



GOVERNMENT OF YUKON
PROPERTY MANAGEMENT DIVISION

ISSUED FOR USE

COMPLETION REPORT FOR WELL 2607
TOMBSTONE TERRITORIAL PARK, VISITOR RECEPTION CENTRE
KM 71 DEMPSTER HIGHWAY, YUKON

W23101173.001

February 2009



EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349

Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA



EXECUTIVE SUMMARY

EBA Engineering Consultants Ltd. (EBA) coordinated the drilling, construction, and testing of Well 2607 which will serve as a water supply well for the Tombstone Territorial Park Visitor Reception Centre. The scope of work for this project included a preliminary site visit, a review of available hydrogeological information, preparing specifications for drilling, well construction and testing, supervision of well drilling, construction and testing, data analysis, and preparation of this report.

Hydraulic testing results from a pumping test completed on the new well show that it is completed within a highly productive aquifer. The theoretical long-term sustainable yield of more than 100 L/s considerably exceeds the demand of about 1 L/s.

Laboratory results show that water quality of the well met all Canadian Drinking Water Quality Guidelines (CDWQG) for health based parameters and aesthetic objectives at the date sampled, except for bacteriological guidelines. The bacteriological analysis showed total coliforms to be present. However, this is likely due to contamination during drilling or sampling. The well should be re-sampled for bacteriological analysis before commissioning of the well. Caution should be exercised during the sampling to avoid any contamination.

A submersible pump should be installed at a depth of approximately 24.8 m bgs (3 m above the top of screen) to maximize drawdown and well performance. The pump to be installed in the well should be capable of pumping at the desired rate to meet the peak building demand, but not in excess of 10 L/s (132 Igpm) overcoming a head of 26 m (depth of pump intake plus 1 m for well head) plus pipe friction losses and possible additional elevation gains.

The table below presents the key information required for the Government of Yukon (YG) to solicit quotes for well connection according to the “Well Connection Standards for Typical YG Small Public Drinking Water Systems” (EBA, 2008).

WELL INFORMATION SUMMARY TABLE		
	Well ID	2607
	Date of Completion	September 28 – October 2, 2008
A	Static Water Level	8.2 m bgs
B	Recommended Maximum Drawdown	24.8 m bgs
C	Depth to Top of Screen	27.8 m bgs
D	Recommended Depth to Pump Intake	24.8 m bgs
E	Well Casing Diameter	152.4 mm
F	Distance to Building	~ 50 m
	Screen Length	1.3 m
	Name of Drilling Contractor	Double D Drilling Ltd.

m bgs = metres below ground surface



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1.0 INTRODUCTION

EBA Engineering Consultants Ltd. (EBA) was retained by the Government of Yukon (YG) Property Management Division (the Owner) to provide hydrogeological consulting and project management services for installation of a water supply well (Well 2607) at the Tombstone Territorial Park Visitor Reception Centre (VRC) located at KM 71 of the Dempster Highway. A site location map is provided as Figure 1.

The purpose of this project was to explore for a suitable groundwater resource to supply potable (drinking) water to the new facility and to ensure that the well is constructed and tested in accordance with the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems).

The scope of work for this project included the following tasks which are documented in the following sections:

- Review of background information and selection of drilling site;
- Prepare well drilling, construction, and testing specifications;
- Coordination and supervision of well drilling, construction and hydraulic testing;
- Data analysis and interpretation; and,
- Reporting.

2.0 FIELD PROGRAM

2.1 WELL LOCATION SELECTION

The well location was selected in accordance with the requirements outlined in the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems). These guidelines require the well to be located:

- 15 meters from a septic tank, sewage holding tank or contained privy,
- 30 metres from a soil absorption system, pit privy, or other potential sources of pollution that may pose a health and safety risk,
- 120 metres from a solid waste site or dump, and cemetery, and
- 300 metres from a sewage lagoon or pit.

The drilling site was selected in consultation with Jim Newnham of YG and to comply with setback distances specified above. The well location is shown on Figure 2. The drilling site is approximately 50 m west-northwest of the new building and 35 m upgradient of the existing on-site sewage disposal system (“Septic Field in Figure 2”).

2.2 WELL DRILLING AND CONSTRUCTION

Well 2607 was drilled from September 28 to 29, 2008 by Double D Drilling Ltd. (Double D) of Terrace, B.C., using a Barber DR-24 dual air rotary drill rig. Figure 3 summarizes subsurface conditions encountered at Well 2607. Soil samples were retained every 3 m (10 ft) while drilling through the unsaturated zone, and every 1.5 m (5 ft) while drilling through water bearing material. The soils encountered consisted of variable amounts of sand and gravel from ground surface to 29.2 m bgs (below ground surface) with some silt present between 10.7 and 13.7 m bgs. Saturated conditions were observed below about 9.4 m bgs. The saturated sand and gravel sequence encountered from 8 to 29.2 m bgs is interpreted as one unconfined aquifer consisting of sand and angular to sub-angular tabular gravel clasts.

EBA designed a well screen based on the flows observed during drilling and grain size analysis of the aquifer material. EBA conducted field grain size (sieve) analyses on a sample obtained from 28.0 to 29.2 m bgs. Grain size results are included as Appendix B. The grain size results indicate that the aquifer material is primarily gravel with some sand; this is consistent with the high flows (>100 USgpm) observed while air lifting during drilling. Based on the grain size results, EBA selected a 0.150 in (150 slot) v-wire stainless steel well screen.

The well screen assembly consisted of 1.3 m of 150-slot Johnson® v-wire stainless steel screen with a K-Packer and 0.74 m riser. Construction details for Well 2607 are included in Figure 3, the Drillers Well Log is attached in Appendix C*. The well was developed for approximately 5.5 hours by air lifting and surging. At the end of well development the water was clear.

A summary of relevant well construction details is presented in Table 1, below.

2.3 WELL AND AQUIFER TESTING

2.3.1 Hydraulic Testing Method

Hydraulic testing was conducted between October 1 and 2, 2008 by Double D under supervision of EBA. A temporary submersible pump was installed in the well with the intake positioned approximately 3.5 m above the top of the screened interval. A HOBOS® Water Level Logger was deployed in the pumping well to monitor the groundwater level during the pumping tests at time intervals of two minutes. In addition the barometric pressure was recorded during the pumping test to correct the measured water pressures for changes in barometric pressure if necessary.

Double D monitored flow during the pumping test using a digital flow meter. Water levels were measured on specified intervals using an electric tape. Water from the well during

* EBA will submit the Drillers Well Log to the Government of Yukon, Department of Environment, Water Resources Section V-310 on behalf of the Owner.

pumping was conveyed to a downgradient location approximately 60 m away from the well and disposed of via infiltration.

Manual data collected during the pumping tests are included as Appendix D.

TABLE 1: SUMMARY OF WELL INFORMATION AND CONSTRUCTION DETAILS FOR WELL 2607

	Well Construction Details
Date of construction:	September 28 to October 2, 2008
Owner of the well:	Government of Yukon, Property Management Agency
Description of the property:	Tombstone Visitor Reception Centre, Dempster Highway
UTM Coordinates (Nad 83):	UTM Zone 7 E 0633451 N 7156051
Location of well on the property:	See Figure 2
Drilling contractor:	Double D Drilling Ltd., Terrace, B.C.
Method of construction:	Dual air rotary
Description, depth, and thickness of geologic materials encountered during construction:	See well log in Figure 3 and drillers well log in Appendix C.
Depth and diameter of the well:	Total depth of well completion is 29.1 m bgs and diameter of well is 152.4 mm (6"). Construction details are included on Figure 3.
Type of casing materials and thickness:	Steel casing - 0.250 inches (6.35 mm) thick
Static water level:	8.2 m bgs (October 2008)
Type, size, length and location of the screen:	Stainless steel V-wire Johnson screen 150-slot (3.81 mm) from 27.8-29.1 m bgs; Total screen length is 1.3 m.
Location of major water-bearing zones:	Water-bearing sand and gravel aquifer from about 8.2 – 29.2 m bgs.
Location, type and thickness of grout sealant placed around the well:	Bentonite seal was placed between the annulus of the casing and native sediments. Seal is completed from grade to 6.0 m bgs.

2.3.2 Step Rate Pumping Test

A step rate test was conducted to determine the optimal rate at which to perform the constant rate pumping test.

The step rate test at Well 2607 consisted of three 30-min steps at rates of 1.1 L/s, 2.1 L/s., and 3.2 L/s. The groundwater level recovered from the step rate test within approximately one minute. The results from the step rate test are presented in Figure 4.

2.3.3 Constant Rate Pumping Test

A constant rate pumping test was conducted following recovery of the groundwater level from the step rate pumping test (see Figure 4). Based on the step rate test results, it was determined that the well could be pumped at the maximum rate capable for the pump on-site (3.2 L/s) for the 24 h constant rate test. Again, the groundwater level recovered to the initial static water level within one minute.

2.4 WATER SAMPLE COLLECTION

EBA collected a water sample from the well at the end of the constant rate pumping test. The sample was collected in laboratory supplied sample containers in accordance with laboratory sampling procedures. Samples were shipped on ice by air cargo to Bodycote Testing Group in Surrey, B.C., for detailed potability analysis. The Bodycote laboratory in Surrey is an accredited ISO/IEC 17025 testing laboratory.

Samples for bacteriological analysis were submitted to Yukon Environmental Health Services.

3.0 HYDRAULIC TESTING RESULTS

3.1 PUMPING TEST RESULTS

The observed drawdown in Well 2607 during the step rate and constant rate pumping tests and the subsequent recovery periods are shown in Figure 4. The change in barometric pressure during the pumping test was < 1%, and therefore no correction of the measured water levels for variation in barometric pressure was necessary.

The maximum drawdown in the pumping well during the constant rate pumping test was about 0.3 m and remained fairly constant throughout the 24 h pumping test. However, the drawdown decreased slightly at the end of the pumping test although the pump rate did not change. Possible scenarios to explain this include:

- increase in well efficiency through pumping; or,
- aquifer recharge from a nearby surface water body.

The data logger readings differ slightly from the manual measurements. Therefore, the more reliable manual data were used for interpretation.

Recovery of the groundwater level in the pumping well to within 95% of the initial static water level occurred in less than one minute.

The drawdown data during the pumping test were analyzed using the Theis and Cooper-Jacob Straight-Line Time-Drawdown Methods (e.g., Fetter, 2001). Both interpretation methods are implemented in the software WHI AquiferTest version 3, which was used to analyze the pumping test data (see Appendix D).

The results of the pumping test are presented in Table 2. The observed hydraulic conductivity of about 10^{-3} m/s is typical for highly-conductive sand and gravel deposits as encountered in Well 2607.

Well	Method	T [m ² /s]	K [m/s]
2607	Theis	1.3E-02	6.1E-04
	Cooper-Jacob	1.2E-01	5.9E-03
	Mean	3.9E-02	1.9E-03

3.2 WELL CAPACITY

To calculate the safe yield of a well, the 100-day specific capacity was multiplied by the safe available drawdown. The 100-day specific capacity of the well (at a given pumping rate) is based on the projection of the observed drawdown at the end of the constant rate pumping test extrapolated to 100 days as shown on Figure 5. This conservatively assumes that the well would be continuously pumped at the same rate for 100-days with no recharge to the aquifer. The safe available drawdown of the well is determined by applying a safety factor of 70% to the physical available drawdown after an allowance has been made for seasonal fluctuations in static water level. The safe yield of a well can also be limited by what the well screen is capable of delivering based on the maximum recommended screen entrance velocity. Table 3, below, details the safe yield calculations for the well.

EBA determined the long-term theoretical sustainable yield of Well 2607 to be 106 L/s (1395 Igpm). However, at such a pump rate the screen entrance velocity would be about ten times higher than the recommended maximum screen entrance velocity of 0.03 m/s. However, the theoretical sustainable yield greatly exceeds the water demand of the Tombstone VRC. The well could be pumped at a rate of 10 L/s without exceeding the recommended maximum screen entrance velocity.

TABLE 3: SUMMARY OF SAFE YIELD CALCULATIONS			
Well Parameter		Unit	Key
Constant Rate Pumping Test Discharge Rate	3.2	L/s	a
Projected 100-Day Drawdown	0.32	m	b
Predicted 100-Day Specific Capacity	10.0	L/s/m	c = a / b
Lowest Expected Seasonal Water Table (1.5 m below static)	9.7	m	d
Recommended Depth of Pump Intake	24.8	m	e
Available Drawdown	15.1	m	f = e-d
Safety Factor	70	%	g
Safe Available Drawdown	10.6	m	h = f × g
Safe Yield Based on Constant Rate Pumping Test			
Theoretical Sustainable Yield	106	L/s	i = c × g
Theoretical Sustainable Yield	1395	Igpm	
Check for Screen Entrance Velocity			
Recommended Maximum Screen Entrance Velocity	0.03	m/s	
Intake Area (m ² /m)	0.237	m ² /m	j
Total Intake Area for 1.3 m Screen	0.31	m ²	k = j × 2.6
Screen Entrance Velocity at Safe Estimated Sustainable Yield	0.34	m/s	(i / 1000) / k
Check: Less than Recommended Maximum Velocity	NO		

4.0 GROUNDWATER UNDER THE DIRECT INFLUENCE (GUDI) ASSESSMENT

Well water or groundwater under the direct influence of surface water (GUDI) refers to groundwater sources that have a direct hydraulic connection to surface water sources and are therefore vulnerable to contamination by surface water organisms. The implication of a well being classified GUDI means that the well water source requires water treatment equivalent to that required for surface water sources.

The Yukon Department of Health and Social Services has published a document titled “Assessment Guideline for Well Water or Groundwater Under the Direct Influence of Surface Water” (GUDI) to determine if a well is potentially under the influence of surface water (YG 2006).

EBA conducted a Phase 1 Initial GUDI Screening and determined that although Well 2607 is properly constructed, and greater than 60 m away from a surface water body, the well is still potentially GUDI because it produces water from an unconfined aquifer. Further

hydrogeological assessment according to the guidelines outlined in YG (2006) would be necessary to identify the well as being either non-GUDI or GUDI.

5.0 RESULTS OF LABORATORY ANALYSIS

Groundwater analytic results and a comparison with Guidelines for Canadian Drinking Water Quality (GCDWQ) are presented in Table 4, attached. The laboratory reports and certificates are included as Appendix F. To evaluate the quality of the analysis EBA calculated the ion balance, i.e., the balance between sum of anion and cation equivalent charges. Usually, an ion balance of within $\pm 5\%$ is considered satisfactory. The calculated ion balance of 4.3% suggests that analytical errors are within acceptable limits and all major cations and anions were analyzed.

The water sample from Well 2607 is hard and can be characterized as a calcium-magnesium-sulphate-bicarbonate (Ca-Mg-SO₄-HCO₃) type water.

Based on the analytical results for the water samples collected on October 2, the water from the well met all GCDWQ for the parameters tested, except for the bacteriological guidelines. Bacteriological results were unsatisfactory for total coliforms whereas *E.coli* were absent. The presence of coliforms is likely resulting from contamination during drilling or sampling.

EBA recommends re-sampling the well for bacteriological analysis prior to commissioning. Great caution should be exercised to avoid any contamination during the sampling. The sampling hose and sampling port should be disinfected prior to sampling, only sterile sample bottles supplied by the lab should be used, and new nitrile gloves should be worn to avoid any skin contact with the sample or the inside of the sample bottle. The sampling instructions provided by the lab should be followed thoroughly. If the test is positive again, the well should be “shock chlorinated” and the test be repeated again. The well should not be used until satisfactory results are obtained.

6.0 CONCLUSIONS

The following conclusions are based on the information presented in this well completion report:

- In September/October 2008, a supply well (Well 2607), was drilled for the new Tombstone Territorial Park Visitor Reception Centre, Yukon to a depth of 29.1 m bgs;
- A screen was set from 27.8 to 29.1 m bgs within an unconfined gravel aquifer;
- The well was constructed in accordance with the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems) and the Canadian Groundwater Association’s Well Construction Guidelines (CGWA 1995);

- Pumping test results from the well indicate an aquifer transmissivity on the order of $3 \times 10^{-2} \text{ m}^2/\text{s}$ (2590 m^2/day);
- The yield of the well will be limited by operational flow velocities within the well casing rather than by aquifer transmissivity or available drawdown. The maximum well yield to remain in laminar flow conditions is 10 L/s (132 Igpm);
- EBA identified the well as potentially GUDI because it produces groundwater from an unconfined aquifer. Therefore, further hydrogeological assessment would be necessary to determine if the well is either non-GUDI or GUDI; and,
- Water from the well met all GCDWQ for health based parameters and aesthetic objectives on the date sampled and for the parameters tested, except for total coliforms. This is likely due to contamination during well construction or sampling and EBA recommends re-sampling of the well for bacteriological analysis prior to commissioning.

7.0 WELL COMMISSIONING, OPERATION AND MAINTENANCE RECOMMENDATIONS

Proper well commissioning, operation and maintenance are fundamental to ensuring a reliable drinking water source. Recommendations pertinent to the commissioning, operation and maintenance of Well 2607 are presented below:

- In accordance with CGWA well construction guidelines (CGWA 1995) the casing of the well should project at least 0.50 m above ground surface upon final completion.
- A submersible pump should be installed at a depth of approximately 24.8 m bgs (3 m above the top of screen) to maximize drawdown and well performance. The pump to be installed in the well should be capable of pumping at the desired rate to meet the peak building demand, but not in excess of 10 L/s (132 Igpm) overcoming a head of 26 m (depth of pump intake plus 1 m for well head) plus pipe friction losses and possible additional elevation gains.
- The well should be connected in accordance with “Well Connection Standards for Typical YG Small Public Drinking Water Systems” (EBA, 2008).
- The water level and specific capacity in a water supply well should be routinely monitored over time to facilitate evaluation of well performance.
- The well should be “shock chlorinated” (disinfected) prior to commissioning.
- The well should be re-sampled for bacteriological analysis to ensure the absence of coliforms that were present at the first sampling.
- The water quality should be monitored at the time of commissioning, in the subsequent year, and every five years thereafter in accordance with the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems) to ensure that all health-based parameters meet the drinking water guidelines.

- Any alterations to the well should be in compliance with the guidelines for Small Public Drinking Water Systems (Government of Yukon Health and Social Services, 2007, Guidelines for Part III – Small Public Drinking Water Systems) and the Canadian Groundwater Association's Well Construction Guidelines (CGWA 1995).

8.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of the Government of Yukon 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 the Government of Yukon, 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 EBA's General Conditions provided in Appendix A of this report.

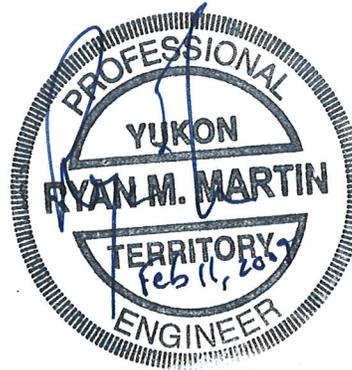
9.0 CLOSURE

Conclusions and recommendations in this report are based upon the Hydrogeological Investigations as described in the previous sections. This report has been prepared for the use of the Government of Yukon. It has been prepared in accordance with generally accepted hydrogeological practices.

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

Respectfully submitted,

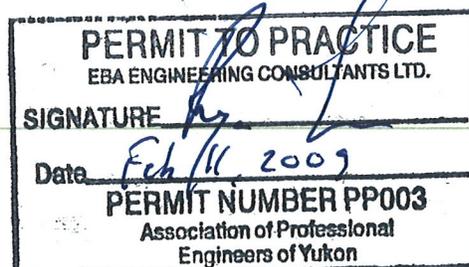
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Stephan Klump

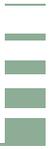
Stephan Klump, Dipl.-Geol., Ph.D.
Hydrogeologist
Whitehorse Environment Group
Direct Line: 867.668.2071 x250
Email: sklump@eba.ca

Ryan Martin, M.Sc.(Eng.), P.Eng.
Hydrogeologist, Team Leader
Whitehorse Environment Group
Direct Line: 867.668.2071 x231
Email: rmartin@eba.ca



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- Government of Yukon, Health and Social Services (2007) Guidelines for Part III – Small Public Drinking Water Systems.
- Government of Yukon, Health and Social Services. (2006) Assessment Guideline for Well Water or Groundwater Under the Direct Influence of Surface Water (GUDI).



TABLES



TABLE 4: LABORATORY ANALYTIC RESULTS FOR TOMBSTONE VRC WELL 2607							
Analyte		Well	2607		Canadian Drinking Water Quality Guidelines ¹		
		Bodycote Lot ID	646916		Upper Limit		
		Date	2-Oct-08		MAC ²	AO ³	
		Sampled by	EBA				
	Unit	Detection Limit	Results				
Ion Balance	%		4.3				
Water Type			Ca-Mg-SO4-HCO3				
Physical and Field Parameters							
Temperature	T	°C	0.1	3.4	-	15	
Colour		CU	5	<5	-	15	
Electrical Conductivity (field)	EC	uS/cm	1	216		-	
Electrical Conductivity (lab)	EC	uS/cm	1	232	-	-	
Total Dissolved Solids (field)	TDS	mg/L	1	110	-	500	
Total Dissolved Solids (lab)	TDS	mg/L	1	133	-	500	
Hardness (CaCO3)		mg/L	1	100	-	-	
pH (field)		pH units		7.67	-	6.5-8.5	
pH (lab)		pH units		7.54	-	6.5-8.5	
Turbidity (lab)		NTU	0.1	0.4	-	-	
Anions							
Alkalinity-Total (CaCO3)		mg/L	5	36	-	-	
Chloride	Cl	mg/L	0.4	0.7	-	250	
Fluoride	F	mg/L	0.05	0.06	1.5	-	
Sulphate	SO4	mg/L	0.9	71.1	-	500	
Nutrients							
Nitrate Nitrogen	N	NO3	mg/L	0.01	0.09	10	-
Nitrite Nitrogen	N	NO2	mg/L	0.005	<0.005	1	-
Extractable Metals							
Aluminum	Al	mg/L	0.005	<0.005	-	-	
Antimony	Sb	mg/L	0.0002	<0.0002	0.006	-	
Arsenic	As	mg/L	0.0002	0.0002	0.010	-	
Barium	Ba	mg/L	0.001	0.049	1	-	
Boron	B	mg/L	0.002	0.004	5	-	
Cadmium	Cd	mg/L	0.00001	0.00002	0.005	-	
Calcium	Ca	mg/L	0.2	31.3	-	-	
Chromium	Cr	mg/L	0.0005	<0.0005	0.05	-	
Copper	Cu	mg/L	0.001	<0.001	-	1	
Iron	Fe	mg/L	0.03	0.04	-	0.3	
Lead	Pb	mg/L	0.0001	0.0001	0.01	-	
Magnesium	Mg	mg/L	0.2	7.0	-	-	
Manganese	Mn	mg/L	0.005	<0.005	-	0.05	
Mercury	Hg	mg/L	0.0001	<0.0001	0.001	-	
Potassium	K	mg/L	0.4	0.5	-	-	
Selenium	Se	mg/L	0.0002	0.0010	0.01	-	
Sodium	Na	mg/L	0.4	2.9	-	200	
Uranium	U	mg/L	0.0005	<0.0005	0.02	-	
Zinc	Zn	mg/L	0.001	0.013	-	5	
Bacteriological							
Total Coliforms			-	present	absent	-	
<i>E.coli</i>			-	absent	absent	-	

Notes:

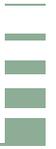
Bold - indicates parameter above GCDWQ MAC

Underline - indicates parameter above GCDWQ AO.

¹ GCDWQ criteria are taken from the "Guidelines for Canadian Drinking Water Quality, May 2008"

² MAC refers to the Maximum Acceptable Concentration according to the GCDWQ criteria.

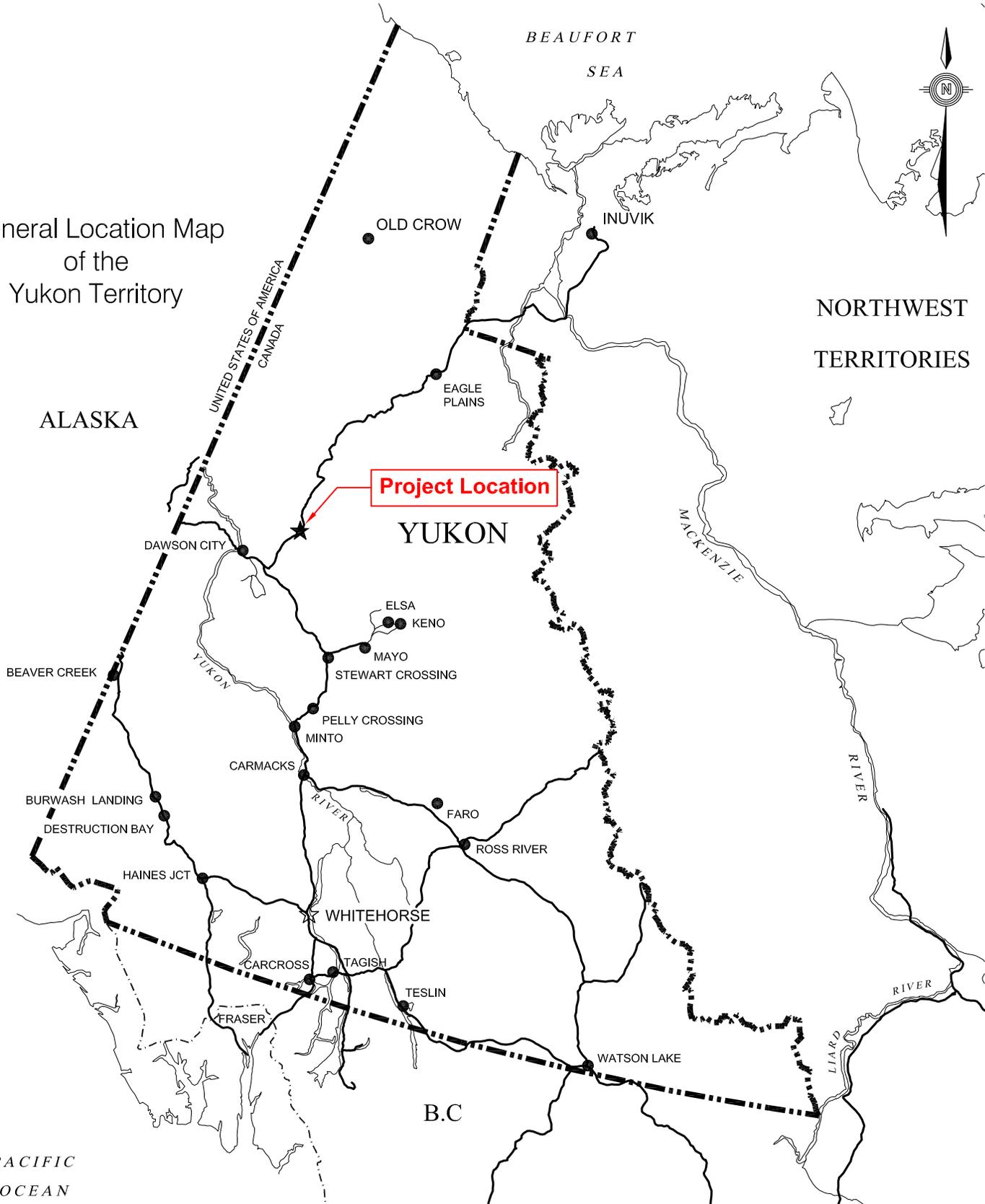
³ AO refers to the Aesthetic Objective according to the GCDWQ criteria.



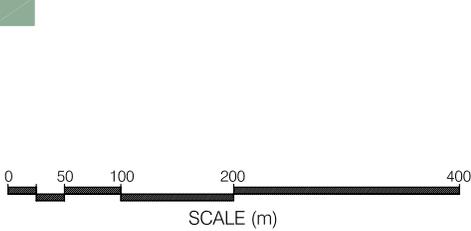
FIGURES



General Location Map
of the
Yukon Territory



C:\Whitehorse\Data\0201\Drawings\Dempster Hwy\W23101173.001 Tomstone VRC\Site location map.dwg [KEY PLAN] February 05, 2009 - 4:39pm ktomczyk



CLIENT
Yukon
Property Management Agency

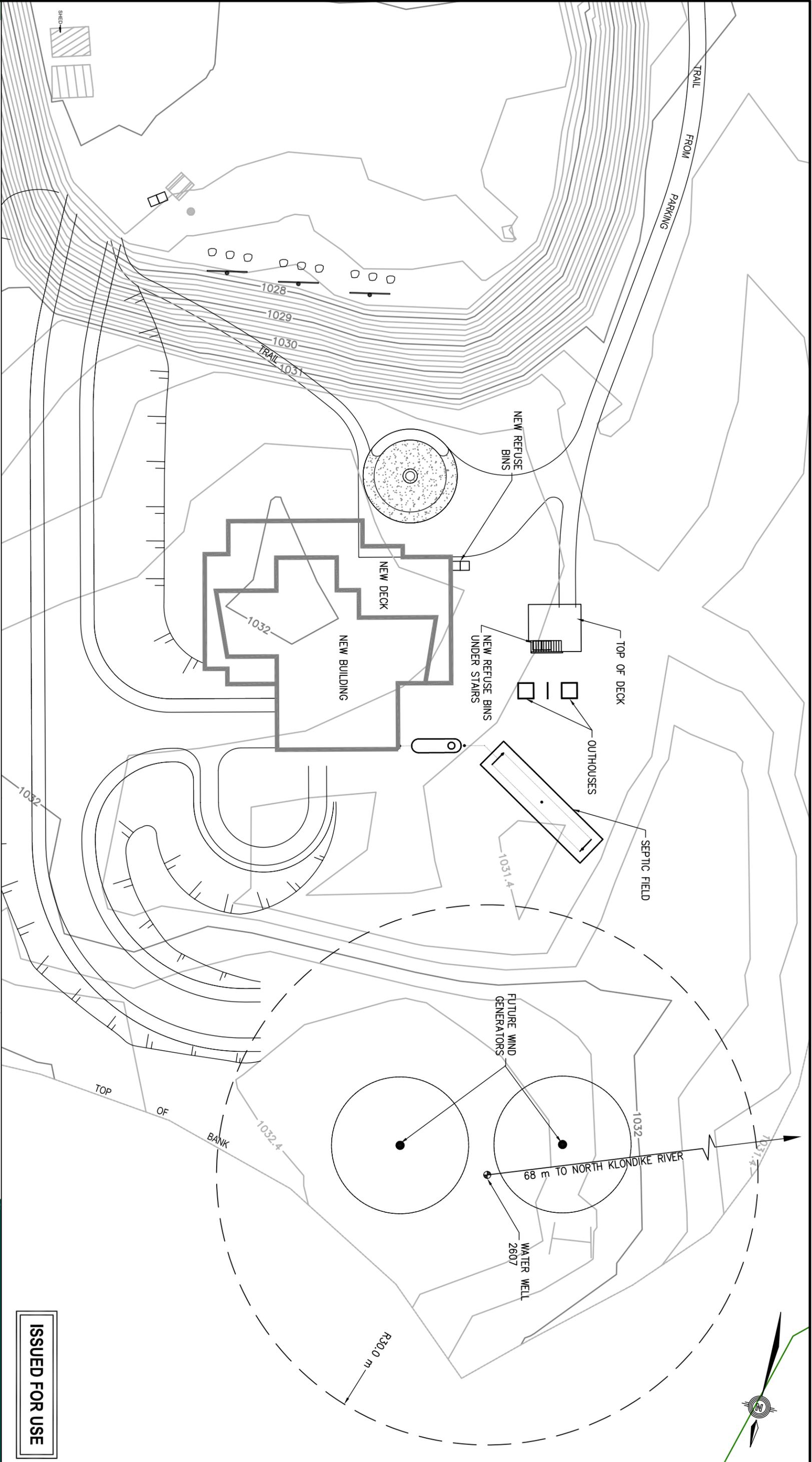
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**TOMBSTONE VRC - WELL COMPLETION
KM 71 DEMPSTER HIGHWAY, YUKON**

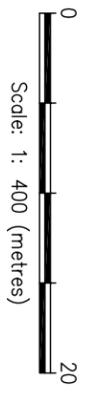
SITE LOCATION MAP

PROJECT NO. W23101173.001	DWN SK	CKD RMM	REV 0
OFFICE EBA-WHSE	DATE February 2009		

Figure 1



LEGEND:
 ● WATER WELL 2607



ISSUED FOR USE

TOMBSTONE VRC - WELL COMPLETION
 KM 71 DEMPSTER HIGHWAY, YUKON



EBA Engineering Consultants Ltd.

PROJECT NO.		DATE		REV	
W23101173.001	KJT	SK	0		
OFFICE		DATE		REV	
EBA-WHSE	January 2009				

SITE PLAN

Figure 2

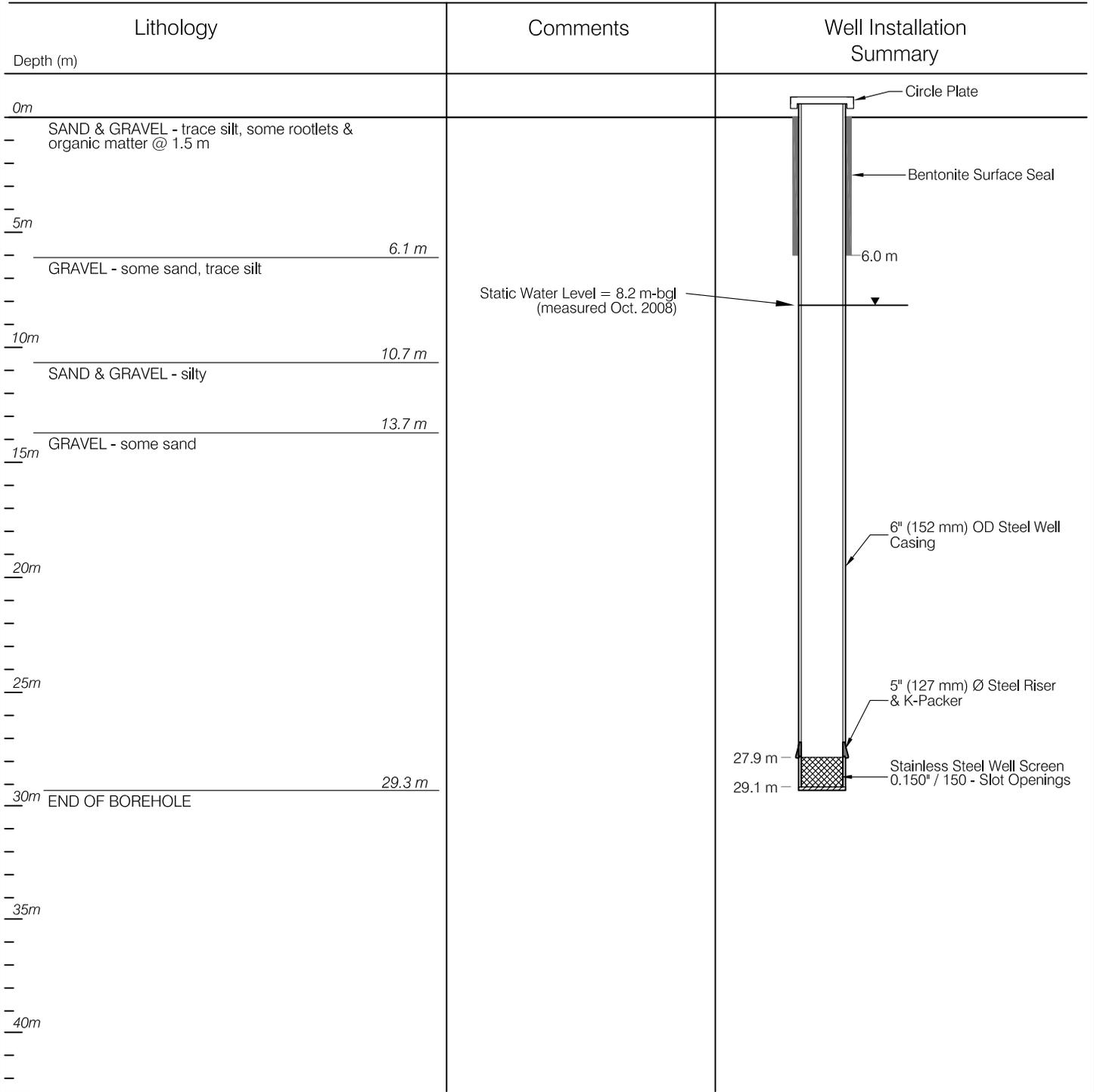
HYDROGEOLOGIC LOG

PURPOSE OF HOLE: Water Supply Well
 DRILLING METHOD: Air Rotary
 DRILLING DATE: 2008/10/01
 SCREEN INSTALLED: 27.9 - 29.1 m
 CONTRACTOR: Double D Drilling Ltd.

BOREHOLE NO.

WELL 2607

CASING STICK UP: 1.0 m above grd.
 DEPTH TO STATIC: 8.2 m bgs
 DEPTH TO SCREEN (m): 27.9 m bgs



C:\Whitehorse\Data\0201\Drawings\Dempster Hwy\W23101173.001\Tombstone VRC\W23101173 Figure 3.dwg [WELL TVC - 1] February 05, 2009 - 4:22pm klemczyk

CLIENT



Property Management Agency

**TOMBSTONE VRC- WELL COMPLETION
 KM 71 DEMPSTER HIGHWAY, YUKON**

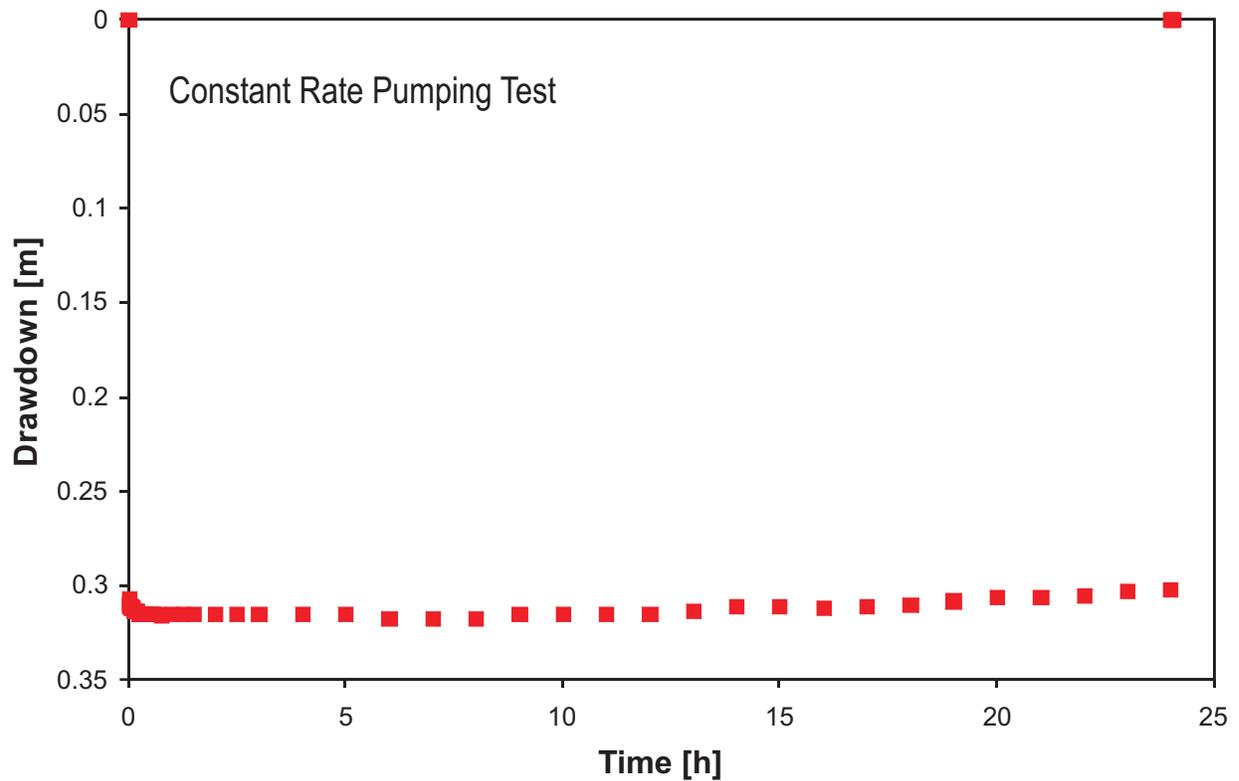
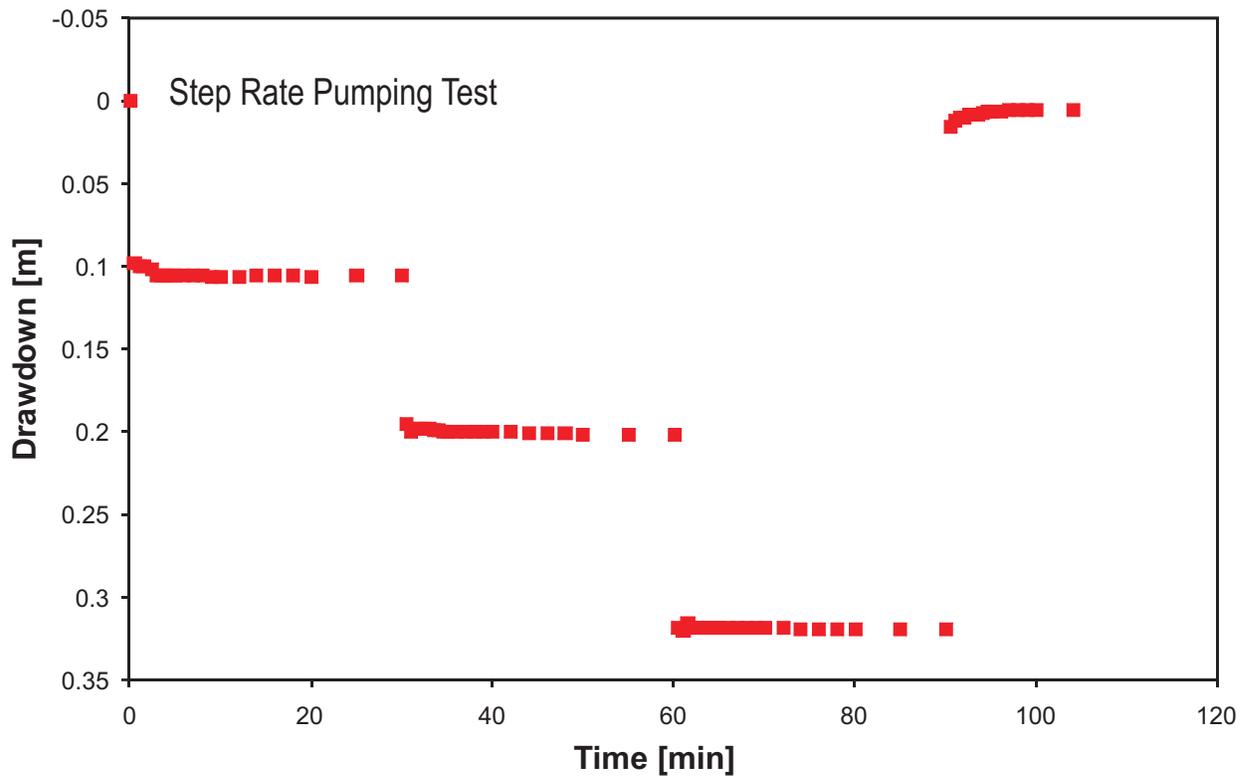
WELL LOG FOR WELL 2607

**EBA Engineering
 Consultants Ltd.**



PROJECT NO. W23101173.001	DWN KJT	CKD SK	REV 0
OFFICE EBA-WHSE	DATE January 2009		

Figure 3



LEGEND

■ Manual Data

CLIENT



**TOMBSTONE VRC - WELL COMPLETION
KM 71 DEMPSTER HIGHWAY, YUKON**

Observed Drawdown During Pumping Tests

EBA Engineering
Consultants Ltd.



PROJECT NO.
W23101173.001

DWN
SK

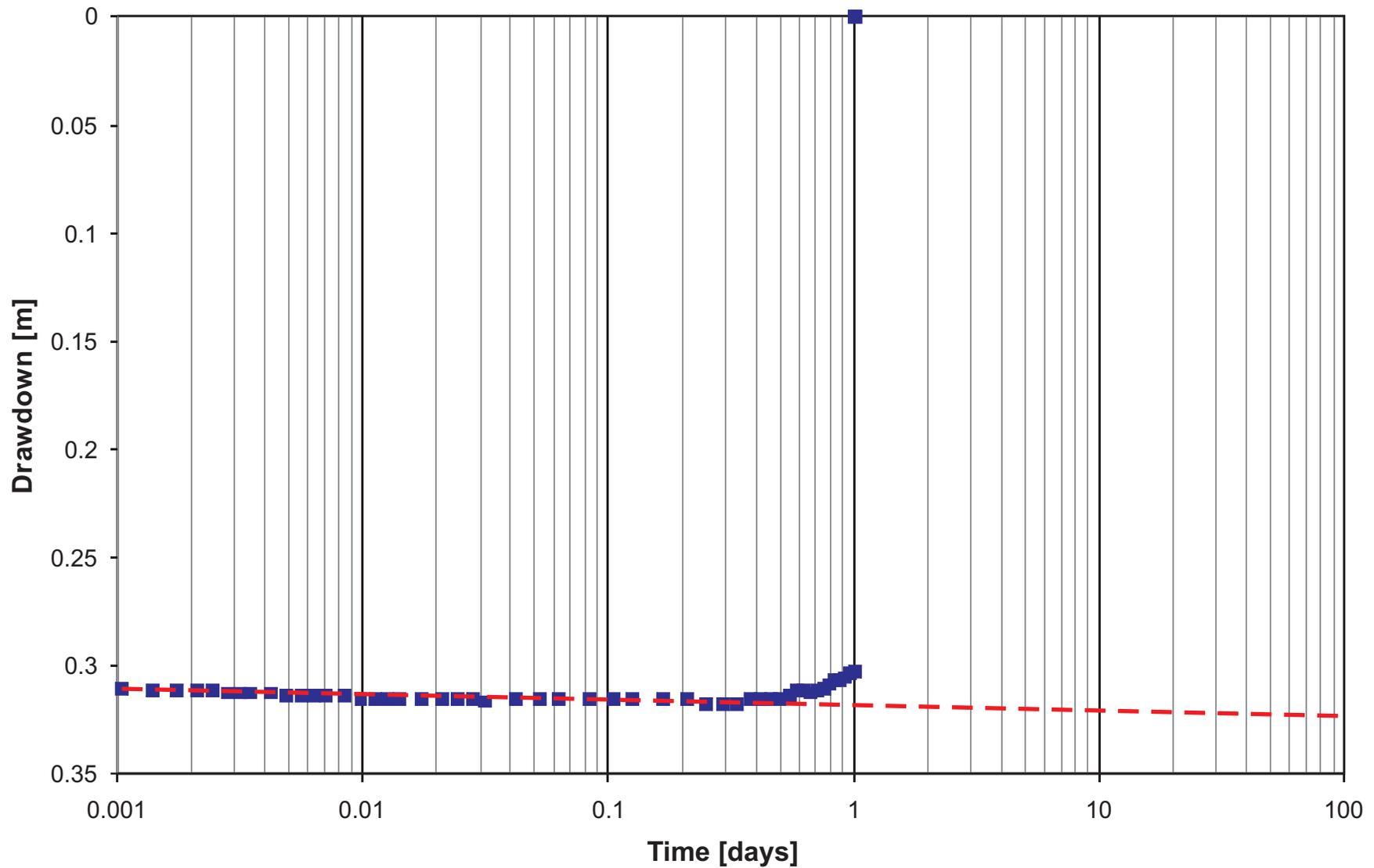
CKD
RMM

REV
0

OFFICE
EBA-WHSE

DATE
February 2009

Figure 4



LEGEND

- Drawdown in pumping well during constant rate pumping test
- Extrapolation of drawdown to 100 days

CLIENT



**TOMBSTONE VRC - WELL COMPLETION
KM 71 DEMPSTER HIGHWAY, YUKON**

**Extrapolation of Drawdown During Constant
Rate Pumping Test to 100 Days**

EBA Engineering
Consultants Ltd.



PROJECT NO.
W23101173.001

DWN
SK

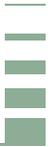
CKD
RMM

REV
0

OFFICE
EBA-WHSE

DATE
February 2009

Figure 5



APPENDIX A

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

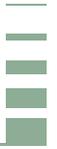
Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed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

APPENDIX B RESULTS OF GRAIN SIZE ANALYSIS



APPENDIX C

APPENDIX C DRILLERS WELL LOG

Surface / Environmental Seal (depth below ground surface, please circle appropriate units)

C8 Seal Material Type: C9 Diameter of Seal: C10 Seal Depth from: C11 Seal Depth to: C12 Volume Placed:

Gravel Pack (depth below ground surface, please circle appropriate units)

C13 Gravel Pack: NO YES If yes, indicated depth (m / ft): from: to: Indicate diameter of material: Material type:

Well Screen Information (depth below ground surface, please circle appropriate units)

C14 Outside Diameter: C15 Screen Material: C16 Screen Type: C17 Depth from: C18 Depth to: Slot Size / Perforation Dia: C19 Screen Comments:

WELL DEVELOPMENT AND STATUS

D1 Well Developed by: D2 Well Head Completion: D3 Well Head Stick-up: D4 Static Water Level: D5 Well Yield Estimate: D6 Final Well Status: D7 Well Abandonment Status: D8 Method Used to Estimate Well Yield:

PUMPING TEST RECORD AND GROUNDWATER QUALITY

(All depths below ground, circle appropriate units)

E1 Pumping Test Information

Pumping Test Start Date: Static Water Level (SWL): Pump Intake Set at: Duration of pumping: Final Water Level (FWL) at end of Pumping Test:

RECOMMENDATIONS

Recomm. Pump Depth: Recomm. Pumping Rate: If flowing, provide rate:

F1 Well Water Level Drawdown/Recovery DATA

Table with 4 columns: Time (min), Water Level (m / ft) for Drawdown and Recovery, and 0 (SWL) / 0 (FWL).

G1 GROUNDWATER QUALITY

Field Data: Date Measurements Taken: Electrical Conductivity: pH: Temperature:

Turbidity/Sand Content

Clear, Slightly turbid/cloudy, Moderately turbid/cloudy, Turbid/cloudy, Trace sand present, No sand present

Groundwater Type

Salty, Sulphur / Egg Odour, Organic Taste / Odour, Metallic Taste, Other:

Well Disinfection

Was the well disinfected upon completion of the pump installation? Briefly describe method of well disinfection.

WELL CONTRACTOR

H1 Name of Contractor / Drilling Company: H2 Name of Driller(s): H3 Address of Driller: Signature of Primary Driller: Date Submitted to Dept. Of Environment

CONSULTANT (If applicable)

I 1 Company Name: I 2 Company Address: I 3 Report Reference: I 4 Report Date:

ADDITIONAL INSTRUCTIONS

Upon completing this form, please mail or fax it to:

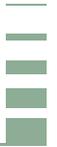
Please feel free to contact us at: Phone: (867) 667-3171, Toll free (in Yukon): (1-800) 661-0408, local 3171 Fax: (867) 667-3195 E-mail: Water.Resources@gov.yk.ca

Water Resources Section (V-310), Department of Environment, Government of Yukon Box 2703, Whitehorse, Yukon, Canada Y1A 2C6

Personal information contained on this form is collected under the authority of the Access to Information and Protection of Privacy (ATIPP) Act, Section 29 (c) and will be used to compile a public database of well and ground water information.

I have read the above clause and understand the purpose for collection of personal information.

Signature of Well Owner



APPENDIX D

APPENDIX D PUMPING TEST DATA

APPENDIX D: STEP RATE PUMPING TEST DATA

EBA Project Number:	W23101173	Project Location:	Tombstone Visitor Centre
Well Name:	TVC-1	Pump Intake Depth (m):	24.4
Static Water Level (m):	9.37	Screen Interval:	27.9
Datum Description:	Top of Sounding Tube	Slot Size ("):	0.150
Datum Stick-Up (m):	1.2	Available Drawdown (m):	15.03
Well Diameter (mm):	152.4	Screen Diameter (mm):	145
Total Well Depth:	29.1	Observer's Name:	Katherine Johnston/ Double D Drilling

Date	Time	Elapsed Time (min)	Depth to Water (m)	Drawdown (m)	Totalizer Reading (Usqpm)	Flow Rate (USGPM)	Flow Rate (L/s)	Specific Capacity (L/s/m)	Comments
10/1/2008	9:00:00	0	9.370	0.000	61	17.3	1.1	-	Start Step 1
10/1/2008	9:00:30	0.5	9.468	0.098	-	17.3	1.1	11.1	
10/1/2008	9:01:00	1	9.470	0.100	-	17.3	1.1	10.9	
10/1/2008	9:01:30	1.5	9.470	0.100	-	17.2	1.1	10.9	
10/1/2008	9:02:30	2.5	9.472	0.102	-	17.3	1.1	10.7	
10/1/2008	9:03:00	3	9.475	0.105	-	17.25	1.1	10.4	
10/1/2008	9:03:30	3.5	9.475	0.105	-	17.3	1.1	10.4	
10/1/2008	9:04:00	4	9.475	0.105	-	17.35	1.1	10.4	
10/1/2008	9:04:30	4.5	9.475	0.105	-	17.3	1.1	10.4	
10/1/2008	9:05:00	5	9.475	0.105	-	17.3	1.1	10.4	
10/1/2008	9:06:00	6	9.475	0.105	166	17.2	1.1	10.3	
10/1/2008	9:07:00	7	9.475	0.105	182	17.3	1.1	10.4	
10/1/2008	9:08:00	8	9.475	0.105	198	17.3	1.1	10.4	Flow check with bucket
10/1/2008	9:09:00	9	9.476	0.106	217	17.3	1.1	10.3	and stopwatch.
10/1/2008	9:10:00	10	9.476	0.106	234	17.3	1.1	10.3	
10/1/2008	9:12:00	12	9.476	0.106	266	17.3	1.1	10.3	
10/1/2008	9:14:00	14	9.475	0.105	303	17.3	1.1	10.4	
10/1/2008	9:16:00	16	9.475	0.105	373	17.4	1.1	10.5	
10/1/2008	9:18:00	18	9.475	0.105	407	17.3	1.1	10.4	
10/1/2008	9:20:00	20	9.476	0.106	493	17.3	1.1	10.3	
10/1/2008	9:25:00	25	9.475	0.105	578	17.3	1.1	10.4	
10/1/2008	9:30:00	30	9.475	0.105	-	17.2	1.1	10.3	
10/1/2008	9:30:30	30.5	9.565	0.195	-	32.8	2.1	10.6	Start Step 2
10/1/2008	9:31:00	31	9.570	0.200	-	32.8	2.1	10.3	
10/1/2008	9:31:30	31.5	9.568	0.198	-	32.8	2.1	10.5	
10/1/2008	9:32:00	32	9.568	0.198	-	32.8	2.1	10.5	
10/1/2008	9:32:30	32.5	9.568	0.198	-	32.88	2.1	10.5	
10/1/2008	9:33:00	33	9.568	0.198	-	32.7	2.1	10.4	
10/1/2008	9:33:30	33.5	9.569	0.199	690	32.8	2.1	10.4	
10/1/2008	9:34:00	34	9.569	0.199	-	32.9	2.1	10.4	
10/1/2008	9:34:30	34.5	9.570	0.200	730	32.9	2.1	10.4	
10/1/2008	9:35:00	35	9.570	0.200	-	33.0	2.1	10.4	
10/1/2008	9:36:00	36	9.570	0.200	778	32.8	2.1	10.3	
10/1/2008	9:37:00	37	9.570	0.200	813	32.7	2.1	10.3	
10/1/2008	9:38:00	38	9.570	0.200	847	32.8	2.1	10.3	
10/1/2008	9:39:00	39	9.570	0.200	878	32.8	2.1	10.3	
10/1/2008	9:40:00	40	9.570	0.200	909	32.8	2.1	10.3	
10/1/2008	9:42:00	42	9.570	0.200	975	32.7	2.1	10.3	
10/1/2008	9:44:00	44	9.571	0.201	1043	32.7	2.1	10.3	
10/1/2008	9:46:00	46	9.571	0.201	1109	32.8	2.1	10.3	
10/1/2008	9:48:00	48	9.571	0.201	1175	32.9	2.1	10.3	
10/1/2008	9:50:00	50	9.572	0.202	1237	32.8	2.1	10.2	
10/1/2008	9:55:00	55	9.572	0.202	1405	32.8	2.1	10.2	
10/1/2008	10:00:00	60	9.572	0.202	1553	32.8	2.1	10.2	
10/1/2008	10:00:30	60.5	9.688	0.318	-	50.3	3.2	10.0	Start Step 3
10/1/2008	10:01:00	61	9.690	0.320	-	50.35	3.2	9.9	
10/1/2008	10:01:30	61.5	9.686	0.316	-	50.5	3.2	10.1	
10/1/2008	10:02:00	62	9.688	0.318	-	50.2	3.2	10.0	
10/1/2008	10:02:30	62.5	9.688	0.318	-	50.3	3.2	10.0	
10/1/2008	10:03:00	63	9.688	0.318	1726	50.3	3.2	10.0	
10/1/2008	10:03:30	63.5	9.688	0.318	1749	50.2	3.2	10.0	
10/1/2008	10:04:00	64	9.688	0.318	1775	50.4	3.2	10.0	
10/1/2008	10:04:30	64.5	9.688	0.318	1798	50.3	3.2	10.0	
10/1/2008	10:05:00	65	9.688	0.318	1820	50.2	3.2	10.0	
10/1/2008	10:06:00	66	9.688	0.318	1875	50.2	3.2	10.0	



APPENDIX D: STEP RATE PUMPING TEST DATA

EBA Project Number:	W23101173	Project Location:	Tombstone Visitor Centre
Well Name:	TVC-1	Pump Intake Depth (m):	24.4
Static Water Level (m):	9.37	Screen Interval:	27.9
Datum Description:	Top of Sounding Tube	Slot Size ("):	0.150
Datum Stick-Up (m):	1.2	Available Drawdown (m):	15.03
Well Diameter (mm):	152.4	Screen Diameter (mm):	145
Total Well Depth:	29.1	Observer's Name:	Katherine Johnston/ Double D Drilling

Date	Time	Elapsed Time (min)	Depth to Water (m)	Drawdown (m)	Totalizer Reading (Usgpm)	Flow Rate (USGPM)	Flow Rate (L/s)	Specific Capacity (L/s/m)	Comments
10/1/2008	10:07:00	67	9.688	0.318	1920	50.3	3.2	10.0	
10/1/2008	10:08:00	68	9.688	0.318	1976	50.2	3.2	10.0	
10/1/2008	10:09:00	69	9.688	0.318	2030	50.1	3.2	9.9	
10/1/2008	10:10:00	70	9.688	0.318	2070	50.3	3.2	10.0	
10/1/2008	10:12:00	72	9.688	0.318	2180	50.4	3.2	10.0	
10/1/2008	10:14:00	74	9.689	0.319	2276	50.2	3.2	9.9	
10/1/2008	10:16:00	76	9.689	0.319	2380	50.3	3.2	9.9	
10/1/2008	10:18:00	78	9.689	0.319	2478	50.3	3.2	9.9	
10/1/2008	10:20:00	80	9.689	0.319	2574	50.2	3.2	9.9	
10/1/2008	10:25:00	85	9.689	0.319	2830	50.3	3.2	9.9	
10/1/2008	10:30:00	90	9.689	0.319	3069	50.3	3.2	9.9	
10/1/2008	10:30:30	90.5	9.385	0.015	-	0.0	0.0	-	Recovery
10/1/2008	10:31:00	91	9.382	0.012	-	0.0	0.0	-	
10/1/2008	10:31:30	91.5	9.380	0.010	-	0.0	0.0	-	
10/1/2008	10:32:00	92	9.380	0.010	-	0.0	0.0	-	
10/1/2008	10:32:30	92.5	9.378	0.008	-	0.0	0.0	-	
10/1/2008	10:33:00	93	9.378	0.008	-	0.0	0.0	-	
10/1/2008	10:33:30	93.5	9.378	0.008	-	0.0	0.0	-	
10/1/2008	10:34:00	94	9.377	0.007	-	0.0	0.0	-	
10/1/2008	10:34:30	94.5	9.376	0.006	-	0.0	0.0	-	
10/1/2008	10:35:00	95	9.376	0.006	-	0.0	0.0	-	
10/1/2008	10:36:00	96	9.376	0.006	-	0.0	0.0	-	
10/1/2008	10:37:00	97	9.375	0.005	-	0.0	0.0	-	
10/1/2008	10:38:00	98	9.375	0.005	-	0.0	0.0	-	
10/1/2008	10:39:00	99	9.375	0.005	-	0.0	0.0	-	
10/1/2008	10:40:00	100	9.375	0.005	-	0.0	0.0	-	
10/1/2008	10:44:00	104	9.375	0.005	-	0.0	0.0	-	

APPENDIX D: CONSTANT RATE PUMPING TEST DATA

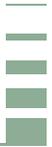
EBA Project Number:	W23101173	Project Location:	Tombstone Visitor Centre
Well Name:	TVC-1	Pump Intake Depth (m):	24.4
Static Water Level (m):	9.37	Screen Interval:	27.9
Datum Description:	Top of Sounding Tube	Slot Size ("):	0.150
Datum Stick-Up (m):	1.2	Available Drawdown (m):	15.03
Well Diameter (mm):	152.4	Screen Diameter (mm):	145
Total Well Depth:	29.1	Observer's Name:	Katherine Johnston/ Double D Drilling

Date	Time	Elapsed Time (min)	Depth to Water (m)	Drawdown (m)	Totalizer (USgpm)	Flow Rate (USGPM)	Flow Rate (L/s)	Specific Capacity (L/s/m)	Comments
10/1/2008	10:45:00	0	9.375	0	3069	-	-	-	
10/1/2008	10:45:30	0.5	9.682	0.307	-	49.9	3.1	10.3	
10/1/2008	10:46:00	1	9.684	0.309	3127	50.0	3.2	10.2	
10/1/2008	10:46:30	1.5	9.685	0.31	3147	50.1	3.2	10.2	
10/1/2008	10:47:00	2	9.686	0.311	3177	50.0	3.2	10.1	
10/1/2008	10:47:30	2.5	9.686	0.311	3206	49.9	3.1	10.1	
10/1/2008	10:48:00	3	9.686	0.311	3226	50.0	3.2	10.1	
10/1/2008	10:48:30	3.5	9.686	0.311	3247	50.0	3.2	10.1	
10/1/2008	10:49:00	4	9.687	0.312	3274	50.1	3.2	10.1	
10/1/2008	10:49:30	4.5	9.687	0.312	3301	50.0	3.2	10.1	
10/1/2008	10:50:00	5	9.687	0.312	3327	50.1	3.2	10.1	
10/1/2008	10:51:00	6	9.687	0.312	3375	50.0	3.2	10.1	
10/1/2008	10:52:00	7	9.688	0.313	3429	50.0	3.2	10.1	
10/1/2008	10:53:00	8	9.688	0.313	3476	50.1	3.2	10.1	
10/1/2008	10:54:00	9	9.688	0.313	3528	50.3	3.2	10.1	
10/1/2008	10:55:00	10	9.688	0.313	3580	50.1	3.2	10.1	
10/1/2008	10:57:00	12	9.688	0.313	3675	49.9	3.1	10.1	
10/1/2008	10:59:00	14	9.690	0.315	3785	50.1	3.2	10.0	
10/1/2008	11:01:00	16	9.690	0.315	3881	50.2	3.2	10.1	
10/1/2008	11:03:00	18	9.690	0.315	3982	50.1	3.2	10.0	
10/1/2008	11:05:00	20	9.690	0.315	4083	50.0	3.2	10.0	
10/1/2008	11:10:00	25	9.690	0.315	4321	50.2	3.2	10.1	
10/1/2008	11:15:00	30	9.690	0.315	4578	49.9	3.1	10.0	
10/1/2008	11:20:00	35	9.690	0.315	4826	50.3	3.2	10.1	
10/1/2008	11:25:00	40	9.690	0.315	5071	50.1	3.2	10.0	
10/1/2008	11:30:00	45	9.691	0.316	5331	50.0	3.2	10.0	
10/1/2008	11:45:00	60	9.690	0.315	6077	50.2	3.2	10.1	
10/1/2008	12:00:00	75	9.690	0.315		50.2	3.2	10.1	
10/1/2008	12:15:00	90	9.690	0.315	7582	50.1	3.2	10.0	
10/1/2008	12:45:00	120	9.690	0.315		50.2	3.2	10.1	
10/1/2008	13:15:00	150	9.690	0.315	10575	50.3	3.2	10.1	
10/1/2008	13:45:00	180	9.690	0.315	12029	50.3	3.2	10.1	EC = 222, ppm = 110
10/1/2008	14:45:00	240	9.690	0.315		50.0	3.2	10.0	EC = 214, ppm = 110
10/1/2008	15:45:00	300	9.690	0.315	18110	50.0	3.2	10.0	EC = 214, ppm = 117
10/1/2008	16:45:00	360	9.692	0.317	21099	50.0	3.2	9.9	
10/1/2008	17:45:00	420	9.692	0.317	24123	50.0	3.2	10.0	EC = 217, ppm = 110
10/1/2008	18:45:00	480	9.692	0.317	27116	50.0	3.2	10.0	
10/1/2008	19:45:00	540	9.690	0.315	30115	50.0	3.2	10.0	EC = 213, ppm = 109
10/1/2008	20:45:00	600	9.690	0.315	33092	50.0	3.2	10.0	EC = 212, ppm = 107
10/1/2008	21:45:00	660	9.690	0.315	36104	50.0	3.2	10.0	EC = 212, ppm = 108
10/1/2008	22:45:00	720	9.690	0.315	39056	50.1	3.2	10.0	EC = 213, ppm = 108
10/1/2008	23:45:00	780	9.688	0.313	42129	50.1	3.2	10.1	EC = 210, ppm = 107
10/2/2008	0:45:00	840	9.686	0.311	45116	50.2	3.2	10.2	
10/2/2008	1:45:00	900	9.686	0.311	48129	50.3	3.2	10.2	
10/2/2008	2:45:00	960	9.687	0.312	51155	50.2	3.2	10.2	
10/2/2008	3:45:00	1020	9.686	0.311	54135	50.1	3.2	10.2	
10/2/2008	4:45:00	1080	9.685	0.31	57139	50.1	3.2	10.2	
10/2/2008	5:45:00	1140	9.683	0.308	60196	50.3	3.2	10.3	
10/2/2008	6:45:00	1200	9.681	0.306	63153	50.1	3.2	10.3	
10/2/2008	7:45:00	1260	9.681	0.306	66152	50.0	3.2	10.3	EC = 217, ppm = 109
10/2/2008	8:45:00	1320	9.68	0.305	69084	50.1	3.2	10.4	EC = 215, ppm = 110
10/2/2008	9:45:00	1380	9.678	0.303	72152	50.0	3.2	10.4	EC = 213, ppm = 108
10/2/2008	10:45:00	1440	9.677	0.302	75156	50.1	3.2	10.5	
10/2/2008	10:45:30	1440.5	9.375	0	-	0.0	0.0	-	Recovery
10/2/2008	10:46:00	1441	9.375	0	-	0.0	0.0	-	

APPENDIX D: CONSTANT RATE PUMPING TEST DATA

EBA Project Number:	W23101173	Project Location:	Tombstone Visitor Centre
Well Name:	TVC-1	Pump Intake Depth (m):	24.4
Static Water Level (m):	9.37	Screen Interval:	27.9
Datum Description:	Top of Sounding Tube	Slot Size ("):	0.150
Datum Stick-Up (m):	1.2	Available Drawdown (m):	15.03
Well Diameter (mm):	152.4	Screen Diameter (mm):	145
Total Well Depth:	29.1	Observer's Name:	Katherine Johnston/ Double D Drilling

Date	Time	Elapsed Time (min)	Depth to Water (m)	Drawdown (m)	Totalizer (USgpm)	Flow Rate (USGPM)	Flow Rate (L/s)	Specific Capacity (L/s/m)	Comments
10/2/2008	10:46:30	1441.5	9.375	0	-	0.0	0.0	-	
10/2/2008	10:47:00	1442	9.375	0	-	0.0	0.0	-	
10/2/2008	10:48:30	1443.5	9.375	0	-	0.0	0.0	-	
10/2/2008	10:49:00	1444	9.375	0	-	0.0	0.0	-	
10/2/2008	10:49:30	1444.5	9.374	-0.001	-	0.0	0.0	-	
10/2/2008	10:50:00	1445	9.374	-0.001	-	0.0	0.0	-	
10/2/2008	10:51:00	1446	9.374	-0.001	-	0.0	0.0	-	
10/2/2008	10:52:00	1447	9.374	-0.001	-	0.0	0.0	-	
10/2/2008	10:53:00	1448	9.374	-0.001	-	0.0	0.0	-	



APPENDIX E

APPENDIX E PUMPING TEST ANALYSIS



EBA Engineering Consultants Ltd.

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

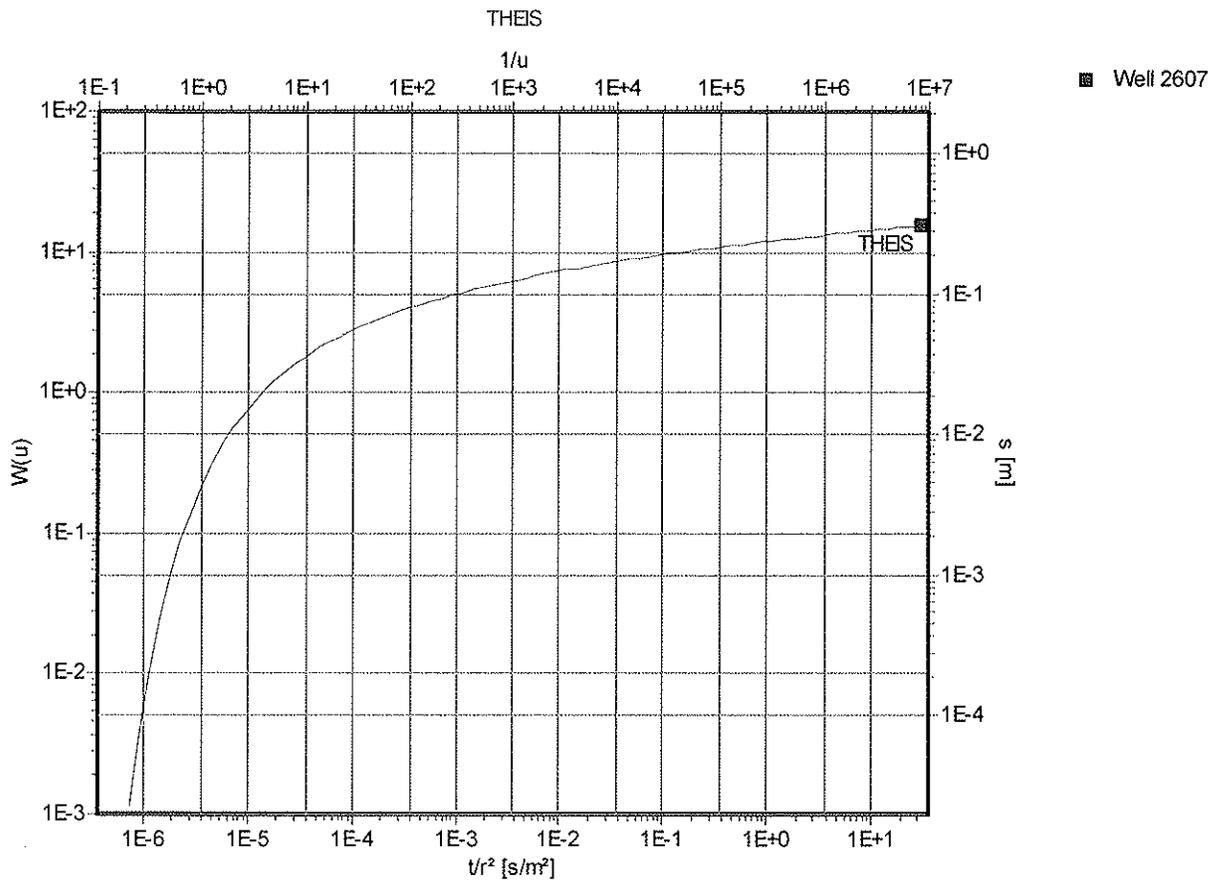
No: W23101173
Project: Tombstone VRC
Client: Government of Yukon

Location: KM 71 Dempster Highway, Yukon

Test performed by: KSJ
Test date: 1/19/2009

Evaluated by: SK
Reviewed by: RMM

Analysis method: THEIS



Transmissivity: 1.28×10^{-2} [m²/s]

Conductivity: 6.14×10^{-4} [m/s]

Comments:



EBA Engineering Consultants Ltd.

Calcite Business Centre
Unit 6, 151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Pumping test analysis

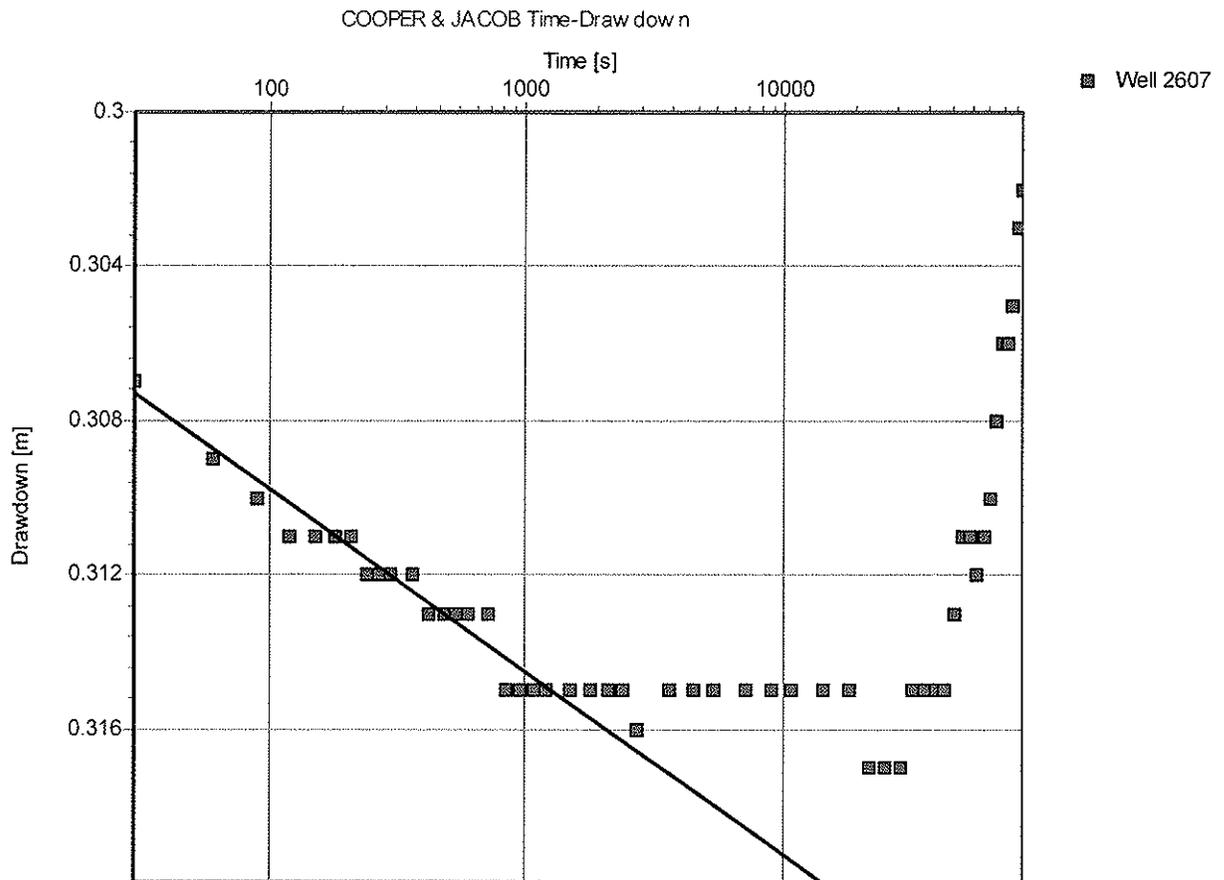
No: W23101173
Project: Tombstone VRC
Client: Government of Yukon

Location: KM 71 Dempster Highway, Yukon

Test performed by: KSJ
Test date: 1/19/2009

Evaluated by: SK
Reviewed by: RMM

Analysis method: COOPER & JACOB Time-Drawdown

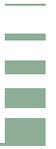


Transmissivity: 1.23×10^{-1} [m²/s]

Conductivity: 5.90×10^{-3} [m/s]

Comments:

Constant Rate Test - Early Time



APPENDIX F

APPENDIX F LABORATORY RESULTS OF CHEMICAL AND BACTERIOLOGICAL ANALYSES

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: Company: EBA Engineering Consulting Ltd. Address: Calcite Business Center QA/QC Report <input type="checkbox"/> Unit 6, 151 Industrial Road Whitehorse, YT Y1A 2V3 Attention: <i>Katherine Johnston</i> Phone: Fax: (867) 668-2071 <i>668-4349</i> Cell: (867) 668-4349 <i>250-718 8583</i> e-mail:	Copy of Report To: Company: Address: Attention: Phone: Fax: Cell: e-mail:	Copy of Invoice: <input type="checkbox"/> Mail Invoice to this address for approval <input type="checkbox"/> Report Results: Fax <input type="checkbox"/> Mail <input type="checkbox"/> Courier <input type="checkbox"/> e-mail <input type="checkbox"/> e-Service <input type="checkbox"/>
---	---	---

Information to be included on Report and Invoice

Project ID: *W23101173.001*
 Project Name: *Tombstone Visitor Ctr*
 Project Location: *Dempster Highway*
 Legal Location: *km. 74*
 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 All analysis As indicated
 required on: **or**

Date Required: _____
 Signature: _____
 Bodycote Authorization: _____

Sample Custody (Please Print)
 Sampled by: *Katherine Johnston*
 Company *EBA* Signature *KJ*

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

Date: *Oct 3* Initial: *KJ*
 Received by: _____ | Sample Temp. _____ °C
 Waybill # _____ | Date _____
 Company _____ | Time _____

Special Instructions / Comments

FOR LAB USE ONLY
 Condition of containers / coolers upon arrival at lab

Please indicate which regulations you are required to meet: _____

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

Check here if you're testing POTABLE WATER for **HUMAN CONSUMPTION.**

Sample Identification	Location	Depth IN CM M	Date/Time Sampled	Matrix	Sampling Method	Number of Containers ↓	Enter tests above (✓ relevant samples below)													
							W99	Dissolved	DW Metals	Asst										
1 <i>TVC-1</i>		-	<i>Oct 1</i>			3	HOLD FOR INSTRUCTIONS													
2 <i>TVC-1</i>		-	<i>Oct 2</i>			3	XX													
3		-																		
4		-																		
5		-																		
6		-																		
7		-																		
8		-																		
9		-																		
10		-																		
11		-																		
12		-																		
13		-																		
14		-																		
15		-																		

Bill To: EBA Engineering Consulting Ltd	Project:	Lot ID: 646916
Report To: EBA Engineering Consulting Lt	ID: W23101173.001	Approval Status: Approved
Calcite Business Centre	Name: Tombstone Visitor Centre	Invoice Frequency: by Lot
Unit 6, 151 Industrial Road	Location: Dempster Highway km 74	COD Status:
Whitehorse, YT, Canada	LSD:	Control Number: A015602
Y1A 2V3	P.O.:	Date Received: Oct 6, 2008
Attn: Kathrine Johnston	Acct code:	Date Reported: Oct 10, 2008
Sampled By: Katherine Johnston		Report Number: 1157308
Company: EBA		

Contact	Company	Address
Kathrine Johnston	EBA Engineering Consulting Lt	Calcite Business Centre, Unit 6, 151 Industrial Road Whitehorse, YT Y1A 2V3 Phone: (867) 668-3068 Fax: (867) 668-4349 Email: ksjohnston@eba.ca

	Copies	Delivery	Format
M	1	Post	
	1	Email - Single Report	PDF

_____ PAGES IN THIS TRANSMISSION

Notes To Clients:**Reports associated with this Lot**Id/Format/Report DateId/Format/Report DateId/Format/Report Date

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Analytical Report

Bill To: EBA Engineering Consulting Ltd	Project:	
Report To: EBA Engineering Consulting Lt	ID: W23101173.001	Lot ID: 646916
Calcite Business Centre	Name: Tombstone Visitor Centre	Control Number: A015602
Unit 6, 151 Industrial Road	Location: Dempster Highway km 74	Date Received: Oct 6, 2008
Whitehorse, YT, Canada	LSD:	Date Reported: Oct 10, 2008
Y1A 2V3	P.O.:	Report Number: 1157308
Attn: Kathrine Johnston	Acct code:	
Sampled By: Katherine Johnston		
Company: EBA		

Reference Number	646916-2
Sample Date	October 02, 2008
Sample Location	
Sample Description	TVC-2
Sample Matrix	Drinking Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments	
Metals Dissolved						
Iron	Dissolved	ug/L	13	10	n/a	
Manganese	Dissolved	ug/L	<5	5	n/a	
Silicon	Dissolved	mg/L	3.03	0.05	n/a	
Sulfur	Dissolved	mg/L	25.7	0.3	n/a	
Aluminum	Dissolved	ug/L	<5	5	n/a	
Antimony	Dissolved	ug/L	<0.2	0.2	n/a	
Arsenic	Dissolved	ug/L	<0.2	0.2	n/a	
Barium	Dissolved	ug/L	49	1	n/a	
Beryllium	Dissolved	ug/L	<0.1	0.1	n/a	
Bismuth	Dissolved	ug/L	<0.5	0.5	n/a	
Boron	Dissolved	ug/L	5	2	n/a	
Cadmium	Dissolved	ug/L	0.02	0.01	n/a	
Chromium	Dissolved	ug/L	<0.5	0.5	n/a	
Cobalt	Dissolved	ug/L	<0.1	0.1	n/a	
Copper	Dissolved	ug/L	<1	1	n/a	
Lead	Dissolved	ug/L	<0.1	0.1	n/a	
Lithium	Dissolved	ug/L	<1	1	n/a	
Molybdenum	Dissolved	ug/L	<1	1	n/a	
Nickel	Dissolved	ug/L	<0.5	0.5	n/a	
Selenium	Dissolved	ug/L	1.2	0.2	n/a	
Silver	Dissolved	ug/L	<0.01	0.01	n/a	
Strontium	Dissolved	ug/L	203	1	n/a	
Thallium	Dissolved	ug/L	<0.05	0.05	n/a	
Tin	Dissolved	ug/L	<1	1	n/a	
Titanium	Dissolved	ug/L	2.1	0.5	n/a	
Uranium	Dissolved	ug/L	<0.5	0.5	n/a	
Vanadium	Dissolved	ug/L	<0.1	0.1	n/a	
Zinc	Dissolved	ug/L	6	1	n/a	
Zirconium	Dissolved	ug/L	<1	1	n/a	
Mercury	Dissolved	ug/L	<0.1	0.1	n/a	
Metals Extractable						
Aluminum	Extractable	mg/L	<0.005	0.005	0.1	Acceptable
Antimony	Extractable	mg/L	<0.0002	0.0002	0.006	Pass
Arsenic	Extractable	mg/L	0.0002	0.0002	0.01	Pass
Barium	Extractable	mg/L	0.049	0.001	1	Pass
Boron	Extractable	mg/L	0.004	0.002	5	Pass
Cadmium	Extractable	mg/L	0.00002	0.00001	0.005	Pass

Analytical Report

Bill To: EBA Engineering Consulting Ltd	Project:	Lot ID: 646916
Report To: EBA Engineering Consulting Lt	ID: W23101173.001	Control Number: A015602
Calcite Business Centre	Name: Tombstone Visitor Centre	Date Received: Oct 6, 2008
Unit 6, 151 Industrial Road	Location: Dempster Highway km 74	Date Reported: Oct 10, 2008
Whitehorse, YT, Canada	LSD:	Report Number: 1157308
Y1A 2V3	P.O.:	
Attn: Kathrine Johnston	Acct code:	
Sampled By: Katherine Johnston		
Company: EBA		

Reference Number 646916-2
 Sample Date October 02, 2008
 Sample Location
 Sample Description TVC-2
 Sample Matrix Drinking Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Metals Extractable - Continued						
Chromium	Extractable	mg/L	<0.0005	0.0005	0.05	Pass
Copper	Extractable	mg/L	<0.001	0.001	1	Acceptable
Lead	Extractable	mg/L	0.0001	0.0001	0.01	Pass
Selenium	Extractable	mg/L	0.0010	0.0002	0.01	Pass
Uranium	Extractable	mg/L	<0.0005	0.0005	0.02	Pass
Zinc	Extractable	mg/L	0.013	0.001	5	Acceptable
Metals Total						
Mercury	Total	mg/L	<0.0001	0.0001	0.001	Pass
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Acceptable
Turbidity		NTU	0.4	0.1	5	Acceptable
Routine Water						
pH			7.54		6.5 - 8.5	Acceptable
Temperature of observed		°C	20.1			n/a
pH						
Electrical Conductivity		µS/cm at 25 C	232	1		n/a
Calcium	Dissolved	mg/L	31.3	0.2		n/a
Magnesium	Dissolved	mg/L	7.0	0.2		n/a
Sodium	Dissolved	mg/L	2.3	0.4	200	Acceptable
Sodium	Extractable	mg/L	2.9	0.4	200	Acceptable
Potassium	Dissolved	mg/L	0.5	0.4		n/a
Iron	Extractable	mg/L	0.04	0.03	0.3	Acceptable
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Acceptable
Chloride	Dissolved	mg/L	0.7	0.4	250	Acceptable
Fluoride		mg/L	0.06	0.05	1.5	Pass
Nitrate - N		mg/L	0.09	0.01	10	Pass
Nitrite - N		mg/L	<0.005	0.005	1	Pass
Sulfate (SO4)		mg/L	71.1	0.9	500	Acceptable
T-Alkalinity	as CaCO3	mg/L	36	5		n/a
Total Dissolved Solids		mg/L	133	1	500	Acceptable
Hardness	Dissolved as CaCO3	mg/L	110			n/a
Hardness	as CaCO3	mg/L	100			Hard
Salinity	Dissolved as NaCl	g/L	0.006	0.001		n/a

Approved by: 
 Andrew Garrard, BSc
 Operations Manager

Methodology and Notes

Bill To: EBA Engineering Consulting Ltd	Project:	Lot ID: 646916
Report To: EBA Engineering Consulting Lt	ID: W23101173.001	Control Number: A015602
Calcite Business Centre	Name: Tombstone Visitor Centre	Date Received: Oct 6, 2008
Unit 6, 151 Industrial Road	Location: Dempster Highway km 74	Date Reported: Oct 10, 2008
Whitehorse, YT, Canada	LSD:	Report Number: 1157308
Y1A 2V3	P.O.:	
Attn: Kathrine Johnston	Acct code:	
Sampled By: Katherine Johnston		
Company: EBA		

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	* Conductivity, 2510	07-Oct-08	BTG Edmonton
Alkalinity, pH, and EC in water	APHA	* Electrometric Method, 4500-H+ B	07-Oct-08	BTG Edmonton
Alkalinity, pH, and EC in water	APHA	* Titration Method, 2320 B	07-Oct-08	BTG Edmonton
Anions (Routine) by Ion Chromatography	APHA	* Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	07-Oct-08	BTG Edmonton
Chloride in Water	APHA	* Automated Ferricyanide Method, 4500-Cl- E	07-Oct-08	BTG Edmonton
Colour (Apparent) in water	APHA	* Visual Comparison Method, 2120 B	10-Oct-08	BTG Edmonton
Mercury (Dissolved) in water	APHA	* Cold Vapour Atomic Absorption Spectrometric Method, 3112 B	08-Oct-08	BTG Edmonton
Mercury (Total) in water	US EPA	* Determination of Hg in Sediment by Cold Vapor Atomic Absorption Spec, 245.5	10-Oct-08	BTG Edmonton
Metals ICP-MS (Dissolved) in water	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	07-Oct-08	BTG Edmonton
Metals ICP-MS (Extractable) in water	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	07-Oct-08	BTG Edmonton
Metals Trace (Dissolved) in water	APHA	Hardness by Calculation, 2340 B	07-Oct-08	BTG Edmonton
Metals Trace (Dissolved) in water	APHA	* Inductively Coupled Plasma (ICP) Method, 3120 B	07-Oct-08	BTG Edmonton
Metals Trace (Extractable) in water	APHA	Hardness by Calculation, 2340 B	07-Oct-08	BTG Edmonton
Metals Trace (Extractable) in water	APHA	* Inductively Coupled Plasma (ICP) Method, 3120 B	07-Oct-08	BTG Edmonton
Turbidity in Water	APHA	* Nephelometric Method, 2130 B	08-Oct-08	BTG Edmonton

* Bodycote method(s) based on reference method

References

APHA	Standard Methods for the Examination of Water and Wastewater
Guideline	Guidelines for Canadian Drinking Water Quality, 6th Edition, May 16, 2006
US EPA	US Environmental Protection Agency Test Methods

Comments:

Methodology and Notes

Bill To: EBA Engineering Consulting Ltd	Project:	Lot ID: 646916
Report To: EBA Engineering Consulting Lt	ID: W23101173.001	Control Number: A015602
Calcite Business Centre	Name: Tombstone Visitor Centre	Date Received: Oct 6, 2008
Unit 6, 151 Industrial Road	Location: Dempster Highway km 74	Date Reported: Oct 10, 2008
Whitehorse, YT, Canada	LSD:	Report Number: 1157308
Y1A 2V3	P.O.:	
Attn: Kathrine Johnston	Acct code:	
Sampled By: Katherine Johnston		
Company: EBA		

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.



Health and Social Services
Santé et des Affaires sociales
Environmental Health Services
Service d'hygiène du milieu

EBA Engineering
Consultants Ltd.
WHITEHORSE

BACTERIOLOGICAL ANALYSIS OF DRINKING WATER
ANALYSE BACTÉRIOLOGIQUE DE L'EAU POTABLE

OCT 10 2002

FAX

#2 Hospital Road, Whitehorse, Yukon Y1A 3H8
phone: (867) 667-8391 fax: (867) 667-8322
Toll free: 1-800-661-0408 ext.8391

Whitehorse Hospital, Whitehorse (Yukon) Y1A 3H8
Tél.: (867) 667-8391 Téléc.: (867) 667-8322
Sans frais au Yukon 1-800-661-0408, poste 8391

Contact Information • Coordonnées de la personne-ressource

Contact Person / Personne-ressource: Katharine Johnston Phone / Téléphone: 867 668 3068
Mailing address / Adresse postale: EBA Engineering Fax / Télécopieur: 867 668 4349
6151 Industrial Rd, Whitehorse Y1A Postal code / Code postal: Y1A 2V3
First Nation, Municipal or Business Name / Nom de la première nation, de la municipalité ou de l'entreprise: YTG - PMA
Agent: * please fax results to EBA * Fax / Télécopieur: _____

Sampling Location • Lieu de la prise d'échantillon

Municipal Address / Adresse municipale: Tombstone Visitor Centre Subdivision / Lotissement: _____
Legal Description / Désignation officielle Terrain: _____ Quads / Quadrilatère: _____ Plan no. / Plan n°: _____
Other Information (e.g., Location, Business / Building Name) / Autres renseignements (par ex.: emplacement, nom de l'entreprise, nom de l'édifice): New supply well

Sample Collection / Échantillonnage

Sample Collected By / Échantillon prélevé par: K. Johnston Date / Date: 08/10/02 Time / Heure: NOON am / pm
Sampling Site (e.g., kitchen tap) / Point d'échantillonnage (par ex.: robinet de cuisine): hose bib e well head
Is this a Resample from a Previous Test? / Est-ce un deuxième échantillon d'un test antérieur? Yes / Oui No / Non Previous Sample Number / Numéro de l'échantillon précédent: _____

Sample Supply / Source d'approvisionnement

Public Supply / Municipal - par canalisation Bulk Water Distributor / Municipal - par camion Business / Privé - entreprise Private Residence / Privé - résidence

Sample Source / Provenance de l'échantillon

Dug Well / Puits creusés Driven Well / Puits tubulaire Drilled Well / Puits foré à la sondeuse Depth of Well / Profondeur du puits: _____
 Water Holding Tank / Eau livrée Other (explain) / Autre (précisez): test well - not yet in use

Water Treatment / Traitement de l'eau

Is the Water Chlorinated? / L'eau contient-elle du chlore? Yes / Oui No / Non Free Available Chlorine / Chlore libre disponible: _____ p.p.m. / mg/L
Other Treatment Systems (e.g., UV, softener, filter) / Autre dispositif de traitement (par ex.: désinfection aux rayons ultraviolets, adoucisseur d'eau, filtre d'eau): _____

For Laboratory Use Only / À l'usage du laboratoire seulement

Receipt of Sample / Réception de l'échantillon: Date / Date: 08/10/02 Time / Heure: 9:10 am / pm By / Par: LT
Condition of Sample / État de l'échantillon: Satisfactory / Satisfaisant Unsatisfactory (explain) / Non satisfaisant (précisez): _____
Incubation: Date / Date: 08/10/02 Time / Heure: 11:0 am / pm By / Par: LT Incubator / Incubation: _____
Analysis Completed / Analyse terminée: Date / Date: 08/10/02 Time / Heure: 11:0 am / pm By / Par: LT

Results (See Reverse Side for Interpretation) / Résultats (Voir au verso l'interprétation des résultats)

Total Coliforms/Coliformes totaux <input checked="" type="checkbox"/> Present / Présence <input type="checkbox"/> Absent / Absence	E. coli/E. coli <input type="checkbox"/> Present / Présence <input checked="" type="checkbox"/> Absent / Absence
--	--

Comments / Commentaires

Results Satisfactory for Bacteriological Quality / Résultats satisfaisants à l'égard de la qualité bactériologique
 Immediately Resample / Rééchantillonnage immédiat
 Investigate and Take Appropriate Corrective Actions / Faire enquête et appliquer les mesures correctives nécessaires
 Boil Water Before Consumption / Traiter l'eau avant de la consommer

Report Authorized By / Reporté par: [Signature] Position / Position: LT Date / Date: 8/10/02

YG(4649)NC3 Rev.03/2005

Sample Number / Numéro de l'échantillon: 28087