License a Municipal Groundwater Supply - Birchcliff Development

Sylvan Lake Area
SE 17-039-01 W5M

Prepared for
Belterra Land Company

Prepared by
hydrogeological consultants ltd. **(HCL)**
1.800.661.7972

January 2010

Our File No.: 09-899.00

PERMIT TO PRACTICE
HYDROGEOLOGICAL CONSULTANTS LTD.
Signature electronically signed
Date
PERMIT NUMBER P 385
The Association of Professional Engineers,
Geologists and Geophysicists of Alberta

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Summary of Approval Conditions

Approval No.
File No.

Legal Location: SE 17-039-01 W5M
Requested Diversion: 22,356 m³/year 61.25 m³/day)

Condition	Description	Status for Conditions under the direction of HCL
1.	Approval for WTH No. 1-09	Noted - See water well completions, Appx B
2.	Acitivity in accordance with information filed in Department records	Noted
3.	Reclaim disturbed banks and beds of water body and areas accociated with activity.	
4.	Shall not deposit substance that will adversly affect water body.	Noted
5.	Release water into a water body only when water is of similar or better quality than that of receiving body.	Not Applicable
5.	Field-Verified Water Well Survey	
a)	plan	completed - 1,600-metre radius - page D-1
b)	list noting details of construction of water wells	completed - Appendix D
c)	table summarizing purpose and quantity	completed - Appendix D
7.	Design of Exploration Program	
a)	unreasonably interfere with other water users	no unreasonable interference
b)	negative inmpact on source aquifer or other aquifers	no negative impact
8.	Pumping Test	
a)	flow rate not less than maximum production rate	completed - page C-7 see report text for interpretation
b)	rate variation within 5%	completed - page C-4; rate for AT III was ± .02%
c)	pump for long enough to identify boundary conditions	completed - Appendix C
d)	recovery measurements for same length of time as pumping interval	completed - Appendix C
e)	not deposit any substance to adversely affect water body	
9.	Position pump intake above top of aquifer	
10.	AENV disclaimer	noted
11.	Submit report to AENV	
a)	diagrams of diversion site and any obs water wells	completed - page D-1
b)	plans showing:	
i)	physical features	completed - page D-1
ii)	location of diversion site	completed - page D-1
iii)	location, ownership, elevation, water levels of water wells identified during field-verified water well survey	completed - Appendix D
c)	names of drilling contractors	completed - pages B-4, B-29
d)	lithology	completed - pages B-4, B-29
e)	drawdown and recovery data and interpretation	completed - Appendix C - text contains interpretation
f)	field-verified survey data	completed - Appendix D
g)	cross section	completed - page 19
h)	calculated cones of depression after 1, 5, and 20 years	completed as table and graph - page 23
i)	table of expected drawdown after 1, 5, and 20 years	completed - page 23
j)	copies of analyses performed on water samples	completed - Appendix B
k)	all other information related to pumping test	completed - Appendix C - text contains interpretation
12.	Alberta government disclaimer	noted
13.	Reclaim any wells not going to be used	not applicable
14.	Retain a copy of approval at site of activity	
15.	Complaint investigation	noted

Executive Summary

This technical report has been prepared for Belterra Land Company, the owner of a proposed residential development in SE 17-039-01 W5M, within Lacombe County. The development would require a water supply of up to 22,356 cubic metres per year (m^3/year), which is 61.25 m^3/day. The intent is to develop the water supply from a water supply well, licensed for municipal use.

This technical report includes the following:
- review of the local hydrogeology
- results of a water test hole drilling program
- results of chemical analyses of groundwater from the water test hole to be licensed
- data from a field survey
- results of aquifer tests and interpretation
- results of a Phase 1 screening for GWUDI and a Phase 3 MPA for GWUDI[1]
- predicted impact due to groundwater diversion.

Water Test Hole No. 1-09 is completed in an unconfined sandstone aquifer of the Dalehurst Member of the Paskapoo Formation, in the depth interval between 30.5 and 39.6 metres BGL. The aquifer test data indicate that the entire groundwater supply for the proposed development of at least 61.25 m^3/day is available from the water test hole without adversely affecting any existing groundwater user or the aquifer in which the water test hole is completed. All of the calculations used for the present analysis do not include recharge, but do include the effects of pumping from 55 other water wells in the area of study.

The chemical analysis of the groundwater from the aquifer in which the water test hole is completed shows that water-quality parameters are within the recommended limits for drinking water. The chemical quality of the groundwater from the water test hole is not expected to change significantly with time.

From the hydrogeological review, it is believed that the groundwater from WTH No. 1-09 is a high-quality groundwater rather than GWUDI. However, it is recommended that a groundwater-sampling program be initiated to ensure that the groundwater quality remains suitable for public consumption.

It is recommended that AENV approve the enclosed application and that groundwater-monitoring requirements should include at least daily water-level and groundwater-production measurements from the water supply well, once the water supply well is put in service.

[1] GWUDI is the acronym for *Groundwater Under the Direct Influence of Surface Water;* MPA is a Microparticulate Analysis.

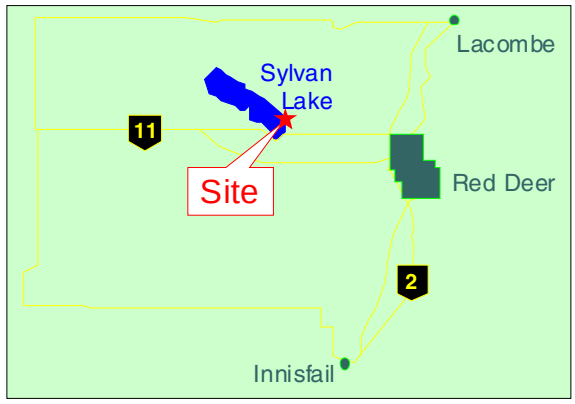
1. Introduction

1.1. Purpose

This technical report has been prepared for Belterra Land Company (Belterra), the owner of the proposed Birchcliff residential development in SE 17-039-01 W5M, within Lacombe County. The development is expected to consist of 50 residential lots, which would require a water supply of up to 22,356 cubic metres per year (m³/year), which is 61.25 m³/day.[1] The intent is to develop the water supply from a water supply well, licensed for municipal use.

The intended groundwater supply is to be from Water Test Hole (WTH) No. 1-09, completed in SE 17 in the depth interval from 30.5 to 39.6 metres below ground level (BGL).

This report was prepared in support of an application by Belterra to Alberta Environment (AENV) to license a total of 22,356 m³/year from WTH No. 1-09 for the required groundwater supply.



Index Maps

1.2. Scope

Hydrogeological Consultants Ltd. (HCL) have been retained to complete a technical report in support of the groundwater application. The technical report includes the following:

- review of the local hydrogeology
- results of a water test hole drilling program
- results of chemical analyses of groundwater from the water test hole to be licensed
- data from a field survey
- results of aquifer tests and interpretation
- results of a Phase 1 screening and Phase 3 microparticulate analysis (MPA) for GWUDI[2]
- predicted impact due to groundwater diversion.

[1] Based on: 50 lots x 3.5 people/lot x 350 litres/person/day = 61.25 m³/day.
[2] GWUDI is the acronym for *Groundwater Under the Direct Influence of Surface Water.*

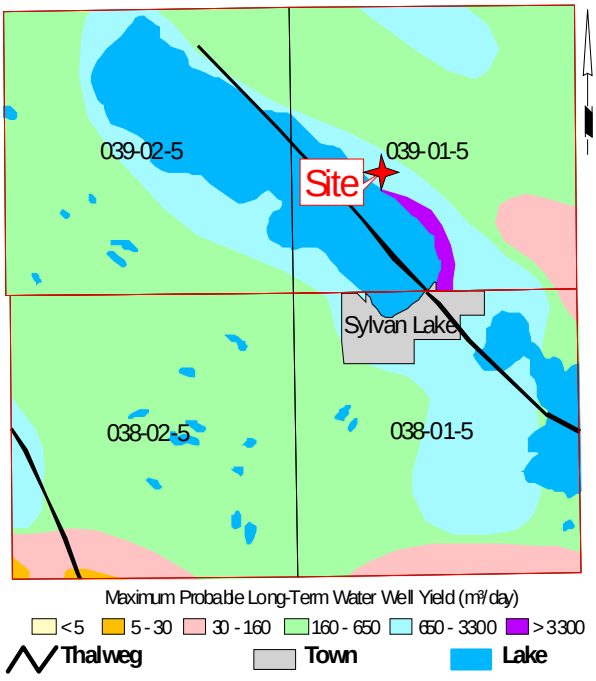
The area of study (AOS) for the present investigation is the nine-section area centred on 17-039-01 W5M. The area of interest (AOI) is the area within a 1,600-metre radius of WTH No. 1-09. The present groundwater investigation is submitted under criteria outlined in AENV's Groundwater Evaluation Guideline, available on AENV's website.[3] Schedule 1 of the Guideline and a signed copy of the Application are included in Appendix A.

2. Background

2.1. General Hydrogeology

The upper bedrock in the AOS is the Paskapoo Formation, composed primarily of non-marine sandstone and shale deposits. The Paskapoo Formation in the AOS includes the Dalehurst Member, underlain by the Upper Lacombe, Lower Lacombe, and Haynes members. The non-marine Scollard Formation underlies the Paskapoo Formation, and is composed of shale, with minor amounts of bentonitic sandstone and coal layers.

The hydrogeological map for the area (Tokarsky, 1971) indicates that water wells completed in aquifers within 100 metres of the land surface in the AOS are expected to have long-term yields ranging from 160 to 3,300 m³/day, as shown in the adjacent map. Tokarsky states that high bedrock water well yields near Sylvan Lake may be due to induced infiltration from the Lake.



***Hydrogeological Map** (after Tokarsky, 1971)*

Regional bedrock aquifers are not usually identified in west-central Alberta where the upper bedrock is the Paskapoo Formation. This is because of two factors: the first is the lenticular nature of the deposits; and the second is that the rocks of the Paskapoo Formation become more indurated the closer they are to the mountain front and the permeability tends to be a fracture-type permeability rather than an inter-granular type of permeability.

Groundwaters from the upper bedrock aquifers are indicated on the regional hydrogeological map as being sodium+potassium-bicarbonate-type waters with total dissolved solids (TDS) of in the order of 500 milligrams per litre (mg/L).

[3] http://www3.gov.ab.ca/env/water/Legislation/Guidelines/Index.cfm

A groundwater query (gwQuery) was developed by Mow-Tech Ltd. as part of the regional groundwater assessments completed for various counties in Alberta. The results of the groundwater query for SE 17-039-01 W5M provide a summary of expected local hydrogeology. The gwQuery results are based on more than 30 regional maps prepared by HCL, and are provided in the adjacent table. The gwQuery is based on regional data and, therefore, local conditions may vary. The Mow-Tech Ltd. gwQuery is available on the internet: http://www.gwquery.com.

Lacombe County
SE 17-039-01 W5M
MOW-TECH LTD. gwQuery Results

General Results Depth(s)	Top metre	Yield* m³/day	NPWL metre	TDS mg/L	Sulfate mg/L	Chloride mg/L	Fluid Expected
gwQuery Determined Minimum	16	35[2]	10	715	115	2	--
gwQuery Determined Maximum	46	35[2]	10	715	115	2	--

Detailed Results Geologic Unit Encountered	Top metre	Yield* m³/day	NPWL metre	TDS mg/L	Sulfate mg/L	Chloride mg/L	Fluid Expected
Lower Surficial Deposits	0	--	--	548	75	7	--
Bedrock Surface	7						
Upper Lacombe Member	7	35[2]	10	715	115	2	--
Lower Lacombe Member	203	23[2]	93	587	--	47	--
Haynes Member	248	4[2]	112	529	39	5	--
Upper Scollard Formation	298	--	114	761	3	60	--
Lower Scollard Formation	397	--	169	952	318	11	--
Battle Formation	433	--	--	--	--	--	--

Parameter	metre
Base of Groundwater Protection (Depth)	370
Ground Elevation (AMSL)	946

gwQuery

The adjacent table shows that there is an expected seven metres of surficial deposits overlying bedrock; the uppermost bedrock unit is expected to be the Upper Lacombe Member of the Paskapoo Formation, which extends from a depth of seven metres BGL to 203 metres BGL.

The gwQuery shows that aquifers within the surficial deposits in SE 17 would not be expected. Groundwater yields from water wells completed in aquifers within the upper bedrock are expected to be less than 50 m³/day. TDS concentrations in groundwaters from upper bedrock aquifers are expected to be in the order of 500 to 700 mg/L.

2.2. GWUDI

The basis for classification of the water well is to be carried out in accordance with AENV's *Assessment Guideline for Groundwater Under the Direct Influence of Surface Water (GWUDI)*.[4]

Direct surface-water influence is that influence that may cause the risk of pathogenic organisms such as *Giardia* and *Cryptosporidium* to be transferred from a surface source to a groundwater source. Groundwater sources generally have the following characteristics:

- the initial intake is below ground surface or below the bottom of a surface-water source
- there is natural, undisturbed soil/geologic material completely surrounding the initial source intake (Montana Department of Environmental Quality, 1999).

The scope of work includes a comparison of available data with AENV's Phase 1 screening criteria and a Phase 3 MPA to determine whether the groundwater from the water test hole is classified as supplying high-quality groundwater, or groundwater under the direct influence of surface water (GWUDI). The Phase 3 MPA is used to determine if surface-water organisms are present in groundwater. GWUDI is indicated by the significant occurrence of "insects, algae, or other large-diameter pathogens." (USEPA, 1992). For an MPA to be definitive, two to four analyses must be performed over a 12- to 18-month interval, during times when surface water is most likely to influence groundwater, such as in the spring and fall.

2.3. Previous Work

The Bibliography section of this report includes documents that contain information that could be used in evaluating the groundwater resource in the AOS.

One report of particular interest was completed in support of a groundwater licence application for a water supply well completed in NE 17-039-01 W5M on behalf of Lance Skinner (HCL, April-2009). The application was for 120 m^3/day from the Skinner WTH No. 1-09, located 807 metres north of the Belterra WTH No. 1-09. The conclusions were that the Skinner WTH No. 1-09 is completed in an unconfined aquifer with an effective transmissivity of 1,074 metres squared per day (m^2/day), and that the projected theoretical long-term yield of the Skinner WTH No. 1-09 was over 5,000 m^3/day.

Additional information used in the Interpretation section of this report was provided in a telephone conversation with the Town of Sylvan Lake's public works operator, who had indicated that the Town's Water Supply Well Nos. 10 and 11 in NE 09-039-01 W5M are considered to be providing high-quality groundwater, rather than GWUDI.

[4] Alberta Environment's assessment guideline is included as Appendix E in the January 2006 "Standards and Guidelines in Municipal Waterworks, Wastewater and Storm Drainage Systems", available at http://environment.gov.ab.ca/info/posting.asp?assetid=6979&subcategoryid=96. Appendix E of these Guidelines is included in Appendix E of this report.

3. Present Program

3.1. Maps, Aerial Photographs

The AOS is situated within the 83/B 1:250,000 National Topographic Series (NTS) map sheet, with local detail available from the 1:50,000 83B/08 map sheet. Digital topographic control is from the 1:20,000 digital elevation model (DEM) prepared by AltaLIS Ltd.

Digital ortho-imagery has been obtained from Valtus Imagery Services (Valtus) for the present program. Otho-imagery is created for a digital image of an aerial photograph when displacements caused by the camera and the terrain have been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. The aerial photographs used in the creation of the ortho-images were flown on 05 Jul 07 at a 1.0-metre resolution.

3.2. Groundwater Database

The Groundwater Centre database, an enhanced version of the AENV groundwater database, includes 292 records for the nine-section AOS.[5] Of the 292 groundwater records, 279 are classified as water wells. Of the 279 water wells in the AOS, 103 are within the AOI (that is, within 1,600 metres of WTH No. 1-09). Water well classification includes the four categories for "Type of Work" as shown in the adjacent table. The "new well" category, although new at the time the information was filed with AENV, may now be many years old. Information relating to the records in the groundwater database has been used in the preparation of cross-sections, as the starting point for the water well survey, and to determine aquifer parameters.

Type of Work	No. of Records
New Well	237
Chemistry	33
Federal Well Survey	4
Water Test Hole	3
Well Inventory	2
Dry Hole - Abandoned	1
New Well - Abandoned	1
Old Well - Abandoned	2
Piezometer	3
Water Test Hole - Abandoned	3
Structure Test Hole	3
Total Water Well Records	***279***
Total Groundwater-Related Records	***13***
Total:	***292***

Groundwater Database Records

[5] The table includes updates to the database made as part of the present program.

3.3. Meteorological Data

Atmospheric pressure data used as part of the aquifer test interpretation were compiled from the Red Deer meteorological station.[6]

3.4. Site Selection

On 20 Oct 09, HCL personnel met on-site with representatives of Belterra, the water well drilling contractor (Alken Basin Drilling Ltd. [Alken Basin]) and a dowser to select water test hole drilling locations. Identification of buried utilities had been conducted by Longview Planning + Design. HCL's responsibility was to ensure that the locations selected would not be within set-back distances for municipal water supply wells outlined in Section 46 of AENV's Water (Ministerial) Regulation,[7] or within 100 metres of any existing surface-water body, and to begin the field survey.

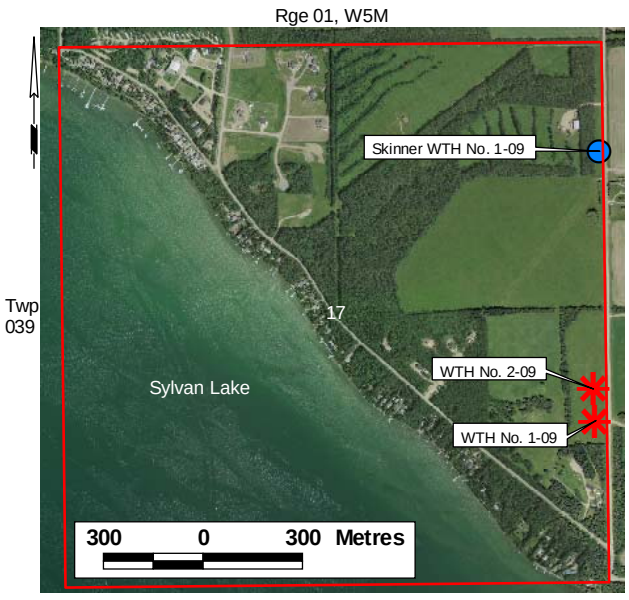
Dowser Selecting Drilling Location

3.5. Field Work

3.5.1. Drilling and Preliminary Aquifer Testing

Water Test Hole No. 1-09 was drilled and completed by Alken Basin on 24 Oct 09 in SE 17-039-01 W5M, as shown on the adjacent site map; WTH No. 2-09, located 98 metres north of WTH No. 1-09, was drilled and completed on 26 Oct 09. The site map also shows the location of the Skinner WTH No. 1-09, which was drilled and tested in March 2009 (HCL, Apr-2009) for on behalf of Lance Skinner.

WTH No. 1-09 was developed at an estimated 159.1 litres per minute (lpm) from a depth of 42.7 metres BGL. WTH No. 2-09 was developed at 204.6 lpm from a depth of 42.7 metres BGL.



Site Map

[6] Accessed from the website: http://www.wunderground.com/
[7] Sections 44 to 58 are in Appendix E, and at: http://www.qp.alberta.ca/574.cfm?page=1998_205.cfm&leg_type=Regs&isbncln=9780779738946

Each of the water test holes was developed with air, and the rate of groundwater removed estimated by the water well contractor. Each of these development periods have been recorded as Aquifer Test I (AT I) with the appropriate water test hole.

A preliminary pumping-and-recovery aquifer test (AT I) was conducted with WTH No. 1-09 on 24 Oct 09 by Alken Basin, which consisted of 120 minutes of groundwater diversion at 159.1 lpm during aquifer development followed by 120 minutes of recovery; water levels were not monitored, but a non-pumping water level (NPWL) of 32.92 metres below top of casing (BTOC) was recorded.

Aquifer Test II (AT II) with WTH No. 1-09 was a pumping-and-recovery-type aquifer test conducted by Alken Basin, which consisted of 120 minutes of pumping at 227.3 lpm, followed by 120 minutes of recovery.

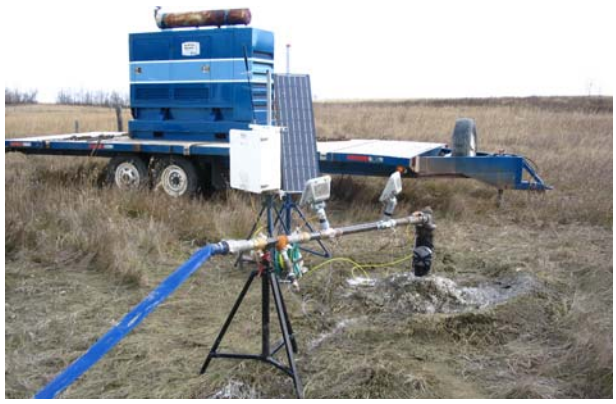
A preliminary pumping-and-recovery aquifer test (AT I) was conducted with WTH No. 2-09 on 26 Oct 09 by Alken Basin, which consisted of groundwater diversion at 204.6 lpm during aquifer development; water levels were not monitored, but an NPWL of 33.53 metres BTOC was recorded.

Aquifer Test II (AT II) with WTH No. 2-09 was a pumping-and-recovery-type aquifer test conducted by Alken Basin on 26 Oct 09, which consisted of 120 minutes of pumping at 172.8 lpm, followed by 120 minutes of recovery.

Water test hole details and preliminary aquifer test results are included in Appendix B, and in the Results section of this report.

3.5.2. Extended Aquifer Test

Aquifer Test III (AT III) with WTH No. 1-09 was an extended aquifer test conducted by Mow-Tech Ltd., which started on 27 Oct 09, and consisted of 2,952 minutes of pumping at 116.9 lpm followed by 7,038 minutes of recovery. Water Test Hole No. 2-09 was used as an observation water well during the extended aquifer test.



Groundwater Monitoring during AT III

Water levels during the extended aquifer test were measured with downhole pressure transducers connected to data loggers, which were programmed to record a water level every ten minutes. A turbine and flow analyzer were used to measure groundwater production. Instantaneous flow measurements were recorded every ten minutes with the data logger. Data from AT III with WTH No. 1-09 are in Appendix C.

3.5.3. Groundwater Sampling

Groundwater samples were collected from WTH No. 1-09 on 31 Oct 09 and submitted to Exova (formerly Bodycote Testing Group) for a municipal suite of chemical analyses that include routine parameters, and all other parameters for which Health Canada has a maximum acceptable concentration. On 09 Nov 09, a sample was collected from WTH No. 1-09 and submitted to Exova for total and fecal coliforms.

Samples collected for a microscopic particulate analysis (MPA) on 28 Oct 09 were submitted to Hyperion Research Ltd. (Hyperion) as part of AENV's Phase 3 GWUDI determination. The sampling procedure is described on Hyperion's website,[8] and summarized below:

- Install filter cartridge
- Connect water sampler to water source and install pressure-reducing valve and by-pass loop
- Run at least two m^3 of water through filter at low rate and low pressure
- At the end of sample collection, remove filter cartridge and ship on ice to Hyperion.

The analyses results are included in Appendix B.

3.5.4. Field-Verified Water Well Survey

HCL personnel conducted a field survey within a 1,600-metre radius of WTH No. 1-09 (the AOI) on 20 Oct 09, 27-28 Oct 09 and 25-26 Nov 09. The field survey was concentrated in the area south of WTH No. 1-09, since the area north of WTH No. 1-09 was included in a water well survey conducted by HCL in March 2009 (HCL, Apr-2009). Water well records available in the enhanced groundwater database for the AOI were used as a starting point for the field survey. Coordinates for features located in the field were determined with a consumer-grade hand-held GPS unit. When the owner allowed, water levels were measured in water wells. If the residents at a visited location were not home, a letter was left explaining the purpose of the water well survey, and an opportunity was given to the residents to include details from their water well(s) for the survey; a copy of the letter is in Appendix A.

A map and tables of the results of the survey are included in the Results section of this report and in Appendix D.

[8] http://www.hyperionlab.ca/

3.6. Data Processing

All field observations have been georeferenced using 10-degree Transverse Mercator (10TM) coordinates based on NAD83. Coordinates were determined for features identified in the field using a consumer-grade, hand-held GPS unit.

Transmissivity values from the aquifer test data from the pumped water test hole have been calculated using the following approximation of the Theis non-equilibrium equation:

$$T = \frac{2.3 \cdot Q}{4 \cdot \pi \cdot \Delta s}$$

Where:

T = Transmissivity
Q = Discharge
Δs = Drawdown per log cycle

Transmissivity from specific capacity is calculated based on the following equation:

$$\frac{Q}{s} = \frac{4 \cdot \pi \cdot T}{2.3 \cdot \log_{10}\left(\frac{2.25 \cdot T \cdot t}{S \cdot r^2}\right)}$$

Where:

S = Storativity and is assumed to be 0.0001
t = time since discharge started
r = effective radius of the water well

Drawdowns at various times and distances from the groundwater discharge point are calculated from the following equation:

$$s = \frac{Q \cdot W(u)}{4 \cdot \pi \cdot T}$$

Where:

W(u) is the well function of u

And

$$u = \frac{r^2 \cdot S}{4 \cdot T \cdot t}$$

When multiple groundwater discharge points are involved, the principle of superposition is used. The multiple discharge points can be at various locations or at one location.

Drawdowns at various times and distances are calculated based on approximations of W(u). For values of u greater than 0 and less than one, the following approximation is used:

$$W(u) = - \ln u + (-0.57721556) + (0.99999193)*u + (-0.24991055)*u^2 + (0.05519968)*u^3 + (-0.000976004)*u^4 + (0.00107857)*u^5$$

Where:

ln = natural logarithm

For values of 1 < u < infinity, the following approximation is used:

$$W(u) = (1/(u*e^{u}))*(((0.250621)+(2.334733*u)+u^{2}))/((1.681534)+(3.330657*u)+u^{2}))$$

Theoretical long-term yield is calculated from the Moell Method[9], using the following equation:

$$Q_{20} = \frac{Q(H_A)}{s_{100} + 5\Delta s} \times 0.7$$

Where

H_A = available drawdown
S_{100} = the drawdown after 100 minutes of pumping
Q = pumping rate during the aquifer tests
Q20 = sustainable yield for 20 years
Δs = drawdown per log cycle
0.7 = safety factor

All gridding uses the Kriging method with a linear variogram model as provided in Golden software Surfer V9.

[9] Groundwater Evaluation Guideline, 05 December 2002. Alberta Environment

4. Results

4.1. Field Work

4.1.1. Drilling and Preliminary Aquifer Testing

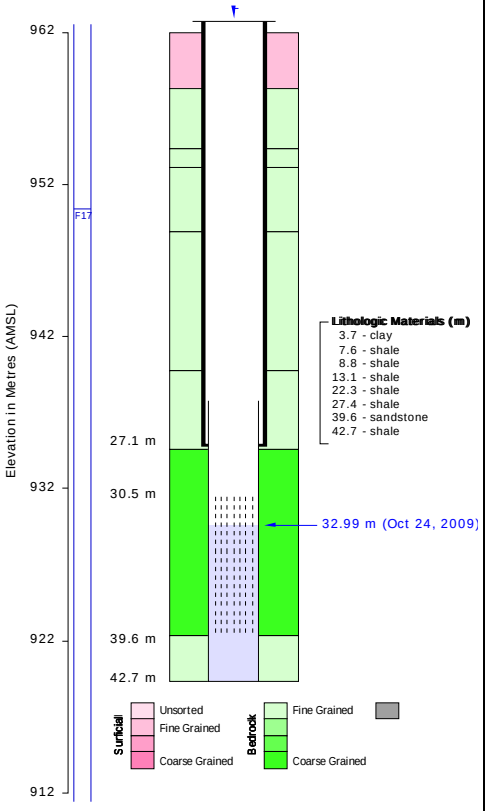
4.1.1.1. WTH No. 1-09

Water Test Hole No. 1-09 was drilled and completed by Alken Basin on 24 Oct 09 to a total depth of 42.7 metres BGL. Lithologic units encountered during drilling included 3.7 metres of clay overlying interbedded sandstone and shale units.

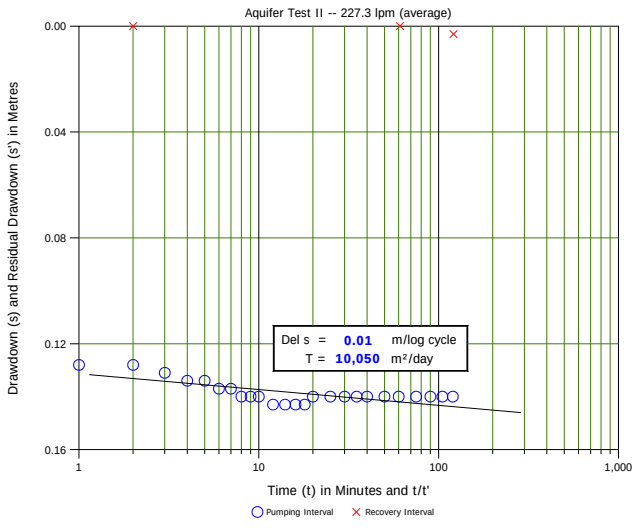
The water test hole was completed with 141-millimetre (mm) outside diameter (OD) steel surface casing set to a depth of 27.1 metres BGL. A 114-mm OD plastic (PVC) liner was installed inside the surface casing, and slotted in the depth interval between 30.5 and 39.6 metres BGL, adjacent to a sandstone aquifer, as shown in the adjacent well diagram. The aquifer is considered to be the sandstone unit in the depth interval between 27.4 and 39.6 metres BGL.

The NPWL measured on 24 Oct 09 was 32.99 metres BTOC; the casing stick-up is 0.46 metres above ground level. Because the NPWL is below the top of the sandstone aquifer, the aquifer is considered to be an unconfined aquifer. Aquifer Test I (AT I) with WTH No. 1-09 consisted of groundwater development at an estimated 159.1 lpm; no water levels were measured during AT I.

WTH No. 1-09



WTH No. 1-09 - Well Diagram



AT II with WTH No. 1-09

Aquifer Test II (AT II) with WTH No. 1-09 consisted of 120 minutes of pumping at 227.3 lpm, followed by 120 minutes of recovery. The adjacent graph shows that the pumping data indicate an effective transmissivity of 10,050 m²/day. The water level recovered to the pre-test level within the first two minutes of recovery. Completion information and the results of AT II with WTH No. 1-09 are included in Appendix B.

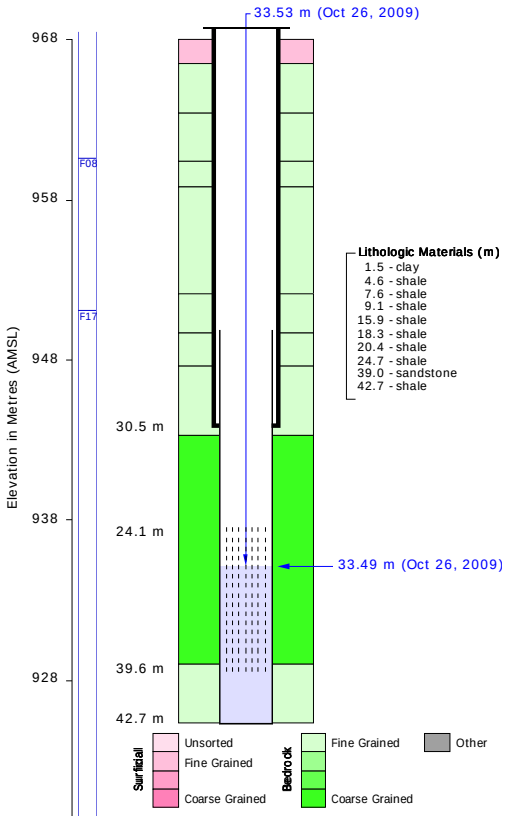
4.1.1.2. WTH No. 2-09

Water Test Hole No. 2-09 was drilled and completed by Alken Basin on 26 Oct 09 to a total depth of 42.7 metres BGL. Lithologic units encountered during drilling included 1.5 metres of clay overlying interbedded sandstone and shale units.

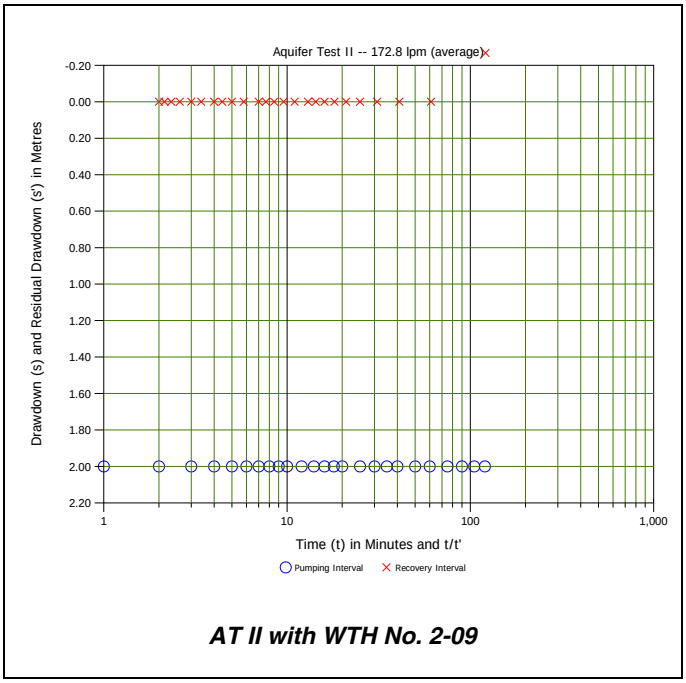
The water test hole was completed with 141-mm OD steel surface casing set to a depth of 24.1 metres BGL. A 114-mm OD PVC liner was installed inside the surface casing, and slotted in the depth interval between 30.5 and 39.6 metres BGL, adjacent to a sandstone aquifer, as shown in the adjacent well diagram. The aquifer is considered to be the sandstone unit in the depth interval between 24.7 and 39.0 metres BGL.

The NPWL measured on 26 Oct 09 was 33.49 metres BTOC; the casing stick-up is 0.97 metres above ground level. Because the NPWL is below the top of the sandstone aquifer, the aquifer is considered to be an unconfined aquifer. Aquifer Test I (AT I) with WTH No. 2-09 consisted of groundwater development at an estimated 204.6 lpm; no water levels were measured during AT I.

WTH No. 2-09



WTH No. 2-09 - Well Diagram



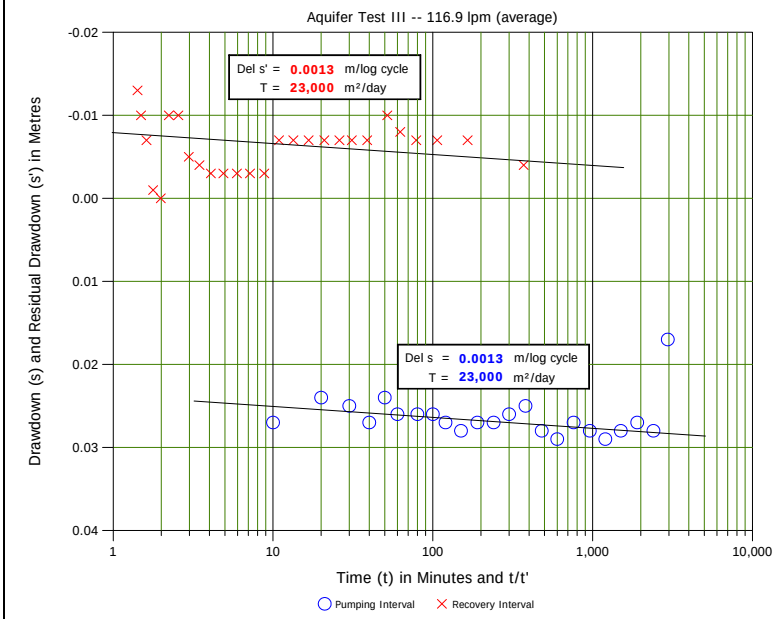
AT II with WTH No. 2-09

Aquifer Test II (AT II) with WTH No. 2-09 consisted of 120 minutes of pumping at 172.8 lpm, followed by 120 minutes of recovery. The graph to the left shows that the water level during the pumping interval drew down 2.00 metres within the first minute of pumping, after which there was no measured water-level change until the pump was turned off. The water level recovered to the pre-test level within the first two minutes of recovery.

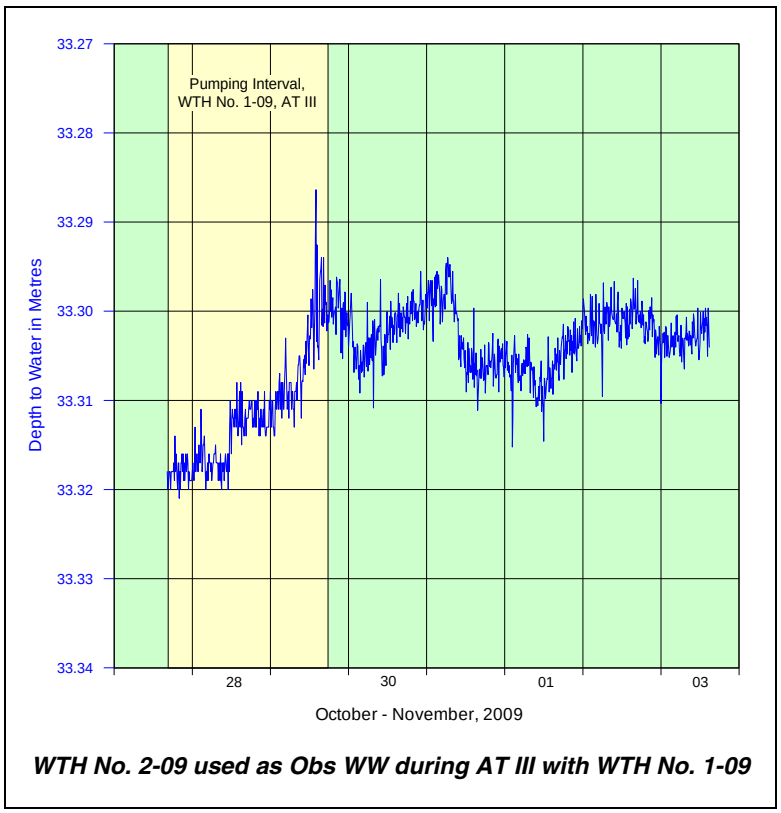
Completion information and the results of AT II with WTH No. 2-09 are included in Appendix B.

4.1.2. Extended Aquifer Test

Aquifer Test III (AT III) with WTH No. 1-09 was an extended pumping-and-recovery-type aquifer test that was started on 27 Oct 09, and consisted of 2,952 minutes of pumping at 116.9 lpm followed by 7,038 minutes of recovery. Water Test Hole No. 2-09 was used as an observation water well during AT III with WTH No. 1-09. The adjacent graph shows that the pumping data and recovery data indicate an effective transmissivity of 23,000 m²/day. The water level recovered above the pre-test level within the first ten minutes of recovery. The graph below shows the measured water levels in WTH No. 2-09; the graph shows that the water level in WTH No. 2-09 rose about 0.02 metres during the pumping interval of AT III with WTH No. 1-09. AT III results are in Appendix C.



WTH No. 1-09 - AT III



WTH No. 2-09 used as Obs WW during AT III with WTH No. 1-09

4.1.3. Water Well Survey

HCL personnel conducted a water well survey within the AOI on 20 Oct 09, 27-28 Oct 09 and 25-26 Nov 09. The field survey was concentrated in the area south of WTH No. 1-09, since the area north of WTH No. 1-09 was included in a water well survey conducted by HCL in March 2009 (HCL, Apr-2009). The purpose of the field-verified water well survey was to locate as many of the 103 water wells in the database for the AOI as practical, and to update records accordingly. A field survey includes seven criteria for identification of a feature:

Physically confirmed - this means the feature was observed, and horizontal coordinates were obtained after receiving authorization to do so by the owner/user.

The feature is confirmed by the owner/user, and horizontal coordinates were obtained based on information provided.

The feature could be expected based on information that is not provided by the owner/user.

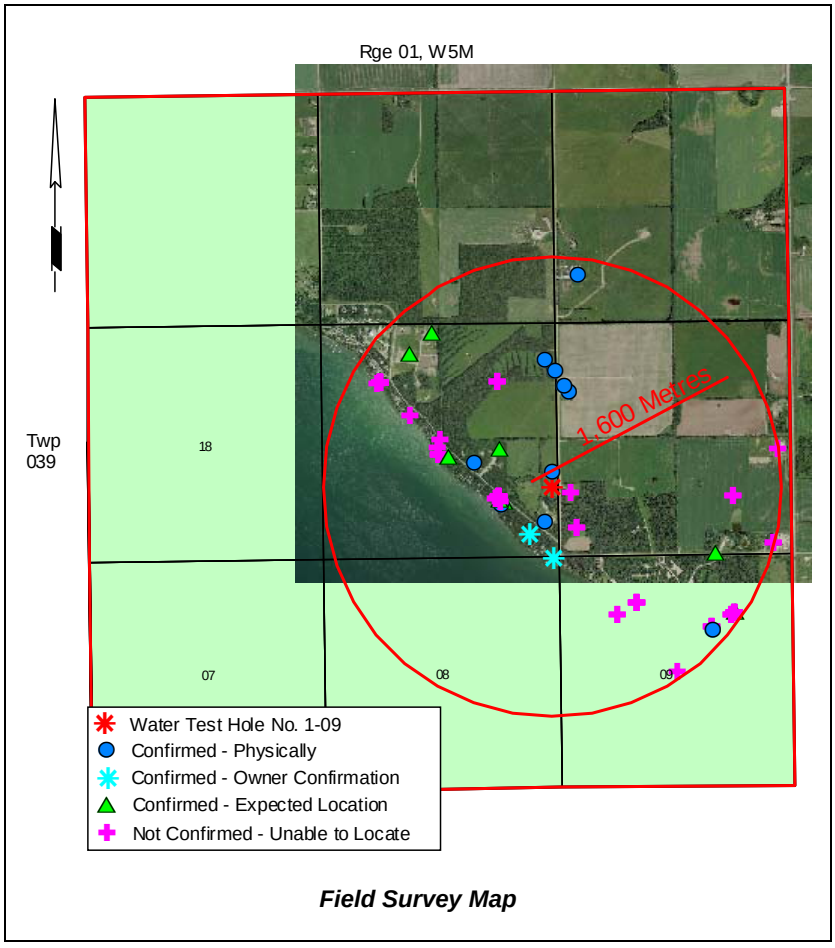
No evidence of the feature could be observed in the field.

The location of the feature is confirmed, but not located in the field.

The location of the feature is confirmed, and there is a chemical analysis associated with the feature.

The location of the feature is confirmed, and there is a measured water level associated with the feature.

The map below shows the spatial distribution of 103 water wells within the AOI. Of these 103 water wells:



Field Survey Map

- one is WTH No. 1-09 (identified with ✸)

- ten additional water wells were physically confirmed in the field (identified with ●)

- two water wells were confirmed based on information provided by the owner (identified with ✸)

- ten water wells were not located, but their location was moved from the centre of the legal location to the most likely site in the land location (identified with ▲)

- 80 water wells were not located in the field and no evidence of the feature could be observed in the field (identified with ✚)

A larger, labelled version of the field survey map is in Appendix D. Water well details for the water wells within the AOI are also included in Appendix D.

4.2. Groundwater Database

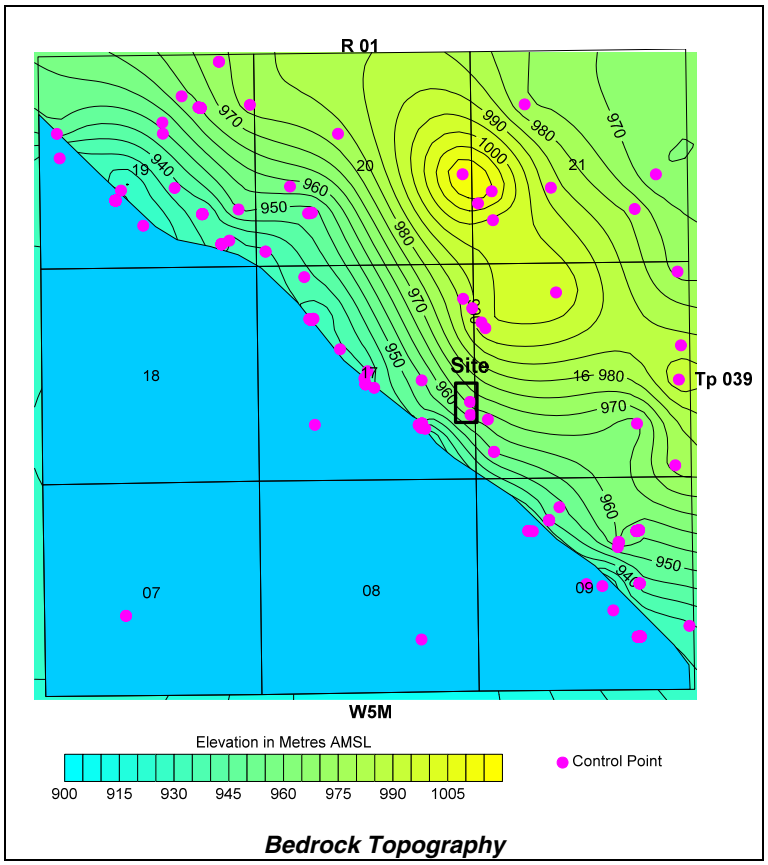
The AENV licensing database indicates that there are nine authorized groundwater diversions in the AOS, comprising five licensed diversions and four groundwater registrations. The total allocated volume of these nine authorizations is 934,171 m³/year, which is 2,559 m³/day, as shown in the adjacent table.

Groundwater Authorizations

Applicant	AENV File No.	Legal Location (039-01 W5M)	Distance from WTH No. 1-09 (m)	Water Well Identifier	Authorized Diversion (m³/year)	Specific Purpose	Authorization Date
Town of Sylvan Lake	19727	NE 09	1,543	M39927.339327	215,860	Urban	04-Jun-96
Town of Sylvan Lake	19727	NE 09	1,543	M39927.339327	387,137	Urban	21-Mar-06
Town of Sylvan Lake	19727	NE 09	1,000 (minimum)		310,980	Urban	19-Aug-09
Gillian Skinner	203562	NE 17	880	M36727.989152	345	Registration	12-Dec-03
Sunnyside Pentecostal Camp	81195	NW 17	1,400	M35379.060869	12,412	Schools	19-Apr-07
Sunnyside Pentecostal Camp	81195	NW 17	1,400	M36234.928477	0	Schools	19-Apr-07
Frank Wilson	170554	SE 20	1,822	M36234.928084	442	Registration	28-May-02
Frank Wilson	170554	SW 20	2,000 (estimated)		745	Registration	28-May-02
EBOR Enterprises Ltd.	180433	SW 21	1,483	M39227.494026	6,250	Registration	07-Jan-04
				Total:	**934,171**		

Authorized Groundwater Diversions in AOS

Information from the water well survey was used to update the groundwater database. Of the 291 records in the groundwater database for the AOS, 243 records included a determination of the top of bedrock, which was used to create the bedrock topography map below. The map shows the presence of a northwest-southeasterly-trending linear bedrock high in the northeastern part of the AOS, approximately parallel to the shoreline of Sylvan Lake. The bedrock underlying the development site is at an elevation of 955 to 970 metres above mean sea level (AMSL), and slopes to the southwest at a gradient of approximately 0.04.



Bedrock Topography

Within the AOS, there are aquifer test summary data for 124 records that allow for a calculation of apparent transmissivity. The 100 apparent transmissivity records range from 0.1 to 1,447 m²/day, with an average of 45.9 m²/day and a median of 12 m²/day. Ninety-four percent of the values are less than 90 m²/day, and only two values exceed 224 m²/day. One hundred two of the 124 apparent transmissivity records have water well completion information that allows for a calculation of apparent long-term yield. The 102 apparent long-term yields range from 1.1 to 7,887 m³/day, with an average of 279 m³/day, and a median of 56 m³/day; 90% of the records are less than 500 m³/day, and 4% exceed 1,000 m³/day.

4.3. Groundwater Quality

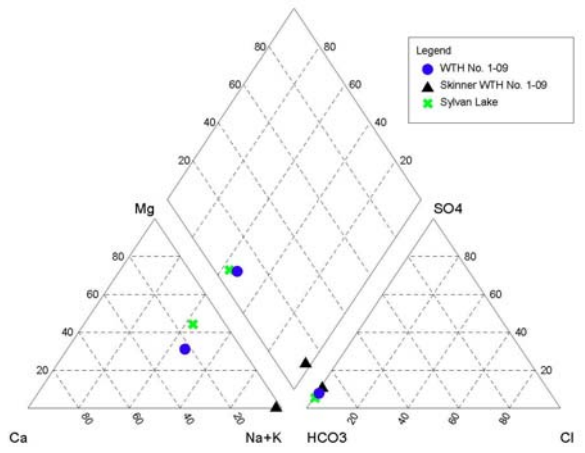
Groundwater samples were collected from WTH No. 1-09 on 31 Oct 09 and submitted to Exova (formerly Bodycote Testing Group) for a municipal suite of chemical analyses. In the adjacent table, selected parameters[10] are compared to the Summary of Guidelines for Canadian Drinking Water Quality (Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment. 2008). The table shows that none of the parameters exceed the recommended SGCDWQ limits for potable water. Copies of the complete chemical analyses are in Appendix B. The additional analyses results show that concentrations of all parameters in the municipal suite of analyses are either below detection limits, or below drinking water guidelines.

Comparison Between Recommended Limits For Concentrations of Chemical Constituents in Potable Water and in Groundwater from WTH No. 1-09

Constituent	WTH No. 1-09 31 Oct 09 mg/L	SGCDWQ Recommended Concentration AO	SGCDWQ Recommended Concentration MAC
pH	8.33	6.5-8.5	---
Conductivity (µS/cm)	716	---	---
Total Dissolved Solids	412	500	---
Sodium	84.4	200	---
Potassium	2.4	---	---
Calcium	{36.7}	---	---
Magnesium	{30.6}	---	---
Total Hardness	218	---	---
Carbonate	< 6	---	---
Bicarbonate	458	---	---
Total Alkalinity	376	---	---
Sulfate	{30.1}	500	---
Hydroxide	< 5		
Chloride	2.2	250	---
Fluoride	0.09	---	1.5
Iron	< 0.01	0.3	
Manganese	< 0.005	0.05	
Nitrate + Nitrite (as N)	0.38	---	10
Colour (colour units)	< 5	15	
Turbidity (NTU)	0.4	5	1
Total Coliforms (CFU/100mL)	<1		0
Fecal Coliforms (CFU/100mL)	<1		0
Ionic Balance (%)	98	---	---
Chromium	0.0013		0.05
Mercury	< 0.0001		0.001
Aluminum	0.002	0.1	
Antimony	< 0.0002		0.006
Arsenic	0.0002		0.025
Barium	0.07		1
Boron	0.071		5
Cadmium	0.00001		0.005
Copper	0.002	1	
Lead	0.0001		0.01
Selenium	0.002		0.01
Uranium	0.0047		0.02
Zinc	0.017	5	

Concentrations are in milligrams per litre unless otherwise stated.
AO - Aesthetic Objective
MAC - Maximum Acceptable Concentration
SGCDWQ - Summary of Guidelines for Canadian Drinking Water Quality, Federal–Provincial–Territorial Committee on Drinking Water, 2008

A Piper tri-linear diagram of the analysis for the groundwater sample collected from WTH No. 1-09 is shown in the figure below.[11] The diagram also includes the chemical quality of water from the Skinner WTH No. 1-09 (HCL, Apr-2009) and from Sylvan Lake.[12] The diagram shows that, chemically, the groundwater from WTH No. 1-09 is classified as a sodium+potassium-bicarbonate-type water, and the water from Sylvan Lake has a similar chemical quality.



Piper Tri-Linear Diagram

Groundwater-Quality Results

Filtered samples from WTH No. 1-09 were collected on 28 Oct 09 and submitted to Hyperion Research Ltd. for MPA as part of the present program. The samples did not contain any *Giardia* or *Cryptosporidium* cysts, although there was a total count of 12 primary particulates and four secondary particulates. Hyperion Research Ltd. concluded that the risk of surface-water contamination is judged to be low, and the risk factor is zero. A copy of the MPA is in Appendix B.

[10] The parameters selected for the table include routine parameters, microbiological parameters, and extractable metals for which there is a guideline limit.
[11] The diagram includes all chemical analyses results in the database for the nine-section AOS.
[12] Average concentrations reported by Mitchell and Prepas (1990).

4.4. GWUDI

The purpose of AENV's Phase 1 screening criteria is to "rapidly identify non-GWUDI sources that do not require a detailed assessment" (Appendix A). Should the water source not meet any of the screening criteria, the source should be flagged as potentially GWUDI, and the assessment can either proceed to Phase 2a, or the source can be declared GWUDI.

The wellhead protection component of a site inspection by HCL personnel was made to determine whether the proposed water supply well satisfies the Water (Ministerial) Regulations 44 to 58, which have to do with water well construction and site specifications (Appendix A). Water Test Hole No. 1-09 is constructed with a cap and casing stick-up that exceeds the 0.2-metre requirement.[13] The water test hole is also not located within the setback distances of any items listed in Table 1 of Regulation 46.

A comparison of WTH No. 1-09 with AENV's GWUDI Phase 1 screening criteria is discussed below.

1. *Sensitivity Setting* **Fail**
   WTH Nos. 1-09 and 2-09 are completed in an unconfined bedrock aquifer with a top of completion for both water test holes that is 30.5 metres BGL. Although the water test holes have a top of completion that is below 15 metres BGL, the aquifer is considered to be unconfined, and therefore fails the GWUDI sensitivity setting.

2. *Proximity to Surface Water* **Pass**
   Both water test holes are more than 100 metres from the nearest permanent, intermittent or seasonal surface-water body. The elevation of the completion interval of WTH No. 1-09 is approximately equivalent to the elevation interval spanning the Sylvan Lake water level and the Lake bottom.

3. *Water Well Construction* **Pass**
   Both water test holes have been drilled and completed by a licensed water well driller. The water test holes are constructed with steel casing set to a depth of at least 24.1 metres BGL, and sealed with bentonite in the borehole annulus. The result is an effective seal against vertical migration of water and/or contaminants. Each water test hole has a casing stick-up that is at least 0.4 metres above ground level, which exceeds the 0.2-metre guideline, and each is equipped with a well cap.

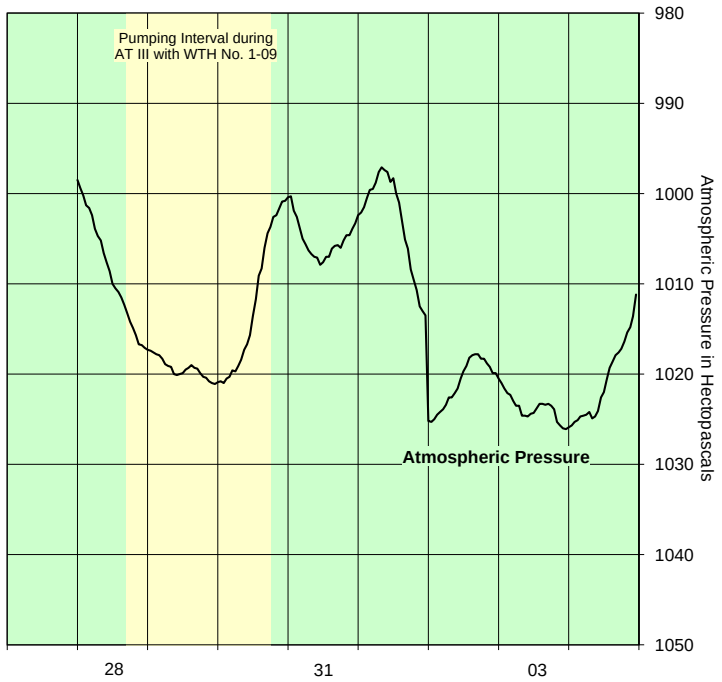
4. *Water Quality* **Pass**
   The groundwater quality from WTH No. 1-09 does not show any evidence of surface-water contamination, although the presence of a small number of primary and secondary particles in the MPA and the concentration of nitrate of 0.38 mg/L does raise a small level of concern.

The groundwater source for the two water test holes fails one of the four AENV Phase 1 screening criteria because the water test holes are completed in an unconfined aquifer. However, although the bedrock aquifer is considered to be unconfined, the guideline is meant to assess shallow water-table type aquifers that may be under the direct influence of surface water. For this reason, the "failure" of the sensitivity setting criterion is not considered to be of great consequence.

[13] The regulation requires a casing stick-up of at least 0.2 metres above the established ground surface, and at least 0.6 metres above the highest flood record in the area if the water well is not equipped with a watertight cap.

4.5. Barometric Pressure

The adjacent graph shows the hourly-recorded barometric pressure at the Red Deer meteorological station from 27 Oct 09 to 04 Nov 09. The graph shows that the pressure during this time interval fluctuated from a low of 997.1 to a high of 1026.1 hectopascals (hpa).

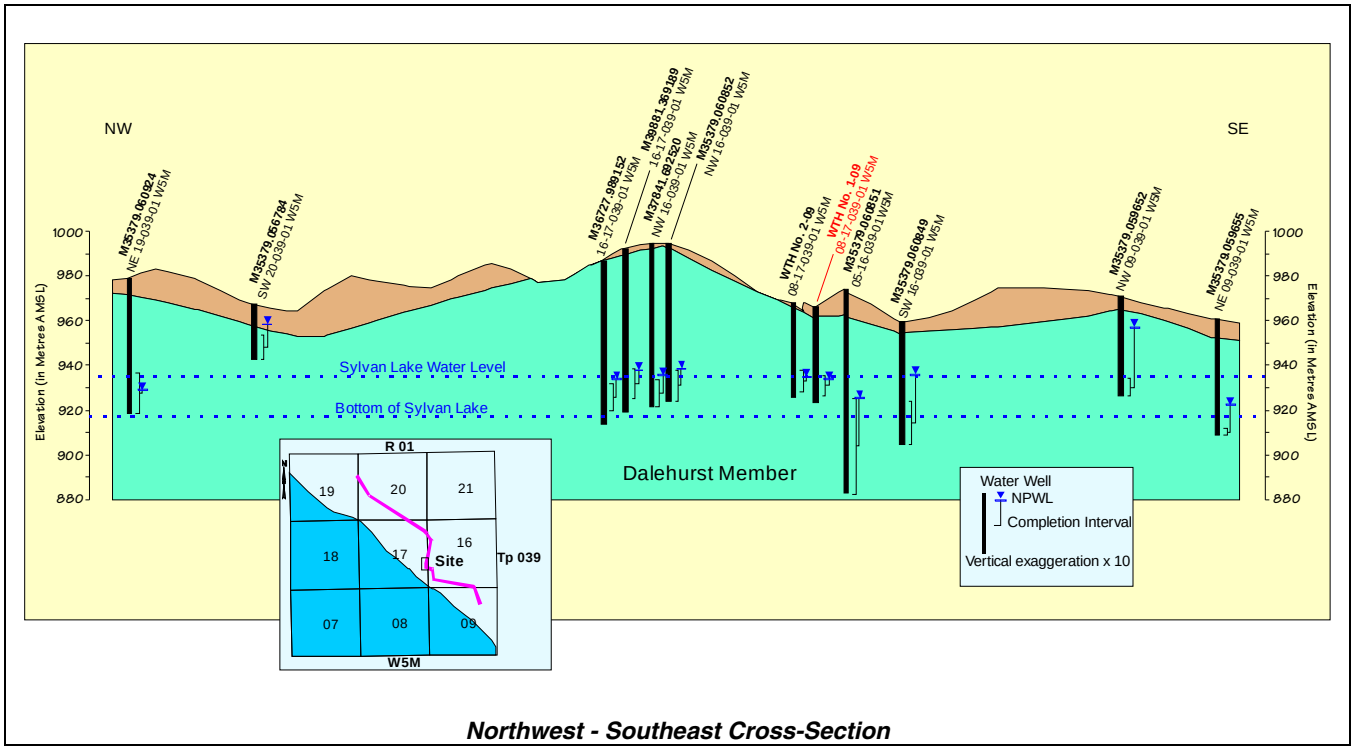


Barometric Pressure Recorded at Red Deer Meteorological Station

5. Interpretation

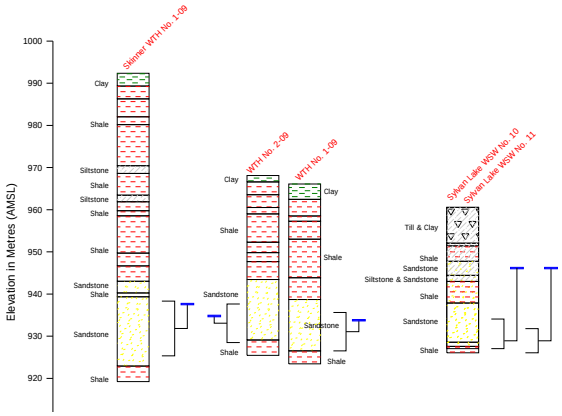
5.1. Geometry of Aquifers

The northwest-southeast cross-section below shows the relationship between WTH No. 1-09 and 11 other water wells in the AOS. The cross-section shows that WTH No. 1-09 is completed in the elevation interval between approximately 926 and 936 metres AMSL, which is in the Dalehurst Member of the Paskapoo Formation. The elevation of the NPWL of WTH No. 1-09 is approximately 934 metres AMSL, which is similar to the water level in Sylvan Lake.[14]



Northwest - Southeast Cross-Section

The schematic diagram to the right shows the vertical relationship between WTH Nos. 1-09 and 2-09, the Skinner WTH No. 1-09, and the Town of Sylvan Lake's WSW Nos. 10 and 11, which are located approximately 1.5 kilometres southeast of WTH No. 1-09, in NE 09. Discussion with the Town's operator indicates that both WSW Nos. 10 and 11 are considered to be providing high-quality groundwater that is not GWUDI. Because WTH No. 1-09 is completed in a sandstone aquifer with similar elevations of completion interval and NPWL as the Town's water supply wells, the five water wells on the cross-section may be completed in the same aquifer, which suggests that the aquifer in which WTH No. 1-09 is completed is not providing GWUDI.



Schematic Cross-Section

[14] The water-level graph in the Atlas of Alberta Lakes (Mitchell and Prepas, 1990) shows that the water level from 1955 to 1987 in Sylvan Lake has fluctuated between 936.0 and 937.2 metres AMSL.

Additional significant information shown on the cross-section includes:

- the completion interval of WTH No. 1-09 and seven other water wells is within the approximate elevation interval spanning the Sylvan Lake water level and the Lake bottom
- the elevation of the NPWL of WTH No. 1-09 and seven other water wells is similar to the elevation of Sylvan Lake's water level.

Even though the water level in WTH No. 2-09 did not draw down due to pumping from WTH No. 1-09 during AT III, the two water test holes are considered to be completed in the same aquifer because:

- of the similarities in the elevation of their completion intervals
- of the similarities in the elevation of their NPWLs
- they are completed in close proximity to each other

Water wells in the AOS may be completed in an aquifer that is hydraulically connected to the aquifer in which WTH No. 1-09 is completed, based on the following criteria:

- If the elevation of the NPWL of the water well is within five metres of the elevation of the NPWL of WTH No. 1-09.
- If the elevation of the completion interval of the water well is within five metres of the elevation of the completion interval of WTH No. 1-09.
- In the absence of a completion interval or NPWL, if the drilled depth is below the elevation or within five metres of the elevation of the top of the completion interval of WTH No. 1-09.
- If there is no information on drilled depth, completion interval or a reported NPWL.

The closest water well that was located during the water well survey (with a Field Action of 1 or 2) is the 1976 Holm Water Well, located 665 metres northeast of WTH No. 1-09 in NW 16-039-01 W5M (GCID No. M35379.060852).

Based on the above criteria, of the nine authorized groundwater diversions in the AOS shown on page 15, the five water supply wells shown below may be completed in aquifers that are hydraulically connected to the aquifer in which WTH No. 1-09 is completed. The five water supply wells are authorized for a combined diversion of 873.3 m³/day.

Groundwater Authorizations

Applicant	AENV File No.	Legal Location (039-01 W5M)	Distance from WTH No. 1-09 (m)	Water Well Identifier	Authorized Diversion (m³/year)	Specific Purpose	Authorization Date
Town of Sylvan Lake	19727	NE 09	1,000 (minimum)		310,980	Urban	19-Aug-09
Gillian Skinner	203562	NE 17	880	M36727.989152	345	Registration	12-Dec-03
Frank Wilson	170554	SE 20	1,822	M36234.928084	442	Registration	28-May-02
Frank Wilson	170554	SW 20	2,000 (estimated)		745	Registration	28-May-02
EBOR Enterprises Ltd.	180433	SW 21	1,483	M39227.494026	6,250	Registration	07-Jan-04

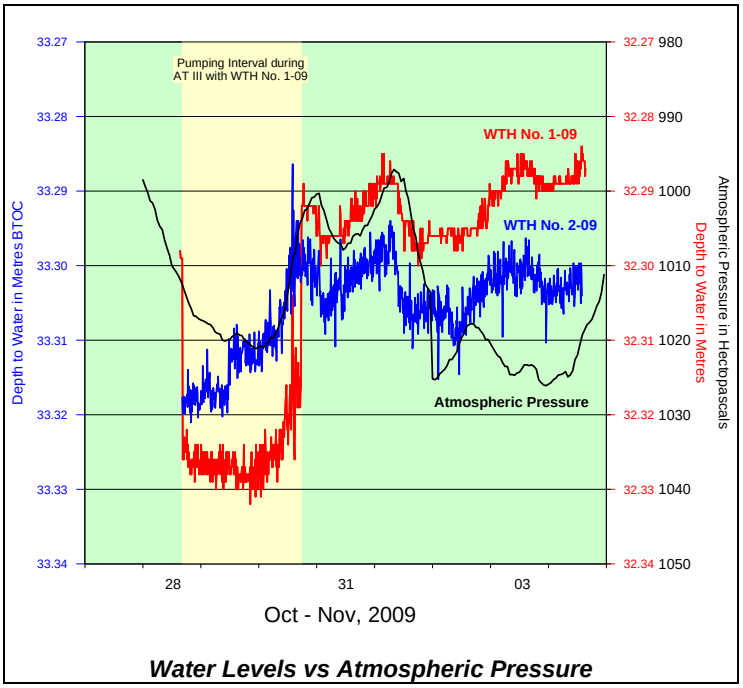
In addition to the five authorized groundwater diversions shown above, 46 domestic water wells and three stock water wells in the AOS may be completed in the same aquifer as WTH No. 1-09. Unlicensed water wells would be protected by AENV for 3.42 m³/day for a domestic supply, or 17.1 m³/day for a stock supply. The 49 domestic or stock water wells are therefore protected for a maximum of 209.0 m³/day.

5.2. Aquifer Test Analysis

The long-term yield is based on an aquifer that is homogeneous, isotropic and of infinite areal extent. To determine a long-term yield, a safety factor is used that limits the drawdown over 20 years to 70% of the available drawdown.

5.2.1. AT III with WTH No. 1-09

Although the cross-section indicates that WTH Nos. 1-09 and 2-09 are completed in the same aquifer, there was no water-level drawdown measured in WTH No. 2-09 during the pumping interval of AT III with WTH No. 1-09. The adjacent graph shows that there is a correlation between the measured water-level fluctuations and atmospheric-pressure fluctuations measured at the Red Deer meteorological station. In general, a decrease in pressure of 10 hpa results in a corresponding water-level decline of 0.02 metres in WTH No. 2-09.



Water Levels vs Atmospheric Pressure

The large value of 23,000 m²/day for effective transmissivity may be a result of induced infiltration from Sylvan Lake, as mentioned by Tokarsky (1971). Data supporting this interpretation include an NPWL elevation in WTH No. 1-09 that is similar to the Lake level, and a completion interval that is similar to the elevation of the water column in the Lake.

5.3. Long-Term Yield

Based on an aquifer that is homogeneous, isotropic and of infinite areal extent and a safety factor that limits the drawdown over 20 years to 70% of the available drawdown, and the following parameters, WTH No. 1-09 has a projected theoretical long-term yield of 16,000 m^3/day, using the Moell Method of analysis:

Available drawdown:	5.2 metres
Specific capacity:	3,900 lpm/metre of drawdown after 10 minutes of pumping
Aquifer transmissivity	23,000 m^2/day
Effective transmissivity:	23,000 m^2/day
Percent of available drawdown used:	70%

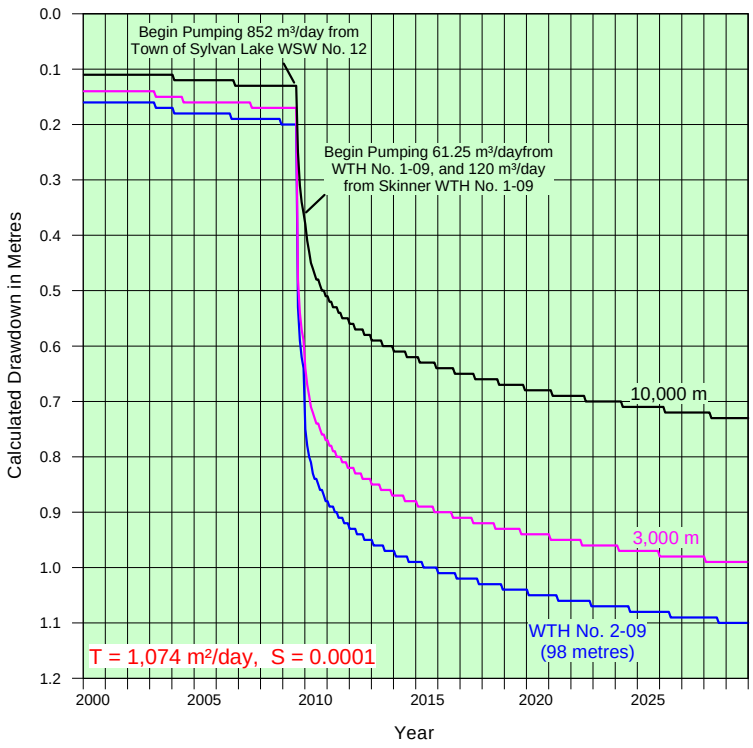
The available drawdown of 5.2 metres in WTH No. 1-09 is based on an NPWL of 32.30 metres BTOC, the bottom of the aquifer at a depth of 39.6 metres BGL, and a casing stick-up of 0.5 metres; these values indicate a saturated thickness of 7.8 metres, two-thirds of which is 5.2 metres. The aquifer transmissivity and effective transmissivity of 23,000 m^2/day are based on the drawdown and recovery data from AT III; this value is unusually high when compared to the effective transmissivity of 1,074 m^2/day determined for the aquifer in which the Skinner WTH No. 1-09 is completed (HCL, Apr-2009). The projected theoretical long-term yield for the Belterra WTH No. 1-09 based on an effective transmissivity of 1,074 m^2/day using the Moell method of analysis is 3,500 m^3/day.

AENV will not license a water supply well for a volume in excess of the maximum pumping rate during aquifer testing. The pumping rate from WTH No. 1-09 was 116.9 lpm (168 m^3/day) during AT III, which is significantly less than the projected theoretical long-term yields, and more than the required diversion of 61.25 m^3/day.

5.4. Predicted Impact

The adjacent graph and table show the predicted drawdowns at various times and various distances from WTH No. 1-09, based on pumping the required 61.25 m³/day beginning 01 Jan 2010, an effective transmissivity of 1,074 m²/day and a storativity of 0.0001.[15] The calculated drawdowns also assume interference from pumping the following:

- the protected 209.0 m³/day from 49 domestic and stock water wells in the AOS that may be completed in the same aquifer as WTH No. 1-09
- the 873.3 m³/day from the five licensed water supply wells in the AOS that may be completed in the same aquifer as WTH No. 1-09[16]
- 120 m³/day from the Skinner WTH No. 1-09 (HCL, Apr-2009), which is assumed to begin pumping on 01 Jan 10.



Distance from WTH No. 1-09 (metres)	1 year	5 years	10 years	20 years
98 (WTH No. 2-09)	0.7	0.8	0.8	0.9
150	0.7	0.8	0.9	0.9
500	0.7	0.8	0.9	0.9
3,000	0.6	0.7	0.8	0.8
10,000	0.4	0.5	0.6	0.6

Calculated Drawdown

It is assumed that the interfering water wells are being pumped at their maximum protected or licensed allocations, and that these groundwater diversions are from aquifers that are hydraulically connected to the aquifer in which WTH No. 1-09 is completed. The start of pumping for interfering diversions is the licensed date for the licensed water wells, and the water well completion date for the domestic and stock water wells; for those water wells with no completion date, a date of 01 Jan 60 is assumed.

The graph and table show that a drawdown of 0.9 metres[17] can be expected at the location of WTH No. 2-09 after 20 years of pumping 123 m³/day from WTH No. 1-09 and a combined 1,202.3 m³/day from the 55 interfering water wells. A drawdown of 0.9 metres represents 17% of the available drawdown of 5.2 metres in WTH No. 1-09;[18] a drawdown of this magnitude is not considered to represent an adverse effect.

[15] The more conservative value of 1,074 m²/day for effective transmissivity was used for the predicted impact calculations; the storativity of 0.0001 is a reasonable value for bedrock aquifers in Alberta

[16] Of this 873.3 m³/day, 852 is allocated for the Town of Sylvan Lake's new WSW No. 12, with an approval date of 19 Aug 09.

[17] 0.9 metres of drawdown is based on the difference of 1.1 metres calculated for 2030 minus the 0.2 metres calculated for mid-2009.

[18] The available drawdown of 5.2 metres in WTH No. 1-09 is based on an NPWL of 32.30 metres BTOC, the bottom of the aquifer at a depth of 39.6 metres BGL, and a casing stick-up of 0.5 metres; these values indicate a saturated thickness of 7.8 metres, two-thirds of which is 5.2 metres.

The calculated drawdowns are considered to be conservative because:

- the calculations are based on each interfering water supply well being pumped at 100% of its allocated diversion until 2030, a situation that typically does not occur
- the calculations are based on the protected 3.42 m^3/day from each interfering domestic water well, which is more than three times the average household use
- the calculations are based on a conservative value for effective transmissivity.

5.5. GWUDI

From the hydrogeological review, it is believed that the groundwater from WTH No. 1-09 is a high-quality groundwater. However, it is important to note that the information collected to date does not indicate that the groundwater is definitely not GWUDI. Areas of concern that need to be addressed to increase the level of confidence are as follows:

1. limited results of microbiological and nitrate analyses of groundwater collected at wellhead
2. limited data related to turbidity of groundwater collected at wellhead
3. there was a total count of 12 primary particulates and four secondary particulates in the MPA
4. no WQA.

The water-quality assessment (WQA) involves frequent and simultaneous measurement of water-quality parameters in groundwater and nearby surface water to determine similar variation patterns if the two are in hydraulic connection. For MPA results to be definitive, two to four MPA analyses must be performed over a 12- to 18-month interval, during times when surface water is most likely to influence groundwater, such as in the spring and fall.

6. Conclusions

Water Test Hole No. 1-09 is completed in an unconfined sandstone aquifer within the Dalehurst Member of the Paskapoo Formation, in the depth interval between 30.5 and 39.6 metres BGL. The aquifer test data indicate that the required groundwater supply of 61.25 m^3/day is available from the water test hole without adversely affecting any existing groundwater user or the aquifer in which the water test hole is completed. All of the calculations used for the present analysis do not include recharge, but do include the effects of pumping from 55 other water wells in the AOS. Therefore, the impact of the diversion can be expected to be less than that calculated.

The chemical analysis of the groundwater from the aquifer in which the water test hole is completed shows that water-quality parameters are within the recommended limits for drinking water. The chemical quality of the groundwater from the water test hole is not expected to change significantly with time.

From the hydrogeological review, it is believed that the groundwater from WTH No. 1-09 is a high-quality groundwater. However, this determination is not made with complete confidence because:

- the water test hole fails one of the Phase 1 screening criteria for GWUDI, and
- there is an indication that there may be hydraulic connection between WTH No. 1-09 and Sylvan Lake, and
- there is no data record consisting of many years of negative GWUDI results with respect to water quality, and
- the proposed water supply well is to be used as a municipal drinking water supply.

7. Recommendations

It is recommended that WTH No. 1-09 be renamed Water Supply Well (WSW) No. 1-09, and WTH No. 2-09 be renamed Observation Water Well (Obs WW) No. 2-09, and that AENV approve the enclosed application by Belterra Land Company to divert and use a total of 22,356 m^3/year of groundwater from the proposed WSW No. 1-09.

When WSW No. 1-09 is put into service as a municipal water supply well, it is recommended that groundwater-monitoring requirements should include at least daily water-level and groundwater-production measurements from the water supply well, and at least daily water-level measurements from Obs WW No. 2-09. The groundwater-monitoring data must be reviewed annually to ensure that parameters calculated from the aquifer tests continue to be representative of the actual hydrogeological conditions. Water levels are to be recorded to the nearest 0.01 metres and groundwater production is to be recorded to the nearest 0.1 cubic metres.

The available data indicate that the groundwater from WTH No. 1-09 is supplying high-quality groundwater rather than GWUDI. However, because:

- the water test hole fails one of the Phase 1 screening criteria for GWUDI, and
- there is an indication that there may be hydraulic connection between WTH No. 1-09 and Sylvan Lake, and
- there is no data record consisting of many years of negative GWUDI results with respect to water quality, and
- the proposed water supply well is to be used as a municipal drinking water supply,

it is recommended that a groundwater-sampling program be initiated when the water supply well is put into service to ensure that the groundwater quality remains suitable for public consumption. Samples should include turbidity, nitrate, and total and fecal coliforms to confirm compliance with Canadian Drinking Water Quality Guidelines.

Jim Touw, P. Geol.
Senior Hydrogeologist

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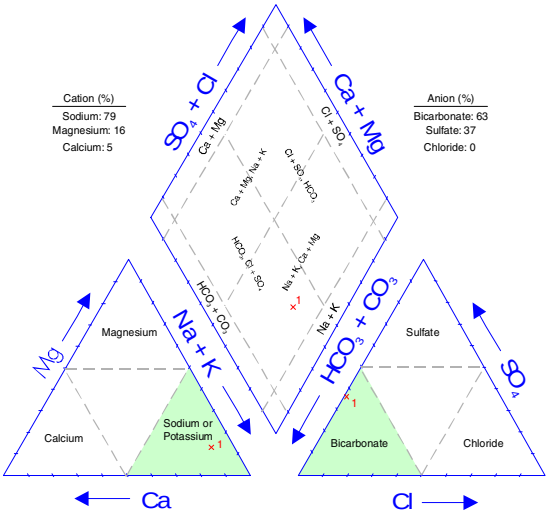
9. Glossary

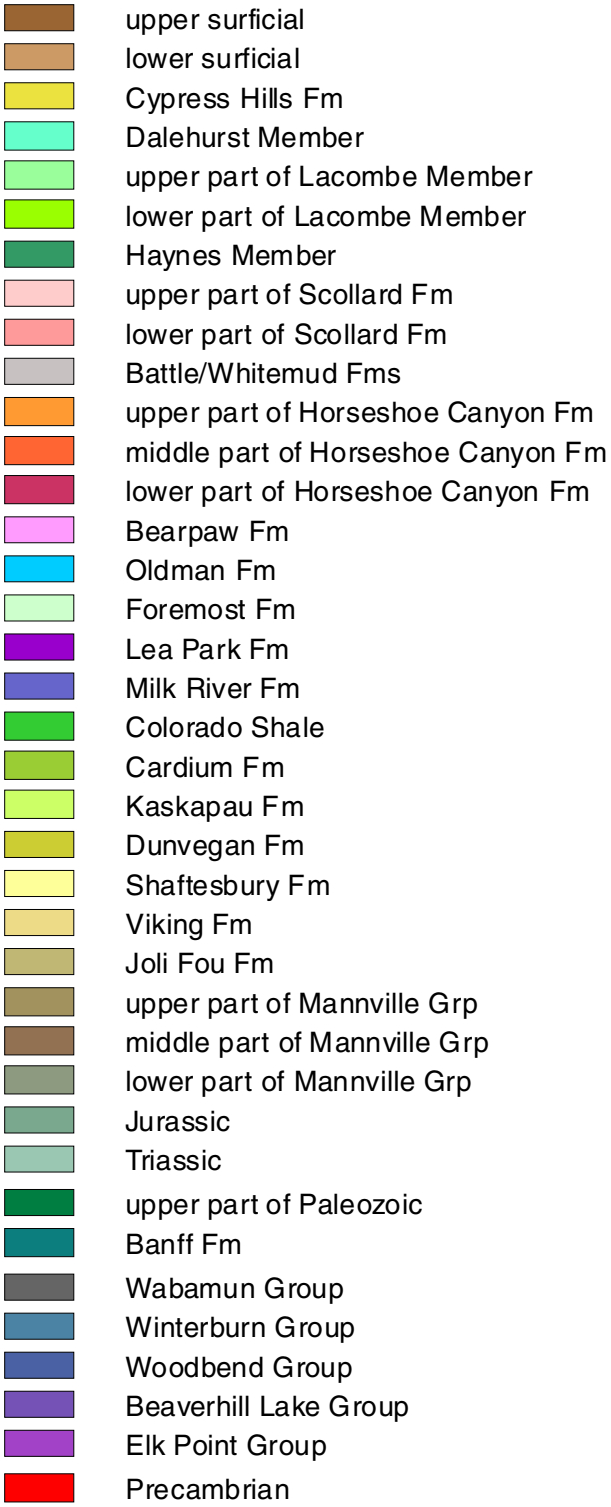
AENV	Alberta Environment
AMSL	above mean sea level
AO	Aesthetic Objectives
AOI	Area of Interest (within 1,600 metres of WTH No. 1-09)
AOS	Area of Study (3x3-section area centred on 17-039-01 W5M)
Aquifer	a formation, group of formations, or part of a formation that contains saturated permeable rocks capable of transmitting groundwater to water wells or springs in economical quantities
Available Drawdown	in a confined aquifer, the distance between the non-pumping water level and the top of the aquifer in an unconfined aquifer (water table aquifer), two thirds of the saturated thickness of the aquifer
BGL	Below Ground Level
BTOC	Below Top of Casing
GWUDI	groundwater under the direct influence of surface water
Kriging	a geo-statistical method for gridding irregularly-spaced data (Cressie, 1990)
MAC	Maximum Acceptable Concentration
m	metres
mm	millimetres
m^2/day	metres squared per day
m^3	cubic metres
m^3/day	cubic metres per day
mg/L	milligrams per litre
NPWL	non-pumping water level
Obs WW	Observation Water Well

Piper tri-linear diagram	a method that permits the major cation and anion compositions of single or multiple samples to be represented on a single graph. This presentation allows groupings or trends in the data to be identified. From the Piper tri-linear diagram, it can be seen that the groundwater from this sample water well is a sodium-bicarbonate-type. The chemical type has been determined by graphically calculating the dominant cation and anion. For a more detailed explanation, please refer to Freeze and Cherry, 1979
SGCDWQ	Summary of Guidelines for Canadian Drinking Water Quality
Surficial Deposits	includes all sediments above the bedrock
TDS	Total Dissolved Solids
Till	a sediment deposited directly by a glacier that is unsorted and consisting of any grain size ranging from clay to boulders
Transmissivity	the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient: a measure of the ease with which groundwater can move through the aquifer
	Apparent Transmissivity: the value determined from a summary of aquifer test data, usually involving only two water-level readings
	Effective Transmissivity: the value determined from late pumping and/or late recovery water-level data from an aquifer test
	Aquifer Transmissivity: the value determined by multiplying the hydraulic conductivity of an aquifer by the thickness of the aquifer
WSW	Water Source Well or Water Supply Well
WTH	Water Test Hole
WW	Water Well
VE	Vertical Exaggeration
Yield	a regional analysis term referring to the rate a properly completed water well could be pumped, if fully penetrating the aquifer
	Apparent Yield: based mainly on apparent transmissivity
	Long-Term Yield: based on effective transmissivity



Piper Tri-Linear Diagram

Stratigraphy of the "Undisturbed" Geology of Alberta as used by Hydrogeological Consultants Ltd.



10. Conversions

Multiply	by	To Obtain
Length/Area		
feet	0.304 785	metres
metres	3.281 000	feet
hectares	2.471 054	acres
centimetre	0.032 808	feet
centimetre	0.393 701	inches
acres	0.404 686	hectares
inches	25.400 000	millimetres
miles	1.609 344	kilometres
kilometre	0.621 370	miles (statute)
square feet (ft^2)	0.092 903	metres (m^2)
metres (m^2)	10.763 910	square feet (ft^2)
metres (m^2)	0.000 001	kilometres (km^2)
Concentration		
grains/gallon (UK)	14.270 050	ppm
ppm	0.998 859	mg/L
mg/L	1.001 142	ppm
Volume (capacity)		
acre feet	1233.481 838	cubic metres
cubic feet	0.028 317	cubic metres
cubic metres	35.314 667	cubic feet
cubic metres	219.969 248	gallons (UK)
cubic metres	264.172 050	gallons (US liquid)
cubic metres	1000.000 000	litres
gallons (UK)	0.004 546	cubic metres
imperial gallons	4.546 000	litres
Rate		
litres per minute	0.219 974	ipgm
litres per minute	1.440 000	cubic metres/day (m^3/day)
igpm	6.546 300	cubic metres/day (m^3/day)
cubic metres/day (m^3/day)	0.152 759	igpm
Pressure		
psi	6.894 757	kpa
kpa	0.145 038	psi
Miscellaneous		
Celsius	F° = 9/5 (C° + 32)	Fahrenheit
Fahrenheit	C° = (F°- 32) * 5/9	Celsius
degrees	0.017 453	radians

APPENDIX A

ADMINISTRATIVE DETAILS

TABLE OF CONTENTS

Application under the Water Act

Application under the *Water Act* for Approvals and/or Licences

Alberta ENVIRONMENT

Documents or information provided to Alberta Environment pursuant to section 15(1)(a) of the *Water (Ministerial) Regulation* are public records and are accessible by the public.

Check one or more of the following to indicate type of application:

Diversion of water ☒ Renewal of a licence ☐ Constructing Works ☐

Applicant:

Print Name and Company Name (if applicable):		Home Telephone:	Bus. Telephone:
Mr. Aden Wells, Belterra Land Company		( )	(403) 670-9166
Address (Street, PO Box, etc.):	**Place, Province:**	**Postal Code:**	**Fax:**
1753, 246 Stewart Green SW	Calgary, AB	T3H 3C8	(403) 685-8113

Are you the registered landowner? Yes ☒ No ☐ If no, please attach a copy of the consent from the landowner.

Consultant, Signing Authority, or Applicant's Representative (if applicable):

Print Name and Company Name (if applicable):		Home Telephone:	Bus. Telephone:
Hydrogeological Consultants Ltd.		( )	(780) 702-2227
Address (Street, PO Box, etc.):	**Place, Province:**	**Postal Code:**	**Fax:**
17740-118 Ave.	Edmonton, AB	T5S 2W3	(780) 484-9413

Contact Person if not shown above:

Print Name:	Telephone:	Fax:
Jim Touw	( )	( )

Project Description:

Tentative Starting Date: _____ (if applicable)

Duration of Construction/Development: _____

Duration of Water Diversion/Use: On-Going

Provide a detailed description including location of works and activities relating to the project and attach plans:

Belterra Land Company requires a groundwater supply of 22,356 m³/year for a proposed residential development in SE 17-039-01 W5M from a water supply well. Technical information in support of this application is provided in the accompanying report by Hydrogeological Consultants Ltd. for Belterra Land Company entitled:

License a Municipal Groundwater Supply – Birchcliff Development, Sylvan Lake Area, SE 17-039-01 W5M

Affected Water Sources (Location of Works and Activities):

Surface Water (if only constructing works, complete the first two columns):

Source (e.g. lake, stream, or name of source, if known)	Diversion/Activity Location ¼ sec twp rge m	Annual Quantity (cubic metres)	Rate of Diversion (show units)	Is Construction or Development Required? (Yes or No)	Purpose
1.					
2.					
3.					

Groundwater:

Date Well Drilled or proposed drilling date	Well (proposed) Locations ¼ sec twp rge m	Total Depth (metres)	Production Interval (metres)	Pumping Rate (show units)	Annual Quantity (cubic metres)	Purpose
1. 24 Oct 2009	08 17 039 01 5	42.7	30-5 – 39.6	327 m³/day	22,356	Municipal
2.						
3.						

The required annual diversion of 19,674 m³ is to be a combined diversion from the two water wells.

Statement of Confirmation:

The information given on this form is true to the best of my knowledge.

Mar 30, 2010		Aden Wells	Belterra Land Company
Date of Signing	Signature	Print Name	Company Name (if applicable)

Return the completed form to the Alberta Environment Regulatory Approvals Centre:

Regulatory Approvals Centre
9th Floor, Oxbridge Place
9820 – 106 Street
Edmonton, Alberta T5K 2J6
Telephone: **(780) 427-6311**
Fax: (780) 422-0154

Northern Regional E-mail address
Aenv.northwaterapprovals@gov.ab.ca
Central Regional E-mail address
Aenv.centralwaterapprovals@gov.ab.ca
Southern Regional E-mail address
Aenv.southwaterapprovals@gov.ab.ca

OFFICE USE:

File Number:	Fee Receipt Number:	Application ID: Operation ID:
Notice Information:	Application Completion Date:	Priority Number:

Form GA1 (September 2002)

AENV Groundwater Evaluation Guideline (Schedule 1)

Table Showing Length of Pumping Test and Information Required for the Anticipated Maximum Water Diversion/Drainage

Anticipated Daily Pumping Rate	Number of Days	Anticipated Maximum Yearly Water Requirement	Length of Pumping & Recovery test at Anticipated Maximum Pumping Rate	Observation/ Monitoring Site	Information Required Under 1.02 & 1.03 of Part 1
up to 10 m^3/day (2200 Igpd) (1.5 Igpm)	365	3650 m^3 (803,000 Ig)	2 + 2 hours* (or longer) and at least 90% recovery	0	(a) (b)(i) (b)(ii) (b)(iii) (A) to (K) (b)(vii) (b)(ix)
10 to 35 m^3/d (2200 to 7700 Igpd) (1.5 to 5.3 Igpm)	applicant to enter	applicant to enter	24 + 24 hours (or longer) and at least 90% recovery	0 – 1	all of 2.0
35 to 65 m^3/d (7700 to 14,300 Igpd) (5.3 to 10.0 Igpm)	applicant to enter	applicant to enter	24 + 24 hours (or longer) and at least 90% recovery	1	all of 2.0
65 to 265 m^3/d 14,300 to 60,500 Igpd) (10.0 to 40.0 Igpm)	applicant to enter	applicant to enter	48 + 48 hours (or longer) and at least 90% recovery	1 – 2	all of 2.0
greater than 265 m^3/d	applicant to enter	applicant to enter	72 + 72 hours (or longer) and at least 90% recovery	1 – 2	all of 2.0

***** In some cases, more information or longer pumping tests may be required.

Legend:
d = day
g = gallons
I = Imperial
m = minute
m^3 = cubic metre = 220 Imperial gallons

Notes:

- The reliability of the estimate on water supply will generally increase with the length of the pumping period and as the geological and hydrogeological conditions in the area become more clearly defined and understood. Therefore a longer pumping test is recommended.
- Household wells, and other types of water wells, could be considered potential monitoring sites.

Field Survey Letter

MTow Tech Sales ♦ Rentals ♦ Service ♦ Information Groundwater Monitoring

_____
Date Delivered

Our File No.: 09-899

To the Resident:

This visit is to gather background data relative to the application by Belterra Land Company to License a Groundwater Supply in SE 17-039-01 W5M. I visited your residence today to confirm some information about your water well(s) and with your permission, to measure the depth to water in the water well(s), if physically possible. Unfortunately, no one was home.

I have information for a number of water wells in this ¼ section, which has not been assigned to any specific building location. A summary of the water well(s) for the ¼ section is attached, and perhaps one of these water well(s) is yours. If you wish to view details for the individual water well(s), the available data can be viewed at www.groundwatercentre.com by referring to the GCID number. If you wish to view details for the individual water well(s) and you do not have internet access, please call me toll-free at 1-800-661-6061 ext. 284, or cell phone No. 780.920.6544.

If you wish to have the data for your water well(s) verified, please call me at either of the above phone numbers and I will make arrangements to revisit you at a mutually acceptable time.

If you choose to have your water well verified, please note that your name, in connection with your water well data, may be made publicly available. For further information, please consult our Privacy Policy, available from our Privacy Officer, Lori Zastre, at 780.483.7240 ext. 243, or at lori@hcl.ca.

Thank you in advance for your time and assistance in the management of the groundwater resource in your area.

Chris Hoffman, T.T.
Hydrogeological Technologist

L:\2009\09-899\1_Admin\corresp\Field Survey - Letter.doc

17740 - 118 Avenue NW, Edmonton, Alberta, T5S 2W3
Phone: 780.484.6356 ♦ Fax: 780.484.9413 ♦ 1.800.GEO.WELL

Appendix B - Water Well Details

TABLE OF CONTENTS

Water Test Hole No. 1-09

08-17-039-01 W5M

(M40112.699763)

10 Degree Transverse Mercator - NAD 83 (10TM):

Easting: **61391**

Northing: **5798356**

Ground Elevation AMSL (m): **966**

Completion Date: **24 Oct 09**

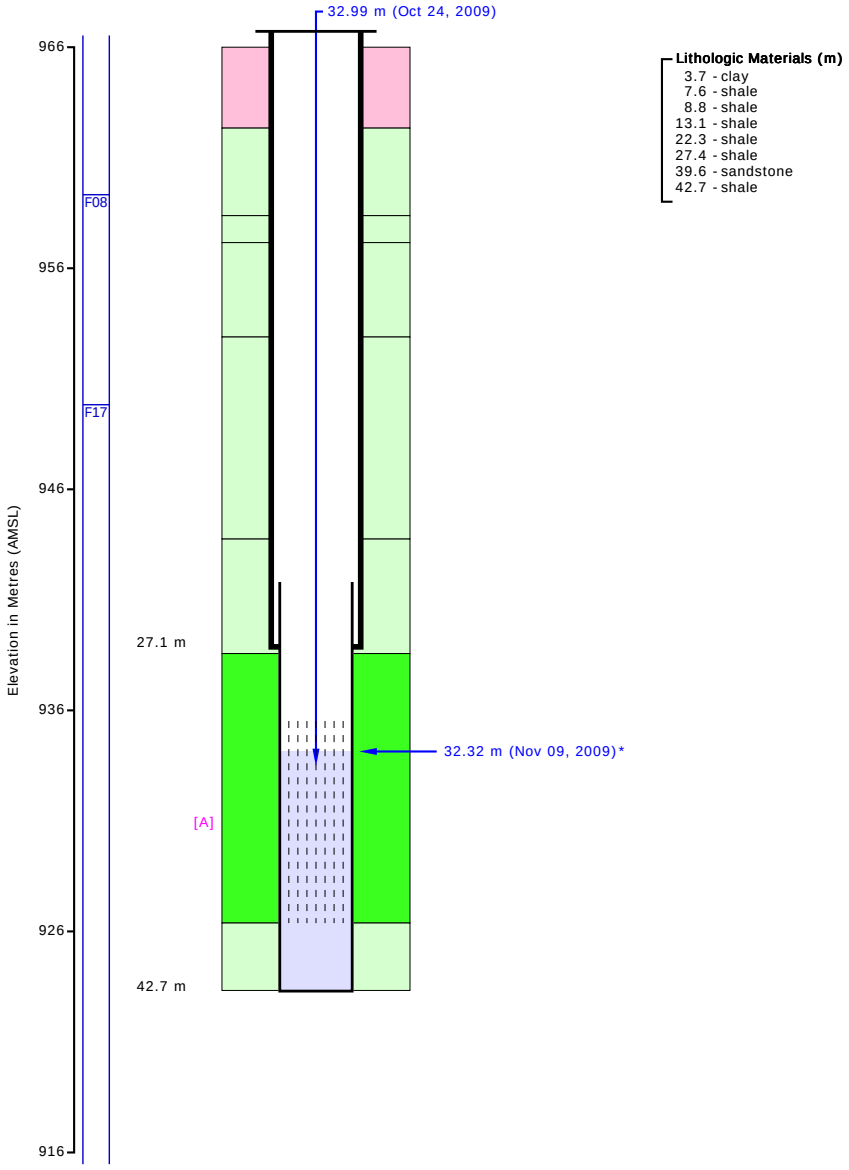
Depth Drilled (m): **42.7**

Completion Interval (m): **30.5** to **39.6**

Most Recent Water Level (m): **32.32 – 09 Nov 09**

Earliest Water Level (m): **32.99 – 24 Oct 09**

Water Test Hole No. 1-09
Well Diagram



Lithology Legend

Surficial: Unsorted; Fine Grained; Coarse Grained

Bedrock: Fine Grained; Coarse Grained

Other

Geologic Unit Legend (Top) - Regional Analysis

F08 - Dalehurst Member
F17 - Upper Lacombe Member

Summary

TGWC ID: M40112.699763
Well Name: Water Test Hole No. 1-09
Legal Location: 08-17-039-01 W5M
Casing (OD): 141.2 mm; Steel (5.6")
Liner (OD): 114.3 mm; PVC (4.5")
Casing Stick-Up: 0.46 m (not drawn to scale)
Interval [A]: 30.5 to 39.6 m; Slotted
*Water Level (recent): 32.32 m on November 9, 2009 @ 16:07 - Reference Point: Top of Casing
Water Level (oldest): 32.99 m on October 24, 2009

** Water-Level Measurements are measured from reference point listed.*
NOTE: Geologic Unit is a guide based on a regional groundwater assessment completed by hydrogeological consultants ltd. (HCL) (http://www.hcl.ca) on behalf of Lacombe County in conjunction with Prairie Farm Rehabilitation Administration (P.F.R.A.).
Drawn: November 18, 2009 11:28 --- http://www.tgwc.ca

Owner: ***Longview Planning & Design***
205, 259 Midway Way SE, Calgary, AB T2X 1M2
Contractor: ***Alken Basin Drilling Ltd.***
Well Name: ***Water Test Hole No. 1-09***
Abandoned:
Field Survey: ***Oct 27, 2009 - Confirmed - Physically***

METRIC REPORT

Easting (m): ***61391.96*** ** 75/80
Northing (m): ***5798356.67*** **
Elevation (m): ***966*** ***
Google Earth

08-17-039-01 W5M
M40112.699763
175901-493944-3

Work Type: ***New Well***
Drilling Method: ***Drilled***
Proposed Use: ***Municipal***
Completion Type: ***Casing/Perforated Liner***
Date Started: ***Oct 24, 2009***
Date Completed: ***Oct 24, 2009***
Well Status: ***Producing***

Elog Taken: ***No***
Gamma Taken: ***No***
Stick Up (m): ***0.5***
Flowing: ***No***

General Details

Depth Completed (m): ***42.7***
Depth Drilled (m): ***42.7***

Completion Details

Surface Casing: ***Steel — 141.2 mm (O.D.) x 6.55 mm (thick) x 27.13 m (bottom)***
Liner: ***PVC — 114.3 mm (O.D.) x 6.53 mm (thick)***

Intervals (Liner: 24.4 m - 42.7 m)

-- Completion Interval(s) --
Slotted: ***30.5 to 39.6 m - 3/8 x 12 inch*** - *Method:* ***Hand Drill***
-- Construction Interval(s) --
Bentonite: ***0.0 to 26.8 m***
Drive Shoe: ***27.0 to 27.1 m***

Lithology Details

Elevation (AMSL)	Depth (BGL)	Lithology Descriptions (8)
962.5	3.7	Brown Clay
958.5	7.6	Grey Shale
957.3	8.8	Brown Shale
953.0	13.1	Grey Shale
943.9	22.3	Silty Grey Shale
938.7	27.4	Grey Shale
926.5	39.6	Grey & Brown Sandstone
923.4	42.7	Grey Shale

Chemistry Summary Details (mg/L, except as noted) (most recent first)

Sampling Details: ***Oct 31, 2009 @ 12:15***
Analysis Details: ***Nov 17, 2009 - Exova (710930-1)***

Constituent	Result	Constituent	Result	Constituent	Result
Conductivity (µS/cm):	***716***	Nitrate as N:	***0.38***	Colour (TCU):	***< 5***
TDS (Calculated):		Nitrite as N:	***< 0.005***	Turbidity (NTU):	***0.4***
Hardness (CaCO3):		pH (pH Unit):	***8.33***	Fluoride:	***0.09***
T-Alkalinity (as CaCO3):	***376***	Ion Balance (%):		Carbonate:	***< 6***
P-Alkalinity (as CaCO3):	***< 5***	Total Coliforms**:		Bicarbonate:	***458***
Nitrate + Nitrite as N:	***0.38***	Fecal Coliforms**:		Hydroxide:	***< 5***
Total Suspended Solids:		Escherichia coli**:		Total Iron:	
Sulfate Reducing Bacteria*:				Total Mn:	
Iron Related Bacteria**:				Temperature (°C):	***21.6***

Constituent	Extractable	Dissolved	Constituent	Extractable	Dissolved
Calcium:			Mercury:		
Chloride:			Molybdenum:		
Iron:			Magnesium:		
Manganese:			Sodium:		
Aluminum:			Potassium:		
Arsenic:			Vanadium:		
Barium:			Strontium:		
Beryllium:			Nickel:		
Cadmium:			Zinc:		
Chromium:			Copper:		
Cobalt:			Lead:		
Sulfate:					

Extractable - unfiltered
Dissolved - filtered
(1 / 3)
*MPN/mL
**CFU/mL

Comments: ***Sample collected by hydrogeological consultants ltd. (HCL)***

note: constituents have been compared to the maximum acceptable concentration, as stated in the Summary of Guidelines for Canadian Drinking Water Quality (Federal–Provincial–Territorial Committee on Drinking Water, May 2008)
175892

General Comments / Observations

Borehole diameter: 171.45 mm from 0 to 26.82 metres BGL, 127 mm from 26.82 to 42.672 metres BGL.

Most Recent Water Level (m): ***32.32 m — Nov 09, 2009***
Oil Present: ***No*** Gas Present: ***No***
Observations (water): Colour: ; Odor: ; Quality:

Aquifer Tests

No.	Date	Testing Method	Duration (minutes) Pumping	Duration (minutes) Recovery	Avg. Rate (lpm)	NPWL (metre)	Drawdown (metre)	Level-End (metre)	Pump (metre)	Q20 (m³/day)* Apparent	Q20 (m³/day)* Effective	Transmissivity (m²/day)* Apparent	Transmissivity (m²/day)* Aquifer	Transmissivity (m²/day)* Effective	
3	2009-10-27 16:30	Pump	2952.0	7038.0	116.9	32.30	0.02	32.32	38.90						R C
2	2009-10-24	Air	120.0	120.0	227.3	32.99	0.14	33.13	42.67						R C
1	2009-10-24	Pump	120.0	120.0	159.1	32.92	—	—	36.58						R

Alias IDs

* ***TGWC*** *calculated or determined value.*
*** 75 - MT GPS — 10TM NAD83*
**** 80 - MT DEM — {Ground ; AMSL}*

Water Test Hole No. 1-09
Chemical Analysis (31 Oct 09)

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Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**710930**
Report To:	Hydrogeological Consultants	ID:	09.899	Control Number:	A153470
	17740 - 118 Avenue	Name:	Birchcliff	Date Received:	Oct 30, 2009
	Edmonton, AB, Canada	Location:		Date Reported:	Nov 17, 2009
	T5S 2W3	LSD:	SE 17-39-01 W5M	Report Number:	1270046
Attn:	Chris Hoffman	P.O.:	13293		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	710930-1
Sample Date	October 31, 2009
Sample Time	12:15
Sample Location	
Sample Description	WTH 1-09 M40112.699763
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Chlorinated Phenols - Water						
2-Chlorophenol		ug/L	<0.1	0.1		
3-Chlorophenol		ug/L	<0.1	0.1		
4-Chlorophenol		ug/L	<0.1	0.1		
4-Chloro-3-methylphenol		ug/L	<0.1	0.1		
2,3-Dichlorophenol		ug/L	<0.1	0.1		
2,6-Dichlorophenol		ug/L	<0.1	0.1		
2,4 & 2,5-Dichlorophenol		ug/L	<0.1	0.1	900	Below MAC
3,4-Dichlorophenol		ug/L	<0.1	0.1		
3,5-Dichlorophenol		ug/L	<0.1	0.1		
2,3,4-Trichlorophenol		ug/L	<0.1	0.1		
2,3,5-Trichlorophenol		ug/L	<0.1	0.1		
2,3,6-Trichlorophenol		ug/L	<0.1	0.1		
2,4,5-Trichlorophenol		ug/L	<0.1	0.1		
2,4,6-Trichlorophenol		ug/L	<0.1	0.1	5	Below MAC
3,4,5-Trichlorophenol		ug/L	<0.1	0.1		
2,3,4,5-Tetrachlorophenol		ug/L	<0.1	0.1		
2,3,4,6-Tetrachlorophenol		ug/L	<0.1	0.1	100	Below MAC
2,3,5,6-Tetrachlorophenol		ug/L	<0.1	0.1		
Pentachlorophenol		ug/L	<0.1	0.1	60	Below MAC
Total Chlorophenols		ug/L	<0.1	0.1		
Inorganic Nonmetallic Parameters						
Ammonium - N		mg/L	<0.05	0.05		
Sulfide	Total	mg/L	<0.005	0.005	0.05	Below AO
Organic Carbon	Total Nonpurgeable	mg/L	1.3	0.5		
Chloramine		mg/L	<0.1	0.1	3	Below MAC
Cyanide	Dissolved	mg/L	<0.001	0.001	0.2	Below MAC
Metals Extractable						
Mercury	Extractable	mg/L	<0.0001	0.0001	0.001	Below MAC
Aluminum	Extractable	mg/L	0.002	0.002	0.1	Below OG
Antimony	Extractable	mg/L	<0.0002	0.0002	0.006	Below MAC
Arsenic	Extractable	mg/L	0.0002	0.0002	0.01	Below MAC
Barium	Extractable	mg/L	0.070	0.001	1	Below MAC
Boron	Extractable	mg/L	0.071	0.002	5	Below MAC
Cadmium	Extractable	mg/L	0.00001	0.00001	0.005	Below MAC
Chromium	Extractable	mg/L	0.0013	0.0005	0.05	Below MAC
Copper	Extractable	mg/L	0.002	0.001	1	Below AO

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Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Metals Extractable - Continued						
Lead	Extractable	mg/L	0.0001	0.0001	0.01	Below MAC
Selenium	Extractable	mg/L	0.0020	0.0002	0.01	Below MAC
Uranium	Extractable	mg/L	0.0047	0.0005	0.02	Below MAC
Zinc	Extractable	mg/L	0.017	0.001	5	Below AO
Physical and Aggregate Properties						
Colour	Apparent, Potable	Colour units	<5	5	15	Below AO
Turbidity		NTU	0.4	0.1	0.1	Above OG
Polycyclic Aromatic Hydrocarbons - Water						
Naphthalene		ug/L	<0.1	0.1		
Quinoline		ug/L	<0.3	0.3		
Acenaphthylene		ug/L	<0.1	0.1		
Acenaphthene		ug/L	<0.1	0.1		
Fluorene		ug/L	<0.1	0.1		
Phenanthrene		ug/L	<0.1	0.1		
Anthracene		ug/L	<0.005	0.005		
Acridine		ug/L	<0.1	0.1		
Fluoranthene		ug/L	<0.01	0.01		
Pyrene		ug/L	<0.01	0.01		
Benzo(a)anthracene		ug/L	<0.01	0.01		
Chrysene		ug/L	<0.1	0.1		
Benzo(b+j)fluoranthene		ug/L	<0.1	0.1		
Benzo(k)fluoranthene		ug/L	<0.1	0.1		
Benzo(a)pyrene		ug/L	<0.008	0.008	0.01	Below MAC
Indeno(1,2,3-c,d)pyrene		ug/L	<0.05	0.05		
Dibenzo(a,h)anthracene		ug/L	<0.05	0.05		
Benzo(g,h,i)perylene		ug/L	<0.05	0.05		
CB(a)P	Carcinogenic Potency Equivalent	ug/L	<0.01	.01		
Routine Water						
pH			8.33		6.5 - 8.5	Within AO
Temperature of observed pH		°C	21.6			
Electrical Conductivity		µS/cm at 25 C	716	1		
Calcium	Extractable	mg/L	36.7	0.2		
Magnesium	Extractable	mg/L	30.6	0.2		
Sodium	Extractable	mg/L	84.4	0.4	200	Below AO

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Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Routine Water - Continued						
Potassium	Extractable	mg/L	2.4	0.4		
Iron	Extractable	mg/L	<0.01	0.01	0.3	Below AO
Manganese	Extractable	mg/L	<0.005	0.005	0.05	Below AO
Chloride	Dissolved	mg/L	2.2	0.4	250	Below AO
Fluoride		mg/L	0.09	0.05	1.5	Below MAC
Nitrate - N		mg/L	0.38	0.01	10	Below MAC
Nitrite - N		mg/L	<0.005	0.005	1	Below MAC
Nitrate and Nitrite - N		mg/L	0.38	0.01	10	Below MAC
Sulfate (SO4)		mg/L	30.1	0.9	500	Below AO
Hydroxide		mg/L	<5	5		
Carbonate		mg/L	<6	6		
Bicarbonate		mg/L	458	5		
P-Alkalinity	as CaCO3	mg/L	<5	5		
T-Alkalinity	as CaCO3	mg/L	376	5		
Total Dissolved Solids		mg/L	412	1	500	Below AO
Hardness	as CaCO3	mg/L	218			
Ionic Balance		%	98			
VOC Screen - Drinking Water						
Benzene		ug/L	<0.1	0.1		
Bromobenzene		ug/L	<0.1	0.1		
Bromochloromethane		ug/L	<0.1	0.1		
Bromodichloromethane		ug/L	<0.5	0.5		
Bromoform		ug/L	<0.1	0.1		
Bromomethane		ug/L	<1	1		
n-Butylbenzene		ug/L	<0.1	0.1		
sec-Butylbenzene		ug/L	<0.1	0.1		
tert-Butylbenzene		ug/L	<0.1	0.1		
Carbon Tetrachloride		ug/L	<0.5	0.5		
Chlorobenzene		ug/L	<0.1	0.1		
Chloroethane		ug/L	<1	1		
Chloroform		ug/L	<0.5	0.5		
Chloromethane		ug/L	<1	1		
2-Chlorotoluene		ug/L	<0.1	0.1		
4-Chlorotoluene		ug/L	<0.1	0.1		
Dibromochloromethane		ug/L	<0.5	0.5		
1,2-Dibromo-3-		ug/L	<0.1	0.1		

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Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
VOC Screen - Drinking Water - Continued					
Chloropropane					
1,2-Dibromoethane	ug/L	<0.1	0.1		
Dibromomethane	ug/L	<0.1	0.1		
1,2-Dichlorobenzene	ug/L	<0.1	0.1		
1,3-Dichlorobenzene	ug/L	<0.1	0.1		
1,4-Dichlorobenzene	ug/L	<0.1	0.1		
1,1-Dichloroethane	ug/L	<0.1	0.1		
1,2-Dichloroethane	ug/L	<0.5	0.5		
1,1-Dichloroethene	ug/L	<0.5	0.5		
1,2-Dichloroethene(cis)	ug/L	<0.1	0.1		
1,2-Dichloroethene(trans)	ug/L	<0.1	0.1		
Dichlorodifluoromethane	ug/L	<1	1		
1,2-Dichloropropane	ug/L	<0.1	0.1		
1,3-Dichloropropane	ug/L	<0.1	0.1		
2,2-Dichloropropane	ug/L	<1	1		
1,1-Dichloropropene	ug/L	<0.1	0.1		
1,3-Dichloropropene(cis)	ug/L	<0.1	0.1		
1,3-Dichloropropene(trans)	ug/L	<0.1	0.1		
Ethylbenzene	ug/L	<0.1	0.1		
Hexachlorobutadiene	ug/L	<0.1	0.1		
p-Isopropyltoluene	ug/L	<0.1	0.1		
Methylene Chloride	ug/L	<10	10		
Methyl t-Butyl Ether	ug/L	<0.1	0.1		
Naphthalene	ug/L	<0.5	0.5		
iso-Propylbenzene	ug/L	<0.1	0.1		
n-Propylbenzene	ug/L	<0.1	0.1		
Styrene	ug/L	<0.1	0.1		
1,1,1,2-Tetrachloroethane	ug/L	<0.1	0.1		
1,1,2,2-Tetrachloroethane	ug/L	<0.1	0.1		
Tetrachloroethene	ug/L	<0.5	0.5		
Toluene	ug/L	0.6	0.1		
1,2,3-Trichlorobenzene	ug/L	<0.1	0.1		
1,2,4-Trichlorobenzene	ug/L	<0.1	0.1		
1,1,1-Trichloroethane	ug/L	<0.1	0.1		
1,1,2-Trichloroethane	ug/L	<0.1	0.1		
Trichloroethene	ug/L	<0.5	0.5		

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Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
VOC Screen - Drinking Water - Continued					
Trichlorofluoromethane	ug/L	<0.1	0.1		
1,2,3-Trichloropropane	ug/L	<0.1	0.1		
1,2,4-Trimethylbenzene	ug/L	<0.1	0.1		
1,3,5-Trimethylbenzene	ug/L	<0.1	0.1		
Total Xylenes (m,p,o)	ug/L	0.5	0.1		
Vinyl Chloride	ug/L	<0.5	0.5		
Chlorinated Phenols - Water - Surrogate Recovery					
2,4,6-Tribromophenol PCP - Surrogate	%	81	10-123		
Organochlorine Pesticides in Water					
Aldrin	ug/L	<0.1	0.1	0.7	Below MAC
BHC (alpha isomer)	ug/L	<0.1	0.1		
BHC (beta isomer)	ug/L	<0.1	0.1		
BHC (delta isomer)	ug/L	<0.1	0.1		
Captan	ug/L	<0.5	0.5		
Chlorbenside	ug/L	<0.1	0.1		
Chlordane-cis	ug/L	<0.1	0.1		
Chlordane-trans	ug/L	<0.1	0.1		
Chlorfenson	ug/L	<0.1	0.1		
Chlorothalonil	ug/L	<0.5	0.5		
Chlorthal-dimethyl	ug/L	<0.1	0.1		
DDD-o,p'	ug/L	<0.1	0.1		
DDD-p,p'	ug/L	<0.1	0.1		
DDE-o,p'	ug/L	<0.1	0.1		
DDE-p,p'	ug/L	<0.1	0.1		
DDT-o,p'	ug/L	<0.1	0.1		
DDT-p,p'	ug/L	<0.1	0.1		
Dichlofluanid	ug/L	<0.1	0.1		
Dicofol	ug/L	<0.5	0.5		
Dieldrin	ug/L	<0.5	0.5		
Endosulfan I	ug/L	<0.1	0.1		
Endosulfan II	ug/L	<0.1	0.1		
Endosulfan sulfate	ug/L	<0.1	0.1		
Endrin	ug/L	<0.1	0.1		
Folpet	ug/L	<0.5	0.5		
Heptachlor	ug/L	<0.1	0.1		
Heptachlor Epoxide	ug/L	<0.1	0.1		

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Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Organochlorine Pesticides in Water - Continued					
Hexachlorobenzene	ug/L	<0.1	0.1		
Lindane	ug/L	<0.1	0.1		
Methoxychlor	ug/L	<0.1	0.1	900	Below MAC
Mirex	ug/L	<0.1	0.1		
Nitrofen	ug/L	<0.1	0.1		
Permethrin-cis	ug/L	<0.1	0.1		
Permethrin-trans	ug/L	<0.1	0.1		
Procymidone	ug/L	<0.1	0.1		
Propachlor	ug/L	<0.1	0.1		
Quintozene	ug/L	<0.1	0.1		
Tecnazene	ug/L	<0.1	0.1		
Tetradifon	ug/L	<0.1	0.1		
Tolyfluanid	ug/L	<0.1	0.1		
Triadimefon	ug/L	<0.1	0.1		
Vinclozolin	ug/L	<0.1	0.1		
Organophosphate Pesticides in Water					
Acephate	ug/L	<0.5	0.5		
Aspon	ug/L	<0.5	0.5		
Azinphos-ethyl	ug/L	<0.5	0.5		
Azinphos-methyl	ug/L	<0.5	0.5	20	Below MAC
Bromophos	ug/L	<0.5	0.5		
Bromophos-ethyl	ug/L	<0.5	0.5		
Carbophenothion	ug/L	<0.5	0.5		
Chlorfenvinphos	ug/L	<0.5	0.5		
Chlormephos	ug/L	<0.5	0.5		
Chlorpyrifos	ug/L	<0.5	0.5	90	Below MAC
Chlorpyrifos-methyl	ug/L	<0.5	0.5		
Chlorthiophos	ug/L	<0.5	0.5		
Cyanophos	ug/L	<0.5	0.5		
Demeton	ug/L	<0.5	0.5		
Diazinon	ug/L	<0.5	0.5	20	Below MAC
Dichlofenthion	ug/L	<0.5	0.5		
Dichlorvos	ug/L	<0.5	0.5		
Dicrotophos	ug/L	<0.5	0.5		
Dimethoate	ug/L	<0.5	0.5	20	Below MAC
Disulfoton	ug/L	<0.5	0.5		

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Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Organophosphate Pesticides in Water - Continued					
EPN	ug/L	<0.5	0.5		
Ethion	ug/L	<0.5	0.5		
Fenchlorphos	ug/L	<0.5	0.5		
Fenitrothion	ug/L	<0.5	0.5		
Fenthion	ug/L	<0.5	0.5		
Fonofos	ug/L	<0.5	0.5		
Isofenphos	ug/L	<0.5	0.5		
Malaoxon	ug/L	<0.5	0.5		
Malathion	ug/L	<0.5	0.5	190	Below MAC
Methyl Parathion	ug/L	<0.5	0.5		
Mevinphos	ug/L	<0.5	0.5		
Omethoate	ug/L	<0.5	0.5		
Parathion	ug/L	<0.5	0.5	50	Below MAC
Phorate	ug/L	<0.5	0.5	2	Below MAC
Phosalone	ug/L	<0.5	0.5		
Phosmet	ug/L	<0.5	0.5		
Phosphamidon	ug/L	<0.5	0.5		
Pirimiphos-ethyl	ug/L	<0.5	0.5		
Pirimiphos-methyl	ug/L	<0.5	0.5		
Profenofos	ug/L	<0.5	0.5		
Pyrazophos	ug/L	<0.5	0.5		
Quinalophos	ug/L	<0.5	0.5		
Sulfotep	ug/L	<0.5	0.5		
Terbufos	ug/L	<0.5	0.5	1	Below MAC
Tetrachlorvinphos	ug/L	<0.5	0.5		
Neutral Herbicides in Water					
Alachlor	ug/L	<0.5	0.5		
Atrazine	ug/L	<0.5	0.5	5	Below IMAC
Benfluralin	ug/L	<0.5	0.5		
Butylate	ug/L	<0.5	0.5		
Chlorpropham	ug/L	<0.5	0.5		
Cyanazine	ug/L	<0.5	0.5	10	Below MAC
Deethylatrazine	ug/L	<0.5	0.5		
Desmetryn	ug/L	<0.5	0.5		
Diallate	ug/L	<0.5	0.5		
Dichlobenil	ug/L	<0.5	0.5		

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Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**710930**
Report To:	Hydrogeological Consultants	ID:	09.899	Control Number:	A153470
	17740 - 118 Avenue	Name:	Birchcliff	Date Received:	Oct 30, 2009
	Edmonton, AB, Canada	Location:		Date Reported:	Nov 17, 2009
	T5S 2W3	LSD:	SE 17-39-01 W5M	Report Number:	1270046
Attn:	Chris Hoffman	P.O.:	13293		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	710930-1
Sample Date	October 31, 2009
Sample Time	12:15
Sample Location	
Sample Description	WTH 1-09 M40112.699763
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Neutral Herbicides in Water - Continued					
Diclofop-methyl	ug/L	<0.5	0.5	9	Below MAC
Diphenylamine	ug/L	<0.5	0.5		
Eptam (EPTC)	ug/L	<0.5	0.5		
Ethalfluralin	ug/L	<0.5	0.5		
Fenoxaprop-ethyl	ug/L	<0.5	0.5		
Fluazifop-p-butyl	ug/L	<0.5	0.5		
Hexazinone	ug/L	<0.5	0.5		
Metalaxyl	ug/L	<0.5	0.5		
Metolachlor	ug/L	<0.5	0.5	50	Below IMAC
Metribuzin	ug/L	<0.5	0.5	80	Below MAC
Pirimicarb	ug/L	<0.5	0.5		
Profluralin	ug/L	<0.5	0.5		
Prometryn	ug/L	<0.5	0.5		
Propazine	ug/L	<0.5	0.5		
Propyzamide	ug/L	<0.5	0.5		
Quizalofop-ethyl	ug/L	<0.5	0.5		
Simazine	ug/L	<0.5	0.5	10	Below MAC
Simetryn	ug/L	<0.5	0.5		
Terbuthylazine	ug/L	<0.5	0.5		
Terbutryn	ug/L	<0.5	0.5		
Triallate	ug/L	<0.5	0.5		
Trifluralin	ug/L	<0.5	0.5	45	Below MAC
Neutral Herbicides - Water - Surrogate Recovery					
TPP Surrogate	%	108	50-140		
Multiresidue Pesticides in Water					
Bifenox	ug/L	<0.5	0.5		
Bromopropylate	ug/L	<0.5	0.5		
Butralin	ug/L	<0.5	0.5		
Carboxin	ug/L	<0.5	0.5		
Chinomethionate	ug/L	<0.5	0.5		
Chlorbromuron	ug/L	<0.5	0.5		
Chlordimeform	ug/L	<0.5	0.5		
Chlorobenzilate	ug/L	<0.5	0.5		
Clomazone	ug/L	<0.5	0.5		
Crufomate	ug/L	<0.5	0.5		
Cypermethrin	ug/L	<0.5	0.5		

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Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**710930**
Report To:	Hydrogeological Consultants	ID:	09.899	Control Number:	A153470
	17740 - 118 Avenue	Name:	Birchcliff	Date Received:	Oct 30, 2009
	Edmonton, AB, Canada	Location:		Date Reported:	Nov 17, 2009
	T5S 2W3	LSD:	SE 17-39-01 W5M	Report Number:	1270046
Attn:	Chris Hoffman	P.O.:	13293		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	710930-1
Sample Date	October 31, 2009
Sample Time	12:15
Sample Location	
Sample Description	WTH 1-09 M40112.699763
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Multiresidue Pesticides in Water - Continued					
Cyprazine	ug/L	<0.5	0.5		
Deltamethrin	ug/L	<0.5	0.5		
Demeton-s-methyl	ug/L	<0.5	0.5		
Dialifos	ug/L	<0.5	0.5		
Dichloran	ug/L	<0.5	0.5		
Dimethachlor	ug/L	<0.5	0.5		
Dinitramine	ug/L	<0.5	0.5		
Diphenamid	ug/L	<0.5	0.5		
Ethofumesate	ug/L	<0.5	0.5		
Etrimfos	ug/L	<0.5	0.5		
Fenamiphos	ug/L	<0.5	0.5		
Fenson	ug/L	<0.5	0.5		
Fenvalerate	ug/L	<0.5	0.5		
Fluchloralin	ug/L	<0.5	0.5		
Heptenophos	ug/L	<0.5	0.5		
Iprodione	ug/L	<0.5	0.5		
Metazachlor	ug/L	<0.5	0.5		
Methamidophos	ug/L	<0.5	0.5		
Methoprene	ug/L	<0.5	0.5		
Myclobutanil	ug/L	<0.5	0.5		
Norflurazon	ug/L	<0.5	0.5		
Paraoxon	ug/L	<0.5	0.5		
Pebulate	ug/L	<0.5	0.5		
Propanil	ug/L	<0.5	0.5		
Propargite	ug/L	<0.5	0.5		
Propiconazole	ug/L	<0.5	0.5		
Pyridaben	ug/L	<0.5	0.5		
Tebuconazole	ug/L	<0.5	0.5		
Terbacil	ug/L	<0.5	0.5		
Tetramethrin	ug/L	<0.5	0.5		
Triadimenol	ug/L	<0.5	0.5		
Triazophos	ug/L	<0.5	0.5		
Vernolate	ug/L	<0.5	0.5		
Carbamates in Water					
3-Hydroxycarbofuran	ug/L	<0.02	0.02		
Aldicarb	ug/L	<0.02	0.02	9	Below MAC

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Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**710930**
Report To:	Hydrogeological Consultants	ID:	09.899	Control Number:	A153470
	17740 - 118 Avenue	Name:	Birchcliff	Date Received:	Oct 30, 2009
	Edmonton, AB, Canada	Location:		Date Reported:	Nov 17, 2009
	T5S 2W3	LSD:	SE 17-39-01 W5M	Report Number:	1270046
Attn:	Chris Hoffman	P.O.:	13293		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	710930-1
Sample Date	October 31, 2009
Sample Time	12:15
Sample Location	
Sample Description	WTH 1-09 M40112.699763
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Carbamates in Water - Continued						
Aldicarb sulfone		ug/L	<0.02	0.02		
Aldicarb sulfoxide		ug/L	<0.02	0.02		
Bendiocarb		ug/L	<0.02	0.02	40	Below MAC
BPMC		ug/L	<0.02	0.02		
Carbaryl		ug/L	<0.02	0.02	90	Below MAC
Carbofuran		ug/L	<0.02	0.02	90	Below MAC
Imidacloprid		ug/L	<0.02	0.02		
Methiocarb		ug/L	<0.02	0.02		
Methomyl		ug/L	<0.02	0.02		
Oxamyl		ug/L	<0.02	0.02		
Promecarb		ug/L	<0.02	0.02		
Propoxur		ug/L	<0.02	0.02		
Sterilants in Water						
Diuron		ug/L	<0.1	0.1	150	Below MAC
Glyphosate in Water						
Glyphosate		ug/L	<10	10		
AMPA		ug/L	<10	10		
PAH - Water - Surrogate Recovery						
Nitrobenzene-d5	PAH - Surrogate	%	100	23-130		
2-Fluorobiphenyl	PAH - Surrogate	%	100	30-130		
p-Terphenyl-d14	PAH - Surrogate	%	90	18-137		
VOC - Drinking Water - Surrogate Recovery						
Dibromofluoromethane	EPA Surrogate	%	93	86-118		
Toluene-d8	EPA Surrogate	%	99	88-110		
Bromofluorobenzene	EPA Surrogate	%	101	86-115		
Acid Herbicides - Water - Surrogate Recovery						
2,4-DCPA	Surrogate	%	78	30-120		
Acid Herbicides in Water						
2,4,5-T		ug/L	<0.1	0.1		
2,4,5-TP		ug/L	<0.1	0.1		
2,4-D		ug/L	<0.1	0.1	100	Below MAC
2,4-DB		ug/L	<0.1	0.1		
Bromoxynil		ug/L	<0.1	0.1	5	Below MAC
Clopyralid		ug/L	<0.1	0.1		
Dicamba		ug/L	<0.1	0.1	120	Below MAC
Dichlorprop		ug/L	<0.1	0.1		

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Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**710930**
Report To:	Hydrogeological Consultants	ID:	09.899	Control Number:	A153470
	17740 - 118 Avenue	Name:	Birchcliff	Date Received:	Oct 30, 2009
	Edmonton, AB, Canada	Location:		Date Reported:	Nov 17, 2009
	T5S 2W3	LSD:	SE 17-39-01 W5M	Report Number:	1270046
Attn:	Chris Hoffman	P.O.:	13293		
Sampled By:	Chris Hoffman	Acct code:			
Company:	HCL				

Reference Number	710930-1
Sample Date	October 31, 2009
Sample Time	12:15
Sample Location	
Sample Description	WTH 1-09 M40112.699763
Sample Matrix	Water

Analyte	Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Acid Herbicides in Water - Continued					
Dinoseb	ug/L	<0.1	0.1	10	Below MAC
Imazamox	ug/L	<0.1	0.1		
Imazapyr	ug/L	<0.1	0.1		
Imazethapyr	ug/L	<0.1	0.1		
MCPA	ug/L	<0.1	0.1		
MCPB	ug/L	<0.1	0.1		
Mecoprop	ug/L	<0.1	0.1		
Picloram	ug/L	<0.1	0.1	190	Below MAC
Triclopyr	ug/L	<0.1	0.1		
Subcontracted Analysis					
Subcontractor Report Id Exova		09-313916			
Subcontractor Report Id Edge		09-17282			
Subcontractor Report Id Hydroqual		09-1996			
Nitrilotriacetic Acid	mg/L	<0.1	0.04		

Approved by: Anthony Neumann

Anthony Neumann, MSc
Laboratory Operations Manager

EDGE ANALYTICAL LABORATORIES

Burlington WA (Corporate Office) | 1620 S Walnut St - 98233 | 800.755.9295 • 360.757.1400 • 360.757.1402fax
Bellingham WA (Microbiology) | 805 Orchard Dr Suite 4 - 98225 | 360.671.0688 • 360.671.1577fax

Data Report

Client Name: Exova-Edmonton
7217 Roper Road NW
Edmonton, AB T6B 3J4

Reference Number: **09-17285**
Project: 710937
Report Date: 11/12/09
Date Received: 11/6/09
Released By:

Sample Description: 710937-1 - WTH 1-09 M40112.699763
Lab Number: 36833
Sample Date: 10/29/09
Collected By: Unknown

CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comment
15541-45-4	**BROMATE**	ND	0.005	0.00046	mg/L	1	300.1	11/11/09	MVP	D091111A	

Notes:
ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
PQL = Practical Quantitation Limit is the lowest level that can be acheived within specified limits of precision and accuracy during routine laboratory operating conditions.
D.F. - Dilution Factor

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.
Form: cRslt_2.rpt

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Certificat d'analyses

Client: **EXOVA (EDMONTON)**

Request Number: 09-313916

P.O. Number	Your Project ID.	Project Manager
500472	710930	Edmonton Lab

Sample(s)

Lab. No.		**1400782**
Your Reference		710930-1
Matrix		Water
Sampled by		CLIENT
Site sampled		NA
Date sampled		NA
Date received		2009-11-03

Parameter(s) Method Reference		
Diquat-Paraquat	Preparation	2009-11-10
QC084-04 / C18 extraction, HPLC-UV analysis	Analysis	2009-11-12
MA 403-D.P. 1.1	Sequential No.	300322
Diquat	µg/L	< 1.0
Paraquat	µg/L	< 0.5
Paraquat (as dichlorides)	µg/L	< 0.7

Note: Results pertain only to the samples submitted for analysis.

Alain Perron, chemist

CHIMISTE Alain Perron 2003-052 QUÉBEC

HydroQual Laboratories Ltd.

Microcystin Test Report

Result Summary

Client: NOR239
Reference: 09-1996- PPI

Contents

Client: Exova; operation Edmonton

Sample: 710930-1

Collection: information not provided
Receipt: received on 2009/11/03 at 0850 by E.A. Benner
Containers: received 1 x 500ml bottle at 7 °C, in good condition with no seals and no initials
Description: type: water; collection method: not given

Analysis: isolated on 2009/11/04 by H. Ditch; enumerated on 2009/11/04 by H. Ditch

Result:

Sample Information			Microcystin	Comment
lab reference	client	collection date	(µg LR equiv/L)	
09-1996	710930-1	not given	0.23	none

The test data and results are authorized and verified correct.

C. Ehman, B.Sc., Technical Lead

S. Krishnappa, B.Sc., Quality Coordinator

HydroQual Laboratories Ltd., #4, 6125 12th Street SE, Calgary, Alberta, Canada T2H 2K1
Tel (403) 253-7121 fax (403) 252-9363 www.hydroqual.ca

SRC Group # 2009-10402

SRC ANALYTICAL
422 Downey Road
Saskatoon, Saskatchewan, Canada
S7N 4N1
(306) 933-6932 or 1-800-240-8808
Fax: (306) 933-7922

Nov 13, 2009

Exova
7217 Roper Road
Edmonton, Alberta T6B 3J4
Attn: Client Services

Page 1 of 1

Sample #	**50757**	Client PO #:	**126024**
Date Sampled:	**Oct 29, 2009**	Date Received:	**Nov 03, 2009**
Sample Matrix:	**WATER**		
Description:	**710930-1 WTH 1-09 M40112.699763**		

Analyte	Units	Result	DL
Inorganic Chemistry			
NTA	mg/L	<0.1*	0.1

"<": not detected at level stated above.

* time between sampling and receipt in lab exceeds recommended 24 hours.

Water Test Hole No. 1-09
Microbiological Analysis (09 Nov 09)

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Analytical Report

Bill To:	Hydrogeological Consultants	Project:		Lot ID:	**712554**
Report To:	Hydrogeological Consultants	ID:	09-899	Control Number:	Z-584240
	17740 - 118 Avenue	Name:	License a Municipal Groundwater	Date Received:	Nov 10, 2009
	Edmonton, AB, Canada	Location:	Sylvan Lake Area	Date Reported:	Nov 16, 2009
	T5S 2W3	LSD:	SE 17-039-01 W5M	Report Number:	1275158
Attn:	Tara Parker	P.O.:	13331		
Sampled By:		Acct code:			
Company:	Mow-Tech Ltd / HCL				

Reference Number	712554-1
Sample Date	November 09, 2009
Sample Time	NA
Sample Location	
Sample Description	M40112.699763 (WTH No. 1-09) / 6.4C / SE 17-039-01 W5M
Sample Matrix	Water

Analyte		Units	Result	Nominal Detection Limit	Guideline Limit	Guideline Comments
Microbiological Analysis						
Total Coliforms	Membrane Filtration	CFU/100 mL	<1	1	0	Below MAC
Fecal Coliforms	Membrane Filtration	CFU/100 mL	<1	1		

Approved by: Bonnie Garbutt
Bonnie Garbutt
Microbiology Team Leader

Terms and Conditions: www.exova.ca/terms&conditions.html

Summary of Guidelines for Canadian Drinking Water Quality

Constituent	AO	MAC
pH (pH units)	6.5 - 8.5	---
Conductivity (µS/cm)	---	---
Total Dissolved Solids	500	---
Sodium	200	---
Potassium	---	---
Calcium	---	---
Magnesium	---	---
Total Hardness	---	---
Manganese	0.05	---
Carbonate	---	---
Bicarbonate	---	---
Total Alkalinity	---	---
Sulfate	500	---
Chloride	250	---
Fluoride	---	1.5
Iron	0.3	---
Nitrate (as N)	---	10
Nitrate	---	45
Nitrite (as N)	---	1
Nitrite	---	3.2
Nitrate + Nitrite (as N)	---	10
Total Coliforms (CFU/100 mL)	---	0*
Fecal Coliforms (CFU/100 mL)	---	0
Escherichia coli (CFU/100 mL)	---	0
Ionic Balance (%)	---	---

Note: Constituents marked with --- do not have a recommended maximum concentration associated with them.
Concentrations are in milligrams per litre unless otherwise stated.
CFU/100 mL - Colony Forming Units per 100 millilitres
AO - Aesthetic Objective
MAC - Maximum Acceptable Concentration
SGCDWQ - Summary of Guidelines for Canadian Drinking Water Quality, Federal–Provincial–Territorial Committee on Drinking Water, May 2008

*No sample should contain total coliform bacteria. The presence of total coliform bacteria, in the absence of Escherichia coli, may indicate the water well is prone to surface water infiltration and therefore faecal contamination. Total coliform detection may also indicate the presence of biofilm in the water well or plumbing system.

Water Test Hole No. 1-09
Microscopic Particulate Analysis (28 Oct 09)

Hyperion Research Ltd.

1008 Allowance Ave. SE,
Medicine Hat, AB T1A 3G8
Tel: (403) 529-0847 Toll Free: (888) 529-0847
Fax: (403) 529-0852 Email: *hyperion@telusplanet.net*
Principal Scientist: Peter M. Wallis, Ph.D.

MICROSCOPIC PARTICULATE ANALYSIS REPORT SHEET (GUDI)

CLIENT: Chris Hoffman
HCL
17740 - 118 Ave. NW
Edmonton, AB
T5S 2W3
TELEPHONE: (780) 702-6238
FAX: (780) 484-9413

Date of Sample: 28/10/2009
Sample Location: WTH 1-09
Type: Raw
Volume Filtered (L): 4020
Temperature (°C): 6.1
pH: 7.99
Conductivity: 730

The methodology used to generate this report conforms to the USEPA Consensus Method for the Microscopic Particulate Analysis. Based on the validation data, the method is fit for its intended use. Hyperion Research Ltd. is accredited for this analysis by CALA under the ISO/IEC 17025:2005 standard.

Sample Processing Information — **Final Pellet Vol. (µL):** 10.0

Date Received	Time Received	Customer #	Temp. on Arrival (°C)	Lab ID	Density Medium	Sediment (mL)
30/10/2009	0935	157	11.6	49375	P/S 1.23	1.00

Total Wash (mL)	Concentrated (mL)	G/C Volume (µL)	MPA Volume (µL)	Suspension Vol. (µL)	Equiv. Vol. (L)
1000	1000	25	75	100	4,020

GIARDIA and *CRYPTOSPORIDIUM* RESULTS

***Giardia* cysts/100 L:** 0.00 ***Cryptosporidium* oocysts/100 L:** 0.00

PARTICULATE ANALYSIS RESULTS

Primary Particulates	Total Count	#/380 L (100 US gal.)	Relative Risk Factor
Diatoms:	0	0.00	NS
Other Algae:	0	0.00	NS
Insect/larvae:	0	0.00	NS
Rotifers:	0	0.00	NS
Plant Debris:	12	1.51	R

Relative Risk Factors: EH - extremely heavy
M - moderate H - heavy
R - Rare NS - not significant

Secondary Particulates	Total Count	#/380 L (100 US gal.)
Pollen	4	1
Nematodes	0	0
Crustacea	0	0
Amoebae	0	0
Ciliates/flagellates	0	0
Other	0	0
Large Debris	silica chips	
Fine Debris	clay	
Minerals	trace iron	

CONCLUSION: Based on this sample, the risk of surface water contamination is judged to be low and the risk factor is **0**

Additional Data: Surface water organisms present.

Analyst:

Peter M. Wallis, Ph.D.

From the EPA Consensus Method:

Risk of Surface Water Contamination
20+ - high risk
10 to 19 - moderate risk
0 to 9 - low risk

Recovery efficiencies for particles are known to be low by this method but are compensated for by filtering a large volume of water. Minimum recovery was measured to be 6.5 +/-1.2% for *Giardia* cysts, 0.5 +/-0.2% for *Cryptosporidium* oocysts and 4.2 +/-2.3% for *Euglena* (algae). Despite the low recovery, the method reliably detected as few as 1 cell/L of groundwater in validation trials with no false positives.

Effective Date: 27/05/2006 Version #: 1.1
Revision Date: 02/01/2007 Document #: HR0013

Note: These results pertain to this sample only.

Water Test Hole No. 1-09
Aquifer Test I

—Insufficient data to plot aquifer test—

Aquifer Test I

Water Test Hole No. 1-09

08-17-039-01 W5M

Average Discharge (lpm):	**159.1**	Pre-Test Water Level - NPWL (m):	**32.92**
Date Test Started:	**Oct 24, 2009**	Depth to Pump Intake (m):	**36.6**
Time Test Started (hours):	**N/A**	Test Interval - Top (m):	**30.5**
Pumping Interval (minutes):	**120**	Test Interval - Bottom (m):	**42.7**
Recovery Interval (minutes):	**120**	Top of Main Aquifer (m):*	**N/A**

***N/A** - Information Not Available*

Reference: M40112.699763 (AT 1)

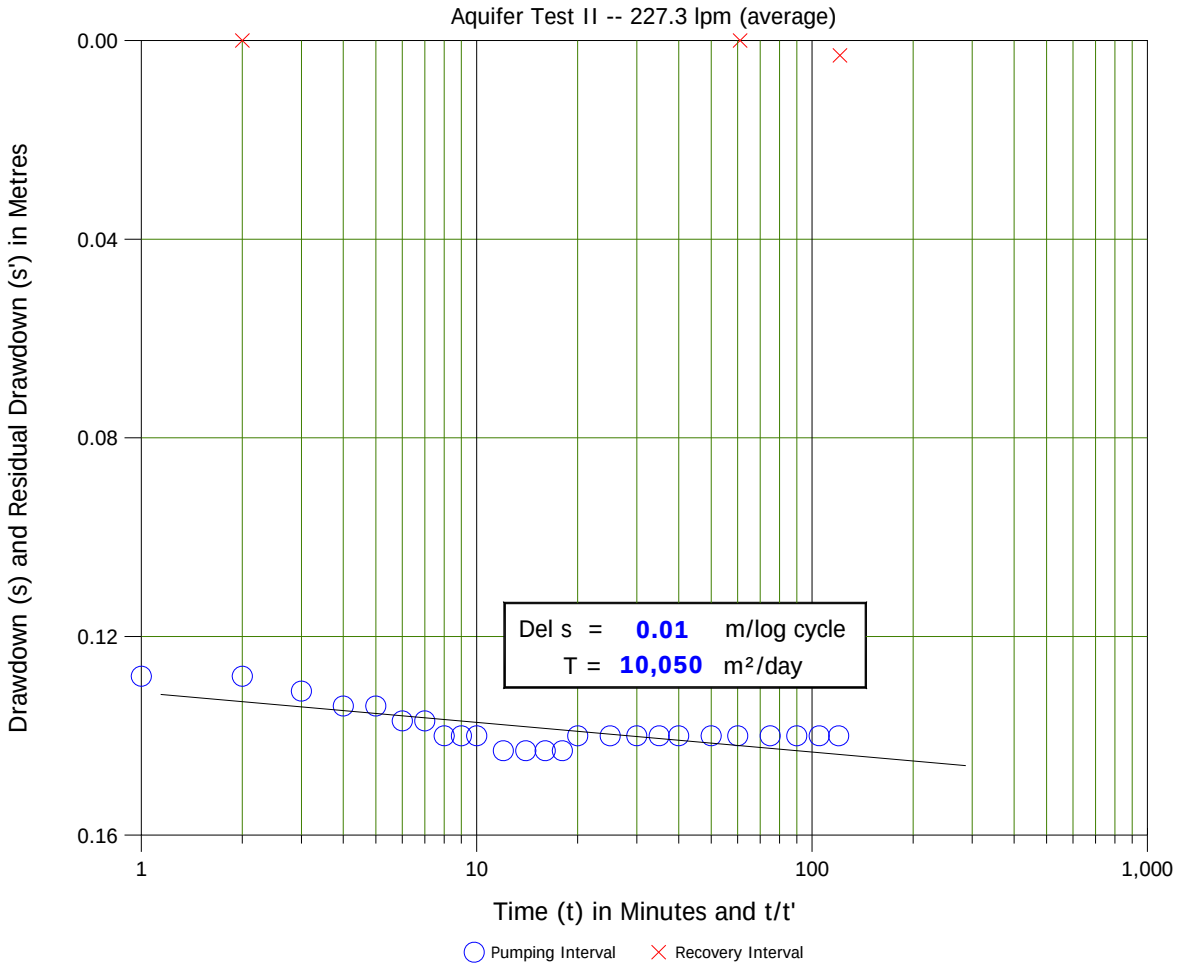
** **TGWC** calculated or determined value.*

This report was generated on: November 18, 2009 — Data "AS IS"; no warranty either expressed or implied. © TGWC — Page 1 of 1

Test Comments:

Test conducted by Alken Basin Drilling Ltd.

Water Test Hole No. 1-09
Aquifer Test II



Aquifer Test II

Water Test Hole No. 1-09

08-17-039-01 W5M

Average Discharge (lpm):	**227.3**	Pre-Test Water Level - NPWL (m):	**32.99**
Date Test Started:	**Oct 24, 2009**	Depth to Pump Intake (m):	**42.7**
Time Test Started (hours):	**N/A**	Test Interval - Top (m):	**30.5**
Pumping Interval (minutes):	**120**	Test Interval - Bottom (m):	**39.6**
Recovery Interval (minutes):	**120**	Top of Main Aquifer (m):*	**N/A**

***N/A** - Information Not Available*

Reference: M40112.699763 (AT 2)

** **TGWC** calculated or determined value.*

Pumping Interval

Measurement Point: Top of Casing

Time (t) Since Pumping Started (minutes)	Drawdown (s) (metre)	Discharge (Lpm)
1	0.13	159
2	0.13	159
3	0.13	159
4	0.13	159
5	0.13	159
6	0.14	159
7	0.14	159
8	0.14	159
9	0.14	159
10	0.14	159
12	0.14	159
14	0.14	159
16	0.14	159
18	0.14	159
20	0.14	159
25	0.14	159
30	0.14	159
35	0.14	159
40	0.14	159
50	0.14	159
60	0.14	159
75	0.14	159
90	0.14	159
105	0.14	159
120	0.14	159

Recovery Interval

Measurement Point: Top of Casing

Time (t') Since Pumping Stopped (minutes)	(t/t')	Residual Drawdown (s') (metre)
1	121	0.00
2	61	0.00
120	2.0	0.00

Test Comments:

Test conducted by Alken Basin Drilling Ltd.

Water Test Hole No. 2-09
08-17-039-01 W5M
(M40113.364984)

10 Degree Transverse Mercator - NAD 83 (10TM):
Easting: **61388**
Northing: **5798454**

Ground Elevation AMSL (m): **968**

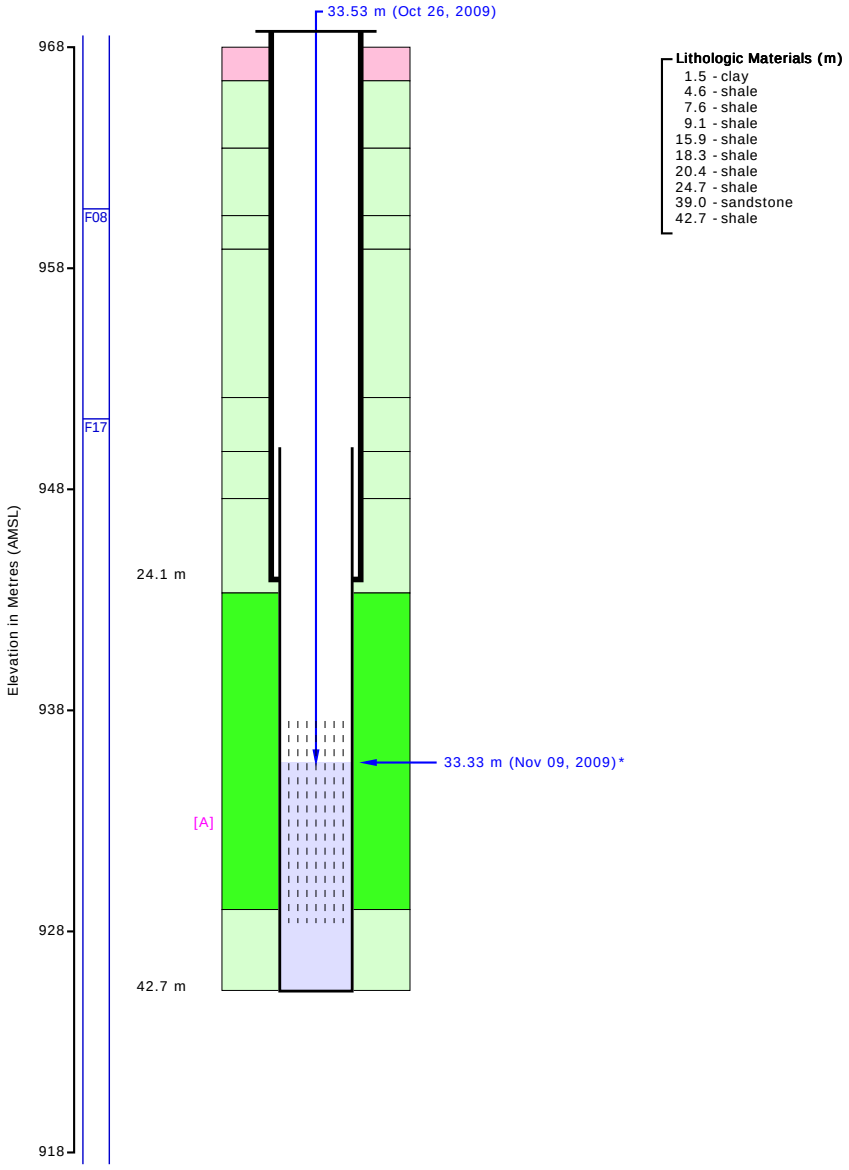
Completion Date: **26 Oct 09**

Depth Drilled (m): **42.7**

Completion Interval (m): **30.5** to **39.6**

Most Recent Water Level (m): **33.33 – 09 Nov 09**
Earliest Water Level (m): **33.53 – 26 Oct 09**

Water Test Hole No. 2-09
Well Diagram



Lithology Legend

Surficial: Unsorted; Fine Grained; Coarse Grained

Bedrock: Fine Grained; Coarse Grained

Other

Geologic Unit Legend (Top) - Regional Analysis

F08 - Dalehurst Member
F17 - Upper Lacombe Member

Summary

TGWC ID: M40113.364984
Well Name: Water Test Hole No. 2-09
Legal Location: 08-17-039-01 W5M
Casing (OD): 141.2 mm; Steel (5.6")
Liner (OD): 114.3 mm; PVC (4.5")
Casing Stick-Up: 0.97 m (not drawn to scale)
Interval [A]: 30.5 to 39.6 m; Slotted
*Water Level (recent): 33.33 m on November 9, 2009 @ 16:00 - Reference Point: Top of Casing
Water Level (oldest): 33.53 m on October 26, 2009

** Water-Level Measurements are measured from reference point listed.*
NOTE: Geologic Unit is a guide based on a regional groundwater assessment completed by hydrogeological consultants ltd. (HCL) (http://www.hcl.ca) on behalf of Lacombe County in conjunction with Prairie Farm Rehabilitation Administration (P.F.R.A.).
Drawn: November 18, 2009 13:23 --- http://www.tgwc.ca

Owner: ***Longview Planning & Design***
205, 259 Midway Way SE, Calgary, AB T2X 1M2
Contractor: ***Alken Basin Drilling Ltd.***
Well Name: ***Water Test Hole No. 2-09***
Abandoned:
Field Survey: ***Oct 27, 2009 - Confirmed - Physically***

METRIC REPORT

Easting (m): ***61388.09*** ** 75/80
Northing (m): ***5798454.76*** **
Elevation (m): ***968*** ***
Google Earth

08-17-039-01 W5M
M40113.364984
0-493865-2

Work Type: ***New Well***
Drilling Method: ***Drilled***
Proposed Use: ***Municipal***
Completion Type: ***Casing/Perforated Liner***
Date Started: ***Oct 26, 2009***
Date Completed: ***Oct 26, 2009***
Well Status: ***Producing***

Elog Taken: ***No***
Gamma Taken: ***No***
Stick Up (m): ***1.0***
Flowing: ***No***

General Details

Depth Completed (m): ***39.6***
Depth Drilled (m): ***42.7***

Completion Details

Surface Casing: ***Steel — 141.2 mm (O.D.) x 6.55 mm (thick) x 24.08 m (bottom)***
Liner: ***PVC — 114.3 mm (O.D.) x 6.53 mm (thick)***

Intervals (Liner: 18.3 m - 42.7 m)

-- Completion Interval(s) --
Slotted: ***30.5 to 39.6 m - 3/8 x 12 inch*** - *Method:* ***Hand Drill***
-- Construction Interval(s) --
Bentonite: ***0.0 to 23.8 m***
Drive Shoe: ***23.9 to 24.1 m***

Lithology Details

Elevation (AMSL)	Depth (BGL)	Lithology Descriptions (10)
966.6	1.5	Clay
963.5	4.6	Silty Brown Shale
960.5	7.6	Grey Shale
959.0	9.1	Brown Shale
952.3	15.9	Grey Shale
949.8	18.3	Brown Shale
947.7	20.4	Silty Grey Shale
943.4	24.7	Grey Shale
929.1	39.0	Brownish Grey Sandstone
925.4	42.7	Brown Shale

Chemistry Summary Details (mg/L, except as noted) (most recent first)

General Comments / Observations

Borehole diameter: 171.45 mm from 0 to 23.77 metres BGL, 127 mm from 23.77 to 42.672 metres BGL.

Most Recent Water Level (m): ***33.33 m — Nov 09, 2009***
Oil Present: ***No*** Gas Present: ***No***
Observations (water): Colour: ; Odor: ; Quality:

Aquifer Tests

No.	Date	Testing Method	Duration (minutes) Pumping	Duration (minutes) Recovery	Avg. Rate (lpm)	NPWL (metre)	Drawdown (metre)	Level-End (metre)	Pump (metre)	Q20 (m³/day)* Apparent	Q20 (m³/day)* Effective	Transmissivity (m²/day)* Apparent	Transmissivity (m²/day)* Aquifer	Transmissivity (m²/day)* Effective	
2	2009-10-26 11:30	Pump	120.0	120.0	172.8	33.49	2.00	35.49	36.58			178.3			R C
1	2009-10-26	Air			204.6	33.53	—	—	42.67						R
		--- Used as Observation Water Well During Aquifer Test No. 3 with M40112.699763 ---													R C

Alias IDs

** **TGWC** calculated or determined value.*
*** 75 - MT GPS — 10TM NAD83*
**** 80 - MT DEM — {Ground ; AMSL}*

Water Test Hole No. 2-09
Aquifer Test I

—Insufficient data to plot aquifer test—

Aquifer Test I

Water Test Hole No. 2-09

08-17-039-01 W5M

Average Discharge (lpm):	**204.6**	Pre-Test Water Level - NPWL (m):	**33.53**
Date Test Started:	**Oct 26, 2009**	Depth to Pump Intake (m):	**42.7**
Time Test Started (hours):	**N/A**	Test Interval - Top (m):	**N/A**
Pumping Interval (minutes):	**N/A**	Test Interval - Bottom (m):	**N/A**
Recovery Interval (minutes):	**N/A**	Top of Main Aquifer (m):*	**N/A**

***N/A** - Information Not Available*

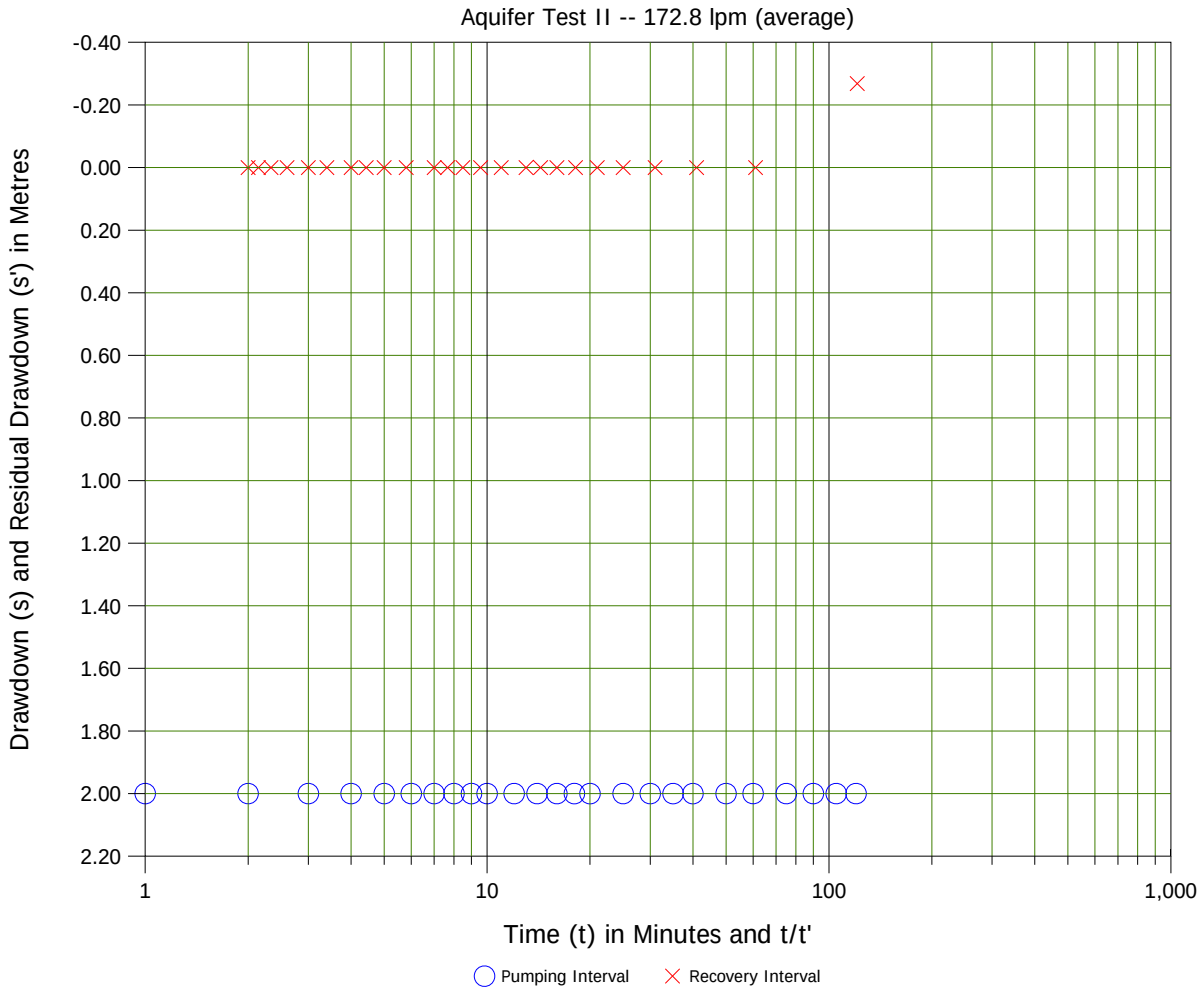
Reference: M40113.364984 (AT 1)

** **TGWC** calculated or determined value.*

Test Comments:

Test conducted by Alken Basin Drilling Ltd.

Water Test Hole No. 2-09
Aquifer Test II



Aquifer Test II

Water Test Hole No. 2-09

08-17-039-01 W5M

Average Discharge (lpm):	**172.8**	Pre-Test Water Level - NPWL (m):	**33.49**
Date Test Started:	**Oct 26, 2009**	Depth to Pump Intake (m):	**36.6**
Time Test Started (hours):	**11:30**	Test Interval - Top (m):	**30.5**
Pumping Interval (minutes):	**120**	Test Interval - Bottom (m):	**39.6**
Recovery Interval (minutes):	**120**	Top of Main Aquifer (m):*	**N/A**

***N/A** - Information Not Available*

Reference: M40113.364984 (AT 2)

** **TGWC** calculated or determined value.*

Pumping Interval

Measurement Point: Top of Casing

Time (t) Since Pumping Started (minutes)	Drawdown (s) (metre)	Discharge (Lpm)
1	2.00	173
2	2.00	173
3	2.00	173
4	2.00	173
5	2.00	173
6	2.00	173
7	2.00	173
8	2.00	173
9	2.00	173
10	2.00	173
12	2.00	173
14	2.00	173
16	2.00	173
18	2.00	173
20	2.00	173
25	2.00	173
30	2.00	173
35	2.00	173
40	2.00	173
50	2.00	173
60	2.00	173
75	2.00	173
90	2.00	173
105	2.00	173
120	2.00	173

Recovery Interval

Measurement Point: Top of Casing

Time (t') Since Pumping Stopped (minutes)	(t/t')	Residual Drawdown (s') (metre)
1	121	-0.27
2	61	0.00
3	41	0.00
4	31	0.00
5	25	0.00
6	21	0.00
7	18.1	0.00
8	16.0	0.00
9	14.3	0.00
10	13.0	0.00
12	11.0	0.00
14	9.6	0.00
16	8.5	0.00
18	7.7	0.00
20	7.0	0.00
25	5.8	0.00
30	5.0	0.00
35	4.4	0.00
40	4.0	0.00
50	3.4	0.00
60	3.0	0.00
75	2.6	0.00
90	2.3	0.00
105	2.1	0.00
120	2.0	0.00

Test Comments:

Test conducted by Alken Basin Drilling Ltd.

Appendix C – Extended Aquifer Test Details

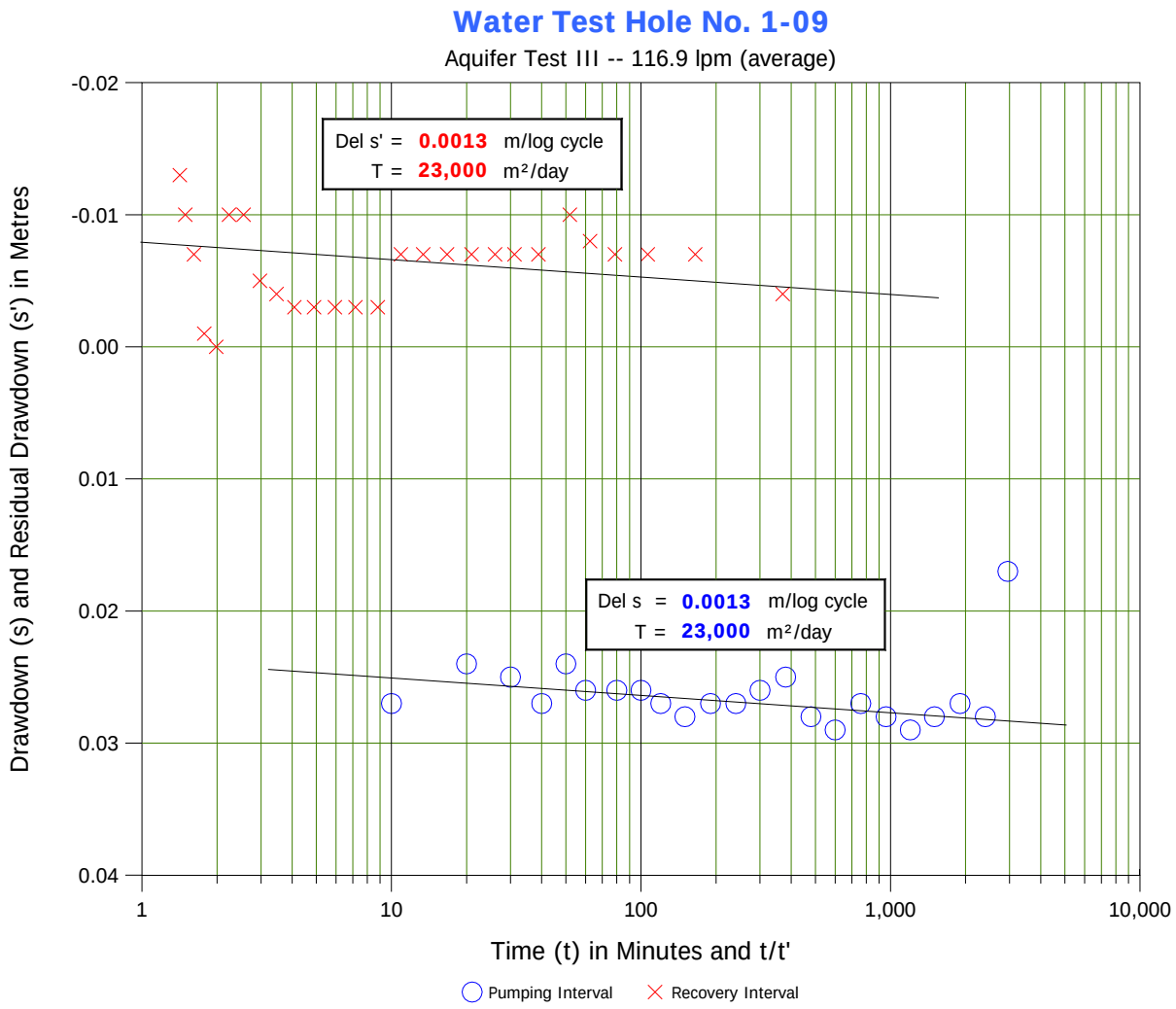
TABLE OF CONTENTS

Aquifer Test III with WTH No. 1-09

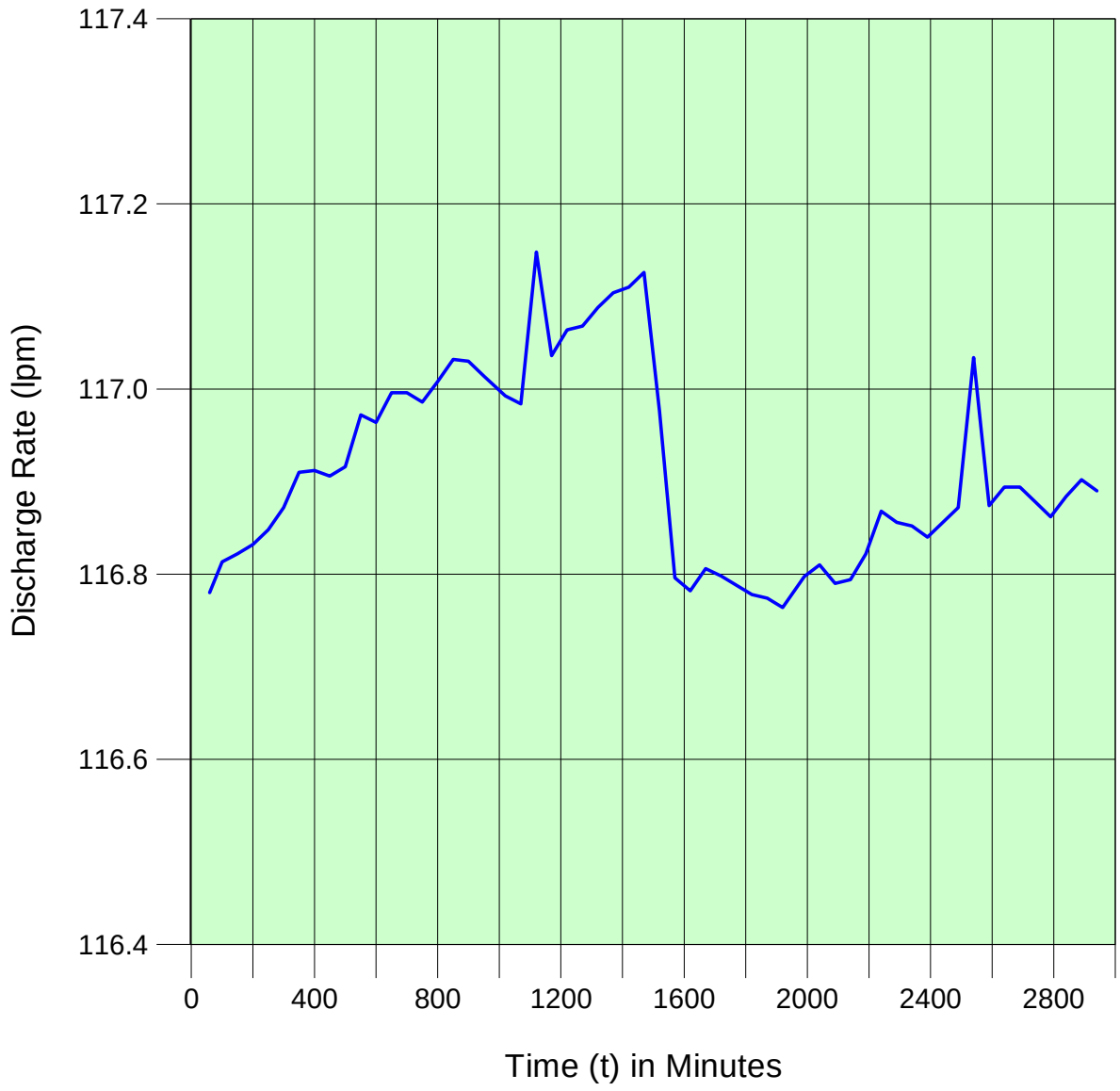
Test Started: 27 Oct 09 @ 16:30 Hrs
Discharge (lpm): 116.9

	NPWL (m)	Distance from Pumped Well (m)
Pumped Water Well:		
Water Test Hole No. 1-09	32.30	not applicable
Observation Water Well:		
Water Test Hole No. 2-09	33.32	98.6

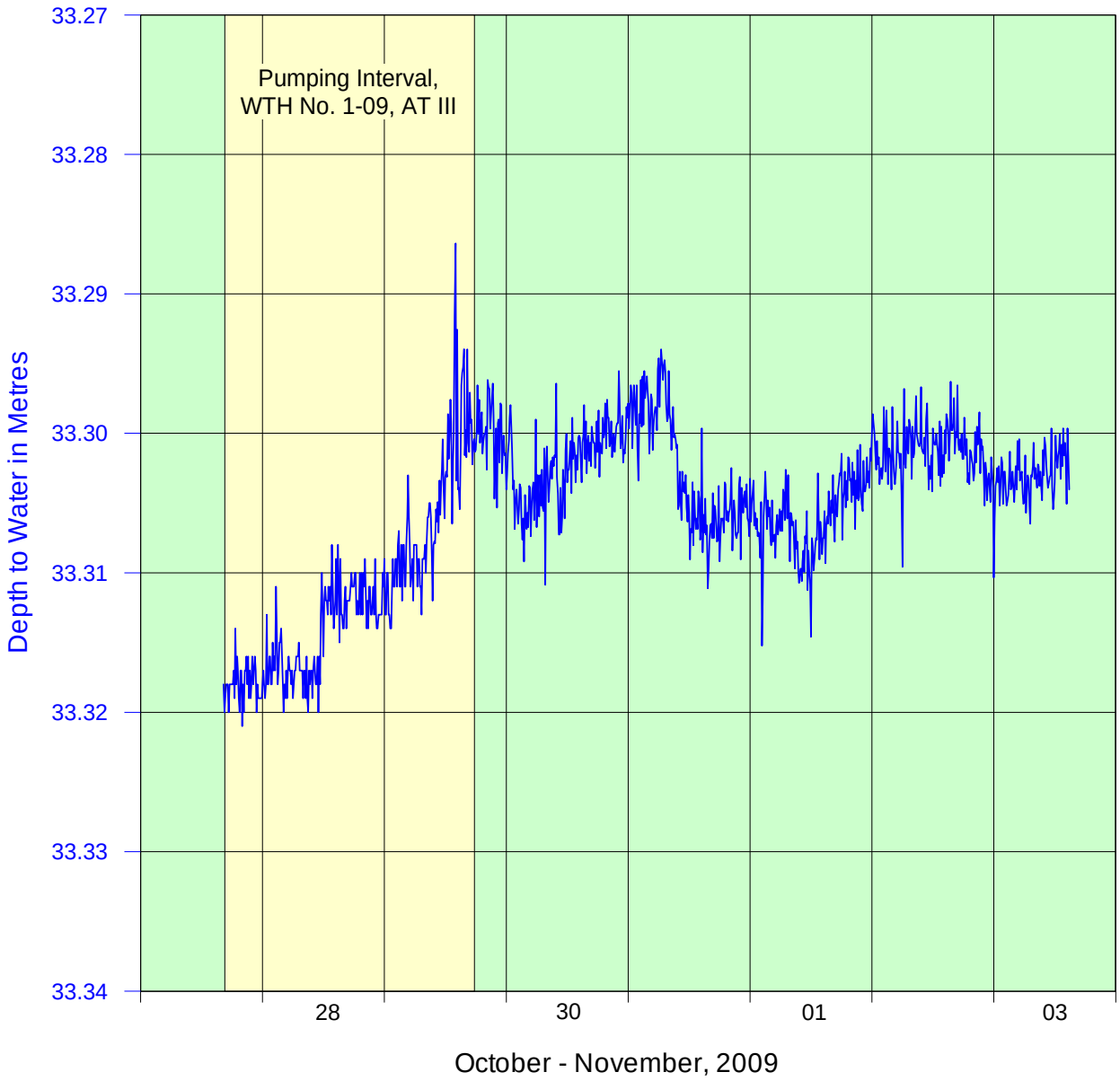
Aquifer Test III
Pumped Water Well (Water Test Hole No. 2-09)



Pumping Rate during AT III



Water Test Hole No. 2-09 Used as Observation WW during Aquifer Test III with WTH No. 1-09



Aquifer Test III Data

Pumped Water Well:
Water Test Hole No. 1-09

Observation Water Well:
Water Test Hole No. 2-09

Aquifer Test III

Water Test Hole No. 1-09

SE 17-039-01 W5M

Average Discharge (lpm):	**116.9**	Pre-Test Water Level - NPWL (m):	**32.30**
Date Test Started:	**Oct 27, 2009**	Depth to Pump Intake (m):	**38.9**
Time Test Started (hours):	**16:30**	Test Interval - Top (m):	**30.5**
Pumping Interval (minutes):	**2,952**	Test Interval - Bottom (m):	**39.6**
Recovery Interval (minutes):	**7,038**	Top of Main Aquifer (m):*	**N/A**

***N/A** - Information Not Available*

Reference: M40112.699763 (AT 3)

** **TGWC** calculated or determined value.*

Pumping Interval

Measurement Point: Top of Casing

Time (t) Since Pumping Started (minutes)	Drawdown (s) (metre)	Discharge (Lpm)
10	0.03	117.10
20	0.02	116.80
30	0.03	116.80
40	0.03	116.80
50	0.02	116.80
60	0.03	116.80
80	0.03	116.80
100	0.03	116.80
120	0.03	116.80
150	0.03	116.80
190	0.03	116.90
240	0.03	116.90
300	0.03	116.90
380	0.03	116.90
480	0.03	116.90
600	0.03	117.00
760	0.03	117.00
960	0.03	117.00
1,200	0.03	117.10
1,500	0.03	117.10
1,900	0.03	116.80
2,400	0.03	116.80
2,952	0.02	116.90

Recovery Interval

Measurement Point: Top of Casing

Time (t') Since Pumping Stopped (minutes)	(t/t')	Residual Drawdown (s') (metre)
8	370	0.00
18	165	-0.01
28	106	-0.01
38	79	-0.01
48	63	-0.01
58	52	-0.01
78	39	-0.01
98	31	-0.01
118	26	-0.01
148	21	-0.01
188	16.7	-0.01
238	13.4	-0.01
298	10.9	-0.01
378	8.8	0.00
478	7.2	0.00
598	5.9	0.00
758	4.9	0.00
958	4.1	0.00
1,198	3.5	0.00
1,498	3.0	-0.01
1,898	2.6	-0.01
2,398	2.2	-0.01
2,998	2.0	0.00
3,798	1.78	0.00
4,798	1.62	-0.01
5,998	1.49	-0.01
7,038	1.42	-0.01

Test Comments:

Groundwater discharged from water well head.

Water Test Hole No. 2-09

Used as Observation Water Well During
Aquifer Test III with Water Test Hole No. 1-09

08-17-039-01 W5M

Pumped Well: Average Discharge (lpm):	**116.9**	Pre-Test Water Level - NPWL (m):	**33.32**
Pumped Well: Date Test Started:	**Oct 27,2009**	Distance From Pumped Well (m):	**98.6**
Pumped Well: Time Test Started (hours):	**16:30**	Test Interval - Top (m):	**30.5**
Pumped Well: Pumping Interval (minutes):	**2,952**	Test Interval - Bottom (m):	**39.6**
Pumped Well: Recovery Interval (minutes):	**7,038**	Top of Main Aquifer (m):*	**N/A**

***N/A** - Information Not Available*

Obs: M40113.364984; 1.1 — Pumped: M40112.699763; 3

** **TGWC** calculated or determined value.*

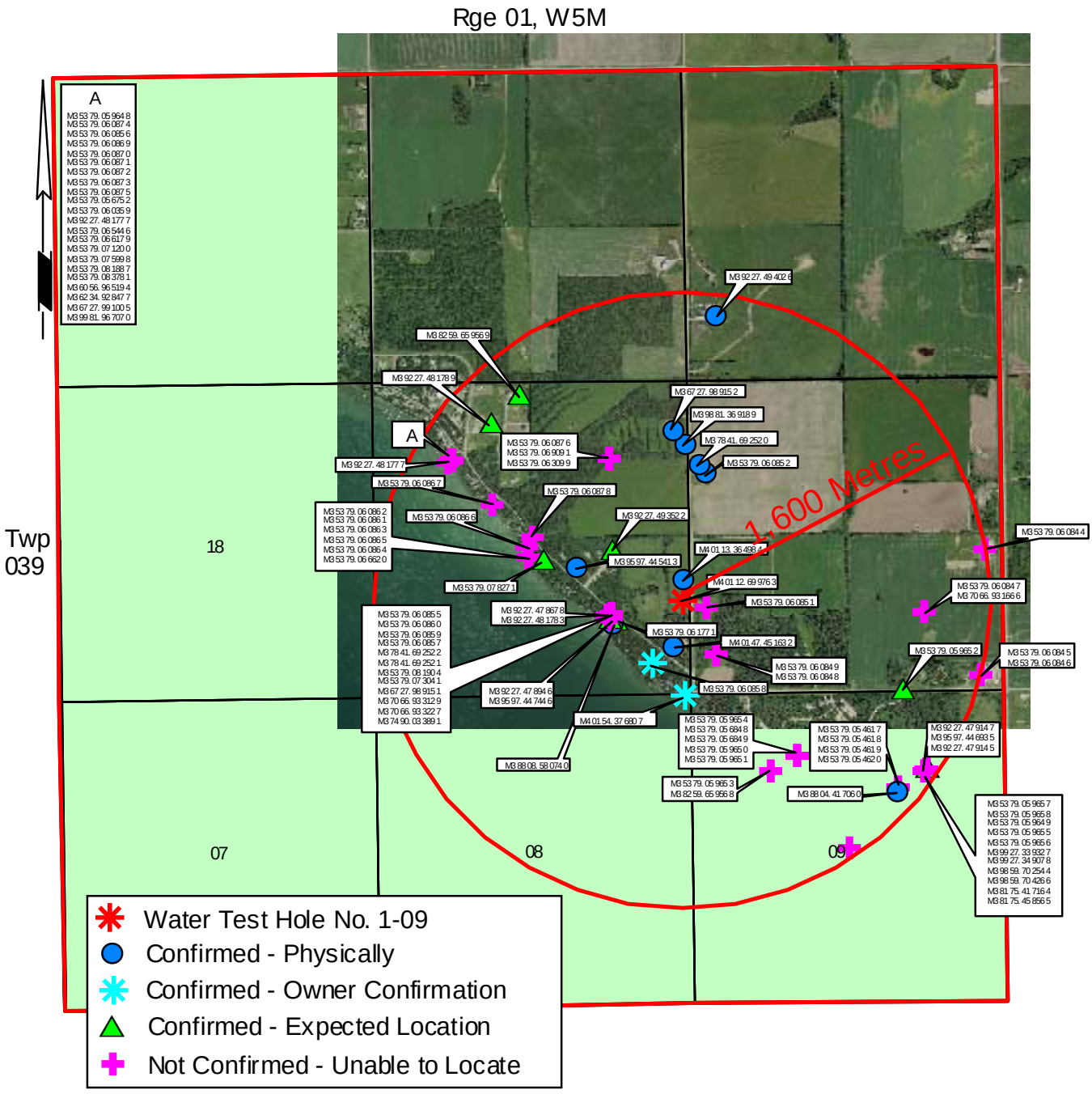
This report was generated on: November 09, 2009 — Data "AS IS", no warranty either expressed or implied. © TGWC — Page 1 of 1

Pumping Interval

Measurement Point: Top of Casing

Time (t) Since Pumping Started (minutes)	Drawdown (s) (metre)	Discharge (Lpm)
10	0.00	117.10
20	0.00	116.80
30	0.00	116.80
40	0.00	116.80
50	0.00	116.80
60	0.00	116.80
80	0.00	116.80
100	0.00	116.80
120	0.00	116.80
150	0.00	116.80
190	0.00	116.90
240	0.00	116.90
300	0.00	116.90
380	0.00	116.90
480	0.00	116.90
600	0.00	117.00
760	0.00	117.00
960	0.00	117.00
1,200	-0.01	117.10
1,500	-0.01	117.10
1,900	-0.01	116.80
2,400	-0.01	116.80
2,952	-0.02	116.90

Appendix D – Water Well Survey



Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

Page: 1 of 18: Printed on December 07, 2009

Parameter						
Owner / Lessee	Longview Planning & Design	Longview Planning & Design	Suncor Energy Inc.	Longview Planning & Design	Ranaghan, R.S.	Ranaghan, Maureen
Legal Location	**08-17-039-01 W5M**	**08-17-039-01 W5M**	**05-16-039-01 W5M**	**SE 17-039-01 W5M**	**SW 16-039-01 W5M**	**SW 16-039-01 W5M**
Ground Elevation	966.1 m	968.1 m	974.1 m	953.7 m	959.4 m	959.4 m
Well Type	New Well	New Well	New Well	Well Inventory	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	42.7 m	42.7 m	91.4 m	-	36.6 m	54.9 m
Pump Intake	42.7 m	42.7 m	54.9 m	-	-	30.8 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	7.3 m	6.3 m	42.7 m	-	-	11.9 m
Max. Pumping Rate	227.3 Lpm	204.6 Lpm	159.1 Lpm	-	181.8 Lpm	113.7 Lpm
Completion Details	30.5 - 39.6 m	30.5 - 39.6 m	48.8 - 91.4 m		31.4 - 36.6 m	35.7 - 54.9 m
Distance	0 m	98 m	136 m	247 m	331 m	331 m
Earliest Water-Level	24 Oct 2009	26 Oct 2009	14 Aug 1985	-	06 Jun 1968	27 May 1982
	33.0 m	33.5 m	48.8 m	-	9.5 m	23.8 m
Latest Water Level	09 Nov 2009	09 Nov 2009	14 Aug 1985	-	06 Jun 1968	27 May 1982
	32.3 m	33.3 m	48.8 m	-	9.5 m	23.8 m
Daily Use	-	-	-	-	-	~909 L
Number Chemistries	3	-	-	-	-	-
(latest analysis)	November 17, 2009					
Comments	Borehole diameter: 171.45 mm from 0 to 26.82 metres BGL, 127 mm from 26.82 to 42.672 metres BGL.	Borehole diameter: 171.45 mm from 0 to 23.77 metres BGL, 127 mm from 23.77 to 42.672 metres BGL.		Hydrogeological Consultants Ltd. (HCL), water well is located 25 metres Southwest of house. Casing was extended by Alken Basin.		Seal type listed as 'Driven' but no interval defined.
AENV Well ID(s)			0359297		0359294	0359295
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M40112.699763	M40113.364984	M35379.060851	M40147.451632	M35379.060848	M35379.060849
Date Verified	27 Oct 2009	27 Oct 2009	28 Oct 2009	20 Oct 2009	25 Nov 2009	28 Oct 2009
Verification Status	(01) Confirmed - Physically	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	Water Test Hole No. 1-09	Water Test Hole No. 2-09	Rig Well (Kenting 39)	Belterra Land Water Well		1982 Ranaghan Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

Page: 2 of 18: Printed on December 07, 2009

Parameter						
Owner / Lessee	Macsween, Ian	Arthur, Collin	Manning	Hancock	Mccaffery, Terrence	Park, Lavern
Legal Location	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**
Ground Elevation	946.3 m	947.3 m	946.7 m	946.7 m	946.7 m	946.7 m
Well Type	New Well	New Well	New Well	New Well	Chemistry	Chemistry
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	42.7 m	42.7 m	22.5 m	21.9 m	38.1 m	33.5 m
Pump Intake	-	-	-	-	-	-
Top of Aquifer	-	-	-	-	-	-
Total Available Head	28.7 m	22.3 m	-	-	-	-
Max. Pumping Rate	36.4 Lpm	136.4 Lpm	54.5 Lpm	45.5 Lpm	-	-
Completion Details	38.4 - 42.7 m	33.2 - 42.7 m	18.0 - 22.6 m	16.8 - 21.9 m		
Distance	358 m	365 m	373 m	373 m	373 m	373 m
Earliest Water-Level	19 Jul 1991	24 Feb 1977	25 May 1966	01 Oct 1964	-	-
	9.8 m	11.0 m	9.8 m	11.6 m	-	-
Latest Water Level	19 Jul 1991	24 Feb 1977	25 May 1966	01 Oct 1964	-	-
	9.8 m	11.0 m	9.8 m	11.6 m	-	-
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments	GPS taken from the end of the driveway with a Macsween sign.	The well is covered and accessible through the basement.		Seal type listed as 'Driven' but no interval defined.		
AENV Well ID(s)	0360245	0359304	0359305	0359306	0359301	0359302
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.061771	M35379.060858	M35379.060859	M35379.060860	M35379.060855	M35379.060856
Date Verified	17 Mar 2009	28 Oct 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009
Verification Status	(03) Confirmed - Expected Location	(02) Confirmed - Owner Confirmation	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location
Well Name	1991 Macsween Water Well	1977 Arthur Water Well	1966 Manning Water Well	1964 Hancock Water Well		

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

Page: 3 of 18: Printed on December 07, 2009

Parameter						
Owner / Lessee	Bast, Joann	Densmore, Art	Walters, Ralphs	Hines, Denis & Marie	Ferguson, Cindy	Wilson, Frank & Delta Res
Legal Location	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**
Ground Elevation	946.7 m	946.7 m	946.7 m	946.7 m	946.7 m	946.7 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	43.9 m	19.8 m	24.4 m	11.9 m	42.7 m	36.6 m
Pump Intake	-	19.8 m	24.1 m	8.5 m	38.1 m	30.5 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	28.7 m	6.1 m	-	6.4 m	-	20.1 m
Max. Pumping Rate	81.8 Lpm	386.4 Lpm	136.4 Lpm	227.3 Lpm	68.2 Lpm	318.2 Lpm
Completion Details	37.5 - 43.9 m	16.8 - 19.8 m	15.5 - 24.4 m	8.2 - 11.9 m	36.6 - 42.7 m	29.3 - 32.0 m
Distance	373 m	373 m	373 m	373 m	373 m	373 m
Earliest Water-Level	08 Mar 1989	02 Jun 1993	05 Jun 1995	30 May 1998	03 Nov 2000	26 Jun 2000
	8.8 m	10.7 m	5.9 m	5.5 m	7.6 m	9.2 m
Latest Water Level	08 Mar 1989	02 Jun 1993	05 Jun 1995	30 May 1998	03 Nov 2000	26 Jun 2000
	8.8 m	10.7 m	5.9 m	5.5 m	7.6 m	9.2 m
Daily Use	-	-	~1,137 L	~1,364 L	~781 L	~1,364 L
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments						
AENV Well ID(s)	0359303	0371572	0380554	0491509	0497110	0496123
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.060857	M35379.073041	M35379.081904	M36727.989151	M37066.933129	M37066.933227
Date Verified	17 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	1989 Bast Water Well	1993 Densmore Water Well	1995 Walters Water Well	1998 Himes Water Well	2000 Furguson Water Well	2000 Wilson Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Delta Land Corporation	Wilson, Chris	Wilson, Des	BUSSE, BARRY	Wilson, Daniel	Burnand, Bernard & Jean
Legal Location	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SW 17-039-01 W5M**	**SE 17-039-01 W5M**
Ground Elevation	946.7 m	946.7 m	946.7 m	946.7 m	943.5 m	944.5 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	54.9 m	79.2 m	79.2 m	48.8 m	27.4 m	36.6 m
Pump Intake	39.0 m	79.2 m	79.2 m	48.8 m	24.4 m	36.6 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	34.0 m	47.5 m	24.4 m		11.9 m	10.7 m
Max. Pumping Rate	-	272.8 Lpm	181.8 Lpm	181.8 Lpm	181.8 Lpm	68.2 Lpm
Completion Details	42.7 - 48.8 m	67.1 - 73.1 m	48.8 - 61.0 m		18.3 - 27.4 m	25.0 - 36.6 m
Distance	373 m	373 m	373 m	378 m	386 m	387 m
Earliest Water-Level	07 May 2001	14 Jun 2002	17 Jun 2002	07 Sep 2007	20 Sep 1999	20 Jul 2004
	8.6 m	19.5 m	24.4 m	9.4 m	6.4 m	14.3 m
Latest Water Level	07 May 2001	14 Jun 2002	17 Jun 2002	07 Sep 2007	20 Sep 1999	20 Jul 2004
	8.6 m	19.5 m	24.4 m	9.4 m	6.4 m	14.3 m
Daily Use	~1,638 L	-	-	-	~1,364 L	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments			Recovery stayed 80' 12-120 minutes.	87' - 97' 18 GH."	10 hard, PH 8.0, FE nil, perforations 5/8 holes, seal other (socket), submersible pump installed at 60.	
AENV Well ID(s)	0498584	0340522	0340523	1065094	1045056	1035041
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M37490.033891	M37841.692521	M37841.692522	M39597.447446	M38808.580740	M39227.478946
Date Verified	17 Mar 2009	17 Mar 2009	17 Mar 2009	25 Nov 2009	28 Oct 2009	26 Mar 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically	(03) Confirmed - Expected Location
Well Name		2002 Chris Wilson Water Well	2002 Des Wilson Water Well		1999 Daniel Wilson Water Well	2004 Burnand Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Handel, Brad	Beluk, Scott	Simpson, Andrew & Sharon	Yaworski, Brian	Hays, Mary	ARRAIAL, CARLOS
Legal Location	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**SE 17-039-01 W5M**	**16-08-039-01 W5M**	**SE 17-039-01 W5M**
Ground Elevation	945.1 m	945.1 m	958.3 m	943.1 m	940.6 m	948.8 m
Well Type	New Well	New Well	New Well	Chemistry	Well Inventory	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	24.4 m	24.4 m	30.5 m	39.6 m	-	48.8 m
Pump Intake	24.4 m	15.2 m	24.4 m	-	-	48.8 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	17.4 m	13.0 m	8.5 m	-	-	
Max. Pumping Rate	272.8 Lpm	90.9 Lpm	113.7 Lpm	-	-	272.8 Lpm
Completion Details	19.8 - 22.9 m	19.8 - 22.9 m	25.0 - 30.5 m			
Distance	398 m	398 m	452 m	469 m	500 m	573 m
Earliest Water-Level	18 Feb 2005	20 Jan 2005	23 Aug 2006	-	-	05 Oct 2006
	2.4 m	6.8 m	21.9 m	-	-	14.3 m
Latest Water Level	18 Feb 2005	20 Jan 2005	23 Aug 2006	-	-	28 Oct 2009
	2.4 m	6.8 m	21.9 m	-	-	13.5 m
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments					Mary Hayes contacted HCL 4 Dec 09 regarding their water well. Matu estimates that the water well was drilled in the 1940's. Mary interested in having thier water well field verified and a non-pumping water-level colected.	
AENV Well ID(s)	1060658	1045149	1735309	0361581		1064749
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M39227.478678	M39227.481783	M39227.493522	M35379.063099	M40154.376807	M39597.445413
Date Verified	17 Mar 2009	17 Mar 2009	26 Mar 2009	26 Mar 2009	04 Dec 2009	28 Oct 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(02) Confirmed - Owner Confirmation	(01) Confirmed - Physically
Well Name	2005 Handel Water Well		2006 Simpson Water Well		Hays Cabin Water Well	2006 Arraial Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Holm, Elmer H	Holm, Elmer H.	Brand, Bruce & Ann	Lance Skinner	Reid, Allan	Wolfe, Marlin
Legal Location	**NW 16-039-01 W5M**	**NW 16-039-01 W5M**	**SE 17-039-01 W5M**	**16-17-039-01 W5M**	**SW 17-039-01 W5M**	**SW 17-039-01 W5M**
Ground Elevation	994.7 m	994.5 m	945.6 m	992.4 m	941.8 m	941.8 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	70.4 m	73.2 m	39.6 m	73.2 m	44.2 m	19.8 m
Pump Intake	65.5 m	73.1 m	39.6 m	64.5 m	44.2 m	-
Top of Aquifer	-	-	-	54.1	-	-
Total Available Head	-	14.1 m	-	12.3 m	35.1 m	9.8 m
Max. Pumping Rate	113.7 Lpm	136.4 Lpm	136.4 Lpm	113.7 Lpm	363.7 Lpm	227.3 Lpm
Completion Details	56.7 - 70.4 m	61.0 - 73.1 m	31.7 - 39.6 m	54.1 - 67.1 m	39.6 - 44.2 m	15.9 - 19.8 m
Distance	666 m	705 m	755 m	808 m	826 m	826 m
Earliest Water-Level	06 May 1976	26 Mar 2002	15 Mar 1994	06 Mar 2009	19 Dec 1991	03 Jun 1974
	56.4 m	59.7 m	10.7 m	54.9 m	4.6 m	6.1 m
Latest Water Level	06 May 1976	23 Mar 2009	15 Mar 1994	17 Mar 2009	19 Dec 1991	03 Jun 1974
	56.4 m	59.1 m	10.7 m	54.8 m	4.6 m	6.1 m
Daily Use	-	~1,364 L	~2,273 L	-	-	-
Number Chemistries	-	-	-	2	-	-
(latest analysis)				May 29, 2009		
Comments	WW located 5m north of the house. Could not get the well cap off for a WL.	3 parts hard, no Iron. WW located near a large spruce tree on the north end of the yard.		Lost circulation at 54.86 m (180 ft.		
AENV Well ID(s)	0359298	0340521	0376814		0365151	0359307
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.060852	M37841.692520	M35379.078271	M39881.369189	M35379.066620	M35379.060861
Date Verified	23 Mar 2009	23 Mar 2009	26 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009
Verification Status	(01) Confirmed - Physically	(01) Confirmed - Physically	(03) Confirmed - Expected Location	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	1976 Holm Water Well	2002 Holm Water Well	1994 Brand Water Well	Water Test Hole No. 1-09	1991 Reid Water Well	1974 Marlin Wolfe Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Mathen, L.J.	Charman, H.G.	Wolfe	Turnbull, Michiel	Lynn-White, Virginia	Warden, A. S.
Legal Location	**SW 17-039-01 W5M**	**SW 17-039-01 W5M**	**SW 17-039-01 W5M**	**SW 17-039-01 W5M**	**NE 17-039-01 W5M**	**·· 17-039-01 W5M**
Ground Elevation	941.8 m	941.8 m	941.8 m	941.8 m	972.6 m	946.5 m
Well Type	New Well	New Well	New Well	New Well	Chemistry	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	25.9 m	16.8 m	19.8 m	49.7 m	33.5 m	31.7 m
Pump Intake	-	-	-	-	-	-
Top of Aquifer	-	-	-	-	-	-
Total Available Head	9.1 m	-	10.7 m	22.9 m	-	-
Max. Pumping Rate	68.2 Lpm	90.9 Lpm	27.3 Lpm	90.9 Lpm	-	136.4 Lpm
Completion Details	19.8 - 25.9 m	12.8 - 16.8 m	15.5 - 19.8 m	41.2 - 48.8 m		26.2 - 31.7 m
Distance	826 m	826 m	826 m	826 m	828 m	844 m
Earliest Water-Level	01 Aug 1973	01 Sep 1973	11 Sep 1974	21 Mar 1987	-	08 Jul 1971
	10.7 m	7.3 m	4.9 m	18.3 m	-	7.3 m
Latest Water Level	01 Aug 1973	01 Sep 1973	11 Sep 1974	21 Mar 1987	-	08 Jul 1971
	10.7 m	7.3 m	4.9 m	18.3 m	-	7.3 m
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments	Seal type listed as 'Driven' but no interval defined.	Seal type listed as 'Driven' but no interval defined.				Seal type listed as 'Driven' but no interval defined.
AENV Well ID(s)	0359308	0359309	0359310	0359311	0367625	0359324
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.060862	M35379.060863	M35379.060864	M35379.060865	M35379.069091	M35379.060878
Date Verified	17 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009	17 Mar 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	1973 Mathen Water Well	1973 Charman Water Well	1974 Wolfe Water Well	1987 Turnbull Water Well		1971 Warden Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Finn, G.N.	Skinner, Lance & Gil	Pentecostal Camp	Pentecostal Camp	Jamieson	Hancock, Dr
Legal Location	**06-17-039-01 W5M**	**16-17-039-01 W5M**	**NW 09-039-01 W5M**	**NW 09-039-01 W5M**	**NW 09-039-01 W5M**	**NW 09-039-01 W5M**
Ground Elevation	943.0 m	987.0 m	952.5 m	952.5 m	952.5 m	952.5 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	21.3 m	73.2 m	33.5 m	30.5 m	19.8 m	27.4 m
Pump Intake	-	61.0 m	-	-	-	18.3 m
Top of Aquifer	-	54.9	-	-	-	-
Total Available Head	-	13.7 m	-	-	-	-
Max. Pumping Rate	45.5 Lpm	113.7 Lpm	45.5 Lpm	45.5 Lpm	45.5 Lpm	68.2 Lpm
Completion Details	15.2 - 21.3 m	54.9 - 67.1 m	19.2 - 33.5 m	18.9 - 30.5 m	12.2 - 19.8 m	23.2 - 27.4 m
Distance	848 m	880 m	994 m	994 m	994 m	994 m
Earliest Water-Level	01 Jun 1964	27 Jul 1998	01 Jun 1970	01 Jun 1970	09 Jun 1962	29 Sep 1976
	5.8 m	53.3 m	9.1 m	7.6 m	4.3 m	11.0 m
Latest Water Level	01 Jun 1964	17 Mar 2009	01 Jun 1970	01 Jun 1970	09 Jun 1962	29 Sep 1976
	5.8 m	53.4 m	9.1 m	7.6 m	4.3 m	11.0 m
Daily Use	-	~4,546 L	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments	Seal type listed as 'Driven' but no interval defined.	WW located 3m south of the shop.	Originally at SW-9-39-2-w5. Depth 50'- Water (hard): 94'-water (soft). Seal Type listed as 'Driven' but no interval defined.	Originally at SW-9-39-2-w5. Depth 94'- Water. Seal Type listed as 'Driven' but no interval defined.	Seal type listed as 'Driven' but no interval defined.	
AENV Well ID(s)	0359312	0491510	0355236	0355237	0358084	0358085
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.060866	M36727.989152	M35379.056848	M35379.056849	M35379.059650	M35379.059651
Date Verified	17 Mar 2009	17 Mar 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	1964 Finn Water Well	1998 Skinner Water Well				

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Presbyterian Church	Jamieson	Weir, Rod	Keglovitsch, R	Sunnyside Pentecostal Camp	Camp Kannawin c/o Paterson, W.
Legal Location	**NW 09-039-01 W5M**	**NW 09-039-01 W5M**	**NW 09-039-01 W5M**	**NW 09-039-01 W5M**	**WH 17-039-01 W5M**	**NW 09-039-01 W5M**
Ground Elevation	938.3 m	952.5 m	938.3 m	937.9 m	940.2 m	971.3 m
Well Type	Chemistry	New Well	New Well	Chemistry	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	-	20.7 m	38.1 m	20.7 m	30.5 m	45.1 m
Pump Intake	-	-	38.1 m	-	-	30.5 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	14.3 m	-	-	-
Max. Pumping Rate	-	45.5 Lpm	181.8 Lpm	-	45.5 Lpm	150.0 Lpm
Completion Details		14.9 - 20.7 m	22.9 - 38.1 m		24.7 - 30.5 m	37.2 - 45.1 m
Distance	994 m	994 m	994 m	999 m	1,103 m	1,229 m
Earliest Water-Level	-	22 Jun 1966	20 Nov 2002	-	01 Jan 1965	25 Jun 1981
	-	9.1 m	8.5 m	-	18.3 m	14.3 m
Latest Water Level	-	22 Jun 1966	20 Nov 2002	-	01 Jan 1965	25 Jun 1981
	-	9.1 m	8.5 m	-	18.3 m	14.3 m
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments				Steel Casing. Hydrocell Pumping Unit Above Well Casing. Sand, Clay. Water is Chemically Suitable after Iron SEttles.		GPS taken from the entrance to the camp.
AENV Well ID(s)	0358087	0358088	0341882	0358082	0359313	0358086
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.059653	M35379.059654	M38259.659568	M35379.059648	M35379.060867	M35379.059652
Date Verified	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	28 Oct 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location
Well Name						1981 Camp Kannawin Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Wagn, C	Safronovich, Randy	Turpin, Kevin	LePage, Cory	Abraham, Ron & Debbie	Wright, Virginia
Legal Location	**SE 16-039-01 W5M**	**SE 16-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**
Ground Elevation	975.4 m	975.4 m	955.1 m	964.2 m	942.6 m	942.6 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	57.9 m	97.5 m	36.6 m	68.6 m	36.6 m	35.0 m
Pump Intake	-	76.2 m	24.4 m	68.6 m	36.6 m	-
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	10.4 m	11.7 m	28.0 m	21.9 m	-
Max. Pumping Rate	-	318.2 Lpm	181.8 Lpm	136.4 Lpm	3.3 Lpm	40.9 Lpm
Completion Details		48.8 - 97.5 m	30.5 - 36.6 m	53.3 - 68.6 m	27.4 - 30.5 m	29.0 - 35.1 m
Distance	1,264 m	1,264 m	1,356 m	1,360 m	1,401 m	1,401 m
Earliest Water-Level	-	02 Dec 1999	12 Oct 2005	25 Sep 2002	21 Oct 2008	22 Oct 1990
	-	38.4 m	18.8 m	25.3 m	5.5 m	4.9 m
Latest Water Level	-	02 Dec 1999	12 Oct 2005	25 Sep 2002	21 Oct 2008	22 Oct 1990
	-	38.4 m	18.8 m	25.3 m	5.5 m	4.9 m
Daily Use	-	~4,546 L	~1,364 L	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments	Paskapoo Formation. 6" Steel Cribbing.				Air lift stem in hole. Depth of pump intake if pump tested: 84 feet.	
AENV Well ID(s)	0359293	0495650	1045150	0341883	1065621	0355140
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.060847	M37066.931666	M39227.481789	M38259.659569	M39981.967070	M35379.056752
Date Verified	25 Nov 2009	25 Nov 2009	26 Nov 2009	26 Nov 2009	25 Nov 2009	25 Nov 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location	(03) Confirmed - Expected Location	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name						

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Treiber, Winnie & Ray	Schmale, John	Fisher, Bruce	Sabistan, Wm	Dyck, Paul	Wall, Cal
Legal Location	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**
Ground Elevation	942.6 m	942.6 m	942.6 m	942.6 m	942.6 m	942.6 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	24.4 m	27.4 m	24.4 m	51.8 m	27.4 m	24.4 m
Pump Intake	24.4 m	-	24.1 m	-	27.4 m	24.4 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	9.8 m	14.3 m	-	-	14.9 m	10.7 m
Max. Pumping Rate	113.7 Lpm	113.7 Lpm	136.4 Lpm	45.5 Lpm	36.4 Lpm	113.7 Lpm
Completion Details	18.3 - 24.4 m	21.9 - 27.4 m	15.2 - 24.4 m	45.4 - 51.8 m	22.9 - 27.4 m	19.8 - 24.4 m
Distance	1,401 m	1,401 m	1,401 m	1,401 m	1,401 m	1,401 m
Earliest Water-Level	26 Mar 1992	13 May 1992	02 May 1995	21 Sep 1995	02 Nov 1992	11 Aug 1993
	8.5 m	7.6 m	5.9 m	9.0 m	7.9 m	9.1 m
Latest Water Level	26 Mar 1992	13 May 1992	02 May 1995	21 Sep 1995	02 Nov 1992	11 Aug 1993
	8.5 m	7.6 m	5.9 m	9.0 m	7.9 m	9.1 m
Daily Use	-	-	~909 L	~909 L	-	~1,364 L
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments	Driller Report 9 Gr Hard.				Driller Report 5 Gr Hard, ph 8, Low Iron.	
AENV Well ID(s)	0363951	0364709	0493365	0380537	0369726	0374536
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.065446	M35379.066179	M36727.991005	M35379.081887	M35379.071200	M35379.075998
Date Verified	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name						

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Biluk, Scott	Stebner, Gary	Sunnyside Pentecostal Camp	Breitkreuz, Bernie	Sunnyside Pentecostal Camp	Burt
Legal Location	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**
Ground Elevation	942.6 m	942.6 m	942.6 m	942.6 m	942.6 m	942.6 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	27.4 m	24.4 m	24.4 m	22.9 m	30.5 m	23.8 m
Pump Intake	27.4 m	24.1 m	24.1 m	22.9 m	-	-
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	-	11.6 m	-	-
Max. Pumping Rate	159.1 Lpm	227.3 Lpm	113.7 Lpm	136.4 Lpm	-	68.2 Lpm
Completion Details	21.3 - 27.4 m	18.3 - 24.4 m	18.3 - 24.4 m	18.3 - 22.9 m	24.4 - 30.5 m	16.5 - 23.8 m
Distance	1,401 m	1,401 m	1,401 m	1,401 m	1,401 m	1,401 m
Earliest Water-Level	14 Apr 1994	28 Mar 1996	08 Apr 1997	12 Jun 1991	01 Jun 1944	05 Jun 1969
	6.1 m	9.0 m	13.0 m	6.7 m	18.3 m	8.5 m
Latest Water Level	14 Apr 1994	28 Mar 1996	08 Apr 1997	12 Jun 1991	01 Jun 1944	05 Jun 1969
	6.1 m	9.0 m	13.0 m	6.7 m	18.3 m	8.5 m
Daily Use	~1,818 L	~909 L	~909 L	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments				Sunnyside Pentacostal Church. 8 Gr Hard, 7.6 ph, Low Iron.		Seal type listed as 'Drive Shoe' but no interval defined.
AENV Well ID(s)	0382443	0466317	0467822	0358804	0359315	0359316
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.083781	M36056.965194	M36234.928477	M35379.060359	M35379.060869	M35379.060870
Date Verified	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name			Camp Well			

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Coake, D./Forsythe G.	Coake, J.C.	Adolf, Ken	Jefferies, Val	Lewis, Robert	Forsyth, R.A.
Legal Location	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**	**NW 17-039-01 W5M**
Ground Elevation	942.6 m	942.6 m	942.6 m	942.6 m	942.6 m	942.6 m
Well Type	New Well	New Well	New Well	Chemistry	New Well	Chemistry
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	27.4 m	45.7 m	30.5 m	24.4 m	33.5 m	41.8 m
Pump Intake	-	-	-	-	15.2 m	-
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	-	-	-	-
Max. Pumping Rate	45.5 Lpm	45.5 Lpm	45.5 Lpm	-	45.5 Lpm	-
Completion Details		14.9 - 45.7 m	15.5 - 30.5 m		19.5 - 33.5 m	
Distance	1,401 m	1,401 m	1,401 m	1,401 m	1,401 m	1,401 m
Earliest Water-Level	01 May 1968	01 May 1968	01 Aug 1968	-	15 Oct 1980	-
	6.7 m	7.6 m	6.4 m	-	8.5 m	-
Latest Water Level	01 May 1968	01 May 1968	01 Aug 1968	-	15 Oct 1980	-
	6.7 m	7.6 m	6.4 m	-	8.5 m	-
Daily Use	-	-	-	-	~455 L	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments		Medium Hard Water. Water Encountered Between 40' & 50' Comes From Soft Sandy Formation That will not Clear Properly. Enough Casing Installed to Properly Seal Off This Area. Water Below Come.			Seal type listed as 'Drive Shoe' but no interval defined.	
AENV Well ID(s)	0359317	0359318	0359319	0359320	0359321	0359322
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M35379.060871	M35379.060872	M35379.060873	M35379.060874	M35379.060875	M35379.060876
Date Verified	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name						

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Barnsness, Bob	Alberta Environment	Alberta Environment	Alberta Environment	Alberta Environment	E-Bor Enterprises (Lance)
Legal Location	**NW 17-039-01 W5M**	**15-09-039-01 W5M**	**15-09-039-01 W5M**	**15-09-039-01 W5M**	**15-09-039-01 W5M**	**04-21-039-01 W5M**
Ground Elevation	939.5 m	963.1 m	92.8 m	963.0 m	962.9 m	1,004.2 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Observation	Observation	Observation	Observation	Producing
Well Depth	42.7 m	36.3 m	5.5 m	30.2 m	18.9 m	85.3 m
Pump Intake	39.6 m	36.3 m	5.5 m	-	18.9 m	82.3 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	6.8 m	8.0 m	-	-	-	13.9 m
Max. Pumping Rate	136.4 Lpm	4.6 Lpm	-	4.6 Lpm	-	227.3 Lpm
Completion Details	33.5 - 42.7 m	35.4 - 36.3 m	1.2 - 5.5 m	29.0 - 29.9 m	18.0 - 18.9 m	74.7 - 83.8 m
Distance	1,417 m	1,476 m	1,478 m	1,478 m	1,480 m	1,483 m
Earliest Water-Level	20 Jan 2005	07 Nov 1990	-	24 Oct 1990	-	28 Jun 2006
	26.7 m	27.1 m	-	26.5 m	-	68.9 m
Latest Water Level	20 Jan 2005	11 Nov 1990	-	29 Oct 1990	-	17 Mar 2009
	26.7 m	27.3 m	-	26.5 m	-	69.9 m
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments		Piezometer Located Approx 10's of SErvice Rd E of Campsite #16 in Jarvis Bay Prov. Park. Slug Test.	Piezometer Located Approx 15's of SErvice Road East of Campsite #16 in Jarvis Bay Prov. Park.	Piezometer Located Approx 50's of SErvice Road East of Campsite #16 in Jarvis Bay Prov. Park. Slug Test.	Piezometer Located Approx 30's of SErvice Road East of Campsite #16 in Jarvis Bay Prov. Park.	Air test drill pipe in hole. wall thickness SDR - 21 /// Seal Type listed as "Driven & Bentonite" & "Drive Shoe" however no interval was provided. WW located on top of a hill east of the old pig barn.
AENV Well ID(s)	1045148	0352965	0352964	0352962	0352963	1064534
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M39227.481777	M35379.054620	M35379.054619	M35379.054617	M35379.054618	M39227.494026
Date Verified	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	17 Mar 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(01) Confirmed - Physically
Well Name		No. 2622E	No. 2615E	No. 2613E	No. 2614E	2006 Skinner Water Well

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	U of Calgary, Department of Geology and Geophysics	Dyrland, Bart / Lake Shose Lease	Wiseman, Tom	NOAH HOMES	Jamieson, Johan	Jamieson
Legal Location	**10-09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**
Ground Elevation	961.6 m	961.0 m	961.0 m	960.6 m	960.6 m	960.6 m
Well Type	New Well	New Well	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	60.8 m	30.5 m	42.7 m	36.6 m	20.1 m	18.3 m
Pump Intake	-	-	-	36.6 m	-	-
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	16.8 m	25.3 m		-	-
Max. Pumping Rate	-	68.2 Lpm	90.9 Lpm	181.8 Lpm	27.3 Lpm	27.3 Lpm
Completion Details	29.6 - 35.7 m	23.2 - 30.5 m	31.7 - 42.7 m		12.8 - 20.1 m	13.4 - 18.3 m
Distance	1,496 m	1,532 m	1,532 m	1,532 m	1,543 m	1,543 m
Earliest Water-Level	23 Mar 2006	29 Nov 2005	26 Oct 2005	30 Aug 2007	01 Jan 1959	01 Jan 1959
	27.1 m	6.4 m	6.4 m	12.2 m	6.1 m	5.5 m
Latest Water Level	23 Mar 2006	29 Nov 2005	26 Oct 2005	30 Aug 2007	01 Jan 1959	01 Jan 1959
	27.1 m	6.4 m	6.4 m	12.2 m	6.1 m	5.5 m
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments		Well owner's name: BART DYRLAND c/o lake SHORE LEASE MAINTENANCE.			Paskapoo Formation. /// Seal Type listed as 'Driven' but no interval defined.	Paskapoo Formation. /// Seal Type listed as 'Driven' but no interval defined.
AENV Well ID(s)		1035153	1035155	1035386	0358083	0358090
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M38804.417060	M39227.479145	M39227.479147	M39597.446935	M35379.059649	M35379.059656
Date Verified	24 Mar 2006	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009
Verification Status	(01) Confirmed - Physically	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	Jarvis Bay Research Pumping Well - 2006					

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Jarvis Bay Park Office	Jarvis Bay Prov Park	Department of Public Works	Capture Developing	Executive Builders Group	Town of Sylvan Lake
Legal Location	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**
Ground Elevation	960.6 m	960.6 m	960.6 m	960.6 m	960.6 m	960.6 m
Well Type	Chemistry	Chemistry	New Well	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	-	-	51.8 m	48.8 m	42.7 m	34.5 m
Pump Intake	-	-	47.2 m	48.8 m	42.7 m	28.5 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	10.5 m	25.0 m	-	14.4 m
Max. Pumping Rate	-	-	118.2 Lpm	9.9 Lpm	8.8 Lpm	1,286.7 Lpm
Completion Details			48.8 - 51.8 m	33.5 - 48.8 m	39.6 - 42.7 m	28.8 - 34.5 m
Distance	1,544 m	1,544 m	1,544 m	1,544 m	1,544 m	1,544 m
Earliest Water-Level	-	-	21 Mar 1968	14 Nov 2007	05 Sep 2007	22 Apr 2004
	-	-	38.1 m	8.5 m	4.8 m	14.4 m
Latest Water Level	-	-	22 Apr 1968	14 Nov 2007	05 Sep 2007	22 Apr 2004
	-	-	38.3 m	8.5 m	4.8 m	14.4 m
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments			Jarvis Bay Provincial Park Sylvan Lake.	52' 20 Gal/hour, at 75' 12 Gal/hour. Air lift stem in hole.	Drilling Water from Lake - 2,000 Gallons.	Rick from Town of Sylvan Lake Public Works indicated on 23 Apr 09 that the groundwater is considered to be high-quality groundwater, and not GWUDI. Lois Collier of AENV indicated on 24 Apr 09 that the two Town of Sylvan Lake groundwater licences in NE 09 are applied to this water supply well (Aopproval ID 31585 and 219498), and that WW No. M39927.349078 is a standby WSW.
AENV Well ID(s)	0358091	0358092	0358089	1065435	1470483	
Licensed/Registered Diversion	-	-	-	-	-	-
Consultant Details						
TGWC ID	M35379.059657	M35379.059658	M35379.059655	M39859.702544	M39859.704266	M39927.339327
Date Verified	25 Nov 2009	25 Nov 2009	28 Oct 2009	25 Nov 2009	25 Nov 2009	28 Oct 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(03) Confirmed - Expected Location
Well Name						Town of Sylvan Lake Water Supply Well No. 11

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter						
Owner / Lessee	Town of Sylvan Lake	Town of Sylvan Lake	Town of Sylvan Lake	Ingles Enterprises & Guild, H	Kotai, Steve	Hamm, Marr
Legal Location	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**NE 09-039-01 W5M**	**·· 09-039-01 W5M**	**SE 16-039-01 W5M**	**SE 16-039-01 W5M**
Ground Elevation	960.6 m	960.6 m	960.6 m	936.2 m	980.8 m	980.8 m
Well Type	New Well	Water Test Hole	Water Test Hole	New Well	New Well	New Well
Water Status	Producing	Producing	Producing	Producing	Producing	Producing
Well Depth	33.5 m	42.7 m	48.8 m	39.0 m	61.0 m	59.4 m
Pump Intake	-	-	-	-	-	57.0 m
Top of Aquifer	-	-	-	-	-	-
Total Available Head	-	-	-	21.6 m	-	-
Max. Pumping Rate	-	-	-	145.5 Lpm	45.5 Lpm	54.5 Lpm
Completion Details	26.5 - 33.5 m	11.6 - 42.7 m	15.2 - 39.6 m	29.0 - 39.0 m	45.7 - 61.0 m	39.6 - 57.9 m
Distance	1,544 m	1,544 m	1,544 m	1,551 m	1,593 m	1,593 m
Earliest Water-Level	-	-	-	15 Oct 1992	01 May 1965	06 Aug 1980
	-	-	-	7.3 m	47.2 m	47.2 m
Latest Water Level	-	-	-	15 Oct 1992	01 May 1965	06 Aug 1980
	-	-	-	7.3 m	47.2 m	47.2 m
Daily Use	-	-	-	-	-	-
Number Chemistries (latest analysis)	-	-	-	-	-	-
Comments	Rick from Sylvan Lake Public Works indicated on 23 Apr 09 that the water well is now referred to as Water Supply Well No. 10, and that the groundwater is considered to be high-quality groundwater, and not GWUDI. Lois Collier of AENV indicated on 24 Apr 09 that this water well is a Standby WSW, and that the licensed production WSW is M39927.339327.					
AENV Well ID(s)				0367034	0359291	0359292
Licensed/Registered Diversion	-	-	-	-	-	-

Consultant Details						
TGWC ID	M39927.349078	M38175.417164	M38175.458565	M35379.068503	M35379.060845	M35379.060846
Date Verified	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009	25 Nov 2009
Verification Status	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate	(04) Not Confirmed - Unable to Locate
Well Name	Town of Sylvan Lake Water Supply Well No. 10	Test Well No. 2	Test Hole No. 1			

Field-Verified Survey
Groundwater Records in Area of Interest (duplicates removed)

Survey Centred on: Water Test Hole No. 1-09

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Parameter	
Owner / Lessee	Hamm, M
Legal Location	**SE 16-039-01 W5M**
Ground Elevation	997.2 m
Well Type	New Well
Water Status	Producing
Well Depth	67.1 m
Pump Intake	64.0 m
Top of Aquifer	-
Total Available Head	11.0 m
Max. Pumping Rate	36.4 Lpm
Completion Details	57.9 - 67.1 m
Distance	1,597 m
Earliest Water-Level	06 Aug 1974
	46.9 m
Latest Water Level	06 Aug 1974
	46.9 m
Daily Use	-
Number Chemistries (latest analysis)	-
Comments	
AENV Well ID(s)	0359290
Licensed/Registered Diversion	-

Consultant Details	
TGWC ID	M35379.060844
Date Verified	25 Nov 2009
Verification Status	(04) Not Confirmed - Unable to Locate
Well Name	

Appendix E - Guidelines and Regulations

TABLE OF CONTENTS

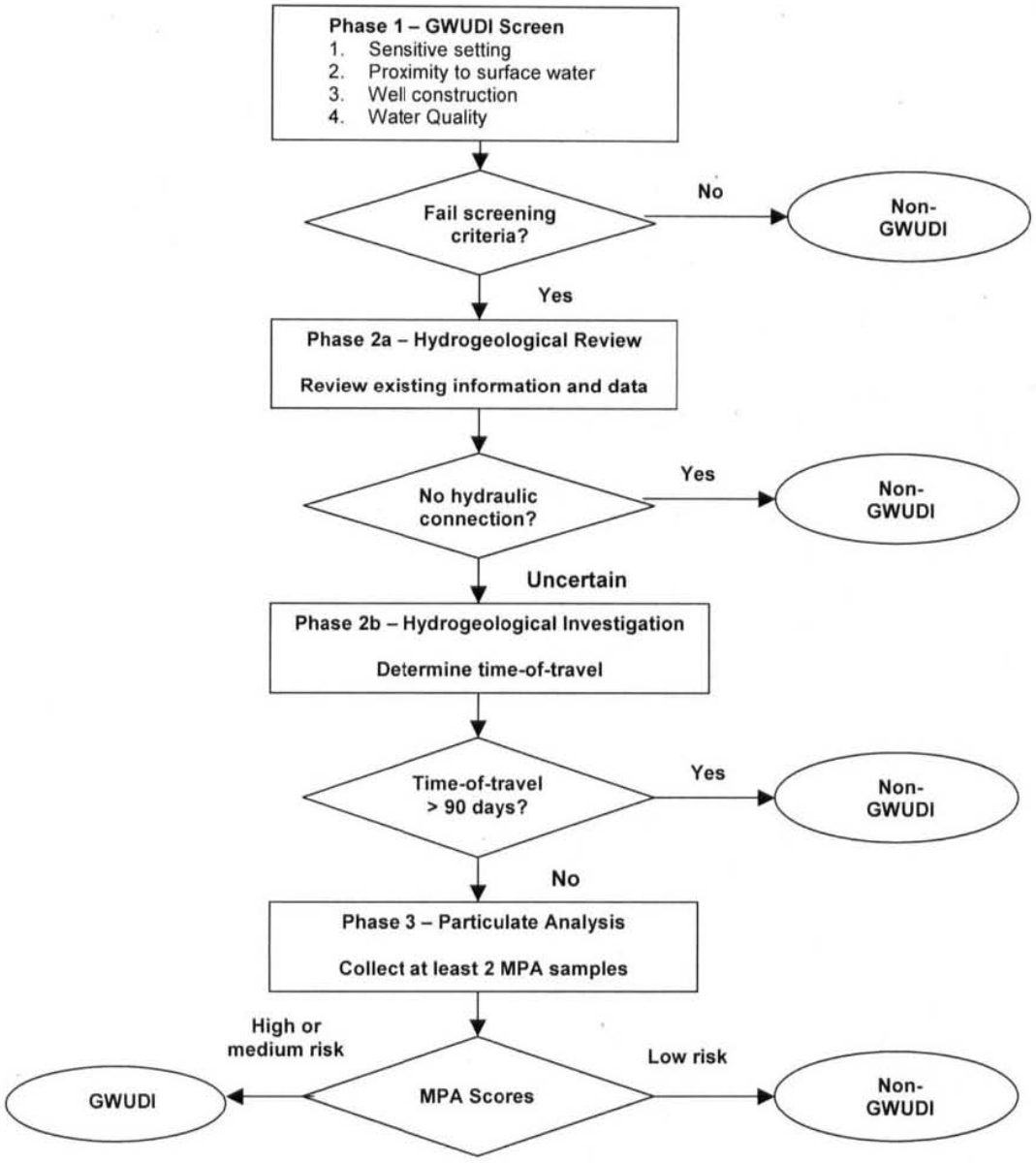
AENV Assessment Guideline for Groundwater Under the Direct Influence of Surface Water (GWUDI)

General

Groundwater under the direct influence of surface water (GWUDI) refers to groundwater supply sources that are vulnerable to contamination by pathogens from nearby surface water or infiltrating precipitation. Groundwater sources that are determined to be GWUDI require treatment equivalent to that required for surface water sources as specified in Section 1.2.1. Waterworks systems using "high quality groundwater" must not be under the direct influence of surface water according to the *Potable Water Regulation (Alberta Regulation 277/2003)*.

This assessment guideline presents the protocol for determining whether a source is GWUDI or non-GWUDI. The assessment is to be carried out by a qualified hydrogeologist or groundwater engineer who is a member of APEGGA. The assessment is divided into three phases, which is outlined in the flow chart in Figure 1. The concept of the guideline is to initially flag potential GWUDI sources, followed by more detailed investigations to determine whether or not a source is GWUDI.

Figure 1: GWUDI Assessment Flowchart



PHASE 1 – GWUDI Screen

The purpose of the screening is to rapidly identify obvious non-GWUDI sources that do not require a detailed assessment. The screening criteria are as follows:

1. ***Sensitive Setting*** – the source shall not be a:

    a. spring, infiltration gallery, shallow collector system, artificial recharge system, bored well or dug well

    b. well with a production zone less than 15m below ground surface

    c. well in an unconfined aquifer

    d. well completed in fractured or karst bedrock exposed at or near the land surface.

2. ***Proximity to surface water*** – the source shall not be located within 100m of any permanent, intermittent or seasonal surface water body, including ponds, sloughs, lakes, rivers, streams, dugouts, lagoons, reservoirs, irrigation canals or ditches, gravel pits, mining pits or any other open water features.

3. ***Well Construction*** – The source shall be a drilled well which meets the requirements under the current version of the *Alberta Water (Ministerial) Regulation (Alberta Regulation 205/98)*. A drilled well shall have a surface seal that prevents surface water from migrating down the annulus of the well. A drilled well shall be constructed in a manner such that only water from the producing interval enters the well. The wellhead shall be well graded and drained and show no signs of poor construction or deterioration.

4. ***Water Quality*** – The raw or treated water from the source shall not exhibit evidence of contamination by surface water. This means significant occurrence of insects, insect parts, and other microorganisms such as total coliforms (on a regular basis), E.coli, algae, *Giardia*, *Cryptosporidium*, or viruses; or significant and relative rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH, closely correlating to climatological or surface water conditions.

Should a drinking water source not meet any of the above criteria, the source is flagged as potentially GWUDI, and the assessment is to proceed to Phase 2 or the source can be declared as GWUDI.

If the criteria under #1 and #2 are met but not the criteria under #3 and #4, instead of proceeding to Phase 2, system owners may modify the well construction to ensure the criteria under #3 and/or #4 are met.

PHASE 2a –Hydrogeological Review

The objective the hydrogeological review is to determine if a water source can be designated as GWUDI or non-GWUDI based on existing data and knowledge. It may identify factors not considered in the screening process. The following information is normally required for this evaluation:

- geological / lithological data, including depth and thickness of production zones, overlying confining beds and other subsurface units
- depth of surface water bodies, penetration of any confining units by surface water bodies
- cross-section(s) showing site stratigraphy in relation to surface water bodies
- any history of flooding
- pumping test results (recharge boundaries , hydraulic connection to surface water)
- hydraulic conductivity testing of confining units
- comparison of any historic groundwater level and surface water level monitoring
- comparison of any historic groundwater quality and surface water quality data
- estimate of time-of-travel between surface water and the source where possible.

If there is reasonable uncertainty as to whether a source is vulnerable to the direct influence of surface water, further assessment is required. Proceed to Phase 2b or declare the source as GWUDI.

PHASE 2b –Hydrogeological Investigation

The objective of the hydrogeological investigation is to determine if there is an existing or potential hydraulic connection that could allow rapid recharge of the well by surface water or precipitation. This phase can be combined with Phase 2a under one hydrogeological investigation.

The hydrogeological investigation will require determination of the time-of- travel between a surface water body and a source well. Various methods are available to determine time-of-travel, including water quality hydrograph analysis, computer modeling, analytical methods or tracer tests. The choice of method should take into account the proximity of the surface water body and/or anticipated travel times. For instance, hydrograph analysis of water quality parameters such as temperature, conductivity and pH may be the best option for surface water bodies that are very close to a source well in the same aquifer. It is recommended that monitoring of these parameters be collected on a weekly basis for a minimum of one year, unless a hydraulic connection is recognized early in the program.

Computer modeling involves using particle-tracking techniques to determine time-of-travel, in a similar manner to capture zone modeling. This option may be best suited to situation where greater travel times are anticipated and sufficient information is available. Note that this option may require further intrusive work (e.g. drilling, pumping test, monitoring, etc) in order to obtain

suitable information for the modeling work. Model assumptions and sensitivity analysis must be included in the final report.

Should the time-of-travel be determined to be less than 90 days, proceed to Phase 3 or declare the source as GWUDI.

PHASE 3 – Microscopic Particulate Analysis

The results of Phase 2b may determine that there is a hydraulic connection between a source well and a nearby surface water body. However if the subsurface units provide sufficient natural filtration to remove most surface water organisms and debris, the well source may be exempted as GWUDI.

Microscopic Particulate Analysis (MPA) is used to determine if there are significant surface water particulates reaching the well source. The test involves filtering approximately 4,500 litres of water to concentrate organisms and debris, which are then identified and quantified under a microscope by an accredited laboratory. The laboratory shall classify the result as low, medium or high risk.

A minimum of two MPA samples shall be collected, during periods when there is the greatest possibility for surface water to impact a source well (i.e. worst-case situation). This will usually be after a significant storm or snow melt event. *The sampling time can only be determined after the time-of-travel has been determined under Phase 2.* If lag time is not used to determine the sampling times, there is a strong possibility that the result will not reflect a worst-case situation. It is recommended that at least one sample be collected in the spring.

The MPA analysis and scoring is to be conducted according to the *Consensus Method for Determining Groundwaters Under the Direct Influence of Surface Water Using Microscopic Particulate Analysis* (USEPA, 1992). Under this method, samples are scored as follows:

- <10 low risk
- 10 – 19 medium risk
- >20 high risk.

A water well source shall be declared GWUDI upon a ***medium*** or ***high-risk*** score, unless remedial action and/or further sampling demonstrate otherwise.

GWUDI Determination

A qualified hydrogeologist or groundwater engineer who is a member of APEGGA shall conduct GWUDI assessments. Professional judgment shall be used to evaluate all the evidence collected in the final determination of whether a water source is GWUDI or non-GWUDI. Generally, all well sources that that do not exhibit any evidence of a current or potential direct connection with surface water or are determined to have a time-of-travel greater than or equal to 90 days to any nearby surface water bodies will be considered non-GWUDI. Evidence for a well source being GWUDI is generally more conclusive than evidence it is not GWUDI. Where uncertainty or doubt exists, it is best to adopt a cautionary approach and consider the source GWUDI.

Information on MPA Analyses with Respect to GWUDI Determination

Hyperion Research Ltd.
1008 Allowance Ave. SE
Medicine Hat, AB T1A 3G8
Tel. (888) 529-0847
hyperion@telusplanet.net
Fax. (403) 529-0852
www.hyperionlab.ca

WHAT IS A GUDI ANALYSIS?

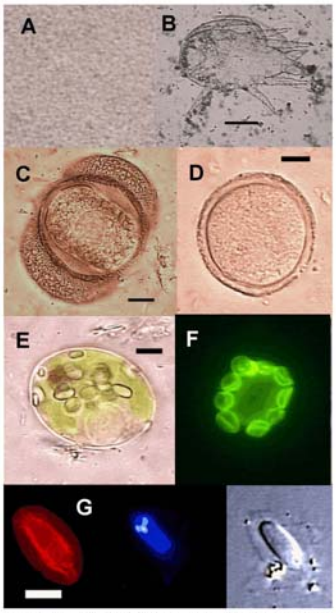
GUDI stands for Groundwater Under the Direct Influence of surface water and it means that water coming from a well or spring is hydraulically connected to a nearby surface water body such as a lake or stream. True groundwater may be deep or shallow but it has passed through soil, weathered material or rock and is stored underground in the tiny spaces between rocks and particles of soil. This provides natural filtration and long term storage that removes potential pathogens. Surface water is defined as water open to the atmosphere and subject to surface runoff which may be contaminated with microbial pathogens. Potential drinking water sources such as springs, infiltration galleries or shallow wells (<15 m or 50 feet) may produce water that has recently been in contact with the surface. Lakes, ponds, streams etc. within 60 m (200 feet) of wells are potential sources of surface water that may reach wells or springs, particularly when large volumes of water are being pumped.

How Can You Tell if a Well is GUDI?

Groundwater under the direct influence of surface water demonstrates significant and relatively rapid shifts in turbidity, temperature, conductivity or pH which closely correlate to climatological or surface water conditions. GUDI wells also contain surface water organisms such as algae and insects and may be contaminated with pathogens such as *Giardia lamblia* (beaver fever) or *Cryptosporidium*.

Monitoring of physical parameters in both well water and adjacent surface waters can reveal correlations that indicate surface water influence. A knowledge of local hydrology and details of the well installation are also very useful. If these factors indicate a possible GUDI well, an additional analysis called a Microscopic Particulate Analysis can be performed. In this test, a large volume of the well water is filtered through a 1 µm filter and the trapped particulate matter is examined for the presence of surface water organisms. Secondary indicators such as plant debris and nematodes which are commonly found in groundwater are not good indicators of surface water infiltration. At least one sample should be taken and preferably two, one at high water in the spring and another at low water later in the year.

The method for the Microscopic Particulate Analysis was developed by the United States Environmental Protection Agency and can be downloaded at www.doh.wa.gov/ehp/dw.



A. Precipitated minerals suspended in a non-GUDI sample. **B.** Immature crustacean. **C**. Spruce pollen. **D**. Nematode egg. **E**. Algae cell from a GUDI well. **F**. *Cryptosporidium* oocysts surrounding a *Giardia* cyst. **G**. *Giardia* cyst by immunofluoresence, showing nuclei and by light microscopy.

Taking A Microscopic Particulate Analysis Sample

An MPA sample is taken by filtering a large volume (2-5000 L) of raw water through a 1 µm cartridge filter at the wellhead. The sample is shipped to the laboratory over ice in a cooler where it is cut open and the particulate matter washed out and concentrated. Background minerals are reduced by density gradient centrifugation and the sample is split for *Giardia/Cryptosporidium* analysis and examination for surface water organisms by light microscopy. *Giardia* and *Cryptosporidium* are stained with fluorescent dyes attached to antibodies which causes them to glow against a dark background (see panel at right). The results are tabulated and a risk assessment is made based on the type and number of organisms found.

Why Hyperion?

Hyperion Research Ltd. has been analyzing water samples for *Giardia*, *Cryptosporidium* and microscopic particulates for 20 years. The company is based in Medicine Hat and serves the Canadian water industry in all provinces and territories. Visit our website at www.hyperionlab.ca for further information.

AENV Water (Ministerial) Regulation (44 to 58)

(b) that a copy of the drilling report is provided to the Director and the owner of the water well.

(2) A person who drills a water well for which an approval is not required under this Regulation must, within 60 days after completion of the water well,

(a) complete a drilling report in a form acceptable to and containing the information required by the Director, and

(b) provide a copy of the drilling report to the Director.

(3) A person required to complete a drilling report under this section must keep a copy of it for at least 5 years after it is completed.

Records during drilling

42 During the drilling of a water well, the driller must

(a) maintain a current record of the construction and testing of the water well, including a lithologic log, and

(b) have the record available for inspection.

Reporting saline groundwater or gas

43**(1)** If saline groundwater is encountered in drilling a water well, the driller must

(a) notify the owner of the water well that saline groundwater has been encountered, and

(b) ensure that the saline groundwater is sealed off to prevent it from mixing with any other water that is not saline groundwater.

(2) If gas is encountered in drilling a water well, the driller must

(a) notify the owner of the water well that the gas has been encountered,

(b) subject to subsection (3), notify the Director within 24 hours after encountering the gas, and

(c) subject to subsection (3), ensure that the gas is immediately sealed off to prevent an adverse effect on the environment, human health, property and public safety.

(3) Subsection (2)(b) and (c) only apply when gas is encountered in a quantity that would prevent the safe drilling or operation of the water well.

(4) If saline groundwater or gas is encountered in the drilling of a water well, the driller must, in the drilling report, report to the Director the remedial steps taken.

Water well site specifications

44**(1)** The driller and the owner of a water well must locate the water well site so that

(a) the water well is accessible for cleaning, treatment, repair, testing, maintenance and inspection,

(b) the area immediately surrounding the water well may be kept in a sanitary condition,

(c) surface water does not collect or form a pond in the vicinity of the water well, and

(d) the water well is at least 3.25 metres away from the nearest building.

(2) No person shall locate a water well in a pit.

Pumphouse

45**(1)** No person shall locate a water well in a building other than a pumphouse that houses only the water well and the pump.

(2) The owner of a water well must ensure that a pumphouse is constructed and maintained so that water does not collect on the pumphouse floor.

Distance from sources of contamination

46**(1)** No person shall locate or drill a water well for the diversion of groundwater, other than saline groundwater, closer to a thing described in Column 1 of Table 1 than the distance specified in Column 2 of Table 1.

(2) If the diversion of water from a water well is licensed for municipal purposes, no person shall locate or drill the water well closer than 100 metres from any thing listed in Column 1 of Table 1.

Table 1

Column 1 **Sources of Substance**	**Column 2** **Minimum Distance Required**
Watertight septic tank or sewage holding tanks	10 metres
Sub-surface weeping tile effluent disposal field or an evaporation mound	15 metres
Sewage effluent discharge to the ground surface	50 metres
Sewage lagoon	100 metres
Above ground storage tanks containing petroleum substances	50 metres

Construction requirements

47 The driller of a water well must ensure that the water well meets the following requirements:

(a) the water well must be constructed so that surface water or substances can not enter any aquifer;

(b) the water well must be designed and developed so as to allow production consistent with the water well owner's water requirements, taking into account the production potential of the aquifer being used;

(c) the water well must be constructed so that the casing extends

(i) not less than 20 centimetres above the pumphouse floor or the established ground surface, and

(ii) at least 60 centimetres above the highest flood record in the area, if the water well is not to be equipped with a watertight cap;

(d) the water well must be sufficiently straight and free of obstructions to admit the pumping equipment without damage;

(e) in the case of a water well intended to be equipped with a submersible or independent jet pump, the water well must be constructed so that the casing has an inside diameter of at least 10.16 centimetres from the top of the water well to below the optimum pump intake depth;

(f) when non-metallic pipe is used as casing, the water well must be protected at the ground surface by steel casing that is firmly anchored in the ground;

(g) in the case of a diversion of groundwater from a water well that must be licensed, the water well must be

(i) constructed in a manner that does not result in multiple aquifer completions,

(ii) constructed with an open hole with a slotted or screened section that does not exceed 7.62 metres if distinct water-producing units are not present, and

(iii) sealed the full length of the annulus from the ground surface to the top of the aquifer using suitable cement, grout, concrete, bentonite or equivalent commercial slurry, or using clay slurry, impervious water well cuttings or impervious overburden materials;

(h) a water well that is bored or dug must be provided with a cover that has a 5-centimetre overlap and does not allow water to enter through the top.

Covering of water well

48 The owner, in the case of a completed water well, and the driller, in the case of a water well that is being drilled and is left unattended, must ensure that the water well is securely covered to prevent the entry of surface water and foreign materials into the water well and to prevent persons or animals from falling into the water well.

Specifications for materials

49 No person shall use or permit the use of materials in the drilling, construction, maintenance, servicing or monitoring of a water well unless the materials

(a) are new and uncontaminated, and

(b) meet or exceed the specifications set out for that material and purpose by the Canadian Standards Association or the American Society for Testing and Materials.

Fluids and substances

50 No driller shall use a fluid or substance in a drilling operation that may cause an adverse effect on the environment, human health, property or public safety.

Casing joints

51 The driller must ensure that all joints in the casing of a water well are made so as to prevent entry into the water well of any substance that may cause an adverse effect on the environment, human health, property or public safety.

Casing specifications

52**(1)** The driller must ensure that casing used in a water well has at least the following wall thickness:

(a) 4.78 millimetres for metal well casing;

(b) 3.96 millimetres for metal liner casing;

(c) for cement-like casing, 6.35 centimetres if the inside casing diameter is 60.96 centimetres or less, with an additional 2.54 centimetres for each additional 30.48 centimetres of diameter;

(d) 16-gauge for corrugated and galvanized steel casing used in bored or dug water wells.

(2) The driller must ensure that plastic casing used in a water well

(a) is ABS or PVC pipe manufactured from virgin resin and approved for potable water use by the Canadian Standards Association or the American Society for Testing and Materials, and

(b) meets or exceeds the specifications for wall thickness set out in Table 2.

Table 2

Nominal Pipe Size (Millimetres)	Standard Dimension Ratio or Schedule Number	Minimum Wall Thickness (Millimetres)
50.8	SDR 21	2.67

	SCH 40	3.91
	SCH 80	5.54
76.2	SDR 21	4.24
	SCH 40	5.49
	SCH 80	7.62
101.6	SDR 21	5.44
	SCH 40	6.02
	SCH 80	8.58
127.0	SDR 21	6.73
	SCH 40	6.55
	SCH 80	9.53
152.4	SDR 21	8.03
	SCH 40	7.11
	SCH 80	10.97
203.2	SDR 21	10.41
	SCH 40	8.18
	SCH 80	12.70
254.0	SDR 21	12.98
	SCH 40	9.27
	SCH 80	15.08

Annulus

53**(1)** A driller who drills a water well by a method other than boring or digging must,

(a) when a casing-liner completion method is used, fill the annulus from the bottom of the casing to the ground surface, and

(b) when a single string casing completion method is used, fill the annulus from immediately above the perforated section to the ground surface.

(2) The annulus must be filled with a suitable cement, grout, concrete, bentonite or equivalent commercial slurry, or with clay slurry, impervious water well cuttings or impervious overburden materials.

(3) A driller who drills a water well by boring or digging to a depth of more than 4.5 metres must fill the annulus

(a) adjacent to the perforated section of the casing, and not closer to the land surface than 4.5 metres, with clean material free of clay and silt, and

(b) between the ground surface and the area described in clause (a) with suitable cement, grout, concrete, bentonite or equivalent commercial slurry, or with clay slurry, impervious water well cuttings or impervious overburden materials.

(4) A driller who drills a water well by boring or digging to a depth of 4.5 metres or less must fill the annulus

(a) from the bottom of the water well to a depth not closer to the ground surface than one metre with clean material free of clay and silt, and

(b) between the ground surface and the area described in clause (a) with suitable cement, grout, concrete, bentonite or equivalent commercial slurry, or with clay slurry, impervious water well cuttings or impervious overburden materials.

Deepening water well

54**(1)** Subject to subsection (2), if an existing water well is deepened, this Regulation applies to the deepening, including the portion of the existing water well that is used as part of the deepened water well.

(2) If an existing water well that was bored or dug is deepened by a method other than boring or digging through the bottom of the water well,

(a) the water well must have casing that extends upward through the dug or bored water well in accordance with section 47(c), and

(b) the annulus between the casing referred to in clause (a) and the casing of the existing bored or dug water well must be filled from the bottom to the ground surface with suitable cement, grout, concrete, bentonite or equivalent commercial slurry, or with clay slurry, impervious water well cuttings or impervious overburden materials.

Potential flowing water well

55 If a water well being drilled has the potential of flowing, the driller must ensure that the water well is drilled in a manner that prevents the water from flowing out of control.

Completed flowing water well

56**(1)** On completion of a flowing water well, the driller must ensure that the water well is equipped with a variable flow control device to control the flow of water from the water well.

(2) After the installation of the variable flow control device, the driller must

(a) stop the flow of water for a period of not less than 48 hours by closing the control device, and

(b) ensure that the water well is effectively sealed to prevent the escape of water from the annulus of the water well or its immediate vicinity.

Maximum allowable flow

57**(1)** No person shall allow a flowing water well to flow at a rate in excess of the lesser of

(a) the water requirements of the owner of the water well, and

(b) 100 cubic metres per week.

(2) Subsection (1) does not apply to a water well that is licensed and the licence authorizes a yield in excess of 100 cubic metres per week.

Disinfection of water well

58 When a water well, other than a flowing water well, has been drilled, developed and yield tested, the driller must

(a) disinfect the water well so that a concentration of 200 milligrams of chlorine per litre of water is present throughout the water in the water well, and

(b) maintain the concentration prescribed in clause (a) in the water well for a period of at least 12 hours.

Protection from sediment

59 The driller must complete a water well in a manner that ensures that the pumping system, plumbing and fixtures are not damaged by sediment in the water.

Installation of pumping equipment

60 A person who installs pumping equipment in a water well must ensure that the pumping equipment is installed so that

(a) the pump, water well and its surroundings can be kept in a sanitary condition,

(b) the flow rate does not exceed the recommended pumping rate of the water well as set out in the drilling report,

(c) the pump is not placed in an unsupported open hole,

(d) if the connection of the pumping equipment through the casing of the water well is made below the ground surface,

(i) a pitless adapter is used and the connection is watertight, and

(ii) the outside excavation

(A) extends a minimum distance outward of 0.5 metre from the casing,