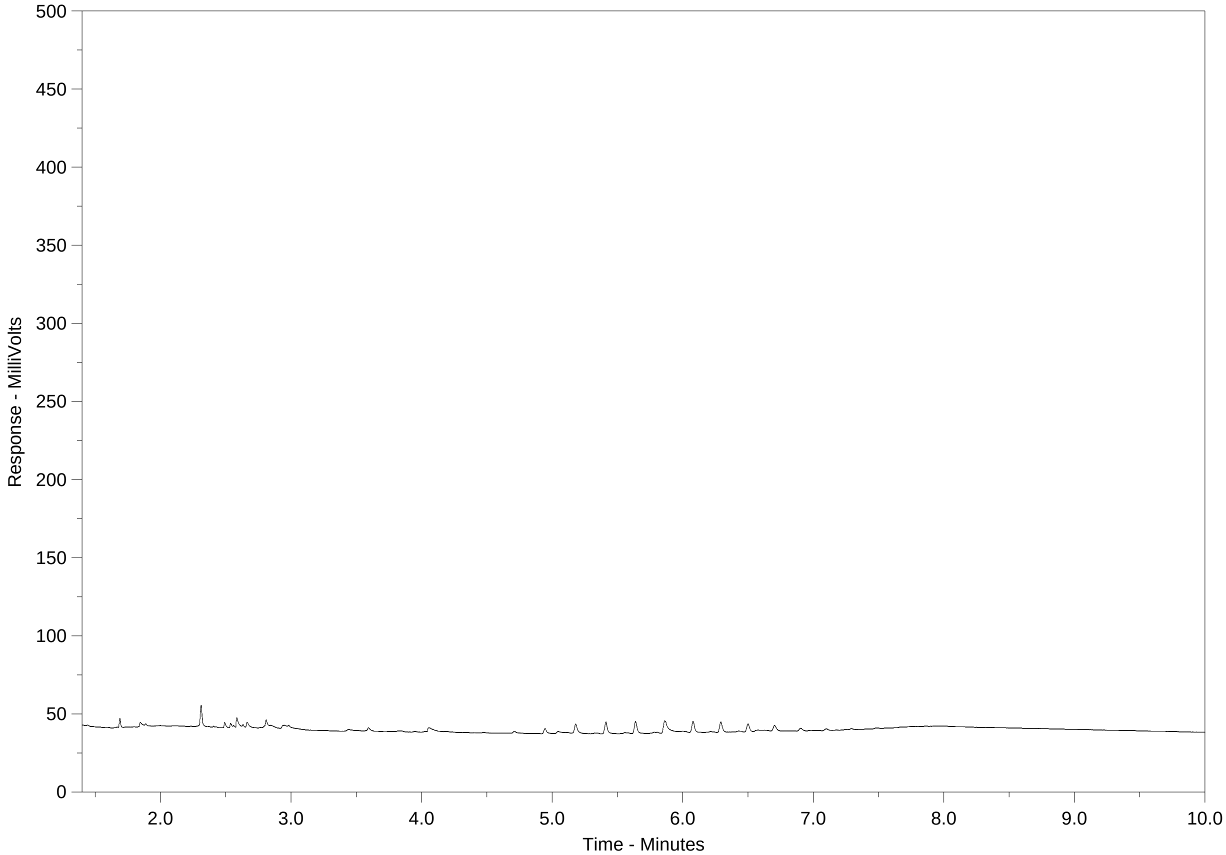
Hydrocarbon Distribution Report

ALS Sample ID: L1148551-7
Client Sample ID: SFC2



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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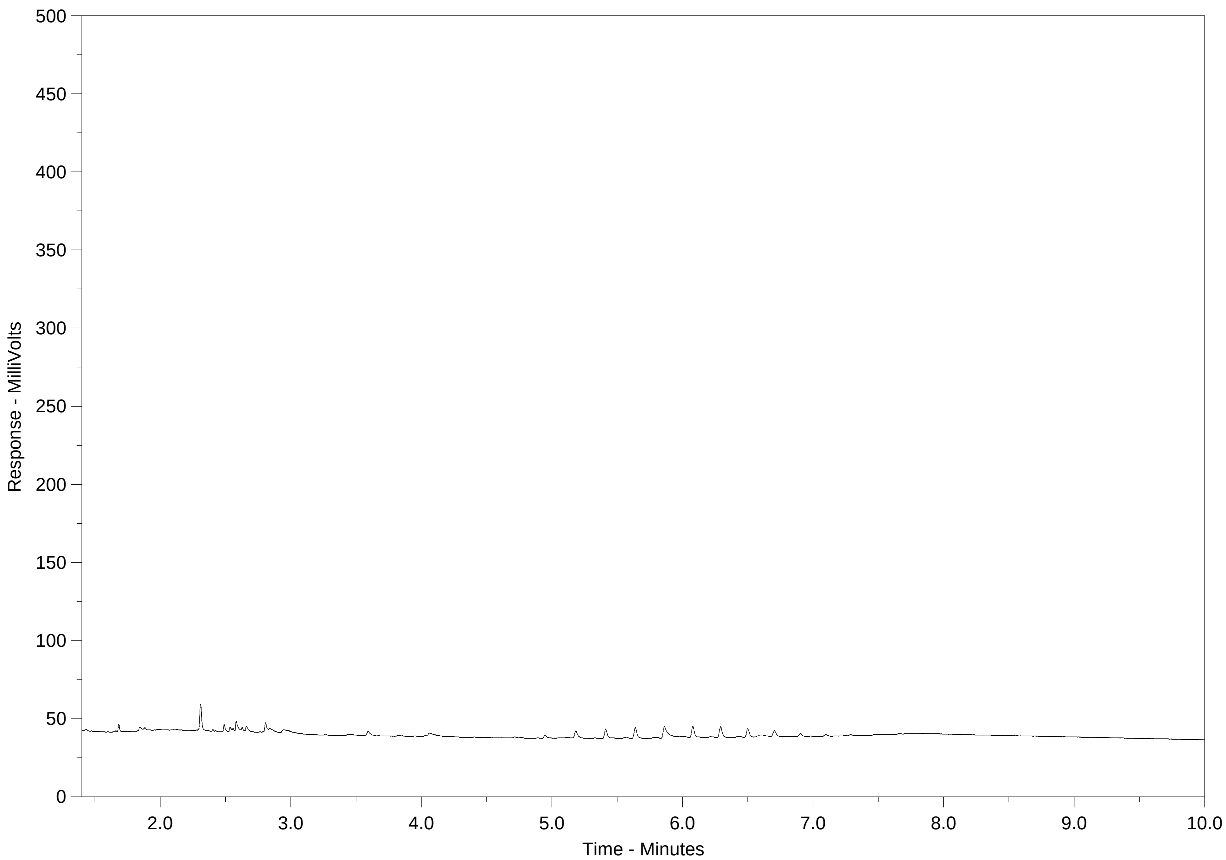
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-8
Client Sample ID: SFC2 REP



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

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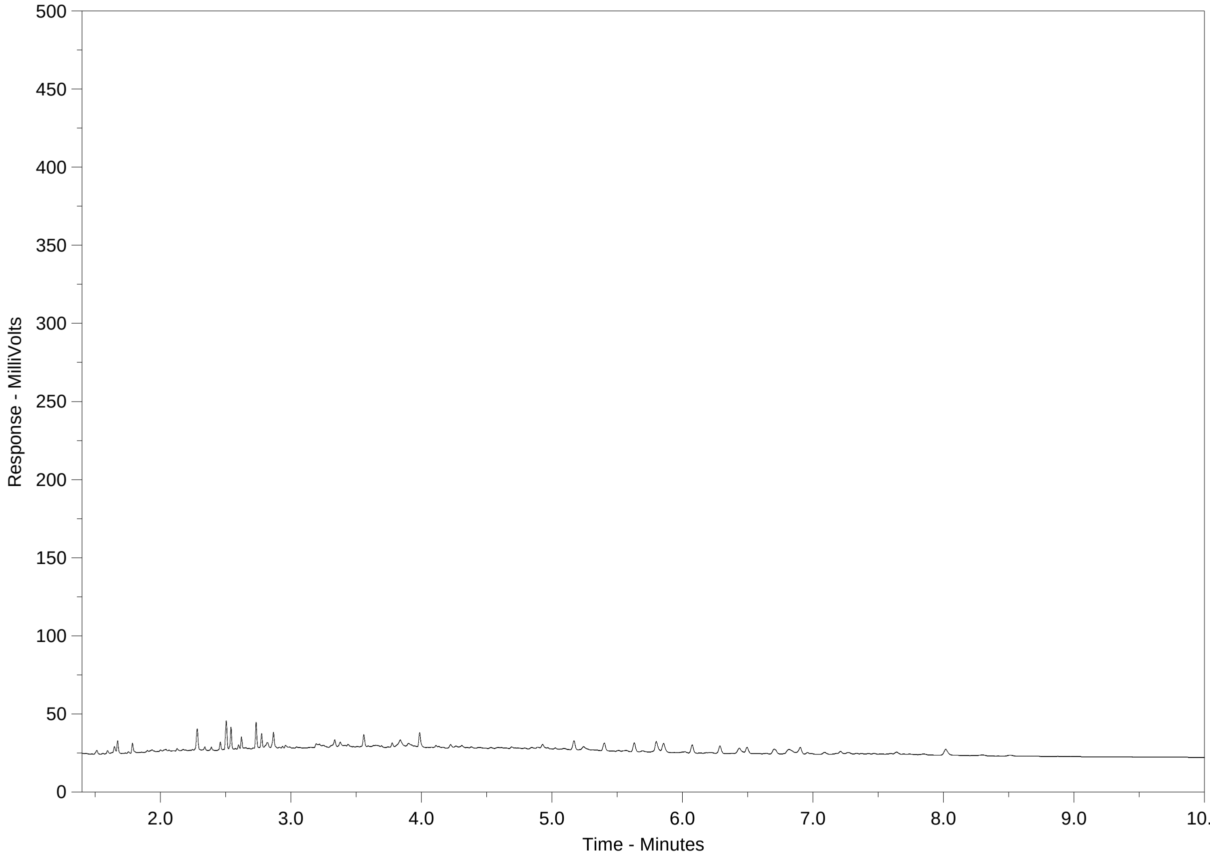
Hydrocarbon Distribution Report

ALS Sample ID: L1148551-9
Client Sample ID: SFC2B



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

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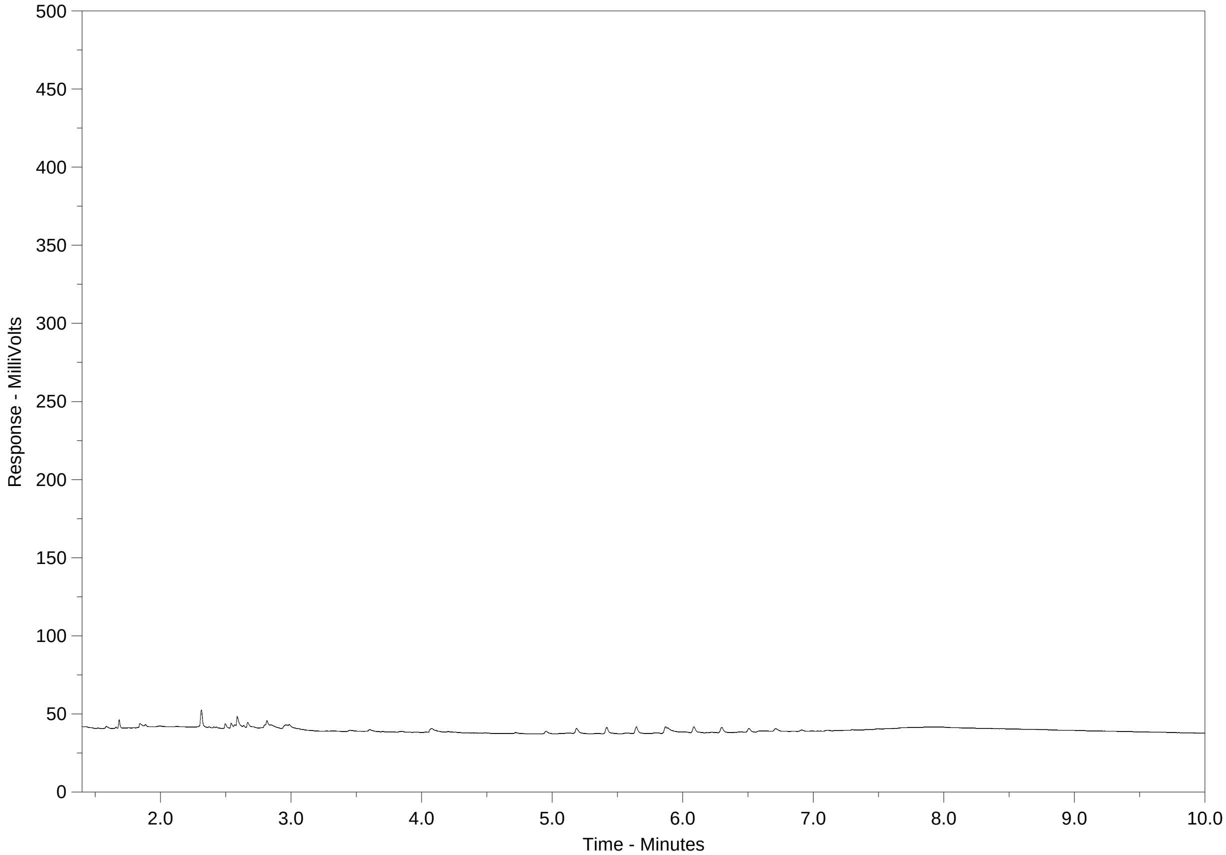
Hydrocarbon Distribution Report

ALS Sample ID: L1148551-10
Client Sample ID: SFC3



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

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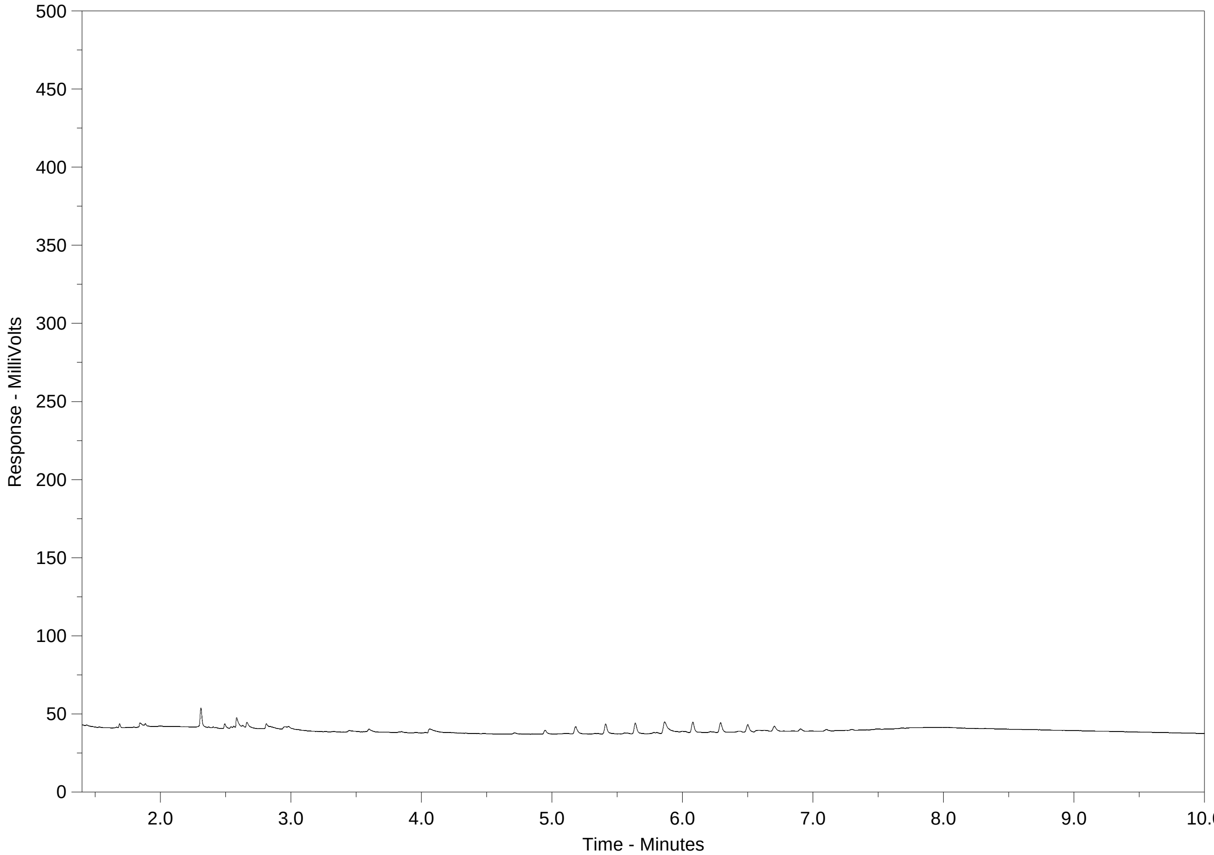
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-11
Client Sample ID: SFC11



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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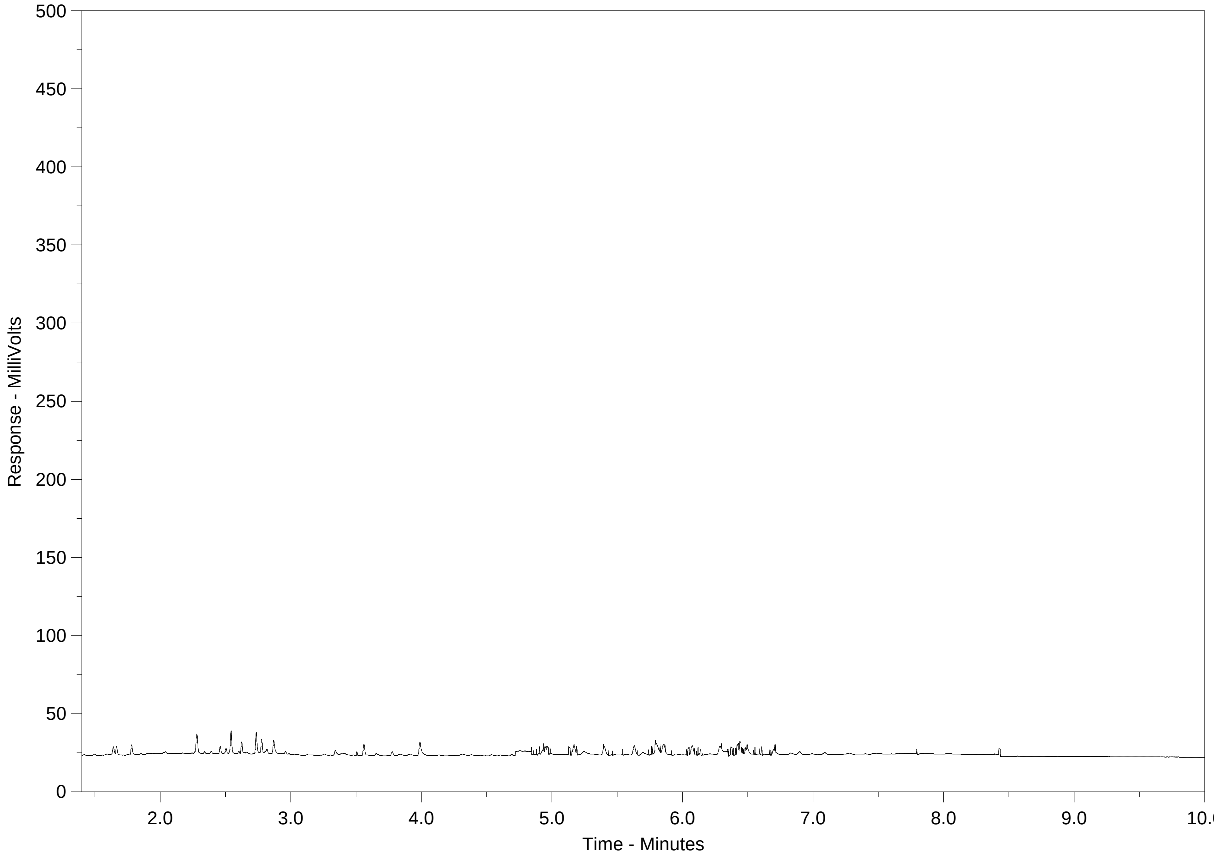
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1148551-12
Client Sample ID: SFC-4



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

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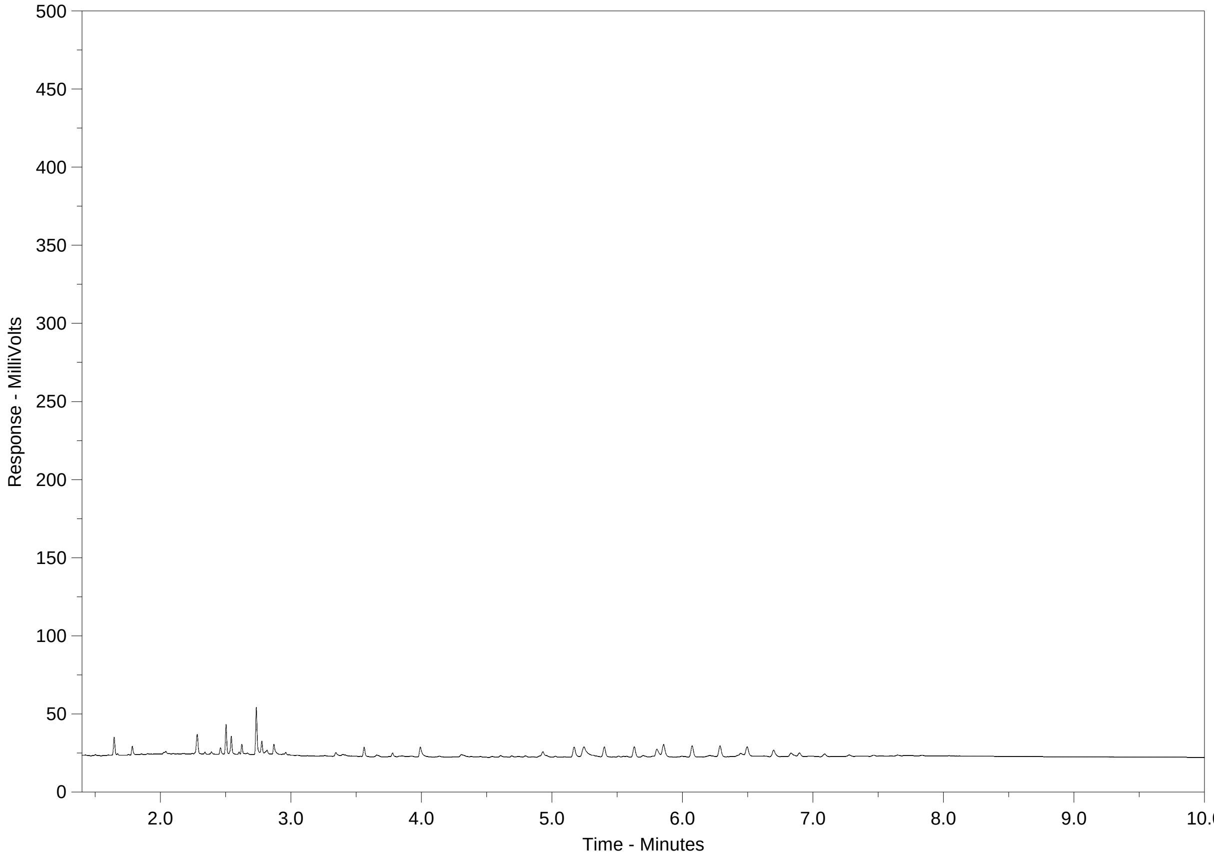
Hydrocarbon Distribution Report

ALS Sample ID: L1148551-13
Client Sample ID: TRAVEL BLANK



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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Short Holding Time

Rush Processing

ALS Env

Chain of Custody
Canada Toll

www.alsglobal.com

L1148551-COFC

10-253206

Report To	MORRISON HERSHFIELD
Company:	
Contact:	JOSIE GILSON
Address:	310-4321 STILL CREEK DRIVE BURNABY, BC
Phone:	604-454-0402 Fax:
Invoice To	Same as Report ? (circle) Yes or No (If No, provide details)
	Copy of Invoice with Report? (circle) Yes or No
Company:	
Contact:	
Address:	
Phone:	Fax:
Lab Work Order # (lab use only)	L1148551

Report Format / Distribution	
Standard: ✓	Other (specify):
Select: PDF ✓ Excel ✓ Digital Fax	
Email 1:	jgilson@morrisonhershfield.com
Email 2:	
Client / Project Information	
Job #:	5164016
PO / AFE:	
LSD:	
Quote #:	
ALS Contact:	Sampler:

Service Request:(Rush subject to availability - Contact ALS to confirm TAT)
Regular (Standard Turnaround Times - Business Days)
Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Same Day or Weekend Emergency - Contact ALS to confirm TAT

Analysis Request

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	COD/TKN/NH3	LEAH ORGANICS (HEPH)	VOCs (BTEX)	Physical Parameters	Metals - Total	Metals - Dissolved						Number of Containers
					Ø					F/P						
	MW-2D	16-MAY-12		GW	✓	✓	✓	✓		✓						
	MW-2S			GW	✓	✓	✓	✓		✓						
	MW-3			GW	✓	✓	✓	✓		✓						
	MW 4			GW	✓	✓	✓	✓		✓						
	MW 6			GW	✓	✓	✓	✓		✓						
	L1			Leachate	✓	✓	✓	✓		✓ Not Filtered						
	SFC 2			SW	✓	✓		✓	✓							
	SFC 2 Rep			SW	✓	✓		✓	✓							
	SFC 2B			SW	✓	✓		✓	✓							
	SFC 3			SW	✓	✓		✓	✓							
	SFC 11			SW	✓	✓		✓	✓							
	SFC-4			SW	✓	✓		✓	✓							

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

VOC's - Pls. include: Acetone, dibromomethane, bromomethane, 1-3 butadiene, MIBK, MEK.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: T.V.	Date: MAY 16/12	Time: 7:30PM	Received by:	Date: May 16	Time: 19:30	Temperature: 15.7 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

MORRISON HERSHFIELD GROUP INC.
ATTN: Josie Gilson
310 - 4321 Still Creek Drive
Burnaby BC V5C 6S7

Date Received: 24-MAY-12
Report Date: 07-JUN-12 16:10 (MT)
Version: FINAL

Client Phone: 604-454-0402

Certificate of Analysis

Lab Work Order #: L1151890

Project P.O. #: NOT SUBMITTED
Job Reference: RESORT MUNICIPLITY OF WHISTLER
C of C Numbers: 10-253782
Legal Site Desc:

Selam Worku
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1151890-1				
	Description	GRAB				
	Sampled Date	24-MAY-12				
	Sampled Time	10:00				
	Client ID	LEACHATE PUMP STATION MANHOLE				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	859				
	Hardness (as CaCO3) (mg/L)	313				
	pH (pH)	7.02				
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	129				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	129				
	Ammonia, Total (as N) (mg/L)	1.48				
	Bromide (Br) (mg/L)	DLM <0.50				
	Chloride (Cl) (mg/L)	84.2				
	Fluoride (F) (mg/L)	DLM <0.20				
	Nitrate (as N) (mg/L)	DLM <0.050				
	Nitrite (as N) (mg/L)	DLM <0.010				
	Total Kjeldahl Nitrogen (mg/L)	1.64				
	Total Nitrogen (mg/L)	1.64				
	Phosphorus (P)-Total (mg/L)	0.034				
	Sulfate (SO4) (mg/L)	197				
Dissolved Metals	Dissolved Metals Filtration Location	LAB				
	Aluminum (Al)-Dissolved (mg/L)	<0.010				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.0010				
	Barium (Ba)-Dissolved (mg/L)	0.094				
	Beryllium (Be)-Dissolved (mg/L)	<0.0050				
	Bismuth (Bi)-Dissolved (mg/L)	<0.20				
	Boron (B)-Dissolved (mg/L)	0.19				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050				
	Calcium (Ca)-Dissolved (mg/L)	108				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050				
	Cobalt (Co)-Dissolved (mg/L)	0.00265				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	17.3				
	Lead (Pb)-Dissolved (mg/L)	<0.0010				
	Lithium (Li)-Dissolved (mg/L)	<0.050				
	Magnesium (Mg)-Dissolved (mg/L)	10.6				
	Manganese (Mn)-Dissolved (mg/L)	3.21				
	Mercury (Hg)-Dissolved (mg/L)	<0.00020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1151890-1
	Description	GRAB
	Sampled Date	24-MAY-12
	Sampled Time	10:00
	Client ID	LEACHATE PUMP STATION MANHOLE
Grouping	**Analyte**	
WATER		
Dissolved Metals	Nickel (Ni)-Dissolved (mg/L)	<0.0050
	Phosphorus (P)-Dissolved (mg/L)	<0.30
	Potassium (K)-Dissolved (mg/L)	6.9
	Selenium (Se)-Dissolved (mg/L)	<0.0010
	Silicon (Si)-Dissolved (mg/L)	8.09
	Silver (Ag)-Dissolved (mg/L)	<0.000050
	Sodium (Na)-Dissolved (mg/L)	45.8
	Strontium (Sr)-Dissolved (mg/L)	0.718
	Thallium (Tl)-Dissolved (mg/L)	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.030
	Titanium (Ti)-Dissolved (mg/L)	<0.050
	Uranium (U)-Dissolved (mg/L)	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.030
	Zinc (Zn)-Dissolved (mg/L)	0.0128
Aggregate Organics	COD (mg/L)	22
Volatile Organic Compounds	Acetone (mg/L)	<0.020
	Benzene (mg/L)	<0.00050
	Bromodichloromethane (mg/L)	<0.0010
	Bromoform (mg/L)	<0.0010
	Bromomethane (mg/L)	<0.0010
	1,3-Butadiene (mg/L)	<0.0010
	Carbon Tetrachloride (mg/L)	<0.00050
	Chlorobenzene (mg/L)	<0.0010
	Dibromochloromethane (mg/L)	<0.0010
	Chloroethane (mg/L)	<0.0010
	Chloroform (mg/L)	<0.0010
	Chloromethane (mg/L)	<0.0050
	Decane (nC10) (mg/L)	<0.0010
	1,2-Dibromoethane (mg/L)	<0.0010
	Dibromomethane (mg/L)	<0.0010
	1,2-Dichlorobenzene (mg/L)	<0.00070
	1,3-Dichlorobenzene (mg/L)	<0.0010
	1,4-Dichlorobenzene (mg/L)	<0.0010
	1,1-Dichloroethane (mg/L)	<0.0010
	1,2-Dichloroethane (mg/L)	<0.0010
	1,1-Dichloroethylene (mg/L)	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1151890-1 GRAB 24-MAY-12 10:00 LEACHATE PUMP STATION MANHOLE				
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	cis-1,2-Dichloroethylene (mg/L)	<0.0010				
	trans-1,2-Dichloroethylene (mg/L)	<0.0010				
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014				
	Dichloromethane (mg/L)	<0.0050				
	1,2-Dichloropropane (mg/L)	<0.0010				
	cis-1,3-Dichloropropylene (mg/L)	<0.0010				
	trans-1,3-Dichloropropylene (mg/L)	<0.0010				
	Ethylbenzene (mg/L)	<0.00050				
	n-Hexane (nC6) (mg/L)	<0.0010				
	Isopropylbenzene (mg/L)	<0.0010				
	4-Isopropyltoluene (mg/L)	<0.0010				
	Methyl ethyl ketone (MEK) (mg/L)	<0.020				
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010				
	Methylcyclohexane (mg/L)	<0.0010				
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050				
	Naphthalene (mg/L)	<0.0010				
	n-Propylbenzene (mg/L)	<0.0010				
	Styrene (mg/L)	<0.00050				
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010				
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010				
	Tetrachloroethylene (mg/L)	<0.0010				
	Toluene (mg/L)	DLB <0.0030				
	1,1,1-Trichloroethane (mg/L)	<0.0010				
	1,1,2-Trichloroethane (mg/L)	<0.0010				
	Trichloroethylene (mg/L)	<0.0010				
	Trichlorofluoromethane (mg/L)	<0.0010				
	1,2,4-Trimethylbenzene (mg/L)	<0.0010				
	1,3,5-Trimethylbenzene (mg/L)	<0.0010				
	Vinyl Chloride (mg/L)	<0.0010				
	ortho-Xylene (mg/L)	<0.00050				
	meta- & para-Xylene (mg/L)	<0.00050				
	Xylenes (mg/L)	<0.00075				
	Surrogate: 4-Bromofluorobenzene (SS) (%)	100.7				
	Surrogate: 1,4-Difluorobenzene (SS) (%)	99.7				
Hydrocarbons	EPH10-19 (mg/L)	<0.25				
	EPH19-32 (mg/L)	<0.25				
	LEPH (mg/L)	<0.25				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1151890-1				
	Description	GRAB				
	Sampled Date	24-MAY-12				
	Sampled Time	10:00				
	Client ID	LEACHATE PUMP STATION MANHOLE				
Grouping	**Analyte**					
WATER						
Hydrocarbons	HEPH (mg/L)	<0.25				
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10				
	VPH (C6-C10) (mg/L)	<0.10				
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	115.5				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	0.000884				
	Acenaphthylene (mg/L)	<0.000050				
	Acridine (mg/L)	<0.000050				
	Anthracene (mg/L)	<0.000050				
	Benz(a)anthracene (mg/L)	<0.000050				
	Benzo(a)pyrene (mg/L)	<0.000010				
	Benzo(b)fluoranthene (mg/L)	<0.000050				
	Benzo(g,h,i)perylene (mg/L)	<0.000050				
	Benzo(k)fluoranthene (mg/L)	<0.000050				
	Chrysene (mg/L)	<0.000050				
	Dibenz(a,h)anthracene (mg/L)	<0.000050				
	Fluoranthene (mg/L)	0.000124				
	Fluorene (mg/L)	0.000286				
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050				
	Naphthalene (mg/L)	<0.000050				
	Phenanthrene (mg/L)	<0.000050				
	Pyrene (mg/L)	0.000066				
	Quinoline (mg/L)	<0.000050				
	Surrogate: Acenaphthene d10 (%)	95.4				
	Surrogate: Acridine d9 (%)	83.9				
	Surrogate: Chrysene d12 (%)	81.8				
	Surrogate: Naphthalene d8 (%)	82.0				
	Surrogate: Phenanthrene d10 (%)	89.2				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Nitrite (as N)	DLM	L1151890-1
Duplicate	Nitrate (as N)	DLM	L1151890-1
Duplicate	Sulfate (SO4)	DLM	L1151890-1
Duplicate	Bromide (Br)	DLM	L1151890-1
Duplicate	Fluoride (F)	DLM	L1151890-1
Duplicate	Bromide (Br)	DLM	L1151890-1
Duplicate	Chloride (Cl)	DLM	L1151890-1
Duplicate	Fluoride (F)	DLM	L1151890-1
Duplicate	Nitrite (as N)	DLM	L1151890-1
Duplicate	Sulfate (SO4)	DLM	L1151890-1
Duplicate	1,1,2-Trichloroethane	DLM	L1151890-1
Duplicate	Bromodichloromethane	DLM	L1151890-1
Duplicate	cis-1,3-Dichloropropylene	DLM	L1151890-1
Duplicate	trans-1,3-Dichloropropylene	DLM	L1151890-1
Method Blank	Toluene	MB-LOR	L1151890-1
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1151890-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1151890-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLB	Detection limit was raised due to detection of analyte at comparable level in Method Blank.
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is

Reference Information

determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-SF-FID-VA	Water	EPH in Water by GCFID	BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

FUELS-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA	Water	Dissolved Metals in Water by ICPMS(Low)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PAH-SF-MS-VA	Water	PAH in Water by GCMS	EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

Reference Information

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

VH-HSFID-VA	Water	VH in Water by Headspace GCFID	B.C. MIN. OF ENV. LAB. MAN. (2009)

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.

VH-SURR-FID-VA	Water	VH Surrogates for Waters	B.C. MIN. OF ENV. LAB. MAN. (2009)
VOC-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC-M-HSMS-VA	Water	Volatile Organic Compounds - GC-MS	EPA 8260B, 5012A

Water samples, with reagents, are heated and an aliquot of the headspace at equilibrium is analysed by GC-MS.

VOC-M2-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA	Water	BTEX/MTBE/Styrene by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Water	VOC7 and/or VOC Surrogates for Waters	EPA8260B, 5021
VPH-CALC-VA	Water	VPH is VH minus select aromatics	BC MOE LABORATORY MANUAL (2005)

These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).

XYLENES-CALC-VA	Water	Sum of Xylene Isomer Concentrations	CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** 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 ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

10-253782

Reference Information

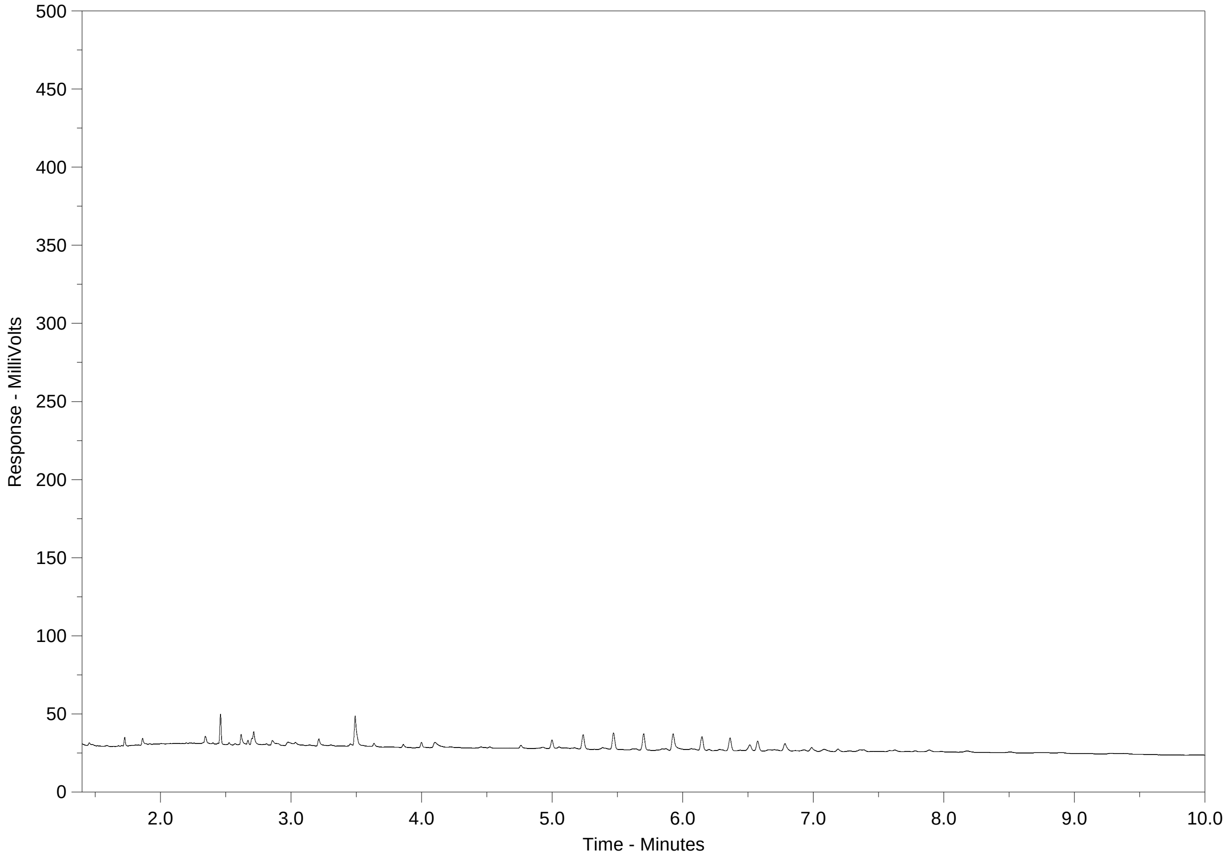
GLOSSARY OF REPORT TERMS

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 received 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.

Hydrocarbon Distribution Report

ALS Sample ID: L1151890-1
Client Sample ID: LEACHATE PUMP STATION MANHOLE



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Short Holding Time 10-253782

Rush Processing

ALS Environmental

Chain of Custody

L1151890-COFC

Page ____ of ____

Report To	jgilson@morrisonhershfield.com
Company:	Morrison Hershfield
Contact:	Josephine Gilson
Address:	Suite 310, 4321 Still Creek Dr. Burnaby
Phone:	604-454-0402 Fax:

Report Format	
Standard:	Other (specify):
Select: PDF Excel Digital Fax	
Email 1:	jgilson@morrisonhershfield.com
Email 2:	labtech@whistler.ca

Request: (Rush subject to availability - Contact ALS to confirm TAT)
- Regular (Standard Turnaround Times - Business Days)
- Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
- Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
- Same Day or Weekend Emergency - Contact ALS to confirm TAT

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)
	Copy of Invoice with Report? (circle) Yes or No
Company:	RMOW via Morrison Hershfield
Contact:	atucker@whistler.ca / jgilson@morrisonhershfield
Address:	
Phone:	Fax:

Client / Project Information	Resort Municipality of Whistler
Job #:	
PO / AFE:	
LSD:	
Quote #:	
ALS Contact:	Sampler:

Lab Work Order # (lab use only): L1151890

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General (Conductivity)	Nutrients (NH3 TKN TP)	Metals	PAH/EPH/F2-F4	BTEX/F1/VH								Number of Containers
1.	Leachate pump station manhole	24/5/12	10am	Grab	X												
2.	"	"	"	"		X											
3.	"	"	"	"			X										
4.	"	"	"	"				X									
5.	"	"	"	"				X									
6.	"	"	"	"					X								
7.	"	"	"	"					X								

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: [signature]	Date: May 24/12	Time: 10am	Received by: [signature]	Date: May 24	Time: 12:55	Temperature: 9.9 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

MORRISON HERSHFIELD GROUP INC.
ATTN: Josie Gilson
310 - 4321 Still Creek Drive
Burnaby BC V5C 6S7

Date Received: 27-SEP-12
Report Date: 12-OCT-12 17:46 (MT)
Version: FINAL

Client Phone: 604-454-0402

Certificate of Analysis

Lab Work Order #: **L1216048**
Project P.O. #: NOT SUBMITTED
Job Reference: 5104016
C of C Numbers: 10-272788
Legal Site Desc:

Selam Worku
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1216048-1 GW 26-SEP-12 MW-2D	L1216048-2 GW 26-SEP-12 MW-2D REP	L1216048-3 GW 26-SEP-12 MW-4	L1216048-4 GW 26-SEP-12 MW-2S	L1216048-5 GW 26-SEP-12 MW-3
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	440	452	260	1390	147
	Hardness (as CaCO3) (mg/L)	155	151	80.4	603	50.1
	pH (pH)	6.93	6.92	6.92	6.83	7.10
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	95.7	98.4	73.2	232	37.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	95.7	98.4	73.2	232	37.9
	Ammonia, Total (as N) (mg/L)	4.14	5.48	3.02	19.4	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.50 DLM	0.057
	Chloride (Cl) (mg/L)	19.5	20.0	20.2	62.5	15.6
	Fluoride (F) (mg/L)	<0.40 DLM	<0.40 DLM	0.113	<0.20 DLM	0.026
	Nitrate (as N) (mg/L)	0.0093	<0.0050	<0.0050	<0.050 DLM	<0.0050
	Nitrite (as N) (mg/L)	0.0018	0.0015	<0.0010	<0.010 DLM	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	5.9	6.07	2.72	23.7	0.069
	Total Nitrogen (mg/L)	6.0	6.07	2.72	23.7	0.069
	Phosphorus (P)-Total (mg/L)	0.828	0.925	0.203	0.294	0.0062
	Sulfate (SO4) (mg/L)	102	104	30.8	496	14.6
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Bismuth (Bi)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-6	L1216048-7	L1216048-8	L1216048-9	L1216048-10
	Description	GW	GW	SW	GW	SW
	Sampled Date	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12
	Sampled Time					
	Client ID	MW-6	JAMES LAKES RD	LM	SFC-2	SFC-2B
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	544	266	682	757	127
	Hardness (as CaCO3) (mg/L)	121	93.2	228	270	45.5
	pH (pH)	6.53	7.47	6.81	7.07	7.47
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	14.2	42.9	143	107	30.7
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	14.2	42.9	143	107	30.7
	Ammonia, Total (as N) (mg/L)	0.0122	<0.0050	1.98	0.36	<0.0050
	Bromide (Br) (mg/L)	<0.050	0.083	<0.25 DLM	<0.50 DLM	<0.050
	Chloride (Cl) (mg/L)	78.3	38.2	76.5	93.9	12.5
	Fluoride (F) (mg/L)	0.051	0.045	<0.10 DLM	<0.20 DLM	0.048
	Nitrate (as N) (mg/L)	0.0877	0.303	0.079	2.15	0.282
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0058	0.019	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	1.57	0.073	2.24	0.969	<0.050
	Total Nitrogen (mg/L)	1.66	0.376	2.33	3.14	0.282
	Phosphorus (P)-Total (mg/L)	31.1	<0.0020	0.027	0.104	<0.0020
	Sulfate (SO4) (mg/L)	129	32.3	101	149	14.0
Total Metals	Aluminum (Al)-Total (mg/L)		0.021		2.66	0.018
	Antimony (Sb)-Total (mg/L)		<0.00050		<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)		<0.0010		0.0014	<0.0010
	Barium (Ba)-Total (mg/L)		0.021		0.117	<0.020
	Beryllium (Be)-Total (mg/L)		<0.0050		<0.0050	<0.0050
	Bismuth (Bi)-Total (mg/L)		<0.20		<0.20	<0.20
	Boron (B)-Total (mg/L)		<0.10		0.21	<0.10
	Cadmium (Cd)-Total (mg/L)		<0.000050		0.000124	<0.000050
	Calcium (Ca)-Total (mg/L)		32.0		92.3	14.5
	Chromium (Cr)-Total (mg/L)		<0.00050		0.00132	<0.00050
	Cobalt (Co)-Total (mg/L)		<0.00050		0.00145	<0.00050
	Copper (Cu)-Total (mg/L)		0.0010		0.0193	<0.0010
	Iron (Fe)-Total (mg/L)		0.127		43.4	0.057
	Lead (Pb)-Total (mg/L)		<0.0010		0.0011	<0.0010
	Lithium (Li)-Total (mg/L)		<0.050		<0.050	<0.050
	Magnesium (Mg)-Total (mg/L)		3.20		9.54	2.23
	Manganese (Mn)-Total (mg/L)		0.112		1.13	0.010
	Mercury (Hg)-Total (mg/L)		<0.00020		<0.00020	<0.00020
	Molybdenum (Mo)-Total (mg/L)		<0.0010		0.0012	<0.0010
	Nickel (Ni)-Total (mg/L)		<0.0050		<0.0050	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-11	L1216048-12	L1216048-13		
	Description	SW	SW	GW		
	Sampled Date	26-SEP-12	26-SEP-12	27-SEP-12		
	Sampled Time					
	Client ID	SFC-3	L1	SFC-11		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	122	3870	133		
	Hardness (as CaCO3) (mg/L)	51.0	1430	45.6		
	pH (pH)	7.35	7.77	7.33		
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	32.9	1430	32.1		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	32.9	1430	32.1		
	Ammonia, Total (as N) (mg/L)	0.0097	157	<0.0050		
	Bromide (Br) (mg/L)	<0.050	1.9	<0.050		
	Chloride (Cl) (mg/L)	11.6	382	12.6		
	Fluoride (F) (mg/L)	0.048	<0.40 DLM	0.048		
	Nitrate (as N) (mg/L)	0.182	22.8	0.301		
	Nitrite (as N) (mg/L)	<0.0010	0.516	<0.0010		
	Total Kjeldahl Nitrogen (mg/L)	0.870	232	<0.050		
	Total Nitrogen (mg/L)	1.05	286	0.301		
	Phosphorus (P)-Total (mg/L)	0.0090	25.6	0.0024		
	Sulfate (SO4) (mg/L)	12.4	160	14.1		
Total Metals	Aluminum (Al)-Total (mg/L)	2.95		0.095		
	Antimony (Sb)-Total (mg/L)	<0.00050		<0.00050		
	Arsenic (As)-Total (mg/L)	0.0020		<0.0010		
	Barium (Ba)-Total (mg/L)	0.060		<0.020		
	Beryllium (Be)-Total (mg/L)	<0.0050		<0.0050		
	Bismuth (Bi)-Total (mg/L)	<0.20		<0.20		
	Boron (B)-Total (mg/L)	<0.10		<0.10		
	Cadmium (Cd)-Total (mg/L)	0.000171		<0.000050		
	Calcium (Ca)-Total (mg/L)	15.1		14.6		
	Chromium (Cr)-Total (mg/L)	0.00182		<0.00050		
	Cobalt (Co)-Total (mg/L)	0.0189		<0.00050		
	Copper (Cu)-Total (mg/L)	0.0224		<0.0010		
	Iron (Fe)-Total (mg/L)	30.3		0.141		
	Lead (Pb)-Total (mg/L)	0.0016		<0.0010		
	Lithium (Li)-Total (mg/L)	<0.050		<0.050		
	Magnesium (Mg)-Total (mg/L)	3.25		2.22		
	Manganese (Mn)-Total (mg/L)	2.01		0.021		
	Mercury (Hg)-Total (mg/L)	<0.00020		<0.00020		
	Molybdenum (Mo)-Total (mg/L)	0.0014		<0.0010		
	Nickel (Ni)-Total (mg/L)	<0.0050		<0.0050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-1	L1216048-2	L1216048-3	L1216048-4	L1216048-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12
	Sampled Time					
	Client ID	MW-2D	MW-2D REP	MW-4	MW-2S	MW-3
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)					
	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silicon (Si)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Strontium (Sr)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.023	<0.010	<0.010	<0.010	0.019
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	0.0071	0.0070	0.0060	0.0138	<0.0010
	Barium (Ba)-Dissolved (mg/L)	0.114	0.106	0.118	0.055	0.063
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	0.16	0.16	<0.10	0.35	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	0.000088
	Calcium (Ca)-Dissolved (mg/L)	48.7	47.5	26.5	198	15.8
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Dissolved (mg/L)	0.00273	0.00271	0.0170	0.0188	0.00155
	Copper (Cu)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	0.0019
	Iron (Fe)-Dissolved (mg/L)	41.5	40.7	40.1	76.4	0.034
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Dissolved (mg/L)	8.14	7.77	3.45	26.3	2.56
	Manganese (Mn)-Dissolved (mg/L)	2.05	1.96	1.93	2.87	1.23
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Dissolved (mg/L)	0.0056	0.0058	0.0286	0.0160	0.0010
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	10.2	9.6	5.2	24.9	2.8
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-6	L1216048-7	L1216048-8	L1216048-9	L1216048-10
	Description	GW	GW	SW	GW	SW
	Sampled Date	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12
	Sampled Time					
	Client ID	MW-6	JAMES LAKES RD	LM	SFC-2	SFC-2B
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)		<0.30		0.30	<0.30
	Potassium (K)-Total (mg/L)		2.0		8.6	<2.0
	Selenium (Se)-Total (mg/L)		<0.0010		<0.0010	<0.0010
	Silicon (Si)-Total (mg/L)		7.58		10.9	10.6
	Silver (Ag)-Total (mg/L)		<0.000050		<0.000050	<0.000050
	Sodium (Na)-Total (mg/L)		15.4		50.7	7.8
	Strontium (Sr)-Total (mg/L)		0.382		0.684	0.204
	Thallium (Tl)-Total (mg/L)		<0.00020		<0.00020	<0.00020
	Tin (Sn)-Total (mg/L)		<0.030		<0.030	<0.030
	Titanium (Ti)-Total (mg/L)		<0.050		0.077	<0.050
	Uranium (U)-Total (mg/L)		<0.00020		<0.00020	<0.00020
	Vanadium (V)-Total (mg/L)		<0.030		<0.030	<0.030
	Zinc (Zn)-Total (mg/L)		<0.0050		0.0813	<0.0050
Dissolved Metals	Dissolved Metals Filtration Location	FIELD		LAB		
	Aluminum (Al)-Dissolved (mg/L)	0.066		<0.010		
	Antimony (Sb)-Dissolved (mg/L)	<0.00050		<0.00050		
	Arsenic (As)-Dissolved (mg/L)	<0.0010		<0.0010		
	Barium (Ba)-Dissolved (mg/L)	0.042		0.081		
	Beryllium (Be)-Dissolved (mg/L)	<0.0050		<0.0050		
	Bismuth (Bi)-Dissolved (mg/L)	<0.20		<0.20		
	Boron (B)-Dissolved (mg/L)	<0.10		0.18		
	Cadmium (Cd)-Dissolved (mg/L)	0.000297		<0.000050		
	Calcium (Ca)-Dissolved (mg/L)	39.1		77.6		
	Chromium (Cr)-Dissolved (mg/L)	<0.00050		<0.00050		
	Cobalt (Co)-Dissolved (mg/L)	0.00653		0.00065		
	Copper (Cu)-Dissolved (mg/L)	0.0025		0.0012		
	Iron (Fe)-Dissolved (mg/L)	0.045		4.39		
	Lead (Pb)-Dissolved (mg/L)	<0.0010		<0.0010		
	Lithium (Li)-Dissolved (mg/L)	<0.050		<0.050		
	Magnesium (Mg)-Dissolved (mg/L)	5.78		8.39		
	Manganese (Mn)-Dissolved (mg/L)	1.91		2.94		
	Mercury (Hg)-Dissolved (mg/L)	<0.00020		<0.00020		
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010		<0.0010		
	Nickel (Ni)-Dissolved (mg/L)	<0.0050		<0.0050		
	Phosphorus (P)-Dissolved (mg/L)	<0.30		<0.30		
	Potassium (K)-Dissolved (mg/L)	3.7		7.4		
	Selenium (Se)-Dissolved (mg/L)	<0.0010		<0.0010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-11	L1216048-12	L1216048-13		
	Description	SW	SW	GW		
	Sampled Date	26-SEP-12	26-SEP-12	27-SEP-12		
	Sampled Time					
	Client ID	SFC-3	L1	SFC-11		
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)	<0.30		<0.30		
	Potassium (K)-Total (mg/L)	<2.0		<2.0		
	Selenium (Se)-Total (mg/L)	<0.0010		<0.0010		
	Silicon (Si)-Total (mg/L)	14.7		10.6		
	Silver (Ag)-Total (mg/L)	<0.000050		<0.000050		
	Sodium (Na)-Total (mg/L)	7.6		7.9		
	Strontium (Sr)-Total (mg/L)	0.206		0.202		
	Thallium (Tl)-Total (mg/L)	<0.00020		<0.00020		
	Tin (Sn)-Total (mg/L)	<0.030		<0.030		
	Titanium (Ti)-Total (mg/L)	0.108		<0.050		
	Uranium (U)-Total (mg/L)	<0.00020		<0.00020		
	Vanadium (V)-Total (mg/L)	<0.030		<0.030		
	Zinc (Zn)-Total (mg/L)	0.0288		<0.0050		
Dissolved Metals	Dissolved Metals Filtration Location		LAB			
	Aluminum (Al)-Dissolved (mg/L)		DLA <0.050			
	Antimony (Sb)-Dissolved (mg/L)		DLA <0.0025			
	Arsenic (As)-Dissolved (mg/L)		DLA <0.0050			
	Barium (Ba)-Dissolved (mg/L)		0.526			
	Beryllium (Be)-Dissolved (mg/L)		<0.0050			
	Bismuth (Bi)-Dissolved (mg/L)		<0.20			
	Boron (B)-Dissolved (mg/L)		3.64			
	Cadmium (Cd)-Dissolved (mg/L)		DLA <0.00025			
	Calcium (Ca)-Dissolved (mg/L)		479			
	Chromium (Cr)-Dissolved (mg/L)		DLA <0.0025			
	Cobalt (Co)-Dissolved (mg/L)		0.0060			
	Copper (Cu)-Dissolved (mg/L)		0.0072			
	Iron (Fe)-Dissolved (mg/L)		0.352			
	Lead (Pb)-Dissolved (mg/L)		DLA <0.0050			
	Lithium (Li)-Dissolved (mg/L)		<0.050			
	Magnesium (Mg)-Dissolved (mg/L)		56.4			
	Manganese (Mn)-Dissolved (mg/L)		9.60			
	Mercury (Hg)-Dissolved (mg/L)		<0.00020			
	Molybdenum (Mo)-Dissolved (mg/L)		DLA <0.0050			
	Nickel (Ni)-Dissolved (mg/L)		DLA <0.025			
	Phosphorus (P)-Dissolved (mg/L)		<0.30			
	Potassium (K)-Dissolved (mg/L)		164			
	Selenium (Se)-Dissolved (mg/L)		DLA <0.0050			

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-1	L1216048-2	L1216048-3	L1216048-4	L1216048-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12
	Sampled Time					
	Client ID	MW-2D	MW-2D REP	MW-4	MW-2S	MW-3
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)	8.94	8.64	8.61	13.7	7.74
	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)-Dissolved (mg/L)	12.1	11.3	14.6	33.3	9.5
	Strontium (Sr)-Dissolved (mg/L)	0.274	0.257	0.170	0.815	0.148
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	0.00038	<0.00020
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	0.0055	<0.0050
Aggregate Organics	COD (mg/L)	<20	26	<20	52	<20
Volatile Organic Compounds	Acetone (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Benzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bromodichloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromoform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Butadiene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dibromochloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Dibromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichlorobenzene (mg/L)	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
	Dichloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1216048-6	L1216048-7	L1216048-8	L1216048-9	L1216048-10
	Description	GW	GW	SW	GW	SW
	Sampled Date	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12
	Sampled Time					
	Client ID	MW-6	JAMES LAKES RD	LM	SFC-2	SFC-2B
WATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)	8.70		7.98		
	Silver (Ag)-Dissolved (mg/L)	<0.000050		<0.000050		
	Sodium (Na)-Dissolved (mg/L)	71.6		46.3		
	Strontium (Sr)-Dissolved (mg/L)	0.684		0.580		
	Thallium (Tl)-Dissolved (mg/L)	<0.00020		<0.00020		
	Tin (Sn)-Dissolved (mg/L)	<0.030		<0.030		
	Titanium (Ti)-Dissolved (mg/L)	<0.050		<0.050		
	Uranium (U)-Dissolved (mg/L)	<0.00020		<0.00020		
	Vanadium (V)-Dissolved (mg/L)	<0.030		<0.030		
	Zinc (Zn)-Dissolved (mg/L)	0.0068		0.0197		
Aggregate Organics	COD (mg/L)	44	<20	27	21	<20
Volatile Organic Compounds	Acetone (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Benzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bromodichloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromoform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Butadiene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dibromochloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Dibromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichlorobenzene (mg/L)	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
	Dichloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-11	L1216048-12	L1216048-13		
	Description	SW	SW	GW		
	Sampled Date	26-SEP-12	26-SEP-12	27-SEP-12		
	Sampled Time					
	Client ID	SFC-3	L1	SFC-11		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)		11.0			
	Silver (Ag)-Dissolved (mg/L)		DLA <0.00025			
	Sodium (Na)-Dissolved (mg/L)		395			
	Strontium (Sr)-Dissolved (mg/L)		3.47			
	Thallium (Tl)-Dissolved (mg/L)		DLA <0.0010			
	Tin (Sn)-Dissolved (mg/L)		<0.030			
	Titanium (Ti)-Dissolved (mg/L)		<0.050			
	Uranium (U)-Dissolved (mg/L)		DLA <0.0010			
	Vanadium (V)-Dissolved (mg/L)		<0.030			
	Zinc (Zn)-Dissolved (mg/L)		0.0975			
Aggregate Organics	COD (mg/L)	39	161	<20		
Volatile Organic Compounds	Acetone (mg/L)	<0.020	<0.020	<0.020		
	Benzene (mg/L)	<0.00050	<0.00050	<0.00050		
	Bromodichloromethane (mg/L)	<0.0010	<0.0010	<0.0010		
	Bromoform (mg/L)	<0.0010	<0.0010	<0.0010		
	Bromomethane (mg/L)	<0.0010	<0.0010	<0.0010		
	1,3-Butadiene (mg/L)	<0.0010	<0.0010	<0.0010		
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050	<0.00050		
	Chlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010		
	Dibromochloromethane (mg/L)	<0.0010	<0.0010	<0.0010		
	Chloroethane (mg/L)	<0.0010	<0.0010	<0.0010		
	Chloroform (mg/L)	<0.0010	<0.0010	<0.0010		
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050		
	Dibromomethane (mg/L)	<0.0010	<0.0010	<0.0010		
	1,2-Dichlorobenzene (mg/L)	<0.00070	<0.00070	<0.00070		
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010		
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010		
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010		
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010		
	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010		
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010		
	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010		
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014	<0.0014	<0.0014		
	Dichloromethane (mg/L)	<0.0050	<0.0050	<0.0050		
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010	<0.0010		
	cis-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-1	L1216048-2	L1216048-3	L1216048-4	L1216048-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12
	Sampled Time					
	Client ID	MW-2D	MW-2D REP	MW-4	MW-2S	MW-3
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	trans-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Ethylbenzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Methyl ethyl ketone (MEK) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Styrene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Tetrachloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Toluene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vinyl Chloride (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	ortho-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	98.5	98.9	98.1	97.7	98.7
	Surrogate: 1,4-Difluorobenzene (SS) (%)	102.9	103.0	103.1	102.1	102.5
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	VPH (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	103.2	106.4	83.2	98.9	113.5
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-6	L1216048-7	L1216048-8	L1216048-9	L1216048-10
	Description	GW	GW	SW	GW	SW
	Sampled Date	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12	26-SEP-12
	Sampled Time					
	Client ID	MW-6	JAMES LAKES RD	LM	SFC-2	SFC-2B
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	trans-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Ethylbenzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Methyl ethyl ketone (MEK) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Styrene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Tetrachloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Toluene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vinyl Chloride (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	ortho-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	98.8	99.5	97.7	96.4	97.3
	Surrogate: 1,4-Difluorobenzene (SS) (%)	102.2	102.1	102.5	102.4	102.5
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	VPH (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	112.4	117.2	106.4	100.2	104.1
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	0.000890	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-11	L1216048-12	L1216048-13		
	Description	SW	SW	GW		
	Sampled Date	26-SEP-12	26-SEP-12	27-SEP-12		
	Sampled Time					
	Client ID	SFC-3	L1	SFC-11		
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	trans-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010		
	Ethylbenzene (mg/L)	<0.00050	<0.00050	<0.00050		
	Methyl ethyl ketone (MEK) (mg/L)	<0.0050	<0.0050	<0.0050		
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010	<0.0010	<0.0010		
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	DLM <0.00070	<0.00050		
	Styrene (mg/L)	<0.00050	<0.00050	<0.00050		
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010		
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010		
	Tetrachloroethylene (mg/L)	<0.0010	<0.0010	<0.0010		
	Toluene (mg/L)	<0.00050	<0.00050	<0.00050		
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010		
	1,1,2-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010		
	Trichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010		
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010	<0.0010		
	Vinyl Chloride (mg/L)	<0.0010	<0.0010	<0.0010		
	ortho-Xylene (mg/L)	<0.00050	<0.00050	<0.00050		
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050	<0.00050		
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075		
	Surrogate: 4-Bromofluorobenzene (SS) (%)	94.1	95.3	98.8		
	Surrogate: 1,4-Difluorobenzene (SS) (%)	102.2	102.7	102.1		
Hydrocarbons	EPH10-19 (mg/L)	<0.25	0.84	<0.25		
	EPH19-32 (mg/L)	<0.25	0.50	<0.25		
	LEPH (mg/L)	<0.25	0.84	<0.25		
	HEPH (mg/L)	<0.25	0.50	<0.25		
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10	<0.10	<0.10		
	VPH (C6-C10) (mg/L)	<0.10	<0.10	<0.10		
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	85.6	81.0	116.2		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050		
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010		
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1216048-1 GW 26-SEP-12 MW-2D	L1216048-2 GW 26-SEP-12 MW-2D REP	L1216048-3 GW 26-SEP-12 MW-4	L1216048-4 GW 26-SEP-12 MW-2S	L1216048-5 GW 26-SEP-12 MW-3
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	81.8	84.0	81.4	87.3	89.1
	Surrogate: Acridine d9 (%)	89.3	89.9	74.5	80.4	81.1
	Surrogate: Chrysene d12 (%)	60.3	97.0	78.0	97.0	85.3
	Surrogate: Naphthalene d8 (%)	86.0	90.3	88.4	94.9	90.2
	Surrogate: Phenanthrene d10 (%)	91.4	95.6	75.8	94.4	89.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID / Description / Sampled Date / Sampled Time / Client ID	L1216048-6 GW 26-SEP-12 MW-6	L1216048-7 GW 26-SEP-12 JAMES LAKES RD	L1216048-8 SW 26-SEP-12 LM	L1216048-9 GW 26-SEP-12 SFC-2	L1216048-10 SW 26-SEP-12 SFC-2B
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	<0.000050	0.000136	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	0.000223	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050	0.000066	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	85.4	89.1	96.2	86.5	85.2
	Surrogate: Acridine d9 (%)	78.6	75.6	62.9	89.7	79.9
	Surrogate: Chrysene d12 (%)	77.2	99.0	86.7	93.9	94.8
	Surrogate: Naphthalene d8 (%)	86.0	89.3	95.7	100.4	88.1
	Surrogate: Phenanthrene d10 (%)	80.9	79.9	67.2	85.0	88.5

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1216048-11	L1216048-12	L1216048-13		
	Description	SW	SW	GW		
	Sampled Date	26-SEP-12	26-SEP-12	27-SEP-12		
	Sampled Time					
	Client ID	SFC-3	L1	SFC-11		
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050		
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050		
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050		
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050		
	Surrogate: Acenaphthene d10 (%)	78.6	82.7	83.6		
	Surrogate: Acridine d9 (%)	67.7	83.2	90.6		
	Surrogate: Chrysene d12 (%)	86.5	81.9	91.7		
	Surrogate: Naphthalene d8 (%)	69.5	80.6	84.0		
	Surrogate: Phenanthrene d10 (%)	70.2	75.8	86.9		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Aluminum (Al)-Dissolved	DLA	L1216048-6
Duplicate	Antimony (Sb)-Dissolved	DLA	L1216048-6
Duplicate	Chromium (Cr)-Dissolved	DLA	L1216048-6
Duplicate	Copper (Cu)-Dissolved	DLA	L1216048-6
Duplicate	Lead (Pb)-Dissolved	DLA	L1216048-6
Duplicate	Selenium (Se)-Dissolved	DLA	L1216048-6
Duplicate	Silver (Ag)-Dissolved	DLA	L1216048-6
Duplicate	Thallium (Tl)-Dissolved	DLA	L1216048-6
Duplicate	Bromide (Br)	DLM	L1216048-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1216048-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1216048-1, -10, -11, -12, -13, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1216048-1, -2
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1216048-1, -2, -3, -4, -5
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1216048-1, -2, -3, -4, -5
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1216048-1, -2, -3, -4, -5
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1216048-1, -2, -3, -4, -5
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1216048-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1216048-1, -2, -3, -4, -5
Matrix Spike	Ammonia, Total (as N)	MS-B	L1216048-1, -11, -2, -3, -4, -5, -7, -9
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1216048-6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

Reference Information

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-SF-FID-VA	Water	EPH in Water by GCFID	BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

FUELS-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA	Water	Total Mercury in Water by CVAFS	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA	Water	LEPHs and HEPHs	BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA	Water	Dissolved Metals in Water by ICPMS(Low)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA	Water	Total Metals in Water by ICPMS(Low)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et

Reference Information

al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PAH-SF-MS-VA	Water	PAH in Water by GCMS	EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

VH-HSFID-VA	Water	VH in Water by Headspace GCFID	B.C. MIN. OF ENV. LAB. MAN. (2009)

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.

VH-SURR-FID-VA	Water	VH Surrogates for Waters	B.C. MIN. OF ENV. LAB. MAN. (2009)
VOC-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC-M-HSMS-VA	Water	Volatile Organic Compounds - GC-MS	EPA 8260B, 5012A

Water samples, with reagents, are heated and an aliquot of the headspace at equilibrium is analysed by GC-MS.

VOC-M2-HSMS-VA	Water	VOCs in water by Headspace GCMS	EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA	Water	BTEX/MTBE/Styrene by Headspace GCMS	EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA	Water	VOC7 and/or VOC Surrogates for Waters	EPA8260B, 5021
VPH-CALC-VA	Water	VPH is VH minus select aromatics	BC MOE LABORATORY MANUAL (2005)

These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).

XYLENES-CALC-VA	Water	Sum of Xylene Isomer Concentrations	CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

** 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:

Reference Information

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-272788

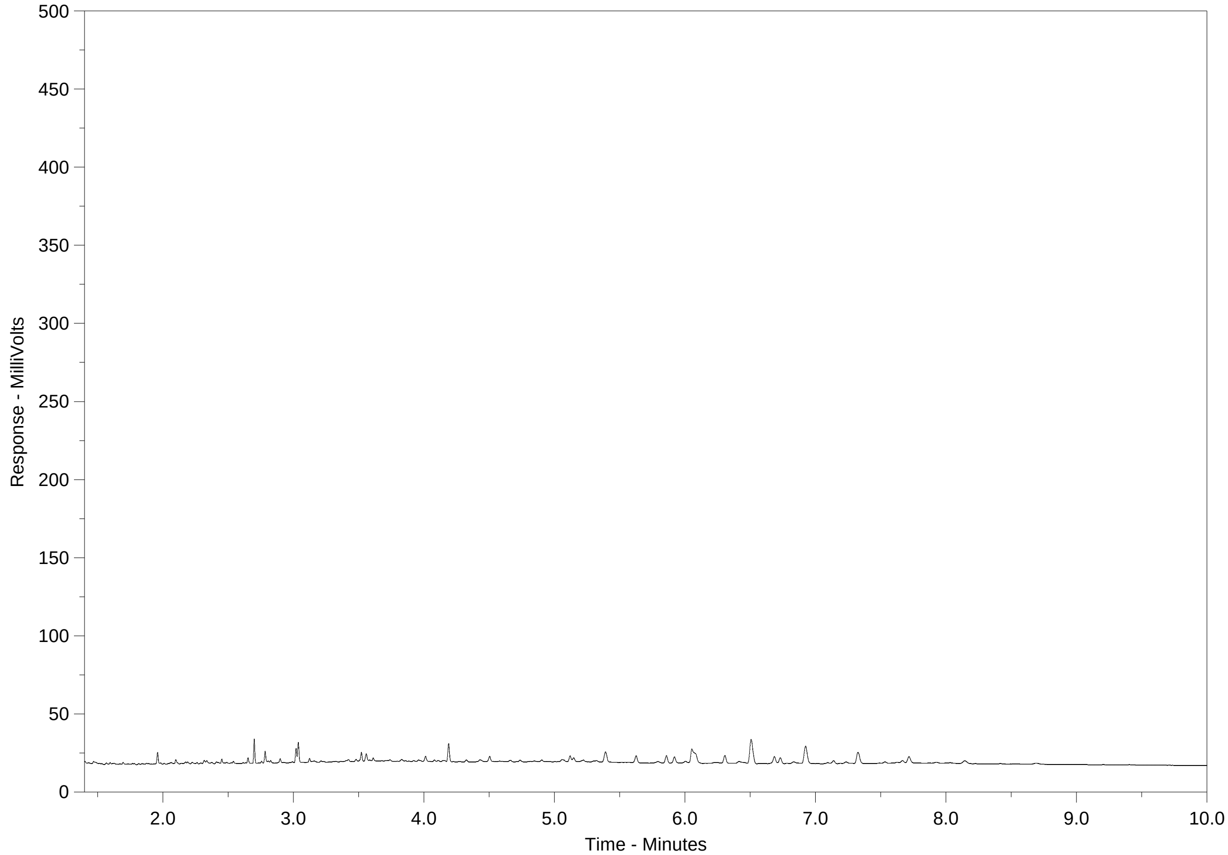
GLOSSARY OF REPORT TERMS

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 received 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.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-1
Client Sample ID: MW-2D



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

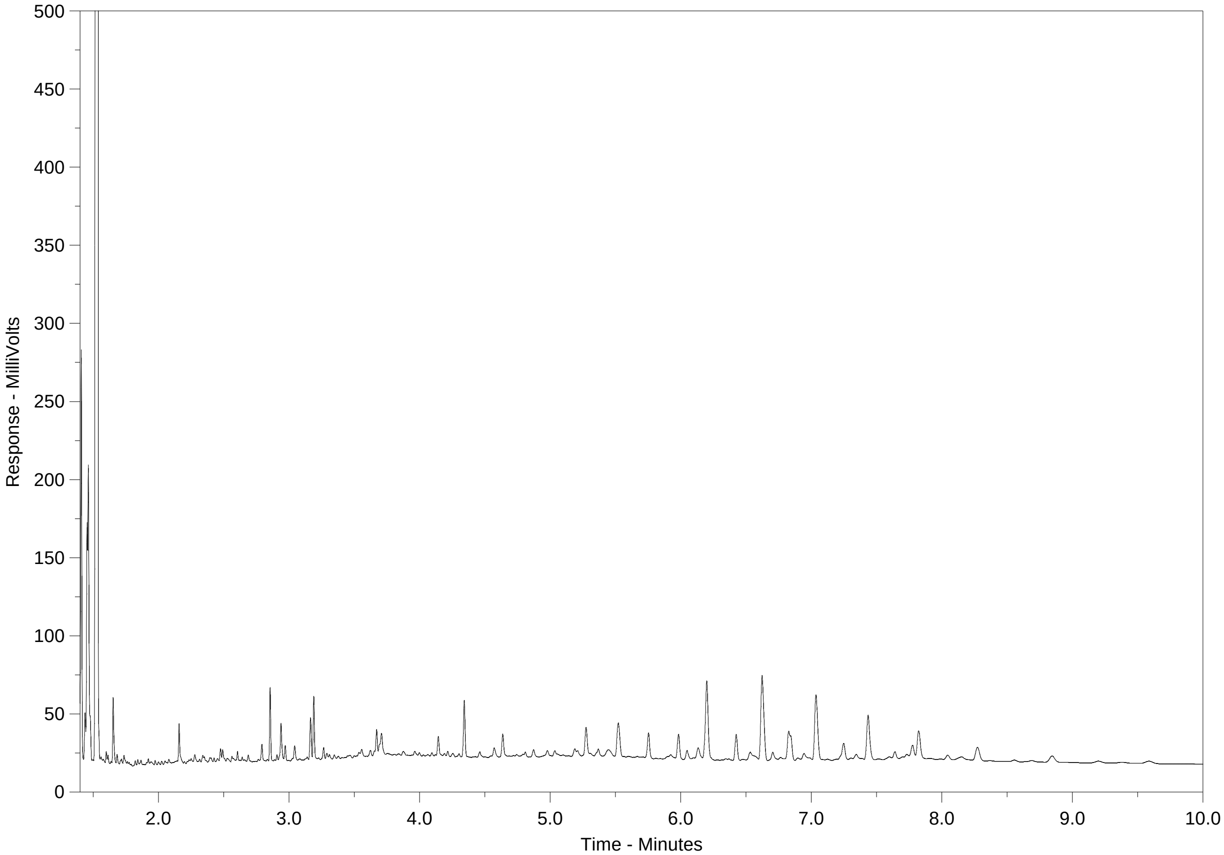
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-2
Client Sample ID: MW-2D REP



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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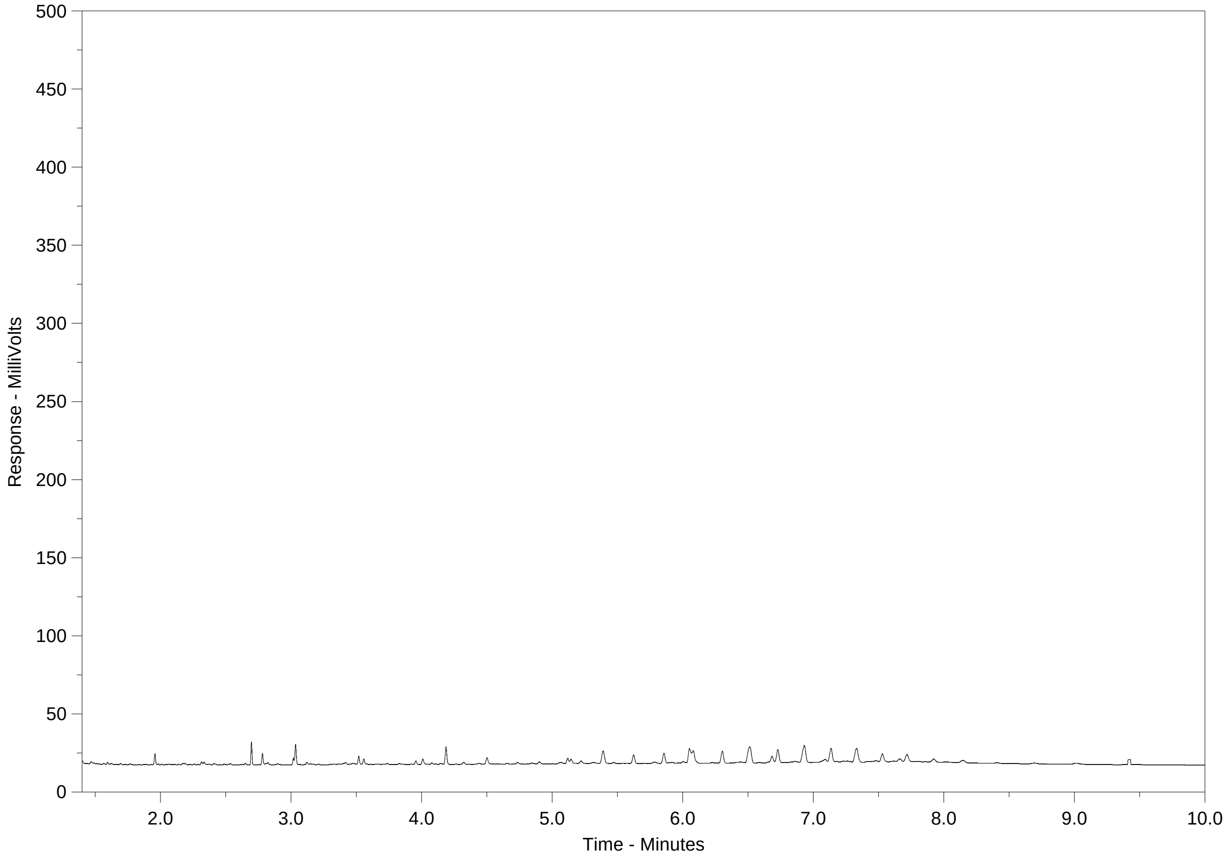
Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-3
Client Sample ID: MW-4



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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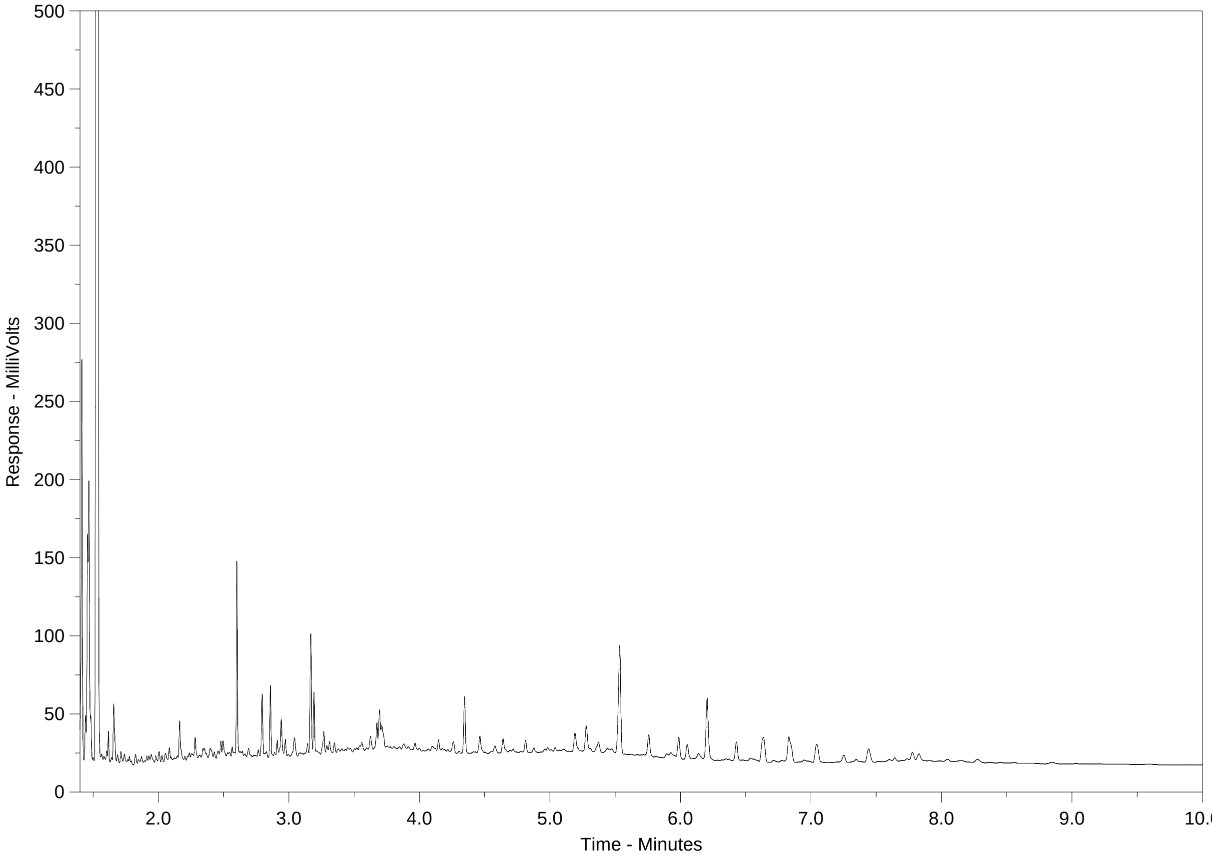
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-4
Client Sample ID: MW-2S



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

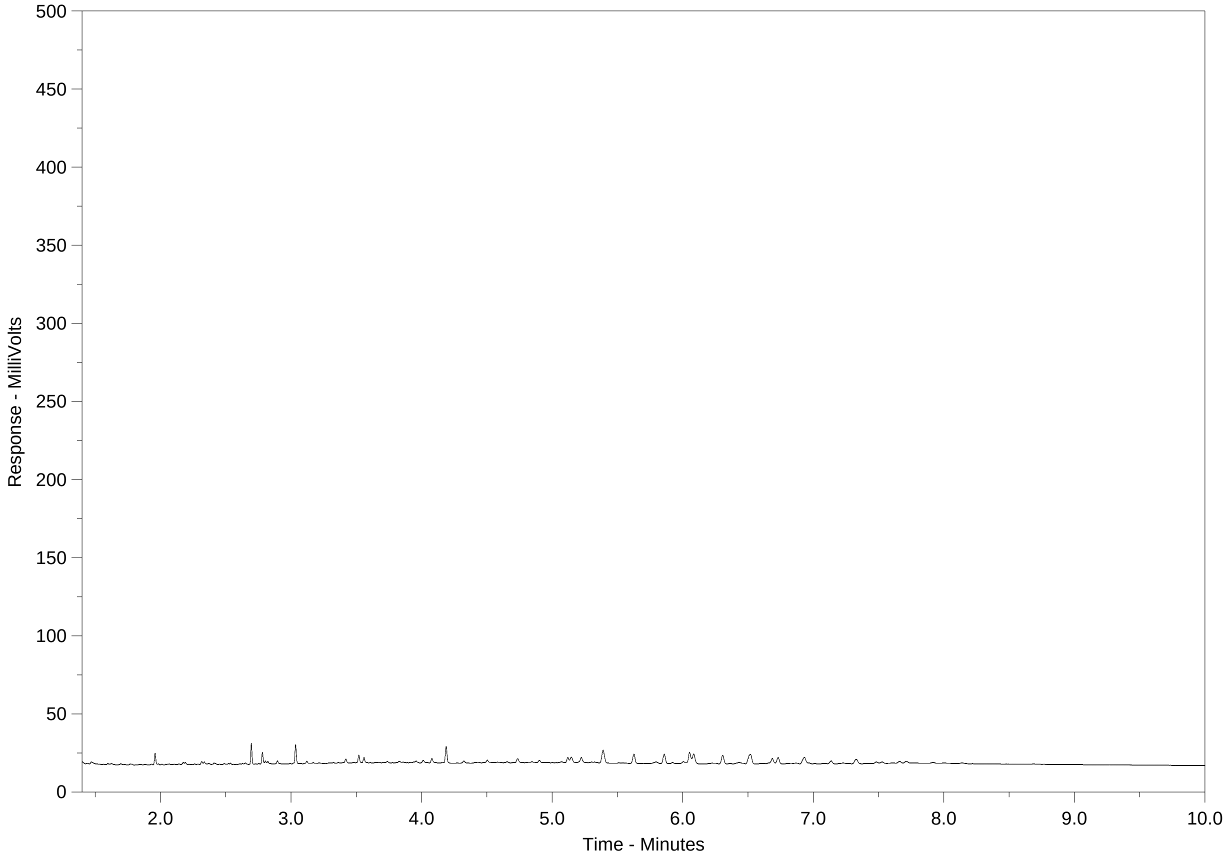
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-5
Client Sample ID: MW-3



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

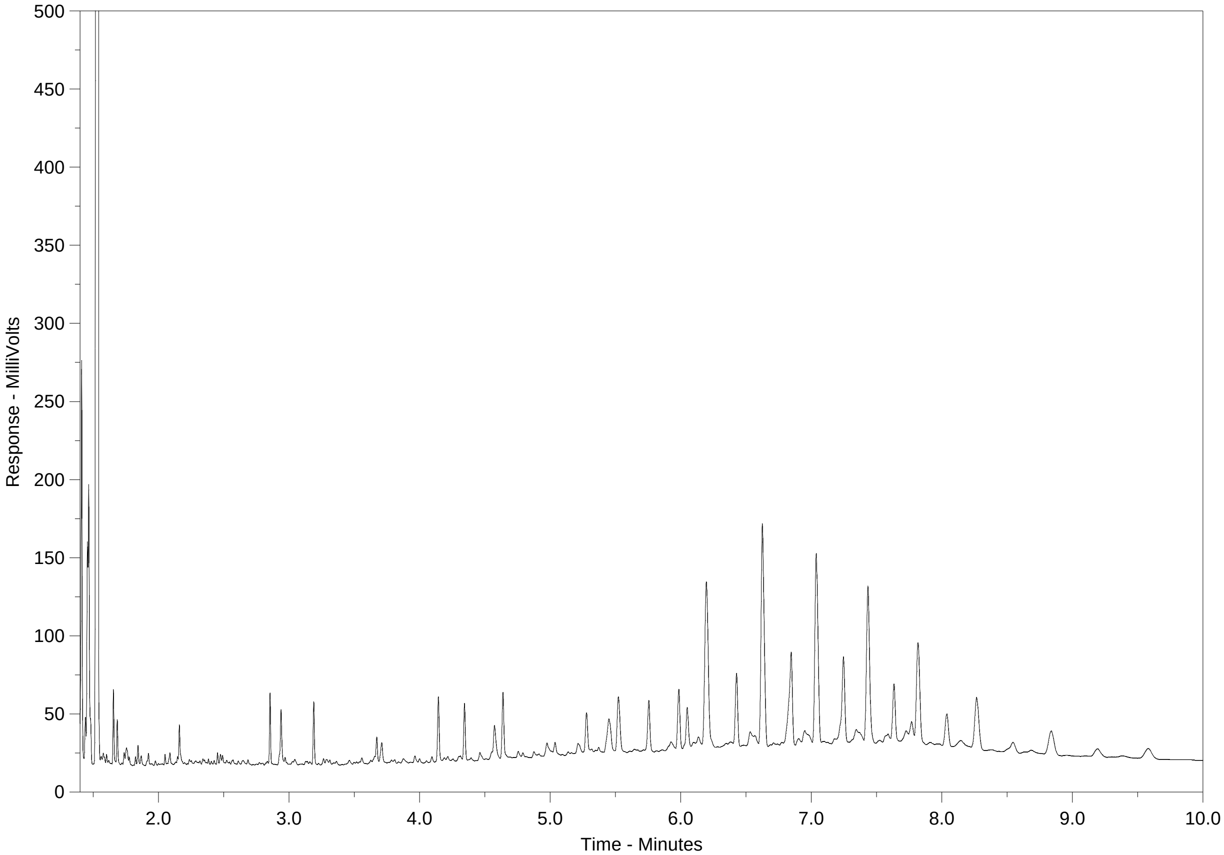
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-6
Client Sample ID: MW-6



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

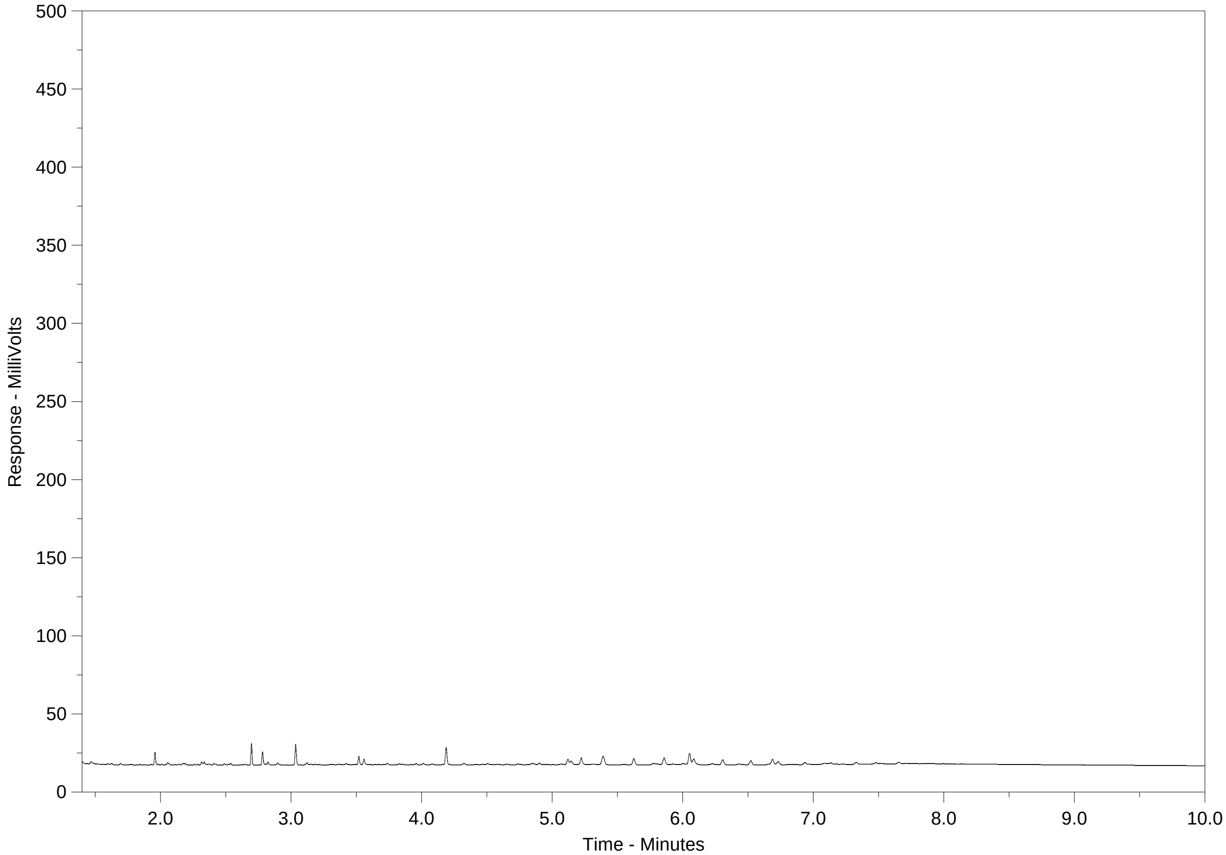
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-7
Client Sample ID: JAMES LAKES RD



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

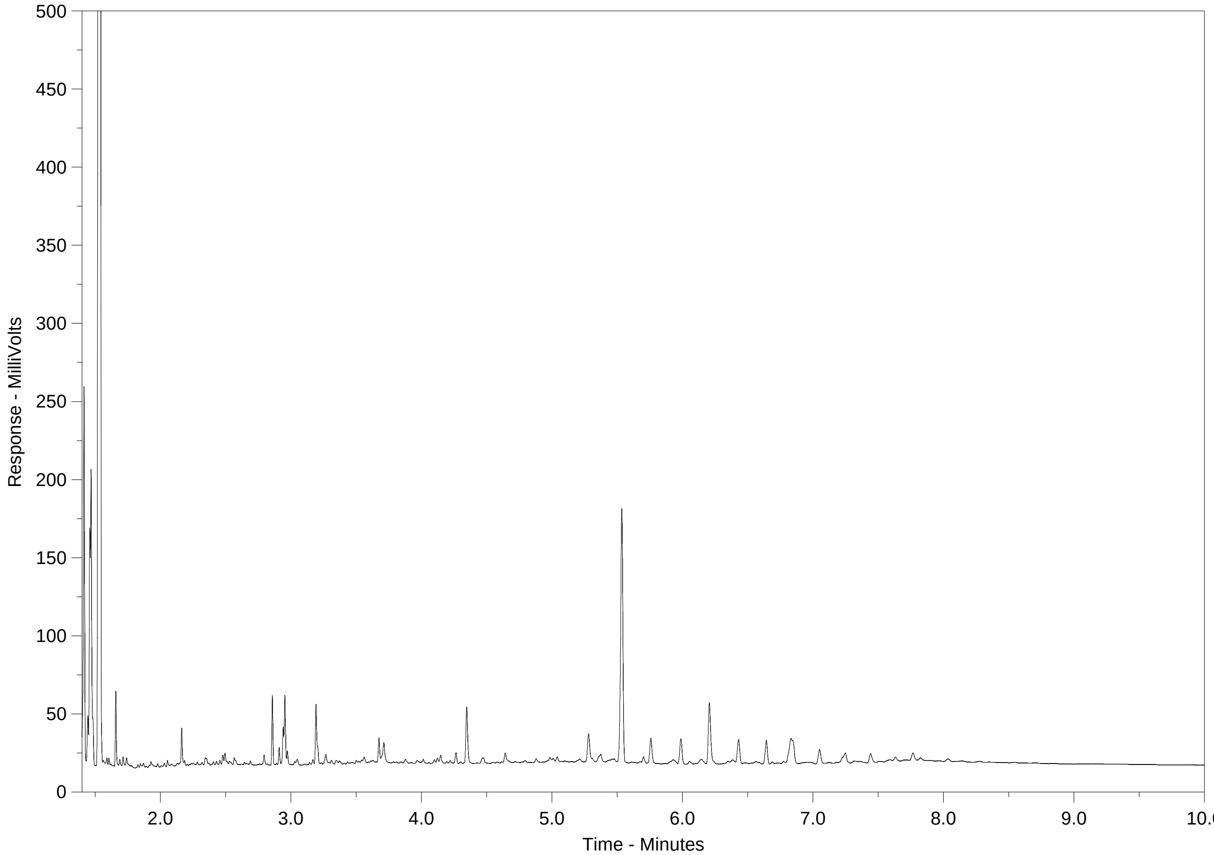
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-8
Client Sample ID: LM



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	←	Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

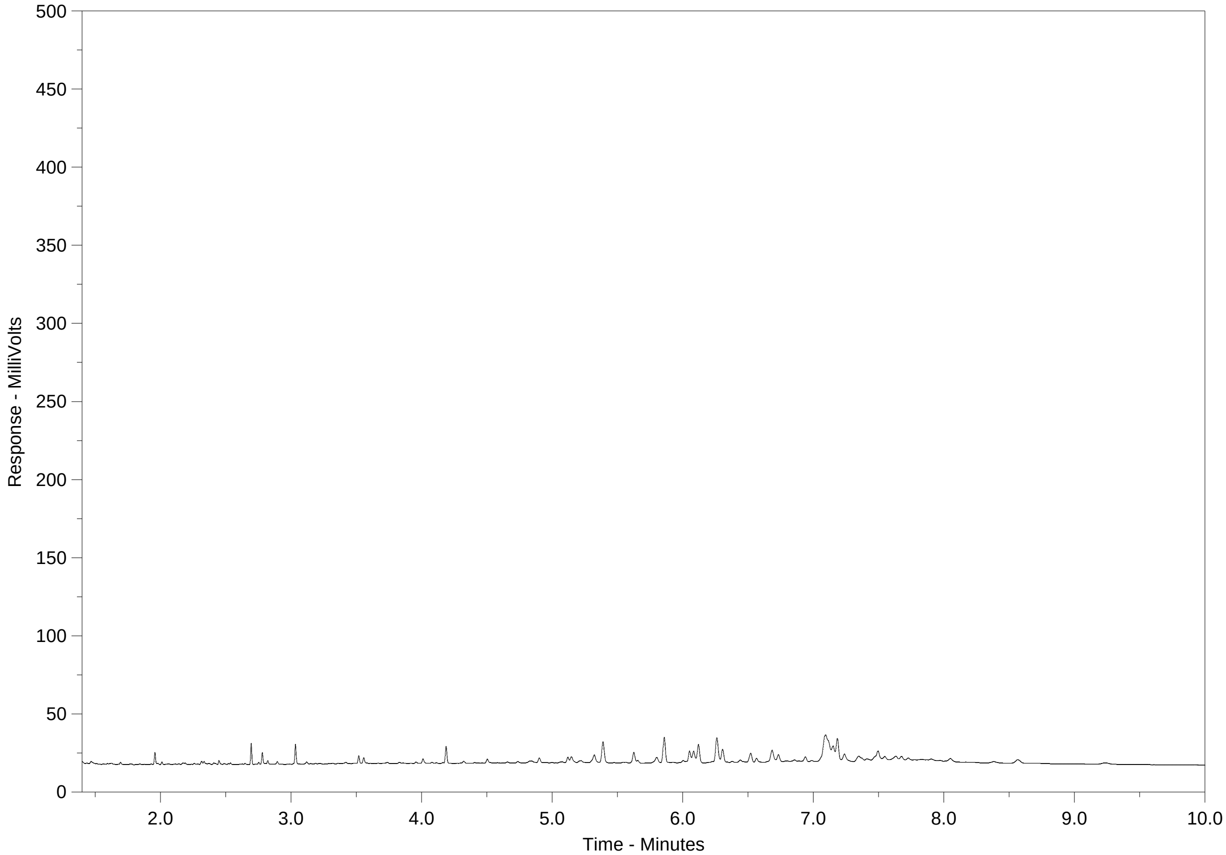
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-9
Client Sample ID: SFC-2



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

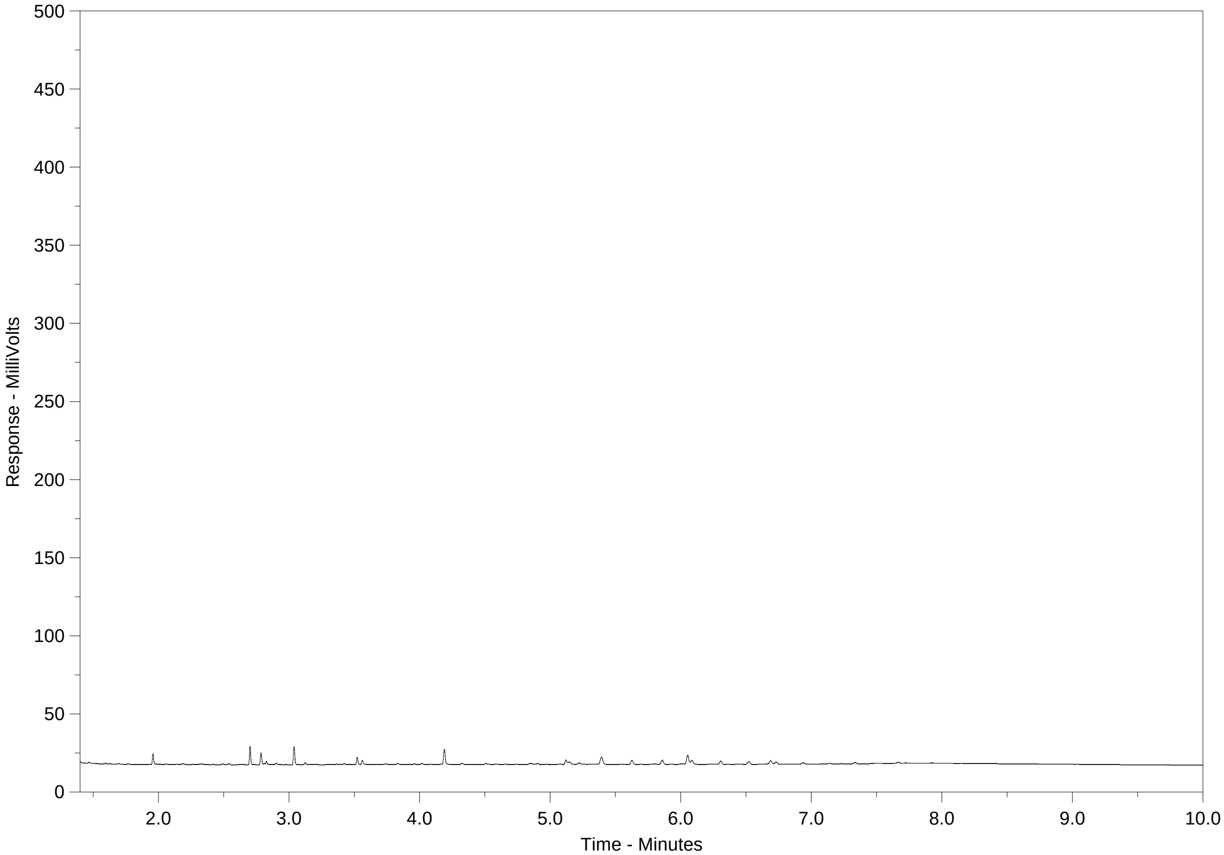
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-10
Client Sample ID: SFC-2B



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

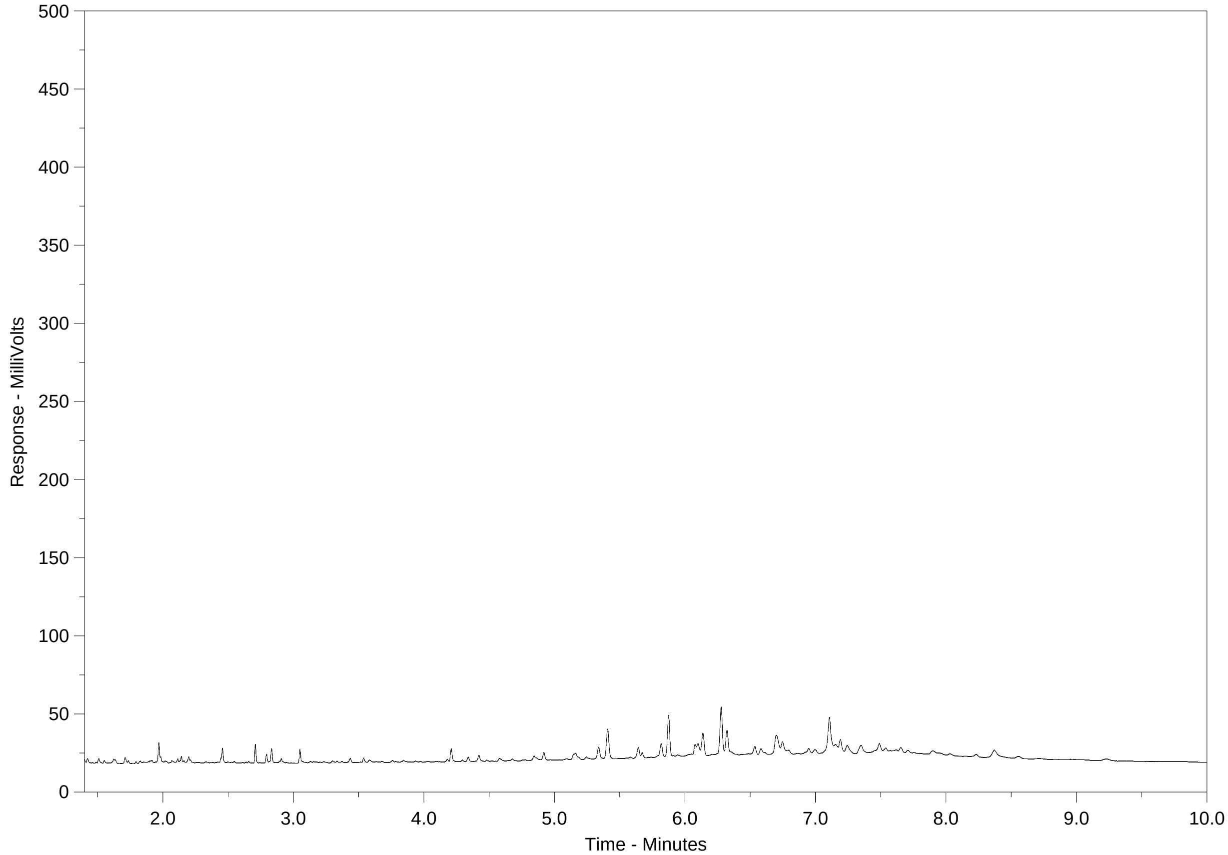
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-11
Client Sample ID: SFC-3



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

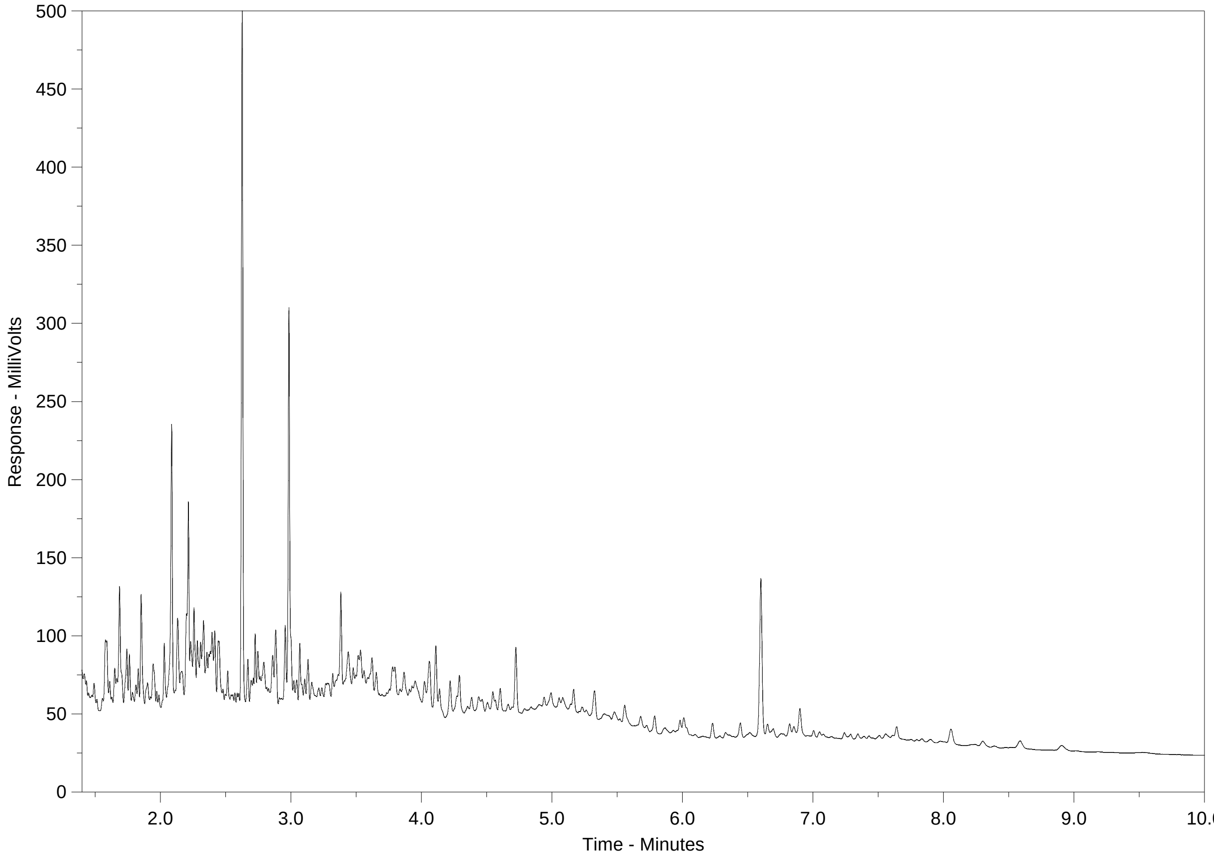
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-12
Client Sample ID: L1



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

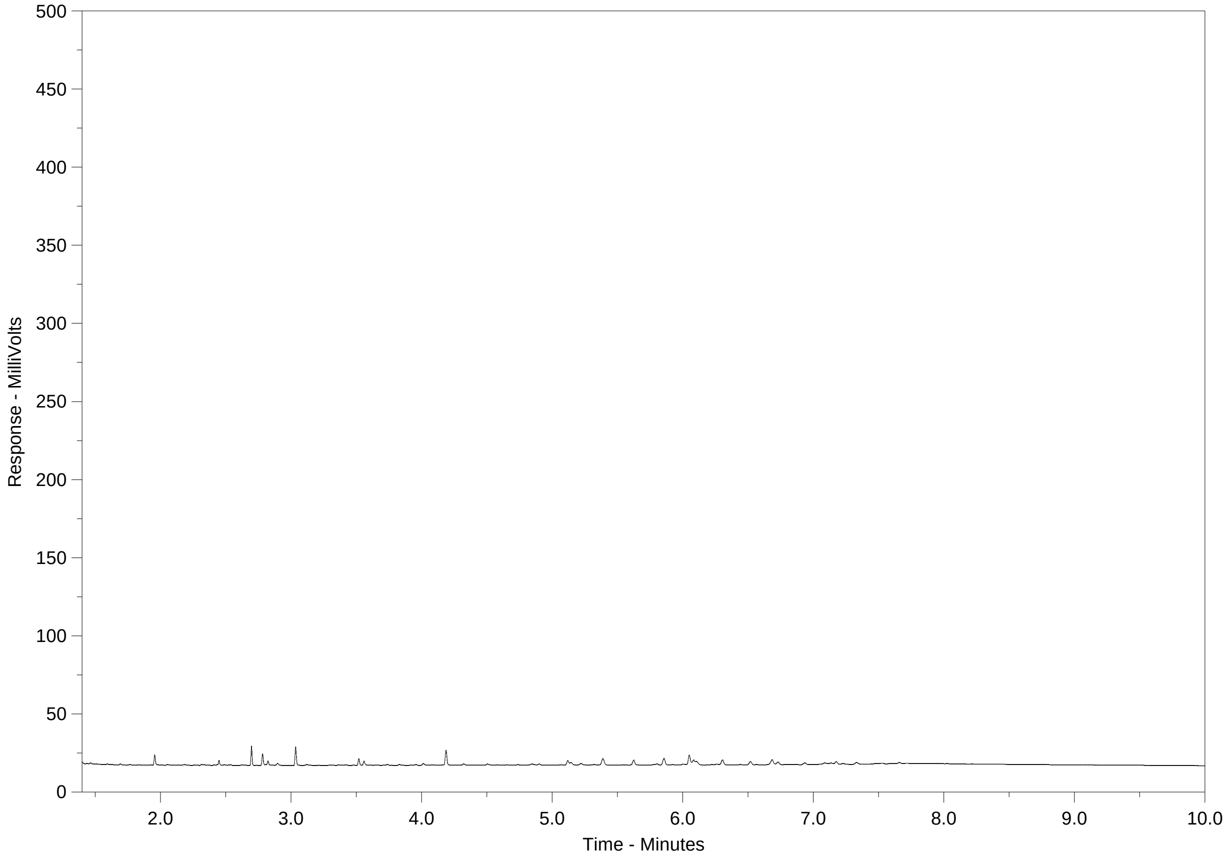
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1216048-13
Client Sample ID: SFC-11



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

10-272788

ALS Environmental

Chain of Custody / Analytica[l]
Canada Toll Free: 1 800
www.alsglobal.c[om]

L1216048-COFC

Page ____ of ____

Report To		Report Format / Distribution	
Company:	Morrison Hershfield	Standard: ✓	Other (specify):
Contact:	Josie Gilson	Select: PDF ✓ Excel ✓ Digital Fax	
Address:	310-4321 Still Creek Drive Burnaby, BC	Email 1:	jgilson@morrisonhershfield.com
Phone:	604-454-0402 Fax:	Email 2:	

Service Request: (Rush subject to availability - Contact ALS to confirm TAT)

- ✓ Regular (Standard Turnaround Times - Business Days)
- Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
- Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
- Same Day or Weekend Emergency - Contact ALS to confirm TAT

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	5104016
Company:	Resort Municipality of Whistler	PO / AFE:	
Contact:	Andrew Tucker	LSD:	
Address:	1135 Cheakamus Lk Rd		
Phone:	604-935-8386 Fax:	Quote #:	

Lab Work Order # (lab use only)	L1216048	ALS Contact: Selam Worku	Sampler: E. Toole

Analysis Request (Indicate Filtered or Preserved, F/P)

Short Holding Time
Rush Processing

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	COD/TKN/NH3 (P)	ORGanics (hepH/HEPH) (P)	VOC's (BTEX) (P)	Physical param.	Metals Total (P)	Metals Dissolved (F/P)		Number of Containers
1	MW-2D	26/9/12		GW	✓	✓	✓	✓		✓		
2	MW-2D Rep	26/9/12		GW	✓	✓	✓	✓		✓		
3	MW-4	26/9/12		GW	✓	✓	✓	✓		✓		
4	MW-2S	26/9/12		GW	✓	✓	✓	✓		✓		
5	MW-3	26/9/12		GW	✓	✓	✓	✓		✓		
6	MW-6	26/9/12		GW	✓	✓	✓	✓		✓		
7	James Lakes Rd	27/09/12		SW	✓	✓	✓	✓	✓			
8	LM	26/09/12		GW	✓	✓	✓	✓		✓	not filtered	
9	SFC-2	26/9/12		SW	✓	✓	✓	✓	✓			
10	SFC-2B	26/9/12		SW	✓	✓	✓	✓	✓			
11	SFC-3	26/9/12		SW	✓	✓	✓	✓	✓			
12	L1	27/09/12		GW	✓	✓	✓	✓		✓	not filtered	

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

VOC's - Pls include Acetone, dibromomethane, bromomethane, 1-3 butadiene, MIBK, MEK.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: [signature]	Date: Sept 27/12	Time: 10 am	Received by: Britt	Date: Sept. 27	Time: 13:50	Temperature: 12.0 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

MORRISON HERSHFIELD GROUP INC.
ATTN: Josie Gilson
310 - 4321 Still Creek Drive
Burnaby BC V5C 6S7

Date Received: 13-DEC-12
Report Date: 31-DEC-12 15:48 (MT)
Version: FINAL

Client Phone: 604-454-0402

Certificate of Analysis

Lab Work Order #: L1249277

Project P.O. #: NOT SUBMITTED
Job Reference: 5104016
C of C Numbers: 10-272784
Legal Site Desc:

Selam Worku
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-1	L1249277-2	L1249277-3	L1249277-4	L1249277-5
	Description	gw	gw	gw	gw	gw
	Sampled Date	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12
	Sampled Time					
	Client ID	MW-2D	MW-4	MW-2S	MW-3	L1
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1450	292	794	228	2500
	Hardness (as CaCO3) (mg/L)	629	138	263	58.9	500
	pH (pH)	6.85	6.89	6.89	6.60	7.73
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	224	90.6	200	33.9	963
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	224	90.6	200	33.9	963
	Ammonia, Total (as N) (mg/L)	18.2	1.60	10.7	0.173	87.3
	Bromide (Br) (mg/L)	<0.50 DLM	<0.050	<0.50 DLM	0.056	<1.0 DLM
	Chloride (Cl) (mg/L)	62.5	17.6	51.2	32.3	173
	Fluoride (F) (mg/L)	<0.20 DLM	0.042	<0.20 DLM	0.029	<0.40 DLM
	Nitrate (as N) (mg/L)	<0.050 DLM	0.0457	<0.050 DLM	0.116	4.53
	Nitrite (as N) (mg/L)	<0.010 DLM	0.0032	<0.010 DLM	<0.0010	0.122
	Total Kjeldahl Nitrogen (mg/L)	20.7	1.99	11.0	0.243	97.5
	Total Nitrogen (mg/L)	20.7	2.04	11.0	0.359	102
	Phosphorus (P)-Total (mg/L)	0.733	1.32	0.358	0.0056	0.490
	Sulfate (SO4) (mg/L)	532	32.9	149	26.3	162
Total Metals	Aluminum (Al)-Total (mg/L)					
	Antimony (Sb)-Total (mg/L)					
	Arsenic (As)-Total (mg/L)					
	Barium (Ba)-Total (mg/L)					
	Beryllium (Be)-Total (mg/L)					
	Bismuth (Bi)-Total (mg/L)					
	Boron (B)-Total (mg/L)					
	Cadmium (Cd)-Total (mg/L)					
	Calcium (Ca)-Total (mg/L)					
	Chromium (Cr)-Total (mg/L)					
	Cobalt (Co)-Total (mg/L)					
	Copper (Cu)-Total (mg/L)					
	Iron (Fe)-Total (mg/L)					
	Lead (Pb)-Total (mg/L)					
	Lithium (Li)-Total (mg/L)					
	Magnesium (Mg)-Total (mg/L)					
	Manganese (Mn)-Total (mg/L)					
	Mercury (Hg)-Total (mg/L)					
	Molybdenum (Mo)-Total (mg/L)					
	Nickel (Ni)-Total (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-6	L1249277-7	L1249277-8	L1249277-9	L1249277-10
	Description	gw	sw	sw	sw	sw
	Sampled Date	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12
	Sampled Time					
	Client ID	LM (DUPLICATE)	SFC-2	SFC-2B	SFC-3	SFC-11
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1000	116	1070	276	83.6
	Hardness (as CaCO3) (mg/L)	428	33.7	456	62.2	28.1
	pH (pH)	6.75	7.38	6.88	7.27	7.43
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	143	22.1	161	33.7	21.9
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	143	22.1	161	33.7	21.9
	Ammonia, Total (as N) (mg/L)	2.18	0.0084	2.50	0.0562	<0.0050
	Bromide (Br) (mg/L)	<0.50 DLM	<0.050	<0.50 DLM	<0.050	<0.050
	Chloride (Cl) (mg/L)	61.2	9.67	66.6	36.3	4.38
	Fluoride (F) (mg/L)	<0.20 DLM	0.048	<0.20 DLM	0.038	0.051
	Nitrate (as N) (mg/L)	<0.050 DLM	0.322	<0.050 DLM	0.218	0.343
	Nitrite (as N) (mg/L)	<0.010 DLM	<0.0010	<0.010 DLM	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	2.75	0.085	2.84	0.141	0.065
	Total Nitrogen (mg/L)	2.75	0.407	2.84	0.360	0.408
	Phosphorus (P)-Total (mg/L)	0.062	0.0083	0.0048	0.0034	0.0098
	Sulfate (SO4) (mg/L)	321	16.6	339	41.9	11.8
Total Metals	Aluminum (Al)-Total (mg/L)		0.261	0.016	0.125	0.320
	Antimony (Sb)-Total (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
	Barium (Ba)-Total (mg/L)		<0.020	0.127	0.030	<0.020
	Beryllium (Be)-Total (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050
	Bismuth (Bi)-Total (mg/L)		<0.20	<0.20	<0.20	<0.20
	Boron (B)-Total (mg/L)		<0.10	0.34	<0.10	<0.10
	Cadmium (Cd)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Calcium (Ca)-Total (mg/L)		10.7	158	21.0	8.67
	Chromium (Cr)-Total (mg/L)		<0.00050	<0.00050	<0.00050	<0.00050
	Cobalt (Co)-Total (mg/L)		<0.00050	0.0133	0.00091	<0.00050
	Copper (Cu)-Total (mg/L)		0.0028	0.0011	0.0056	0.0023
	Iron (Fe)-Total (mg/L)		0.178	24.6	0.325	0.175
	Lead (Pb)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)		<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Total (mg/L)		1.69	15.2	2.38	1.57
	Manganese (Mn)-Total (mg/L)		0.015	4.40	0.068	<0.010
	Mercury (Hg)-Total (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-11
	Description	SW
	Sampled Date	13-DEC-12
	Sampled Time	
	Client ID	SFC-4B DEC13/12
Grouping	**Analyte**	
WATER		
Physical Tests	Conductivity (uS/cm)	233
	Hardness (as CaCO3) (mg/L)	86.5
	pH (pH)	7.62
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	33.5
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	33.5
	Ammonia, Total (as N) (mg/L)	0.214
	Bromide (Br) (mg/L)	<0.050
	Chloride (Cl) (mg/L)	15.3
	Fluoride (F) (mg/L)	0.057
	Nitrate (as N) (mg/L)	0.526
	Nitrite (as N) (mg/L)	0.0020
	Total Kjeldahl Nitrogen (mg/L)	0.329
	Total Nitrogen (mg/L)	0.857
	Phosphorus (P)-Total (mg/L)	0.0058
	Sulfate (SO4) (mg/L)	54.1
Total Metals	Aluminum (Al)-Total (mg/L)	0.762
	Antimony (Sb)-Total (mg/L)	<0.00050
	Arsenic (As)-Total (mg/L)	<0.0010
	Barium (Ba)-Total (mg/L)	0.028
	Beryllium (Be)-Total (mg/L)	<0.0050
	Bismuth (Bi)-Total (mg/L)	<0.20
	Boron (B)-Total (mg/L)	<0.10
	Cadmium (Cd)-Total (mg/L)	<0.000050
	Calcium (Ca)-Total (mg/L)	29.2
	Chromium (Cr)-Total (mg/L)	<0.00050
	Cobalt (Co)-Total (mg/L)	0.00392
	Copper (Cu)-Total (mg/L)	0.0116
	Iron (Fe)-Total (mg/L)	1.18
	Lead (Pb)-Total (mg/L)	<0.0010
	Lithium (Li)-Total (mg/L)	<0.050
	Magnesium (Mg)-Total (mg/L)	3.28
	Manganese (Mn)-Total (mg/L)	0.491
	Mercury (Hg)-Total (mg/L)	<0.00020
	Molybdenum (Mo)-Total (mg/L)	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0050

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-1	L1249277-2	L1249277-3	L1249277-4	L1249277-5
	Description	gw	gw	gw	gw	gw
	Sampled Date	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12
	Sampled Time					
	Client ID	MW-2D	MW-4	MW-2S	MW-3	L1
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)					
	Potassium (K)-Total (mg/L)					
	Selenium (Se)-Total (mg/L)					
	Silicon (Si)-Total (mg/L)					
	Silver (Ag)-Total (mg/L)					
	Sodium (Na)-Total (mg/L)					
	Strontium (Sr)-Total (mg/L)					
	Thallium (Tl)-Total (mg/L)					
	Tin (Sn)-Total (mg/L)					
	Titanium (Ti)-Total (mg/L)					
	Uranium (U)-Total (mg/L)					
	Vanadium (V)-Total (mg/L)					
	Zinc (Zn)-Total (mg/L)					
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	LAB
	Aluminum (Al)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.017	<0.010
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Arsenic (As)-Dissolved (mg/L)	0.0158	0.0030	0.0097	<0.0010	<0.0010
	Barium (Ba)-Dissolved (mg/L)	0.043	0.175	0.194	0.082	0.109
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Dissolved (mg/L)	0.36	<0.10	0.21	<0.10	2.24
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050	0.000437	<0.000050	0.000177	<0.000050
	Calcium (Ca)-Dissolved (mg/L)	208	43.6	85.3	18.3	156
	Chromium (Cr)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	0.00190
	Cobalt (Co)-Dissolved (mg/L)	0.0198	0.0367	0.00330	0.00447	0.00712
	Copper (Cu)-Dissolved (mg/L)	<0.0010	0.0010	<0.0010	0.0027	0.0097
	Iron (Fe)-Dissolved (mg/L)	79.4	33.3	65.9	0.146	0.085
	Lead (Pb)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Magnesium (Mg)-Dissolved (mg/L)	26.9	6.94	12.2	3.20	27.0
	Manganese (Mn)-Dissolved (mg/L)	2.81	2.83	3.49	1.69	3.42
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Molybdenum (Mo)-Dissolved (mg/L)	0.0147	0.0083	0.0046	<0.0010	0.0023
	Nickel (Ni)-Dissolved (mg/L)	<0.0050	0.0055	<0.0050	<0.0050	0.0090
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	26.8	5.9	15.7	3.2	92.2
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID		L1249277-6	L1249277-7	L1249277-8	L1249277-9	L1249277-10
Description		gw	sw	sw	sw	sw
Sampled Date		12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12
Sampled Time						
Client ID		LM (DUPLICATE)	SFC-2	SFC-2B	SFC-3	SFC-11
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)		<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)		<2.0	10.0	2.3	<2.0
	Selenium (Se)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010
	Silicon (Si)-Total (mg/L)		7.56	8.91	6.60	7.79
	Silver (Ag)-Total (mg/L)		<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)-Total (mg/L)		9.3	50.9	29.6	5.7
	Strontium (Sr)-Total (mg/L)		0.108	1.01	0.162	0.0959
	Thallium (Tl)-Total (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Total (mg/L)		<0.030	<0.030	<0.030	<0.030
	Titanium (Ti)-Total (mg/L)		<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Total (mg/L)		<0.00020	<0.00020	<0.00020	<0.00020
	Vanadium (V)-Total (mg/L)		<0.030	<0.030	<0.030	<0.030
	Zinc (Zn)-Total (mg/L)		<0.0050	0.0234	0.0060	<0.0050
Dissolved Metals	Dissolved Metals Filtration Location	LAB				
	Aluminum (Al)-Dissolved (mg/L)	<0.010				
	Antimony (Sb)-Dissolved (mg/L)	<0.00050				
	Arsenic (As)-Dissolved (mg/L)	<0.0010				
	Barium (Ba)-Dissolved (mg/L)	0.113				
	Beryllium (Be)-Dissolved (mg/L)	<0.0050				
	Bismuth (Bi)-Dissolved (mg/L)	<0.20				
	Boron (B)-Dissolved (mg/L)	0.31				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050				
	Calcium (Ca)-Dissolved (mg/L)	148				
	Chromium (Cr)-Dissolved (mg/L)	<0.00050				
	Cobalt (Co)-Dissolved (mg/L)	0.00884				
	Copper (Cu)-Dissolved (mg/L)	<0.0010				
	Iron (Fe)-Dissolved (mg/L)	3.56				
	Lead (Pb)-Dissolved (mg/L)	<0.0010				
	Lithium (Li)-Dissolved (mg/L)	<0.050				
	Magnesium (Mg)-Dissolved (mg/L)	14.4				
	Manganese (Mn)-Dissolved (mg/L)	3.82				
	Mercury (Hg)-Dissolved (mg/L)	<0.00020				
	Molybdenum (Mo)-Dissolved (mg/L)	<0.0010				
	Nickel (Ni)-Dissolved (mg/L)	<0.0050				
	Phosphorus (P)-Dissolved (mg/L)	<0.30				
	Potassium (K)-Dissolved (mg/L)	8.9				
	Selenium (Se)-Dissolved (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-11				
	Description	SW				
	Sampled Date	13-DEC-12				
	Sampled Time					
	Client ID	SFC-4B DEC13/12				
Grouping	**Analyte**					
WATER						
Total Metals	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	2.5				
	Selenium (Se)-Total (mg/L)	<0.0010				
	Silicon (Si)-Total (mg/L)	6.56				
	Silver (Ag)-Total (mg/L)	<0.000050				
	Sodium (Na)-Total (mg/L)	12.4				
	Strontium (Sr)-Total (mg/L)	0.209				
	Thallium (Tl)-Total (mg/L)	<0.00020				
	Tin (Sn)-Total (mg/L)	<0.030				
	Titanium (Ti)-Total (mg/L)	<0.050				
	Uranium (U)-Total (mg/L)	<0.00020				
	Vanadium (V)-Total (mg/L)	<0.030				
	Zinc (Zn)-Total (mg/L)	0.0097				
Dissolved Metals	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-1	L1249277-2	L1249277-3	L1249277-4	L1249277-5
	Description	gw	gw	gw	gw	gw
	Sampled Date	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12
	Sampled Time					
	Client ID	MW-2D	MW-4	MW-2S	MW-3	L1
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)	14.3	10.5	10.7	7.43	8.06
	Silver (Ag)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Sodium (Na)-Dissolved (mg/L)	33.5	16.5	24.3	16.0	191
	Strontium (Sr)-Dissolved (mg/L)	0.800	0.245	0.435	0.146	0.833
	Thallium (Tl)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Titanium (Ti)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Uranium (U)-Dissolved (mg/L)	0.00022	<0.00020	<0.00020	<0.00020	0.00028
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Zinc (Zn)-Dissolved (mg/L)	<0.0050	0.0117	<0.0050	<0.0050	0.0248
Aggregate Organics	COD (mg/L)	65	61	57	<20	174
Volatile Organic Compounds	Acetone (mg/L)	<0.010	<0.010	<0.010	<0.010	0.011
	Benzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Bromodichloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromoform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Butadiene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Carbon Disulfide (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Carbon Tetrachloride (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Chlorobenzene (mg/L)	0.0011	<0.0010	0.0013	<0.0010	<0.0010
	Dibromochloromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloroform (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	2-Chlorotoluene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	4-Chlorotoluene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Decane (nC10) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dibromoethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Dibromomethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichlorobenzene (mg/L)	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
	1,3-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,4-Dichlorobenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2-Dichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID / Description / Sampled Date / Sampled Time / Client ID	L1249277-6 gw 12-DEC-12 LM (DUPLICATE)	L1249277-7 sw 12-DEC-12 SFC-2	L1249277-8 sw 12-DEC-12 SFC-2B	L1249277-9 sw 12-DEC-12 SFC-3	L1249277-10 sw 12-DEC-12 SFC-11
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)	8.37				
	Silver (Ag)-Dissolved (mg/L)	<0.000050				
	Sodium (Na)-Dissolved (mg/L)	46.7				
	Strontium (Sr)-Dissolved (mg/L)	0.909				
	Thallium (Tl)-Dissolved (mg/L)	<0.00020				
	Tin (Sn)-Dissolved (mg/L)	<0.030				
	Titanium (Ti)-Dissolved (mg/L)	<0.050				
	Uranium (U)-Dissolved (mg/L)	<0.00020				
	Vanadium (V)-Dissolved (mg/L)	<0.030				
	Zinc (Zn)-Dissolved (mg/L)	0.0355				
Aggregate Organics	COD (mg/L)	38	<20	38	<20	<20
Volatile Organic Compounds	Acetone (mg/L)	<0.010				
	Benzene (mg/L)	<0.00050				
	Bromodichloromethane (mg/L)	<0.0010				
	Bromoform (mg/L)	<0.0010				
	Bromomethane (mg/L)	<0.0010				
	1,3-Butadiene (mg/L)	<0.0010				
	Carbon Disulfide (mg/L)	<0.0050				
	Carbon Tetrachloride (mg/L)	<0.00050				
	Chlorobenzene (mg/L)	<0.0010				
	Dibromochloromethane (mg/L)	<0.0010				
	Chloroethane (mg/L)	<0.0010				
	Chloroform (mg/L)	<0.0010				
	Chloromethane (mg/L)	<0.0050				
	2-Chlorotoluene (mg/L)	<0.0010				
	4-Chlorotoluene (mg/L)	<0.0010				
	Decane (nC10) (mg/L)	<0.0010				
	1,2-Dibromoethane (mg/L)	<0.0010				
	Dibromomethane (mg/L)	<0.0010				
	1,2-Dichlorobenzene (mg/L)	<0.00070				
	1,3-Dichlorobenzene (mg/L)	<0.0010				
	1,4-Dichlorobenzene (mg/L)	<0.0010				
	1,1-Dichloroethane (mg/L)	<0.0010				
	1,2-Dichloroethane (mg/L)	<0.0010				
	1,1-Dichloroethylene (mg/L)	<0.0010				
	cis-1,2-Dichloroethylene (mg/L)	<0.0010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-11				
	Description	sw				
	Sampled Date	13-DEC-12				
	Sampled Time					
	Client ID	SFC-4B DEC13/12				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
Aggregate Organics	COD (mg/L)	<20				
Volatile Organic Compounds	Acetone (mg/L)					
	Benzene (mg/L)					
	Bromodichloromethane (mg/L)					
	Bromoform (mg/L)					
	Bromomethane (mg/L)					
	1,3-Butadiene (mg/L)					
	Carbon Disulfide (mg/L)					
	Carbon Tetrachloride (mg/L)					
	Chlorobenzene (mg/L)					
	Dibromochloromethane (mg/L)					
	Chloroethane (mg/L)					
	Chloroform (mg/L)					
	Chloromethane (mg/L)					
	2-Chlorotoluene (mg/L)					
	4-Chlorotoluene (mg/L)					
	Decane (nC10) (mg/L)					
	1,2-Dibromoethane (mg/L)					
	Dibromomethane (mg/L)					
	1,2-Dichlorobenzene (mg/L)					
	1,3-Dichlorobenzene (mg/L)					
	1,4-Dichlorobenzene (mg/L)					
	1,1-Dichloroethane (mg/L)					
	1,2-Dichloroethane (mg/L)					
	1,1-Dichloroethylene (mg/L)					
	cis-1,2-Dichloroethylene (mg/L)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1249277-1 gw 12-DEC-12 MW-2D	L1249277-2 gw 12-DEC-12 MW-4	L1249277-3 gw 12-DEC-12 MW-2S	L1249277-4 gw 12-DEC-12 MW-3	L1249277-5 gw 12-DEC-12 L1
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	trans-1,2-Dichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
	Dichloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	1,2-Dichloropropane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	cis-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	trans-1,3-Dichloropropylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Ethylbenzene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	n-Heptane (nC7) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	n-Hexane (nC6) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	2-Hexanone (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Isopropylbenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	4-Isopropyltoluene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Methyl ethyl ketone (MEK) (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Methylcyclohexane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Naphthalene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	n-Octane (nC8) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	n-Propylbenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Styrene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Tetrachloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Toluene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	1,1,1-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,1,2-Trichloroethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichloroethylene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Trichlorofluoromethane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2,3-Trichloropropane (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,2,4-Trimethylbenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	1,3,5-Trimethylbenzene (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Vinyl Chloride (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	ortho-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	meta- & para-Xylene (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	93.0	88.5	91.0	90.0	92.5
	Surrogate: 1,4-Difluorobenzene (SS) (%)	102.7	99.2	100.6	100.3	101.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1249277-6 gw 12-DEC-12 LM (DUPLICATE)	L1249277-7 sw 12-DEC-12 SFC-2	L1249277-8 sw 12-DEC-12 SFC-2B	L1249277-9 sw 12-DEC-12 SFC-3	L1249277-10 sw 12-DEC-12 SFC-11
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	trans-1,2-Dichloroethylene (mg/L)	<0.0010				
	1,3-Dichloropropene (cis & trans) (mg/L)	<0.0014				
	Dichloromethane (mg/L)	<0.0050				
	1,2-Dichloropropane (mg/L)	<0.0010				
	cis-1,3-Dichloropropylene (mg/L)	<0.0010				
	trans-1,3-Dichloropropylene (mg/L)	<0.0010				
	Ethylbenzene (mg/L)	<0.00050				
	n-Heptane (nC7) (mg/L)	<0.0010				
	n-Hexane (nC6) (mg/L)	<0.0010				
	2-Hexanone (mg/L)	<0.0010				
	Isopropylbenzene (mg/L)	<0.0010				
	4-Isopropyltoluene (mg/L)	<0.0010				
	Methyl ethyl ketone (MEK) (mg/L)	<0.010				
	Methyl isobutyl ketone (MIBK) (mg/L)	<0.0010				
	Methylcyclohexane (mg/L)	<0.0010				
	Methyl t-butyl ether (MTBE) (mg/L)	<0.00050				
	Naphthalene (mg/L)	<0.0010				
	n-Octane (nC8) (mg/L)	<0.0010				
	n-Propylbenzene (mg/L)	<0.0010				
	Styrene (mg/L)	<0.00050				
	1,1,1,2-Tetrachloroethane (mg/L)	<0.0010				
	1,1,2,2-Tetrachloroethane (mg/L)	<0.0010				
	Tetrachloroethylene (mg/L)	<0.0010				
	Toluene (mg/L)	<0.00050				
	1,1,1-Trichloroethane (mg/L)	<0.0010				
	1,1,2-Trichloroethane (mg/L)	<0.0010				
	Trichloroethylene (mg/L)	<0.0010				
	Trichlorofluoromethane (mg/L)	<0.0010				
	1,2,3-Trichloropropane (mg/L)	<0.0010				
	1,2,4-Trimethylbenzene (mg/L)	<0.0010				
	1,3,5-Trimethylbenzene (mg/L)	<0.0010				
	Vinyl Chloride (mg/L)	<0.0010				
	ortho-Xylene (mg/L)	<0.00050				
	meta- & para-Xylene (mg/L)	<0.00050				
	Xylenes (mg/L)	<0.00075				
	Surrogate: 4-Bromofluorobenzene (SS) (%)	90.8				
	Surrogate: 1,4-Difluorobenzene (SS) (%)	99.6				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L1249277-11 SW 13-DEC-12 SFC-4B DEC13/12				
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	trans-1,2-Dichloroethylene (mg/L)					
	1,3-Dichloropropene (cis & trans) (mg/L)					
	Dichloromethane (mg/L)					
	1,2-Dichloropropane (mg/L)					
	cis-1,3-Dichloropropylene (mg/L)					
	trans-1,3-Dichloropropylene (mg/L)					
	Ethylbenzene (mg/L)					
	n-Heptane (nC7) (mg/L)					
	n-Hexane (nC6) (mg/L)					
	2-Hexanone (mg/L)					
	Isopropylbenzene (mg/L)					
	4-Isopropyltoluene (mg/L)					
	Methyl ethyl ketone (MEK) (mg/L)					
	Methyl isobutyl ketone (MIBK) (mg/L)					
	Methylcyclohexane (mg/L)					
	Methyl t-butyl ether (MTBE) (mg/L)					
	Naphthalene (mg/L)					
	n-Octane (nC8) (mg/L)					
	n-Propylbenzene (mg/L)					
	Styrene (mg/L)					
	1,1,1,2-Tetrachloroethane (mg/L)					
	1,1,2,2-Tetrachloroethane (mg/L)					
	Tetrachloroethylene (mg/L)					
	Toluene (mg/L)					
	1,1,1-Trichloroethane (mg/L)					
	1,1,2-Trichloroethane (mg/L)					
	Trichloroethylene (mg/L)					
	Trichlorofluoromethane (mg/L)					
	1,2,3-Trichloropropane (mg/L)					
	1,2,4-Trimethylbenzene (mg/L)					
	1,3,5-Trimethylbenzene (mg/L)					
	Vinyl Chloride (mg/L)					
	ortho-Xylene (mg/L)					
	meta- & para-Xylene (mg/L)					
	Xylenes (mg/L)					
	Surrogate: 4-Bromofluorobenzene (SS) (%)					
	Surrogate: 1,4-Difluorobenzene (SS) (%)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1249277-1	L1249277-2	L1249277-3	L1249277-4	L1249277-5
	Description	gw	gw	gw	gw	gw
	Sampled Date	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12	12-DEC-12
	Sampled Time					
	Client ID	MW-2D	MW-4	MW-2S	MW-3	L1
Grouping	**Analyte**					
WATER						
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	0.58
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	0.41
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	0.58
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	0.41
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	VPH (C6-C10) (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	88.9	SURR-ND 62.1	90.0	SURR-ND 68.3	80.7
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	DLM <0.00020
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	DLM <0.000080
	Surrogate: Acenaphthene d10 (%)	98.5	68.4	99.6	110.9	96.9
	Surrogate: Acridine d9 (%)	112.3	75.7	109.4	110.7	117.0
	Surrogate: Chrysene d12 (%)	111.0	73.6	104.2	111.6	108.5
	Surrogate: Naphthalene d8 (%)	98.4	67.7	94.9	102.9	99.0
	Surrogate: Phenanthrene d10 (%)	102.3	70.5	104.0	103.6	104.1

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID / Description / Sampled Date / Sampled Time / Client ID	L1249277-6 gw 12-DEC-12 LM (DUPLICATE)	L1249277-7 sw 12-DEC-12 SFC-2	L1249277-8 sw 12-DEC-12 SFC-2B	L1249277-9 sw 12-DEC-12 SFC-3	L1249277-10 sw 12-DEC-12 SFC-11
Grouping	**Analyte**					
WATER						
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	EPH19-32 (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	HEPH (mg/L)	<0.25	<0.25	<0.25	<0.25	<0.25
	Volatile Hydrocarbons (VH6-10) (mg/L)	<0.10				
	VPH (C6-C10) (mg/L)	<0.10				
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	99.3				
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	0.000805	<0.000050	0.000627	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	0.000115	<0.000050	0.000113	<0.000050	<0.000050
	Fluorene (mg/L)	0.000331	<0.000050	0.000236	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	0.000066	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Pyrene (mg/L)	0.000072	<0.000050	0.000058	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	88.7	90.7	97.3	95.1	91.3
	Surrogate: Acridine d9 (%)	88.5	97.9	97.0	98.2	95.3
	Surrogate: Chrysene d12 (%)	99.7	91.6	98.0	96.1	91.8
	Surrogate: Naphthalene d8 (%)	83.7	90.5	99.2	96.3	92.2
	Surrogate: Phenanthrene d10 (%)	86.9	96.8	104.2	100.4	96.4

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

		L1249277-11				
	Sample ID	L1249277-11				
	Description	SW				
	Sampled Date	13-DEC-12				
	Sampled Time					
	Client ID	SFC-4B DEC13/12				
Grouping	**Analyte**					
WATER						
Hydrocarbons	EPH10-19 (mg/L)	<0.25				
	EPH19-32 (mg/L)	<0.25				
	LEPH (mg/L)	<0.25				
	HEPH (mg/L)	<0.25				
	Volatile Hydrocarbons (VH6-10) (mg/L)					
	VPH (C6-C10) (mg/L)					
	Surrogate: 3,4-Dichlorotoluene (SS) (%)					
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050				
	Acenaphthylene (mg/L)	<0.000050				
	Acridine (mg/L)	<0.000050				
	Anthracene (mg/L)	<0.000050				
	Benz(a)anthracene (mg/L)	<0.000050				
	Benzo(a)pyrene (mg/L)	<0.000010				
	Benzo(b)fluoranthene (mg/L)	<0.000050				
	Benzo(g,h,i)perylene (mg/L)	<0.000050				
	Benzo(k)fluoranthene (mg/L)	<0.000050				
	Chrysene (mg/L)	<0.000050				
	Dibenz(a,h)anthracene (mg/L)	<0.000050				
	Fluoranthene (mg/L)	<0.000050				
	Fluorene (mg/L)	<0.000050				
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050				
	Naphthalene (mg/L)	<0.000050				
	Phenanthrene (mg/L)	<0.000050				
	Pyrene (mg/L)	<0.000050				
	Quinoline (mg/L)	<0.000050				
	Surrogate: Acenaphthene d10 (%)	93.7				
	Surrogate: Acridine d9 (%)	99.1				
	Surrogate: Chrysene d12 (%)	93.6				
	Surrogate: Naphthalene d8 (%)	93.2				
	Surrogate: Phenanthrene d10 (%)	99.4				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Aluminum (Al)-Dissolved	DLA	L1249277-5, -6
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1249277-5, -6
Duplicate	Chromium (Cr)-Dissolved	DLA	L1249277-5, -6
Duplicate	Cobalt (Co)-Dissolved	DLA	L1249277-5, -6
Duplicate	Lead (Pb)-Dissolved	DLA	L1249277-5, -6
Duplicate	Nickel (Ni)-Dissolved	DLA	L1249277-5, -6
Duplicate	Selenium (Se)-Dissolved	DLA	L1249277-5, -6
Duplicate	Silver (Ag)-Dissolved	DLA	L1249277-5, -6
Duplicate	Thallium (Tl)-Dissolved	DLA	L1249277-5, -6
Duplicate	Copper (Cu)-Dissolved	DLA	L1249277-5, -6
Duplicate	Nitrite (as N)	DLM	L1249277-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1249277-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrate (as N)	DLM	L1249277-1, -10, -11, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L1249277-1, -10, -11, -2, -3, -4, -5, -6, -7, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1249277-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1249277-1, -2, -3, -4
Matrix Spike	Phosphorus (P)-Total	MS-B	L1249277-8
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1249277-5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1249277-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L1249277-10, -11, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L1249277-10, -11, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
SURR-ND	Surrogate recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

COD-COL-VA Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EPH-SF-FID-VA Water EPH in Water by GCFID BCMOE EPH GCFID

This analysis is carried out in accordance with the British Columbia Ministry of Environment, Lands and Parks (BCMELP) Analytical Method for Contaminated Sites "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 1999). The procedure involves extraction of the entire water sample with dichloromethane. The extract is then solvent exchanged to toluene and analysed by capillary column gas chromatography with flame ionization detection (GC/FID). EPH results include Polycyclic Aromatic Hydrocarbons (PAH) and are therefore not equivalent to Light and Heavy Extractable Petroleum Hydrocarbons (LEPH/HEPH).

FUELS-HSMS-VA Water VOCs in water by Headspace GCMS EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in $CaCO_3$ equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA Water Dissolved Mercury in Water by CVAFS EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

LEPH/HEPH-CALC-VA Water LEPHs and HEPHs BC MOE LABORATORY MANUAL (2005)

Light and Heavy Extractable Petroleum Hydrocarbons in water. These results are determined according to the British Columbia Ministry of Environment, Lands, and Parks Analytical Method for Contaminated Sites "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water". According to this method, LEPH and HEPH are calculated by subtracting selected Polycyclic Aromatic Hydrocarbon results from Extractable Petroleum Hydrocarbon results. To calculate LEPH, the individual results for Acenaphthene, Acridine, Anthracene, Fluorene, Naphthalene and Phenanthrene are subtracted from EPH(C10-19). To calculate HEPH, the individual results for Benz(a)anthracene, Benzo(a)pyrene, Fluoranthene, and Pyrene are subtracted from EPH(C19-32). Analysis of Extractable Petroleum Hydrocarbons adheres to all prescribed elements of the BCMELP method "Extractable Petroleum Hydrocarbons in Water by GC/FID" (Version 2.1, July 20, 1999).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Reference Information

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

PAH-SF-MS-VA Water PAH in Water by GCMS EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA Water PAH Surrogates for Waters EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA Water Total Nitrogen (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

VH-HSFID-VA Water VH in Water by Headspace GCFID B.C. MIN. OF ENV. LAB. MAN. (2009)

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Compounds eluting between n-hexane and n-decane are measured and summed together using flame-ionization detection.

VH-SURR-FID-VA Water VH Surrogates for Waters B.C. MIN. OF ENV. LAB. MAN. (2009)

VOC-HSMS-VA Water VOCs in water by Headspace GCMS EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transferred into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC-M-HSMS-VA Water Volatile Organic Compounds - GC-MS EPA 8260B, 5012A

Water samples, with reagents, are heated and an aliquot of the headspace at equilibrium is analysed by GC-MS.

VOC-M2-HSMS-VA Water VOCs in water by Headspace GCMS EPA8260B, 5035A, 5021, BC MELP

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7-HSMS-VA Water BTEX/MTBE/Styrene by Headspace GCMS EPA8260B, 5021

The water sample, with added reagents, is heated in a sealed vial to equilibrium. The headspace from the vial is transfered into a gas chromatograph. Target compound concentrations are measured using mass spectrometry detection.

VOC7/VOC-SURR-MS-VA Water VOC7 and/or VOC Surrogates for Waters EPA8260B, 5021

VPH-CALC-VA Water VPH is VH minus select aromatics BC MOE LABORATORY MANUAL (2005)

These results are determined according to the British Columbia Ministry of Environment Analytical Method for Contaminated Sites "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water". The concentrations of specific Monocyclic Aromatic Hydrocarbons (Benzene, Toluene, Ethylbenzene, Xylenes and, in solids, Styrene) are subtracted from the collective concentration of Volatile Hydrocarbons (VH) that elute between n-hexane (nC6) and n-decane (nC10).

XYLENES-CALC-VA Water Sum of Xylene Isomer Concentrations CALCULATION

Calculation of Total Xylenes

Total Xylenes is the sum of the concentrations of the ortho, meta, and para Xylene isomers. Results below detection limit (DL) are treated as zero. The DL for Total Xylenes is set to a value no less than the square root of the sum of the squares of the DLs of the individual Xylenes.

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

Reference Information

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 ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-272784

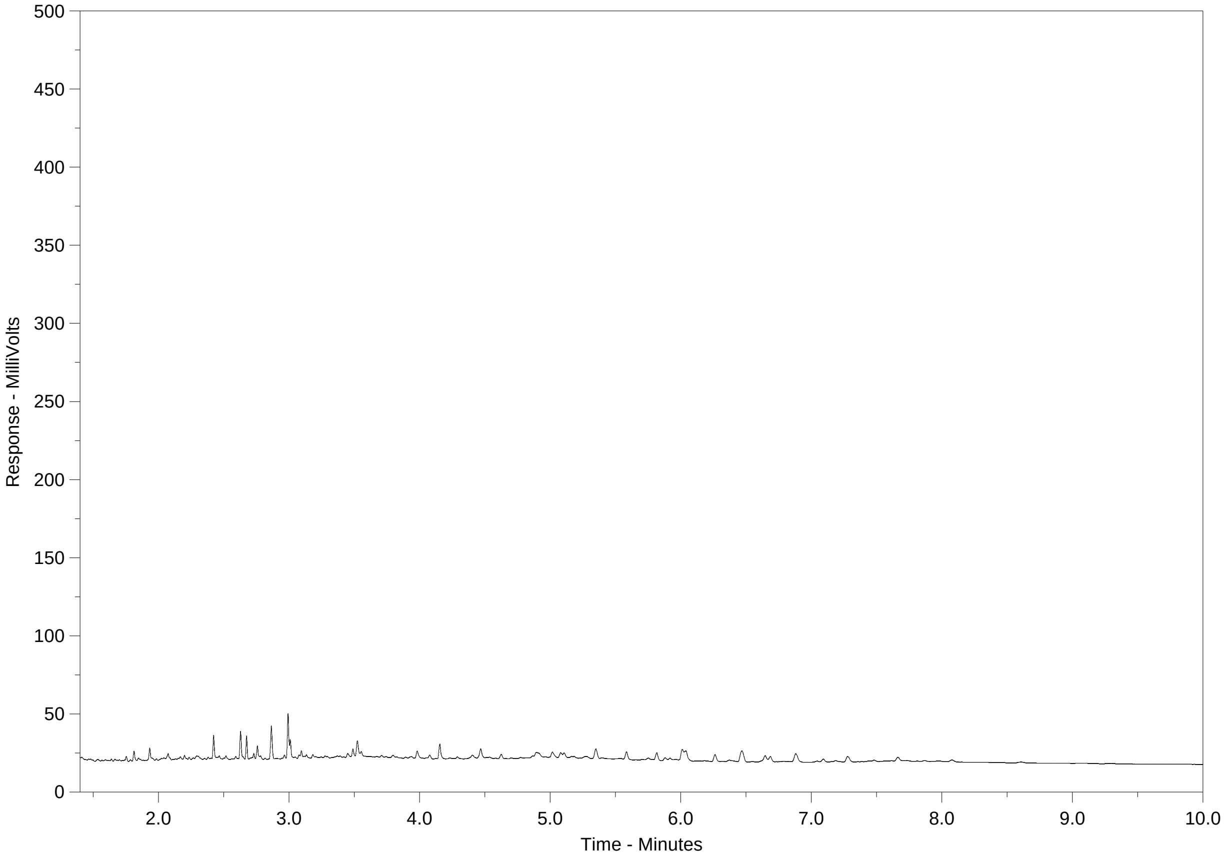
GLOSSARY OF REPORT TERMS

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 received 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.

Hydrocarbon Distribution Report

ALS Sample ID: L1249277-1
Client Sample ID: MW-2D



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

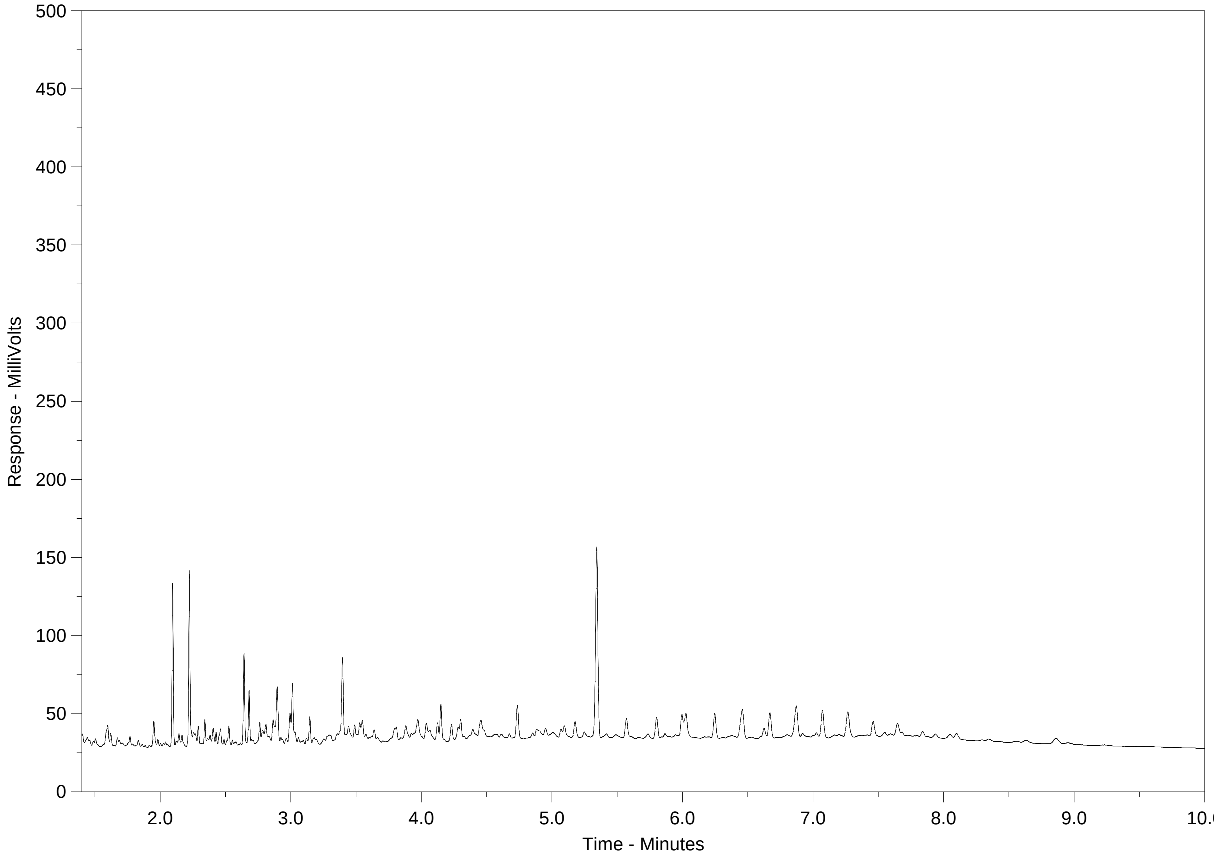
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1249277-2
Client Sample ID: MW-4



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

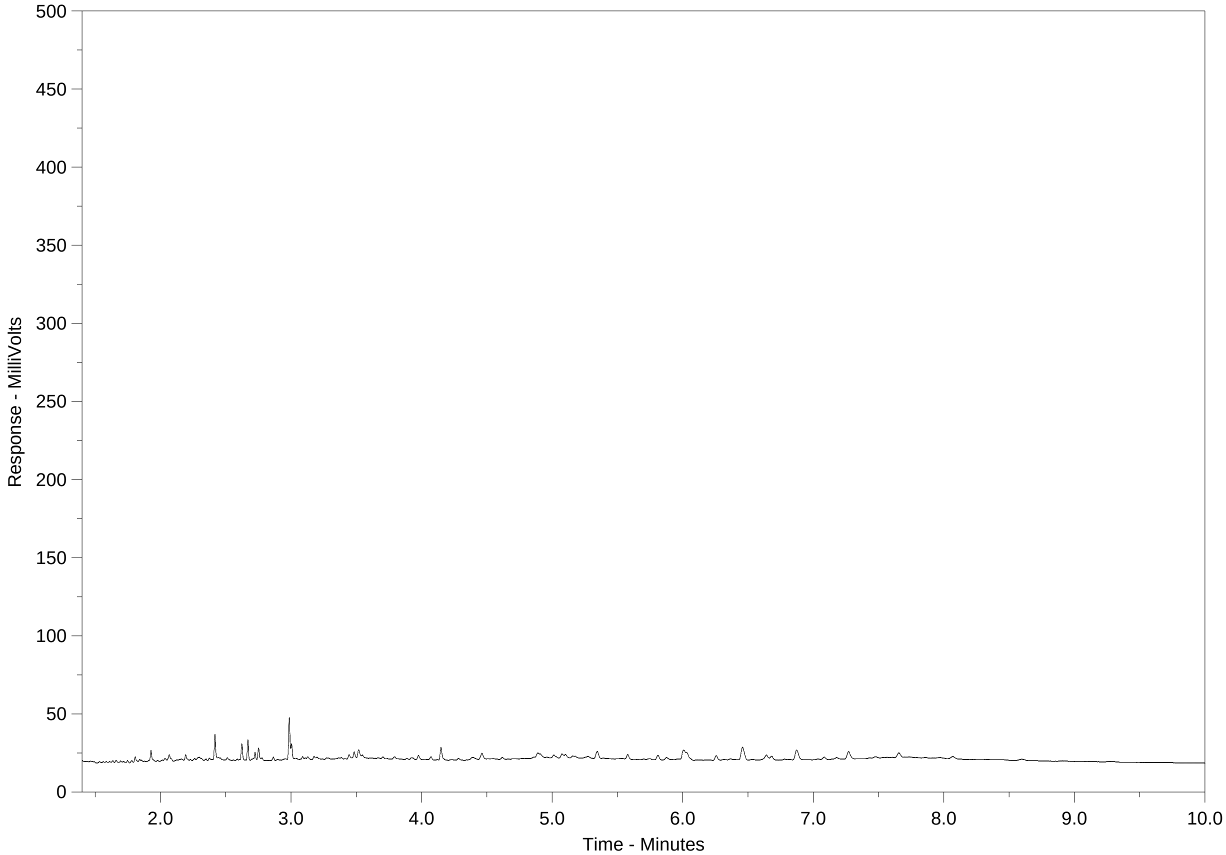
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1249277-3
Client Sample ID: MW-2S



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

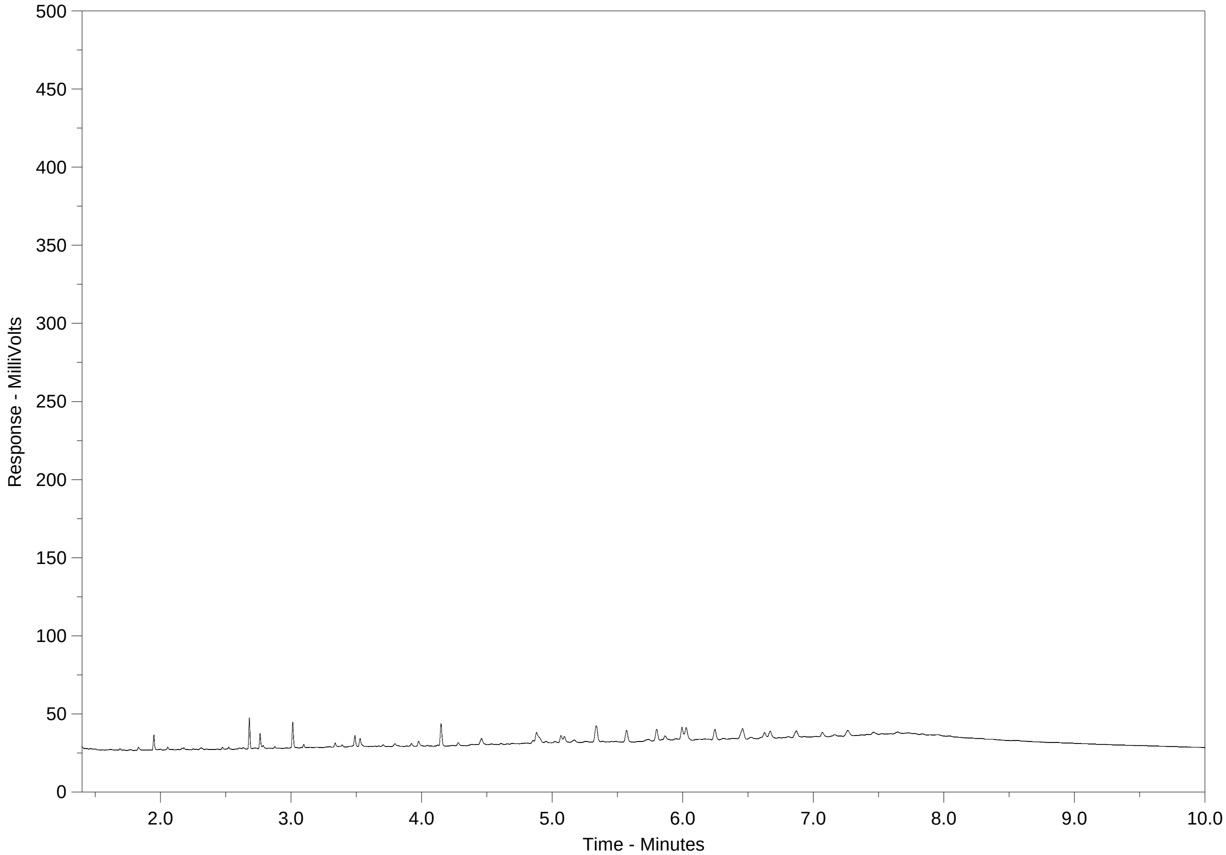
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1249277-4
Client Sample ID: MW-3



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

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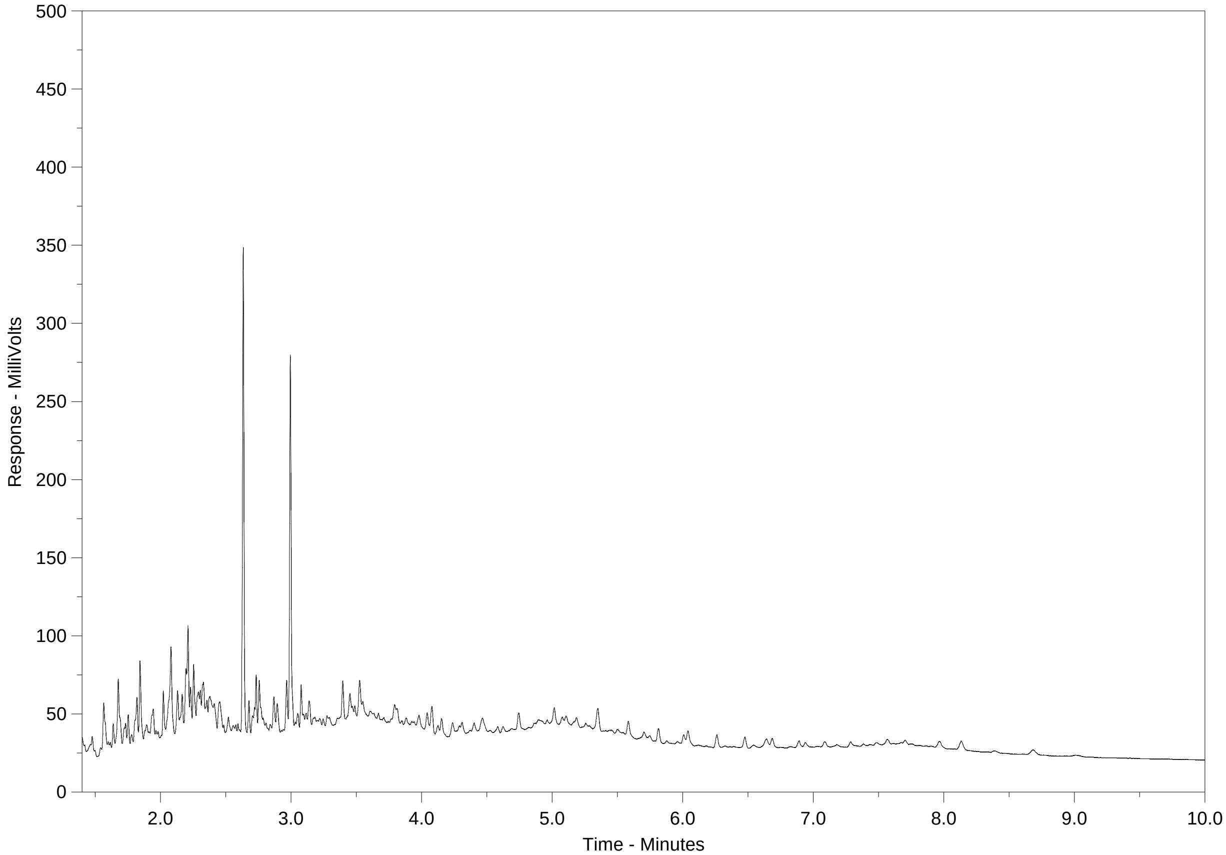
Hydrocarbon Distribution Report

ALS Sample ID: L1249277-5
Client Sample ID: L1



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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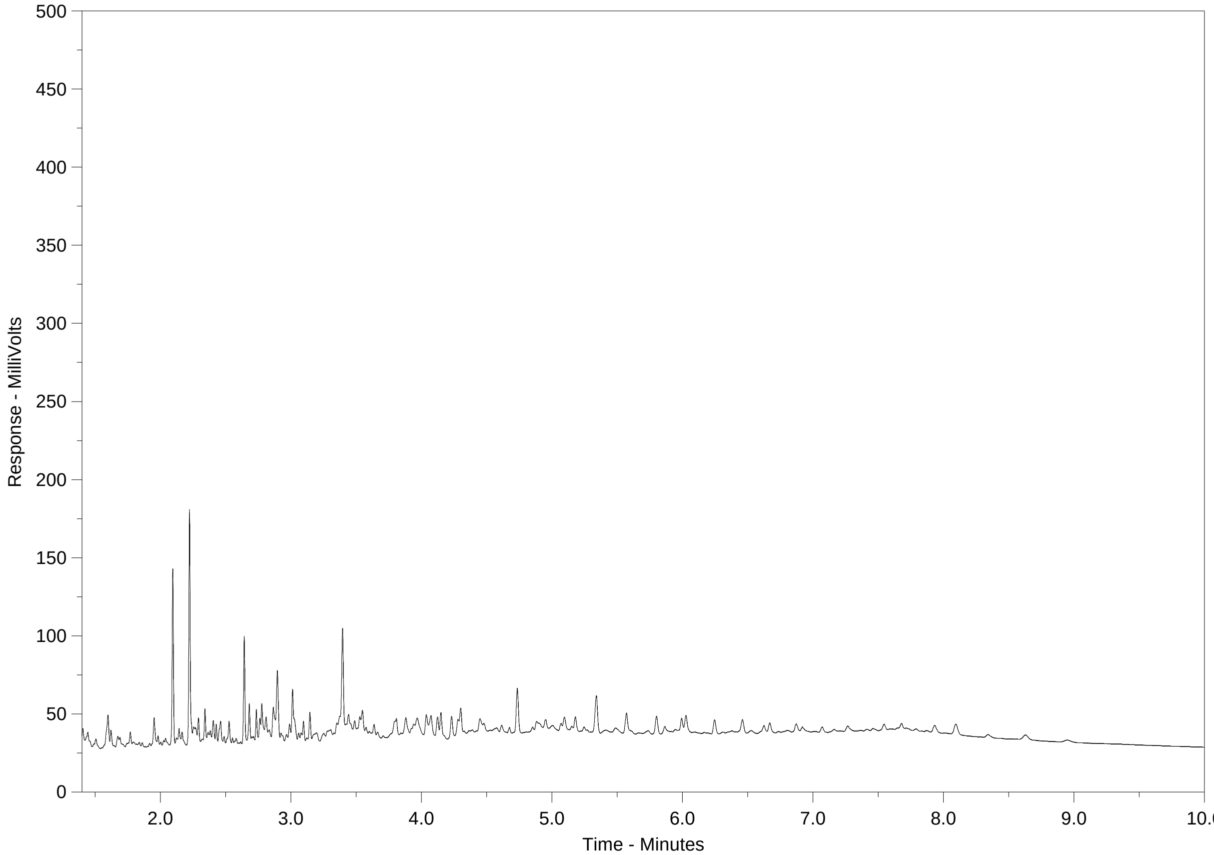
Hydrocarbon Distribution Report

ALS Sample ID: L1249277-6
Client Sample ID: LM (DUPLICATE)



nC10	nC19	nC32
174°C 346°F	330°C 626°F	467°C 873°F
← Gasoline → ← Diesel / Jet Fuels →	← Motor Oils / Lube Oils / Grease →	

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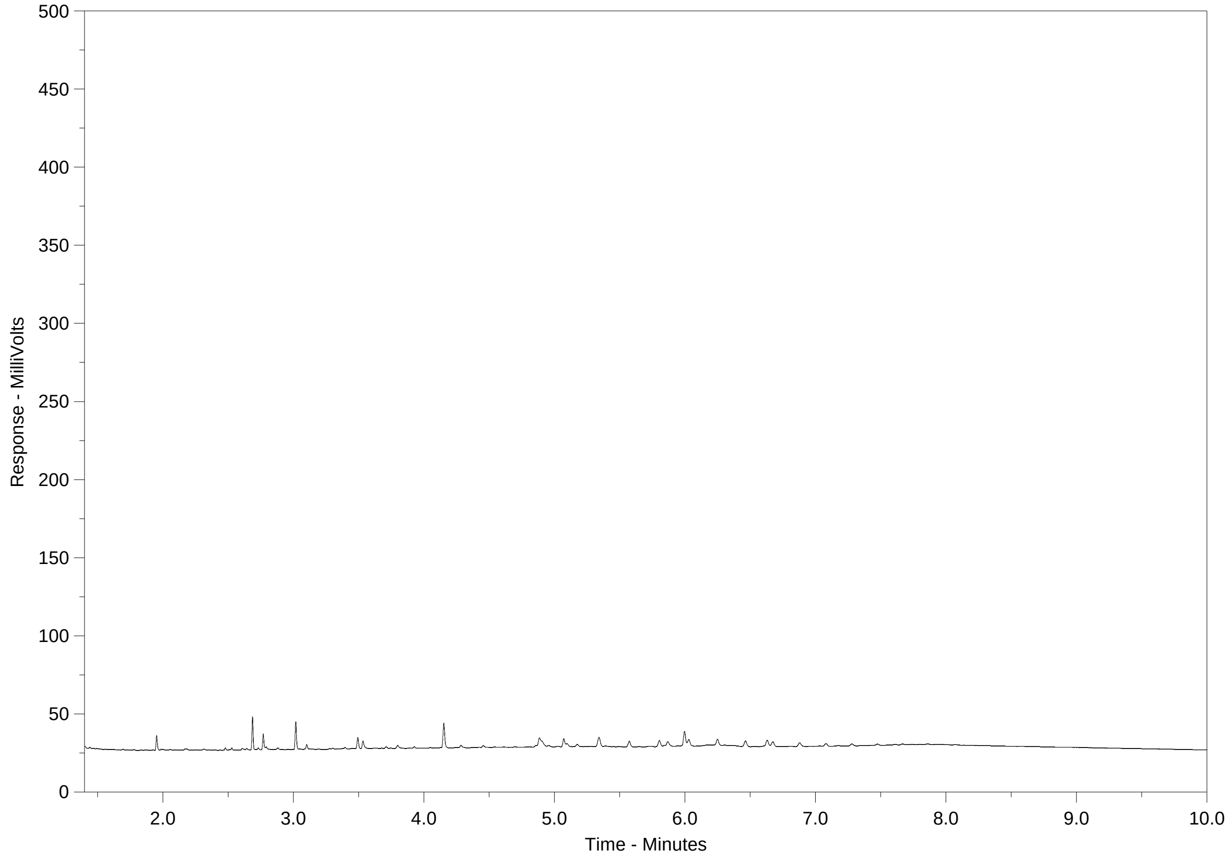
Hydrocarbon Distribution Report

ALS Sample ID: L1249277-7
Client Sample ID: SFC-2



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

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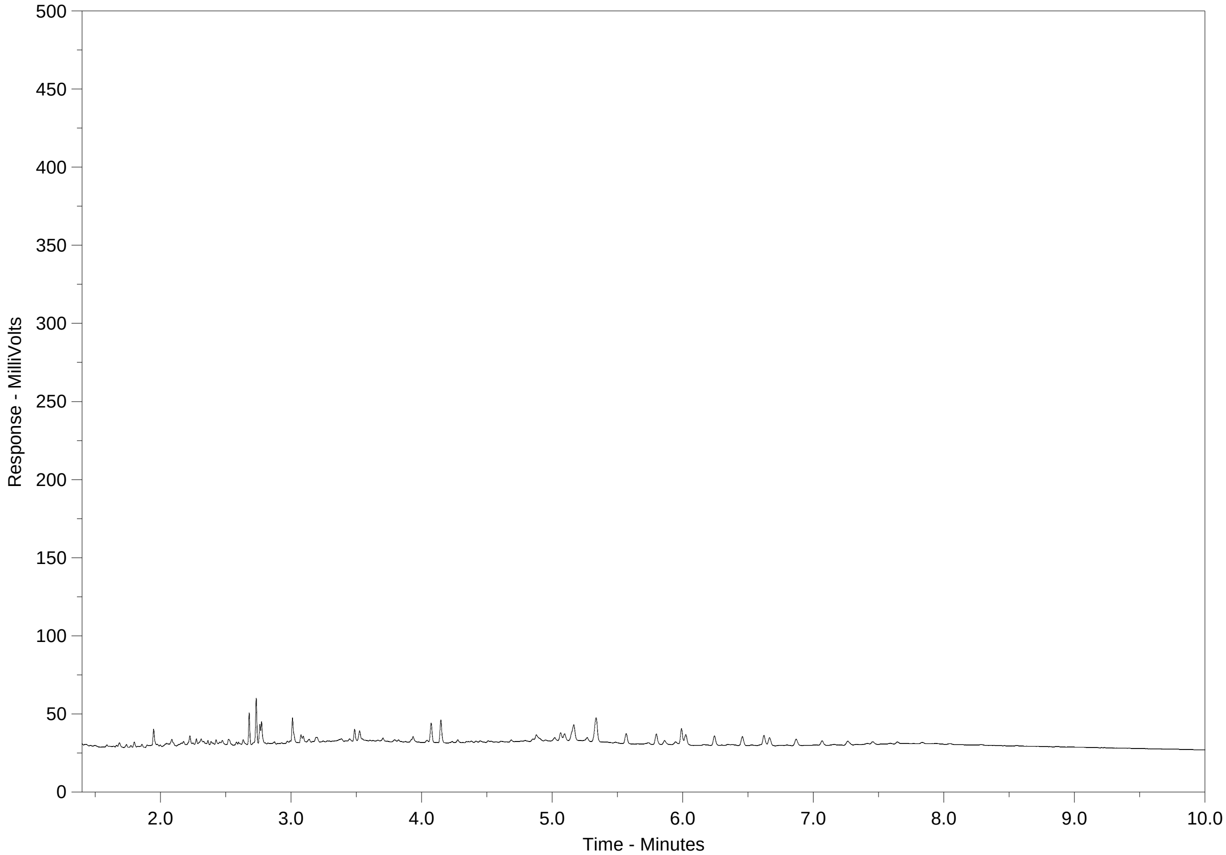
Hydrocarbon Distribution Report

ALS Sample ID: L1249277-8
Client Sample ID: SFC-2B



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

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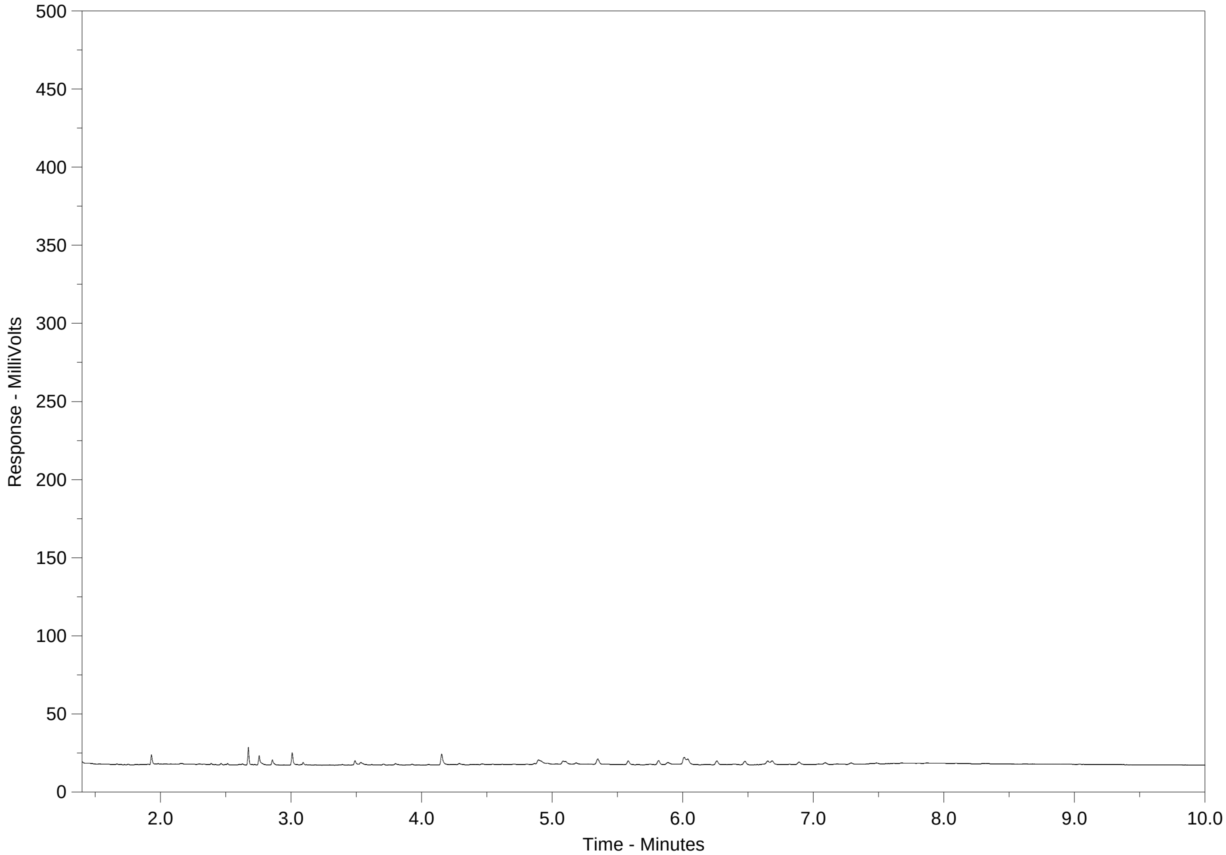
Hydrocarbon Distribution Report

ALS Sample ID: L1249277-9
Client Sample ID: SFC-3



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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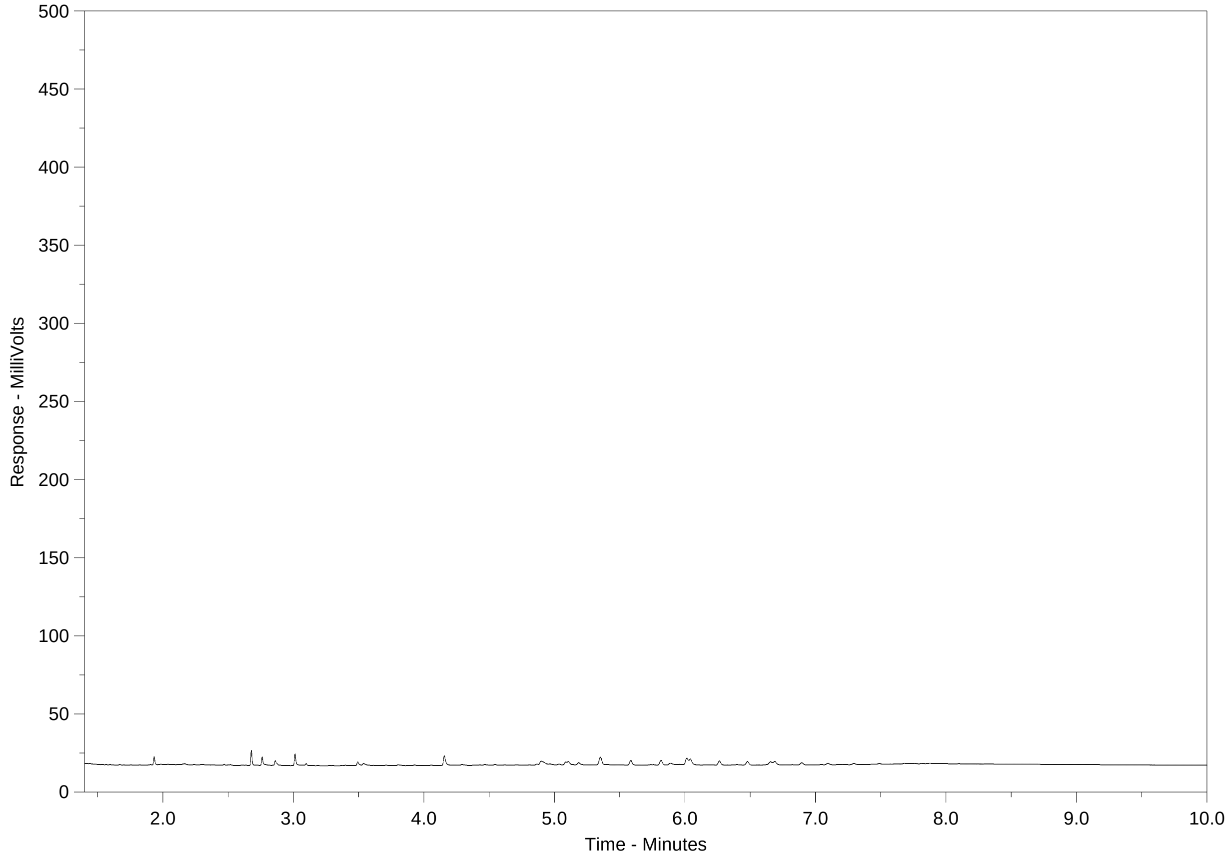
A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

Hydrocarbon Distribution Report

ALS Sample ID: L1249277-10
Client Sample ID: SFC-11



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

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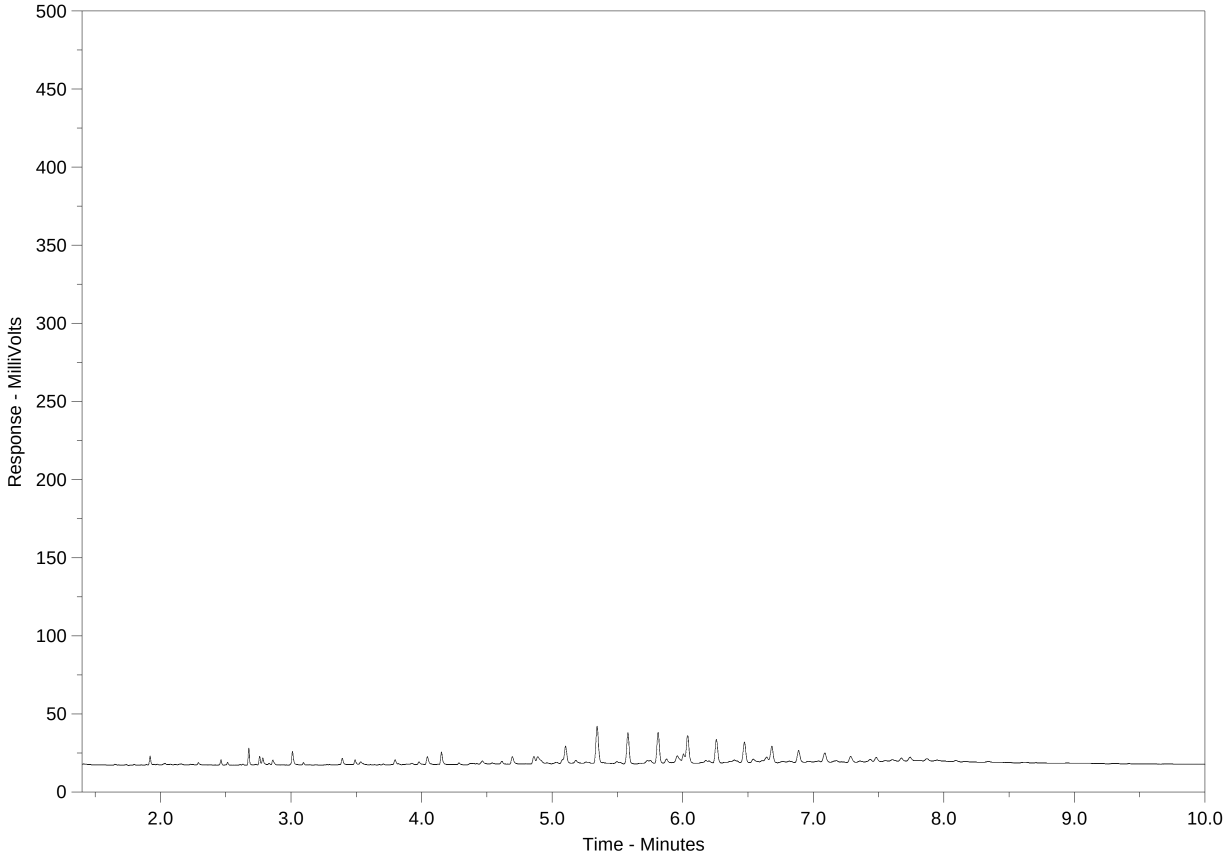
Hydrocarbon Distribution Report

ALS Sample ID: L1249277-11
Client Sample ID: SFC-4B DEC13/12



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F

← Gasoline → ← Motor Oils / Lube Oils / Grease →
← Diesel / Jet Fuels →

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The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

10-272784

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page ___ of ___

L1249277-COFC

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company:	Morrison Hershfield	Standard: ✓ Other (specify):		✓ Regular
Contact:	Josie Gilson	Select: PDF ✓ Excel ✓ Digital Fax		Priority
Address:	310-4321 Still Creek Drive Burnaby, BC	Email 1: jgilson@morrisonhershfield.com		Emergency
		Email 2:		Same Day
Phone:	604-454-0402 Fax:			

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	5104016
Company:	Resort Municipality of Whistler	PO / AFE:	
Contact:	Andrew Tucker	LSD:	
Address:	1135 Cheakamus Lk Rd		
Phone:	604-935-8386 Fax:	Quote #:	
Lab Work Order # (lab use only)		ALS Contact: Selam Worku	Sampler: E. Toole

Short Holding Time

Rush Processing

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	COD/TKN/NH3 (P)	ORGANICS (heph, hepl) (P)	VOC's (Btex) (P)	Physical Parameters	Metals - Total (P)	Metals - Dissolved (F, P)	Metals - Dissolved	Number of Containers
	MW-2D	12/12/12		GW	✓	✓	✓	✓		✓		
	MW-4			GW	✓	✓	✓	✓		✓		
	MW-2S			GW	✓	✓	✓	✓		✓		
	MW-3			GW	✓	✓	✓	✓		✓		
	L1			GW	✓	✓	✓	✓			✓	
	LM (Duplicate)			GW	✓	✓	✓	✓			✓	
	SFC-2			SW	✓	✓		✓	✓			
	SFC-2B			SW	✓	✓		✓	✓			
	SFC-3			SW	✓	✓		✓	✓			
	SFC-11			SW	✓	✓		✓	✓			
	SFC-4B Dec 13/12	13/12/12		SW	✓	✓		✓	✓			
								✓				

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

* L1 + LM not filtered or preserved for metals | VOCs - Pls. include Acetone, dibromomethane, bromomethane, 1-3 butadiene, MIBK, MEK

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: E Toole	Date: Dec 13/12	Time: 10 am	Received by: TN	Date: Dec 13	Time: 13:15	Temperature: 10 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

APPENDIX H: Laboratory Results for Groundwater Quality Monitoring Data Compared to Standards and Guidelines

Q1 - 2012 Groundwater Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	MW2S 1/26/2012	MW2D 1/26/2012	MW3 1/26/2012	MW4 1/26/2012	MW6 1/26/2012
Physical Parameters								
Conductivity	uS/cm	-	-	644	1610	377	600	673
Hardness (as CaCO3)	mg/L	-	-	173	614	98.8	158	144
pH	pH	-	9	7.27	7.12	6.81	6.99	6.35
Nutrient & Anions								
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	182	293	40.8	183	10.1
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	182	293	40.8	183	10.1
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	12.9	**22.8**	0.185	3.69	0.0299
Bromide (Br)	mg/L	-	-	<0.25	<1.0	0.162	0.099	<0.25
Chloride (Cl)	mg/L	1500	150	30.5	44	74.9	50.7	111
Fluoride (F)	mg/L	2	0.4	<0.10	<0.40	0.032	<0.10	<0.10
Nitrate (as N)	mg/L	400	32.8	<0.025	<0.10	0.298	<0.0050	<0.025
Nitrite (as N)	mg/L	0.2	0.06	<0.0050	<0.020	<0.0010	<0.0010	<0.0050
Total Kjeldahl Nitrogen	mg/L	-	-	12.6	20.7	0.261	3.57	0.351
Total Nitrogen	mg/L	-	-	12.6	20.7	0.559	3.57	0.351
Phosphorus (P)-Total	mg/L	-	-	0.565	0.382	<0.0020	0.178	2.12
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	106	611	28	59.5	137
Dissolved Metals								
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	<0.010	<0.010	0.019	0.115	0.084
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	0.0011	0.002	<0.0010	<0.0010	<0.0010
Barium (Ba)-Dissolved	mg/L	10	1	0.137	0.043	0.107	0.214	0.049
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	0.23	0.4	<0.10	0.1	<0.10
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	0.000064	<0.000050	0.000289	0.000143	0.000402
Calcium (Ca)-Dissolved	mg/L	-	-	58	206	31.1	50.8	46.9
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.00306	0.0245	0.00667	0.0356	0.033
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 150 - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	<0.0010	<0.0010	0.0033	0.0033	0.0035
Iron (Fe)-Dissolved	mg/L	-	0.35	19.9	55.7	0.04	30.8	0.313
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	6.92	24.5	5.15	7.63	6.57
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	2.24	2.81	2.88	3.4	1.64
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	0.0035	0.0127	<0.0010	0.0072	<0.0010
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	0.0074	<0.0050	<0.0050	<0.0050
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	-	373	14.3	29.1	3.7	8.1	3.7
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)-Dissolved	mg/L	-	-	8.32	12.9	7.54	9.83	7.75
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	17.3	35.8	22.3	20.8	68.6
Strontium (Sr)-Dissolved	mg/L	-	-	0.311	0.891	0.236	0.322	0.388
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Dissolved	mg/L	-	-	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	<0.00020	0.00039	<0.00020	<0.00020	<0.00020
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Aggregate Organics								
COD	mg/L	-	-	72	83	<20	23	36
VOCs								
Acetone	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Benzene	mg/L	4	0.04	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromoform	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloromethane	mg/L	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dibromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Styrene	mg/L	0.72	0.072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0030	<0.0020	<0.0010	<0.0020	<0.0020
Toluene	mg/L	0.39	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Xylenes	mg/L	-	0.03	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
Hydrocarbons								
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10	<0.10	<0.10	<0.10	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10	<0.10	<0.10	<0.10	<0.10
PAHs								
Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the
gudielines are in **bold and underlined**.

Q2 - 2012 Groundwater Results		BCCSR-S6-WATER-FAL	BC Ambient Water	MW-2S	MW-2D	MW-3	MW4	MW6
Analyte	Units		Quality Guidelines	5/16/2012	5/16/2012	5/16/2012	5/16/2012	5/16/2012
Physical Parameters								
Conductivity	uS/cm	-	-	541	1550	292	412	616
Hardness (as CaCO3)	mg/L	-	-	186	677	91.1	168	119
pH	pH	-	9	7.16	7.15	7	7.4	6.56
Nutrient & Anions								
Alkalinity, Total (as CaCO3)	mg/L	-	-	119	197	38	128	10.7
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	7.94	**20.1**	0.0254	3.02	<0.0050
Bromide (Br)	mg/L	-		<0.050	<0.50	0.058	<0.050	<0.050
Chloride (Cl)	mg/L	1500	150	19.5	64.5	46.4	22.9	112
Fluoride (F)	mg/L	2	0.4	<0.10	<0.20	0.022	<0.10	0.123
Nitrate (as N)	mg/L	400	32.8	<0.0050	<0.050	1.03	0.0607	0.0325
Nitrite (as N)	mg/L	0.2	0.06	<0.0010	<0.010	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	-	-	9.42	20.5	0.073	2.84	0.433
Total Nitrogen	mg/L	-	-	9.42	20.5	1.1	2.9	0.465
Phosphorus (P)-Total	mg/L	-	-	0.431	0.369	<0.0020	0.899	2.14
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	120	616	25.4	45.2	107
Dissolved Metals								
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	<0.010	<0.020 *	0.02	<0.010	0.282
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050	<0.0010 *	<0.00050	<0.00050	<0.00050
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	0.0079	0.0165	<0.0010	0.0064	<0.0010
Barium (Ba)-Dissolved	mg/L	10	1	0.129	0.041	0.096	0.258	0.051
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	0.19	0.38	<0.10	0.1	<0.10
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	<0.000050	<0.00010	0.000228	0.000168	0.000364
Calcium (Ca)-Dissolved	mg/L	-	-	59.6	225	28.9	54.2	38.5
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.00178	0.0227	0.00438	0.0368	0.0189
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	<0.0010	<0.0020	0.0035	<0.0010	0.0051
Iron (Fe)-Dissolved	mg/L	-	0.35	45.6	89.3	<0.030	61.1	0.109
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	8.98	28.2	4.62	7.85	5.48
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	2.54	3.15	1.97	3.29	0.883
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	0.0042	0.0162	<0.0010	0.0149	<0.0010
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	<0.010	<0.0050	0.0052	<0.0050
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	-	373	12	27.1	3.5	8.7	3.8
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010
Silicon (Si)-Dissolved	mg/L	-	-	9.39	14.1	7.44	11.3	7.8
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	15.1	34.9	14.5	26	75.4
Strontium (Sr)-Dissolved	mg/L	-	-	0.316	0.895	0.248	0.332	0.359
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020	<0.00040	<0.00020	<0.00020	<0.00020
Tin (Sn)-Dissolved	mg/L	-	-	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	<0.00020	<0.00040	<0.00020	<0.00020	<0.00020
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	0.0098	<0.0050	0.0067	0.0111	0.0066
Aggregate Organics								
COD	mg/L	-	-	45	62	<20	<20	51
VOCs								
Acetone	mg/L	-	-	<0.020	<0.020	<0.020	<0.020	<0.020
Benzene	mg/L	4	0.04	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromoform	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloromethane	mg/L	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dibromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010	<0.010
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Styrene	mg/L	0.72	0.072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	mg/L	0.39	0.0005	<0.0030	<0.0050	<0.0030	<0.0030	<0.0040
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Xylenes	mg/L	-	0.03	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
Hydrocarbons								
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10	<0.10	<0.10	<0.10	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10	<0.10	<0.10	<0.10	<0.10
PAHs								
Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q3 - 2012 Groundwater Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	MW-2S 9/26/2012	MW-2D 9/26/2012	MW-2D REP 9/26/2012	MW-3 9/26/2012	MW-4 9/26/2012	MW-6 9/26/2012
Physical parameters									
Conductivity	uS/cm	-	-	1390	440	452	147	260	544
Hardness (as CaCO3)	mg/L	-	-	603	155	151	50.1	80.4	121
pH	pH	-	9	6.83	6.93	6.92	7.1	6.92	6.53
Nutrients & Anions									
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	232	95.7	98.4	37.9	73.2	14.2
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	232	95.7	98.4	37.9	73.2	14.2
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	**19.4**	4.14	5.48	<0.0050	3.02	0.0122
Bromide (Br)	mg/L	-	-	<0.50 *	<0.050	<0.050	0.057	<0.050	<0.050
Chloride (Cl)	mg/L	1500	150	62.5	19.5	20	15.6	20.2	78.3
Fluoride (F)	mg/L	2	0.4	<0.20 *	<0.40 *	<0.40 *	0.026	0.113	0.051
Nitrate (as N)	mg/L	400	32.8	<0.050 *	0.0093	<0.0050	<0.0050	<0.0050	0.0877
Nitrite (as N)	mg/L	0.2	0.06	<0.010 *	0.0018	0.0015	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	-	-	23.7	5.9	6.07	0.069	2.72	1.57
Total Nitrogen	mg/L	-	-	23.7	6	6.07	0.069	2.72	1.66
Phosphorus (P)-Total	mg/L	-	-	0.294	0.828	0.925	0.0062	0.203	31.1
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	496	102	104	14.6	30.8	129
Dissolved Metals									
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	<0.010	0.023	<0.010	0.019	<0.010	0.066
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	0.0138	0.0071	0.007	<0.0010	0.006	<0.0010
Barium (Ba)-Dissolved	mg/L	10	1	0.055	0.114	0.106	0.063	0.118	0.042
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	0.35	0.16	0.16	<0.10	<0.10	<0.10
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	<0.000050	<0.000050	<0.000050	0.000088	<0.000050	0.000297
Calcium (Ca)-Dissolved	mg/L	-	-	198	48.7	47.5	15.8	26.5	39.1
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.0188	0.00273	0.00271	0.00155	0.017	0.00653
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	<0.0010	<0.0010	<0.0010	0.0019	<0.0010	0.0025
Iron (Fe)-Dissolved	mg/L	-	0.35	76.4	41.5	40.7	0.034	40.1	0.045
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	26.3	8.14	7.77	2.56	3.45	5.78
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	2.87	2.05	1.96	1.23	1.93	1.91
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	0.016	0.0056	0.0058	0.001	0.0286	<0.0010
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	-	373	24.9	10.2	9.6	2.8	5.2	3.7
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)-Dissolved	mg/L	-	-	13.7	8.94	8.64	7.74	8.61	8.7
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	33.3	12.1	11.3	9.5	14.6	71.6
Strontium (Sr)-Dissolved	mg/L	-	-	0.815	0.274	0.257	0.148	0.17	0.684
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Dissolved	mg/L	-	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	0.00038	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	0.0068
Aggregate Organics									
COD	mg/L	-	-	52	<20	26	<20	<20	44
VOCs									
Acetone	mg/L	-	-	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Benzene	mg/L	4	0.04	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromoform	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Chloromethane	mg/L	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Dibromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070	<0.00070

1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Styrene	mg/L	0.72	0.072	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	mg/L	0.39	0.0005	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Xylenes	mg/L	-	0.03	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
Hydrocarbons									
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
PAHs									
Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q4 - 2012 Groundwater Results		BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	MW-2S	MW-2D	MW-3	MW-4
Analyte	**Units**			**12/12/2012**	**12/12/2012**	**12/12/2012**	**12/12/2012**
Physical Parameters							
Conductivity	uS/cm	-	-	794	1450	228	292
Hardness (as CaCO3)	mg/L	-	-	263	629	58.9	138
pH	pH	-	9	6.89	6.85	6.6	6.89
Nutrients & Anions							
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	200	224	33.9	90.6
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	200	224	33.9	90.6
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	10.7	18.2	0.173	1.6
Bromide (Br)	mg/L	-	-	<0.50	<0.50	0.056	<0.050
Chloride (Cl)	mg/L	1500	150	51.2	62.5	32.3	17.6
Fluoride (F)	mg/L	2	0.4	<0.20	<0.20	0.029	0.042
Nitrate (as N)	mg/L	400	32.8	<0.050	<0.050	0.116	0.0457
Nitrite (as N)	mg/L	0.2	0.06	<0.010	<0.010	<0.0010	0.0032
Total Kjeldahl Nitrogen	mg/L	-	-	11	20.7	0.243	1.99
Total Nitrogen	mg/L	-	-	11	20.7	0.359	2.04
Phosphorus (P)-Total	mg/L	-	-	0.358	0.733	0.0056	1.32
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	149	532	26.3	32.9
Dissolved Metals							
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	<0.010	<0.010	0.017	<0.010
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	0.0097	0.0158	<0.0010	0.003
Barium (Ba)-Dissolved	mg/L	10	1	0.194	0.043	0.082	0.175
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20	<0.20	<0.20	<0.20
Boron (B)-Dissolved	mg/L	50	1.2	0.21	0.36	<0.10	<0.10
Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	<0.000050	<0.000050	0.000177	0.000437
Calcium (Ca)-Dissolved	mg/L	-	-	85.3	208	18.3	43.6
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.0033	0.0198	0.00447	0.0367
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L) (for total metals)	<0.0010	<0.0010	0.0027	0.001
Iron (Fe)-Dissolved	mg/L	-	0.35	65.9	79.4	0.146	33.3
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Dissolved	mg/L	-	-	12.2	26.9	3.2	6.94
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	3.49	2.81	1.69	2.83
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum (Mo)-Dissolved	mg/L	10	1	0.0046	0.0147	<0.0010	0.0083
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	<0.0050	<0.0050	0.0055
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	-	373	15.7	26.8	3.2	5.9
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)-Dissolved	mg/L	-	-	10.7	14.3	7.43	10.5
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Dissolved	mg/L	-	-	24.3	33.5	16	16.5
Strontium (Sr)-Dissolved	mg/L	-	-	0.435	0.8	0.146	0.245
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Dissolved	mg/L	-	-	<0.030	<0.030	<0.030	<0.030
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Dissolved	mg/L	3	0.3	<0.00020	0.00022	<0.00020	<0.00020
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030

Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	<0.0050	<0.0050	<0.0050	0.0117
Aggregate Organics							
COD	mg/L	-	-	57	65	<20	61
VOCs							
Acetone	mg/L	-	-	<0.010	<0.010	<0.010	<0.010
Benzene	mg/L	4	0.04	<0.00050	<0.00050	<0.00050	<0.00050
Bromodichloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Bromoform	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Bromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Butadiene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Carbon Disulfide	mg/L	-	-	<0.0050	<0.0050	<0.0050	<0.0050
Carbon Tetrachloride	mg/L	0.13	0.0133	<0.00050	<0.00050	<0.00050	<0.00050
Chlorobenzene	mg/L	0.013	0.0013	0.0013	0.0011	<0.0010	<0.0010
Dibromochloromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Chloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Chloroform	mg/L	0.02	0.0018	<0.0010	<0.0010	<0.0010	<0.0010
Chloromethane	mg/L	-	-	<0.0050	<0.0050	<0.0050	<0.0050
2-Chlorotoluene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
4-Chlorotoluene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Decane (nC10)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dibromoethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Dibromomethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichlorobenzene	mg/L	0.007	0.0007	<0.00070	<0.00070	<0.00070	<0.00070
1,3-Dichlorobenzene	mg/L	1.5	0.15	<0.0010	<0.0010	<0.0010	<0.0010
1,4-Dichlorobenzene	mg/L	0.26	-	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,2-Dichloroethane	mg/L	1	0.1	<0.0010	<0.0010	<0.0010	<0.0010
1,1-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,2-Dichloroethylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,3-Dichloropropene (cis & trans)	mg/L	-	-	<0.0014	<0.0014	<0.0014	<0.0014
Dichloromethane	mg/L	0.98	0.0981	<0.0050	<0.0050	<0.0050	<0.0050
1,2-Dichloropropane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,3-Dichloropropylene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Ethylbenzene	mg/L	2	0.2	<0.00050	<0.00050	<0.00050	<0.00050
n-Heptane (nC7)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
n-Hexane (nC6)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
2-Hexanone	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Isopropylbenzene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
4-Isopropyltoluene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Methyl ethyl ketone (MEK)	mg/L	-	-	<0.010	<0.010	<0.010	<0.010
Methyl isobutyl ketone (MIBK)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Methylcyclohexane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Methyl t-butyl ether (MTBE)	mg/L	34	3.4	<0.00050	<0.00050	<0.00050	<0.00050
Naphthalene	mg/L	0.01	-	<0.0010	<0.0010	<0.0010	<0.0010
n-Octane (nC8)	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
n-Propylbenzene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Styrene	mg/L	0.72	0.072	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2,2-Tetrachloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Tetrachloroethylene	mg/L	1.1	0.111	<0.0010	<0.0010	<0.0010	<0.0010
Toluene	mg/L	0.39	0.0005	<0.00050	<0.00050	<0.00050	<0.00050
1,1,1-Trichloroethane	mg/L	-	11.1	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2-Trichloroethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Trichloroethylene	mg/L	0.2	0.021	<0.0010	<0.0010	<0.0010	<0.0010
Trichlorofluoromethane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,2,3-Trichloropropane	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,2,4-Trimethylbenzene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
1,3,5-Trimethylbenzene	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
Vinyl Chloride	mg/L	-	-	<0.0010	<0.0010	<0.0010	<0.0010
ortho-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050
meta- & para-Xylene	mg/L	-	0.03	<0.00050	<0.00050	<0.00050	<0.00050
Xylenes	mg/L	-	0.03	<0.00075	<0.00075	<0.00075	<0.00075
Hydrocarbons							
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10	<0.10	<0.10	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10	<0.10	<0.10	<0.10
PAHs							
Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050

Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the
gudielines are in **bold and underlined**.

APPENDIX I: Laboratory Results for Surface Water Quality Monitoring Compared to Standards and Guidelines

Q1- 2012 Surface Water Results		BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	SFC 2	SFC 2B	SFC 3	SFC 11	SFC4B
Analyte	Units			1/26/2012	1/26/2012	1/26/2012	1/26/2012	2/9/2012
Physical Parameters								
Conductivity	uS/cm	-	-	381	681	253	100	226
Hardness (as CaCO3)	mg/L	-	-	129	225	56	32.5	76
pH	pH	8.5	9	7.22	6.96	7.52	7.49	7.71
Nutrient & Anions								
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	78.8	85.4	34.6	24	37.8
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	78.8	85.4	34.6	24	37.8
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	1.6	6.75	0.0095	<0.0050	0.137
Bromide (Br)	mg/L	-	-	<0.050	<0.25	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1500	150	23.2	37.6	33.8	7.11	24
Fluoride (F)	mg/L	2	0.4	0.069	<0.10	0.039	0.046	0.051
Nitrate (as N)	mg/L	400	32.8	1.28	8.08	0.257	0.413	0.56
Nitrite (as N)	mg/L	0.2	0.06	0.0076	0.0576	<0.0010	<0.0010	0.0017
Total Kjeldahl Nitrogen	mg/L	-	-	1.51	3.52	0.057	0.079	0.226
Total Nitrogen	mg/L	-	-	2.8	11.7	0.315	0.492	0.788
Phosphorus (P)-Total	mg/L	-	-	0.002	0.0137	0.0024	0.0047	0.0023
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	74.5	175	36.3	13.9	36.9
Total Metals								
Aluminum (Al)-Total	mg/L	-	-	-	-	-	-	0.293
Antimony (Sb)-Total	mg/L	0.2	0.02	-	-	-	-	<0.00050
Arsenic (As)-Total	mg/L	0.05	0.005	-	-	-	-	<0.0010
Barium (Ba)-Total	mg/L	10	1	-	-	-	-	0.026
Beryllium (Be)-Total	mg/L	0.053	-	-	-	-	-	<0.0050
Bismuth (Bi)-Total	mg/L	-	-	-	-	-	-	<0.20
Boron (B)-Total	mg/L	50	1.2	-	-	-	-	<0.10
Cadmium (Cd)-Total	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.00001	-	-	-	-	<0.000050
Calcium (Ca)-Total	mg/L	-	-	-	-	-	-	25.4
Chromium (Cr)-Total	mg/L	0.01	0.001	-	-	-	-	<0.00050
Cobalt (Co)-Total	mg/L	0.04	0.004	-	-	-	-	0.00225
Copper (Cu)-Total	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L)	-	-	-	-	0.0055
Iron (Fe)-Total	mg/L	-	1	-	-	-	-	0.473
Lead (Pb)-Total	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003 (H ≤ 8mg/L) e(1.273 ln (H) - 1.460) (H > 8 mg/L)	-	-	-	-	<0.0010
Lithium (Li)-Total	mg/L	-	0.014	-	-	-	-	<0.050
Magnesium (Mg)-Total	mg/L	-	-	-	-	-	-	3.04
Manganese (Mn)-Total	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300)	-	-	-	-	0.308
Mercury (Hg)-Total	mg/L	0.001	0.000001	-	-	-	-	<0.00020
Molybdenum (Mo)-Total	mg/L	10	1	-	-	-	-	<0.0010
Nickel (Ni)-Total	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	-	-	-	-	<0.0050
Phosphorus (P)-Total	mg/L	-	-	-	-	-	-	<0.30
Potassium (K)-Total	mg/L	-	373	-	-	-	-	2.2
Selenium (Se)-Total	mg/L	0.01	0.002	-	-	-	-	<0.0010
Silicon (Si)-Total	mg/L	-	-	-	-	-	-	6.28
Silver (Ag)-Total	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	-	-	-	-	<0.000050
Sodium (Na)-Total	mg/L	-	-	-	-	-	-	13.6
Strontium (Sr)-Total	mg/L	-	-	-	-	-	-	0.206
Thallium (Tl)-Total	mg/L	0.003	0.0003	-	-	-	-	<0.00020
Tin (Sn)-Total	mg/L	-	-	-	-	-	-	<0.030
Titanium (Ti)-Total	mg/L	1	2	-	-	-	-	<0.050
Uranium (U)-Total	mg/L	3	0.3	-	-	-	-	<0.00020
Vanadium (V)-Total	mg/L	-	0.006	-	-	-	-	<0.030
Zinc (Zn)-Total	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90)	-	-	-	-	<0.0050
Dissolved Metals								
Aluminum (Al)-Dissolved	mg/L	-	Maximum 0.1 (pH ≥ 6.5)	<0.010	<0.020	0.035	0.045	<20
Antimony (Sb)-Dissolved	mg/L	0.2	0.02	<0.00050	<0.0010	<0.00050	<0.00050	<0.25
Arsenic (As)-Dissolved	mg/L	0.05	0.005 (for total metals)	<0.0010	<0.0020	<0.0010	<0.0010	<0.25
Barium (Ba)-Dissolved	mg/L	10	1	0.06	0.077	0.024	<0.020	<0.25
Beryllium (Be)-Dissolved	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.25
Bismuth (Bi)-Dissolved	mg/L	-	-	<0.20	<0.20	<0.20	<0.20	<0.000050
Boron (B)-Dissolved	mg/L	50	1.2	<0.10	<0.10	<0.10	<0.10	<0.000050

Cadmium (Cd)-Dissolved	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.01 (H = 30) 0.02 (H= 60) 0.03 (H = 90) 0.04 (H = 120) 0.05 (H = 150) 0.06 (H= 210) (for total metals)	0.000074	0.00026	<0.000050	<0.000050	<0.000050
Calcium (Ca)-Dissolved	mg/L	-	-	44.1	72	18.8	10.1	<0.000050
Chromium (Cr)-Dissolved	mg/L	0.01	0.001	<0.00050	<0.0010	<0.00050	<0.00050	<0.000050
Cobalt (Co)-Dissolved	mg/L	0.04	0.11 (for total metals)	0.00963	0.0317	<0.00050	<0.00050	<0.000010
Copper (Cu)-Dissolved	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 150 - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (for total metals))	0.0014	0.0158	0.0022	<0.0010	<0.000050
Iron (Fe)-Dissolved	mg/L	-	0.35	1.49	2.41	0.049	<0.030	<0.000050
Lead (Pb)-Dissolved	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003	<0.0010	<0.0020	<0.0010	<0.0010	<0.000050
Lithium (Li)-Dissolved	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050	<0.000050
Magnesium (Mg)-Dissolved	mg/L	-	-	4.72	11	2.21	1.74	<0.000050
Manganese (Mn)-Dissolved	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300) (for total metals)	1.95	5.99	0.024	<0.010	<0.000050
Mercury (Hg)-Dissolved	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020	<0.000050
Molybdenum (Mo)-Dissolved	mg/L	10	1	0.0019	<0.0020	<0.0010	<0.0010	<0.000050
Nickel (Ni)-Dissolved	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	0.011	<0.0050	<0.0050	<0.000050
Phosphorus (P)-Dissolved	mg/L	-	-	<0.30	<0.30	<0.30	<0.30	<0.000050
Potassium (K)-Dissolved	mg/L	-	373	4.9	10.3	<2.0	<2.0	<0.000050
Selenium (Se)-Dissolved	mg/L	0.01	0.002	<0.0010	<0.0020	<0.0010	<0.0010	<0.000050
Silicon (Si)-Dissolved	mg/L	-	-	4.25	6.75	6.26	7.46	
Silver (Ag)-Dissolved	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.00010	<0.000050	<0.000050	
Sodium (Na)-Dissolved	mg/L	-	-	15.7	27.1	24.6	5.6	
Strontium (Sr)-Dissolved	mg/L	-	-	0.253	0.376	0.145	0.108	
Thallium (Tl)-Dissolved	mg/L	0.003	0.0003	<0.00020	<0.00040	<0.00020	<0.00020	
Tin (Sn)-Dissolved	mg/L	-	-	<0.030	<0.030	<0.030	<0.030	
Titanium (Ti)-Dissolved	mg/L	1	2	<0.050	<0.050	<0.050	<0.050	
Uranium (U)-Dissolved	mg/L	3	0.3	<0.00020	<0.00040	<0.00020	<0.00020	
Vanadium (V)-Dissolved	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030	
Zinc (Zn)-Dissolved	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90) (for total metals)	0.0094	0.0319	<0.0050	<0.0050	
Aggregate Organics								
COD	mg/L	-	-	<20	33	<20	<20	
Hydrocarbons								
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25	
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25	
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	
PAHs								
Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050	<0.000050	<0.000050	
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050	<0.000050	<0.000050	
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050	<0.000050	<0.000050	
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	<0.000050	<0.000050	
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050	
Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050	<0.000050	<0.000050	
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050	

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q2 - 2012 Surface Water Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	SFC2 5/16/2012	SFC2 REP 5/16/2012	SFC2B 5/16/2012	SFC3 5/16/2012	SFC11 5/16/2012	SFC-4 5/16/2012
Physical Parameters									
Conductivity	uS/cm	-	-	314	316	542	192	71	154
Hardness (as CaCO3)	mg/L	-	-	120	118	-	44.9	24.5	51.1
pH	pH	-	9	7.5	7.44	7.03	7.55	7.52	7.65
Nutrient & Anions									
Alkalinity, Total (as CaCO3)	mg/L	-	-	71.7	66.9	39.7	28.4	19.1	27.6
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	0.73	0.87	2.87	<0.0050	<0.0050	0.0617
Bromide (Br)	mg/L	-		<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1500	150	21.4	21.4	26.8	21.8	4.51	13.6
Fluoride (F)	mg/L	2	0.4	0.056	0.058	0.149	0.048	0.057	0.053
Nitrate (as N)	mg/L	400	32.8	0.328	0.329	2.31	0.0949	0.118	0.228
Nitrite (as N)	mg/L	0.2	0.06	0.002	0.0018	0.0174	<0.0010	<0.0010	0.0011
Total Kjeldahl Nitrogen	mg/L	-	-	0.825	0.749	2.99	0.056	0.065	0.128
Total Nitrogen	mg/L	-	-	1.16	1.08	5.32	0.15	0.184	0.357
Phosphorus (P)-Total	mg/L	-	-	<0.0020	0.0021	<0.020	0.0042	0.0115	0.0066
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	56.1	56.1	173	28.5	8.29	23.7
Total Metals									
Aluminum (Al)-Total	mg/L	-	-	0.435	0.447	2.2	0.106	0.397	0.214
Antimony (Sb)-Total	mg/L	0.2	0.02	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.05	0.005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Barium (Ba)-Total	mg/L	10	1	0.056	0.054	0.065	0.022	<0.020	<0.020
Beryllium (Be)-Total	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Total	mg/L	-	-	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Total	mg/L	50	1.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.00001	0.000056	0.000053	0.000255	<0.000050	<0.000050	<0.000050
Calcium (Ca)-Total	mg/L	-	-	41.2	40.7	65.1	14.7	7.55	17
Chromium (Cr)-Total	mg/L	0.01	0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	0.04	0.004	0.00608	0.00606	0.0307	<0.00050	<0.00050	0.00078
Copper (Cu)-Total	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L)	0.0105	0.0107	0.0705	0.0044	0.0029	0.0032
Iron (Fe)-Total	mg/L	-	1	3.89	4.15	14.5	0.184	0.2	0.305
Lead (Pb)-Total	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003 (H ≤ 8mg/L) e(1.273 ln (H) - 1.460) (H > 8 mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Total	mg/L	-	-	4.12	3.89	10.7	1.98	1.37	2.11
Manganese (Mn)-Total	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300)	1.43	1.38	4.28	0.019	<0.010	0.155
Mercury (Hg)-Total	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum (Mo)-Total	mg/L	10	1	0.0032	0.0033	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	<0.0050	0.0121	<0.0050	<0.0050	<0.0050
Phosphorus (P)-Total	mg/L	-	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Total	mg/L	-	373	4.6	4.3	8	<2.0	<2.0	<2.0
Selenium (Se)-Total	mg/L	0.01	0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)-Total	mg/L	-	-	4.34	4.07	7.26	6.49	7.33	6.11
Silver (Ag)-Total	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	-	-	16	15.3	22.2	20.5	5	9.3
Strontium (Sr)-Total	mg/L	-	-	0.246	0.239	0.371	0.124	0.0853	0.154
Thallium (Tl)-Total	mg/L	0.003	0.0003	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Total	mg/L	-	-	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium (Ti)-Total	mg/L	1	2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	mg/L	3	0.3	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc (Zn)-Total	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90)	0.0067	0.0068	0.0229	0.0053	<0.0050	<0.0050
Aggregate Organics									
COD	mg/L	-	-	<20	20	24	<20	<20	<20
Hydrocarbons									
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	-	-	-	-	-	-
VPH (C6-C10)	mg/L	1.5	-	-	-	-	-	-	-
PAHs									
Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q3 - 2012 Surface Water Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	SFC-2 9/26/2012	SFC-2B 9/26/2012	SFC-3 9/26/2012	SFC-11 9/26/2012	SFC-4B 9/26/2012
Physical Parameters								
Conductivity	uS/cm	-	-	127	757	122	133	266
Hardness (as CaCO3)	mg/L	-	-	45.5	270	51	45.6	93.2
pH	pH	-	9	7.47	7.07	7.35	7.33	7.47
Nutrients & Anions								
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	30.7	107	32.9	32.1	42.9
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	30.7	107	32.9	32.1	42.9
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	<0.0050	0.36	0.0097	<0.0050	<0.0050
Bromide (Br)	mg/L	-	-	<0.050	<0.50 *	<0.050	<0.050	0.083
Chloride (Cl)	mg/L	1500	150	12.5	93.9	11.6	12.6	38.2
Fluoride (F)	mg/L	2	0.4	0.048	<0.20 *	0.048	0.048	0.045
Nitrate (as N)	mg/L	400	32.8	0.282	2.15	0.182	0.301	0.303
Nitrite (as N)	mg/L	0.2	0.06	<0.0010	0.019	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	-	-	<0.050	0.969	0.87	<0.050	0.073
Total Nitrogen	mg/L	-	-	0.282	3.14	1.05	0.301	0.376
Phosphorus (P)-Total	mg/L	-	-	<0.0020	0.104	0.009	0.0024	<0.0020
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	14	149	12.4	14.1	32.3
Total Metals								
Aluminum (Al)-Total	mg/L	-	-	0.018	2.66	2.95	0.095	0.021
Antimony (Sb)-Total	mg/L	0.2	0.02	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.05	0.005	<0.0010	0.0014	0.002	<0.0010	<0.0010
Barium (Ba)-Total	mg/L	10	1	<0.020	0.117	0.06	<0.020	0.021
Beryllium (Be)-Total	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Total	mg/L	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Total	mg/L	50	1.2	<0.10	0.21	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.00001	<0.000050	0.000124	0.000171	<0.000050	<0.000050
Calcium (Ca)-Total	mg/L	-	-	14.5	92.3	15.1	14.6	32
Chromium (Cr)-Total	mg/L	0.01	0.001	<0.00050	0.00132	0.00182	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	0.04	0.004	<0.00050	0.00145	0.0189	<0.00050	<0.00050
Copper (Cu)-Total	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L)	<0.0010	0.0193	0.0224	<0.0010	0.001
Iron (Fe)-Total	mg/L	-	1	0.057	43.4	30.3	0.141	0.127
Lead (Pb)-Total	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003 (H ≤ 8mg/L) e(1.273 ln (H) - 1.460) (H > 8 mg/L)	<0.0010	0.0011	0.0016	<0.0010	<0.0010
Lithium (Li)-Total	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Total	mg/L	-	-	2.23	9.54	3.25	2.22	3.2
Manganese (Mn)-Total	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300)	0.01	1.13	2.01	0.021	0.112
Mercury (Hg)-Total	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum (Mo)-Total	mg/L	10	1	<0.0010	0.0012	0.0014	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus (P)-Total	mg/L	-	-	<0.30	0.3	<0.30	<0.30	<0.30
Potassium (K)-Total	mg/L	-	373	<2.0	8.6	<2.0	<2.0	2
Selenium (Se)-Total	mg/L	0.01	0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)-Total	mg/L	-	-	10.6	10.9	14.7	10.6	7.58
Silver (Ag)-Total	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	-	-	7.8	50.7	7.6	7.9	15.4
Strontium (Sr)-Total	mg/L	-	-	0.204	0.684	0.206	0.202	0.382
Thallium (Tl)-Total	mg/L	0.003	0.0003	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Total	mg/L	-	-	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium (Ti)-Total	mg/L	1	2	<0.050	0.077	0.108	<0.050	<0.050
Uranium (U)-Total	mg/L	3	0.3	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc (Zn)-Total	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90)	<0.0050	0.0813	0.0288	<0.0050	<0.0050
Aggregate Organics								
COD	mg/L	-	-	<20	21	39	<20	<20
Hydrocarbons								
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	<0.10	<0.10	<0.10	<0.10	<0.10
VPH (C6-C10)	mg/L	1.5	-	<0.10	<0.10	<0.10	<0.10	<0.10
PAHs								

Acenaphthene	mg/L	0.06	0.006	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

Q4 - 2012 Surface Water Results Analyte	Units	BCCSR-S6-WATER-FAL	BC Ambient Water Quality Guidelines	SFC-2 12/12/2012	SFC-2B 12/12/2012	SFC-3 12/12/2012	SFC-11 12/12/2012	SFC-4B 12/12/2012
Physical Parameters								
Conductivity	uS/cm	-	-	116	1070	276	83.6	233
Hardness (as CaCO3)	mg/L	-	-	33.7	456	62.2	28.1	86.5
pH	pH	-	9	7.38	6.88	7.27	7.43	7.62
Nutrients & Anions								
Alkalinity, Bicarbonate (as CaCO3)	mg/L	-	-	22.1	161	33.7	21.9	33.5
Alkalinity, Carbonate (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Hydroxide (as CaCO3)	mg/L	-	-	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as CaCO3)	mg/L	-	-	22.1	161	33.7	21.9	33.5
Ammonia, Total (as N)	mg/L	1.31 @ pH ≥ 8.5 3.7 @ pH 8.0 - < 8.5 11.3 @ pH 7.5 - < 8.0 18.5 @ pH 7.0 - < 7.5 18.4 @ pH < 7.0	-	0.0084	2.5	0.0562	<0.0050	0.214
Bromide (Br)	mg/L	-	-	<0.050	<0.50	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	1500	150	9.67	66.6	36.3	4.38	15.3
Fluoride (F)	mg/L	2	0.4	0.048	<0.20	0.038	0.051	0.057
Nitrate (as N)	mg/L	400	32.8	0.322	<0.050	0.218	0.343	0.526
Nitrite (as N)	mg/L	0.2	0.06	<0.0010	<0.010	<0.0010	<0.0010	0.002
Total Kjeldahl Nitrogen	mg/L	-	-	0.085	2.84	0.141	0.065	0.329
Total Nitrogen	mg/L	-	-	0.407	2.84	0.36	0.408	0.857
Phosphorus (P)-Total	mg/L	-	-	0.0083	0.0048	0.0034	0.0098	0.0058
Sulfate (SO4)	mg/L	1000	50 (warning level) 100 (maximum)	16.6	339	41.9	11.8	54.1
Total Metals								
Aluminum (Al)-Total	mg/L	-	-	0.261	0.016	0.125	0.32	0.762
Antimony (Sb)-Total	mg/L	0.2	0.02	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Arsenic (As)-Total	mg/L	0.05	0.005	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Barium (Ba)-Total	mg/L	10	1	<0.020	0.127	0.03	<0.020	0.028
Beryllium (Be)-Total	mg/L	0.053	-	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Bismuth (Bi)-Total	mg/L	-	-	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)-Total	mg/L	50	1.2	<0.10	0.34	<0.10	<0.10	<0.10
Cadmium (Cd)-Total	mg/L	0.0001 @ H ≤ 30 0.0003 @ H = 30 - < 90 0.0005 @ H = 90 - < 150 0.0006 @ H = 150 - < 210	0.00001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Calcium (Ca)-Total	mg/L	-	-	10.7	158	21	8.67	29.2
Chromium (Cr)-Total	mg/L	0.01	0.001	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Cobalt (Co)-Total	mg/L	0.04	0.004	<0.00050	0.0133	0.00091	<0.00050	0.00392
Copper (Cu)-Total	mg/L	0.02 @ H < 50 0.03 @ H = 50 - < 75 0.04 @ H = 75 - < 100 0.05 @ H = 100 - < 125 0.06 @ H = 125 - < 150 0.07 @ H = 15- - < 175 0.08 @ H = 175 - < 200 0.09 @ H ≥ 200	0.094(H) + 2 (in µg/L)	0.0028	0.0011	0.0056	0.0023	0.0116
Iron (Fe)-Total	mg/L	-	1	0.178	24.6	0.325	0.175	1.18
Lead (Pb)-Total	mg/L	0.04 @ H < 50 0.05 @ H = 50 - < 100 0.06 @ H = 100 - < 200 0.11 @ H = 200 - < 300 0.16 @ H ≥ 300	0.003 (H ≤ 8mg/L) e(1.273 ln (H) - 1.460) (H > 8 mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	mg/L	-	0.014	<0.050	<0.050	<0.050	<0.050	<0.050
Magnesium (Mg)-Total	mg/L	-	-	1.69	15.2	2.38	1.57	3.28
Manganese (Mn)-Total	mg/L	-	0.8 (H = 25) 1.1 (H = 50) 1.6 (H = 100) 2.2 (H = 150) 3.8 (H = 300)	0.015	4.4	0.068	<0.010	0.491
Mercury (Hg)-Total	mg/L	0.001	0.000001	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Molybdenum (Mo)-Total	mg/L	10	1	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Nickel (Ni)-Total	mg/L	0.25 @ H < 60 0.65 @ H = 60 - < 120 1.1 @ H = 120 - < 180 1.5 @ H ≥ 180	0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Phosphorus (P)-Total	mg/L	-	-	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Total	mg/L	-	373	<2.0	10	2.3	<2.0	2.5
Selenium (Se)-Total	mg/L	0.01	0.002	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Silicon (Si)-Total	mg/L	-	-	7.56	8.91	6.6	7.79	6.56
Silver (Ag)-Total	mg/L	0.0005 @ H ≤ 100 0.015 @ H > 100	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Sodium (Na)-Total	mg/L	-	-	9.3	50.9	29.6	5.7	12.4
Strontium (Sr)-Total	mg/L	-	-	0.108	1.01	0.162	0.0959	0.209
Thallium (Tl)-Total	mg/L	0.003	0.0003	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Tin (Sn)-Total	mg/L	-	-	<0.030	<0.030	<0.030	<0.030	<0.030
Titanium (Ti)-Total	mg/L	1	2	<0.050	<0.050	<0.050	<0.050	<0.050
Uranium (U)-Total	mg/L	3	0.3	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Vanadium (V)-Total	mg/L	-	0.006	<0.030	<0.030	<0.030	<0.030	<0.030
Zinc (Zn)-Total	mg/L	0.075 @ H ≤ 90 0.15 @ H = 90 - < 100 0.9 @ H = 100 - < 200 1.65 @ H = 100 - < 200 2.4 @ H = 300 - < 400	33 + 0.75 (H - 90)	<0.0050	0.0234	0.006	<0.0050	0.0097
Aggregate Organics								
COD	mg/L	-	-	<20	38	<20	<20	<20
Hydrocarbons								
EPH10-19	mg/L	5	-	<0.25	<0.25	<0.25	<0.25	<0.25
EPH19-32	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
LEPH	mg/L	0.5	-	<0.25	<0.25	<0.25	<0.25	<0.25
HEPH	mg/L	-	-	<0.25	<0.25	<0.25	<0.25	<0.25
Volatile Hydrocarbons (VH6-10)	mg/L	15	-	-	-	-	-	-
VPH (C6-C10)	mg/L	1.5	-	-	-	-	-	-
PAHs								

Acenaphthene	mg/L	0.06	0.006	<0.000050	0.000627	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.0005	0.00005	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.001	0.0001	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.0001	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	0.001	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.002	0.0002	<0.000050	0.000113	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.12	0.012	<0.000050	0.000236	<0.000050	<0.000050	<0.000050
Indeno(1,2,3-c,d)pyrene	mg/L	-	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Naphthalene	mg/L	0.01	0.001	<0.000050	<0.000050	0.000066	<0.000050	<0.000050
Phenanthrene	mg/L	0.003	0.0003	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Pyrene	mg/L	0.0002	0.00002	<0.000050	0.000058	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.034	0.0034	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

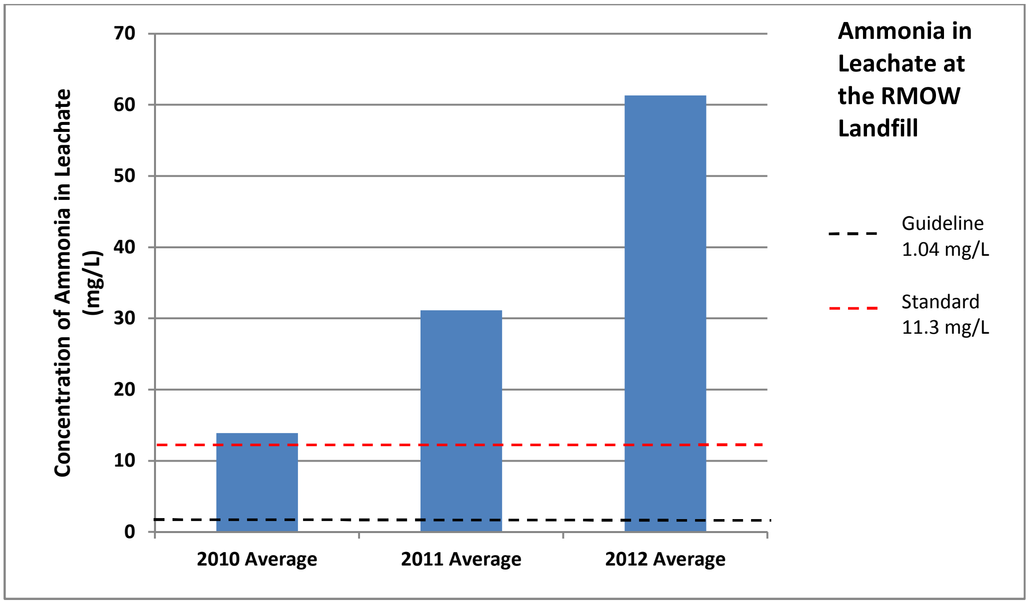
Note: Cells exceed the standards are **bold.**
Cells that exceed the guidelines are underlined.
Cells that exceed both the standard and the gudielines are in **bold and underlined**.

APPENDIX J: Field Data Collection Results for Leachate, Groundwater, and Surface Water Monitoring

		Groundwater Levels						Water Quality				
Well ID	**Date**	**Ground Surface elevation**	**Top of Well Riser Elevation**	**Depth to Water**	**Static Water Level Elevation**		**Temp**	**Conductivity**	**D.O.**	**pH**	**ORP**	**Comments**
		mASML	**mASML**	**m below top of well riser**	**mASL**		**C**	**uS/cm**	**mg/l**			
MW2D	26-Jan-12	603.84	604.9	6.23	598.67		4.6	1.973	3.91	6.4	-886.3	
MW2S	26-Jan-12	603.84	604.94	6.28	598.66		3.35	0.841	3.24	6.58	-739.8	
MW3	26-Jan-12	600.61	601.47	1.52	599.95		7.12	0.494	1.97	5.71	-765.3	
MW4	26-Jan-12	596.54	677.54	4.25	673.29		3.7	0.797	3.55	6.48	-886.1	
MW6	26-Jan-12	610.88	610.88	5.04	605.84		5.71	0.78	4.83	5.37	-687.9	
SFC2	26-Jan-12						6.52	0.447	8.9	6.49	-642.7	
SFC2B	26-Jan-12						0.55	0.513	12.73	6.1	-630.1	
SFC3	26-Jan-12						2.83	0.304	13.48	7.36	-396.4	
SFC11	26-Jan-12						3.35	0.118	23.3	7.66	-392.3	
L1	26-Jan-12						5.06	0.81	13.82	6.12	-540	
Wet Well	26-Jan-12						7.23	0.7	13.7	6.31	-485.8	
MW2D	16-May-12	603.84	604.9	6.28	598.62		8.22	2.155	6.85	6.27	-321.6	
MW2S	16-May-12	603.84	604.94	6.32	598.62		7.98	0.811	3.58	6.63	-315.6	
MW3	16-May-12	600.61	601.47	1.52	599.95		8	0.378	1.36	5.88	-260.9	
MW4	16-May-12	596.54	677.54	4.04			7.84	0.891	2.4	6.53	-155	
MW6	16-May-12	610.88	610.88	4.96	605.92		7.57	0.787	5.93	5.44	-277.1	
SFC2	16-May-12						7.43	0.407	8.63	6.37	-430.1	
SFC2B	16-May-12						13.8	0.713	7.22	6.26	-511	Very little flow, skin on the waters surface.
SFC3	16-May-12						7.96	0.232	11.09	6.91	-660.9	
SFC4B	16-May-12						7.24	0.195	12.37	7.11	-399.9	
SFC11	16-May-12						5.94	0.097	15.71	7.14	-429.18	
L1	16-May-12						10.6	0.776	5.74	6.2	-214.3	
Wet Well	24-May-12						9			6.27		RMOW did not collect the other parameters.
MW2D	26-Sep-12	603.84	604.9	6.41	598.49		8.76	0.352	3.44	6.72	-93	
MW2S	26-Sep-12	603.84	604.94	6.42	598.52		8.79	1.03	3.46	6.52	-91.2	
MW3	26-Sep-12	600.61	601.47	1.8	599.67		9.01	0.109	2.58	5.98	110.7	
MW4	26-Sep-12	596.54	677.54	4.3	673.24		10.16	0.253	4.88	6.7	-96.7	
MW6	27-Sep-12	610.88	610.88	6.2	598.49		7.96	0.361	7.07	5.42	195.6	
SFC2	26-Sep-12						10.53	0.551	7.39	6.3	86.8	
SFC2B	26-Sep-12						7.51	0.086	11.6	7.69	80.6	Very little flow, skin on the waters surface.
SFC3	26-Sep-12						8.66	0.085	10	7.12	43	
SFC11	26-Sep-12						6.71	0.083	8.7	6.83	83.7	
SFC4B	26-Sep-12						8.63	0.187	7.94	6.99	75.1	
L1	27-Sep-12						11.22	2.816	4.09	7.11	-0.7	
Wet Well	26-Sep-12						10.94	0.55	3.2	6.02	-4.2	
MW2D	12-Dec-12	603.84	604.9	5.983	598.917		7.04	1.068	3.61	6.51	-57.50	
MW2S	12-Dec-12	603.84	604.94	6.023	598.917		6.00	0.596	4.00	6.61	-79.40	PVC Stand pipe broken, needs to be fixed
MW3	12-Dec-12	600.61	601.47	1.42	600.05		7.83	0.182	3.21	5.90	43.00	
MW4	12-Dec-12	596.54	677.54	4.002	673.538		7.37	0.239	5.40	6.26	31.30	

MW6	CNL	610.88	610.88									Could not locate flush mount well due to heavy snow banks, needs to be marked
SFC2	12-Dec-12						4.36	0.063	11.98	7.21	56.00	Culvert
SFC2B	12-Dec-12						8.15	0.782	3.57	6.15	80.30	Tributary
SFC3	12-Dec-12						4.62	0.176	10.22	6.84	86.40	
SFC11	12-Dec-12						4.40	0.053	11.00	6.99	97.30	
SFC4B	12-Dec-13						3.84	0.147	11.55	7.39	-38.20	Sampled on Dec 13, am
L1	12-Dec-12						6.80	1.360	5.91	7.20	-51.30	
LM	12-Dec-12						6.03	0.463	3.96	6.28	23.30	

APPENDIX K: Trends for Key Leachate Parameters (2010 – 2012)

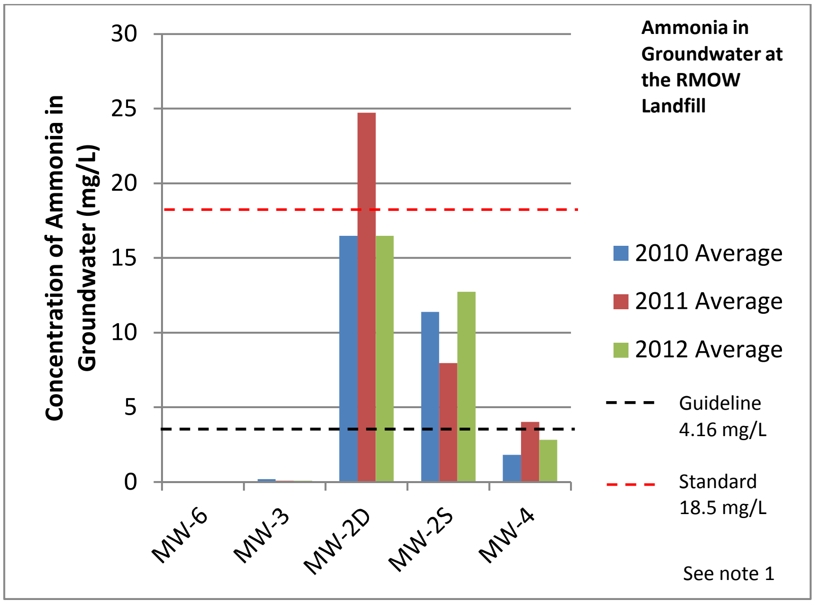


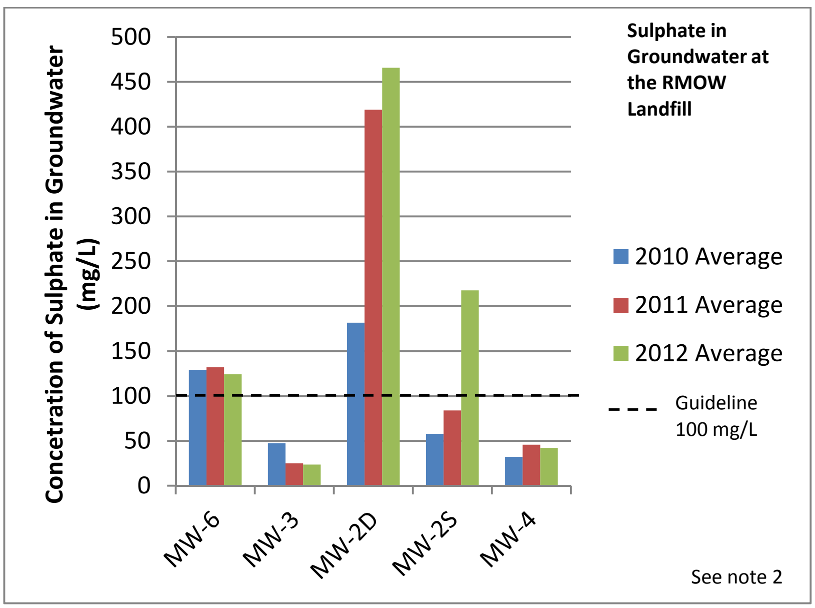
NOTES:

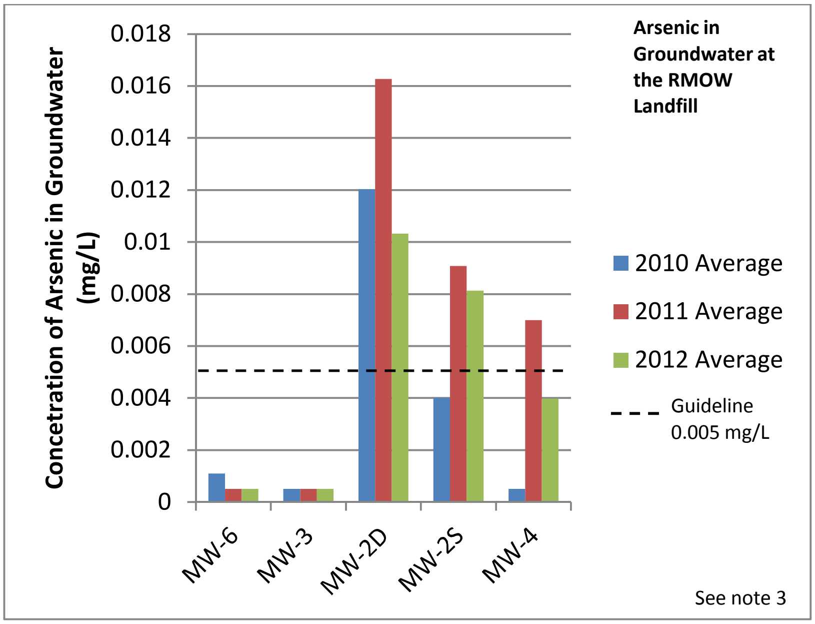
Standard = BC Contaminated Sites Regulation, Schedule 6, Column II, Generic Numerical Water Standards for Aquatic Life
Guideline = BC Working and Approved Water Quality Guidelines

1. The guideline and standard for ammonia is based on the worst case scenario in leachate samples from 2010 – 2012 for pH.

APPENDIX L: Trends for Key Groundwater Parameters (2010 – 2012)


Ammonia in Groundwater at the RMOW Landfill
Concentration of Ammonia in Groundwater (mg/L)
30
25
20
15
10
5
0
MW-6
MW-3
MW-2D
MW-2S
MW-4
2010 Average
2011 Average
2012 Average
Guideline 4.16 mg/L
Standard 18.5 mg/L
See note 1


Sulphate in Groundwater at the RMOW Landfill
Concetration of Sulphate in Groundwater (mg/L)
500
450
400
350
300
250
200
150
100
50
0
MW-6
MW-3
MW-2D
MW-2S
MW-4
2010 Average
2011 Average
2012 Average
Guideline 100 mg/L
See note 2

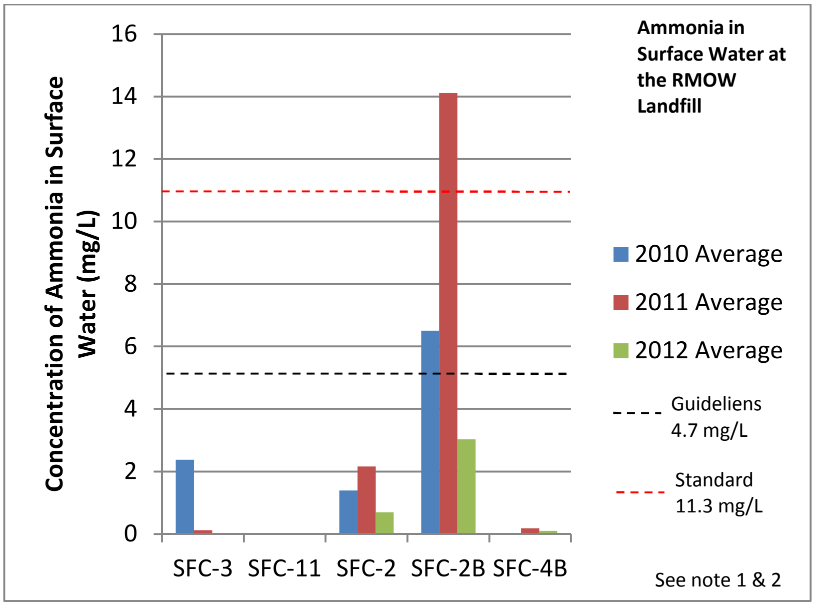


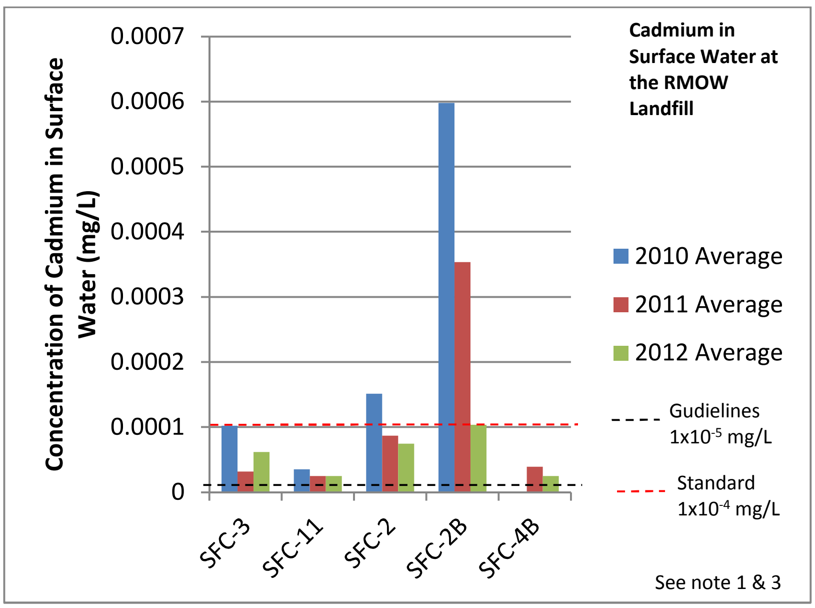
NOTES:

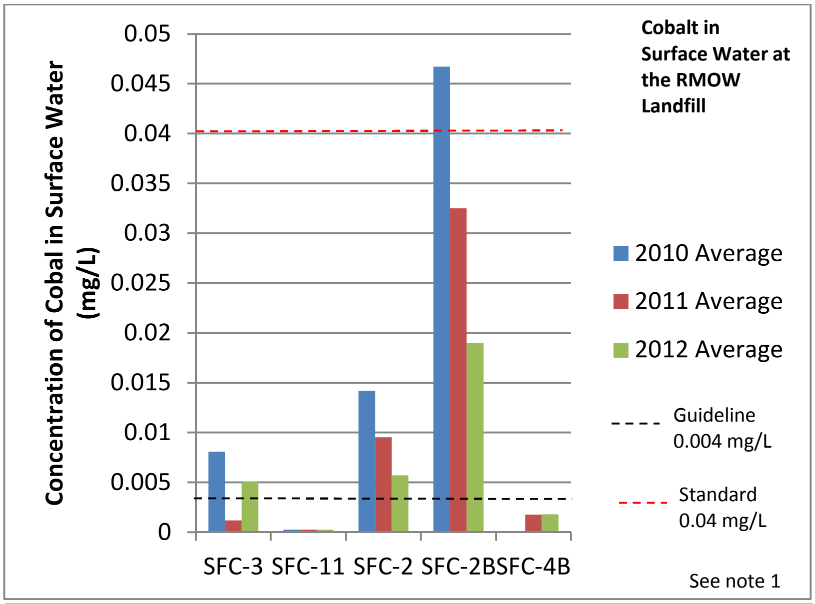
Standard = BC Contaminated Sites Regulation, Schedule 6, Column II, Generic Numerical Water Standards for Aquatic Life
Guideline = BC Working and Approved Water Quality Guidelines

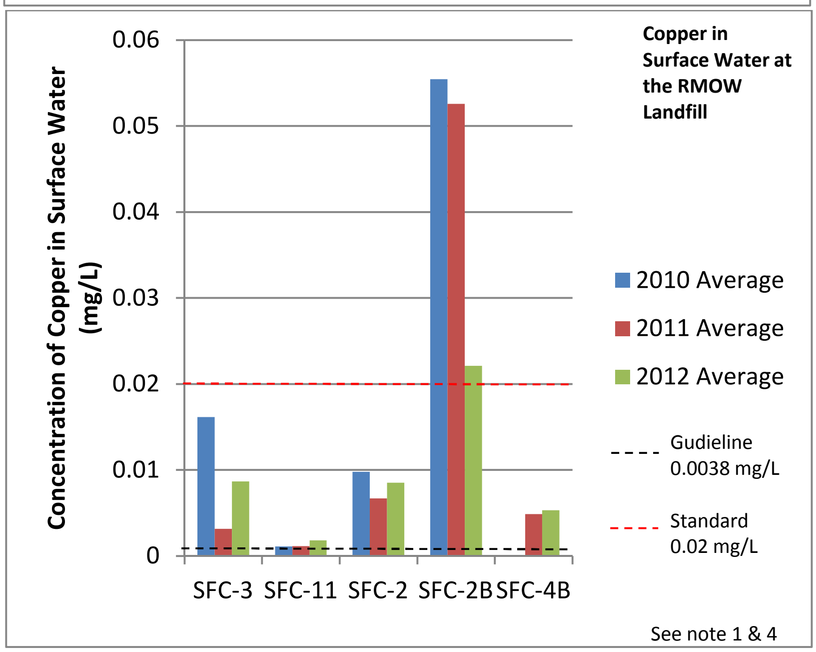
1. The guideline and standard for ammonia is based on the worst case scenario in groundwater samples for 2010 – 2012 for pH.
2. Standard for sulphate is 1000 mg/L which is greater than the values within the chart.
3. Standard for arsenic is 0.05 mg/L which is greater than the values in the chart.

APPENDIX M: Trends for Key Surface Water Parameters (2010 – 2012)


Ammonia in Surface Water at the RMOW Landfill
Concentration of Ammonia in Surface Water (mg/L)
16
14
12
10
8
6
4
2
0
SFC-3
SFC-11
SFC-2
SFC-2B
SFC-4B
2010 Average
2011 Average
2012 Average
Guideliens 4.7 mg/L
Standard 11.3 mg/L
See note 1 & 2


Cadmium in Surface Water at the RMOW Landfill
Concentration of Cadmium in Surface Water (mg/L)
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
SFC-3
SFC-11
SFC-2
SFC-2B
SFC-4B
2010 Average
2011 Average
2012 Average
Gudielines 1x10-5 mg/L
Standard 1x10-4 mg/L
See note 1 & 3





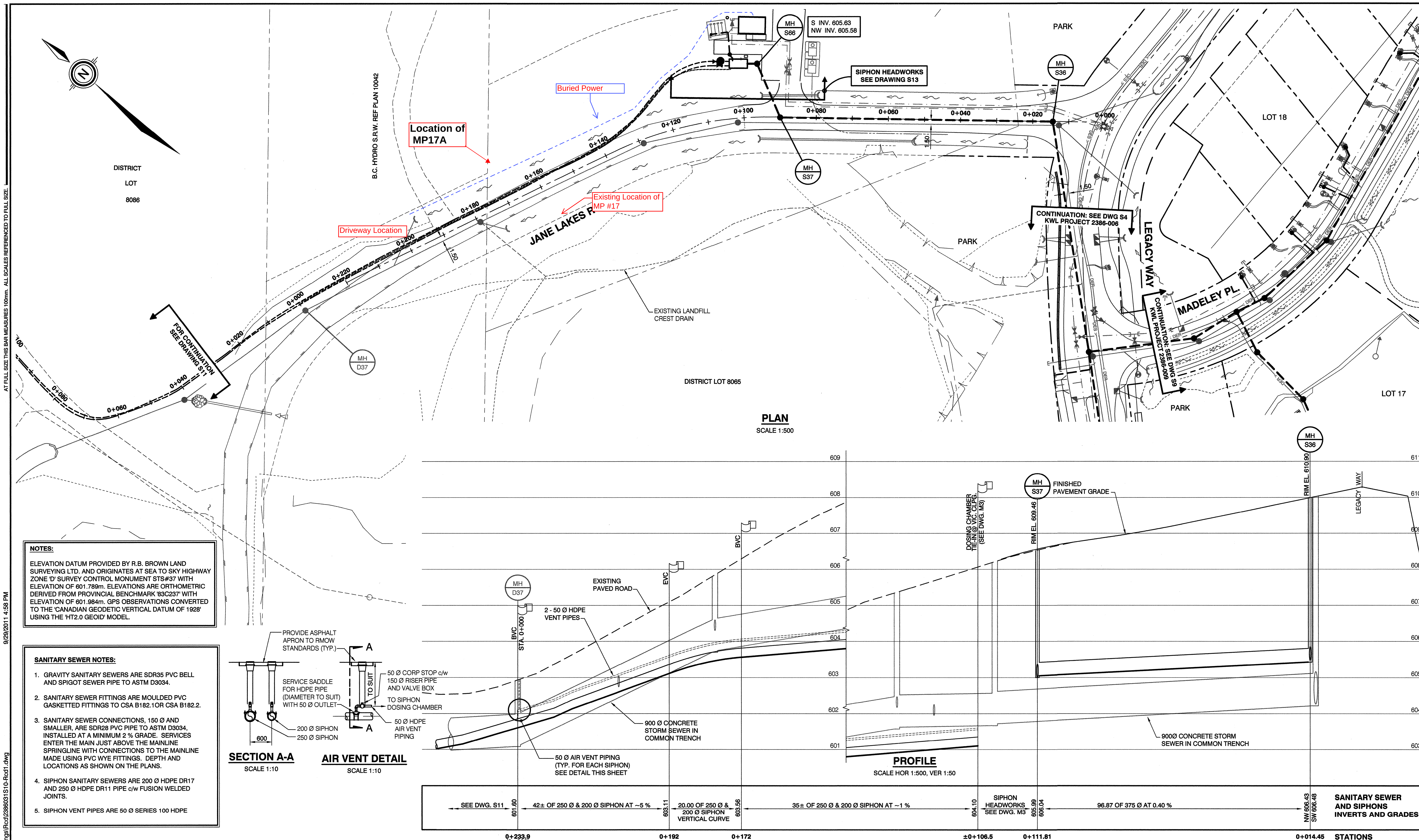
NOTES:

Standard = BC Contaminated Sites Regulation, Schedule 6, Column II, Generic Numerical Water Standards for Aquatic Life

Guideline = BC Working and Approved Water Quality Guidelines

1. The average analyte values for 2010 at SFC-4B have been omitted as they are significantly higher than the other readings and they were not sampled and analyzed using the same methods as the rest of the samples.
2. The guideline and standard for ammonia is based on the worst case scenario in surface water samples from 2010 – 2012 for pH.
3. The standard for cadmium is based on the worst case scenario in surface water samples from 2010 – 2012 for hardness.

APPENDIX N: Location drawings for Monitoring Probe 17A



NOTES:

ELEVATION DATUM PROVIDED BY R.B. BROWN LAND SURVEYING LTD. AND ORIGINATES AT SEA TO SKY HIGHWAY ZONE 'D' SURVEY CONTROL MONUMENT STS#37 WITH ELEVATION OF 601.789m. ELEVATIONS ARE ORTHOMETRIC DERIVED FROM PROVINCIAL BENCHMARK '83C237' WITH ELEVATION OF 601.984m. GPS OBSERVATIONS CONVERTED TO THE 'CANADIAN GEODETIC VERTICAL DATUM OF 1928' USING THE 'HT2.0 GEOID' MODEL.

SANITARY SEWER NOTES:

1. GRAVITY SANITARY SEWERS ARE SDR35 PVC BELL AND SPIGOT SEWER PIPE TO ASTM D3034.
2. SANITARY SEWER FITTINGS ARE MOULDED PVC GASKETTED FITTINGS TO CSA B182.1OR CSA B182.2.
3. SANITARY SEWER CONNECTIONS, 150 Ø AND SMALLER, ARE SDR28 PVC PIPE TO ASTM D3034, INSTALLED AT A MINIMUM 2 % GRADE. SERVICES ENTER THE MAIN JUST ABOVE THE MAINLINE SPRINGLINE WITH CONNECTIONS TO THE MAINLINE MADE USING PVC WYE FITTINGS. DEPTH AND LOCATIONS AS SHOWN ON THE PLANS.
4. SIPHON SANITARY SEWERS ARE 200 Ø HDPE DR17 AND 250 Ø HDPE DR11 PIPE c/w FUSION WELDED JOINTS.
5. SIPHON VENT PIPES ARE 50 Ø SERIES 100 HDPE

AT FULL SIZE THIS BAR MEASURES 100mm. ALL SCALES REFERENCED TO FULL SIZE

9/29/2011 4:58 PM

O:\2300-2399\2386-031\500-Drawings\Rcd\2386031S10-Rcd1.dwg

ISSUED INFORMATION: Issued for	Issue	Date	Issued By
Reference			
Approvals	A1	Nov.17/08	KAF
Tender			
Permits	P0	Aug.06/08	KAF
Construction	C1	Sep.24/08	KAF
Record Drawings	R1	Apr.11/11	KRS

REVISION INFORMATION: Rev. No.	Date	Designed	Drawn	Checked	Description of Revision
0	Jan.04/08	SB	SB	RK	-
1	Jul.14/08	SB	AU	RK	ISSUED FOR CONSTRUCTION
2	Oct.08/10	SB	SB	KAF	RECORD DRAWING
3	Apr.11/11	KRS	SB	KRS	RECORD DRAWING SECOND SUBMISSION

THE INFORMATION COMPILED ON THIS DRAWING WAS PROVIDED BY VARIOUS SITE CONTRACTORS AND SURVEYORS AND SUPPLEMENTED WHERE POSSIBLE BY KERR WOOD LEIDAL ASSOCIATES LTD. AS SUCH, THIS DRAWING REASONABLY REPRESENTS AN AS BUILT RECORD OF THE CONSTRUCTED WORKS.

Seal

KERR WOOD LEIDAL associates limited
CONSULTING ENGINEERS

200 - 4185A Still Creek Dr.
Burnaby, B.C.
V5C 6G9
Tel: 604-294-2088
Fax: 604-294-2090
www.kwl.ca

RESORT MUNICIPALITY OF WHISTLER
CHEAKAMUS CROSSING DEVELOPMENT
SANITARY SEWERS & SIPHONS TO WWTP
JANE LAKES ROAD

KWL Project No.	2386-031	Scale	AS SHOWN	S10
Sheet	2 of 22	Rev. No.	3	Drawing Number

Client: WHISTLER 2020 DEVELOPMENT CORPORATION

APPENDIX O: Borehole Log for Monitoring Probes

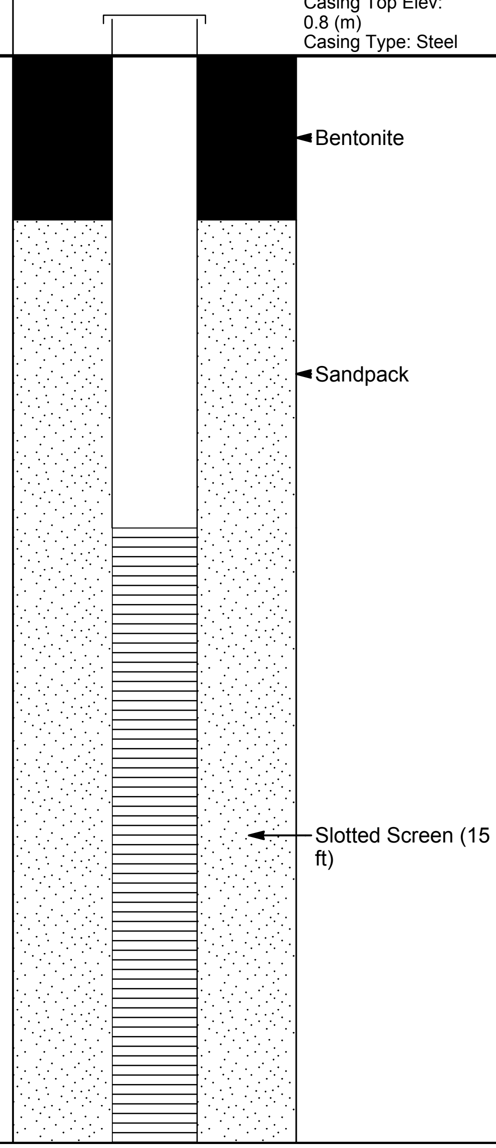
Morrison Hershfield Ltd.
310 - 4321 Still Creek. Dr.
Burnaby, BC V5C 6S7

BORING NUMBER MP17A

CLIENT Resort Municipality of Whistler
PROJECT NAME Whistler Landfill
PROJECT NUMBER 5104016.02
PROJECT LOCATION Function Junction, BC
DATE STARTED 5/11/12 **COMPLETED** 5/11/12
GROUND ELEVATION **HOLE SIZE** 6"
DRILLING CONTRACTOR Sonic Drilling
GROUND WATER LEVELS:
DRILLING METHOD Truck Mount
AT TIME OF DRILLING ---
LOGGED BY J. Gilson **CHECKED BY**
AT END OF DRILLING ---
NOTES UTM 10 U 497070.5 mE 5547780.1 mN
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
0				
2				
4			Soil sampling was not completed as part of this monitoring probe installation.	
6				
8		8.1		

Casing Top Elev: 0.8 (m)
Casing Type: Steel



Bottom of borehole at 8.1 m.

APPENDIX P: Monitoring Probe Results for 2012

Sampling Events Measuring Methane (as %) at Monitoring Probes in 2012

Monitoring Probe #	Jan.3, 2012	Jan. 6, 2012	Jan.12, 2012	Jan.16, 2012	Jan.23, 2012	Feb.3, 2012	Feb. 7, 2012	Feb.16, 2012	Feb.23, 2012	Mar.4, 2012	Mar.12, 2012	Mar.23, 2012	Mar.26, 2012	Mar.28, 2012	Apr.8, 2012	Apr.15, 2012	Apr.18, 2012	Apr.27, 2012	May 14 ,2012	Jun. 20, 2012	Jul. 4, 2012	Aug.10 , 2012	Sept.13, 2012	Oct.4' 2012	Oct.30, 2012	Oct.31, 2012	Nov.1, 2012	Nov.2, 2012	Nov.7, 2012	Nov.15, 2012	Nov.21, 2012	Nov.28, 2012	Dec.5, 2012	Dec.12, 2012	Dec.18, 2012	Dec.28, 2012
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	water	0	Water	Water	Water	water	0	Water	Water	water	0	Water	0	Water	water	0	Water	0	0	0	0	0	0	0	Water	Water	Water	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0 (broken)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0
14	4%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	12%	11%	0	4%	9%	20%	0	4%	8%	2%	0	0	0	2%	2%	7%	8%	10%	17%	23%	0	0	0	Monitoring at this location discontinued, now using MP17A							
17A	Well was not yet installed.																												0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0