TETRA TECH EBA

Updated Hydrogeological Assessment for Land Treatment Facility, (LTF), Disposition #2005-0223, Mayo, Yukon

PRESENTED TO

Al's Environmental Cleanup Inc.

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CONSULTING ENGINEERS & SCIENTISTS · www.eba.ca

Tetra Tech EBA Inc.
61 Wasson Place
Whitehorse, YT Y1A 0H7 CANADA
Tel 867.668.3068 Fax 867.668.4349

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LIMITATIONS OF REPORT

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1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) was engaged by AI's Environmental Cleanup (the Client) to conduct hydrogeological assessment work at the Mayo Land Treatment Facility (the Site), located at the junction of Janet Lake Rd. and Old Stage Coach Rd., Mayo, YT (Disposition #2005-0223). This work was performed in accordance with the Site's Land Treatment Facility Permit (Permit No. 24-019 [the Permit]), relevant Environment Yukon Protocols and in accordance with the Yukon Environmental & Socioeconomic Assessment Act (YESAA) Decision Document issued for the Site (YESAA File Number: 2014-0180). The scope of work included the following tasks:

- Design a groundwater monitoring network to further asses the hydrogeological regime and the Site's impact on groundwater quality;
- Update the Sites conceptual hydrogeological model following the 2015 field program;
- Assess groundwater quality against relevant Yukon CSR water quality standards and assess risk to relevant receptors;
- Where necessary, recommend further works to be completed as necessary to more comprehensively assess the impact to groundwater quality.

To complete the scope of work, Tetra Tech EBA completed the following tasks:

- Background data compilation and review;
- Design of a monitoring well network;
- Groundwater monitoring in summer and fall 2015;
- Aquifer testing in summer 2015;
- Installed pressure transducers and loggers in three groundwater monitoring wells in summer 2015;
- Data review and interpretation of results assessing impact to groundwater quality and risk to downgradient receptors; and,
- Reporting.

This work was undertaken in general accordance with relevant Yukon Contaminated Sites Regulation (YCSR). Table 1-1 summarizes the tasks and sequence of events to arrive at this report.

Table 1-1: Site Assessment and Task Sequence

Date	Activity
March 31, 2015	Tetra Tech EBA formally appointed by Client to undertake the work.
May 2015	Four groundwater monitoring wells installed and developed under the direction of West 80 Environmental Consulting Ltd.
June 16 - 17, 2015	Early summer groundwater monitoring event and hydraulic response testing of monitoring wells undertaken by Tetra Tech EBA.
October 8 & 9, 2015	Fall groundwater monitoring event undertaken by Tetra Tech EBA.
March 14, 2016	Issued for Review report provided to Client.
March 18, 2016	Issued for Use report provided to Client.

2.0 BACKGROUND

Site Description

The Site is located approximately 6 km north of Mayo, YT within a cleared area of approximately 2.5 ha (Figure 1, Figure 2). This site was chosen due to the low permeability native soil which is considered to be a natural containment area, appropriate for the storage and remediation of contaminated soil. The facility was constructed in 2007 and currently operates under LTF Permit 24-019 (Appendix B). Under the terms of the Permit, the Permittee is permitted to operate a Commercial Land Treatment Facility for the acceptance, storage and treatment of soil and water contaminated with petroleum hydrocarbons, including:

- soil containing metal contaminants below the special waste criteria for those contaminants; and
- water containing contaminants other than petroleum hydrocarbons below the applicable CSR standards for those contaminants.

Hydrocarbon impacted soil and liquid (generally oil, hydraulic fluid, and fuel impacted), typically originating from spills and leaks from equipment, fuel storage and fuel transfer operations are trucked, stored and remediated at the Site.

The Site comprises two treatment cells, a soil holding cell, water holding cell, two above-ground storage tanks (ASTs) and associated access roads and berms. The entire Site is approximately 1 ha in size.

The two treatment cells comprise a total area of approximately 0.7 ha capable of storing and treating approximately 5,500 m^3 of contaminated soil and snow. The soil holding cell is approximately 0.2 ha (36 m by 47 m) and used to temporarily store up to 800 m^3 of unanalyzed contaminated soil and snow prior to transfer to the treatment cell. The two ASTs are used to store contaminated liquids and have a capacity of approximately 30 m^3 each. The water holding cell has a capacity of approximately 1,150 m^3 (1 m deep) and is used to store potentially contaminated meltwater prior to analysis and appropriate disposal. The general site layout is shown in Figure 1.

Liner Composition

The LTF is lined with a minimum of 1 m of compacted silt, to ensure a permeability of less than 1×10^{-7} m/s (1×10^{-5} cm/s). The liner is graded on approximately a 2% slope to direct meltwater towards water collection areas. The liner is tested once each biopile is remediated and removed from the treatment cell to ensure that it has not been contaminated or potentially breached. Any contaminated liner material within the LTF is excavated and biopiled for remediation to comply with YCSR industrial/commercial standards. The excavated liner area would be replaced with clean compacted silt. Testing of the liner (up to October, 2014) has not resulted in the identification of any contamination to or breaches through the compacted silt liner.

Contaminated Soil Deposition and Remediation

Received soil is typically organised into biopiles up to 4.0 m in height. Typically, separate soil stockpiles are started for each new shipment of contaminated soil to ensure mixing of soils from differing sites does not occur. Contaminated stockpiles are tilled (soil from the base of the biopile is removed and dropped to form a new pile within the cell) on a regular (typically bi-monthly) basis between June and September. This process mixes soil horizontally and vertically within the biopile, distributing microorganisms, and exposing the soil to oxygen needed for the aerobic biodegradation of the hydrocarbons.

Emergency spills requiring immediate excavation and transport of contaminated material to the Site are accommodated in the soil holding cell located in the southwest corner of the Site. Soil remains in the holding area

until analytical results are available to confirm concentrations of contaminants. Once analytical results are received, soil is moved to an appropriate location for treatment/disposal.

Contaminated Snow Deposition

The LTF is open to accept contaminated snow or soil from November to April, which is placed in the treatment cell or soil holding cell. During spring conditions, contaminated snowmelt is collected into meltwater collecting areas of the treatment and soil holding cells. Meltwater is pumped into the water holding cell and/or sprayed onto the biopiles as required with contaminants in the liquid remediated with the contaminated soil in the biopile.

Contaminated Liquid Deposition

Contaminated liquid from petroleum leaks or spills is pumped into one of two 30.3 m^3 (8,000 gallon) ASTs and stored until analysis is conducted and results received. If contaminated liquid is found to not exceed YCSR Aquatic Life Standards, it is either sprayed over the biopiles for dust control and to maintain soil moisture content or pumped to vegetated ground outside the LTF. If analysis indicates hydrocarbon contamination, liquids in the ASTs are sprayed onto the biopiles with contaminants in the liquid remediated with the contaminated soil in the biopile.

Meltwater Management

In spring conditions, meltwater collects in the southeast corner of the treatment cell and soil holding cell, and is then pumped into a bermed water holding cell for future use (as detailed below). Snow cover from areas of the LTF where there is no contaminated soil or water remediation occurring is removed from the site in later winter to reduce the volume of meltwater at the site. Snow cover from areas of the LTF with contaminated soil or liquid remediation occurring is moved to the water holding cell to melt. Non-contaminated liquids (not exceeding YCSR Aquatic Life Standards) are sprayed over the biopiles for dust control and to maintain soil moisture content or pumped onto vegetated ground outside the LTF. Contaminated meltwater is sprayed onto the biopiles with contaminants in the liquid remediated with the contaminated soil in the biopile.

3.0 METHODOLOGY

The following sections outline the methodology undertaken in the preparation of this hydrogeological assessment.

3.1 Data Sources

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

- Site inspections and interviews with site operational personnel;
- Topographic and Geological maps;
- Review of past Tetra Tech EBA assessment reports and YESSA application;
- Review of reports and data relating to groundwater and soil testing provided by West 80 Environmental Consulting Ltd (West 80).
- Operational permits issued by Environment Yukon for the LTF;
- Environment Canada Climate Normals (1971 – 2000). (http://www.climate.weatheroffice.gc.ca/climate_normals/index_e.html);

- Yukon Water Well Registry, Department of Environment, Government of Yukon (http://www.environmentyukon.gov.yk.ca/pdf/YukonWaterWellsSummary.pdf)
- Canada Lands Survey System Map Browser (http://clss.nrcan.gc.ca/map-carte-eng.php)
- Groundwater Information Network Basic Map Viewer (http://gin.gw-info.net/service/api_ngwds:gin2/en/wmc/standard.html)

3.2 Review of Waste Disposal Facility Permit and Waste Management Plan

The Site's Land Treatment Facility Permit (Permit No: 34-019, Exp. December 31, 2019) and YESAA Decision Document (YESAA File Number 2014-0180) were reviewed and used in conjunction with relevant background information to assess accepted and potential waste streams, to aid in the assessment of potential contaminant transport mechanisms, to confirm monitoring requirements and develop a monitoring network in compliance with the Permit. A summary of the main requirements of the Permit in regards to this hydrogeological assessment are outlined in Table 3-1.

Table 3-1: Summary of Current Permit Groundwater Monitoring Requirements

Site Name	Land Treatment Facility Permit No.	YESAA Decision Document	Permit Requires Monitoring	Permit Specifies Groundwater Analysis	Permit Details Monitoring Schedule
Mayo Land Treatment Facility	34-019	2014-0180	Yes	Yes - petroleum hydrocarbons, dissolved metals, pH, conductivity, dissolved oxygen, redox potential, temperature, and any other contaminants of concern:	Yes. (i) at the time of the revised hydrogeological assessment; and (ii) biannually thereafter at the determined high and low water points

3.3 2015 Field Investigations

Hydrogeological field investigations conducted as part of the 2015 work program were as follows:

Groundwater Monitoring Well Installation

Four groundwater monitoring wells (MW05, MW05a, MW06, MW07) were installed under the direction of West 80 in May 2015. Further information on the drilling and installation of these wells is provided in Section 4.0.

Monitoring Well Surveying

West 80 surveyed the vertical elevation of the top of the well PVC standpipe at each of the well locations on May 21, 2015. Elevations were surveyed relative to a local benchmark assigned an elevation of 556 m (based on the elevation provided by a hand held GPS). The monitoring wells were not surveyed for location, locations were obtained using a handheld GPS. Tetra Tech EBA note that the accuracy of these elevations were not verified and locations shown on figures and subsequent interpretations based on these well locations may include a degree of error. It is recommended by Tetra Tech EBA that at minimum, MW05, MW05a, MW06 and MW07 be surveyed for location and elevation prior to the next groundwater monitoring event to ensure confidence in elevation readings and associated interpretations (such as groundwater flow direction).

Groundwater Monitoring

All eight groundwater monitoring wells onsite were gauged with depth to groundwater (where present) and total depth recorded by Tetra Tech EBA in June and October, 2015. In addition, West 80 gauged MW05, MW05a, MW06 and MW07 on August 3, 2015

Groundwater monitoring wells MW05a, MW06 and MW07 were sampled by Tetra Tech EBA on June 17, 2015 and October 8 and 9, 2015 using methods in accordance with YCSR Protocol No. 7: *Groundwater Monitoring Well Installation, Sampling and Decommissioning*. Wells were sampled approximately one month after the completion of drilling, installation and development, which is considered to be sufficient time for the recovery of the water levels and to allow for the groundwater in the monitoring well to reach equilibrium with the aquifer.

Prior to sampling, the standing water level (SWL) was measured in each well, using an electric measuring tape. Each well was purged of at least three well volumes using dedicated polyethylene bailers or Waterra non-return foot valve pumps prior to a sample being obtained. During purging, physicochemical parameters (pH, temperature, EC, Redox and DO) were measured and recorded. Groundwater Purge and Sampling Field Sheets are provided in Appendix C.

Each sample bottle was labeled with the location ID, project number and date. Sample containers and appropriate preservatives for each suite of tests were provided by the laboratory. Samples for dissolved metals analysis were field filtered using new, clean 0.45 µm filters and preserved with nitric acid. All samples were stored in coolers containing ice-bricks and delivered to the analytical laboratory (ALS) under Chain of Custody and within appropriate holding times. ALS is certified by the Canadian Association for Laboratory Accreditation and is accredited as conforming to ISO/IEC 17025 for analysis.

West 80 collected a sample from MW06 on August 3, 2015. The sample was sent to an analytical laboratory accredited as conforming to ISO/IEC 17025 by an accrediting body that conforms to ISO/IEC17011 and analysed total petroleum hydrocarbons. A field sheet from this monitoring was not provided to Tetra Tech EBA.

Hydraulic Response Tests

Hydraulic response tests were conducted on June 16 and 17, 2015 in order to estimate the hydraulic conductivity of the aquifer. A rising head test was performed on MW05a, MW06 and MW07 to estimate hydraulic conductivity of the aquifer at these specific locations. The rising head test was performed by rapidly removing 1 liter of water from the well using 50.8 mm diameter dedicated polyethylene bailers. The recovery response in each well was monitored using the electronic water level sounder until the water level had recovered to at least 80% of its static water level. In addition to the manual data, a pressure transducer logger was deployed in the well to automatically record the water level data at one second intervals.

Bail-down tests were also conducted at MW05a and MW06 with both wells being bailed to almost dry on the evening of June 16, 2015 and overnight recovery response being monitored using a pressure transducer logger.

Groundwater Elevation Logging

Pressure transducer loggers were installed in three groundwater monitoring wells (MW05a, MW06, MW07) in June 2015. These loggers are to be left in the wells for a minimum of one year in order to monitor seasonal and event based fluctuations in groundwater elevations. Data from each logger was downloaded by Tetra Tech EBA during the October 2015 mobilisation, then the logger re-deployed in each well.

3.4 Laboratory Testing

The laboratory testing completed for the submitted groundwater samples collected on June 17, 2015 [Summer (1)] , August 3, 2015 [Summer (2)] and October 8 and 9, 2015 [Fall] is summarized in Table 3-2. This analysis list is in compliance with the requirements of the Site's Permit.

Table 3-2: Laboratory Testing Program, 2015

Sample ID	2015 Monitoring Round	Routine Parameters (Electrical Conductivity, Hardness, pH, TDS, Turbidity, Alkalinity, Cl, F, NO3, NO2, SO4)	LEPH/HEPH/ PAH/BTEX/ VPH	Dissolved and Total Metals (Al, Sb, As, Ba, Be, B, Cd, Ca, Cr, Co Cu, Fe, Pb, Li, Mg, Mn, Hg, Mo, Ni, Se, Ag, Na Tl, Ti, U, V, Zn)	EPH 19-32
MW05a	Summer (1) [1]	✓	✓	✓	*X*
	Fall [1]	*X*	✓	✓	*X*
MW06	Summer (1) [1]	✓	✓	✓	*X*
	Summer (2) [2]	*X*	*X*	*X*	✓
	Fall [1]	*X*	✓	✓	*X*
MW07	Summer (1) [1]	✓	✓	✓	*X*
	Fall [1]	*X*	✓	✓	*X*

Notes:

[1] Samples collected by Tetra Tech EBA

[2] Samples collected by West 80

Field and laboratory results are summarized, interpreted and presented in this report.

3.5 Quality Control/Quality Assurance

This section describes the Quality Assurance (QA) and Quality Control (QC) procedures undertaken to ensure sample integrity and representativeness, as well as the reliability and accuracy of field and laboratory results.

Data validation is summarized in Table 3-3.

Table 3-3: Review of QA/QC

QA/QC Aspect	Evidence and Evaluation
Data Representativeness	
Sample integrity	All samples were received by the laboratory within appropriate holding times
Background Samples	MW06 is considered to be hydraulically up gradient of the Site and the groundwater samples from this location can be considered to be representative of background conditions.
Field Procedures	Monitoring wells were sampled using dedicated polyethylene bailers. All equipment that was used in multiple wells (i.e. depth tape) was decontaminated using a three stage wash procedure (detergent, tap water, distilled water).
Calibration of Field Equipment	Calibration of field equipment was undertaken prior to each day of field work.

Data Precision and Accuracy	
Blind Duplicates	One blind duplicate sample was collected from MW07 during the June 2015 groundwater monitoring event. This sample was analysed for the same suite of analytes as MW07.
	Of the 70 analyte pairs tested, RPD values could not be calculated for 51 pairs as both values were below the laboratory method detection limit (MDL). Of the remaining analyte pairs tested, all were below the RPD acceptance criteria of ±30%.
	RPD calculations are presented in Table 2.
	One blind duplicate sample was collected from MW06 during the October 2015 groundwater monitoring event. This sample was analysed for hardness, dissolved metals and organic analytes. Of the 60 analyte pairs tested, RPD values could not be calculated for 47 pairs as both values were below the laboratory method detection limit (MDL). Of the remaining analyte pairs tested, 12 were below the RPD acceptance criteria of ±30%. One analyte pair (filtered chromium) exceeded the RPD acceptance criteria of ±30%, reporting an RPD of > 176% (primary sample <0.5 µg/L, duplicate 1.38 µg/L). This exceedances is considered relatively minor and likely related to low concentrations of both analyte pairs. Tetra Tech EBA notes that for the purpose of this assessment, the higher concentration will be assessed against relevant guidelines, where applicable. RPD calculations are presented in Table 2.
Trip Blanks	One trip blank was collected during the June 2015 groundwater monitoring event and analysed for the full analytical schedule other than dissolved metals. All results were reported at concentrations below the laboratory detection limit.
	One trip blank was collected during the October 2015 groundwater monitoring event and placed on hold at the laboratory. Following the receipt of groundwater analytical results, Tetra Tech EBA determined that analysis of the trip blank was not required.
Laboratory Internal QA/QC	Laboratory internal QA/QC is detailed within the laboratories reports (Appendix D). Overall, both laboratories showed acceptable testing frequency and results for method blanks, laboratory duplicates and matrix spikes.
Holding Times	Holding times for samples were in conformance with applicable ASTM and laboratory requirements.
Laboratory Detection Limit	Laboratory reports indicate that the method detection limits were lower than the respective assessment criteria.
Completeness of test program	The scope of work undertaken was generally consistent with that required to characterize the Site and meet the study objective.
Validity of Data Set	The data quality review indicates no significant systematic errors in the data collection or analysis process for groundwater and therefore, the data set used as the basis for the groundwater assessment is considered valid and complete.

4.0 MONITORING NETWORK

The monitoring network consists of eight groundwater monitoring wells, installed in 2008 and in 2015. Well locations are shown in Figure 1 and Figure 3 and well logs provided in Appendix E.

2008 Monitoring Network

EBA Engineering Consultants Ltd. oversaw the installation of four groundwater monitoring wells (MW08-01 through MW08-04) at the LTF in October, 2008. These wells were installed in compliance with the Environmental Programs Branch Policy "*Hydrogeological Assessments at Land Treatment Facilities*" which, at the time of the 2008 study, stated that "the proponent will be required to drill to a minimum of 7.5 m below ground surface or until groundwater is encountered, whichever comes first. Upon reaching 7.5 m without encountering ground-water, the proponent may choose to continue drilling or complete the well at this depth". Two wells were drilled at inferred up-gradient locations and two wells drilled at inferred downgradient locations. Each well was drilled to a total depth of 7.5 m below grade (bg) without groundwater being intercepted. All four wells were constructed with 1.5 m long screens terminating at 7.5 m bg. All four wells have remained effectively dry since they were installed.

2015 Monitoring Network

In 2014, Tetra Tech EBA completed the regulatory services for LTF permit renewal, including management through the Yukon Environmental and Socio-economic Assessment Process. The Decision Document issued on February 9, 2015 included a requirement to "install groundwater monitoring wells in accordance with guidelines developed by the Environmental Programs Branch". The applicable guideline when installing groundwater monitoring wells at a land treatment facility is *Guidelines for Land Treatment Facilities* (Environment Yukon, October 2013). These guidelines state that: "When drilling wells for the hydrogeological assessment, the proponent will be required to drill to a depth that will allow for adequate characterization of the groundwater regime".

Tetra Tech EBA designed a groundwater monitoring network intended to characterize the groundwater regime and assess potential impact from the LTF. The network was based on inferred groundwater flow conditions and comprised of one upgradient well and two downgradient wells, with scope to add additional wells during the drilling program if necessary to capture downgradient flow.

At the request of the Client, supervision of the drilling program was contracted to West 80. A general work plan detailing proposed well locations and installation details was provided to West 80 prior to their mobilization. Tetra Tech EBA conveyed the importance of ensuring the monitoring network captured up and downgradient locations and was sufficient to determine groundwater flow directions.

Four groundwater monitoring wells (MW05, MW05a, MW06, MW07) were installed in May 2015 by Donjek Drilling based in Whitehorse, Yukon, under the supervision of West 80. Two wells (MW05a and MW06) were installed roughly in the area proposed in the work plan. MW07 was field fitted and moved approximately 60 m to the south due to the proposed location being in a depression which contained standing water. Tetra Tech EBA was not consulted prior to the relocation and drilling of MW07. The revised location was based on placing the well outside of the depressed area and also in consideration of a truck turning area which is located to the south of the facility's southern perimeter. A monitoring well could not be installed in the area to east of the water holding cell due to this area being low-lying and waterlogged, limiting drill rig access and confidence in constructing a well that would prevent surface water ingress.

Of the four monitoring wells installed in 2015, three wells (MW05a, MW06, MW07) encountered groundwater and were completed with screens spanning the water table. One well (MW05) was installed with a screen spanning damp to wet soils. This well failed to produce water after two days; so a second well (MW05a) was drilled adjacent to it. Well logs and construction details are provided in Appendix E and in the West 80 report, provided in Appendix F.

5.0 CONCEPTUAL HYDROGEOLOGICAL MODEL

5.1 Setting

The LTF is located approximately 6 km north of the centre of the Village of Mayo and approximately 1 km east of the Silver Trail. The closest residential development is approximately 1 km north of the site. The site has been cleared of vegetation with most cleared areas used for LTF operations. The area surrounding the LTF has a heavy cover of native vegetation (Figure 2, Figure 3).

The topography across the Site is generally flat at about 560 m above mean sea level (asl). At the Sites southern perimeter, there is a rapid drop in elevation toward the south. Surficial relief increases relatively gently to the north. The closest major water body to the LTF, Five Mile Lakes, is located approximately 600 m north of the Site at an elevation of around 590 m asl. The local topography rises markedly to the east of the Site with a consistent elevation gain from around 560 m asl at the LTF to over 1100 m asl within 3 km. Immediately to the west of the Site and along the site access road, there is little change in elevation between the Site and the Silver Trail.

The Mayo and Stewart Rivers are located 2.5 km to the west and 3.7 km to the southeast, respectively, at their closest points. Based on topographical differences, the Mayo River is expected to be in a different catchment to the Site. There is a substantial wetland/lake system that starts approximately 600 m south of the Site and extends south/southeast to the Stewart River (Figure 2). This system has a relatively consistent elevation of around 520 m asl.

5.2 Surficial Geology

The surficial geology of the Mayo area is considered to be quite complex. The area has been affected by a combination of valley glaciation and fluvial action related to the Mayo and Stewart River channels. Glacial sediments have been found to extend to depths in excess of two hundred metres during water well drilling. Nearer the surface, glacial melt water deposited glaciolacustrine silt and clay in temporary pro-glacial lakes. Fluvial deposition of coarse granular outwash deposits is also common. The presence of groundwater can be variable with shallow groundwater encountered on underlying permafrost where ice rich soils have melted out, leaving groundwater perched on frozen glaciolacustrine soils; or it may be encountered at shallow depths in channels within the floodplain deposits.

A conceptual cross section through the LTF is included in Figure 4. In general, native soils underlying the LTF consist primarily of glacial till and outwash deposits, with alternating layers of sand and silt; sand, gravel and silt; and sand and gravel. Thin silt layers are logged in several West 80 borehole logs. Soils appear to be laterally variable with West 80 logs from adjoining boreholes (i.e. MW05 and MW05a) differing substantially. A comparison of logs from boreholes across the Site also shows little lateral continuity in stratigraphy. Tetra Tech EBA note that the logged variability may be accentuated due to the drilling method (solid and hollow stem augering), with accurate logging of thin intervals from auger cuttings being difficult.

5.3 Groundwater Flow Direction and Potential Receiving Environments

Regional and Intermediate Flow

Groundwater occurrence and flow can generally be described by a series of interconnected flow systems on a regional, intermediate and local scale with flow from areas of recharge to areas of discharge. On a broad scale, regional and intermediate groundwater flow is expected to generally reflect the topography, with groundwater flowing from the north beneath the site in a southerly direction towards the major regional discharge features; the low lying wetland system about 600 m south/southeast of the Site and the Stewart River, which ranges from

approximately 3 km to 6 km from the site. Figure 5 shows a schematic cross section depicting groundwater flow in the vicinity of the Site.

Local Groundwater Flow

On a local scale, groundwater recharge is expected to occur primarily through infiltration of snowmelt and rainfall. The deforested area the Site is located on would be expected to be subject to greater infiltration than the surrounding forest area. Areas of free standing water (such as the Site water storage area) may be considered subject to increased recharge, although the low permeability of the compacted liner would limit infiltration.

The closest inferred downgradient groundwater discharge location to the LTF are the low lying wetlands and ponds to the south/southeast of the Site. Given the LTF's proximity to the wetlands, water infiltrating to ground at the LTF would not be expected to move into a deep flow paths, alternatively remaining in the upper flow system and discharging to the nearby wetlands system (Figure 5). Based on anecdotal information provided by the Site owner (Wilf Tuck) there are no seeps (groundwater discharge locations) between the Site and the wetlands/lakes 600 m.

5.4 Site Groundwater Elevations, Flow Direction, Gradient

Groundwater Elevations

Subsurface conditions at the LTF were investigated with the installation of four groundwater monitoring wells (MW05, MW05a, MW06 and MW07) in May 2015 under the direction of West 80. Subsurface conditions were also previously investigated by Tetra Tech EBA in 2008. Groundwater monitoring wells MW05, MW05a, MW06 and MW07 were completed with the screen installed across the interval where the moisture content of the formation appeared to be transitioning from moist to wet/saturated. Further information on the drilling program is provided in Section 4.0 and in West 80's report which is provided in Appendix F.

Groundwater levels were collected manually by Tetra Tech EBA or West 80 on four occasions in 2015 (May, June, August and October). Tetra Tech EBA used the groundwater depth data from each monitoring event and well survey elevation information provided by West 80 to calculate the groundwater elevation at each monitoring well that intercepted groundwater. Water level measurements and groundwater elevations from each monitoring round are detailed in Table 1. The following points are noted by Tetra Tech EBA in relation to manually collected groundwater elevation data and related observations made during the monitoring program:

- Elevations in MW06 and MW07 were relatively consistent at each monitoring round.
- The groundwater elevation in MW05a increased almost five (5) metres between the June and August 2015 monitoring events. Between the August and October monitoring events the elevation in MW05a decreased approximately 0.5 m.
- MW05 was dry when gauged in May, June and August. When gauged by Tetra Tech EBA in October, 0.85 m of water was measure in the well.
- Ice was noted on the pump used to purge and sample MW05a when it was removed from the well;
- There was considerable differences (almost 2 m) in the total depth of MW06 between monitoring rounds.
- MW01 had approximately 0.05 m of standing water at the base of the well.

In addition to collecting manual groundwater elevation data, elevation data was obtained from pressure transducers installed in MW05a, MW06 and MW07. Elevation data (compensated for changes in barometric pressure) is presented in Figure 6. Precipitation data obtained from the Mayo Airport, approximately 3.4 km to the south of the

Site is also shown on Figure 6. Tetra Tech EBA notes that elevation data presented for MW05a is shown from August 1, 2015 onwards due to data prior to this date being compromised. Tetra Tech EBA notes the following in relation to the elevation and precipitation data:

- Logged elevation data generally concurs with manually collected data.
- The relationship between rainfall and groundwater elevation fluctuations is undetermined. Links between specific events may be difficult to ascertain given the low permeability soils, expected slow aquifer recharge time and subsequent delayed response in elevations.
- All three wells appear to show similar fluctuations in elevations at corresponding times, although the response of MW05a appears to be more subdued than MW06 and MW07. Tetra Tech EBA considers these fluctuations in elevation are most likely in response to recharge to the aquifer from rainfall.
- The elevation in MW05a showed a steady decline from August 1, 2015 through to October 2015.
- There is insufficient data to determine seasonal trends.

Based on the observed groundwater elevations it is likely that two separate flow systems have been intercepted; a deeper water table aquifer and a shallow perched aquifer. MW06 and MW07 are considered to be screened in the water table aquifer.

The relative elevation of the base of the well screen (Figure 4) and presence of wet soils at the base of MW05a during drilling indicates MW05a has also likely been completed screening the water table aquifer. This assumption is supported by MW05a showing similar (but subdued) fluctuations in elevation data as MW06 and MW07 (Figure 6). However, large changes in elevation in MW05a over the monitoring period suggests that this well may be subject to water ingress.

Tetra Tech EBA considers there are two likely sources of water ingress; migration along the borehole annulus either from an overlying perched aquifer or from surface. Based on a review of drill logs and observations during the monitoring program, Tetra Tech EBA consider a perched aquifer may be present in the vicinity of MW05 and MW05a. While West 80 logged a 0.38 m thick silt layer in gravel in MW05 that could act as a low permeability layer, the presence of ice in MW05a provides a strong indication of a perched aquifer due to permafrost at this location. While the presence, thickness and extent of permafrost (and resultant perched aquifer) cannot be confirmed, the following well log notes and observations made during monitoring can provide an indication of its occurrence:

- The presence of damp to wet soils at 9.14 m bg in MW05 during drilling suggest interception of the perched aquifer.
- Ice was removed from MW05a during sampling in October 2015, an indication that at least the top of the water column (approximately 14.3 m bg) was frozen and was within permafrost.
- West 80 logs for MW05a showed harder drilling from 12.5 m below grade, possibly indicating the top of permafrost.
- The presence of permafrost is supported by the low temperature (0.2°C) measured in MW05a over the logging period. In comparison, temperatures of 1.5°C and 2.4°C were recorded at MW06 and MW07 respectively.

Based on these observations, permafrost is likely present in the vicinity of MW05a from around 12.5 m to 14.3 m bg.

Elevation Fluctuations at MW05 and MW05a

Tetra Tech EBA consider the elevation fluctuations observed at MW05 and MW05a may be related to the perched aquifer inferred to be present at this location.

We consider it likely that the perched aquifer was drilled through during the May 2015 groundwater monitoring installation, conducted by West 80, potentially creating a conduit between the two aquifers. Perched water has likely seeped down the borehole annulus and into MW05a. The low hydraulic conductivity of the soils at MW05a has likely limited recharge from the well to the water table aquifer, resulting in a slow rise in water elevation in the annulus and monitoring well. After August, the water level in MW05a decreased, indicating seepage into the well may have stopped or slowed to below the aquifer recharge rate. Alternatively, ingress may have stopped due to the borehole annulus being sealed, possibly from re-freezing of the permafrost zone or sealing of the bentonite plug at the top of the sand.

In order to more comprehensively assess the changes in groundwater elevation at MW05 and MW05a, further assessment will be required in 2016. This will enable a full years' worth of elevation data to be logged and allow more time for equilibrium conditions to be established. A comprehensive review of the MW05 and MW05a wellhead and surrounding area should also be conducted to assess the potential for surface water ingress to the subsurface.

Flow Directions and Gradient

Based on drilling and monitoring data, the local groundwater table is between 14 m and 17 m beneath the Site at an elevation of approximately 546 m to 540 m asl. While flow directions and the hydraulic gradient cannot be accurately determined as there are not sufficient wells completed assessing the water table aquifer, the information collected during the 2015 monitoring program can be used to estimate these parameters.

Figure 3 presents groundwater elevations and inferred groundwater flow direction based on the October 2015 monitoring round and topographical data. Figure 3 indicates that MW06 is likely located upgradient of the LTF area and can be considered representative of background/upgradient conditions and MW07 is likely located downgradient of waste deposition areas. Using the data presented in Figure 3, the horizontal hydraulic gradient of the water table aquifer across the site (between MW06 and MW07) has been calculated to be approximately 0.03 m/m. Groundwater flow is expected to be in a generally southerly direction which reflects the topography and is generally consistent with the expected flow direction towards the low lying wetlands system and Stewart River.

Data from MW05 and MW05a suggest that there may be a localised perched aquifer underlying the Site at this location. The extent of the perched aquifer is not known. Groundwater would be expected to mound on top of a low permeability layer (likely permafrost) and flow laterally along the dip of the low permeability surface. This may or may not be in the direction of regional groundwater flow. MW05a has potentially been completed screening the water table aquifer, with this well showing similar (but subdued) small fluctuations in elevation data as MW06 and MW07 (Figure 6). However, given the large variations in elevation over the course of monitoring, MW05a has potentially been impacted from water ingress from an overlying perched aquifer. Further assessment of the large variations and impact on groundwater flow will be required following the collection of further data.

5.5 Rising Head Test Results

Tetra Tech EBA analyzed rising head test results from MW05a, MW06, MW07 using Bouwer & Rice (1976) analysis methods implemented in the AquiferTestTM (ver. 4.6) software. The hydraulic conductivity test results and plots are attached in Appendix G. The estimated hydraulic conductivities for each well are presented in Table 5-1.

Table 5-1: Estimated Hydraulic Conductivity

Monitoring Well ID	Hydrogeological Unit[1]	Hydraulic Test Type	Analysis Method	Hydraulic Conductivity (m/s)
MW05a	GRAVEL, SAND, cobbles	Rising Head	Bouwer & Rice	3.5×10^{-8}
MW06	SAND, silt	Rising Head	Bouwer & Rice	1.6×10^{-6}
MW07 [2]	SAND, GRAVEL	Rising Head	Bouwer & Rice	5.8×10^{-7}

[1] Logged by West 80

[2] Average of two tests

As shown in Table 5-1, the inferred hydraulic conductivities ranged from 1.6×10^{-6} to 3.5×10^{-8} m/s with a geometric mean of 3.5×10^{-7}. Tetra Tech EBA notes that MW05a, which is logged as being completed in gravel and sand showed the lowest hydraulic conductivity, approximately one order of magnitude lower that MW07 and two orders of magnitude lower than MW06. None of the inferred hydraulic conductivities agree with the lithology logged by West 80, consisting primarily of sand and gravel. Based on the regional surficial geology, it is likely that the encountered sediments represent glacial till and that the silt fraction was systematically underrepresented in the logs provided by West 80. The inferred hydraulic conductivities fall at the lower end of literature values for glacial till (Fetter, 2001).

5.5.1 Vertical Travel Time to Regional Water Table

Vertical travel times from ground surface to the regional groundwater table (at approximately 16 m depth) have conservatively been estimated using the inferred hydraulic conductivity of the underlying soils and a hydraulic gradient of 1 using Darcy's Law:

$V = K\times i/\theta$ where:

V = average linear groundwater flow velocity

K = hydraulic conductivity

i = hydraulic gradient

θ = soil porosity (assumed to be 0.2, e.g. [Fetter, 2001])

The LTF is underlain by a silt liner with a minimum thickness of 1.0 m and a hydraulic conductivity of 1×10^{-7} m/s or lower. Based on the results presented in Table 5-1, the hydraulic conductivity of the underlying material is conservatively estimated to be 1.6×10^{-6} m/s or lower.

For the purpose of this investigation, the hydraulic conductivity value that would control the rate of vertical migration of potentially impacted surface water has been assumed to be the more conservative value of 1.6×10^{-6} m/s. Assuming the depth to the regional groundwater table is about 15 m, a vertical travel time from ground surface to the water table of 22 days has been estimated. This estimate conservatively assumes that retardation or natural attenuation of contaminants would not occur during migration through the unsaturated zone. The estimate also neglects the presence of the 1 m thick silt liner with a hydraulic conductivity of at least six times smaller than the one used for the travel time calculation.

5.5.2 Horizontal Travel Time to Downgradient Receptors

Horizontal groundwater travel time beneath the site is a function of the hydraulic conductivity of the underlying soil and the regional hydraulic gradient. The average linear groundwater flow velocity in the area of the LTF and potential downgradient receptors has been inferred using Darcy's Law (see Section 5.5.1).

Tetra Tech EBA used the highest calculated hydraulic conductivity (1.6×10^{-6} m/s at MW06) to conservatively estimate groundwater velocity beneath the site. As discussed above, the hydraulic gradient beneath the Site is about 0.03 based on observed groundwater elevation at MW06 and MW07. However, the groundwater travel time between the Site and potential downgradient receptor is controlled by the average hydraulic gradient to the south of the Site between the LTF and the nearest surface water body at a distance of about 600 m from the LTF. Based on the observed groundwater elevation at MW07 of about 540 m asl and the elevation of the nearest receiving surface water body of about 520 m asl, the hydraulic gradient between the LTF and the downgradient receptor is about 0.03, i.e., similar to the hydraulic gradient beneath the Site.

The inferred average linear groundwater flow velocity is about 7.4 m/year. The groundwater travel time to the nearest downgradient receptor (wetlands to the south/southeast at a distance of 600 m from the LTF) is therefore estimated to be approximately 81 years. However, groundwater may travel much faster or slower through the subsurface depending on the permeability of the unit and degree of interconnectivity between permeable units.

This estimate conservatively assumes that:

- Potential contaminants at the LTF site are instantly released at the groundwater table (no retardation by the compacted liner or travel through the unsaturated zone as per the estimate in Section 5.5.1);
- Retardation and natural attenuation of contaminants would not occur during migration through the unsaturated or saturated zone; and,
- Flow is in a straight line and the tortuosity of the flow path is not taken into account.

5.6 Potential for Contamination of Groundwater and Transport Mechanisms

The following identified potential sources of groundwater contamination are based on Site operations, Site history and inspection and processes governing contaminant migration. Potential contaminants and sources identified include:

- Petroleum hydrocarbons, other organic compounds (PAHs, chlorinated hydrocarbons), other miscellaneous contaminants (e.g. metals) in soil biopiles and stockpiles.
- Petroleum hydrocarbons, other organic compounds (PAHs, chlorinated hydrocarbons), other miscellaneous contaminants (e.g. metals) in impacted water that accumulates within the Site and is stored in the water holding cell.
- Leakage and spillage of petroleum hydrocarbons, other organic compounds (PAHs, chlorinated hydrocarbons), other miscellaneous contaminants (e.g. metals) from the two ASTs.
- Leakage and/or spillage of petroleum hydrocarbons from onsite heavy machinery.
- There were no off-site sources of pollution identified which could be considered to have impacted upon the groundwater flowing beneath the site.

The main pathways for the transport of contaminants from the sources identified above to groundwater and downgradient receptors are:

- Infiltration of rainwater and/or snowmelt into contaminated stockpiles/biopiles, dissolution of contaminants into the infiltrated water and then percolation of impacted water through underlying soils to the water table.
- Direct infiltration of contaminated water to the water table from:
  - water pooled within working cells and within the water holding cell; and,
  - leaks/spills from the two ASTs.
  - water sprayed on biopiles and within the site for dust control
- Direct infiltration of spilt/leaking fuel/oils through the underlying soils to the water table.
- Dissolution of spilt/leaking fuel/oils into rain/snowmelt then infiltration through the underlying soils to the water table

Tetra Tech EBA notes that there are active measures in place to reduce the potential for contaminants to infiltrate to the subsurface including:

- A compacted and graded silt liner underlying stockpiles and biopiles. The liner is tested following the removal of soil stockpiles and biopiles. As of February 2016, all analytical testing to date has shown that contaminants of concern (specifically hydrocarbons and metals) have not breached the underlying liner (Wilf Tuck, Don Wilson pers. comm.). The liner is also regularly tested to ensure the permeability is 1×10^{-7} m/s or lower (Wilf Tuck, pers. comm.).
- An active water management system is in place to remove water from working cells and pump it to the water holding cell. Anecdotal information provided by the Site owner (Mr. Wilf Tuck) indicates that water pumped into the water holding cell in spring typically takes several months to completely disappear, indicating the primary mechanism for water removal is evaporation rather than infiltration to ground.

Assuming infiltration of contaminants to the water table aquifer occurs, transport of contaminants within the water table aquifer towards downgradient discharge locations may occur.

6.0 APPLICATION OF APPLICABLE WATER QUALITY STANDARDS

The YCSR (Environment Act) provides standards for the assessment and remediation of contaminated sites in Yukon. The water quality standards applying to the assessment of groundwater contamination in Yukon are those specified in Schedule 6 of the CSR. 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 6-1.

Table 6-1: Applicable Water Quality Standards

Water Use	Applicable Water Quality Standard	Applicable Radius (km)	Applicability to Assessment
Aquatic Life	Schedule 6 – Contaminated Sites Regulation (O.I.C. 2002/171)	1	Applicable
Drinking Water	Schedule 6 – Contaminated Sites Regulation (O.I.C. 2002/171)	1.5	Not Applicable
Irrigation	Schedule 6 – Contaminated Sites Regulation (O.I.C. 2002/171)	1.5	Not Applicable
Livestock	Schedule 6 – Contaminated Sites Regulation (O.I.C. 2002/171)	1.5	Not Applicable

The following presents an assessment of the applicability of each water use detailed above to this assessment.

Aquatic Life

The closest potential downgradient Aquatic Life receptor (groundwater discharge locations such as wetlands, lakes or rivers) are the wetlands and ponds located approximately 600 m to the south of the site. As this water use is hydraulically downgradient, within 1 km of the site and is a potential groundwater discharge location, this water use is considered to be **applicable**. Tetra Tech EBA note that although the calculated travel time (81 years) is beyond the 50 year period that would render this guideline not applicable, due to current uncertainties in groundwater conditions, this water use has been deemed applicable.

Drinking Water

A review of the Yukon Water Well Registry and online Groundwater Information Network by Tetra Tech EBA on September 25, 2015 indicates there are no drinking water wells located within a 1.5 km radius of the site. It is noted these databases may not be complete and they often do not provide accurate well locations and it is therefore possible that there are more wells than that recorded on the registry in the local vicinity of the LTF.

Based on a review of Google Earth images (2005), the Yukon Mining Map Viewer and discussions with the Site owner (Mr. Wilf Tuck), there are no downgradient domestic developments within 1.5 km of the Site.

As there are no domestic developments that are located within the allotted distances for drinking water use (1.5 km) and there is no land designated for domestic development, this water use is considered to be **not applicable.**

Irrigation

Based on a review of Google Earth images (2005), the Yukon Mining Map Viewer and discussions with the Site owner (Mr. Wilf Tuck), there are no downgradient land uses that would constitute an irrigation water use within 1.5 km of the LTF Therefore, the potential for Irrigation Water use downgradient of the site does not exist and this water use is considered not applicable.

Livestock

Based on a review of Google Earth images (2005), the Yukon Mining Map Viewer and discussions with the Site owner (Mr. Wilf Tuck), there are no downgradient land uses that would constitute an agricultural land use with surface water bodies potentially being used as water supply for Livestock within 1.5 km of the LTF. Therefore,

potential for Livestock water use downgradient of the site does not exists and this water use is considered **not applicable**.

7.0 GROUNDWATER IMPACT ASSESSMENT

Two full rounds of groundwater sampling and one reduced sampling round were conducted as discussed in Section 3.3. Copies of original laboratory reports and Chain of Custody documentation are included in Appendix D. Tabulated laboratory results from each monitoring round compared against the YCSR Schedule 3 criteria for Aquatic Life are presented in Table 1. Table 7-1 details parameters that exceeded applicable YCSR guideline values during the 2015 monitoring program.

Table 7-1: Groundwater Results Exceeding Relevant CSR Schedule 3 Criteria

Parameter	Guideline Value (mg/L)	Water Use	Well ID
			MW05a
Cobalt	0.009	Aquatic Life	0.0188

A discussion of general groundwater chemistry and exceedances of relevant water quality guideline criteria are presented below.

General Groundwater Quality

Based on data from the first two monitoring rounds, the water chemistry of MW06 and MW07 is quite similar (Ca-Mg-HCO_3 type) indicating a similar water source and likely presence within the same flow system. Groundwater chemistry at MW05a is quite different to the other two wells, exhibiting a Ca-Mg-Na,K-HCO_3-SO_4 water type and reporting a significantly higher TDS. The higher TDS at MW05a indicates a longer groundwater residence time, which correlates with the lower hydraulic conductivity calculated at this well.

Between the June and October monitoring rounds, the TDS at MW05a lowered by approximately 25% (1200 mg/L to 900 mg/L), indicating a change in groundwater conditions at this location. MW06 and MW07 did not show similar changes in TDS concentration. The reason for the differing water chemistry at MW05a is not known but may be associated with the rise and subsequent fall in water elevation at this well and detection of water in MW05 (not sampled due to insufficient water volume) as discussed in Section 5.3.

Tetra Tech EBA recommends that general water quality in MW05a be re-evaluated after the 2016 monitoring events in consideration of a full year of groundwater elevation data in order to further assess the water quality differences at MW05a. Additionally, MW05 should be sampled during the 2016 monitoring events should there be sufficient water in the well.

Metals

Dissolved metals results compared against the YCSR Schedule 3 Aquatic Life criteria are provided in Table 1. Tetra Tech EBA notes that while total metals were analysed and reported by the laboratory, these results have not been provided in Table 1 or compared against standards. Non-filtered samples analysed for total metals typically contain clay, silt and sand particles introduced during the sampling process which can increase metals concentrations, leading to results not representative of mobile phase concentrations. In accordance with the YCSR, samples filtered through a 0.45µm filter (to remove soil particles) are considered representative of dissolved and mobile metals concentrations and suitable for comparison against guideline criteria.

As shown in Table 7-1, cobalt exceeded the YCSR Schedule 3 Aquatic Life criterion at MW05a in the October 2015 monitoring event. This analyte was below the guideline value in the June 2015 monitoring round. Cobalt was below the level of detection (0.005 mg/L) in both monitoring rounds at downgradient well MW07 and close to the level of detection in both rounds at upgradient well MW06. Given that the concentration at MW05a is significantly higher than the inferred background well, there is the potential that that exceedance could be due to impact from Site operations.

To further asses the source and significance of the exceedance, Tetra Tech EBA reviewed cobalt results from analysis of stockpile and liner samples collected in 2010, 2011 and 2012 and samples collected from MW06 during the 2015 drilling program. Table 7-2 shows a summary of the data.

Table 7-2: Cobalt Soil Concentration

Soil Source	Number of Samples	Results (mg/kg)	
Stockpiles (16) and Liner (1)	17	Max	0.10
		Min	0.075
		Average	0.092
MW06 [1] (offsite, considered background)	2	Average	0.067
[1] Collected by West 80 during 2015 groundwater monitoring well installation program			

Tetra Tech EBA notes that while there is insufficient data to definitively assess the source of the elevated cobalt at MW05a, the results of the soil testing presented in Table 7-2 indicate that natural cobalt concentrations are similar to concentrations in stockpile material brought onto site. Therefore, impact to groundwater from cobalt from stockpiled soils would be expected to be similar in magnitude to impact from natural soils. Therefore, Tetra Tech EBA consider that the elevated cobalt concentration is likely representative of background conditions and inherent variability associated with groundwater sampling. Tetra Tech EBA recommends that cobalt continue to be tested at all wells and the source of cobalt be reviewed following the 2016 monitoring program.

Tetra Tech EBA notes that given a distance to the closest downgradient receptor of 600 m, if sourced from Site operations, the cobalt concentration would be expected to be reduced to below the guideline value prior to discharge through attenuation on negatively charged clays/silts or the concentration reduced through dilution, dispersion and/or diffusion prior to discharge to surface water.

Hydrocarbons

VOCs, PAHs, Volatile Hydrocarbons ($VH6_{-10}$), VPH (C6-C10), EPH_{10-19} and LEPH were reported at concentrations below the laboratory limit of reporting (LOR) at all tested wells. HEPH and EPH_{19-32} were reported at concentrations below the LOR at MW05a and MW07.

Inferred upgradient monitoring well MW06 reported HEPH and EPH_{19-32} above the LOR in the June 2015 monitoring round. The YCSR Schedule 3 Generic Numerical Water Standard for Aquatic Life does not indicate a guideline value for HEPH or EPH_{19-32}, therefore a comparison cannot be made.

In accordance with the Permit, which requires the permittee to contact an environmental protection analyst within seven (7) days of receipt of the results if groundwater analyses show detectable concentrations of hydrocarbons in

any well during any sampling event, Tetra Tech EBA notified an Environment Yukon representative two days after the receipt of this result. At the request of Environment Yukon, MW06 was resampled by West 80 on August 3, 2015 and the sample analysed for HEPH and EPH_{19-32}. Concentrations of these analytes were reported below the laboratory LOR. MW06 was resampled during the October 2015 monitoring round and again, HEPH and EPH_{19-32} were reported at concentrations below the MDL.

Given the implications associated with a hydrocarbon detection in groundwater, further investigation was conducted to assess the reliability of the detectable result and the potential source of the detection. Based on the well location, geological and hydrogeological regime and site history and operations, Tetra Tech EBA considers the detection could be due to one or more of the following reasons as outlined in Table 7-3.

Table 7-3: Potential Sources of HEPH / EPH19-32 Detection in MW06

Potential Source	Reasoning and Further Investigation Undertaken
Laboratory Contamination	▪ At the request of Tetra Tech EBA, the detection was checked and confirmed by the analytical laboratory. ▪ The laboratory verbally advised Tetra Tech EBA that the potential for contamination of the sample during the laboratory analytical procedure was “very small”.
Natural Concentration in Groundwater	▪ Tetra Tech EBA requested the analytical laboratory perform a silica gel column cleanup to differentiate biogenic organics (i.e. lipids, plant oils, tannins, lignins, animal fats, proteins, humic acids, fatty acids, and resin acids) from petroleum hydrocarbons. A silica gel cleanup removes biogenic organics from the sample leaving the petroleum hydrocarbons to be analysed. The result of the silica gel cleanup analysis (Appendix D) confirms that at least some component of the detection is related to biogenic organics (non-petroleum hydrocarbons) as the EPH_{19-32} concentration decreased from 330 µg/L to <300 µg/L after the cleanup.
Contamination Introduced During Drilling and/or Well Construction	▪ Hydrocarbons may have been introduced from lubricating oils used on the augers or contamination of the PVC casing used for the monitoring well (i.e. from handling or storage).
Impact from the LTF	▪ Contamination from the LTF has migrated through the subsurface and impacted the well.

While it is not possible to definitively identify a source of the HEPH and EPH_{19-32} detection in June 2015, the fact that the detection was immediately after the drilling and installation of MW06 and hydrocarbons were not detected in the subsequent two monitoring events indicates the source is likely to be either laboratory contamination or contamination introduced during drilling. If the LTF was impacting the well water or detections were related to natural concentrations, it would be expected that further detections would have likely been observed. In accordance with the Permit requirements, future sampling events should include the analysis of HEPH and EPH_{19-32} in all groundwater samples.

8.0 SUMMARY AND CONCLUSIONS

The following conclusions are made based on the findings of the 2015/2016 hydrogeological assessment:

- Based on drilling and monitoring data, the local water table is between 14 m and 17 m beneath the Site at an elevation of approximately 546 m to 540 m asl.
- Regional groundwater flow in the water table aquifer is expected to be to the south/southeast which reflects the topography and is generally consistent with the expected flow direction towards the low lying wetlands system and Stewart River.

- MW06 and MW07 are believed to have been completed screening the water table aquifer. MW05a has potentially been completed screening the water table aquifer, with this well showing similar (but subdued) small fluctuations in elevation data as MW06 and MW07.
- Data from MW05 and MW05a suggests that there may be a localised perched aquifer on top of permafrost underlying the Site at this location. The extent of the perched aquifer is not known. If present, groundwater would be expected to mound on top of the low permeability layer (likely permafrost) and flow laterally along the dip of the low permeability surface. This may or may not be in the direction of regional groundwater flow.
- There was considerable difference in water chemistry between MW05a and the two other groundwater monitoring wells on site from which water quality data was collected (MW06 and MW07). The reason for the difference in not known but is potentially related to ingress of perched groundwater to MW05a and the rise and subsequent fall in water elevation at this well.
- Based on a distance of 600 m to the nearest potential downgradient receptor (wetlands to the south/southeast), the groundwater travel time is estimated to be approximately 81 years. However, groundwater may travel much faster or slower through the subsurface depending on the permeability of the unit and degree of interconnectivity between permeable units.
- Dissolved cobalt exceeded the YCSR Schedule 3 Aquatic Life criteria at MW05a in the October 2015 monitoring event. Tetra Tech EBA consider that the elevated cobalt concentration is likely representative of natural background conditions and inherent variability associated with groundwater sampling.
- HEPH and EPH_{19-32} were detected in MW06 in June 2015, however were not detected in the subsequent two monitoring rounds. Tetra Tech EBA considers the June 2015 detection is likely to be either laboratory contamination or contamination introduced during drilling or sampling.

9.0 RECOMMENDATIONS

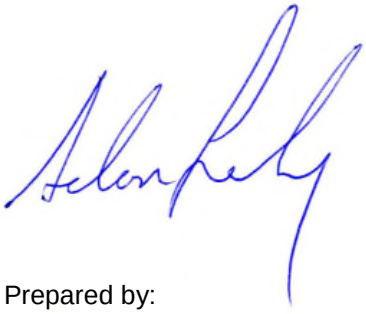
The following recommendations are made based on the findings of the 2015/16 hydrogeological assessment:

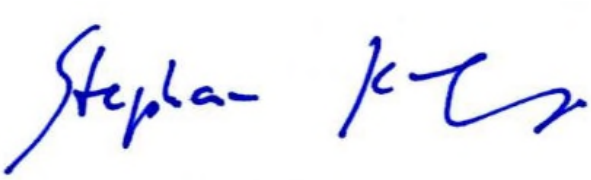
- All groundwater monitoring wells should be surveyed for location and elevation prior to the next monitoring round.
- In order to more comprehensively assess the changes in groundwater elevation and chemistry at MW05 and MW05a, further assessment will be required after the summer 2016 monitoring program. This will enable a full years' worth of elevation data to be logged and allow more time for equilibrium conditions to be established.
- Following review of summer 2016 monitoring data, the Site conceptual hydrogeological model should be reviewed and updated, if necessary, to describe conditions at the Site. Data gaps and monitoring network deficiencies should be identified and recommendations made to address them.
- A comprehensive review of the MW05 and MW05a wellhead and surrounding area should also be conducted in summer 2016 to assess the potential for surface water ingress to the subsurface at these locations.
- MW05 should be sampled during the 2016 monitoring events should there be sufficient water in the well.
- Cobalt should continue to be tested at all wells and the significance of the guideline exceedance be reviewed following the 2016 monitoring program.
- Data from the loggers should be reviewed following the June 2016 monitoring event to determine high and low water elevations and to aid in the determination of the second 2016 monitoring event.

10.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.





Prepared by:
Adam Seeley, B.Sc. M.Hyd.
Hydrogeologist
Water Practice
Direct Line: 867.668.9224
Adam.Seeley@tetratech.com

Reviewed by:
Stephan Klump, Ph.D.
Senior Hydrogeologist
Water Practice
Direct Line: 867.668.9220
Stephan.Klump@tetratech.com

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TABLES

Table 1: Mayo LTF Groundwater Elevations, 2015

					Date	21-May-15		16-Jun-15		3-Aug-15		9-Oct-15	
					Gauged by	West 80		Tetra Tech EBA		West 80		Tetra Tech EBA	
Well ID	Stick up (m)	Relative Elevation - TOC (masl)	Relative Ground Elevation (m asl)	Depth to Base of Well (m btoc)	Relative Base Elevation (masl)[1]	SWL (m bTOC)	Groundwater Elevation (masl)	SWL (m bTOC)	Groundwater Elevation (masl)	SWL (m bTOC)	Groundwater Elevation (masl)	SWL (m bTOC)	Groundwater Elevation (masl)
MW01	-	560.61	-	-	-	dry	-	dry	-	-	-	dry	-
MW02	-	556.00	-	-	-	dry	-	dry	-	-	-	dry	-
MW03	-	561.01	-	-	-	dry	-	dry	-	-	-	dry	-
MW05	0.61	560.30	559.69	-	548.46	-	-	dry	-	dry	-	11.38	548.92
MW05A	0.67	560.20	559.53	18.51	541.69	18.505	541.70	14.73	545.47	13.74	546.46	14.30	545.90
MW06	0.88	561.50	560.62	15.4	545.22	15.41	546.09	15.30	546.20	15.32	546.18	15.08	546.42
MW07	0.85	557.65	556.80	17.26	540.39	17.255	540.40	17.18	540.47	17.16	540.49	17.00	540.65

[1] Elevation data from West 80 Environmental Consulting (2015) RL - relative level m bTOC - metres below top of PVC casing masl - metres above sea level

Table 2: Mayo LTF - Groundwater Analytical Results

Parameter	Unit	Location	MW05A		MW06				MW07		
		Sampled_Date_Time	6/17/2015	10/9/2015	6/17/2015	8/3/2015	10/9/2015		6/17/2015	6/17/2015	10/8/2015
		Field_ID	MW05A	MW05A	MW06	MW06	DUP	MW06	MW07	DUP 1	MW07
		SDG	L1629047	L1688148	L1629047	B567012	L1688148	L1688148	L1629047	L1629047	L1688148
		SampleCode	L1629047-1	L1688148-1	L1629047-2	MV2076	L1688148-4	L1688148-2	L1629047-3	L1629047-4	L1688148-3
		Yukon CSR GW - AW									
Field											
Field Temperature	°C	-	1.7	-	4.1	-	-	-	3.7	-	-
Field Dissolved Oxygen (Filtered)	mg/L	-	6.09	-	3.54	-	-	-	8.14	-	-
Field Electric Conductivity	uS/cm	-	1362	-	431.7	-	-	-	476.8	-	-
Field Redox	mV	-	-30.9	-	-32.2	-	-	-	-44.7	-	-
Field pH	pH_Units	-	8.12	-	8.14	-	-	-	8.4	-	-
Physical Parameters		-									
pH	pH Units	-	8.03	8.14	8.25	-	-	8.06	8.25	8.1	8.14
Electrical Conductivity (EC)	uS/cm	-	1600	1340	523	-	-	528	538	555	499
Chloride (Cl)	µg/L	-	12,900	4500	<500	-	-	610	930	950	<500
Alkalinity (total as CaCO3)	µg/L	-	449,000	578,000	260,000	-	-	290,000	257,000	261,000	273,000
Fluoride (F)	µg/L	**2000**	253	168	95	-	-	95	143	140	109
Sulphate (SO4)	µg/L	**1000000**	452,000	289,000	7250	-	-	13,300	25,800	26,100	18,800
Total Dissolved Solids (TDS) (Filtered)	µg/L	-	1,210,000	895,000	313,000	-	-	325,000	323,000	343,000	319,000
Hardness as CaCO3	µg/L	-	902,000	729,000	284,000	-	316,000	301,000	297,000	294,000	304,000
Turbidity	NTU	-	3450	-	>4000	-	-	-	>4000	>4000	-
Nutrients		-									
Nitrate (as N)	µg/L	**400000**	339	<10	10.5	-	-	19.4	289	292	257
Nitrite (as N)	µg/L	**200**	36.9	<2	1.9	-	-	1	5	4.7	2
Dissolved Metals		-									
Aluminum (Filtered)	µg/L	-	<10	<10	<10	-	<10	<10	<10	<10	<10
Antimony (Filtered)	µg/L	**200**	0.57	<0.5	1.4	-	0.95	0.95	<0.5	<0.5	<0.5
Arsenic (Filtered)	µg/L	**50**	1	<1	14.6	-	4.7	4.7	<1	<1	<1
Barium (Filtered)	µg/L	**10000**	33	35	573	-	410	413	135	136	142
Beryllium (Filtered)	µg/L	**53**	<5	<5	<5	-	<5	<5	<5	<5	<5
Boron (Filtered)	µg/L	**500000**	100	<100	<100	-	<100	<100	<100	<100	<100
Cadmium (Filtered)	µg/L	**0.1** [2]	0.056	0.066	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Calcium (Filtered)	µg/L	-	244,000	165,000	90,500	-	102,000	95,600	86,500	85,400	89,000
Chromium (Filtered)	µg/L	**10**	<0.5	<0.5	<0.5	-	1.38	<0.5	0.68	0.66	0.79
Cobalt (Filtered)	µg/L	**9**	1.11	**18.8**	0.66	-	0.91	0.91	<0.5	<0.5	<0.5
Copper (Filtered)	µg/L	**20** [2]	2.1	<1	<1	-	<1	<1	<1	<1	<1
Iron (Filtered)	µg/L	-	<30	204	57	-	<30	<30	<30	<30	<30
Lead (Filtered)	µg/L	**40** [2]	<1	<1	<1	-	<1	<1	<1	<1	<1
Lithium (Filtered)	µg/L	-	54	<50	<50	-	<50	<50	<50	<50	<50
Magnesium (Filtered)	µg/L	-	71,000	77,100	14,100	-	15,100	15,100	19,700	19,600	19,800
Manganese (Filtered)	µg/L	-	306	1120	541	-	604	599	83	80	95
Mercury (Filtered)	µg/L	**1**	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2
Molybdenum (Filtered)	µg/L	**10000**	1.2	3.9	3.3	-	2	2	1.7	1.8	1.2
Nickel (Filtered)	µg/L	**250** [2]	6	5.5	<5	-	<5	<5	<5	<5	<5
Selenium (Filtered)	µg/L	**10**	5.2	<1	<1	-	<1	<1	3	3.1	2.8
Silver (Filtered)	µg/L	**0.5** [2]	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Sodium (Filtered)	µg/L	-	35,200	69,000	2000	-	2300	2300	3500	3500	3000
Thallium (Filtered)	µg/L	**3**	<0.2	<0.2	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium (Filtered)	µg/L	**1000**	<50	<50	<50	-	<50	<50	<50	<50	<50
Uranium (Filtered)	µg/L	**3000**	28.3	23.7	10.9	-	6.07	6.01	5.7	5.8	4.19
Vanadium (Filtered)	µg/L	-	<30	<30	<30	-	<30	<30	<30	<30	<30
Zinc (Filtered)	µg/L	**75** [2]	<5	10.3	<5	-	<5	<5	<5	<5	5.6

Table 2: Mayo LTF - Groundwater Analytical Results

Parameter	Unit	Location	MW05A		MW06				MW07		
		Sampled_Date_Time	6/17/2015	10/9/2015	6/17/2015	8/3/2015	10/9/2015		6/17/2015	6/17/2015	10/8/2015
		Field_ID	MW05A	MW05A	MW06	MW06	DUP	MW06	MW07	DUP 1	MW07
		SDG	L1629047	L1688148	L1629047	B567012	L1688148	L1688148	L1629047	L1629047	L1688148
		SampleCode	L1629047-1	L1688148-1	L1629047-2	MV2076	L1688148-4	L1688148-2	L1629047-3	L1629047-4	L1688148-3
		Yukon CSR GW - AW									
BTEXS & MTBE		**-**									
Benzene	µg/L	**4000**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene	µg/L	**390**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	µg/L	**2000**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes (m & p)	µg/L	**-**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5
Xylene (o)	µg/L	**-**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5
Xylenes Total	µg/L	**-**	<0.75	<0.75	<0.75	-	<0.75	<0.75	<0.75	<0.75	<0.75
Styrene	µg/L	**720**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5
MTBE	µg/L	**-**	<0.5	<0.5	<0.5	-	<0.5	<0.5	<0.5	<0.5	<0.5
Hydrocarbons		**-**									
EPH10-19	µg/L	**5000**	<250	<250	<250	-	<250	<250	<250	<250	<250
EPH19-32	µg/L	**-**	<250	<250	330	<200	<250	<250	<250	<250	<250
LEPH	µg/L	**500**	<250	<250	<250	-	<250	<250	<250	<250	<250
HEPH	µg/L	**-**	<250	<250	330	-	<250	<250	<250	<250	<250
VH6-10	µg/L	**-**	<100	<100	<100	-	<100	<100	<100	<100	<100
VPH6-10	µg/L	**1500**	<100	<100	<100	-	<100	<100	<100	<100	<100
Polycyclic Aromatic Hydrocarbons (PAHs)		**-**									
Acenaphthene	µg/L	**60**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Acenaphthylene	µg/L	**-**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	µg/L	**1**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Acridine	µg/L	**0.5**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Benz(a)anthracene	µg/L	**1**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(a) pyrene	µg/L	**0.1**	<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01
Benzo(b)fluoranthene	µg/L	**-**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	µg/L	**-**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	µg/L	**-**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Chrysene	µg/L	**-**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	µg/L	**-**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoranthene	µg/L	**2**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	µg/L	**120**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)pyrene	µg/L	**-**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Naphthalene	µg/L	**10**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Phenanthrene	µg/L	**3**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Pyrene	µg/L	**0.2**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05
Quinoline	µg/L	**34**	<0.05	<0.05	<0.05	-	<0.05	<0.05	<0.05	<0.05	<0.05

Notes:

[1] Environment Act. Contaminated Sites Regulation (CSR) (2002). Schedule 3, Generic Numerical Water Standards for Freshwater Aquatic Life (AW) and Irrigation (IW) and Livestock (LW)

[2] Standard varies with hardness. Values shown based on site hardness range of 284 mg/L to 902 mg/L

[3] Standard varies with pH and temperature.

"-" No applicable guideline or standard

BOLD - Greater than applicable guidelines or standards

Table 3: Groundwater Quality Assurance/Quality Control Analytical Results

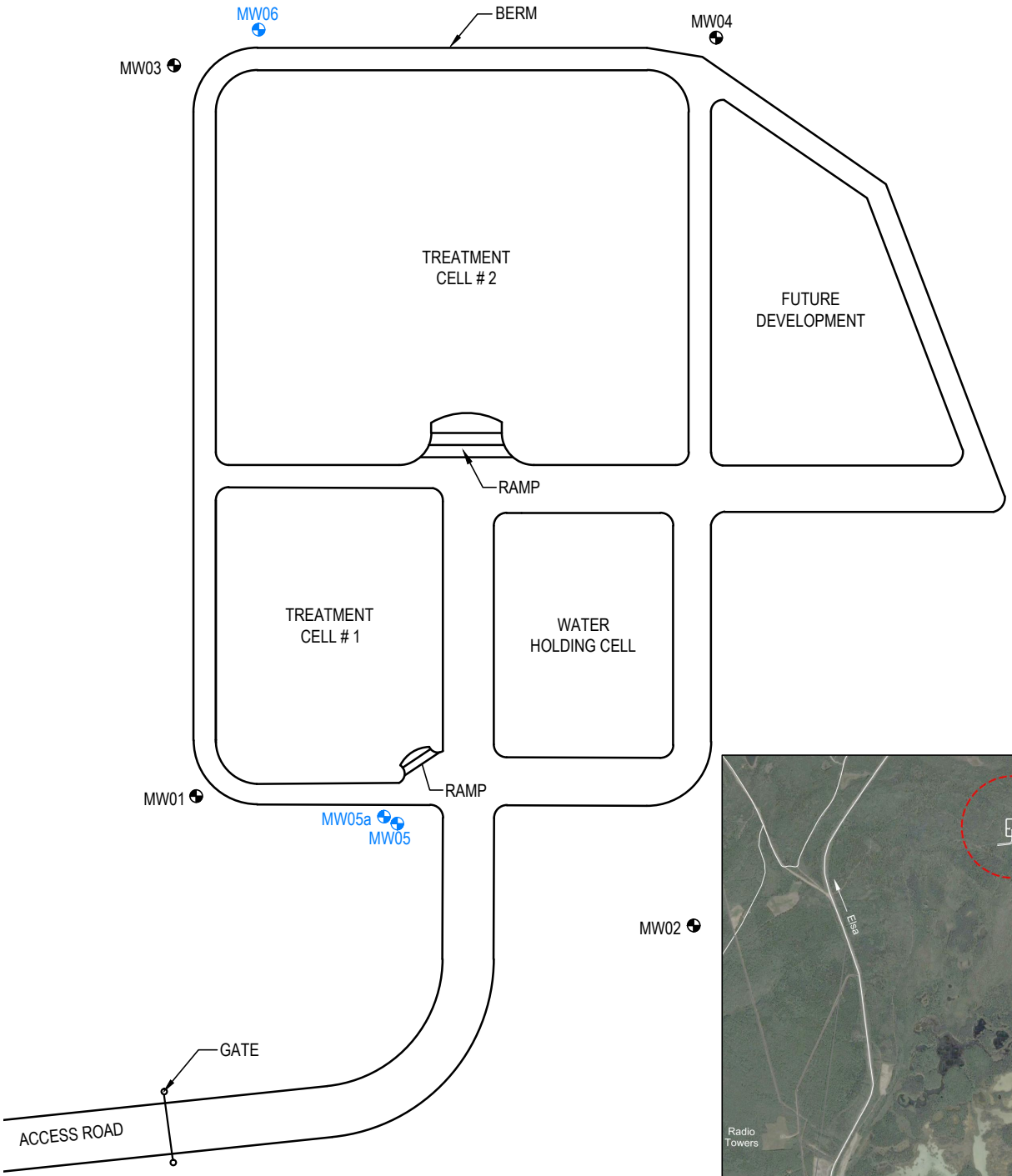
Parameter	Unit	Location	BLANKS	DUPLICATES					
		Field_ID	FIELD BLANK	MW06	DUP	RPD (%)	MW07	DUP 1	RPD (%)
		ampled_Date_Tim	6/17/2015	10/9/2015			6/17/2015		
		SampleCode	L1629047-5	L1688148-2	L1688148-4		L1629047-3	L1629047-4	
		RDL							
Physical Parameters									
pH	pH Units	0.1	5.5	8.06	-	-	8.25	8.1	1.8
Electrical Conductivity (EC)	uS/cm	2	7.3	528	-	-	538	555	3.1
Chloride (Cl)	µg/L	500	<500	610	-	-	930	950	2.1
Alkalinity (total as CaCO3)	µg/L	2000	<2000	290,000	-	-	257,000	261,000	1.5
Fluoride (F)	µg/L	20	<20	95	-	-	143	140	2.1
Sulphate (SO4)	µg/L	300	<300	13,300	-	-	25,800	26,100	1.2
Total Dissolved Solids (TDS) (Filtered)	µg/L	10000	<10,000	325,000	-	-	323,000	343,000	6.0
Hardness as CaCO3	µg/L	500	<500	301,000	316,000	4.9	297,000	294,000	1.0
Turbidity	NTU	0.1	<0.1	-	-	-	>4000	>4000	-
Nutrients									
Nitrate (as N)	µg/L	5	<5	19.4	-	-	289	292	1.0
Nitrite (as N)	µg/L	1	<1	1	-	-	5	4.7	6.2
Dissolved Metals									
Aluminum (Filtered)	µg/L	10	-	<10	<10	-	<10	<10	-
Antimony (Filtered)	µg/L	0.5	-	0.95	0.95	0.0	<0.5	<0.5	-
Arsenic (Filtered)	µg/L	1	-	4.7	4.7	0.0	<1	<1	-
Barium (Filtered)	µg/L	20	-	413	410	0.7	135	136	0.7
Beryllium (Filtered)	µg/L	5	-	<5	<5	-	<5	<5	-
Boron (Filtered)	µg/L	100	-	<100	<100	-	<100	<100	-
Cadmium (Filtered)	µg/L	0.05	-	<0.05	<0.05	-	<0.05	<0.05	-
Calcium (Filtered)	µg/L	100	-	95,600	102,000	6.5	86,500	85,400	1.3
Chromium (Filtered)	µg/L	0.5	-	<0.5	1.38	#VALUE!	0.68	0.66	3.0
Cobalt (Filtered)	µg/L	0.5	-	0.91	0.91	0.0	<0.5	<0.5	-
Copper (Filtered)	µg/L	1	-	<1	<1	-	<1	<1	-
Iron (Filtered)	µg/L	30	-	<30	<30	-	<30	<30	-
Lead (Filtered)	µg/L	1	-	<1	<1	-	<1	<1	-
Lithium (Filtered)	µg/L	50	-	<50	<50	-	<50	<50	-
Magnesium (Filtered)	µg/L	100	-	15,100	15,100	0.0	19,700	19,600	0.5
Manganese (Filtered)	µg/L	10	-	599	604	0.8	83	80	3.7
Mercury (Filtered)	µg/L	0.2	-	<0.2	<0.2	-	<0.2	<0.2	-
Molybdenum (Filtered)	µg/L	1	-	2	2	0.0	1.7	1.8	5.7
Nickel (Filtered)	µg/L	5	-	<5	<5	-	<5	<5	-
Selenium (Filtered)	µg/L	1	-	<1	<1	-	3	3.1	3.3
Silver (Filtered)	µg/L	0.05	-	<0.05	<0.05	-	<0.05	<0.05	-
Sodium (Filtered)	µg/L	2000	-	2300	2300	0.0	3500	3500	0.0
Thallium (Filtered)	µg/L	0.2	-	<0.2	<0.2	-	<0.2	<0.2	-
Titanium (Filtered)	µg/L	50	-	<50	<50	-	<50	<50	-
Uranium (Filtered)	µg/L	0.2	-	6.01	6.07	1.0	5.7	5.8	1.7
Vanadium (Filtered)	µg/L	30	-	<30	<30	-	<30	<30	-
Zinc (Filtered)	µg/L	5	-	<5	<5	-	<5	<5	-
Total Metals									
Aluminum	µg/L	10	<10	53,000	-	-	-	-	-
Antimony	µg/L	0.5	<0.5	3.11	-	-	-	-	-
Arsenic	µg/L	1	<1	55.2	-	-	-	-	-
Barium	µg/L	20	<20	2630	-	-	-	-	-
Beryllium	µg/L	5	<5	<5	-	-	-	-	-
Boron	µg/L	100	<100	<100	-	-	-	-	-
Cadmium	µg/L	0.05	<0.05	3.73	-	-	-	-	-
Calcium	µg/L	100	<100	153,000	-	-	-	-	-
Chromium	µg/L	0.5	<0.5	95.4	-	-	-	-	-
Cobalt	µg/L	0.5	<0.5	64.7	-	-	-	-	-
Copper	µg/L	1	<1	193	-	-	-	-	-
Iron	µg/L	30	<30	127,000	-	-	-	-	-
Lead	µg/L	1	<1	76.1	-	-	-	-	-
Lithium	µg/L	50	<50	113	-	-	-	-	-
Magnesium	µg/L	100	<100	45,000	-	-	-	-	-
Manganese	µg/L	10	<10	3550	-	-	-	-	-
Mercury	µg/L	0.2	<0.2	0.74	-	-	-	-	-
Molybdenum	µg/L	1	<1	2.3	-	-	-	-	-
Nickel	µg/L	5	<5	177	-	-	-	-	-
Selenium	µg/L	1	<1	3.1	-	-	-	-	-
Silver	µg/L	0.05	<0.05	1.23	-	-	-	-	-
Sodium	µg/L	2000	<2000	3400	-	-	-	-	-
Thallium	µg/L	0.2	<0.2	0.69	-	-	-	-	-
Titanium	µg/L	50	<50	498	-	-	-	-	-
Uranium	µg/L	0.2	<0.2	15.2	-	-	-	-	-
Vanadium	µg/L	30	<30	97	-	-	-	-	-
Zinc	µg/L	5	<5	565	-	-	-	-	-

Table 3: Groundwater Quality Assurance/Quality Control Analytical Results

Parameter	Unit	Location	BLANKS	DUPLICATES					
		Field_ID	FIELD BLANK	MW06	DUP	RPD (%)	MW07	DUP 1	RPD (%)
		Sampled_Date_Tim	6/17/2015	10/9/2015			6/17/2015		
		SampleCode	L1629047-5	L1688148-2	L1688148-4		L1629047-3	L1629047-4	
		RDL							
BTEXS & MTBE									
Benzene	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
Toluene	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
Ethylbenzene	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
Xylenes (m & p)	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
Xylene (o)	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
Xylenes Total	µg/L	0.75	<0.75	<0.75	<0.75	-	<0.75	<0.75	-
Styrene	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
MTBE	µg/L	0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	-
Hydrocarbons									
EPH10-19	µg/L	250	<250	<250	<250	-	<250	<250	-
EPH19-32	µg/L	200	<250	<250	<250	-	<250	<250	-
LEPH	µg/L		<250	<250	<250	-	<250	<250	-
HEPH	µg/L		<250	<250	<250	-	<250	<250	-
VH6-10	µg/L	100	<100	<100	<100	-	<100	<100	-
VPH6-10	µg/L	100	<100	<100	<100	-	<100	<100	-
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Acenaphthylene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Anthracene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Acridine	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Benz(a)anthracene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Benzo(a) pyrene	µg/L	0.01	<0.01	<0.01	<0.01	-	<0.01	<0.01	-
Benzo(b)fluoranthene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Benzo(g,h,i)perylene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Benzo(k)fluoranthene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Chrysene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Dibenz(a,h)anthracene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Fluoranthene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Fluorene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Indeno(1,2,3-c,d)pyrene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Naphthalene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Phenanthrene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Pyrene	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-
Quinoline	µg/L	0.05	<0.05	<0.05	<0.05	-	<0.05	<0.05	-

Notes:
RDL - Reportable detection limit
RPD - Relative percent difference calculated as (abs(C1-C2)/average(C1+C2))*100
"-" Indicates RPD not calculated. RPD cannot be calculated if one or more of the analytical results are less than detection limits or within 5 times the detection limits.
Blank - Not analyzed

FIGURES



LOCATION PLAN

0 50

Scale: 1: 1000 (metres)

CLIENT

WILF'S CONTRACTING LTD.

UPDATED HYDROGEOLOGICAL ASSESSMENT
MAYO LAND TREATMENT FACILITY - MAYO, YUKON

SITE LOCATION AND GENERAL SITE LAYOUT

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
ENVSWM03460-02	CB	AJS	0

OFFICE	DATE
EBA-WHSE	February 11, 2016

Figure 1

Q:\Whitehorse\Data\02\01drawings\Mayo\ENVSWM03460-01 Mayo LTF Permit Renewal\02\ENVSWM03460-02 Fig.1_R1.dwg [FIGURE 1] February 15, 2016 - 2:50:48 pm (BY: BUCHAN, CAMERON)

0 500

Scale: 1: 10 000 (metres)

CLIENT

WILF'S CONTRACTING LTD.

UPDATED HYDROGEOLOGICAL ASSESSMENT MAYO LAND TREATMENT FACILITY - MAYO, YUKON

SITE SETTING

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
ENVSWM03460-02	CB	AJS	0

OFFICE	DATE
EBA-WHSE	February 11, 2016

Figure 2

Q:\Whitehorse\Data\02\01drawings\Mayo\ENVSWM03460-01 Mayo LTF Permit Renewal\02\ENVSWM03460-02 Fig.1_R1.dwg [FIGURE 2] February 15, 2016 - 10:19:48 am (BY: BUCHAN, CAMERON)

LEGEND:

- MONITORING WELL LOCATION (EBA 2008)
- MONITORING WELL LOCATION (WEST 80 2015)
(540.65) - GROUNDWATER ELEVATION (masl - OCTOBER 2015)
- INFERRED GENERAL GROUNDWATER FLOW DIRECTION

CLIENT

WILF'S CONTRACTING LTD.

UPDATED HYDROGEOLOGICAL ASSESSMENT
MAYO LAND TREATMENT FACILITY - MAYO, YUKON

GROUNDWATER MONITORING WELL LOCATIONS

TETRA TECH EBA

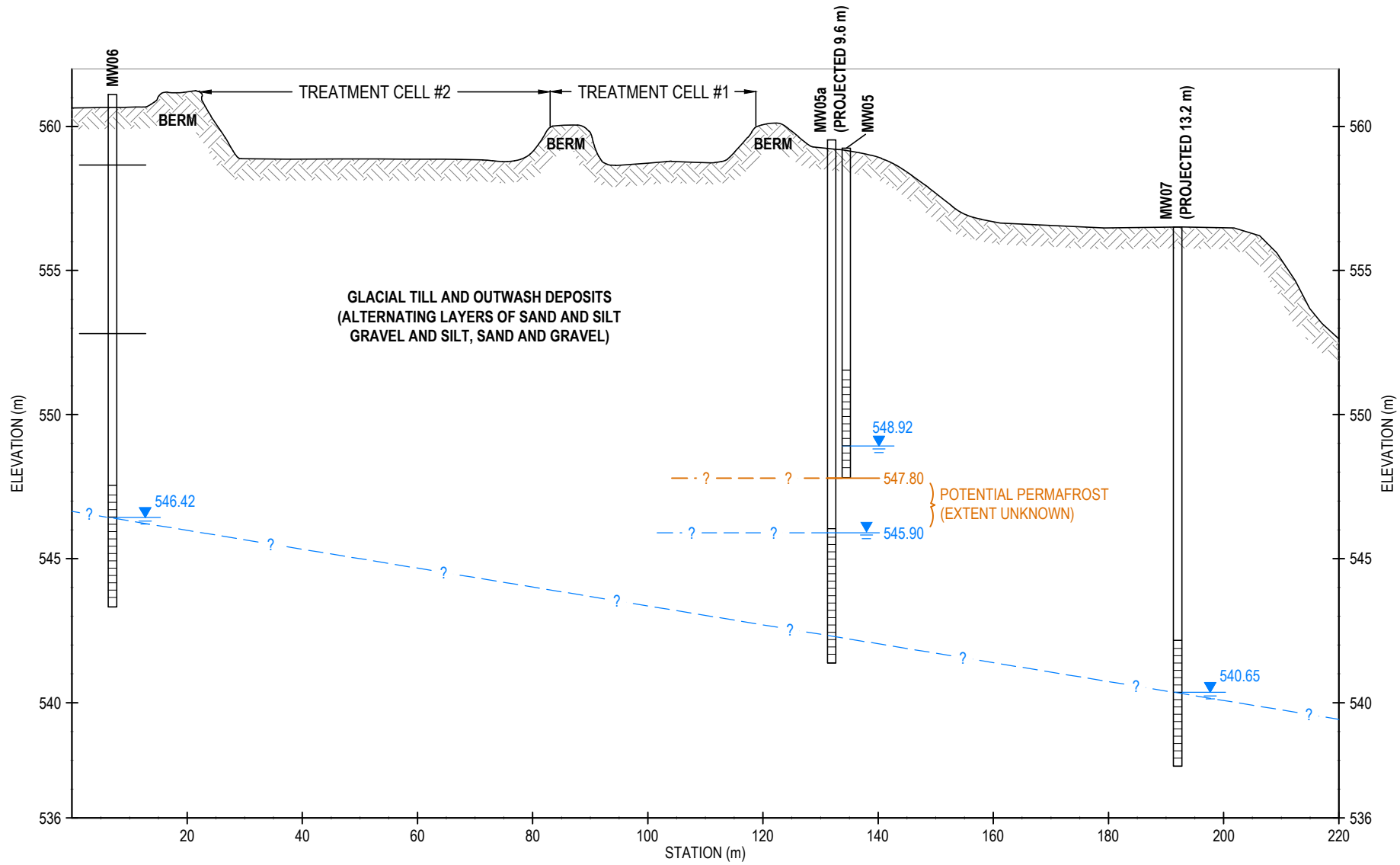
PROJECT NO.	DWN	CKD	REV
ENVSWM03460-02	CB	AJS	0

OFFICE	DATE
EBA-WHSE	February 11, 2016

Figure 3

Q:\Whitehorse\Data\02\01drawings\Mayo\ENVSWM03460-01 Mayo LTF Permit Renewal\02\ENVSWM03460-02 Fig.1_R1.dwg [FIGURE 3] February 16, 2016 - 10:06:40 am (BY: BUCHAN, CAMERON)

Q:\Whitehorse\Data\0201drawings\Mayo\ENVSWM03460-01 Mayo LTF Permit Renewal\02\ENVSWM03460-02 Fig.1_R1.dwg [FIGURE 4] March 08, 2016 - 9:21:49 am (BY: FULLER, KEN)



LEGEND

545.00 - WATER ELEVATION (OCTOBER 9, 2015)

— — - INFERRED WATER TABLE ELEVATION

0 50m

Scale: 1:1,000 @ 8.5"x11"

CLIENT

WILF'S CONTRACTING LTD.

UPDATED HYDROGEOLOGICAL ASSESSMENT
MAYO LAND TREATMENT FACILITY - MAYO, YUKON

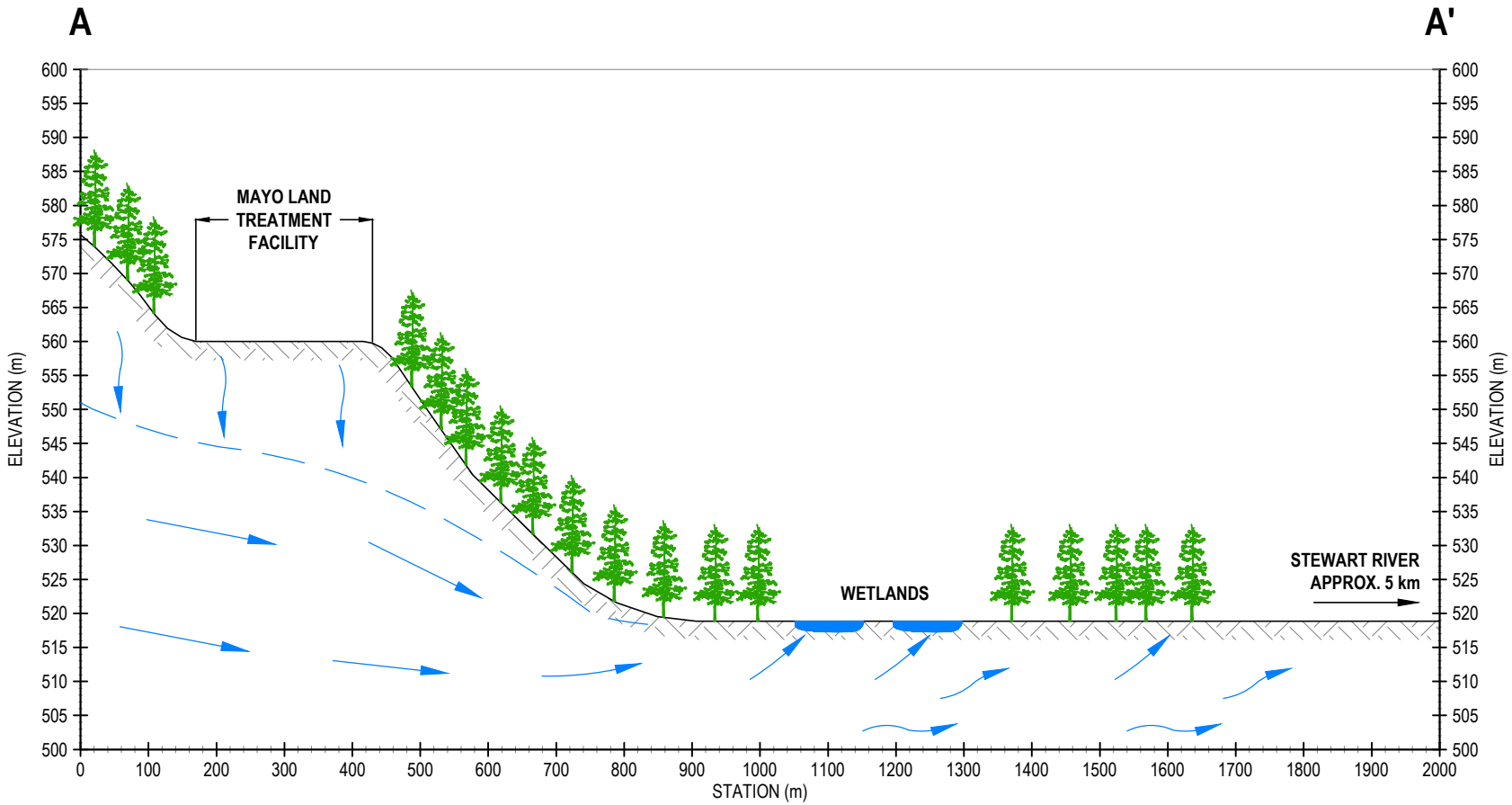
CROSS-SECTION B - B'

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
ENVSWM03460-02	CB	AJS	0

OFFICE	DATE
EBA-WHSE	February 12, 2016

Figure 4



VERTICAL EXAGGERATION: APPROXIMATELY 1V : 10H

LEGEND

- INFERRED SUB-SURFACE FLOW
- INFERRED WATER TABLE ELEVATION

0 500m

Scale: 1:10,000 @ 8.5"x11"

CLIENT

WILF'S CONTRACTING LTD.

UPDATED HYDROGEOLOGICAL ASSESSMENT
MAYO LAND TREATMENT FACILITY - MAYO, YUKON

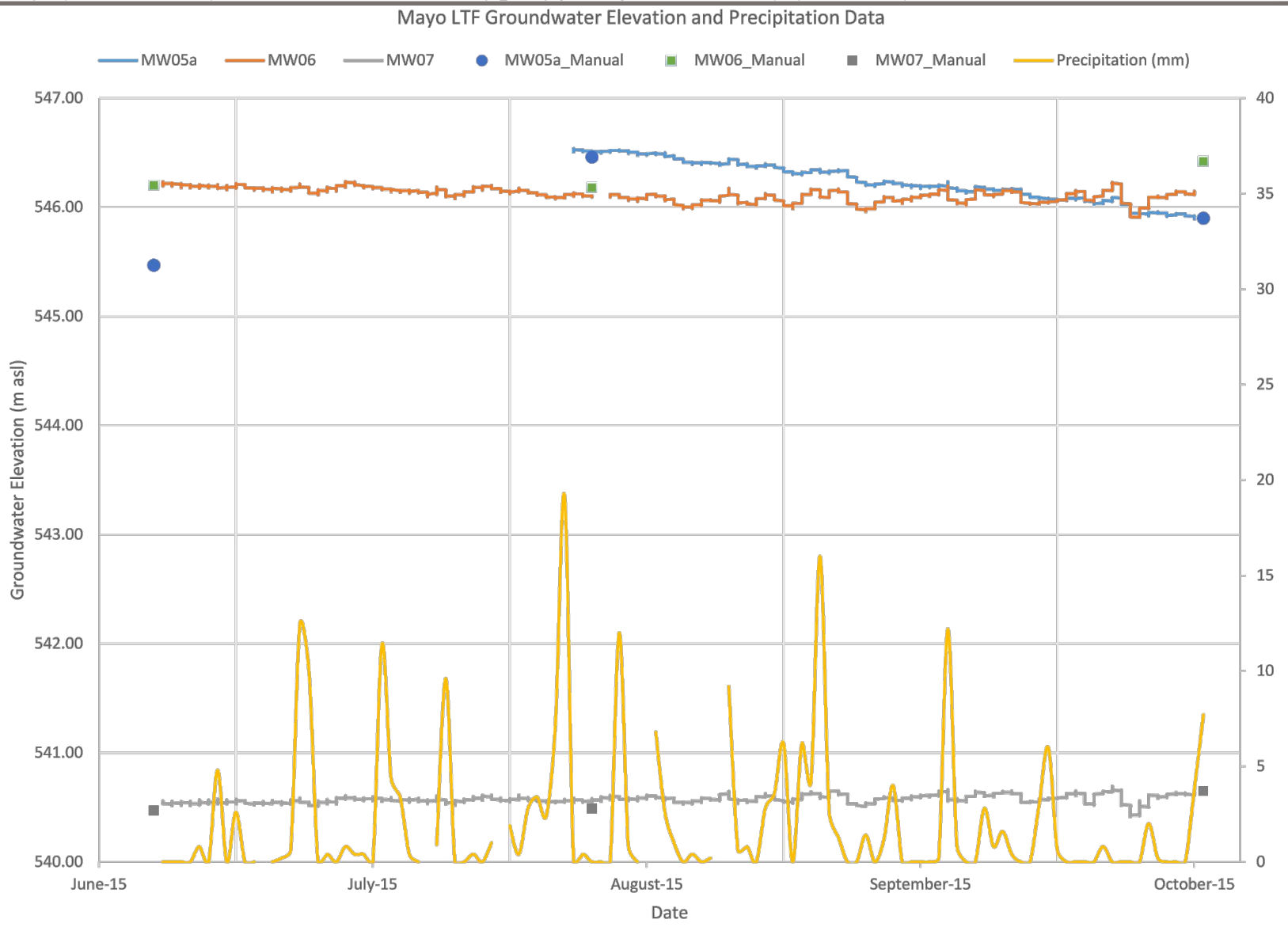
CONCEPTUAL REGIONAL CROSS-SECTION A - A'

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
ENVSWM03460-02	CB	AJS	0

OFFICE	DATE
EBA-WHSE	February 12, 2016

Figure 5



CLIENT

WILF'S CONTRACTING LTD.

UPDATED HYDROGEOLOGICAL ASSESSMENT
MAYO LAND TREATMENT FACILITY - MAYO, YUKON

GROUNDWATER ELEVATION AND PRECIPITATION DATA

TETRA TECH EBA

PROJECT NO.	DWN	CKD	REV
ENVSWM03460-02	CB	AJS	0

OFFICE	DATE
EBA-WHSE	February 12, 2016

Figure 6

APPENDIX A
TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOENVIRONMENTAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This report pertains to a specific site, a specific development, and a specific scope of work. It is not applicable to any other sites, nor should it be relied upon for types of development other than those to which it refers. Any variation from the site or proposed development would necessitate a supplementary investigation and assessment.

This report and the assessments and recommendations contained in it are intended for the sole use of Tetra Tech EBA’s client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analysis or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. The Client warrants that Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 NOTIFICATION OF AUTHORITIES

In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by Tetra Tech EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

MAYO LTF PERMIT 24-019

Yukon
Environment

Permit No: 24-019

LAND TREATMENT FACILITY PERMIT

Issued for the Operation of a Land Treatment Facility Pursuant to the *Environment Act* and the *Contaminated Sites Regulation*

Permittee: **Al's Environmental Cleanup Inc.**

Mailing Address: **Box 173, Mayo, YT Y0B 1M0**

Site Location: **Junction of Janet Lake Rd. and Old Stage Coach Rd., Mayo, YT Disposition #2005-0223, 63°38'52.7" N, 135°51'47 .2" W**

Authorized Representative: **Wilf Tuck**
Phone/Fax: **(867) 996-2531 / (867) 996-2532**
Email: **wilfscontracting@northwestel.net**

Effective Date: **Date of Director's signature**
Expiry Date: **December 31, 2019**

Scope of Authorization:
In accordance with your application and supporting documents, **Al's Environmental Cleanup Inc.**, represented by yourself, is hereby permitted to operate a Commercial Land Treatment Facility (a "facility") for the acceptance, storage and treatment of soil and water contaminated with petroleum hydrocarbons, including

- soil also containing metal contaminants below the special waste criteria for those contaminants; and
- water also containing contaminants other than petroleum hydrocarbons below the applicable CSR standards for those contaminants,

hereinafter referred to as contaminated material, as set out in the terms and conditions of this permit.

This permit replaces LTF permit 24-019 issued on October 1st, 2014.

Dated this ____ day of _____, 2015

_____
Director, Environmental Programs Branch
Environment Yukon

PART 1. DEFINITIONS

1. In this permit,
   a) "Act" means the *Environment Act*, R.S.Y. 2002, c.76;
   b) "approved plan" means a plan that is submitted by the permittee and approved by an environmental protection analyst under this permit and includes any terms and conditions specified by the environmental protection analyst in the approval;
   c) "associated personnel" means all employees, contractors and volunteers involved in the permitted activities;
   d) "berm" means an earthen raised barrier which completely encloses a staging or treatment cell and is compacted to a permeability of less than 10^{-5} cm/sec (or 10^{-6} cm/sec);
   e) "Branch" means the Environmental Programs Branch, Environment Yukon;
   f) "contaminant of concern" means any contaminant that is known or suspected to be present at concentrations above applicable CSR standards;
   g) "commercial land treatment facility" means a facility that is permitted to accept contaminated material generated by the permittee's operations and from other parties or individuals;
   h) "contaminated material" means any soil, snow, sediment, or water that has one or more parameters in excess of applicable standards in the Contaminated Sites Regulation, O.I.C. 2002/171;
   i) "CSR" means the *Contaminated Sites Regulation*, O.I.C. 2002/171;
   j) "environmental protection analyst" means an employee of the Branch so designated by the Minister of Environment under the Act;
   k) "environmental protection officer" means an employee of the Government of Yukon so designated by the Minister of Environment under the Act;
   l) "facility" means the entire area of the Land Treatment Facility, including the staging cells, treatment cells, and all access roads;
   m) "freeboard" means the distance between the water level within the Land Treatment Facility and the top of the berm(s);
   n) "free-phase petroleum hydrocarbons" are petroleum hydrocarbons that exist in a distinct layer or phase (considered to be special waste) when present with water or other liquid;
   o) "non-biodegradable contaminants" are contaminants including but not limited to metals that cannot be remediated by means of biodegradation;
   p) "ppm" means parts per million;
   q) "protocols" are those protocols created under section 21(1) of the CSR and which are then in force;
   r) "Regulations" means the *Contaminated Sites Regulation*, O.I.C. 2002/17; the *Special Waste Regulations*, O.I.C. 1995/047; and the Spills Regulations O.I.C. 1996/193, as applicable;
   s) "spill" means a spill in excess of the amounts specified in Schedule A of the Spills Regulations, O.I.C. 1996/193;
   t) "staging cell" means a bermed area into which contaminated material without analytical results is initially placed upon acceptance at the facility;

u) "supporting documents" means documents, correspondence or other material submitted in conjunction with the permit application;
v) "treatment cell" means a fully enclosed bermed area into which contaminated material is placed for treatment;
w) "treatment" includes but is not limited to tilling/turning the material, mixing it with other materials, or adding moisture or nutrients; and
x) "vehicle" has the same meaning as in the *Motor Vehicles Act*, R.S.Y. 2002, c. 153.

2. Any term not defined in this permit that is defined in the Act or the Regulations has the same meaning as in the Act or the Regulations.

PART 2. GENERAL CONDITIONS

1. No condition of this permit limits the applicability of any other law or bylaw.

2. The permittee shall ensure that all activities authorized by this permit occur on property that the permittee has the right to enter upon and use for that purpose.

3. The permittee shall ensure that all associated personnel:
   a) have access to a copy of this permit;
   b) are knowledgeable of the terms and conditions of this permit; and
   c) receive the appropriate training for the purposes of carrying out the requirements of this permit.

4. The permittee shall provide notice in writing to an environmental protection analyst prior to any significant change of circumstances, including without limitation:
   a) closure of the facility;
   b) a change in the ownership of the facility; or
   c) a change in the mailing address, site location or phone number of the permittee.

5. The permittee shall ensure that the facility is operated as described in the permit application, supporting documents, land treatment facility plans and closure plans, except where conflicts exist between such documents and this permit, in which case the permit shall prevail.

6. If an inspection reveals that the facility is in any way not in compliance with this permit or approved plans, the permittee shall repair the deficiency or take other actions as required to bring the facility into compliance.

7. All sampling must be conducted in accordance with all applicable protocols pursuant to the CSR that pertain to sampling and analysis. Sample collection must be carried out by trained personnel using appropriate equipment and procedures.

8. All analytical testing required by this permit must be performed by a laboratory accredited as described in *Protocol 2: Analysis of Samples Taken in Relation to the Contaminated Sites Regulation*.

9. For clarity, all obligations of the permittee under this permit survive the expiry date.

PART 3. FACILITY SPECIFICATIONS

1. The permittee shall not construct or operate a facility on any portion of land where:
   a) The slope is greater than 6%;
   b) The seasonal high water table is less than 3 metres below the surface;
   c) The facility would be within 100 metres of a surface water body;
   d) The land is identified as being within a 25 year floodplain; or
   e) Residential property lines or buildings are less than 60 metres away.

2. The permittee shall ensure that a natural compacted liner with a permeability of less than 10^{-5} cm/sec and a thickness of one metre or greater is installed and maintained beneath all staging and treatment cells in the facility.

3. The permittee shall ensure that the following characterization analysis is performed on the liner and berm source material used to construct the treatment cell identified in section 3.11(a)(iii) at a rate of one sample per 500 m^3 or at a greater frequency if visual changes in soil type are observed at the source location:
   a) Particle size analysis;
   b) Calculated hydraulic conductivity;
   c) Moisture-density proctor test (minimum 5-point curve); and
   d) Moisture content.

4. The permittee shall ensure that laboratory hydraulic conductivity testing using a minimum 90% modified proctor density or 95% standard proctor density is conducted on the liner and berm source material used to construct the treatment cell identified in section 3.11(a)(iii) at a rate of one sample per 1500 m^3 or at a greater frequency if visual changes in soil type are observed at the source location.

5. The permittee shall ensure that liner and berm material used to construct the treatment cell identified in section 3.11(a)(iii) is excavated and screened to remove organic debris and all rocks with a diameter of 75 millimeters or greater prior to placement and compaction.

6. The permittee shall ensure that the liner and berms of the treatment cell identified in section 3.11(a)(iii) are compacted to a minimum 90% modified proctor density or 95% standard proctor density or to the density used in hydraulic conductivity testing if a higher density is required to acheive minimum permeabilty.

7. The permittee shall ensure that the liner and berms of the treatment cell identified in section 3.11(a)(iii) are compacted in lifts. Lift thickness shall be adequate to achieve compaction density prescribed in section 3.6.

8. The permittee shall ensure that a moisture content 2 to 5 percent wetter than the ideal moisture content determined in section 3.3(c) is maintained in the liner and berm material during compaction activities.

9. Within one week of installation and compaction of the liner and berms of the treatment cell identified in section 3.11(a)(iii), the permittee shall ensure that in situ quality control testing is conducted as follows:
   a) The soil moisture content and density of the liner shall be analyzed once per every 20 metre running length of each cell, or at a minimum of two locations within each cell (whichever is greater); and
   b) The soil moisture content and density of each berm on all four sides of each cell shall be analysed once per every 20 metre running length.

   A minimum of one soil moisture content measurement and one density measurement shall be taken within each 0.5 metre depth interval at all testing locations in 3.9(a) and 3.10 (b).

10. Prior to acceptance of material into the facility, the permittee shall ensure that all sampling locations in section 3.9 are sealed and compacted to the permeability and density prescribed in sections 3.2 and 3.6.

11. In accordance with the permit application and supporting documents:
    a) the facility shall consist of:
       i. one staging cell with maximum interior dimensions of 36 metres by 47 metres;
       ii. one treatment cell with maximum interior dimensions of 62 metres by 75 metres;
       iii. one treatment cell with maximum interior dimensions of 46 metres by 74 metres; and
       iv. one water treatment cell with maximum interior dimensions of 28 metres by 39 metres;
    b) the maximum height of piles of contaminated material within the facility shall be 4 metres; and
    c) the facility shall be contained within the boundaries of the site location.

12. The permittee shall notify an environmental protection analyst upon completion of the treatment cell identified in section 3.11(a)(iii), and submit for approval results of liner testing prescribed in sections 3.3, 3.4 and 3.9.

13. Prior to altering the size or number of cells or the capacity of the facility, except as allowed for by section 3.11 above, the permittee shall apply for and obtain an amendment to this permit from the Branch.

14. The permittee shall construct and maintain berms around all treatment cells to prevent the escape of contaminated material, runoff or leachate from the cells. The height and lateral extent of such berms must be sufficient to contain all contaminated material, runoff, and leachate in the cells.

15. Berms surrounding staging or treatment cells shall not be removed or breached except as approved by an environmental protection analyst in writing or as instructed by an environmental protection officer.

16. The permittee shall construct and maintain ramps to allow equipment to access the cells without damaging or degrading the berms or the liner.

17. The permittee shall construct and maintain diversion berms and/or ditches, as required, to ensure that runoff cannot enter the cells.

18. The permittee shall secure the facility to prevent access by unauthorized persons.

19. The permittee shall post a sign at the entrance to the facility identifying that the facility contains contaminated material.

20. The permittee shall ensure that a qualified hydrogeologist updates the hydrogeological assessment of the site in order to:
    a) determine the direction and rate of groundwater flow;
    b) identify potential receiving environments;
    c) assess travel times for potential contaminant pathways; and
    d) ensure that hydrogeological interpretations are based on data from a minimum of one well upgradient of the facility and two wells downgradient of the facility, at locations chosen by the qualified hydrogeologist, and which are installed in such a way as to allow their use for monitoring of groundwater for contamination as required in section 7.2 of this permit.

21. If an environmental protection analyst identifies any deficiency in the hydrogeological assessment, the permittee shall rectify the deficiency as directed by an environmental protection analyst.

PART 4. FACILITY MAINTENANCE

1. The permittee shall ensure that:
    a) the berms, ditches, tanks, fencing, signage, and all other facility components are properly maintained and repaired; and
    b) the facility is inspected every two weeks from April 1 to October 31 of each year.

2. If an inspection in section 4.1 reveals that the facility is in any way not in compliance with this permit or approved plans, the permittee shall repair the deficiency or take other actions as required to bring the facility into compliance.

3. The permittee shall take all reasonable measures to ensure that wildlife, including waterfowl, is not attracted to the site. These measures may include, but need not be limited to, fencing, the use of bird scare devices, removal of suitable habitat (e.g. standing water and vegetation), or the installation of netting over the cells.

PART 5. INTAKE OF CONTAMINATED MATERIAL

1. The permittee shall obtain a permit amendment before collecting, storing or treating materials other than those authorized by this permit.

2. The permittee shall ensure that no material is accepted into the treatment cell identified in section 3.11(a)(iii), until approval under section 3.12 and 3.20 is provided by an environmental protection analyst.

3. The permittee shall obtain the relocation permit number under which incoming material is transported prior to acceptance of the material into the facility, or as directed by an environmental protection analyst or environmental protection officer.

4. The permittee shall ensure that samples of incoming contaminated material from each source are analyzed for petroleum hydrocarbons and any other contaminants of concern within 60 days of acceptance of the material.

5. If the permittee has reasonable grounds to believe that incoming contaminated material may contain contaminants other than those authorized under this permit, the permittee shall contact an environmental protection analyst prior to accepting the contaminated material and shall follow the direction provided by an environmental protection analyst.

6. Should analysis of incoming contaminated material show that it contains contaminants other than those authorized under this permitabove the standards for those contaminants for Industrial Land Use in the CSR, the permittee shall contact an environmental protection analyst for direction on the disposal of the material within 5 days of receipt of the analytical results, and shall remove the material from the facility within 30 days of receipt of the analytical results or as directed by an environmental protection analyst.

7. The permittee shall ensure that analytical results establishing the type and level of contaminants in incoming contaminated material are received prior to initiating treatment of that material, including but not limited to tilling or applying water or other soil conditioners or amendments.

8. The permittee shall not accept material contaminated solely with non-biodegradable contaminants above the standards for those contaminants for industrial land use.

9. The permittee shall not accept contaminated material known or suspected to be special waste without first obtaining an amendment to this permit from the Branch which authorizes the handling and/or treatment of the special waste material.

10. Should analysis of incoming contaminated material show that it has a hydrocarbon content of 30,000 parts per million or more, or is otherwise considered a special waste in accordance with written guidelines developed by the Branch, the permittee shall inform an environmental protection analyst within 5 days of receipt of the analytical

results. Within 30 days of the receipt of the results, the permittee shall remove the special waste material from the facility, or apply for and obtain an amendment to this permit from the Branch which authorizes the handling and/or treatment of the special waste material.

11. If the permittee has grounds to believe that incoming contaminated material contains or may contain non-biodegradable contaminants that will not interfere with the treatment process and is authorized under this permit, the permittee shall ensure this material is placed only in:
    a) the staging cell; or
    b) an enclosed, bermed, lined, isolated area within a treatment cell dedicated solely to treating soils containing non-biodegradable contaminants.

12. Contaminated material the permittee suspects may contain non-biodegradable contaminants and that has been placed in a staging cell or an isolated area under section 5.11 above shall not be moved to the main area of the treatment cell until analytical results have been received which demonstrate that no such contaminants are present at concentrations above CSR Industrial Land Use standards or applicable CSR matrix standards.

13. If analytical results demonstrate concentrations of non-biodegradable contaminants are above the CSR Industrial Land Use standards, the material shall not be removed from the enclosed, bermed isolated area referred to in section 5.10 unless authorized by an environmental protection analyst under section 8.1.

PART 6. SOIL HANDLING AND STOCKPILING

1. The permittee shall ensure that contaminated material from different sources or containing different types of contamination is handled, stored and treated separately except as authorized by this permit or as directed by an environmental protection analyst.

2. Following the receipt of analytical results for samples from each stockpile, the permittee may consolidate stockpiles of soil from different sources into a single stockpile with a maximum volume of 500 m^3, provided that each original stockpile:
    a) contains only petroleum hydrocarbon-contaminated material; and
    b) has a total petroleum hydrocarbon concentration of less than 30,000 ppm.

3. The permittee shall analyze petroleum hydrocarbon concentrations in stockpiles also containing non-biodegradable contaminants every two years at minimum.

4. The permittee shall ensure that no contaminated material is mixed with special waste material, treated material or non-contaminated material, except as authorized by this permit or as directed by an environmental protection analyst.

5. The permittee shall ensure that contaminated material is handled and stored in a manner that prevents its release into the environment.

6. The permittee shall ensure that contaminated material within a cell is placed a sufficient distance from all berms to prevent contaminated material, runoff or leachate from escaping the cell.

7. The permittee shall ensure that there is sufficient separation between piles or windrows of contaminated material to allow equipment to access each pile or windrow, and to prevent inadvertent mixing of piles or windrows of contaminated material from different sources or containing different levels or types of contamination.

8. The permittee shall ensure that no contaminated material is placed on the ramp(s) into the cells, the berms surrounding the cells or on access road(s) into or within the facility.

9. All stockpiles within the facility must be labelled with signage identifying the relocation permit number under which the material was transported to the facility and/or the origin of the material. Stockpiles with non-biodegradable contaminants shall include signage which clearly identifies that those stockpiles contain non-biodegradable contaminants.

PART 7. MONITORING

1. The permittee shall develop and implement a sampling and monitoring program for all contaminated material being treated at the facility, in accordance with all guidelines and protocols pursuant to the CSR that pertain to the sampling, analysis and monitoring of contaminated material within a land treatment facility.

2. The permittee shall ensure that all groundwater wells at the facility with detectable water levels are monitored, sampled and analyzed as follows:
   a) to determine the timing of high and low water conditions, the groundwater elevation in all wells shall be monitored quarterly for one year following the completion of the revised hydrogeological assessment. In subsequent years, all wells shall be monitored twice annually for groundwater elevation at the determined high and low water points;
   b) to establish baseline levels and monitor for groundwater contamination, samples from all wells at the facility shall be analyzed for petroleum hydrocarbons, dissolved metals, pH, conductivity, dissolved oxygen, redox potential, temperature, and any other contaminants of concern:
      (i) at the time of the revised hydrogeological assessment; and
      (ii) biannually thereafter at the determined high and low water points.

3. If groundwater is not encountered during the initial or revised hydrogeological assessment, the permittee shall ensure that the groundwater wells are checked for water at least once annually during known periods of high water in the area. If groundwater is encountered, the permittee shall conduct the monitoring, sampling, and analysis described in section 7.2 above.

4. If groundwater analyses show detectable concentrations of hydrocarbons in any well during any sampling event, the permittee shall contact an environmental protection analyst within 7 days of receipt of the results.

5. If hydrocarbons are detected in any groundwater well under section 7.4, the permittee shall conduct additional monitoring or develop and implement an adaptive management plan to address the contamination as directed in writing by an environmental protection analyst.

PART 8. REMOVAL OF REMEDIATED SOIL

1. The permittee shall not remove any material from the facility without first:
   a) submitting a written request to an environmental protection analyst to remove the material;
   b) providing information on the land use at the receiving site;
   c) providing analytical results demonstrating that the material to be removed is suitable for use at the receiving site, based on the applicable CSR land use standards, for all contaminants of concern;
   d) providing a description of sampling methodology applied;
   e) ensuring that if the material removed from the facility is contaminated above CSR standards for all land uses, that the material is transported, in accordance with applicable transport laws, to a facility permitted to receive the contaminated material;
   f) providing the date on which the soil was last tilled;
   g) receiving the written approval of an environmental protection analyst for the removal; and
   h) obtaining a relocation permit for the relocation of the remediated material, if the concentration of any contaminant in the material is above any of the standards in the CSR.

2. Initial characterization results for non-biodegradable contaminants will be used to determine the suitability of the proposed receiving site.

3. Stockpiles contaminated with non-biodegradable contaminants shall be removed from the facility in accordance with section 8.1 within one year of receipt of analytical results demonstrating that petroleum hydrocarbons concentrations are below applicable CSR standards, or as directed by an environmental protection analyst.

4. Within two weeks prior to collecting confirmatory samples from a stockpile in support of a request to remove the soil from the facility, the permittee shall thoroughly till or turn the material at least once using appropriate equipment.

5. Following the removal of material from a treatment cell, the permittee shall have the underlying natural liner tested to determine the level of all contaminants known to have been present in the removed material at any point during its course of treatment. That portion of the treatment cell shall not be used again to store or treat contaminated material

until the level of each contaminant in the natural liner is at or below the standards for that contaminant for industrial land use as prescribed in the Yukon CSR.

6. Prior to removal of stockpiles that have been combined in accordance with section 6.2 above, the permittee shall ensure that confirmatory samples are analyzed for all contaminants of concern from each individual stockpile or source.

PART 9. MANAGEMENT OF CONTAMINATED WATER

1. The permittee shall ensure that all runoff within cells, including rain water, snow and ice melt, is either contained within the berms of each cell while still leaving a minimum of 30 cm freeboard or is removed from the cells and is contained within the facility in aboveground storage tanks of sufficient volume.

2. All liquid contaminated materials, other than runoff from soil in the facility, shall be stored in aboveground storage tanks equipped with secondary containment or stored within the treatment cell in other suitable enclosed containers.

3. Prior to using any contaminated liquid other than runoff from soil in the facility to provide moisture to remediating soil, the permittee shall ensure that:
   a) the liquid is collected in a storage tank;
   b) the liquid does not contain free-phase petroleum hydrocarbons;
   c) a sample of the liquid is analyzed for total metals and any other contaminants of concern; and
   d) the results do not exceed the applicable special waste criteria.

4. Prior to discharging or removing any contaminated liquid from the facility, including runoff from soil in the facility and liquid that has been treated or filtered, the permittee shall:
   a) collect a representative sample of the liquid proposed for discharge;
   b) submit a written request to an environmental protection analyst to discharge the water; and
   c) provide analytical results demonstrating that hydrocarbons, total metals, and any other contaminants of concern are below applicable CSR standards.

5. Notwithstanding section 9.4 above, the permittee may remove snow from the facility and discharge it to the environment without sampling, provided that the snow is from an area of the facility where no contaminated soil is present and that the snow has not come into contact with contaminants or contaminated material.

6. The permittee shall ensure that a sample of the contaminated liquid referred to in 9.3 and 9.4 above is collected when no additional material is to be added to the storage tank or treatment cell, and shall ensure that no additional material is added to that storage tank or treatment cell between the collection of the sample and the use or disposal of the sampled liquid.

7. Free-phase petroleum hydrocarbons shall be disposed of in accordance with all applicable regulations and shall not be sprayed onto soil in the facility.

8. Any contaminated liquid at the facility found to exceed special waste criteria for any contaminant other than petroleum hydrocarbons shall not be sprayed onto soil in the facility. Such liquid shall be disposed of in accordance with all applicable regulations.

9. On an annual basis, or more often if necessary, the permittee shall monitor the level of solids in each liquid storage tank. The solids shall be removed as necessary to ensure that the tanks do not fill with sediment.

10. The permittee shall ensure that solids being removed from tanks used to contain contaminated liquids are sampled and analyzed for all contaminants of concern. If suitable for bioremediation, the solids may be placed in a treatment cell. If unsuitable for bioremediation, the solids must be disposed of at an approved facility. The solids may not be discharged to the environment unless all contaminants are present at concentrations below the applicable standards for the receiving site in the CSR.

PART 10. SPILLS

1. The permittee shall ensure that substances are stored or handled so as not to cause spills, leakage, leaching or other discharges or releases of the substances from their storage containers, equipment, or other sources.

2. The permittee shall contact either an environmental protection officer or the 24-hour Yukon Spill Report Centre (867-667-7244), as soon as possible under the circumstances, in the event of a release, spill, unauthorized emission, discharge or escape of any material as defined in the Act or Regulations.

3. The permittee shall ensure that appropriate clean-up equipment (such as sorbent, shovel, broom, bucket, gloves, boots, etc.) is in a readily available location on site.

4. The permittee shall ensure that emergency spill procedures are written down and available to all personnel when working on-site and that all personnel are familiar with those procedures.

PART 11. REPORTING AND RECORD KEEPING

1. The permittee shall maintain records detailing:
   a) the origin of all contaminated material being treated;
   b) the volume of contaminated material accepted from each source;
   c) a figure(s) showing the entire facility including the location within the facility of contaminated material from each source;
   d) for soil combined in accordance with 6.2, the original source and volume of each component stockpile;
   e) the total volume of contaminated material in the facility;

f) soil and/or water analysis results for samples from any contaminated material accepted for treatment or removed from the facility;
g) soil and/or water analysis results for any interim samples taken in order to assess remediation progress, including results required by section 6.3;
h) results of any water analyses conducted on runoff from the facility;
i) details of any nutrients added (including type, dates, quantity and location of application);
j) soil and/or water analysis results for any confirmatory samples taken for the purpose of determining if the soil or water was remediated;
k) soil analysis results from sampling of the natural liner underneath each stockpile upon removal from the facility in accordance with 8.3;
l) groundwater elevations for all wells at the facility and the date of each elevation reading;
m) original analytical results of all groundwater analyses conducted;
n) details of any handling of special waste (including volumes accepted and/or removed from the facility);
o) the volume of material removed from the facility, the location and applicable land use(s) of the receiving site(s), and the written approval of an environmental protection analyst for removal of the material;
p) summaries of all inspections carried out under this permit (including the name of the person conducting the inspection, the date of each inspection, any observations recorded during the inspection, actions taken as a result of those observations, and the date each action was taken);
q) notes concerning any spills or leaks occurring at the site, including substance involved, estimated quantity, date of observation of the spill or leak, spill reports made, and clean-up procedures implemented; and
r) any and all deficiencies remedied in accordance with section 4.2, and details describing how and when they were remedied.

2. The permittee shall submit an annual report to an environmental protection analyst on or before March 31 of each year which includes but need not be limited to:
   a) a description of all activities undertaken at the facility in the previous calendar year;
   b) all records required to be maintained under section 11.1 as they pertain to the previous calendar year and reflective of conditions as of the end of that year, including original laboratory reports for all sample results reported;
   c) a figure showing the entire facility, including the location of contaminated material from each source within the facility;
   d) a sampling and monitoring plan for the current calendar year, pursuant to section 7.1 of this permit; and
   e) a work plan for the entire facility for the current calendar year.

3. Notwithstanding the reporting requirements listed in section 11.2, analytical results for samples from contaminated or remediated material accepted for treatment or removed from the facility need not be included in the annual report where these results have previously been submitted to the Branch. Additionally, authorizations received from an environmental protection analyst (such as for the removal of treated soil) need not be

included in the annual report. All other applicable information pertaining to this material (e.g. volumes, sources, etc.) must still be included in the report.

4. The permittee shall ensure that the annual report described in section 11.2 notes and describes any case where a requirement of section 11.1 does not apply (for example, if no nutrients were added in the previous calendar year). The permittee shall submit the annual report described in section 11.2 even if no activity was undertaken in the previous calendar year.

5. The permittee shall keep all records required under this permit in a format acceptable to an environmental protection officer for a minimum of three years and make them available for inspection by an environmental protection officer upon request.

PART 12. DECOMMISSIONING

1. At least two months prior to the intended closure of the facility or any individual cells, the permittee shall submit a detailed decommissioning plan to an environmental protection analyst for approval which includes:
   a) a schedule for decommissioning the facility or cell(s);
   b) the results of sampling demonstrating the levels of contaminants in all soil in the facility or cell(s);
   c) details of the intended use and receiving location of all soil in the facility or cell(s);
   d) a description of the methods to be used to restore the site, or portion thereof, or to prepare the site or portion thereof for its future uses; and
   e) any other information required by the Branch.

2. The permittee shall obtain written approval of the decommissioning plan from an environmental protection analyst prior to the commencement of any work to decommission the facility or any individual cells.

3. Amendments to the decommissioning plan must be approved by an environmental protection analyst.

4. Following approval of the decommissioning plan, the permittee shall ensure that no additional contaminated material is accepted into the facility or individual cells to be closed.

5. All work to decommission the facility or any individual cells shall be carried out in accordance with the decommissioning plan approved by an environmental protection analyst.

6. Decommissioning of the cell(s) or facility shall commence within six months of receiving approval from an environmental protection analyst or as directed by an environmental protect analyst.

7. During decommissioning of the facility, confirmatory samples shall be collected from the bases of all cells in the facility, the berm material and any other area(s) of the site location that may have been impacted due to the operation of the facility. Samples shall be collected and analysed for all contaminants of concern in accordance with *Protocol 11: Sampling Procedures for Land Treatment Facilities*.

8. Any contaminated material excavated during implementation of the decommissioning plan must be relocated to another cell, in the case of the closure of one or more cells, or another facility permitted to accept the material in accordance with the CSR, in the case of closure of the facility.

9. All groundwater monitoring wells shall be decommissioned in accordance with *Protocol No. 7: Groundwater Monitoring Well Installation, Sampling and Decommissioning*.

10. Within 120 days of implementation of the decommissioning plan, the permittee shall submit a report to an environmental protection analyst describing the effectiveness of the implementation of the approved decommissioning plan, including confirmatory sampling results which demonstrate that contaminant concentrations at the former cell or at the land treatment facility site location are below applicable CSR standards.

APPENDIX C

TETRA TECH EBA 2015 SAMPLING FIELD SHEETS

DRAFT** Groundwater Purge and Sample Form **DRAFT

WELL ID.: MW05a | PROJECT NO.: ENV SWM 03460-07
SITE: May's LTE | FIELD PERSONNEL: Rob Dickson
WEATHER: Sunny, 15°C | DATE & TIME SAMPLED: 5:15 pm June 16/2015
TEMPERATURE: 15°C | GPS LOCATION: N:_____ E:_____ Zone:_____ (Map datum NAD8

Is well ID visible? ☑ Yes ☐ No | Is seal intact? ☑ Yes ☐ No | Is lid/j-plug in place/working? ☑ Yes ☐ No
Is well locked? ☑ Yes ☐ No | General well condition - list any damage, pooled water around well etc.:
Well Casing Inner Diameter (mm) 51

Depth to Water Below Top of Casing **(A)**:	14.73 (metres)	Depth to Product Below Top of Casing:	— (metres)
Depth to Bottom of Well Below Top of Casing **(B)**:	18.64 (metres)	Product Thickness:	— (metres)
Depth to Ground Below Top of Casing (stand-up):	0.40 (metres)	☐ LNAPL ☐ DNAPL Colour/Odour:	—
Screen Interval (if known)	(m bTOC)	Confirmed by: ☐ Bailer ☐ Interface Probe ☐ Paste	

FIELD EQUIPMENT

Field Meters Calibrated:_____ Calibration Reference Sheet ID:_____

Pump:	☐ none	☐ Waterra	☐ Submersible	☐ Peristaltic	☐ Bladder
Bailer:	☑ none		☐ Stainless Steel	☑ Teflon	☐ PVC
Filter:	☐ none		☐ In-line	☐ Vacuum	☐ Other
Equipment left in well:	☐ none		☑ Bailer	☐ Waterra	☐ Other

WELL PURGING

Purge Volumes

Casing In. Diam. (mm)	38	51	78	100	150
Vol (L/m of casing)* **(C)**	1.1	2.0	4.5	7.9	17.7

*double for filter pack

One well volume **((B – A(* C)**: 8 litres
Purge volume to aim for: ~ 40 litres
or until parameters stabilize:
Pump inlet depth (m bTOC):— (m bTOC)

TIME	PURGE RATE (L/min)	VOLUME REMOVED (L)	TEMP (°C)	pH (UNITS)	SpCOND (uS/cm)	Redox (mV)	DIS O_2 (mg/L) or %	Water Level (m bTOC)	REMARKS (colour, odour, sheen, brittle film, silt content, etc.)
Stabilisation Criteria			+/- 0.5	+/-0.05	+/- 3%	+/- 10	+/- 10%	+/- 0.1m if low flow	Visual observations (colour, turbidity, odour etc should be stable)
9:30am	June 16/15	20L						16.23m	Will Monitor Parameters next d
									turbid, light brown
8:50am	June 17/15	21L	2.9	8.26	1362	-29.1	6.86	14.81	transluscent, silty
		22L	1.7	7.99	1345	-23.6	8.12		light brown translucent
		25L	1.6	7.95	1340	-22.3	6.94		" some sand
		30L	1.3	7.98	1421	-23.0	6.70		" (fine
		35L	1.8	8.02	1417	-25.7	5.91		"
		40L	1.7	8.12	1457	-30.9	6.89		Sample collected at 7:3
									June 17/2015

SAMPLING Water Odour: ☑ No ☐ Yes (describe)_____ Sheen ☑ No ☐ Yes (describe)_____

Turbidity:_____ NTU or relative scale (circle as appropriate): Clear 1 2 3 **4** 5 6 7 8 9 10 Very Silty

Parameter	Size & # of bottles:	40mL	100mL	250mL	500mL	1L	Filter and Size (µm)	Preservatives
Routine	☑ Plastic ☐ Glass				1		☐ Yes ☑ No	
LEPH/HEPH	☐ Plastic ☑ Glass			2			☐ Yes ☑ No	
BTEX	☐ Plastic ☑ Glass	2					☐ Yes ☑ No	
Diss Metals	☑ Plastic ☐ Glass		1				☑ Yes ☐ No 0.45	Nitric acid
Diss Mercury	☐ Plastic ☑ Glass	1					☐ Yes ☑ No	

Samples placed on ice for transport ☑ Yes ☐ No

QA/QC Sample/s - ☐ Yes ☑ No | **QA/QC Type and ID -**

Other (comments, notes, observations, headspace measurements [incl. ref to calibration sheet]):

PID Readings, somewhat inconsistent with MW06.
Some trouble getting bailer down, when purging. Had to jig the line to fill the bailer.

DRAFT** Groundwater Purge and Sample Form **DRAFT

WELL ID.: MW06 | PROJECT NO.: ENVSWH03460-01
SITE: Mayo ~~Motors~~ LTF | FIELD PERSONNEL: Rob Dickson
WEATHER: Overcast | DATE & TIME SAMPLED: 6:00pm June 16/2015
TEMPERATURE: 15°C | GPS LOCATION: N:_____ E:_____ Zone:_____ (Map datum NAD83)

Is well ID visible? ☑ Yes ☐ No | Is seal intact? ☑ Yes ☐ No | Is lid/j-plug in place/working? ☑ Yes ☐ No
Is well locked? ☑ Yes ☐ No | General well condition - list any damage, pooled water around well etc.:
Well Casing Inner Diameter (mm) 51

Depth to Water Below Top of Casing **(A)**:	15.30 (metres)	Depth to Product Below Top of Casing:	– (metres)
Depth to Bottom of Well Below Top of Casing **(B)**:	17.20 (metres)	Product Thickness:	– (metres)
Depth to Ground Below Top of Casing (stand-up):	0.65 (metres)	☐ LNAPL ☐ DNAPL	Colour/Odour: –
Screen Interval (if known)	(m bTOC)	Confirmed by: ☐ Bailer ☐ Interface Probe ☐ Paste	

FIELD EQUIPMENT
Field Meters Calibrated: _____ Calibration Reference Sheet ID: _____

Pump:	☐ none	☐ Waterra	☐ Submersible	☐ Peristaltic	☐ Bladder
Bailer:	☐ none		☐ Stainless Steel	☑ Teflon	☐ PVC
Filter:	☐ none		☐ In-line	☐ Vacuum	☐ Other
Equipment left in well:	☐ none		☑ Bailer	☐ Waterra	☐ Other

WELL PURGING
Purge Volumes

Casing In. Diam. (mm)	38	51	78	100	150
Vol (L/m of casing)* **(C)**	1.1	2.0	4.5	7.9	17.7

*double for filter pack

One well volume **((B – A(* C)**: 4 litres
Purge volume to aim for: 20 litres
or until parameters stabilize: _____
Pump inlet depth (m bTOC): _____ (m bTOC)

TIME	PURGE RATE (L/min)	VOLUME REMOVED (L)	TEMP (°C)	pH (UNITS)	SP.COND (uS/cm)	Redox (mV)	DIS O_2 (mg/L) or %	Water Level (m bTOC)	REMARKS (colour, odour, sheen, brittle film, silt content, etc.)
	Stabilisation Criteria		+/- 0.5	+/-0.05	+/- 3%	+/- 10	+/- 10%	+/- 0.1m if low flow	Visual observations (colour, turbidity, odour etc should be stable)
9:00pm	June 16/15	10L							Will monitor parameters next day
									Very turbid, dark brown
7:30am	June 17/15	11 L	4.5	8.29	489.9	-36.5	3.33	15.34	opaque silty
		12 L	4.6	8.17	463.3	-35.1	3.29		" (some sand ~1cm)
		13 L	3.1	8.16	470.6	-32.0	3.92		"
8:30am		15 L	4.1	8.14	431.7	-32.2	3.54		Sample collected at 8:30am June 17/2015

SAMPLING Water Odour: ☑ No ☐ Yes (describe) _____ Sheen ☑ No ☐ Yes (describe) _____
Turbidity: _____ NTU or relative scale (circle as appropriate): Clear 1 2 3 4 5 6 7 8 9 10 Very Silty

Parameter	Size & # of bottles:		40mL	100mL	250mL	500mL	1L	Filter and Size (µm)		Preservatives
Routine	☑ Plastic	☐ Glass				1		☐ Yes	☐ No	
LEPH/HEPH	☐ Plastic	☑ Glass			2			☐ Yes	☐ No	
BTEX	☐ Plastic	☑ Glass	2					☐ Yes	☐ No	
Diss Metals	☑ Plastic	☐ Glass		1				☑ Yes	☐ No 0.45	Nitric Acid.
Diss Mercury	☐ Plastic	☑ Glass	1					☐ Yes	☑ No	

Samples placed on ice for transport ☑ Yes ☐ No

QA/QC Sample/s - ☐ Yes ☑ No | **QA/QC Type and ID -**

Other (comments, notes, observations, headspace measurements [incl. ref to calibration sheet]):

Water very turbid, silty with some fine sand recovered in bailers. Was able to bail the well mostly dry until only 1/4 bailer could be recovered. Mostly recovered by 10-12 hrs

DRAFT** Groundwater Purge and Sample Form **DRAFT

WELL ID.: MW07 | PROJECT NO.: ENSWM03460-01
SITE: Mayo LTF | FIELD PERSONNEL: Rob Dickson
WEATHER: Cloudy | DATE & TIME SAMPLED: 6:30pm June 16/2015
TEMPERATURE: 15°C | GPS LOCATION: N:_____ E:_____ Zone:_____ (Map datum NAD83)

Is well ID visible? ☑ Yes ☐ No | Is seal intact? ☑ Yes ☐ No | Is lid/j-plug in place/working? ☑ Yes ☐ No
Is well locked? ☑ Yes ☐ No | General well condition - list any damage, pooled water around well etc.:
Well Casing Inner Diameter (mm) 51

Depth to Water Below Top of Casing **(A)**:	17.18 (metres)	Depth to Product Below Top of Casing:	— (metres)
Depth to Bottom of Well Below Top of Casing **(B)**:	19.40 (metres)	Product Thickness:	— (metres)
Depth to Ground Below Top of Casing (stand-up):	0.80 (metres)	☐ LNAPL ☐ DNAPL	Colour/Odour: —
Screen Interval (if known)	(m bTOC)	Confirmed by: ☐ Bailer ☐ Interface Probe	☐ Paste

FIELD EQUIPMENT

Field Meters Calibrated: _____ Calibration Reference Sheet ID: _____

Pump:	☐ none	☐ Waterra	☐ Submersible	☐ Peristaltic	☐ Bladder
Bailer:	☐ none		☐ Stainless Steel	☐ Teflon	☑ PVC
Filter:	☐ none		☐ In-line	☐ Vacuum	☐ Other
Equipment left in well:	☐ none		☑ Bailer	☐ Waterra	☐ Other

WELL PURGING

Purge Volumes

Casing In. Diam. (mm)	38	51	78	100	150
Vol (L/m of casing)* **(C)**	1.1	2.0	4.5	7.9	17.7

*double for filter pack

One well volume **((B – A(* C)**: 4 litres
Purge volume to aim for: 20 litres
or until parameters stabilize: _____
Pump inlet depth (m bTOC): _____ (m bTOC)

TIME	PURGE RATE (L/min)	VOLUME REMOVED (L)	TEMP (°C)	pH (UNITS)	COND (uS/cm)	Redox (mV)	DIS O_2 (mg/L) or %	Water Level (m bTOC)	REMARKS (colour, odour, sheen, brittle film, silt content, etc.)
Stabilisation Criteria			+/- 0.5	+/-0.05	+/- 3%	+/- 10	+/- 10%	+/- 0.1m if low flow	Visual observations (colour, turbidity, odour etc should be stable)
June 17/2015								17.18	
10:30am		5	2.8	8.55	503.2	-46.3	7.84		Light brown, silty, organic
		10	3.2	8.34	499.5	-40.7	7.87		" some sand (fine)
		15	3.2	8.22	496.2	-36.4	7.75		"
11:20am		20	3.7	8.48	476.8	-44.7	8.14		"
									Samples taken at 11:30a

SAMPLING

Water Odour: ☑ No ☐ Yes (describe) _____ Sheen ☑ No ☐ Yes (describe) _____

Turbidity: _____ NTU or relative scale (circle as appropriate): Clear 1 2 3 **4** 5 6 7 8 9 10 Very Silty

Parameter	Size & # of bottles:	40mL	100mL	250mL	500mL	1L	Filter and Size (µm)	Preservatives
Routine	☑ Plastic ☐ Glass				1		☐ Yes ☑ No	
LEPH/HEPH	☐ Plastic ☑ Glass	2		2			☐ Yes ☑ No	Yes
BTEX	☐ Plastic ☑ Glass	2					☐ Yes ☑ No	Yes
Diss. Metals	☑ Plastic ☐ Glass		1				☐ Yes ☑ No	
Mercury (Diss)	☐ Plastic ☑ Glass	1					☐ Yes ☑ No	

Samples placed on ice for transport ☑ Yes ☐ No

QA/QC Sample/s - ☑ Yes ☐ No | **QA/QC Type and ID -** Field Blank and Dup 1

Other (comments, notes, observations, headspace measurements [incl. ref to calibration sheet]):

Turbidity did not reduce with time. Sand (fine) was recovered in the bailer. As purging, the bailer began to rub on the inside of the casing, making it hard to force down to the bottom of the holes.

Calibration Sheet — June 17/2015

		Before	Calibration Value	After
DO		6.32 mg/L (75.6%)	100%	8.32 mg/L (99.6%)
Temp		21.6°C	—	21.6°C
SPC (µS/cm)		1322 µS/cm	1413 µS/cm (1382 µS/cm)	1366 µS/cm
pH	1	7.12	7.00	7.11
	2	4.38	4.00	4.20
	3	9.21	10.00	10.00

Time taken — approximately 15 to 20 minutes.

Groundwater Development, Purging and Sampling Sheet

☐ Development
☒ Purge/Sample

WELL NO.: MW05A
LOCATION: Mayo LTF
WEATHER: Overcast, calm
TEMPERATURE: ~3°C

JOB NO.: ENVSWM03640-01.002
COMPLETED BY: Elizne Ray
DATE: Oct. 9, 2015
TIME: ~~7:00~~ 7AM.

MONITORING WELL INFORMATION

Depth to Bottom of Well Below Top of Casing:	A	18.64	(metres)	Diameter Standpipe:	51	(mm)
Depth to Water Below Top of Casing:	B	14.30	(metres)	(B-A)*2.0 =	8.68	liters -for a 51mm (2.0 inch) diameter well
Water Column:	A-B	4.34	(meters)	(B-A)*1.1 =	—	liters -for a 38mm (1.5 inch) diameter well

EQUIPMENT LIST

pH and Temp. Meter: Model Rental YSI Serial No. _____ Calibration Buffers: 4 ✓ 7 ✓ 10 ✓
Conductivity Meter: Model _____ Serial No. _____ Calibration Solutions: DO% sat. and 1413 µS/cm
Dissolved Oxygen Meter: Model _____ Serial No. _____ ORP 240mV.
Turbidity Meter: Model _____ Serial No. _____

Pump:	none	~~Waterra~~	Peristaltic	Submersible
Bailer:	~~none~~	Stainless Steel	Teflon	PVC
Filter:	none	~~Waterra in-line~~	Vacuum (disposal)	Vacuum (re-usable)

WELL DEVELOPMENT/PURGING

Purge volume: Well vol x _____ volumes = _____ litres Method: QED Bladder pump & microvanes
Flow Rate _____ L/min Volume: _____ Start: _____ Finish: _____

TIME	VOLUME REMOVED (L)	WATER LEVEL (m)	TEMP (oC)	pH (UNITS)	~~COND.~~ ORP (uS/cm)	SP. COND (uS/cm)	DIS.02 (mg/L) or %	REMARKS (colour, odour, sheen, brittle film, etc.)
7h31	0.7L	—	2.02	7.32	-0.2	729	8.1	brown, Silt 10/10, no odour, flocks
7h33	1.7	—	0.99	7.24	-7.6	707	~6.2	" "
7h29	3.7	14.75	0.78	7.19	-18.4	703	~4.9	" "
7h36	5.7	14.91						
7h40	6.5	15.01	1.24	7.19	-23.1	720	~3.4	" "
7h46	7.5	15.10	1.24	7.17	-24.8	731	~2.9	" "
7h52	8.5	15.18	1.55	7.16	-27.9	736	~2.2	" "
7h58	9.5	15.24	1.49	7.16	-29.9	742	2.05	Switched to microvanes
11h13	~10.0	15.19	3.38	7.27	-15.4	802	~2.8	brownish, Silt 2/10, no odour
11h27	~11.5	~~15.36~~	1.86	7.17	-32.8	774	~3.6	clear, Silt 0/10, no odour or sheen
	Started collecting sample because bottle, water level							

SAMPLING Water Odour ~~no~~ yes (describe) _____ Sheen ~~no~~ yes (describe) _____
Turbidity: _____ NTU Clear: 1 2 3 4 5 6 7 8 9 10 Very Silty
or 1 – 10 relative scale (circle as appropriate):
1L bottle "General" clear (Silt 3/10)
NAPL Information (odour, colour, etc.) other bottles filled using microvanes, Silt 2/10.

COMMENTS MW05: ▼ 11.38m, bottom @ 12.23m

- Pump hung up? Could not get it any deeper than 15.36m.
- Started with settings ab-70psi, 6s charge, 4s exhaust. Let go for awhile, reduced cycles to 55psi, 2Ss charge, 3Os exhaust.
- ▼ below pump intake, removed pump & noted ice crystals on top end.

Used 3/8" water line in microvanes, portable to finish sampling.

Groundwater Development, Purging and Sampling Sheet

☐ Development
☑ Purge/Sample

WELL NO.: MW06 | JOB NO.: ENVSLWM03460-01.002
LOCATION: Mayo LTF | COMPLETED BY: Renée Roy
WEATHER: mostly overcast, windy | DATE: Oct. 9, 2015
TEMPERATURE: ~5°C | TIME: 13h30

MONITORING WELL INFORMATION

Depth to Bottom of Well Below Top of Casing: A 16.64 (metres) Diameter Standpipe: 51 (mm)
Depth to Water Below Top of Casing: B 15.08 (metres) (B-A)*2.0 = ~3 liters -for a 51mm (2.0 inch) diameter well
Water Column: A-B 1.56 (meters) (B-A)*1.1 = — liters -for a 38mm (1.5 inch) diameter well

EQUIPMENT LIST

pH and Temp. Meter: Model Rentz/YSI Serial No. _____ Calibration Buffers: 4✓ 7✓ 10✓
Conductivity Meter: Model _____ Serial No. _____ Calibration Solutions: DO% Sat. and 1413 µS/cm
Dissolved Oxygen Meter: Model _____ Serial No. _____ & ORP 240mV.
Turbidity Meter: Model _____ Serial No. _____

Pump:	none	Micro-Waterra	Peristaltic	Submersible
Bailer:	~~none~~	Stainless Steel	Teflon	(PVC)
Filter:	none	Syringe. Waterra in-line	Vacuum (disposal)	Vacuum (re-usable)

WELL DEVELOPMENT/PURGING

Purge volume: Well vol x _____ volumes = _____ litres Method: _____
Flow Rate _____ L/min Volume: _____ Start: _____ Finish: _____

TIME	VOLUME REMOVED (L)	WATER LEVEL (m)	TEMP (oC)	pH (UNITS)	~~COND (uS/cm)~~ ORP	SP. COND (uS/cm)	DIS.02 (mg/L) or %	REMARKS (colour, odour, sheen, brittle film, etc.)
14h00	1L	—	3.82	7.56	-65.2	306	~2.7	Brown, extreme silt, headspace smell.
14h10	2L	15.37	3.71	7.33	-59.4	296	~1.7	— " "
14h15	3L	—	3.89	7.22	-57.4	292	~0.8	" "
14h18	4L	15.52	3.39	7.27	-53.8	292	~0.8	→ Issue w/ electrical reading being
14h52	5L	15.36	4.15	7.29	-46.2	207	~0.5	picked pull of Soft. Many attempts
15h13	6L	(15.22 @ 15h02)	2.58	7.34	-34.0	298	—	to decant the tube & filtering tubing
15h19	7L	—	2.58	7.22	-38.7	296	4.78?	clean... Started to brittle
15h26	7.5	15.39	2.64	7.25	-46.8	296	5.15?	→ Pulling partial bailers?
15h31	8.5	—	2.49	7.24	-37.2	294	3.71	
15h43	10.	(15.46)	2.58	7.25	-35.4	296	~6.2?	
	Finished sampling @ 15h52							

SAMPLING Water Odour (no) yes (describe) _____ Sheen (no) yes (describe) _____
Turbidity: _____ NTU Clear: 1 2 3 4 5 6 7 8 9 10 Very Silty
or 1 – 10 relative scale (circle as appropriate):

NAPL Information (odour, colour, etc.) _____

COMMENTS Extremely Silty/fine sand; ~~Lit Sample~~ collected extra water & left settle (~4h drive back to WN) so that filtering would be easier → filtered & preserved once back at the office.

Groundwater Development, Purging and Sampling Sheet

☐ Development
☒ Purge/Sample

WELL NO.: MW07
LOCATION: Mayo LTF
WEATHER: Overcast, calm
TEMPERATURE: ~ 6°C

JOB NO.: ENVSWM034160-01.002
COMPLETED BY: Elaine Roy
DATE: October 2, 2015
TIME: 16h00

MONITORING WELL INFORMATION

Depth to Bottom of Well Below Top of Casing: A 19.35 (metres) Diameter Standpipe: 51 (mm)
Depth to Water Below Top of Casing: B 17.00 (metres) (B-A)*2.0 = 4.7 liters -for a 51mm (2.0 inch) diameter well
Water Column: A-B 2.35 (meters) (B-A)*1.1 = — liters -for a 38mm (1.5 inch) diameter well

EQUIPMENT LIST

pH and Temp. Meter: Model Rental YSI Serial No. _____ Calibration Buffers: 4 ✓ 7 ✓ 10 ✓
Conductivity Meter: Model _____ Serial No. _____ Calibration Solutions: DO% sat. and 1413µS/cm
Dissolved Oxygen Meter: Model _____ Serial No. _____ & ORP 240mV.
Turbidity Meter: Model _____ Serial No. _____

Pump:	none	Waterra	Peristaltic	Submersible
Bailer:	~~none~~	Stainless Steel	Teflon	PVC
Filter:	none	~~Waterra in-line~~	Vacuum (disposal)	Vacuum (re-usable)

WELL DEVELOPMENT/PURGING Low flow sampling

Purge volume: Well vol x _____ ~~volumes~~ = _____ litres Method: Bladder pump
Flow Rate _____ L/min Volume: _____ Start: _____ Finish: _____

TIME	VOLUME REMOVED (L)	WATER LEVEL (m)	TEMP (oC)	pH (UNITS)	~~COND.~~ ORP (uS/cm)	SP. COND (uS/cm)	DIS.02 (mg/L) or %	REMARKS (colour, odour, sheen, brittle film, etc.)
17h48	0.7L	17.06	3.81	7.68	-87.7	305	14??	brown, SiH 10/10, bloody sheet
17h51	1L	—	2.72	7.50	-88.4	294		" " "
17h53	~2L	17.11	2.38	7.46	-85.3	292	10.23	" " "
17h56	~3L	17.14	2.17	7.39	-94.3	290	~9.8	" " "
17h58	~4.5L	17.15	2.10	7.37	-99.7	289	~9.6	
18h01	~6L	17.17	2.05	7.36	-98.2	289	~ —	
18h04	~7.5L	17.18	2.05	7.34	-100.3	289	~9.0	
18h05	~8.5L	17.19	2.02	7.34	-109.2	288	~8.5	
18h08	~9.5L	17.19	2.05	7.33	-109.8	289	~8.2	brown, SiH 10/10.

SAMPLING Water Odour (no) yes (describe) _____ Sheen (no) yes (describe) _____
Turbidity: _____ NTU Clear: 1 2 3 4 5 6 7 8 9 10 Very Silty
or 1 – 10 relative scale (circle as appropriate):

NAPL Information (odour, colour, etc.) _____

COMMENTS pump set at 18.5m from top of PVC.
Pressure ~70psi, charge 6, exhaust 14

MAYO LTF – OCT 9/10, 2015
ENVSWM03640-01.002

- Water levels (Oct. 8, 2015):
  - MW07: ▽ 17.00m, bottom 19.35m
  - MW05: ▽ 11.38m, bottom 12.33m
  - MW05Z: ▽ 14.30m, bottom 18.64m
  - MW02: DRY, bottom 7.71m
  - MW01: ▽ 8.41S, bottom 8.47m from top of casing
  - MW04: DRY, bottom 8.50m, protective casing
  - MW03: DRY, bottom 8.38m
  - MW06: ▽ 15.08m, bottom 16.69m

- Site Reconnaissance: - walked around & took pictures of the south/south-east portion of site for potential/accessible new MW location. Ground mostly accessible for trucking. One location identified just out of site boundary/details, coordinates 047360.0E, 7057919.6N also see site plan.
  - Rained overnight & morning of Oct. 10. Site soil very slippery/sticky. Noted that drill site might be difficult to access if wet/raining.

Return the Rain

Scale: 1 square = _____

APPENDIX D
LABORATORY ANALYTICAL REPORTS

Tetra Tech EBA Inc.
ATTN: Rob Dickson
61 Wasson Place
Whitehorse YT Y1A 0H7

Date Received: 18-JUN-15
Report Date: 09-JUL-15 15:22 (MT)
Version: FINAL REV. 2

Client Phone: 867-668-3068

Certificate of Analysis

Lab Work Order #: L1629047

Project P.O. #: NOT SUBMITTED
Job Reference: ENVSWM03406-01
C of C Numbers: 14-469555
Legal Site Desc:

Comments: Surrogate recoveries for d9-acridine for sample L1629047-2, 3 fell outside the ALS Data Quality Objective of 60% recovery due to sample matrix issues. The reported recoveries for d9-acridine in this report are absolute recoveries. Associated test results for acridine in these samples were recovery-corrected using the isotope dilution technique, which effectively corrects for matrix issues, and ensures that reported results are accurate, unbiased, and defensible.

Please note the detection limit for EPHsg (19-32) was increased due to analytical interferences.

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1629047-1	L1629047-2	L1629047-3	L1629047-4	L1629047-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15
	Sampled Time	09:45	08:30	11:20	11:30	11:30
	Client ID	MW05A	MW06	MW07	DUP 1	FIELD BLANK
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1600	523	538	555	7.3
	Hardness (as CaCO3) (ug/L)	902000	284000	297000	294000	<500
	pH (pH)	8.03	8.25	8.25	8.10	5.50
	Total Dissolved Solids (ug/L)	1210000	313000	323000	343000	<10000
	Turbidity (NTU)	3450	>4000 TMV	>4000 TMV	>4000 TMV	<0.10
Anions and Nutrients	Alkalinity, Total (as CaCO3) (ug/L)	449000	260000	257000	261000	<2000
	Chloride (Cl) (ug/L)	12900	<500	930	950	<500
	Fluoride (F) (ug/L)	253	95	143	140	<20
	Nitrate (as N) (ug/L)	339	10.5	289	292	<5.0
	Nitrite (as N) (ug/L)	36.9	1.9	5.0	4.7	<1.0
	Sulfate (SO4) (ug/L)	452000	7250	25800	26100	<300
Total Metals	Aluminum (Al)-Total (ug/L)					<10
	Antimony (Sb)-Total (ug/L)					<0.50
	Arsenic (As)-Total (ug/L)					<1.0
	Barium (Ba)-Total (ug/L)					<20
	Beryllium (Be)-Total (ug/L)					<5.0
	Boron (B)-Total (ug/L)					<100
	Cadmium (Cd)-Total (ug/L)					<0.050
	Calcium (Ca)-Total (ug/L)					<100
	Chromium (Cr)-Total (ug/L)					<0.50
	Cobalt (Co)-Total (ug/L)					<0.50
	Copper (Cu)-Total (ug/L)					<1.0
	Iron (Fe)-Total (ug/L)					<30
	Lead (Pb)-Total (ug/L)					<1.0
	Lithium (Li)-Total (ug/L)					<50
	Magnesium (Mg)-Total (ug/L)					<100
	Manganese (Mn)-Total (ug/L)					<10
	Mercury (Hg)-Total (ug/L)					<0.20
	Molybdenum (Mo)-Total (ug/L)					<1.0
	Nickel (Ni)-Total (ug/L)					<5.0
	Selenium (Se)-Total (ug/L)					<1.0
	Silver (Ag)-Total (ug/L)					<0.050
	Sodium (Na)-Total (ug/L)					<2000
	Thallium (Tl)-Total (ug/L)					<0.20
	Titanium (Ti)-Total (ug/L)					<50
	Uranium (U)-Total (ug/L)					<0.20
	Vanadium (V)-Total (ug/L)					<30

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1629047-1	L1629047-2	L1629047-3	L1629047-4	L1629047-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15
	Sampled Time	09:45	08:30	11:20	11:30	11:30
	Client ID	MW05A	MW06	MW07	DUP 1	FIELD BLANK
Grouping	**Analyte**					
WATER						
Total Metals	Zinc (Zn)-Total (ug/L)					<5.0
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (ug/L)	<10	<10	<10	<10	
	Antimony (Sb)-Dissolved (ug/L)	0.57	1.40	<0.50	<0.50	
	Arsenic (As)-Dissolved (ug/L)	1.0	14.6	<1.0	<1.0	
	Barium (Ba)-Dissolved (ug/L)	33	573	135	136	
	Beryllium (Be)-Dissolved (ug/L)	<5.0	<5.0	<5.0	<5.0	
	Boron (B)-Dissolved (ug/L)	100	<100	<100	<100	
	Cadmium (Cd)-Dissolved (ug/L)	0.056	<0.050	<0.050	<0.050	
	Calcium (Ca)-Dissolved (ug/L)	244000	90500	86500	85400	
	Chromium (Cr)-Dissolved (ug/L)	<0.50	<0.50	0.68	0.66	
	Cobalt (Co)-Dissolved (ug/L)	1.11	0.66	<0.50	<0.50	
	Copper (Cu)-Dissolved (ug/L)	2.1	<1.0	<1.0	<1.0	
	Iron (Fe)-Dissolved (ug/L)	<30	57	<30	<30	
	Lead (Pb)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	
	Lithium (Li)-Dissolved (ug/L)	54	<50	<50	<50	
	Magnesium (Mg)-Dissolved (ug/L)	71000	14100	19700	19600	
	Manganese (Mn)-Dissolved (ug/L)	306	541	83	80	
	Mercury (Hg)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	
	Molybdenum (Mo)-Dissolved (ug/L)	1.2	3.3	1.7	1.8	
	Nickel (Ni)-Dissolved (ug/L)	6.0	<5.0	<5.0	<5.0	
	Selenium (Se)-Dissolved (ug/L)	5.2	<1.0	3.0	3.1	
	Silver (Ag)-Dissolved (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Sodium (Na)-Dissolved (ug/L)	35200	2000	3500	3500	
	Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	
	Titanium (Ti)-Dissolved (ug/L)	<50	<50	<50	<50	
	Uranium (U)-Dissolved (ug/L)	28.3	10.9	5.70	5.80	
	Vanadium (V)-Dissolved (ug/L)	<30	<30	<30	<30	
	Zinc (Zn)-Dissolved (ug/L)	<5.0	<5.0	<5.0	<5.0	
Volatile Organic Compounds	Benzene (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Ethylbenzene (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Methyl t-butyl ether (MTBE) (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Styrene (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	Toluene (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	ortho-Xylene (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50
	meta- & para-Xylene (ug/L)	<0.50	<0.50	<0.50	<0.50	<0.50

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1629047-1	L1629047-2	L1629047-3	L1629047-4	L1629047-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15
	Sampled Time	09:45	08:30	11:20	11:30	11:30
	Client ID	MW05A	MW06	MW07	DUP 1	FIELD BLANK
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	Xylenes (ug/L)	<0.75	<0.75	<0.75	<0.75	<0.75
	Surrogate: 4-Bromofluorobenzene (SS) (%)	101.3	101.1	102.1	101.4	102.0
	Surrogate: 1,4-Difluorobenzene (SS) (%)	101.0	101.8	101.7	100.6	101.4
Hydrocarbons	EPH10-19 (ug/L)	<250	<250	<250	<250	<250
	EPH10-19 (sg) (ug/L)		<250			
	EPH19-32 (ug/L)	<250	330	<250	<250	<250
	EPH19-32 (sg) (ug/L)		<300			
	LEPH (ug/L)	<250	<250	<250	<250	<250
	HEPH (ug/L)	<250	330	<250	<250	<250
	Volatile Hydrocarbons (VH6-10) (ug/L)	<100	<100	<100	<100	<100
	VPH (C6-C10) (ug/L)	<100	<100	<100	<100	<100
	Surrogate: 2-Bromobenzotrifluoride (%)	110.6	105.3	107.9	104.7	104.7
	Surrogate: 2-Bromobenzotrifluoride, EPH-sg (%) (%)		81.7			
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	100.1	91.0	102.6	102.2	104.3
Polycyclic Aromatic Hydrocarbons	Acenaphthene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acenaphthylene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Acridine (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Anthracene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benz(a)anthracene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(a)pyrene (ug/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Benzo(b)fluoranthene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(g,h,i)perylene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Benzo(k)fluoranthene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chrysene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Dibenz(a,h)anthracene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluoranthene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Fluorene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Indeno(1,2,3-c,d)pyrene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Naphthalene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Phenanthrene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Pyrene (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Quinoline (ug/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Surrogate: Acridine d9 (%)	65.5	23.1	49.1	60.1	81.6
	Surrogate: Chrysene d12 (%)	104.9	96.4	98.9	108.4	77.2
	Surrogate: Naphthalene d8 (%)	119.7	113.7	107.1	116.0	85.1

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1629047-1	L1629047-2	L1629047-3	L1629047-4	L1629047-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15	17-JUN-15
	Sampled Time	09:45	08:30	11:20	11:30	11:30
	Client ID	MW05A	MW06	MW07	DUP 1	FIELD BLANK
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Surrogate: Phenanthrene d10 (%)	116.7	110.4	108.9	116.6	84.0

* 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	Antimony (Sb)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Cadmium (Cd)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Chromium (Cr)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Cobalt (Co)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Lead (Pb)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Nickel (Ni)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Selenium (Se)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Silver (Ag)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Thallium (Tl)-Dissolved	DLA	L1629047-1, -2, -3, -4
Duplicate	Fluoride (F)	DLM	L1629047-5
Duplicate	Nitrite (as N)	DLM	L1629047-5
Duplicate	Nitrate (as N)	DLM	L1629047-5
Duplicate	Nitrite (as N)	DLM	L1629047-5
Duplicate	Nitrite (as N)	DLM	L1629047-5
Duplicate	Nitrate (as N)	DLM	L1629047-5
Matrix Spike	Boron (B)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1629047-1, -2, -3, -4
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1629047-1, -2, -3, -4

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
TMV	Turbidity exceeded upper limit of the nephelometric method. Minimum value reported.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	EPA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

CL-IC-N-WR	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

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

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

EPH-ME-FID-VA	Water	EPH in Water	BC Lab Manual

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

EPH-SG-ME-FID-VA	Water	EPHsg in Water	BC Lab Manual

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. The BC Lab Manual method "Silica Gel Cleanup of Extractable Petroleum Hydrocarbons" (May 6, 2004) is applied to selectively remove naturally occurring organics. This analysis is sometimes also referred to as Total Petroleum Hydrocarbons.

Reference Information

F-IC-N-VA	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

F-IC-N-WR	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA	Water	Dissolved Hg in Water by CVAFS LOR=50ppt	APHA 3030B/EPA 1631E (mod)

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 or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA	Water	Total Hg in Water by CVAFS LOR=50ppt	EPA 1631E (mod)

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption 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-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

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-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

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

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

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO2-L-IC-N-WR	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Reference Information

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

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.

SO4-IC-N-VA Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

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 (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.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

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)

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
WR	ALS ENVIRONMENTAL - WHITEHORSE, YUKON, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-469555

Reference Information

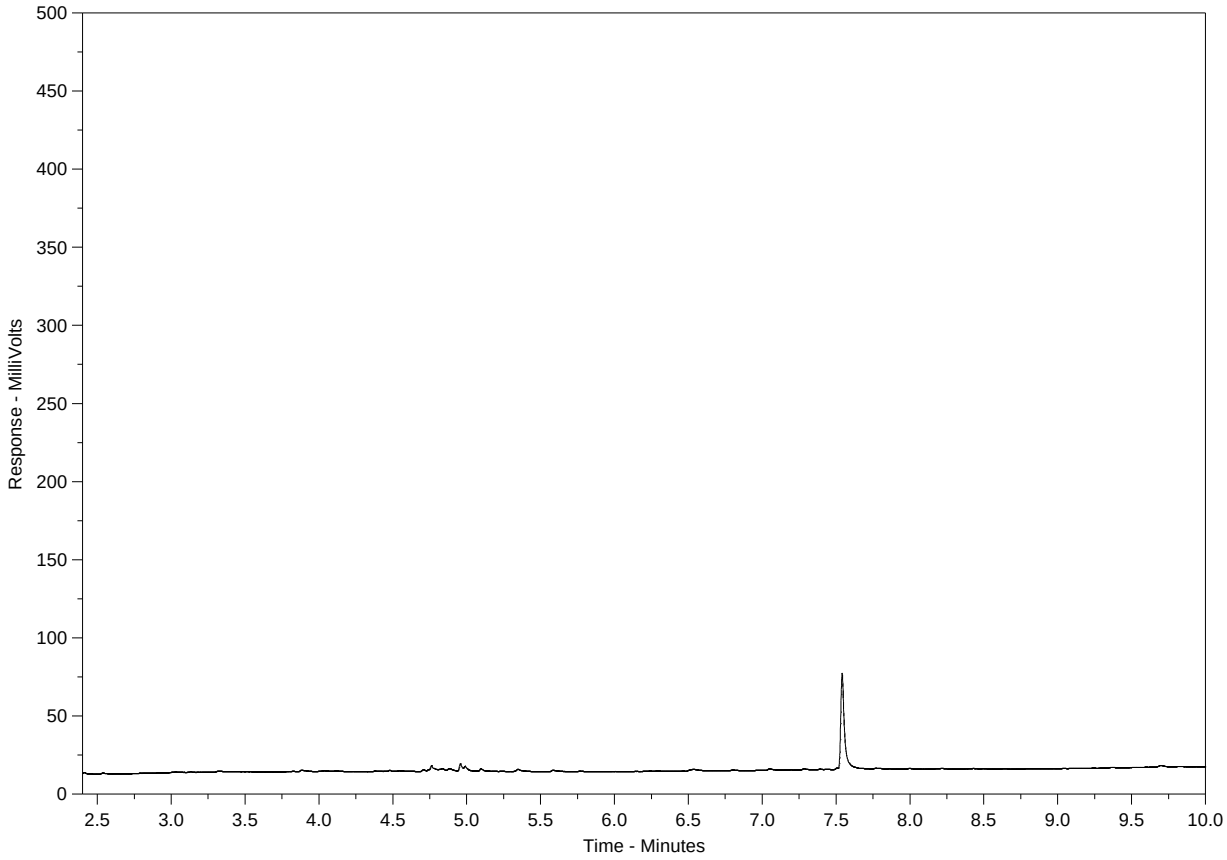
GLOSSARY OF REPORT TERMS

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

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

Hydrocarbon Distribution Report

ALS Sample ID: L1629047-1
Client Sample ID: MW05A



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.

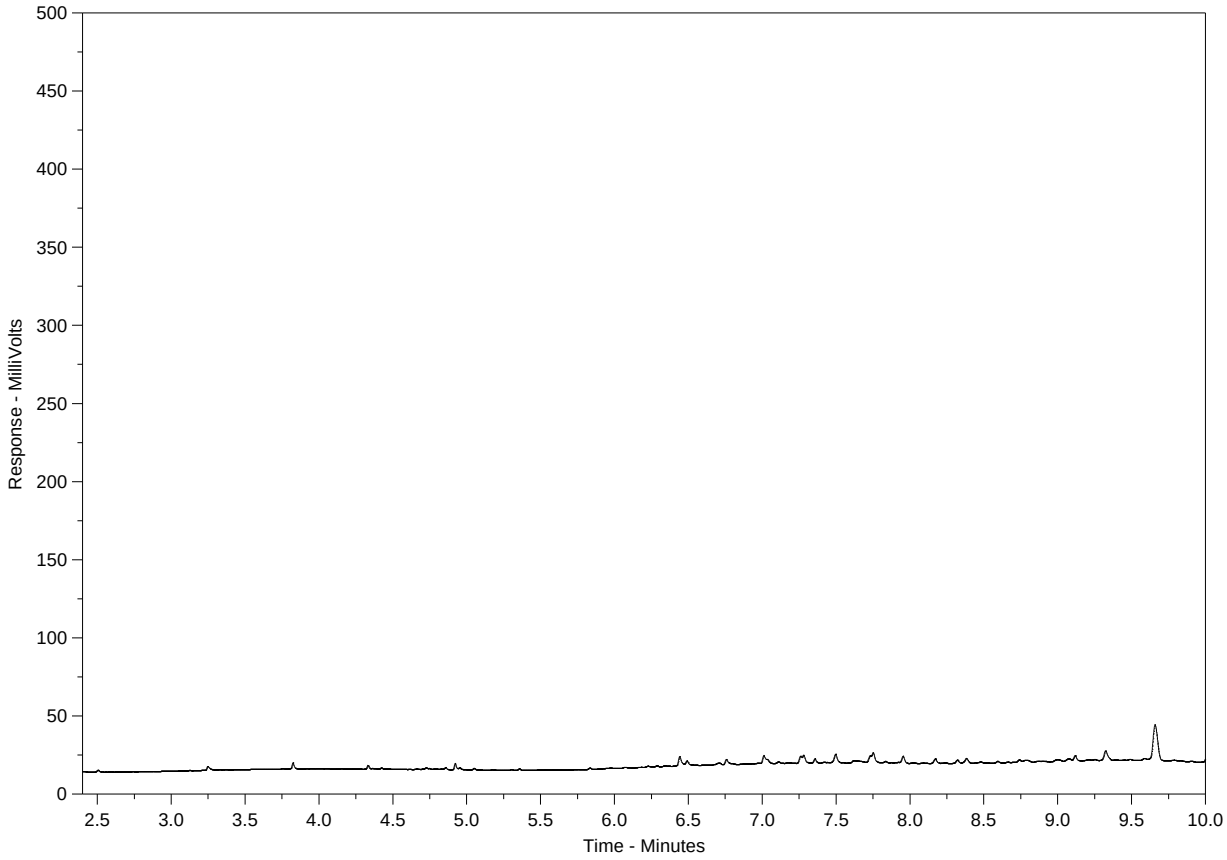
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1629047-2
Client Sample ID: MW06



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.

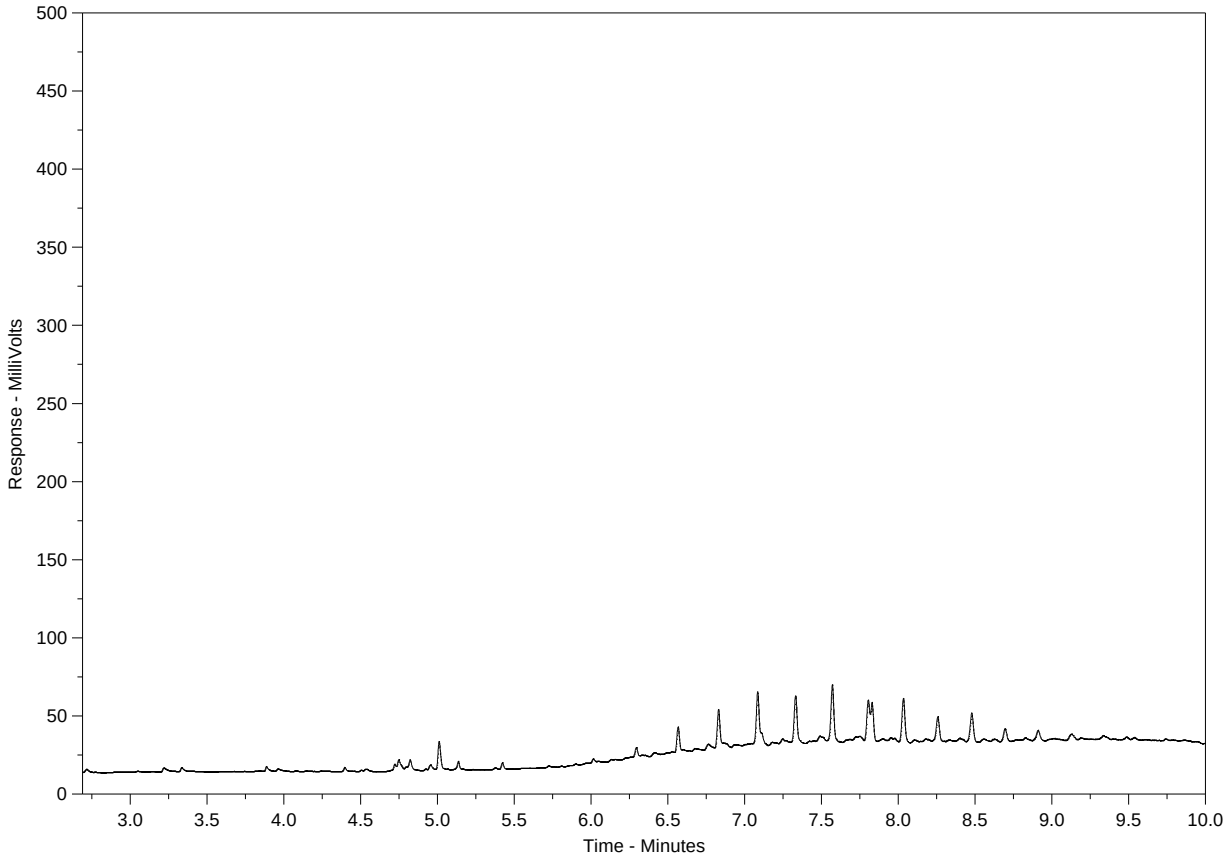
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1629047-S-2
Client Sample ID: MW06



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.

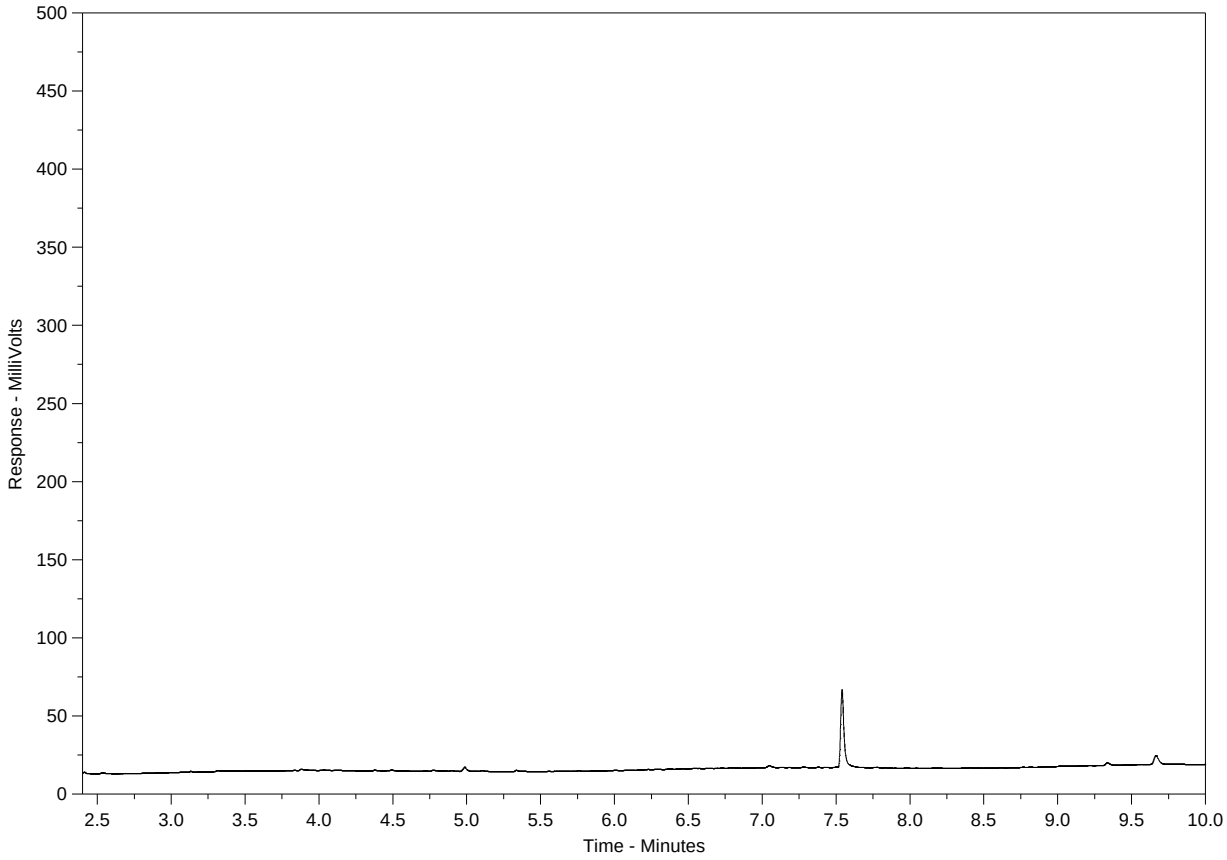
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1629047-3
Client Sample ID: MW07



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.

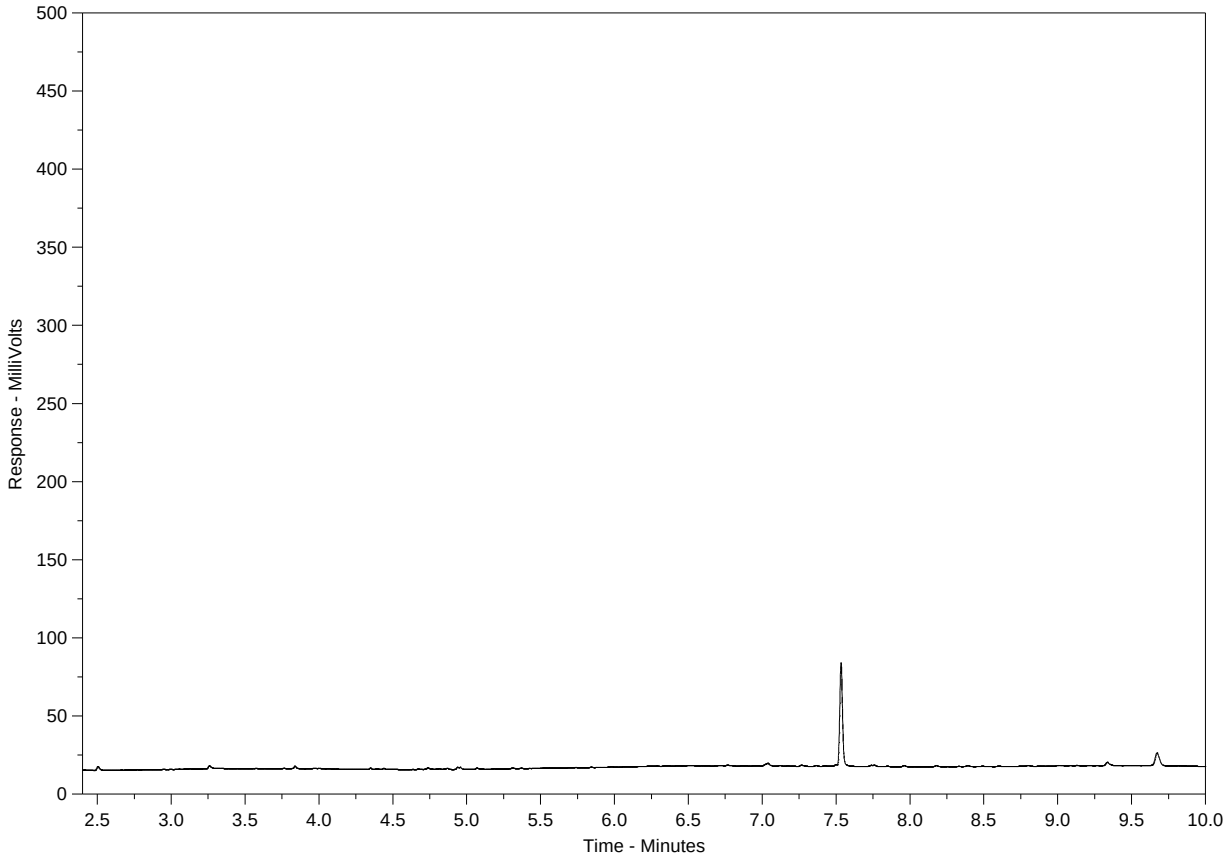
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1629047-4
Client Sample ID: DUP 1



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.

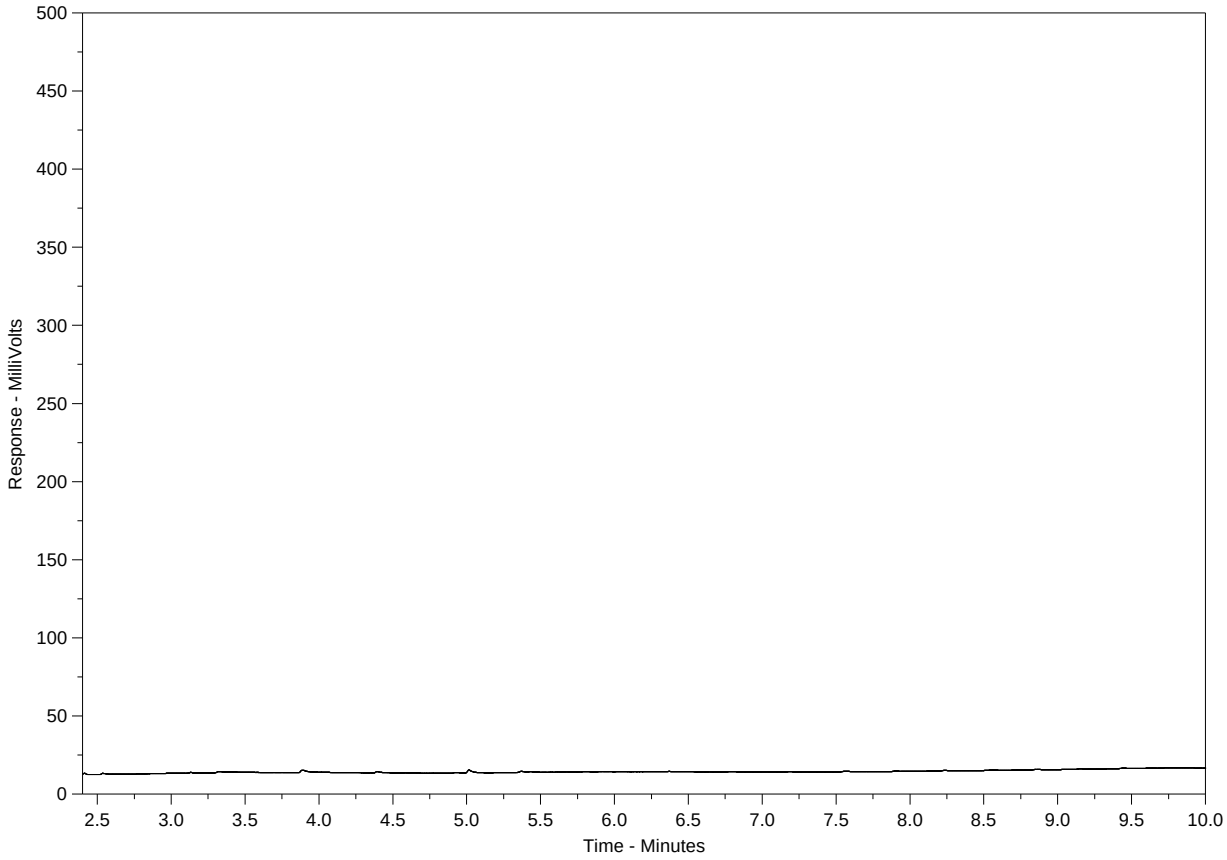
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1629047-5
Client Sample ID: FIELD BLANK



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
← Gasoline →	← Motor Oils / Lube Oils / Grease →	
← Diesel / Jet Fuels →		

The EPH Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample. For further interpretation, a current library of reference products is available on www.alsglobal.com or upon request.

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

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor, and the response scale at the left.

A "-L-" in the sample ID denotes a low level sample. A "-S-" denotes a silica gel cleaned sample.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1629047-COFC

COC Number: 14 - 469555

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Tetra Tech EBA	Select Report Format:	PDF EXCEL EDD (DIGITAL)	R Regular (Standard TAT if received by 3pm)
Contact:	Rob Dickson	Quality Control (QC) Report with Report	Yes No	P Priority (2-4 business days if received by 3pm)
Address:	61 Wasson Pl Yellowknife NT	Criteria on Report - provide details below if box checked		E Emergency (1-2 business days if received by 3pm)
Phone:	867 669 9243	Select Distribution:	EMAIL MAIL FAX	E2 Same day or weekend emergency if received by 10am – contact ALS for surcharge.
		Email 1 or Fax	rob.dickson@tetratech.com	Specify Date Required for E2,E or P:
		Email 2	adam.sealey@tetratech.com	

Invoice To		Invoice Distribution	
	Same as Report To: Yes No	Select Invoice Distribution:	EMAIL MAIL FAX
	Copy of Invoice with Report: Yes No		
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	ENV~~EBA~~-SWM03406-01	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)	ALS Contact:	Sampler: Tetra Tech Rob Dickson

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	LEPH/HEPH/PAH	BTEX/VPH	Dissolved Metals (CCME)	Dissolved Mercury (CCME)	Routine Parameters	Anions, Alk, pH TDS, Hardness, EC, Turb	Number of Containers
1	MW05a	17-06-15	09:45	Water	/	/	/	/	/		7
2	MW06	17-06-15	08:30		/	/	/	/	/		7
3	MW07	17-06-15	11:20		/	/	/	/	/		7
4	Dup 1	17-06-15	11:30		/	/	/	/	/		7
5	Field Blank	17-06-15	11:30		/	/	/	/	/		7

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? Yes No	Metals not field filtered or preserved for MW07, Dup 1. Mercury not field filtered. Need to take mercury from four the bottles.
Are samples for human drinking water use? Yes No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen		SIF Observations	Yes	No	
Ice packs	Yes / No	Custody seal intact	Yes	No	
Cooling Initiated					

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
4.1					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
Rob Dickson	June 18/2015	10:20 am		18-JUN-15	10:25			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Your Project #: ENVSWM03406-01
Site Location: MAYO
Your C.O.C. #: 08412546

Attention:ADAM SEELEY

TETRA TECH EBA INC.
61 Wasson Pl
Whitehorse, BC
Canada Y1A 0H7

Report Date: 2015/08/11
Report #: R2021148
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B567012
Received: 2015/08/06, 08:30

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
EPH in Water by GC/FID	1	2015/08/11	2015/08/11	BBY8SOP-00029	BCMOE EPH w 07/99 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Tabitha Rudkin, AScT, Burnaby Project Manager
Email: TRudkin@maxxam.ca
Phone# (604)638-2639
==========
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B567012
Report Date: 2015/08/11

TETRA TECH EBA INC.
Client Project #: ENVSWM03406-01
Site Location: MAYO
Sampler Initials: AS

TOTAL PETROLEUM HYDROCARBONS (WATER)

Maxxam ID		MV2076		
Sampling Date		2015/08/03		
COC Number		08412546		
	Units	**MW06**	**RDL**	**QC Batch**
Ext. Pet. Hydrocarbon				
EPH (C19-C32)	mg/L	<0.20	0.20	7998026
Surrogate Recovery (%)				
O-TERPHENYL (sur.)	%	100		7998026
RDL = Reportable Detection Limit				

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B567012
Report Date: 2015/08/11

TETRA TECH EBA INC.
Client Project #: ENVSWM03406-01
Site Location: MAYO
Sampler Initials: AS

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	2.7°C

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B567012
Report Date: 2015/08/11

QUALITY ASSURANCE REPORT

TETRA TECH EBA INC.
Client Project #: ENVSWM03406-01
Site Location: MAYO
Sampler Initials: AS

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits
7998026	O-TERPHENYL (sur.)	2015/08/11	108	50 - 130	99	50 - 130	110	%		
7998026	EPH (C19-C32)	2015/08/11	113	50 - 130	109	50 - 130	<0.20	mg/L	NC	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

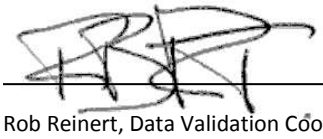
Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B567012
Report Date: 2015/08/11

TETRA TECH EBA INC.
Client Project #: ENVSWM03406-01
Site Location: MAYO
Sampler Initials: AS

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, Data Validation Coordinator

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

MaxxamA Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

08412546

BBY FCD-00077/05

Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information	Turnaround Time (TAT) Required
Company Name: TETRA TECH	Company Name: TETRATECH EBA	Quotation #:	☑ Regular TAT 5 days (Most analyses)
Contact Name:	Contact Name: Adam Seeley	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address: 61 WASSON PLACE	Project #: ENVSWM03406-01	Rush TAT (Surcharges will be applied)
	Whitehorse, YK PC: V1A 0H7	Site Location: Mayo	☐ Same Day ☐ 2 Days ☐ 1 Day ☐ 3 Days
Phone:	Phone: (867) 668-9224	Site #:	
Email:	Email: ADAM.SEELEY@TETRATECH.COM	Sampled By: West 80 Env. Cons.	Date Required:
			Rush Confirmation #:

Regulatory Criteria	Special Instructions
☐ BC CSR Soil ☐ BC CSR Water	☐ Return Cooler
☐ CCME (Specify) ☑ Other (Specify) Yukon CSR	☐ Ship Sample Bottles (Please Specify)
☐ Drinking Water ☐ BC Water Quality	USE SCENARIO # 12485

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	CPH 19-32	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1					W			
2	MW06	MW2076	2015/8/3		W	✓		
3								
4								
5								
6								
7								
8								
9								
10								

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	2015/08/06
NA	NA	2.3

COOLING MEDIA PRESENT Y / N

COMMENTS

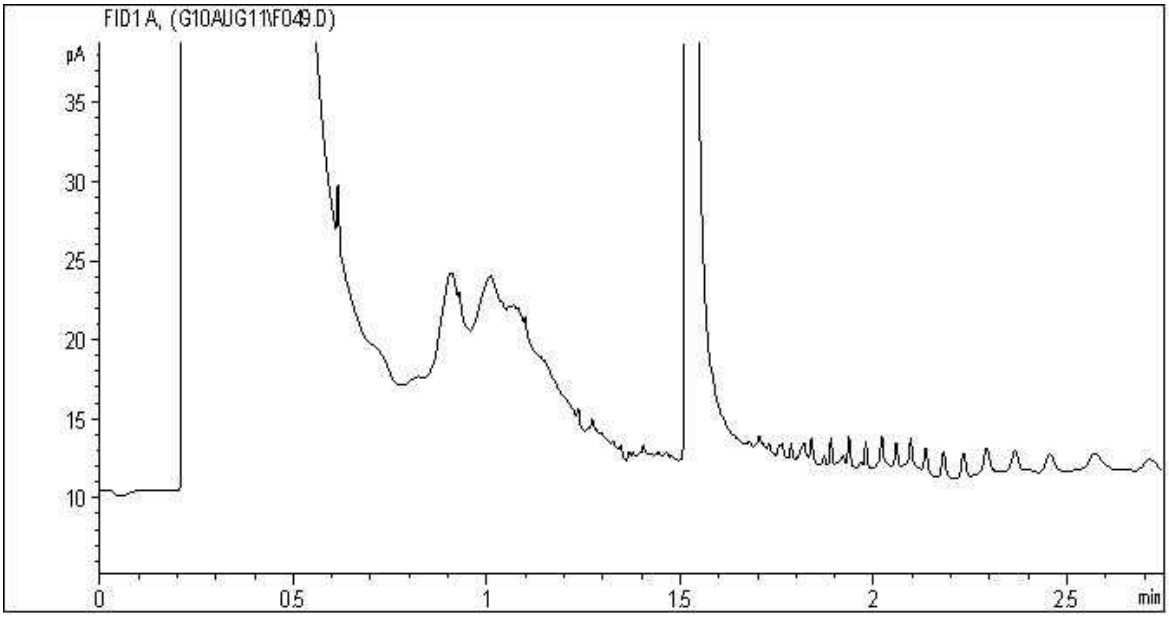
B567012

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #:
Adam Seeley	15/8/5	12:30	Laurel Berthier	2015/08/06	08:30	B566012

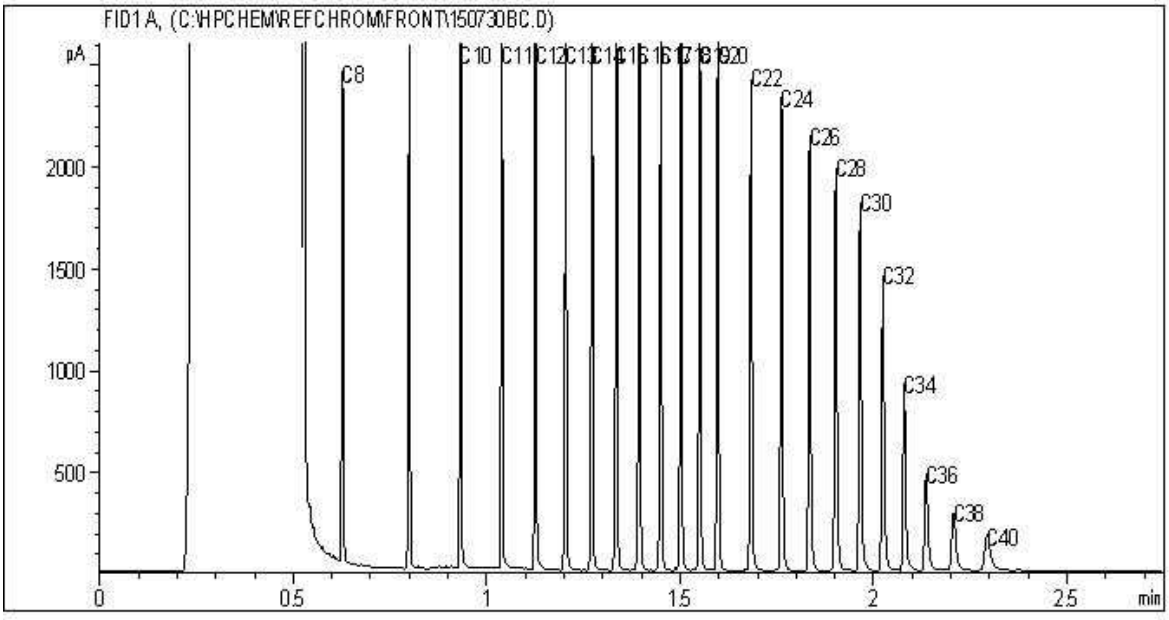
Maxxam Job #: B567012
Report Date: 2015/08/11
Maxxam Sample: MV2076

TETRA TECH EBA INC.
Client Project #: ENVSWM03406-01
Site Reference: MAYO
Client ID: MW06

EPH in Water by GC/FID Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline:	C4 - C12	Diesel:	C8 - C22
Varsol:	C8 - C12	Lubricating Oils:	C20 - C40

Note: This information is provided for reference purposes only. Should detailed chemist interpretation or fingerprinting be required, please contact the laboratory.

Tetra Tech EBA Inc.
ATTN: Eliane Roy
61 Wasson Place
Whitehorse YT Y1A 0H7

Date Received: 15-OCT-15
Report Date: 23-OCT-15 14:26 (MT)
Version: FINAL

Client Phone: 867-668-2071

Certificate of Analysis

Lab Work Order #: L1688148

Project P.O. #: NOT SUBMITTED
Job Reference: ENVSWM03460-01
C of C Numbers: 1
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1688148-1	L1688148-2	L1688148-3	L1688148-4	
	Description	Groundwater	Groundwater	Groundwater	Groundwater	
	Sampled Date	09-OCT-15	09-OCT-15	08-OCT-15	09-OCT-15	
	Sampled Time	11:30	17:00	18:15	17:00	
	Client ID	MW05A	MW06	MW07	DUP	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1340	528	499		
	Hardness (as CaCO3) (ug/L)	729000	301000	304000	316000	
	pH (pH)	8.14	8.06	8.14		
	Total Dissolved Solids (ug/L)	895000	325000	319000		
Anions and Nutrients	Alkalinity, Total (as CaCO3) (ug/L)	578000	290000	273000		
	Chloride (Cl) (ug/L)	4500	610	<500		
	Fluoride (F) (ug/L)	168	95	109		
	Nitrate (as N) (ug/L)	<10 DLA	19.4	257		
	Nitrite (as N) (ug/L)	<2.0 DLA	1.0	2.0		
	Sulfate (SO4) (ug/L)	289000	13300	18800		
Total Metals	Aluminum (Al)-Total (ug/L)	5410	53000	2270		
	Antimony (Sb)-Total (ug/L)	1.17	3.11	0.52		
	Arsenic (As)-Total (ug/L)	10.8	55.2	4.4		
	Barium (Ba)-Total (ug/L)	290	2630	214		
	Beryllium (Be)-Total (ug/L)	<5.0	<5.0	<5.0		
	Boron (B)-Total (ug/L)	<100	<100	<100		
	Cadmium (Cd)-Total (ug/L)	0.432	3.73	0.115		
	Calcium (Ca)-Total (ug/L)	177000	153000	87300		
	Chromium (Cr)-Total (ug/L)	15.0	95.4	4.95		
	Cobalt (Co)-Total (ug/L)	26.2	64.7	2.81		
	Copper (Cu)-Total (ug/L)	19.2	193	7.5		
	Iron (Fe)-Total (ug/L)	16900	127000	5470		
	Lead (Pb)-Total (ug/L)	6.0	76.1	2.7		
	Lithium (Li)-Total (ug/L)	<50	113	<50		
	Magnesium (Mg)-Total (ug/L)	78500	45000	20400		
	Manganese (Mn)-Total (ug/L)	1350	3550	263		
	Mercury (Hg)-Total (ug/L)	<0.20	0.74	<0.20		
	Molybdenum (Mo)-Total (ug/L)	5.0	2.3	1.4		
	Nickel (Ni)-Total (ug/L)	21.8	177	7.5		
	Selenium (Se)-Total (ug/L)	<1.0	3.1	2.8		
	Silver (Ag)-Total (ug/L)	0.208	1.23	0.055		
	Sodium (Na)-Total (ug/L)	66200	3400	3100		
	Thallium (Tl)-Total (ug/L)	<0.20	0.69	<0.20		
	Titanium (Ti)-Total (ug/L)	222	498	81		
	Uranium (U)-Total (ug/L)	24.1	15.2	4.29		
	Vanadium (V)-Total (ug/L)	<30	97	<30		
	Zinc (Zn)-Total (ug/L)	72.2	565	20.5		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1688148-1	L1688148-2	L1688148-3	L1688148-4	
Description	Groundwater	Groundwater	Groundwater	Groundwater	
Sampled Date	09-OCT-15	09-OCT-15	08-OCT-15	09-OCT-15	
Sampled Time	11:30	17:00	18:15	17:00	
Client ID	MW05A	MW06	MW07	DUP	
Grouping / **Analyte**					
WATER					
Dissolved Metals					
Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	
Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
Aluminum (Al)-Dissolved (ug/L)	<10	<10	<10	<10	
Antimony (Sb)-Dissolved (ug/L)	<0.50	0.95	<0.50	0.95	
Arsenic (As)-Dissolved (ug/L)	<1.0	4.7	<1.0	4.7	
Barium (Ba)-Dissolved (ug/L)	35	413	142	410	
Beryllium (Be)-Dissolved (ug/L)	<5.0	<5.0	<5.0	<5.0	
Boron (B)-Dissolved (ug/L)	<100	<100	<100	<100	
Cadmium (Cd)-Dissolved (ug/L)	0.066	<0.050	<0.050	<0.050	
Calcium (Ca)-Dissolved (ug/L)	165000	95600	89000	102000	
Chromium (Cr)-Dissolved (ug/L)	<0.50	<0.50	0.79	1.38	
Cobalt (Co)-Dissolved (ug/L)	18.8	0.91	<0.50	0.91	
Copper (Cu)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	
Iron (Fe)-Dissolved (ug/L)	204	<30	<30	<30	
Lead (Pb)-Dissolved (ug/L)	<1.0	<1.0	<1.0	<1.0	
Lithium (Li)-Dissolved (ug/L)	<50	<50	<50	<50	
Magnesium (Mg)-Dissolved (ug/L)	77100	15100	19800	15100	
Manganese (Mn)-Dissolved (ug/L)	1120	599	95	604	
Mercury (Hg)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	
Molybdenum (Mo)-Dissolved (ug/L)	3.9	2.0	1.2	2.0	
Nickel (Ni)-Dissolved (ug/L)	5.5	<5.0	<5.0	<5.0	
Selenium (Se)-Dissolved (ug/L)	<1.0	<1.0	2.8	<1.0	
Silver (Ag)-Dissolved (ug/L)	<0.050	<0.050	<0.050	<0.050	
Sodium (Na)-Dissolved (ug/L)	69000	2300	3000	2300	
Thallium (Tl)-Dissolved (ug/L)	<0.20	<0.20	<0.20	<0.20	
Titanium (Ti)-Dissolved (ug/L)	<50	<50	<50	<50	
Uranium (U)-Dissolved (ug/L)	23.7	6.01	4.19	6.07	
Vanadium (V)-Dissolved (ug/L)	<30	<30	<30	<30	
Zinc (Zn)-Dissolved (ug/L)	10.3	<5.0	5.6	<5.0	
Volatile Organic Compounds					
Benzene (ug/L)	<0.50	<0.50	<0.50	<0.50	
Ethylbenzene (ug/L)	<0.50	<0.50	<0.50	<0.50	
Methyl t-butyl ether (MTBE) (ug/L)	<0.50	<0.50	<0.50	<0.50	
Styrene (ug/L)	<0.50	<0.50	<0.50	<0.50	
Toluene (ug/L)	<0.50	<0.50	<0.50	<0.50	
ortho-Xylene (ug/L)	<0.50	<0.50	<0.50	<0.50	
meta- & para-Xylene (ug/L)	<0.50	<0.50	<0.50	<0.50	
Xylenes (ug/L)	<0.75	<0.75	<0.75	<0.75	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1688148-1	L1688148-2	L1688148-3	L1688148-4	
	Description	Groundwater	Groundwater	Groundwater	Groundwater	
	Sampled Date	09-OCT-15	09-OCT-15	08-OCT-15	09-OCT-15	
	Sampled Time	11:30	17:00	18:15	17:00	
	Client ID	MW05A	MW06	MW07	DUP	
Grouping	**Analyte**					
WATER						
Volatile Organic Compounds	Surrogate: 4-Bromofluorobenzene (SS) (%)	98.2	98.2	96.6	99.0	
	Surrogate: 1,4-Difluorobenzene (SS) (%)	98.9	98.9	98.4	98.3	
Hydrocarbons	EPH10-19 (ug/L)	<250	<250	<250	<250	
	EPH19-32 (ug/L)	<250	<250	<250	<250	
	LEPH (ug/L)	<250	<250	<250	<250	
	HEPH (ug/L)	<250	<250	<250	<250	
	Volatile Hydrocarbons (VH6-10) (ug/L)	<100	<100	<100	<100	
	VPH (C6-C10) (ug/L)	<100	<100	<100	<100	
	Surrogate: 2-Bromobenzotrifluoride (%)	94.3	97.1	96.6	97.4	
	Surrogate: 3,4-Dichlorotoluene (SS) (%)	91.2	97.0	81.8	91.1	
Polycyclic Aromatic Hydrocarbons	Acenaphthene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Acenaphthylene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Acridine (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Anthracene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Benz(a)anthracene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Benzo(a)pyrene (ug/L)	<0.010	<0.010	<0.010	<0.010	
	Benzo(b)fluoranthene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Benzo(g,h,i)perylene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Benzo(k)fluoranthene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Chrysene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Dibenz(a,h)anthracene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Fluoranthene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Fluorene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Indeno(1,2,3-c,d)pyrene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Naphthalene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Phenanthrene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Pyrene (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Quinoline (ug/L)	<0.050	<0.050	<0.050	<0.050	
	Surrogate: Acridine d9 (%)	95.7	61.5	92.9	61.2	
	Surrogate: Chrysene d12 (%)	79.6	72.9	79.3	73.6	
	Surrogate: Naphthalene d8 (%)	89.0	84.4	88.6	85.9	
	Surrogate: Phenanthrene d10 (%)	97.5	88.7	92.8	90.2	

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

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulfate (SO4)	MS-B	L1688148-1, -2, -3
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1688148-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1688148-1, -2, -3, -4
Matrix Spike	Iron (Fe)-Dissolved	MS-B	L1688148-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1688148-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1688148-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1688148-1, -2, -3, -4
Matrix Spike	Sulfate (SO4)	MS-B	L1688148-1, -2, -3
Matrix Spike	Sulfate (SO4)	MS-B	L1688148-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALK-COL-VA Water — Alkalinity by Colourimetric (Automated) — EPA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

CL-IC-N-WR Water — Chloride in Water by IC — EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

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

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

EPH-ME-FID-VA Water — EPH in Water — BC Lab Manual

EPH is extracted from water using a hexane micro-extraction technique, with analysis by GC-FID, as per the BC Lab Manual. EPH results include PAHs and are therefore not equivalent to LEPH or HEPH.

F-IC-N-WR Water — Fluoride in Water by IC — EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

HARDNESS-CALC-VA Water — Hardness — APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA Water — Dissolved Hg in Water by CVAFS LOR=50ppt — APHA 3030B/EPA 1631E (mod)

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 or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA Water — Total Hg in Water by CVAFS LOR=50ppt — EPA 1631E (mod)

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption 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-D-CCMS-VA Water — Dissolved Metals in Water by CRC ICPMS — APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Reference Information

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

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-T-CCMS-VA Water Total Metals in Water by CRC ICPMS EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

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

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

NO2-L-IC-N-WR Water Nitrite in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-WR Water Nitrate in Water by IC (Low Level) EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PAH-ME-MS-VA Water PAHs in Water EPA 3511/8270D (mod)

PAHs are extracted from water using a hexane micro-extraction technique, with analysis by GC/MS. Because the two isomers cannot be readily separated chromatographically, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

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.

SO4-IC-N-WR Water Sulfate in Water by IC EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

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 (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.

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)

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

Reference Information

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, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

1

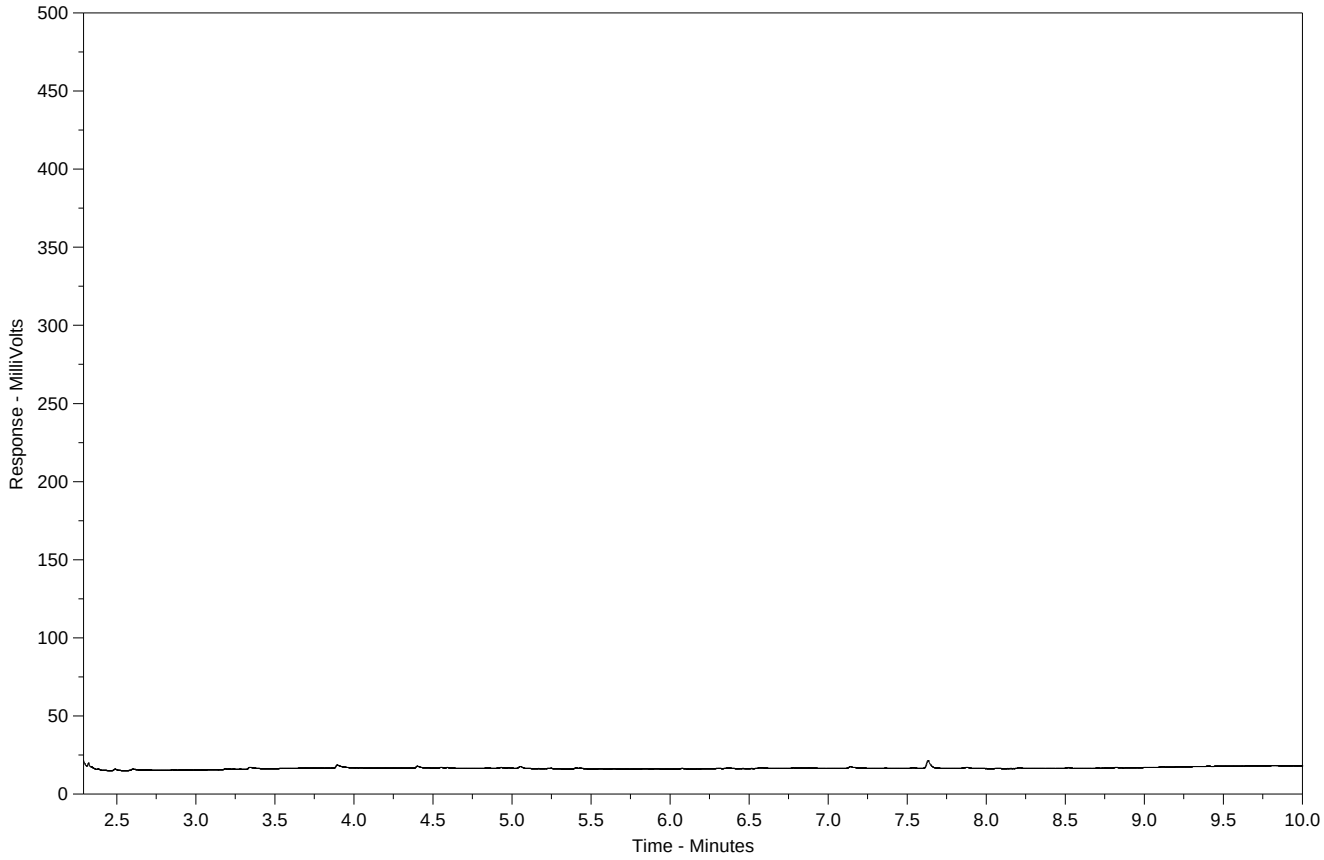
GLOSSARY OF REPORT TERMS

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

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

Hydrocarbon Distribution Report

ALS Sample ID: L1688148-1
Client Sample ID: MW05A



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.

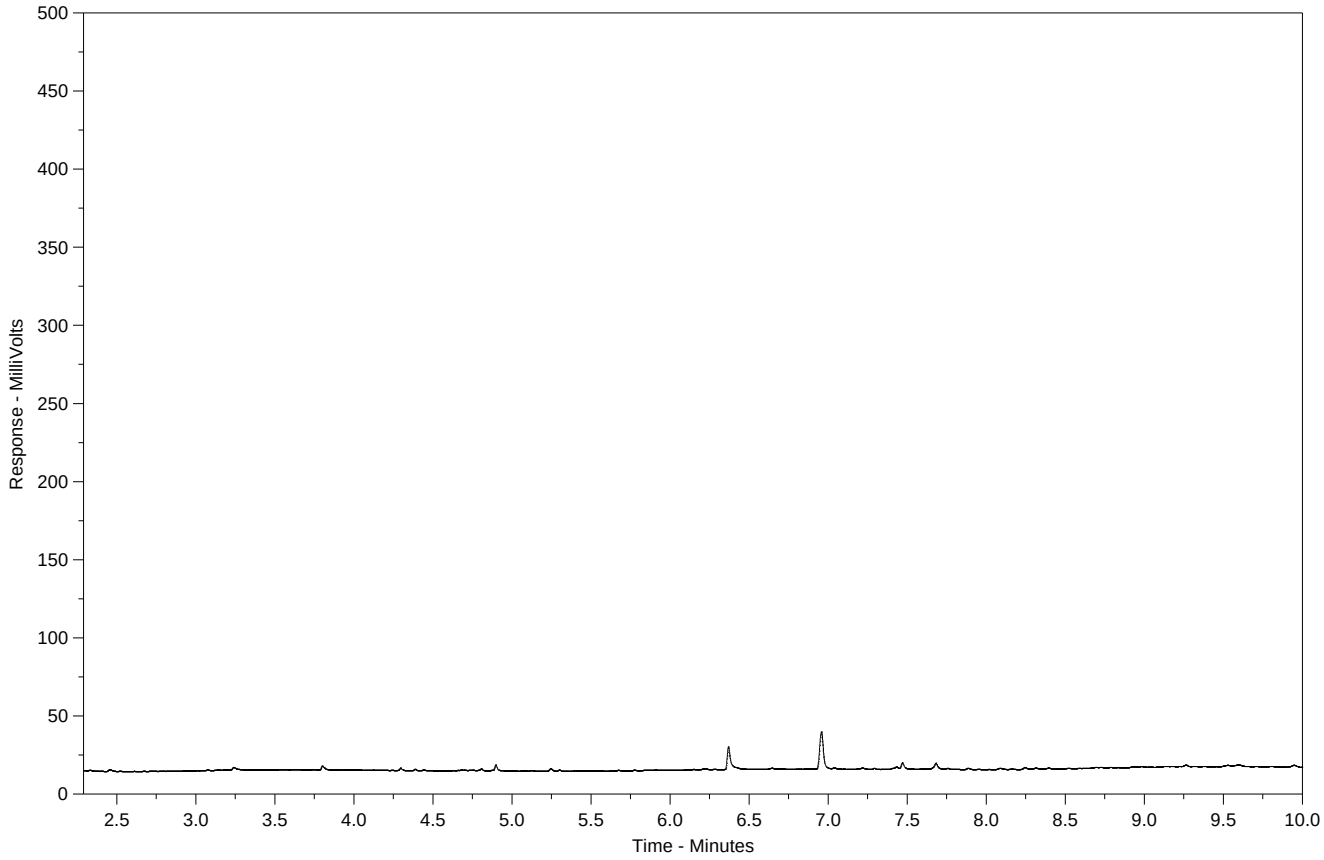
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1688148-2
Client Sample ID: MW06



nC10	nC19	nC32
174°C	330°C	467°C
346°F	626°F	873°F
←Gasoline→	←Motor Oils / Lube Oils / Grease→	
←Diesel / Jet Fuels→		

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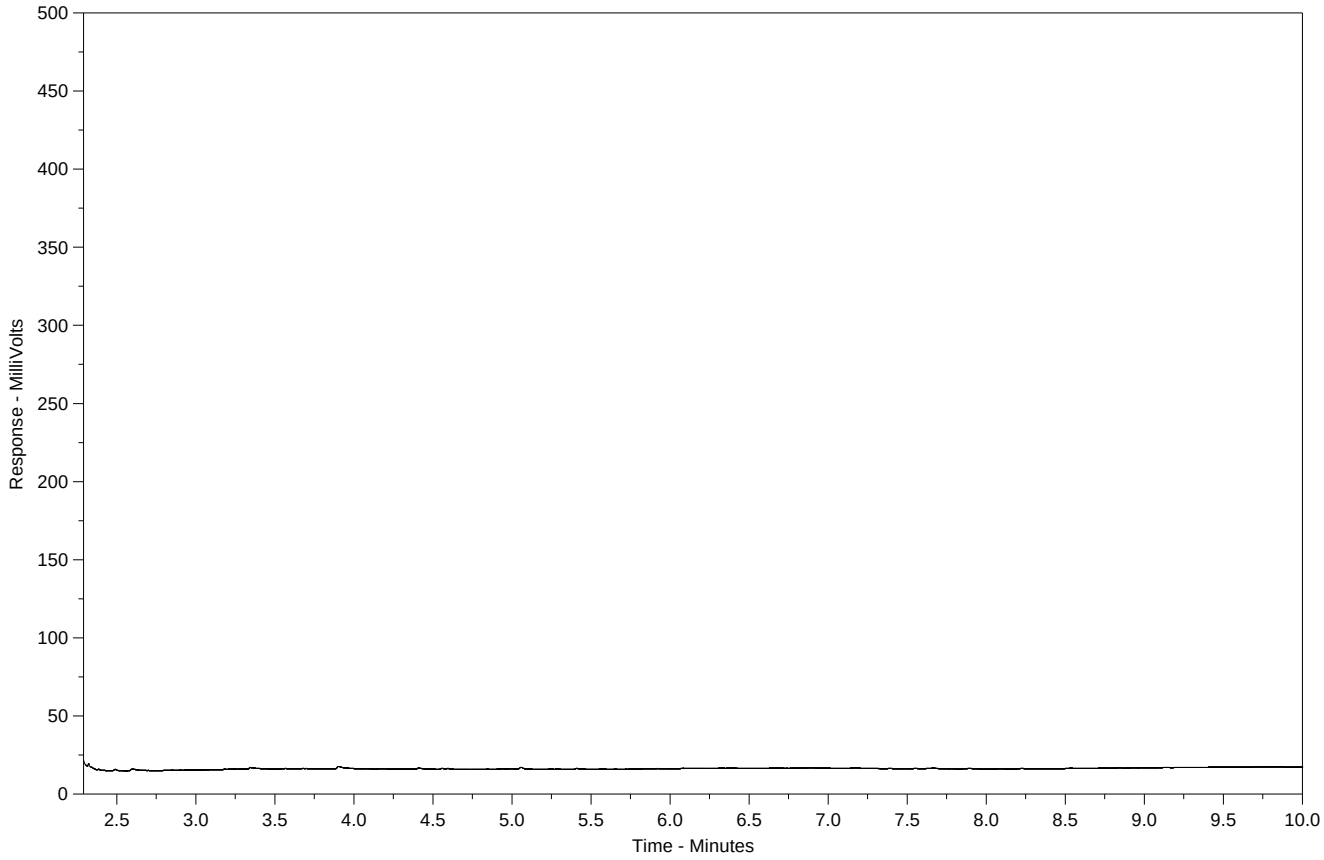
Hydrocarbon Distribution Report

ALS Sample ID: L1688148-3
Client Sample ID: MW07



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.

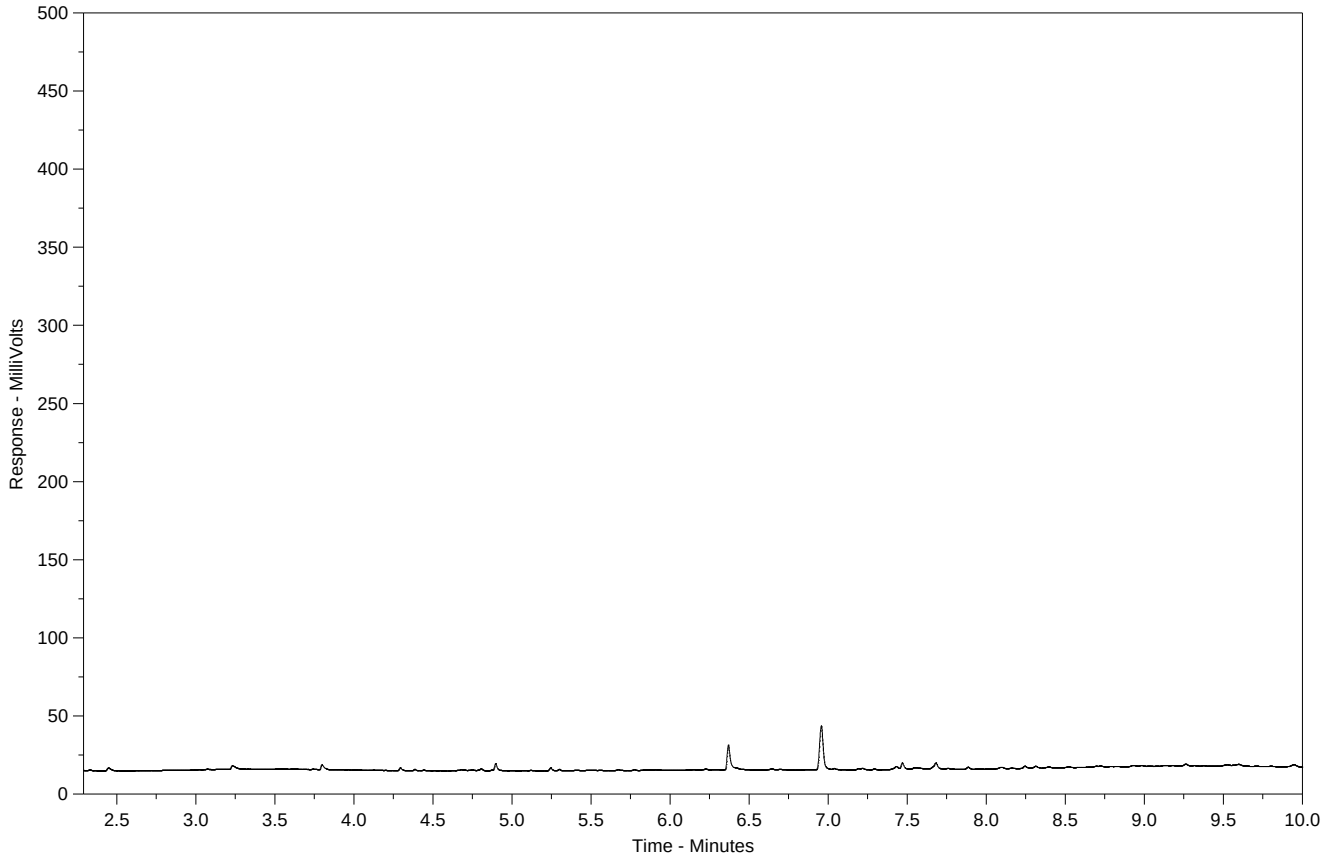
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products, and three n-alkane hydrocarbon marker compounds. Retention times may vary between samples by as much as 0.5 minutes.

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: L1688148-4
Client Sample ID: DUP



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.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1688148-COFC

COC Number: 14 -

Page 1 of 1

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Tetra Tech EBA Inc.	Select Report Format: ☑PDF ☑EXCEL ☐EDD (DIGITAL)	R ☒ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Eliane Roy	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	61 Wasson Place Whitehorse, YT Y1A0H7	☐ Criteria on Report - provide details below if box checked Select Distribution: ☑EMAIL ☐MAIL ☐FAX	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-668-2071 (f) 867-668-4349	Email 1 or Fax adam.seeley@tetratech.com Email 2 eliane.roy@tetratech.com	Specify Date Required for E2,E or P:

Invoice To		Invoice Distribution	Analysis Request
	Same as Report To ☐ Yes ☐ No	Select Invoice Distribution: ☐EMAIL ☐MAIL ☐FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
	Copy of Invoice with Report ☐ Yes ☐ No	Email 1 or Fax	
Company:		Email 2	
Contact:			

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:		Approver ID:	Cost Center:
Job #:	ENVSWM03460-01	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact: Sean Sluggett	Sampler: Eliane Roy

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PH-PCT-VA, EC-PCT-VA, ALK-PCT-VA	TDS-VA, ANIONS-ALL-IC-WR (Cl-, F-, SO4-, NO2-, NO3-)	MET-DIS-CSR-VA + Hg	MET-TOT-CSR-VA	HARDNESS-CALC-VA	BTEX+VPH+MTBE-CSR-VA	LEPH/HEPH-VA	Number of Containers
	MW05a	OCT 9	11h30	Water	X	X	X	X	X	X	X	9
	MW06	OCT 9	17h	GW	X	X	X	X	X	X	X	9
	MW07	OCT 8	19h15	GW	X	X	X	X	X	X	X	9
	Dup	OCT 9	19h	GW			X			X	X	3 6
	Field Blank			DI	HOLD.							3

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)	SAMPLE CONDITION AS RECEIVED (lab use only)
Are samples taken from a Regulated DW System? ☐ Yes ☒ No	Alberta Tier 1 Groundwater Remediation Guidelines Yukon CSR. All samples were field filtered and/or preserved as required	Frozen ☐ SIF Observations Yes ☐ No ☐ Ice packs Yes ☑ No ☐ Custody seal intact Yes ☐ No ☐ Cooling Initiated ☑
Are samples for human drinking water use? ☐ Yes ☒ No		INITIAL COOLER TEMPERATURES °C: 6.8 3.2 — FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Eliane Roy	Date: Oct 10	Time: 10 AM	Received by:	Date: 15-Oct-11	Time: 10:30	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0328a v09 Front/04 January 2014

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.

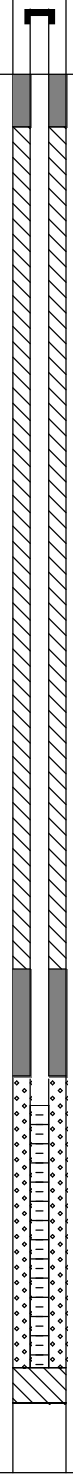
APPENDIX E
WELL LOGS

Project: Hydrogeological Assessment at	Client: Al's Environmental Cleanup Inc.	PROJECT NO. - BOREHOLE NO.
Land Treatment Facility	Drill: Hollow Stem Auger	W23101165 MW1-08
Mayo, Yukon		

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Depth (ft)
0	SAND, some silt, dry, brown		STICK-UP = 0.375 m BENTONITE	0
1				5
2				
3			CUTTINGS	10
4				
5			BENTONITE	15
6				20
7			FILTER SAND	
8	SANDY SILT, trace clay, dry, brown END OF BOREHOLE AT 7.6 METRES. MONITORING WELL INSTALLED TO 7.4 m.		Well dry in October 2008 & May 2009	25 26



eba	LOGGED BY: KSJ	COMPLETION DEPTH: 7.6m
	REVIEWED BY: KSJ	COMPLETE: 7/7/2009
	DRAWING NO: MW1-08	Page 1 of 1

Project: Hydrogeological Assessment at	Client: Al's Environmental Cleanup Inc.	PROJECT NO. - BOREHOLE NO.
Land Treatment Facility	Drill: Hollow Stem Auger	W23101165 MW2-08
Mayo, Yukon		

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
0	SANDY SILT, trace clay, dry, brown		STICK-UP = 0.280 m BENTONITE		0
1					5
2					
3			CUTTINGS		10
4					
5					15
6			BENTONITE		20
7			FILTER SAND		
8	END OF BOREHOLE AT 7.6 METRES. MONITORING WELL INSTALLED TO 7.4 m.		Well dry in October 2008 & May 2009		25 26

eba	LOGGED BY: KSJ	COMPLETION DEPTH: 7.6m
	REVIEWED BY: KSJ	COMPLETE: 7/7/2009
	DRAWING NO: MW2-08	Page 1 of 1

Project: Hydrogeological Assessment at	Client: Al's Environmental Cleanup Inc.	PROJECT NO. - BOREHOLE NO.
Land Treatment Facility	Drill: Hollow Stem Auger	W23101165 MW3-08
Mayo, Yukon		

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
0	SANDY GRAVEL, trace silt, dry		STICK-UP = 0.320 m BENTONITE		0
1					5
2					
	SILTY SAND, moist, dense				
3			CUTTINGS		10
	GRAVEL, some sand, trace silt, dry				
4	SILTY SAND, trace clay, dry				15
5					
	SANDY GRAVEL, trace silt, dry		BENTONITE		
6					20
			FILTER SAND		
7					
			Well dry in October 2008 & May 2009		25
	END OF BOREHOLE AT 7.6 METRES. MONITORING WELL INSTALLED TO 7.4 m.				
8					26

eba	LOGGED BY: KSJ	COMPLETION DEPTH: 7.6m
	REVIEWED BY: KSJ	COMPLETE: 7/7/2009
	DRAWING NO: MW3-08	Page 1 of 1

Project: Hydrogeological Assessment at	Client: Al's Environmental Cleanup Inc.	PROJECT NO. - BOREHOLE NO.
Land Treatment Facility	Drill: Hollow Stem Auger	W23101165 MW4-08
Mayo, Yukon		

SAMPLE TYPE: DISTURBED | NO RECOVERY | SPT | A-CASING | SHELBY TUBE | CORE

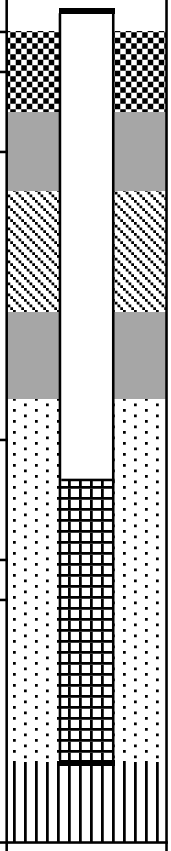
BACKFILL TYPE: BENTONITE | PEA GRAVEL | SLOUGH | GROUT | DRILL CUTTINGS | SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	NOTES & COMMENTS	Monitoring well	Depth (ft)
0	GRAVEL, some sand, trace silt, dry		STICK-UP = 0.320 m BENTONITE		0
1					5
2					
3			CUTTINGS		10
4					
5					15
			BENTONITE		
6	GRAVEL, some sand, trace silt, moist to wet				20
7			FILTER SAND		
			Well dry in October 2008 & May 2009		25
8	END OF BOREHOLE AT 7.6 METRES. MONITORING WELL INSTALLED TO 7.4 METRES.				26

eba	LOGGED BY: KSJ	COMPLETION DEPTH: 7.6m
	REVIEWED BY: KSJ	COMPLETE: 7/7/2009
	DRAWING NO: MW4-08	Page 1 of 1

Project	Groundwater Monitoring Well Installations	**Project #**	W801500
		BH number	MW05
Location	Al's Environmental Cleanup Inc. LTF	**Zone**	08V
LSD		**GPS**	0457296 E 7057955 N
Community	Mayo, YT	**Elevation (mas)**	560

Sample type		Disturbed		No Recovery		SPT		
Backfill type		Bentonite		Slough		Concrete	Filter sand	Drill cuttings

Depth from	Depth to	Soil Discription	MW05	Sample Type	Depth (m bgs)
+0.61	0	PVC Stick Up			
0	0.53	Organics			
0.53	1.15	SILT, trace sand, dry light brown 1.0 m top of bentonite			
1.15	6.10	SILT, sand, gravel, dry light brown 1.83 top of drill cuttings 5.791 m top of bentonite 6.0 m top of sand			
6.10	8.00	GRAVEL, cobble, dry brown 6.71 m top of screen 7.62 m drilling becomes harder			
7.62	8.00	SILT, clay, moist grey brown			
8.00	12.19	GRAVEL, silt, trace sand, dark brown 9.14 m becomes damp to wet 10.66 m becomes moist light brown 11.28 m bottom of well 11.28 m sloughed material			
		12.19 m End of Hole			

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Project	Groundwater Monitoring Well Installations	**Project #**	W801500
		BH number	MW05a
Location	Al's Environmental Cleanup Inc. LTF	**Zone**	08V
LSD		**GPS**	0457298 E 7057954 N
Community	Mayo, YT	**Elevation (mas)**	560

Sample type		Disturbed		No Recovery		SPT		
Backfill type		Bentonite		Slough		Concrete		Filter sand		Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW05a	Sample Type	Depth (m bgs)
+0.67	0	PVC stick up			
0.00	0.46	Organics			
0.46	2.44	SILT, sand, trace clay and gravel, dry light brown 0.46 m top of bentonite 1.3 m top of drill cuttings			
2.44	3.00	GRAVEL sand, trace silt, dry light brown			
3.00	11.28	SILT, SAND, gravel, dry light brown			
11.28	12.90	GRAVEL, silt, sand, dry brown 12.5 m top of bentonite 12.5 m harder drilling 12.8 m top of sand			
12.90	14.00	GRAVEL, SAND, cobbles trace silt, dry 13.41 m top of screen			
14.00	17.98	GRAVEL, SAND, cobbles, moist grey brown 17.68 m harder drilling 17.98 m bottom of well			17.83
		End of hole at 17.98 m			

West 80 Environmental Consulting Ltd.

Project	Groundwater Monitoring Well Installations	**Project #**	W801500
		BH number	MW06
Location	Al's Environmental Cleanup Inc. LTF	**Zone**	08V
LSD		**GPS**	0457276 E 7058080 N
Community	Mayo, YT	**Elevation (mas)**	561

Sample type		Disturbed		No Recovery		SPT		
Backfill type		Bentonite		Slough		Concrete	Filter sand	Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW06b	Sample Type	Depth (m bgs)
0.88	0	PVC stick up			
0	0.85	Organics 0.85 m top of bentonite			
1	2	SILT, sand, dry light brown 1.8 m top of drill cuttings			
2	8	GRAVEL, SAND, trace silt, cobbles, dry light 7.62 m harder drilling			
8	13.11	GRAVEL, SILT, sand, cobbles, dry 11.3 m top of bentonite 12.0 m top of sand			
13.11	17.68	SAND Silt 13.11 m top of screen 13.71 m saturated			14.53
		End of hole at 17.68 m			

West 80 Environmental Consulting Ltd.

Project	Groundwater Monitoring Well Installations				**Project #**		W801500		
					BH number		MW07		
Location	Al's Environmental Cleanup Inc. LTF				**Zone**		08V		
LSD					**GPS**	0457328 E		7057887 N	
Community	Mayo, YT				**Elevation (mas)**		557		
Sample type		Disturbed		No Recovery	SPT				
Backfill type		Bentonite		Slough	Concrete		Filter sand		Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW07	Sample Type	Depth (m bgs)
0.85	0.00	PVC stick up			
0.00	0.30	Organics			
0.30	11.58	SAND, gravel, silt, dry light brown 0.304 m top of bentonite 0.609 m top of drill cuttings			
11.58	18.00	SAND, gravel, trace silt, dry light brown 12.95 m top of bentonite 13.56 m top of sand 14.18 m top of screen 14.63-15.24 m more silt, damp to wet			16.40
18.00	18.75	GRAVEL, cobbles very slow drilling			
		End of hole at 18.75 m			

West 80 Environmental Consulting Ltd.

APPENDIX F

WEST 80 ENVIRONMENTAL CONSULTING LTD. REPORT

West 80 Environmental Consulting Ltd.
110 Crag Road• Whitehorse, Yukon Y1A 5C1• Phone: (867) 335-6501
E-mail: wilsonwest80@gmail.com

July 23, 2015

Al's Environmental Cleanup Inc.
P.O. Box 173
Mayo, Yukon
Y0B 1M0
Attn: Wiff Tuck

Subject: Installation of Groundwater Monitoring Wells at LTF – Mayo, Yukon (Revised)

Introduction

West 80 Environmental Consulting Ltd. (West 80) was retained by Al's Environmental Cleanup Inc. to coordinate and supervise on-site drilling and monitoring well installations the Mayo Land Treatment Facility (LTF).

Objective

The project objective was to install a minimum of three groundwater monitoring wells intersecting the seasonal ground water table: one well upgradient of the LTF, and two wells downgradient of the LTF.

Methods

A work plan was developed by Tetra Tech EBA (April 23, 2015) for guidance in locating and installing the groundwater monitoring wells. Well locations were adjusted to accommodate access roads on the site and traffic flow during operation of the LTF.

A Nodwell mounted CME 75 auger rig, contracted by Al's Environmental Cleanup Inc., and operated by Donjack Drilling, was used for all drilling work. Initially hollow stem augering (20.3 cm) was used to advance boreholes. However, due to refusal, presumably due to bedrock, large cobbles, or boulders the drilling method switched to drilling probe holes with solid stem augers (15.2 cm) and then re-drilling with hollow stem augers for well installation.

Saturated soils were not encountered in any boreholes during drilling so boreholes were either left open or augers were left in place and monitored for evidence of groundwater infiltration. Once evidence of water infiltration was found monitoring wells were installed to the depth of hole. All boreholes were logged and relative elevations were recorded using a level gauge and rod. Wells were developed by purging in excess of six times the calculated well water volumes or until the well was dry.

Results and Discussion

Four wells were installed on site although only three had measurable water levels one week after installation. Borehole and well logs are attached and all borehole locations are presented in Figure 1.

MW05 was installed in damp to wet soils at approximately 11.28 m below ground surface. This well failed to produce water after two days so a second well (MW05A) was installed, adjacent to MW05, to a depth of 17.98 m. This well did produce water but recovery was extremely slow during well development.

Three attempts were made before MW06 was installed. The first attempt was halted at approximately 8 m due to refusal possibly due to bedrock or a large cobble or boulder. The second attempt reached 16.76 m before refusal and no saturated soils were encountered. MW06 was installed in the third borehole attempt at a depth of 17.68 m below grade. Saturated soils were not encountered and the lead auger was noted to be dry, however water was infiltrating into the open well annulus after approximately 10 minutes. It is noted that the measured depth of installation of MW06 on May 13, 2015 was 18.55 m and the depth to the bottom of the well, as measured on May 21, 2015, was 17.20 m (see Table 1). This suggests that some siltation may have occurred following well installation.

MW07 could not be installed in the original location due to this area being approximately two metres lower than the surrounding area, and having standing water in late April, which contributed to access issues. Based on local knowledge of the area an alternate well location was proposed via email April 27, 2015. MW07 was installed, as indicated in Figure 1 near the southern end of the site, at a depth of approximately 18.75 m below ground surface. The lead auger was noted to be dry but after approximately 20 minutes water infiltration was noted and the well was installed.

Well elevations were established using a handheld GPS. Based on relative well elevations and depths to groundwater it was determined that monitoring well MW06 was upgradient from the other two wells. Monitoring wells MW05a and MW07 were downgradient from well MW06 and downgradient from the existing LTF cells.

Relative well elevations were later confirmed with a survey rod and level. Monitoring well MW02 (dry) was used as a benchmark with an estimated elevation of 560 metres above sea level (m.a.s.l.) established using a handheld GPS unit. Relative elevations and well installation data are presented in Table 1.

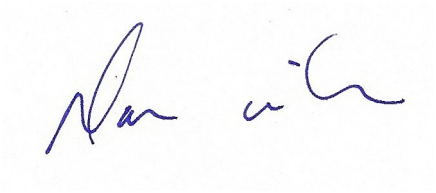
All wells were developed on May 21, 2015 by removing at least six times the calculated well water volume or until the well failed to recover sufficient water to continue development.

Closure

This report has been prepared for Al's Environmental Cleanup Inc. respecting the installation of groundwater monitoring wells at the Mayo LTF.

If there are any questions or concerns please contact the undersigned.

Sincerely,



Don Wilson
West 80 Environmental Consulting Ltd.
(867) 335-6501

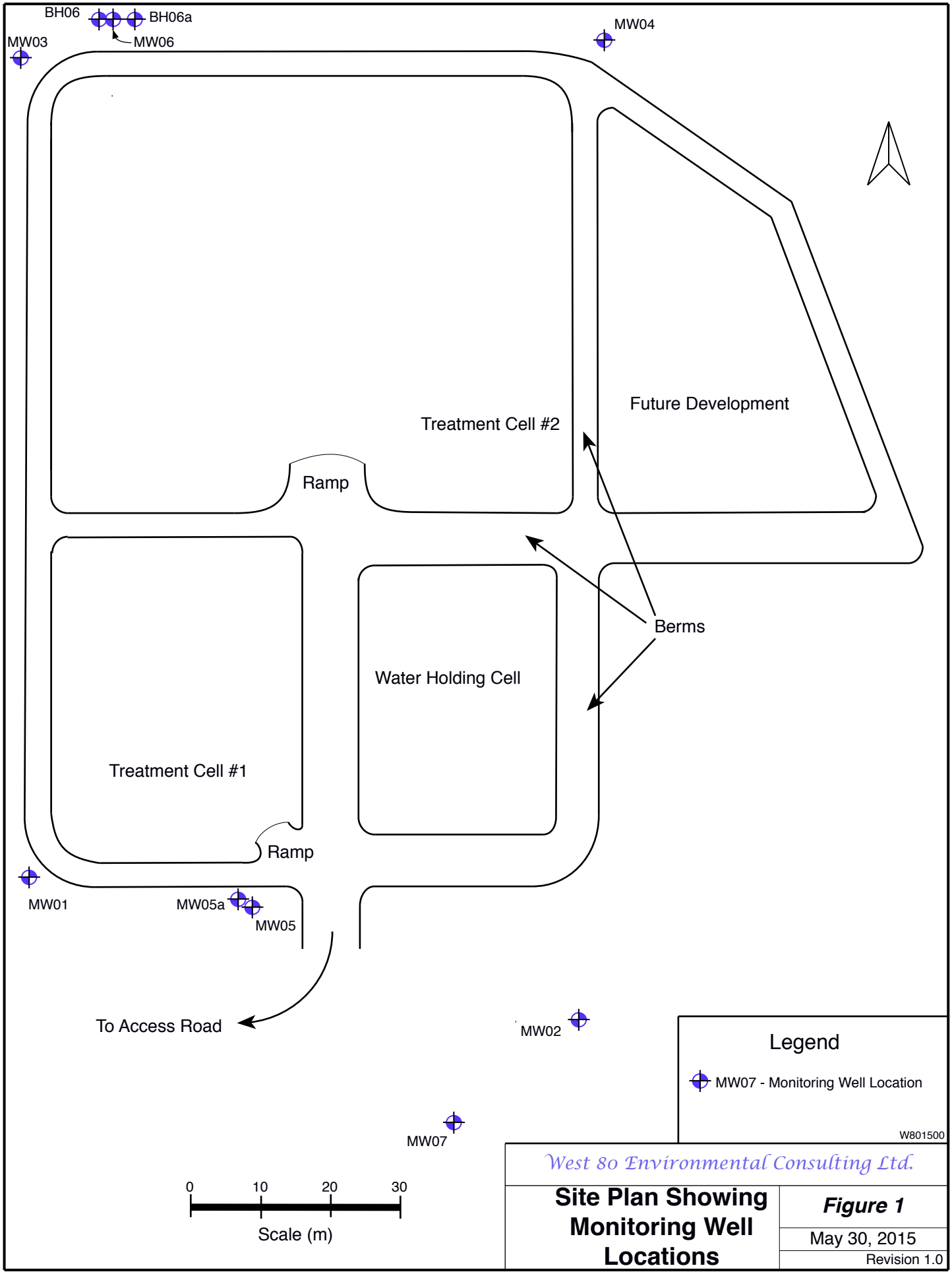
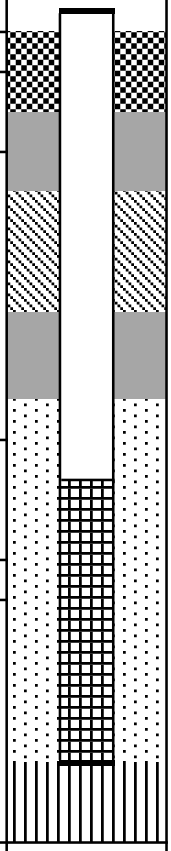

BH06
BH06a
MW06
MW03
MW04
Treatment Cell #2
Future Development
Ramp
Berms
Water Holding Cell
Treatment Cell #1
Ramp
MW01
MW05a
MW05
To Access Road
MW02
MW07
0
10
20
30
Scale (m)
Legend
MW07 - Monitoring Well Location
W801500
West 80 Environmental Consulting Ltd.
Site Plan Showing Monitoring Well Locations
Figure 1
May 30, 2015
Revision 1.0

Table 1 Well Installation Details					Date Recorded		21-May-15
Well #	Stick up (m)	Relative Elevation Top of Casing (m.a.s.l.)	Relative Ground Elevation (m.a.s.l.)	Depth to H_2O (m) (toc)	Relative Depth to H_20 (m.a.s.l.)	Depth to Bottom (m) (toc)	Relative Bottom Elevation as Installed (m.a.s.l.)
MW02		556*		dry			
MW07	0.85	557.65	556.80	17.26	540.40	19.41	538.24
MW05	0.61	560.30	559.69	dry	-	11.84	548.46
MW05a	0.67	560.20	559.53	18.51	541.70	18.64	541.56
MW01		560.61		dry			
MW03		561.01		dry			
MW06	0.88	561.50	560.62	15.4	546.09	17.20	542.95

*Benchmark elevation from hand held GPS
Relative elevations based on MW02
m.a.s.l. - metres above sea level
toc - top of casing

Project	Groundwater Monitoring Well Installations	**Project #**	W801500
		BH number	MW05
Location	Al's Environmental Cleanup Inc. LTF	**Zone**	08V
LSD		**GPS**	0457296 E 7057955 N
Community	Mayo, YT	**Elevation (mas)**	560

Sample type		Disturbed		No Recovery		SPT		
Backfill type		Bentonite		Slough		Concrete	Filter sand	Drill cuttings

Depth from	Depth to	Soil Discription	MW05	Sample Type	Depth (m bgs)
+0.61	0	PVC Stick Up			
0	0.53	Organics			
0.53	1.15	SILT, trace sand, dry light brown 1.0 m top of bentonite			
1.15	6.10	SILT, sand, gravel, dry light brown 1.83 top of drill cuttings 5.791 m top of bentonite 6.0 m top of sand			
6.10	8.00	GRAVEL, cobble, dry brown 6.71 m top of screen 7.62 m drilling becomes harder			
7.62	8.00	SILT, clay, moist grey brown			
8.00	12.19	GRAVEL, silt, trace sand, dark brown 9.14 m becomes damp to wet 10.66 m becomes moist light brown 11.28 m bottom of well 11.28 m sloughed material			
		12.19 m End of Hole			

West 80 Environmental Consulting Ltd.

Project	Groundwater Monitoring Well Installations	**Project #**	W801500
		BH number	MW05a
Location	Al's Environmental Cleanup Inc. LTF	**Zone**	08V
LSD		**GPS**	0457298 E 7057954 N
Community	Mayo, YT	**Elevation (mas)**	560

Sample type		Disturbed		No Recovery		SPT		
Backfill type		Bentonite		Slough		Concrete		Filter sand		Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW05a	Sample Type	Depth (m bgs)
+0.67	0	PVC stick up			
0.00	0.46	Organics			
0.46	2.44	SILT, sand, trace clay and gravel, dry light brown 0.46 m top of bentonite 1.3 m top of drill cuttings			
2.44	3.00	GRAVEL sand, trace silt, dry light brown			
3.00	11.28	SILT, SAND, gravel, dry light brown			
11.28	12.90	GRAVEL, silt, sand, dry brown 12.5 m top of bentonite 12.5 m harder drilling 12.8 m top of sand			
12.90	14.00	GRAVEL, SAND, cobbles trace silt, dry 13.41 m top of screen			
14.00	17.98	GRAVEL, SAND, cobbles, moist grey brown 17.68 m harder drilling 17.98 m bottom of well			17.83
		End of hole at 17.98 m			

West 80 Environmental Consulting Ltd.

Project	Groundwater Monitoring Well Installations				**Project #**		W801500		
					BH number		BH06		
Location	Al's Environmental Cleanup Inc. LTF				**Zone**		08V		
LSD					**GPS**	-		-	
Community	Mayo, YT				**Elevation (mas)**		-		
Sample type		Disturbed		No Recovery		SPT			
Backfill type		Bentonite		Slough		Concrete		Filter sand	Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW06	Sample Type	Elevation
0.00	1.00	organics 1.0 m seal of bentonite and drill cuttings			
1.00	7.92	SAND, gravel, trace silt, dry light brown 1.3 to 1.7 m sample 2.44 m less gravel 3 m more gravel 6.2 to 6.5 m sample			
7.92		Refusal, cobbles or bedrock			
		End of hole at 7.92 m			

West 80 Environmental Consulting Ltd.

Project	Groundwater Monitoring Well Installations	**Project #**	W801500
		BH number	BH06a
Location	Al's Environmental Cleanup Inc. LTF	**Zone**	08V
LSD		**GPS**	- -
Community	Mayo, YT	**Elevation (mas)**	-

Sample type		Disturbed		No Recovery		SPT		
Backfill type		Bentonite		Slough		Concrete		Filter sand		Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW06a	Sample Type	Elevation
0	1	Organics 1.0 m seal of bentonite and drill cuttings			
1	3.657	SAND, GRAVEL, trace silt, cobbles, dry light brown			
3.657	3.962	SILT, trace sand, dry light brown			
3.962	16	SAND, GRAVEL, some silt, dry light brown			
16	16.76	SILT, sand, gravel, dry light brown			
		End of hole at 16.76 m			

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Project	Groundwater Monitoring Well Installations	**Project #**	W801500
		BH number	MW06
Location	Al's Environmental Cleanup Inc. LTF	**Zone**	08V
LSD		**GPS**	0457276 E 7058080 N
Community	Mayo, YT	**Elevation (mas)**	561

Sample type		Disturbed		No Recovery		SPT		
Backfill type		Bentonite		Slough		Concrete	Filter sand	Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW06b	Sample Type	Depth (m bgs)
0.88	0	PVC stick up			
0	0.85	Organics 0.85 m top of bentonite			
1	2	SILT, sand, dry light brown 1.8 m top of drill cuttings			
2	8	GRAVEL, SAND, trace silt, cobbles, dry light 7.62 m harder drilling			
8	13.11	GRAVEL, SILT, sand, cobbles, dry 11.3 m top of bentonite 12.0 m top of sand			
13.11	17.68	SAND Silt 13.11 m top of screen 13.71 m saturated			14.53
		End of hole at 17.68 m			

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Project	Groundwater Monitoring Well Installations				**Project #**		W801500		
					BH number		MW07		
Location	Al's Environmental Cleanup Inc. LTF				**Zone**		08V		
LSD					**GPS**	0457328 E		7057887 N	
Community	Mayo, YT				**Elevation (mas)**		557		
Sample type		Disturbed		No Recovery	SPT				
Backfill type		Bentonite		Slough	Concrete		Filter sand		Drill cuttings

Depth (m) from	Depth (m) to	Soil Discription	MW07	Sample Type	Depth (m bgs)
0.85	0.00	PVC stick up			
0.00	0.30	Organics			
0.30	11.58	SAND, gravel, silt, dry light brown 0.304 m top of bentonite 0.609 m top of drill cuttings			
11.58	18.00	SAND, gravel, trace silt, dry light brown 12.95 m top of bentonite 13.56 m top of sand 14.18 m top of screen 14.63-15.24 m more silt, damp to wet			16.40
18.00	18.75	GRAVEL, cobbles very slow drilling			
		End of hole at 18.75 m			

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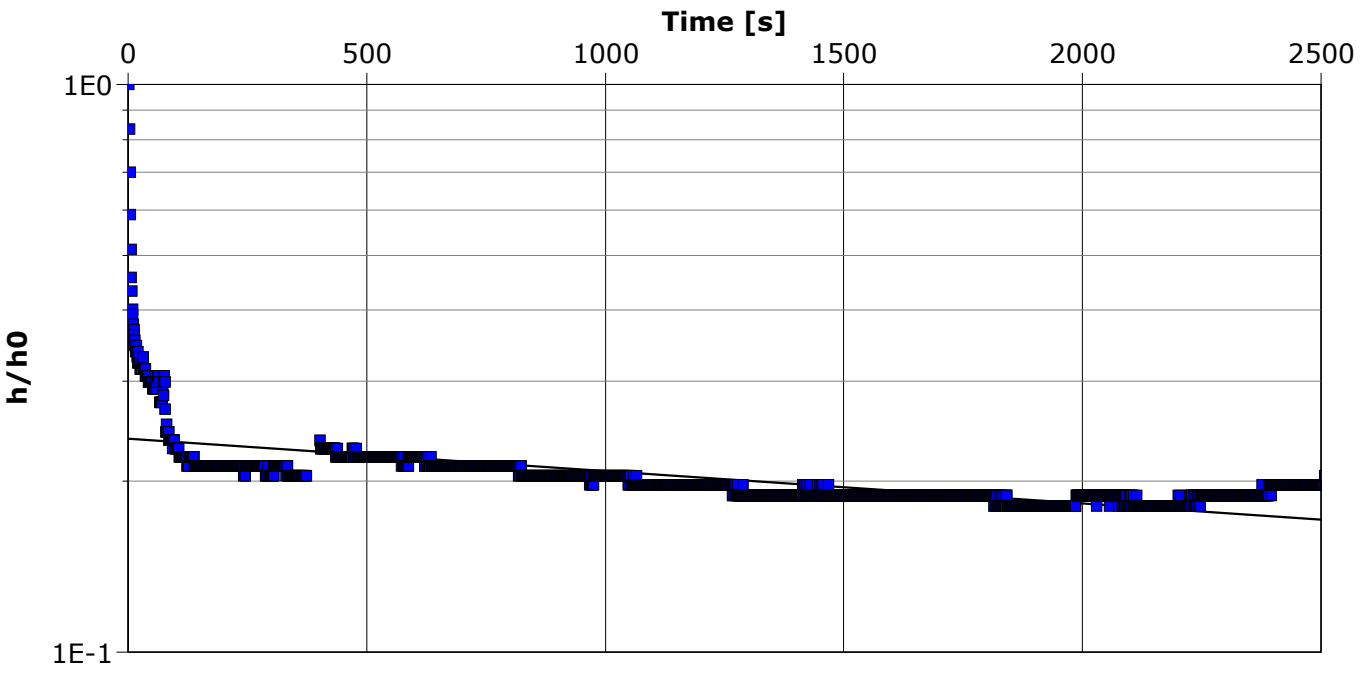
APPENDIX G
AQUIFER TEST REPORTS

Slug Test Analysis Report	
Project: Mayo LTF	
Number: 704-ENVSWM03460	
Client: Wilf's Contracting Ltd.	

Location: Mayo, YT	Slug Test: MW05a-Rising Head 1	Test Well: MW05a
Test Conducted by: Rob Dickson		Test Date: 6/16/2015
Analysis Performed by: AJS	MW05a-Rising Head	Analysis Date: 1/28/2016
Aquifer Thickness: 10.00 m		

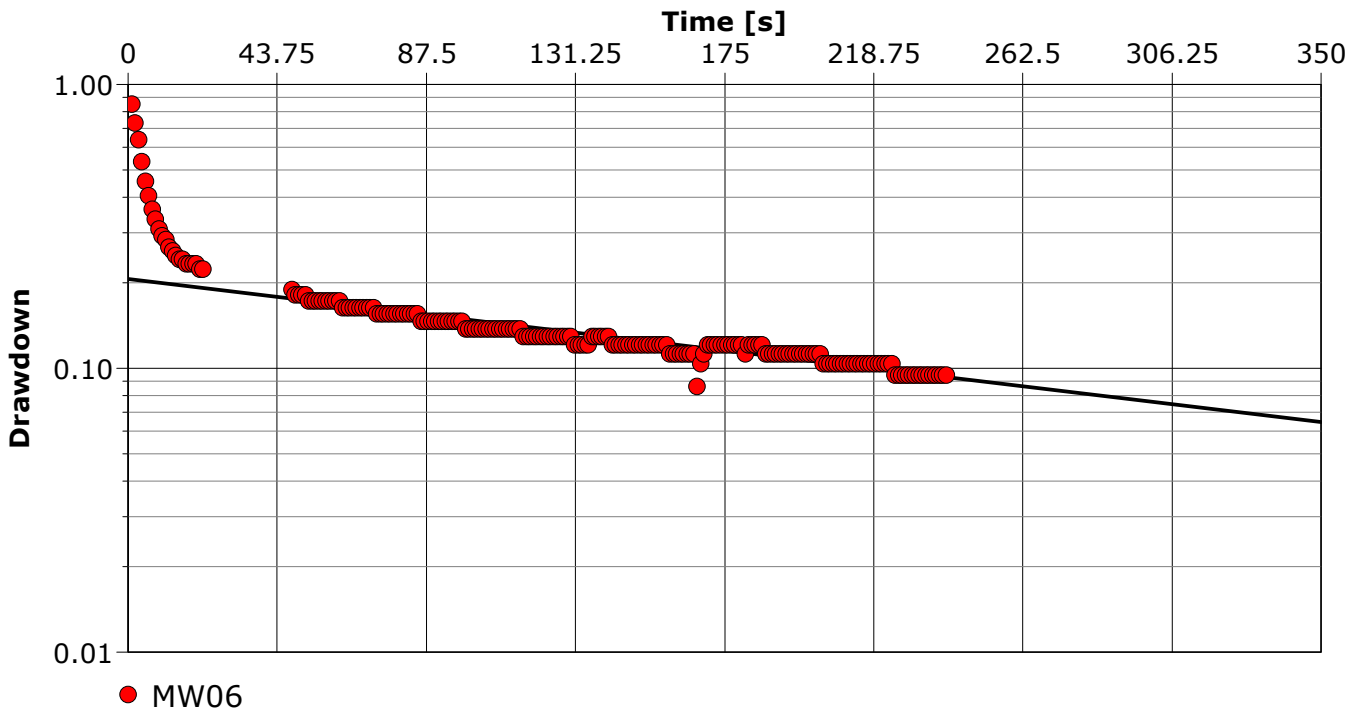


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW05a	3.54×10^{-8}	

	Slug Test Analysis Report
	Project: Mayo LTF
	Number: 704-ENVSWM03460
	Client: Wilf's Contracting Ltd.

Location: Mayo, YT	Slug Test: MW06-Rising Head 1	Test Well: MW06
Test Conducted by: Rob Dickson		Test Date: 6/16/2015
Analysis Performed by: AJS	MW06 Rising Head	Analysis Date: 1/28/2016
Aquifer Thickness: 10.00 m		

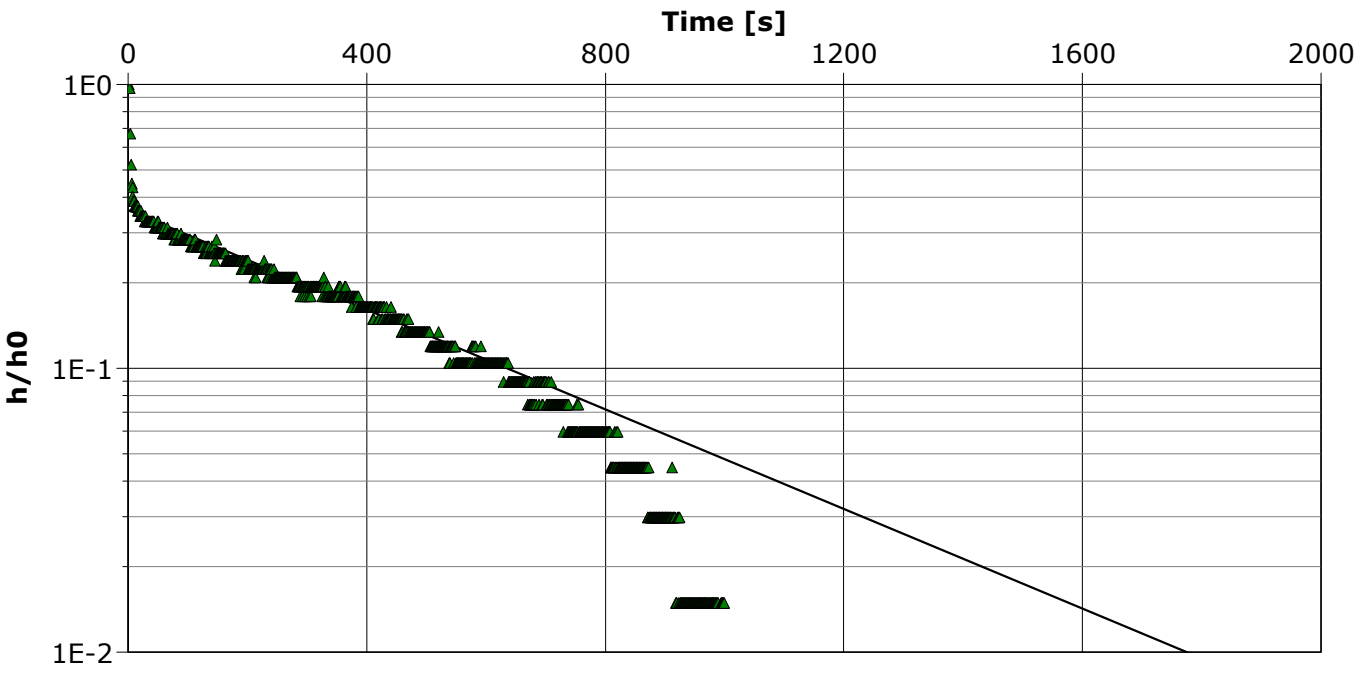


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW06	1.56×10^{-6}	

	Slug Test Analysis Report
	Project: Mayo LTF
	Number: 704-ENVSWM03460
	Client: Wilf's Contracting Ltd.

Location: Mayo, YT	Slug Test: MW07-Rising Head 1	Test Well: MW07
Test Conducted by: Rob Dickson		Test Date: 6/16/2015
Analysis Performed by: AJS	MW07 Rising Head 1	Analysis Date: 1/28/2016
Aquifer Thickness: 10.00 m		

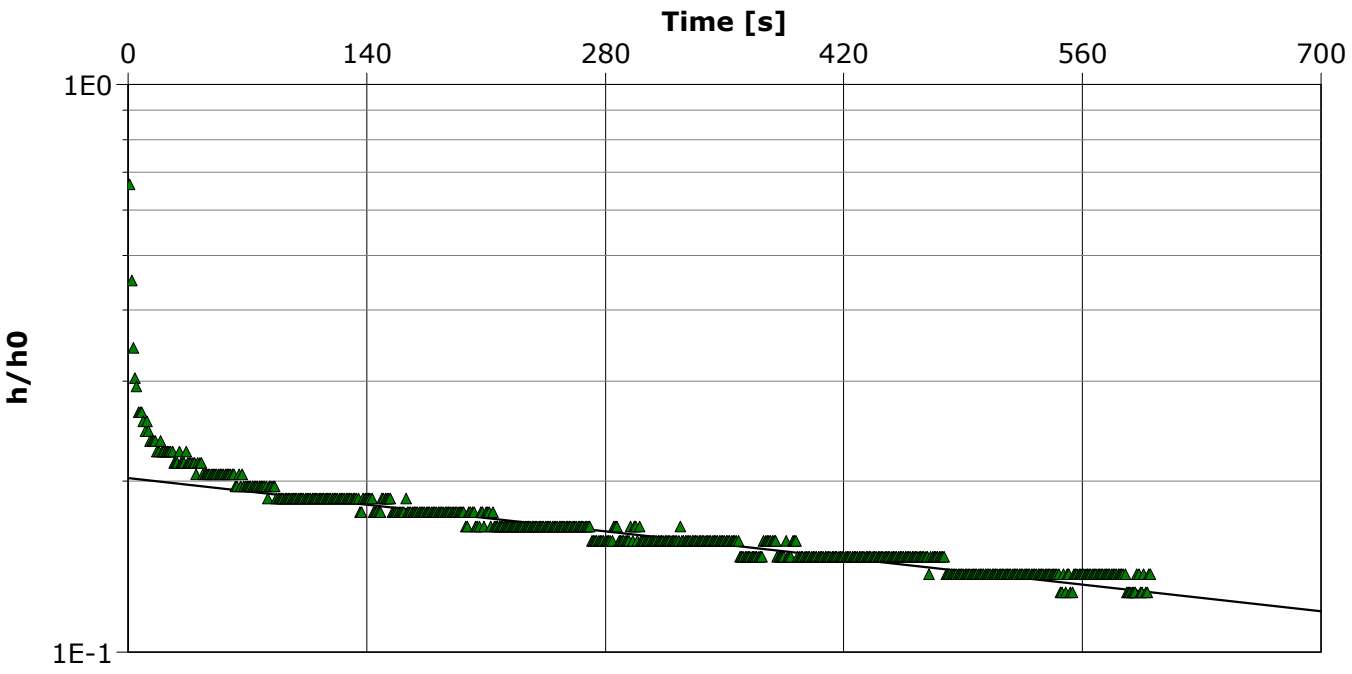


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW07	8.43×10^{-7}	

	Slug Test Analysis Report
	Project: Mayo LTF
	Number: 704-ENVSWM03460
	Client: Wilf's Contracting Ltd.

Location: Mayo, YT	Slug Test: MW07-Rising Head 2	Test Well: MW07
Test Conducted by: Rob Dickson		Test Date: 6/16/2015
Analysis Performed by: AJS	MW07 Rising Head 2	Analysis Date: 1/28/2016
Aquifer Thickness: 10.00 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
MW07	3.21×10^{-7}	