February 22, 2013

HYDROGEOLOGICAL ASSESSMENT REPORT

Watson Lake
Solid Waste Disposal Facility

Submitted to:
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Community Services, Infrastructure Development Branch
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REPORT

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Executive Summary

Golder Associates Ltd. (“Golder”) was retained by the Government of Yukon Community Services Infrastructure Branch on September 28, 2011 to complete a groundwater monitoring well network installation and hydrogeological assessment program at up to 20 solid waste facilities located across the Territory. The Town of Watson Lake Solid Waste Facility (the “Facility” or the “Site”) is one of the sites included in the program. The first phase completed for the work was a review of Site-specific requirements and considerations. The second phase was the preparation of a work plan and schedule. The third phase was to develop and present a Background Research and Facility Site Assessment Plan. The fourth phase consisted of the drill program tender specification and tender process management. The fifth phase consisted of the installation of a monitoring well network and collection of data on water levels, water quality, and aquifer parameters. This sixth and final phase resulted in a draft of this complete Hydrogeological Assessment Report detailing the impact of the Facility to groundwater quality, and risk to down gradient receptors.

In summary, the information obtained during the Hydrogeological Site Assessment indicated the following:

- Site Description: The Site access is located at kilometre 1,022 of the Alaska Highway, approximately 1.5 km west of the Town of Watson Lake. The Facility is a Municipal Facility that is operated by the Town of Watson Lake. The Facility was opened in the late 1960s or early 1970s and is currently in use. No evidence of chemical or fuel storage, above or below ground tanks, spills or discharges or hazardous materials storage was observed during the reconnaissance.
- Topography: The cleared area at the Facility is generally flat, with the surrounding area characterized as very gently sloped (0-5%) or undulating hillock and hollows with multidirectional slopes (less than 25 percent) characteristic of kame and kettle topography. The Facility is located at a topographic high at an elevation of approximately 715 m above mean sea level (amsl); a melt water channel is located along the northwest corner draining run off to the north towards an unnamed pond and Watson Lake (elevation 680 m amsl). The regional topography slopes south towards the Liard River (elevation approximately 600 m amsl).
- Hydrogeology:
  - A search of the Natural Resources Canada, Groundwater Information Network identified three groundwater wells within 1,500 metres of the Site. Each well was installed at a surface elevation of 701.95 m, with water levels recorded at depths 9.14 m and 11.58 m below ground surface.
  - Sub-surface conditions were investigated with four monitoring wells (WL-MW12-01, WL-MW12-02, WL-MW12-03 and WL-MW12-04), which were installed from May 13 to 24, 2012 under the supervision of Golder Associates to establish a monitoring well network at the Facility.
  - The Site stratigraphy consists of up to 25 m of sandy silt, silty sand and gravel and/or clayey silt, underlain by a steeply sloping rock outcrop found along the northern edge of the Site. Bedrock is identified as a Tertiary or Quaternary basalt flow of the Selkirk Volcanics formation. This formation was found to be approximately 3 m to 8 m thick throughout the Site and overlies unconsolidated sediments. Layers of gravel, silty sand, sand and silt were encountered below the basalt to a depth of 60 m where bedrock was encountered.

  - Saturated media was encountered under confining conditions at various elevations across the Site. At three of the four well locations, confined saturated conditions were encountered below a basalt unit. The hydraulic conductivity of the fractured basalt and the underlying formation may be on the order of 2×10^{-6} to 7×10^{-4} m/sec. At the fourth well location (WL-MW12-02), confined saturated conditions were encountered within the regional bedrock unit.
  - Due to the complex hydrogeological conditions encountered, groundwater flow direction at the Site could not be determined from the installed wells. WL-MW12-01, WL-MW12-03, and WL-MW12-04 may be screened in different saturated units, and at significantly different depths due to the presence of basalt upper confining unit.
  - The piezometric surface measured in the four wells varied from 685 m to 706 m amsl.
  - Regional groundwater flow can be inferred from the topography to be towards the Liard River approximately 4 km to the south of the Facility. Local groundwater flow direction may be inferred from the topography at the Site, and relative groundwater elevations, to be towards a wetland in the glacial melt-water channel adjoining the Facility to the north and west.

- Groundwater Chemistry:
  - Groundwater sampling of the newly installed monitoring wells and surface water sampling from a seep in a wetland to the north of the Site was conducted May 30, 2012.
  - WL-MW12-01 and WL-MW12-03 contained elevated total dissolved solids (TDS), chloride, sulphate, ammonia, and petroleum hydrocarbons, which are all consistent with the effect of leachate contamination.
  - Of the petroleum hydrocarbons:
    - WL-MW12-04 had levels of LEPHw (Light Extractable Petroleum Hydrocarbons) in excess of the Yukon Contaminated Sites Regulation Standard for freshwater aquatic life.
  - All other parameters were within acceptable levels at all sampling locations.
  - Results of samples taken from WL-MW12-03 and the surface water sample taken from the adjacent wetland met Yukon CSR aquatic life standard and had lower levels of all of these constituents, and did not show evidence of hydrocarbons, indicating less or little impact from leachate.
  - Sulphate exceeded freshwater aquatic life standards at WL-MW12-04.

The following recommendations are made based on the results of the hydrogeological assessment presented in this report:

- As required by the Solid Waste Permit for the facility, future groundwater monitoring should be conducted in the spring and late summer.
- Monitoring well locations and elevations should be surveyed by a professional land surveyor. The elevation and position of the top of PVC pipe, and the ground elevation at each well should be surveyed.
- The potential impact that landfill leachate may be having on groundwater quality at the facility should be revaluated following two rounds of groundwater monitoring. As part of the monitoring:
  - WL-MW12-04 should be over developed to attempt to remove excess sediment in the well.
  - The source and significance of the detectable levels of petroleum hydrocarbons, primarily LEPHw that was found in WL-MW12-04, should be re-evaluated following the two rounds of groundwater sampling. There is the possibility that the detected petroleum hydrocarbons are associated with the method used to drill the wells, and therefore may not have been representative of actual groundwater conditions.
  - The sulphate exceedance in MW-12-04 should be evaluated further following the two rounds of additional groundwater sampling.

Study Limitations

This report was prepared for the Government of Yukon, Community Services Infrastructure Development Branch.

The findings and conclusions documented in this report have been prepared for the specific application to this project, and have been developed in a manner consistent with that level of care normally exercised by environmental professionals currently practicing under similar conditions in the jurisdiction.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

With respect to regulatory compliance issues, regulatory statutes are subject to interpretation. These interpretations may change over time, and should be reviewed.

If new information is discovered during future work, Golder should be requested to re-evaluate the conclusions of this report and to provide amendments, as required, prior to any reliance upon the information presented herein.

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1.0 INTRODUCTION

1.1 Background

Golder Associates Ltd. (“Golder”) was retained by the Government of Yukon Community Services Infrastructure Branch on September 28, 2011 to complete a groundwater monitoring well network installation and hydrogeological assessment program at up to 20 solid waste facilities located across the territory. The Town of Watson Lake Solid Waste Facility (the “Facility”, or the “Site”) is one of the sites included in the program. This completed Hydrogeological Assessment Report represents the final stage of this project.

These works have been performed in accordance with the approved scope of work detailed in Golder’s proposal (P1-1436-0073) dated August 29, 2011, accepted by Yukon Government Community Services on October 7, 2011 and additional works detailed in our letter dated April 26, 2012 and accepted on April 30, 2012.

1.2 Purpose and Objectives

A phased approach is typically implemented in order to develop a Site-specific groundwater monitoring program. The following items are included in the development of the program:

- Develop a conceptual hydrogeological model of the Site using existing data that identifies source(s), pathways and receptors;
- Visit the Site to confirm the hydrogeological model, assess Site conditions and identify monitoring well locations;
- Design a monitoring well network and drilling program;
- Install groundwater monitoring wells in accordance with the plan;
- Sample the groundwater and, if applicable, surface water;
- Analyze the data and identify potential impacts;
- With the new data, re-evaluate the conceptual hydrogeological model and groundwater monitoring program; and
- Provide recommendations, if needed, to further assess potential impacts to groundwater quality.

1.3 Scope and Sequence of Work

The following scope was proposed to develop the hydrogeological conceptual model for the Site. This work was performed in accordance with the Waste Disposal Facility Permit (Permit No: 80-005 effective August 3, 2011 to December 31, 2011), relevant Environment Yukon Protocols and in accordance with the Yukon Environmental and Socioeconomic Assessment Act (YESAA) Decision Document issued for the Site (YESAA File Number 2011-0258) on February 21, 2012.

In summary, the work completed at the facility included the following six phases:

- Phase 1 assessed the needs for special considerations at the Site;
- Phase 2 outlined a work plan and schedule;
- Phase 3 consisted of background research and finalization of a draft of the Site Assessment Plan;
- Phase 4 consisted of the drill program tender specification and tender process management;
- Phase 5 consisted of the installation of a monitoring well network and collection of data on water levels, water quality, and aquifer parameters; and
- Phase 6 comprised preparation of the draft of this Hydrogeological Assessment Report detailing the impact of the Facility on groundwater quality, and risk to down gradient receptors.

1.4 Qualifications of Assessors

Project Manager

The role of Project Manager was filled by Gary Hamilton, P. Geo., of Golder's Burnaby, BC office. Mr. Hamilton is a senior contaminant hydrogeologist and Principal with Golder Associates. He has over 25 years of experience, has completed landfill monitoring projects locally, and is very familiar with Yukon environmental regulations. Mr. Hamilton conducted the initial Site inspections, co-ordinated the drilling work and reviewed this assessment report.

Project Director

The role of Project Director was filled by Guy Patrick, P. Eng., of Golder's Victoria, BC office. Mr. Patrick is a senior hydrogeologist and a Principal with Golder Associates. He is a Professional Engineer registered with the Association of Professional Engineers of the Yukon Territory. Mr. Patrick has over 30 years of experience in the field of environmental and hydrogeological assessments.

Field Hydrogeologist-Engineer

The role of Project Hydrogeologist was filled by Calvin Beebe of Golder's Nelson, BC office. Mr. Beebe has completed numerous projects as a Hydrogeologist with Golder Associates including work on contaminated sites, and works with senior personnel on a regular basis.

Mr. Beebe was assisted by Ms. Andrea Badger. Ms. Badger joined Golder in May 2012 as a Junior Engineer-in-Training. She obtained a B.Sc. in Civil Engineering with an Environmental Option, from the University of Alberta, Edmonton (2012) and a Diploma of Northern Studies, Outdoor and Environmental Studies at Yukon College, Whitehorse (2007). She has been involved with monitoring well drilling, development, testing and sampling at landfills across the Yukon. She has also been involved with surface water monitoring at a construction site in Northern British Columbia.

Technicians

Krista Meneghetti assisted with the drilling program. Ms. Meneghetti is a Senior Environmental Technologist based out of Golder’s Vancouver, BC office. Joe Marquardson assisted with developing and sampling of wells. Mr. Marquardson is a Senior Fisheries Technician based out of Golder’s Whitehorse office.

1.5 Authorization

Written authorization and a signed contract to proceed with the work outlined in our proposal dated August 29, 2011 was received by Ms. Laura Prentice, Program Manager, on October 7, 2011. Golder received e-mail authorization to proceed with additional work detailed in our letter dated April 26, 2012 on April 30, 2012. The Change Order for the work was attached to the e-mail message.

2.0 FACILITY DESCRIPTION AND HISTORY

2.1 Location of the Study Area

The Watson Lake Solid Waste Facility is located in the southeast part of the Yukon Territory, within the Liard Basin Ecological Region, at latitude 60°04’62” North and longitude 128°44’45” West. The Facility is located approximately 1.5 km northwest of the Town of Watson Lake and is accessed by Auburn Drive, a 690 m gravel road north off kilometre 1022 of the Alaska Highway (Figure 1). The nearest residential structure is located approximately 1,200 m north east of the Site. The closest First Nation land is LFN C-75 (Interim Protected First Nations Lands) located 400 m north east of the Site.

An un-named drainage feature located less than 100 m north and northwest of the facility is the closest water body. This drainage feature flows northward to a small pond located 920 m north of the facility. At the northwest end of the pond there is a drainage feature that flows to the north into Watson Lake. The Liard River is located approximately 4,200 m south of the facility.

The facility is located on a topographic high level bench at an elevation of approximately 715 m above mean sea level (amsl). The water level elevation in Watson Lake is approximately 680 m amsl and the elevation of the Liard River is approximately 600 amsl. Locally, the natural terrain slopes to the north towards Watson Lake and the south towards the Liard River. Regionally the ground surface slopes towards the Liard River to the south.

2.2 Facility History

In 1939 the Government of Canada committed to building a chain of airfields across the North-western region of the country under the Northwest Staging Route Program and the Watson Lake airfield was one of the links in the chain. Construction of the airfield began in 1941, and the Town of Watson Lake was developed in 1941 and 1942 for the purpose of supporting the military airport as a supply centre for the construction of the Alaska Highway. The town landfill was reportedly developed in the late 1960s or early 1970s approximately 1.5 km northwest of Watson Lake. A review of historical aerial photographs for the area indicates that the land was undeveloped prior to its use as a landfill. The approximate area land filled can be seen as cleared land in Figure 2 (Site Plan), which also shows current features including areas of construction debris, automotive and metal debris, buried tires, appliances, and a burning trench. Historically, waste was placed in trenches, and periodically burnt and covered (Access, 2003). Typical depths of waste burial are on the order of 4.5 m, with a one m thick cap of inert material. Since 2000, some segregation of metals and other recyclable material from the waste was conducted.

3.0 METHODOLOGY

3.1 Preliminary Hydrogeological Assessment

The preliminary hydrogeological assessment involved a review and interpretation of existing information and an inspection for the Watson Lake solid waste disposal facility. The initial inspection of the facility was conducted on October 22, 2011 and a follow up inspection was completed on May 12, 2012. The purpose of preliminary hydrogeological assessment was to identify the appropriate drilling methods and equipment, and potential monitoring well locations. This portion of the work included the following three tasks:

- Compilation and review of available information;
- Assessment and interpretation of available hydrogeological data; and
- Development of a conceptual hydrogeological model.

Results of the preliminary hydrogeological assessment are documented in our report entitled “Town of Watson Lake, Solid Waste Facility: Background Research and Facility Assessment Plan” dated January 27, 2012.

3.1.1 Data sources

Data used to complete the hydrogeological assessment was obtained from the following sources:

- Site inspections on October 22, 2011 and May 12, 2012;
- Topographic map (Energy Mines and Resources Canada. Watson Lake, Yukon Territory 1:50 000. Map Sheet 105A/2, Edition 1985);
- Surface geology map (Lipovsky, P.S., McKenna, L. and Huscroft, C.A., 2005. *Surficial geology of Watson Lake (NTS 105A/2), Yukon* (1:50 000 scale), Yukon Geological Survey, Energy Mines and Resources, Yukon Government, Open file 2005-7);
- Access Consulting Group and G. J. Bull and Associates Inc.. *Town of Watson Lake Solid Waste Management Plan.* Prepared for the Town of Watson Lake. February 2003;
- Close, Susan. Yukon Environmental and Socio-economic Assessment Board, Watson Lake Designated Office. *Project: 2008-0184 – Watson Lake Municipal Landfill Site*, Map Package. July 18, 2008;
- Environment Canada, Meteorological Service of Canada Last Modified 2011-11-16, Website: http://www.climate.weatheroffice.ec.gc.ca/climate_normals/Canadian Climate Normals or Averages 1971-2000;

- Government of Yukon Territory, Yukon Environment, Solid Waste Disposal Facility Permit, No 80-005, Special Waste Permit No. 42-067 and Air Emissions Permit No. 4201-60-019;
- Government of Yukon Territory, Yukon Water, Water Data Catalogue Website: http://yukonwater.ca/MonitoringYukonWater/WaterDataCatalogue;
- Government of Yukon Territory, Department of Environment, Compiled from The Yukon Water Well Registry Summary of Yukon Water Wells, May 11, 2006- Website: http://www.env.gov.yk.ca/monitoringenvironment/hydrology.php;
- J. Gibson Environmental Consulting. March 2007, Water Quality Analysis Results and September 2007, Water Quality Analysis Results; and
- Town of Watson Lake Website: http://www.watsonlake.ca.

3.1.2 Site Inspection

Site inspections were conducted on October 22, 2011 and May 13, 2012. These two Site visits were conducted to review the layout of the Facility and confirm geological and topographic information obtained from the review of background data. Proposed monitoring well locations were reviewed for access constraints. Selected photographs of the Facility taken during the reconnaissance are presented in Appendix A.

3.1.3 Background Geological Information

Geological information was obtained through a review of topographic and geological maps from the department of Energy Mines and Resources Canada, and through the Canadian Geological Survey. Additional data on the subsurface of the surrounding area was obtained through the online Groundwater Information Network (GIN), provided by Natural Resources Canada (NRCAN), and the Yukon Water Well Registry.

3.1.4 Contaminated Sites Registry

A Site Registry search was conducted by Yukon Environment on December 1, 2011. The search identified no contaminated sites files or spill reports for the Watson Lake Solid Waste Facility; however, it was noted by that the Facility does not have any analytical results in the file to compare against the Yukon CSR standards to determine if any contamination exists.

3.1.5 Interviews with Solid Waste Disposal Facility Personnel

Interviews were conducted with persons knowledgeable about the activities at or adjacent to the Site during the Facility reconnaissance.

The information summarized below was submitted to the Yukon Environmental and Socio-economic Assessment Board (YESAB) by Mr. Bill Wagoner on July 17, 2008:

- At the time, the Town of Watson Lake was in the process of securing a new landfill site, and intended to use the current recycle depot as a transfer station. A compactor bailer had already been ordered, and was to be used to compact cardboard, cans, plastics, *etc*., for recycling/transport purposes.

- The Site is located within the boundaries of the Watson Lake Landfill site, which had been operating as a landfill for around 40 years.
- The surrounding area is boreal forest, with pine and spruce mix, as well as deciduous species such as aspen, poplar and birch.
- There is a small creek north of the property.
- Wildlife is present in the vicinity of the landfill, such as fox, bear, wolves, eagles, ravens, *etc*., typical of the general area.
- Brush and trees are a minimum of 200 metres from the dump site.
- Prevailing wind direction is normally south westerly. An open burn pit was at one time situated at the north western side of the landfill.
- The landfill's elevation was approximately 20 metres higher than the Alaskan Highway.

3.1.6 Review of Solid Waste Disposal Facility Permit and Waste Management Plan

A Solid Waste Permit, Special Waste Permit and Air Emissions Permit for the Facility have been reviewed. The permits are summarized as follows:

- The Solid Waste Permit was issued on November 25, 2005. It states that the Facility is to be operated in compliance with any applicable requirements in federal, territorial, and municipal legislation including the Environment Act and Solid Waste Regulations.
- A Special Waste Permit was issued on November 25, 2005. It states that the Facility be operated in compliance with any applicable requirements in federal, territorial, and municipal legislation including the Environment Act and Special Waste Regulations. This permit authorizes the collection and storage of household hazardous waste, waste oil and waste batteries.
- An Air Emissions Permit was issued on November 25, 2005. This permit authorizes the Facility to conduct open burns (greater that 5 kg) of solid waste in compliance with the Environment Act and the Air Emissions Regulations.

The SWMP for the facility was reviewed. It is understood through conversation with Alan Puckett, Operations Manager, on November 28, 2011 that the current SWMP is not currently fully adhered to and that an updated SWMP is going to be prepared following completion of the 2011/2012 Monitoring Well Installation and Hydrogeological Assessment.

Monitoring requirements set out in Waste Permit 80-005 include:

- Monitoring water levels and collecting water samples from groundwater monitoring wells at the facility twice a year (spring and late summer).

- Sampling of down gradient surface water bodies concurrently with the groundwater sampling.
- Analyze surface water and groundwater samples for the parameters outline in section 3.7.
- Analyze water samples at a laboratory that is accredited as conforming to ISO/IEC 17025 by an accrediting body that conforms to ISO/IEC 17011.
- Submitting monitoring results to Environment Yukon by January 31st each year.

Table 1: Summary of Waste Disposal Facility Permits and Groundwater Monitoring Requirements

Site	Site Disposal Facility Permit Number	Permit Type	Solid Waste Management Plan	Required Groundwater Monitoring
Watson Lake Solid Waste Disposal Facility	80-005	Solid Waste Disposal Facility	Yes (Access 2003)	Twice Per Year
Watson Lake Solid Waste Disposal Facility	42-067	Special Waste	Yes (Access 2003)	Twice Per Year
Watson Lake Solid Waste Disposal Facility	4201-60-019	Air Emissions (Burn)	Yes (Access 2003)	No

3.2 Field Investigations

3.2.1 Scope of Field Investigations

The scope of the field investigation included the following:

- Four on-site groundwater wells were drilled by Midnight Sun Drilling under the supervision of Golder Associates between May 13 and 24, 2012.
- Wells were developed and sampled by Golder Associates on May 30, 2012. The water levels at each well were measured prior to purging and sampling, and physiochemical parameters were monitored at each well during development and sampling. Groundwater samples were sent ISO/IEC 17025-accredited laboratories for analysis.
- Wells were slug tested to assess hydraulic conductivity and linear groundwater velocity.
- Field and laboratory results were summarized and are interpreted in this report.

3.2.2 Groundwater Monitoring Well Network

Groundwater monitoring well installation was undertaken in general accordance with Yukon Contaminated Site Regulation Protocol (Yukon Environment, 2011).

Four (4) groundwater monitoring wells were proposed to be installed at the Site to assess potential groundwater contamination sourced from the waste disposal facility. A Site plan showing the monitoring well locations and key Site features is provided in Figure 2. WL-MW12-01 was targeted to characterize up-gradient groundwater conditions, while WL-MW12-02, WL-MW12-03, and WL-MW12-04 were intended to assess any impact to groundwater quality sourced from the landfill.

Locations of the monitoring wells (Figure 2) were selected based on regional topography, aerial photography, review of Site history, and a Site inspection:

- WL-MW12-01 was installed on the northern edge of the Site at a depth of 7.3 m below grade (m bg).
- WL-MW12-02 was installed on the southern edge of the Site and advanced to 71.6 m bg.
- WL-MW12-03 was installed on the eastern edge of the Site and advanced to a depth of 22.9 m bg.
- WL-MW12-04 was installed on the western edge of the Site and advanced to 28.7 m bg.

All wells were installed using an air rotary drilling technique.

The location and elevation of the newly installed wells were obtained by Trimble handheld GPS to an accuracy of 0.5 m or better.

Grab samples of drill cuttings were taken at regular intervals to log the lithology encountered in each borehole. Borehole logs indicating observed lithology along with well construction details are provided in Appendix B, with a summary of well construction details provided in Table 2. Saturated zones were encountered at varying depths throughout the Site, indicating complex hydrogeological conditions. The following is a summary of the depth of the saturated zones that were encountered at the Site:

- At well WL-MW12-01 groundwater saturation was encountered at a depth of 5.5 m below grade in a silt, sand and gravel unit underlying a basalt unit.
- At well WL-MW12-02 unsaturated conditions were encountered to a depth of greater than 60 m. Lithology encountered consisted of 7 m of till overlying approximately 4 m of basalt, overlying 48 m of silty sand and gravel sediments, overlying bedrock at a depth of approximately 59 m below grade. Groundwater saturation was encountered in fractured bedrock at a depth of 65.5 m below grade.
- At well WL-MW12-03, which is located at the eastern edge of the Site, saturated groundwater conditions were encountered at a depth of approximately 19.8 m below grade in a sand and gravel unit underlying the basalt unit.
- At well WL-MW12-04, which is located on the western edge of the Site, saturated groundwater conditions were encountered at a depth of approximately 28.8 m below grade in a silty sand and gravel unit immediately underlying a basalt unit.

Each monitoring well was completed with the top of the screen installed as close as possible to the interval where the moisture content of the formation appeared to be transitioning from unsaturated to saturated.

Installation details are included on the borehole logs in Appendix B. Typical completion details are:

- Monitoring wells were completed with 50 mm PVC Schedule 40 pipes;
- A 3 m long well screen (10-slot) was installed in all four monitoring wells;

- An un-slotted PVC pipe was installed above the well screen to about 0.60 m above grade;
- A silica sand pack was used to fill the annulus between the PVC well screen and the borehole wall. The sand pack was extended approximately 1.5 m above the top of the screened interval;
- A seal consisting of approximately 1.5 m of bentonite chips was placed directly above the sand pack. The remainder of the annulus was filled with bentonite grout;
- Each well was capped with a PVC end-cap and the well PVC-standpipe protected with a lockable steel protective casing; and
- Each well was developed by removing a minimum of three well volumes using dedicated Waterra tubing and a Hydrolift pump. Development logs are provided in Appendix C.

Table 2: Well Construction Details

Well ID	Drilled Depth (m bg)	Aquifer Unit Monitored	Casing Diameter (mm)	Screened Interval (m bg)	Filter Pack Interval (m bg)
WL-MW12-01	7.3	Silt, Sand, Gravel, and Basalt	50	4.3 – 7.3	2.6 – 7.3
WL-MW12-02	71.6	Fractured Bedrock	50	67.1 – 70.1	64.9 – 71.6
WL-MW12-03	23.5	Medium Sand	50	20.3 – 23.3	19.5 – 23.3
WL-MW12-04	28.7	Basalt, Silty Sand	50	25.6 – 28.7	24.4 – 28.7

3.2.3 Monitoring Well Surveying

Golder surveyed the vertical elevation to the top of the well PVC standpipe at WL-MW12-01, WL-MW12-02, and WL-MW12-03 on May 17, 2012. Elevations were relative to a benchmark, for which the elevation was obtained via Trimble GPS with a vertical accuracy of approximately 0.5 m. Surveyed elevations were then determined relative to this single GPS elevation. Monitoring well locations as well as the elevation of WL-MW12-04 were not surveyed, but instead obtained via Trimble GeoXT GPS with an accuracy of 0.5 m. Table 3 presents a summary of survey data and water-level measurements.

Table 3: Monitoring Well Locations and Groundwater Elevations from the Monitoring Event on May 30, 2012

Well ID	GPS Location	Top of PVC Casing Elevation (m asl).	Standing Water Level (m btoc)	Groundwater Elevation (m asl).
WL-MW12-01	6659204.1 m N 514147.4 m E	713.1	6.22	706.8
WL-MW12-02	6658974.7 m N 514149.9 m E	717.0	31.80	685.2
WL-MW12-03	6659106.6 m N 514238.0 m E	714.1	21.03	693.0
WL-MW12-04	6659142.0 m N 513997.5 m E	709.6	24.55	685.1

3.2.4 Groundwater Monitoring Event

Monitoring wells WL-MW12-01, WL-MW12-03, and WL-MW12-04 were developed and sampled by Golder on May 30, 2012. This resulted in approximately one week of rest after the installation of WL-MW12-04, and two weeks of rest after the installation of WL-MW12-01 and WL-MW12-03. Due to logistical constraints, the wells could not be developed immediately following installation.

WL-MW12-02 was too deep to be developed using the standard technique employed for the other wells for development and sampling, and thus could not be sampled during this groundwater monitoring event.

The procedure used for sampling followed Contaminated Sites Regulation Protocol no. 7. Prior to and during development/purging of each well, the water level was first measured with an electronic measuring tape. Between three and ten well volumes were then purged from each well using 5/8” high density polyethylene (HDPE) Waterra™ tubing, a foot valve, and a Hydrolift™ pump. Following purging, a sample was collected immediately. During purging, physiochemical parameters (pH, temperature, EC, DO) were collected using a YSI 650MDS at regular intervals, and allowed to reach equilibrium prior to sampling. Groundwater Development and Surging/Sampling Datasheets are presented in Appendix D. In addition to the three groundwater monitoring wells sampled, a surface water sample from the nearest potential down gradient receptor was acquired during the same monitoring round.

Sample containers and appropriate preservatives were obtained from ALS’s Whitehorse laboratory. Samples for dissolved metals were field filtered using 0.45-micron, in-line filters and preserved with nitric acid. WL-MW12-04 could not be filtered for dissolved metals because of insufficient sample caused by high turbidity that clogged the field filters. Instead, an unfiltered sample was submitted for total metals analysis. All samples were kept in coolers with ice pack prior to their delivery to ALS’s Whitehorse office, within appropriate holding times. ALS’s laboratory is certified by the Canadian Association for Laboratory Accreditation and is accredited as conforming to ISO/IEC 17025 for analysis.

3.2.5 Hydraulic Response Tests

Hydraulic response (slug) tests were performed on July 4, 2012 to assess the hydraulic conductivity of aquifers at the Site. Both rising head and falling head tests were performed using a solid PVC slug and a Solinst Levellogger electronic pressure transducer set to measure head fluctuations at one-second intervals. Manual water-level measurements were also recorded throughout the tests.

Multiple falling head tests were conducted in WL-MW12-01 and WL-MW12-03. ML-MW12-04 recovered slowly, and therefore only a single falling head test was interpreted. WL-MW12-02 could not be slug tested, as it was undeveloped at the time the slug tests were conducted.

3.3 Laboratory Testing

Parameters included in the laboratory testing of groundwater samples are summarized in Table 4. The parameter list complies with the Facility’s Solid Waste Disposal Permit (Permit No. 80-005).

Sampling and analysis were undertaken in general accordance with Yukon Contaminated Site Regulation Protocols 2 and 5 (YCSR, 2011).

Table 4: Parameters Sampled for May 2012

Sample ID	General Parameters	Nutrients	Dissolved Metals	PAH, BTEX, DOC	Fecal Coliform
WL-MW12-01	√	√	√	√	√
WL-MW12-03	√	√	√	√	√
WL-MW12-04	√	√	-	√	√
Surface water	√	√	√	√	√

3.4 Quality Control Assurance

The following section provides a detailed description of the Quality Assurance (QA) and Quality Control (QC) measures taken by Golder to ensure the accuracy and integrity of groundwater quality sample analysis.

The following table (Table 5) summarizes the QA/QC evaluation.

Table 5: Review of QA/QC Procedures Taken

QA/QC Aspect	Evidence and Evaluation
Data Representativeness	
Sample Integrity	All samples were kept at the appropriate temperature and delivered to the laboratory within the appropriate holding times.
Background Samples	WL-MW12-01 was intended to be up gradient of the Facility to provide background levels of physiochemical parameters; however, due to complex hydrogeological conditions encountered at the Site, at this time none of the groundwater samples from any of the wells can be considered to represent background conditions.
Field Procedures	Monitoring wells were developed and sampled using dedicated tubing. All equipment used in sampling more than one well was decontaminated using soap (Alconox™) and distilled water. Surface water samples were collected using one-time-use syringes.
Calibration of Field Equipment	Calibration of field equipment was undertaken daily, prior to sampling wells.
Data Precision and Accuracy	
Blind Duplicate	One blind duplicate was collected from WL-MW12-01 during the May 2012 groundwater monitoring event. Of the 51 analyte pairs tested, RPD values could not be calculated for 24 of the pairs as both values in each pair were below the laboratory method detection limit (MDL). Of the remaining pairs tested, only three analytes (nitrate, nitrite, and Total Kjeldahl Nitrogen) exceeded the RPD acceptance criteria of ±30%. These exceedances are considered to be generally minor, and are related to the poor reproducibility of the analytical methods at low analyte concentrations.
Trip Blanks	A trip blank was not collected during the May 2012 groundwater monitoring event.
Laboratory Internal QA/QC	Laboratory QA/QC is detailed in the primary laboratory report (Appendix D). Overall, the primary lab showed acceptable testing frequency and acceptable results for the method blanks, laboratory duplicates and matrix spikes.
Holding Times	No samples exceeded maximum holding times.

QA/QC Aspect	Evidence and Evaluation
Laboratory Detection Limit	Laboratory reports indicate that detection limits were below the standards applicable to this assessment.
Completeness of test program	With the exception of WL-MW12-02 (as discussed in text), all wells were sampled in accordance with the Site Assessment and Work Plan criteria.
Validity of Data Set	The data quality review indicates no significant systematic errors in the data collection or analysis process for groundwater. The results of laboratory internal QA/QC and analysis of blind duplicates were acceptable, and therefore, the data set is considered valid and complete for use as the basis for groundwater assessment.

3.5 Application of Applicable Water Quality Standards

In accordance with the Government of Yukon's solid waste facility monitoring requirements, groundwater wells and the nearest surface water receptor were sampled and tested for the following parameters:

- Major ions (Ca, Mg, Na, K, Cl, SO_4, N, NO_2, NO_3 and P)
- Dissolved Metals
- Mercury
- Hardness
- Alkalinity
- Carbonate
- Bicarbonate
- pH
- Total dissolved solids
- Ammonia
- Dissolved organic carbon
- VOCs
- Chemical oxygen demand
- Total Kjeldahl Nitrogen
- EPH_{w10-10} & VH_{w6-10}
- BTEX
- PAHs
- Faecal coliform

Groundwater and surface water analytical results were compared to the Yukon Contaminated Sites Regulation water standards, or to the Canadian Environmental Quality Guidelines where no Yukon standard was available.

The four types of water uses outlined in the YCSR, the relevant water quality standards, and their applicability to this assessment are presented in Table 6.

Table 6: Applicable Water Quality Standards

Water Use	Applicable Water Quality Standard	Applicable Plume Radius (km)	Applicability to Assessment
Aquatic Life	Schedule 3 – Contaminated Sites Regulation (O.I.C. 2002/171)	1.0	Applicable
Drinking Water	Schedule 3 – Contaminated Sites Regulation (O.I.C. 2002/171)	1.5	Not Applicable
Irrigation	Schedule 3 – Contaminated Sites Regulation (O.I.C. 2002/171)	1.5	Not Applicable
Livestock	Schedule 3 – Contaminated Sites Regulation (O.I.C. 2002/171)	1.5	Not Applicable

The following discusses the applicability of each water quality standard to the Facility.

Aquatic Life

Aquatic life guidelines are applicable primarily due to the presence of wetlands adjoining the Site to the north and west. In addition, there are several small ponds located to the north and east of the Site, which although are not predicted to be down-gradient of the Site, fall within the 1 km radius of the Site, as required by the standard. It was determined, therefore, that aquatic life guidelines were **applicable** for the Watson Lake Facility.

Drinking Water

A search of drinking water wells on the groundwater Information Network website (accessed July 10, 2012) showed no drinking water wells located along the predicted down gradient direction between the Site and the Liard River. The majority of nearby drinking water wells were located at least 1.5 km north or 2.0 km east of the Site. It was therefore concluded that drinking water standards were **not applicable** for the Watson Lake Facility.

Irrigation

The Summary of Yukon Water Wells compiled from The Yukon Water Well Registry was reviewed by Golder on July 10, 2012. No irrigation wells were identified on record for the Watson Lake area. It should be noted, however, that this is not a complete record of all wells in the Yukon. As a further check, Google Earth Images from 2004 were reviewed by Golder on July 10, 2012, and several visits to the Facility were conducted in May and July 2012. No agricultural land was identified within 1.5 km of the Facility. Given these findings, it is concluded that irrigation standards are **not applicable** to the Watson Lake Facility.

Livestock

Similar to the irrigation standards review, Golder's review of the Summary of Yukon Water Wells, Google Earth Images from 2004, as well as several visits to the Facility, lead us to conclude that livestock water standards are **not applicable** to the Watson Lake Facility.

4.0 CONCEPTUAL HYDROGEOLOGICAL MODEL

4.1 Setting

The Facility is located approximately 1.5 kilometres west of the Town of Watson Lake, approximately 400 m north of the Alaska Highway. Residential areas are located 1.5 km to the north and east of the Site and are part of the Town of Watson Lake.

On a regional scale, as shown in Figure 1, land around the Site slopes to the south towards the Liard River. However, the ground surface at the Site generally slopes to the north towards a glacial drainage channel and peat-land, which adjoins the Site and is at a maximum approximately 20 m below the elevation of the Site. There is a topographic divide across the Site, and a smaller portion of ground at the Site slopes off to the southwest towards the Alaska Highway and an abandoned sawmill. There has been significant disturbance of the natural land surface within the Site boundary. The Site has been cut and filled to construct a level bench containing a trench for household garbage. Significant alterations have also been made to the landfill portion of the Site, parts of which have been covered with a thin layer of inert fill.

All of the large vegetation species have been removed from the Site and there are only shrubs, small trees, grasses, and weeds remaining within the Site boundaries. The area surrounding the Site has medium to heavy cover of native vegetation, with the exception of the rocky slope to the northwest of the Site, and a cutline to the south.

4.2 Climate

The nearest available climate data is recorded at the Watson Lake Airport, 6 km northwest of the Site. This data indicates an average annual precipitation of 404.4 mm, with a majority falling as rain between May and October. The average annual temperature at the Watson Lake Airport is -2.9º C, with the warmest average monthly temperature being in July at 15.1º C and the coldest month being January with an average temperature of -24.2º C (Environment Canada, 2011). From this information it can be concluded that the highest groundwater recharge through surface water infiltration will be between May and October.

Annual precipitation is relatively low (about 0.4 m per year) and would suggest that infiltration of water through the waste and into the subsurface soils is relatively low. With a significant portion of the precipitation occurring in the form of snow, and the relatively cold climate, little infiltration would be expected during the winter months. During spring snow melt, there is the greatest potential for infiltration of water through the waste; however, a significant portion of the water would occur over land as surface runoff or interflow during this period.

4.3 Geology and Hydrogeology

4.3.1 Geological Framework

The southern Yukon, including the Watson Lake area, has undergone several episodes of glaciation, the most recent being the Quaternary McConnell glaciation (Figure 3, Regional Geology). During that period, sediments such as glacial till, and glaciofluvial, and glaciolacustrine sediments were deposited, especially in low elevation areas such as Watson Lake.

The Watson Lake Region is mapped as being underlain primarily by unconsolidated till and glaciofluvial deposits of Quaternary origin, with minor modern organic deposits associated with lakes and wetlands, and fluvial deposits associated with the Liard River. Till is generally found in locations with higher elevation in the Watson Lake region, while glaciofluvial and organic sediments naturally occupy lower elevations, filling valleys and depressions.

The Watson Lake 1:50,000 Surficial Geology map shows blanketed, (less than 1 m thick) anthropogenic fill and glacial till underlying the Facility, as well as a steeply sloping rock outcrop. This rock is identified as a Tertiary or Quaternary basalt flow of the Selkirk Volcanics (YGS MapMaker Online, 2012). This rock formation was encountered at the Site and found to be between 3 m and 8 m thick. It is relatively flat and is likely continuous beneath the Facility, with the exception of WL-MW12-04 where it was found to dip sharply to a minimum depth of 22 m below ground surface. The Selkirk Volcanics formation overlies unconsolidated sediments that consist of silt, sand, and rounded gravel with minor clay at the Site. Bedrock was encountered at a depth of approximately 61 m in WL-MW12-02 that was composed of Carboniferous and Permian Anvil group chert and pelite or Lower Tertiary, mostly Eocene Ross group terrestrial clastic rock consisting of claystone, siltstone, shale and coal, sandstone and chert conglomerate (Geological Survey of Canada, 1966),.

Surficial geology in the area surrounding the Facility is mapped as Quaternary deposits consisting of unconsolidated glacial, glaciofluvial and glaciolacustrine deposits; fluvial silt, sand, and gravel, and local volcanic ash, in part with cover of soil and organic deposits (Yukon Geological Survey, 2005).

4.3.2 Principle Aquifers

As shown in Figure 4A and 4B (Hydrogeological Conceptual Model Section 1 North-South and Section 2 East to West), within the immediate vicinity of the Site groundwater occurs in unconsolidated Quaternary or Tertiary sediments beneath the Selkirk Volcanic basalt flow. At the south end of the Site, in WL-MW12-02, no surficial water table was found, but a confined regional bedrock aquifer was encountered.

For ease of reference in this report, these units have been named the Surficial Aquifer and the Regional Bedrock Aquifer.

Table 7 Aquifer Units Encountered at the Site

Aquifer Name	Location	Aquifer Type	Comment
Surficial Aquifer	Underlying all but the far southern extent of the Site.	Inter-granular, porous media	▪ Basalt upper confining layer ▪ Probably silt lower confining layer
Regional Bedrock Aquifer	Mapped to the south of the Site and presumably underlying a large region around the Site.	Fractured rock	▪ Deep regional flow in this aquifer ▪ Recharged by infiltration in outcrop areas and through lateral and vertical flow from the overlying surficial aquifer

4.4 Groundwater Flow Systems

4.4.1 Regional Groundwater Flow

It can be inferred from the topography that the regional groundwater flow is likely from Watson Lake (water level elevation 680 m amsl) in the north towards the Liard River (elevation 600 m amsl) in the south. Groundwater recharges the bedrock aquifer through infiltration of rainfall in high elevation areas and exposed outcrops, and by the direct infiltration of surface water surrounding the Site. Groundwater may accumulate within unconsolidated, materials and form surficial saturated zones that are recharged by direct infiltration, leakage from the bedrock, and direct infiltration of surface water. Most of the intermediate to deep groundwater zones at the Site likely discharge to the Liard River to the south, whereas local flow zones likely migrate to the north and west, as discussed below.

4.4.2 Local Groundwater Flow

It can be inferred from the Site topography, groundwater elevations, and the presence of seeps along the rocky slope adjacent to the Facility, that surface water and shallow groundwater will mostly drain towards the wetland and glacial melt-water channel in the topographic low to the northwest of the Facility (Figure 6, Piezometric Surface). From there, groundwater be directed along the alignment of the melt-water channel to one of the small ponds to the northwest of the Site, as shown in Figure 2, where it may discharge.

Groundwater elevations were measured within each well during the May 2012 sampling program. The water-level measurements and groundwater elevations as of May 30, 2012 are summarized in Table 3 and posted on Figure 6. Due to confined groundwater conditions at the Site and the occurrence of spatially separate zones of saturation at different depths, a consistent potentiometric surface could not be identified.

4.5 Rising/Falling Head Tests

Golder Associates conducted slug tests on WL-MW12-01, WL-MW12-03 and WL-MW12-04 in July 2012. Results were analyzed using AQTESOLV version 4.5 software and the results of the analysis are included in Appendix D. The following is a summary of the findings.

Table 8: Estimated Hydraulic Conductivity

Monitoring Well ID	Primary Hydrogeological Unit	Solution Used	Estimated Hydraulic Conductivity (m/s)
WL-MW12-01	Fractured Basalt	Bouwer-Rice (1976)	2×10^{-4}
WL-MW12-03	Medium Sand	Bouwer-Rice (1976)	7×10^{-4}
WL-MW12-04	Fractured Basalt	Bouwer-Rice (1976)	2×10^{-6}

4.6 Estimated Average Linear Groundwater Velocity

Average linear groundwater velocities can be estimated in aquifers where the hydraulic gradient is known, and hydraulic conductivity has been estimated. However, at the Site hydraulic conductivity estimates are available for two separate local flow systems, but hydraulic gradients are not known due to complex aquifer conditions and wells screened in different units.

4.7 Potential Contamination of Groundwater and Transport Mechanisms

Potential sources and transport mechanisms of groundwater contamination are evaluated based on the Site history, Site inspections, interviews with Facility personnel, hydrogeological investigation and contaminant transport principals. Potential sources include:

- Leachate from present and former domestic waste, commercial waste, industrial waste, metals, wood, rubber (tires), construction debris, derelict vehicles and any other waste disposed of at the Facility. Potential contaminates leaching from these sources include: heavy metals, nutrients ($NO_{3,}$ NH_3), organic hydrocarbons (fuels, polyaromatic hydrocarbons, chlorinated hydrocarbons), and salts.

- Leakage and spillage from onsite hydrocarbon storage areas.
- Although no offsite sources of pollution have been identified in this report, the Facility is located in an industrial area, and offsite sources of contamination are possible.

Transport mechanisms that may act on these sources of contamination and cause contamination of downgradient receptors include:

- Percolation of precipitation from the surface, through the unsaturated zone, and into the saturated zone.
- Transport of contaminants within the saturated zone (aquifer) to other downgradient locations.

5.0 GROUNDWATER IMPACT ASSESSMENT

5.1 Review of Groundwater Chemistry

As discussed in section 3.2.4, one round of groundwater monitoring was conducted on three of the four newly installed wells and one surface water location at the Watson Lake Solid Waste Disposal Facility on May 30, 2012. Chain-of-custody forms for the groundwater samples can be found in Appendix E. Table 9 summarizes important parameters from the groundwater chemistry results. The complete groundwater chemistry results, along with QA/QC data can be found in Appendix C.

Table 9: Important Groundwater Chemistry Results

Sample Location	Total Dissolved Solids (mg/L)	Chloride (mg/L)	Ammonia (mg/L)	Sulphate (mg/L)	LEPHw (mg/L)
WL-MW12-01	1,090	191	0.0095	354	<0.25
WL-MW12-03	463	33.8	0.0091	178	<0.25
WL-MW12-04	2,960	287	0.087	1,770	2.33
Surface Water	155	9.88	<0.0050	4.54	<0.25

Total Dissolved Solids

Total Dissolved Solids (TDS) is a measurement of the total amount of dissolved organic and inorganic material contained within a liquid. Elevated TDS can indicate the presence of groundwater contamination caused by, for example, landfill leachate. Typically, major ions that can comprise TDS include: NO_3, NH_3, Na, K, Mg, Ca, SO_4, Cl, and HCO_3.

Values of TDS in the monitoring well samples ranged from 463 mg/L to 2,960 mg/L across the Site. TDS in the surface water sample was much lower than that found in any of the monitoring well samples. This is generally expected in surface water, especially in peat-lands, because they are primarily ombrotrophic (*i.e.,* rain fed as opposed to groundwater fed.

Chloride

Chloride is often used as a tracer for anthropogenic influence on groundwater chemistry. Elevated chloride levels are associated with a number of sources including sewage, leachate, and road salting. In the case of landfills, elevated chloride might is typically expected due degradation of waste with high chloride concentration. Levels of chloride ranged from 33.8 mg/L to 287 mg/L in the monitoring well samples and were highest in WL-MW12-04. Chloride concentration in the surface water was much lower at 9.88 mg/L. All chloride concentrations are within the levels allowed under the CCME guidelines for freshwater aquatic life.

Sulphate

Sulphate concentration is elevated in MW-12-04 and MW12-01, with values of 1,770 mg/L and 354 mg/L, respectively. It is lower in MW12-03 at 178 mg/L, and at even lower concentration in the surface water sample at 4.54 mg/L. Sulphate concentrations at MW12-04 exceeded the maximum allowable concentration set by the Yukon CSR aquatic life standards of 1,000 mg/L.

Metals

No significant metals contamination was encountered and no concentrations of dissolved metals exceeded the Yukon CSR for freshwater aquatic life standards. The laboratory analysis of total metals concentrations for well MW12-04 indicated elevated selenium concentrations; however, because the sample was not filtered, the results likely represents colloidal material that was not representative of the groundwater system. Most dissolved metals concentrations were highest in WL-MW12-01, lower in WL-MW12-03, and lowest in the surface water sample.

Hydrocarbons

Detectable levels of petroleum hydrocarbons, primarily LEPHw, were found WL-MW12-04. Since these are rarely found to be naturally occurring, it suggests that landfill leachate may be a potential source of these elevated hydrocarbon levels. Levels of the same analytes were below detectable limits in WL-MW12-03 and the surface water sample. LEPHw in WL-MW12-04 was 2.33 mg/L, exceeding the Yukon CSR standards for freshwater aquatic life of 0.5 mg/L. Trace levels of trichloromethane (1.3 ug/L) and xylenes (0.7 ug/L) were also detected at MW12-04.

5.2 Interpretation of Groundwater Chemistry

Four factors that may affect natural groundwater quality include:

- The source and chemical composition of recharge water;
- The lithological and hydrological properties of the geologic unit;
- The various chemical processes occurring within the geologic unit; and
- The amount of time the water has remained in contact with the geologic unit (residence time).

These factors may affect the type and quantities of dissolved constituents in ground water. The ionic composition of water can be used to classify the water into ionic types based on the dominant dissolved cation and anion, expressed in milliequivalents per litre (meq/L). These can be compared for different water samples using various types of plots.

The ionic compositions of samples from the Site were compared to discern different water types by plotting the meq/L concentrations of the samples on three types of diagrams: a Schoeller plot (Figure 7), a Piper diagram (Figure 8) and a Stiff diagram (Figure 9).

- Schoeller: The Schoeller semi-logarithmic diagram (Figure 7) shows total concentrations of the cations and anions and may be used to identify different water types. The water samples from the wells are similar; however, WL-MW12-01 appears to have slightly higher concentrations for most anions and cations. This suggests that this water may have had a longer residence time than the sample from WL-MW12-03, or that there is a difference in the lithology and/or permeability, or that the sample is impacted by a surficial source (*e.g.,* landfill leachate). The surface water sample appears to be significantly different than the two water samples and is typical of surface rather than groundwater.
- Piper: The Piper diagram (Figure 8) also illustrates that the well sample chemistry is distinct from the surface water chemistry. The groundwater would be classified as calcium-sulphate type and the surface water would be classified as calcium-bicarbonate type water.
- Stiff: A visual inspection of the Stiff diagram also indicates a significant difference between the surface water sample and the groundwater samples. Water chemistry for well WL-MW12-01, located in the northern portion of the facility, has a relatively low HCO_3 proportion and high chloride compared with the other groundwater sample (WL-MW12-03) located at the eastern side of the facility. Low HCO_3 groundwater may be indicative of a mixture of rainwater and groundwater, whereas high chloride may be indicative of impact from a surficial source.

In addition to the above, a trend of elevated parameters consistent with landfill leachate can be discerned in WL-MW12-01 and WL-MW12-04. These include elevated chloride, sulphate, metals, ammonia, and petroleum hydrocarbons. This suggests that the subsurface is influenced by contamination from the landfill.

Relatively lower concentrations of parameters analyzed at WL-MW12-03 indicate that this well may not be influenced by leachate and may, therefore, serve as a background well. The surface water sample appears unaffected by leachate.

6.0 CONCLUSIONS

The following conclusions are presented on the findings of the hydrogeological assessment of the Watson Lake facility:

- Site Description: The Site access is located at kilometre 1,022 of the Alaska Highway, approximately 1.5 km west of the Town of Watson Lake. The Facility is a Municipal Facility that is operated by the Town of Watson Lake. The Facility was opened in the late 1960s or early 1970s and is currently in use. No evidence of chemical or fuel storage, above or below ground tanks, spills or discharges or hazardous materials storage was observed during the reconnaissance.
- Topography: The cleared area at the Facility is generally flat, with the surrounding area characterized as very gently sloped (0-5%) or undulating hillock and hollows with multidirectional slopes (less than 25 percent) characteristic of kame and kettle topography. The Facility is located at a topographic high at an elevation of approximately 715 m above mean sea level (amsl); a melt water channel is located along the northwest corner draining run off to the north towards an unnamed pond and Watson Lake (elevation 680 m amsl). The regional topography slopes south towards the Liard River (elevation approximately 600 m amsl).
- Hydrogeology:
  - A search of the Natural Resources Canada, Groundwater Information Network identified three groundwater wells within 1,500 metres of the Site. Each well was installed at a surface elevation of 701.95 m, with water levels recorded at depths 9.14 m and 11.58 m below ground surface.
  - Sub-surface conditions were investigated with four monitoring wells (WL-MW12-01, WL-MW12-02, WL-MW12-03 and WL-MW12-04) which were installed from May 13 to 24, 2012 under the supervision of Golder Associates to establish a monitoring well network at the Facility.
  - The Site stratigraphy consists of up to 25 m of sandy silt, silty sand and gravel and/or clayey silt, underlain by a steeply sloping rock outcrop found along the northern edge of the Site. Bedrock is identified as a Tertiary or Quaternary basalt flow of the Selkirk Volcanics formation. This formation was found to be approximately 3 m to 8 m thick throughout the Site and overlies unconsolidated sediments. Layers of gravel, silty sand, sand and silt were encountered below the basalt to a depth of 60 m where bedrock was encountered.
  - Saturated media was encountered under confining conditions at various elevations across the Site. At three of the four well locations confined saturated condition were encountered below a basalt unit. The hydraulic conductivity of the fractured basalt and the underlying formation may be on the order of 2×10-6 to 7×10-4 m/sec. At the fourth well location (WL-MW12-02) confined saturated conditions were encountered within the regional bedrock unit.
  - Due to the complex hydrogeological conditions encountered, groundwater flow direction at the Site could not be determined from the installed wells. WL-MW12-01, WL-MW12-03, and WL-MW12-04 may be screened in different saturated units, and at significantly different depths due to the presence of basalt upper confining unit.
  - The peizometric surface measured in the four wells varied from 685 to 706 m amsl.

  - Regional groundwater flow can be inferred from the topography to be towards the Liard River approximately 4 km to the south of the Facility. Local groundwater flow direction may be inferred from the topography at the Site, and relative groundwater elevations, to be towards a wetland in the glacial melt-water channel adjoining the Facility to the north and west.

- Groundwater Chemistry:
  - Groundwater sampling of the newly installed monitoring wells and surface water sampling from a seep in a wetland to the north of the Site was conducted May 30, 2012.
  - WL-MW12-01 and WL-MW12-03 contained elevated TDS, chloride, sulphate, ammonia, and petroleum hydrocarbons, which are all consistent with the effect of leachate contamination.
  - Of the petroleum hydrocarbons:
    - WL-MW12-04 had levels of LEPHw (Light Extractable Petroleum Hydrocarbons) in excess of the Yukon Contaminated Sites Regulation Standard for freshwater aquatic life.
  - All other parameters were within acceptable levels at all sampling locations.
  - Results of samples taken from WL-MW12-03 and the surface water sample taken from the adjacent wetland met Yukon CSR aquatic life standard and had lower levels of all of these constituents, and did not show evidence of hydrocarbons, indicating less or little impact from leachate.
  - Sulphate exceeded freshwater aquatic life standards at WL-MW12-04.

7.0 RECOMMENDATIONS

The following recommendations are made based on the results of the hydrogeological assessment presented in this report:

- As required by the Solid Waste Permit for the facility, future groundwater monitoring should be conducted in the spring and late summer.
- Monitoring well location and elevations should be surveyed by a professional land surveyor. Elevation and position of top of PVC pipe and ground elevation should be surveyed.
- The potential impact that landfill leachate may be having on groundwater quality at the facility should be revaluated following two rounds of groundwater monitoring.
- WL-MW12-04 should be overdeveloped to attempt to remove excess sediment in the well.
- The source and significance of the detectable levels of petroleum hydrocarbons, primarily LEPHw that was found in WL-MW12-04, should be re-evaluated following the two rounds of groundwater sampling. There is the possibility that the detected petroleum hydrocarbons are associated with the method used to drill the wells, and therefore may not have been representative of actual groundwater conditions.
- The sulphate exceedance in MW-12-04 should be evaluated further following the two rounds of additional groundwater sampling.

8.0 CLOSURE

We trust that this draft report is adequate for your current needs. Should you have any questions or require any additional information please contact the undersigned at your convenience.

GOLDER ASSOCIATES LTD.

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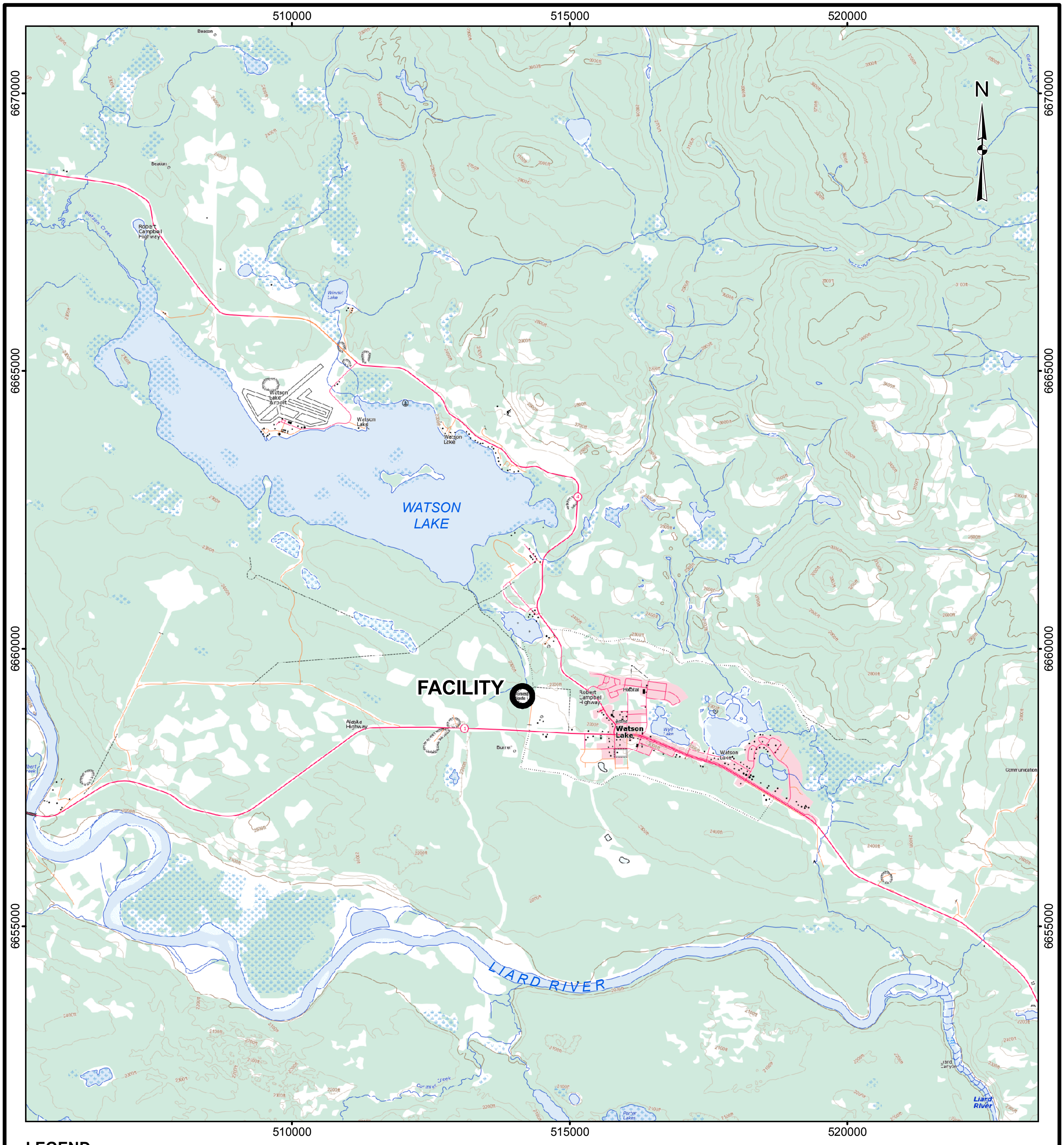

LEGEND

▭ FACILITY

2 0 2

SCALE 1:100,000 KILOMETRES

PROJECT

WATSON LAKE SOLID WASTE FACILITY HYDROGEOLOGICAL ASSESSMENT
GOVERNMENT OF YUKON, DEPARTMENT OF COMMUNITY SERVICES
WATSON LAKE, YUKON

TITLE

KEY PLAN

Golder Associates
Greater Vancouver Office, B.C.

PROJECT No.	11-1436-0073		PHASE No. 1400	
DESIGN	CB	06 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	JW	06 Jul. 2012	FIGURE: 1	
CHECK				
REVIEW				

REFERENCE

BASEDATA OBTAINED FROM GEOGRATIS (NATURAL RESOURCES CANADA).
DATUM: NAD83 PROJECTION: UTM ZONE 9

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LEGEND

⌖ MONITORING WELL

▨ WETLAND

50 0 50

SCALE (APPROX.) METRES

REFERENCE

IMAGE OBTAINED FROM GOOGLE EARTH, USED UNDER LICENSE.
IMAGERY DATE: JUNE 7, 2007. GOOGLE EARTH IMAGE IS NOT TO SCALE.
DATUM: NAD83 PROJECTION: UTM ZONE 9

PROJECT

WATSON LAKE SOLID WASTE FACILITY HYDROGEOLOGICAL ASSESSMENT
GOVERNMENT OF YUKON, DEPARTMENT OF COMMUNITY SERVICES
WATSON LAKE, YUKON

TITLE

SITE PLAN

Golder Associates
Greater Vancouver Office, B.C.

PROJECT No.	11-1436-0073		PHASE No. 1400	
DESIGN	CB	06 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	JW	06 Jul. 2012	**FIGURE: 2**	
CHECK				
REVIEW				

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Figure 3 – Regional Geology

PROJECT BACKGROUND

This map was produced as part of a biophysical mapping pilot study carried out in the Watson Lake (NTS 105A/2) area in 2004. Biophysical mapping (also known as ecological land classification) is an integrated system of mapping describing terrain conditions (surficial geology, slope, landscape position, drainage and permafrost conditions) as well as ecological values (vegetation community and structure, and soil moisture and nutrient regimes). At a local (1:50 000) scale, biophysical maps are an essential tool for facilitating stewardship and sustainable development of energy, mineral and land resources.

This map accompanies the report "Local scale biophysical mapping for integrated resource management, Watson Lake area (NTS 105A/2), Yukon" (Lipovsky and McKenna, 2005). Please refer to this report for more detailed background, methodology and descriptions of map units; GIS data is also included with the report on CD-ROM.

GLACIAL HISTORY

The Watson Lake map area has been glaciated at least six times since the Quaternary period (the last 2 million years; Jackson et. al, 1991). Aside from scattered section localities, evidence of the older glacial episodes are completely masked by deposits from the latest glaciation, which is known as the McConnell Glaciation. During this late Wisconsinan McConnell Glaciation, the Liard Lobe of the Cordilleran ice sheet flowed in an easterly direction out of the Cassiar Mountains and in a southeasterly direction out of the Pelly and Selwyn mountains, following the Tintina Trench/Liard Lowland.

At Tom Creek, just northwest of the map area, twig fragments in a silt unit underlying the McConnell till were found to be as young as 23 900 ± 1140 BP by radiocarbon dating (Klassen, 1987), implying that the onset of glaciation in the Watson Lake area occurred some time after that. The timing of deglaciation likely occurred after 10 700 years ago, according to radiocarbon dating on Marcella Lake cores in southwestern Yukon (Anderson et al., 2002). At the height of the McConnell Glaciation, ice in the Liard Lowland would have overtopped the highest uplands suggesting a minimum ice thickness of at least 500 m.

Northeast of the Liard River floodplain, a thick, gently undulating and rolling till plain is extensively streamlined with drumlins, flutings and grooves that provide clear indications of southeasterly to easterly ice flow directions. Till blankets and veneers are found on the slopes further to the northeast, while the higher ridge tops have been scoured to bedrock.

Prior to glacial retreat, damming of meltwater by the ice sheet produced extensive glacial lakes in the Liard valley floor. Fine-grained glaciolacustrine deposits underlying glaciofluvial outwash are exposed along the banks of the Liard River immediately south of the town of Watson Lake and just upstream of the mouth of Watson Creek.

As the ice sheet down-wasted and retreated to the northwest, vast amounts of meltwater deposited outwash plains of sand and gravel up to 30 m thick along the valley floor currently occupied by the Liard River. Extensive ice stagnation during deglaciation left behind blocks of ice that became buried by the outwash. The buried ice blocks have subsequently melted out leaving steep sided depressions and the distinctive pitted, hummocky terrain around Upper Liard, Lucky Lake and the town of Watson Lake. The meltwater also carved deep meltwater channels through bedrock in various locations north and northeast of town.

KEY TO INTERPRETING SURFICIAL GEOLOGY MAP LABELS

Surficial geology polygons are labeled with a composite group of letters, which are arranged so that each letter position represents a particular characteristic of the terrain, including some or all of the following: texture, type of surficial material, surface expression, geomorphologic process, and activity state qualifiers. There may also be one or several surfical geology units incorporated in a polygon label. All labelling conventions are based on the British Columbia terrain classification system (Howes and Kenk, 1997).

In the sample label below, the characteristic that each letter represents is identified by the upper case type directly below each letter. For further details on each characteristic, refer to the appropriate sections of the legend.

This label indicates that the polygon is dominantly covered by muddy (m) sandy (s) pebbly (p) active (A) floodplain (FAp) with lesser amounts of flat-lying (p) and terraced (t) silty clay (zc) glaciolacustrine (LG) deposits, all of which is modified by thermokarst (e) permafrost (X) processes, gullying (V) and beaver damming (Q), and is underlain by gently dipping (j) phyllite (ph) bedrock (R).

mspFAp / zcLGpt-XeVQ \ phRj

tertiary TEXTURE 1
secondary TEXTURE 1
primary TEXTURE 1
SURFICIAL MATERIAL 1
QUALIFIER (activity) 1
SURFACE EXPRESSION 1
DELIMITER
secondary TEXTURE 2
primary TEXTURE 2
SURFICIAL MATERIAL 2
QUALIFIER (glacial) 2
primary SURFACE EXPRESSION 2
secondary SURFACE EXPRESSION 2
primary GEOMORPHOLOGICAL PROCESS
primary geomorphological PROCESS SUBCLASS
secondary GEOMORPHOLOGICAL PROCESS
tertiary GEOMORPHOLOGICAL PROCESS
STRATIGRAPHIC SYMBOL
BEDROCK SUBCLASS
underlying SURFICIAL MATERIAL 3
SURFACE EXPRESSION 3

QUALIFIERS

Qualifier symbols are used to indicate a glacial mode of surficial material formation, or the activity status of a surficial material or geomorphological process. Qualifier symbols are denoted by an upper case superscript that follows the surficial material symbol or the geomorphological process symbol. Up to two qualifiers may be used together.

SYMBOL	NAME	DESCRIPTION
G	glacial	used where there is direct evidence that glacier ice has controlled deposition
A	active	used where there is evidence that a surficial material is undergoing formation at the present time, or where a geomorphological process is occurring at present, unless activity is already inferred in the definition of surficial material or process
I	inactive	used where there is no evidence that a surficial material is undergoing formation at the present time, or where a geomorphological process is occurring at present, unless inactivity is already inferred in the definition of surficial material or process

DELIMITERS

Where multiple surficial materials are impossible to separate at map scale, up to three surficial materials can be listed, along with their textures and surface expressions, in order of decreasing importance. Each surficial material is separated by one of the following three delimiters:

SYMBOL	DESCRIPTION
.	components on either side of the symbol are of approximately equal proportion
/	the component in front of the symbol is more extensive than the one that follows
//	the component in front of the symbol is considerably more extensive than the one that follows

STRATIGRAPHIC SYMBOLS ("\" and "/")

Where one surficial material overlies another, the surficial materials are separated by a backward slash (\) symbol.

Where the overlying material is discontinous, but moderately extensive, a forward slash is included at the beginning of that unit (e.g., /sEv\gFt).

TEXTURE

Texture refers to the size, shape (roundness) and sorting of particles in clastic sediments, and the proportion and degree of decomposition of plant fibre in organic sediments. Texture is indicated by up to three lower case letters that are listed before the surficial material designator in order of increasing importance. The use of two or three textural terms together indicates that either the various textures are intermixed or they are interstratified. Generalized textures are assigned based on representative field checking, but users should be aware that these textures can somewhat vary both laterally and vertically within a polygon.

SYMBOL	NAME	SIZE (mm)	DESCRIPTION
a	blocks	> 256	angular
b	boulders	>256	rounded
c	clay	<0.002	
d	mixed fragments	>2	rounded and angular
e	fibric	fibric	poorly decomposed organic material
g	gravel	>2	rounded, mixture of two or more size ranges
h	humic		organic material, advanced decomposition
k	cobbles	64 - 256	rounded
m	mud	<0.0625	mixture of silt and clay
p	pebbles	2-64	rounded
r	rubble	2-256	angular
s	sand	0.0625 - 2	
u	mesic		organic material, intermediate decomposition
x	angular fragments	>2	mixture of angular blocks and rubble
y	shells		consists of shells and/or shell fragments
z	silt	0.002 - 0.0625	

BEDROCK SUBCLASSES

When describing bedrock, a subclass precedes the surficial material descriptor (R), instead of using a textural term as above. Bedrock subclasses used on this map include:

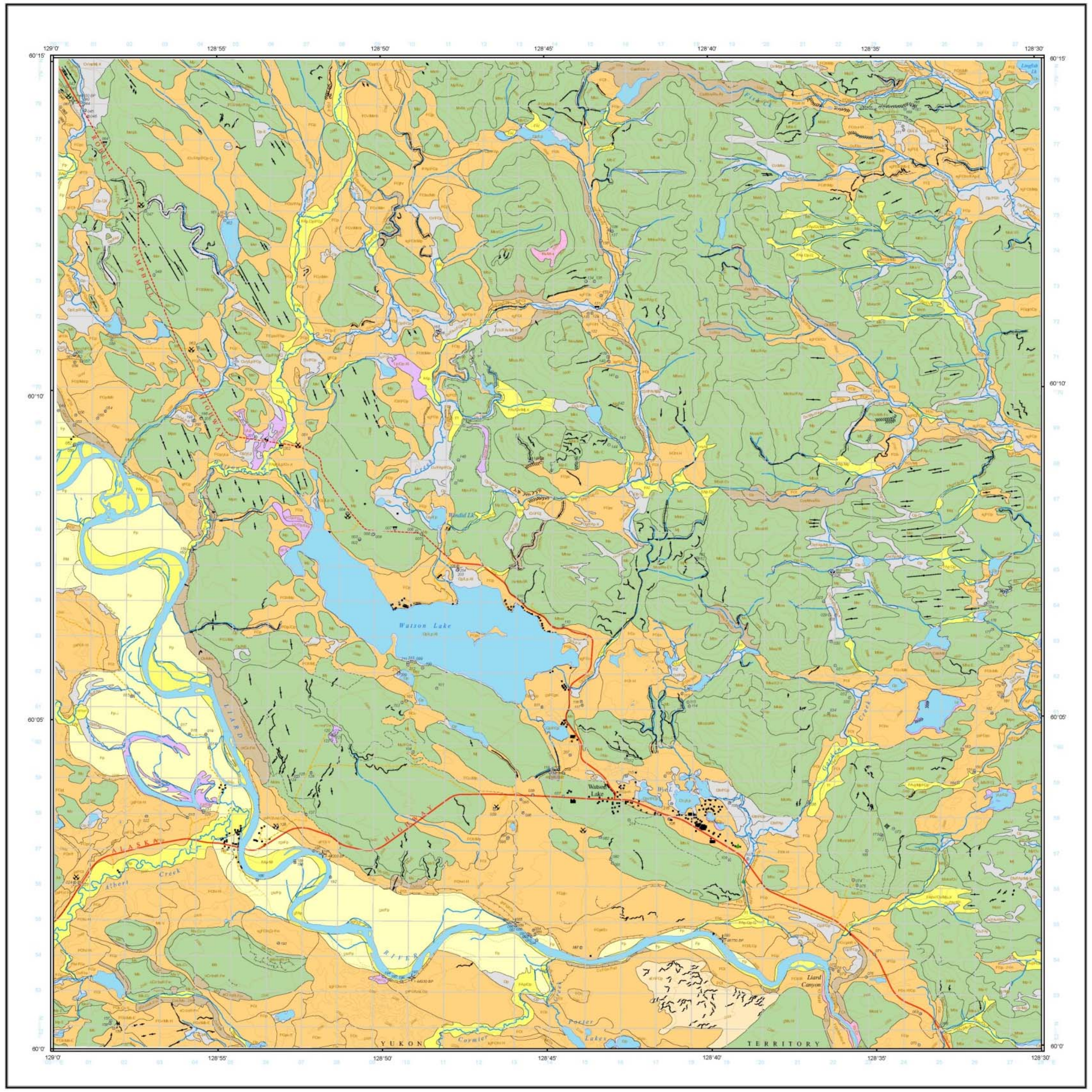
LABEL	NAME
bs	basalt
ph	phyllite
ss	sandstone

Canada

Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada
Knowledge & Innovation Fund

Yukon Geological Survey

Yukon Energy, Mines and Resources



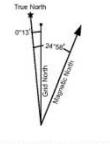
1:50 000-scale topographic base data
produced by
CENTRE FOR TOPOGRAPHIC INFORMATION
NATURAL RESOURCES CANADA

ONE THOUSAND METRE GRID
Universal Transverse Mercator Projection
North American Datum 1983
Zone 9

CONTOUR INTERVAL 100 FEET
elevations in feet above mean sea level

SURFICIAL GEOLOGY
WATSON LAKE
YUKON

SCALE 1:50 000



Use diagram to obtain numerical values
APPROXIMATE MEAN DECLINATION 2005
FOR CENTRE OF MAP: 24° 58' E
Annual change decreasing 18.4'

105A/6 MIDDLE CANYON	105A/7 TOM LAKE	105A/8 SUNRISE CREEK
105A/3 DODO LAKES	105A/2 **THIS MAP**	105A/1 BLIND LAKE
104P/14 OLD FADDY LAKE	104P/15 LUTZ CREEK	104P/16 LOWER POST

SURFICIAL MATERIALS

Surficial materials are non-lithified, unconsolidated sediments. They are produced by weathering, sediment deposition, biological accumulation, human and volcanic activity. In general, surficial materials are of relatively young geological age and they constitute the parent material of most (pedological) soils. On the map, surficial materials form the core of the polygon label. They are symbolized with a single upper case letter, with texture written to the left, and surface expression to the right. If actual activity state is different than the assumed activity state (indicated in brackets next to the surficial material name below), a qualifier A (active) or I (inactive) must be used as a superscript following the surficial material designator. Note that a single polygon will be coloured only by the dominant surficial material, but other materials may exist in that unit.

A	Anthropogenic (A): surficial materials so modified by human activities that their original physical properties (e.g., structure, cohesion, compaction) have been drastically altered. These materials commonly have a wide range of textures. They are typically formed by the removal of material from an original site followed by redeposition elsewhere. Includes landfills and tailings.
C	Colluvium(A): materials that have reached their present positions as a result of direct, gravity-induced mass movement involving no agent of transportation such as water or ice, although the moving material may have contained water and/or ice. Generally consists of massive to moderately well stratified, non-sorted to poorly sorted sediments with any range of particle sizes from clay to boulders and blocks. Includes landslide debris, talus slopes and weathered mantles of till or bedrock.
E	Eolian (I): materials transported and deposited by wind action. Generally consists of medium to fine sand and coarse silt that is well sorted, non-compacted, and may contain internal structures such as cross-bedding or ripple laminae, or may be massive. A thin veneer of silty loess (zEvw) between 5 and 30 cm thick is widespread throughout the map area over till and glaciofluvial deposits, especially in hollows and depressions. Inactive sand dune fields (sEr) are found immediately north and south of the Liard River, just east of Porter Lakes.
F F^A	Fluvial (I): materials transported and deposited by streams and rivers. Deposits generally consist of gravel and/or sand and/or silt (and rarely, clay). Gravel is typically rounded and contains interstitial sand. Fluvial sediments are commonly moderately to well sorted and display stratification. Includes floodplain, delta, fluvial terrace and fan deposits.
F^G	Glaciofluvial (I): materials that exhibit clear evidence of having been deposited by glacial meltwater streams either directly in front of, or in contact with, glacier ice. Materials typically range from non-sorted and non-bedded gravel made up of a wide range of particle sizes, to moderately to well sorted, stratified gravel; flow tills may occur in some deposits. Hummocky or irregular terrain may be present and is indicative of collapse of the material due to melting of supporting ice. Kettles may occur on the surface of these deposits as a result of buried or partially buried ice melting out. Includes pitted outwash plains, kames and eskers.
M	Till (I): morainal material deposited directly by glacier ice without modification by any other agent of transportation. Morainal material can be transported beneath, beside, on, within and in front of a glacier. The physical characteristics of till deposits are highly variable and depend upon both the source of material incorporated by the glacier and the mode of deposition. In general, till consists of well compacted to non-compacted material that is non-stratified and contains a heterogeneous mixture of particle sizes, commonly in a matrix of sand, silt and clay.
L	Lacustrine (I): sediments that have settled in bodies of standing fresh water either from suspension or from underwater gravity flows, such as turbidity currents. Lacustrine sediments can also accumulate along lake margins through the action of waves. Sediments commonly consist of stratified fine sand, silt and/or clay deposited on the lake bed from suspension, or moderately to well sorted, stratified sand and coarser materials that are beach and other littoral sediments transported and deposited by wave action.
L^G	Glaciolacustrine (I): lacustrine materials deposited in or along the margins of glacial (ice-dammed) lakes, including sediments that were released by the melting of floating ice. Glaciolacustrine sediments include lake bed sediments consisting of stratified fine sand, silt and/or clay; they commonly contain ice-rafted stones and lenses of till and/or glaciofluvial material. Slump structures and/or their topographic expression, such as hummocky or irregular terrain, may be present and are indicative of collapse of the material due to melting of supporting ice. Kettles may occur on the surface of lake bed sediments as a result of the melting of buried or partially buried ice. A second type of glaciolacustrine deposite occurs as moderately sorted to well sorted, stratified sand and coarser beach sediments transported and deposited by wave action along the margins of glacial lakes.
O	Organic (A): sediments composed largely of organic materials resulting from the accumulation of vegetative matter; they contain at least 30% organic matter by weight (17% or more organic carbon). Organic materials are commonly saturated with water and consist mainly of the accumulated remains of mosses, sedges, or other hydrophytic vegetation in wetland settings.
R	Bedrock: Areas with bedrock outcrops, which may or may not be covered by a thin mantle (< 10 cm) of unconsolidated till, colluvium or organic materials.

SURFACE EXPRESSION

Surface expression refers to the form (assemblage of slopes) and pattern of forms expressed by a surficial material at the land surface. This three-dimensional shape of the material is equivalent to 'landform' used in a non-genetic sense (e.g., ridges, plain). Surface expression symbols also describe the manner in which unconsolidated surficial materials relate to the underlying substrate (e.g., veneer). Surface expression is indicated by up to three lower case letters, placed immediately following the surficial material designator, listed in order of decreasing extent.

a - Moderate slope: unidirectional (planar) surface; 16-26° (27-50%) slope; longitudinal profile smooth and straight, or slightly concave/convex; relief of local surface irregularities generally <1 m.

b - Blanket: a layer of unconsolidated material thick enough (>1 m) to mask minor irregularities of the surface of the underlying material, but still conforms to the general underlying topography; outcrops of the underlying unit are rare.

c - Cone: a cone or sector of a cone, mostly steeper than 15° (26%); longitudinal profile is smooth and straight, or slightly concave/convex; typically applied to talus cones.

d - Depression: circular or irregular area of lower elevation (hollow) than the surrounding terrain, >2 m deep, delimited by an abrupt break in slope steeper than the surrounding terrain; commonly applied to kettle holes and pitted outwash plains in glaciofluvial materials.

f - Fan: sector of a cone with a slope gradient less than 15° (26%) from apex to toe; longtitudinal profile is smooth and straight, or slightly concave/convex.

h - Hummock: steep sided hillock(s) and hollow(s) with multidirectional slopes dominantly between 15-35° (26-70%) if composed of unconsolidated materials, whereas bedrock slopes may be steeper; local relief >1 m; in plan, an assemblage of non-linear, generally chaotic forms that are rounded or irregular in cross-profile; commonly applied to knob-and-kettle glaciofluvial terrain.

j - Gentle slope: unidirectional (planar) surface; 4-15° (7-26%) slope; longitudinal profile smooth and straight, or slightly concave/convex; relief of local surface irregularities generally <1 m.

k - Moderately steep slope: unidirectional (planar) surface; 27-35° (50-70%) slope; longitudinal profile smooth and straight, or slightly concave/convex; relief of local surface irregularities generally <1 m.

m - Rolling: elongate hillock(s); slopes dominantly between 3-15° (5-26%); local relief >1 m; in plan, an assemblage of parallel or sub-parallel linear forms with subdued relief (commonly applied to bedrock ridges and fluted or streamlined till plains).

p - Plain: a level or very gently sloping, unidirectional (planar) surface with slopes 0-3° (0-5%); relief of local surface irregularities generally <1 m; applied to (glacio)fluvial floodplains, organic deposits, lacustrine deposits and till plains.

r - Ridge: elongate hillock(s) with slopes dominantly 15-35° (26-70%) if composed of unconsolidated materials, bedrock slopes may be steeper; local relief is >1 m; in plan, an assemblage of parallel or sub-parallel linear forms; commonly applied to drumlinized till plains, eskers, morainal ridges, crevasse fillings and ridged bedrock.

s - Steep slope: unidirectional (planar) surface; >35° (70%) slope; longitudinal profile smooth and straight, or slightly concave/convex; relief of local surface irregularities generally <1 m; bedrock slopes may be more irregular; commonly applied to terrace scarps, gully side walls and bedrock cliffs.

t - Terrace: a single or assemblage of step-like forms where each step-like form consists of a scarp face and a horizontal or gently inclined surface above it; applied to fluvial and lacustrine terraces and stepped bedrock topography.

u - Undulating: gently sloping hillock(s) and hollow(s) with multidirectional slopes up to 15° (26%); local relief >1 m; in plan, an assemblage of non-linear, generally chaotic forms that are rounded or irregular in cross-profile; commonly applied to till plains, sand dunes and kame topography.

v - Veneer: a layer of unconsolidated materials too thin to mask the minor irregularities of the surface of the underlying material; 10 cm - 1m in thick; commonly applied to eolian/loess veneers and colluvial veneers.

w - Mantle of variable thickness: a layer or discontinuous layer of surficial material of variable thickness (0-3 m) that fills or partly fills depressions in an irregular substrate.

x - Thin veneer: a very thin layer of unconsolidated material, 2-20 cm thick.

SYMBOL LEGEND

building
campground
airstrip
seaplane base
tank
tower
lake
stream
topographical contour
trail
highway, paved
main road, loose surface
secondary road (paved, loose surface)
street (paved, loose surface)

field observation site
observation of frozen ground
C14 radiocarbon dated wood sample
stratigraphic section site
gravel pit
kettle hole
landslide headwall and track
sand dunes
streamlined landform (drumlins, flutings, grooves)
terrain boundary (defined, approximate)
meltwater channel
scarp
esker
tension crack

GEOMORPHOLOGICAL PROCESSES

Geomorphological processes are natural mechanisms of weathering, erosion and deposition that result in the modification of the surficial materials and landforms at the earth's surface. Unless a qualifier (A (active) or I (inactive)) is used, all processes are assumed to be active, except for deglacial processes. Process is indicated by up to three upper case letters, listed in order of decreasing importance, placed after the surface expression symbol, and separated from the surface expression by a dash (-).

Subclasses can be used to provide more specific information about a general geomorophological process, and are represented by lower case letter(s) placed after the related process designator. Up to three subclasses can be attached to each process. Process subclasses used on this map are defined with the related process below.

EROSIONAL PROCESSES

V - Gully erosion: running water, mass movement and/or snow avalanching, resulting in the formation of parallel and sub-parallel long, narrow ravines.

FLUVIAL PROCESSES

I - Irregularly sinuous channel: a clearly defined main channel displaying irregular turns and bends without repetition of similar features; backchannels may be common, and minor side channels and a few bars and islands may be present, but regular and irregular meanders are absent.

J - Anastomosing channel: a channel zone where channels diverge and converge around many islands. The islands are vegetated and have surfaces that are relatively far above mean maximum discharge levels. Some channels are dry at moderate or low flows.

M - Meandering channel: a clearly defined channel characterized by a regular and repeated pattern of bends with relatively uniform amplitude and wave length.

Q - Beaver damming: interruption of regular fluvial transport by beaver dams leading to widespread and repeated ponding.

MASS MOVEMENT PROCESSES

F - Slow mass movements: slow downslope movement of masses of cohesive or non-cohesive surficial material and/or bedrock by creeping, flowing or sliding.

Subclasses: (k) tension cracks - fissures commonly near the crest of a slope; (u) slump: sliding of internally cohesive mass of surficial material along a slip plane that is concave upward or planar.

R - Rapid mass movements: rapid downslope movement by falling, rolling, sliding or flowing of dry, moist or saturated debris derived from surficial material and/or bedrock.

Subclasses: (") initiation zone - headscarps of debris slides or earthflows and source areas for rockfall and debris flows; (d) debris flow - rapid flow of saturated debris; (m, u) slump - sliding of internally cohesive masses of bedrock (m) or surficial material (u) along a slip plane that is concave upward or planar; (r) rockslide - sliding mass of disintegrating bedrock; (s) debris slide - sliding mass of disintegrating surficial material.

PERIGLACIAL PROCESSES

C - Cryoturbation: movement of surficial materials by heaving and/or churning due to frost action (repeated freezing and thawing).

X - Permafrost processes: processes controlled by the presence of permafrost, and permafrost aggradation or degradation.

Subclasses (e) - thermokarst: depressions created by melting of ice-rich permafrost due to heat transfer from water bodies; (t) - surface depressions created by the thaw of ice-rich permafrost and resulting soil subsidence.

DEGLACIAL PROCESSES

E - Channeled by meltwater: erosion and channel formation by meltwater alongside, beneath, or in front of a glacier.

H - Kettled: depressions in surficial materials resulting from the melting of buried glacier ice.

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RECOMMENDED CITATION

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Digital cartography and drafting by P.S. Lipovsky using ArcGIS 9.0. Mapping based on hard-copy and soft-copy (using MicroStation Diap Viewer) air photo interpretation using 1:40 000-scale 1998/1999 photos. Field checking was performed in summer 2004.

Any revisions or additional geological information known to the user would be welcomed by the Yukon Geological Survey.

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A digital PDF (Portable Document File) file of this map may be downloaded free of charge from the Yukon Geological Survey website: http://www.geology.gov.yk.ca.

Yukon Geological Survey
Energy, Mines and Resources
Government of Yukon

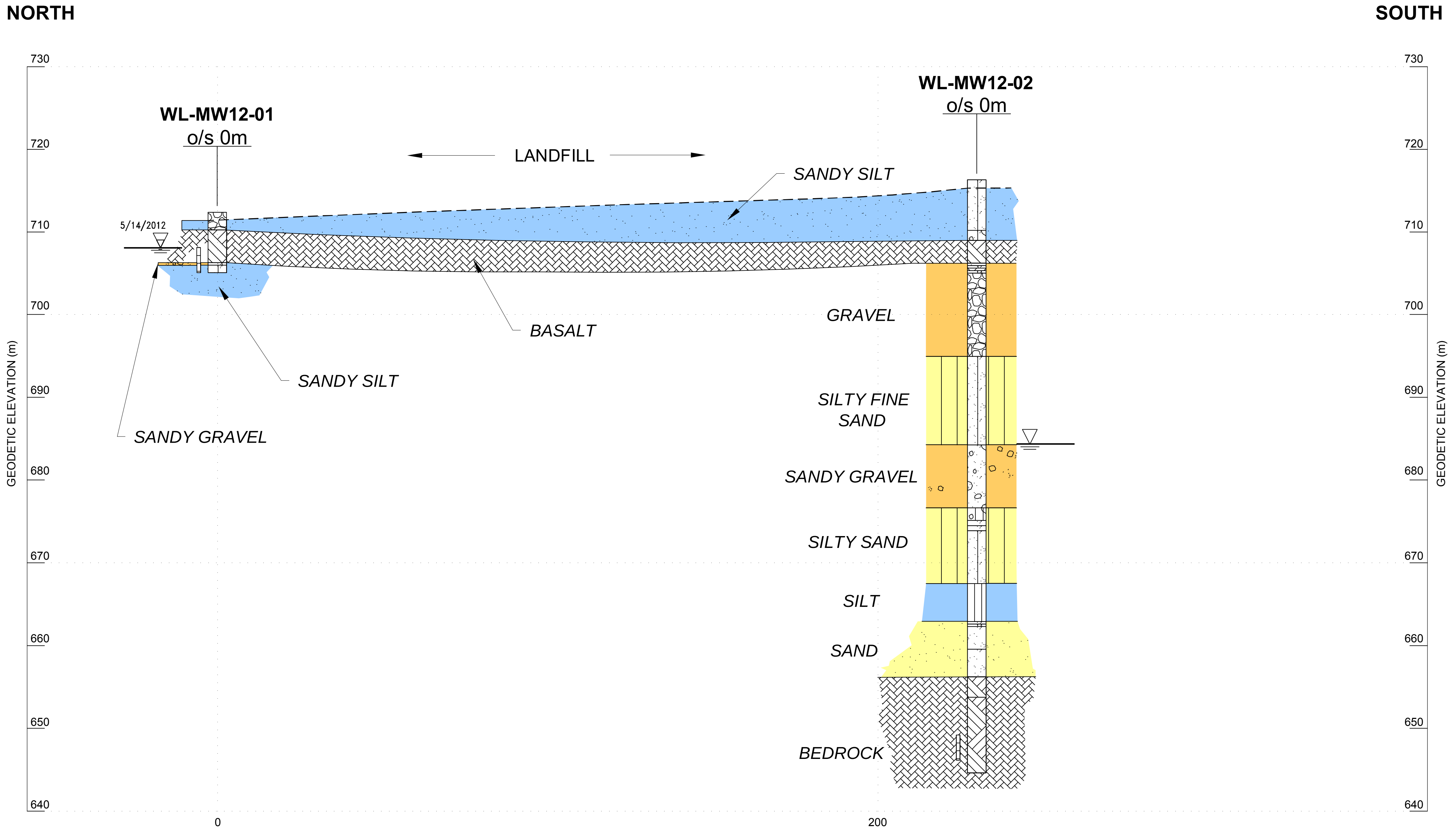
Open File 2005-7

Surficial Geology of Watson Lake Area (NTS 105A/2), Yukon (1:50 000 scale)

by

P.S. Lipovsky[1], K. McKenna[2], and C.A. Huscroft[1]

[1] Yukon Geological Survey
[2] Cryogeographic Consulting



LEGEND

– – – –	APPROXIMATE GROUND SURFACE ELEVATION	⁙	SAND
▽	POTENTIOMETRIC SURFACE	⁙	SANDY SILT
┃	SCREEN INTERVAL	▨	BEDROCK (BASALT)
		◌	GRAVEL
		▥	SILT

0 15 30 45 60 75

SCALE IN METRES

VERTICAL EXAGGERATION X 2.5

PROJECT

GOVERNMENT OF YUKON, DEPARTMENT OF COMMUNITY SERVICES
WATSON LAKE WASTE FACILITY HYDROGEOLOGICAL ASSESSMENT
WATSON LAKE, YUKON

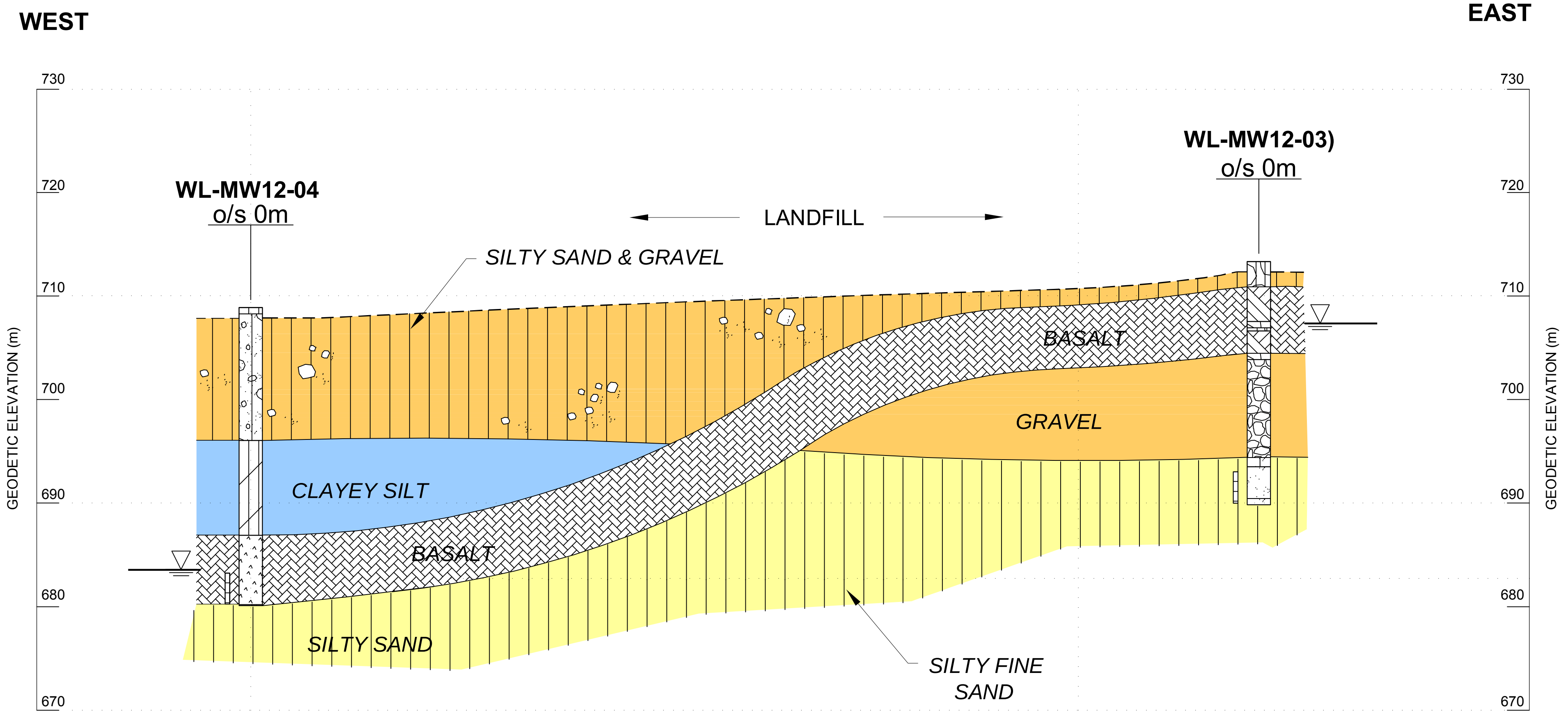
TITLE

HYDROGEOLOGICAL CROSS-SECTION 1

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 12–1436–0073			PHASE No.	1400
DESIGN	CB	05JUL12	SCALE AS SHOWN	REV. –
CADD	TS	11JUL12	FIGURE 4A	
CHECK				
REVIEW				

Drawing File: N:\Bur-Graphics\Projects\2011\1436\11-1436-0073\Drafting\Phase 1400\1436-0073-1400-01.dwg Wednesday, July 11, 2012 3:34:04 PM By: tsemina



LEGEND

– – – –	APPROXIMATE GROUND SURFACE ELEVATION
▽	POTENTIOMETRIC SURFACE
▯	SCREEN INTERVAL
▨	SAND
▨	SANDY SILT
▨	BEDROCK (BASALT)
▨	GRAVEL
▥	SILT

0 15 30 45 60 75

SCALE IN METRES

VERTICAL EXAGGERATION X 2.5

PROJECT
GOVERNMENT OF YUKON, DEPARTMENT OF COMMUNITY SERVICES
WATSON LAKE WASTE FACILITY HYDROGEOLOGICAL ASSESSMENT
WATSON LAKE, YUKON

TITLE

HYDROGEOLOGICAL CROSS-SECTION 2

Golder Associates
Greater Vancouver Office, BC

PROJECT No. 12-1436-0073			PHASE No.	1400
DESIGN	CB	05JUL12	SCALE AS SHOWN	REV. –
CADD	TS	11JUL12		
CHECK				
REVIEW				

FIGURE 4B

Drawing File: N:\Bur-Graphics\Projects\2011\1436\11-1436-0073\Drafting\Phase 1400\1436-0073-1400-01.dwg Wednesday, July 11, 2012 3:34:04 PM By: tsemina

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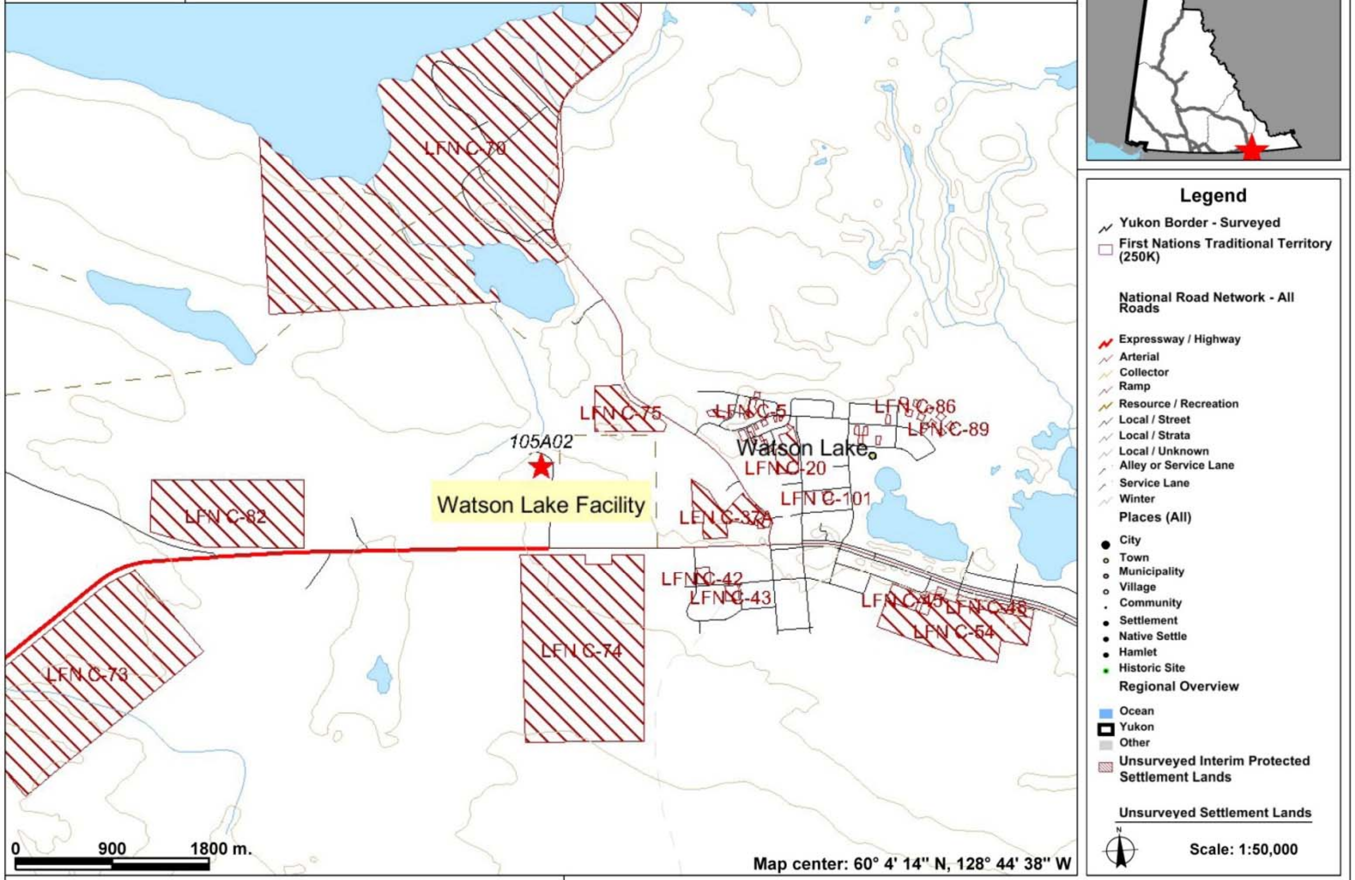
Regional Drainageand Land Zoning



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PROJECT
GOVERNMENT OF YUKON, DEPT OF COMMUNITY SERVICES
SOLID WASTE DISPOSAL FACILITY HYDROGEOLOGICAL ASSESSMENT
WATSON LAKE, YUKON

TITLE

REGIONAL DRAINAGE AND LAND ZONING

Golder Associates

PROJECT No.		----	FILE No. ----	
DESIGN	SYD	08AUG12	SCALE NTS	REV.
CADD	--	01JAN04	**FIGURE 5**	
CHECK	--	01JAN04		
REVIEW				

LEGEND

▼	GROUND WATER ELEVATION (MEASURED ON MAY 30, 2012)
⌖	MONITORING WELL
▨	WETLAND

50 0 50

SCALE (APPROX.) METRES

REFERENCE

IMAGE OBTAINED FROM GOOGLE EARTH, USED UNDER LICENSE.
IMAGERY DATE: JUNE 7, 2007. GOOGLE EARTH IMAGE IS NOT TO SCALE.
DATUM: NAD83 PROJECTION: UTM ZONE 9

PROJECT
WATSON LAKE SOLID WASTE FACILITY HYDROGEOLOGICAL ASSESSMENT
GOVERNMENT OF YUKON, DEPARTMENT OF COMMUNITY SERVICES
WATSON LAKE, YUKON

TITLE

PIEZOMETRIC SURFACE

Golder Associates
Greater Vancouver Office, B.C.

PROJECT No.	11-1436-0073		PHASE No. 1400	
DESIGN	CB	06 Jul. 2012	SCALE AS SHOWN	REV. 0
GIS	JW	06 Jul. 2012	**FIGURE: 6**	
CHECK				
REVIEW				

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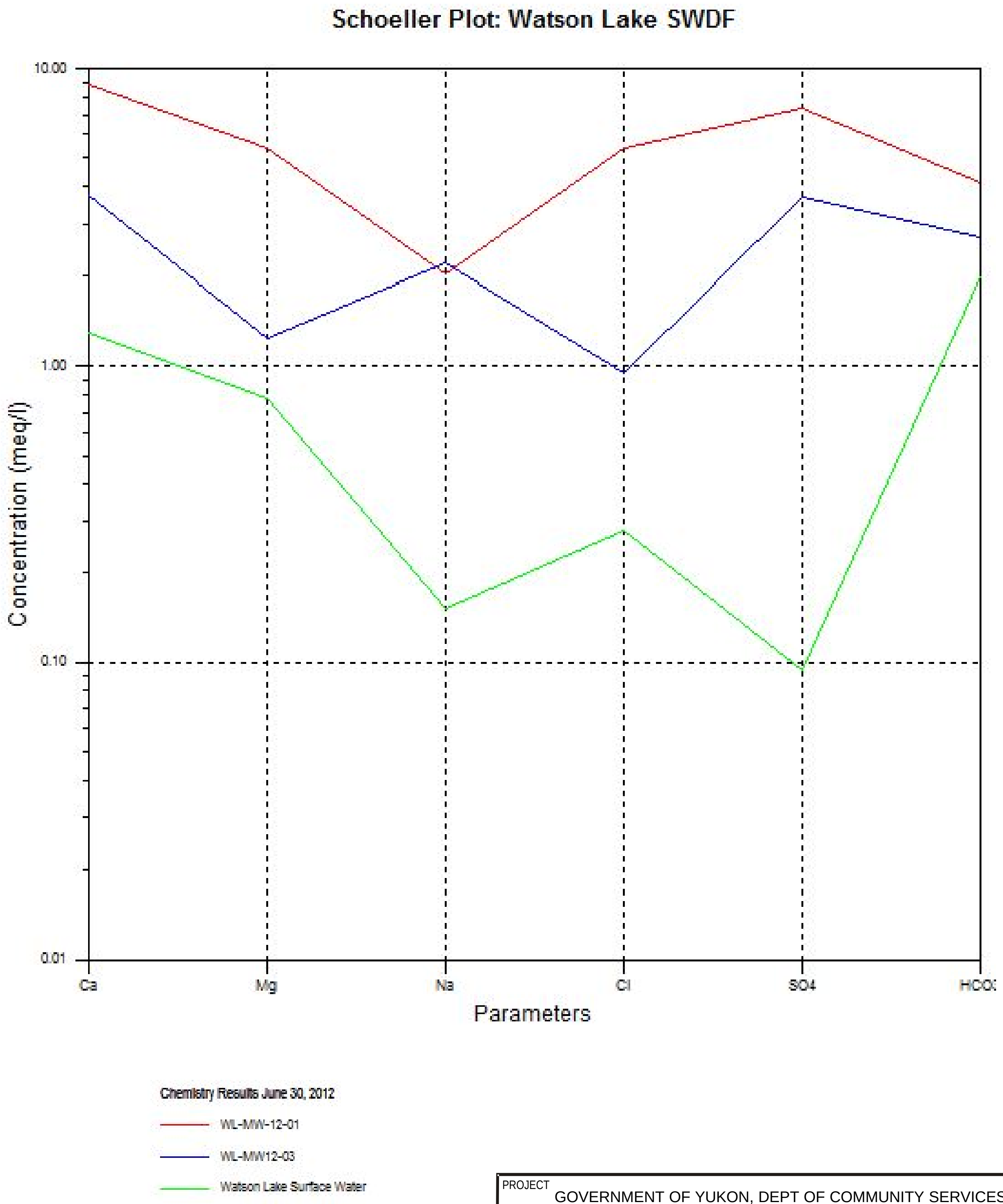

PROJECT
GOVERNMENT OF YUKON, DEPT OF COMMUNITY SERVICES
SOLID WASTE DISPOSAL FACILITY HYDROGEOLOGICAL ASSESSMENT
WATSON LAKE, YUKON

TITLE

SCHOELLER PLOT

Golder Associates

PROJECT No.	06-1412-115		FILE No.	----
DESIGN	SYD	07AUG12	SCALE NTS	REV.
CADD				
CHECK			**FIGURE 7**	
REVIEW				

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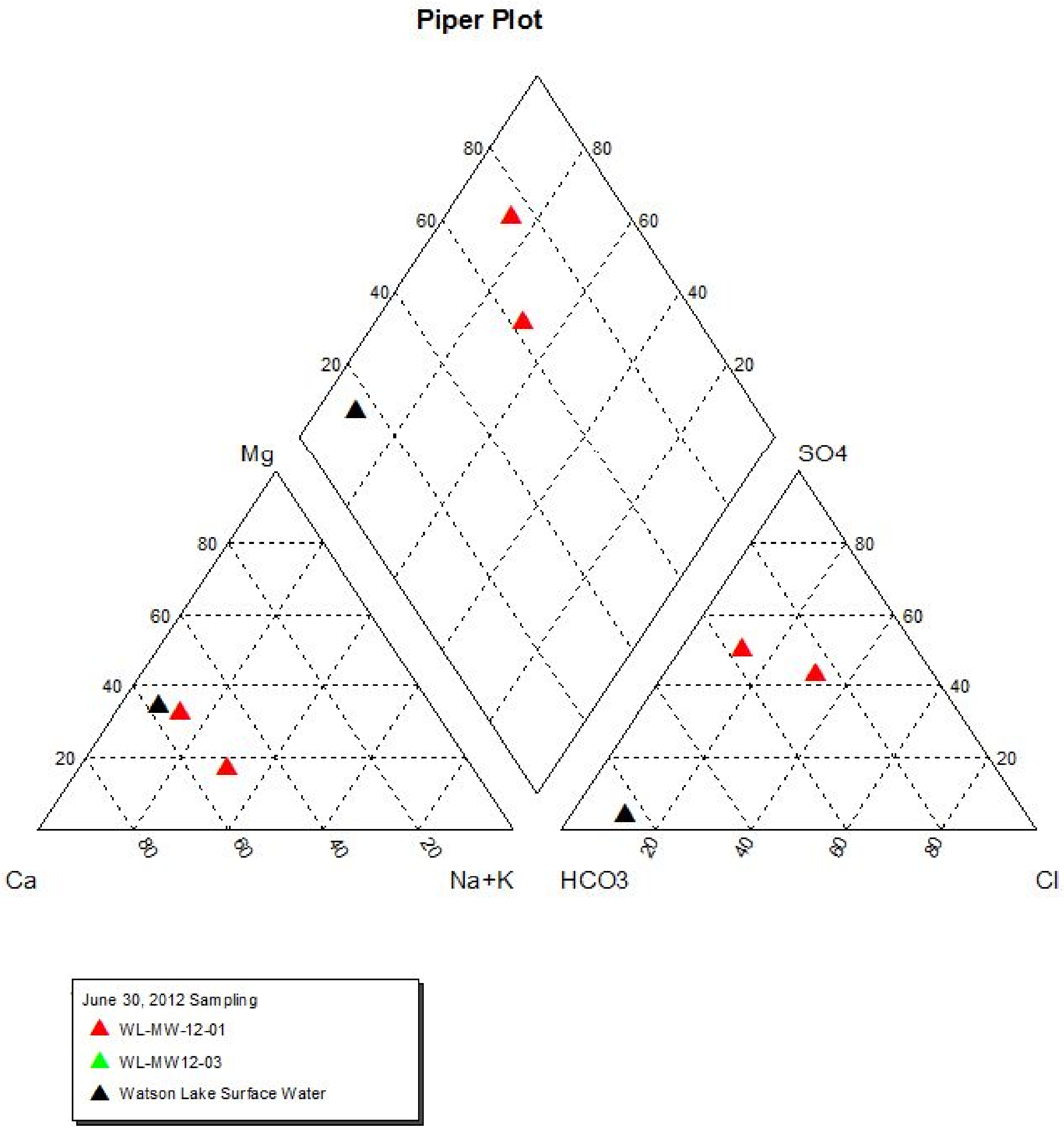

PROJECT
GOVERNMENT OF YUKON, DEPT OF COMMUNITY SERVICES
SOLID WASTE DISPOSAL FACILITY HYDROGEOLOGICAL ASSESSMENT
WATSON LAKE, YUKON

TITLE

PIPER PLOT

Golder Associates

PROJECT No.	06-1412-115		FILE No.	----
DESIGN	SYD	07AUG12	SCALE NTS	REV.
CADD			**FIGURE 8**	
CHECK				
REVIEW				

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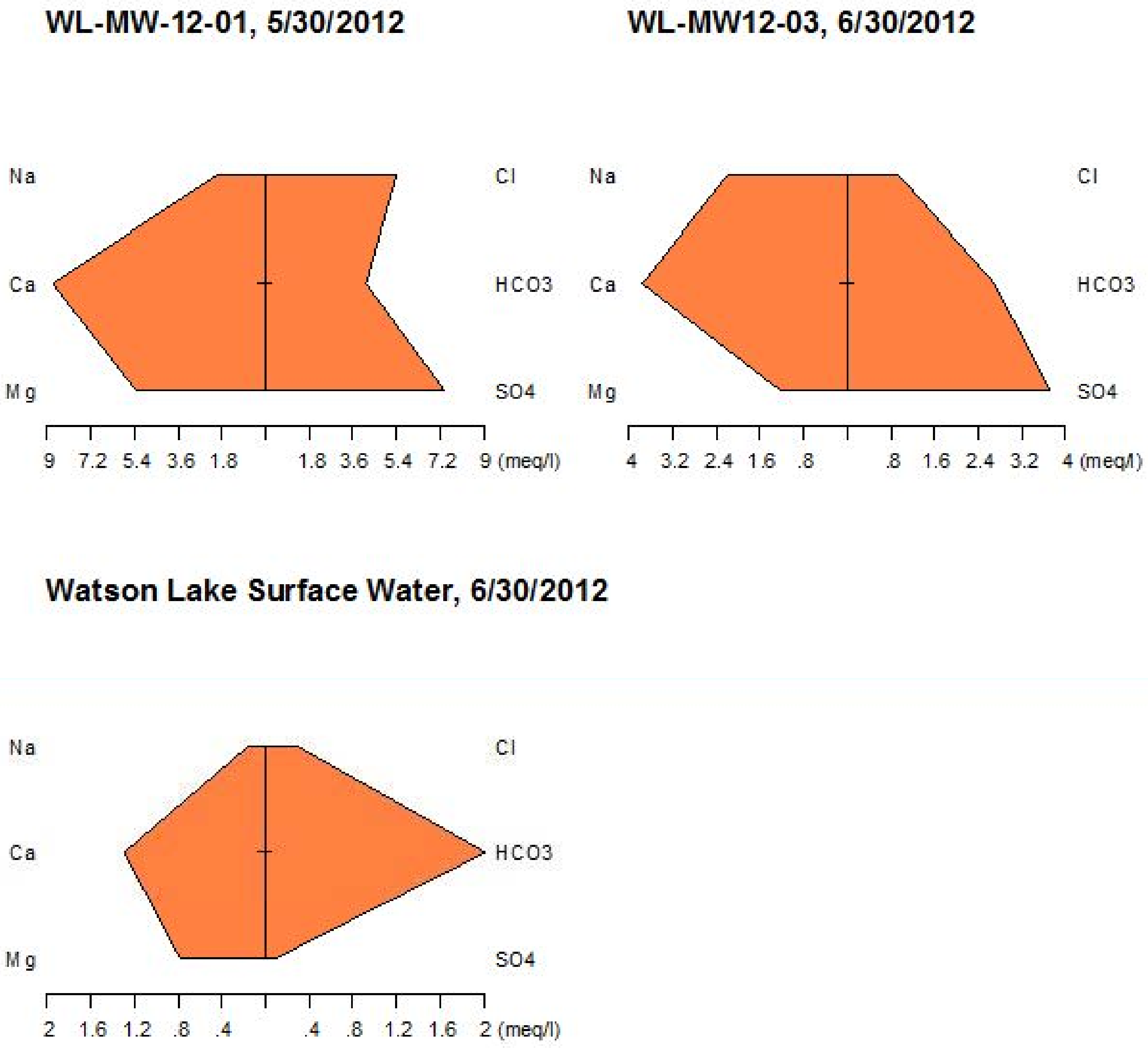

PROJECT
GOVERNMENT OF YUKON, DEPT OF COMMUNITY SERVICES
SOLID WASTE DISPOSAL FACILITY HYDROGEOLOGICAL ASSESSMENT
WATSON LAKE, YUKON

TITLE

STIFF DIAGRAMS

Golder Associates

PROJECT No.	06-1412-115		FILE No.	----	
DESIGN	SYD	07AUG12	SCALE	NTS	REV.
CADD			**FIGURE 9**		
CHECK					
REVIEW					

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APPENDIX A

Site Photographs

Photograph 1: The west edge of the landfill containing metals and automotive waste.

Photograph 2: Outcrop of the Selkirk Volcanics Basalt formation at the north edge of the Site.

Photograph 3: The wetland seen in this photo located to the north of the Site is part of a wetland complex that stretches between the Site and Watson Lake.

APPENDIX B

Well Construction Logs

PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-01

SHEET 1 OF 1
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659207.3 E: ~514205.49 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 13, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 PID ppm □ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		Ground Surface											
0	M5 Driltech Air Rotary	(SM) SILTY SAND, some gravel, brown, slight cohesion, moist.		0.00									
1 2 3 4 5 6		ROCK, black, crystaline, aphanitic.		0.76									
7		(CL) SANDY CLAY, dark brown, moist.		6.71									
		(GM-SM) SAND and GRAVEL, some clay, brown, wet.		7.01									
		(GM) GRAVEL, some sand, trace silt, trace clay, brown, moist.		7.32									
8 9 10		End of Borehole.		7.62									

DEPTH SCALE
1 : 50

LOGGED: CB
CHECKED: **DRAFT**

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-02 (WL-MW12-01)

SHEET 1 OF 1
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659202.45 E: ~514146.47 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 13, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

BORING METHOD: M5 Driltech, Air Rotary

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0	Ground Surface	
0	(GM) GRAVEL, some sand, trace silt, brown, moist.	0.00
	ROCK, black, crystaline, aphanitic.	2.13
	(GW) sandy GRAVEL, trace silt, brown, wet.	6.10
	(ML) SANDY SILT, gre-brown, wet, very soft.	6.40
	End of Borehole.	7.32

SAMPLES: NUMBER | TYPE | BLOWS/0.3m | CORE No. | CORE RECOVERY %

PID ppm ⊕ 5 10 15 20

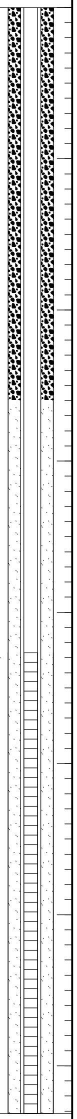
PID ppm ☐ 50 100 150 200

WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

Stick-up = 0.71m



DEPTH SCALE
1 : 50

Golder Associates

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CHECKED: **DRAFT**

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 1 OF 8
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

BORING METHOD: M5 Driltech Air Rotary

DEPTH SCALE METRES	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0	Ground Surface	
0	(ML) sandy SILT, some gravel, orange to light brown, moist. - from 0m - 2.44m depth: (FILL) - from 2.44m - 6.10m depth: (Native)	0.00
6.10	(SM-GM) silty SAND and GRAVEL, dark brown, moist.	6.10
7.32	ROCK, dark grey, crystaline.	7.32

SAMPLES: NUMBER | TYPE | BLOWS/0.3m | CORE No. | CORE RECOVERY %

PID ppm ⊕ 5 10 15 20

PID ppm □ 50 100 150 200

WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION: Hydrated Bentonite Chip Seal (0 – 10 m)

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DEPTH SCALE
1 : 50

Golder Associates

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 2 OF 8
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm ☐ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10	M5 Driltech Air Rotary	(CL) sandy CLAY, some silt, trace gravel, blue-grey to dark brown, soft, wet.	10.06									Hydrated Bentonite Chip Seal
		(SL-GM) clayey SAND and GRAVEL, trace silt, dark brown, wet.	10.36									
		ROCK, dark grey, crystaline.	10.67									
11		(SM-GM) silty SAND and GRAVEL, subrounded, light brown, moist.	10.97									
		(GM) GRAVEL, some sand, trace silt, light brown, moist.	11.28									
12												
13												
14												
15												
16												
17												
18												
19												
20												

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DEPTH SCALE
1 : 50

Golder Associates

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 3 OF 8
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm □ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20	M5 Driltech Air Rotary	(GM) GRAVEL, some sand, trace silt, light brown, moist. *(continued)*											
21													
		(ML) silty fine SAND, orange, moist.		21.34									
22													
23													
24													
		- clay lense at 24.38m depth.											
25													Hydrated Bentonite Chip Seal
26													
27													
		- trace gravel and colour change at ~27.4m depth.											
28													
		- increased moisture and orange-brown at ~28.7m depth.											
29													
30													

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DEPTH SCALE
1 : 50

Golder Associates

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 4 OF 8
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm □ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
30	M5 Driltech Air Rotary	(ML) silty fine SAND, orange, moist. *(continued)*										
31												
32		(GM) sandy GRAVEL, some silt, orange to dark brown, moist.	32.00									
33												
34												
35												Hydrated Bentonite Chip Seal
36												
37												
38												
39												
		(ML) gravelly SILT, some sand, dark brown, moist.	39.62									
40												

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DEPTH SCALE
1 : 50

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 5 OF 8

DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake

N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North

Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012

DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
40	M5 Driltech Air Rotary	(ML) gravelly SILT, some sand, dark brown, moist. *(continued)*		Hydrated Bentonite Chip Seal
41		(SM) SAND, some silt and gravel, dark grey, moist.	41.15	
		(SM) SAND, some silt and gravel, trace clay, some cohesion, moist.	41.76	
42		(ML) sandy SILT, trace gravel, dark grey, moist.	42.37	
43				
44				
45				
		- yellow brown at 45.72m depth.		
46				
47				
		- slightly drier, yellow-orange at 47.53m depth.		
48				
		(ML) SILT, some sand and gravel, yellow-orange, moist.	48.77	
49				
50				

SAMPLES: NUMBER, TYPE, BLOWS/0.3m, CORE No., CORE RECOVERY %

PID ppm ⊕ 5 10 15 20

PID ppm □ 50 100 150 200

WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

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DEPTH SCALE

1 : 50

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 6 OF 8
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
50		(ML) SILT, some sand and gravel, yellow-orange, moist. *(continued)*		
51				
52		- light brown at 51.82m depth.		
53				
		(SM) SAND, some silt, trace gravel, orange-yellow, moist.	53.34	
		(SM-GM) silty SAND and GRAVEL, subrounded, some clay, brown, moist.	53.64	
54		(SM) SAND, some silt, some fine rounded gravel, yellow-orange, moist.	53.95	
55	M5 Driltech Air Rotary			Hydrated Bentonite Chip Seal
56				
		(SM) SAND, some silt, some fine rounded gravel, olive-grey, moist.	56.69	
57				
58		- light brown at 57.91m depth.		
59		- trace clay, dry at 59.13m depth.		
60				

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DEPTH SCALE
1 : 50

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PROJECT No.: 11-1436-0073 (1400)

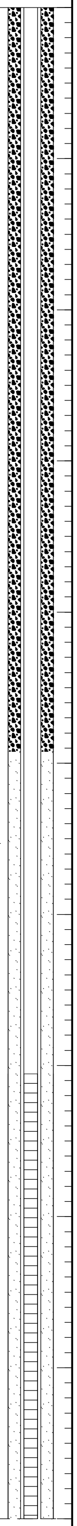
RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 7 OF 8
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm □ 50 100 150 200	WATER CONTENT PERCENT Wp ├──○W──┤ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
60	M5 Driltech Air Rotary	Weathered ROCK.		60.05									Hydrated Bentonite Chip Seal
61													
62		Competent ROCK.		62.48									
63													
64													
65													05/15/2012 WL-BH12-03 ▽
66													10/20 Silica Sand
67													
68													Slotted PVC Pipe
69													
70		*CONTINUED NEXT PAGE*											



DEPTH SCALE
1 : 50

Golder Associates

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-03 (WL-MW12-02)

SHEET 8 OF 8

DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake

N: ~6658974.77 E: ~514149.05 Zone: UTM 9 North

Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 14, 2012

DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	SAMPLES: CORE No.	SAMPLES: CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm ☐ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
70 71	M5 Driltech Air Rotary	Competent ROCK. *(continued)*	▨										
72 73 74 75 76 77 78 79 80		End of Borehole.		71.63									

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CB

CHECKED: **DRAFT**

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-04

SHEET 1 OF 3
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659138.5 E: ~513997.48 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 16, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	ELEV. DEPTH (m)
0	M5 Driltech Air Rotary	Ground Surface	
		(SM) SILTY SAND, some gravel, with boulders and cobbles, brown, moist.	0.00
2		(GM) sandy GRAVEL, trace to some silt, light brown, moist.	1.83
3		(GM) GRAVEL, some clay, trace sand, trace silt, moist.	3.35
5		(GM) GRAVEL, some silt, trace sand, wet.	4.88
9		(SM) gravelly SAND, some silt, light brown, moist.	9.14
10			

Column headings: SAMPLES: NUMBER, TYPE, BLOWS/0.3m, CORE No., CORE RECOVERY %; PID ppm ⊕ 5 10 15 20; PID ppm ☐ 50 100 150 200; WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40; ADDITIONAL LAB. TESTING; PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION

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DEPTH SCALE
1 : 50

LOGGED: CB
CHECKED: **DRAFT**

PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-04

SHEET 2 OF 3
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659138.5 E: ~513997.48 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 16, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm □ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10	M5 Driltech Air Rotary	(SM) gravelly SAND, some silt, light brown, moist. *(continued)*										
11		- trace silt at 10.97m depth.										
12		(SM) SILTY SAND, some gravel, moist.	12.19									
13												
14												
15												
16												
17												
18												
19												
20												

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DEPTH SCALE
1 : 50

Golder Associates

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-04

SHEET 3 OF 3
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659138.5 E: ~513997.48 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 16, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm □ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20	M5 Driltech Air Rotary	(SM) SILTY SAND, some gravel, moist. *(continued)*										
22		ROCK, dark grey, crystaline, aphanitic.	21.95									
24		(GW) sandy GRAVEL, dark grey, moist.	24.08									
		(GM) SILTY GRAVEL, some sand, grey-brown, wet.	24.69									
26		ROCK, dark grey, crystaline, aphanitic.	25.91									
28		(GM) SILTY GRAVEL, some sand, grey-brown, wet.	28.04									
29		End of Borehole.	28.96									

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: CB
CHECKED: **DRAFT**

PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-05 (WL-MW12-03)

SHEET 1 OF 3

DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake

N: ~6659104.8 E: ~514236.58 Zone: UTM 9 North

Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 16, 2012

DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. DEPTH (m)	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		Ground Surface		Stick-up = 0.76m
0	M5 Driltech Air Rotary	(GM) SILTY GRAVEL, some sand, light brown, moist.	0.00	Hydrated Bentonite Chip Seal
2.44		ROCK, dark grey, crystaline, basalt flow.	2.44	
5.79		(GC) CLAYEY GRAVEL, grey-brown, moist.	5.79	
6.40		(ML) gravelly SILT, trace sand, grey, moist.	6.40	
6.71		ROCK, dark grey, crystaline, basalt flow.	6.71	
8.84		(GC) CLAYEY GRAVEL, trace sand and silt, light brown, wet.	8.84	
9.45		(GW) GRAVEL, trace sand and silt, light brown, moist.	9.45	
10		*CONTINUED NEXT PAGE*		

SAMPLES: NUMBER | TYPE | BLOWS/0.3m | CORE No. | CORE RECOVERY %

PID ppm ⊕ 5 10 15 20

PID ppm □ 50 100 150 200

WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40

ADDITIONAL LAB. TESTING

DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CB

CHECKED: DRAFT

PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-05 (WL-MW12-03)

SHEET 2 OF 3

DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake

N: ~6659104.8 E: ~514236.58 Zone: UTM 9 North

Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 16, 2012

DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm ☐ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10	M5 Driltech Air Rotary	(GW) GRAVEL, trace sand and silt, light brown, moist. *(continued)*											
14		- sandy GRAVEL at 14.02m depth.											
15													Hydrated Bentonite Chip Seal
19		(SM) silty SAND, trace gravel, light brown to orange, moist.		18.90									
		- some gravel at 19.51m depth.											
20				19.80									10/20 Silica

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DEPTH SCALE

1 : 50

Golder Associates

LOGGED: CB

CHECKED: **DRAFT**

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PROJECT No.: 11-1436-0073 (1400)

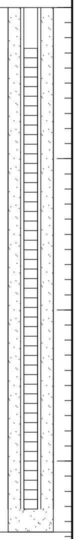
RECORD OF BOREHOLE: WL-BH12-05 (WL-MW12-03)

SHEET 3 OF 3
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659104.8 E: ~514236.58 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 16, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/0.3m	SAMPLES CORE No.	SAMPLES CORE RECOVERY %	PID ppm ⊕ (5, 10, 15, 20) / PID ppm ☐ (50, 100, 150, 200)	WATER CONTENT PERCENT Wp ⊢ ○W ⊣ Wl (10, 20, 30, 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20	M5 Driltech Air Rotary	(SW) SAND, some gravel, orange-brown, grades from moist to wet. *(continued)*											Sand
21													
22													Slotted PVC Pipe
23		(SW) medium SAND, trace fine sand, some gravel, orange-brown, wet.		22.86									
		End of Borehole.		23.47									
24													
25													
26													
27													
28													
29													
30													



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DEPTH SCALE
1 : 50

LOGGED: CB
CHECKED: **DRAFT**

PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-06 (WL-MW12-04)

SHEET 1 OF 3

LOCATION: Yukon Landfills, Watson Lake
N: ~6659148 E: ~513998 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 24, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DATUM: Ground Surface

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm ☐ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		Ground Surface											
0	M5 Driltech Air Rotary	(CI/ML) CLAYEY SILT to SILTY CLAY, brown, cohesive, moist.		0.00									Grout
		(SM/GW) fine to medium SILTY SAND and GRAVEL, fine to coarse, subangular, brown, dry.		0.61									
1													
		- from 1.52m - 2.44m depth: boulder, grey.											
2													
		- from 2.44m - 12.80m depth: grading to moist.											
3													
4													
5													
6													
7													
8													
9													
10													

CONTINUED NEXT PAGE

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KM
CHECKED: **DRAFT**

PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-06 (WL-MW12-04)

SHEET 2 OF 3
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659148 E: ~513998 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 24, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm □ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10	M5 Driltech Air Rotary	(SM/GW) fine to medium SILTY SAND and GRAVEL, fine to coarse, subangular, brown, dry. *(continued)*											Grout
11													
12													
13		(CL/ML) CLAYEY SILT to SILTY CLAY, trace to some fine to medium sand, some fine to coarse gravel, subangular, brown, moist.		12.80									
14													
15													
16													
17													
18													
19													
20													

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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: KM
CHECKED: **DRAFT**

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PROJECT No.: 11-1436-0073 (1400)

RECORD OF BOREHOLE: WL-BH12-06 (WL-MW12-04)

SHEET 3 OF 3
DATUM: Ground Surface

LOCATION: Yukon Landfills, Watson Lake
N: ~6659148 E: ~513998 Zone: UTM 9 North
Note: Northing and Easting Coordinates have been determined by GPS in the field and are approximate only.

DRILLING DATE: May 24, 2012
DRILLING CONTRACTOR: Midnight Sun Drilling

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES NUMBER	TYPE	BLOWS/0.3m	CORE No.	CORE RECOVERY %	PID ppm ⊕ 5 10 15 20 / PID ppm ☐ 50 100 150 200	WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20	M5 Driltech Air Rotary	(CL/ML) CLAYEY SILT to SILTY CLAY, trace to some fine to medium sand, some fine to coarse gravel, subangular, brown, moist. *(continued)*											
21													Grout
22		Dark grey BASALT. (Bedrock) - from 21.95m - 25.60m depth: solid rock.		21.95									
23													Hydrated Bentonite Chip Seal
24													
25													10/20 Silica Sand
		- from 25.60m - 28.65m depth: fractured and wet.											
26													
27													Slotted PVC Pipe
28													
		(SM) SILTY SAND, fine to medium, grey, wet.		28.65 28.75									
29		End of Borehole.											
30													

DEPTH SCALE
1 : 50

LOGGED: KM
CHECKED: **DRAFT**

✓

FIELD BOREHOLE LOG

Borehole No. WL-BH12-01

Project Name: Yukon Landfills
GPS Coordinates:
Project No.: 11-1436-0073 (1400)
Location: Watson Lake
Date: 13/5/12
Time: 10:00
Field Screening Method: —
Depth: —
to —
Boring Method: Air Rotary
Model: M5 Driltech
Contractor: Midnight Sun Drilling
Casing/Borehole Diameter: 6 5/8" / 7 1/4"
Weather: Sunny 10°c
Completed by: Calvin Beebe

DEPTH ELEV.	SOIL STRATIGRAPHY	*WELL SKETCH	DEPTH SCALE	SAMPLES Cond.	Type	No.	Recov	PID (ppm)	SAMPLE DESCRIPTION & BORING NOTES
			0'						0'-2'6" SM, silty SAND, some gravel, moist, brown, slight cohesion.
	Sm - silty SAND		1'						
			2'						
	Rock		3'						2'6" - 22' ROCK, black, crystaline, aphanitic.
			4'						
			5'						
			6'						22'-23' CL - SANDY CLAY, dark brown, moist.
			7'						
			8'						
			9'						23'-24' GM-SM, SAND and GRAVEL, some clay, brown, wet
			10'						
			11'						
			12'						24'-25' GM - GRAVEL, some sand, trace silt, trace clay, brown, moist.
			13'						
			14'						
			15'						
			16'						
			17'						Casing Refusal at 17',
			18'						
			19'						pulled casing and abandoned.
			20'						
			21'						
			22'						
	CL								
	Gm-sm		24'						
	Gm								
			26'						

SAMPLE CONDITION

☒ DISTURBED
▥ FAIR
▧ GOOD
■ LOST

SAMPLE TYPES

A.S. - Auger sample
C.S. - Chunk sample (odex)
S.S. - Split spoon
C.C. - Sonic
D.P. - Direct Push

SPECIAL NOTES:

Est. Volume of drill H_2O used: ______ L(sonic)
Depth of H_2O: ______
Drum No.: ______ Date: ______ Time: ______

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Note: this log is double-sided.

FIELD BOREHOLE LOG

Borehole No. ______________

Well ID: ________________

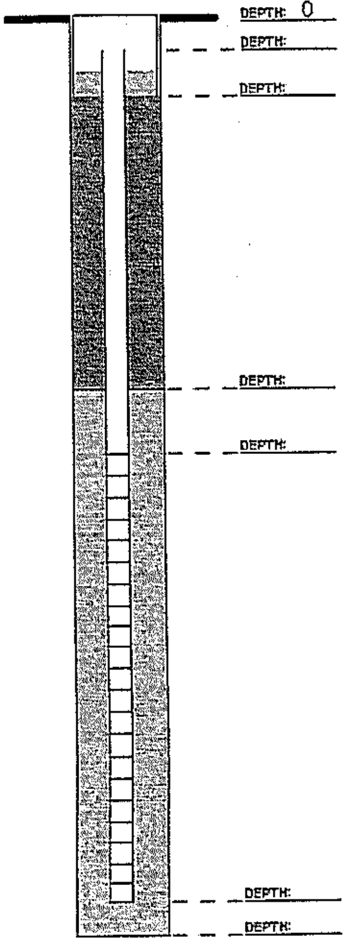
Water Level (mbtoc): ________________

Well Depth (mbtoc): ________________

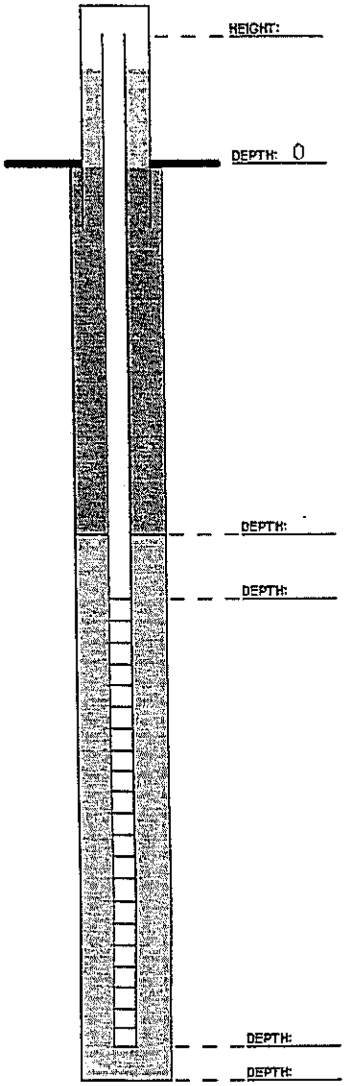
Date: ________________

Borehole Diameter: ________________

FLUSHMOUNT WELL INSTALLATION



STICK-UP WELL INSTALLATION



ft	m	ft	m
1	0.3	41	12.5
2	0.6	42	12.8
3	0.9	43	13.1
4	1.2	44	13.4
5	1.5	45	13.7
6	1.8	46	14.0
7	2.1	47	14.3
8	2.4	48	14.6
9	2.7	49	14.9
10	3.0	50	15.2
11	3.4	51	15.5
12	3.7	52	15.8
13	4.0	53	16.2
14	4.3	54	16.5
15	4.6	55	16.8
16	4.9	56	17.1
17	5.2	57	17.4
18	5.5	58	17.7
19	5.8	59	18.0
20	6.1	60	18.3
21	6.4	61	18.6
22	6.7	62	18.9
23	7.0	63	19.2
24	7.3	64	19.5
25	7.6	65	19.8
26	7.9	66	20.1
27	8.2	67	20.4
28	8.5	68	20.7
29	8.8	69	21.0
30	9.1	70	21.3
31	9.4	71	21.6
32	9.8	72	21.9
33	10.1	73	22.3
34	10.4	74	22.6
35	10.7	75	22.9
36	11.0	76	23.2
37	11.3	77	23.5
38	11.6	78	23.8
39	11.9	79	24.1
40	12.2	80	24.4

Note:
0.15 meters = 6 inches

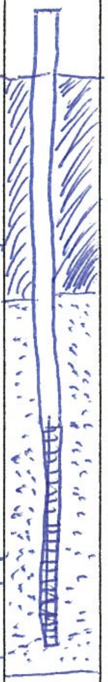
MONITORING WELL INSTALLATION GUIDELINES

▨ BENTONITE ▨ SILICA SAND

FIELD BOREHOLE LOG

Borehole No. WL - BH12-02

Project Name: Yukon Landfills
Location: Watson Lake
Field Screening Method: 10-Slot 2" PVC
Boring Method: Air Rotary
Casing/Borehole Diameter: 6 5/8" / 7 1/4"
GPS Coordinates:
Model: M5 - Driltech
Weather: Overcast 10°
Project No.: 11-1436-0073 (1400)
Date: 13/5/12
Time: 15:30
Depth: 24'
to 14'
Contractor: Midnight Sun Drilling
Completed by: Calvin Beebe

DEPTH ELEV.	SOIL STRATIGRAPHY	WELL SKETCH	DEPTH SCALE	SAMPLES					SAMPLE DESCRIPTION & BORING NOTES
				Cond.	Type	No.	Recov	PID (ppm)	
	GM - GRAVEL, some sand, trace silt, brown, moist, (ablation Fill) ROCK GW - Sandy GRAVEL ML - SANDY SILT		2 0 2 4 6 8 10 12 14 16 18 20 22 24 26						0'-7' GM - GRAVEL, some sand, trace silt, brown, moist 7'-20' ROCK, black, crystaline, aphanitic - encounterd wet return at 18' - drilled with "ODEX" hammer to 19' then pulled and reset normal casing - pushed casing ahead to 24' only bottom of hole was wet. 20'-21' GW, sandy GRAVEL, trace silt, brown, wet. 21'-24' ML - SANDY SILT, greyish brown, wet, very soft. ▽ 4.3 mbgs 10:13 14/5/12

SAMPLE CONDITION

☒	DISTURBED	▨	GOOD
▥	FAIR	■	LOST

SAMPLE TYPES

A.S. - Auger sample
C.S. - Chunk sample (odex)
S.S. - Split spoon
C.C. - Sonic
D.P. - Direct Push

SPECIAL NOTES:

Est. Volume of drill $H_2$0 used: ______ L(sonic)
Depth of $H_2$0: ______
Drum No.: ______ Date: ______ Time: ______

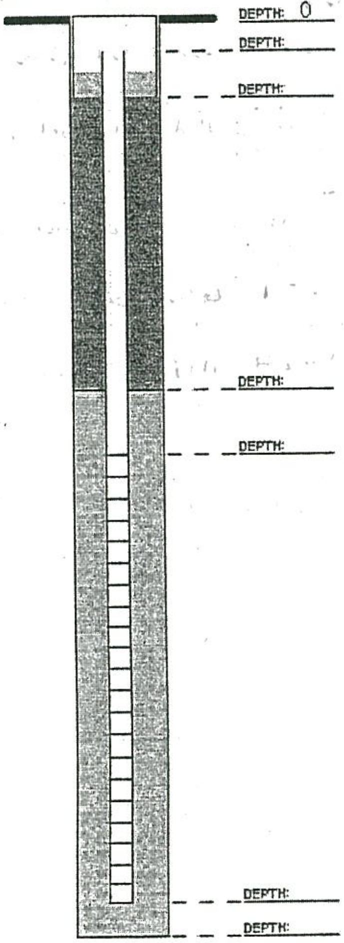
Note: this log is double-sided.

FIELD BOREHOLE LOG

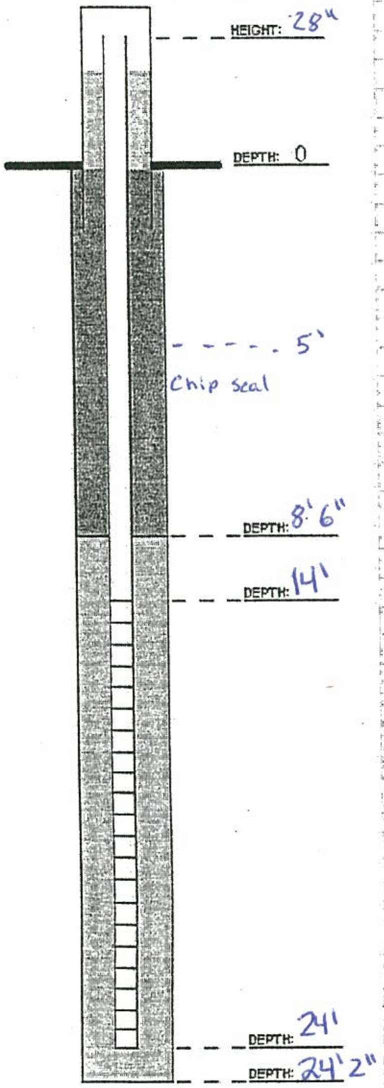
Borehole No. WL-BH12-02

Well ID: WL-MW12-01
Water Level (mbtoc): 6.22
Well Depth (mbtoc): 7.85
Date: 14/5/12
Borehole Diameter: 7¼"

FLUSHMOUNT WELL INSTALLATION


DEPTH: 0
DEPTH:
DEPTH:
DEPTH:
DEPTH:
DEPTH:
DEPTH:

STICK-UP WELL INSTALLATION


HEIGHT: 28"
DEPTH: 0
5'
Chip seal
DEPTH: 8'6"
DEPTH: 14'
DEPTH: 24'
DEPTH: 24'2"

ft	m	ft	m
1	0.3	41	12.5
2	0.6	42	12.8
3	0.9	43	13.1
4	1.2	44	13.4
5	1.5	45	13.7
6	1.8	46	14.0
7	2.1	47	14.3
8	2.4	48	14.6
9	2.7	49	14.9
10	3.0	50	15.2
11	3.4	51	15.5
12	3.7	52	15.8
13	4.0	53	16.2
14	4.3	54	16.5
15	4.6	55	16.8
16	4.9	56	17.1
17	5.2	57	17.4
18	5.5	58	17.7
19	5.8	59	18.0
20	6.1	60	18.3
21	6.4	61	18.6
22	6.7	62	18.9
23	7.0	63	19.2
24	7.3	64	19.5
25	7.6	65	19.8
26	7.9	66	20.1
27	8.2	67	20.4
28	8.5	68	20.7
29	8.8	69	21.0
30	9.1	70	21.3
31	9.4	71	21.6
32	9.8	72	21.9
33	10.1	73	22.3
34	10.4	74	22.6
35	10.7	75	22.9
36	11.0	76	23.2
37	11.3	77	23.5
38	11.6	78	23.8
39	11.9	79	24.1
40	12.2	80	24.4

Note:
0.15 meters = 6 inches

MONITORING WELL INSTALLATION GUIDELINES

▩ BENTONITE ▨ SILICA SAND

1/2

FIELD BOREHOLE LOG

Borehole No. WL-BH12-03

Project Name: Yukon Landfills
GPS Coordinates:
Location: Watson Lake
Field Screening Method: 10-Slot 7" PVC Well screen
Boring Method: Air Rotary
Model: MS - Drilltech
Casing/Borehole Diameter: 6 5/8" / 7 1/4"
Weather: 13° sunny
Project No.: 11-1436-0073 (1400)
Date: 14/5/12
Time: 13:00
Depth: to
Contractor: Midnight Sun Drilling
Completed by: Calvin Beebe

DEPTH ELEV.	SOIL STRATIGRAPHY	WELL SKETCH	DEPTH SCALE	SAMPLES Cond.	Type	No.	Recov	PID (ppm)	SAMPLE DESCRIPTION & BORING NOTES
	ML - SANDY SILT Some gravel, Some cobbles, moist.		5 5 5 10 15 15 25						0'-17' ML - SANDY SILT, some ~~GRAV~~ Gravel, some cobbles, orange to light brown, moist. 0'-8' is soft ("reworked") 8'-17" is harder ("native")
			10						17'-20' similar
			5 15 45						20'-24' SM-GM, silty SAND and GRAVEL, dark brown, moist.
	SM-GM ROCK		20 55 25						24'-33' ROCK, crystaline, dark grey color.
			30						33'-34' CL - sandy CLAY, some silt, trace gravel, blue-grey to dark brown, soft, wet.
SC-GC → Rock →			35						34'-35' SC-GC, clayey SAND and GRAVEL, trace silt, dark brown, wet.
	GM - GRAVEL, some sand, trace silt, moist		40 45						35'-36' BOULDER or Rock, dark grey, crystaline.
	with SM silty sand @ 36-37'		50						36'-37' SM-GM, silty SAND and GRAVEL, light brown, moist, subrounded.
			55 60 65						37'-70' GM, light brown GRAVEL, some sand, trace silt, moist.
	ML - silty fine SAND orange, moist.		70 75						70'-105' ML, silty fine SAND, orange, moist.
80'	- clay lense		80						- Clay lense at 80'
90'	trace gravel		85 90						- trace gravel and color change around 90'
94'	more moisture		95 100						- more moisture and orange-brown around 94'
	GM Sandy GRAVEL some silt, ~~moist~~ orange to dark brown, moist.		105 110 115						105'-130' GM, sandy GRAVEL, some silt, orange to dark brown, moist.
			120						130'-135' ML - GRAVELY SILT, some sand, dark brown, moist.
			125						135'-137' SM - SAND, some silt, some gravel, dark grey, moist.
			130						137'-139' SM, SAND, some silty, some gravel, trace clay, some cohesion, moist.

drilling fluid added.

SAMPLE CONDITION

☒ DISTURBED
▥ FAIR
▧ GOOD
■ LOST

SAMPLE TYPES

A.S. - Auger sample
C.S. - Chunk sample (odex)
S.S. - Split spoon
C.C. - Sonic
D.P. - Direct Push

SPECIAL NOTES:

Est. Volume of drill H_2O used: ____ L(sonic)
Depth of H_2O:
Drum No.: ____ Date: ____ Time: ____

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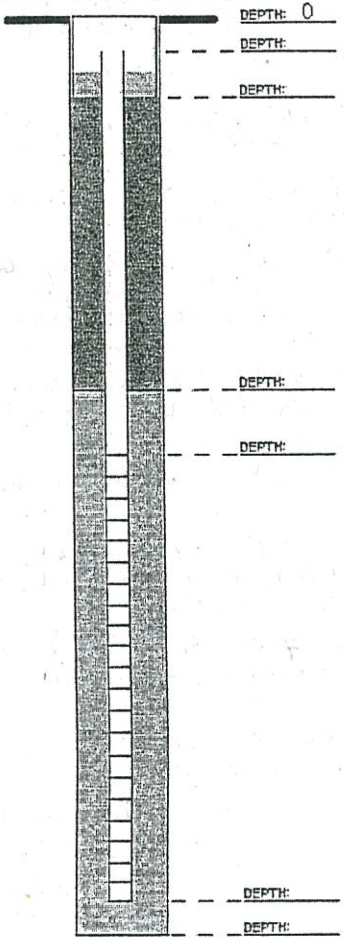
Note: this log is double-sided.

FIELD BOREHOLE LOG

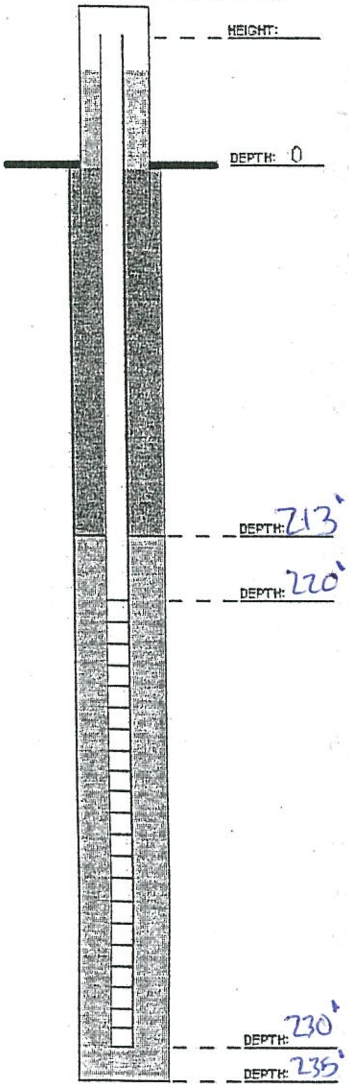
Borehole No. ______________

Well ID: MW12-02-WL
Water Level (mbtoc): ______________
Well Depth (mbtoc): ______________
Date: 15/5/12
Borehole Diameter: 5 ½"

FLUSHMOUNT WELL INSTALLATION



STICK-UP WELL INSTALLATION



ft	m	ft	m
1	0.3	41	12.5
2	0.6	42	12.8
3	0.9	43	13.1
4	1.2	44	13.4
5	1.5	45	13.7
6	1.8	46	14.0
7	2.1	47	14.3
8	2.4	48	14.6
9	2.7	49	14.9
10	3.0	50	15.2
11	3.4	51	15.5
12	3.7	52	15.8
13	4.0	53	16.2
14	4.3	54	16.5
15	4.6	55	16.8
16	4.9	56	17.1
17	5.2	57	17.4
18	5.5	58	17.7
19	5.8	59	18.0
20	6.1	60	18.3
21	6.4	61	18.6
22	6.7	62	18.9
23	7.0	63	19.2
24	7.3	64	19.5
25	7.6	65	19.8
26	7.9	66	20.1
27	8.2	67	20.4
28	8.5	68	20.7
29	8.8	69	21.0
30	9.1	70	21.3
31	9.4	71	21.6
32	9.8	72	21.9
33	10.1	73	22.3
34	10.4	74	22.6
35	10.7	75	22.9
36	11.0	76	23.2
37	11.3	77	23.5
38	11.6	78	23.8
39	11.9	79	24.1
40	12.2	80	24.4

Note:
0.15 meters = 6 inches

MONITORING WELL INSTALLATION GUIDELINES

▨ BENTONITE ▨ SILICA SAND

Casing stopped at 199' drilled to 235' with hammer only.

Golder

✓ 2/2

FIELD BOREHOLE LOG

Borehole No. WL-BH12-03

Project Name: Yukon Landfills
GPS Coordinates:
Location: Watson Lake
Field Screening Method: 10-Slot 2" PVC
Boring Method: Air Rotary
Model: MS Drilltech
Casing/Borehole Diameter: 6 5/8" / 7 1/4"
Weather: Snowing 0°
Project No.: 11-1436-0073 (1400)
Date: 15/5/12
Time: 09:00 to
Depth:
Contractor: Midnight Sun Drilling
Completed by: Calvin Beebe

DEPTH ELEV.	SOIL STRATIGRAPHY	WELL SKETCH	DEPTH SCALE	SAMPLES					SAMPLE DESCRIPTION & BORING NOTES
				Cond.	Type	No.	Recov	PID (ppm)	
	SM SAND, some silt								139' - 150' ML - SANDY SILT trace gravel, dark grey, moist.
			140						
	ML		145						150' - 156' ML, SANDY SILT, some gravel, yellowish brown, moist
			150						
			155						156' - 160' ML; similar, yellowish orange, slightly drier.
			160						
			165						160' - 170' ML, yellowish orange SILT, some sand, some gravel, moist
			170						
			175						170' - 178' ML, similar, light brown.
	SM		180						175' - 176' SM, SAND, some silt, trace gravel, orange-yellow, moist.
			185						
			190						176' - 177' SM-GM, silty SAND and GRAVEL, some clay, brown, moist. gravel is subangular.
			195						
			200						
	Weathered rock		205						177' - 186' SM, SAND, some silt some fine rounded gravel, moist, yellowish-orange.
	Bedrock		210						186' - 190' SM similar, color change to olive grey
			215						
			220						190' - 191' SM - similar, color change to light brown
			225						194' - 197' SM, SAND, some silt, some gravel, trace clay, drier.
			230						
			235						197' - 205' Weathered rock
									205' - 235' competent rock
									▽ encountered at ~215'

SAMPLE CONDITION

☒ DISTURBED
▨ GOOD
▥ FAIR
■ LOST

SAMPLE TYPES

A.S. - Auger sample
C.S. - Chunk sample (odex)
S.S. - Split spoon
C.C. - Sonic
D.P. - Direct Push

SPECIAL NOTES:

Est. Volume of drill H_2O used: L(sonic)
Depth of H_2O:
Drum No.: Date: Time:

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Note: this log is double-sided.

✓

FIELD BOREHOLE LOG

Borehole No. WL-BH12-04

Project Name: Yukon Landfills
GPS Coordinates: ______
Location: Watson Lake
Field Screening Method: ———
Boring Method: Air Rotary
Model: MS Driltech
Casing/Borehole Diameter: 7 5/8" (syncro)
Weather: Snowing 5°
Project No.: 11-1436-0073
Date: 16/5/12
Time: 10:00
Depth: — to —
Contractor: Midnight Sun Drilling
Completed by: Calvin Beebe

DEPTH ELEV.	SOIL STRATIGRAPHY	WELL SKETCH	DEPTH SCALE	SAMPLES Cond.	Type	No.	Recov	PID (ppm)	SAMPLE DESCRIPTION & BORING NOTES
	SM- silty SAND		0'						0'-6' SM - silty SAND, some gravel, trace boulders & cobbles, brown, moist.
	GM- GRAVEL		5'						
	6'-11' sandy GRAVEL		10'						6'-30' GM - GRAVEL
			15'						6'-11' sandy GRAVEL, some-trace silt, light brown, moist
			20'						11'-16' GRAVEL, some clay, trace sand, trace silt
			25'						
	SM		30'						16'-30' GRAVEL, some silt trace sand, wet
	30'-40' Gravely SAND		35'						
			40'						30'-72' SM
	40'-72' silty SAND		45'						30'-36' gravely SAND, some silt, light brown, moist
			50'						36'-40' gravely SAND, trace silt
			55'						
			60'						40'-72' silty SAND, some gravel, moist
			65'						72'-79' ROCK, dark grey, aphanitic, crystaline.
	ROCK		70'						
			75'						79'-81' GW - Sandy GRAVEL, dark grey, moist.
GW →	GM		80'						81'-85' GM - silty GRAVEL, sand, greyish brown, wet.
	ROCK		85'						85'-92' ROCK - similar to above Rock.
	Gm		90'						
			95'						92' GM - silty GRAVEL, trace sand, greyish brown, wet.
									- producing water at 92'
									- Casing refusal at 72'
									end hole

SAMPLE CONDITION

☒ DISTURBED ▨ GOOD
▥ FAIR ■ LOST

SAMPLE TYPES

A.S. - Auger sample
C.S. - Chunk sample (odex)
S.S. - Split spoon
C.C. - Sonic
D.P. - Direct Push

SPECIAL NOTES:

Est. Volume of drill H_2O used: ______ L(sonic)
Depth of H_2O: ______
Drum No.: ______ Date: ______ Time: ______

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Note: this log is double-sided.

FIELD BOREHOLE LOG

Borehole No. ______________

Well ID: ________________

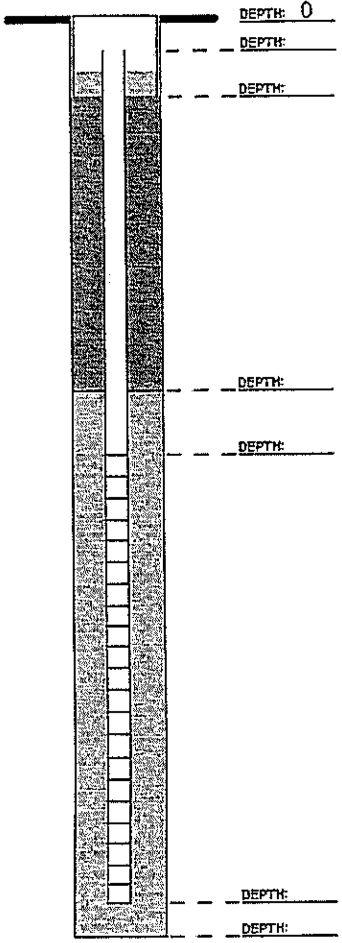
Water Level (mbtoc): ________________

Well Depth (mbtoc): ________________

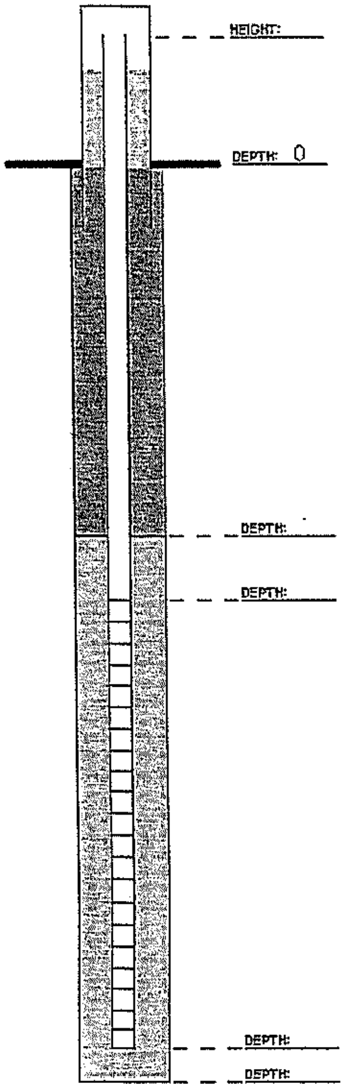
Date: ________________

Borehole Diameter: ________________

FLUSHMOUNT WELL INSTALLATION



STICK-UP WELL INSTALLATION



ft	m	ft	m
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3	0.9	43	13.1
4	1.2	44	13.4
5	1.5	45	13.7
6	1.8	46	14.0
7	2.1	47	14.3
8	2.4	48	14.6
9	2.7	49	14.9
10	3.0	50	15.2
11	3.4	51	15.5
12	3.7	52	15.8
13	4.0	53	16.2
14	4.3	54	16.5
15	4.6	55	16.8
16	4.9	56	17.1
17	5.2	57	17.4
18	5.5	58	17.7
19	5.8	59	18.0
20	6.1	60	18.3
21	6.4	61	18.6
22	6.7	62	18.9
23	7.0	63	19.2
24	7.3	64	19.5
25	7.6	65	19.8
26	7.9	66	20.1
27	8.2	67	20.4
28	8.5	68	20.7
29	8.8	69	21.0
30	9.1	70	21.3
31	9.4	71	21.6
32	9.8	72	21.9
33	10.1	73	22.3
34	10.4	74	22.6
35	10.7	75	22.9
36	11.0	76	23.2
37	11.3	77	23.5
38	11.6	78	23.8
39	11.9	79	24.1
40	12.2	80	24.4

Note:
0.15 meters = 6 inches

MONITORING WELL INSTALLATION GUIDELINES

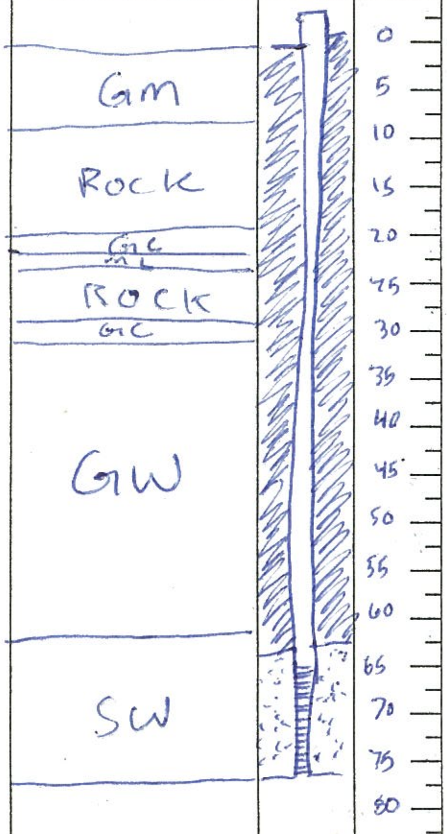
▩ BENTONITE ▨ SILICA SAND

FIELD BOREHOLE LOG

Borehole No. WL-BH12-05

Project Name: Yukon Landfills
GPS Coordinates:
Location: Watson Lake
Field Screening Method: 2" 10-Slot Sched 40 PVC
Boring Method: Air rotary
Model: M5 Drilltech
Casing/Borehole Diameter: 7 5/8"
Weather: Snowing
Project No.: 11-1436-0073 (1400)
Date: 16/5/12
Time: 13:45
Depth: 66' 6" to 76' 6"
Contractor: Midnight Sun Drilling
Completed by: Calvin Beebe

DEPTH ELEV.	SOIL STRATIGRAPHY	WELL SKETCH	DEPTH SCALE	SAMPLES					SAMPLE DESCRIPTION & BORING NOTES
				Cond.	Type	No.	Recov	PID (ppm)	



0'-8' GM - silty GRAVEL, some sand, light brown, moist

8'-19' ROCK, dark grey, crystalline Basalt flow.

19'-21' GC Clayey GRAVEL, grey-brown, moist.

21'-22' ML - GRAVELY SILT, grey, moist, trace sand

22'-29' ROCK

29-31' GC - clayey gravel, light brown, wet, trace sand & silt.

31'-46' 31' GW GRAVEL, trace sand trace silt, light brown, moist

46'-62' similar GW sandy GRAVEL

62' - SM - silty SAND, light brown to orange, moist, trace gravel

-64' similar, some gravel

-65-75 SW - SAND, some gravel orange-brownish, moist to wet.

-Water @ 72'

75-77' SW - medium SAND, trace fine sand, ~~trace~~ gravel
Orange-brown, Wet, some

∇ ≤ 67' in casing

SAMPLE CONDITION
☒ DISTURBED
▥ FAIR
▨ GOOD
■ LOST

SAMPLE TYPES
A.S. - Auger sample
C.S. - Chunk sample (odex)
S.S. - Split spoon
C.C. - Sonic
D.P. - Direct Push

SPECIAL NOTES:
Est. Volume of drill H_2O used: ____ L(sonic)
Depth of H_2O:
Drum No.: ____ Date: ____ Time: ____

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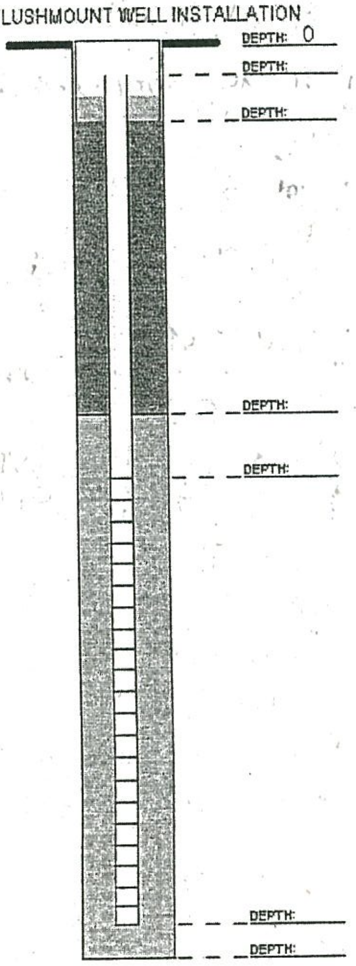
Note: this log is double-sided.

FIELD BOREHOLE LOG

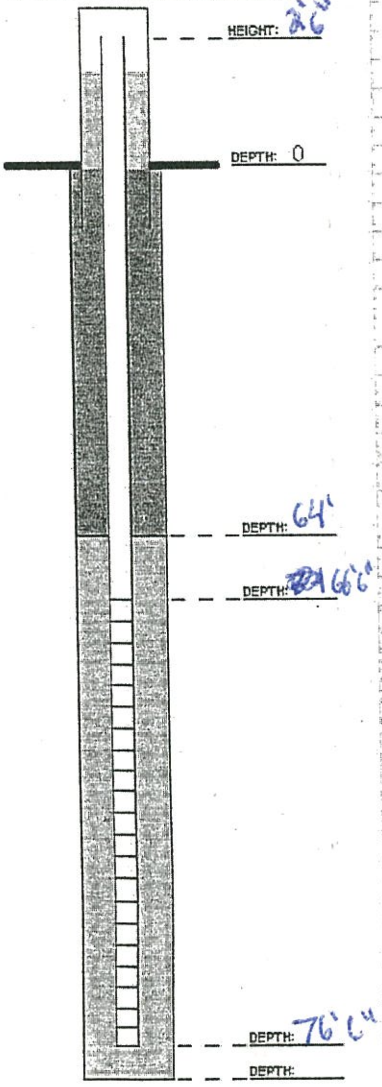
Borehole No. BH12-05

Well ID: MW12-03
Water Level (mbtoc):
Well Depth (mbtoc): 23.3m
Date: 17/5/12
Borehole Diameter: 7½"

FLUSHMOUNT WELL INSTALLATION



STICK-UP WELL INSTALLATION



ft	m	ft	m
1	0.3	41	12.5
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3	0.9	43	13.1
4	1.2	44	13.4
5	1.5	45	13.7
6	1.8	46	14.0
7	2.1	47	14.3
8	2.4	48	14.6
9	2.7	49	14.9
10	3.0	50	15.2
11	3.4	51	15.5
12	3.7	52	15.8
13	4.0	53	16.2
14	4.3	54	16.5
15	4.6	55	16.8
16	4.9	56	17.1
17	5.2	57	17.4
18	5.5	58	17.7
19	5.8	59	18.0
20	6.1	60	18.3
21	6.4	61	18.6
22	6.7	62	18.9
23	7.0	63	19.2
24	7.3	64	19.5
25	7.6	65	19.8
26	7.9	66	20.1
27	8.2	67	20.4
28	8.5	68	20.7
29	8.8	69	21.0
30	9.1	70	21.3
31	9.4	71	21.6
32	9.8	72	21.9
33	10.1	73	22.3
34	10.4	74	22.6
35	10.7	75	22.9
36	11.0	76	23.2
37	11.3	77	23.5
38	11.6	78	23.8
39	11.9	79	24.1
40	12.2	80	24.4

Note:
0.15 meters = 6 inches

MONITORING WELL INSTALLATION GUIDELINES

▩ BENTONITE ▨ SILICA SAND

FIELD BOREHOLE LOG

Boring Number BH12-06 (MW12-04)
Project Yukon Landfill assessment
Location Watson Lake / YK
Casing 7 1/2" OD casing 6" Drill Shoe
Weather Sunny 18°C
Drill Rig Air Rotary

Depth 0' to 94'4"
Job No. 11-1436-0073
Elevation
Casing Hammer, wt
Sampler Hammer, wt
Driller Midnight sun drilling

Sheet 1 of 2
Date May 24/12 Install May 25
Datum Ground Surface
drop
drop
Engineer Krista M

DEPTH ELEV.	SOIL STRATIGRAPHY	BLOWS PER FOOT	DEPTH SCALE	% WATER RETURN	SAMPLES Cond.	Type	No.	BH Diam Recov	Force	SAMPLE DESCRIPTION & BORING NOTES
			0							0-2' Braun Clayey SILT to SILTY CLAY
(Cl/ML)	CLAYEY SILT to SILTY CLAY, Braun Cohesive, moist		2 4 6	Dry	☒	DO		7½ OD of Shoe		2'-5' Silty SAND (f-M) AND f-C (GRAVEL) (Sub Angular) Braun Dry (SM/GW) possibly till?? (5'-8' Boulder / Grey) 8'-42' same as 2'-5', moist, braun
2' (SM/GW)	fine to Medium SILTY SAND, AND GRAVEL, fine to coarse Sub Angular, Braun, Dry @5'-8' Boulder Grey. @8'-42' graded to moist		8 10 12 14 16 18 20 22	moist	☒					0-15' Drilled from 3 - 320PM 320 - 340 welding 340 - 400 drilled 15' - 35' 400 - 420 welding 420 - 436 35' - 56' Drilled
42' (Cl/ML)	CLAYEY SILT to SILTY CLAY, trace to some fine to Medium Sand, some fine to coarse gravel subangular, brown, moist		24 26 28 30 32 34 36	moist	☒	DO		7½ OD		42' - 72' Harder drilling, very dusty clay CLAYEY SILT to SILTY CLAY trace - Some f-M Sand, some f-C Gravel subangular, braun, moist @ 56' Drill jamming up possible till again 436 - 5:06 welding 5:06 - 530 Drilled 56' - 76'
70'	Dark Grey basalt like bedrock 72'-84' Solid rock 84'-94' Fractured and wet		38 40 42 44		☒					72'-94 Bed Rock Dark Grey / black Basalt-like @76' had to drill w/ water @84-94' water blown out drill water not used @ this point Driller mentioned it Felt like Fractured Rock. Alternating solid and Fractured Rock
94'	SILTY SAND fine to Medium Grey, wet		46 48 50	moist	☒	DO		7½ OD		94' ~~94'4"~~ Broke through bed rock and into a Silty SAND (f-M) very fine Grey, wet (Hard to tell soil type very wet) 94'4" EOH leaving overnight to sort out install Finished Drilling @ 6:45pm Clean up and cutting of casing till Sample Collected @ 94' to 94'4"
94'4"	EOH		52 54	Cont'd	☒					* Well completion on the Back →

SAMPLE CONDITION

☒	DISTURBED
▥	FAIR
▧	GOOD
■	LOST

SAMPLE TYPES

A.S. - Auger sample
C.S. - Chunk sample
D.O. - Drive open
R.C. - Rock core
S.T. – Slotted tube
T.O. – Thin walled, open
T.P. - Thin walled, piston
W.S. – Wash sample

ABBREVIATIONS

Wh – Weight, hammer
Ph – Pressure, hydraulic
Pm – Pressure, manual
V – In-situ vane shear test

SPECIAL NOTES: (water conditions etc.)

Time: 3pm - 645
Hrs. Productive:
Hrs. Delayed:
Depth of Hole: 94' 4"
Depth of Casing:
Depth of Water: 84' (25.5 m) May 25/12

(2)

FIELD BOREHOLE LOG

Boring Number ~~BH12-06~~ 06 BH12-06
Project Yukon Landfill Assessment
Location Watson Lake
Casing 7 1/2" OD casing 6" Drill Shoe
Weather Sunny 18°C
Drill Rig Air Rotary

Depth 54' to 94'
Job No. 11-1436 0073
Elevation
Casing Hammer, wt ______ drop ______
Sampler Hammer, wt ______ drop ______
Driller Midnight Sun

Sheet 2 of 2
Date May 24/12 Install May 25
Datum
Engineer Krista Meneghetti

DEPTH ELEV.	SOIL STRATIGRAPHY	BLOWS PER FOOT	DEPTH SCALE	% WATER RETURN	SAMPLES Cond.	Type	No.	BH ~~Recov~~ Diam	Force
			54						
			56	↑	☒	DO		7½	
			58	moist ↓					
			60	↑					
			62						
			64						
			66					7⅛	
			68						
			70	moist	☒	DO			
			72	↑					
			74	Rock					
			76	↓					
			78						
			80						
			82	Fract Rock					
			84	wet				7½	
			86		☒	PO			
			88						
			90						
			92	wet					
			94'4"				sal		
			96		EOH				
			98						
			100						

SAMPLE DESCRIPTION & BORING NOTES

GW measured @ 7 AM May 25/12 = 25.5m

Well Install May 25/12

94'-84' Screen 2" Dia Slot 10 sch 40
94'-80' Sand 10/20 silica
80'-75' Bentonite chip hydrated
75-0' Grout
0 stick up casing

~76' of casing stuck in the ground

GPS Co ordinates
±5 09V 0513998
6659148

@10 AM Finished install

Materials used
4 Bags of sand
3 bags of chip
13 bags of grout

SAMPLE CONDITION
- ☒ DISTURBED
- FAIR
- GOOD
- ■ LOST

SAMPLE TYPES
- A.S. - Auger sample
- C.S. - Chunk sample
- D.O. - Drive open
- R.C. - Rock core
- S.T. – Slotted tube
- T.O. – Thin walled, open
- T.P. - Thin walled, piston
- W.S. – Wash sample

ABBREVIATIONS
- Wh – Weight, hammer
- Ph – Pressure, hydraulic
- Pm – Pressure, manual
- V – In-situ vane shear test

SPECIAL NOTES: (water conditions etc.)

Time: ______________
Hrs. Productive: ______________
Hrs. Delayed: ______________
Depth of Hole: ______________
Depth of Casing: ______________
Depth of Water: ______________

APPENDIX C

Well Development and Sampling Logs

GROUNDWATER DEVELOPMENT AND PURGING/SAMPLING DATA SHEET

☑ Development
☐ Purging/Sampling

Well No.: WL - MW12-02
Location: WATSON LAKE 514147/6658976
Weather: SUNNY / CALM Temperature: 12
Project No.: 11-1436-0073/1400
Date: 30 MAY 2012 Time: 0830
Completed by: J. MARQUARDSON A. BADGER

MONITORING WELL INFORMATION

Time of Measurement: 0830
Depth to product: — Product thickness: —
Depth to water Below Top of Casing: A 31.800 metres
Depth to Bottom of Well Below Top of Casing: B 62.5 metres
Diameter Standpipe: C 50 mm
Tidally Influenced: ☐ Yes ☑ No
One well volume:
(B-A)*2.0 = 61.4 litres - for a 51 mm (2.0 inch) diameter well
(B-A)*1.1 = ______ litres - for a 38 mm (1.5 inch) diameter well
Sample intake depth: ______ metres

62.5
-31.8
30.7
×2
61.4

EQUIPMENT LIST

pH and Temp. Meter: Model YSI Serial No.
Conductivity Meter: Model ↓ Serial No.
Dissolved Oxygen Meter: Model Serial No.
Pump: ☐ None ☑ Waterra ☐ Peristaltic ☐ Submersible
Pump Details:
Calibration Buffers: ☑ 4 ☑ 7 ☐ 10
Calibration Solution: 1413
☐ D.O. Chemet Ampoule
☐ Bailer Type:

WELL DEVELOPMENT/PURGING

Purge Volume: Well. Vol. X — = — litres
Avg. Flow Rate: — L/min. Start: — Finish: —

Time	Volume Removed (L)	Temp. (°C)	pH (Units)	Cond. (uS/cm)	Redox (mV)	Diss. O_2 (mg/L) or %		Water Level (m)	Remarks

COULDN'T GET WATER UP
- TOO DEEP
- NEED BIGGER PUMP

Comments:
Odour: ☐ Yes ☐ No If yes
Sheen: ☐ Yes ☐ No If yes Hydrocarbon-like ☐ OR Metallic-like ☐
Turbidity: Clear IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII Very Silty

Analysis	Type		Container Size 40 mL	100 mL	250 mL	500 mL	1 L	2 L	4 L	Filtered		Preservatives
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	

SCN No.
Field Dup.
Consumables: ☐ Waterra Tubing ☐ Silicon Tubing ☐ HDPE/Teflon Tubing ☐ D.O. Ampoules ☐ Groundwater Filter ☐

GROUNDWATER DEVELOPMENT AND PURGING/SAMPLING DATA SHEET

☑ Development
☑ Purging/Sampling

Well No.: WL-ML12-01
Location: WATSON LAKE 514147/6659 200
Weather: SUN CALM **Temperature:** 17
Project No.: 11-1436-0073/1400
Date: 30-MAY-2011 **Time:** 1150
Completed by: J. MARQUARDSON A. BADGER

MONITORING WELL INFORMATION

Time of Measurement: 1150
Depth to product: — Product thickness: —
Depth to water Below Top of Casing: A 6.218 metres
Depth to Bottom of Well Below Top of Casing: B 7.852 metres
Diameter Standpipe: C 50 mm
Tidally Influenced: ☐ Yes ☑ No
One well volume:
(B-A)*2.0 = 2.8 litres - for a 51 mm (2.0 inch) diameter well
(B-A)*1.1 = ____ litres - for a 38 mm (1.5 inch) diameter well
Sample intake depth: 7.5 metres

7.6
6.2
1.4
× 2
2.8

EQUIPMENT LIST

pH and Temp. Meter: Model YSI Serial No. WHS
Conductivity Meter: Model ↓ Serial No. ↓
Dissolved Oxygen Meter: Model ↓ Serial No. ↓
Pump: ☐ None ☑ Waterra ☐ Peristaltic ☐ Submersible
Pump Details:
Calibration Buffers: ☑ 4 ☑ 7 ☐ 10
Calibration Solution: 1413
☐ D.O. Chemet Ampoule
☐ Bailer Type:

WELL DEVELOPMENT/PURGING

Purge Volume: Well. Vol. X ____ = ____ litres
Avg. Flow Rate: ____ L/min. Start: 1200 Finish: ____

Time	Volume Removed (L)	Temp. (°C)	pH (Units)	Cond. (uS/cm)	Redox (mV)	Diss. O$_2$ (mg/L) or %		Water Level (m)	Remarks
1208	5	9.82	6.61	1094		10.08		7.077	VERY SILTY
1224	10	6.81	6.73	1005		10.40		7.475	~~so~~ LIGHT SILT

Comments:
Odour: ☐ Yes ☑ No If yes
Sheen: ☐ Yes ☑ No If yes Hydrocarbon-like ☐ OR Metallic-like ☐
Turbidity: Clear I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I Very Silty

Analysis	Type		Container Size							Filtered		Preservatives
			40 mL	100 mL	250 mL	500 mL	1 L	2 L	4 L			
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	

SEE COC

SCN No. ____
Field Dup. ____
Consumables: ☐ Waterra Tubing ☐ Silicon Tubing ☐ HDPE/Teflon Tubing ☐ D.O. Ampoules ☐ Groundwater Filter ☐

GROUNDWATER DEVELOPMENT AND PURGING/SAMPLING DATA SHEET

☑ Development
☑ Purging/Sampling

Well No.: WL-MW12-04
Location: WATSON LAKE 514000/6659141
Weather: SUN/WIND S 15 KMH
Temperature: 16
Project No.: 11.1436-0073/1400
Date: 30 MAY 2012
Time: 1030
Completed by:

MONITORING WELL INFORMATION

Time of Measurement: 1030
Depth to product: ~~ ~~ Product thickness: ~~ ~~
Depth to water Below Top of Casing: A 24.55 metres
Depth to Bottom of Well Below Top of Casing: B 29.155 metres
Diameter Standpipe: C 50 mm

Tidally Influenced: ☐ Yes ☑ No
One well volume:
(B-A)*2.0 = 4.50522 9 litres - for a 51 mm (2.0 inch) diameter well
(B-A)*1.1 = litres - for a 38 mm (1.5 inch) diameter well
Sample intake depth: metres

EQUIPMENT LIST

pH and Temp. Meter: Model YSI Serial No. WHS
Conductivity Meter: Model ↓ Serial No. ↓
Dissolved Oxygen Meter: Model ↓ Serial No.
Pump: ☐ None ☐ Waterra ☐ Peristaltic ☐ Submersible
Pump Details:

Calibration Buffers: ☑ 4 ☑ 7 ☐ 10
Calibration Solution: 1413
☐ D.O. Chemet Ampoule
☐ Bailer Type:

WELL DEVELOPMENT/PURGING

Purge Volume: Well. Vol. X 3.9 = 27 litres
Avg. Flow Rate: L/min. Start: 1035 Finish:

Time	Volume Removed (L)	Temp. (°C)	pH (Units)	Cond. (uS/cm)	Redox (mV)	Diss. O₂ (mg/L) or %		Water Level (m)	Remarks
1035	0							24.55	START PUMP
1100	30	TOO	MUDDY	FOR		YSI		27.74	THICK MUD
1105	35	5.03	6.88	2926		4.24		27.23	VERY SILTY
1110	40	5.74	7.52	3020		2.81		27.18	

Comments: COULD NOT FILTER DOC/METALS - TOO MUCH PRESSURE BROKE 2 FILTERS - HIGH TURBIDITY

Odour: ☐ Yes ☑ No If yes
Sheen: ☐ Yes ☑ No If yes Hydrocarbon-like ☐ OR Metallic-like ☐
Turbidity: Clear IIIIIIIIIIIIIIIIIIIIIIIIIIIIIII [✓ III] Very Silty

Analysis	Type		40 mL	100 mL	250 mL	500 mL	1 L	2 L	4 L	Filtered		Preservatives
			Container Size									
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
										☐ Yes	☐ No	

SEE COC

SCN No.
Field Dup.
Consumables: ☐ Waterra Tubing ☐ Silicon Tubing ☐ HDPE/Teflon Tubing ☐ D.O. Ampoules ☐ Groundwater Filter ☐

GROUNDWATER DEVELOPMENT AND PURGING/SAMPLING DATA SHEET

☐ Development
☐ Purging/Sampling

Well No.: WL-MW12-03
Location: WATSON LAKE 514236 /6659104
Weather: ~~SM~~ SUN WIND S 10K
Temperature: 14
Project No.: 11-1436-0073 / 1400
Date: 30 MAY 2012
Time: 0925
Completed by: J. MARQUARDSON, A. BADGER

MONITORING WELL INFORMATION

Time of Measurement: 0925
Depth to product: —
Product thickness: —
Depth to water Below Top of Casing: A 8.60 metres
Depth to Bottom of Well Below Top of Casing: B 22.88 metres
Diameter Standpipe: C ____ mm
Tidally influenced: ☐ Yes ☑ No
One well volume:
(B-A)*2.0 = 28.4 litres - for a 51 mm (2.0 inch) diameter well
(B-A)*1.1 = ____ litres - for a 38 mm (1.5 inch) diameter well
Sample intake depth: ____ metres

22.8
-8.6
14.2
× 2
28.4

EQUIPMENT LIST

pH and Temp. Meter: Model YSI Serial No. WHS
Conductivity Meter: Model ↓ Serial No. ↓
Dissolved Oxygen Meter: ✓ Model ↓ Serial No. ↓
Calibration Buffers: ☑ 4 ☑ 7 ☐ 10
Calibration Solution: 1413
☐ D.O. Chemet Ampoule
☐ Bailer Type:
Pump: ☐ None ☑ Waterra ☐ Peristaltic ☐ Submersible
Pump Details:

WELL DEVELOPMENT/PURGING

Purge Volume: Well. Vol. X ____ = ____ litres
Avg. Flow Rate: ____ L/min.
Start: 0925
Finish:

Time	Volume Removed (L)	Temp. (°C)	pH (Units)	Cond. (uS/cm)	Redox (mV)	Diss. O$_2$ (mg/L) or %		Water Level (m)	Remarks
0930	15	5.14	6.87	989				16.81	VERY SILTY
0935	30	4.95	7.11	585				19.02	STARTING TO CLEAR
0939	45	4.52	7.20	521		5.77		20.98	NOW CLEAR
0942	60	4.02	7.24	473		6.65		~~21.30~~ 21.03	
0945	75	4.37	7.24	476		6.30		21.01	
0948	90	4.31	7.29	442		7.21		21.03	
0950		COLLECT	WQ	SAMPLES					

Comments:
Odour: ☐ Yes ☑ No If yes ____
Sheen: ☐ Yes ☑ No If yes Hydrocarbon-like ☐ OR Metallic-like ☐
Turbidity: Clear I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I Very Silty

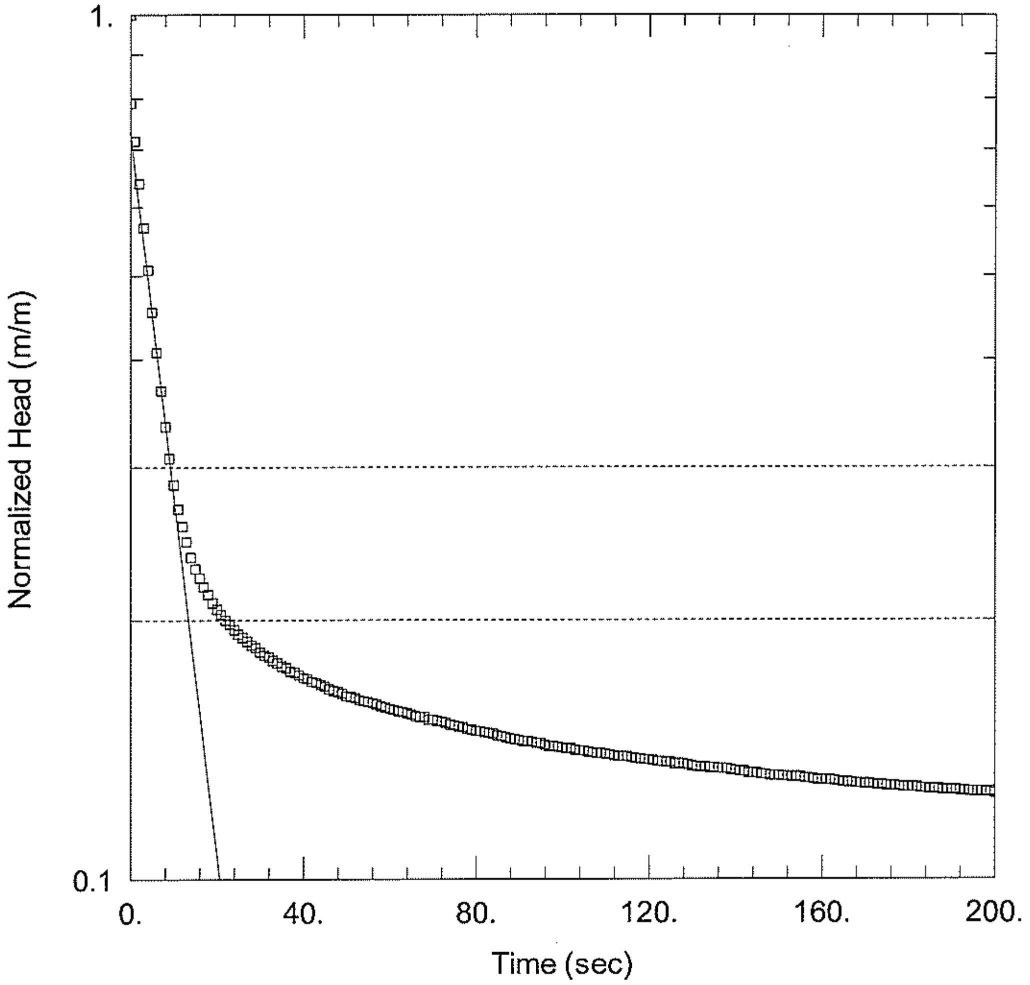
Analysis	Type		Container Size 40 mL	100 mL	250 mL	500 mL	1 L	2 L	4 L	Filtered		Preservatives
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	
	☐ Plastic	☐ Glass								☐ Yes	☐ No	

SEE COC

SCN No. ____
Field Dup. ____
Consumables: ☐ Waterra Tubing ____ ☐ HDPE/Teflon Tubing ____ ☐ Groundwater Filter ____
☐ Silicon Tubing ____ ☐ D.O. Ampoules ____ ☐ ____

APPENDIX D

Rising/Falling Head Test Data



SLUG TEST ANALYISIS FOR WELL WL-MW12-01 (TEST #1)

Data Set: \...\WL-MW12-01_TEST_1_CB_Jul.6.12 GP.aqt

Date: 07/25/12 Time: 10:11:55

AQUIFER DATA

Saturated Thickness: 1.945 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (WL-MW12-01)

Initial Displacement: 0.562 m

Total Well Penetration Depth: 3.05 m

Casing Radius: 0.025 m

Static Water Column Height: 1.945 m

Screen Length: 3.05 m

Well Radius: 0.092 m

Gravel Pack Porosity: 0.3

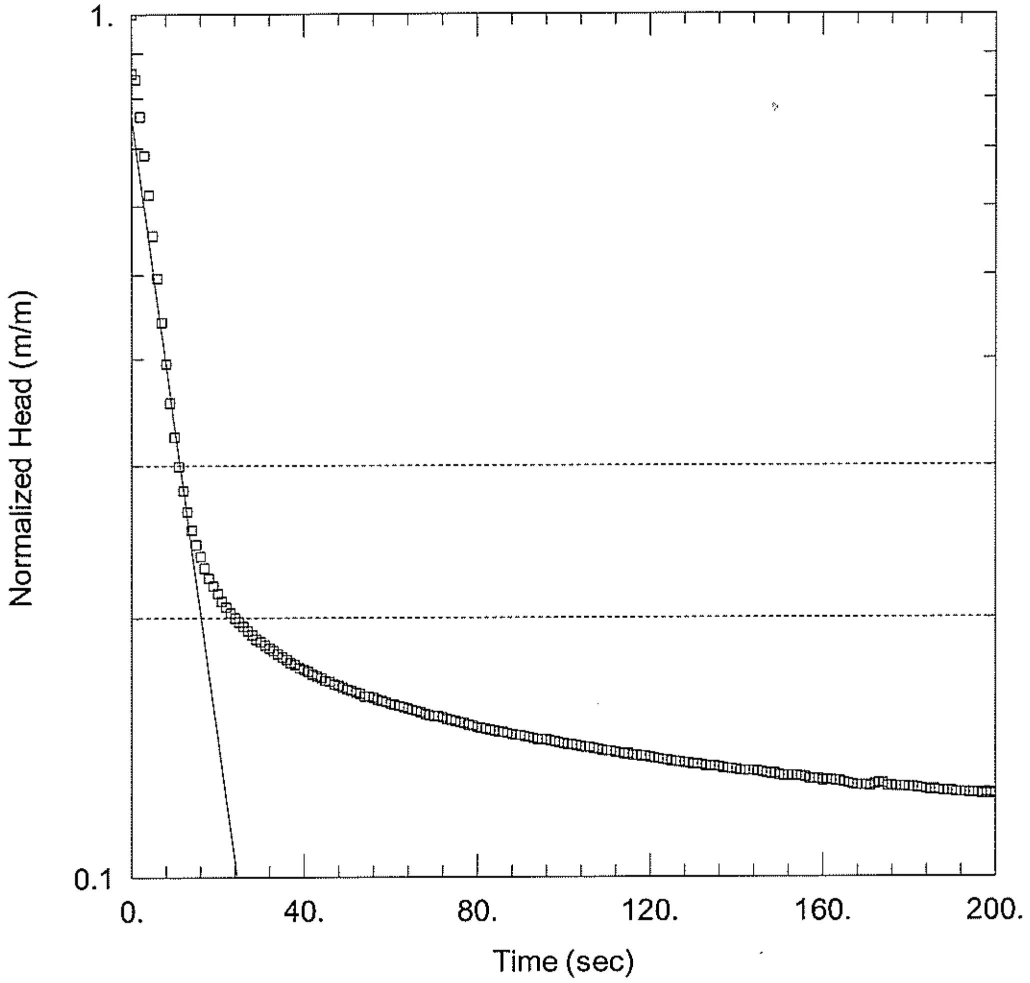
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.0001869 m/sec

y0 = 0.4111 m



SLUG TEST ANALYSIS FOR WELL WL-MW12-01 (TEST #2)

Data Set: \...\WL-MW12-01_TEST_2_CB_Jul.6.12 GP.aqt
Date: 07/25/12
Time: 10:13:01

AQUIFER DATA

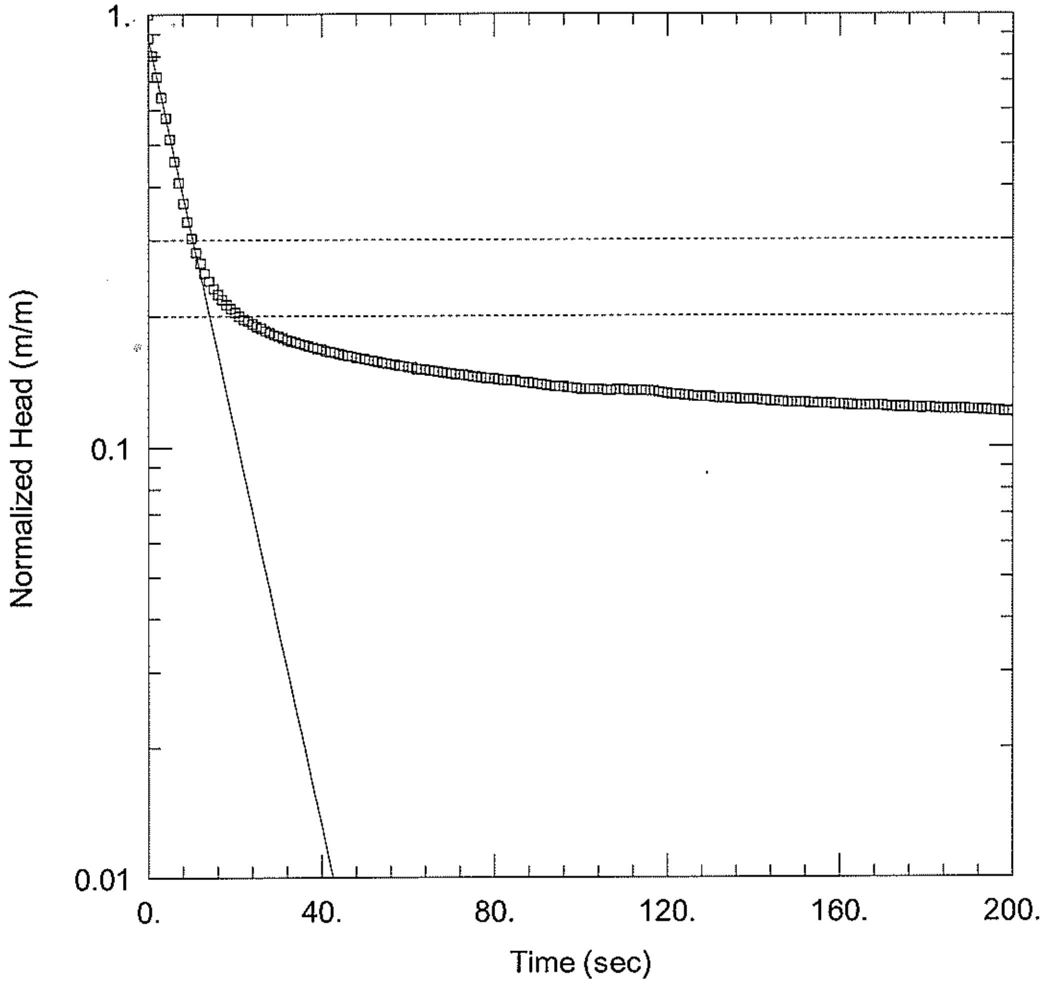
Saturated Thickness: 0.3 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (WL-MW12-01)

Initial Displacement: 0.562 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.025 m
Static Water Column Height: 1.945 m
Screen Length: 3.05 m
Well Radius: 0.092 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 0.0001666 m/sec
y0 = 0.4305 m



SLUG TEST ANALYSIS FOR WELL WL-MW12-01 (TEST #3)

Data Set: \...\WL-MW12-01_TEST_3_CB_Jul.6.12 GP.aqt
Date: 07/25/12 Time: 10:15:03

AQUIFER DATA

Saturated Thickness: 0.3 m

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (WL-MW12-01)

Initial Displacement: 0.562 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.025 m

Static Water Column Height: 1.945 m
Screen Length: 3.05 m
Well Radius: 0.092 m
Gravel Pack Porosity: 0.3

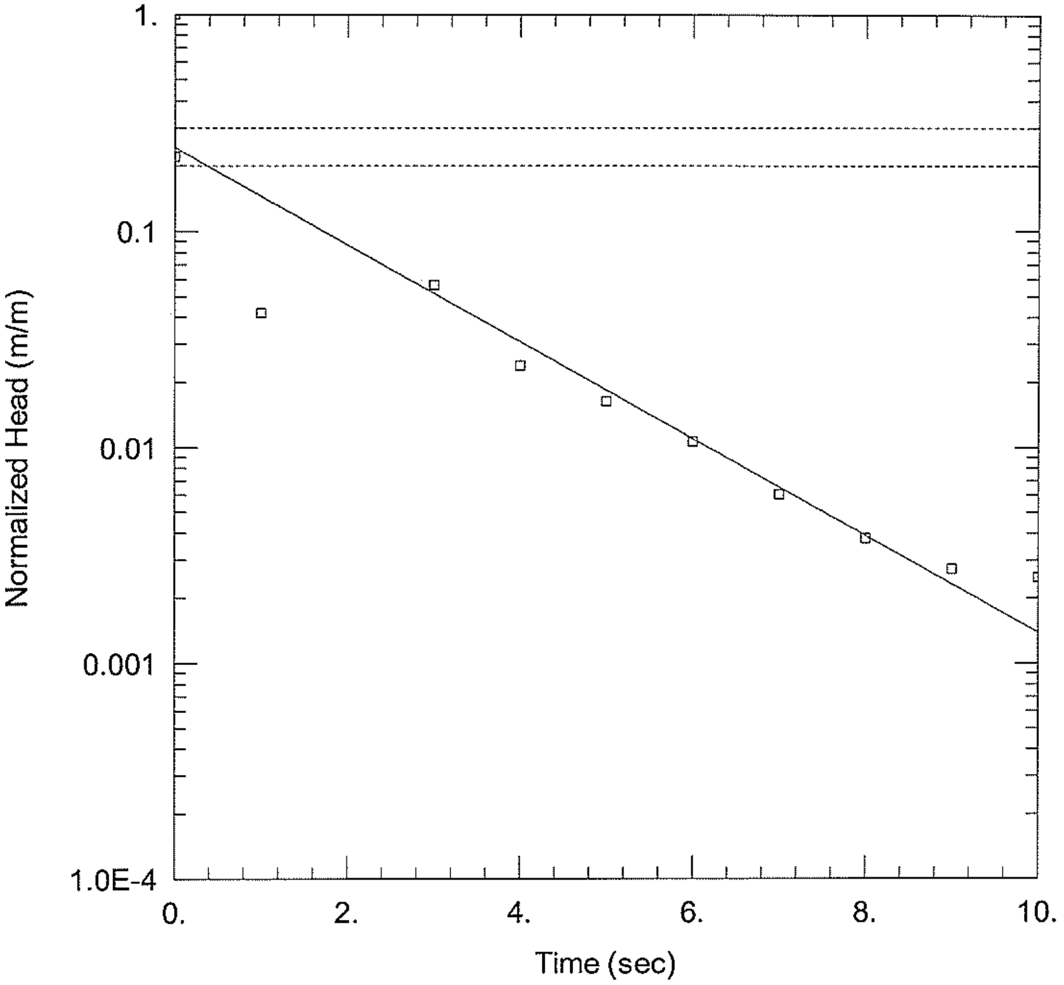
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 0.0002097 m/sec

y0 = 0.4943 m



SLUG TEST ANALYSIS FOR WELL WL-MW12-03

Data Set: \...\WL-MW12-03_Test_2_CB_Jul.6.12 GP.aqt
Date: 07/25/12
Time: 10:15:50

AQUIFER DATA

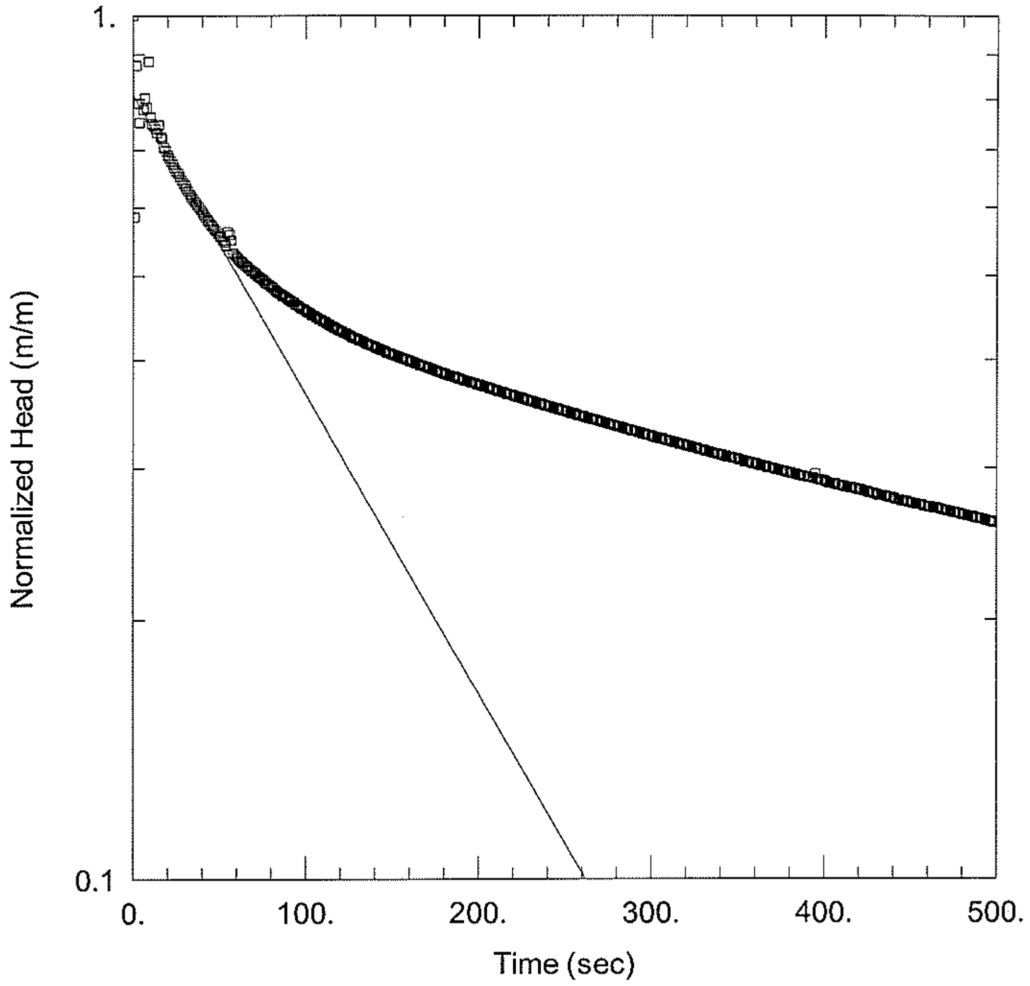
Saturated Thickness: 3.03 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (WL-MW12-03)

Initial Displacement: 0.844 m
Total Well Penetration Depth: 3.05 m
Casing Radius: 0.025 m
Static Water Column Height: 3.03 m
Screen Length: 3.05 m
Well Radius: 0.092 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0006734 m/sec
y0 = 0.2059 m



SLUG TEST ANALYSIS FOR WELL WL-MW12-04

Data Set: \...\WL-MW12-04_Test_1_CB_Jul.6.12 GP.aqt
Date: 07/25/12 Time: 10:16:19

AQUIFER DATA

Saturated Thickness: 5.41 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (WM-MW12-04)

Initial Displacement: 0.844 m
Static Water Column Height: 5.41 m
Total Well Penetration Depth: 3.05 m
Screen Length: 3.05 m
Casing Radius: 0.025 m
Well Radius: 0.092 m

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 1.898E-6 m/sec
y0 = 0.6849 m

Single-well Response Test
Data Sheet

☑ Rising Head

☐ Falling Head

Well No.: WL-MW12-01

Location: WATSON LAKE

Project No.: 11-1436-0073/1400

Completed By: A BADGER

Date: 04-JUL-12

Time: 8:40.

MONITORING WELL INFORMATION

Depth to water below top of casing: 5.94 meters

Depth to bottom of well below top of casing: 7.805 meters

Distance from top of pipe to ground surface: ______ meters

Well casing diameter: 0.05 meters (1 inch = 0.025 meters)

Borehold diameter: 0.181 meters

Screen length: 3.048 meters (1 foot = 0.3048 meters)

Screened unit: ______ (eg: sand, silt, clay)

EQUIPMENT LIST

☑ Slug

Mass: ______ kilograms

Length: 1.0 meters

Diameter: 0.0375 meters

☐ Bailer

Water column height: ______ meters

Inside diameter: ______ meters

and/or Volume of water removed: ______ litres

Pressure transducer serial #: 0011032680

Sampling Interval: 1 [✓ seconds] or minutes (circle one)

SINGLE-WELL RESPONSE TEST

Start time: 840

Finish time: 1139

Time	Elapsed Time	Water Level (m)	Comments
840		5.92	Tx in (0.2 m off BOTTOM)
847		5.83	SLUG IN
850		5.855	
852		5.860	
853		5.860	
1031			SLUG IN
1039			SLUG OUT
1047			SLUG IN
1055			SLUG OUT
1103			SLUG IN
1111			SLUG OUT
1123			SLUG IN
1131			SLUG OUT

1139 Tx OUT

Single-well Response Test Data Sheet

☑ Rising Head

☐ Falling Head

Well No.: WL-MW12-03
Location: WATSON LANE
Project No.: 11-1436-0073/1400
Completed By: A BADGER
Date: 04-JUL-12
Time: 1054

MONITORING WELL INFORMATION

Depth to water below top of casing: 20.90 meters
Depth to bottom of well below top of casing: 23.93 meters
Distance from top of pipe to ground surface: ______ meters
Well casing diameter: 0.05 meters (1 inch = 0.025 meters)
Borehold diameter: 0.181 meters
Screen length: 3.048 meters (1 foot = 0.3048 meters)
Screened unit: ______ (eg: sand, silt, clay)

EQUIPMENT LIST

☑ Slug
Mass: ______ kilograms
Length: 1.5 meters
Diameter: 0.0375 meters

☐ Bailer
Water column height: ______ meters
Inside diameter: ______ meters
and/or Volume of water removed: ______ litres

Pressure transducer serial #: W11032680
Sampling Interval: 1 [✓ seconds] or minutes (circle one)

SINGLE-WELL RESPONSE TEST

Start time: 1154
Finish time: 1308

Time	Elapsed Time	Water Level (m)	Comments
1154			Tx IN (0.2 m OFF BOTTOM)
1158		20.90	SLUG IN
1203		20.92	
1204		20.92	
1205			SLUG-OUT
1212			SLUG IN
1219			SLUG OUT
1226			SLUG IN
1233			SLUG OUT
1240			SLUG IN
1247			SLUG OUT
1254			SLUG IN
1301			SLUG OUT
1308			Tx OUT

Single-well Response Test
Data Sheet

☑ Rising Head

☐ Falling Head

Well No.: WL-MW12-04
Location: WATSON LAKE
Project No.: 11-1436-0073/1400
Completed By: A BADGER
Date: 04-JUL-12
Time: 13:45

MONITORING WELL INFORMATION

Depth to water below top of casing: 24.27 meters
Depth to bottom of well below top of casing: 29.68 meters
Distance from top of pipe to ground surface: ______ meters
Well casing diameter: 0.050 meters (1 inch = 0.025 meters)
Borehold diameter: 0.181 meters
Screen length: 3.048 meters (1 foot = 0.3048 meters)
Screened unit: ______ (eg: sand, silt, clay)

EQUIPMENT LIST

☑ Slug
Mass: ± kilograms
Length: 1.5 meters
Diameter: 0.0375 meters

☐ Bailer
Water column height: ______ meters
Inside diameter: ______ meters
and/or Volume of water removed: ______ litres

Pressure transducer serial #: 0011032680
Sampling Interval: 1 [✓ seconds] or minutes (circle one)

SINGLE-WELL RESPONSE TEST

Start time: 13.45 Finish time: 16.08

Time	Elapsed Time	Water Level (m)	Comments
13:45			Tx in (0.2m off BOTTOM)
13:48		23.75	SLUG IN
13:54		23.935	
13:56		23.955	
13:58		23.99	
14:00		24.005	
14:02		24.02	
14:04		24.04	
14:06		24.04	SLUG OUT
14:26			SLUG IN
14:46			SLUG OUT
15:06			SLUG IN
15:26			SLUG OUT
15:46			SLUG IN

16:06 SLUG OUT
16:08 Tx OUT

APPENDIX E

Analytical Reports and Chain of Custody Forms

Table E-1
Results of Water Analyses - Metals
[YTG Landfill Monitoring, Watson Lake, Yukon]

SCN			174289-01	174289-02	174289-03	174289-04	174289-05
Location	**Aquatic Life CSR-AW (freshwater)**		WL-MW12-01	WL-MW12-01D	WL-MW12-03	WL-MW12-04	WATSON LAKE SURFACE
QA/QC			FDA	FD			
Date		Notes	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12
Parameters							
pH (field)			6.73	6.73	7.29	7.52	-
Temperature °C			6.81	6.81	4.31	5.74	-
Conductivity (uS/cm)			1005	1005	442	3020	-
Dissolved Oxygen (mg/L)			10.4	10.4	7.21	2.81	-
Laboratory Parameters							
pH (laboratory)			7.72	7.75	8.1	7.84	7.83
Hardness (as CaCO3)			708	705	250	313	104
total dissolved solids			1090	1080	463	2960	155
Aggregate Organics							
COD			73	64	22	56	39
dissolved organic carbon			16.3	16.5	3.10	3.62	9.13
Bacteriological							
Coliform Bacteria - Fecal			<2	<2	<2	<2	<2
Dissolved Metals							
aluminum			<0.010	<0.010	<0.010	86.5*	0.011
antimony	**0.2**		<0.00050	<0.00050	<0.00050	0.0026*	<0.00050
arsenic	**0.05**		0.00028	0.00029	0.00024	0.00659*	0.00051
barium	**10**		0.046	0.046	0.079	0.17*	0.039
beryllium	**0.053**		<0.0050	<0.0050	<0.0050	<0.025*	<0.0050
bismuth			<0.20	<0.20	<0.20	<1.0*	<0.20
boron	**50**		1.42	1.47	<0.10	<0.50*	<0.10
cadmium	**0.0001 - 0.0006**	H/P	<0.00020	<0.00020	<0.00020	<0.0010*	<0.00020
calcium			176	176	75.3	71.9*	26
chromium	**0.010^{VI}, 0.090^{III}**	V	<0.0020	<0.0020	<0.0020	<0.010*	<0.0020
cobalt	**0.04**		<0.010	<0.010	<0.010	*<0.050**	<0.010
copper	**0.020 - 0.090**	H	0.0072	0.0075	<0.0010	0.0214*	<0.0010
iron			0.049	0.055	<0.030	26.7*	0.86
lead	**0.040 - 0.160**	H	<0.00050	<0.00050	<0.00050	0.0214*	<0.00050
lithium			<0.010	<0.010	<0.010	0.098*	<0.010
magnesium			65.1	64.4	15.1	32.3*	9.49
manganese			0.0668	0.0604	0.244	0.455	0.857
mercury	**0.001**		<0.00020	<0.00020	<0.00020	<0.00020*	<0.00020
molybdenum	**10**		<0.030	<0.030	<0.030	<0.15*	<0.030
nickel	**0.250 - 1.5**	H	<0.050	<0.050	<0.050	<0.25*	<0.050
phosphorus			<0.30	<0.30	<0.30	<1.5*	<0.30
potassium			7.52	7.53	2.72	7.76*	1.14
selenium	**0.01**		<0.0010	<0.0010	<0.0010	**0.0123***	<0.0010
silicon			13	13	9.11	214*	4.97
silver	**0.0005 - 0.015**	H	<0.010	<0.010	<0.010	*<0.050**	<0.010
sodium			46.7	48	50.7	970*	3.5
strontium			0.62	0.631	0.209	1.08*	0.0793
thallium	**0.003**		*<0.20*	*<0.20*	*<0.20*	*<1.0**	*<0.20*
tin			<0.030	<0.030	<0.030	<0.15*	<0.030
titanium	**1**		<0.010	<0.010	0.013	0.825*	<0.010
uranium	**3**		0.00683	0.0068	0.00242	0.0272*	0.00024
vanadium			<0.030	<0.030	<0.030	<0.15*	<0.030
zinc	**0.075 - 2.4**	H/P	<0.050	<0.050	<0.050	<0.25*	<0.050
Other Inorganics							
bicarbonate (CaCO3)			207	214	135	318	101
carbonate (CaCO3)			<2.0	<2.0	<2.0	<1.0	<2.0
hydroxide (CaCO3)			<2.0	<2.0	<2.0	<1.0	<2.0
total alkalinity (CaCO3)			207	214	135	318	101
ammonia	**1.31 - 18.4**	pH/T	0.0095	<0.0050	0.0091	0.87	<0.0050
bromide (free)			2.07	2.07	0.36	<1.0	0.08
chloride	**1500**		191	187	33.8	287	9.88
fluoride	**2 - 3**	H	<0.20	<0.20	0.15	<0.40	0.117
nitrate (as N)	**400**		7.55	4.28	2.25	3.82	<0.0050
nitrite (as N)	**0.2 - 2**	Cl	0.802	1.37	0.0244	0.248	<0.0010
total Kjeldahl nitrogen			2.21	1.54	0.215	4.18	0.411
sulphate	**1000**		354	347	178	**1770**	4.54

Notes:
All concentrations in milligrams per litre (mg/L), unless otherwise noted.
Standards from the Contaminated Sites Regulation (CSR), its associated Schedules (Schedules 6 and 10) and
Technical Guidance Documents, enacted in 1997, and updated from time to time (includes May 31, 2011 updates).
Land Use abbreviations: AW (Aquatic Life) and DW (Drinking Water).
P = Protocol 10
H = standard is Hardness dependent
CL = standard is chloride dependent
pH = standard is pH dependent
V= Standard is valence dependent VI refers to chromium VI and III refers to chromium III
T = standard varies with temperature
MCS = Most Conservative Standard
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
SCN = sample control number
Italics indicates standard is below detection limit.
COC = Chain of Custody
* = Samples tested for dissolved metals were unfiltered

Table E-2
Results of Water Analyses - Hydrocarbons
[YTG Landfill Monitoring, Watson Lake, Yukon]

SCN			174289-01	174289-02	174289-03	174289-04	174289-05
Location	**Aquatic Life CSR-AW (freshwater)**		WL-MW12-01	WL-MW12-01D	WL-MW12-03	WL-MW12-04	WATSON LAKE SURFACE
QA/QC			FDA	FD			
Date			30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12
		Notes					
Monoaromatic Hydrocarbons							
benzene	**4**		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
ethylbenzene	**2**		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
styrene	**0.72**		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
toluene	**0.39**		<0.00050	<0.00050	<0.00060	<0.0040	<0.00050
ortho-xylene			<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
meta- & para-xylene			<0.00050	<0.00050	<0.00050	0.00071	<0.00050
total xylene			<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
VHw_{6-10}	**15**		<0.10	<0.10	<0.10	<0.10	<0.10
VPHw	**1.5**		<0.10	<0.10	<0.10	<0.10	<0.10
Polycyclic Aromatic Hydrocarbons							
acenaphthene	**0.06**		<0.000050	<0.000050	<0.000050	<0.00030	<0.000050
acenaphthylene			<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
acridine	**0.0005**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
anthracene	**0.001**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
benzo(a)anthracene	**0.001**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
benzo(a)pyrene	**0.0001**		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
benzo(b)fluoranthene			<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
benzo(g,h,i)perylene			<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
benzo(k)fluoranthene			<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
chrysene	**0.001**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
dibenzo(a,h)anthracene			<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
fluoranthene	**0.002**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
fluorene	**0.12**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
indeno(1,2,3-c,d)pyrene			<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
naphthalene	**0.01**		<0.000050	<0.000050	<0.000050	<0.00020	<0.000050
phenanthrene	**0.003**		<0.000050	<0.000050	<0.000050	<0.000060	<0.000050
pyrene	**0.0002**		<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
quinoline	**0.034**		<0.00020	<0.00020	<0.000050	<0.000050	<0.000050
Other Hydrocarbons							
$EPHw_{10-19}$	**5**		<0.25	<0.25	<0.25	2.33	<0.25
$EPHw_{19-32}$			0.54	0.44	<0.25	2.60	<0.25
LEPHw	**0.5**		<0.25	<0.25	<0.25	**2.33**	<0.25
HEPHw			0.54	0.44	<0.25	2.60	<0.25
Miscellaneous Organics							
methyl tertiary butyl ether (MTBE)	**34**		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Chlorinated Hydrocarbons							
bromodichloromethane (BDCM)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
tribromomethane (bromoform)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
tetrachloromethane (carbon tetrachloride)	**0.13**		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
monochlorobenzene (chlorobenzene)	**0.013**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
dibromochloromethane (DBCM)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
chloroethane (ethyl chloride)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trichloromethane (chloroform)	**0.02**		<0.0010	<0.0010	<0.0010	0.0013	<0.0010
chloromethane (methyl chloride)			<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-dichlorobenzene	**0.007**		<0.00070	<0.00070	<0.00070	<0.00070	<0.00070
1,3-dichlorobenzene	**1.5**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,4-dichlorobenzene	**0.26**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-dichloroethane			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-dichloroethane	**1**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1-dichloroethylene (1,1-dichloroethene)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-dichloroethylene (cis) (1,2-dichloroethene (cis))			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,2-dichloroethylene (trans) (1,2-dichloroethene (trans))			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,3-dichloropropene			<0.0014	<0.0014	<0.0014	<0.0014	<0.0014
dichloromethane (methylene chloride)	**0.98**		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
1,2-dichloropropane (propylene dichloride)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
cis-1,3-Dichloropropylene			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trans-1,3-Dichloropropylene			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,1,2-tetrachloroethane			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2,2-tetrachloroethane			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
tetrachloroethylene (1,1,2,2-tetrachloroethene)	**1.1**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,1-trichloroethane			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
1,1,2-trichloroethane			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trichloroethylene (1,1,2-trichloroethene)	**0.2**		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
trichlorofluromethane (freon 11)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
vinyl chloride (chloroethene)			<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Notes:
All concentrations in milligrams per litre (mg/L), unless otherwise noted.
Standards from the Contaminated Sites Regulation (CSR), its associated Schedules (Schedules 6 and 10) and
Technical Guidance Documents, enacted in 1997, and updated from time to time (includes May 31, 2011 updates).
Land Use abbreviations: AW (Aquatic Life); IW (Irrigation); LW (Livestock); and DW (Drinking Water).
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
SCN = sample control number
COC = Chain of Custody
$EPHw_{10-19}$ = extractable petroleum hydrocarbons, carbon range 10-19
LEPHw = light extractable petroleum hydrocarbons
Where water use for the protection of aquatic life applies, the standards for $EPHw_{10-19}$ is equivalent to LEPHw, when no LEPHw analysis is undertaken.
VPHw = volatile petroleum hydrocarbons
VHw_{6-10} = volatile hydrocarbons, carbon range 6-10
Where water use for the protection of aquatic life applies, the standards for VHw6-10 equivalent to VPHw, when no VPHw analysis is undertaken.
PAH = polycyclic aromatic hydrocarbon

Table E-3
Results of Quality Control Analyses - Metals
[YTG Landfill Monitoring, Watson Lake, Yukon]

SCN	174289-01	174289-02	**Method Detection Limit**	**Mean**	**Relative Percent Difference**	**Difference Factor (DF)**
Location	WL-MW12-01	WL-MW12-01D				
QA/QC	FDA	FD				
Date	30-MAY-12	30-MAY-12				
Laboratory Parameters						
pH (laboratory)	7.72	7.75	0.10	7.735	0.39%	NA
Hardness (as CaCO3)	708	705	0.50	706.5	0.42%	NA
total dissolved solids	1090	1080	10	1085	0.92%	NA
Aggregate Organics						
COD	73	64	20	68.5	NA	0.45
dissolved organic carbon	16.3	16.5	1.0	16.4	1.22%	NA
Bacteriological						
Coliform Bacteria - Fecal	<2	<2	2	NC	NC	NA
Dissolved Metals						
aluminum	<0.010	<0.010	0.010	NC	NC	NA
antimony	<0.00050	<0.00050	0.00050	NC	NC	NA
arsenic	0.00028	0.00029	0.00010	0.000285	NA	0.10
barium	0.046	0.046	0.020	0.046	NA	0.00
beryllium	<0.0050	<0.0050	0.0050	NC	NC	NA
bismuth	<0.20	<0.20	0.20	NC	NC	NA
boron	1.42	1.47	0.10	1.445	3.46%	NA
cadmium	<0.00020	<0.00020	0.00020	NC	NC	NA
calcium	176	176	0.10	176	0.00%	NA
chromium	<0.0020	<0.0020	0.0020	NC	NC	NA
cobalt	<0.010	<0.010	0.010	NC	NC	NA
copper	0.0072	0.0075	0.0010	0.00735	4.08%	NA
iron	0.049	0.055	0.030	0.052	NA	0.20
lead	<0.00050	<0.00050	0.00050	NC	NC	NA
lithium	<0.010	<0.010	0.010	NC	NC	NA
magnesium	65.1	64.4	0.10	64.75	1.08%	NA
manganese	0.0668	0.0604	0.0020	0.0636	10.06%	NA
mercury	<0.00020	<0.00020	0.00020	NC	NC	NA
molybdenum	<0.030	<0.030	0.030	NC	NC	NA
nickel	<0.050	<0.050	0.050	NC	NC	NA
phosphorus	<0.30	<0.30	0.30	NC	NC	NA
potassium	7.52	7.53	0.10	7.525	0.13%	NA
selenium	<0.0010	<0.0010	0.0010	NC	NC	NA
silicon	13	13	0.050	13	0.00%	NA
silver	<0.010	<0.010	0.010	NC	NC	NA
sodium	46.7	48	2.0	47.35	2.75%	NA
strontium	0.62	0.631	0.0050	0.6255	1.76%	NA
thallium	<0.20	<0.20	0.20	NC	NC	NA
tin	<0.030	<0.030	0.030	NC	NC	NA
titanium	<0.010	<0.010	0.010	NC	NC	NA
uranium	0.00683	0.0068	0.00010	0.006815	0.44%	NA
vanadium	<0.030	<0.030	0.030	NC	NC	NA
zinc	<0.050	<0.050	0.050	NC	NC	NA
Other Inorganics						
bicarbonate (CaCO3)	207	214	2.0	210.5	3.33%	NA
carbonate (CaCO3)	<2.0	<2.0	2.0	NC	NC	NA
hydroxide (CaCO3)	<2.0	<2.0	2.0	NC	NC	NA
total alkalinity (CaCO3)	207	214	2.0	210.5	3.33%	NA
ammonia	0.0095	<0.0050	0.0050	NC	NC	NA
bromide (free)	2.07	2.07	0.50	2.07	NA	0.00
chloride	191	187	5.0	189	2.12%	NA
fluoride	<0.20	<0.20	0.20	NC	NC	NA
nitrate (as N)	7.55	4.28	0.050	5.915	**55.28%**	NA
nitrite (as N)	0.802	1.37	0.010	1.086	**52.30%**	NA
total Kjeldahl nitrogen	2.21	1.54	0.25	1.875	**35.73%**	NA
sulphate	354	347	5.0	350.5	2.00%	NA

Notes:
All concentrations in milligrams per litre (mg/L), unless otherwise noted.
Method Detection Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.
Mean indicates the mean or average value calculated of a field duplicate pair (the FDA and the FD).
Relative Percent Difference is calculated when the mean value is greater than five times the method detection limit; Golder's internal QA/QC target is less than 35%.
Difference Factor is calculated when the mean value is less than five times the method detection limit; Golder's internal QA/QC target is less than 2.
NC = Not Calculated
NA = not applicable
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
SCN = sample control number
COC = Chain of Custody
BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.

Table E-4
Results of Quality Control Analyses - Hydrocarbons
[YTG Landfill Monitoring, Watson Lake, Yukon]

SCN	174289-01	174289-02	**Method Detection Limit**	**Mean**	**Relative Percent Difference**	**Difference Factor (DF)**
Location	WL-MW12-01	WL-MW12-01D				
QA/QC	FDA	FD				
Date	30-MAY-12	30-MAY-12				
Monoaromatic Hydrocarbons						
benzene	<0.00050	<0.00050	0.00050	NC	NC	NA
ethylbenzene	<0.00050	<0.00050	0.00050	NC	NC	NA
styrene	<0.00050	<0.00050	0.00050	NC	NC	NA
toluene	<0.00050	<0.00050	0.00050	NC	NC	NA
ortho-xylene	<0.00050	<0.00050	0.00050	NC	NC	NA
meta- & para-xylene	<0.00050	<0.00050	0.00050	NC	NC	NA
total xylene	<0.00075	<0.00075	0.00075	NC	NC	NA
VHw$_{6-10}$	<0.10	<0.10	0.10	NC	NC	NA
VPHw	<0.10	<0.10	0.10	NC	NC	NA
Polycyclic Aromatic Hydrocarbons						
acenaphthene	<0.000050	<0.000050	0.000050	NC	NC	NA
acenaphthylene	<0.000050	<0.000050	0.000050	NC	NC	NA
acridine	<0.000050	<0.000050	0.000050	NC	NC	NA
anthracene	<0.000050	<0.000050	0.000050	NC	NC	NA
benzo(a)anthracene	<0.000050	<0.000050	0.000050	NC	NC	NA
benzo(a)pyrene	<0.000010	<0.000010	0.000010	NC	NC	NA
benzo(b)fluoranthene	<0.000050	<0.000050	0.000050	NC	NC	NA
benzo(g,h,i)perylene	<0.000050	<0.000050	0.000050	NC	NC	NA
benzo(k)fluoranthene	<0.000050	<0.000050	0.000050	NC	NC	NA
chrysene	<0.000050	<0.000050	0.000050	NC	NC	NA
dibenzo(a,h)anthracene	<0.000050	<0.000050	0.000050	NC	NC	NA
fluoranthene	<0.000050	<0.000050	0.000050	NC	NC	NA
fluorene	<0.000050	<0.000050	0.000050	NC	NC	NA
indeno(1,2,3-c,d)pyrene	<0.000050	<0.000050	0.000050	NC	NC	NA
naphthalene	<0.000050	<0.000050	0.000050	NC	NC	NA
phenanthrene	<0.000050	<0.000050	0.000050	NC	NC	NA
pyrene	<0.000050	<0.000050	0.000050	NC	NC	NA
quinoline	<0.00020	<0.00020	0.00020	NC	NC	NA
Other Hydrocarbons						
EPHw$_{10-19}$	<0.25	<0.25	0.25	NC	NC	NA
EPHw$_{19-32}$	0.54	0.44	0.25	0.49	NA	0.40
LEPHw	<0.25	<0.25	0.25	NC	NC	NA
HEPHw	0.54	0.44	0.25	0.49	NA	0.40
Miscellaneous Organics						
methyl tertiary butyl ether (MTBE)	<0.00050	<0.00050	0.00050	NC	NC	NA
Chlorinated Hydrocarbons						
bromodichloromethane (BDCM)	<0.0010	<0.0010	0.0010	NC	NC	NA
tribromomethane (bromoform)	<0.0010	<0.0010	0.0010	NC	NC	NA
tetrachloromethane (carbon tetrachloride)	<0.00050	<0.00050	0.00050	NC	NC	NA
monochlorobenzene (chlorobenzene)	<0.0010	<0.0010	0.0010	NC	NC	NA
dibromochloromethane (DBCM)	<0.0010	<0.0010	0.0010	NC	NC	NA
chloroethane (ethyl chloride)	<0.0010	<0.0010	0.0010	NC	NC	NA
trichloromethane (chloroform)	<0.0010	<0.0010	0.0010	NC	NC	NA
chloromethane (methyl chloride)	<0.0050	<0.0050	0.0050	NC	NC	NA
1,2-dichlorobenzene	<0.00070	<0.00070	0.00070	NC	NC	NA
1,3-dichlorobenzene	<0.0010	<0.0010	0.0010	NC	NC	NA
1,4-dichlorobenzene	<0.0010	<0.0010	0.0010	NC	NC	NA
1,1-dichloroethane	<0.0010	<0.0010	0.0010	NC	NC	NA
1,2-dichloroethane	<0.0010	<0.0010	0.0010	NC	NC	NA
1,1-dichloroethylene (1,1-dichloroethene)	<0.0010	<0.0010	0.0010	NC	NC	NA
1,2-dichloroethylene (cis) (1,2-dichloroethene (cis))	<0.0010	<0.0010	0.0010	NC	NC	NA
1,2-dichloroethylene (trans) (1,2-dichloroethene (trans))	<0.0010	<0.0010	0.0010	NC	NC	NA
1,3-dichloropropene	<0.0014	<0.0014	0.0014	NC	NC	NA
dichloromethane (methylene chloride)	<0.0050	<0.0050	0.0050	NC	NC	NA
1,2-dichloropropane (propylene dichloride)	<0.0010	<0.0010	0.0010	NC	NC	NA
cis-1,3-Dichloropropylene	<0.0010	<0.0010	0.0010	NC	NC	NA
trans-1,3-Dichloropropylene	<0.0010	<0.0010	0.0010	NC	NC	NA
1,1,1,2-tetrachloroethane	<0.0010	<0.0010	0.0010	NC	NC	NA
1,1,2,2-tetrachloroethane	<0.0010	<0.0010	0.0010	NC	NC	NA
tetrachloroethylene (1,1,2,2-tetrachloroethene)	<0.0010	<0.0010	0.0010	NC	NC	NA
1,1,1-trichloroethane	<0.0010	<0.0010	0.0010	NC	NC	NA
1,1,2-trichloroethane	<0.0010	<0.0010	0.0010	NC	NC	NA
trichloroethylene (1,1,2-trichloroethene)	<0.0010	<0.0010	0.0010	NC	NC	NA
trichlorofluromethane (freon 11)	<0.0010	<0.0010	0.0010	NC	NC	NA
vinyl chloride (chloroethene)	<0.0010	<0.0010	0.0010	NC	NC	NA

Notes:
All concentrations in milligrams per litre (mg/L), unless otherwise noted.
Method Detection Limit indicates the minimum concentration that could be measured by laboratory instrumentation for a specific sample.
Mean indicates the mean or average value calculated of a field duplicate pair (the FDA and the FD).
Relative Percent Difference is calculated when the mean value is greater than five times the method detection limit; Golder's internal QA/QC target is less than 35%.
Difference Factor is calculated when the mean value is less than five times the method detection limit; Golder's internal QA/QC target is less than 2.
NC = Not Calculated
NA = not applicable
FDA = field duplicate available
FD = field duplicate
QA/QC = quality assurance/quality control
SCN = sample control number
COC = Chain of Custody
BOLD font indicates the parameter analysed exceeds Golder's internal QA/QC targets.

10- 174289

ALS Environmental

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

Page 1 of 1

Report To

Company: GOLDER

Contact: JOE MARQUARDSON

Address: 201 B 170 TITANIUM WAY
VIA 0G1

Phone: 867·334·7423 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)

Report Format / Distribution

Standard: X Other (specify):

Select: PDF X Excel X Digital Fax

Email 1: jmarquardson@golder.com

Email 2: ghamilton@golder.com

Client / Project Information

Job #: 11-1436-0073/1400

PO / AFE:

LSD:

Quote #:

ALS Contact:

Sampler: J. MARQUARDSON
A. BADGER

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	GENERAL	DOC	PAH	BTEX	NUTRIENTS	DISSOLVED METALS	FECAL COLIFORM						Number of Containers
	WL-MW12-01	30-MAY-12	12:25	GW	X	X	X	X	X	X	X						
	WL-MW12-01D	30-MAY-12	12:45	GW	X	X	X	X	X	X	X						
	WL-MW12-03	30-MAY-12	9:50	GW	X	X	X	X	X	X	X						
	WL-MW12-04	30-MAY-12	11:10	GW	X	X	X	X	X	X	X	AB					
	WATSON LAKE SURFACE	30-MAY-12	13:30	SW	X	X	X	X	X	X	X						

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

NOTE WL-MW12-04 METALS AND DOC SAMPLES ARE NOT FILTERED OR PRESERVED AB

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)

Released by: J. MARQUARDSON

Date: 30-MAY-12

Time: 19:00

SHIPMENT RECEPTION (lab use only)

Received by:

Date:

Time:

Temperature: °C

SHIPMENT VERIFICATION (lab use only)

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

GOLDER ASSOCIATES LTD.
ATTN: Joe Marquardson
201B 170 Titanium Way
Whitehorse YT Y1A 0G1

Date Received:	31-MAY-12
Report Date:	08-JUN-12 13:19 (MT)
Version:	FINAL

Client Phone: 867-334-7423

Certificate of Analysis

Lab Work Order #:	**L1155320**
Project P.O. #:	NOT SUBMITTED
Job Reference:	11-1436-0073/1400
C of C Numbers:	10-174289
Legal Site Desc:	

Amber Springer

Amber Springer
Account Manager

	Sample ID	L1155320-1	L1155320-2	L1155320-3	L1155320-4	L1155320-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12
	Sampled Time	12:25	12:45	09:50	11:10	13:30
	Client ID	WL-MW12-01	WL-MW12-01D	WL-MW12-03	WL-MW12-04	WATSON LAKE SURFACE
Grouping	**Analyte**					
WATER						
Physical Tests	Hardness (as CaCO3) (mg/L)	708	705	250	313	104
	pH (pH)	7.72	7.75	8.10	7.84	7.83
	Total Dissolved Solids (mg/L)	1090	1080	463	2960	155
Anions and Nutrients	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	207	214	135	318	101
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<1.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<1.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	207	214	135	318	101
	Ammonia, Total (as N) (mg/L)	0.0095	<0.0050	0.0091	0.870	<0.0050
	Bromide (Br) (mg/L)	2.07	2.07	0.36	<1.0 DLM	0.080
	Chloride (Cl) (mg/L)	191	187	33.8	287	9.88
	Fluoride (F) (mg/L)	<0.20 DLM	<0.20 DLM	0.15	<0.40 DLM	0.117
	Nitrate (as N) (mg/L)	7.55	4.28	2.25	3.82	<0.0050
	Nitrite (as N) (mg/L)	0.802	1.37	0.0244	0.248	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	2.21	1.54	0.215 TKNI	4.18	0.411
	Sulfate (SO4) (mg/L)	354	347	178	1770	4.54
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)	16.3	16.5	3.10	3.62	9.13
Bacteriological Tests	Coliform Bacteria - Fecal (MPN/100mL)	<2 PEHR	<2 PEHR	<2 PEHR	<2 PEHR	<2 PEHR
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	LAB	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.010	<0.010	<0.010	86.5	0.011
	Antimony (Sb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.0026	<0.00050
	Arsenic (As)-Dissolved (mg/L)	0.00028	0.00029	0.00024	0.00659	0.00051
	Barium (Ba)-Dissolved (mg/L)	0.046	0.046	0.079	0.17	0.039
	Beryllium (Be)-Dissolved (mg/L)	<0.0050	<0.0050	<0.0050	<0.025 DLA	<0.0050
	Bismuth (Bi)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<1.0 DLA	<0.20
	Boron (B)-Dissolved (mg/L)	1.42	1.47	<0.10	<0.50 DLA	<0.10
	Cadmium (Cd)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.0010 DLA	<0.00020
	Calcium (Ca)-Dissolved (mg/L)	176	176	75.3	71.9	26.0
	Chromium (Cr)-Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	<0.010 DLA	<0.0020
	Cobalt (Co)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.050 DLA	<0.010
	Copper (Cu)-Dissolved (mg/L)	0.0072	0.0075	<0.0010	0.0214	<0.0010
	Iron (Fe)-Dissolved (mg/L)	0.049	0.055	<0.030	26.7	0.860
	Lead (Pb)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.0214	<0.00050
	Lithium (Li)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.098	<0.010
	Magnesium (Mg)-Dissolved (mg/L)	65.1	64.4	15.1	32.3	9.49
	Manganese (Mn)-Dissolved (mg/L)	0.0668	0.0604	0.244	0.455	0.857
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1155320-1	L1155320-2	L1155320-3	L1155320-4	L1155320-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12
	Sampled Time	12:25	12:45	09:50	11:10	13:30
	Client ID	WL-MW12-01	WL-MW12-01D	WL-MW12-03	WL-MW12-04	WATSON LAKE SURFACE
Grouping	**Analyte**					
WATER						
Dissolved Metals	Molybdenum (Mo)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.15 DLA	<0.030
	Nickel (Ni)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.25 DLA	<0.050
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<1.5 DLA	<0.30
	Potassium (K)-Dissolved (mg/L)	7.52	7.53	2.72	7.76	1.14
	Selenium (Se)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	0.0123	<0.0010
	Silicon (Si)-Dissolved (mg/L)	13.0	13.0	9.11	214	4.97
	Silver (Ag)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.050 DLA	<0.010
	Sodium (Na)-Dissolved (mg/L)	46.7	48.0	50.7	970	3.5
	Strontium (Sr)-Dissolved (mg/L)	0.620	0.631	0.209	1.08 DLA	0.0793
	Thallium (Tl)-Dissolved (mg/L)	<0.20	<0.20	<0.20	<1.0 DLA	<0.20
	Tin (Sn)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.15 DLA	<0.030
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	0.013	0.825	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00683	0.00680	0.00242	0.0272	0.00024
	Vanadium (V)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.15 DLA	<0.030
	Zinc (Zn)-Dissolved (mg/L)	<0.050	<0.050	<0.050	<0.25 DLA	<0.050
Aggregate Organics	COD (mg/L)	73	64	22	56	39
Volatile Organic Compounds	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
	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	0.0013	<0.0010
	Chloromethane (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1155320-1	L1155320-2	L1155320-3	L1155320-4	L1155320-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12
	Sampled Time	12:25	12:45	09:50	11:10	13:30
	Client ID	WL-MW12-01	WL-MW12-01D	WL-MW12-03	WL-MW12-04	WATSON LAKE SURFACE
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	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 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	<0.00060^{DLM}	<0.0040^{DLB}	<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	0.00071	<0.00050
	Xylenes (mg/L)	<0.00075	<0.00075	<0.00075	<0.00075	<0.00075
	Surrogate: 4-Bromofluorobenzene (SS) (%)	101.7	99.2	102.5	102.0	101.7
	Surrogate: 1,4-Difluorobenzene (SS) (%)	105.2	104.6	105.5	100.0	105.3
Hydrocarbons	EPH10-19 (mg/L)	<0.25	<0.25	<0.25	2.33	<0.25
	EPH19-32 (mg/L)	0.54	0.44	<0.25	2.60	<0.25
	LEPH (mg/L)	<0.25	<0.25	<0.25	2.33	<0.25
	HEPH (mg/L)	0.54	0.44	<0.25	2.60	<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) (%)	79.5	103.4	105.9	95.1	109.1
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.00030^{DLM}	<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

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1155320-1	L1155320-2	L1155320-3	L1155320-4	L1155320-5
	Description	GW	GW	GW	GW	GW
	Sampled Date	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12	30-MAY-12
	Sampled Time	12:25	12:45	09:50	11:10	13:30
	Client ID	WL-MW12-01	WL-MW12-01D	WL-MW12-03	WL-MW12-04	WATSON LAKE SURFACE
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	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	DLM <0.00020	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	DLM <0.000060	<0.000050
	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	DLM <0.00020	DLM <0.00020	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	92.0	92.3	95.9	100.2	99.1
	Surrogate: Acridine d9 (%)	118.8	98.2	102.1	90.8	105.0
	Surrogate: Chrysene d12 (%)	87.1	90.4	93.1	96.4	98.2
	Surrogate: Naphthalene d8 (%)	95.1	90.0	99.4	87.9	97.6
	Surrogate: Phenanthrene d10 (%)	103.8	96.5	99.7	87.9	102.1

* 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	Aluminum (Al)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Chromium (Cr)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Lead (Pb)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Selenium (Se)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Zinc (Zn)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Aluminum (Al)-Dissolved	DLA	L1155320-4
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1155320-4
Duplicate	Chromium (Cr)-Dissolved	DLA	L1155320-4
Duplicate	Lead (Pb)-Dissolved	DLA	L1155320-4
Duplicate	Selenium (Se)-Dissolved	DLA	L1155320-4
Duplicate	Zinc (Zn)-Dissolved	DLA	L1155320-4
Duplicate	Beryllium (Be)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Molybdenum (Mo)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Phosphorus (P)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Silver (Ag)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Thallium (Tl)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Tin (Sn)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Titanium (Ti)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Vanadium (V)-Dissolved	DLA	L1155320-1, -2, -3, -5
Duplicate	Bromide (Br)	DLM	L1155320-1, -2, -3, -4, -5
Duplicate	Bromide (Br)	DLM	L1155320-1, -2, -3, -4, -5
Duplicate	Chloride (Cl)	DLM	L1155320-1, -2, -3, -4, -5
Duplicate	Nitrite (as N)	DLM	L1155320-1, -2, -3, -4, -5
Duplicate	Nitrate (as N)	DLM	L1155320-1, -2, -3, -4, -5
Duplicate	Cadmium (Cd)-Dissolved	DLM	L1155320-1, -2, -3, -5
Duplicate	Cadmium (Cd)-Dissolved	DLM	L1155320-1, -2, -3, -5
Laboratory Control Sample	1,1,1-Trichloroethane	LCS-ND	L1155320-1, -2, -3, -5
Laboratory Control Sample	Carbon Tetrachloride	LCS-ND	L1155320-1, -2, -3, -5
Laboratory Control Sample	Chloroform	LCS-ND	L1155320-1, -2, -3, -5
Laboratory Control Sample	Tetrachloroethylene	LCS-ND	L1155320-1, -2, -3, -5
Laboratory Control Sample	Trichloroethylene	LCS-ND	L1155320-1, -2, -3, -5
Laboratory Control Sample	Trichlorofluoromethane	LCS-ND	L1155320-1, -2, -3, -5
Laboratory Control Sample	cis-1,2-Dichloroethylene	LCS-ND	L1155320-1, -2, -3, -5
Method Blank	Toluene	MB-LOR	L1155320-4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1155320-1, -2, -3, -5
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1155320-4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1155320-4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLB	Detection limit was raised due to detection of analyte at comparable level in Method Blank.

Reference Information

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.
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.
PEHR	Parameter Exceeded Recommended Holding Time On Receipt: Proceed With Analysis As Requested.
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.			
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-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. OR 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".			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
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.			
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).			
FCOLI-MTF-ENV-VA	Water	Fecal coliform by MPN	APHA METHOD 9221
This analysis is carried out using procedures adapted from APHA Method 9221 "Multiple-Tube Fermentation Technique for Members of the Coliform Group". Serial dilutions of the sample are incubated with the appropriate growth medium, and coliform bacteria is quantified by a statistical estimation of bacteria density (most probable number). The test involves an initial 48 hour incubation (presumptive test), postive results require further testing (up to an additional 72 hours) to confirm and quantify total and fecal coliform.			

Reference Information

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.

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-MAN-VA Water pH by Manual Meter 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-MAN-VA Water pH by Manual Meter 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.

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.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids

Reference Information

(TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

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.

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.

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:

10-174289

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.

Quality Control Report

Workorder: L1155320 Report Date: 08-JUN-12

Client: GOLDER ASSOCIATES LTD.
201B 170 Titanium Way
Whitehorse YT Y1A 0G1
Contact: Joe Marquardson

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-VA	**Water**							
Batch R2378230								
WG1483829-11 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			109.9		%		85-115	05-JUN-12
WG1483829-12 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			108.6		%		85-115	05-JUN-12
WG1483829-13 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			108.0		%		85-115	05-JUN-12
WG1483829-14 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			108.4		%		85-115	05-JUN-12
WG1483829-8 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			109.9		%		85-115	05-JUN-12
WG1483829-9 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			108.4		%		85-115	05-JUN-12
WG1483829-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Bicarbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Carbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Hydroxide (as CaCO3)			<1.0		mg/L		1	05-JUN-12
WG1483829-2 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Bicarbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Carbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Hydroxide (as CaCO3)			<1.0		mg/L		1	05-JUN-12
WG1483829-3 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Bicarbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Carbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Hydroxide (as CaCO3)			<1.0		mg/L		1	05-JUN-12
WG1483829-4 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Bicarbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Carbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Hydroxide (as CaCO3)			<1.0		mg/L		1	05-JUN-12
WG1483829-5 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Bicarbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Carbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Hydroxide (as CaCO3)			<1.0		mg/L		1	05-JUN-12

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-VA	**Water**							
Batch R2378230								
WG1483829-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Bicarbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Carbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Hydroxide (as CaCO3)			<1.0		mg/L		1	05-JUN-12
WG1483829-7 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Bicarbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Carbonate (as CaCO3)			<1.0		mg/L		1	05-JUN-12
Alkalinity, Hydroxide (as CaCO3)			<1.0		mg/L		1	05-JUN-12
ALK-SCR-VA	**Water**							
Batch R2376596								
WG1483140-2 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			100.9		%		85-115	04-JUN-12
WG1483140-5 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			94.4		%		85-115	04-JUN-12
WG1483140-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	04-JUN-12
WG1483140-4 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	04-JUN-12
WG1483140-7 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	04-JUN-12
ANIONS-BR-IC-VA	**Water**							
Batch R2376810								
WG1483031-15 LCS								
Bromide (Br)			100.9		%		85-115	04-JUN-12
WG1483031-2 LCS								
Bromide (Br)			101.4		%		85-115	04-JUN-12
WG1483031-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	04-JUN-12
WG1483031-10 MB								
Bromide (Br)			<0.050		mg/L		0.05	04-JUN-12
WG1483031-13 MB								
Bromide (Br)			<0.050		mg/L		0.05	04-JUN-12
WG1483031-4 MB								
Bromide (Br)			<0.050		mg/L		0.05	04-JUN-12
WG1483031-7 MB								
Bromide (Br)			<0.050		mg/L		0.05	04-JUN-12

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-BR-IC-VA	**Water**							
Batch R2376810								
WG1483031-11 MS		**L1156445-4**						
Bromide (Br)			97.0		%		75-125	04-JUN-12
WG1483031-14 MS		**L1156448-1**						
Bromide (Br)			100.8		%		75-125	04-JUN-12
WG1483031-8 MS		**L1155597-4**						
Bromide (Br)			106.0		%		75-125	04-JUN-12
ANIONS-CL-IC-VA	**Water**							
Batch R2376810								
WG1483031-15 LCS								
Chloride (Cl)			100.3		%		85-115	04-JUN-12
WG1483031-2 LCS								
Chloride (Cl)			100.0		%		85-115	04-JUN-12
WG1483031-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-10 MB								
Chloride (Cl)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-13 MB								
Chloride (Cl)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-7 MB								
Chloride (Cl)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-11 MS		**L1156445-4**						
Chloride (Cl)			101.3		%		75-125	04-JUN-12
WG1483031-14 MS		**L1156448-1**						
Chloride (Cl)			101.5		%		75-125	04-JUN-12
WG1483031-8 MS		**L1155597-4**						
Chloride (Cl)			100.2		%		75-125	04-JUN-12
ANIONS-F-IC-VA	**Water**							
Batch R2376810								
WG1483031-15 LCS								
Fluoride (F)			106.2		%		85-115	04-JUN-12
WG1483031-2 LCS								
Fluoride (F)			105.8		%		85-115	04-JUN-12
WG1483031-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	04-JUN-12
WG1483031-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	04-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-F-IC-VA	**Water**							
Batch R2376810								
WG1483031-13 MB								
Fluoride (F)			<0.020		mg/L		0.02	04-JUN-12
WG1483031-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	04-JUN-12
WG1483031-7 MB								
Fluoride (F)			<0.020		mg/L		0.02	04-JUN-12
WG1483031-11 MS		**L1156445-4**						
Fluoride (F)			106.6		%		75-125	04-JUN-12
WG1483031-14 MS		**L1156448-1**						
Fluoride (F)			106.9		%		75-125	04-JUN-12
WG1483031-8 MS		**L1155597-4**						
Fluoride (F)			108.5		%		75-125	04-JUN-12
ANIONS-NO2-IC-VA	**Water**							
Batch R2376810								
WG1483031-15 LCS								
Nitrite (as N)			103.2		%		85-115	04-JUN-12
WG1483031-2 LCS								
Nitrite (as N)			101.1		%		85-115	04-JUN-12
WG1483031-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	04-JUN-12
WG1483031-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	04-JUN-12
WG1483031-13 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	04-JUN-12
WG1483031-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	04-JUN-12
WG1483031-7 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	04-JUN-12
WG1483031-11 MS		**L1156445-4**						
Nitrite (as N)			100.1		%		75-125	04-JUN-12
WG1483031-14 MS		**L1156448-1**						
Nitrite (as N)			100.6		%		75-125	04-JUN-12
WG1483031-5 MS		**L1155050-19**						
Nitrite (as N)			99.1		%		75-125	04-JUN-12
WG1483031-8 MS		**L1155597-4**						
Nitrite (as N)			100.5		%		75-125	04-JUN-12
ANIONS-NO3-IC-VA	**Water**							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO3-IC-VA	**Water**							
Batch R2376810								
WG1483031-15 LCS								
Nitrate (as N)			105.4		%		85-115	04-JUN-12
WG1483031-2 LCS								
Nitrate (as N)			104.7		%		85-115	04-JUN-12
WG1483031-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	04-JUN-12
WG1483031-10 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	04-JUN-12
WG1483031-13 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	04-JUN-12
WG1483031-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	04-JUN-12
WG1483031-7 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	04-JUN-12
WG1483031-11 MS		**L1156445-4**						
Nitrate (as N)			105.8		%		75-125	04-JUN-12
WG1483031-14 MS		**L1156448-1**						
Nitrate (as N)			106.9		%		75-125	04-JUN-12
WG1483031-5 MS		**L1155050-19**						
Nitrate (as N)			104.8		%		75-125	04-JUN-12
WG1483031-8 MS		**L1155597-4**						
Nitrate (as N)			107.0		%		75-125	04-JUN-12
ANIONS-SO4-IC-VA	**Water**							
Batch R2376810								
WG1483031-15 LCS								
Sulfate (SO4)			103.0		%		85-115	04-JUN-12
WG1483031-2 LCS								
Sulfate (SO4)			102.5		%		85-115	04-JUN-12
WG1483031-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-13 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-7 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	04-JUN-12
WG1483031-11 MS		**L1156445-4**						

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-SO4-IC-VA	**Water**							
Batch R2376810								
WG1483031-11 MS		**L1156445-4**						
Sulfate (SO4)			102.3		%		75-125	04-JUN-12
WG1483031-14 MS		**L1156448-1**						
Sulfate (SO4)			102.9		%		75-125	04-JUN-12
WG1483031-8 MS		**L1155597-4**						
Sulfate (SO4)			102.5		%		75-125	04-JUN-12
CARBONS-DOC-VA	**Water**							
Batch R2376983								
WG1483515-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	04-JUN-12
WG1483515-2 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	04-JUN-12
Batch R2377622								
WG1484301-1 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	05-JUN-12
WG1484301-2 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	05-JUN-12
WG1484301-3 MB								
Dissolved Organic Carbon			<0.50		mg/L		0.5	05-JUN-12
COD-COL-VA	**Water**							
Batch R2376581								
WG1483142-6 DUP		**L1155320-1**						
COD		73	73		mg/L	0.3	20	04-JUN-12
WG1483142-2 LCS								
COD			101.9		%		85-115	04-JUN-12
WG1483142-5 LCS								
COD			103.3		%		85-115	04-JUN-12
WG1483142-8 LCS								
COD			101.9		%		85-115	04-JUN-12
WG1483142-1 MB								
COD			<20		mg/L		20	04-JUN-12
WG1483142-4 MB								
COD			<20		mg/L		20	04-JUN-12
WG1483142-7 MB								
COD			<20		mg/L		20	04-JUN-12
EPH-SF-FID-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EPH-SF-FID-VA	**Water**							
Batch R2378052								
WG1484780-1 MB								
EPH10-19			<0.25		mg/L		0.25	07-JUN-12
EPH19-32			<0.25		mg/L		0.25	07-JUN-12
Batch R2378250								
WG1484780-3 MB								
EPH10-19			<0.25		mg/L		0.25	07-JUN-12
EPH19-32			<0.25		mg/L		0.25	07-JUN-12
HG-DIS-CVAFS-VA	**Water**							
Batch R2375154								
WG1481705-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	01-JUN-12
Batch R2376273								
WG1482531-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	04-JUN-12
WG1481705-3 MS		**L1155048-15**						
Mercury (Hg)-Dissolved			80.6		%		70-130	04-JUN-12
Batch R2376930								
WG1481705-8 MS		**L1155418-1**						
Mercury (Hg)-Dissolved			91.9		%		70-130	05-JUN-12
MET-DIS-ICP-VA	**Water**							
Batch R2375338								
WG1481705-3 MS		**L1155048-15**						
Iron (Fe)-Dissolved			94.7		%		70-130	01-JUN-12
Sodium (Na)-Dissolved			97.0		%		70-130	01-JUN-12
Titanium (Ti)-Dissolved			103.9		%		70-130	01-JUN-12
Batch R2375353								
WG1481705-2 CRM		**VA-HIGH-WATRM**						
Beryllium (Be)-Dissolved			98.4		%		80-120	01-JUN-12
Bismuth (Bi)-Dissolved			99.2		%		80-120	01-JUN-12
Cobalt (Co)-Dissolved			96.0		%		80-120	01-JUN-12
Iron (Fe)-Dissolved			98.2		%		80-120	01-JUN-12
Lithium (Li)-Dissolved			98.8		%		80-120	01-JUN-12
Molybdenum (Mo)-Dissolved			99.0		%		80-120	01-JUN-12
Nickel (Ni)-Dissolved			100.1		%		80-120	01-JUN-12
Phosphorus (P)-Dissolved			100.5		%		80-120	01-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2375353								
WG1481705-2 CRM		**VA-HIGH-WATRM**						
Silicon (Si)-Dissolved			104.2		%		80-120	01-JUN-12
Silver (Ag)-Dissolved			91.7		%		80-120	01-JUN-12
Sodium (Na)-Dissolved			101.7		%		80-120	01-JUN-12
Strontium (Sr)-Dissolved			101.5		%		80-120	01-JUN-12
Thallium (Tl)-Dissolved			97.8		%		80-120	01-JUN-12
Tin (Sn)-Dissolved			99.6		%		80-120	01-JUN-12
Titanium (Ti)-Dissolved			101.8		%		80-120	01-JUN-12
Vanadium (V)-Dissolved			98.4		%		80-120	01-JUN-12
WG1481705-1 MB								
Beryllium (Be)-Dissolved			<0.0050		mg/L		0.005	01-JUN-12
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	01-JUN-12
Cobalt (Co)-Dissolved			<0.010		mg/L		0.01	01-JUN-12
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	01-JUN-12
Lithium (Li)-Dissolved			<0.010		mg/L		0.01	01-JUN-12
Molybdenum (Mo)-Dissolved			<0.030		mg/L		0.03	01-JUN-12
Nickel (Ni)-Dissolved			<0.050		mg/L		0.05	01-JUN-12
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	01-JUN-12
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	01-JUN-12
Silver (Ag)-Dissolved			<0.010		mg/L		0.01	01-JUN-12
Sodium (Na)-Dissolved			<2.0		mg/L		2	01-JUN-12
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	01-JUN-12
Thallium (Tl)-Dissolved			<0.20		mg/L		0.2	01-JUN-12
Tin (Sn)-Dissolved			<0.030		mg/L		0.03	01-JUN-12
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	01-JUN-12
Vanadium (V)-Dissolved			<0.030		mg/L		0.03	01-JUN-12
Batch R2375891								
WG1482531-3 CRM		**VA-HIGH-WATRM**						
Beryllium (Be)-Dissolved			100.5		%		80-120	02-JUN-12
Bismuth (Bi)-Dissolved			100.2		%		80-120	02-JUN-12
Cobalt (Co)-Dissolved			96.9		%		80-120	02-JUN-12
Iron (Fe)-Dissolved			98.7		%		80-120	02-JUN-12
Lithium (Li)-Dissolved			102.6		%		80-120	02-JUN-12
Molybdenum (Mo)-Dissolved			100.0		%		80-120	02-JUN-12
Nickel (Ni)-Dissolved			101.7		%		80-120	02-JUN-12
Phosphorus (P)-Dissolved			101.5		%		80-120	02-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2375891								
WG1482531-3 CRM		**VA-HIGH-WATRM**						
Silicon (Si)-Dissolved			105.6		%		80-120	02-JUN-12
Silver (Ag)-Dissolved			92.8		%		80-120	02-JUN-12
Sodium (Na)-Dissolved			98.8		%		80-120	02-JUN-12
Strontium (Sr)-Dissolved			103.4		%		80-120	02-JUN-12
Thallium (Tl)-Dissolved			99.2		%		80-120	02-JUN-12
Tin (Sn)-Dissolved			99.8		%		80-120	02-JUN-12
Titanium (Ti)-Dissolved			105.2		%		80-120	02-JUN-12
Vanadium (V)-Dissolved			100.5		%		80-120	02-JUN-12
WG1482531-1 MB								
Beryllium (Be)-Dissolved			<0.0050		mg/L		0.005	02-JUN-12
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	02-JUN-12
Cobalt (Co)-Dissolved			<0.010		mg/L		0.01	02-JUN-12
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	02-JUN-12
Lithium (Li)-Dissolved			<0.010		mg/L		0.01	02-JUN-12
Molybdenum (Mo)-Dissolved			<0.030		mg/L		0.03	02-JUN-12
Nickel (Ni)-Dissolved			<0.050		mg/L		0.05	02-JUN-12
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	02-JUN-12
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	02-JUN-12
Silver (Ag)-Dissolved			<0.010		mg/L		0.01	02-JUN-12
Sodium (Na)-Dissolved			<2.0		mg/L		2	02-JUN-12
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	02-JUN-12
Thallium (Tl)-Dissolved			<0.20		mg/L		0.2	02-JUN-12
Tin (Sn)-Dissolved			<0.030		mg/L		0.03	02-JUN-12
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	02-JUN-12
Vanadium (V)-Dissolved			<0.030		mg/L		0.03	02-JUN-12
Batch R2376264								
WG1482531-4 MS		**L1155319-4**						
Iron (Fe)-Dissolved			91.7		%		70-130	03-JUN-12
Sodium (Na)-Dissolved			96.3		%		70-130	03-JUN-12
Titanium (Ti)-Dissolved			100.1		%		70-130	03-JUN-12
Batch R2376807								
WG1481705-9 MS		**L1155041-2**						
Iron (Fe)-Dissolved			94.9		%		70-130	04-JUN-12
Sodium (Na)-Dissolved			100.8		%		70-130	04-JUN-12
Titanium (Ti)-Dissolved			103.1		%		70-130	04-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2376833								
WG1481705-8 MS		**L1155418-1**						
Iron (Fe)-Dissolved			92.3		%		70-130	04-JUN-12
Sodium (Na)-Dissolved			96.6		%		70-130	04-JUN-12
Titanium (Ti)-Dissolved			107.1		%		70-130	04-JUN-12
MET-DIS-LOW-MS-VA	**Water**							
Batch R2376155								
WG1481705-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	02-JUN-12
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	02-JUN-12
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	02-JUN-12
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	02-JUN-12
Boron (B)-Dissolved			<0.010		mg/L		0.01	02-JUN-12
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	02-JUN-12
Calcium (Ca)-Dissolved			<0.020		mg/L		0.02	02-JUN-12
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	02-JUN-12
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	02-JUN-12
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	02-JUN-12
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	02-JUN-12
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	02-JUN-12
Potassium (K)-Dissolved			<0.050		mg/L		0.05	02-JUN-12
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	02-JUN-12
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	02-JUN-12
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	02-JUN-12
Batch R2376765								
WG1481705-3 MS		**L1155048-15**						
Aluminum (Al)-Dissolved			112.6		%		70-130	04-JUN-12
Antimony (Sb)-Dissolved			118.1		%		70-130	04-JUN-12
Arsenic (As)-Dissolved			129.5		%		70-130	04-JUN-12
Barium (Ba)-Dissolved			N/A	MS-B	%		-	04-JUN-12
Boron (B)-Dissolved			122.5		%		70-130	04-JUN-12
Cadmium (Cd)-Dissolved			113.1		%		70-130	04-JUN-12
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	04-JUN-12
Chromium (Cr)-Dissolved			109.2		%		70-130	04-JUN-12
Copper (Cu)-Dissolved			104.8		%		70-130	04-JUN-12
Lead (Pb)-Dissolved			104.4		%		70-130	04-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-LOW-MS-VA	**Water**							
Batch R2376765								
WG1481705-3 MS		**L1155048-15**						
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	04-JUN-12
Manganese (Mn)-Dissolved			N/A	MS-B	%		-	04-JUN-12
Potassium (K)-Dissolved			N/A	MS-B	%		-	04-JUN-12
Selenium (Se)-Dissolved			116.1		%		70-130	04-JUN-12
Uranium (U)-Dissolved			111.2		%		70-130	04-JUN-12
Zinc (Zn)-Dissolved			103.5		%		70-130	04-JUN-12
Batch R2377264								
WG1481705-8 MS		**L1155418-1**						
Antimony (Sb)-Dissolved			117.3		%		70-130	05-JUN-12
Barium (Ba)-Dissolved			N/A	MS-B	%		-	05-JUN-12
Boron (B)-Dissolved			119.6		%		70-130	05-JUN-12
Cadmium (Cd)-Dissolved			127.9		%		70-130	05-JUN-12
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	05-JUN-12
Chromium (Cr)-Dissolved			125.9		%		70-130	05-JUN-12
Copper (Cu)-Dissolved			119.9		%		70-130	05-JUN-12
Lead (Pb)-Dissolved			108.2		%		70-130	05-JUN-12
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	05-JUN-12
Manganese (Mn)-Dissolved			N/A	MS-B	%		-	05-JUN-12
Potassium (K)-Dissolved			N/A	MS-B	%		-	05-JUN-12
Uranium (U)-Dissolved			104.4		%		70-130	05-JUN-12
Zinc (Zn)-Dissolved			123.0		%		70-130	05-JUN-12
Batch R2377503								
WG1482531-4 MS		**L1155319-4**						
Aluminum (Al)-Dissolved			N/A	MS-B	%		-	05-JUN-12
Antimony (Sb)-Dissolved			100.7		%		70-130	05-JUN-12
Arsenic (As)-Dissolved			100.6		%		70-130	05-JUN-12
Barium (Ba)-Dissolved			102.3		%		70-130	05-JUN-12
Boron (B)-Dissolved			97.1		%		70-130	05-JUN-12
Cadmium (Cd)-Dissolved			102.1		%		70-130	05-JUN-12
Calcium (Ca)-Dissolved			95.9		%		70-130	05-JUN-12
Chromium (Cr)-Dissolved			98.0		%		70-130	05-JUN-12
Copper (Cu)-Dissolved			98.0		%		70-130	05-JUN-12
Lead (Pb)-Dissolved			98.5		%		70-130	05-JUN-12
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	05-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-LOW-MS-VA	**Water**							
Batch R2377503								
WG1482531-4 MS		**L1155319-4**						
Manganese (Mn)-Dissolved			97.9		%		70-130	05-JUN-12
Potassium (K)-Dissolved			97.5		%		70-130	05-JUN-12
Selenium (Se)-Dissolved			103.5		%		70-130	05-JUN-12
Uranium (U)-Dissolved			100.8		%		70-130	05-JUN-12
Zinc (Zn)-Dissolved			96.8		%		70-130	05-JUN-12
Batch R2377632								
WG1482531-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	06-JUN-12
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	06-JUN-12
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	06-JUN-12
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	06-JUN-12
Boron (B)-Dissolved			<0.010		mg/L		0.01	06-JUN-12
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	06-JUN-12
Calcium (Ca)-Dissolved			<0.020		mg/L		0.02	06-JUN-12
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	06-JUN-12
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	06-JUN-12
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	06-JUN-12
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	06-JUN-12
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	06-JUN-12
Potassium (K)-Dissolved			<0.050		mg/L		0.05	06-JUN-12
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	06-JUN-12
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	06-JUN-12
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	06-JUN-12
Batch R2378075								
WG1481705-8 MS		**L1155418-1**						
Aluminum (Al)-Dissolved			111.7		%		70-130	06-JUN-12
Arsenic (As)-Dissolved			122.8		%		70-130	06-JUN-12
Selenium (Se)-Dissolved			118.3		%		70-130	06-JUN-12
NH3-F-VA	**Water**							
Batch R2376836								
WG1483429-2 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			104.4		%		85-115	05-JUN-12
WG1483429-4 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			102.6		%		85-115	05-JUN-12
WG1483429-6 CRM		**VA-NH3-F**						

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-VA	**Water**							
Batch R2376836								
WG1483429-6 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			103.2		%		85-115	05-JUN-12
WG1483429-8 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			97.6		%		85-115	05-JUN-12
WG1483429-1 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483429-3 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483429-5 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483429-7 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483429-10 MS		**L1150266-1**						
Ammonia, Total (as N)			94.1		%		75-125	05-JUN-12
Batch R2377037								
WG1483864-10 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			102.8		%		85-115	05-JUN-12
WG1483864-2 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			105.4		%		85-115	05-JUN-12
WG1483864-4 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			100.4		%		85-115	05-JUN-12
WG1483864-6 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			100.4		%		85-115	05-JUN-12
WG1483864-8 CRM		**VA-NH3-F**						
Ammonia, Total (as N)			102.7		%		85-115	05-JUN-12
WG1483864-1 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483864-3 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483864-5 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483864-7 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483864-9 MB								
Ammonia, Total (as N)			<0.0050		mg/L		0.005	05-JUN-12
WG1483864-14 MS		**L1152666-6**						
Ammonia, Total (as N)			99.3		%		75-125	05-JUN-12
PAH-SF-MS-VA	**Water**							

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-SF-MS-VA	**Water**							
Batch R2378045								
WG1484780-2 LCS								
Acenaphthene			102.9		%		60-130	07-JUN-12
Acenaphthylene			102.2		%		60-130	07-JUN-12
Acridine			99.9		%		60-130	07-JUN-12
Anthracene			98.6		%		60-130	07-JUN-12
Benz(a)anthracene			100.8		%		60-130	07-JUN-12
Benzo(a)pyrene			103.3		%		60-130	07-JUN-12
Benzo(b)fluoranthene			97.8		%		60-130	07-JUN-12
Benzo(g,h,i)perylene			100.0		%		60-130	07-JUN-12
Benzo(k)fluoranthene			104.5		%		60-130	07-JUN-12
Chrysene			105.2		%		60-130	07-JUN-12
Dibenz(a,h)anthracene			92.1		%		60-130	07-JUN-12
Fluoranthene			102.9		%		60-130	07-JUN-12
Fluorene			103.5		%		60-130	07-JUN-12
Indeno(1,2,3-c,d)pyrene			96.3		%		60-130	07-JUN-12
Naphthalene			103.2		%		50-130	07-JUN-12
Phenanthrene			104.1		%		60-130	07-JUN-12
Pyrene			104.8		%		60-130	07-JUN-12
Quinoline			101.1		%		60-130	07-JUN-12
WG1484780-1 MB								
Acenaphthene			<0.000050		mg/L		0.00005	07-JUN-12
Acenaphthylene			<0.000050		mg/L		0.00005	07-JUN-12
Acridine			<0.000050		mg/L		0.00005	07-JUN-12
Anthracene			<0.000050		mg/L		0.00005	07-JUN-12
Benz(a)anthracene			<0.000050		mg/L		0.00005	07-JUN-12
Benzo(a)pyrene			<0.000010		mg/L		0.00001	07-JUN-12
Benzo(b)fluoranthene			<0.000050		mg/L		0.00005	07-JUN-12
Benzo(g,h,i)perylene			<0.000050		mg/L		0.00005	07-JUN-12
Benzo(k)fluoranthene			<0.000050		mg/L		0.00005	07-JUN-12
Chrysene			<0.000050		mg/L		0.00005	07-JUN-12
Dibenz(a,h)anthracene			<0.000050		mg/L		0.00005	07-JUN-12
Fluoranthene			<0.000050		mg/L		0.00005	07-JUN-12
Fluorene			<0.000050		mg/L		0.00005	07-JUN-12
Indeno(1,2,3-c,d)pyrene			<0.000050		mg/L		0.00005	07-JUN-12
Naphthalene			<0.000050		mg/L		0.00005	07-JUN-12

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PAH-SF-MS-VA	**Water**							
Batch R2378045								
WG1484780-1 MB								
Phenanthrene			<0.000050		mg/L		0.00005	07-JUN-12
Pyrene			<0.000050		mg/L		0.00005	07-JUN-12
Quinoline			<0.000050		mg/L		0.00005	07-JUN-12
Batch R2378363								
WG1484780-3 MB								
Acenaphthene			<0.000050		mg/L		0.00005	07-JUN-12
Acenaphthylene			<0.000050		mg/L		0.00005	07-JUN-12
Acridine			<0.000050		mg/L		0.00005	07-JUN-12
Anthracene			<0.000050		mg/L		0.00005	07-JUN-12
Benz(a)anthracene			<0.000050		mg/L		0.00005	07-JUN-12
Benzo(a)pyrene			<0.000010		mg/L		0.00001	07-JUN-12
Benzo(b)fluoranthene			<0.000050		mg/L		0.00005	07-JUN-12
Benzo(g,h,i)perylene			<0.000050		mg/L		0.00005	07-JUN-12
Benzo(k)fluoranthene			<0.000050		mg/L		0.00005	07-JUN-12
Chrysene			<0.000050		mg/L		0.00005	07-JUN-12
Dibenz(a,h)anthracene			<0.000050		mg/L		0.00005	07-JUN-12
Fluoranthene			<0.000050		mg/L		0.00005	07-JUN-12
Fluorene			<0.000050		mg/L		0.00005	07-JUN-12
Indeno(1,2,3-c,d)pyrene			<0.000050		mg/L		0.00005	07-JUN-12
Naphthalene			<0.000050		mg/L		0.00005	07-JUN-12
Phenanthrene			<0.000050		mg/L		0.00005	07-JUN-12
Pyrene			<0.000050		mg/L		0.00005	07-JUN-12
Quinoline			<0.000050		mg/L		0.00005	07-JUN-12
PH-MAN-VA	**Water**							
Batch R2376409								
WG1483635-1 CRM		**VA-PH7-BUF**						
pH			7.09		pH		6.9-7.1	05-JUN-12
PH-PCT-VA	**Water**							
Batch R2376309								
WG1482725-24 CRM		**VA-PH7-BUF**						
pH			6.99		pH		6.9-7.1	02-JUN-12
WG1482725-25 CRM		**VA-PH7-BUF**						
pH			7.00		pH		6.9-7.1	02-JUN-12
WG1482725-26 CRM		**VA-PH7-BUF**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-PCT-VA	**Water**							
Batch R2376309								
WG1482725-26 CRM		**VA-PH7-BUF**						
pH			7.02		pH		6.9-7.1	02-JUN-12
WG1482725-27 CRM		**VA-PH7-BUF**						
pH			7.04		pH		6.9-7.1	02-JUN-12
WG1482725-28 CRM		**VA-PH7-BUF**						
pH			7.03		pH		6.9-7.1	02-JUN-12
TDS-VA	**Water**							
Batch R2376685								
WG1482528-3 DUP		**L1155320-5**						
Total Dissolved Solids		155	149		mg/L	3.5	20	02-JUN-12
WG1482528-2 LCS								
Total Dissolved Solids			99.5		%		85-115	02-JUN-12
WG1482528-1 MB								
Total Dissolved Solids			<10		mg/L		10	02-JUN-12
TKN-F-VA	**Water**							
Batch R2377312								
WG1483574-3 DUP		**L1155320-5**						
Total Kjeldahl Nitrogen		0.411	0.406		mg/L	1.2	20	05-JUN-12
WG1483574-2 LCS								
Total Kjeldahl Nitrogen			97.6		%		75-125	05-JUN-12
WG1483574-5 LCS								
Total Kjeldahl Nitrogen			96.2		%		75-125	05-JUN-12
WG1483574-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	05-JUN-12
WG1483574-4 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	05-JUN-12
Batch R2377677								
WG1484256-5 LCS								
Total Kjeldahl Nitrogen			98.7		%		75-125	06-JUN-12
WG1484256-1 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	06-JUN-12
WG1484256-4 MB								
Total Kjeldahl Nitrogen			<0.050		mg/L		0.05	06-JUN-12
VH-HSFID-VA	**Water**							
Batch R2374599								
WG1483283-3 DUP		**L1155320-5**						
Volatile Hydrocarbons (VH6-10)		<0.10	<0.10	RPD-NA	mg/L	N/A	50	05-JUN-12
WG1483283-2 LCS								

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VH-HSFID-VA	**Water**							
Batch R2374599								
WG1483283-2 LCS								
Volatile Hydrocarbons (VH6-10)			114.3		%		70-130	05-JUN-12
WG1483283-1 MB								
Volatile Hydrocarbons (VH6-10)			<0.10		mg/L		0.1	05-JUN-12
Batch R2377680								
WG1484319-2 LCS								
Volatile Hydrocarbons (VH6-10)			103.8		%		70-130	06-JUN-12
Batch R2378338								
WG1484319-1 MB								
Volatile Hydrocarbons (VH6-10)			<0.10		mg/L		0.1	07-JUN-12
VOC-HSMS-VA	**Water**							
Batch R2373952								
WG1483283-3 DUP		**L1155320-5**						
Bromodichloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Bromoform		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Carbon Tetrachloride		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
Chlorobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Dibromochloromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Chloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	04-JUN-12
Chloroform		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Chloromethane		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	04-JUN-12
1,2-Dichlorobenzene		<0.00070	<0.00070	RPD-NA	mg/L	N/A	30	04-JUN-12
1,3-Dichlorobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
1,4-Dichlorobenzene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
1,1-Dichloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
1,2-Dichloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
1,1-Dichloroethylene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
cis-1,2-Dichloroethylene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
trans-1,2-Dichloroethylene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Dichloromethane		<0.0050	<0.0050	RPD-NA	mg/L	N/A	50	04-JUN-12
1,2-Dichloropropane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
cis-1,3-Dichloropropylene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
trans-1,3-Dichloropropylene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
1,1,1,2-Tetrachloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Water**							
Batch R2373952								
WG1483283-3 DUP		**L1155320-5**						
1,1,2,2-Tetrachloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Tetrachloroethylene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
1,1,1-Trichloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
1,1,2-Trichloroethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Trichloroethylene		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	04-JUN-12
Trichlorofluoromethane		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	04-JUN-12
Vinyl Chloride		<0.0010	<0.0010	RPD-NA	mg/L	N/A	50	04-JUN-12
WG1483283-2 LCS								
Bromodichloromethane			110.1		%		70-130	04-JUN-12
Bromoform			107.8		%		70-130	04-JUN-12
Carbon Tetrachloride			132.9	LCS-ND	%		70-130	04-JUN-12
Chlorobenzene			121.7		%		70-130	04-JUN-12
Dibromochloromethane			106.0		%		70-130	04-JUN-12
Chloroethane			122.3		%		60-140	04-JUN-12
Chloroform			134.7	LCS-ND	%		70-130	04-JUN-12
Chloromethane			100.0		%		60-140	04-JUN-12
1,2-Dichlorobenzene			110.9		%		70-130	04-JUN-12
1,3-Dichlorobenzene			112.7		%		70-130	04-JUN-12
1,4-Dichlorobenzene			109.5		%		70-130	04-JUN-12
1,1-Dichloroethane			120.8		%		70-130	04-JUN-12
1,2-Dichloroethane			102.2		%		70-130	04-JUN-12
1,1-Dichloroethylene			120.0		%		70-130	04-JUN-12
cis-1,2-Dichloroethylene			131.2	LCS-ND	%		70-130	04-JUN-12
trans-1,2-Dichloroethylene			122.6		%		70-130	04-JUN-12
Dichloromethane			121.6		%		60-140	04-JUN-12
1,2-Dichloropropane			111.0		%		70-130	04-JUN-12
cis-1,3-Dichloropropylene			106.6		%		70-130	04-JUN-12
trans-1,3-Dichloropropylene			96.3		%		70-130	04-JUN-12
1,1,1,2-Tetrachloroethane			119.3		%		70-130	04-JUN-12
1,1,2,2-Tetrachloroethane			98.9		%		70-130	04-JUN-12
Tetrachloroethylene			130.3	LCS-ND	%		70-130	04-JUN-12
1,1,1-Trichloroethane			134.8	LCS-ND	%		70-130	04-JUN-12
1,1,2-Trichloroethane			112.0		%		70-130	04-JUN-12
Trichloroethylene			134.3	LCS-ND	%		70-130	04-JUN-12

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Water**							
Batch R2373952								
WG1483283-2 LCS								
Trichlorofluoromethane			156.7	LCS-ND	%		60-140	04-JUN-12
Vinyl Chloride			120.9		%		60-140	04-JUN-12
WG1483283-1 MB								
Bromodichloromethane			<0.0010		mg/L		0.001	04-JUN-12
Bromoform			<0.0010		mg/L		0.001	04-JUN-12
Carbon Tetrachloride			<0.00050		mg/L		0.0005	04-JUN-12
Chlorobenzene			<0.0010		mg/L		0.001	04-JUN-12
Dibromochloromethane			<0.0010		mg/L		0.001	04-JUN-12
Chloroethane			<0.0010		mg/L		0.001	04-JUN-12
Chloroform			<0.0010		mg/L		0.001	04-JUN-12
Chloromethane			<0.0050		mg/L		0.005	04-JUN-12
1,2-Dichlorobenzene			<0.00070		mg/L		0.0007	04-JUN-12
1,3-Dichlorobenzene			<0.0010		mg/L		0.001	04-JUN-12
1,4-Dichlorobenzene			<0.0010		mg/L		0.001	04-JUN-12
1,1-Dichloroethane			<0.0010		mg/L		0.001	04-JUN-12
1,2-Dichloroethane			<0.0010		mg/L		0.001	04-JUN-12
1,1-Dichloroethylene			<0.0010		mg/L		0.001	04-JUN-12
cis-1,2-Dichloroethylene			<0.0010		mg/L		0.001	04-JUN-12
trans-1,2-Dichloroethylene			<0.0010		mg/L		0.001	04-JUN-12
Dichloromethane			<0.0050		mg/L		0.005	04-JUN-12
1,2-Dichloropropane			<0.0010		mg/L		0.001	04-JUN-12
cis-1,3-Dichloropropylene			<0.0010		mg/L		0.001	04-JUN-12
trans-1,3-Dichloropropylene			<0.0010		mg/L		0.001	04-JUN-12
1,1,1,2-Tetrachloroethane			<0.0010		mg/L		0.001	04-JUN-12
1,1,2,2-Tetrachloroethane			<0.0010		mg/L		0.001	04-JUN-12
Tetrachloroethylene			<0.0010		mg/L		0.001	04-JUN-12
1,1,1-Trichloroethane			<0.0010		mg/L		0.001	04-JUN-12
1,1,2-Trichloroethane			<0.0010		mg/L		0.001	04-JUN-12
Trichloroethylene			<0.0010		mg/L		0.001	04-JUN-12
Trichlorofluoromethane			<0.0010		mg/L		0.001	04-JUN-12
Vinyl Chloride			<0.0010		mg/L		0.001	04-JUN-12
Batch R2377683								
WG1484319-2 LCS								
Bromodichloromethane			99.0		%		70-130	06-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Water**							
Batch R2377683								
WG1484319-2 LCS								
Bromoform			97.2		%		70-130	06-JUN-12
Carbon Tetrachloride			100.9		%		70-130	06-JUN-12
Chlorobenzene			99.2		%		70-130	06-JUN-12
Dibromochloromethane			99.8		%		70-130	06-JUN-12
Chloroethane			94.8		%		60-140	06-JUN-12
Chloroform			103.1		%		70-130	06-JUN-12
Chloromethane			84.6		%		60-140	06-JUN-12
1,2-Dichlorobenzene			98.1		%		70-130	06-JUN-12
1,3-Dichlorobenzene			96.6		%		70-130	06-JUN-12
1,4-Dichlorobenzene			96.5		%		70-130	06-JUN-12
1,1-Dichloroethane			96.1		%		70-130	06-JUN-12
1,2-Dichloroethane			94.9		%		70-130	06-JUN-12
1,1-Dichloroethylene			93.0		%		70-130	06-JUN-12
cis-1,2-Dichloroethylene			99.9		%		70-130	06-JUN-12
trans-1,2-Dichloroethylene			95.8		%		70-130	06-JUN-12
Dichloromethane			101.7		%		60-140	06-JUN-12
1,2-Dichloropropane			97.2		%		70-130	06-JUN-12
cis-1,3-Dichloropropylene			96.4		%		70-130	06-JUN-12
trans-1,3-Dichloropropylene			93.3		%		70-130	06-JUN-12
1,1,1,2-Tetrachloroethane			102.2		%		70-130	06-JUN-12
1,1,2,2-Tetrachloroethane			99.1		%		70-130	06-JUN-12
Tetrachloroethylene			101.5		%		70-130	06-JUN-12
1,1,1-Trichloroethane			95.7		%		70-130	06-JUN-12
1,1,2-Trichloroethane			100.7		%		70-130	06-JUN-12
Trichloroethylene			101.2		%		70-130	06-JUN-12
Trichlorofluoromethane			114.4		%		60-140	06-JUN-12
Vinyl Chloride			92.5		%		60-140	06-JUN-12
WG1484319-1 MB								
Bromodichloromethane			<0.0010		mg/L		0.001	06-JUN-12
Bromoform			<0.0010		mg/L		0.001	06-JUN-12
Carbon Tetrachloride			<0.00050		mg/L		0.0005	06-JUN-12
Chlorobenzene			<0.0010		mg/L		0.001	06-JUN-12
Dibromochloromethane			<0.0010		mg/L		0.001	06-JUN-12
Chloroethane			<0.0010		mg/L		0.001	06-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC-HSMS-VA	**Water**							
Batch R2377683								
WG1484319-1 MB								
Chloroform			<0.0010		mg/L		0.001	06-JUN-12
Chloromethane			<0.0050		mg/L		0.005	06-JUN-12
1,2-Dichlorobenzene			<0.00070		mg/L		0.0007	06-JUN-12
1,3-Dichlorobenzene			<0.0010		mg/L		0.001	06-JUN-12
1,4-Dichlorobenzene			<0.0010		mg/L		0.001	06-JUN-12
1,1-Dichloroethane			<0.0010		mg/L		0.001	06-JUN-12
1,2-Dichloroethane			<0.0010		mg/L		0.001	06-JUN-12
1,1-Dichloroethylene			<0.0010		mg/L		0.001	06-JUN-12
cis-1,2-Dichloroethylene			<0.0010		mg/L		0.001	06-JUN-12
trans-1,2-Dichloroethylene			<0.0010		mg/L		0.001	06-JUN-12
Dichloromethane			<0.0050		mg/L		0.005	06-JUN-12
1,2-Dichloropropane			<0.0010		mg/L		0.001	06-JUN-12
cis-1,3-Dichloropropylene			<0.0010		mg/L		0.001	06-JUN-12
trans-1,3-Dichloropropylene			<0.0010		mg/L		0.001	06-JUN-12
1,1,1,2-Tetrachloroethane			<0.0010		mg/L		0.001	06-JUN-12
1,1,2,2-Tetrachloroethane			<0.0010		mg/L		0.001	06-JUN-12
Tetrachloroethylene			<0.0010		mg/L		0.001	06-JUN-12
1,1,1-Trichloroethane			<0.0010		mg/L		0.001	06-JUN-12
1,1,2-Trichloroethane			<0.0010		mg/L		0.001	06-JUN-12
Trichloroethylene			<0.0010		mg/L		0.001	06-JUN-12
Trichlorofluoromethane			<0.0010		mg/L		0.001	06-JUN-12
Vinyl Chloride			<0.0010		mg/L		0.001	06-JUN-12
VOC7-HSMS-VA	**Water**							
Batch R2373952								
WG1483283-3 DUP		**L1155320-5**						
Benzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
Ethylbenzene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
Methyl t-butyl ether (MTBE)		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
Styrene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
Toluene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
meta- & para-Xylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
ortho-Xylene		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	04-JUN-12
WG1483283-2 LCS								
Benzene			126.2		%		70-130	04-JUN-12

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
VOC7-HSMS-VA	**Water**							
Batch R2373952								
WG1483283-2 LCS								
Ethylbenzene			123.5		%		70-130	04-JUN-12
Methyl t-butyl ether (MTBE)			110.6		%		70-130	04-JUN-12
Styrene			116.7		%		70-130	04-JUN-12
Toluene			115.4		%		70-130	04-JUN-12
meta- & para-Xylene			123.6		%		70-130	04-JUN-12
ortho-Xylene			122.4		%		70-130	04-JUN-12
WG1483283-1 MB								
Benzene			<0.00050		mg/L		0.0005	04-JUN-12
Ethylbenzene			<0.00050		mg/L		0.0005	04-JUN-12
Methyl t-butyl ether (MTBE)			<0.00050		mg/L		0.0005	04-JUN-12
Styrene			<0.00050		mg/L		0.0005	04-JUN-12
Toluene			<0.00050		mg/L		0.0005	04-JUN-12
meta- & para-Xylene			<0.00050		mg/L		0.0005	04-JUN-12
ortho-Xylene			<0.00050		mg/L		0.0005	04-JUN-12
Batch R2377683								
WG1484319-2 LCS								
Benzene			97.2		%		70-130	06-JUN-12
Ethylbenzene			97.5		%		70-130	06-JUN-12
Methyl t-butyl ether (MTBE)			99.3		%		70-130	06-JUN-12
Styrene			99.7		%		70-130	06-JUN-12
Toluene			94.7		%		70-130	06-JUN-12
meta- & para-Xylene			96.9		%		70-130	06-JUN-12
ortho-Xylene			97.9		%		70-130	06-JUN-12
WG1484319-1 MB								
Benzene			<0.00050		mg/L		0.0005	06-JUN-12
Ethylbenzene			<0.00050		mg/L		0.0005	06-JUN-12
Methyl t-butyl ether (MTBE)			<0.00050		mg/L		0.0005	06-JUN-12
Styrene			<0.00050		mg/L		0.0005	06-JUN-12
Toluene			0.00061	MB-LOR	mg/L		0.0005	06-JUN-12
meta- & para-Xylene			<0.00050		mg/L		0.0005	06-JUN-12
ortho-Xylene			<0.00050		mg/L		0.0005	06-JUN-12

Quality Control Report

Legend:

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

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
LCS-ND	Lab Control Sample recovery was slightly outside ALS DQO. Reported non-detect results for associated samples were unaffected.
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.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Manual Meter							
	4	30-MAY-12 11:10	05-JUN-12 00:00	0.25	133	hours	EHTR-FM
pH by Meter (Automated)							
	1	30-MAY-12 12:25	02-JUN-12 13:45	0.25	73	hours	EHTR-FM
	2	30-MAY-12 12:45	02-JUN-12 13:45	0.25	73	hours	EHTR-FM
	3	30-MAY-12 09:50	02-JUN-12 13:45	0.25	76	hours	EHTR-FM
	5	30-MAY-12 13:30	02-JUN-12 13:45	0.25	72	hours	EHTR-FM
Anions and Nutrients							
Nitrate in Water by Ion Chromatography							
	1	30-MAY-12 12:25	04-JUN-12 08:21	3	5	days	EHT
	2	30-MAY-12 12:45	04-JUN-12 08:21	3	5	days	EHT
	3	30-MAY-12 09:50	04-JUN-12 08:21	3	5	days	EHT
	4	30-MAY-12 11:10	04-JUN-12 08:21	3	5	days	EHT
	5	30-MAY-12 13:30	04-JUN-12 08:21	3	5	days	EHT
Nitrite in Water by Ion Chromatography							
	1	30-MAY-12 12:25	04-JUN-12 08:21	3	5	days	EHT
	2	30-MAY-12 12:45	04-JUN-12 08:21	3	5	days	EHT
	3	30-MAY-12 09:50	04-JUN-12 08:21	3	5	days	EHT
	4	30-MAY-12 11:10	04-JUN-12 08:21	3	5	days	EHT
	5	30-MAY-12 13:30	04-JUN-12 08:21	3	5	days	EHT
Bacteriological Tests							
Fecal coliform by MPN							
	1	30-MAY-12 12:25	01-JUN-12 16:00	30	52	hours	EHTL
	2	30-MAY-12 12:45	01-JUN-12 16:00	30	51	hours	EHTL
	3	30-MAY-12 09:50	01-JUN-12 16:00	30	54	hours	EHTL
	4	30-MAY-12 11:10	01-JUN-12 16:00	30	53	hours	EHTL
	5	30-MAY-12 13:30	01-JUN-12 16:00	30	50	hours	EHTL

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1155320 were received on 31-MAY-12 13:40.

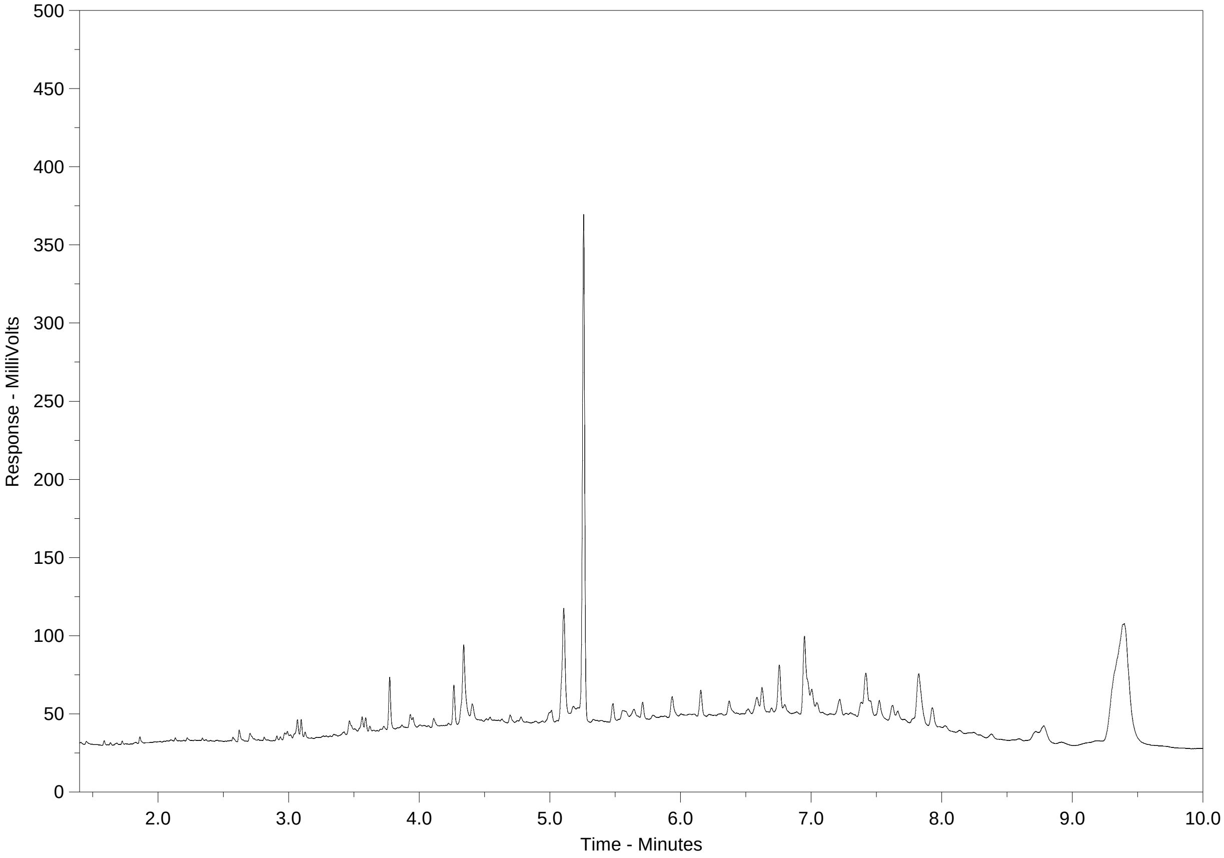
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

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

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

Hydrocarbon Distribution Report

ALS Sample ID: L1155320-1
Client Sample ID: WL-MW12-01



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.

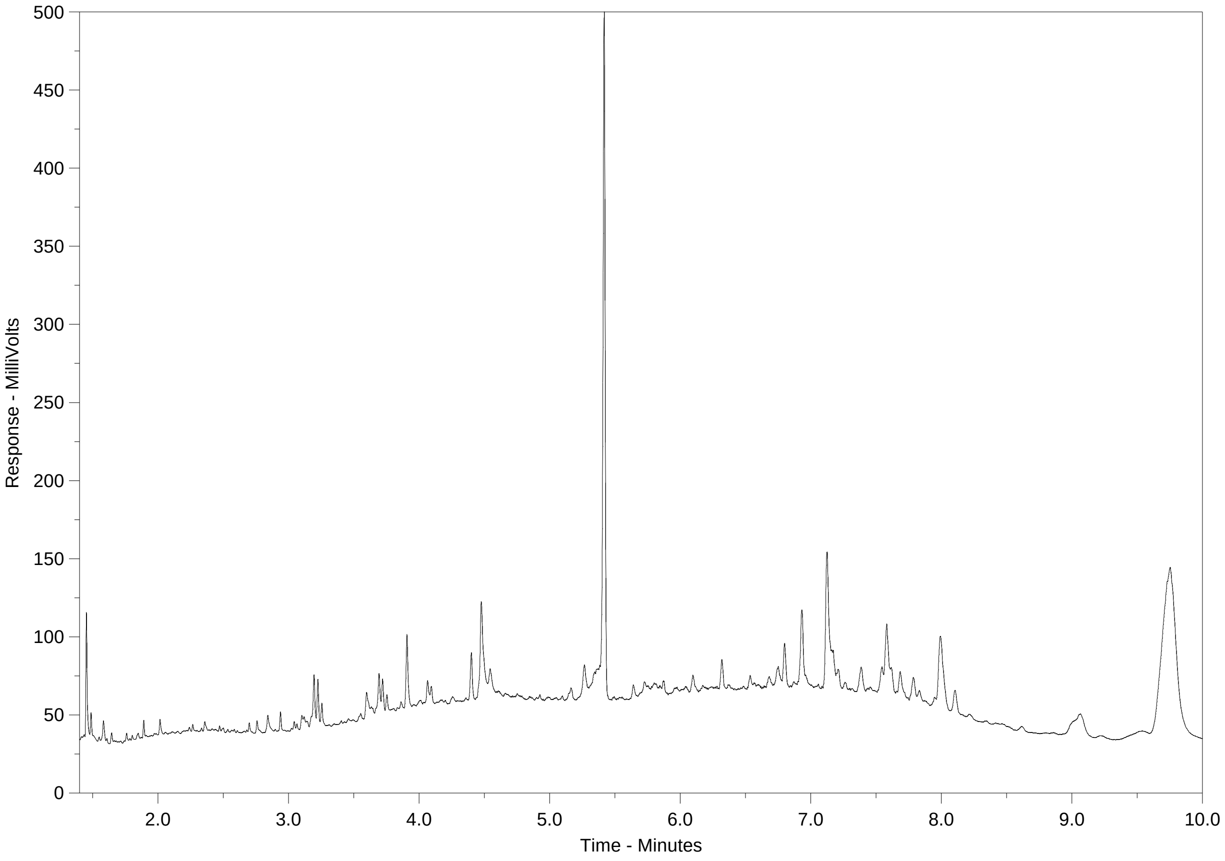
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1155320-2
Client Sample ID: WL-MW12-01D



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.

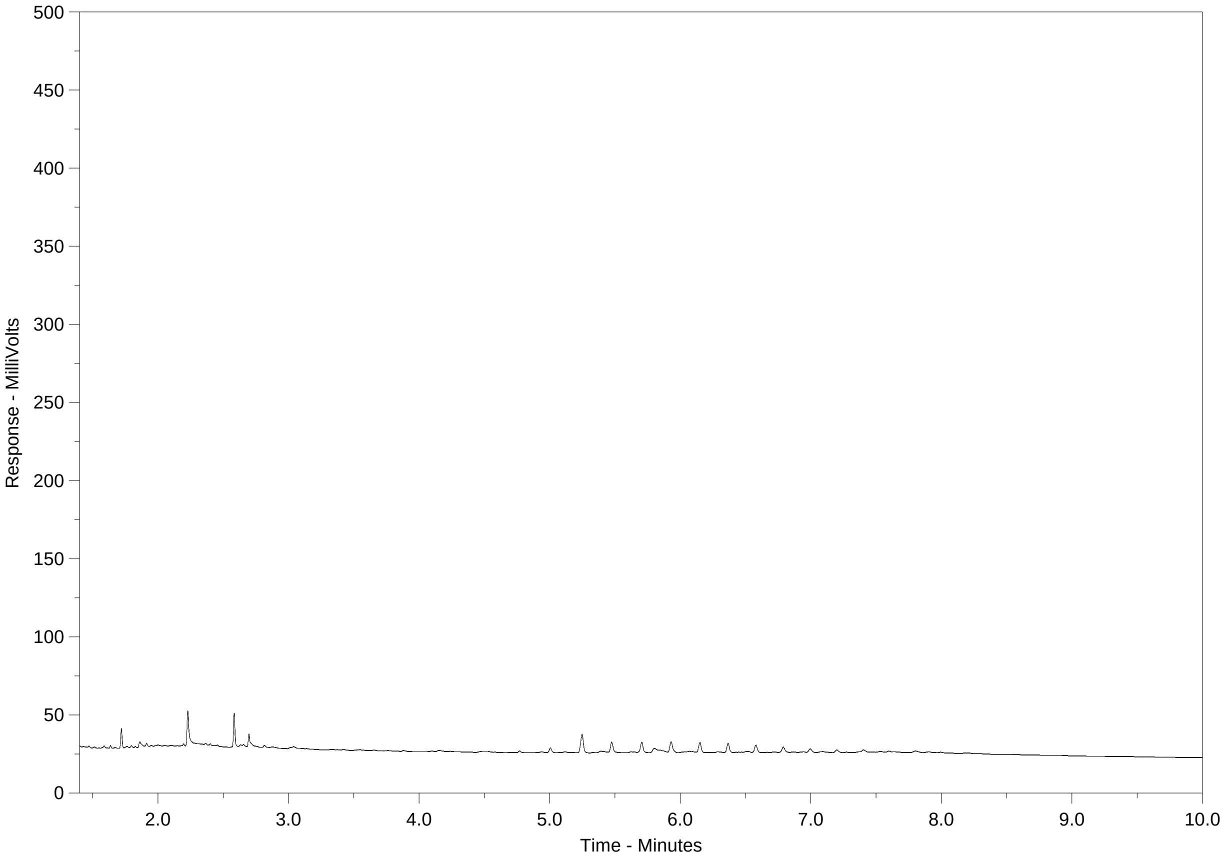
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1155320-3
Client Sample ID: WL-MW12-03



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.

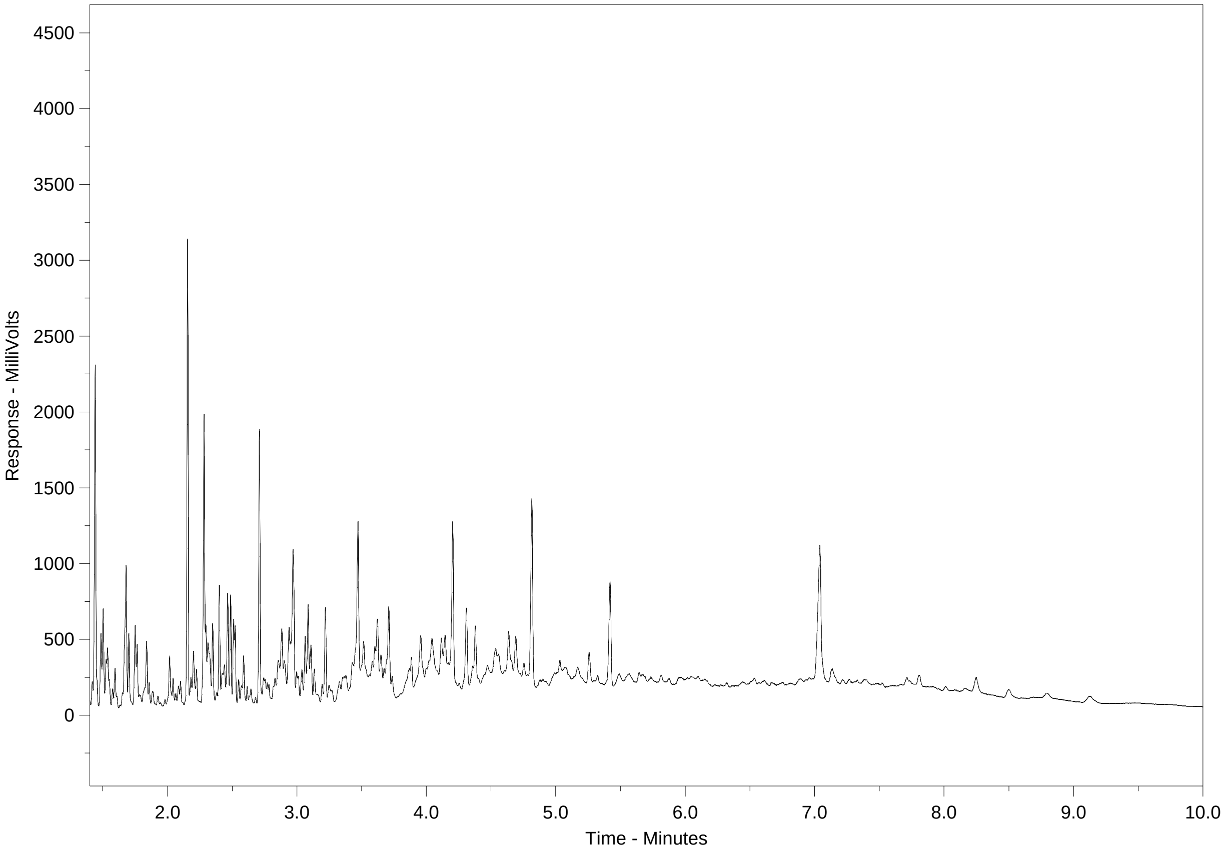
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1155320-4
Client Sample ID: WL-MW12-04



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.

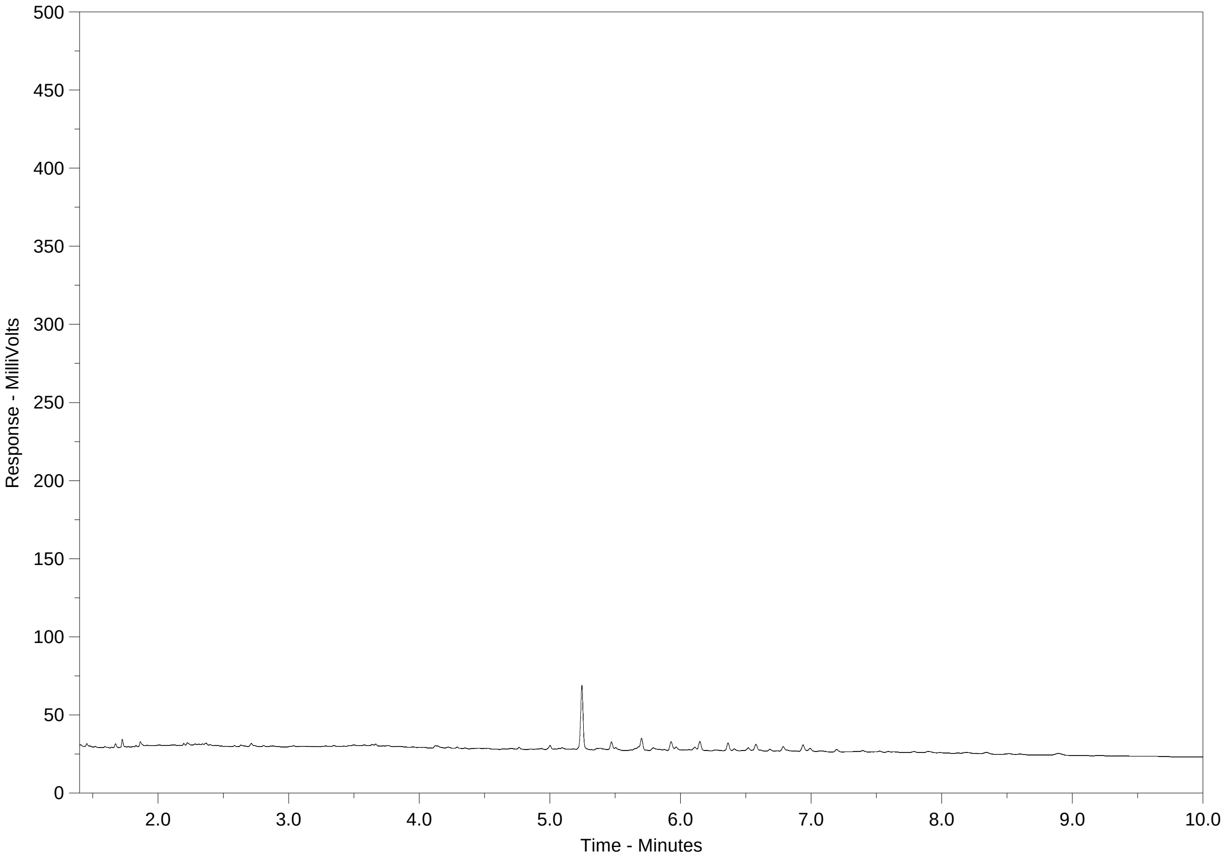
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1155320-5
Client Sample ID: WATSON LAKE SURFACE



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- 174289

ALS Environmental

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www.alsgl

* L 1 1 5 5 3 2 0 - C O F C *

Page 1 of 1

Report To	**Report Format / Distribution**
Company: GOLDER	Standard: X Other (specify):
Contact: JOE MARQUARDSON	Select: PDF X Excel X Digital Fax
Address: 201 B 170 TITANIUM WAY	Email 1: jmarquardson@golder.com
VIA OGI	Email 2: ghamilton@golder.com
Phone: 867.334.7423 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 #: 11-1436-0073/1400
Company:	PO / AFE:
Contact:	LSD:
Address:	
Phone: Fax:	Quote #:
Lab Work Order # (lab use only) L1155320-	**ALS Contact:** **Sampler:** J. MARQUARDSON A. BADGER

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**	GENERAL	DOC	PAH	BTEX	NUTRIENTS	DISSOLVED METALS	FECAL COLIFORM						Number of Containers
	WL-MW12-01	30-MAY-12	12:25	GW	X	X	X	X	X	X	X						
	WL-MW12-01D	30-MAY-12	12:45	GW	X	X	X	X	X	X	X						
	WL-MW12-03	30-MAY-12	9:50	GW	X	X	X	X	X	X	X						
	WL-MW12-04	30-MAY-12	11:10	GW	X	X	X	X	X	X	X						
	WATSON LAKE SURFACE	30-MAY-12	13:30	SW	X	X	X	X	X	X	X						

Short Holding Time

Rush Processing

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

* NOTE * WL-MW12-04 METALS AND DOC SAMPLES ARE NOT FILTERED OR 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: J. MARQUARDSON	Date: 30-MAY-12	Time: 19:00	Received by: TN	Date: May 30	Time: 13:40	Temperature: 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

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

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Europe	+ 356 21 42 30 20
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South America	+ 55 21 3095 9500

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