



A TETRA TECH COMPANY

December 8, 2011

ISSUED FOR USE
EBA FILE: L22101183.005

Village of Barons
P.O. Box 129
Barons, AB T0L 0G0

Attention: Ms. Laurie Beck
Town Administrator
Subject: Risk Management Plan
Alberta Municipal Affairs Site 9558
124 Main Street, Barons, Alberta

1.0 INTRODUCTION

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA), was retained by Ms. Laurie Beck, of the Village of Barons (Barons), to prepare a Risk Management Plan (RMP) for the property at 124 Main Street in Barons, Alberta (Figure 1). The Alberta Municipal Affairs (AMA) number for the site is 9558.

This RMP is based on information collected during previous investigations conducted by EBA at the site. This RMP provides information relevant to the management of environmental risks at this site. Further information regarding other aspects of work to date can be found in the referenced documents.

The objectives of the RMP are:

- To characterize the potential risk for adverse human health and ecological effects due to exposure to the affected soils and groundwater at the site; and
- To evaluate mitigative options available to manage risk of adverse effects by controlling the exposure routes.

2.0 BACKGROUND AND SITE DESCRIPTION

2.1 Site Description

The site is a rectangular-shaped property, approximately 26,000 m² in area, located on the southeast quarter of Section 16, Township 012, Range 23, West of the Fourth Meridian at 124 Main Street, in Barons, Alberta. The northern portion of the site is used as a public park and contains trees, park benches, and a gazebo. The southern portion is vacant.

2.2 Past Reports Summary

Phase II and Phase III Environment Site Assessments (ESAs) were initiated and written by EBA in 2009 (EBA 2009). The ESAs followed a geotechnical evaluation for a roadway improvement and water line upgrade project along Main Street from Railway Avenue to Prairie Avenue, which identified petroleum

EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company
Riverbend Atrium One, 115, 200 Rivercrest Drive SE
Calgary, AB T2C 2X5 CANADA
p. 403.203.3355 f. 403.203.3301

hydrocarbons (PHCs) within soils and groundwater to the east of the site. The detection of PHCs during the geotechnical evaluation triggered a historical site assessment. EBA was not able to locate any records regarding the historical operations; however, anecdotal information provided by long-term residents of the Village of Barons confirmed the presence of a gas service station on site prior to 1970.

The Phase II and Phase III ESAs identified a previously unknown underground storage tank (UST) and concentrations exceeding applicable guidelines in the surrounding soil/and or groundwater. It was recommended that the UST be removed from the site and remedial activities be explored.

Based on the Phase II and Phase III ESA results, the following conclusions were made:

- Various PHC and benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds were detected at concentrations greater than the Alberta Environment (AENV) Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Tier 1 Guidelines) within soil samples collected at depths between 1.8 m below ground level (mbg) and 3.6 mbg at 08MW06 (east of the former tank nest) and 09BH10 (north of the former tank nest).
- Various PHC parameters were detected within groundwater samples collected from 08MW06 and 09MW11 at a concentration greater than the Tier 1 Guidelines.

The Tier 1 Guidelines provide a framework for the management of contaminated sites. The Tier 1 approach is based on the assumption that all exposure pathways and receptors relevant to a particular land use are present.

Based on the findings of the Phase II and Phase III ESA, EBA has determined that the former site operations have resulted in impacts to the soil and/or groundwater in the areas of 08MW06, 09MW10, and 09MW11.

In November 2010, EBA was on site to monitor the removal of the UST by Hazco Environmental Services (Hazco), characterize the soils within the former tank nest for potential residual hydrocarbon impacts, and summarize monitoring details in a report (EBA 2011). A summary of the observations during the UST removal is as follows.

The asphalt and concrete sidewalk above the UST was cut (approximately 6.3 m by 5.2 m) on November 2, 2010. The asphalt and the concrete were removed using a track hoe and piled on the northeast side of the excavation, and were later hauled to the Lethbridge Waste and Recycling Centre for disposal. Unimpacted soil above the UST to a depth of approximately 0.6 m was segregated from the impacted material using the track hoe and stockpiled on the northwest side of the excavation.

The UST (approximately 2,000 L capacity) was removed from the tank nest using the track hoe and placed on the east side of the excavation for inspection. The tank was visually inspected by Mr. Shewchuk, of Hazco. A large hole at the base of the UST as well as significant corrosion were noted. Labels were not present on the tank.

Hazco crushed the tank on-site using the track hoe and disposed of it at the Lethbridge Waste and Recycling Centre. A Statute of Declaration was provided by Hazco stating that the storage tank was removed according to all required and applicable Petroleum Tank Management Association of Alberta (PTMAA) standards.

Following removal of the UST, excavation of the suspected PHC impacted soil commenced to a depth of approximately 4.5 m (depth to bedrock in the area of the excavation). Impacted soil was stockpiled along the north side of the excavation and 356 tonnes were later hauled to the Lethbridge Waste and Recycling Centre.

While conducting drilling at AMA Site No. 9557, east of the site, a borehole was advanced within the excavation limits of the UST and a composite sample sent for analysis. The excavation required dewatering prior to backfilling due to groundwater infiltration. Badger Daylighting was contracted by Hazco to remove and dispose of approximately 4 m³ of PHC impacted-water to Palko Environmental Ltd., near Claresholm, Alberta.

Additional excavation of impacted soil to the west, east, and south was not undertaken due to urban infrastructure (buildings and unexposed utilities to the west and east) and concerns raised by the town hall committee of Barons regarding risk of damage to the rooting system of the mature trees within the park south of the excavation.

Samples obtained from the south, east, and west sidewalls and base of the excavation were found to have concentrations of benzene, ethylbenzene, xylenes, and PHC (Fractions F1 and F2) greater than the AENV Tier 1 Guidelines for fine-grained soils under residential/parkland land use.

Further details of the findings can be found in the referenced reports.

2.3 Data Evaluation

To assist in assessing the quality of soil and groundwater analyzed during the environmental assessment at the site, AENV'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, residential dwellings, and parkland. Therefore, the most sensitive land use within 30 m of the site is residential/parkland.

Drilling at the site demonstrated that the underlying soils are predominantly fined-grained. The depth to groundwater at the time of the assessment ranged between 2.2 mbg and 2.6 mbg.

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 Guideline is based on the protection of ecological receptors and that is the pathway for direct soil contact by ecological organisms.

2.4 Geology and Hydrogeology

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 sandstone and shale strata from the St. Mary River Formation of the late Cretaceous age.

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 350 m southwest of the site; however, they are no longer being used, and according to Mrs. 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.

Sediments observed in boreholes drilled in 2009 as a component of the Phase II ESA (EBA 2009) consisted of clays with intermittent silt/sand lenses from below a surficial topsoil layer (0-0.1 mbg) to a maximum depth of 4.7 mbg. Below these deposits, weathered claystone bedrock was observed to the maximum depth of investigation (13.7 mbg). The laboratory sieve analysis results indicate that the dominant grain size is fine-grained. For reference, the water well records and borehole logs are provided in Appendix A.

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).

2.4.1 Land Use

According to the Village of Barons, the site is zoned Commercial (C1). Surrounding land use within 30 m or less of the site is comprised of Residential (R1) and C1. The current use of the property is considered parkland. Based on the surrounding receptors and potential exposure pathways, a residential/parkland land use is appropriate for the site.

2.4.2 Groundwater Use

According to provincial water well records (AENV 2011), 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 Site	Approximate Depth	Year Installed	Owner
0194222	SE ¼ 16-012-23 W4M	150 m northeast	29 m	1958	Unknown
0194216	SE ¼ 16-012-23 W4M	300 m south	29 m	1971	AENV No. 0613E
2058577	SE ¼ 16-012-23 W4M	300 m south	20 m	1971	AENV 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 via Nobleford's water treatment plant.

2.4.3 Groundwater Flow Direction

In March 2009, groundwater was encountered at depths ranging from 2.2 mbg at 08BH07 to 2.6 mbg at 09BH11. Groundwater monitoring results indicate that the groundwater table is relatively flat with a slight hydraulic gradient to the south.

Hydraulic conductivity tests conducted during the ESAs in November 2009 for 08MW01 (9×10^{-6} m/s), 08MW07 (5×10^{-7} m/s), and 08MW08 (4×10^{-5} m/s) provide a geometric hydraulic conductivity value of 6×10^{-6} m/s. The maximum reported value of 9×10^{-6} m/s is used for this assessment.

3.0 RISK CHARACTERIZATION

For risk to exist there must be a source of a compound of concern, a receptor that risks being impacted, and a media pathway to link the two.

Risk of an adverse impact to human health and ecological receptors has been characterized according to the linkages between the source areas, migration pathways, and receptors as described in Sections 3.1 to 3.3.

3.1 Source Areas of Environmental Impairment

EBA identified one area of environmental concern at the site based on the results of previous site investigations. The UST previously utilized on site during the operation of the former service station was removed, along with the majority of the impacted soil, in November 2010.

3.1.1 Soil Quality

Samples obtained from the south, east, and west sidewalls and base of the excavation were found to have concentrations of benzene, ethylbenzene, xylenes, and PHC (Fractions F1 and F2) greater than the Tier 1 Guidelines for domestic use (benzene, ethylbenzene, and xylenes) and ecological direct contact (PHC [Fractions F1 and F2]).

Concentrations of benzene (0.059 mg/kg) and ethylbenzene (4.09 mg/kg) on the west wall of the excavation, at sample area W3 at a depth of 4.0 m, were greater than the Tier 1 Guidelines.

Concentrations of ethylbenzene (0.524 mg/kg) on the east wall of the excavation, at sample area E5 at a depth of 4.5 m, were greater than the Tier 1 Guidelines.

Concentrations of benzene (0.062 mg/kg) and ethylbenzene (4.02 mg/kg) on the south wall of the excavation, at sample area S3 at a depth of 4.0 m, were greater than the Tier 1 Guidelines.

Concentrations of benzene at sample locations B4 (0.216 mg/kg), B5 (0.161 mg/kg), B6 (0.782 mg/kg), B8 (0.085 mg/kg), and B9 (0.134 mg/kg), ethylbenzene at sample locations B5 (0.228 mg/kg), B6 (0.794 mg/kg), B8 (1.17 mg/kg), and B9 (8.66 mg/kg), xylenes at sample location B6 (5.05 mg/kg), PHC Fraction F1 at sample location B9 (1,220 mg/kg), and PHC Fraction F2 at sample locations B6 (165 mg/kg) and B9 (694 mg/kg) at the base of the excavation, at depths ranging from 4.4 m to 5.0 m, were greater than the Tier 1 Guidelines.

Lead concentrations ranged between 7 mg/kg (08MW01 at 1.2 mbg and 08MW07 at 0.6 mbg) and 62 mg/kg (08MW06 at 0.6 mbg). All concentrations of lead were less than the ecological direct soil contact guideline (300 mg/kg).

The UST was removed and soil practical to excavate in regards to PHC impacted material was also removed and landfilled. Impacted material impractical to excavate due to potential risks to adjacent infrastructure and vegetation was left in place. Soil analytical results collected during the UST removal are summarized in Table 1.

Soil analytical results show that PHC affected soils (with concentrations of one or more of BTEX, PHC Fractions F1 to F2 greater than the applicable guidelines) remain unexcavated along the south, east, and west wall of the excavation, as well at the base of the excavation. Fill was imported to replace the contaminated soils removed from the excavation and to fill the void left from the previous UST.

3.1.2 Groundwater Quality

Prior to source removal, eight groundwater samples, plus one duplicate from monitoring well 09MW13, were submitted for chemical analysis. Groundwater analytical results are summarized in Table 2.

Benzene concentrations were detected at 08MW06 (0.068 mg/L), 09MW09 (0.0017 mg/L), and 09MW11 (0.0057 mg/L). The concentration of benzene detected at 08MW06 and 09MW11 were greater than the DUA guideline (0.005 mg/L).

The concentration of ethylbenzene detected at 08MW06 (0.036 mg/L) was greater than the DUA guideline (0.0024 mg/L).

The xylenes concentration detected at 08MW06 (0.072 mg/L) was less than the DUA guideline (0.3 mg/L).

Concentrations of PHC Fraction F1 detected at 08MW06 (1.6 mg/L) and 09MW11 (0.1 mg/L) were less than the DUA guideline (2.2 mg/L).

Concentrations of PHC fraction F2 were detected at 08MW06 (1.7 mg/L) and 09MW09 (0.1 mg/L). The F2 concentration detected at 08MW06 was greater than the DUA guideline (1.1 mg/L).

Lead was detected within samples collected from 08MW06 (0.0031 mg/L) and 08MW07 (0.0003 mg/L); however, the concentrations were less than the DUA guideline (0.01 mg/L).

3.1.3 Air

Air monitoring has not been performed on site as part of EBA's past investigations.

3.2 Migration Pathways

All exposure pathways presented in the Alberta Tier 1 Guidelines for residential/parkland land use are considered for this site.

3.3 Potential Receptors

The final factor in the source-pathway-receptor framework is the receptor. If no receptor is present, there is no potential for adverse health or ecological affects and subsequently no risk. This section outlines

potential receptors at the site. For reference, the pathway(s) by which the receptor may become exposed to potential sources of concern are discussed.

3.3.1 Human and Ecological Risks

Potential ecological receptors (and exposure pathways) include the following:

- Plants, through root uptake;
- Potable water, through groundwater migration; and
- Vapour inhalation.

Hydrocarbon impacted soil remains unexcavated along the walls and base of the former UST excavation (EBA 2011). Impacted soil is situated approximately 4.0 m below surface. Human exposure to impacted soil is not considered a risk since direct contact is minimal due to the depth of the impacted soil.

Impacted soils are not situated on or near the surface. The site is vegetated, which reduces surface runoff. Also, no major surface waterbodies are present near the site. The potential for down-gradient surface water being affected by runoff from the site is low.

Protection of aquatic life must be considered when surface waterbodies are present within 300 m of the site. Major surface waterbodies are not present near the site within this zone; however, with groundwater existing as a pathway, protection of aquatic life is considered as a potential receptor.

Testing of groundwater beneath the site yielded a geometric mean value for the maximum hydraulic conductivity value of 9×10^{-6} m/s with an aquifer thickness greater than 2.5 m (EBA 2009). These conditions suggest that the saturated soils might yield sufficient water for domestic use. Therefore, the pathway for protection of drinking water cannot be excluded.

Human vapour inhalation is considered to be operative in all cases at Tier 2. Soil PHC contaminants interact with air through volatilization. Inhalation of volatile hydrocarbon vapours migrating into buildings applies in the case where a building is or may be present. No buildings (other than the gazebo) are directly above or near the area of impact. However, the site is a common public space in Barons and appropriate measures to mitigate human and other organisms' exposure should be discussed.

Some evidence for hydrocarbon staining and vapours was discovered beneath the roadway. This sort of institutional barrier eliminates the opportunity for direct contact by soil organisms north of the site. However, the soil excavation was ceased regarding risk of damage to the rooting system of the mature trees within the park south of the excavation, and samples obtained from the south sidewalls were found to have concentrations of benzene and ethylbenzene. Therefore, exposure controls do not limit direct ecological contact and the pathway applies to this assessment.

3.3.2 Assessment of Environmental Risk

The environmental risk from residual hydrocarbon impact to local receptors is considered low based on current site conditions. However, the need to ensure that management of the site stays consistent with assumptions built into the risk assessment will require the use of exposure control.

4.0 MITIGATIVE OPTIONS (RISK MANAGEMENT PLAN)

The primary source of the hydrocarbon impact has been removed; however, residential soil and groundwater PHC impacts remain. The mobility of the residual chemical of potential concern is reduced by subsurface conditions and chemical properties of the PHCs. The exposure pathways outlined in the Tier 1 Guidelines document have been described.

In situ natural biodegradation over time should reduce concentrations of BTEX and PHCs in soil and groundwater. Hydrocarbons present at the site are considered readily degraded, whereas more complex molecular structures are generally more resistant to biodegradation. However, further evaluation of the potential to utilize such natural processes to remediate the groundwater is required.

A monitoring plan and continuance of the monitoring plan should be implemented until such time as contaminant concentrations are at acceptable levels. A monitoring plan should include collecting information regarding aerobic and anaerobic biodegradation processes at the site.

For groundwater applications, in situ bioremediation approaches include biosparging with air or oxygen, introduction of oxygen releasing compounds, liquid delivery of nutrients and/or electron acceptors, or monitored natural attenuation. Monitored natural attenuation should be implemented prior to introducing active bioremediation technology.

Previous investigations did not include vapour monitoring at surface. A vapour monitoring program at the site should be implemented to measure potentially emitted vapours from the subsurface. The vapour monitoring program can be conducted concurrently with the groundwater monitoring program.

4.1 Contingency Plan

Contingency plans have been developed for the risk management measures indicated. The contingency plans are outlined below. As the monitoring plans progress, the contingency plan will be updated as necessary.

Contingency Plan

Potential Occurrence	Precautions	Responses	
		Action	Time Frame
PHC and BTEX fractions in groundwater continue to increase relative to 2009 concentrations.	Monitor groundwater chemistry and field parameters annually (including alkalinity, dissolved iron, and manganese, nitrate/nitrite, sulphate, and total organic carbon).	Move from natural attenuation to active bioremediation.	Immediately, with discussion with Barons and AMA.
Volatile organic compounds (VOCs) (i.e., BTEX) vapours migrate to the surface.	Introducing a vapour monitoring system to measure surface vapour concentrations.	Determine potential risk to humans and other organisms in the area, and relay to appropriate authorities.	Immediately, with discussion with Barons and AMA.

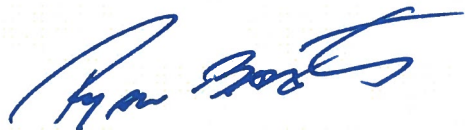
5.0 LIMITATIONS OF LETTER REPORT

This letter report and its contents are intended for the sole use of the Village of Barons and their agents. EBA Engineering Consultants Ltd. operating as EBA, A Tetra Tech Company (EBA), does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the letter report when the report is used or relied upon by any party other than the Village of Barons, or for any project other than the proposed development at the subject site. Any such unauthorized use of this letter report is at the sole risk of the user. Use of this letter report is subject to the terms and conditions stated in EBA's Services Agreement. EBA's General Conditions are provided in Appendix B of this report.

6.0 CLOSURE

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

Respectfully submitted,
EBA Engineering Consultants Ltd.



Prepared by:
Ryan Baxter, B.Sc., Geol.I.T.
Environmental Scientist
Environment Practice
Direct Line: 403.203.3305 x262
rbaxter@eba.ca



Reviewed by:
J. T. Dance, M.Sc., P.Geol.
Principal Consultant
Environment Practice
Direct Line: 403.723.6880
tdance@eba.ca

/jbn:nmk



Reviewed by:
Mandi Parker, P.Ag.
Project Director
Environment Practice
Direct Line: 403.329.9009 x224
mparker@eba.ca

PERMIT TO PRACTICE EBA ENGINEERING CONSULTANTS LTD. Signature:  Date: <u>Dec 16, 2011</u> PERMIT NUMBER: P245 The Association of Professional Engineers, Geologists and Geophysicists of Alberta

Attachments (6):

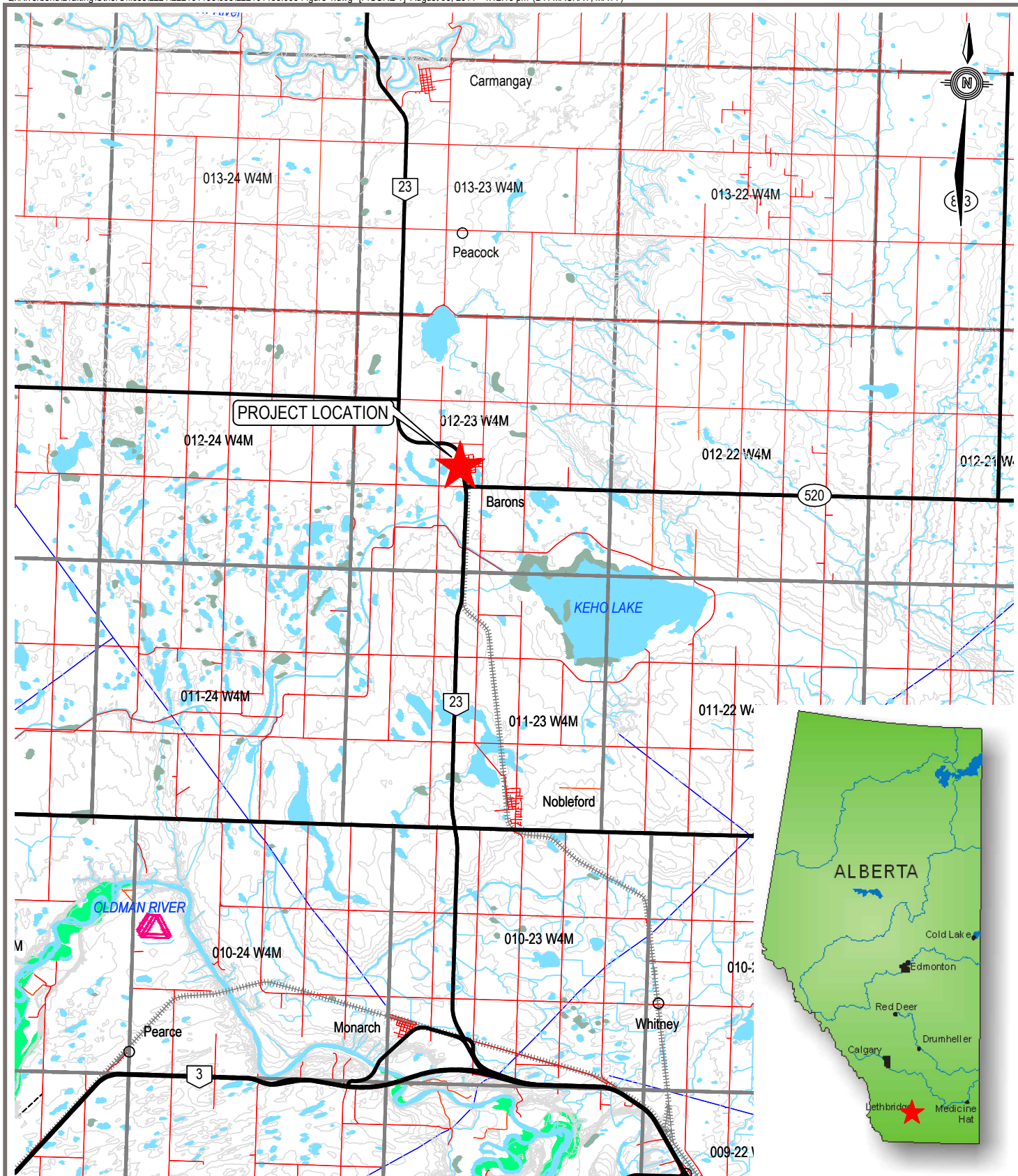
Figure 1	-	Site Location Plan
Figure 2	-	Site Plan
Table 1	-	Soil Analytical Results
Table 2	-	Groundwater Analytical Results
Appendix A	-	Borehole Logs and Water Well Database Summary
Appendix B	-	Geo-Environmental Report – General Conditions

REFERENCES

- Adams, J.D. et al. February 2006. Evaluating In Situ Bioremediation for Groundwater Cleanup. CEP Magazine.
- Alberta Geologic Survey. 1971. Geological Map of Alberta. Alberta Research Council, Natural Resources Division.
- Alberta Environment. December 2010. Alberta Tier 2 Soil and Groundwater Remediation Guidelines.
- EBA Engineering Consultants Ltd. October 2009. Phase II and Phase III Environmental Site Assessment, 124 Main Street, Lot 17, Block 2, Plan 2605X, AMA Site 9558, Barons, Alberta. EBA File: L22101183.001.
- EBA Engineering Consultants Ltd. March 2011. Underground Storage Tank Removal and Monitoring, AMA Site No. 9558. EBA File: L22101183.004.

FIGURES

- | | |
|----------|--------------------|
| Figure 1 | Site Location Plan |
| Figure 2 | Site Plan |



NOTES
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CLIENT

**VILLAGE OF BARONS
(AMA SITE 9558)**

**RISK MANAGEMENT PLAN
AMA SITE 9558
124 MAIN STREET, BARONS, ALBERTA**

SITE LOCATION PLAN

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



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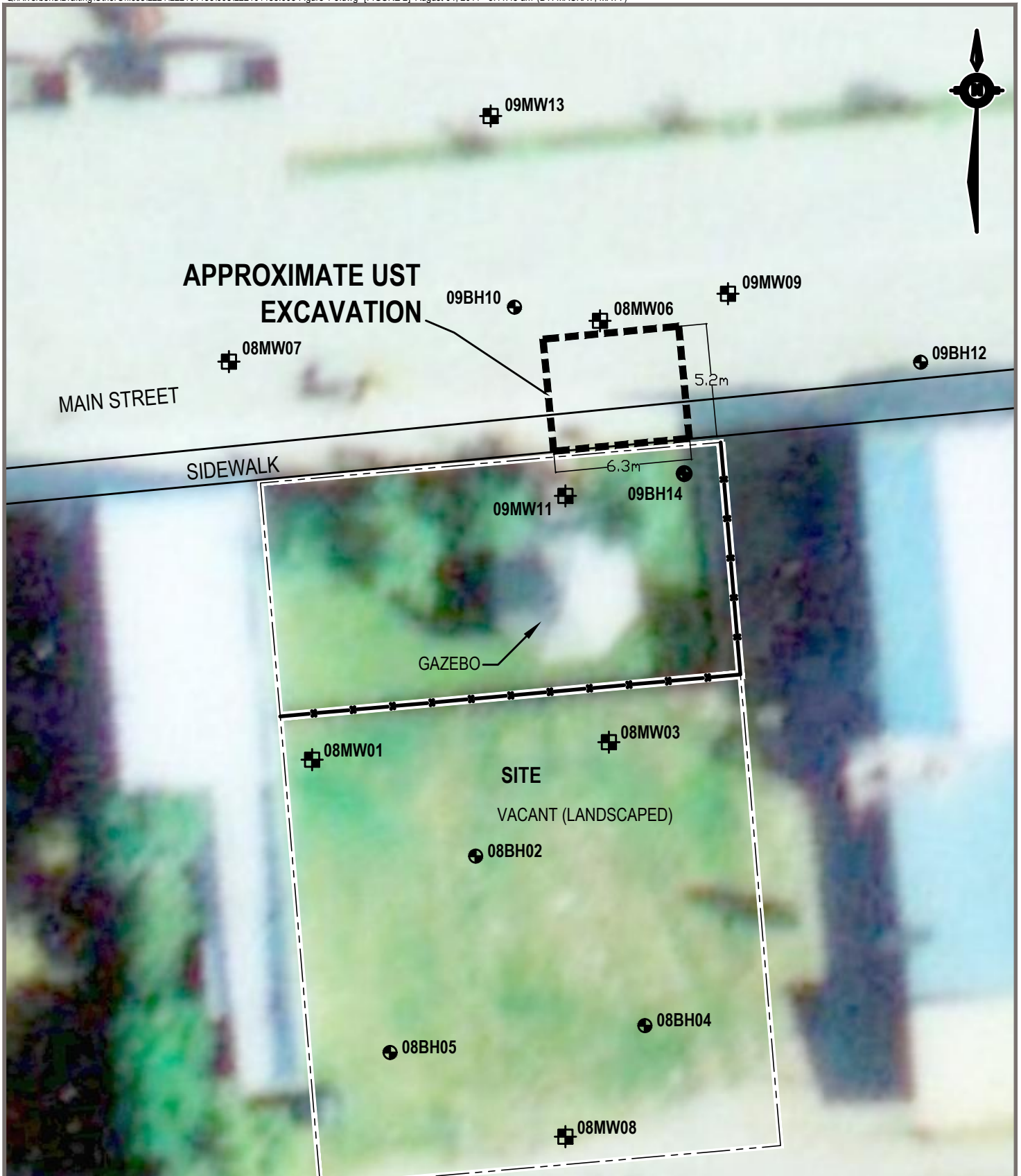
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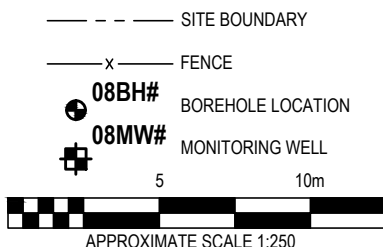
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DATE
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Figure 1



LEGEND



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VILLAGE OF BARONS
(AMA SITE 9558)



RISK MANAGEMENT PLAN

AMA SITE 9558
124 MAIN STREET, BARONS, ALBERTA

SITE PLAN

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Figure 2

TABLES

Table 1	Soil Analytical Results
Table 2	Groundwater Analytical Results

TABLE 1: SOIL ANALYTICAL RESULTS - AMA SITE 9558

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	17-Nov-08															
						08MW01			08BH02		08MW03			08MW06				08MW07			
			< 3.0 m	> 3.0 m		< 3.0 m	1.2 m	4.2 m	5.4 m	1.8 m	3.6 m	1.8 m	3.6 m	4.8 m	0.6 m	1.8 m	3.6 m	4.5 m	0.6 m	2.4 m	4.2 m
Petroleum Hydrocarbons																					
Benzene	0.02	mg/kg	0.046	0.046	120	nd	nd	nd	nd	nd	nd	nd	nd	nd	<u>0.076</u>	0.011	nd	nd	--	nd	nd
Toluene	0.01	mg/kg	0.52	0.52	220	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.15	nd	nd	nd	--	nd	nd
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	nd	nd	nd	nd	nd	nd	nd	nd	nd	<u>12</u>	<u>0.12</u>	nd	nd	--	nd	nd
Xylenes	0.04	mg/kg	15	15	130	nd	nd	nd	nd	nd	nd	nd	nd	nd	<u>29</u>	0.32	nd	nd	--	nd	nd
F1 (C ₆ to C ₁₀)	12	mg/kg	210	1,100	420	nd	nd	nd	nd	nd	nd	nd	nd	nd	<u>570</u>	36	nd	nd	--	nd	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	150	1,500	300	nd	nd	nd	nd	nd	nd	nd	nd	nd	<u>370</u>	nd	nd	nd	--	nd	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	2,600	nd	nd	nd	nd	nd	nd	nd	nd	nd	<10	nd	nd	nd	--	nd	nd
F4 (C ₃₄ to C ₅₀)	10	mg/kg	ng	ng	11,200	nd	nd	nd	nd	nd	nd	nd	nd	nd	<10	nd	nd	nd	--	nd	nd
Metals																					
Lead (Pb)	1	mg/kg	ng	ng	300	7	8	17	11	9	11	8	14	62	32	9	8	7	--	12	11
Physical Properties																					
Soil Moisture Content	0.3	%	ng	ng	ng	16	15	12	24	14	24	11	13	12	19	17	7.1	12	23	14	9.5
<75 um Sieve	0.2	%	ng	ng	ng	92	nt	nt	nt	nt	nt	nt	87	nt	nt	nt	nt	nt	90	nt	nt
>75 um Sieve	0.2	%	ng	ng	ng	8	nt	nt	nt	nt	t	nt	13	nt	nt	nt	nt	nt	10	nt	nt
CCME Class	0.2		ng	ng	ng	FINE	nt	nt	nt	nt	nt	nt	FINE	nt	nt	nt	nt	nt	FINE	nt	nt

Parameters	Detection Limits	Units	Protection of Domestic Use Aquifer		Ecological Direct Soil Contact	11-Mar-09											
						09MW09			09BH10			09MW11			09MW13	09BH14	
			< 3.0 m	> 3.0 m		4.2 m	4.8 m	6.0 m	1.8 m	3.0 m	4.8 m	3.6 m	4.8 m	6.0 m	4.8 m	3.0 m	4.8 m
Petroleum Hydrocarbons																	
Benzene	0.02	mg/kg	0.046	0.046	120	nd	nd	nd	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	nd	nd	nd
Ethylbenzene	0.04	mg/kg	0.11	0.11	240	nd	nd	nd	0.02	nd	nd	nd	nd	nd	nd	nd	nd
Xylenes	0.04	mg/kg	15	15	130	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
F1 (C ₆ to C ₁₀)	12	mg/kg	210	1,100	420	nd	nd	nd	160	nd	nd	nd	nd	nd	nd	nd	nd
F2 (C ₁₀ to C ₁₆)	10	mg/kg	150	1,500	300	nd	nd	nd	420	nd	nd	nd	nd	nd	nd	nd	nd
F3 (C ₁₆ to C ₃₄)	10	mg/kg	ng	ng	2,600	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	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	8	9	7	14	14	16	10	16	15	8	10	15
Physical Properties																	
Soil Moisture Content	0.3	%	ng	ng	ng	13	11	13	19	26	21	20	15	13	14	15	12
<75 um Sieve	0.2	%	ng	ng	ng	63	75	nt	81	nt	nt	nt	nt	91	nt	67	nt
>75 um Sieve	0.2	%	ng	ng	ng	37	25	nt	19	nt	nt	nt	nt	9.2	nt	33	nt
CCME Class	0.2		ng	ng	ng	FINE	FINE	nt	FINE	nt	nt	nt	nt	FINE	nt	FINE	nt

Notes:

¹ Alberta Environment. August 2008. Alberta Tier 1 Soil Remediation Guideline values for soil and groundwater for residential land use for fine-grained soils.

* Detection limits raised 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: GROUNDWATER ANALYTICAL RESULTS - AMA SITE 9558

Parameter	Detection Limits	Units	AENV Tier 1 ¹	28-Nov-08					26-Mar-09			
				08MW01	08MW03	08MW06	08MW07	08MW08	09MW09	09MW11	09MW13	09DUP01*
Petroleum Hydrocarbons												
Benzene	0.0009	mg/L	0.005	nd	nd	0.068	nd	nd	0.0017	0.0057	nd	nd
Toluene	0.0009	mg/L	0.024	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.0009	mg/L	0.0024	nd	nd	0.036	nd	nd	nd	nd	nd	nd
Xylenes	0.002	mg/L	0.3	nd	nd	0.072	nd	nd	nd	nd	nd	nd
F1 (C ₆ to C ₁₀)	0.2	mg/L	2.2	nd	nd	1.6	nd	nd	nd	0.1	nd	nd
F2 (C ₁₀ to C ₁₆)	0.1	mg/L	1.1	nd	nd	1.7	nd	nd	0.1	nd	nd	nd
Metals												
Lead (Pb)	1	mg/L	0.01	nd	nd	0.0031	0.0003	nd	nd	nd	nd	nd

Notes:

¹ Alberta Environment. August 2008. Alberta Tier 1 Soil and Groundwater Remediation Guideline values for residential lands with fine-grained soils.

nt - Parameter not analyzed.

nd - Below analytical detection limits.

ng - No guidelines established.

Bold and Underlined - Greater than the referenced guideline.

* 09DUP01 - Duplicates sample of 09MW13.

APPENDIX A

APPENDIX A BOREHOLE LOGS AND WATER WELL DATABASE SUMMARY

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	GW, GP, SW, SP, GM, GC, SM, SC Borderline Classification requiring use of dual symbols Classification on basis of percentage of fines Less than 5% Pass 75 µm sieve More than 12% Pass 75 µm sieve 5% to 12% Pass 75 µm sieve	$C_u = D_{60}/D_{10}$ 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		
			For classification of fine-grained soils and fine fraction of coarse-grained soils.					
			FINE-GRAINED SOILS (by behavior) 50% or more passes 75 µm sieve*	SILTS		Liquid limit	<50	ML
>50	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts						
CLAYS	Liquid limit	<30		CL	Inorganic clays of low plasticity, gravelly clays, sandy clays, silty clays, lean clays			
		30-50		CI	Inorganic clays of medium plasticity, silty clays			
		>50		CH	Inorganic clays of high plasticity, fat clays			
ORGANIC SILTS AND CLAYS	Liquid limit	<50		OL	Organic silts and organic silty clays of low plasticity			
		>50		OH	Organic clays of medium to high plasticity			
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

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 08MW01	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.64m	
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics CLAY - silty, sandy, damp, stiff, low to medium plastic, brown, trace roots									98.0
...	... trace to some sand, medium to high plastic, dark brown		B1							
1	... moist, dark grey brown		B2							
...	... brown with dark brown mottling, high plastic clay inclusions		B3							97.0
2			B4							96.0
3	... damp		B5							95.0
...	... moist		B6							
4	... sandy, very moist to wet, soft to firm, low to medium plastic, sandstone fragments		B7							94.0
5	BEDROCK - claystone, silty, damp, low to moderate, strength, weathered, grey, sandstone inclusions		B8							
...			B9							93.0
6	End of Borehole @ 6.1m		B10							92.0
7	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 4.5m screened									91.0
8										90.0
9										89.0
10										

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/8/2008
	DRAWING NO: B1	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 08BH02	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics CLAY - silty, sandy, damp, stiff, low to medium plastic, brown, trace roots								0
1	... dark brown mottling, high plastic clay inclusions		B1						5
2	... trace sand, damp to moist, high plastic		B2						
			B3						
			B4						
			B5						10
	... sandy, moist, low to medium plastic, sandstone fragments		B6						
			B7						15
	BEDROCK - claystone, silty, damp, low to moderate, strength, weathered, grey brown		B8						
			B9						
			B10						20
6	End of Borehole @ 6.1m								
7	No Seepage or Sloughing on Completion Backfilled with Cuttings & Bentonite								25
8									
9									30
10									33

EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/8/2008
	DRAWING NO: B2	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 08MW03		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.71m		
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics CLAY - silty, trace to some sand, damp, stiff, medium plastic, grey brown									98.0
1	... brown with dark brown mottling, high plastic clay inclusions ... moist		B1							97.0
2	... damp to moist		B2							96.0
3	... very moist to wet, soft to firm		B3							95.0
4	... sandy, very moist to wet, soft to firm, low to medium plastic, sandstone fragments		B4							94.0
5	BEDROCK - claystone, silty, damp, low to moderate, strength, weathered, yellow brown		B5							93.0
6	... grey brown		B6							92.0
7			B7							91.0
8			B8							90.0
9			B9							89.0
10	End of Borehole @ 6.1m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 4.5m screened		B10							



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LOGGED BY: JL

REVIEWED BY: DM

DRAWING NO: B3

COMPLETION DEPTH: 6.1m

COMPLETE: 11/8/2008

Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 08BH04	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
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	SAMPLE NUMBER	HYDROCARBONS (ppm) 200 400 600 800	NOTES & COMMENTS	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics CLAY - silty, trace to some sand, moist, stiff, medium plastic, grey brown					0
1	... damp to moist, dark brown mottling, high plastic clay inclusions		B1			3
			B2			4
2	...moist		B3			6
			B4			7
3	... sandy, moist, low to medium plastic, sandstone fragments		B5			9
4	BEDROCK - claystone, silty, damp, low to moderate, strength, weathered, grey brown		B6			13
			B7			14
5			B8			16
			B9			18
6	... grey		B10			20
	End of Borehole @ 6.1m					
	No Seepage or Sloughing on Completion Backfilled with Cuttings & Bentonite					
7						23
8						26
9						29
10						33

EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/8/2008
	DRAWING NO: B4	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 08BH05		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
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	SAMPLE NUMBER	HYDROCARBONS (ppm) 200 400 600 800	NOTES & COMMENTS	Depth (ft)
0	TOPSOIL - clay, silty, sandy, damp, dark brown, roots, organics CLAY - silty, trace to some sand, damp, stiff, medium plastic, grey brown					0
1	... damp to moist, dark brown mottling, high plastic clay inclusions		B1			3
	...moist		B2			5
2			B3			7
			B4			9
3	... very moist to wet, firm		B5			11
			B6			13
4	... sandy, moist, low to medium plastic, sandstone fragments		B7			15
	BEDROCK - claystone, silty, damp, low to moderate, strength, weathered, grey brown		B8			17
5			B9			19
6	... grey		B10			21
	End of Borehole @ 6.1m					23
	No Seepage or Sloughing on Completion Backfilled with Cuttings & Bentonite					25
7						27
8						29
9						31
10						33

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/8/2008
	DRAWING NO: B5	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 08MW06	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.63m	
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	ASPHALT Concrete (100mm) CLAY (FILL) - silty, sandy, trace gravel to 30mm, moist, firm to stiff, low to medium plastic, yellow brown									98.0
1	CLAY - silty, trace to some sand, damp, stiff, medium plastic, dark brown ... dark grey to black staining, strong hydrocarbon odor ... moist		B1							97.0
2	... brown with dark brown mottling, high plastic clay inclusions ... grey mottling		B2							96.0
3			B3					2500		95.0
4	... brown, no staining, trace odor ... sandy, very moist to wet, soft to firm, low to medium plastic, sandstone fragments		B4					1250		94.0
5	BEDROCK - claystone, silty, damp, low to moderate, strength, weathered, yellow brown, trace odor ... light grey		B5							93.0
6			B6							92.0
7			B7							91.0
8			B8							90.0
9										89.0
10										

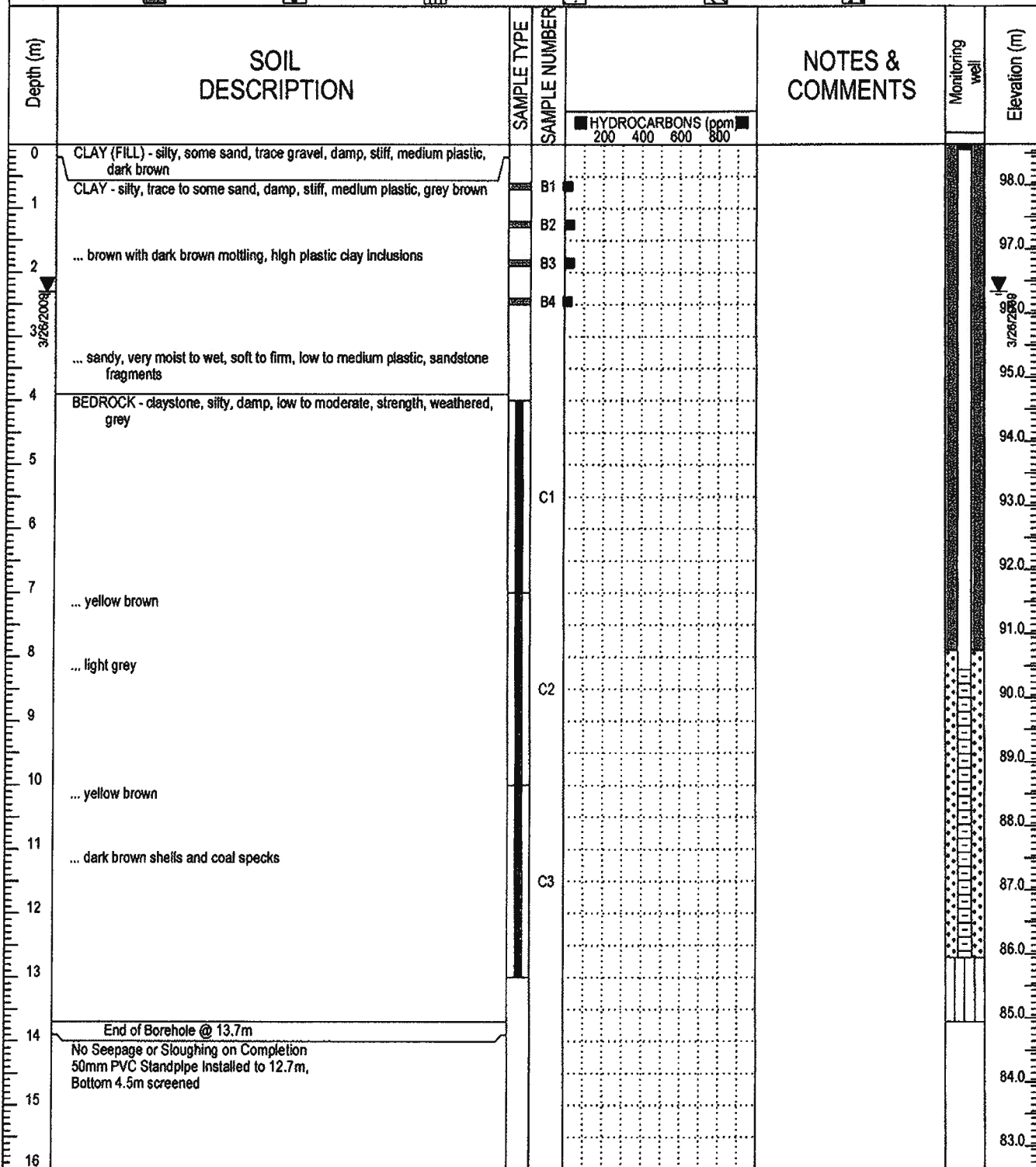
 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/8/2008
	DRAWING NO: B6	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 08MW07	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.47m	
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	ASPHALT Concrete (100mm) CLAY (FILL) - silty, sandy, trace gravel to 30mm, moist, firm to stiff, low to medium plastic, yellow brown									98.0
1	CLAY - silty, trace to some sand, damp, stiff, medium plastic, dark grey brown		B1							
	... brown with dark brown mottling, high plastic clay inclusions		B2							97.0
2	... grey mottling		B3							
			B4							96.0
3	... sandy, very moist to wet, soft to firm, low to medium plastic, sandstone fragments		B5							95.0
			B6							
4	BEDROCK - claystone, silty, damp, low to moderate, strength, weathered, yellow brown, trace odor		B7							94.0
	... light grey		B8							
5			B9							93.0
6	... yellow brown		B10							
	End of Borehole @ 6.1m									92.0
7	No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 4.5m screened									
8										91.0
9										90.0
10										89.0

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 11/8/2008
	DRAWING NO: B7	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm CORE		L22101183.001 - 08MW08	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.64m	
SAMPLE TYPE	☒ DISTURBED	☒ NO RECOVERY	☒ SPT	☐ A-CASING	☐ SHELBY TUBE
BACKFILL TYPE	☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS
				☐ CORE	☐ SAND

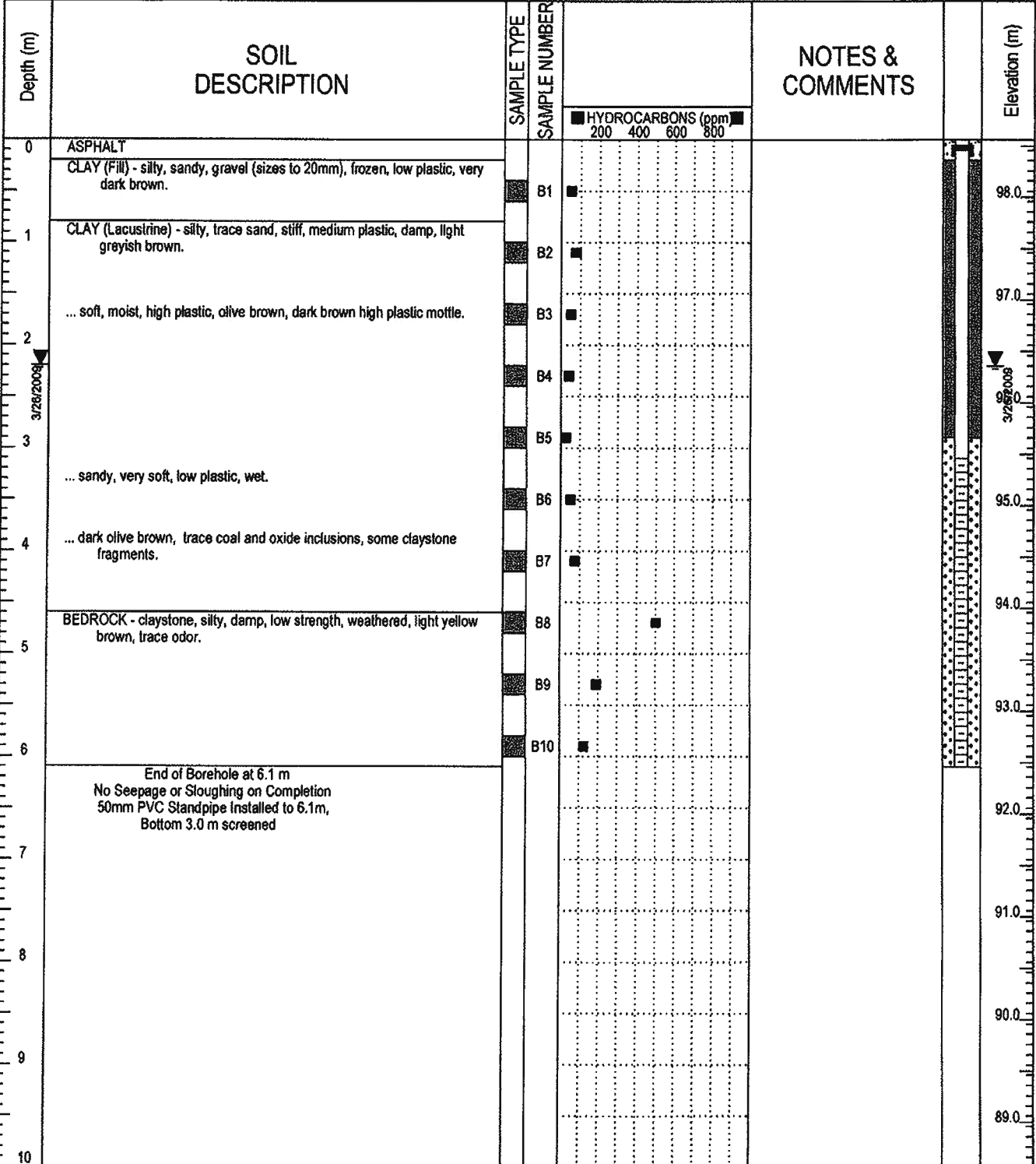


EBA Engineering Consultants Ltd.

LOGGED BY: JL
REVIEWED BY: DM
DRAWING NO: B8

COMPLETION DEPTH: 13.7m
COMPLETE: 11/8/2008
Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 09MW09	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.56m	
SAMPLE TYPE	☒ DISTURBED	☐ NO RECOVERY	☒ SPT	☐ A-CASING	☐ SHELBY TUBE
BACKFILL TYPE	☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS
					☐ CORE
					☐ SAND



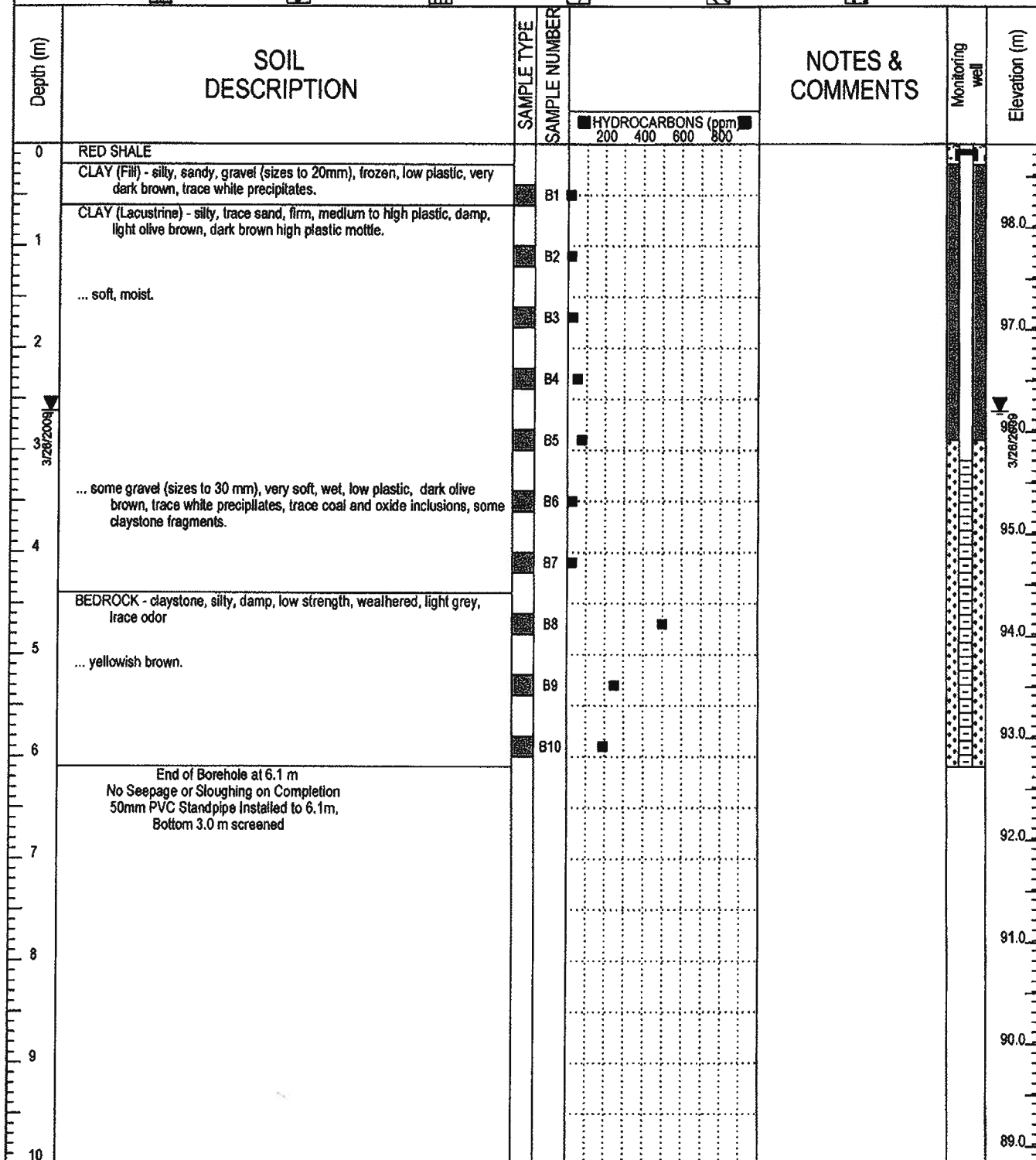
 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/11/2009
	DRAWING NO: B9	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 09BH10	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	ASPHALT								0
	CLAY (Fill) - silty, sandy, gravel (sizes to 25mm), frozen, low plastic, very dark brown.	☒	B1						
1	CLAY (Lacustrine) - silty, trace sand, stiff, medium plastic, damp, light greyish brown, trace white precipitates.	☒	B2						
	... soft, moist, high plastic, olive brown, dark brown high plastic mottle.		B3						5
	... grey to black staining and strong odor.		B4						
2	... no staining or odor.		B5						10
	... sandy, very soft, low plastic, wet.		B6						
	... dark olive brown, trace coal and oxide inclusions, some claystone fragments.		B7						
3	BEDROCK - claystone, silty, damp, low strength, weathered, greyish brown, trace odor	☒	B8						15
	... yellowish brown.		B9						
6	End of Borehole at 6.1 m	☒	B10						20
7									25
8									30
9									33
10									

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/11/2009
	DRAWING NO: B10	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 09MW11	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.82m	
SAMPLE TYPE	☒ DISTURBED	☐ NO RECOVERY	☒ SPT	☐ A-CASING	☐ SHELBY TUBE
BACKFILL TYPE	☒ BENTONITE	☐ PEA GRAVEL	☐ SLOUGH	☐ GROUT	☐ DRILL CUTTINGS
					☐ CORE
					☐ SAND



EBA Engineering Consultants Ltd.

LOGGED BY: JL
REVIEWED BY: DM
DRAWING NO: B11

COMPLETION DEPTH: 6.1m
COMPLETE: 3/11/2009
Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.		
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 09BH12		
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN				
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	ASPHALT								0
	CLAY (Fill) - silty, sandy, gravel (sizes to 25mm), frozen, low plastic, very dark brown, trace white precipitates.		B1						
1	CLAY (Lacustrine) - silty, trace sand, firm, medium plastic, damp, light greyish brown, trace white precipitates. ... soft, moist, high plastic, olive brown, dark brown high plastic mottle.		B2						5
			B3						
2			B4						
			B5						10
3	... sandy, some gravel (sizes to 20 mm), low plastic, dark brown, trace coal and oxide inclusions, some claystone fragments.		B6						
			B7						
4	BEDROCK - claystone, silty, damp, low strength, weathered, grey.		B8						15
5	... yellowish brown.		B9						
6	End of Borehole at 6.1 m		B10						20
7									25
8									
9									30
10									33

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/11/2009
	DRAWING NO: B12	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 09MW13	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN		ELEVATION: 98.77m	
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Monitoring well	Elevation (m)
				200	400	600	800			
0	ASPHALT									
	CLAY (Fill) - silty, sandy, gravel (sizes to 20mm), frozen, low plastic, very dark brown, trace white precipitates.		B1							98.0
1	CLAY (Lacustrine) - silty, trace sand, firm, medium plastic, damp, light greyish brown, trace white precipitates.		B2							
	... soft, moist, dark brown high plastic mottle, olive brown.		B3							97.0
2			B4							
3			B5							96.0
	... some gravel (sizes to 20 mm), soft, moist, low plastic, dark brown, trace white precipitates, trace coal and oxide inclusions, some claystone fragments.		B6							95.0
4	BEDROCK - claystone, silty, damp, low strength, weathered, light grey.		B7							
5			B8							94.0
			B9							93.0
6	... yellowish brown.		B10							92.0
7	End of Borehole at 6.1 m No Seepage or Sloughing on Completion 50mm PVC Standpipe Installed to 6.1m, Bottom 3.0 m screened									91.0
8										90.0
9										89.0
10										

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/11/2009
	DRAWING NO: B13	Page 1 of 1

PROJECT: PHASE II DRILLING		CLIENT: VILLAGE OF BARONS		PROJECT NO. - BOREHOLE NO.	
ADDRESS: 124 MAIN STREET		DRILL METHOD: 150mm SOLID STEM AUGER		L22101183.001 - 09BH14	
CITY: BARONS, AB		PROJECT ENGINEER: DERYCK MASTERMAN			
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	SAMPLE NUMBER	HYDROCARBONS (ppm)				NOTES & COMMENTS	Depth (ft)
				200	400	600	800		
0	TOPSOIL								0
	CLAY (Fill) - silty, sandy, gravel (sizes to 20mm), frozen, low plastic, very dark brown.		B1						
1	CLAY (Lacustrine) - silty, trace sand, firm, medium to high plastic, damp, greyish brown, trace white precipitates. ... very soft, moist. ... dark brown high plastic mottled, olive brown.		B2						5
2			B3						
			B4						
3			B5						10
	... sandy, wet.		B6						
4	... some gravel (sizes to 20 mm), very soft, wet, low plastic, greyish brown, trace white precipitates, trace coal and oxide inclusions, some claystone fragments.		B7						15
	BEDROCK - claystone, silty, damp, low strength, weathered, greyish brown.		B8						
5			B9						
6	... yellowish brown.		B10						20
	End of Borehole at 6.1 m								
7									25
8									
9									30
10									33

 EBA Engineering Consultants Ltd.	LOGGED BY: JL	COMPLETION DEPTH: 6.1m
	REVIEWED BY: DM	COMPLETE: 3/11/2009
	DRAWING NO: B14	Page 1 of 1



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 EH 16 012 23 M 4
 Location in Quarter
 0 FT from Boundary
 0 FT from Boundary
 Lot Block Plan

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

6. Well Yield

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

4. Formation Log

Depth from ground level (feet)	Lithology Description
1	Topsoli
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): 1958/02/10 Date Completed (yyyy/mm/dd):
 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 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:

Depth of pump intake: 0 FT
 Water level at end of pumping: FT
 Distance from top of casing to ground level: inches

Depth To water level (feet)
 Elapsed Time
 Drawdown Minutes: Sec Recovery
 Total Drawdown: 0 FT
 If water removal was less than 2 hr duration, reason why:

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?

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



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 SE 16 012 23 M 4
Location in Quarter
0 FT from Boundary
0 FT from Boundary
Lot Block Plan

3. Drilling Information

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

6. Well Yield

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

Test Method:

Non pumping FT

static level:

Rate of water removal: Gallons/Min

Depth of pump intake: FT

Water level at end of pumping: FT

Distance from top of casing to ground level: inches

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

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): 1971/03/01
Date Completed(yyyy/mm/dd):
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
from: 0 FT to: 0 FT
from: 0 FT to: 0 FT
from: 0 FT to: 0 FT
Perforations Size:
0 Inches x 0 Inches
0 Inches x 0 Inches
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:
from: 0 FT to: 0 FT
Screen ID: 0 Inches
Slot Size: 0 Inches
Screen Type:
from: 0 FT to: 0 FT
Screen ID: 0 Inches
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

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?



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 M
SE 16 012 23 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:

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 Perforations Size:
from: FT to: FT Inches x Inches
from: FT to: FT Inches x Inches
Inches x Inches
Perforated by: Unknown

Depth of pump FT
intake:
Water level at FT
and of
pumping:
Distance from inches
top of casing to
ground level:
Depth To water level (feet)
Elapsed Time
Drawdown Minutes:Sec Recovery

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

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

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

Recommended pumping rate:
Gallons/Min
Recommended pump intake: FT
Type pump installed
Pump type:
Pump model:
H.P.:

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:

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.: 0184195
 Map Verified: Field
 Date Report Received: 1981/05/27
 Measurements: Imperial

1. Contractor & Well Owner Information

Company Name: ALBERTA ENVIRONMENT/EARTH SCIENCES DIVISION
 Mailing Address: 9820-106 ST, OXBRIDGE PLACE
 Well Owner's Name: ALTA ENV #1998E
 P.O. Box Number:
 City:
 Province:
 Country:

City or Town: EDMONTON AB CA
 Well Location Identifier:
 Mailing Address:
 Postal Code:

Drilling Company Approval No.: 99998
 Postal Code: T5K 2J6

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:
 Method of Drilling: Rotary
 Flowing Well: No
 Gas Present: No

Materials Used:
 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

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
 from: 0 FT to: 0 FT
 from: 0 FT to: 0 FT
 Perforations Size:
 0 Inches x 0 Inches
 0 Inches x 0 Inches
 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:
 from: 0 FT to: 0 FT
 Screen ID: 0 Inches
 Slot Size: 0 Inches
 Screen Type:
 from: 0 FT to: 0 FT
 Screen ID: 0 Inches
 Slot Size: 0 Inches
 Screen Installation Method:
 Fittings
 Top: Bottom:
 Pack:
 Grain Size: Amount:

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?

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.: 0184421
 Map Verified: Field
 Date Report Received: 1988/02/17
 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 14 16 012 23 M
 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): 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 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: Diameter:

Length: 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?

Water Well Report

Page 2 of 2

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

Report 1



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: 1989/12/10
 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 14 15 012 23 M
 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:

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.

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?

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 GENERAL CONDITIONS – GEO-ENVIRONMENTAL REPORT

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.

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