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Attention: David Morrison, CEO

Subject: Hydrogeochemistry and Isotope Signature of Stinky Lake and Versluce Warm Springs in Whitehorse, Yukon

1.0 INTRODUCTION

As part of the 2009 Yukon Geothermal Exploration Program, EBA assessed the hydrogeochemistry and isotope signature of three natural warm springs near Porter Creek, Whitehorse, Yukon. The information collected will be used to enhance our understanding of potential geothermal activity in the Whitehorse area.

Besides the well-known Takhini Hot Springs about 30 km northwest of Whitehorse, anecdotal information exists on additional warm springs in the Whitehorse area. More specifically, residents of Porter Creek reported that a small lake south of Porter Creek remains partly unfrozen in the winter and is known as Stinky Lake. Reportedly, there is also another warm spring just west of Porter Creek that has been used by some of the residents and has been described in Crandall and Sadlier-Brown (1976) as Versluce Spring.

The scope of services of Phase 014 was to locate and sample these warm springs and to explore the adjacent areas for further warm springs.

2.0 METHODS

2.1 SITE VISITS AND SAMPLING LOCATIONS

EBA first collected information on the location of the two potential warm springs in the Porter Creek area by using information provided in Crandall and Sadlier-Brown (1976), anecdotal information from residents, and air photos. Both warm springs could then be located in the field and sampled during site visits. Additionally, EBA considered reports of winter open water sightings in the area west of Crestview and south of the Alaska Highway. During a site visit in this area, EBA collected two additional water samples.

Table 1 summarizes the locations where water samples were collected. Figure 1 shows a map of the study area and sampling locations.

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TABLE 1: SAMPLING LOCATIONS AND SITE DESCRIPTIONS

Location ID	Location Type	UTM (NAD83, Zone 8)		Water Temp. (°C)	Site Description
		Easting	Northing		
SLP-Spring (Stinky Lake Spring)	Spring	493023	6735225	18.5	The spring is located about 20 m to the west of the lake. It feeds a small creek flowing into Stinky Lake and provides the only obvious inflow to the lake (see Photos 1 and 2). The estimated flow rate was in the order of 1 L/s. The water was clear with a slight H_2S odour. There was also a slight but noticeable H_2S smell present in the area adjacent to the Stinky Lake.
SLC-1	Pond	488960	6739305	15.8	The sample was collected from a shallow pond (< 0.3 m deep) in a wetland that remains partially unfrozen during the winter according to anecdotal information. The water temperature at the time of sampling was likely strongly influenced by warm ambient air temperature which had exceeded 20°C for several days prior to the site visit.
SLC-2	Spring	489047	6739272	12.0	The spring is located in the same wetland as SLC-1 and feeds a small creek flowing toward the northeast. The water was clear with no obvious odour. Flow rate was in the order of < 1 L/s.
Spring-PC (Versluce Spring)	Spring	492054	6736227	12.7	The spring is located just to the west of Porter Creek and to the northeast of the Whitehorse landfill. This spring has previously been described as Versluce Spring in Crandall and Sadlier-Brown (1976). It is situated at an east-northeast facing slope about 20 m above the elevation of the Alaska Highway. The spring is being used by the local residents and captured by a small wooden cistern. Discharge pipes convey the water to the residences. Therefore the flow rate could not be estimated but was likely in the order of a few litres per second. The water was clear and without any obvious odour. Small bubbles rose from the bottom of the cistern.

2.2 WATER SAMPLING AND FIELD MEASUREMENTS

Field parameters measured during the site visits included: temperature, pH, electrical conductivity, total dissolved solids, and dissolved oxygen (in the case of a spring). The field instruments were calibrated on the day of sampling. Table 2 summarizes the field instruments used along with their resolution and accuracy.

TABLE 2: SUMMARY OF FIELD WATER CHEMISTRY INSTRUMENTS			
Parameter	Instrument	Resolution	Accuracy
UTM Coordinates	Magellan Meridian Platinum handheld GPS	1 m	~7 m
pH	Hanna HI 991300	0.01 pH units	0.1
EC	Hanna HI 991300	0.01 µS/cm	2% full scale
TDS	Hanna HI 991300	1 ppm	2% full scale
Temperature	Hanna HI 991300	0.1°C	0.5°C
Dissolved O_2	YSI 550A	0.01 mg/L	0.1 mg/L
Alkalinity	Hach Alkalinity Test Kit AL-AP MG-L	5 mg/L (5-100 mg/L); 20 mg/L (20-400 mg/L)	10 mg/L (5-100 mg/L); 40 mg/L (20-400 mg/L)
Ferrous Iron	Hach Ferrous Iron Test Kit IR-18C	0.1 mg/L	0.2 mg/L

Water samples were analyzed for hardness, alkalinity, cations and anions, dissolved metals and environmental isotopes of oxygen (oxygen-18) and hydrogen (deuterium and tritium). The major ion chemistry was included in order to classify the waters and determine their general chemical character. The metals analyses were used to support geothermometer calculations, specifically using sodium (Na), potassium (K), calcium (Ca), magnesium (Mg) and silicon (Si). Silicon was used to calculate the equivalent silica (SiO_2) concentration for use in the silica-based geothermometer formulas. The stable isotopes of water were included in order to plot them against a meteoric water line to determine if the sample waters were of meteoric origin, or were fractionated to enriched oxygen-18 values which can be an isotopic characteristic of geothermal waters. The radioactive hydrogen isotope tritium (^3H) was included to obtain information on the subsurface residence time of the water.

Water samples were collected in new, laboratory-supplied sample containers in accordance with laboratory recommended sampling procedures. Dissolved metals samples were field-filtered through a 0.45 µm filter and preserved with nitric acid (HNO_3). EBA field-diluted a sample (1 part sample, 9 parts de-ionized water) for a diluted silicon analysis of the Stinky Lake Spring sample. This dilution retards silicon precipitation prior to filtration and preservation due to cooling of the sample. Using this ratio, the laboratory result for the diluted sample can be multiplied by 10 to get the original concentration prior to dilution. No diluted samples were collected from the other two springs because the low temperature (< 13°C) did not cause any risk of silica precipitation prior to filtration and preservation of the sample.

Water samples were shipped on ice by air cargo to the laboratories. Inorganic water chemistry was analyzed by Exova (formerly Bodycote Testing Group) in Surrey, British

Columbia. Isotope analyses were conducted by the University of Waterloo, Environmental Isotope Laboratory in Waterloo, Ontario.

2.3 GEOTHERMOMETER

There are a wide range of empirical chemical geothermometer formulas in the literature. One group is based on the equilibrium reached among alkali elements (sodium (Na), potassium (K) and calcium (Ca); Fournier and Truesdell 1973). Another group is based on the solubility of various mineralogical forms of silica (SiO_2) in hot geothermal waters. Silica solubility is rate- dependent, so waters that gain silica at elevated temperatures only slowly release that silica as the waters cool (i.e., as they move upwards and discharge at the surface). For this reason, the silica content of discharging geothermal waters can be used to calculate the approximate maximum subsurface temperature at which the water acquired the silica content.

Some of the prominent formulas are presented in Table 3.

TABLE 3: COMMON GEOTHERMOMETER FORMULAS

#	Formula	Source	Comment
	Alkali-based formulas		
1	T°C = {1647/ [(log(Na/K) + B(log (sqrt(Ca)/Na) + 2.06)+2.47)]} – 273.15	Fournier and Truesdell, 1973	B = 4/3 below 100°C and 1/3 above 100°C; useable for T > 70°C, best 180–300°C
2	T°C = [1217/ (log(Na/K) + 1.483)] – 273.15	Fournier 1981	Alkali formula using Na and K only
3	T°C = [876.3/ (log(Na/K) + 0.8775)] – 273.15	Diaz-Gonzalez and Santoyo, 2008	Updated using world database of geothermal fluids
4	T°C = [1289/ (log(Na/K) + 1.635)] – 273.15	Verma and Santoyo 1995	Updated using an error propagation method, with Fournier's original data
	Silica-based formulas		
5	T°C = [1309/ (5.19 – logSiO_2)] – 273.15	Fournier 1981	Silica form is quartz with no steam loss; best for T > 180°C
6	T°C = [1522/ (5.75 – logSiO_2)] – 273.15	Fournier 1981	Silica form is quartz with steam loss from reservoir; best for T > 180°C
7	T°C = [1032/ (4.69 – logSiO_2)] – 273.15	Garcher and Arehart 2008	Silica form is chalcedony; best for T = 180-140°C
8	T°C = [731/ (4.52 – logSiO_2)] – 273.15	Garcher and Arehart 2008	Form is amorphous silica; best for T < 140°C
9	T°C = -44.119 +0.24469(SiO_2) – 1.7414 E-4(SiO_2)^2 + 79.305log(SiO_2)	Verma and Santoyo 1995	Updated using an error propagation method, with Fournier's original data; useful for T = 20-210°C

Note: All concentrations in molality (mg/kg). For water with density ~1 kg/L, concentrations of mg/L can be used.

Because calcium is the dominant cation in all water samples collected, we have chosen to use the classic alkali formula no. 1 (Fournier and Truesdell 1973) with the constant term B = 1/3 (assuming subsurface temperatures are over 100°C).

For a silica geothermometer, we chose to use formula No. 9 (Verma and Santoyo 1995) since this is an update of Fournier's original formula and is applicable for temperatures ranging from 20 to 210°C. These formulae fit the hydrochemical setting and temperature ranges expected for the samples collected, and provide a reasonable estimate of subsurface temperatures for purposes of this reconnaissance study.

In applying the silica geothermometer, we assumed that for the waters sampled in this program, silicon (Si) is always bound as silica (SiO_2). The dilute sample silicon (Si) concentrations reported by the laboratory were first multiplied by 10 to determine the undiluted silicon concentration at the sampling point. The corrected silicon concentrations were then multiplied by 2.14 which is the ratio of atomic weights of Si and SiO_2. This calculated SiO_2 value was then used in the silica geothermometer formula. Note that the analytical results for silicon and diluted silicon are very similar which indicates that no significant amounts of silicon were lost during sampling due to cooling of the sample and associated precipitation of silicon.

3.0 RESULTS

Table 4 presents a summary of the chemistry and isotope analytical results. The laboratory reports and certificates are included as Appendix B. To evaluate the quality of the analysis EBA calculated the ion balance for each sample, i.e., the balance between sum of anion and cation equivalent charges. Usually, an ion balance of within ± 5% is considered satisfactory. The calculated ion balances vary from -0.3% to 1.0%, i.e., all ion balances are considerably smaller than 5%, which suggests that analytical errors are within acceptable limits and all major cations and anions were included in the analyses.

The water samples can be classified based on their major ion chemical composition, taking into account all major anions and cations exceeding 10 meq-%[1]. The water or hydrochemical facies is determined by listing the ions with concentrations greater than 10 meq-% in decreasing order (cations are listed first).

All samples collected can be characterized as calcium-magnesium-bicarbonate (Ca-Mg-HCO_3) type waters. Other parameters such as pH, hardness, electrical conductivity, and total dissolved solids are also very similar for all water samples, indicating a similar origin of all samples. Furthermore, dissolved metals concentrations do not show any considerable variations and are similar for all samples.

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1 The unit meq-% represents the percentage of cations and anions calculated from their milliequivalents per litre (meq/L). The unit meq/L is the molar concentration multiplied by the charge of the ions.

Figure 2 presents the results of the oxygen-18 and deuterium stable isotope analyses along with the Global (GMWL) and Local (LMWL) Meteoric Water Lines. The results are expressed in per mil units (parts per thousand) relative to Standard Mean Ocean Water (SMOW). All samples plot close to the LMWL for Whitehorse.

The tritium concentrations are similar for all samples and vary from a minimum of about 6 TU[2] in the sample from the Stinky Lake Spring to a maximum of about 11 TU in the sample from the Versluce Spring.

4.0 ANALYSIS AND DISCUSSION

The fact that the stable isotope results of all samples collected plot close to the LMWL indicates that the spring water is of local meteoric origin (Figure 2). Stable isotopic fractionation which can be typical for high-temperature geothermal waters with high residence times was not observed.

The comparable chemistry of all water samples collected indicates a similar origin, most likely from local shallow groundwater. The chemical composition of all samples is similar to the chemistry of the Versluce Spring reported in Crandall and Sadlier-Brown (1976), except for the dissolved SiO_2 concentration which was considerably lower in the sample from the Versluce Spring (SiO_2=15.6 mg/L) taken by EBA in May 2009 compared to the sample (SiO_2=44 mg/L) described in Crandall and Sadlier-Brown (1976).

The Ca-Mg-HCO_3 water type suggests an origin of the thermal water in sedimentary, carbonate-rich rocks. The tritium isotopes found in all water samples suggest either a relatively short residence time of the water in the subsurface of less than about 50 years or a mixture of young, shallow and likely cold groundwater with an older thermal water component. The mixing ratio cannot be estimated with any reasonable level of confidence based on the data available. Nonetheless, assuming a modern tritium concentration of 5-10 TU for the shallow, cold groundwater component and tritium-free thermal water, the percentage of the thermal water in the samples collected could be considerably less than 50%. In this case, the temperature of the thermal water would be much higher than the water temperatures observed. However, no further quantification of mixing ratios or temperature of the thermal water component is possible based on the information available at this stage of the project.

EBA used geothermometer methods to estimate subsurface geothermal reservoir temperatures as described in Section 2.3. Table 5 summarizes the temperatures estimated for the different samples collected. The temperature obtained from the Na-K-Ca geothermometer (Fournier and Truesdell 1973) strongly depends on the chosen parameter B = 1/3 for temperatures > 100°C or B = 4/3 for temperatures < 100°C. As mentioned

[2] TU – Tritium Unit: 1 TU corresponds to $^3H/^2H = 10^{-18}$ or 1 TU = 0.1181 Bq/kg (3.193 pCi/kg)

above, EBA used B = 1/3 assuming that the maximum reservoir temperature is > 100°C. Assuming a reservoir temperature of < 100°C and using B = 4/3, would yield temperatures which are lower than the observed temperatures and are obviously erroneous. Furthermore, the ideal temperature range for the use of the Na-K-Ca geothermometer is 180-300°C, which is likely to be higher than the maximum temperature of the geothermal source. The alkali geothermometer is usually less affected by mixing and dilution than the silica-based geothermometer because it uses concentration ratios rather than absolute concentrations. However, this is only true if the majority of the alkali elements originate from the thermal water component. Since alkali concentrations are very similar in all samples collected this condition does not seem to be fulfilled in this case.

EBA therefore suggests that the silica-based geothermometer provides the more reasonable estimate of the maximum reservoir temperature. Based on current information and the use of the silica-based geothermometer, the hottest temperature that the spring water was exposed to along its subsurface flow path has been estimated to be about 85°C for the Stinky Lake Spring and about 55°C for the Versluce Spring. No temperature has been estimated for sample SLC-1 because this sample was taken from a surface water source which had likely been affected by evaporation, preventing any meaningful subsurface temperature estimate.

It is important to note that the geothermometers do not provide any information on the depth and location of these temperature conditions. Furthermore, the silica geothermometer calculations do not take into account any mixing between the geothermal water and cold, shallow groundwater, and therefore present a lower estimate of the reservoir temperature.

TABLE 5: ESTIMATED SUBSURFACE TEMPERATURES USING GEOTHERMOMETERS (°C)

Sample	SiO_2	Na-K-Ca
SLP-Spring (Stinky Lake Spring)	87	(164)
SLC-2	39	(163)
Spring-PC (Versluce Spring)	54	(160)

Note: Silica-based geothermometer temperatures are likely more reliable minimum estimates for geothermal reservoir temperature (see text for more details).

5.0 CONCLUSIONS

The observed spring water temperatures in the range of 12.0°C to 18.5°C significantly exceed background temperatures of shallow groundwater that are typically lower than about 5°C in the Whitehorse area. This fact together with the chemical composition and estimated subsurface temperatures using geothermometer methods indicate the presence of a geothermal anomaly in the area of Porter Creek and possibly Crestview.

EBA (2008) assessed the groundwater temperature regime in the City of Whitehorse and found the highest geothermal gradient of about 6°C/100 m in a shallow (~35 m deep) well in Porter Creek while the highest well water temperature of 8.8°C was observed in a 145 m deep well in Riverdale. Earlier work by Hydrogeological Consultants Ltd. (1976) also revealed some indication of geothermal anomalies in the Porter Creek and Riverdale areas.

The geothermal reservoir temperature cannot be estimated with any confidence based on the currently available data because possible mixing ratios with cold, shallow groundwater are unknown. However, temperature estimates based on the silica geothermometer method suggest minimum reservoir temperatures of about 55°C (Versluce Spring) and about 85°C (Stinky Lake Spring). Because the Stinky Lake and Versluce Springs are located in close proximity and in a similar geological setting it is very likely that both are related to the same geothermal anomaly.

Both springs are located within sedimentary rocks of the Triassic Lewes River Group close to the contact with a Cretaceous granodiorite intrusion. Bedrock in this area is usually covered by quaternary glacial deposits at lower elevations (Wheeler, 1961).

The Takhini Hot Spring, which is located about 20 km to the northwest of the Stinky Lake and Versluce Springs, is situated in a similar geological setting, most likely also within Lewes River Group sedimentary rocks. The reservoir temperature estimates using geothermometer methods are similar for both Takhini Hot Spring (96°C, based on silica geothermometer) and Stinky Lake Spring (87°C, based on silica geothermometer). However, the chemical composition of the Takhini Hot Spring differs considerably from that of the Stinky Lake and Versluce Springs. The Takhini Hot Spring water represents a calcium-sulphate ($Ca\text{-}SO_4$) type water and is much more mineralized compared to the Stinky Lake and Versluce Springs (EBA, 2009).

6.0 REFERENCES

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7.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Yukon Energy Corporation and their agents. 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 Yukon Energy Corporation, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA's Services Agreement and in the General Conditions provided in Appendix A of this report.

8.0 CLOSURE

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

Respectfully submitted,

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TABLES

TABLE 4: RESULTS OF CHEMICAL AND ISOTOPE ANALYSES

Analyte		Units	Sample Name	SLP-Spring	SLP-D (diluted)	SLC-1	SLC-2	Spring-PC
			Lab ID	685948-1	685948-2	685948-3	685948-4	685948-5
			Sample Date	27-May-09	28-May-09	29-May-09	2-Jun-09	3-Jun-09
			Sample Location	Porter Creek, Whse	Porter Creek, Whse	Crestview, Whse	Crestview, Whse	Porter Creek, Whse
			Easting (UTM, Nad83)	08 493023 E	08 493023 E	08 488960 E	08 489047 E	08 492054 E
			Northing (UTM, Nad83)	6735225 N	6735225 N	6739305 N	6739272 N	6736227 N
			Matrix	Water	Water	Water	Water	Water
			Detection Limit	Results				
Ion Balance		%		0.8		1.0	-0.3	1.0
Water type				Ca-Mg-HCO3		Ca-Mg-HCO3	Ca-Mg-HCO3	Ca-Mg-HCO3
Field Parameters								
Temperature	T	°C		18.5		15.8	12.0	12.7
pH		pH units		7.56		7.76	7.67	7.60
Dissolved O2	DO	mg/L		0.25		-	-	-
Electrical Conductivity	EC	μS/cm at 25°C		347		360	404	336
Total Dissolved Solids	TDS	ppm		176		183	206	171
Physical Parameters								
pH		pH units	-	7.98		8.05	8.18	8.06
Electrical Conductivity	EC	μS/cm at 25°C	1	373		420	318	357
Total Dissolved Solids		mg/L		208		238	180	200
Hardness		mg/L	1	190		213	162	182
Dissolved Major Ions								
Calcium	Ca	mg/L	0.2	51		60.1	44.8	49.5
Magnesium	Mg	mg/L	0.2	15.1		15.3	12	14.3
Sodium	Na	mg/L	0.4	6.9		7.3	5.5	5.8
Potassium	K	mg/L	0.4	1.7		2.1	1.4	1.4
Chloride	Cl	mg/L	0.4	1		1.2	0.9	1
Fluoride	F	mg/L	0.05	0.5		0.35	0.32	0.35
Nitrate - N	NO_3	mg/L	0.01	<0.01		<0.01	<0.01	0.12
Nitrite - N	NO2	mg/L	0.005	<0.005		<0.005	<0.005	<0.005
Nitrate and Nitrite - N		mg/L	0.01	<0.01		<0.01	<0.01	0.12
Sulfate (SO4)	SO_4	mg/L	0.9	30.1		43.9	27	28
Ortho Phosphorus	P	mg/L	0.3	<0.05		<0.05	<0.05	<0.05
Hydroxide	OH	mg/L	5	<5		<5	<5	<5
Carbonate	CO_3	mg/L	6	<6		<6	<6	<6
Bicarbonate	HCO_3	mg/L	5	208		219	179	198
P-Alkalinity	$CaCO_3$	mg/L	5	<5		<5	<5	<5
T-Alkalinity	$CaCO_3$	mg/L	5	171		180	147	163
Metals - Dissolved								
Aluminum	Al	mg/L	0.005	<0.005		0.005	0.006	<0.005
Antimony	Sb	mg/L	0.0002	0.0004		0.0007	0.0005	0.0005
Arsenic	As	mg/L	0.0002	0.0011		0.0014	0.0013	0.0006
Barium	Ba	mg/L	0.001	0.048		0.042	0.034	0.036
Beryllium	Be	mg/L	0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Bismuth	Bi	mg/L	0.0005	<0.0005		<0.0005	<0.0005	<0.0005
Boron	B	mg/L	0.002	0.024		0.018	0.012	0.01
Cadmium	Cd	mg/L	0.0000	0.00002		0.00001	0.00001	0.00001
Chromium	Cr	mg/L	0.0005	<0.0005		0.0252	<0.0005	0.0006
Cobalt	Co	mg/L	0.0001	<0.0001		0.0002	<0.0001	<0.0001
Copper	Cu	mg/L	0.001	<0.001		0.001	<0.001	0.001
Iron	Fe	mg/L	0.01	0.01		0.11	<0.01	<0.01
Lead	Pb	mg/L	0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Lithium	Li	mg/L	0.001	0.006		0.005	0.003	0.004
Manganese	Mn	mg/L	0.005	<0.005		0.034	<0.005	<0.005
Mercury	Hg	mg/L	0.0001	<0.0001		<0.0001	<0.0001	<0.0001
Molybdenum	Mo	mg/L	0.001	0.013		0.006	0.007	0.01
Nickel	Ni	mg/L	0.0005	<0.0005		0.0086	<0.0005	<0.0005
Selenium	Se	mg/L	0.0002	<0.0002		<0.0002	<0.0002	0.0006
Silicon	Si	mg/L	0.050	16.4	15.1	7.29	4.91	7.27
Silver	Ag	mg/L	0.00001	<0.00001		<0.00001	<0.00001	<0.00001
Strontium	Sr	mg/L	0.001	0.574		0.659	0.424	0.474
Sulfur	S	mg/L	0.300	10		14.6	8.9	9.4
Thallium	Tl	mg/L	0.00005	<0.00005		<0.00005	<0.00005	<0.00005
Tin	Sn	mg/L	0.001	<0.001		0.001	<0.001	<0.001
Titanium	Ti	mg/L	0.0005	<0.0005		0.0006	0.0005	<0.0005
Uranium	U	mg/L	0.0005	0.0026		0.0008	0.0019	0.0045
Vanadium	V	mg/L	0.0001	0.0021		0.0006	0.0014	0.0018
Zinc	Zn	mg/L	0.001	0.002		0.003	0.002	0.001
Environmental Isotopes								
Oxygen-18[1]	$\delta^{18}O$	‰		-21.33	-	-20.83	-19.52	-20.59
Deuterium[1]	$\delta^{2}H$	‰		-169.81	-	-166.80	-161.55	-167.06
Tritium	^{3}H	TU[2]		5.9±0.8	-	8.9±1.0	7.9±0.9	11.3±1.1

Notes:

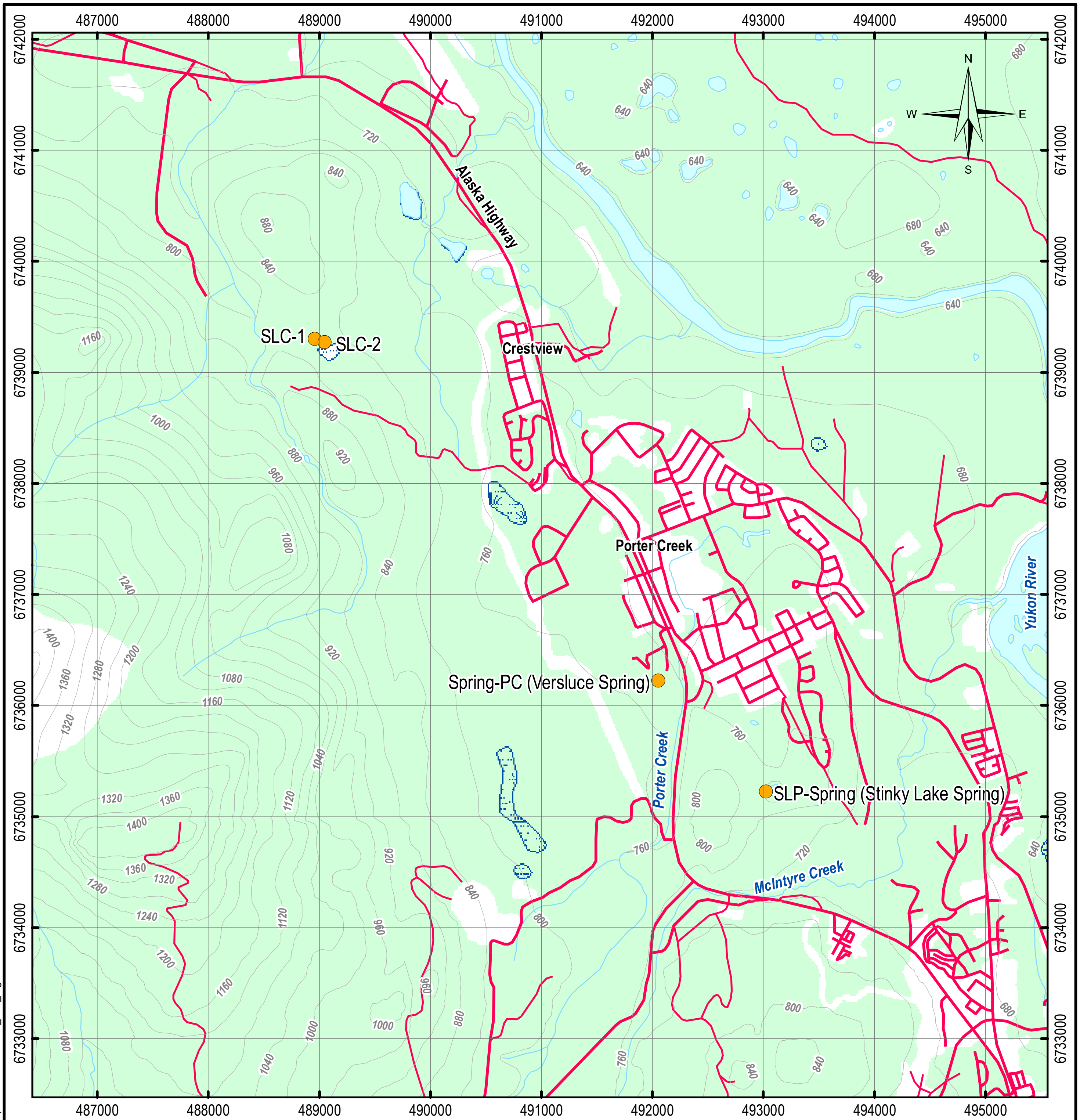
"<" indicates less than the laboratory detection limit

"-" indicates not analyzed

[1] Stable isotope ratios are measured relative to the VSMOW (Vienna Standard Mean Ocean Water): $\delta^{18}O = ((^{18}O/^{16}O)\_sample/(^{18}O/^{16}O)\_reference))*1000‰VSMOW; \delta^{2}H =$

[2] TU - Tritium Units (1TU = 0.11919 Becquerels/L per IAEA, 2000 Report; 1TU equals 1 ^{3}H atom in 10^{18} ^{1}H atoms)

FIGURES



LEGEND

- Sample Location
- Contour (40m)
- Limited Use Road
- Road
- Watercourse
- Waterbody
- Wetland
- Vegetation

NOTES

Base data source:
NTS 1:50,000 (Sheets 105D11 & 105D14)

ISSUED FOR USE

2009 GEOTHERMAL EXPLORATION PROGRAM STINKY LAKES, PORTER CREEK, YUKON

Study Area and Sampling Locations

PROJECTION	DATUM
UTM Zone 8	NAD83

Scale: 1:50,000
800 400 0 800
Meters

FILE NO.
W23101159_014_Figure01.mxd

PROJECT NO.	DWN	CKD	REV
W23101159.014	MEZ	SK	0

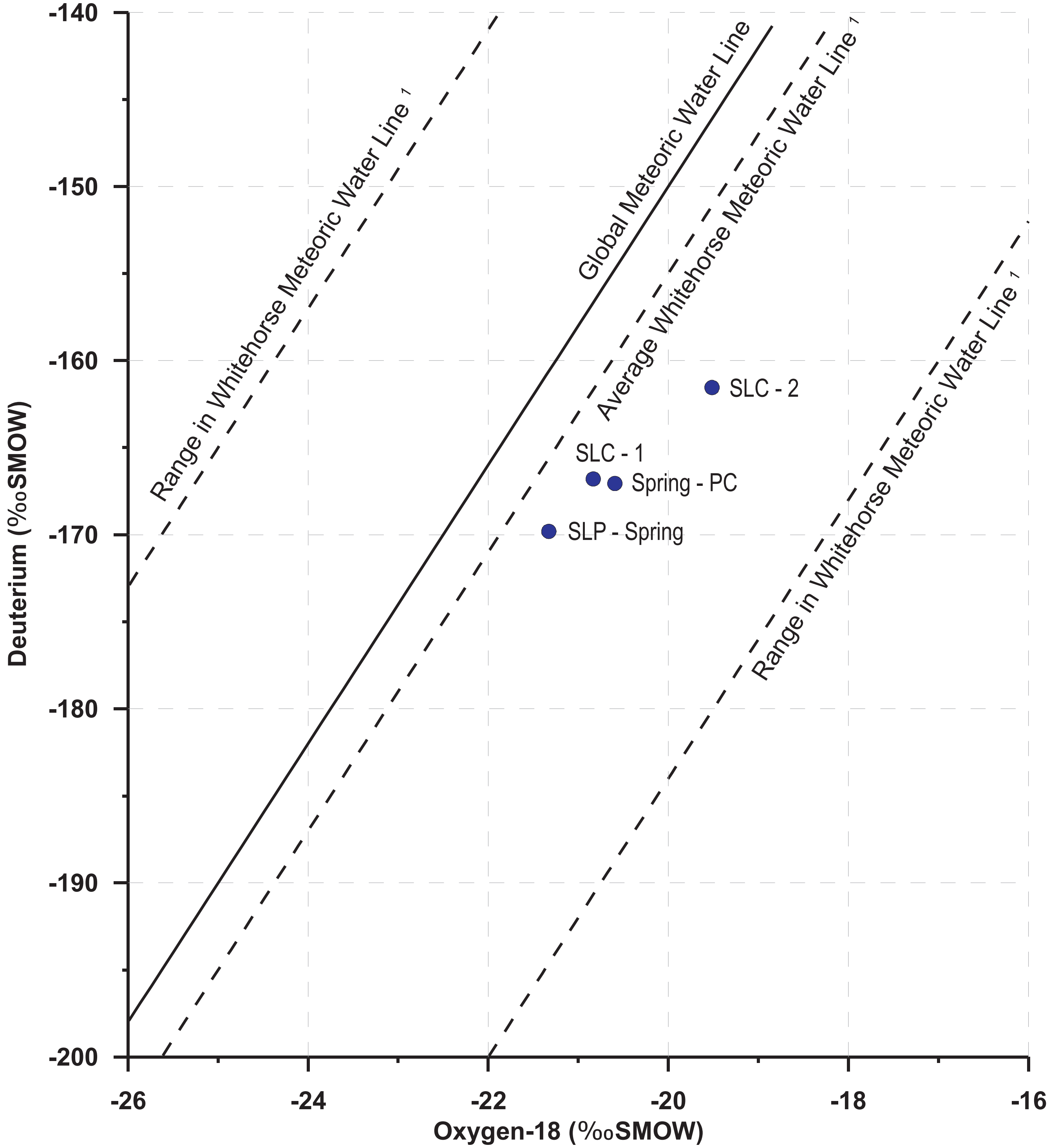
OFFICE	DATE
EBA-VANC	October 27, 2009

YUKON ENERGY

EBA Engineering Consultants Ltd.

Figure 1

Q:\Vancouver\GIS\ENVIRONMENTAL\W231\W23101159_YU_GeothermalMaps\014\W23101159_014_Figure01.mxd



NOTES

1) LMWL - Local (Whitehorse) Meteoric Water Line from Birks, Edwards, Gibson, Michel, Drimmie, and MacTavish, Canadian Network for Isotopes in Precipitation, Univeristy of Waterloo/ Meteorological Service of Canada 2003.
2) GMWL - Global Meteoric Water Line from Fetter (1994) citing Craig (1961).
3) Takhini Hotsprings 1980 Measurement from Everdingen (1981).
4) SMOW = Standard Mean Ocean Water

CLIENT

YUKON ENERGY

EBA Engineering Consultants Ltd.

eba

2009 GEOTHERMAL EXPLORATION PROGRAM
STINKY LAKE, PORTER CREEK, YUKON

Plot of Stable Isotope Data with Meteoric Water Line

PROJECT NO.	DWN	CKD	REV
W23101159.014	SK	RMM	0
OFFICE	DATE		
EBA-WHSE	October 26, 2009		

Figure 2

PHOTOGRAPHS

Photo 1
Stinky Lake south of Porter Creek (looking west). The arrow in the centre of the picture shows the location of the Stinky Lake Warm Spring.

Photo 2
Small creek fed by the Stinky Lake Warm Spring and discharging into Stinky Lake.

APPENDIX

APPENDIX A GENERAL CONDITIONS

GEO-ENVIRONMENTAL REPORT – GENERAL CONDITIONS

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.

APPENDIX

APPENDIX B LABORATORY ANALYTICAL REPORT

Bodycote TESTING GROUP

Report Transmission Cover Page

Bill To:	EBA Engineering Consulting Lt	Project:		Lot ID:	**685948**
Report To:	EBA Engineering Consulting Lt	ID:	W23101159.014	Approval Status:	Approved
	Calcite Business Centre	Name:	Geothermal-Stinky Lakes	Invoice Frequency:	by Lot
	Unit 6, 151 Industrial Road	Location:	Whitehorse	COD Status:	
	Whitehorse, YT, Canada	LSD:		Control Number:	
	Y1A 2V3	P.O.:		Date Received:	Jun 4, 2009
Attn:	Stephan Klump	Acct code:		Date Reported:	Jun 9, 2009
Sampled By:	Ryan Martin			Report Number:	1225258
Company:	EBA				

Contact & Affiliation	Address	Delivery Commitments
Stephan Klump EBA Engineering - Edmonton	Unit 6, 151 Industrial Road, Calcite Business Whitehorse, Yukon Territory Y1A 2V3 Phone: (867) 668-2071 Fax: (867) 668-4349 Email: sklump@eba.ca	On [Lot Verification] send (COA) by Email - Single Report On [Report Approval] send (COC, Test Report) by Email - Merge Reports On [Report Approval] send (Test Report) by Email - Single Report On [Lot Approval and Final Test Report Approval] send (COC, Test Report, Invoice) by Post M

Notes To Clients:

Bodycote TESTING GROUP

Sample Custody

Bill To:	EBA Engineering Consulting Lt	Project:		Lot ID:	**685948**
Report To:	EBA Engineering Consulting Lt	ID:	W23101159.014	Control Number:	
	Calcite Business Centre	Name:	Geothermal-Stinky Lakes	Date Received:	Jun 4, 2009
	Unit 6, 151 Industrial Road	Location:	Whitehorse	Date Reported:	Jun 9, 2009
	Whitehorse, YT, Canada	LSD:		Report Number:	1225258
	Y1A 2V3	P.O.:			
Attn:	Stephan Klump	Acct code:			
Sampled By:	Ryan Martin				
Company:	EBA				

Sample Disposal Date: September 07, 2009

All samples will be stored until this date unless other instructions are received. Please indicate other requirements below and return this form to the address or fax number on the bottom of this page.

☐ Extend Sample Storage Until ______________________ (MM/DD/YY)

The following charges apply to extended sample storage:

Storage for 1 to 5 samples per month	$ 10.00
Storage for 6 to 20 samples per month	$ 15.00
Storage for 21 to 50 samples per month	$ 30.00
Storage for 51 to 200 samples per month	$ 60.00
Storage for more than 200 samples per month	$ 110.00

☐ Return Sample, collect, to the address below via:

- ☐ Greyhound
- ☐ Loomis
- ☐ Purolator
- ☐ Other (specify) ______________________

Name ______________________

Company ______________________

Address ______________________

____

Phone ______________________

Fax ______________________

Signature ______________________

Bodycote TESTING GROUP

Analytical Report

Bill To:	EBA Engineering Consulting Lt	Project:		Lot ID:	**685948**
Report To:	EBA Engineering Consulting Lt	ID:	W23101159.014	Control Number:	
	Calcite Business Centre	Name:	Geothermal-Stinky Lakes	Date Received:	Jun 4, 2009
	Unit 6, 151 Industrial Road	Location:	Whitehorse	Date Reported:	Jun 9, 2009
	Whitehorse, YT, Canada	LSD:		Report Number:	1225258
	Y1A 2V3	P.O.:			
Attn:	Stephan Klump	Acct code:			
Sampled By:	Ryan Martin				
Company:	EBA				

Analyte		Units	Results	Results	Results	Nominal Detection Limit
		Reference Number	685948-1	685948-2	685948-3	
		Sample Date	May 27, 2009	May 27, 2009	May 27, 2009	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	SLP-Spring	SLP-D	SLC-1	
		Matrix	Water	Water	Water	
Routine Water						
pH			7.98		8.05	
Temperature of observed pH		°C	22.7		23.1	
Electrical Conductivity		µS/cm at 25 C	373		420	1
Calcium	Dissolved	mg/L	51.0		60.1	0.2
Magnesium	Dissolved	mg/L	15.1		15.3	0.2
Sodium	Dissolved	mg/L	6.9		7.3	0.4
Potassium	Dissolved	mg/L	1.7		2.1	0.4
Iron	Dissolved	mg/L	0.01		0.11	0.01
Manganese	Dissolved	mg/L	<0.005		0.034	0.005
Chloride	Dissolved	mg/L	1.0		1.2	0.4
Fluoride		mg/L	0.50		0.35	0.05
Nitrate - N		mg/L	<0.01		<0.01	0.01
Nitrite - N		mg/L	<0.005		<0.005	0.005
Nitrate and Nitrite - N		mg/L	<0.01		<0.01	0.01
Sulfate (SO4)	Dissolved	mg/L	30.1		43.9	0.9
Hydroxide		mg/L	<5		<5	5
Carbonate		mg/L	<6		<6	6
Bicarbonate		mg/L	208		219	5
P-Alkalinity	as CaCO3	mg/L	<5		<5	5
T-Alkalinity	as CaCO3	mg/L	171		180	5
Total Dissolved Solids	Calculated	mg/L	208		238	1
Hardness	Dissolved as CaCO3	mg/L	190		213	
Ionic Balance	Dissolved	%	102		102	
Silicon	Dissolved	mg/L		1.51		0.05

Bodycote TESTING GROUP

Analytical Report

Bill To:	EBA Engineering Consulting Lt	Project:		Lot ID:	**685948**
Report To:	EBA Engineering Consulting Lt	ID:	W23101159.014	Control Number:	
	Calcite Business Centre	Name:	Geothermal-Stinky Lakes	Date Received:	Jun 4, 2009
	Unit 6, 151 Industrial Road	Location:	Whitehorse	Date Reported:	Jun 9, 2009
	Whitehorse, YT, Canada	LSD:		Report Number:	1225258
	Y1A 2V3	P.O.:			
Attn:	Stephan Klump	Acct code:			
Sampled By:	Ryan Martin				
Company:	EBA				

		Reference Number	685948-1	685948-3	685948-4	
		Sample Date	May 27, 2009	May 27, 2009	Jun 02, 2009	
		Sample Time	NA	NA	NA	
		Sample Location				
		Sample Description	SLP-Spring	SLC-1	SLC-2	
		Matrix	Water	Water	Water	
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Inorganic Nonmetallic Parameters						
Phosphorus	Dissolved	mg/L	<0.05	<0.05	<0.05	0.05
Metals Dissolved						
Silicon	Dissolved	mg/L	16.4	7.29	4.91	0.05
Sulfur	Dissolved	mg/L	10.0	14.6	8.9	0.3
Mercury	Dissolved	mg/L	<0.0001	<0.0001	<0.0001	0.0001
Aluminum	Dissolved	mg/L	<0.005	0.005	0.006	0.005
Antimony	Dissolved	mg/L	0.0004	0.0007	0.0005	0.0002
Arsenic	Dissolved	mg/L	0.0011	0.0014	0.0013	0.0002
Barium	Dissolved	mg/L	0.048	0.042	0.034	0.001
Beryllium	Dissolved	mg/L	<0.0001	<0.0001	<0.0001	0.0001
Bismuth	Dissolved	mg/L	<0.0005	<0.0005	<0.0005	0.0005
Boron	Dissolved	mg/L	0.024	0.018	0.012	0.002
Cadmium	Dissolved	mg/L	0.00002	0.00001	0.00001	0.00001
Chromium	Dissolved	mg/L	<0.0005	0.0252	<0.0005	0.0005
Cobalt	Dissolved	mg/L	<0.0001	0.0002	<0.0001	0.0001
Copper	Dissolved	mg/L	<0.001	0.001	<0.001	0.001
Lead	Dissolved	mg/L	<0.0001	<0.0001	<0.0001	0.0001
Lithium	Dissolved	mg/L	0.006	0.005	0.003	0.001
Molybdenum	Dissolved	mg/L	0.013	0.006	0.007	0.001
Nickel	Dissolved	mg/L	<0.0005	0.0086	<0.0005	0.0005
Selenium	Dissolved	mg/L	<0.0002	<0.0002	<0.0002	0.0002
Silver	Dissolved	mg/L	<0.00001	<0.00001	<0.00001	0.00001
Strontium	Dissolved	mg/L	0.574	0.659	0.424	0.001
Thallium	Dissolved	mg/L	<0.00005	<0.00005	<0.00005	0.00005
Tin	Dissolved	mg/L	<0.001	0.001	<0.001	0.001
Titanium	Dissolved	mg/L	<0.0005	0.0006	0.0005	0.0005
Uranium	Dissolved	mg/L	0.0026	0.0008	0.0019	0.0005
Vanadium	Dissolved	mg/L	0.0021	0.0006	0.0014	0.0001
Zinc	Dissolved	mg/L	0.002	0.003	0.002	0.001
Subsample	Field Filtered		Field Filtered	Field Filtered	Field Filtered	

Bodycote TESTING GROUP

Analytical Report

Bill To:	EBA Engineering Consulting Lt	Project:		Lot ID:	**685948**
Report To:	EBA Engineering Consulting Lt	ID:	W23101159.014	Control Number:	
	Calcite Business Centre	Name:	Geothermal-Stinky Lakes	Date Received:	Jun 4, 2009
	Unit 6, 151 Industrial Road	Location:	Whitehorse	Date Reported:	Jun 9, 2009
	Whitehorse, YT, Canada	LSD:		Report Number:	1225258
	Y1A 2V3	P.O.:			
Attn:	Stephan Klump	Acct code:			
Sampled By:	Ryan Martin				
Company:	EBA				

		Reference Number	685948-4	685948-5		
		Sample Date	Jun 02, 2009	Jun 01, 2009		
		Sample Time	NA	NA		
		Sample Location				
		Sample Description	SLC-2	Spring-PC		
		Matrix	Water	Water		
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Routine Water						
pH			8.18	8.06		
Temperature of observed pH		°C	22.7	22.7		
Electrical Conductivity		µS/cm at 25 C	318	357		1
Calcium	Dissolved	mg/L	44.8	49.5		0.2
Magnesium	Dissolved	mg/L	12.0	14.3		0.2
Sodium	Dissolved	mg/L	5.5	5.8		0.4
Potassium	Dissolved	mg/L	1.4	1.4		0.4
Iron	Dissolved	mg/L	<0.01	<0.01		0.01
Manganese	Dissolved	mg/L	<0.005	<0.005		0.005
Chloride	Dissolved	mg/L	0.9	1.0		0.4
Fluoride		mg/L	0.32	0.35		0.05
Nitrate - N		mg/L	<0.01	0.12		0.01
Nitrite - N		mg/L	<0.005	<0.005		0.005
Nitrate and Nitrite - N		mg/L	<0.01	0.12		0.01
Sulfate (SO4)	Dissolved	mg/L	27	28		0.9
Hydroxide		mg/L	<5	<5		5
Carbonate		mg/L	<6	<6		6
Bicarbonate		mg/L	179	198		5
P-Alkalinity	as CaCO3	mg/L	<5	<5		5
T-Alkalinity	as CaCO3	mg/L	147	163		5
Total Dissolved Solids	Calculated	mg/L	180	200		1
Hardness	Dissolved as CaCO3	mg/L	162	182		
Ionic Balance	Dissolved	%	100	102		

Bodycote TESTING GROUP

Analytical Report

Bill To:	EBA Engineering Consulting Lt	Project:		Lot ID:	**685948**
Report To:	EBA Engineering Consulting Lt	ID:	W23101159.014	Control Number:	
	Calcite Business Centre	Name:	Geothermal-Stinky Lakes	Date Received:	Jun 4, 2009
	Unit 6, 151 Industrial Road	Location:	Whitehorse	Date Reported:	Jun 9, 2009
	Whitehorse, YT, Canada	LSD:		Report Number:	1225258
	Y1A 2V3	P.O.:			
Attn:	Stephan Klump	Acct code:			
Sampled By:	Ryan Martin				
Company:	EBA				

		Reference Number	685948-5			
		Sample Date	Jun 01, 2009			
		Sample Time	NA			
		Sample Location				
		Sample Description	Spring-PC			
		Matrix	Water			
Analyte		**Units**	**Results**	**Results**	**Results**	Nominal Detection Limit
Inorganic Nonmetallic Parameters						
Phosphorus	Dissolved	mg/L	<0.05			0.05
Metals Dissolved						
Silicon	Dissolved	mg/L	7.27			0.05
Sulfur	Dissolved	mg/L	9.4			0.3
Mercury	Dissolved	mg/L	<0.0001			0.0001
Aluminum	Dissolved	mg/L	<0.005			0.005
Antimony	Dissolved	mg/L	0.0005			0.0002
Arsenic	Dissolved	mg/L	0.0006			0.0002
Barium	Dissolved	mg/L	0.036			0.001
Beryllium	Dissolved	mg/L	<0.0001			0.0001
Bismuth	Dissolved	mg/L	<0.0005			0.0005
Boron	Dissolved	mg/L	0.010			0.002
Cadmium	Dissolved	mg/L	0.00001			0.00001
Chromium	Dissolved	mg/L	0.0006			0.0005
Cobalt	Dissolved	mg/L	<0.0001			0.0001
Copper	Dissolved	mg/L	0.001			0.001
Lead	Dissolved	mg/L	<0.0001			0.0001
Lithium	Dissolved	mg/L	0.004			0.001
Molybdenum	Dissolved	mg/L	0.01			0.001
Nickel	Dissolved	mg/L	<0.0005			0.0005
Selenium	Dissolved	mg/L	0.0006			0.0002
Silver	Dissolved	mg/L	<0.00001			0.00001
Strontium	Dissolved	mg/L	0.474			0.001
Thallium	Dissolved	mg/L	<0.00005			0.00005
Tin	Dissolved	mg/L	<0.001			0.001
Titanium	Dissolved	mg/L	<0.0005			0.0005
Uranium	Dissolved	mg/L	0.0045			0.0005
Vanadium	Dissolved	mg/L	0.0018			0.0001
Zinc	Dissolved	mg/L	0.001			0.001
Subsample	Field Filtered		Field Filtered			

Approved by: Andrew Garrard

Andrew Garrard, BSc
General Manager

Bodycote TESTING GROUP

Methodology and Notes

Bill To:	EBA Engineering Consulting Lt	Project:		Lot ID:	**685948**
Report To:	EBA Engineering Consulting Lt	ID:	W23101159.014	Control Number:	
	Calcite Business Centre	Name:	Geothermal-Stinky Lakes	Date Received:	Jun 4, 2009
	Unit 6, 151 Industrial Road	Location:	Whitehorse	Date Reported:	Jun 9, 2009
	Whitehorse, YT, Canada	LSD:		Report Number:	1225258
	Y1A 2V3	P.O.:			
Attn:	Stephan Klump	Acct code:			
Sampled By:	Ryan Martin				
Company:	EBA				

Method of Analysis

Method Name	Reference		Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	*	Conductivity, 2510	08-Jun-09	BTG Edmonton
Alkalinity, pH, and EC in water	APHA	*	Electrometric Method, 4500-H+ B	08-Jun-09	BTG Edmonton
Alkalinity, pH, and EC in water	APHA	*	Titration Method, 2320 B	08-Jun-09	BTG Edmonton
Anions (Routine) by Ion Chromatography	APHA	*	Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	08-Jun-09	BTG Edmonton
Approval-Edmonton	APHA		Checking Correctness of Analyses, 1030 E	08-Jun-09	BTG Edmonton
Chloride in Water	APHA	*	Automated Ferricyanide Method, 4500-Cl- E	08-Jun-09	BTG Edmonton
Kjeldahl Nitrogen & Phosphorus (Dissolved) in Water	APHA	*	Automated Ascorbic Acid Reduction Method, 4500-P F	08-Jun-09	BTG Edmonton
Mercury (Dissolved) in water	APHA	*	Cold Vapour Atomic Absorption Spectrometric Method, 3112 B	08-Jun-09	BTG Edmonton
Metals ICP-MS (Dissolved) in water	US EPA	*	Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	08-Jun-09	BTG Edmonton
Metals SemiTrace (Dissolved) in water	US EPA	*	Metals & Trace Elements by ICP-AES, 6010B	05-Jun-09	BTG Surrey
Metals Trace (Dissolved) in water	APHA		Hardness by Calculation, 2340 B	08-Jun-09	BTG Edmonton
Metals Trace (Dissolved) in water	APHA	*	Inductively Coupled Plasma (ICP) Method, 3120 B	08-Jun-09	BTG Edmonton

** Bodycote method(s) based on reference method*

References

US EPA	US Environmental Protection Agency Test Methods
APHA	Standard Methods for the Examination of Water and Wastewater

Comments:

Please direct any inquiries regarding this report to our Client Services group.
Results relate only to samples as submitted.
The test report shall not be reproduced except in full, without the written approval of the laboratory.

Bodycote TESTING GROUP

LOT: ______ Control Number ______

Environmental Sample Information Sheet

Note: Proper completion of this form is required in order to proceed with analysis

See reverse for your nearest Bodycote location and proper sampling protocol

Billing Address:			**Copy of Report To:**	Copy of invoice: [ ]
Company:	EBA Engineering Consulting Ltd.		Company:	Mail invoice to this address for approval [ ]
Address:	Unit 6, 151 Industrial Rd Whitehorse, YT Y1A 2V3	QA/QC Report [x]	Address:	
		Report Result:		Report Result:
Attention:	Stephan Klump	Fax [ ]	Attention:	Fax [ ]
Phone:	867-668-3068	Mail [x]	Phone:	Mail [ ]
Fax:	867-668-4349	Courier [ ]	Fax:	Courier [ ]
Cell:		e-mail [x]	Cell:	e-mail [ ]
e-mail:	sklump@eba.ca	e-Service [ ]	e-mail:	e-Service [ ]

Information to be included on Report and Invoice

Project ID:	W23101159.014
Project Name:	Geothermal - Stinky Lakes
Project Location:	Whitehorse
Legal Location:	
PO#:	
Proj. Acct. Code:	
Agreement ID:	

RUSH Please contact the laboratory to confirm rush dates and times before submitting samples.

Upon filling out this section, client accepts that surcharges will be attached to this analysis

RUSH required on: All Analysis [ ] or As indicated [ ]

Date Required: ______

Signature: ______

Bodycote Authorization: ______

Sample Custody (Please Print)

Sampled by: Ryan Martin

Company EBA Signature KC

I authorize Bodycote to proceed with the work indicated on this form:

Date: 3-Jun Initial: SK

Received by: Osy Core JUN 04 2009 Sample Temp. 11°C

Waybill #: Date

Company Time 2:40pm

Special Instructions / Comments

All "Dissolved Metals" samples are field-filtered and preserved.

FOR LAB USE ONLY

Condifition of containers/coolers upon arrival at lab

[ ] Check here if Bodycote is required to report results directly to a regulatory body (Please include contact information)

[ ] Check here if you are testing POTABLE WATER for **HUMAN CONSUMPTION**

Please indicate which regulations you are required to meet:

	Sample Identification	Location	Depth (IN CM M)	Date/Time Sampled	Matrix	Sampling Method	Number of Containers	TW33F	TDP	F	Si								
1	SLP-Spring	Spring	n/a	27-May-09	Water	Grab	2	[x]	[x]	[x]									
2	SLP-D	Spring	n/a	27-May-09	Water	Grab	1				[x]								
3	SLC-1	Spring	n/a	27-May-09	Water	Grab	2	[x]	[x]	[x]									
4	SLC-2	Pond	n/a	02-Jun-09	Water	Grab	2	[x]	[x]	[x]									
5	Spring-PC	Spring	n/a	01-Jun-09	Water	Grab	2	[x]	[x]	[x]									
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			

Enter tests above (✓ relevant samples below)

NOTE: All hazardous samples must be labelled according to WHIMIS guidelines.