23.0 BUILDING 6536: CARMACKS FORESTRY CREW QUARTERS

23.1 Description of Existing Water Supply System

The Carmacks Forestry Department Crew Quarters (Building 6536) has water supplied from a 10.5 m deep well approximately 3 m away from the crew quarters. The building is used seasonally, and the well is currently not used in the winter months. A site plan that shows the location of the well, as well as other details about the property, is provided as Figure 6536-A in Appendix A23. The coordinates of the wellhead, measured by a hand held GPS device, were recorded as:

- UTM ZONE 8
- Northing: 6886336
- Easting: 433882

During the assessment, the water system inside the crew quarters could not be inspected, because access could not be gained to the building. There is currently no heat trace to protect the pump or the piping, nor is there any kind of measure in place to prevent access by unauthorized persons to the well.

23.2 Description of Existing Wastewater Systems

The septic tank for the Carmacks Forestry Department Crew Quarters is located east of the crew quarters building (opposite to the well). The wellhead is located approximately 20 m from the septic tank. The septic tank discharges effluent to a field located east of the tank and approximately 20 m from the well. Septic field construction is unknown, however, it may consist of a leach pit. The septic tank and effluent field are both likely upgradient from the well. Figure 6536-A, located in Appendix A23, details the location of the septic system, well and other site features.

23.3 Water Quality Results

23.3.1 Water Quality Results from Previous Sampling

Bacteriological

Bacteriological sampling of water from the Carmacks Forestry Department Crew Quarters water system has previously been completed by YTG this year. EBA was provided access to the YTG database in order to review the results of this previous bacteriological sampling.

Two samples were collected from this system in 2005 and were tested for total coliform and *E. coli* by Yukon Environmental Health Services using the presence/absence test method. Results are tabulated in Table 6536-1 located in Appendix A23.

According to the YTG database, *E. coli* and Total Coliform Bacteria were reported as absent in each of the two samples for which results were provided.

Detailed Potability Analyses

A water sample was previously collected from the Carmacks Forestry Department Crew Quarters water system on October 5, 2004. Because access to the building and water system was not possible at the time of assessment, it is unknown if there is a treatment or disinfection system, however it is considered unlikely based on the previous water quality results. The sample was submitted to ETL EnviroTest in Surrey BC for detailed potability analyses. The results are summarized in Table 6536-2 and are included in Appendix A23. EBA reviewed the analytical results to compare them with the CDWQG and to observe general water quality, identify and recommend additional sampling and analytical, and to identify potential indicators of contamination.

- The raw water quality for the sample obtained on October 5, 2004 indicated that the groundwater source was calcium- bicarbonate type with a pH of 8.
- The water quality results indicated that all health based and aesthetic objectives were met for the parameters analyzed. The hardness (as $CaCO_3$) was reported to be 197 mg/L, and is considered poor for aesthetic purposes.

23.3.2 Identification of Additional Analytical Testing Required

Additional analytical for the Carmacks Forestry Department Crew Quarters that was identified to be included during the field inspection is detailed below:

- UV absorbance, to determine potential for UV treatment as a disinfection option.
- Measurements in the field for total dissolved solids, conductivity, pH, and temperature were completed at the time of sampling.

23.3.3 Additional Analytical Results

A water sample was obtained during the water system assessment on May 25, 2005, and was submitted for analysis to ALS Environmental in Vancouver BC for UV absorbance.

These results are summarized in Table 6536-2 located in Appendix A23 and the laboratory reports are included in Appendix B.

23.3.4 Indicators of Potential Contamination

Chloride, nitrate and nitrite concentrations can indicate impacts from surfacewater sources or septic waste. The chloride concentration for the sample obtained on October 5, 2004 was reported to be low and can be considered to be within the normal background range for groundwater in the Carmacks area. Nitrate and nitrite concentrations from this sample were also reported to be low and within the normal background range for the Carmacks area. These water quality results indicate that the well does not appear to be under the influence of anthropogenic sources of nutrients or anions such as septic wastes at the time of sampling.

23.4 Conceptual Hydrogeology

Based on topography and proximity to surfacewater bodies, the groundwater flow direction in the vicinity of the site is inferred to be east or southeast toward the Yukon River. The static water level for the well is 10.5 m below grade.

23.5 Potential Contaminant Sources

Potential contaminant sources from observations during the site investigation are compiled in Table 6536-4 in Appendix A23. Photos of potential contaminant sources are provided in Appendix A23.

A summary of potential contaminant sources within 30 m of the well is provided below:

- Above ground fuel storage tank at 14 m;
- Septic Tank: 19 m (this meets existing and proposed regulation); and,
- Septic Field: starts at 20 m, which is in contravention of proposed regulation.

23.5.1 Spills Records and Contaminated Sites Search Results

The Government of Yukon Environment Branch did not identify any recorded spill events or contaminated site issues for this site or neighbouring sites.

23.6 Identified Water System Deficiencies and Associated Risk

23.6.1 High and Medium Risk

The following deficiencies were identified as high-risk for the Carmacks Forestry Department Crew Quarters:

- The well is located within 30 m of potential sources of contamination. There is an above ground fuel storage tank located 14 m from the well, and there is also a septic tank and field located 20 m upgradient (inferred) from the well;
- There is no surface sanitary seal (grout or bentonite seal as required by the Canadian Groundwater Association's Well Construction Guidelines);
- By definition of the Draft Yukon GUDI Assessment Guideline, the well is potentially under the direct influence of surface water because it does not meet the requirements of the Guidelines for Water Well Construction;
- Although the silt and clay near surface offers some protection from surface sources of contamination, the on-site sewage disposal system would discharge below this fine-grained layer. At 11 m deep, the well is considered to be a shallow well. The well, therefore, would be considered to be at high-risk of contamination from surface sources;
- The wellhead construction is poor. Currently all of the piping and wiring is exposed to the elements.

Access could not be gained to the crew quarters during the time of inspection and as thus the water supply system could not be properly assessed.

23.6.2 Low Risk Deficiencies

The following deficiencies were identified as low-risk for the Carmacks Forestry Department Crew Quarters:

- There is no freeze-protection for the well or plumbing.
- The well is located directly in front of the parking area around the crew quarters and could be damaged by a vehicle.

23.7 Mitigative Options for Deficiencies

Mitigative options were developed to address the deficiencies identified in the previous section. Deficiencies are categorized by recommended level of priority (with Priority 1 being most critical).

23.7.1 Priority 1

Because the well is a shallow well in close proximity to potential sources of contamination, it is recommended that a new well should be drilled:

- The new well must be located at least 30 m away from any potential source of contamination;
- The well should be equipped with a surface seal to at least 6 m and the casing should be extended above grade (500 mm) within a lockable enclosure that is not inaccessible to animals and unauthorized personnel;
- The water from the new well must meet all CDWQG health based guidelines. If there are any exceedences in the CDWQG health-based guidelines then a treatment system must be designed and installed as necessary. It is likely that a treatment and disinfection system will be recommended.
- If the new well is successful, the old well should be properly decommissioned in accordance with the Canadian Guidelines for Water Well Construction.

23.7.2 Priority 2

Access to the crew quarters should be obtained so that a proper assessment of the existing water system can be completed in order to determine what options for treatment are available.

23.7.3 Priority 3

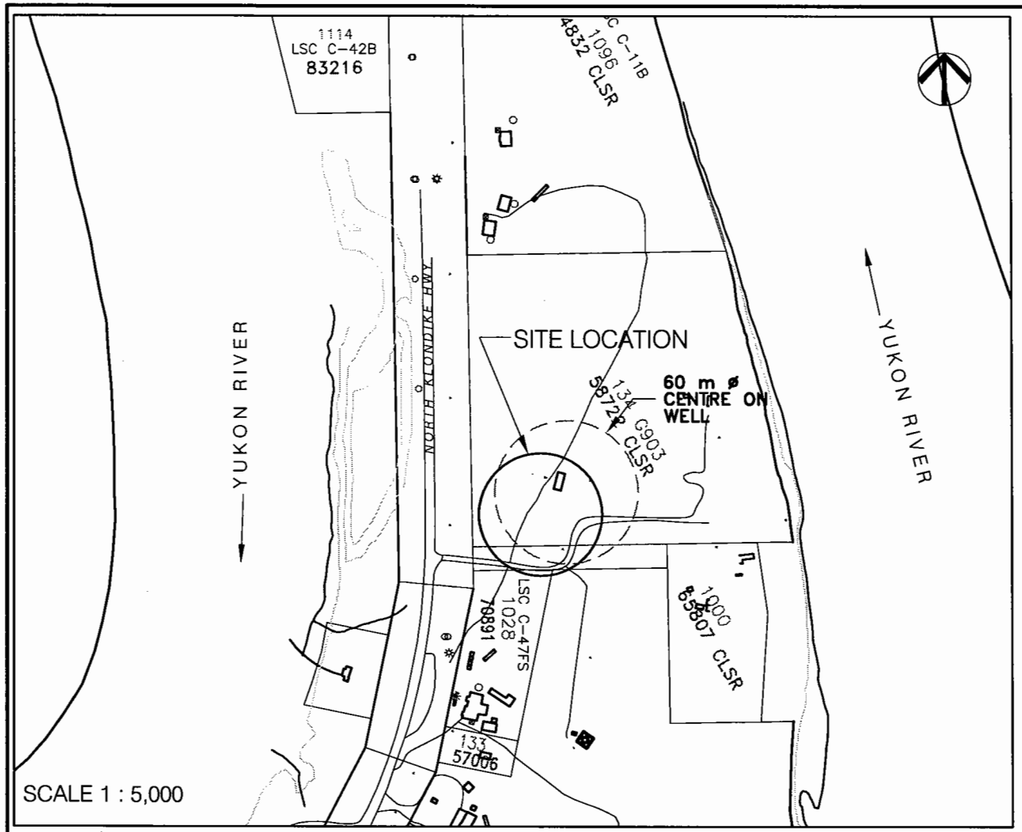
All low risk deficiencies for this water system are mitigated if a new well is drilled.

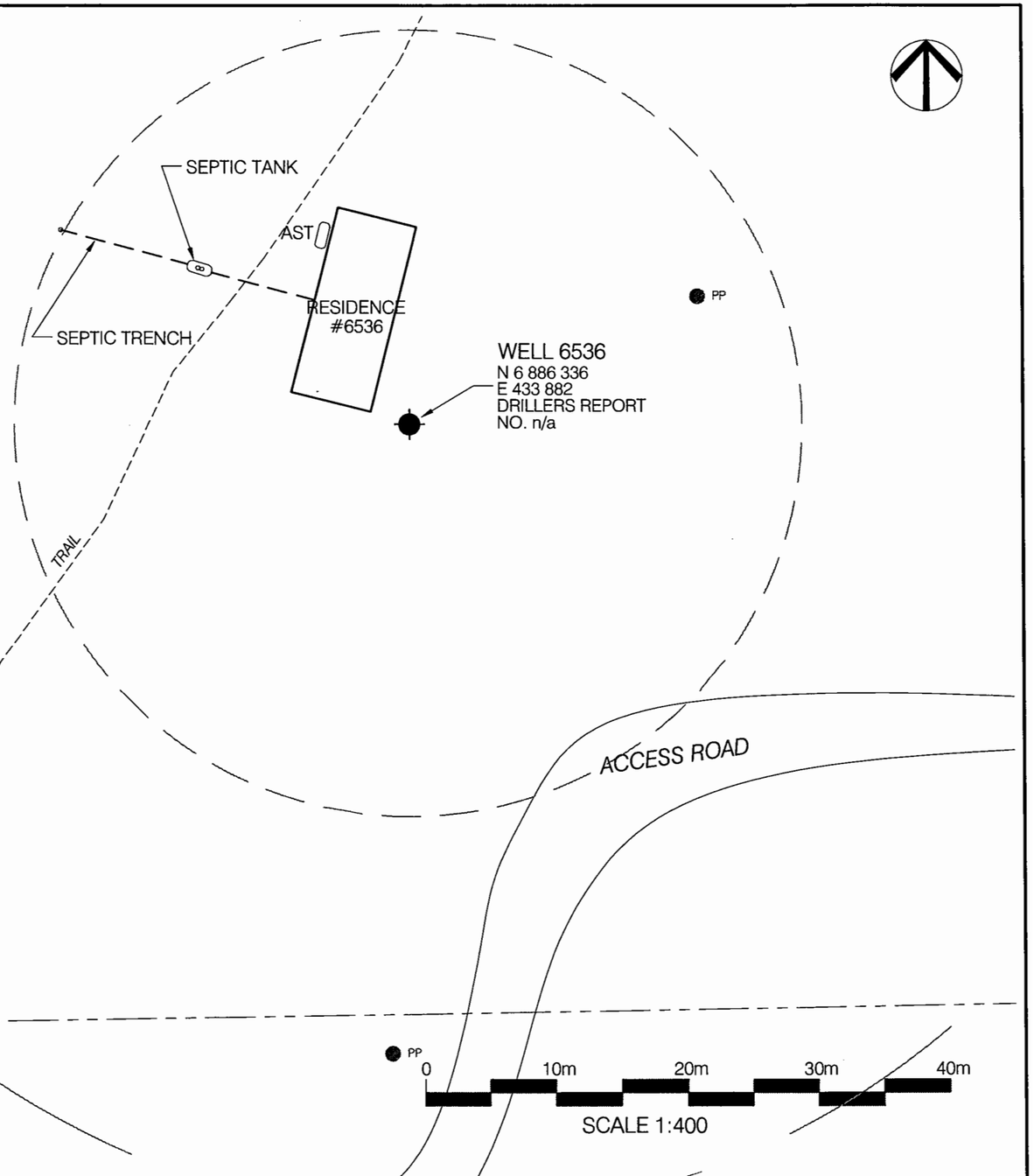
23.8 Cost Estimates for Mitigative Options

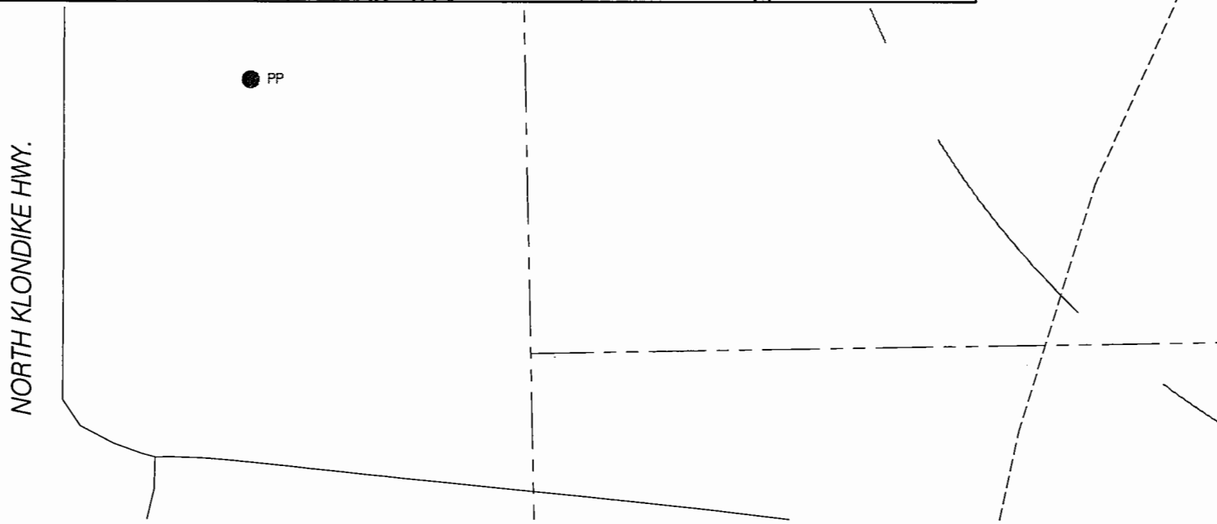
Engineering costs for pre-design and preparation of process diagrams and specifications for project tendering for water treatment systems are estimated to be 25% of construction costs. Engineering costs for other mitigative options are estimated to be 20% of construction costs, and would include inspection and completion reporting. The costs for materials and labour (not including engineering) are provided in the sections below. An additional contingency allowance of 20% is suggested for budgetary purposes.

23.8.1 Priority 1

- Assuming overburden to a depth of approximately 20 m, it is recommended that **$25,000** be budgeted for materials and labour to drill, test, completion, and hook-up of the well.
- If the new well is successful, the old well should be properly decommissioned in accordance with the Guidelines for Water Well Construction. It is estimated that this would cost approximately **$1000**.
- An estimated amount of **$5,000** should be allocated for water treatment if necessary.







NOTES:
1. UTM COORDINATES OBTAINED WITH A HAND HELD GPS USING NAD83 SYSTEM AND ARE CONSIDERED TO BE ACCURATE TO 10.0 m, APPROXIMATELY.

30 m RADIUS FROM WATER WELL FOR CONSIDERATION OF PROXIMITY TO POTENTIAL CONTAMINANT SOURCES.

No.	DESCRIPTION	DATE	APPROVED
0	ISSUED FOR CLIENT REVIEW	DD/MM/YY	XXX

REVISION

EBA Engineering Consultants Ltd.

DESIGNED BY:	R. MARTIN
DRAWN BY:	J. BUYCK
DATE:	JUNE 2005
SCALE:	AS SHOWN
PROJECT No.:	1260002.001
ACAD FILENAME:	001-WHITEHORSE REGION

CLIENT: Yukon
Highways and Public Works
Property Management Branch

SMALL PUBLIC WATER SYSTEMS ASSESSMENT
WHITEHORSE REGION

GOVERNMENT OF YUKON
HIGHWAYS & PUBLIC WORKS

CARMACKS FORESTRY CREW QUARTERS
BUILDING 6536
SITE LOCATION DIAGRAM
WELL ID: 6536

REVISION ISSUE: 0

DRAWING No.: FIGURE 6536A

Z:\0201Drawings\1260002 Water Assessment YTG\001 - Whitehorse Region\carmacks\1260002 Carmacks Overall Plan.dwg, 6/13/2005 10:58:13 AM, \\whi-eb-dc001\WHI201COMMON

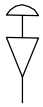
LEGEND


PUMP

PRESSURE GAUGE


GATE VALVE


CHECK VALVE

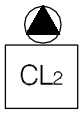

SOLENOID

#2 COMPONENT ID. No.
(SEE TABLE ON FOLLOWING PAGE)

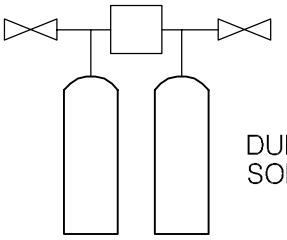
FLOW METER

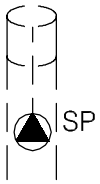
WATER FILTER
(CARTRIDGE TYPE)

PRESSURE TANK

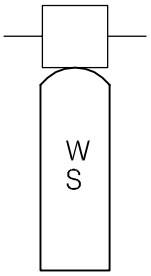


CHLORINE RESERVOIR AND
INJECTION PUMP


DUPLEX WATER
SOFTENER



WELL WITH
SUBMERSIBLE PUMP



ACTIVATED
CARBON

EBA Engineering Consultants Ltd.			PROJECT	SMALL PUBLIC WATER SYSTEMS ASSESSMENT WHITEHORSE REGION	
CLIENT Yukon Highways and Public Works Property Management Branch			TITLE	SCHEMATIC SYSTEM LEGEND	
DATE APRIL 2006	DWN. JSB	CHKD. RMM	FILE NO. 1260002		DRWG. LEGEND

TABLE 6536-1: SUMMARY OF BACTERIOLOGICAL RESULTS

Building #	Building Name	Number of Sampling Events	Time Period over which Sampling was Done	Any Positive Total Coliform Results? (yes or no)	Fraction of Positive Total Coliform Results vs. Total Sampling Events	Any positive E.Coli results? (yes or no)	Most Recent Sampling Event Available for EBA Review	Is Most Recent Result Positive?
6536	Crew Quarters	2	Apr-05 to May-05	no	0/2	no	May 05	no

Table 6536-2: Water Quality Results

SOURCE:	Building 6536 - Forestry Crew Quarters		GCDWQ Criteria		
Location/ Resident	Carmacks				
Address	Lot 12 Parcel C-1				
Treatment	No				
Source of Water	On-Site Well				
Purpose of Sampling	Baseline	Additional Sampling			
Sample Location		Kitchen Tap			
Date Sampled	5-Oct-04	25-May-05	**Lower Limit**	**Upper Limit**	
Physical Tests *(ALS)*			**AO**	**MAC**	**AO**
Colour (CU)	5				15
Conductivity (uS/cm)	310				
Total Dissolved Solids	213				500
Hardness CaCO3	197		AO >200 = poor, > 500 unacceptable[A]		
pH	8.0		6.5		8.5
Turbidity (NTU)	0.95			1	5
UV Absorbance		<0.0010			
Dissolved Anions *(ALS)*					
Alkalinity-Total CaCO3	190				
Chloride Cl	2				250
Fluoride F	0.21			1.5	
Sulphate SO4	18.1				500
Nitrate Nitrogen N	<0.1			10	
Nitrite Nitrogen N	<0.05			1	
Total Metals *(ALS)*					
Aluminum T-Al	<0.02			0.1	
Antimony T-Sb	0.0007			0.006	
Arsenic T-As	0.0009			0.025	
Barium T-Ba	0.0739			1	
Boron T-B	<0.02			5	
Cadmium T-Cd	<0.0002			0.005	
Calcium T-Ca	56.4				
Chromium T-Cr	<0.0008			0.05	
Copper T-Cu	0.001			1	
Iron T-Fe	0.131				0.3
Lead T-Pb	0.0003			0.01	
Magnesium T-Mg	12.7				
Manganese T-Mn	0.021				0.05
Mercury T-Hg	<0.0002			0.001	
Potassium T-K	2.3				
Selenium T-Se	<0.0004			0.01	
Sodium T-Na	6				200
Uranium T-U	0.0011			0.02	
Zinc T-Zn	0.004				5
Field Chemistry (EBA)					
pH		8.72	6.5		8.5
TDS		79			500
EC (uS/cm)		158			
Temperature		6.5			
Free Available Chlorine					250

Notes:

A. Guidelines indicated for hardness are not CDWQG, rather they are general aesthetic guidelines - exceedences are indicated in yellow highlighting.

Shading indicates exceedence of Proposed MAC guideline (arsenic).

Bold Underline with Yellow shading indicates exceedence of CDWQG MAC

Results are expressed as milligrams per litre except for pH and Colour (CU), Conductivity (umhos/cm),Temperature (^{o}C) and Turbidity (NTU)

< = Less than the detection limit indicated.

AO = Aesthetic Objective

MAC = Maximum Acceptable Concentration (Health Based)

Table 6536-3: Summary of Well Assessment Results
SMALL PUBLIC DRINKING WATER SYSTEMS

Well Identification and Location					
Building #	**Building Name**	**Location**	**Northing (+/- 10 m)**	**Easting (+/- 10 m)**	**Grade Elevation (+/- 10 m)**
6536	**Crew Quarters**	**Carmacks**	6886336	433882	526

Well Details							
Well Casing Diameter (mm)	**Year Well Installed**	**Well Log?**	**Well Depth (m bg)**	**Reported Low Permeabilty Protective Layer?**	**Pump Setting (m bg)**	**Well Capacity - Tested, or Reported by User**	**Static Water Level Below Ground (m-btwc)**
125	?	No	10.460	No, shallow well	?	?	6.090

Well Construction Details				
Wellhead Above ground (m)	**Well Cap**	**Well Screen**	**Surface Seal**	**Apron Grading**
0.5 above grade	Split Cap Gasket	No	No	No, ground is even

Table 6536-4: Potential Contaminant Sources
Building 6536 – Carmacks Forestry Crew Quarters

Potential Contaminant Source	Potential Contaminants	Distance from Water Source	Northing	Easting
Dump or Landfill	***Organic*** and inorganic chemicals.	3500 m		
Cemetery	***Biological***[1]***,*** inorganic[2] and organic parameters.	2600 m		
Sewage lagoon	***Biological,*** inorganic and organic parameters.	>300 m		
Sewage lines, tanks and lift stations	***Biological,*** inorganic and organic parameters.	**Approx.12 m**		
Septic fields	***Biological and Inorganic*** parameters.	**20 m likely up-gradient**	6886342	433866
Helicopter Fueling Station	***Organic and Inorganic*** parameters.	150m		
Undergrounds Fuel Storage Tanks (USTs)	***Organic*** parameters.	>>30 m		
Above ground storage tanks (ASTs)	***Organic*** *parameters.*	**14 m**	6886346	433875
Naturally occurring sources of contamination	***Radionuclides, Bacteria and Viruses from surfacewater sources.***	>150 m		

Notes: ***Bold highlighting of distances indicates non-compliance with proposed guidelines***

1- Biological parameters include: bacteria, viruses, protozoa (parasitic organisms), helminthes (intestinal worms), and bio aerosols (inhalable moulds and fungi).

2 – Inorganic contaminants could include arsenic in embalming chemicals (prior to early 1900's), and heavy metals in caskets.

Required Setback Distances Draft Guidelines for Part III – Small Public Drinking Water Systems:

300 m (1,000 ft) from a sewage lagoon or pit and manure heaps
120 m (400 ft) from a solid waste dump or a cemetery
30 m (100 ft) from any other potential source of contamination

*No Well Log

EBA Engineering Consultants Ltd.

Creating and Delivering Better Solutions

6530
6528

SMALL PUBLIC WATER SYSTEM ASSESSMENT

PART A: EBA Site Inspection

Inspector: Ryan Martin
Luke Lebel

Date May 13, 2005

WELL ID #	Owner	Location Description
6536	YTG	Carmacks Forestry Crew Quarters → Across River

1. Well Location and Potential Contaminant Sources

a. General location of well: (Community, Subdivision, etc.)
Carmacks

b. Specific location: (Road or street, Building number, name of owner and/, legal description,
Forestry compound off of the North Klondike highway

c. GPS location: 433882 Easting 6886336 Northing 526m elevation

d Is there electric power? ☒ Yes ☐ No

e. Does the well system have:

☐ 15 or more service connections to a piped distribution system ? If so how many No
Services crew quarters (1 building)

☐ 5 or more delivery sites on a trucked distribution system? If so how many NO

f. Nearest building, specify Carmacks Forestry Crew Quarters

g. Distance from well to building 3m

h. If there is an effluent disposal field, is its location known? ☒ Yes ☐ No

i. Distance from well to nearest point of known field: 20m

j. Well location relative to field: ☐ upslope ☐ downslope ☒ lateral
likely up gradient from well

k. Is there any part of a sewage disposal system(s)or other potential sources of pollution that may pose a health and safety risk within 30 m? ☒ Yes ☐ No
Septic is ~ 20m from the well

l. Is the well located within 300 m from a sewage lagoon or pit? ☐ Yes ☒ No

m. Is the well located within 120 m from a solid waste site or dump, cemetery? ☐ Yes ☒ No

n. Is the infrastructure protecting the wellhead, pumphouse, storage tank and/or water treatment plant designed and secured to prevent:

Unauthorized access by humans? ☐ Yes ☒ No The well head is outside at the front of the crew quarters
Entrance by animals? ☐ Yes ☒ No The well is directly outside

o. Is well site subject to flooding? ☐ Yes ☒ No

p. Is the well site well drained? ☒ Yes ☐ No

q. Is there a buried fuel tank on the property? ☐ Yes ☒ No very unlikely

If yes, is it ☐ in use ☐ abandoned

Is the location known? ☐ Yes ☐ No

Distance from the well to known buried tank _____

r. Are there any other known contaminant sources on the property?

☐ Yes ☐ No Describe _____

If yes, specify the source: ☐ dump ☐ sewage lagoon ☐ cemetery ☐ other

Potential Source 1: AST ; Distance from well to Potential Source 1: ~ 14m
Potential Source 2: _____ ; Distance from well to Potential Source 2: _____
Potential Source 3: _____ ; Distance from well to Potential Source 3: _____
Potential Source 4: _____ ; Distance from well to Potential Source 4: _____

s. Are there other wells on this property? ☐ Yes ☒ No

How many? _____ ☐ in use ☐ abandoned ☐ require proper sealing

2. Well and Wellhead information:

a. When was well installed? Year [illegible] Month [illegible]

b. Type: ☒ drilled ☐ dug ☐ sand point ☐ other _____

c. Is there a drillers log for the well: ☐ Yes ☐ No

d. Is there a surface seal to 6 m ☐ Yes ☒ No ☐ unknown ☐ unlikely

e. Surface casing: ☐ Yes Diameter _____ ☒ No
well is outside

f. Well casing: Diameter 15cm Material: ☒ steel ☐ plastic ☐ concrete

g. Depth of well: 10.960m bc ☒ measured (if possible) ☐ reported ☒ from log

h. Static water level below ground: 6.090m bc

☒ measured (if possible) ☐ reported ☐ from log ☐ flowing

i. (If granular) Is the well completed: ☐ open end casing ☐ with a well screen

☐ with slotted pipe ☐ unknown other _____

j. (If bedrock) Does the well have a liner? ☐ yes ☐ No ☐ steel ☐ plastic

k. If there is a well screen: length _____ slot size(s) _____
Location of screen: from _____ to _____ from log reported

l. Is there a sump below the screen? ☐ Yes ☐ No unknown

m. Is the well head: ☐ in pumphouse ☐ in pit ☐ pitless adaptor ☐ in a building

☐ in a wooden enclosure other, describe In nothing. The well is outside

n. If the well head is located in a wooden enclosure,

i. Is the well head below grade? describe in detail no, well is 0.5m above grade

ii. Are there signs of ponding on the enclosure(e.g. water stains, etc.)? ☑ Yes ☐ No
There is no enclosure

iii. Is the wellhead enclosed by fiberglass insulations? ☐ Yes ☒ No

iv. Any evidence of rodents? Specify Likely, the well is outside

v. Does the well casing have a proper seal cap? ☒ Yes ☐ No

If no, describe condition split cap gasket

3. Water Supplying This Well:

a. By definition is the water from a surface water source or under the direct influence of surface water?

☒ Yes ☐ No ☐ farther investigation required.

If yes is there treatment ☐ Yes ☐ No

Explain (filtration, disinfection etc…)_____

---

4. Aquifer Supplying This Well:

a. The aquifer is: ☐ bedrock ☒ granular sediment ☐ unknown

b. Does water level and/or well capacity show seasonal fluctuation? ☐ Yes ☒ No
No reports of seasonal fluctuation

5. Pump Installation:

a. Is the well equipped with a pump? ☒ yes ☐ No

b. Type of pump: ☐ hand ☐ electric submersible ☒ jet

☐ shallow well centrifugal ☐ other, _____

c. Description: Manufacturer _____ Model _____

horsepower _____ capacity _____ voltage _____

d. Date installed: _____ By: _____

e. For submersible pump, depth of setting below surface _____

f. Drop pipe for submersible pump: ☒ steel ☐ plastic

g. Pump delivers water to: ☐ pressure tank ☐ elevated tank ☐ other
unknown

h. Are there automatic pump controls: ☐ Yes ☐ No
unknown

i. Is there provision for taking water samples before water reaches storage? ☐ Yes ☐ No
unknown

j. Is there a water meter on the system? ☐ Yes ☐ No
unknown

k. Is the pump and piping protected from freezing? ☐ Yes ☒ No
If yes, describe: The well is directly outside with no heat trace, no insulation, no encasing. The well appears to be under construction

l. Comments on pump installation: Could not access the inside of building

6. Conclusions

a. Comments on overall installation:

b. Recommendations:

Driller's Report 109010067

Location: YTG Forestry Well Portion of Lot 1066 CRMK LIKELY CREW QUARTERS - OTHER SIDE RIVER.

NAD 83 **Zone** 8 **Easting** 437838 **Northing** 6887580 **Elevation ASL** 1778 ft.

Location Accuracy: **Horizontal** 300-1000 (topo) **Vertical** 30.5 metres (100ft)

Purpose of well: Commercial - not fabrication or manufacturing

Permafrost encountered? No

LOG OF OVERBURDEN AND BEDROCK MATERIALS

Layer	From	To		General Colour	Most Common Material	Secondary Material	General Description
1	0	4	ft.		Silty CLAY		
2	4	5	ft.		SAND		
3	5	8	ft.		GRAVEL	Cobbles	
4	8	28	ft.		SAND and GRAVEL		
5	28	30	ft.		loose GRAVEL		
6	30	40	ft.		SAND and GRAVEL		

WELL CONSTRUCTION

Well No. 1090100671 **Completion date** 7/12/1974 **Drilling method** Air Rotary (conventional) **Well type** Overburden

Casing: **OS Diameter** 5 in. **Material** Steel **Wall thickness** **Depth to** 41 ft.

Comments

Surface/Env'l seal: **Material** **Diameter** **Depth from** **to** **Volume**

Gravel Pack ? ☐ **Material** **Diameter** **Depth from** **to**

Well Screen Information

OS Diameter	Material	Screen Type	Comments
		Perforated	

Screen Sections

Section	From	to		Slot size/ perforation diameter
1	29	34	ft.	

WELL DEVELOPMENT AND STATUS

Well ID	Developed by	Wellhead completion	Adapter depth	Static water level	Yield Estimate	Estimate method
1090100671	Air lifting	None		15.16 ft.	30 gpm	Bailing

Final Status New, in use for intended purpose

No

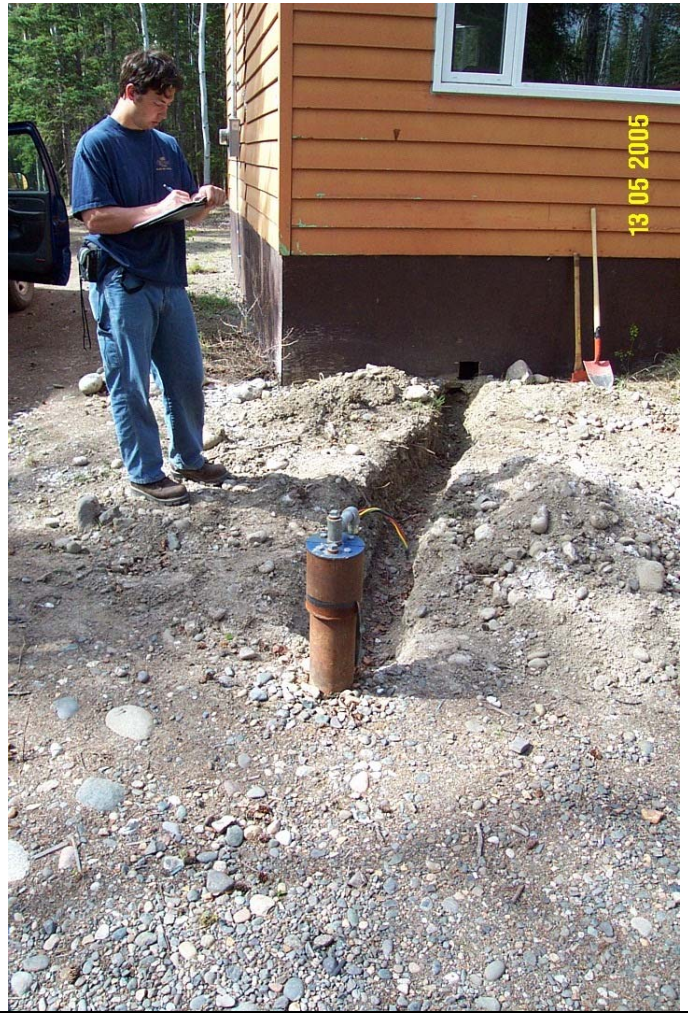


Photo 0163: 6536 Wellhead (front) and Forestry Crew Quarters (back)

Photo 0164: 6536 Wellhead

Photo 0165: 6536 Septic Field (left) and Forestry Crew Quarters (right)