

VILLAGE OF BARONS

ADDITIONAL PHASE III ENVIRONMENTAL SITE ASSESSMENT 202 MAIN STREET LOT 1 AND LOT 2, BLOCK 7, PLAN 2605X BARONS, ALBERTA



REPORT

DECEMBER 2011
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EXECUTIVE SUMMARY

Foreword

Ms. Laurie Beck, Administrator for the Village of Barons, retained EBA Engineering Consultants Ltd., operating as EBA, A Tetra Tech Company (EBA), to conduct an additional Phase III environmental site assessment (ESA) at a property located at 202 Main Street (legally described as Lot 1 and Lot 2, Block 7, Plan 2605X), in Barons, Alberta.

EBA conducted the Phase II and initial Phase III ESAs in 2008 and 2009 and discussed the methods and results of the assessments in a report titled *"Phase II and Phase III Environmental Site Assessment, 202 Main Street, Lot 1 and Lot2, Block 7, Plan2605X, Barons, Alberta"*, issued in October 2009 (EBA 2009).

The Phase II and initial Phase III ESAs were initiated following a geotechnical evaluation for a roadway improvement and waterline upgrade project along Main Street from Railway Avenue to Prairie Avenue. The geotechnical investigation conducted by EBA in December 2007 (EBA File No. L22101182) identified petroleum hydrocarbons (PHCs) within soil and groundwater to the north of the site. The detection of the PHCs triggered a historical assessment of the site, which determined that prior to the current operations, the site operated as a gas service station (Tjostheim Transport Ltd.). According to the Petroleum Tank Management Association of Alberta (PTMAA), two underground storage tanks (USTs) were likely abandoned on site and that signs of leakage were noted during site closure. No remediation activities were reported following the closure of the service station.

The objectives of the additional Phase III ESA were:

- To further evaluate the extent of the PHC impacts to the east and south-southeast of the former pump islands.
- To assess subsurface distribution (potential source areas) and potential migrations of PHC compounds beneath the site.

The additional Phase III ESA was prepared in general accordance Canadian Standards Association (CSA) document "Z769-00 Phase II Environmental Site Assessment", updated in March 2000.

Findings and Conclusions

During the course of the 2009 and 2011 Phase II and Phase III ESAs, the following soil and groundwater conditions were identified:

- PHC impacts extended beyond the site boundary to the north and west.
- PHC impacts were encountered within soil samples collected at depths between 1.2 m below ground level (mbgl) and 4.8 mbgl during the 2009 assessment and between 2.4 mbgl and 4.8 mbgl during the 2011 assessment (towards the east and south-southeast of the former pump islands).
- During the 2009 and 2011 assessments, the bedrock appears to be restricting the vertical migration of the impacts because the PHCs were not identified below 4.8 mbgl in any of the well drilled on site.

- In 2011, the deep groundwater in the bedrock was observed to not be impacted by the hydrocarbons in the shallow groundwater.
- The shallow impacted saturated soils and bedrock may yield sufficient water for domestic use; therefore, the protection of drinking water pathway guidelines for benzene, toluene, ethylbenzene, and xylene (BTEX) and the protection of direct soil contact by ecological organisms pathway (most stringent pathway) for F1 to F4 are considered to be the applicable guidelines for the soil and groundwater remediation.
- Distribution of PHC compounds near the monitoring locations 08MW02, 09 BH17, and 09BH20 suggest that these are potential source areas.
- Insufficient data exists to determine the dominant migration process (advective or dispersive). The uneven recharge rate through infiltration on paved and unpaved areas and the disturbed groundwater flow regime due to presence of utility corridor along the main street (up-gradient of the site) may have caused seasonally changed groundwater flow direction resulting in an uneven dispersion of the plume.

Based on foregoing analysis, it is recommended to remediate the potential source areas on site and a risk management plan should be developed to assess and manage risks due to residual PHC concentrations in the soil and groundwater.

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1.0 INTRODUCTION

1.1 General

Ms. Laurie Beck, Administrator for the Village of Barons, retained EBA Engineering Consultants Ltd., operating as EBA, A Tetra Tech Company (EBA), to conduct an additional Phase III environmental site assessment (ESA) at a property located at 202 Main Street (legally described as Lot 1 and Lot 2, Block 7, Plan 2605X), in Barons, Alberta (Figure 1).

EBA conducted Phase II and initial Phase III ESAs in 2008 and 2009 and discussed the methods and results of the assessments in a report titled *"Phase II and Phase III Environmental Site Assessment, 202 Main Street, Lot 1 and Lot 2, Block 7, Plan 2605X, Barons, Alberta"*, issued in October 2009 (EBA 2009).

The Phase II and initial Phase III ESAs were initiated following a geotechnical evaluation for a roadway improvement and waterline upgrade project along Main Street between Railway Avenue and Prairie Avenue. The geotechnical investigation conducted by EBA in December 2007 (EBA File No. L22101182) identified petroleum hydrocarbons (PHCs) within soil and groundwater to the north of the site. The detection of PHCs triggered a historical assessment of the site, which determined that prior to the current operations, the site operated as a gas service station (Tjostheim Transport Ltd.). According to the Petroleum Tank Management Association of Alberta (PTMAA), two underground storage tanks (USTs) were likely abandoned on site and that signs of leakage were noted during site closure. No remediation activities were reported following the closure of the service station.

The objectives of the additional Phase III ESA were:

- To further evaluate the extent of the PHC impacts to the east and south-southeast of the former pump islands.
- To assess subsurface distribution (potential source areas) and potential migrations of PHC compounds beneath the site.

The additional Phase III ESA was prepared in general accordance Canadian Standards Association (CSA) document "Z769-00 Phase II Environmental Site Assessment", updated in March 2000.

1.2 Scope of Work

In accordance with our additional Phase III ESA proposal dated July 7, 2010, EBA conducted the following tasks:

- Coordinated utilities locates (above-ground and underground) within 30 m of all proposed subsurface exploration areas.
- Monitored drilling activities at the proposed three borehole locations towards the east and southeast of the former pump island.
- Measured organic vapour emissions (OVE) from bulk soil samples using a Gastech RKI Eagle™ set in methane elimination mode.

- Collected bulk soil samples at regular intervals (i.e., 0.75 m), stratigraphic variations, or where staining is encountered. EBA visually classified and recorded the soil profile during the drilling program using the Unified Soil Classification System (USCS).
- Collected Shelby tubes from three boreholes. These samples were submitted for soil permeability, porosity, bulk density, and water content.
- Monitored the installation of groundwater monitoring wells within select boreholes.
- Submitted selected soil samples for chemical analysis consisting of benzene, toluene, ethylbenzene, xylenes (BTEX), PHC fractions F1 to F4, and particle size analysis.
- Conducted a relative elevation survey of all monitoring wells and tied with the elevations of existing monitoring wells.
- Monitored OVEs and groundwater levels/free-product thickness within each of the three monitoring wells.
- Collected and submitted groundwater samples from all monitoring wells to Maxxam Analytics Ltd. (Maxxam) for chemical analysis of BTEX and PHC fractions F1 to F2.
- Compared laboratory results with the selected guidelines and identified area(s) where soil and/or groundwater exceed their respective guidelines.
- Analyzed data to assess subsurface distribution (potential source areas) and potential migrations of PHC compounds beneath the site.
- Prepared this comprehensive report that documents the procedures followed and includes available historical information, guideline selection and rationale, data analysis and interpretation, as well as recommendations to address contamination issues at the site.

I.3 Qualifications of Assessors

Mr. Jamie LaMontagne oversaw all fieldwork on site. Mr. LaMontagne is an environmental technologist with EBA's Lethbridge environment practice and has more than eight years of experience in the environmental industry.

Mr. Aziz Shaikh M.Sc., P.Eng., interpreted the data and results and wrote this report. Mr. Shaikh is a hydrogeological engineer with EBA's Calgary office and has more than 14 years of civil and environmental engineering experience.

Ms. Mandi Parker, P.Ag., conducted the preliminary review of the report and assisted in the interpretation of the results. Ms. Parker is an environmental scientist for EBA's Lethbridge environment practice and has more than ten years of experience in the environmental industry.

Mr. Tom Dance, M.Sc., P.Geol., conducted the final review of the report. Mr. Dance is a principal consultant in EBA's environment practice in Calgary and has more than 31 years of experience in the environmental industry.

2.0 BACKGROUND INFORMATION

2.1 Site Description

The site is a rectangular-shaped property, approximately 12,700 m² in area, located on the southeast quarter of Section 16, Township 012, Range 23, West of the Forth Meridian at 202 Main Street, Barons, Alberta. The site consists of a rectangular-shaped building, approximately 6,300 m² in area, and is owned by the Village of Barons. The buildings foundation is slab-on-grade. Historically, the site operated as a gas service station (Tjostheim Transport Ltd.). The former tank-nest area is suspected to have been located north of the building. The site is currently utilized as the Village of Barons maintenance building and also serves as a car wash.

A site plan is provided on Figure 2.

2.2 Land Use

According to the Village of Barons, the site is zoned Direct Control (DC). Surrounding land use within 30 m or less of the site is comprised of Residential (R1), Commercial (C1), and DC.

2.3 Geology

The surficial geology in the Barons area is characterized as glaciolacustrine material with clay, silt, and sand forming the dominant geologic deposits (Shetson 1981). Bedrock in the Barons area consists of strata from the St. Mary River Formation of the late Cretaceous age and is comprised of sandstone and shale.

2.4 Surface Water

There are several ephemeral wetlands located near the Village of Barons municipal boundaries; however, all identified wetlands are greater than 300 m from the site. Two water reservoirs are also located approximately 420 m southwest of the site; however, the reservoirs are no longer being used and according to Ms. Beck, will be reclaimed in the near future. The nearest surface waterbody of significance is Keho Lake, located approximately 5.25 km southeast of the site.

2.5 Groundwater

Based on hydrogeological maps for the area, it is anticipated that shallow and regional groundwater flow would generally be southeast towards Keho Lake (Tokarsky 1974).

According to provincial water well records [Alberta Environment and Water (AEW) 2008], there are three registered water wells located within approximately 300 m of the site. The information gathered for registered water wells within 300 m of the site has been tabulated below.

Water Wells Within 300 m of the Site

Well ID No.	Location	Approximate Distance and Direction from the Site	Approximate Depth	Year Installed	Owner
0194222	SE ¼ 16-012-23 W4M	75 m northeast	29 m	1958	Unknown
0194216	SE ¼ 16-012-23 W4M	300 m south	29 m	1971	AEW No. 0613E
2058577	SE ¼ 16-012-23 W4M	Not verified	20 m	1971	AEW No. 0611E

According to Ms. Beck, the Village of Barons began importing its potable water from the Village of Nobleford in April 2008. Potable water is piped to the Village of Barons from Nobleford's water treatment plant.

Water well locations are illustrated on Figure 3, and a summary of reported water wells near the site is provided in Appendix A.

3.0 2011 FIELD ASSESSMENT METHODOLOGY

3.1 Utility Location Information

Prior to drilling, Alberta One-Call and Shaw Cable were notified to locate public utilities on the property. In addition, a private utility locator (Alberta Line Find) was contracted by EBA to locate private underground utilities and verify underground utilities marked by representatives contacted by the Alberta One-Call system.

3.2 Borehole Drilling and Soil Sampling

EBA contracted Chilako Drilling Services Ltd. of Coaldale, Alberta to conduct the drilling using a truck-mounted drill rig equipped with 150 mm diameter solid-stem augers. Three boreholes (11MW01, 11MW02, and 11MW03) were advanced on site on March 14, 2011, and March 15, 2011. The boreholes were advanced to the east and southeast of the former pump islands and completed as monitoring wells. The depth assessed ranged between 9.8 meters below ground level (mbgl) at 11MW03 and 10.4 mbgl at 11MW01. Soil stratigraphy was logged in the field using the USCS and observations of staining and/or odours were recorded.

Groundwater monitoring wells were completed using 50 mm diameter polyvinyl chloride (PVC) standpipes. Silica sand was placed from the base of the borehole to approximately 0.3 m above the slotted interval of the standpipe within the borehole annulus. To reduce the possibility of inflow of surface water into the standpipe, the annulus of the monitoring wells above the slotted section was sealed with bentonite chips to approximately 0.2 mbgl and secured with a flush-mounted road box founded in concrete.

Borehole logs, including field screening results and a key to the USCS are presented in Appendix B. A site plan (Figure 2) shows the approximate locations of newly installed and existing borehole/monitoring well locations.

Soil samples were taken at regular depth intervals (0.75 m) and where changes in soil types were observed. Bagged soil samples were screened for OVEs using a GasTech TankTechtor™ 1238 ME (GasTech™) set in methane elimination mode.

Field vapour readings are not intended to provide a quantitative measurement of the level of hydrocarbon contamination in soil samples. The readings assist in the selection of samples for chemical analysis.

Based on OVE results, observations made during drilling, and the observed groundwater interface, samples were selected for laboratory analysis. Soil samples were placed in laboratory-supplied 250 mL glass jars with Teflon™-lined lids, kept cool in coolers, and transported to Maxxam under the chain-of-custody (COC) for laboratory chemical analyzes of BTEX, PHC fractions F1 to F4, and PSA. Soil analytical results are summarized in Table 1 and are discussed in Section 5.1.

The analytical methodologies are referenced with Maxxam's laboratory reports in Appendix C. The reader is directed to these references for further details on specific analytical methods.

During drilling, Shelby tube samples were collected from all three boreholes at the following depth intervals;

- 11MW01: 5.5 mbgl to 5.9 mbgl
- 11MW02: 6.7 mbgl to 7.0 mbgl
- 11MW03: 8.2 mbgl to 8.5 mbgl

These samples were submitted to EBA's geotechnical laboratory in Calgary for the analysis of soil permeability, porosity, bulk density, and water content. The laboratory results of the core samples are also provided in Appendix C.

3.3 Groundwater Monitoring, Sampling, and Analytical Testing

On March 31, 2011, all of the groundwater monitoring wells on site were monitored for OVEs using a GasTech™ operated in methane elimination mode. Liquid levels in the monitoring wells were also measured at that time using a Heron™ interface probe.

Subsequently, the newly installed groundwater monitoring wells (11MW01 to 11MW03) were purged of approximately three well volumes of standing water and allowed to recover to approximately 80% of the static level prior to sample collection. Groundwater samples were then collected using dedicated disposable bailers and were stored in laboratory-supplied bottles. Samples were preserved according to laboratory instructions and transported in coolers to Maxxam under COC for analysis of BTEX and PHC fractions F1 to F2. Groundwater monitoring and sampling was conducted in accordance with EBA work methods (WM4203) to ensure sample quality was maintained.

The analytical program was developed following a review of historical land use, which identified the potential presence of PHCs and lead as contaminants of potential concern. Analytical methodologies are referenced with Maxxam's laboratory reports in Appendix C. Monitoring well completion details and field monitoring results are summarized in Table 2. Groundwater analytical results are summarized in Table 3 and are discussed in Section 5.2.

During the March 31, 2011, site visit the newly installed monitoring wells were surveyed to tie in with the exiting monitoring well network.

3.4 Materials Management

Drill cuttings were placed within a soil bag identified as containing potentially hazardous materials. Water purged from the monitoring wells was stored within 205 L drums. Both soil bags and the 205 L drums were left on site for the disposal to a disposal facility.

4.0 2011 FIELD ASSESSMENT RESULTS

Section 4.1 to Section 4.4 discuss the soil materials encountered, groundwater and soil conditions, applicable soil and groundwater remediation guidelines, and soil and groundwater analytical results.

4.1 Soil Materials

During previous drilling investigations, the soil materials generally consisted of asphalt and/or clay fill from surface grade to approximately 0.7 mbgl, clay (lacustrine) with intermittent silt/sand lenses from 0.7 mbgl to 4.0 mbgl, and weathered sandstone (bedrock) from 4.0 mbgl to the maximum depth of investigation of 15.2 mbgl (EBA 2009).

During the 2011 drilling investigations at 11MW01 to 11MW03, the stratigraphy observed generally consisted of clay fill from surface grade to approximately 0.5 mbgl, clay (lacustrine) with intermittent silt/sand lenses between 0.5 mbgl and 3.8 mbgl, and weathered bedrock (sandstone, siltstone, and mudstone) between 3.8 mbgl and the maximum depth of investigation of 10.4 mbgl. The laboratory results of the core samples (Appendix C) collected from the bedrock describe soils as clay, silty, sandy (11MW01 and 11MW02), and shale, clayey, trace muscovite accessories (11MW03).

In 2009, with the exception of the sample collected from 08MW01 (4.8 mbgl), which was coarse-grained, soil samples submitted for PSA were determined to be fine-grained material (EBA 2009). In 2011, the samples collected from 11MW01 and 11MW03 were determined to be coarse-grained and samples collected from 11MW02 as fine-grained.

4.2 Groundwater and Soil Conditions

On March 14, 2011, and March 15, 2011, EBA measured the OVE concentrations and groundwater levels within all accessible monitoring locations. Monitoring wells 08MW06, 08MW07, and 09MW13 were not accessible during the site visit as the flush-mount monitoring wells were under the standing water.

OVE concentrations ranged between 10 parts per million (ppm) (09MW10) and 950 ppm (08MW08). Groundwater was encountered at depths ranging between 1.7 mbgl (08MW01) to 2.3 mbgl (08MW02 and 09MW10). During the March 2009 monitoring event, approximately 8.5 cm of free product was noted within 08MW06 (EBA 2009), whereas this well was not accessible during the 2011 monitoring event. No free product was observed at any of the accessible wells. A representative shallow groundwater flow direction cannot be established due to the presence of standing water at a few monitoring locations. Insufficient data was available from the monitoring wells screened in the shallow zone to develop a groundwater flow pattern. The groundwater elevations available were widespread and do not follow any

noticeable pattern. For this reason, the shallow groundwater elevation contours was not established. However, the previous groundwater monitoring results showed that the groundwater table is relatively flat with a slight hydraulic gradient to the south southwest (EBA 2009).

Based on the measured groundwater elevations at the newly installed deep monitoring wells (11MW01 to 11MW03), the groundwater flow direction in the bedrock is towards south-southeast.

The hydraulic parameters of the core samples analyzed (Appendix C) are summarized in the following table.

Hydraulic Parameters of the Core Samples Analyzed

Borehole Location	Depth Interval (mbgl)	Vertical hydraulic Conductivity (cm/sec)	Porosity	Dry Density (kg/m ³)	Moisture Content (%)	
					Initial	Final
11MW01	5.5 to 5.9	8.2×10^{-9}	20	2,110	11.4	13.3
11MW02	6.7 to 7.0	2.7×10^{-8}	20	2,018	12.1	12.5
11MW03	8.2 to 8.5	9.5×10^{-9}	22	2,041	10.6	12.6

4.3 Applicable Remedial Guidelines for the Site

To assist in assessing the quality of the soil and groundwater analyzed during the environmental assessment at the site, AEW's Tier 1 and Tier 2 Remediation Guidelines were applied. To apply these guidelines, the background information summarized in Section 2.0 was used to assess the land use and sensitivity of the site.

The site is located within an area of commercial buildings and residential dwellings. Therefore, the most sensitive land use within 30 m of the site is residential.

Drilling at the site demonstrated that the underling soils are predominantly fine-grained.

The chemicals of potential concern associated with gasoline include the monocyclic aromatic hydrocarbons (BTEX) and the aliphatic hydrocarbons F1 (C₆ to C₁₀ hydrocarbon chain), F2 (C₁₁ to C₁₆ hydrocarbon chain), F3 (C₁₇ to C₂₄ hydrocarbon chain), and F4 (longer than C₂₅ hydrocarbon chains).

Under the residential land use scenario for fine-grained soils, the Tier 1 Guidelines for aromatic hydrocarbons include the exposure pathway for the protection of drinking water. However, for the F1 to F4 hydrocarbons, the Tier 1 criteria is based on the protection of ecological receptors and that is the pathway for direct soil contact by ecological organisms.

Within the guidelines, allowance can be made for exclusion of some pathways if site conditions permit.

During the 2009 site investigations, testing of the shallow groundwater yielded a hydraulic conductivity value of 5×10^{-6} m/s, with a saturated soil thickness greater than 2.5 m (EBA 2010). These values were obtained from the wells completed within the impacted zones in the surficial till material and upper impacted bedrock material. The estimated hydraulic conductivity values are at the margin of the values identified by AEW as being representative of the domestic use aquifer. The conditions suggest that the shallow impacted saturated soils may yield sufficient water for domestic use.

An average vertical hydraulic conductivity of the core samples collected from bedrock is 1.5×10^{-10} m/sec. The laboratory estimated values represents the vertical component of the hydraulic conductivity, which is one or two order of magnitude less than the horizontal hydraulic conductivity.

Considering that the shallow impacted saturated soils and bedrock may yield sufficient water for domestic use and keeping with the conservation nature of the Tier 1 Guidelines, we have applied the protection of drinking water pathway guidelines for BTEX and the protection of direct soil contact by ecological organisms pathway (most stringent pathway) for F1 to F4.

Table 1 and Table 3 provide applicable guideline values for soil and groundwater remediation, respectively, and used for the comparisons of the soil and groundwater quality in Sections 4.4 and 4.5.

4.4 Soil and Groundwater Analytical Results

Historical and 2011 soil and groundwater quality results are summarized in Table 1 and Table 3, respectively. Soil and groundwater parameters exceeding the applicable guidelines are shown on Figure 4 and Figure 5, respectively.

The historical soil and groundwater analytical results are discussed in EBA's 2009 report (EBA 2009). This section discusses the 2011 soil and groundwater quality results.

Indications of PHC staining and/or odours were noted during the drilling investigation at all three borehole location; however, the vertical extent of the PHC indicators varied between borehole locations (Appendix B).

Three samples from each borehole were submitted for chemical analysis. Ethylbenzene and xylenes at 2.4 m depth (11MW01) and hydrocarbon fraction F3 at 4.8 m depth (11MW03) were greater than the applicable guidelines (Table 1). All of the remaining samples had hydrocarbon parameter concentrations less than the applicable guidelines.

The bedrock appears to be restricting the vertical migration of the impacts as PHCs were not identified below 4.8 mbgl in any of the well drilled in 2011.

Three groundwater samples, plus one duplicate from Monitoring Well 11MW03 were submitted for chemical analysis of BTEX, F1 and F2, and all the samples analyzed had hydrocarbon parameter concentrations less than the analytical detection limits (Table 3).

5.0 ASSESSMENT OF SUBSURFACE DISTRIBUTION (POTENTIAL SOURCE AREAS) AND POTENTIAL MIGRATIONS OF PHC COMPOUNDS BENEATH THE SITE

The relative compositions of the BTEX and F1 and F2 fractions in the groundwater and soil (above and below the water table) are illustrated on Figures 6, 7, and 8, respectively. The relative compositions are shown as rose diagrams on these figures. Figure 9 and 10 show benzene concentration contours in the soil and groundwater, respectively.

These diagrams were plotted to assess potential source areas and the potential migration of PHC compounds.

The data collected during the 2009 Phase II ESA and initial Phase III ESA and the 2011 additional Phase III ESA were used to plot these diagrams. The available information forms the adjacent sites, i.e., hardware store and Turbo bulk station sites were also incorporated in diagrams. These sites are located in the northeast of the site. Based on the shallow groundwater flow direction from both sites being towards southwest, the site is located down-gradient of the hardware store and Turbo bulk station sites. At the site, the shallow groundwater table is considered to be relatively flat with a slight hydraulic gradient to the south. The groundwater flow direction in the bedrock wells (11MW01 to 11MW03) was interpreted to be towards the south-southeast in 2011.

EBA compared distribution of the hydrocarbons based upon the shapes of the rose diagram. We have assumed two facts:

- The primary source area will have the same product composition because limited dilution processes will have caused fractionation of the chemicals of concern (BTEX, F1 and F2).
- The secondary source area, or halo, is where advective and dispersive transport mechanisms act to disperse the product released in the primary source area. Various dilution factors, as calculated by Canadian Council of Ministers of Environment's (CCME) Canada Wide Standards for PHC in Soil (CCME 2008), will act to fractionate the concentrations of these parameters at different rates over time. These factors are compound specific, and result in unique compositions of each of the compounds illustrated in the rose diagrams.

Hence, we look for areas where the rose diagrams have the same or different composition to ascertain whether the compounds are in the source areas (primary or secondary source areas).

Noticing that the shapes of the rose diagrams of 08MW02, 09BH17, and 09BH20 in soil have similar shapes (Figures 7 and 8); therefore, we infer that these areas are either in the primary source only or in the secondary source area only.

Given that the shapes of the rose diagrams are similar in soil samples collected from both above and below the water table suggests one of two mechanisms:

- Either these compounds are still in the primary source area and dilution factors have not yet fractionated the compounds leaching into the groundwater; or
- These compounds are in the secondary source area where groundwater has transported the compounds away from the source area.

Additional assessment, such as comparing a seasonal hydrograph with the depths of the chemicals of concern in the soil will help to assess whether these compounds are in the primary or secondary source area.

Given the understanding that the benzene is more mobile in the dissolved phase than the F1 and F2 parameters, we seek to establish areas where benzene is more prevalent than the F1 and F2 compounds. The transportation of benzene from the F1 and F2 compounds will, therefore, suggest a separation of the compounds, which in turn indicate that transport of the chemicals of concern has occurred. Typically, one would expect that this process would dominate towards down-gradient direction when advective transport dominates. If dispersive transport mechanisms dominate in the dissolved phase, then a relatively radial

pattern would be observed. Unfortunately, insufficient data exists to allow EBA to make this comparison. Further, an uneven recharge rate through infiltration on paved and unpaved areas and the disturbed groundwater flow regime due to presence of utility corridor along the main street (up-gradient of the site) may have caused the radial pattern and/or seasonally changed groundwater flow direction resulting in uneven dispersion of the plume.

The site is located down-gradient of the hardware store and Turbo bulk station site. The potential migration from these areas to the site has not been assessed; however, measures need to be taken to prevent any potential migration from those sites.

Once the source areas near the vicinity of 08MW02, 09BH17, and 09BH20 are removed and the potential migration from the up-gradient site is controlled, a risk management plan (RMP) needs to be developed by establishing a local flow regime and potential risks to nearby receptors.

6.0 CONCLUSIONS AND RECOMMENDATIONS

During the course of the 2009 and 2011 Phase II and Phase III ESAs, the following soil and groundwater conditions were identified:

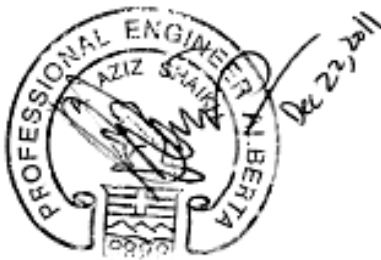
- PHC impacts extended beyond the site boundary to the north and west.
- PHC impacts were encountered within soil samples collected at depths between 1.2 mbgl and 4.8 mbgl during the 2009 assessment and between 2.4 mbgl and 4.8 mbgl during the 2011 assessment (towards the east and south-southeast of the former pump islands).
- During the 2009 and 2011 assessments, the bedrock appears to be restricting the vertical migration of the impacts because PHCs were not identified below 4.8 mbgl in any of the wells drilled on site.
- In 2011, the deep groundwater in the bedrock was observed to be not impacted by the hydrocarbons in the shallow groundwater.
- The shallow impacted saturated soils and bedrock may yield sufficient water for domestic use; therefore, the protection of drinking water pathway guidelines for BTEX and the protection of direct soil contact by ecological organisms pathway (most stringent pathway) for F1 to F4 are considered to be the applicable guidelines for the soil and groundwater remediation.
- Distribution of PHC compounds near the monitoring locations 08MW02, 09BH17, and 09BH20 suggest that these are potential source areas.
- Insufficient data exists to determine the dominant migration process (advective or dispersive). The uneven recharge rate through infiltration on paved and unpaved areas and the disturbed groundwater flow regime due to the presence of utility corridors along the main street (up-gradient of the site) may have caused seasonally changed groundwater flow direction resulting in an uneven dispersion of the plume.

Based on foregoing analysis, it is recommended to remediate the potential source areas on site and a RMP should be developed to assess and manage risks due to residual PHC concentrations in soil and groundwater.

7.0 CLOSURE

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

Respectfully submitted,
EBA Engineering Consultants Ltd.



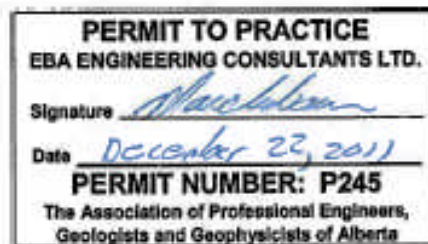
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/lef

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TABLES

Table 1	Soil Analytical Results
Table 2	Monitoring Well Construction Details and Field Monitoring Results
Table 3	Groundwater Analytical Results

Table 1: Soil Analytical Results – AMA Site 9557

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	17-Nov-08																				
						08MW01			08MW02			08BH03			08BH04			08BH05			08MW06			08MW07		
			< 3.0 mbgl	> 3.0 mbgl		1.5 m	4.2 m	4.8 m	1.6 m	2.2 m	4.2 m	1.2 m	1.8 m*	4.8 m	1.9 m	3.0 m	5.4 m	1.8 m	2.4 m	4.8 m	1.6 m	2.4 m	5.4 m	3.0 m	4.2 m	6.0 m
Petroleum Hydrocarbons																										
Benzene	0.02	mg/kg	0.046	0.046	120	nd	6.3	nd	nd	3.2	nd	0.15	54	nd	nd	19	nd	nd	1.1	nd	nd	2	nd	nd	nd	nd
Toluene	0.01	mg/kg	0.52	0.52	220	nd	nd	nd	nd	nd	nd	0.11	6.4	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	nd	13	0.092	nd	41	nd	0.21	310	nd	nd	36	nd	nd	6.3	nd	nd	21	nd	nd	nd	nd
Xylenes	0.04	mg/kg	15	15	130	nd	16	0.16	nd	50	nd	1	1,500	nd	0.24	50	nd	nd	8	nd	nd	31	nd	nd	nd	nd
F1 (C6 to C10)	12	mg/kg	210	1,100	420	nd	710	nd	nd	1,000	nd	nd	5,300	nd	nd	1,300	nd	nd	140	nd	nd	280	nd	nd	nd	nd
F2 (C10 to C16)	10	mg/kg	150	1,500	300	nd	4,700	250	nd	310	23	nd	3,500	nd	nd	4,200	nd	nd	2,000	nd	nd	1,300	nd	nd	nd	nd
F3 (C16 to C34)	10	mg/kg	ng	ng	2,600	nd	2,100	140	nd	nd	21	360	9,400	nd	nd	1,700	nd	nd	1,000	nd	nd	510	nd	nd	nd	nd
F4 (C34 to C50)	10	mg/kg	ng	ng	11,200	nd	23	nd	nd	nd	nd	100	1,500	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Metals																										
Lead (Pb)	1	mg/kg	ng	ng	300	9	8	6	8	13	5	46	67	7	21	17	7	6	16	9	9	14	8	9	9	8
Physical Properties																										
Soil Moisture Content	0.3	%	ng	ng	ng	22	14	5.3	20	26	6.1	16	24	14	20	20	19	17	23	12	24	23	11	24	14	10
<75 um Sieve	0.2	%	ng	ng	ng	94	nt	49	nt	nt	nt	nt	nt	nt	nt	73	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
>75 um Sieve	0.2	%	ng	ng	ng	6	nt	51	nt	nt	nt	nt	nt	nt	nt	27	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt
CCME Class	0.2		ng	ng	ng	FINE	nt	COARSE	nt	nt	nt	nt	nt	nt	nt	FINE	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	12-Mar-09											
						09BH09		09BH11	09BH12		09MW13	09BH17		09MW19		09BH20	
			< 3.0 mbgl	> 3.0 mbgl		5.4 m	6.0 m	4.2 m	2.4 m	3.0 m	4.8 m	3.0 m	4.2 m	4.8 m	5.4 m	3.0 m	3.6 m
Petroleum Hydrocarbons																	
Benzene	0.02	mg/kg	0.046	0.046	120	nd	nd	0.023	0.016	1.5	0.054	0.97	0.036	0.02	0.018	9.7	0.53
Toluene	0.01	mg/kg	0.52	0.52	220	nd	nd	nd	nd	<0.020	nd	nd	nd	nd	nd	0.06	0.1
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	d	d	0.028	d	12	0.057	19	0.051	nd	nd	21	0.2
Xylenes	0.04	mg/kg	15	15	130	nd	nd	0.11	nd	18	0.069	29	0.066	nd	nd	36	0.7
F1 (C ₆ to C ₁₀)	12	mg/kg	210	1,100	420	nd	nd	nd	nd	410	nd	580	nd	nd	nd	430	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	150	1,500	300	13	11	nd	nd	180	69	1,400	nd	nd	nd	660	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	2,600	nd	nd	nd	d	24	nd	520	nd	nd	nd	230	nd
F4 (C ₃₄ to C ₅₀)	10	mg/kg	ng	ng	11,200	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Metals																	
Lead (Pb)	1	mg/kg	ng	ng	300	10	8	7	9	13	4	13	7	8	8	12	7
Physical Properties																	
Soil Moisture Content	0.3	%	ng	ng	ng	18	19	14	18	23	17	21	15	18	17	19	13
<75 um Sieve	0.2	%	ng	ng	ng	nt	51	nt	89	nt	71	90	nt	nt	52	nt	nt
>75 um Sieve	0.2	%	ng	ng	ng	nt	49	nt	11	nt	29	10	nt	nt	48	nt	nt
CCME Class	0.2		ng	ng	ng	nt	FINE	nt	FINE	nt	FINE	FINE	nt	nt	FINE	nt	nt

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	15-Mar-11								
						11MW01			11MW02			11MW03		
			< 3.0 mbgl	> 3.0 mbgl		1.8 m	2.4 m	4.2 m	1.6 m	2.2 m	6.0 m	3.6 m	4.8 m	5.4 m
Petroleum Hydrocarbons														
Benzene	0.02	mg/kg	0.046	0.046	120	nd	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	0.01	mg/kg	0.52	0.52	220	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	0.059	5.5	0.062	nd	nd	nd	nd	nd	nd
Xylenes	0.04	mg/kg	15	15	130	0.14	16	nd	nd	nd	nd	nd	nd	nd
F1 (C ₆ to C ₁₀)	12	mg/kg	210	1,100	420	nd	150	nd	nd	nd	nd	nd	260	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	150	1,500	300	nd	21	nd	nd	nd	230	nd	1,700	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	2,600	nd	nd	nd	nd	nd	110	nd	800	nd
F4 (C ₃₄ to C ₅₀)	10	mg/kg	ng	ng	11,200	nd	nd	nd	nd	nd	nd	nd	nd	nd
Physical Properties														
Soil Moisture Content	0.3	%	ng	ng	ng	22	13	15	15	16	10	13	15	12
<75 um Sieve	0.2	%	ng	ng	ng	nt	nt	48	nt	nt	60	nt	nt	41
>75 um Sieve	0.2	%	ng	ng	ng	nt	nt	52	nt	nt	40	nt	nt	59
CCME Class	0.2		ng	ng	ng	nt	nt	Coarse	nt	nt	Fine	nt	nt	Coarse

Notes:
¹ Alberta Environment. December 2010. Alberta Tier 1 Soil Remediation Guideline Values for Soil and Groundwater for Residential Land Use for Fine-Grained Soils.
* Detection limits increased by one significant figure due to dilution of sample.
nt - Parameter not analyzed.
nd - Less than analytical detection limits.
ng - No guidelines established.
Bold and Underlined - Greater than the referenced guideline.

Table 2: Monitoring Well Completion Details and Field Monitoring Results – AMA Site 9557

Monitoring Well Identifier	Date of Installation	TOC Elevation ¹ (m)	Monitoring Well Depth (mBTOC) ²	Screen Interval (mbg) ³	Screened In	Free Product (mBTOC)	Depth to Groundwater (mBTOC)	Groundwater Elevation (m)	Organic Vapour Emissions ⁴	Free Product (mBTOC)	Depth to Groundwater (mBTOC)	Groundwater Elevation (m)	Organic Vapour Emissions ⁴
						26-Mar-09				31-Mar-11			
08MW01	17-Nov-08	99.22	4.62	1.5 to 4.5	Clay and bedrock	nd	2.83	96.39	2% LEL	nd	1.70	97.52	130 ppm
08MW02	17-Nov-08	99.33	5.25	2.2 to 5.2	Clay and bedrock	nd	2.90	96.43	390 ppm	nd	2.32	97.01	400 ppm
08MW06	17-Nov-08	99.17	5.81	1.5 to 6.1	Clay and bedrock	2.77	2.86	96.32	20% LEL	Flush mount well under water			
08MW07	17-Nov-08	99.13	4.90	1.5 to 6.1	Clay and bedrock	nd	2.74	96.39	190 ppm	Flush mount well under water			
08MW08	19-Nov-08	99.15	14.30	10.5 to 15.2	Bedrock	nd	2.55	96.60	50 ppm	nd	1.87	97.28	950 ppm
09MW10	12-Mar-09	99.29	6.10	3.1 to 6.1	Clay and bedrock	nd	2.91	96.38	50 ppm	nd	2.33	96.96	10 ppm
09MW13	12-Mar-09	98.86	6.10	3.1 to 6.1	Clay and bedrock	nd	2.50	96.36	2% LEL	Flush mount well under water			
09MW19	12-Mar-09	99.38	6.10	3.1 to 6.1	Clay and bedrock	nd	3.00	96.38	150 ppm	nd	0.00	99.38	10 ppm
11MW01	15-Mar-11	99.22	9.690	8.2 - 9.7	Bedrock					nd	1.990	97.23	5 ppm
11MW02	15-Mar-11	99.24	10.030	8.5 - 10.0	Bedrock					nd	2.010	97.23	10 ppm
11MW03	15-Mar-11	99.16	9.400	7.9 - 9.4	Bedrock					nd	2.120	97.04	15 ppm

Notes:

Benchmark: Top bolt of fire hydrant located on the northwest corner of Main Street and Alberta Avenue.

¹ Elevation of top of plastic casing.

² Meters below top of plastic casing.

³ Meters below grade.

⁴ Organic vapour emissions recorded using a Gastech 1238 ME™ calibrated to hexane and operated in methane elimination mode.

nd - Not detected.

ppm - Parts per million.

%LEL - Percentage of the lower explosive limit.

Table 3: Groundwater Analytical Results – AMA Site 9557

Parameter	Detection Limits	Units	AENV Tier ¹	28-Nov-08					26-Mar-09				31-Mar-11		
				08MW01	08MW02	08MW06	08MW07	08MW08	09MW10	09DUP02*	09MW13	09MW19	11MW01	11MW02	11MW03
Petroleum Hydrocarbons															
Benzene	0.0009	mg/L	0.005	<u>5.5</u>	<u>1.6</u>	<u>1.2</u>	<u>0.056</u>	nd	<u>0.13</u>	<u>0.13</u>	<u>0.7</u>	<u>0.23</u>	nd	nd	nd
Toluene	0.0009	mg/L	0.024	0.0005	0.0017	0.0022	nd	nd	0.0007	0.0007	0.0013	0.0007	nd	nd	nd
Ethylbenzene	0.0009	mg/L	0.0024	<u>0.47</u>	<u>0.4</u>	<u>0.35</u>	nd	nd	0.0004	0.0006	<u>0.28</u>	nd	nd	nd	nd
Xylenes	0.002	mg/L	0.3	<u>0.5</u>	<u>0.5</u>	<u>0.52</u>	0.014	nd	0.027	0.028	<u>0.37</u>	0.0017	nd	nd	nd
F1 (C ₆ to C ₁₀)	0.2	mg/L	2.2	nd	1	2	0.5	nd	0.3	0.2	<u>3.9</u>	nd	nd	nd	nd
F2 (C ₁₀ to C ₁₆)	0.1	mg/L	1.1	<u>6.4</u>	<u>8.2</u>	<u>31.9</u>	0.7	nd	0.2	0.2	<u>28.4</u>	nd	nd	nd	nd
Metals															
Lead (Pb)	1	mg/L	0.01	0.0059	nd	nd	0.0002	nd	nd	nd	nd	nd			

Notes:

¹ Alberta Environment. December 2010. Alberta Tier 1 Soil and Groundwater Remediation Guidelines for Fine-Grained Soils on Residential Land Use.

nt - Parameter not analyzed.

nd - Below analytical detection limits.

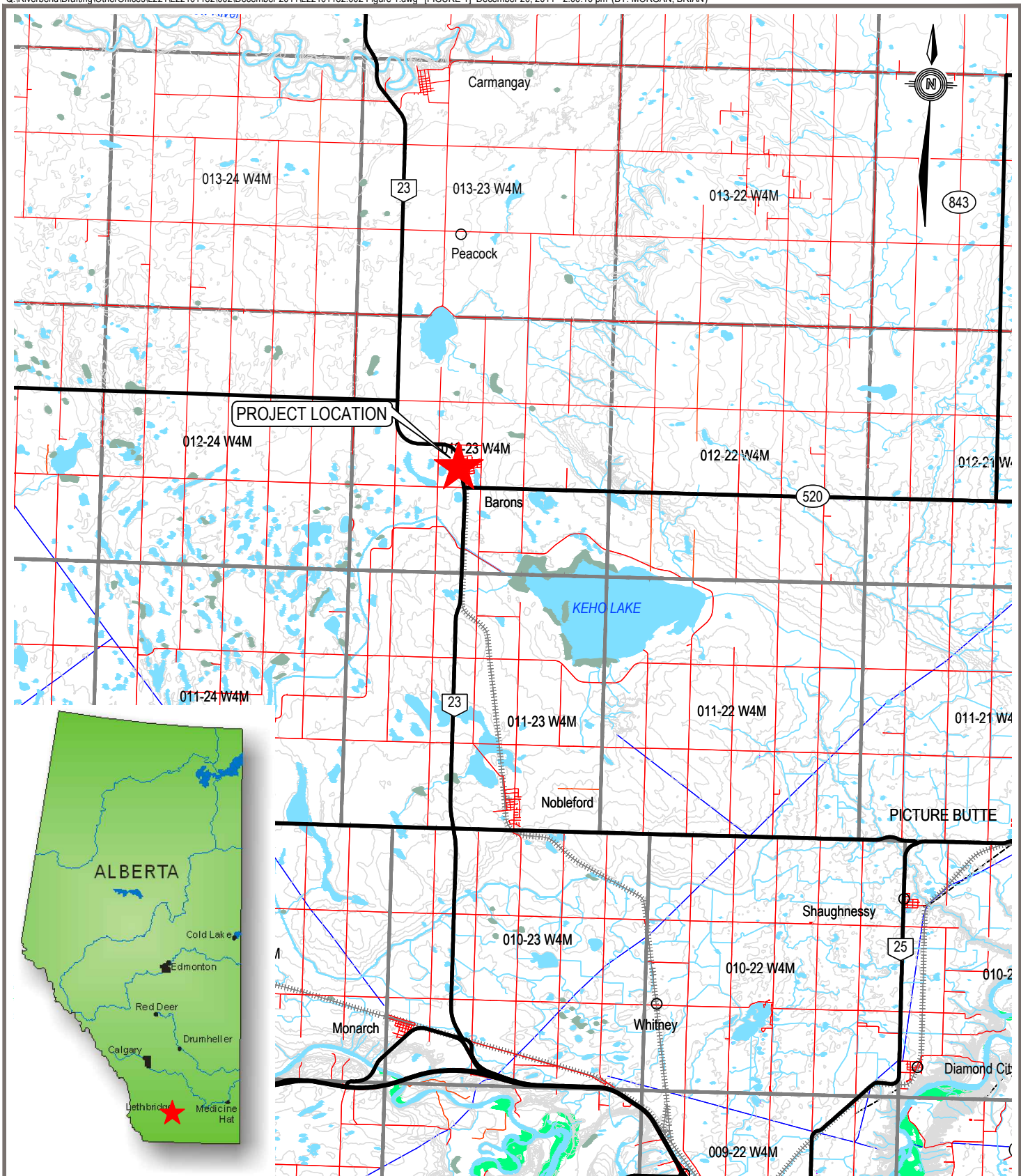
ng - No guidelines established.

Bold and Underlined - Greater than the referenced guideline.

*09DUP02 - Duplicate sample of 09MW10.

FIGURES

Figure 1	Site Location Plan
Figure 2	Site Plan Showing Borehole/ Monitoring Well Locations
Figure 3	Estimated Locations of Wells near the Site
Figure 4	Soil Analytical Results Greater than AENV Tier I Guidelines
Figure 5	Groundwater Analytical Results Greater than AENV Tier I Guidelines
Figure 6	Mole Percentages of Compounds in Groundwater
Figure 7	Mole Percentages of Compounds in Soil (Above Water Table)
Figure 8	Mole Percentages of Compounds in Soil (Below Water Table)
Figure 9	Benzene Concentrations Contours for Soils Above Water Table in the 2008 and 2009 Drilling Events
Figure 10	Benzene Concentrations Contours in Groundwater Found in the Spring 2008 and 2009 Sampling Events



NOTES

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CLIENT

VILLAGE OF BARONS

**ADDITIONAL ENVIRONMENTAL SITE ASSESSMENT
AMA SITE 9557**

SITE LOCATION PLAN

0 10,000m
Scale: 1:200,000 @ 8.5"x11"



PROJECT NO.
L22101182.002

DWN
MMK/BM

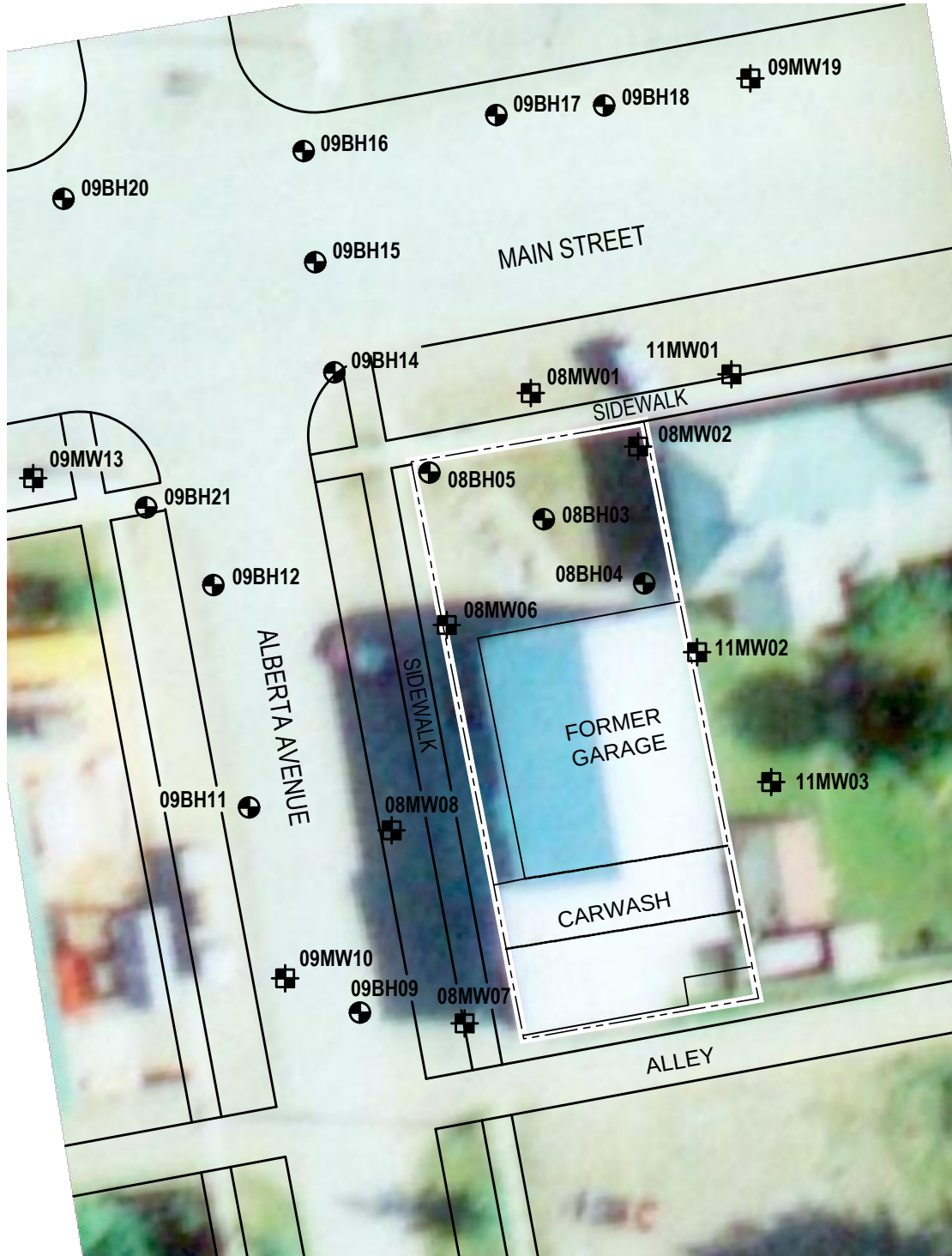
CKD
RB

REV
0

OFFICE
EBA-RIV

DATE
December 2011

Figure 1



LEGEND:

- SITE BOUNDARY
- BOREHOLE LOCATION
- ⊕ MONITORING WELL

0 20
Scale: 1: 400 (metres)

CLIENT

VILLAGE OF BARONS



ADDITIONAL PHASE III ENVIRONMENTAL SITE ASSESSMENT
AMA SITE 9557

SITE PLAN

PROJECT NO.
L22101182.002

DWN
TK

CKD
AS

REV
0

OFFICE
EBA-RIV

DATE
December 2011

Figure 2

Q:\Riverbend\Drafting\Other\Office\1221\122101182\December 2011\122101182.002_FIG 2-5.dwg [FIGURE 3] December 20, 2011 - 1:54:54 pm (BY: MORGAN, BRIAN)



LEGEND:



- WELL LOCATION

0194421 - AENV WELL ID



Scale: 1: 7 500 (metres)

CLIENT

VILLAGE OF BARONS



**ADDITIONAL PHASE III ENVIRONMENTAL SITE ASSESSMENT
AMA SITE 9557**

ESTIMATED LOCATION OF WELLS NEAR THE SITE

PROJECT NO.
L22101182.002

DWN
TK

CKD
AS

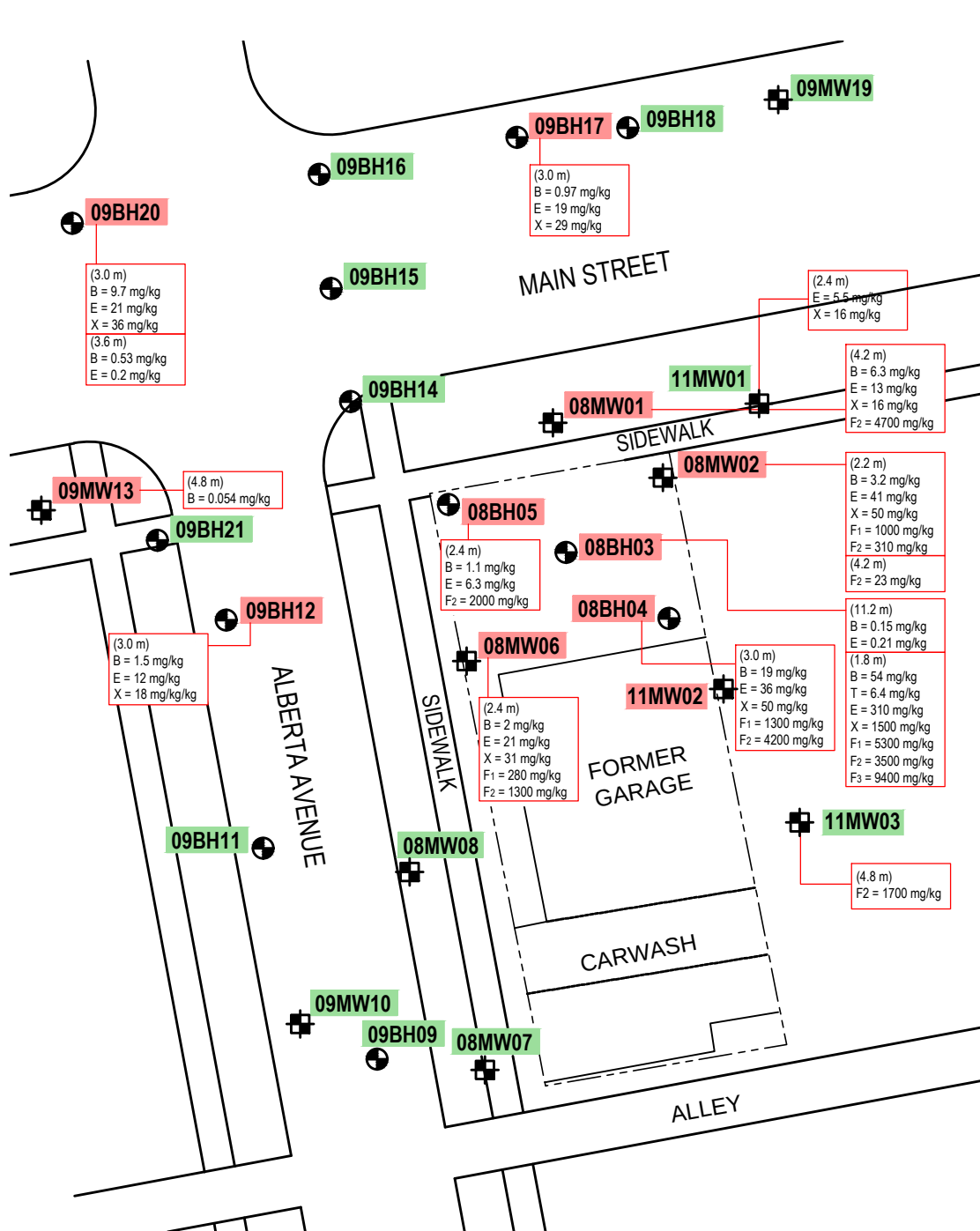
REV
0

OFFICE
EBA-RIV

DATE
December 2011

Figure 3

Q:\Riverbend\Drafting\Other\Office\L221\122101182\002 December 20, 2011 - 4:22:29 pm (BY: MORGAN, BRIAN) FIGURE 4



SOIL ANALYTICAL RESULTS LEGEND

- BH/MW#** BOREHOLE OR MONITORING WELL MEETS AENV TIER 1 GUIDELINES FOR SOIL AT RESIDENTIAL SITES, FOR FINE GRAINED SOILS
- BH/MW#** BOREHOLE OR MONITORING WELL EXCEEDS AENV TIER 1 GUIDELINES FOR SOIL AT RESIDENTIAL SITES, FOR FINE GRAINED SOILS

B = Benzene (mg/kg)
T = Toluene (mg/kg)
E = Ethylbenzene (mg/kg)
X = Xylene (mg/kg)
F1 = Petroleum Hydrocarbon Fraction 1 (mg/kg)
F2 = Petroleum Hydrocarbon Fraction 2 (mg/kg)
F3 = Petroleum Hydrocarbon Fraction 3 (mg/kg)

LEGEND:

- SITE BOUNDARY
- ⊕ BOREHOLE LOCATION
- ⊞ MONITORING WELL

0 20
Scale: 1: 400 (metres)

CLIENT

VILLAGE OF BARONS



ADDITIONAL PHASE III ENVIRONMENTAL SITE ASSESSMENT AMA SITE 9557

SOIL ANALYTICAL RESULTS GREATER THAN AENV TIER 1 GUIDELINES

PROJECT NO.
L22101182.002

OFFICE
EBA-RIV

DWN
TK

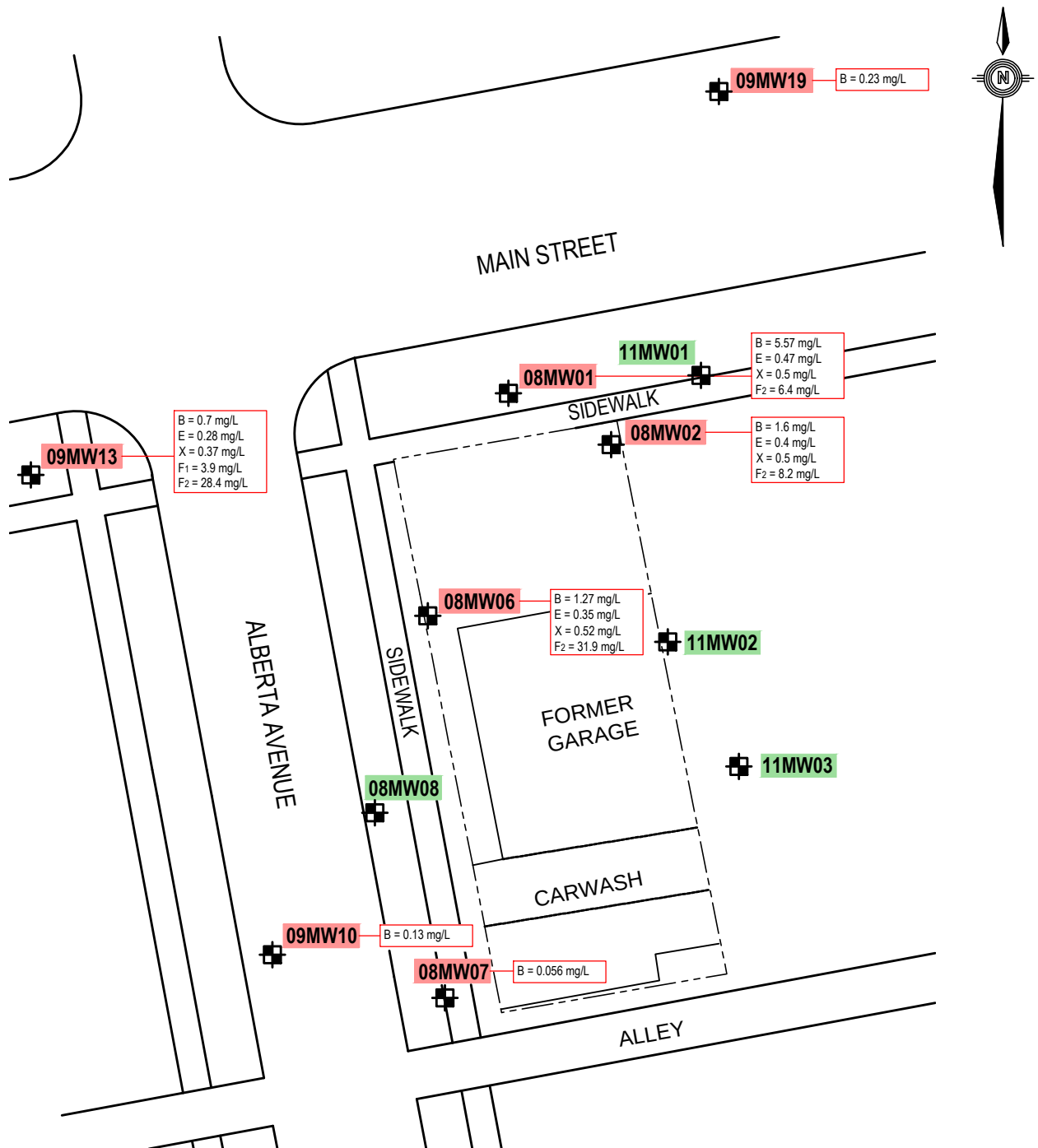
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REV
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DATE
December 2011

Figure 4

Q:\Riverbend\Drafting\Other\Office\1221102\122101182\December 2011\122101182.002_FIG 2-5.dwg [FIGURE 5] December 20, 2011 - 1:56:29 pm (BY: MORGAN, BRIAN)



GROUNDWATER ANALYTICAL RESULTS LEGEND

- MW#** BOREHOLE OR MONITORING WELL MEETS AENV TIER 1 GUIDELINES FOR GROUNDWATER AT RESIDENTIAL SITES, FOR FINE GRAINED SOILS
- MW#** BOREHOLE OR MONITORING WELL EXCEEDS AENV TIER 1 GUIDELINES FOR GROUNDWATER AT RESIDENTIAL SITES, FOR FINE GRAINED SOILS

B = Benzene (mg/L)
T = Toluene (mg/L)
E = Ethylbenzene (mg/L)
X = Xylene (mg/L)
F1 = Petroleum Hydrocarbon Fraction 1 (mg/L)
F2 = Petroleum Hydrocarbon Fraction 2 (mg/L)
F3 = Petroleum Hydrocarbon Fraction 3 (mg/L)

LEGEND:

- SITE BOUNDARY
- MONITORING WELL

0 20
Scale: 1: 400 (metres)

CLIENT

VILLAGE OF BARONS

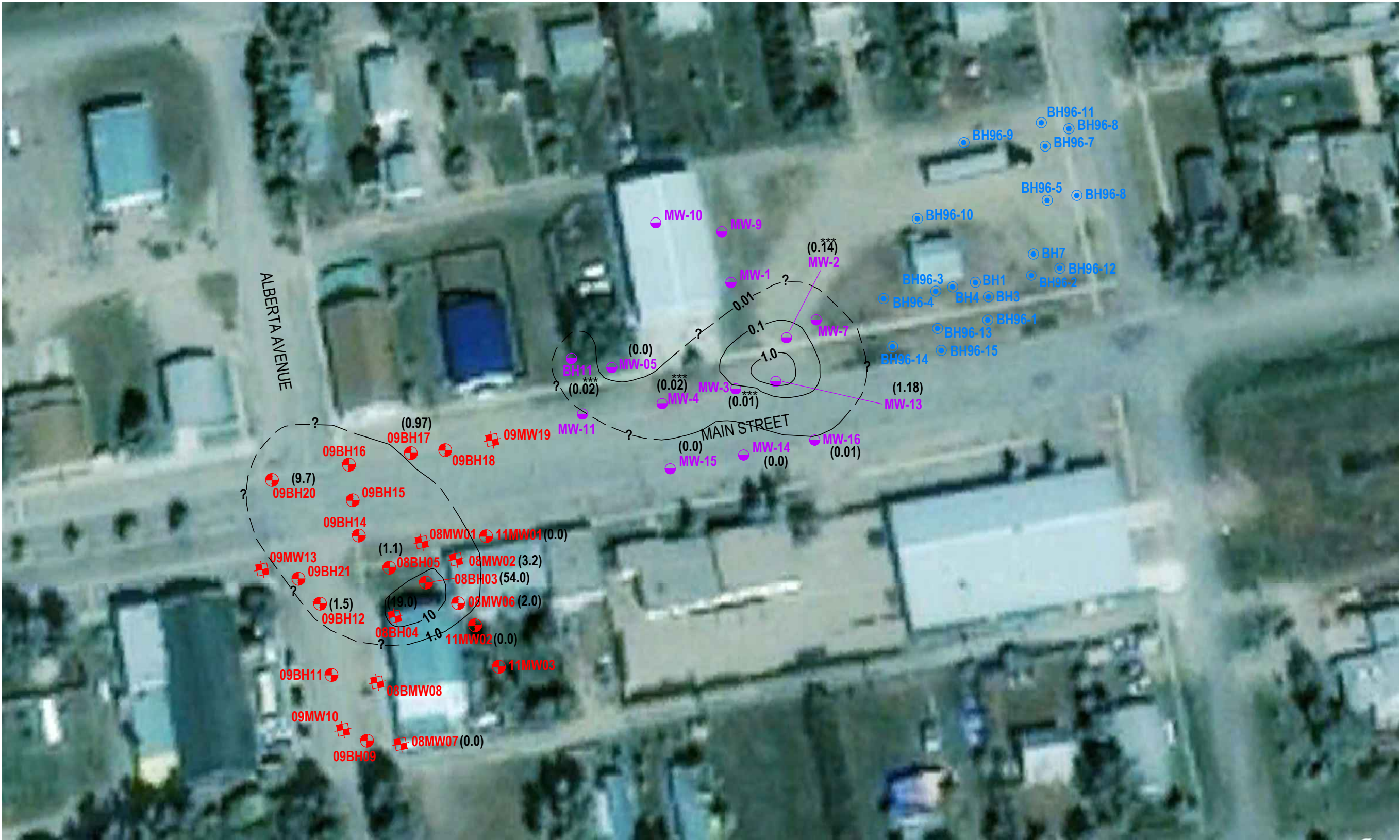


ADDITIONAL PHASE III ENVIRONMENTAL SITE ASSESSMENT AMA SITE 9557

GROUNDWATER ANALYTICAL RESULTS GREATER THAN AENV TIER 1 GUIDELINES

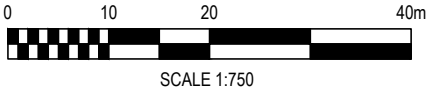
PROJECT NO. L22101182.002	DWN TK	CKD AS	REV 0
OFFICE EBA-RIV	DATE December 2011		

Figure 5



LEGEND

- - BOREHOLE LOCATION
EBA ENGINEERING CONSULTANTS LTD. (2008, 2009 AND 2011)
- - BOREHOLE LOCATION
HASEGAWA ENGINEERING LTD. (2009)
- - BOREHOLE LOCATION
SEACOR ENVIRONMENTAL ENGINEERING INC. (1993 AND 1996)
- (xx.x) - BENZENE CONCENTRATIONS IN SOIL(mg/kg)
- - APPROXIMATE BENZENE CONCENTRATION CONTOURS
- *** - USE OF HALF LIFE CALCULATION TO ESTIMATE CURRENT CONCENTRATIONS



CLIENT

Town of Barons



ADDITIONAL PHASE III ENVIRONMENTAL SITE
ASSESSMENT AMA SITE 9557

BENZENE CONCENTRATION CONTOURS FOR SOILS
ABOVE WATER TABLE IN 08' AND 09' DRILLING EVENTS

PROJECT NO. L22101182.002	DWN MMK	CKD AG	REV 0
OFFICE EBA-RIV	DATE November 2011		

Figure 9

LEGEND

-  - BOREHOLE LOCATION
EBA ENGINEERING CONSULTANTS LTD. (2008, 2009 AND 2011)
-  - BOREHOLE LOCATION
HASEGAWA ENGINEERING LTD. (2009)
-  - BOREHOLE LOCATION
SEACOR ENVIRONMENTAL ENGINEERING INC. (1993 AND 1996)
- (x.x)** - BENZENE CONCENTRATIONS IN GROUNDWATER (mg/L)
- - APPROXIMATE BENZENE CONCENTRATION CONTOURS

* - FREE PRODUCT FOUND IN WELL (MAR-08)
*** - USE OF HALF LIFE CALCULATION TO ESTIMATE CURRENT CONCENTRATIONS

CLIENT

Village of Barons

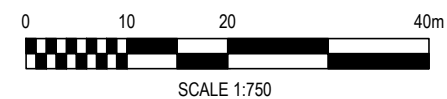


ADDITIONAL PHASE III ENVIRONMENTAL SITE ASSESSMENT AMA SITE 9557

**BENZENE CONCENTRATION CONTOURS IN GROUNDWATER
FOUND IN SPRING 08' AND SPRING 09' SAMPLING EVENTS**

PROJECT NO. L22101182.002	DWN MMK	CKD AG	REV 0
OFFICE EBA-RIV	DATE November 2011		

Figure 10



APPENDIX A

APPENDIX A WATER WELL DRILLERS REPORT



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194222
 Map Verified: Not Verified
 Date Report Received:
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: INTERPROVINCIAL DRLG Drilling Company Approval No.:
 Mailing Address: City or Town: Postal Code:
 Well Owner's Name: Well Location Identifier:
 P.O. Box Number: Mailing Address: Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 EH 16 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan

Well Elev: 3165 FT
 How Obtain: Estimated

3. Drilling Information

Type of Work: Well Inventory
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Drilled
 Flowing Well: No
 Gas Present: No Rate: Gallons
 Oil Present: No 0 Gallons

Proposed well use:
 Domestic
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:
 1958/02/10 11:00 AM
 Test Method: Bailor
 Non pumping 32 FT
 static level:
 Rate of water 15 Gallons/Min
 removal:

4. Formation Log

Depth from
 ground
 level (feet) Lithology Description

1 Topsoil
 10 Gravel & Boulders
 21 Sand & Gravel
 23 Silty Sand & Gravel
 44 Blue Shale
 59 Gray Shale
 63 Sand & Shale
 79 Gray Shale
 83 Gray Sandy Shale
 90 Gray Water Bearing Sandstone
 96 Blue Shale

5. Well Completion

Date Started(yyyy/mm/dd): Date Completed(yyyy/mm/dd):
 1958/02/10
 Well Depth: 96 FT Borehole Diameter: 0 Inches
 Casing Type: Unknown Liner Type:
 Size OD: 5 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 96 FT Top: 0 FT Bottom: 0 FT
 Perforations Perforations Size:
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches

Perforated by:

Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT

Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Installation Method:

Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount:

Geophysical Log Taken:

Retained on Files:

Additional Test and/or Pump Data

Chemistries taken By Driller: No
 Held: 0 Documents Held: 1

Pitless Adapter Type:

Drop Pipe Type:
 Length: FT Diameter: Inches

Comments:

OWNER STATES CEALR, MEDIUM HARD WATER.

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER

Certification No.:

This well was constructed in accordance with the Water Well
 regulation of the Alberta Environmental Protection &
 Enhancement Act. All information in this report is true.

Signature

Yr Mo Day

Recommended pumping rate: 0
 Gallons/Min

Recommended pump intake: 0 FT

Type Pump Installed

Pump Type:

Pump Model:

H.P.:

Any further pump test information?

Any further pump test information?

Any further pump test information?

Any further pump test information?

Any further pump test information?

Any further pump test information?

Any further pump test information?

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Any further pump test information?

Any further pump test information?



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194216
 Map Verified: Field
 Date Report Received:
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION
 Drilling Company Approval No.: 99998
 Mailing Address: 9820-106 ST, OXBRIDGE PLACE City or Town: EDMONTON AB CA Postal Code: T5K 2J6
 Well Owner's Name: ALTA ENV #0613E Well Location Identifier:
 P.O. Box Number: Mailing Address: Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 SE 16 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan

Well Elev: FT
 How Obtain: Not Obtain

3. Drilling Information

Type of Work: Test Hole
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Drilled
 Flowing Well: No
 Gas Present: No Rate: Gallons
 Oil Present: No

Proposed well use:
 Unknown
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:

Test Method:

Non pumping FT

static level:

Rate of water Gallons/Min
 removal:

Depth of pump FT
 intake:

Water level at FT
 end of

pumping:

Distance from inches
 top of casing to
 ground level:

Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes:Sec Recovery

Total Drawdown: FT

If water removal was less than 2 hr
 duration, reason why:

Recommended pumping rate:
 Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pumptest information?

4. Formation Log

Depth from ground level (feet)	Lithology Description
9	Clay
12	Hard Shale
28	Shale
35	Hard Shale & Sandstone
47	Siltstone
55	Hard Sandstone
56	Shale
63	Hard Sandstone
64	Shale
80	Water Bearing Sandstone
95	Shale & Sandstone

5. Well Completion

Date Started(yyyy/mm/dd): Date Completed(yyyy/mm/dd):
 1971/03/01
 Well Depth: 95 FT Borehole Diameter: 0 Inches
 Casing Type: Liner Type:
 Size OD: 0 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 0 FT Top: 0 FT Bottom: 0 FT
 Perforations Perforations Size:
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches

Perforated by:

Seal:
 from: 0 FT to: 0 FT

Seal:
 from: 0 FT to: 0 FT

Seal:
 from: 0 FT to: 0 FT

Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Installation Method:

Fittings

Top: Bottom:

Pack:

Grain Size: Amount:

Geophysical Log Taken:

Retained on Files:

Additional Test and/or Pump Data

Chemistries taken By Driller: No

Held: 0

Documents Held: 1

Pitless Adapter Type:

Drop Pipe Type:

Length:

Diameter:

Comments:

OWNER STATES AIR DRILLED 100FT W. & 25FT S. OF 612-E.

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER

Certification No.:

This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.

Signature

Yr Mo Day



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

The Information contained in this "Water Well Drilling Report" is unverified by Alberta Environment

Well I.D.: 2058577
 Map Verified: Not Verified
 Date Report Received: 2007/03/09
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: UNKNOWN DRILLING COMP. 10 Drilling Company Approval No.: 10
 Mailing Address: UNKNOWN City or Town: Postal Code:

Well Owner's Name: ALTA ENV - 611E Well Location Identifier:

P.O. Box Number: Mailing Address: Postal Code:

City: EDMONTON Province: AB Country: CA

2. Well Location

1/4 or Sec Twp Rge West of
 LSD SE 16 012 23 M
 4

Location in Quarter
 FT from N Boundary
 FT from E Boundary

Lot Block Plan

Well Elev: FT How Obtain: Not Obtain

3. Drilling Information

Type of Work: Test Hole
 Reclaimed Well
 Date Reclaimed: Materials Used: Unknown
 Method of Drilling: Rotary
 Flowing Well: No Rate: Gallons
 Gas Present: No Oil Present: No
 Proposed well use:
 Observation
 Anticipated Water
 Requirements/day
 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:

Test Method:

Non pumping FT
 static level:

Rate of water Gallons/Min
 removal:

Depth of pump FT
 intake:

Water level at FT
 end of
 pumping:

Distance from Inches
 top of casing to
 ground level:

Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes:Sec Recovery

4. Formation Log

Depth from
 ground
 level (feet) Lithology Description

5. Well Completion

Date Started(yyyy/mm/dd): 1971/03/12 Date Completed(yyyy/mm/dd): 1971/03/12

Well Depth: 65 FT Borehole Diameter: Inches

Casing Type: Unknown Liner Type: Unknown

Size OD: Inches Size OD: Inches

Wall Thickness: Inches Wall Thickness: Inches

Bottom at: FT Top: FT Bottom: FT

Perforations
 from: FT to: FT
 from: FT to: FT
 from: FT to: FT
 Perforations Size:
 Inches x Inches
 Inches x Inches
 Inches x Inches

Perforated by: Unknown

Seal: Unknown
 from: FT to: FT

Seal: Unknown
 from: FT to: FT

Seal: Unknown
 from: FT to: FT

Screen Type: Unknown Screen ID: Inches
 from: FT to: FT Slot Size: Inches

Screen Type: Unknown Screen ID: Inches
 from: FT to: FT Slot Size: Inches

Screen Installation Method: Unknown

Fittings
 Top: Unknown Bottom: Unknown

Pack: Unknown
 Grain Size: Amount: Unknown

Geophysical Log Taken:
 Retained on Files:

Additional Test and/or Pump Data

Chemistries taken By Driller: No

Held: Documents Held:

Pitless Adapter Type:

Drop Pipe Type:
 Length: Diameter:

Comments:

Total Drawdown: FT

If water removal was less than 2 hr
 duration, reason why:

Recommended pumping rate:
 Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pump test information?

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER10
 Certification No.: 10

This well was constructed in accordance with the Water Well
 regulation of the Alberta Environmental Protection &
 Enhancement Act. All information in this report is true.

Signature Yr Mo Day



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194195
 Map Verified: Field
 Date Report Received: 1981/05/27
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION
 Drilling Company Approval No.: 99998
 Mailing Address: 9820-106 ST, OXBRIDGE PLACE City or Town: EDMONTON AB CA Postal Code: T5K 2J6
 Well Owner's Name: ALTA ENV #1998E Well Location Identifier:
 P.O. Box Number: Mailing Address: Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 SW 15 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary

Lot Block Plan

Well Elev: 3175 FT
 How Obtain: Estimated

3. Drilling Information

Type of Work: Test Hole
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Rotary
 Flowing Well: No
 Gas Present: No Rate: Gallons
 Oil Present: No

Proposed well use:
 Unknown
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:

Test Method:

Non pumping FT

static level:

Rate of water Gallons/Min
 removal:

Depth of pump FT
 intake:

Water level at FT
 end of

pumping:

Distance from Inches
 top of casing to
 ground level:

Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes: Sec Recovery

Total Drawdown: FT

If water removal was less than 2 hr
 duration, reason why:

Recommended pumping rate:
 Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pump test information?

4. Formation Log

Depth from
 ground
 level (feet) Lithology Description

10 Silt
 25 Shale
 71 Silty Shale
 72 Sandstone
 84 Shale
 89 Sandstone
 98 Shale
 100 Sandstone
 104 Shale
 107 Sandstone
 110 Shale
 112 Sandstone
 115 Shale
 120 Sandstone
 135 Shale
 137 Sandstone
 138 Shale
 140 Sandstone
 141 Shale
 148 Sandstone
 190 Shale
 196 Sandstone
 198 Shale
 200 Sandstone

5. Well Completion

Date Started(yyyy/mm/dd): 1980/11/09 Date Completed(yyyy/mm/dd): 1980/11/20

Well Depth: 200 FT Borehole Diameter: 0 Inches

Casing Type: Liner Type:

Size OD: 0 Inches Size OD: 0 Inches

Wall Thickness: 0 Inches Wall Thickness: 0 Inches

Bottom at: 0 FT Top: 0 FT Bottom: 0 FT

Perforations from: 0 FT to: 0 FT Perforations Size: 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches

Perforated by:

Seal: to: 0 FT

Seal: to: 0 FT

Seal: to: 0 FT

Seal: to: 0 FT

Screen Type: Screen ID: 0 Inches

from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Type: Screen ID: 0 Inches

from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Installation Method:

Fittings

Top: Bottom:

Pack: Grain Size: Amount:

Geophysical Log Taken:

Retained on Files:

Additional Test and/or Pump Data

Chemistries taken By Driller: No

Held: 0 Documents Held: 4

Pitless Adapter Type:

Drop Pipe Type:

Length: Diameter:

Comments:

OWNER STATES WELL CORED.

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER

Certification No.:
 This well was constructed in accordance with the Water Well
 regulation of the Alberta Environmental Protection &
 Enhancement Act. All information in this report is true.

Signature Yr Mo Day



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194421
 Map Verified: Field
 Date Report Received: 1986/02/17
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: UNKNOWN DRILLER Drilling Company Approval No.: 99999
 Mailing Address: UNKNOWN City or Town: UNKNOWN AB CA Postal Code: _____
 Well Owner's Name: ARC# TH 28-76 Well Location Identifier: _____
 P.O. Box Number: _____ Mailing Address: _____ Postal Code: _____
 City: _____ Province: _____ Country: _____

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 14 16 012 23 4

Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan

Well Elev: 3153 FT How Obtain: Survey-Tra

3. Drilling Information

Type of Work: Coal Test Hole
 Reclaimed Well
 Date Reclaimed: _____ Materials Used: _____
 Method of Drilling: Unknown
 Flowing Well: No Rate: Gallons
 Gas Present: No Oil Present: No

Proposed well use:
 Other
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date(yyyy/mm/dd): Start Time:

Test Method:
 Non pumping FT
 static level:
 Rate of water Gallons/Min
 removal:

4. Formation Log

Depth from
 ground
 level (feet) Lithology Description

5 Brown Till
 15 Brownish Yellow Till
 20 Brown Medium Grained Sandstone
 24 Till
 25 Brownish Yellow Shale
 30 Light Gray Shale
 35 Greenish Gray Shale
 40 Light Gray Fine Grained Sandstone
 75 Gray Fine Grained Shale & Sandstone
 80 Gray Silty Shale & Sandstone
 85 Gray Fine Grained Shale & Sandstone
 90 Greenish Gray Fine Grained Shale & Sandstone
 95 Greenish Gray Shale
 100 Greenish Gray Fine Grained Shale & Sandstone
 110 Greenish Gray Fine Grained Shale & Sandstone
 120 Greenish Gray Bentonitic Shale & Sandstone
 130 Greenish Gray Silty Shale & Sandstone
 135 Brownish Gray Bentonitic Shale & Sandstone
 145 Greenish Gray Shale & Sandstone
 150 Brownish Gray Bentonitic Shale & Sandstone
 165 Greenish Gray Bentonitic Shale & Sandstone
 175 Brownish Green Bentonitic Shale & Sandstone
 180 Brownish Gray Fine Grained Shale & Sandstone
 185 Gray Fine Grained Shale & Sandstone
 190 Brownish Gray Shale & Sandstone
 195 Brownish Gray Bentonitic Shale & Sandstone
 200 Brownish Gray Shale
 205 Brown Shale & Coal
 210 Brownish Gray Bentonitic Shale
 215 Brownish Gray Bentonitic Shale & Sandstone
 220 Dark Gray Bentonitic Shale
 225 Gray Bentonitic Shale & Sandstone
 235 Brownish Gray Fine Grained Shale & Sandstone
 240 Dark Brown Carbonaceous Shale
 245 Brown Shale
 250 Brownish Gray Bentonitic Shale & Sandstone
 260 Brownish Gray Shale

5. Well Completion

Date Started(yyyy/mm/dd): 1976/06/13 Date Completed(yyyy/mm/dd): 1976/06/13
 Well Depth: 674 FT Borehole Diameter: 0 Inches
 Casing Type: _____ Liner Type: _____
 Size OD: 0 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 0 FT Top: 0 FT Bottom: 0 FT

Perforations
 from: 0 FT to: 0 FT Perforations Size:
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches
 from: 0 FT to: 0 FT 0 Inches x 0 Inches

Perforated by:

Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT

Screen Type: _____ Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: _____ Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches

Screen Installation Method:

Fittings
 Top: _____ Bottom: _____
 Pack:
 Grain Size: _____ Amount: _____
 Geophysical Log Taken: ELECTRIC and GAMMA
 Retained on Files: ELECTRIC yes and GAMMA yes
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 0 Documents Held: 6

Pitless Adapter Type:
 Drop Pipe Type:
 Length: _____ Diameter: _____

Comments:
 345'-365' SHALE, SILT & FOSSILS

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
 Certification No.: _____
 This well was constructed in accordance with the Water Well
 regulation of the Alberta Environmental Protection &
 Enhancement Act. All information in this report is true.
 Signature _____ Yr Mo Day

Depth of pump FT
 intake:
 Water level at FT
 end of
 pumping:

Distance from Inches
 top of casing to
 ground level:

Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes:Sec Recovery

Total Drawdown: FT
 If water removal was less than 2 hr
 duration, reason why:

Recommended pumping rate:
 Gallons/Min

Recommended pump intake: FT

Type pump installed
 Pump type:
 Pump model:
 H.P.:
 Any further pump test information?

265	Brownish Gray Bentonitic Shale		
275	Brownish Gray Bentonitic Shale & Sandstone		
285	Gray Shale		



Water Well Drilling Report

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.: 0194196
 Map Verified: Not Verified
 Date Report Received: 1969/12/10
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: HENNING DRILLING LTD. Drilling Company Approval No.:
 Mailing Address: City or Town: Postal Code:
 Well Owner's Name: BARONS OIL Well Location Identifier:
 P.O. Box Number: Mailing Address: BARONS Postal Code:
 City: Province: Country:

2. Well Location

1/4 or Sec Twp Rge West of
 LSD M
 14 15 012 23 4
 Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan
 Well Elev: How Obtain:
 FT Not Obtain

3. Drilling Information

Type of Work: New Well
 Reclaimed Well
 Date Reclaimed: Materials Used:
 Method of Drilling: Rotary
 Flowing Well: No Rate: Gallons
 Gas Present: No Oil Present: No
 Proposed well use:
 Injection
 Anticipated Water
 Requirements/day
 0 Gallons

6. Well Yield

Test Date (yyyy/mm/dd): Start Time:
 Test Method:
 Non pumping FT
 static level:
 Rate of water Gallons/Min
 removal:
 Depth of pump FT
 intake:
 Water level at FT
 end of
 pumping:
 Distance from Inches
 top of casing to
 ground level:
 Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes: Sec Recovery

4. Formation Log

Depth from ground level (feet)	Lithology Description
4	Brown Clay
20	Shale
48	Dark Shale
49	Sandstone
381	Sandstone
391	Hard Unknown
532	Hard Unknown
542	Hard Unknown
555	Shale

5. Well Completion

Date Started (yyyy/mm/dd): Date Completed (yyyy/mm/dd):
 1967/02/01
 Well Depth: 555 FT Borehole Diameter: 0 Inches
 Casing Type: Liner Type: Unknown
 Size OD: 0 Inches Size OD: 0 Inches
 Wall Thickness: 0 Inches Wall Thickness: 0 Inches
 Bottom at: 0 FT Top: 0 FT Bottom: 547 FT
 Perforations Perforations Size:
 from: 316 FT to: 354 FT 0 Inches x 0 Inches
 from: 370 FT to: 407 FT 0 Inches x 0 Inches
 from: 510 FT to: 547 FT 0 Inches x 0 Inches
 Perforated by:
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Seal:
 from: 0 FT to: 0 FT
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Type: Screen ID: 0 Inches
 from: 0 FT to: 0 FT Slot Size: 0 Inches
 Screen Installation Method:
 Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount:
 Geophysical Log Taken: ELECTRIC
 Retained on Files: ELECTRIC yes
 Additional Test and/or Pump Data
 Chemistries taken By Driller: No
 Held: 0 Documents Held: 7
 Pitless Adapter Type:
 Drop Pipe Type:
 Length: Diameter:
 Comments:
 OWNER STATES INJECTION TEST INCLUDED IN FILE.

Total Drawdown: FT

If water removal was less than 2 hr duration, reason why:

Recommended pumping rate:
 Gallons/Min

Recommended pump intake: FT

Type pump installed

Pump type:

Pump model:

H.P.:

Any further pump test information?

7. Contractor Certification

Driller's Name: UNKNOWN DRILLER
 Certification No.:
 This well was constructed in accordance with the Water Well regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
 Signature Yr Mo Day

APPENDIX B

APPENDIX B BOREHOLE LOGS

TERMS USED ON BOREHOLE LOGS

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on 0.075mm sieve): Includes (1) clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as inferred from laboratory or in situ tests.

DESCRIPTIVE TERM	RELATIVE DENSITY	N (blows per 0.3m)
Very Loose	0 TO 20%	0 to 4
Loose	20 TO 40%	4 to 10
Compact	40 TO 75%	10 to 30
Dense	75 TO 90%	30 to 50
Very Dense	90 TO 100%	greater than 50

The number of blows, N, on a 51mm O.D. split spoon sampler of a 63.5kg weight falling 0.76m, required to drive the sampler a distance of 0.3m from 0.15m to 0.45m.

FINE GRAINED SOILS (major portion passing 0.075mm sieve): Includes (1) inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as estimated from laboratory or in situ tests.

DESCRIPTIVE TERM	UNCONFINED COMPRESSIVE STRENGTH (KPA)
Very Soft	Less than 25
Soft	25 to 50
Firm	50 to 100
Stiff	100 to 200
Very Stiff	200 to 400
Hard	Greater than 400

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil.

GENERAL DESCRIPTIVE TERMS

Slickensided - having inclined planes of weakness that are slick and glossy in appearance.

Fissured - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated - composed of thin layers of varying colour and texture.

Interbedded - composed of alternate layers of different soil types.

Calcareous - containing appreciable quantities of calcium carbonate.;

Well graded - having wide range in grain sizes and substantial amounts of intermediate particle sizes.

Poorly graded - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

MODIFIED UNIFIED SOIL CLASSIFICATION

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION	LABORATORY CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS More than 50% retained on 75 µm sieve*	GRAVELS 50% or more of coarse fraction retained on 4.75 mm sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines GW, GP, SW, SP GM, GC, SM, SC Borderline Classification requiring use of dual symbols	$C_u = D_{60}/D_{10}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line or plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes 4.75 mm sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above "A" line or plasticity index greater than 7	
FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS	Liquid limit	<50	ML	For classification of fine-grained soils and fine fraction of coarse-grained soils. PLASTICITY CHART 		
			>50	MH			
	CLAYS	Above "A" line on plasticity chart negligible organic content	Liquid limit	<30		CL	
			30-50	CI			
			>50	CH			
	ORGANIC SILTS AND CLAYS	Liquid limit	<50	OL			
			>50	OH			
HIGHLY ORGANIC SOILS				PT	Peat and other highly organic soils	*Based on the material passing the 75 mm sieve Reference: ASTM Designation D2487, for identification procedure see D2488. USC as modified by PFRA	
SOIL COMPONENTS					OVERSIZE MATERIAL		
FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS		Rounded or subrounded		
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR	COBBLES 75 mm to 300 mm BOULDERS > 300 mm		
GRAVEL					Not rounded		
coarse	75 mm	19 mm	>35 %	"and"	ROCK FRAGMENTS >75 mm		
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"	ROCKS > 0.76 cubic metre in volume		
SAND			10 to 20 %	"some"			
coarse	4.75 mm	2.00 mm	>0 to 10 %	"trace"			
medium	2.00 mm	425 µm					
fine	425 µm	75 µm					
SILT (non plastic) or CLAY (plastic)	75 µm		as above but by behavior				
					 A TETRA TECH COMPANY		

SOIL COMPONENTS

OVERSIZE MATERIAL

FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY MASS OF MINOR COMPONENTS		Rounded or subrounded
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR	COBBLES 75 mm to 300 mm BOULDERS > 300 mm
GRAVEL					
coarse	75 mm	19 mm	>35 %	“and”	Not rounded
fine	19 mm	4.75 mm	21 to 35 %	“y-adjective”	ROCK FRAGMENTS >75 mm
SAND					ROCKS > 0.76 cubic metre in volume
coarse	4.75 mm	2.00 mm	10 to 20 %	“some”	
medium	2.00 mm	425 μm	>0 to 10 %	“trace”	
fine	425 μm	75 μm			
SILT (non plastic) or CLAY (plastic)	75 μm		as above but by behavior		



A TETRATECH COMPANY

ROCK DESCRIPTION TERMS USED ON BOREHOLE LOGS

MECHANICAL STRENGTH CALCULATIONS			
TERM	UCS* (MPa)	GRADE	FIELD IDENTIFICATION**
Extremely Strong	> 250	R6	Specimen can only be chipped with geological hammer
Very Strong	100 - 250	R5	Specimen requires many blows of geological hammer to fracture
Strong	50 - 100	R4	Specimen requires more than one blow of geological hammer to fracture
Medium Strong	25 - 50	R3	Cannot be scraped or peeled with pocket knife; can be fractured with single firm blow of geologic hammer
Weak	5 - 25	R2	Can be peeled by pocket knife with difficulty; shallow indentation made by firm blow with geological hammer
Very Weak	1 - 5	R1	Crumbles under firm blow with point of geological hammer; can be peeled by a pocket knife
Extremely Weak	0.25 - 1	R0	Indented by thumbnail

*UCS - unconfined compressive strength; **Correlations determined by Field Identification are approximate.

GRAIN SIZE			
NON-CARBONATE DETRITAL SEDIMENTARY ROCKS		OTHER ROCKS	GRAIN SIZE
Conglomerate or Breccia		Very Coarse Grained	More than 80 mm
Conglomerate or Breccia		Coarse Grained	4 to 80 mm
Sandstone ¹		Medium Grained	80 µm to 4 mm
FISSILE	NON-FISSILE		
Silt Shale	Siltstone	Fine Grained	> 2/3 silt-sized (2 to 80 µm)
Mud Shale	Mudstone	Fine Grained	Silt and clay-sized (<80 µm)
Clay Shale	Claystone	Very Fine Grained	> 2/3 clay-sized (<2 µm)

¹ Sandstone further subdivided where appropriate into fine, medium, coarse

DISCONTINUITY SPACING		
BEDDING	OTHER DISCONTINUITY	SPACING
Very Thickly Bedded	Very Widely Spaced	More than 2 m
Thickly Bedded	Widely Spaced	600 mm to 2 m
Medium Bedded	Moderately Widely Spaced	200 to 600 mm
Thinly Bedded	Closely Spaced	60 to 200 mm
Very Thinly Bedded	Very Closely Spaced	20 to 60 mm
Laminated	Extremely Closely Spaced	6 to 20 mm
Thinly Laminated	Extremely Closely Spaced	2 to 6 mm
Fissile	Extremely Closely Spaced	Less than 2 mm

ROCK QUALITY	
TERM	RQD
Very Poor Quality	0 to 25
Poor Quality	25 to 50
Fair Quality	50 to 75
Good Quality	75 to 90
Excellent Quality	90 to 100

WEATHERED STATE	
TERM	DEGREE
Fresh	No visible signs of weathering
Slightly Weathered	Weathering only on open discontinuity surfaces
Moderately Weathered	Rock mass weathered but not friable
Highly Weathered	Rock mass weathered and partly friable
Completely Weathered	Wholly decomposed but texture and structure preserved
Residual Soil	Original rock texture and structure destroyed

CORE RECOVERY	
TERM	DESCRIPTION
Total Core Recovery	Total recovery expressed as a percentage of run length
Solid Recovery	Solid recovery expressed as a percentage of run length
Rock Quality Designation (RQD)	Sum of lengths of solid core more than 100 mm long expressed as a percentage of run length
Fracture Frequency (FF)	The number of fractures per metre of core (FF's in excess of 30 denoted at 30+)

Project: Phase III ESA		Client: Village of Barons		PROJECT NO. - BOREHOLE NO.	
Location: 202 Main Street		Drill Method: Wet Rotary Core		I22101182.002 - 11MW01	
City: Barons, Alberta		Project Scientist: Deryck Masterman		ELEVATION: 99.22m	
SAMPLE TYPE		☒ DISTURBED	☐ NO RECOVERY	☒ SPT	☐ A-CASING
BACKFILL TYPE		☒ BENTONITE	☒ PEA GRAVEL	☐ SLOUGH	☐ GROUT
				☐ DRILL CUTTINGS	☐ SAND
Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	HYDROCARBONS (ppm)	NOTES & COMMENTS
				200 400 600 800	
0	CLAY (Fill) - silty, some sand to sandy, some gravel, frozen, low to medium plastic, dark brown.				
1	CLAY - silty, some sand, moist, soft, medium plastic, light grey to brown.		B1		
2	... brown, dark brown high plastic mottling.		B2		
3	... very soft, very moist to wet, medium plastic.		B3		
4	... grey and black hydrocarbon staining and odor.		B4	2150	
5	... sandy (fine grained), firm, low plastic, moist.		B5		
6	... trace sandstone inclusions.		B6		
7	SANDSTONE BEDROCK - low strength, highly weathered, medium grained, yellowish brown, no distinct hydrocarbon staining or odour.		B7		
8	... medium to high strength, fractured, grey to dark grey, oxide staining along fractures.				
9	... some silt, medium strength, fine grained, yellowish brown.				
10	... increased oxide staining.				
11	... high strength, medium grained, blueish grey.				
12	... 10 cm coal seam, coarse, wet, dark black.				
13	CLAYSTONE BEDROCK - trace silt, high strength, fractured, dark brown.				
14	... light grey.				
15	SILTSTONE BEDROCK - medium to high strength, fractured, light grey, abundance of oxide staining along fractures.		B8		
16	CLAYSTONE BEDROCK - trace silt, high strength, fractured, dark brown, oxide staining along fractures.				
17	... light grey to olive.				
18	End of Borehole at 10.4 m				

Project: Phase III ESA		Client: Village of Barons		PROJECT NO. - BOREHOLE NO.	
Location: 202 Main Street		Drill Method: Wet Rotary Core		I22101182.002 - 11MW02	
City: Barons, Alberta		Project Scientist: Deryck Masterman		ELEVATION: 99.24m	
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	
0	TOPSOIL				
	CLAY - silty, some sand to sandy, low to medium plastic, firm, moist, dark brown.				
	... soft, very moist, light grey.				
1	... very soft, wet.				
	... firm, moist, brown, dark brown high plastic inclusions.				
2	... high plastic, dark brown.				
3					
	... sandstone inclusions, trace coal and oxide inclusions.				
4					
5					
6					
7					
8					
9					
10					
11					
12					
 EBA Engineering Consultants Ltd.			LOGGED BY: JL REVIEWED BY: DM DRAWING NO: D2		COMPLETION DEPTH: 10.03m COMPLETE: 3/15/2011 Page 1 of 1

APPENDIX C

APPENDIX C LABORATORY CERTIFICATIONS AND CORE SAMPLE RESULTS

CONSTANT HEAD PERMEABILITY TEST REPORT

ASTM D5084

Project: Site Reconnaissance - Site 9557

Test No.: 11MW01

Project No.: L22101182.002

Borehole No.: 11MW01

Client: Village of Barons

Sample Depth: 5.5 m - 5.9 m

Attention: Laurie Beck

Date Tested: March 24, 2011

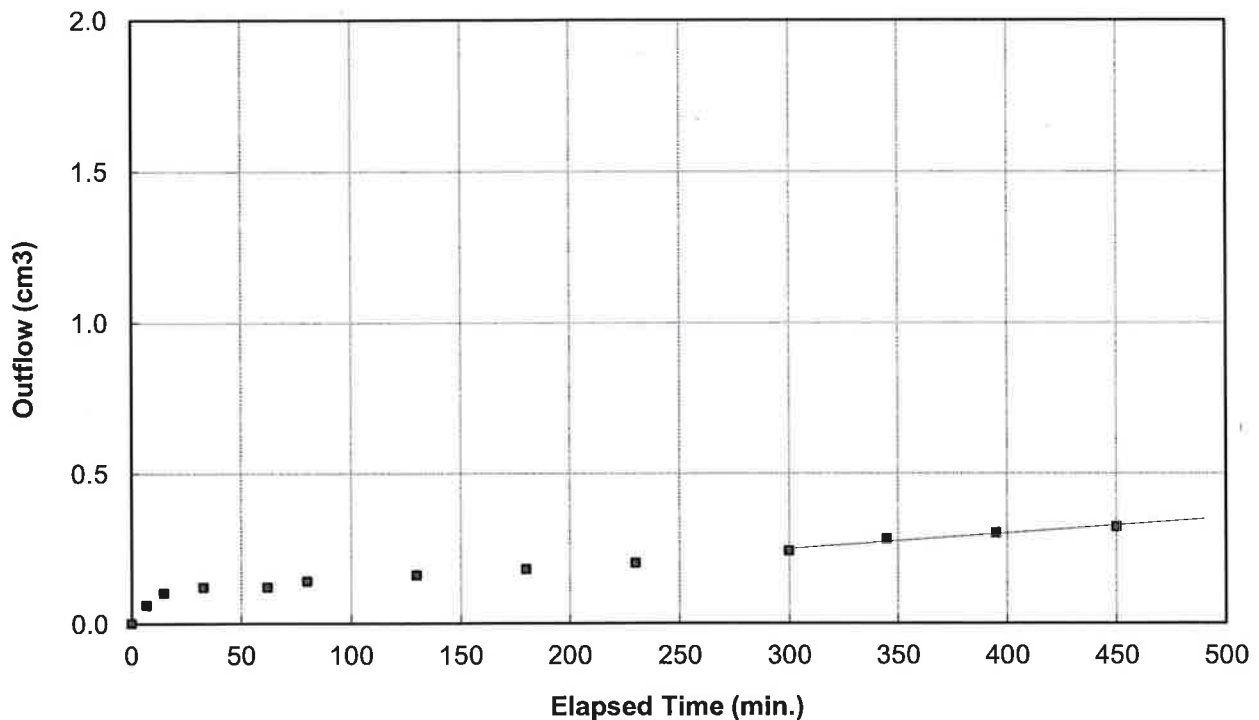
Tested By: MS

Soil Description: CLAY, silty, sandy

	Initial	Final
Moisture Content (%)	11.4	13.3
Dry Density (kg/m ³)	2110	2110

$k_{20} =$	8.22E-09 cm/sec
------------	-----------------

Height = 10.090 cm
Diameter = 6.165 cm
Head Diff. = 35 kPa
Q = 8.89E-06 cm³/sec
i = 35.39
A = 29.85 cm²



Remarks: Porosity of sample $\phi = 20\%$

Reviewed By:

Cronwell

P.Eng.

Data presented hereon is for the sole use of the stipulated client. EBA is not responsible, nor can be held liable, for use made of this report by any other party, with or without the knowledge of EBA. The testing services reported herein have been performed by an EBA technician to recognized industry standards, unless otherwise noted. No other warranty is made. These data do not include or represent any interpretation or opinion of specification compliance or material suitability. Should engineering interpretation be required, EBA will provide it upon written request.

CONSTANT HEAD PERMEABILITY TEST REPORT

ASTM D5084

Project: Site Reconnaissance - Site 9557

Test No.: 11MW02

Project No.: L22101182.002

Borehole No.: 11MW02

Client: Village of Barons

Sample Depth: 6.7 m - 7 m

Attention: Laurie Beck

Date Tested: March 24, 2011

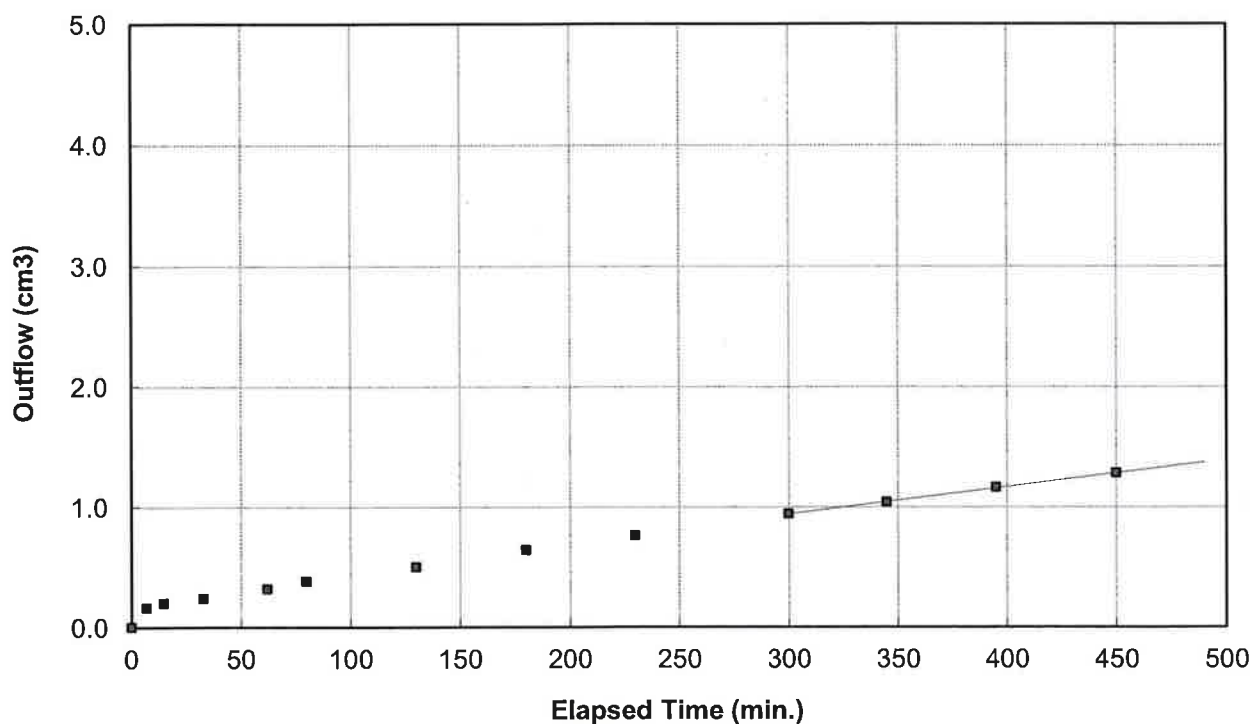
Tested By: MS

Soil Description: SHALE, clayey, trace muskovite accessories

	Initial	Final
Moisture Content (%)	12.1	12.5
Dry Density (kg/m ³)	2018	2018

$$k_{20} = 2.72E-08 \text{ cm/sec}$$

Height = 8.401 cm
 Diameter = 6.376 cm
 Head Diff. = 35 kPa
 Q = 3.78E-05 cm³/sec
 i = 42.51
 A = 31.93 cm²



Remarks: Porosity of sample $\phi = 20\%$

Reviewed By: *Quoneche* P.Eng.

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CONSTANT HEAD PERMEABILITY TEST REPORT

ASTM D5084

Project: Site Reconnaissance - Site 9557

Test No.: 11MW03

Project No.: L22101182.002

Borehole No.: 11MW03

Client: Village of Barons

Sample Depth: 8.2 m - 8.5 m

Attention: Laurie Beck

Date Tested: March 24, 2011

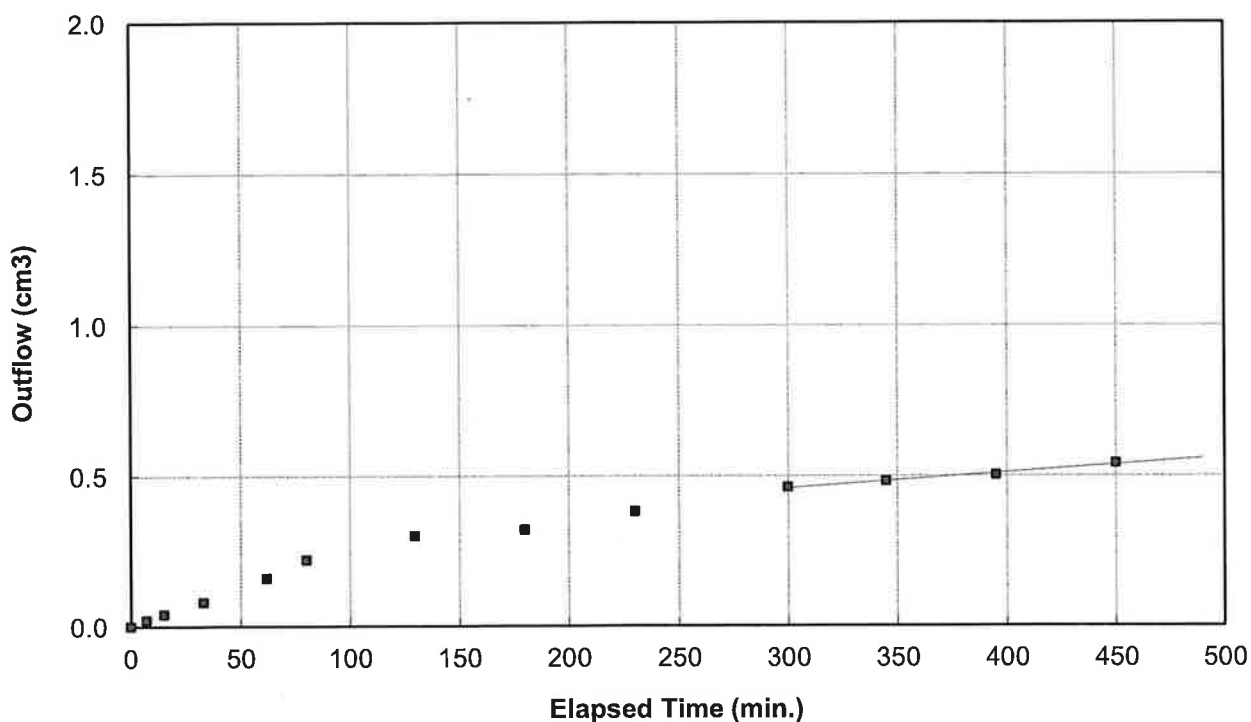
Tested By: MS

Soil Description: CLAY, silty, sandy

	Initial	Final
Moisture Content (%)	10.6	12.6
Dry Density (kg/m ³)	2041	2041

k_{20} =	9.48E-09 cm/sec
------------	-----------------

Height = 12.290 cm
 Diameter = 6.334 cm
 Head Diff. = 35 kPa
 Q = 8.89E-06 cm³/sec
 i = 29.06
 A = 31.51 cm²



Remarks: Porosity of sample ϕ = 22%

Reviewed By:

Laurie Beck

P.Eng.

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Your P.O. #: L22101182.002
 Your Project #: BARONS AMA SITE
 Site: BARONS, AB
 Your C.O.C. #: A034802

Attention: DERYCK MASTERMAN
 EBA ENGINEERING CONSULTANTS LTD.
 442-10 STREET NORTH
 LETHBRIDGE, AB
 CANADA T1H 2C7

Report Date: 2011/04/08

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B125774
Received: 2011/04/01, 8:45

Sample Matrix: Water
 # Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
BTEX/F1 in Water by HS GC/MS	4	N/A	2011/04/05	CAL SOP-00190	CCME CWS, EPA 8260C
CCME Hydrocarbons in Water (F2; C10-C16)	4	2011/04/05	2011/04/07	CAL SOP-00086 AB WI-00017	EPA3510C/CCME PHCCWS

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

BRIAN ISSLER, Project Manager
 Email: BIssler@maxxam.ca
 Phone# (403) 735-2250 Ext:2250

=====

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Total cover pages: 1

Maxxam Job #: B125774
Report Date: 2011/04/08

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE
Site Reference: BARONS, AB
Your P.O. #: L22101182.002
Sampler Initials: JL

AT1 BTEX AND F1 (WATER)

Maxxam ID		AG4146	AG4148	AG4149	AG4150		
Sampling Date		2011/03/31	2011/03/31	2011/03/31	2011/03/31		
COC Number		A034802	A034802	A034802	A034802		
	Units	11MW01	11MW02	11MW03	11DUP	RDL	QC Batch

Volatiles							
Benzene	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	0.0004	4756175
Toluene	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	0.0004	4756175
Ethylbenzene	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	0.0004	4756175
o-Xylene	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	0.0004	4756175
m & p-Xylene	mg/L	<0.0008	<0.0008	<0.0008	<0.0008	0.0008	4756175
Xylenes (Total)	mg/L	<0.0008	<0.0008	<0.0008	<0.0008	0.0008	4756175
F1 (C6-C10) - BTEX	mg/L	<0.1	<0.1	<0.1	<0.1	0.1	4756175
(C6-C10)	mg/L	<0.1	<0.1	<0.1	<0.1	0.1	4756175
Surrogate Recovery (%)							
4-BROMOFLUOROBENZENE (sur.)	%	92	92	92	93	N/A	4756175
D4-1,2-DICHLOROETHANE (sur.)	%	95	97	99	98	N/A	4756175
D8-TOLUENE (sur.)	%	100	102	98	97	N/A	4756175

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: B125774
Report Date: 2011/04/08

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE
Site Reference: BARONS, AB
Your P.O. #: L22101182.002
Sampler Initials: JL

AT1 F2 (WATER)

Maxxam ID		AG4146	AG4148	AG4149	AG4150		
Sampling Date		2011/03/31	2011/03/31	2011/03/31	2011/03/31		
COC Number		A034802	A034802	A034802	A034802		
	Units	11MW01	11MW02	11MW03	11DUP	RDL	QC Batch

Hydrocarbons							
F2 (C10-C16 Hydrocarbons)	mg/L	<0.1	<0.1	<0.1	<0.1	0.1	4759978
Surrogate Recovery (%)							
O-TERPHENYL (sur.)	%	102	94	102	96	N/A	4759978
N/A = Not Applicable RDL = Reportable Detection Limit							

Maxxam Job #: B125774
Report Date: 2011/04/08

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE
Site Reference: BARONS, AB
Your P.O. #: L22101182.002
Sampler Initials: JL

Package 1	7.0°C
-----------	-------

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

General Comments

Results relate only to the items tested.

EBA ENGINEERING CONSULTANTS LTD.
Attention: DERYCK MASTERMAN
Client Project #: BARONS AMA SITE
P.O. #: L22101182.002
Site Reference: BARONS, AB

Quality Assurance Report
Maxxam Job Number: CB125774

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4756175 MJ0	Matrix Spike	4-BROMOFLUOROBENZENE (sur.)	2011/04/05		101	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2011/04/05		99	%	70 - 130
		D8-TOLUENE (sur.)	2011/04/05		99	%	70 - 130
		Benzene	2011/04/05		91	%	70 - 130
		Toluene	2011/04/05		93	%	70 - 130
		Ethylbenzene	2011/04/05		98	%	70 - 130
	Spiked Blank	o-Xylene	2011/04/05		102	%	70 - 130
		m & p-Xylene	2011/04/05		101	%	70 - 130
		4-BROMOFLUOROBENZENE (sur.)	2011/04/05		104	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2011/04/05		101	%	70 - 130
		D8-TOLUENE (sur.)	2011/04/05		99	%	70 - 130
		Benzene	2011/04/05		97	%	70 - 130
	Method Blank	Toluene	2011/04/05		98	%	70 - 130
		Ethylbenzene	2011/04/05		103	%	70 - 130
		o-Xylene	2011/04/05		105	%	70 - 130
		m & p-Xylene	2011/04/05		105	%	70 - 130
		(C6-C10)	2011/04/05		96	%	70 - 130
		4-BROMOFLUOROBENZENE (sur.)	2011/04/05		94	%	70 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2011/04/05		95	%	70 - 130
		D8-TOLUENE (sur.)	2011/04/05		104	%	70 - 130
		Benzene	2011/04/05	<0.0004		mg/L	
		Toluene	2011/04/05	<0.0004		mg/L	
		Ethylbenzene	2011/04/05	<0.0004		mg/L	
		o-Xylene	2011/04/05	<0.0004		mg/L	
		m & p-Xylene	2011/04/05	<0.0008		mg/L	
		Xylenes (Total)	2011/04/05	<0.0008		mg/L	
	RPD	F1 (C6-C10) - BTEX	2011/04/05	<0.1		mg/L	
		(C6-C10)	2011/04/05	<0.1		mg/L	
		Benzene	2011/04/05	NC		%	40
		Toluene	2011/04/05	NC		%	40
		Ethylbenzene	2011/04/05	NC		%	40
		o-Xylene	2011/04/05	NC		%	40
		m & p-Xylene	2011/04/05	NC		%	40
		Xylenes (Total)	2011/04/05	NC		%	40
		F1 (C6-C10) - BTEX	2011/04/05	NC		%	40
		(C6-C10)	2011/04/05	NC		%	40
4759978 LQ	Matrix Spike	O-TERPHENYL (sur.)	2011/04/07		104	%	70 - 130
		F2 (C10-C16 Hydrocarbons)	2011/04/07		118	%	50 - 130
	Spiked Blank	O-TERPHENYL (sur.)	2011/04/07		109	%	70 - 130
		F2 (C10-C16 Hydrocarbons)	2011/04/07		106	%	70 - 130
	Method Blank	O-TERPHENYL (sur.)	2011/04/07		97	%	70 - 130
		F2 (C10-C16 Hydrocarbons)	2011/04/07	<0.1		mg/L	
	RPD	F2 (C10-C16 Hydrocarbons)	2011/04/07	NC		%	40

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 to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

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 (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

Validation Signature Page

Maxxam Job #: B125774

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



JANET GAO, Senior Analyst, Organics Department

=====

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Company:	Invoice To:	C/D Report Address	☒
Contact:	EBA ENGINEERING		
Address:	DERECK MASTERMAN		
Contact #s:	6142-10th ST. W. LETH.		
	Prov:	PC:	
	Ph:	Cell:	
	Ph:	Cell:	
	Report To:	Same as Invoice	☒
	Report Distribution (E-Mail):		
	dmasterman@eba.ca		
	jmasterm@eba.ca		

REGULATORY GUIDELINES:

☒ AT1

☐ CCME

☐ Regulated Drinking Water

☐ Other:

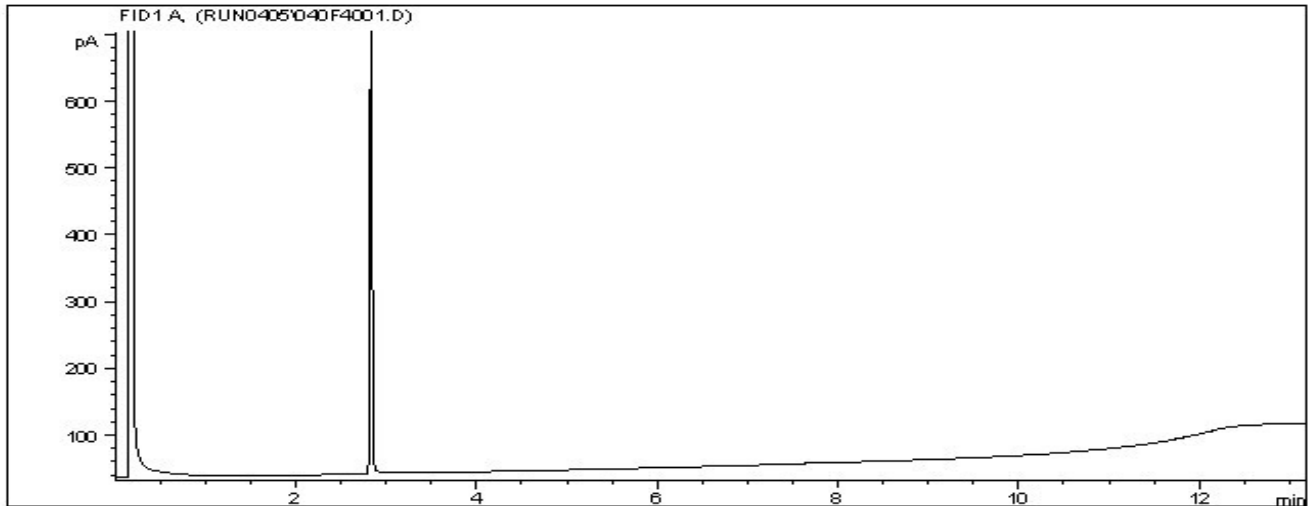
[illegible]

Relinquished By (Signature/Print): JAMIE LAWONTAGNE	Date (YYMM/DD): MARCH 3/11	Time (24:00): 5:00pm
Relinquished By (Signature/Print): <i>[Signature]</i>	Date (YYMM/DD): <i>[Signature]</i>	Time (24:00):
Special Instructions: # of Jars Used & Not Submitted		

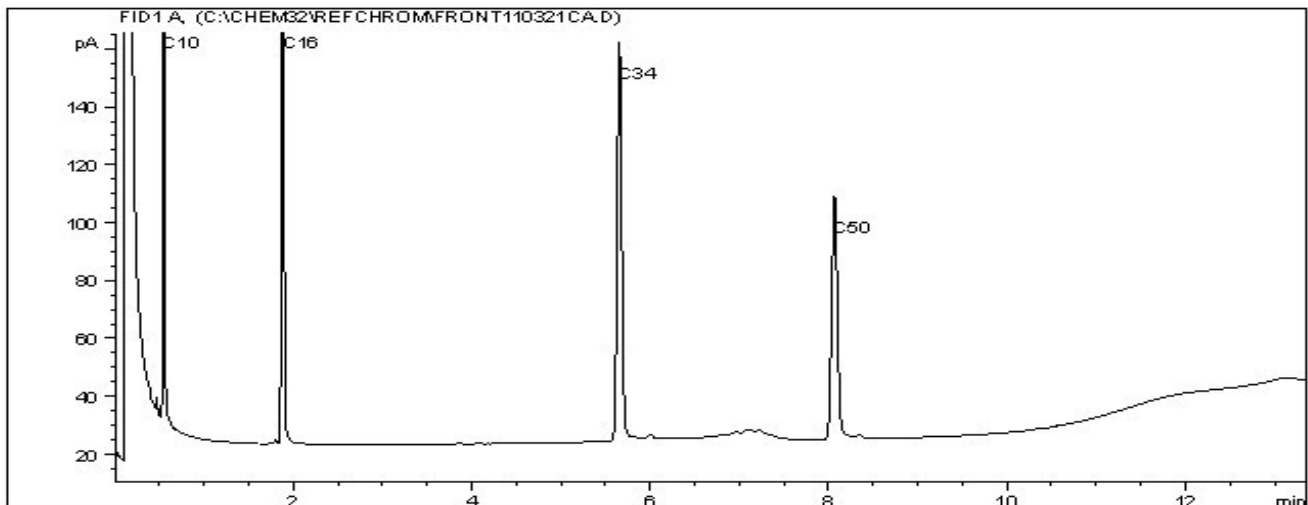
Report Date: 2011/04/08
Maxxam Job #: B125774
Maxxam Sample: AG4146

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE
Site Reference: BARONS, AB
Client ID: 11MW01

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

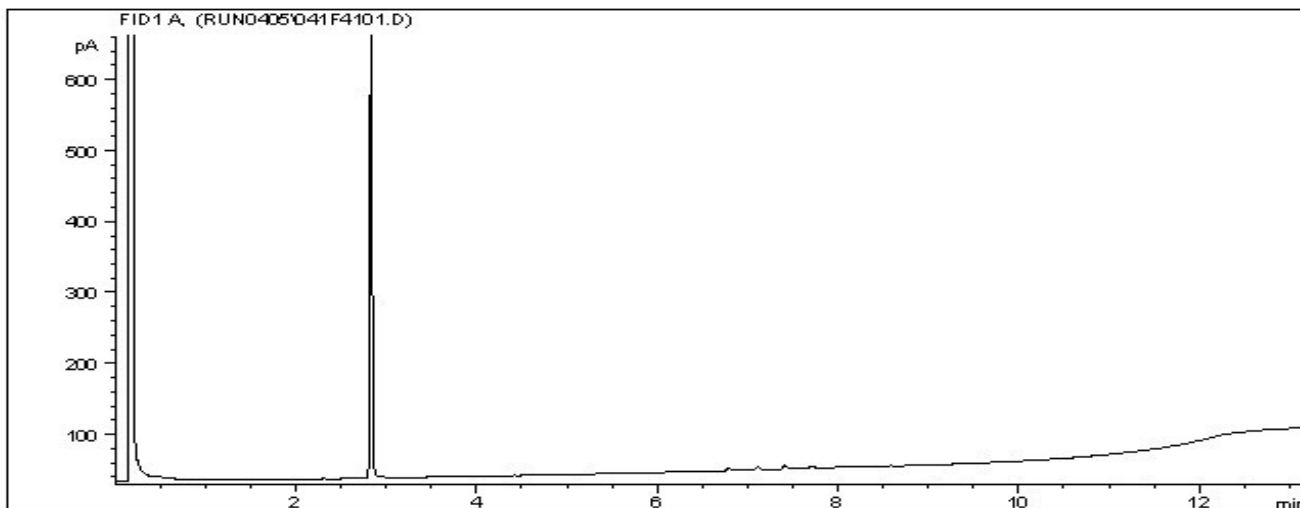
Page 1 of 1

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

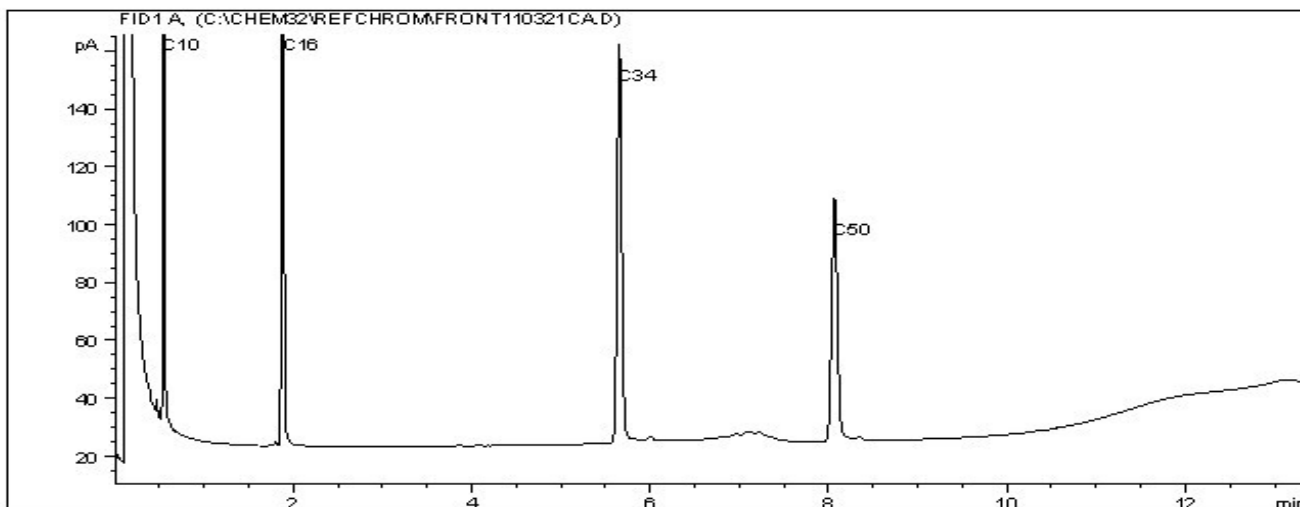
Report Date: 2011/04/08
Maxxam Job #: B125774
Maxxam Sample: AG4148

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE
Site Reference: BARONS, AB
Client ID: 11MW02

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

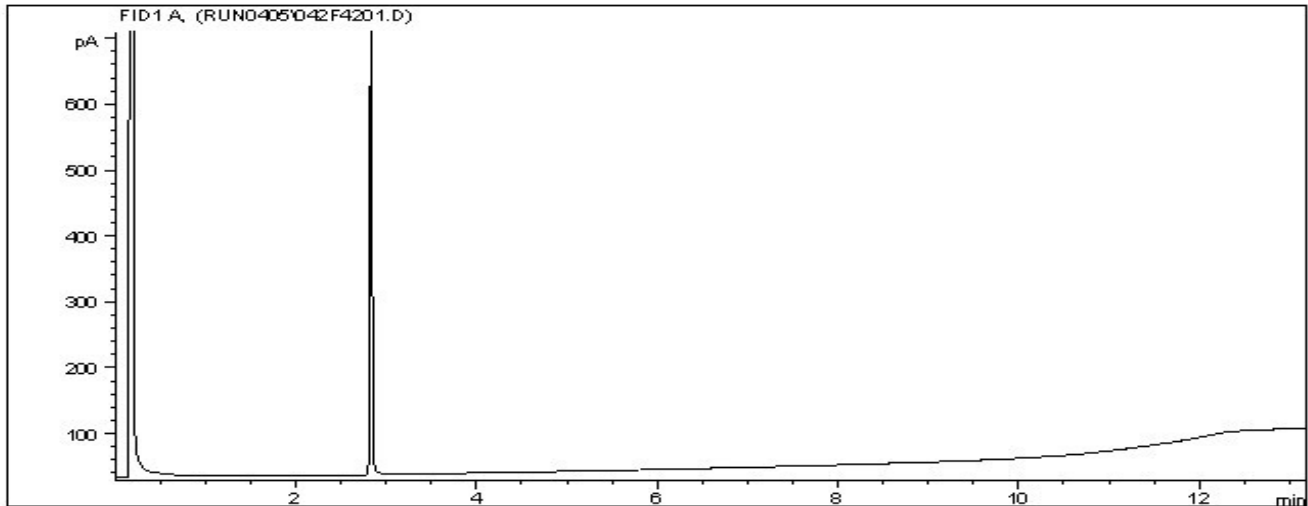
Page 1 of 1

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

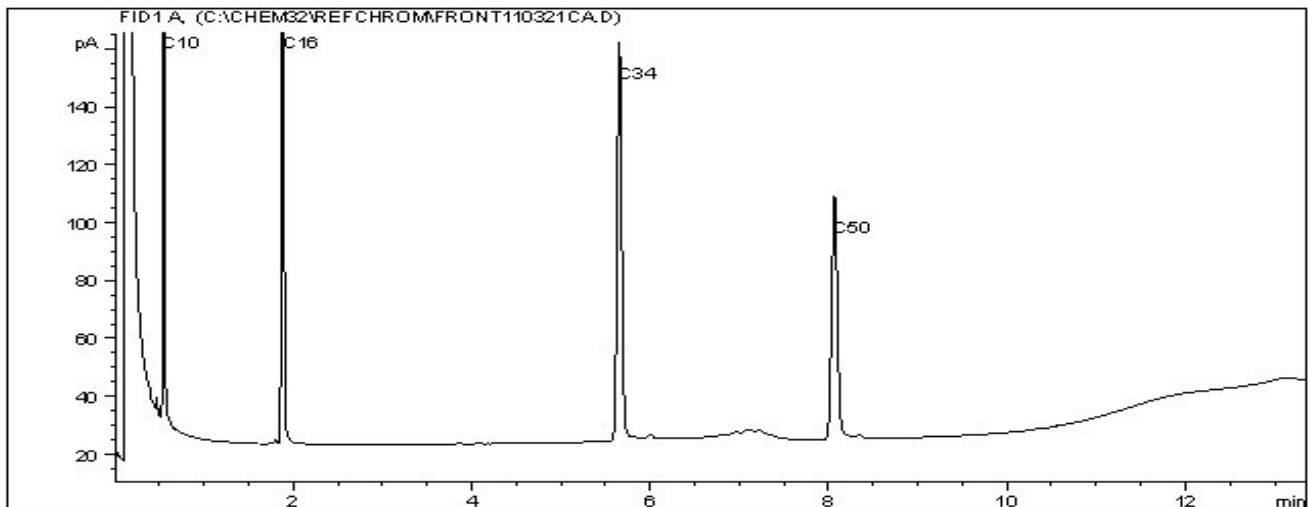
Report Date: 2011/04/08
Maxxam Job #: B125774
Maxxam Sample: AG4149

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE
Site Reference: BARONS, AB
Client ID: 11MW03

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

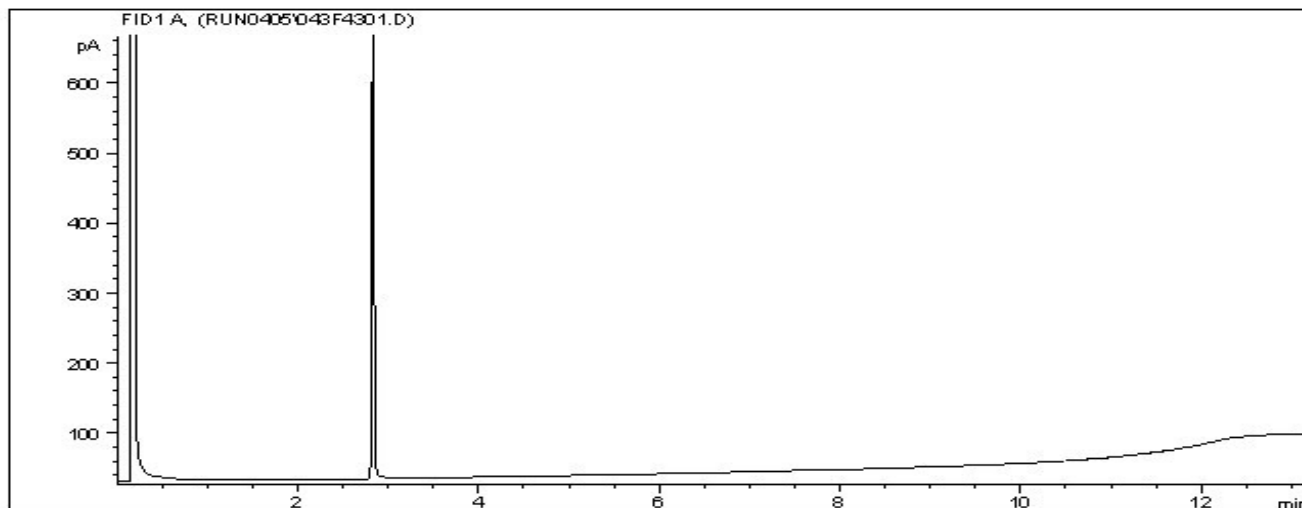
Page 1 of 1

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

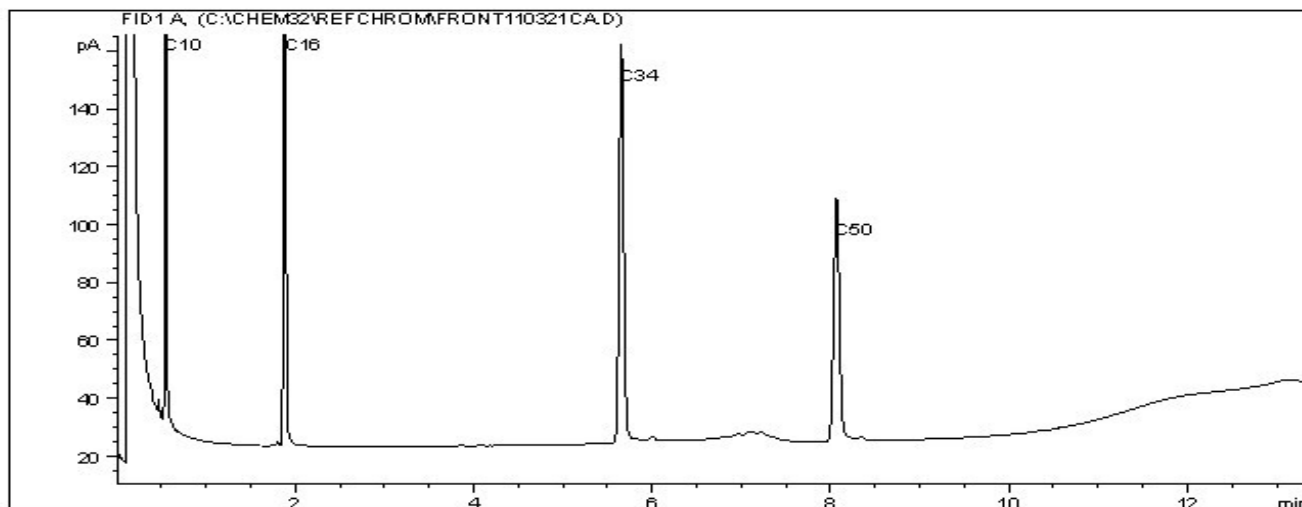
Report Date: 2011/04/08
Maxxam Job #: B125774
Maxxam Sample: AG4150

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE
Site Reference: BARONS, AB
Client ID: 11DUP

CCME Hydrocarbons in Water (F2; C10-C16) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

Page 1 of 1

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

Your P.O. #: L22101182.002
 Your Project #: BARONS AMA SITE 9557
 Site: BARONS, AB
 Your C.O.C. #: A011824

Attention: DERYCK MASTERMAN
 EBA ENGINEERING CONSULTANTS LTD.
 442-10 STREET NORTH
 LETHBRIDGE, AB
 CANADA T1H 2C7

Report Date: 2011/03/23

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B121162
Received: 2011/03/17, 11:25

Sample Matrix: Soil
 # Samples Received: 9

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
BTEX/F1 by HS GC/MS (MeOH extract)	7	2011/03/17	2011/03/18	CAL SOP-00190	CCME CWS, EPA 8260C
BTEX/F1 by HS GC/MS (MeOH extract)	2	2011/03/17	2011/03/21	CAL SOP-00190	CCME CWS, EPA 8260C
CCME Hydrocarbons (F2-F4 in soil)	9	2011/03/17	2011/03/18	CAL SOP-00086 AB SOP-00036	CCME PHC-CWS
Moisture	9	N/A	2011/03/18	CAL SOP-00023	McKeague MSSMA 2.411
Particle Size by Sieve (75 micron)	3	N/A	2011/03/21	AB SOP-00022	SSMA 55.4

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

BRIAN ISSLER, Project Manager
 Email: BIssler@maxxam.ca
 Phone# (403) 735-2250 Ext:2250

=====

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.

Total cover pages: 1

Maxxam Job #: B121162
Report Date: 2011/03/23

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Your P.O. #: L22101182.002
Sampler Initials: JL

AT1 BTEX AND F1-F4 IN SOIL (SOIL)

Maxxam ID		AD8725	AD8726	AD8726	AD8728	AD8729		
Sampling Date		2011/03/15	2011/03/15	2011/03/15	2011/03/15	2011/03/15		
COC Number		A011824	A011824	A011824	A011824	A011824		
	Units	11MW01 @ 1.8 M	11MW01 @ 2.4 M	11MW01 @ 2.4 M Lab-Dup	11MW02 @ 3.6 M	11MW02 @ 4.8 M	RDL	QC Batch

Physical Properties								
Moisture	%	22	13	N/A	15	16	0.3	4716338
Ext. Pet. Hydrocarbon								
F2 (C10-C16 Hydrocarbons)	mg/kg	<10	21	N/A	<10	<10	10	4716276
F3 (C16-C34 Hydrocarbons)	mg/kg	<10	<10	N/A	<10	<10	10	4716276
F4 (C34-C50 Hydrocarbons)	mg/kg	<10	<10	N/A	<10	<10	10	4716276
Reached Baseline at C50	mg/kg	Yes	Yes	N/A	Yes	Yes	N/A	4716276
Volatiles								
Benzene	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	4716259
Toluene	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	4716259
Ethylbenzene	mg/kg	0.059	5.5	6.4	<0.010	<0.010	0.010	4716259
Xylenes (Total)	mg/kg	0.14	16	18	<0.040	<0.040	0.040	4716259
m & p-Xylene	mg/kg	0.14	16	18	<0.040	<0.040	0.040	4716259
o-Xylene	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	4716259
F1 (C6-C10) - BTEX	mg/kg	<12	150	130	<12	<12	12	4716259
(C6-C10)	mg/kg	<12	170	150	<12	<12	12	4716259
Surrogate Recovery (%)								
4-BROMOFLUOROBENZENE (sur.)	%	104	105	108	104	106	N/A	4716259
D10-ETHYLBENZENE (sur.)	%	81	81	81	80	81	N/A	4716259
D4-1,2-DICHLOROETHANE (sur.)	%	105	109	106	103	104	N/A	4716259
D8-TOLUENE (sur.)	%	89	91	90	88	89	N/A	4716259
O-TERPHENYL (sur.)	%	115	117	N/A	117	119	N/A	4716276

N/A = Not Applicable
RDL = Reportable Detection Limit

Maxxam Job #: B121162
Report Date: 2011/03/23

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Your P.O. #: L22101182.002
Sampler Initials: JL

AT1 BTEX AND F1-F4 IN SOIL (SOIL)

Maxxam ID		AD8731	AD8732		
Sampling Date		2011/03/15	2011/03/15		
COC Number		A011824	A011824		
	Units	11MW03 @ 3.6 M	11MW03 @ 4.8 M	RDL	QC Batch

Physical Properties					
Moisture	%	13	15	0.3	4716338
Ext. Pet. Hydrocarbon					
F2 (C10-C16 Hydrocarbons)	mg/kg	<10	1700	10	4716276
F3 (C16-C34 Hydrocarbons)	mg/kg	<10	800	10	4716276
F4 (C34-C50 Hydrocarbons)	mg/kg	<10	<10	10	4716276
Reached Baseline at C50	mg/kg	Yes	Yes	N/A	4716276
Volatiles					
Benzene	mg/kg	<0.0050	<0.0050	0.0050	4716259
Toluene	mg/kg	<0.020	<0.020	0.020	4716259
Ethylbenzene	mg/kg	<0.010	<0.010	0.010	4716259
Xylenes (Total)	mg/kg	<0.040	<0.040	0.040	4716259
m & p-Xylene	mg/kg	<0.040	<0.040	0.040	4716259
o-Xylene	mg/kg	<0.020	<0.020	0.020	4716259
F1 (C6-C10) - BTEX	mg/kg	<12	260	12	4716259
(C6-C10)	mg/kg	<12	260	12	4716259
Surrogate Recovery (%)					
4-BROMOFLUOROBENZENE (sur.)	%	102	101	N/A	4716259
D10-ETHYLBENZENE (sur.)	%	80	84	N/A	4716259
D4-1,2-DICHLOROETHANE (sur.)	%	100	108	N/A	4716259
D8-TOLUENE (sur.)	%	87	93	N/A	4716259
O-TERPHENYL (sur.)	%	116	124	N/A	4716276
N/A = Not Applicable RDL = Reportable Detection Limit					

Maxxam Job #: B121162
Report Date: 2011/03/23

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Your P.O. #: L22101182.002
Sampler Initials: JL

AT1 BTEX, F1-F4, AND SIEVE (SOIL)

Maxxam ID		AD8727	AD8730	AD8735		
Sampling Date		2011/03/15	2011/03/15	2011/03/15		
COC Number		A011824	A011824	A011824		
	Units	11MW01 @ 4.2 M	11MW02 @ 6.0 M	11MW03 @ 5.4 M	RDL	QC Batch

Physical Properties						
Moisture	%	15	10	12	0.3	4716338
Sieve - Pan	%	48	60	41	0.2	4720666
Sieve - #200 (>0.075mm)	%	52	40	59	0.2	4720666
Grain Size	%	COARSE	FINE	COARSE	0.2	4720666
Ext. Pet. Hydrocarbon						
F2 (C10-C16 Hydrocarbons)	mg/kg	<10	230	<10	10	4716276
F3 (C16-C34 Hydrocarbons)	mg/kg	<10	110	<10	10	4716276
F4 (C34-C50 Hydrocarbons)	mg/kg	<10	<10	<10	10	4716276
Reached Baseline at C50	mg/kg	Yes	Yes	Yes	N/A	4716276
Volatiles						
Benzene	mg/kg	<0.0050	<0.0050	<0.0050	0.0050	4716259
Toluene	mg/kg	<0.020	<0.020	<0.020	0.020	4716259
Ethylbenzene	mg/kg	0.062	<0.010	<0.010	0.010	4716259
Xylenes (Total)	mg/kg	<0.040	<0.040	<0.040	0.040	4716259
m & p-Xylene	mg/kg	<0.040	<0.040	<0.040	0.040	4716259
o-Xylene	mg/kg	<0.020	<0.020	<0.020	0.020	4716259
F1 (C6-C10) - BTEX	mg/kg	<12	<12	<12	12	4716259
(C6-C10)	mg/kg	<12	<12	<12	12	4716259
Surrogate Recovery (%)						
4-BROMOFLUOROBENZENE (sur.)	%	104	106	104	N/A	4716259
D10-ETHYLBENZENE (sur.)	%	80	80	80	N/A	4716259
D4-1,2-DICHLOROETHANE (sur.)	%	112	103	110	N/A	4716259
D8-TOLUENE (sur.)	%	88	88	88	N/A	4716259
O-TERPHENYL (sur.)	%	118	123	117	N/A	4716276
N/A = Not Applicable RDL = Reportable Detection Limit						

Maxxam Job #: B121162
Report Date: 2011/03/23

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Your P.O. #: L22101182.002
Sampler Initials: JL

Package 1	9.7°C
-----------	-------

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

General Comments

Results relate only to the items tested.

EBA ENGINEERING CONSULTANTS LTD.
Attention: DERYCK MASTERMAN
Client Project #: BARONS AMA SITE 9557
P.O. #: L22101182.002
Site Reference: BARONS, AB

Quality Assurance Report
Maxxam Job Number: CB121162

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4716259 RSA	Matrix Spike [AD8726-01]	4-BROMOFLUOROBENZENE (sur.)	2011/03/18		104	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2011/03/18		87	%	30 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2011/03/18		107	%	60 - 140
		D8-TOLUENE (sur.)	2011/03/18		92	%	60 - 140
		Benzene	2011/03/18		104	%	60 - 140
		Toluene	2011/03/18		96	%	60 - 140
		Ethylbenzene	2011/03/18		118	%	60 - 140
		m & p-Xylene	2011/03/18		114	%	60 - 140
		o-Xylene	2011/03/18		108	%	60 - 140
		(C6-C10)	2011/03/18		104	%	60 - 140
	Spiked Blank	4-BROMOFLUOROBENZENE (sur.)	2011/03/18		104	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2011/03/18		83	%	30 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2011/03/18		114	%	60 - 140
		D8-TOLUENE (sur.)	2011/03/18		92	%	60 - 140
		Benzene	2011/03/18		113	%	60 - 140
		Toluene	2011/03/18		105	%	60 - 140
		Ethylbenzene	2011/03/18		116	%	60 - 140
		m & p-Xylene	2011/03/18		114	%	60 - 140
		o-Xylene	2011/03/18		114	%	60 - 140
		(C6-C10)	2011/03/18		107	%	60 - 140
	Method Blank	4-BROMOFLUOROBENZENE (sur.)	2011/03/18		101	%	60 - 140
		D10-ETHYLBENZENE (sur.)	2011/03/18		81	%	30 - 130
		D4-1,2-DICHLOROETHANE (sur.)	2011/03/18		107	%	60 - 140
		D8-TOLUENE (sur.)	2011/03/18		89	%	60 - 140
		Benzene	2011/03/18	<0.0050		mg/kg	
		Toluene	2011/03/18	<0.020		mg/kg	
		Ethylbenzene	2011/03/18	<0.010		mg/kg	
		Xylenes (Total)	2011/03/18	<0.040		mg/kg	
		m & p-Xylene	2011/03/18	<0.040		mg/kg	
		o-Xylene	2011/03/18	<0.020		mg/kg	
	RPD [AD8726-01]	F1 (C6-C10) - BTEX	2011/03/18	<12		mg/kg	
		(C6-C10)	2011/03/18	<12		mg/kg	
		Benzene	2011/03/18	NC		%	50
		Toluene	2011/03/18	NC		%	50
		Ethylbenzene	2011/03/18	14.3		%	50
		Xylenes (Total)	2011/03/18	15.4		%	50
		m & p-Xylene	2011/03/18	15.4		%	50
		o-Xylene	2011/03/18	NC		%	50
		F1 (C6-C10) - BTEX	2011/03/18	15.7		%	50
		(C6-C10)	2011/03/18	11.3		%	50
4716276 LQ	Matrix Spike	O-TERPHENYL (sur.)	2011/03/18		108	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2011/03/18		N/C	%	50 - 130
		F3 (C16-C34 Hydrocarbons)	2011/03/18		98	%	50 - 130
		F4 (C34-C50 Hydrocarbons)	2011/03/18		107	%	50 - 130
	Spiked Blank	O-TERPHENYL (sur.)	2011/03/18		101	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2011/03/18		99	%	80 - 120
		F3 (C16-C34 Hydrocarbons)	2011/03/18		92	%	80 - 120
		F4 (C34-C50 Hydrocarbons)	2011/03/18		96	%	80 - 120
	Method Blank	O-TERPHENYL (sur.)	2011/03/18		98	%	50 - 130
		F2 (C10-C16 Hydrocarbons)	2011/03/18	<10		mg/kg	
		F3 (C16-C34 Hydrocarbons)	2011/03/18	<10		mg/kg	
		F4 (C34-C50 Hydrocarbons)	2011/03/18	<10		mg/kg	
	RPD	F2 (C10-C16 Hydrocarbons)	2011/03/22	67.8 (l)		%	50
		F3 (C16-C34 Hydrocarbons)	2011/03/22	64.0 (l)		%	50

EBA ENGINEERING CONSULTANTS LTD.
Attention: DERYCK MASTERMAN
Client Project #: BARONS AMA SITE 9557
P.O. #: L22101182.002
Site Reference: BARONS, AB

Quality Assurance Report (Continued)

Maxxam Job Number: CB121162

QA/QC Batch Num Init	QC Type	Parameter	Date Analyzed yyyy/mm/dd	Value	Recovery	Units	QC Limits
4716276 LQ	RPD	F4 (C34-C50 Hydrocarbons)	2011/03/22	NC		%	50
4720666 RK3	QC Standard	Sieve - Pan	2011/03/21		99	%	92 - 108
		Sieve - #200 (>0.075mm)	2011/03/21		103	%	79 - 121
	RPD	Sieve - Pan	2011/03/21	0.07		%	35
		Sieve - #200 (>0.075mm)	2011/03/21	0.2		%	35

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.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

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 (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

(1) Duplicate exceeds acceptance criteria due to sample non homogeneity. Reanalysis yields similar results.

Validation Signature Page

Maxxam Job #: B121162

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

Junzhi Gao

JANET GAO, Senior Analyst, Organics Department

JTL Zhou

LILI ZHOU, Senior analyst, Inorganic department.

=====

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.

Company:	Invoice To:	C/O Report Address	☐
Contact:	EBA ENGINEERING		
Address:	DERYCK MASTERMAN		
Contact #s:	442-10th ST. N. LEHIGH BLVD		
	Phone:	PC:	
	403.329.7009	714.267	
	Fax:	Cell:	
	403.329.7009	403.334.3566	

Report To:	Same as Invoice	☒
Prov:	PC	
Ph:	Cell	

Report Distribution (E-Mail):
dmasterman@boe.ca

REGULATORY GUIDELINES:

☒ AT1

☐ CCME

☐ Regulated Drinking Water

☐ Other:

All samples are held for 60 calendar days after sample receipt, unless specified otherwise.

PO #: 222101182.002
Project # / Name: BARON'S AMASITE 9557
Site Location: BARON'S AR
Quote #:
Sampled By: T. LAMONTAGNE

SERVICE REQUESTED:

☐ RUSH (Contact lab to reserve)

Date Required: _____

☒ REGULAR (5 to 7 Days)

Sample ID	Depth (unit)	Matrix GW / SW Soil	Date/Time Sampled YY/MM/DD 24:00
1 11MW01	1.8m	Soil	MARCH 15/11
2 11MW01	2.4m		
3 11MW01	4.2m		
4 11MW02	3.6m		
5 11MW02	4.8m		
6 11MW02	6.0m		
7 11MW03	3.6m		
8 11MW03	4.8m		
9 11MW03	5.4m		
10			
11			
12			

Please indicate Filtered, Preserved or Both (F, P, F/P)

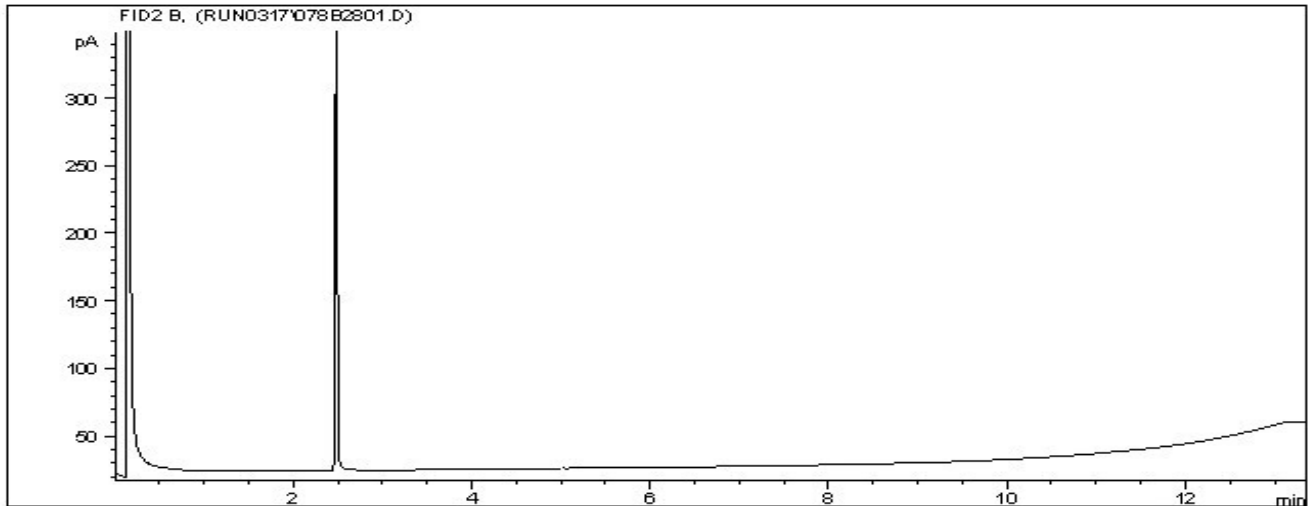
Relinquished By (Signature/Print):  J. Lawstac	Date (YYMMDD): 11/03/16	Time (24:00): 5:00 pm.
Relinquished By (Signature/Print): 	Date (YYMMDD):	Time (24:00):
Special Instructions:	# of Jars Used & Not Submitted	

Received By:	RECEIVED MAR 17 2011 MAR 17 2011 MAR 17 2011	LAB USE ONLY	
		Time:	
Lab Comments:		Maximum Job #:	CB121162
		Custody Seal	No
		Temperature	Ice
			11/12/6
			Yes

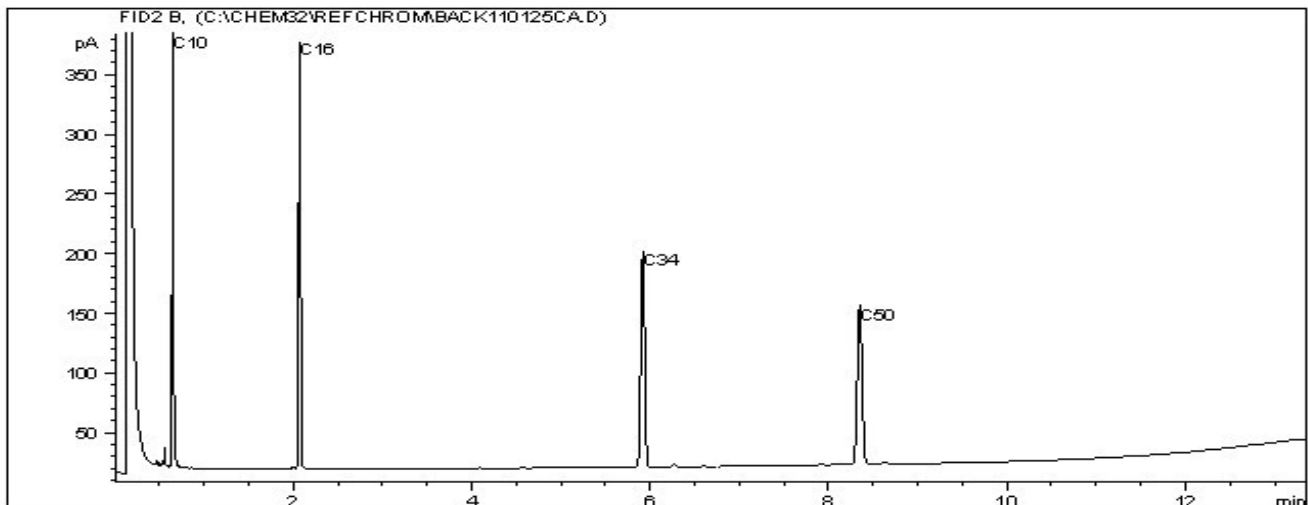
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8725

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW01 @ 1.8 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

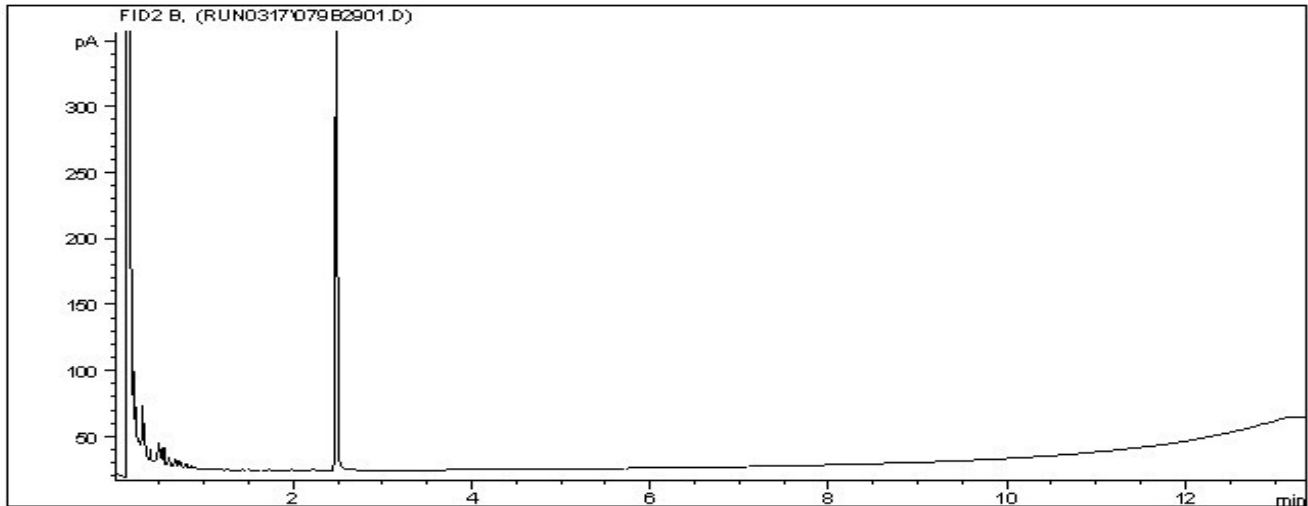
Page 1 of 1

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

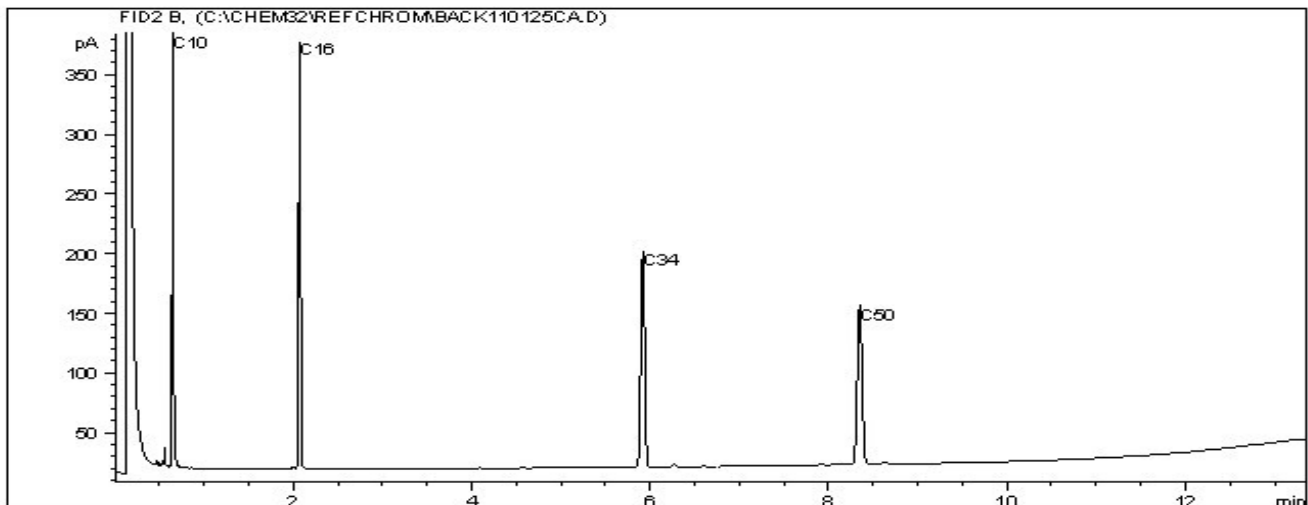
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8726

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW01 @ 2.4 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

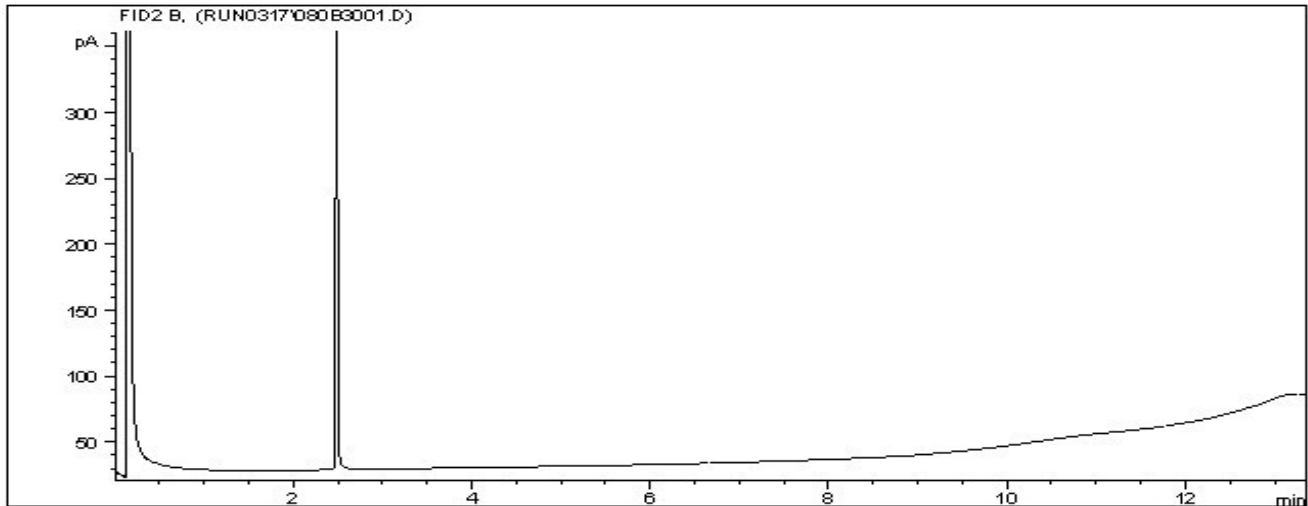
Page 1 of 1

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

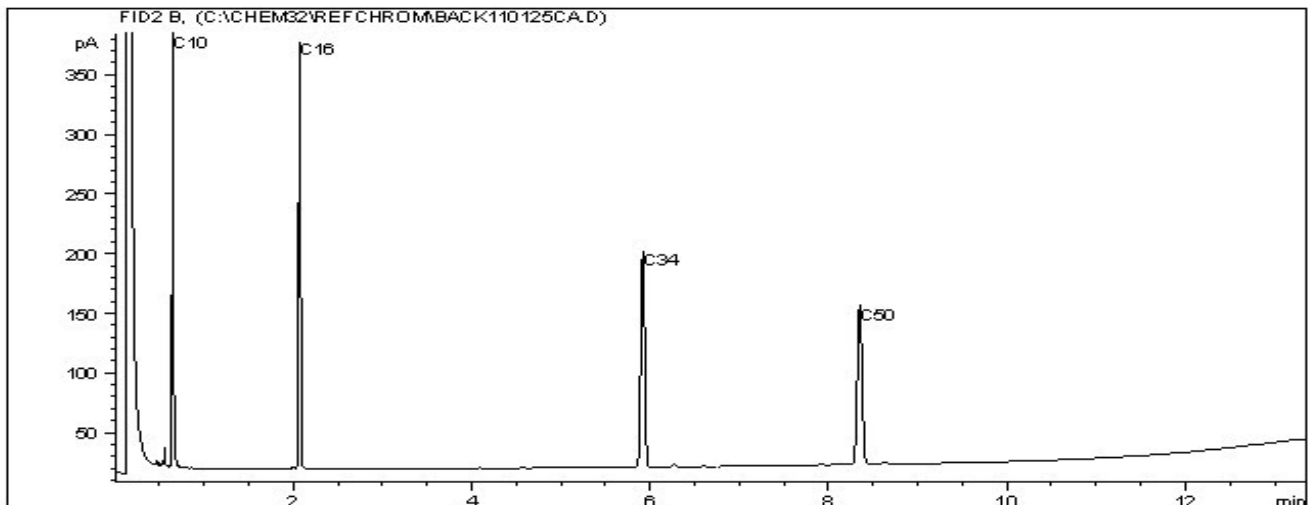
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8727

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW01 @ 4.2 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

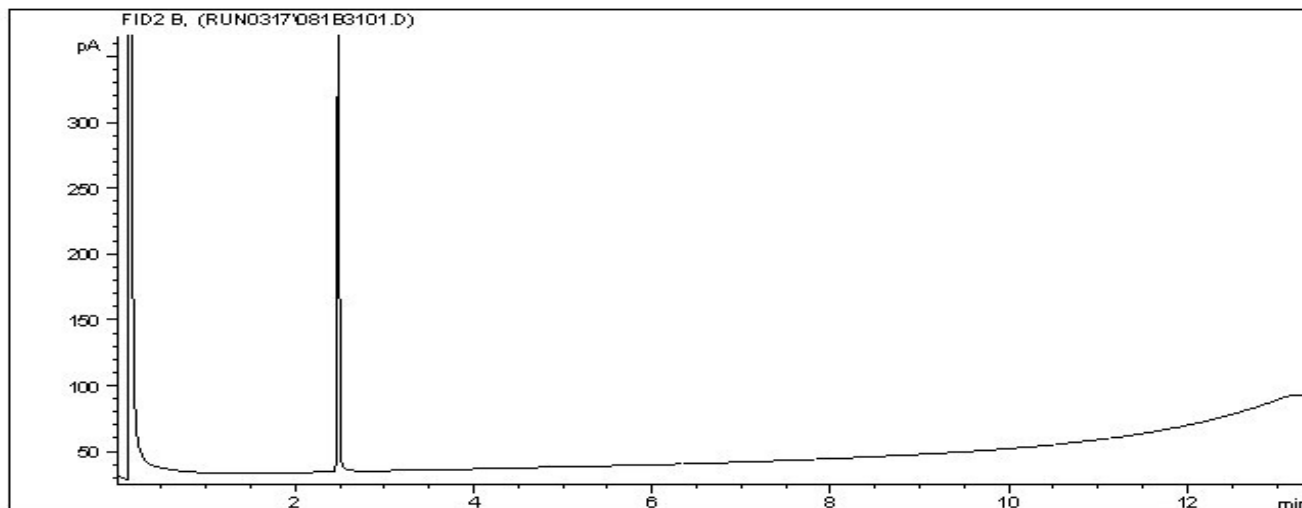
Page 1 of 1

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

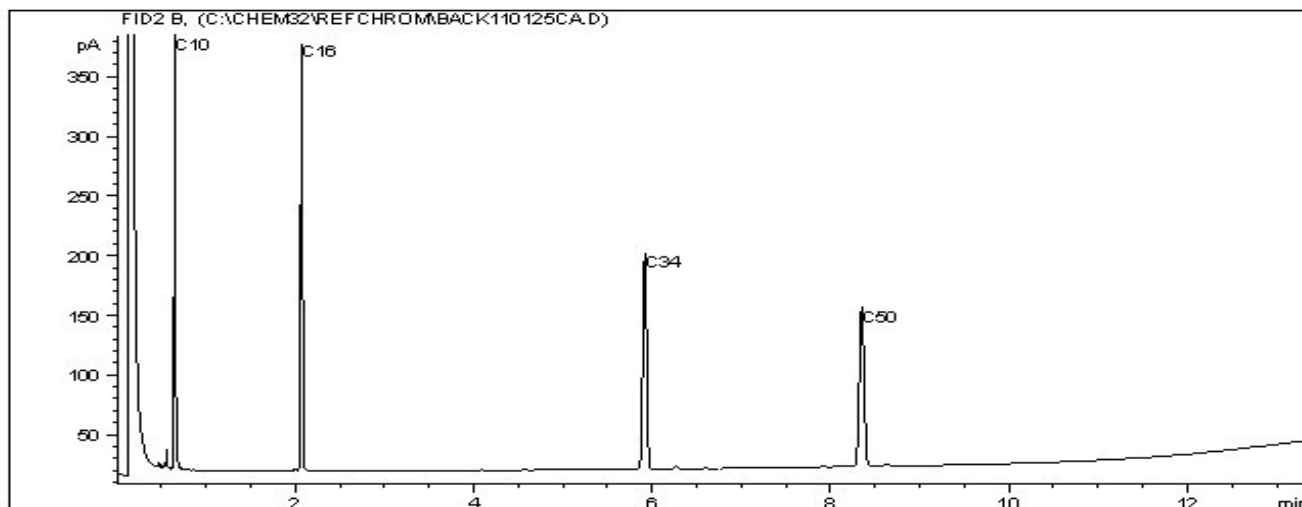
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8728

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW02 @ 3.6 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

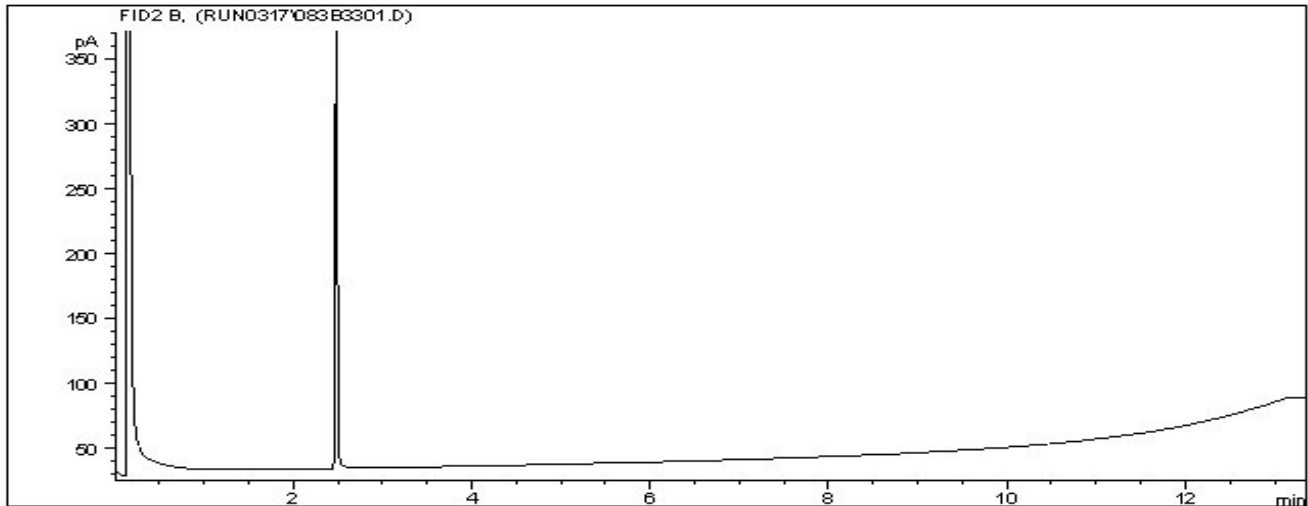
Page 1 of 1

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

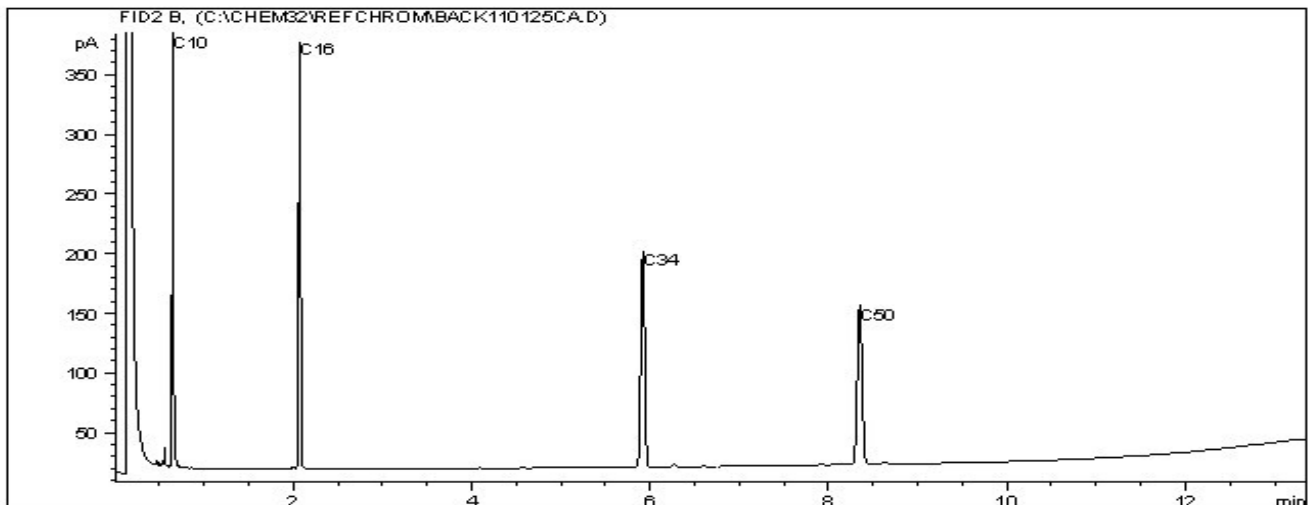
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8729

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW02 @ 4.8 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

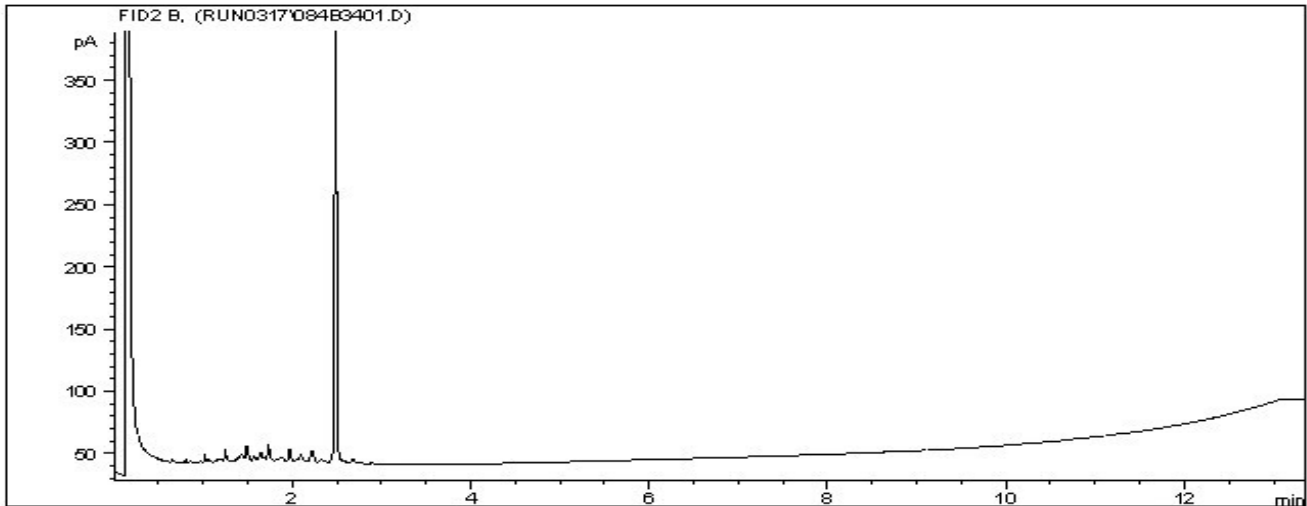
Page 1 of 1

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

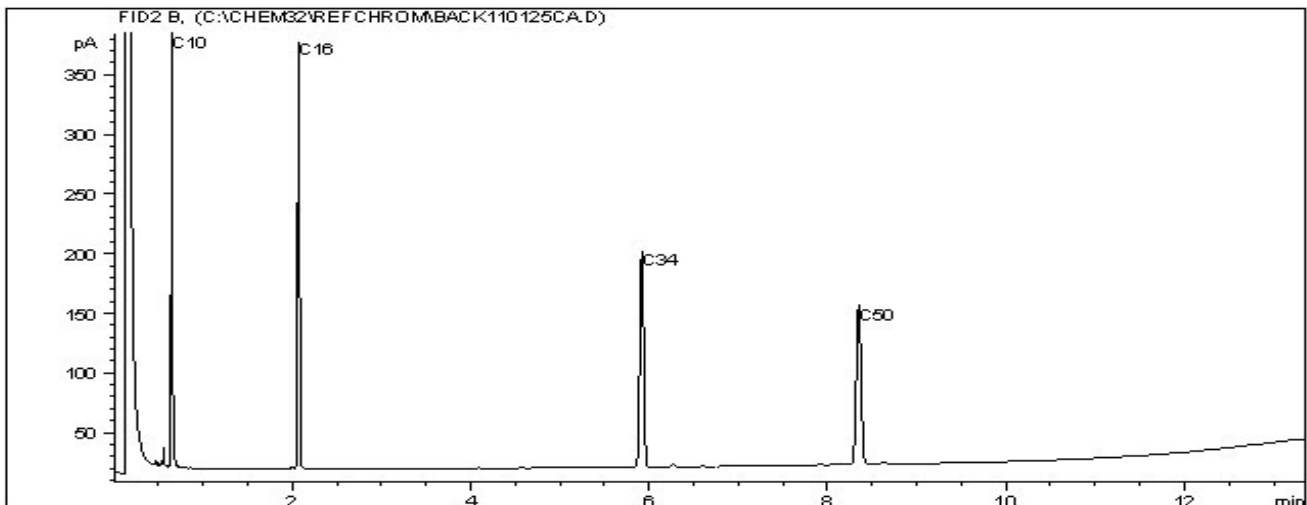
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8730

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW02 @ 6.0 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

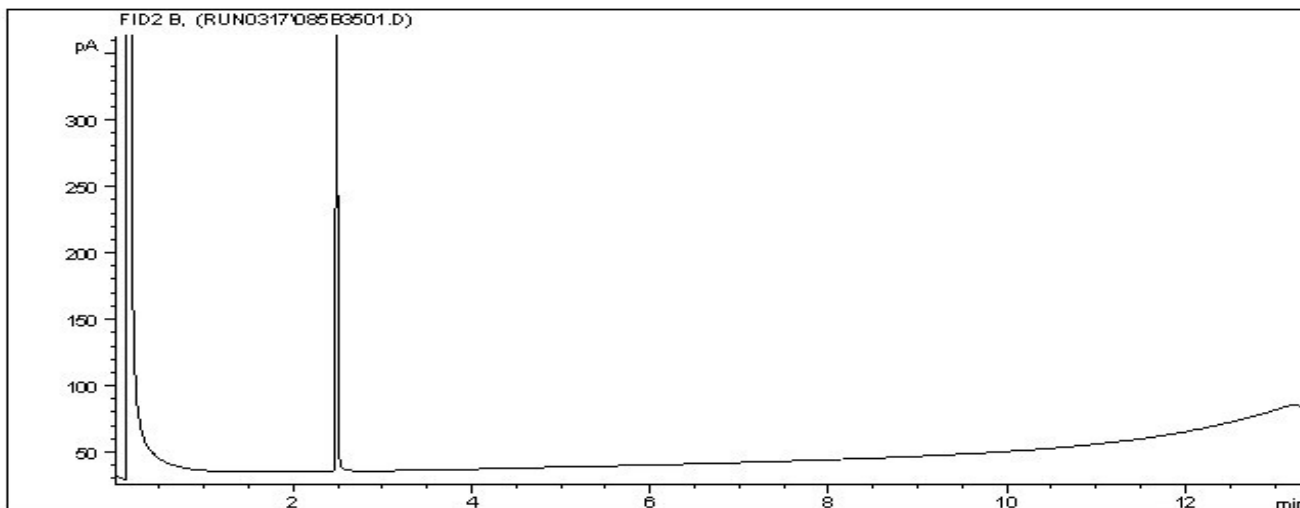
Page 1 of 1

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

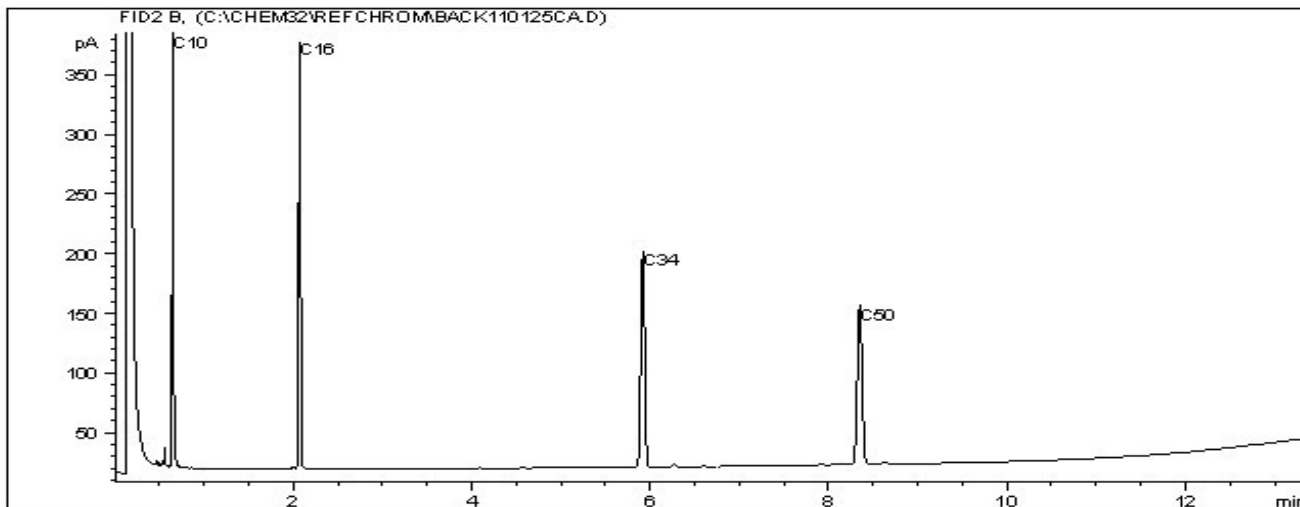
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8731

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW03 @ 3.6 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

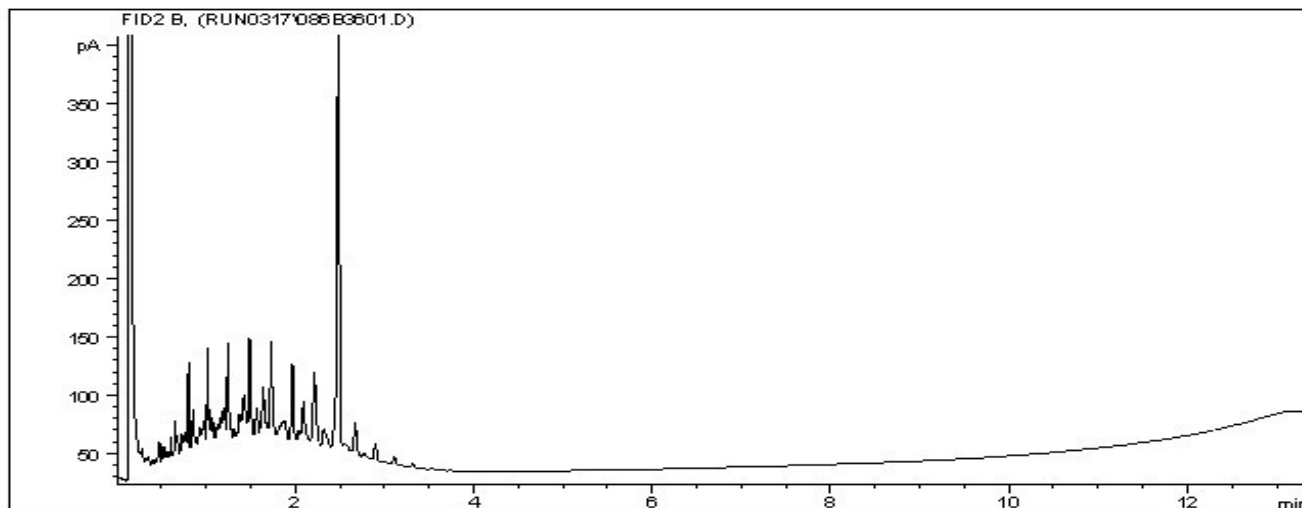
Page 1 of 1

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

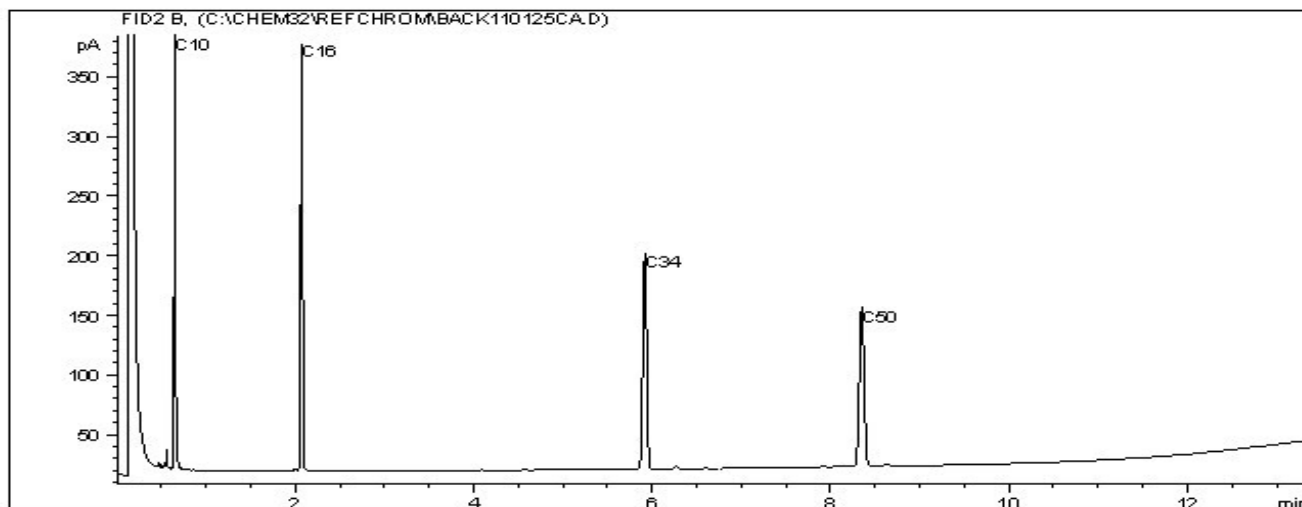
Report Date: 2011/03/23
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Maxxam Sample: AD8732

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW03 @ 4.8 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

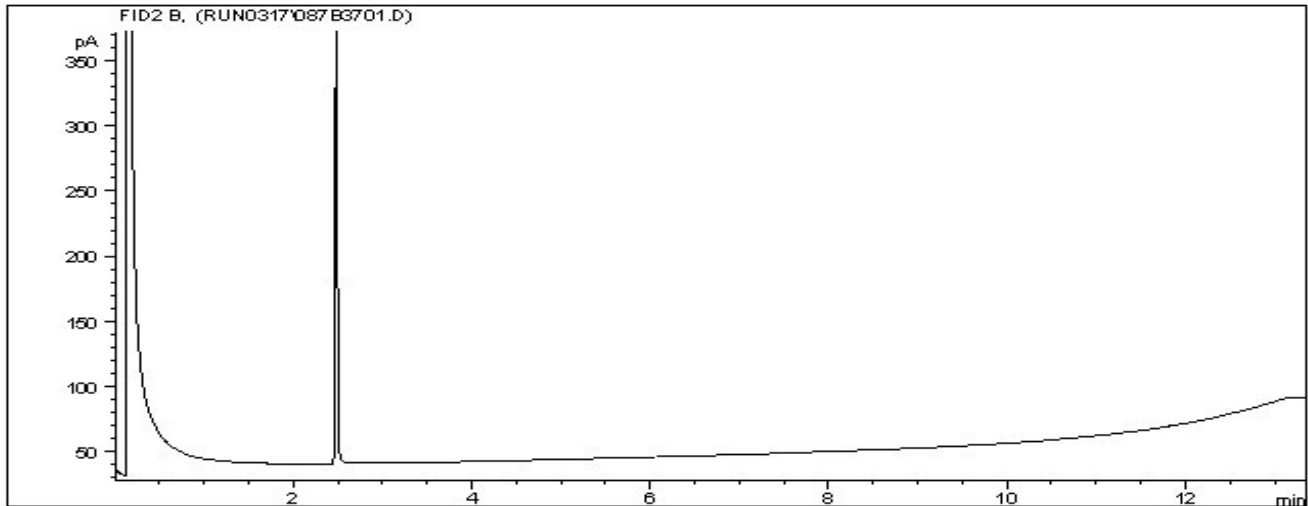
Page 1 of 1

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

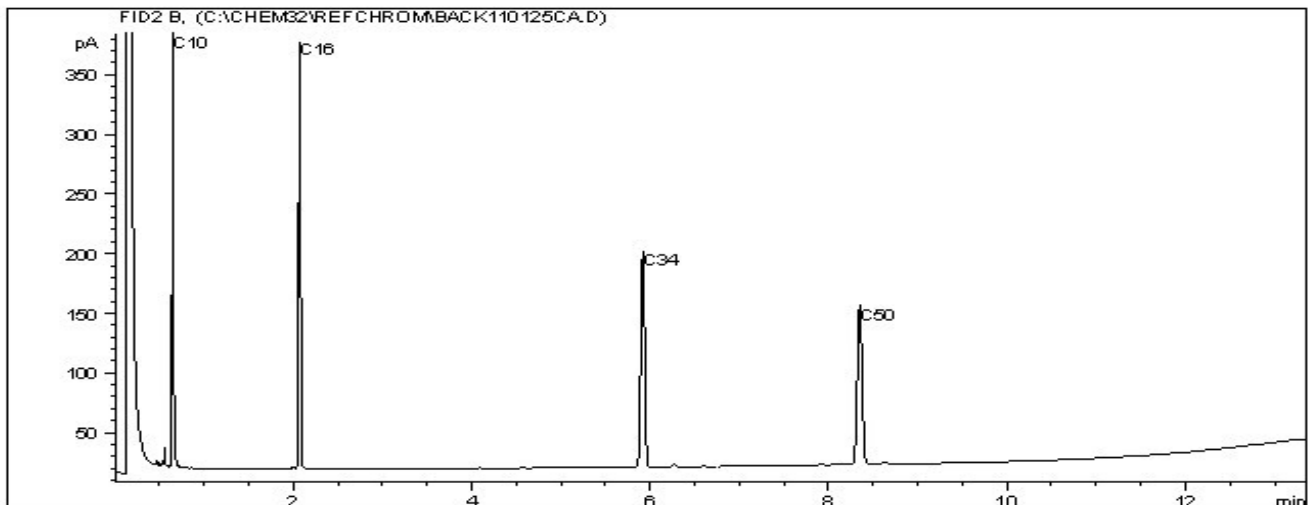
Report Date: 2011/03/23
Maxxam Job #: B121162
Maxxam Sample: AD8735

EBA ENGINEERING CONSULTANTS LTD.
Client Project #: BARONS AMA SITE 9557
Site Reference: BARONS, AB
Client ID: 11MW03 @ 5.4 M

CCME Hydrocarbons (F2-F4 in soil) Chromatogram



Carbon Range Distribution - Reference Chromatogram



TYPICAL PRODUCT CARBON NUMBER RANGES

Gasoline: C4 - C12
Varsol: C8 - C12
Kerosene: C7 - C16

Diesel: C8 - C22
Lubricating Oils: C20 - C40
Crude Oils: C3 - C60+

Page 1 of 1

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

APPENDIX D

APPENDIX D GEO-ENVIRONMENTAL REPORT – GENERAL CONDITIONS

GENERAL CONDITIONS

GEO-ENVIRONMENTAL 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 EBA's client. 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 EBA's Client unless otherwise authorized in writing by 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 EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed 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 EBA shall be deemed to be the original for the Project.

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

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. 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 EBA in its reasonably exercised discretion.

4.0 INFORMATION PROVIDED TO EBA BY OTHERS

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