



Groundwater Information Technologies Ltd.

Water Supply Evaluation

Sundre Gravel Pit

SE – 35 – 32 – 06W5

Prepared For:

West-Can Seal Coatings Inc.

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Executive Summary

An aquifer study was undertaken for a commercial groundwater supply well for a gravel pit operation in SE – 35 – 32 – 06W5. The purpose of the study was to determine whether the gravel aquifer underlying the site can supply water for a net amount of 6,927m³/year for a gravel washing operation.

Three wells were installed on the site in February 2018 to determine aquifer properties. A main supply well obtains water from a laterally extensive and thick sandy gravel aquifer deposited by glacial melt water channels and streams in a buried valley type deposit. Two observation wells were installed completed in the same gravel aquifer to serve as long term observation wells during gravel pit operation.

The sandy gravel is approximately 20 – 30 meters in thickness and underlain by the sandstones and shales of the Paskapoo Formation. These gravels extend northward to Bearberry Creek and southward to Red Deer River and it is interpreted that these gravels are in direct communication with surface water sources.

A field verified survey was undertaken February 8th, 26th and March 1st, 2018 by personnel from Groundwater Information Technologies Ltd. to assess groundwater users within a one-mile radius of the supply well. Fifty-two well users were interviewed for their water usage; the vast majority of wells are designated for domestic purposes. Approximately two thirds of the users obtain water from the gravel aquifer.

A long term 72-hour pumping test was conducted from February 26th to March 1st by personnel from Aaron Drilling Inc. Water was pumped at a rate of 130 m³/day (20 imperial gallons per minute). Water levels were recorded for 4320 minutes of continuous pumping and for an additional 4320 minutes after pumping cessation. Analysis of the pumping test data calculated a long term safe yield (Q₂₀) of 1,600,000 m³ per year and 4373 m³/day, indicated West-Can should be able to pump at the requested rate with no adverse effects.

A numerical model was developed to examine future drawdowns in the aquifer for a groundwater extraction program from a pit rather than a well. No adverse effects to existing wells in the area is calculated as drawdowns at the distance of neighbouring wells will be insignificant and the aquifer will be recharged by precipitation and flow from the Bearberry Creek or Red Deer River.

The water in the area is a calcium bicarbonate type with elevated levels of manganese and relatively low total dissolved solids concentration (259 mg/L), and is acceptable for its intended use.



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Appendix B – Water Well Drilling Reports

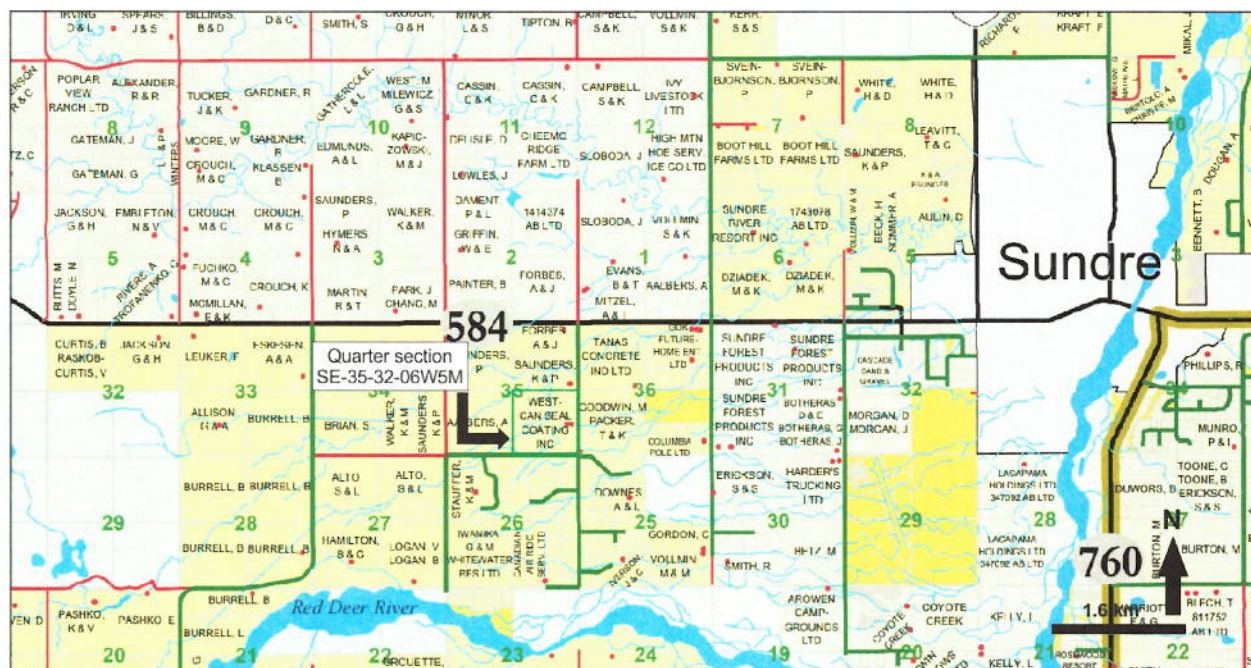
Appendix C – Exova/Element Labs Water Well Chemistry Report

[1.0] Introduction

A ground water investigation was undertaken for a commercial water supply located in the SE ¼ – Section 35 – Twp 32 – Range 06W5M west of the town site of Sundre Alberta, for proposed gravel pit to be operated by West Can Seal Coating Ltd. The investigation is undertaken to obtain a water licence from Alberta Environment and Parks (AEP).

The gravel pit (hereafter referred to as the site) is located within the County of Mountain View. The site map as shown on Figure 1 shows the site location south of highway 584 roughly 6 kilometers west of Sundre.

Figure 1: Quarter section site location, Mountain View land owner map



Three wells were installed on the site in February 2018 by personnel from Aaron Drilling Inc. The purpose of the wells is to determine aquifer properties of the sands and gravels underlying the site, determine if a main production well can supply sufficient water for the gravel operations, and serve as long term observation wells during operation of the gravel pit. Numerous acreages are located south of the site and one observation well was installed along the south property line to record water levels between the gravel pit production well and acreage wells.

An aerial photograph of the site and well head locations is shown in Figure 2

Figure 2: Aerial Photograph of site and well locations



[2.0] Water well supply needs

West Can Seal Coatings gravel pit will pump water at a rate 3 m³/min, washing will occur for 12 hours a day for 60 days per year for a total use of 130,000 m³/year. Most of the water will be recycled through a series of settling and take up ponds. It is estimated that 1% of the water pumped through the system will be lost to adherence to the aggregate and evaporation. Base of a total surface area of 8,500 m² and an annual evaporative loss of 662 mm for the Sundre area, 5,627 m³ of evaporation loss will occur.

Table 1: Calculations table

Calculations Table		
Discharge Ponds area	=	8,500 m ²
Annual Evaporation (662mm/yr), 0.662 m * 8500 m ²	=	5,627 m ³
Annual Adherence and Stockpile loss	=	1,300 m ³
Annual Total loss	=	6,927 m ³



The above table shows that annual adherence and stockpile evaporation is estimated to result in an additional 1,300 m³ in losses. The total annual loss is calculated at 6,927 m³.

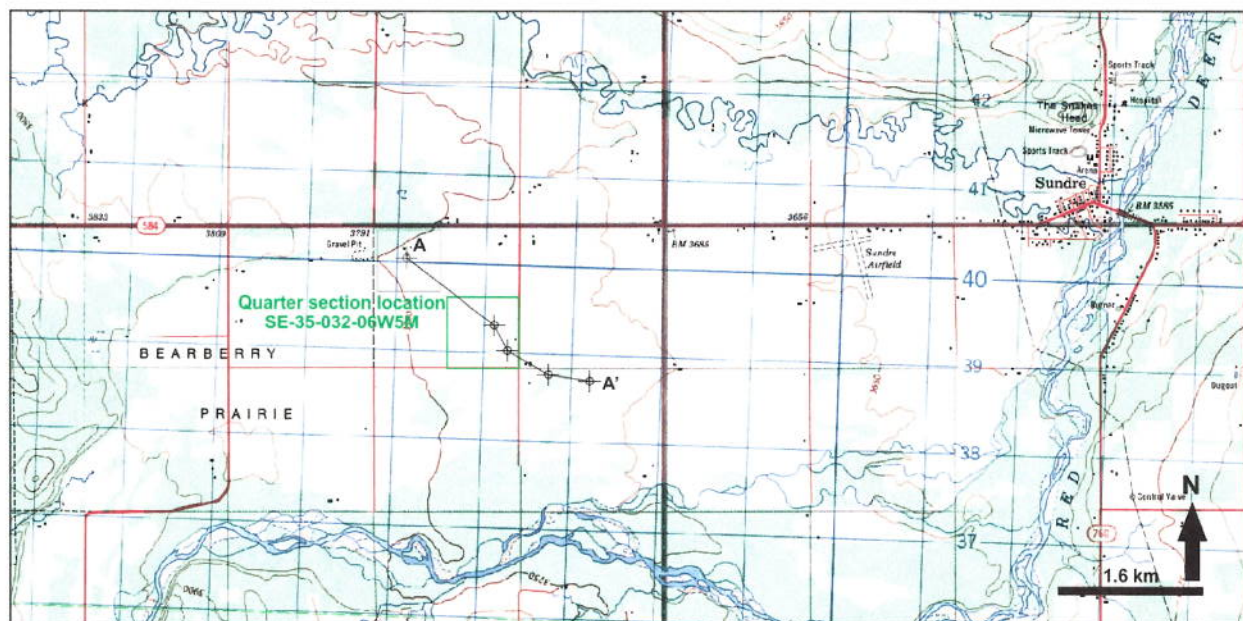
[3.0] Nature of Regional Aquifers

[3.1] Topography

The local topography is relatively flat and is termed the Bearberry Prairie area within an overall foothills type of environment. Topographic maps show there is roughly less than 25 meters change in elevation over the entire section, and that the wider area slopes to the east toward the town of Sundre. The area is characterized by remnant channel beds which are visible in Figure 2. These, unlike seasonal tributaries and coulees, do not define modern day drainage but are the result of glacial retreat and deposition of the surficial geology.

A topographic map of the area quarter section showing the approximate cross section and its well locations as follows:

Figure 3: Topographic map of area, ¼ section and cross section location



[3.2] Surficial Geology

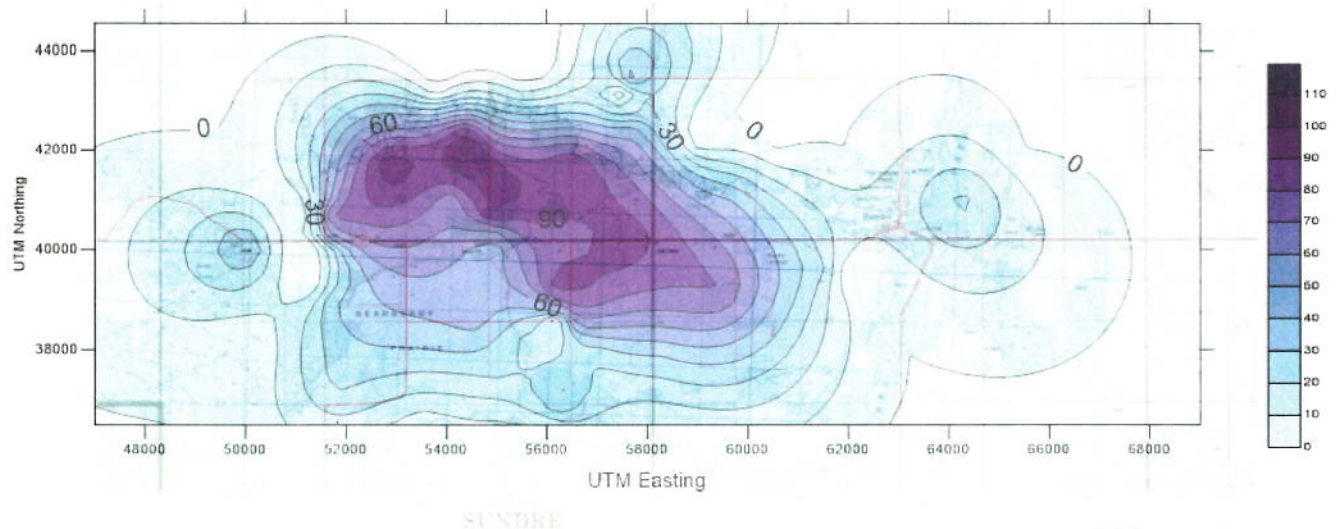
Water well drilling reports from the area describe the upper 10 – 30 metres of sediment as predominantly gravel with minor amount sand lenses and areas of sandy gravel. The surficial strata in the area are mapped by Fenton (Surficial Geology of Alberta; AGS map 601) as fluvial deposits which are the result of streams and rivers. These types of deposits may include gravels, sands, silts and clays, however the area



is likely depleted of finer grained sediments indicating higher energy fluvial environment. It is interpreted these surficial sediments are in hydraulic communication with the Red Deer River and Bearberry Creek.

AEP water well data was reviewed to determine the gravel thickness and aerial extent. Location and thickness data of gravels from the water well records was entered into the SURFER program developed by Golden Software to illustrate the thickness in feet and extent of gravel as follows:

Figure 4: Isopach map showing gravel thickness and extent



The map shows that a maximum thickness of over 110 feet (33.5 m) is obtained in the area, generally on the north side of Highway 584. A gravel thickness of approximately 70 feet (21.3 m) underlies the gravel pit site.

Although numerous groundwater levels were measured the groundwater flow directions are not determined as part of this report as well elevations could not be established with sufficient certainty without a formal survey of elevations. It is likely that groundwater flow in the gravel aquifer has an eastward component. Whether the flow has a northward or southward component to Bearberry Creek or the Red Deer River would require further survey. These measurements would illustrate whether these surface water bodies are gaining or losing streams, which may change seasonally.

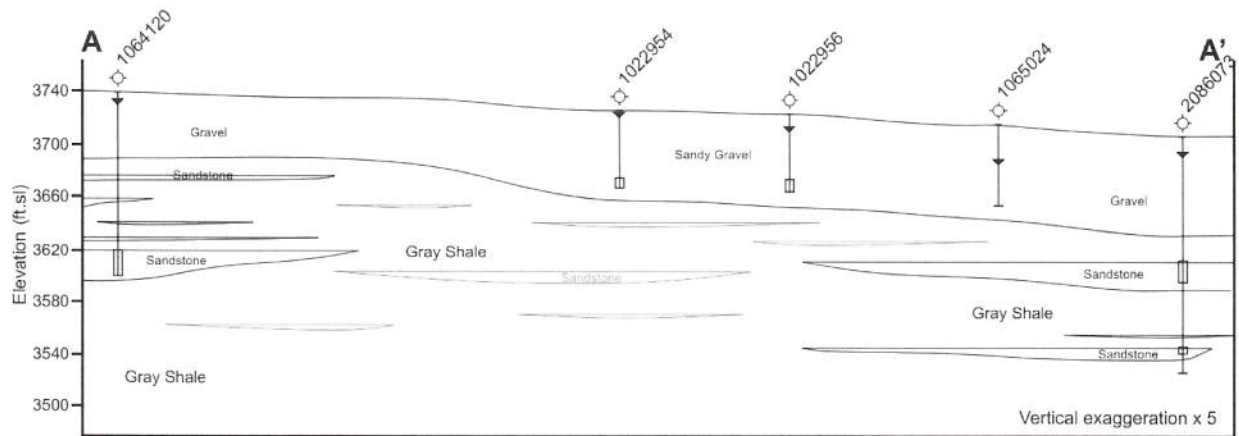
[3.3] Bedrock Geology

Underlying the relatively thick surficial cover are the early/lower Paleocene deposits of the Paskapoo Formation, most likely belonging to the upper most Lacombe member in this area. Generally, the Paskapoo Formation consists of interbedded fluvial sandstone and overbank mudstone and shales with limited bentonites and coals. Individual sandstone channels are usually limited in regional extent and thickness, channel belts comprised of overlapping channels (termed multi-story channels) are preferred aquifer targets to ensure a thick and laterally continuous sandstone aquifer. A cross section is shown in



Figure 5 using water well drilling records from the area, showing relative depth of surficial quaternary sediment, depth to bedrock, and apparent thickness of sandstone channels.

Figure 5: Geological cross section A-A'



[3.4] Hydrogeology

The Agriculture and Agri-Food Canada Hydrogeological Assessment report for Mountain View County estimates water yields 10 – 100 m³/day for the surficial sand and gravel aquifers. While sand and gravel aquifers are expected to have higher permeability, these aquifers occur mainly as hydraulically discontinuous pockets, limiting apparent water well yields. Aquifers adjacent to parts of the Red Deer River may have apparent water well yields ranging from 100 – 500 m³/day.

Apparent water well yields for the upper most bedrock in the area are relatively low, generally less than 10 m³/day. However, the average yields for the bedrock strata range from 10 – 100 m³/day which are generally sufficient for domestic use.

[4.0] Area Ground water users

Alberta Environment and Parks water well database lists 56 wells within a 1.6-kilometer radius (1 mile) with the majority of the wells are designated for domestic purposes, with ~10 wells purposed for stock watering. Wells are drilled to depths between 10 – 60 metres, with most wells drilled to depths between 15 – 25 metres. Static water levels in the area for shallow, with water well levels consistently between 3 – 6 metres below the top of casing. The AEP reconnaissance report is attached in Appendix A.

[4.1] Groundwater wells in the area

A search of AEP water licence database was undertaken to determine if any water licences are present in the area. A summary of ground water licences and registrations in the subject section and surround eight sections is as follows:



Table 2: Water Licences and registrations

Location	License/ Registration	Depth (m)	Volume (m3/year)	Licensee
01-33-06W5	-/-	-	-	-
02-33-06W5	-/1	-	-	-
03-33-06W5	-/2	-	-	-
36-32-06W5	-/2	-	-	-
35-32-06W5	-/1	-	-	-
34-32-06W5	-/2	-	-	-
27-32-06W5	-/-	-	-	-
26-32-06W5	-/-	-	-	-
25-32-06W5	-/2	-	-	-

Licenses for surface water diversions were not included in Table 2. No existing ground water licenses exist in the site section or surrounding eight sections. The ground water use in the area based on domestic and stock water usage can be described as marginal to moderate.

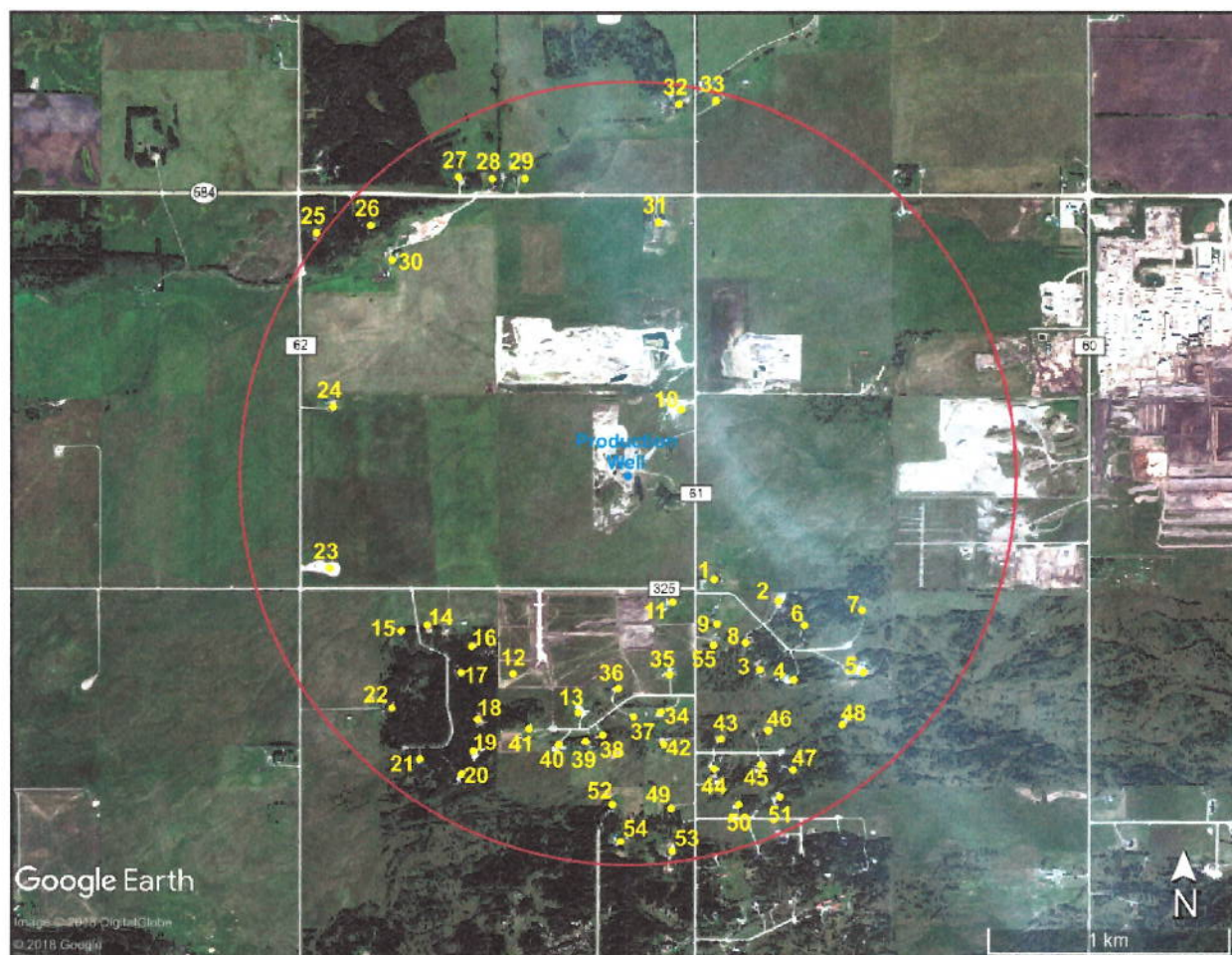
[4.2] Field Verified Survey

A field verified survey of ground water users within 1.6 km of the site was under taken on February 8th, February 26th and March 1st, 2018. Questions to occupants were made concerning the source of their water supply and details of the well such as age, depth, driller etc. Permission to measure the non-pumping water level in each well was requested. The water levels were read with the aid of a sonic water level meter. Due to safety concerns, water levels were not read in pits, sheds or basements. Reported artesian wells capped were not measured and caps not removed.

At residences where no answer was received (possibly due to seasonal occupation of the site) a letter with a stamped return address was left. A copy of the letter is attached in Appendix A.

An air photo of area showing the location of field verified wells is shown as following:

Figure 6: Field Verified Survey aerial photograph



A summary of water users is as follows:

Table 3: Field Verified Survey results

Map Well Identifier	1	2	3	4
Location LSD/DLS	SW-36-032-06W5	13-25-32-06W5	NW-25-32-06W5	NW-25-32-06W5
well owner	Goodwin, Mary	Thompson, Bill	Tifford, John & Karen	Smith/Poulson
Use	Residence + cattle	Residence	Residence	Residence
Well ID		1065024	1245174	1060305
Depth (ft)		60	133	60
Aquifer Type			Sandstone	Gravel
Aquifer zone (ft)			87-120	57-60
Date drilled	>50 yrs	2007/08/10	2004/07/07	2004/04/12
Original SWL (ft)		34	19.82	13
Current NPWL (ft)	No permission	36	No Location	Not accessible



Map Well Identifier	5	6	7	8
Location LSD/DLS	NW-25-32-06W5	NW-25-32-06W5	NW-25-32-06W5	NW-25-32-06W5
well owner	Wild, Phil	Stevenson Homes	Watkins, Muranda & Brad	Pannenbecker
Use	Residence	unoccupied	Residence	Residence
Well ID	No Location	2085938	2086073	467277 (?)
Depth (ft)		140	180	61
Aquifer Type		Sandstone	Sandstone	Gravel
Aquifer zone (ft)		89-114	89-169	49-61
Date drilled		2016/08/16	2017/10/02	1997/06/10
Original SWL (ft)		14	13	14
Current NPWL (ft)		No permission	Not accessible	26.1

Map Well Identifier	9	10	11	12
Location LSD/DLS	NW-25-32-06W5	SE-35-32-06W5	NE-26-32-06W5	NE-26-32-06W5
well owner	Hunts	Our Can Co	Packers	Tudors
Use	Residence + Horses	Wash room	Residence + Horses	Residence
Well ID	No Location	499487	415735	
Depth (ft)		160	16	
Aquifer Type		Sandstone		
Aquifer zone (ft)		104-132		
Date drilled		2001/10/16		
Original SWL (ft)		22		
Current NPWL (ft)		40.5	No Answer	No Answer

Map Well Identifier	13	14	15	16
Location LSD/DLS	NE-26-32-06W5	NW-26-32-06W5	NW-26-32-06W5	NW-26-32-06W5
well owner		Johnson	Crouch	Proud
Use	Residence	Residence + Horses	Residence + Horses	Residence
Well ID			491461	
Depth (ft)			60	
Aquifer Type		Gravel	Gravel	
Aquifer zone (ft)			?	
			1999/04/22	
Original SWL (ft)			18	
Current NPWL (ft)	No Access	31.4	No Answer	No permission



Map Well Identifier	17	18	19	20
Location LSD/DLS	NW-26-32-06W5	NW-26-32-06W5	NW-26-32-06W5	NW-26-32-06W5
well owner		Bergman, Curtis		
Use	Residence	Residence	Residence	Residence
Well ID				
Depth (ft)				
Aquifer Type				
Aquifer zone (ft)				
Date drilled				
Original SWL (ft)				
Current NPWL (ft)	No Answer	31.7	No Access	No Access

Map Well Identifier	21	22	23	24
Location LSD/DLS	NW-26-32-06W5	NW-26-32-06W5	SW-35-32-06W5	SW-35-32-06W5
well owner		Stauffer	Taq North	Robins, Jeff
Use	Residence	Residence	Gas Well	Residence
Well ID				469421
Depth (ft)				66
Aquifer Type				Gravel
Aquifer zone (ft)				47-66
Date drilled				20/04/1998
Original SWL (ft)				20
Current NPWL (ft)	No Answer	No Access		19.2

Map Well Identifier	25	26	27	28
Location LSD/DLS	NW-35-32-06W5	NW-35-32-06W5	SW-02-33-06W5	SW-02-33-06W5
well owner	King	Faubert	Botheras, Wendy & Greg	Belt
Use	Residence	Residence	Residence	Residence
Well ID	415866	1064120(?)		
Depth (ft)	185	140	~100	~45
Aquifer Type	Sandstone	Sandstone		
Aquifer zone (ft)	143-162	120-140		
Date drilled	1988/07/18	2004/08/26	>30 years	~1950's
Original SWL (ft)	71.5	10		
Current NPWL (ft)	No Answer	No Access	41.8	41.7



Map Well Identifier	29	30	31	32
Location LSD/DLS	SW-02-33-06W5	NW-35-32-06W5	NE-35-32-06W5	SW-02-33-06W5
well owner	Belt	Saunders	Forbes, Allen & Jackie	Forbes, Allen & Jackie
Use	Residence	Residence + cattle	Residence + cattle	Residence
Well ID				
Depth (ft)	~45		~75	~75
Aquifer Type				
Aquifer zone (ft)				
Date drilled	1960's		~2000	
Original SWL (ft)				
Current NPWL (ft)	In Pit	No Answer	20.8	In Pit

Map Well Identifier	33	34	35	36
Location LSD/DLS	SW-01-33-06W5	NE-26-32-06W5	NE-26-32-06W5	NE-26-32-06W5
well owner	Forbes, Allen & Jackie	Pierunek	Ellithorpe	Madisson
Use	Mobile home	Residence + Horses	Residence	Residence
Well ID		491316	466206	2085219
Depth (ft)		58	41	80
Aquifer Type		Gravel	Gravel	Gravel
Aquifer zone (ft)			37-41	
Date drilled		1998/07/31	1996/06/23	2010/07/23
Original SWL (ft)		7	8	23
Current NPWL (ft)	No Answer	No permission	No Answer	27.9

Map Well Identifier	37	38	39	40
Location LSD/DLS	NE-26-32-06W5	NE-26-32-06W5	NE-26-32-06W5	NE-26-32-06W5
well owner	Taylor, Gord	Jenson	Tim & Sandra, Duke	
Use	Residence	Residence	Residence	Residence
Well ID	469419 (?)		469419	
Depth (ft)	50		50	
Aquifer Type	Gravel		Gravel	
Aquifer zone (ft)	33-50		33-50	
Date drilled	1998/04/20		1998/04/20	
Original SWL (ft)	11		11	
Current NPWL (ft)	28.9	No Access	No permission	Closed gate



Map Well Identifier	41	42	43	44
Location LSD/DLS	NE-26-32-06W5	NE-26-32-06W5	NW-25-32-06W5	NW-25-32-06W5
well owner	Griffins	Young	Swanson	Lambert
Use	Residence	Residence	Residence	Residence + Horses
Well ID				359669
Depth (ft)			~160	25
Aquifer Type				Gravel
Aquifer zone (ft)				20-25
Date drilled			>20 years	1991/08/13
Original SWL (ft)				11
Current NPWL (ft)	No permission	No Answer	11.5	No answer

Map Well Identifier	45	46	47	48
Location LSD/DLS	NW-25-32-06W5	NW-25-32-06W5	NW-25-32-06W5	NW-25-32-06W5
well owner	Lee & Donna Waldorff	Jorgenson	McElhinney	Downes
Use	Residence	Residence	Residence	Residence
Well ID				1067509
Depth (ft)	100		50	160
Aquifer Type				Sandstone
Aquifer zone (ft)				105-130
Date drilled	~20 yrs		1998	2015/04/28
Original SWL (ft)				15
Current NPWL (ft)	No Answer	No Access	29.5	17

Map Well Identifier	49	50	51	52
Location LSD/DLS	SE-26-32-06W5	NW-25-32-06W5	NW-25-32-06W5	SE-26-32-06W5
well owner	Paschke	Kynel, Conner	Les & Connie Volk	
Use	Residence + Horses	Residence	Residence + Stock	Residence
Well ID		414027		
Depth (ft)	~60	40		
Aquifer Type		Gravel		
Aquifer zone (ft)		32-40		
Date drilled	late 1980's	1995/09/21		
Original SWL (ft)		12		
Current NPWL (ft)	No Access	18.2	No Answer	Closed gate



Map Well Identifier	53	54	55
Location LSD/DLS	SE-26-32-06W5	SE-26-32-06W5	NW-25-32-06W5
well owner	Tetreaults, Rodger	Adams	Brewster
Use	Residence	Residence	Residence
Well ID			493021
Depth (ft)	63		50
Aquifer Type			Gravel
Aquifer zone (ft)			38-50
Date drilled	~1980	~1995	1999/07/29
Original SWL (ft)			11
Current NPWL (ft)	No Answer	No Answer	Advised not to visit

[5.0] GWUDI Assessment

An assessment was undertaken to determine if the aquifer supply for the well is hydraulically isolated from surface water bodies or can be considered under direct influence of surface water (called a GWUDI well by Alberta Environment). The screening process for a GWUDI well consists of the following criteria:

1. Setting – the water supply does consist of a shallow water source. The surficial geology from driller reports indicates a significantly thick sand gravel layer which is the target for many wells in the area and the target aquifer of the production well.
2. Proximity to surface source – The Red Deer River is located roughly 2.4 kilometers to the south with Bearberry Creek located approximately 3 km north of the site. These surface water sites are highly likely in direct communication with surficial sands and gravels.
3. Well construction – the wells were constructed and installed to proper standards.
4. Water Chemistry The water is a calcium bicarbonate type, with relatively low amount of TDS (259 mg/L). This is very similar water chemistry from the Red Deer River which is also a calcium bicarbonate type with a measured TDS of 260 mg/L from the AEP long term river network data from Sundre station.

Water levels in the well are at ~1 m below top of casing. As a result, the well supply is considered a GWUDI well in communication with the Red Deer River and potentially Bearberry Creek.



[6.0] Pump test

[6.1] Well details

The Production well GIC well ID 1022954 was installed onsite February 9th 2018 by personnel from Aaron Drilling Inc. The two observation wells, 1022955 and 1022956 were installed February 8th and 13th respectively, by personnel from Aaron Drilling Inc. Based on roller meter measurements observation well 1022955 is located 34.5 meters to the northwest. Based on hand-held GPS coordinates the second observation well 1022956 is located 386 meters to the southeast of the supply well. The supply well and observation well's location is shown in Figure 2, and the water well drilling reports are attached in Appendix B.

A summary of the supply well and observation well's features are tabulated below as follows:

Table 4: Production and observation well details

Well	Production Well	Observation Well	Observation Well
GIC Well ID #	1022954	1022955	1022956
GPS location	51.784466° N -114.737743° E	51.784679° N -114.738408° E	51.781440° N - 114.735318° E
Well depth (metres)	17.7	17.5	17.5
Aquifer zone (metres)	1.8 – 17.7	1.2 – 17.5	4.9 – 17.5
Completion zone (metres)	14.0 – 17.1	13.7 – 16.8	14.3 – 17.4
Surface Casing Depth (metres)	13.7	17.4	17.5
Static water level after installation (metres)	0.93	1.04	4.21
Non-pumping water level (metres)	0.93	1.04	4.21

Although the water level appears deeper in Observation Well 1022956 than the other two wells, Production Well 1022954 and Observation Well 1022955 are located in a partially mined out area of the site and at a lower surface elevation than Observation Well 1022956. As a result, the water levels in all three wells are at the same elevation.

[6.2] Details of the pumping test

A 72-hour (4320 minute) pump test was conducted on February 26th to March 1st, 2018 by personnel from Aaron Drilling Inc. Two observation wells (1022955, 1022956) were used to measure water levels for the duration of the pumping test. The supply well was pumped at a rate of 20 imperial gallons per minute (igpm) or 90.92 liters per minute. Water levels were measured for an additional 72 hours after pump cessation. All water level measurements were recorded from the supply well and observation well via water level loggers for the duration of the pump test and recovery period.

A graph showing water levels with time and a schematic of the well construction and lithology encountered are as follows:

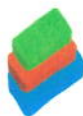
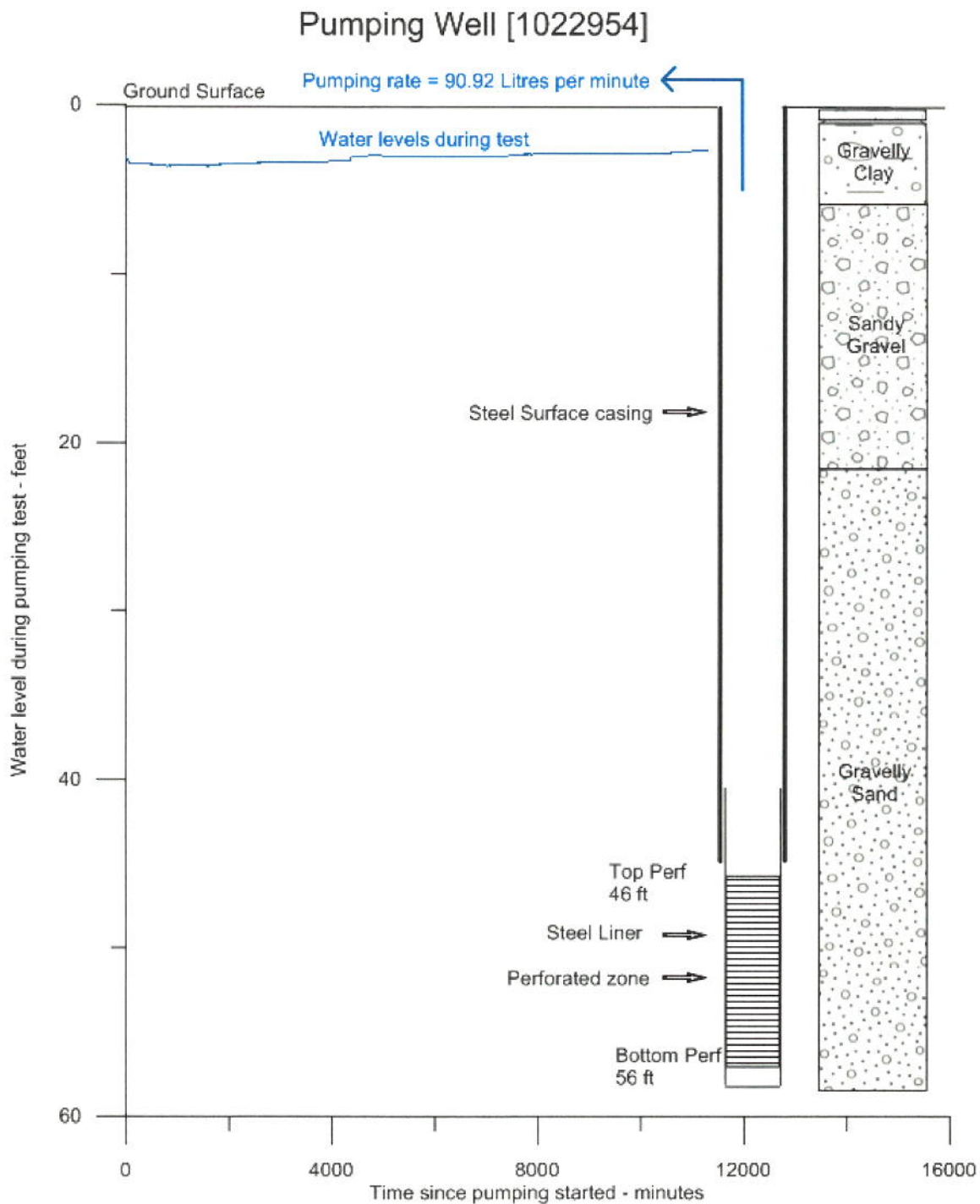


Figure 7: Pumping Well Schematic and water levels during pumping test

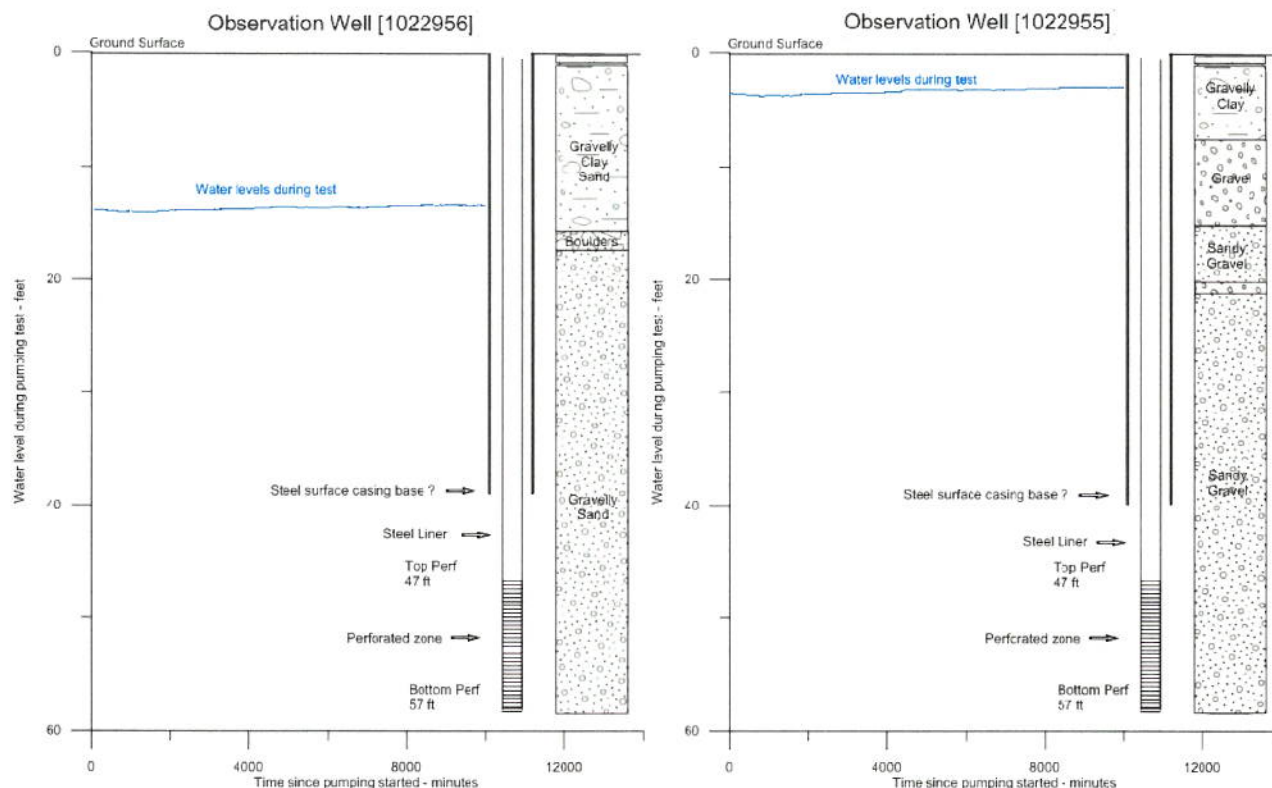




Water levels in the pumping well drew down 0.185 meters or 0.6 feet after 1500 minutes of pumping and began to recover for the remainder of the pump period. Water levels had recovered to 0.08 meters of drawdown before pumping cessation. Water levels had recovered to 100% 77 minutes after pumping cessation.

Water levels and schematic of the observation wells are shown below as follows

Figure 8: Observation wells schematics and water levels during pumping test



[6.3] Interpretation of the pumping test

A highly productive well is indicated by the small amount of drawdown during the pump test, and the ability for water levels to recover before pumping cessation. The quick buildup is characteristic of an unconfined aquifer and the buildup data will not be used in the interpretation. The drawdown levels of the three wells for the duration of the pump test is shown below as follows.

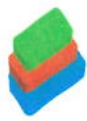
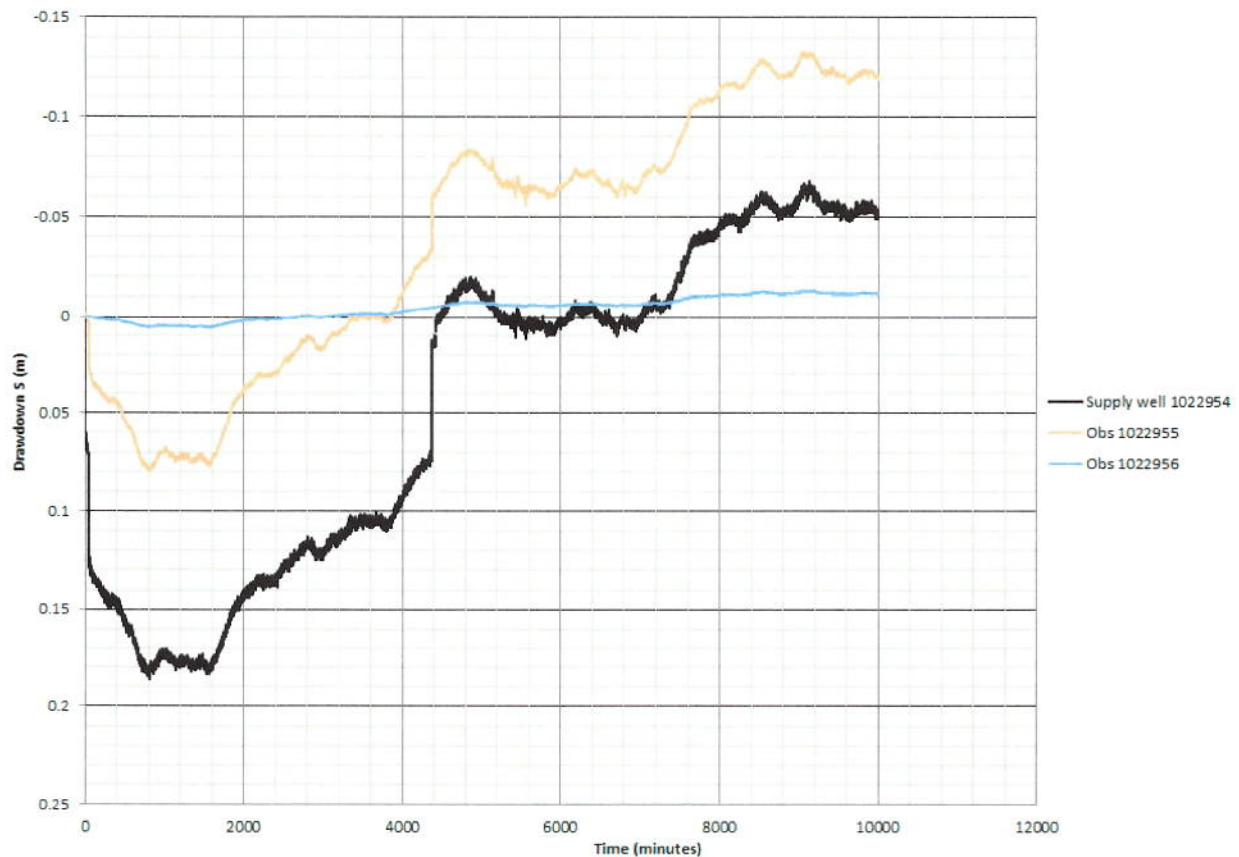


Figure 9: Drawdown levels of supply and observation wells

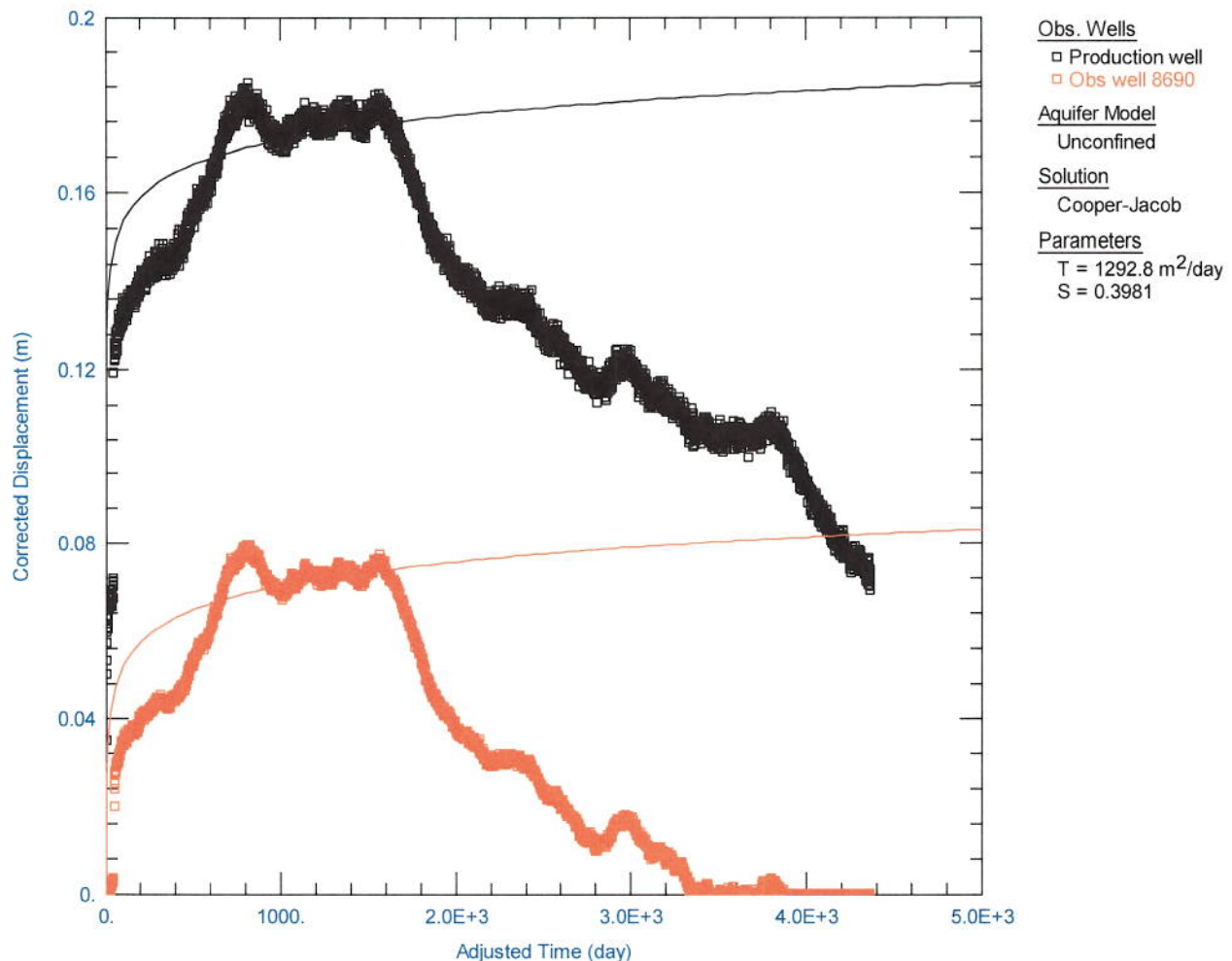


The supply well drawdown reaches a maximum at 800 to 1600 minutes into the pump test. Observation well 1022955 also shows a maximum draw down during the same time period and both wells begin to recover for the remainder of the pumping period. Both the supply well and near observation well (1022955) show the same small scale perturbations and variation in water levels, while observation well 1022956 did not show a response to the pumping well drawdown or similar small scale variations.

The pump test data was interpreted with the aid of the AQTESOLV program developed by Hydrosoft Inc. A Cooper-Jacob unconfined aquifer solution was used to fit the pumping data with a graph showing water displacement with time and the Cooper-Jacob solution as follows:



Figure 10: Cooper-Jacob Solution for Unconfined Aquifer



[6.4] Well yield

The twenty year safe yield of the well (Q_{20}) can be calculated using the modified Moell method as suggested in Alberta Environments guide to groundwater authorization (March 2011) as follows

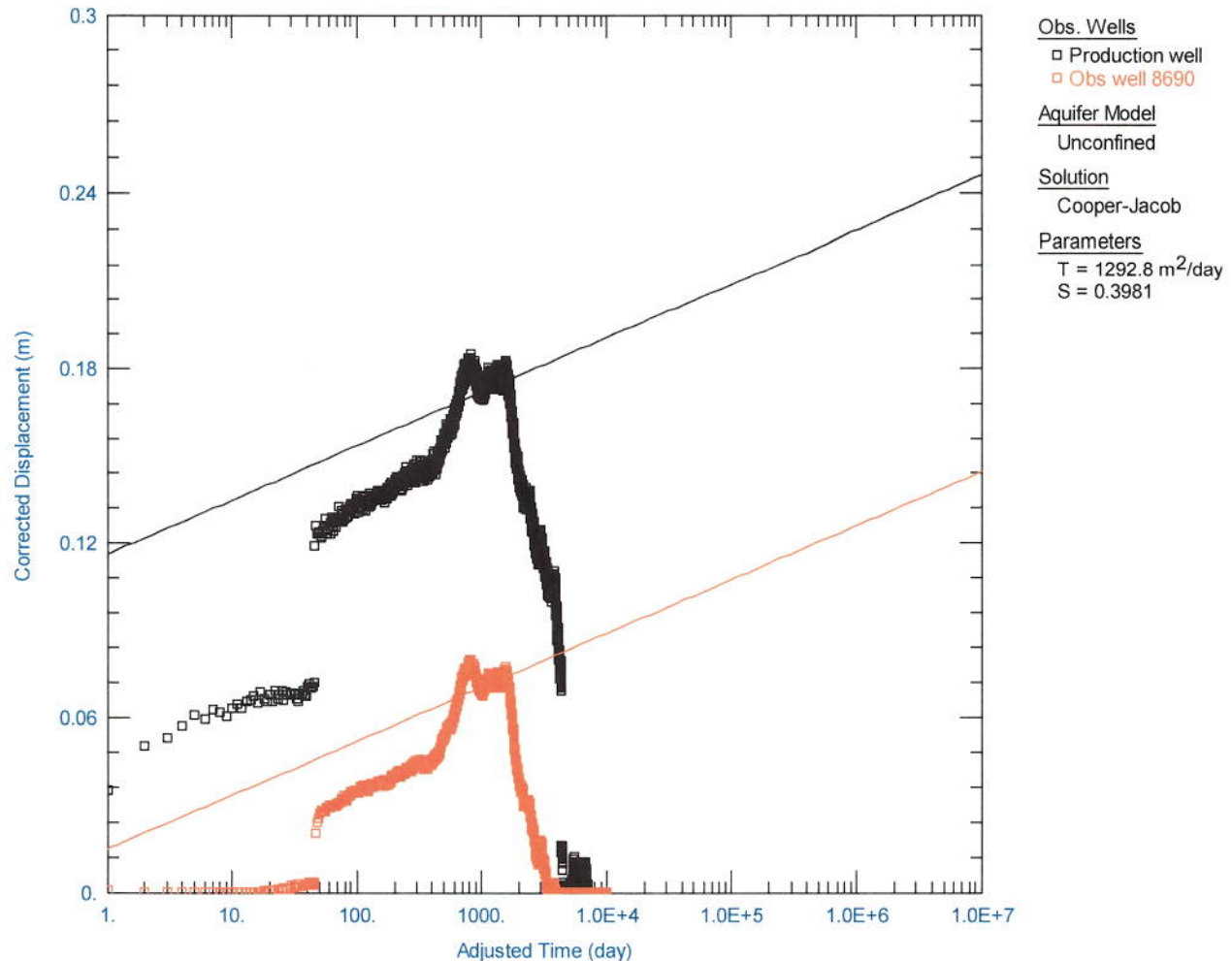
$$Q_{20} = \frac{(0.7 * Q * H_a)}{S_{100min} + (S_{20yrs} - S_{100th})}$$

Where

- Q - Pump test flow rate 90.92 litres/min (flow rate 130.92 m³/day)
- H_a - Available Head for unconfined aquifer = 2/3 saturated thickness (10.5m)
- $S_{100 min}$ - Observed drawdown at 100 minutes (0.13 m)
- $(S_{20yrs} - S_{100 th})$ - Difference between drawdown at 20 years and 100 min (0.24 - 0.15 = 0.09 m)
- 0.7 - Safety factor

The theoretical 20 year drawdown is determined by extrapolating the Cooper-Jacob solution curve as follows:

Figure 11: Cooper-Jacob solution extrapolated to 20 years of pumping



The aquifer's transmissivity was calculated to be $1,292.8 \text{ m}^2/\text{day}$ and the storativity 0.39 by the best fit estimate of the Copper-Jacob solution. These values seem reasonable given the coarse grained unconfined nature of the aquifer.

Substituting in these data values, a twenty year safe yield of $4,373 \text{ m}^3/\text{day}$ (668 Imperial gallons per minute) and an annual amount of $1,597,574 \text{ m}^3$ is calculated. This calculated Q_{20} is in excess of the requested $6,927 \text{ m}^3/\text{year}$ that will be lost due to evaporation and adherence. The calculated Q_{20} of $4,373 \text{ m}^3/\text{day}$ is also in excess of the maximum pump rate ($2,160 \text{ m}^3/\text{day}$, $3 \text{ m}^3/\text{min}$) requested.

These calculations show the aquifer can support sufficient amount of water for the intended purpose.

[7.0] Effect on water levels

[7.1] Existing users

Using the Cooper-Jacob equation we can calculate the expected drawdown (m) through time (days) over distance (m) due to pumping of the well.

$$s = \frac{(0.183 * Q)}{T} \times \text{Log} \left(\frac{2.25 * T * t}{r^2 S} \right)$$

Where

s	-	Drawdown (m)
S	-	Storativity (S_y) (3.98×10^{-1})
Q	-	Pump rate safe Q_{20} (2,160 m ³ /day)
T	-	Transmissivity (1,292.8 m ² /day)
t	-	Time (days)
r	-	Radial distance from pumping well (m)

A table showing water level drawdown with distance as a function of time and distance is as follows:

Table 5: Cooper-Jacob Distance Drawdown matrix

Distance (m)		100	300	500	1000	1600	3000
Time (days)							
1		0.03	0.00	-	-	-	-
7		0.05	0.02	0.01	-	-	-
30		0.08	0.04	0.03	0.01	0.00	-
365		0.11	0.08	0.06	0.05	0.03	0.01
1826		0.13	0.10	0.09	0.07	0.05	0.04
3652		0.14	0.11	0.10	0.08	0.06	0.05
7305		0.15	0.12	0.11	0.09	0.07	0.06

The following assumptions were included in the above calculation: A storativity value of 3.98×10^{-1} as calculated by the pumping test, a continuous consumption rate of 2,160 m³/day for 365 days a year (in reality the gravel operation will involve pumping for 60 days a year), transmissivity as determined from the pumping test interpretation (1,292.8 m²/day), and no recharge is occurring, and all wells are screened over the same aquifer. From this table, we can infer that the most a neighboring well (< 100m) in the same aquifer will experience in additional drawdown will be on the order of 0.15 meters over a 20 year pumping period.

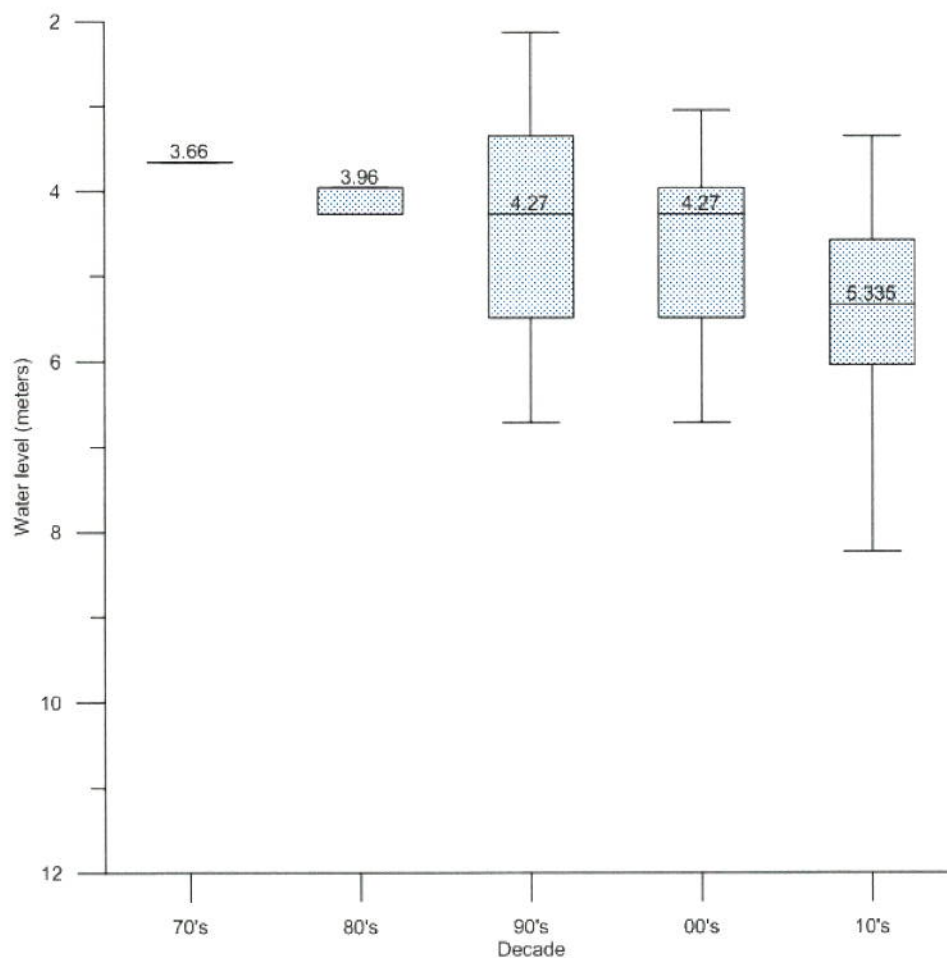


In reality the sandy gravels are connected to surface water sources such as the Red Deer River and Bearberry Creek, as well as the well will only be operational 60 days of the year. this well greatly reduce any possible drawdown in neighboring wells.

[7.2] Water levels versus time

A review of static water levels through time was conducted for the area. Well selected were drilled within 1.6 km radius of the subdivision site and were completed between 1970 to present day. The water levels by decade are show below as follows.

Figure 12: Water levels versus time



Water levels have appeared to have lowered over the last 5 decades. The wells are all completed at depths less than 50 meters within the surficial gravel aquifer the supply well targets. The above graph shows that water levels have slowly declined over the past four decades. However low sample counts of water levels in the early decades may bias the results.

[7.3] Modelling

As groundwater may be obtained from a pond rather than a well on site a different form of analysis is required to predict drawdowns. Ponds obtain most of their water from vertical flow into the base of the pond rather than lateral flow into the sides of a well and typical well test solutions are not appropriate for groundwater flow into ponds.

A groundwater model was generated to determine long term effects of pumping groundwater from the site. The MicroFEM software (developed by Philip Nienhuis and Kick Hemker) was used to simulate flow. The model requires input data concerning aquifer properties, boundary conditions and geometry and nature of pumping

A dual layer aquifer system was used with an impermeable base. An upper layer that allowed for insertion of pit nodes was used with an underlying node representing constant aquifer conditions in the aquifer below the pit levels. The bedrock layer was assumed to be impermeable, which is not the case but would contribute negligible flow compared to flow conditions in the gravel aquifer.

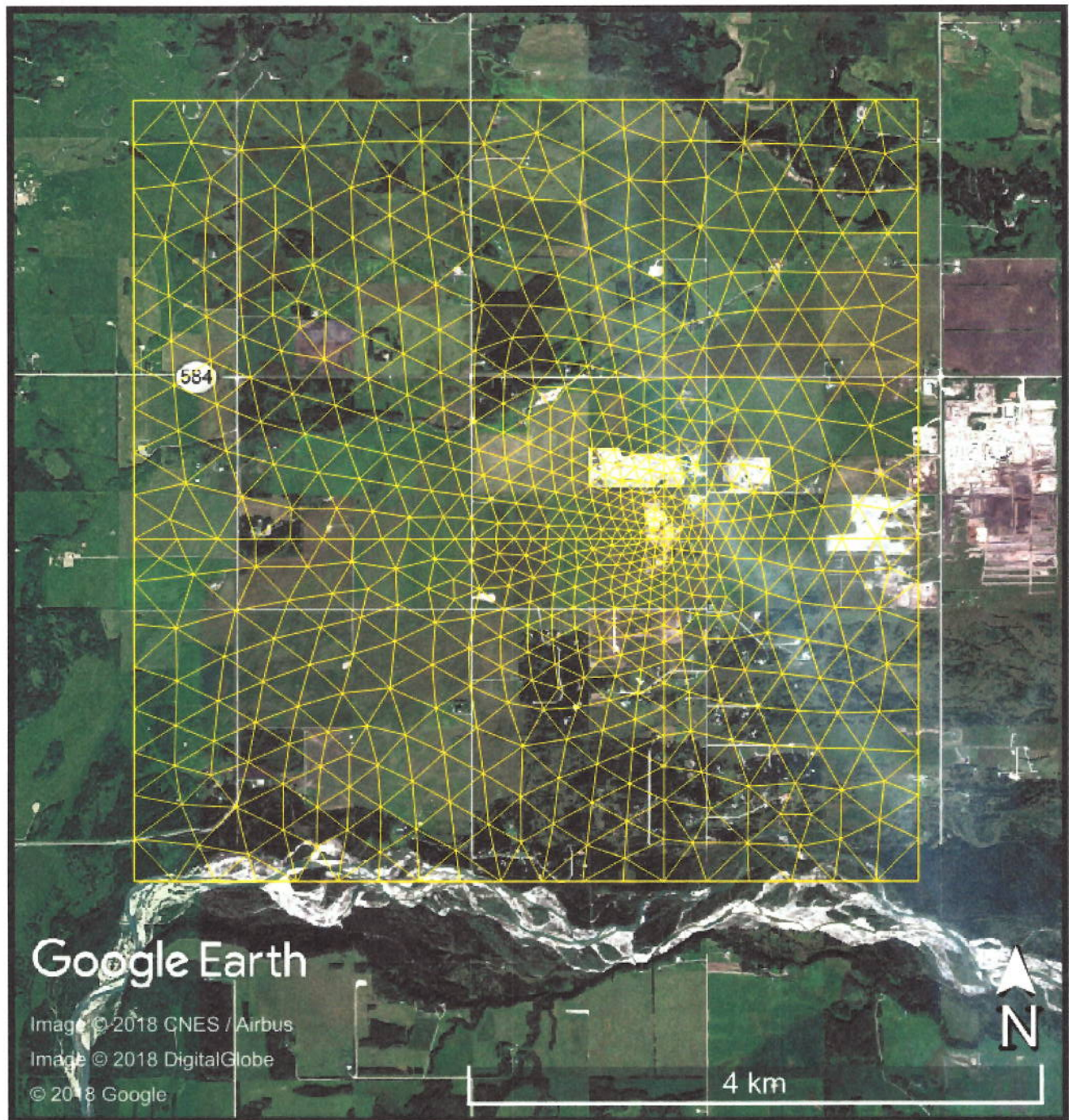
An aquifer thickness of 20 meters (saturated thickness of gravel in the area) was used, and boundary conditions for the simulation consisted of a constant head boundary on the north and south margins representing Bearberry Creek and the Red Deer River. No flow boundaries along the east and west side of the site was utilized. The top boundary (surface) condition was given a finite flux value of 0.0495 m/year to simulate annual net recharge by precipitation.

A small pond was simulated by utilizing a very high hydraulic conductivity value in the node overlying the site as recommended by Schwalbaum (A Technique for Modeling Pond/Groundwater Interactions with Applications for Wellhead Protection and Contaminant Transport: A Case Study on Cape Cod – Proceedings of the Focus Conference on Eastern Regional Ground Water, 1993).

A finite element model with 666 nodes was created. The model used a 200 metre node spacing away from the subject site and 50 metre node spacing at the site. The FEM grid mesh is shown below overlaid a site air photograph as follows



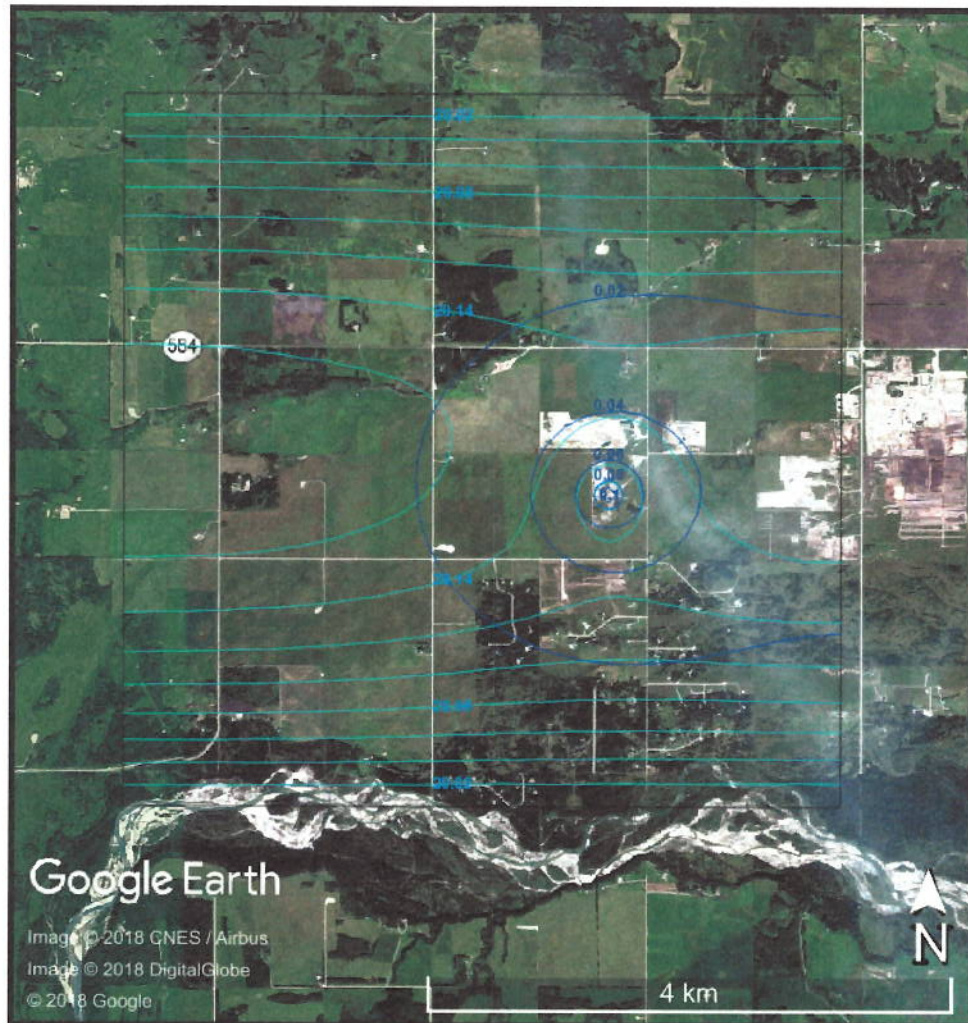
Figure 13: Finite element mesh for flow simulation



The model was calculated under steady state conditions with a continuous pump rate of 2160 m³/day (the maximum pump rate required). The modelled hydraulic head levels from base of aquifer (water table) and drawdown are shown below as follows.



Figure 14: Steady state head levels and drawdown (meters)





[8.0] Water Quality

Water Samples were collected just before the pump test began on February 26th 2018. By personnel from Groundwater Information Technologies Ltd. Samples were collected into appropriate containers and delivered to Exova/Element Labs for routine water potability testing and fluoride concentrations. Field tests for pH and electrical conductivity were also recorded using a hand held Oaktron meter. The weather at the time of sampling was sunny with an air temperature of -8° C.

The water quality report from Exova/Element labs is attached in Appendix C. The chemical analysis is summarized in the table below and compared to Health Canada water quality guidelines.

Table 6: Water Chemistry

Parameter	Production Well	Drinking water limits
Depth (ft)	58.0	
Field Temp	5.8	
Field pH	7.83	
Field EC	291	
Lab pH	7.82	6.5-8.5
Lab EC	466	
Calcium	64.2	
Magnesium	19.3	
Sodium	6.2	200 (AO)
Potassium	1.2	
Iron	0.02	<0.03 (AO)
Manganese	0.193	<0.05 (AO)
Chloride	1.5	250 (AO)
Fluoride	0.11	1.5 (MAC)
Nitrate-N	0.024	10 (MAC)
Sulfate	49.3	500 (AO)
Bicarbonate	238	
Total Alkalinity	195	
Total Dissolved Solids	259	500 (AO)
Ionic Balance	1.02	~1

All results in mg/L (ppm) except in pH in pH units, electrical conductivity µS/cm and temperature in °C

The water is a calcium bicarbonate type with a concentration of total dissolved solids (TDS) of 259 mg/L. Concentrations of manganese are above the aesthetic objective (AO) guideline limit. AO are based on taste and not health criteria. Water with elevated levels of manganese may result in poor taste and staining of laundry and plumbing fixtures however the water quality is sufficient for its intended use.



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Hydrogeological Consultants Ltd. 2000, Mountain View County, part of the Red Deer River basin, Parts of Tp 029 to 034, R 26 to 29, W4M, and R 01 to 07, W5M. Regional Groundwater Assessment. Agriculture and Agri-Food Canada, file No.:00-164.

Health Canada - Guidelines for Canadian drinking water quality summary table "*Federal-Provincial-Territorial Committee on Drinking Water of the Federal-Provincial-Territorial Committee on Health and the Environment February 2017*"

Prior, G. J., Hathway, B., Glombick, P. M., Pana, D. I., Banks, C. J., Hay, D. C., ... & Weiss, J. A. (2013). Bedrock geology of Alberta. *Alberta Geological Survey, Map, 600*, 2013-0813.



Quality Assurance Statement

GRIT has performed the work as described above and made the findings and conclusions set out in the report in a manner consistent with the level of care and skill normally exercised by members of the geological science profession practising under similar conditions at the time the work was performed.

This report presents a reasonable review of information available to GRIT Ltd. within the established scope, work schedule and budgetary constraints. GRIT Ltd. accepts no responsibility for any deficiency, misstatement or inaccuracy in this report resulting from misinformation from any individuals that provided information as part of this report.



Appendix A – Reconnaissance Report and Survey Letter

Reconnaissance Report

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Groundwater Wells

Please click the water Well ID to generate the Water Well Drilling Report.

Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (gpm)	SC DIAM (in)
340425	NW	26	32	6	5	ALKEN BASIN DRILLING LTD.	2002-06-05	38.00	New Well	Domestic		2	5	FRANKHAUSEN, MARK/TAMMY	18.00	30.00	5.50
353159	NW	36	32	6	5	WICKENS WATERWELL DRILLING CO. LTD.	1990-10-20	86.00	New Well	Domestic & Stock		8		ALLISON, GLEN	15.00	40.00	5.50
359669	12	25	32	6	5	RANKIN DRILLING	1991-08-13	25.00	New Well	Domestic		4		LAMBERT, H.E.	11.00	8.00	5.56
364856	NW	26	32	6	5	M.E. LAWSON WATER WELLS	1989-08-09	28.00	New Well	Domestic		1		STAUFFER, K.J.	14.00	7.00	5.50
366352	NE	26	32	6	5	M.E. LAWSON WATER WELLS	1992-09-23	60.00	New Well	Domestic		3		WEST, FRED	13.00	18.00	5.50
367007	NW	26	32	6	5	UNKNOWN DRILLER		25.00	Chemistry	Domestic				LESTER, CHRISTINA			0.00
415678	NW	25	32	6	5	M.E. LAWSON WATER WELLS	1978-09-04	30.00	New Well	Unknown		1		MCINTYRE, EMILY	12.00	8.00	5.50
415730	NW	26	32	6	5	M.E. LAWSON WATER WELLS	1978-05-11	30.00	New Well	Domestic & Stock		2		HOFFINGER	12.00	15.00	5.50
415732	NW	26	32	6	5	LAWSON	1987-06-18	25.00	New Well	Domestic & Stock		1		STAUFFER, KEN	13.00	8.00	5.50
415735	NE	26	32	6	5	UNKNOWN DRILLER		16.00	Chemistry	Domestic		1		PACKER, TOM			0.00
415737	NE	26	32	6	5	M.E. LAWSON WATER WELLS	1982-07-31	30.00	New Well	Stock		1		MINOR, C.E.	13.00	8.00	5.50
415738	NE	26	32	6	5	UNKNOWN DRILLER		47.00	Chemistry	Domestic		1		GOODWIN, BOB			0.00
415742	NE	26	32	6	5	M.E. LAWSON WATER WELLS	1978-08-30	30.00	New Well	Domestic & Stock		2		CROUCH, GORDON	12.00	12.00	5.50
415859	SW	35	32	6	5	M.E. LAWSON WATER WELLS	1974-09-07	40.00	New Well	Stock		1		BAUMAN	11.00	12.00	5.50
415861	NW	35	32	6	5	DOERING DRILLING LTD.	1984-04-18	89.00	New Well	Domestic		3		NIELSON, J.	65.00		5.56
415866	NW	35	32	6	5	DOERING DRILLING LTD.	1988-07-18	185.00	New Well	Domestic & Stock		9		NIELSON, JAMES	71.50	2.50	5.50
415874	NE	35	32	6	5	M.E. LAWSON WATER WELLS	1962-05-04	40.00	New Well	Domestic		1		NEILSON, C.P.	17.00	4.00	4.50
415877	NE	35	32	6	5	FORESTER, AUGUST R.	1977-11-11	35.00	New Well	Stock		1		PECK, FRANK E	0.00	5.00	5.50
415879	16	35	32	6	5	UNKNOWN DRILLER		22.00	Chemistry	Domestic		1		PECK, FRANK			0.00
417206	2	2	33	6	5	M.E. LAWSON WATER WELLS	1977-10-11	28.00	New Well	Domestic		2		VOLLMIN, VERLA	18.00	7.00	5.56

Reconnaissance Report

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Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC_DIAM (in)
458854	NE	35	32	6	5	AARON DRILLING INC.	2001-04-11	80.00	Test Hole	Domestic		2		HUNT OIL#TH1	15.00	20.00	0.00
458855	NE	35	32	6	5	AARON DRILLING INC.	2001-04-10	95.00	Test Hole	Domestic		3		HUNT OIL#TH2	15.00	20.00	0.00
466206	16	26	32	6	5	RANKIN DRILLING	1996-06-26	41.00	New Well	Domestic		4	1	ELLITHORPE, LARRY	8.00	10.00	5.50
466207	NE	26	32	6	5	ALKEN BASIN DRILLING LTD.	1996-07-03	63.00	New Well	Domestic		3	10	JAYCOCK, DARREL	11.00	60.00	5.50
466263	NE	26	32	6	5	ALKEN BASIN DRILLING LTD.	1996-11-14	70.00	New Well	Domestic		4	10	MCTAGGART, BRIAN	18.00	50.00	5.50
467276	NW	25	32	6	5	ALKEN BASIN DRILLING LTD.	1997-06-24	40.00	New Well	Domestic		6	11	PARKIN, DWAYNE	12.00	45.00	5.50
467277	NW	25	32	6	5	ALKEN BASIN DRILLING LTD.	1997-06-10	61.00	New Well	Domestic		6	12	WALDROFF, LES	14.00	60.00	5.50
468522	NE	26	32	6	5	ALKEN BASIN DRILLING LTD.	1997-09-18	40.00	New Well	Domestic		2	8	MCNAB, LARRY/SHARI	16.00	15.00	5.50
469417	NW	25	32	6	5	ALKEN BASIN DRILLING LTD.	1998-05-07	58.00	New Well	Domestic		3	5	EVANOCHKO, LORNA	13.00	20.00	5.50
469418	NW	25	32	6	5	ALKEN BASIN DRILLING LTD.	1998-03-27	55.00	New Well	Domestic		5	9	HARNDEN, GREG	14.00	50.00	5.50
469419	NE	26	32	6	5	ALKEN BASIN DRILLING LTD.	1998-04-20	50.00	New Well	Domestic		5	10	DUKE, TIM	11.00	50.00	5.50
469421	5	35	32	6	5	ALKEN BASIN DRILLING LTD.	1998-04-20	66.00	New Well	Domestic		5	12	BOUCHARD, LAWRENCE	20.00	40.00	5.50
491316	NE	26	32	6	5	M.E. LAWSON WATER WELLS	1998-07-31	58.00	New Well	Domestic		1	9	PIERUNEK, PAUL	7.00	9.00	5.50
491461	NE	26	32	6	5	ALKEN BASIN DRILLING LTD.	1999-04-22	60.00	New Well	Domestic		1	2	CROUCH, GORDON	18.00	40.00	5.50
491462	NW	26	32	6	5	ALKEN BASIN DRILLING LTD.	1999-04-19	115.00	New Well	Domestic		11	11	SOMERS, DON	22.00	60.00	5.50
491463	NE	26	32	6	5	ALKEN BASIN DRILLING LTD.	1999-03-16	52.00	New Well	Domestic		5	9	DOUBLE J WELDING INC	17.00	35.00	5.50
493021	NW	25	32	6	5	ALKEN BASIN DRILLING LTD.	1999-07-29	50.00	New Well	Domestic		3	3	BREWSTER, WILLIAM	11.00	40.00	5.50
496592	NW	26	32	6	5	ALKEN BASIN DRILLING LTD.	2000-08-25	120.00	New Well	Domestic		10	15	HARRIS, PAUL	14.00	7.00	5.50
498476	NW	26	32	6	5	ALKEN BASIN DRILLING LTD.	2001-05-30	40.00	New Well	Domestic		1	6	HAMILTON, DAVE	14.00	30.00	5.50
499487	SE	35	32	6	5	ALKEN BASIN DRILLING LTD.	2001-10-16	160.00	New Well	Domestic		8	14	OUR CAN CO	22.00	15.00	5.50

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Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC DIAM (in)
1060305	NW	25	32	6	5	ALKEN BASIN DRILLING LTD.	2004-07-09	160.00	Deepened	Domestic		10	11	SMITH, JOHN M.	12.00	30.00	5.56
1060305	NW	25	32	6	5	ALKEN BASIN DRILLING LTD.	2004-04-12	60.00	New Well	Domestic		5	4	SMITH, JOHN M.	13.00	60.00	5.56
1060542	NW	26	32	6	5	ALKEN BASIN DRILLING LTD.	2003-05-01	61.00	New Well	Domestic		4	13	WORKS, DWAYNE	20.00	40.00	5.56
1064120	NW	35	32	6	5	ALKEN BASIN DRILLING LTD.	2004-08-26	140.00	New Well	Domestic		11	25	NIELSON, KAREN	10.00	40.00	5.56
1065024	13	25	32	6	5	ALKEN BASIN DRILLING LTD.	2007-08-10	60.00	New Well	Domestic		1	7	THOMPSON, BILL	34.00	50.00	
1066262	15	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-02-28	47.00	New Well	Domestic		5	5	DOOGIE DEVELOPMENTS	14.00	40.00	5.56
1066263	15	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-01	50.00	New Well	Domestic		6	7	DOOGIE DEVELOPMENTS	14.00	40.00	5.56
1066264	NE	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-02	52.00	New Well	Domestic		6	5	DOOGIE DEVELOPMENTS	19.00	40.00	5.56
1066265	15	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-03	62.00	New Well	Domestic		5	6	DOOGIE DEVELOPMENTS	17.00	40.00	5.56
1066266	15	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-04	60.00	New Well	Domestic		7	8	DOOGIE DEVELOPMENTS	19.00	40.00	5.56
1066267	16	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-15	60.00	New Well	Domestic		6	6	DOOGIE DEVELOPMENTS	15.00	40.00	5.56
1066338	16	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-23	60.00	New Well	Domestic		2	13	BATES, NEIL / DOOGIE DEVELOPMENTS	11.00	40.00	5.56
1066339	16	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-23	60.00	New Well	Domestic		2	8	BATES, NEIL / DOOGIE DEVELOPMENTS	12.00	40.00	5.56
1066340	15	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-24	60.00	New Well	Domestic		2	8	BATES, NEIL / DOOGIE DEVELOPMENTS	18.00	40.00	5.56
1066341	15	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-03-25	60.00	New Well	Domestic		2	8	BATES, NEIL / DOOGIE DEVELOPMENTS	18.00	40.00	5.56
1066505	15	26	32	6	5	ALKEN BASIN DRILLING LTD.	2011-10-06	60.00	New Well	Domestic		1	4	DOOGIE DEVELOPMENT	16.00	50.00	5.56
1066788	4	1	33	6	5	ALKEN BASIN DRILLING LTD.	2012-10-15	70.00	New Well	Domestic		2	7	EVANOCHKO, BOB	15.00	50.00	5.56
1067509	11	25	32	6	5	ALKEN BASIN DRILLING LTD.	2015-04-28	160.00	New Well	Domestic		5	26	DOWNES, ROSS	15.00	13.00	5.56
1245174	NW	25	32	6	5	DOERING DRILLING LTD.	2004-07-07	133.00	New Well	Domestic		5	14	AAA CONTRACTING	19.82	6.00	5.63
2085219	16	26	32	6	5	BLACK DOG DRILLING & ENV SERV. LTD.	2010-07-23	80.00	New Well	Domestic		2	7	MADISSON, JAN	23.00	30.00	5.56



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Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (ft)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (ft)	TEST RATE (igpm)	SC_DIAM (in)
2085562	9	35	32	6	5	BLACK DOG DRILLING & ENV SERV. LTD.	2014-03-21	40.00	New Well	Domestic		2	9	SAUNDERS, DUANE	27.00	40.00	
2085938	14	25	32	6	5	BLACK DOG DRILLING & ENV SERV. LTD.	2016-08-16	140.00	New Well	Domestic		8	14	STEVENSON HOMES	14.00	6.00	5.56
2086073	14	25	32	6	5	BLACK DOG DRILLING & ENV SERV. LTD.	2017-10-02	180.00	New Well	Domestic		9	24	STEVENSON HOMES	13.00	3.00	5.56



Groundwater Information Technologies Ltd.

February 2018

File No: 17-1436

Dear Sir or Madam:

**RE: Water Well Survey
West Can Seal Coatings Gravel Pit
SE-35-032-06W5M, Sundre, Alberta**

We are working with West-Can Seal Coating Inc. (West-Can) to obtain a water license from Alberta Environment and Parks to utilize groundwater for their purposed gravel pit (SE-35-032-06 W5M). As part of the licensing requirements, we are completing a survey of water well users in the area.

The data collected will be submitted to Alberta Environment and Parks as part of the West-Can water well licensing application. We are requesting that you provide us with some or all of the following information for our survey:

RR2 SITE 12 Box 31
Address

BRIAN AND BEVERLY ADAMS
Lot Owner

Water Well Use (please check one): Domestic ☒ Livestock ☐

1995?
Age of Well

?
Water Well Driller

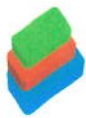
?
Depth of Well (include units in meters or feet)

Please complete the survey and return to us via mail in the enclosed postage paid envelope, or scan and email to khugo@gritltd.com. If you require additional information, please contact me at 403-650-8511. Thank you for your participation.

Yours truly,
Groundwater Information Technologies Ltd.

Ken Hugo, Hydrogeologist

17
21
54



Appendix B – Water Well Drilling Reports



Water Well Drilling Report

View in Metric

GIC Well ID 1022954
GoA Well Tag No.
Drilling Company Well ID 8689
Date Report Received

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

Well Identification and Location										Measurement in Imperial		
Owner Name		Address			Town		Province		Country		Postal Code	
WEST-CAN SEAL COATING		P.O. BOX 669 2317 - 16 ST			DIDSBURY		ALBERTA		CANADA		T0M 0W0	
Location		1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description		
8			35	32	6	5						
Measured from Boundary of					GPS Coordinates in Decimal Degrees (NAD 83)					Elevation		
ft from					Latitude 51.784466 Longitude -114.737743					ft		
ft from					How Location Obtained					How Elevation Obtained		
					Hand held autonomous GPS 20-30m					Not Obtained		

Drilling Information		Type of Work	
Method of Drilling		110 656144.06	
Rotary - Air		5736151.3N	
Proposed Well Use			
Commercial			

Formation Log			Measurement in Imperial		
Depth from ground level (ft)	Water Bearing	Lithology Description			
6.00		Gravelly Clay			
22.00		Sandy Gravel			
58.00	Yes	Gravelly Sand			

Yield Test Summary				Measurement in Imperial	
Recommended Pump Rate		igpm			
Test Date		Water Removal Rate (igpm)		Static Water Level (ft)	

Well Completion				Measurement in Imperial	
Total Depth Drilled	Finished Well Depth	Start Date	End Date		
58.00 ft	58.00 ft	2018/02/08	2018/02/09		
Borehole					
Diameter (in)		From (ft)	To (ft)		
6.50		0.00	58.00		
Surface Casing (if applicable)			Well Casing/Liner		
Steel			Stainless Steel		
Size OD :		6.63 in	Size OD :		5.57 in
Wall Thickness :		0.250 in	Wall Thickness :		0.130 in
Bottom at :		45.00 ft	Top at :		40.50 ft
			Bottom at :		58.00 ft
Perforations					
From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)	
Perforated by					
Annular Seal Bentonite Slurry					
Placed from		0.00 ft	to	45.00 ft	
Amount		150.00 Gallons			
Other Seals					
Type		K-Packer		At (ft)	40.50
Screen Type Stainless Steel					
Size OD :		5.57 in			
From (ft)		To (ft)	Slot Size (in)		
46.00		56.00	0.020		
Attachment Telescoped					
Top Fittings		Packer	Bottom Fittings		Plug
Pack					
Type		Natural		Grain Size	
Amount					

Contractor Certification		Certification No	
Name of Journeyman responsible for drilling/construction of well		180762A	
NICK CORRIGAN		Copy of Well report provided to owner	
Company Name		Date approval holder signed	
AARON DRILLING INC.			



Water Well Drilling Report

[View in Metric](#)

GIC Well ID 1022954
GoA Well Tag No.
Drilling Company Well ID 8689
Date Report Received

GOWN ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

Well Identification and Location										Measurement in Imperial
Owner Name		Address		Town		Province		Country	Postal Code	
WEST-CAN SEAL COATING		P.O. BOX 669 2317 - 16 ST		DIDSBURY		ALBERTA		CANADA	T0M 0W0	
Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description	
8		35	32	6	5					
Measured from Boundary of					GPS Coordinates in Decimal Degrees (NAD 83)					
ft from					Latitude 51.784466 Longitude -114.737743					Elevation ft
ft from					How Location Obtained					How Elevation Obtained
					Hand held autonomous GPS 20-30m					Not Obtained

Additional Information										Measurement in Imperial
Distance From Top of Casing to Ground Level 36.00 in										
Is Artesian Flow										Is Flow Control Installed
Rate igpm										Describe
Recommended Pump Rate igpm										Pump Installed Depth ft
Recommended Pump Intake Depth (From TOC) ft										Type Make H.P. Model (Output Rating)
Did you Encounter Saline Water (>4000 ppm TDS)										Depth ft Well Disinfected Upon Completion
Gas										Depth ft Geophysical Log Taken
										Submitted to ESRD
Additional Comments on Well										Sample Collected for Potability Submitted to ESRD

Yield Test										Taken From Ground Level	Measurement in Imperial
Test Date		Start Time		Static Water Level		ft					
Method of Water Removal											
Type											
Removal Rate igpm											
Depth Withdrawn From ft											
If water removal period was < 2 hours, explain why											

Water Diverted for Drilling									
Water Source		Amount Taken		Diversion Date & Time					
CITY OF CALGARY		2000.00 ig		2018/02/08 8:00 AM					

Contractor Certification									
Name of Journeyman responsible for drilling/construction of well					Certification No				
NICK CORRIGAN					180762A				
Company Name					Copy of Well report provided to owner Date approval holder signed				
AARON DRILLING INC.									



Water Well Drilling Report

Wells

View in Metric

GIC Well ID 1022956
GoA Well Tag No.
Drilling Company Well ID 8691
Date Report Received

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

GOWN ID

Well Identification and Location										Measurement in Imperial		
Owner Name		Address			Town		Province		Country		Postal Code	
WEST-CAN SEAL COATING		P.O. BOX 669 2317, 16 ST			DIDSBURY		ALBERTA		CANADA		T0M 0W0	
Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description			
1		35	32	6	5							
Measured from Boundary of					GPS Coordinates in Decimal Degrees (NAD 83)					Elevation		
ft from					Latitude 51.781440 Longitude -114.735318					ft		
ft from					How Location Obtained					How Elevation Obtained		
					Hand held autonomous GPS 20-30m					Not Obtained		

Drilling Information	
Method of Drilling	Type of Work
Rotary - Air	Piezometer
Proposed Well Use	
Monitoring	

Formation Log			Measurement in Imperial	
Depth from ground level (ft)	Water Bearing	Lithology Description		
16.00		Gravelly Clay & Sand		
18.00		Boulders		
57.50	Yes	Gravelly Sand		

Yield Test Summary			Measurement in Imperial	
Recommended Pump Rate			igpm	
Test Date	Water Removal Rate (igpm)	Static Water Level (ft)		

Well Completion				Measurement in Imperial	
Total Depth Drilled	Finished Well Depth	Start Date	End Date		
57.50 ft	57.50 ft	2018/02/13	2018/02/13		
Borehole					
Diameter (in)	From (ft)	To (ft)			
6.50	0.00	57.00			
Surface Casing (if applicable)			Well Casing/Liner		
Steel			Plastic		
Size OD :	6.63 in	Size OD :	2.00 in		
Wall Thickness :	0.188 in	Wall Thickness :	0.250 in		
Bottom at :	57.50 ft	Top at :	0.00 ft		
		Bottom at :	57.00 ft		
Perforations					
From (ft)	To (ft)	Diameter or Slot Width (in)	Slot Length (in)	Hole or Slot Interval (in)	
47.00	57.00	0.130	3.00	3.00	
Perforated by Other					
Annular Seal Bentonite Chips/Tablets					
Placed from	0.00 ft	to	44.00 ft		
Amount	10.00 Bags				
Other Seals					
Type					At (ft)
Driven					57.00
Shale Trap					43.00
Screen Type Slotted PVC					
Size OD :	2.00 in				
From (ft)	To (ft)			Slot Size (in)	
47.00	57.00			0.020	
Attachment Telescoped					
Top Fittings	Riser Pipe			Bottom Fittings	Plug
Pack					
Type	Gravel			Grain Size	4-8
Amount	4.00 Bags				

Contractor Certification	
Name of Journeyman responsible for drilling/construction of well	Certification No
NICK CORRIGAN	180762A
Company Name	Copy of Well report provided to owner Date approval holder signed
AARON DRILLING INC.	



Water Well Drilling Report

View in Metric

GIC Well ID 1022956
GoA Well Tag No.
Drilling Company Well ID 8691
Date Report Received

GOWN ID

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Well Identification and Location										Measurement in Imperial		
Owner Name		Address			Town		Province		Country		Postal Code	
WEST-CAN SEAL COATING		P.O. BOX 669 2317, 16 ST			DIDSBURY		ALBERTA		CANADA		T0M 0W0	
Location		1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description		
1		35	32	6	5							
Measured from Boundary of					GPS Coordinates in Decimal Degrees (NAD 83)					Elevation		
ft from					Latitude 51.781440 Longitude -114.735318					ft		
ft from					How Location Obtained					How Elevation Obtained		
					Hand held autonomous GPS 20-30m					Not Obtained		

Additional Information										Measurement in Imperial	
Distance From Top of Casing to Ground Level 30.00 in											
Is Artesian Flow										Is Flow Control Installed	
Rate igpm										Describe	
Recommended Pump Rate igpm										Pump Installed	
Recommended Pump Intake Depth (From TOC) ft										Depth ft	
										Type	
										Make	
										H.P.	
										Model (Output Rating)	
Did you Encounter Saline Water (>4000 ppm TDS)										Depth ft	
Gas										Depth ft	
										Well Disinfected Upon Completion	
										Geophysical Log Taken	
										Submitted to ESRD	
										Sample Collected for Potability	
										Submitted to ESRD	
Additional Comments on Well											

Yield Test			Taken From Ground Level		Measurement in Imperial	
Test Date	Start Time	Static Water Level				
		ft				
Method of Water Removal						
Type						
Removal Rate igpm						
Depth Withdrawn From ft						
If water removal period was < 2 hours, explain why						

Water Diverted for Drilling		
Water Source	Amount Taken	Diversion Date & Time
CITY OF CALGARY	2000.00 ig	2018/02/13 8:00 AM

Contractor Certification	
Name of Journeyman responsible for drilling/construction of well	Certification No
NICK CORRIGAN	180762A
Company Name	Copy of Well report provided to owner
AARON DRILLING INC.	Date approval holder signed



Water Well Drilling Report

Obs well near
View in Metric

GIC Well ID 1022955
GoA Well Tag No.
Drilling Company Well ID 8690
Date Report Received

GOWN ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

Well Identification and Location										Measurement in Imperial		
Owner Name		Address			Town		Province		Country		Postal Code	
WEST-CAN SEALCOATING		P.O. BOX 669 2317, 16 ST			DIDSBURY		ALBERTA		CANADA		T0M 0W0	
Location		1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description		
		8	35	32	6	5						
Measured from Boundary of					GPS Coordinates in Decimal Degrees (NAD 83)							
					Latitude 51.784679 Longitude -114.738408					Elevation ft		
					How Location Obtained					How Elevation Obtained		
					Hand held autonomous GPS 20-30m					Not Obtained		

Drilling Information	
Method of Drilling Rotary - Air	Type of Work Piezometer
Proposed Well Use Monitoring	

Formation Log			Measurement in Imperial		
Depth from ground level (ft)	Water Bearing	Lithology Description			
4.00		Gravelly Clay			
16.00		Gravel			
20.00	Yes	Sandy Gravel			
21.00		Pebbly Gravel			
57.50	Yes	Sandy Gravel			

Yield Test Summary			Measurement in Imperial		
Recommended Pump Rate igpm					
Test Date	Water Removal Rate (igpm)	Static Water Level (ft)			

Well Completion				Measurement in Imperial	
Total Depth Drilled	Finished Well Depth	Start Date	End Date		
57.50 ft	57.00 ft	2018/02/06	2018/02/08		
Borehole					
Diameter (in)		From (ft)	To (ft)		
6.50		0.00	57.50		
Surface Casing (if applicable)			Well Casing/Liner		
Steel			Plastic		
Size OD : 6.63 in			Size OD : 2.00 in		
Wall Thickness : 0.250 in			Wall Thickness : 0.250 in		
Bottom at : 57.00 ft			Top at : 0.17 ft		
			Bottom at : 57.00 ft		
Perforations					
From (ft)	To (ft)	Diameter or Slot Width (in)	Slot Length (in)	Hole or Slot Interval (in)	
45.00	55.00	0.130	3.00	3.00	
Perforated by Other					
Annular Seal Bentonite Chips/Tablets					
Placed from 0.00 ft to 44.00 ft					
Amount 9.00 Bags					
Other Seals					
Type				At (ft)	
Driven				57.00	
Shale Trap				43.00	
Screen Type Slotted PVC					
Size OD : 2.00 in					
From (ft)	To (ft)	Slot Size (in)			
47.00	57.00	0.020			
Attachment Telescoped					
Top Fittings Riser Pipe			Bottom Fittings Plug		
Pack					
Type Gravel				Grain Size 4-8	
Amount 4.00 Bags					

Contractor Certification	
Name of Journeyman responsible for drilling/construction of well NICK CORRIGAN	Certification No 180762A
Company Name AARON DRILLING INC.	Copy of Well report provided to owner Date approval holder signed



Water Well Drilling Report

View in Metric

GIC Well ID 1022955
GoA Well Tag No.
Drilling Company Well ID 8690
Date Report Received

GOWN ID

The driller supplies the data contained in this report. The Province disclaims responsibility for its accuracy. The information on this report will be retained in a public database.

Well Identification and Location										Measurement in Imperial	
Owner Name		Address			Town		Province		Country	Postal Code	
WEST-CAN SEALCOATING		P.O. BOX 669 2317, 16 ST			DIDSBURY		ALBERTA		CANADA	T0M 0W0	
Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description		
8		35	32	6	5						
Measured from Boundary of					GPS Coordinates in Decimal Degrees (NAD 83)						
ft from					Latitude 51.784679 Longitude -114.738408					Elevation ft	
ft from					How Location Obtained					How Elevation Obtained	
					Hand held autonomous GPS 20-30m					Not Obtained	

Additional Information										Measurement in Imperial
Distance From Top of Casing to Ground Level 36.00 in										
Is Artesian Flow										Is Flow Control Installed
Rate igpm										Describe
Recommended Pump Rate igpm										Pump Installed
Recommended Pump Intake Depth (From TOC) ft										Depth ft
										Type
										Make
										H.P.
										Model (Output Rating)
Did you Encounter Saline Water (>4000 ppm TDS)										Depth ft
Gas										Depth ft
										Well Disinfected Upon Completion
										Geophysical Log Taken
										Submitted to ESRD
										Sample Collected for Potability
										Submitted to ESRD
Additional Comments on Well										

Yield Test			Taken From Ground Level	Measurement in Imperial
Test Date	Start Time	Static Water Level		
		ft		
Method of Water Removal				
Type				
Removal Rate igpm				
Depth Withdrawn From ft				
If water removal period was < 2 hours, explain why				

Water Diverted for Drilling		
Water Source	Amount Taken	Diversion Date & Time
CITY OF CALGARY	2000.00 ig	2018/02/06 8:00 AM

Contractor Certification	
Name of Journeyman responsible for drilling/construction of well	Certification No
NICK CORRIGAN	180762A
Company Name	Copy of Well report provided to owner: Date approval holder signed
AARON DRILLING INC.	



Appendix C – Exova/Element Labs Water well Chemistry Report

Analytical Report

Bill To: Groundwater Information
44, 2110 - 41 Avenue NE
Calgary, AB, Canada
T2E 8Z7
Attn: Ken Hugo
Sampled By:
Company:

Project ID: 17-1436
Project Name: West Can
Project Location: Sundre
LSD:
P.O.:
Proj. Acct. code:

Lot ID: **1256790**
Control Number: C115303
Date Received: Feb 28, 2018
Date Reported: Mar 6, 2018
Report Number: 2267164

Reference Number 1256790-1
Sample Date Feb 26, 2018
Sample Time NA
Sample Location
Sample Description Production Well /
18.7C
Matrix Water

Analyte		Units	Results	Results	Results	Nominal Detection Limit
Metals Dissolved						
Subsample	Field Filtered		Lab Filtered			
Routine Water						
pH			7.82			
Temperature of observed pH		°C	21.6			
Electrical Conductivity	at 25 °C	µS/cm	466			1
Electrical Conductivity	at 25 °C	dS/m	0.466			0.001
Calcium	Dissolved	mg/L	64.2			0.2
Magnesium	Dissolved	mg/L	19.3			0.2
Sodium	Dissolved	mg/L	6.2			0.4
Potassium	Dissolved	mg/L	1.2			0.4
Iron	Dissolved	mg/L	0.02			0.01
Manganese	Dissolved	mg/L	0.193			0.005
Chloride	Dissolved	mg/L	1.5			0.4
Fluoride		mg/L	0.11			0.05
Nitrate - N		mg/L	0.27			0.01
Nitrite - N		mg/L	0.024			0.005
Nitrate and Nitrite - N		mg/L	0.29			0.01
Sulfate (SO4)	Dissolved	mg/L	49.3			0.9
Hydroxide		mg/L	<5			
Carbonate		mg/L	<6			
Bicarbonate		mg/L	238			
P-Alkalinity	as CaCO3	mg/L	<5.0			5
T-Alkalinity	as CaCO3	mg/L	195			5
Total Dissolved Solids	Calculated	mg/L	259			1
Hardness	Dissolved as CaCO3	mg/L	240			
Ionic Balance	Dissolved	%	102			

Approved by:



Anthony Neumann, MSc
Laboratory Operations Manager

Data have been validated by Analytical Quality Control and Exova's Integrated Data Validation System (IDVS).
Generation and distribution of the report, and approval by the digitized signature above, are performed through a secure and controlled automatic process.

Methodology and Notes

Bill To: Groundwater Information 44, 2110 - 41 Avenue NE Calgary, AB, Canada T2E 8Z7 Attn: Ken Hugo	Project ID: 17-1436 Project Name: West Can Project Location: Sundre LSD: P.O.: Proj. Acct. code:	Lot ID: 1256790 Control Number: C115303 Date Received: Feb 28, 2018 Date Reported: Mar 6, 2018 Report Number: 2267164
Sampled By: Company:		

Method of Analysis

Method Name	Reference	Method	Date Analysis Started	Location
Alkalinity, pH, and EC in water	APHA	* Alkalinity - Titration Method, 2320 B	Mar 2, 2018	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	* Conductivity, 2510 B	Mar 2, 2018	Exova Edmonton
Alkalinity, pH, and EC in water	APHA	* pH - Electrometric Method, 4500-H+ B	Mar 2, 2018	Exova Edmonton
Anions (Routine) by Ion Chromatography	APHA	* Ion Chromatography with Chemical Suppression of Eluent Cond., 4110 B	Mar 1, 2018	Exova Edmonton
Approval-Edmonton	APHA	Checking Correctness of Analyses, 1030 E	Mar 1, 2018	Exova Edmonton
Chloride in Water	APHA	* Automated Ferricyanide Method, 4500-Cl-E	Mar 1, 2018	Exova Edmonton
Metals Trace (Dissolved) in water	APHA	Hardness by Calculation, 2340 B	Mar 2, 2018	Exova Edmonton
Metals Trace (Dissolved) in water	APHA	* Inductively Coupled Plasma (ICP) Method, 3120 B	Mar 2, 2018	Exova Edmonton

* Reference Method Modified

References

APHA Standard Methods for the Examination of Water and Wastewater

Please direct any inquiries regarding this report to our Client Services Group or to the Operations Manager at the coordinates indicated at the top left of this page.

Results relate only to samples as submitted.

The test report shall not be reproduced except in full, without the written approval of the laboratory.