Combined Phase I and Phase II Groundwater Supply Assessment for Subdivision

SE-03-33-1W5
GIC Well ID 10136136
Mountain View County
Lat/Long: 51.797691, -114.050044

Project #: AW.78.01
August 2024

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arletta water resources

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1. EXECUTIVE SUMMARY

Arletta Water Resources (Arletta) was retained by 1273927 Alberta Ltd. to complete a combined Phase I and Phase II Groundwater Supply Evaluation for a proposed 45-lot residential and 56.5-acres commercial development to determine the aquifer potential underlying the Site located within SE-03-33-1W5 (the "Site"). The purpose of the investigation was to evaluate the depth, quality and yield of aquifer units underlying the Site and how they relate to the future development of the property and its water requirements. The analysis will be used to indicate if water can be supplied to the future development without causing adverse effects to existing groundwater users in the area.

Aquifers in the area consist of shallow bedrock sandstones or shales of the Paskapoo Formation. Groundwater use in the area is low, consisting largely of individual unregistered residential acreages with low licensed groundwater usage. Available pumping tests for existing nearby wells were analyzed to determine long term yield rates. Well yields of existing wells are generally high, with long term yields on the order of 110.3 – 551.9 m^3/day. These existing wells produce from a shallower sandstone aquifer than that accessed by the supply well on Site.

A supply well (GIC Well ID 10136136) was installed on Site December 14th, 2023, by personnel from Black Dog Drilling Inc to determine aquifer conditions underlying the Site. The well obtains water from a confined bedrock sandstone aquifer present at depths of 35.7 – 40.2 metres below ground, which is 14 – 25 meters below the aquifer units accessed by existing neighbouring domestic supply wells. Approximately 25 metres of mixed sand and clay, and at least 10 metres of interbedded sandstone and shale bedrock overlying the screened interval should aid in preventing surface water contaminants, such as septic field effluents, from migrating to the aquifer.

A pumping test was conducted on the supply well December 15th, 2023, by personnel from Black Dog Drilling Inc The supply well was pumped at a rate of 15 imperial gallons per minute for (igpm) for 360 minutes. Water levels were measured during the pumping period and for an additional 360 minutes following pumping cessation.

A twenty-year safe yield (Q_{20}) 530.2 m^3/day (81.0 imperial gallons per minute or 193,647 m^3/year) was calculated. At the calculated Q_{20} rate, the well could supply 155 domestic lots at the rate of 1,250 m^3/year. Typical homes use less than half this amount of water per year. For a potential community supply well, typical consumption rates are approximately 400 m^3/year for both residential lots and commercial sites that need water for just sinks and toilets. This well would be able to supply approximately 484 lots at this rate.

There are approximately 10 neighbouring domestic groundwater users adjacent to the proposed development, located in the quarter section to the northeast of the Site in NW-02-33-01W5. These wells produce from a shallower aquifer unit than the one accessed by the supply well on Site. Drawdown interference calculations indicate that drawdown in existing neighbouring wells as a result of pumping from 45 domestic wells on Site would result in up to 2.84 metres of drawdown over 20 years, which will not prevent existing wells from continuing to supply water. Calculations are also conservative and

assume wells are completed within the same aquifer (which is likely a false assumption) and that no recharge to the aquifer occurs over 20 years.

Previous studies on the aquifers in the area undertaken in the early 1960's show that water levels have declined regionally at a rate of about 1 metre per decade. As over 15 metres of drawdown is available the aquifer supplies should be sufficient for the foreseeable future.

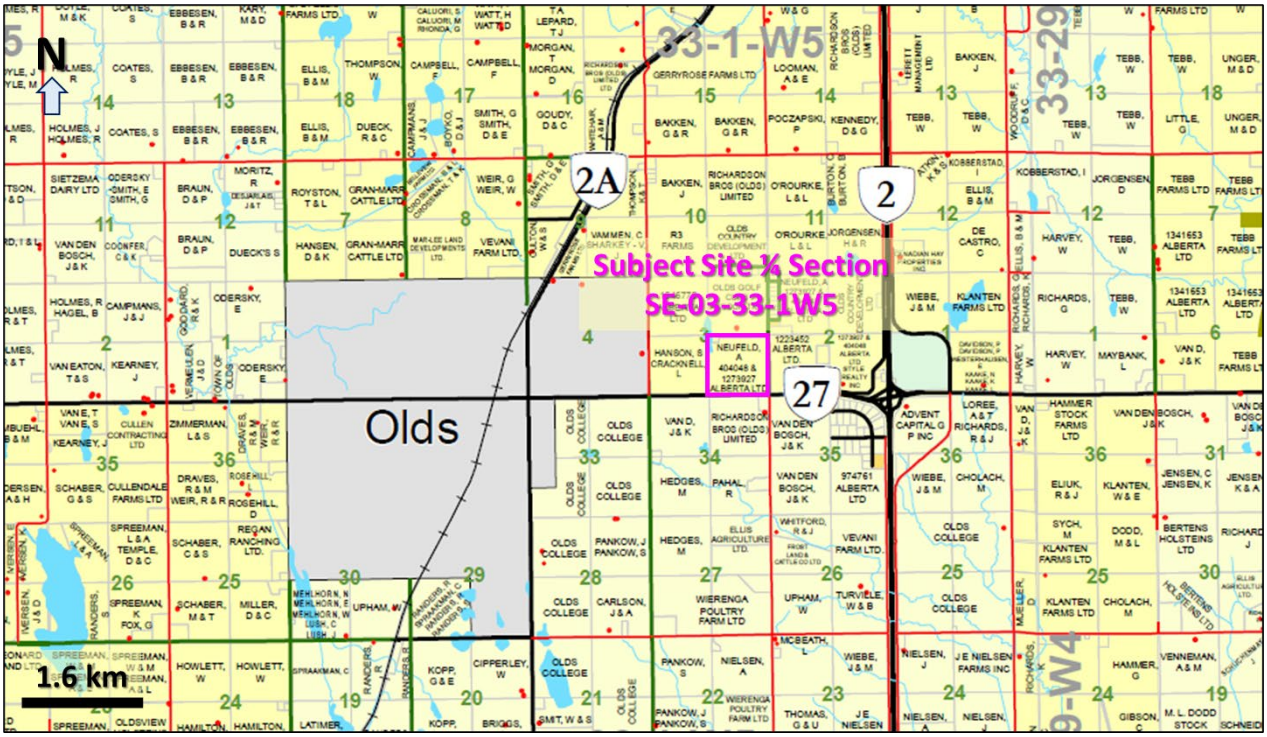
A water sample was obtained from the supply well for routine dissolved constituents and microbiology analysis. The water from the supply well exceeds AO guidelines for the concentration of sodium, sulfate, iron and total dissolved solids (TDS). The MAC guideline for manganese concentration and fluoride concentration were exceeded. The water from the supply well is suitable for drinking water use with recommended treatment to reduce manganese and fluoride concentrations. Depending on if the nature of the future water use is for sinks, toilets, shower, kitchen or for drinking water the water from the supply well may be suitable for use without treatment (e.g. for commercial use).

2. INTRODUCTION

Arletta Water Resources (Arletta) was retained by 1273927 Alberta Ltd. to complete a combined Phase I and Phase II Groundwater Supply Evaluation for a proposed 45-lot residential and 56.5-acres commercial development to determine the aquifer potential underlying the Site located within SE-03-33-1W5 (the "Site"). The purpose of the investigation was to evaluate the depth, quality and yield of aquifer units underlying the Site and how they relate to the future development of the property and its water requirements. The analysis will be used to indicate if water can be supplied to the future development without causing adverse effects to existing groundwater users in the area.

The Site is in Mountain View County, approximately 800 metres east of the Town of Olds, Alberta. The Site is in an area occupied by low to moderate density rural residential development, sections of farmland and is immediately south of the Olds Golf Course. A portion of the Mountain View County land map and subject site quarter section location is shown in Figure 1.

Figure 1. Mountain View County land map and subject site ¼ section location



The future development will require 44 water supply wells for domestic supply, in addition to the existing well already drilled on the Site, as well as water supply wells to supply the potential commercial area. According to the *Water Act* each residential (domestic) lot is to be supplied with 1,250 m^3/year of water without causing adverse effects to existing domestic, licensed or traditional agricultural water users in the area. The precise water demands of the proposed commercial development area are not known but are typically on the order of 400 m^3/year per business. The future water supply for the commercial developments will require licensing through the *Water Act*.

One water supply well, GIC Well ID 10136136, was recently drilled on Site to help establish aquifer conditions below the development area. The well was drilled on December 14th, 2023 by personnel from Black Dog Drilling Inc.

An aerial photograph of the Site quarter section showing the current land conditions and existing well location is shown in Figure 2.

Figure 2. Air photo of subdivision site with new supply well location

A map showing the proposed subdivision lot boundaries is included in Appendix I.

3. WATER WELL SUPPLY NEEDS

The new well drilled on Site is proposed to supply a single residential lot. Water for residential developments needs to be supplied at a rate, as defined in the Water Act, of 1250 m^3/year per residential lot if each lot utilizes its own on-site water well. The future development would require individual water supply wells to be drilled on each of the proposed domestic lots.

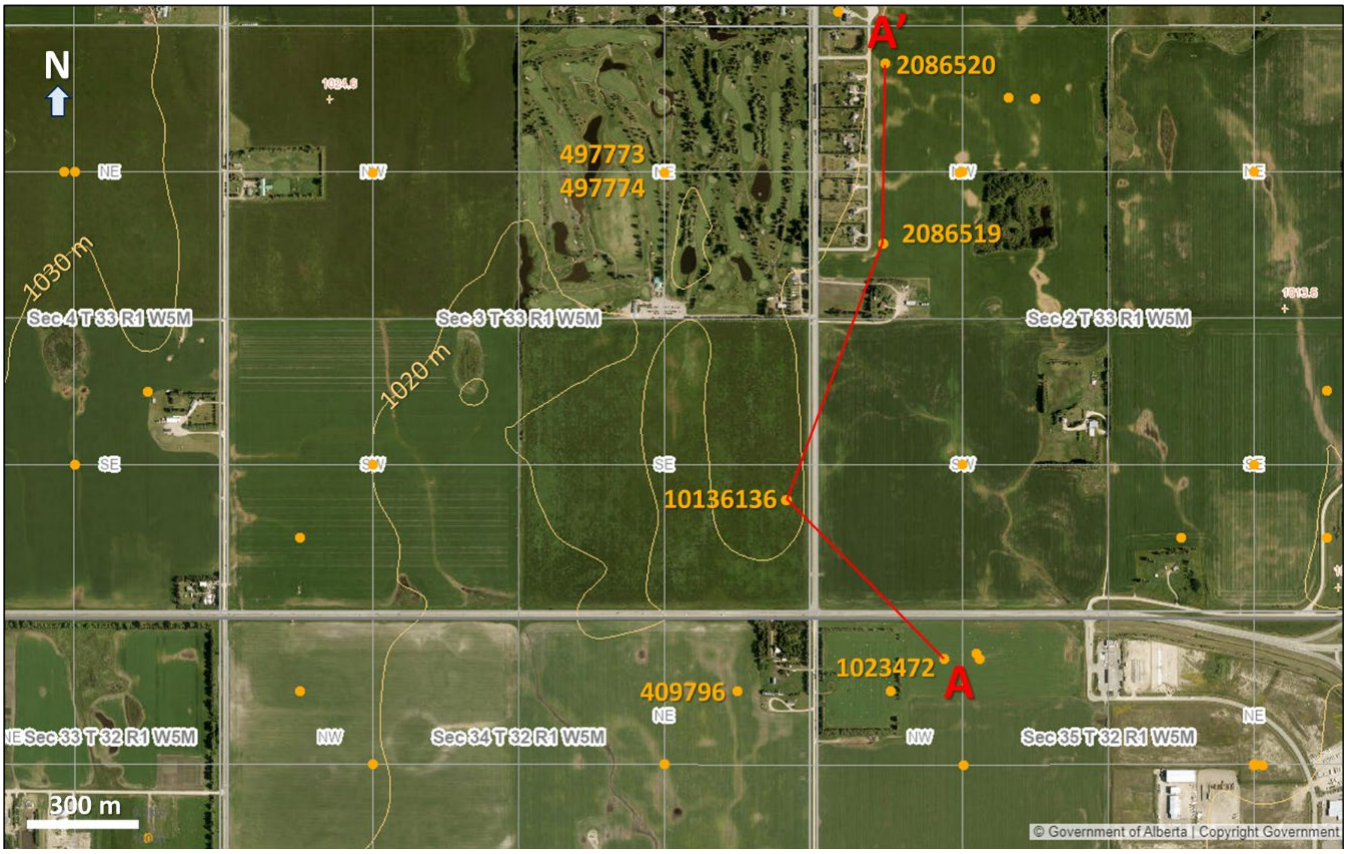
The water supply needs of the commercial portion of the development have not been defined yet. The investigation is in preliminary stages to determine the quantity of water that can be sustainably produced from an aquifer unit underlying the Site. Future wells supplying the commercial subdivision will require licensing under the *Water Act*. Water licenses can only be obtained once details of water demand for the commercial facilities are known. Commercial groundwater use is estimated at 15 m^3/day, assuming commercial facilities will only require water for sinks, toilets, showers and lunch room for staff and no processing water.

4. SITE DESCRIPTION

4.1. TOPOGRAPHY

The subdivision land is hummocky with surface elevation ranging less than 5 metres across the Site. The new supply well head is located at an approximate elevation of 1,021 metres above sea level (m asl). The closest major surface water body is Lonepine Creek, located approximately 4.4 km northeast of the subdivision Site at an elevation of 990 m asl. An aerial photo with surface topography contours and location of wells used in the geologic cross section is as follows:

Figure 3. Aerial photo with surface topography contours and A-A' cross section well locations



4.2. SURFICIAL GEOLOGY

The surficial strata in the area are mapped in *Quaternary Geology, Southern Alberta* (Shetsen, 1987) and indicates that the Site is underlain by glacially derived till consisting of a mixture of clay, silt, sand and gravel. Locally this unit can include water sorted material and bedrock, with local bedrock exposes as thick as five metres.

According to the Water Well Drilling Report for the new supply well the surficial sediment is described as 26.8 metres of interbedded sandy clay with a layer of clay, which is consistent with the surficial mapping. The presence of clay in the relatively thick surficial deposits is favorable in preventing contamination from surface sources (such as septic effluent) from entering lowering aquifers.

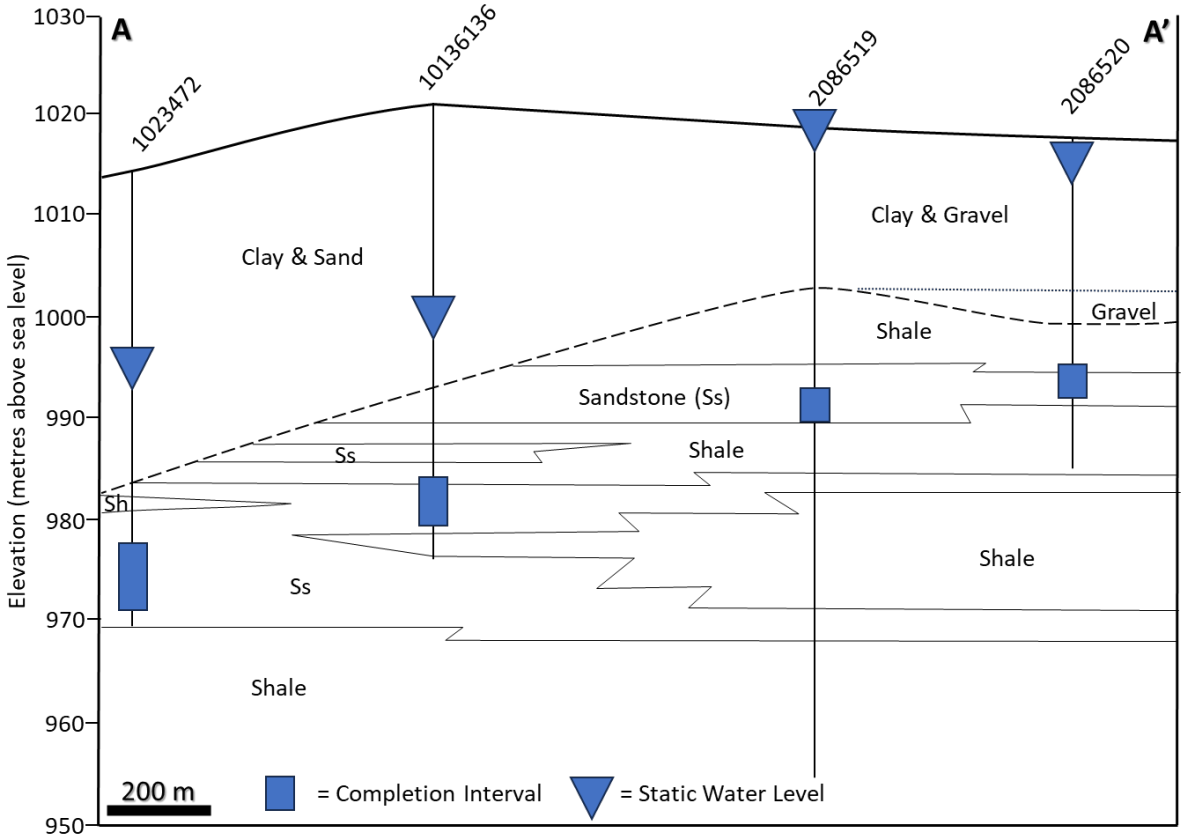
4.3. BEDROCK GEOLOGY

The underlying bedrock geology consists of the early/lower Paleocene fluvial sandstones of the Paskapoo Formation. The Paskapoo Formation is a non-marine fluvial deposit consisting of interbedded sandstone channel bodies and overbank mudstone, siltstone and shale. The formation is one of Alberta's largest and most prolific aquifers, supporting more wells

than any other aquifer in Alberta's prairies. The priority target aquifers in the formation are the permeable and porous channel sandstones, while the surrounding mud and shale act as confining aquitards.

It was reported by Toth (1963) that a volcanic deposit, termed the Olds Tuff Bed, is present in the area. As this deposit is usually associated with lake deposits, likely deposited in a back water swamp adjacent to the river deposits. The Olds Tuff is found at an elevation of around 900 m above sea level, or at a depth of approximately 21 m in the well. This zone is reported to be a grey sandy clay in the Water Well Drilling Report, consistent with the soft nature of tuffs.

Figure 4. Geologic cross section A – A'



Surficial deposits are thicker underlying the Site and thin towards the northeast. The sandstone aquifer accessed by the well on Site (#10136136) is deeper than the aquifer accessed by wells to the northeast of the Site. The different static water levels in the two south wells compared to the two north wells indicates the two sets of well are completed over different aquifer units which are not in direct hydraulic connection. Future supply wells on the Site can target the shallower aquifer zone or deeper aquifer zone, as pumping tests results indicate the wells completed in either aquifer unit are more than sufficient to meet domestic supply needs (see Sections 6 and 7).

The regional study by Toth (1965) indicates a thicker sandstone unit south of the site which was utilized by the Town of Olds as municipal supply in Two 32 – Range 1W5.

5. AREA GROUNDWATER USERS

A search of Alberta Environment and Parks water well data base was done to determine the number of water wells and their associated use in the area. A search was conducted of the wells within 1.6 km (1-mile) of the site. The search shows a total of 33 wells within the area. Of these wells, a majority are designated for domestic use, one for stock watering, three wells designated for both domestic and stock uses, three wells for commercial supply and the remaining wells have an unknown or other use listed.

Well depths range from 18.3 – 195 metres with most wells on the order of 30 – 45 metres deep. Initial pumping rates range for 5 to 70 imperial gallons per minute (igpm), with most wells tested at 20 igpm or below.

5.1. LICENSED AND REGISTERED GROUNDWATER USERS

A search of AEP's authorization viewer water license database was undertaken to determine if any groundwater licenses are present in the area. A search of licenses and registrations for the subject site and adjoining eight sections was undertaken. A summary of the groundwater licenses and registrations in the area is as follows:

Table 1. Groundwater licences and registrations

Location	Licences/ Registration	Licensed Depth Interval (m)	Licensed Volume (m^3)	Licensee/*Registrant*
33-32-01W5	1/0	30.5 – 106.7	41,369	Olds College
34-32-01W5	0/1	--	--	*Ray Pahal*
35-32-01W5	1/0	39.6 – 50.2 36.5 – 42.6 48.7 – 51.8 48.7 – 54.8 49.4 – 53.3 47.6 – 53.0 49.1 – 50.6	54,750	Mountain View County (Mountain View County Business Park)
02-33-01W5	0/1	--	--	*Blair Burton*
03-33-01W5	1/0	18.6 – 24.4 18.9 – 29.0 11.9 – 21.3 35.4 – 44.2	1,200	Olds Golf Club Association (Washroom and Clubhouse Water Supply)
09-33-01W5	0/3	--	--	*Susen & Wesley Oulton*

		--	--	*Nola & Buck Godwin*
		--	--	*Jacqueline & Chris Vammen*
10-33-01W5	0/1	--	--	*Jacqueline & Chris Vammen*
11-33-01W5	0/2	--	--	*Olds County Development Ltd.*
		--	--	*Connie Burton & H.M. Jorgensen*

Licenses for surface water withdrawals were not included in the Table 1 summary. Three licenses for groundwater extraction were found in the area, amounting to a total maximum licensed annual groundwater diversion of 97,319 m^3. There were also eight registrations found in the area. Registrations may include surface water or groundwater diversions up to 6,250 m^3 per year. The groundwater use in the area can be described as low, consisting largely of individual unregistered residential acreages with low licensed groundwater usage.

6. AREA AQUIFER PROPERTIES

Five existing supply wells within the Site area with pumping test information included in their Water Well Drilling Reports, or collected as part of a previous water supply investigation were assessed. Locations of the wells relative to the Site are shown in Figure 2. The pumping tests were analyzed with the aid of AQTESOLV software developed by Hydrosoft Inc. to estimate aquifer properties (Appendix III). A summary of well yield and associated aquifer properties produced from this analysis are tabulated below.

Table 2. Area aquifer properties

GIC Well ID	Depth to Top of Aquifer (m)	Aquifer Thickness (m)	Aquifer Transmissivity (m^2/day)	Safe Well Yield (Q_{20}) (m^3/day)
497773	38.1	6.1	17.7	101.1
497774	15.2	6.1*	28.1	176.9
1023472	32.0	10.7	90.6	450.4
2086519	21.9	5.5	49.9	551.9
2086520	21.9	2.5	9.2	100.3
* indicates completion over multiple aquifer zones				

Analysis of pumping test data from wells completed in confined bedrock aquifers near the Site produce a safe yield ranging from 100.3 – 551.9 m^3/day. There does not appear to be a correlation between aquifer depth and the calculated safe yield rate. All the wells greatly exceed the domestic supply need of 1,250 m^3/year.

7. AQUIFER PROPERTIES BELOW SITE

One new water supply well was drilled, and pump tested within the residential subdivision area, GIC Well ID 10136136. The well was completed within a confined bedrock sandstone aquifer belonging to the Paskapoo Formation. The pumping test on the well was analyzed to determine if the well can supply the 1250 m^3/year required for a subdivision lot and to determine the magnitude of drawdown interference effects, as most domestic wells within the area target the same sandstone aquifer.

7.1. SUPPLY WELL DETAILS

The supply well was installed on Site December 14th, 2023, by personnel from Black Dog Drilling Inc. The supply well location is shown in Figure 2 and the well's details are summarized in Table 2. The Water Well Drilling Report is attached in Appendix I.

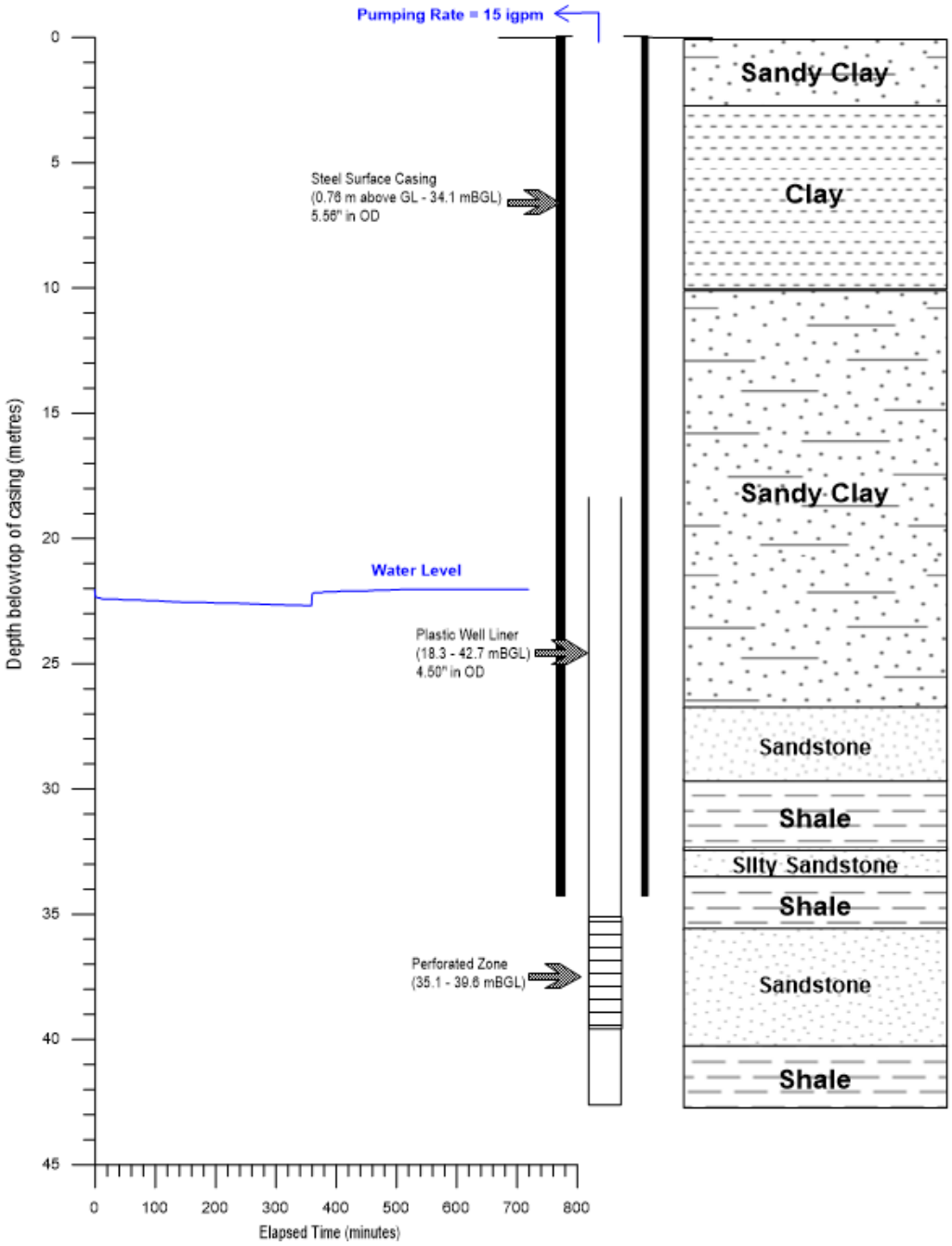
Table 3. Supply well details

Well	Supply Well
GIC Well ID	10136136
GPS Location	51.797691° N, -114.050044° E
Well depth (m BGS[1])	42.7
Aquifer zone (m BGS)	35.7 – 40.2
Completion Zone (m BGS)	35.1 – 39.6
Surface Casing (m BGS)	+0.76 – 34.1
Static water level after installation (m BTC[2])	22.01
[1]below ground surface [2]below top of casing	

7.2. PUMPING TEST DETAILS

A pumping test was conducted December 15th, 2023, by personnel from Black Dog Drilling Inc. The supply well was pumped at a rate of 15 imperial gallons per minute for (igpm) for 360 minutes. Water levels were measured during the pumping period and for an additional 360 minutes following pumping cessation. A graph showing water levels with time and a schematic of the well construction and strata of the supply well is shown in Figure 4.

Figure 5. Pumping well schematic and water levels during pumping test

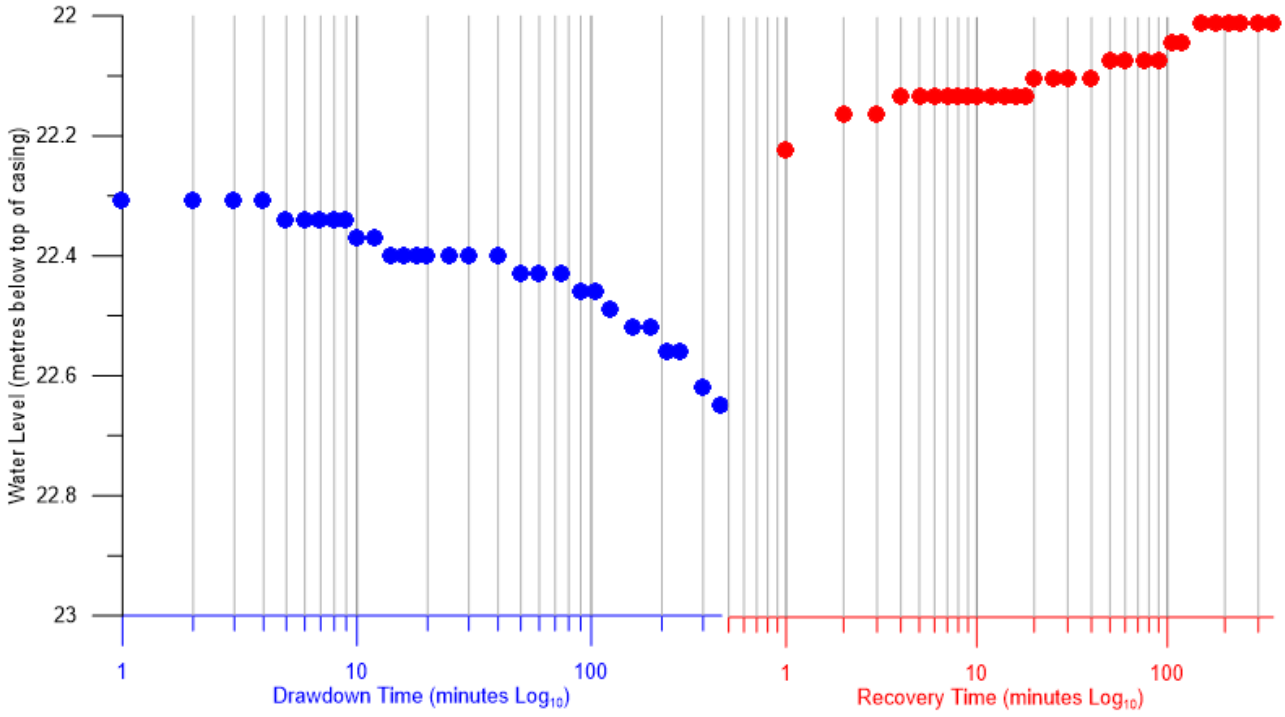


The well had an initial static water level of 22.01 metres below the top of the well casing (m BTC) prior to pumping and drew down 0.64 metres to 22.65 m BTC by the end of the pumping period. By the end of the recovery period, water level in the well had built back up to 22.01 m BTC, for a 100% recovery.

7.3. PUMPING TEST INTERPRETATION

A dual semi-log graph showing water level in the supply well during the drawdown (pumping) and recovery portions of the pumping test is displayed in the figure below. A high productivity aquifer is indicated by the low rate of drawdown throughout the pumping period given the high (for domestic use) pumping rate, and the quick recovery to near static conditions following pumping cessation.

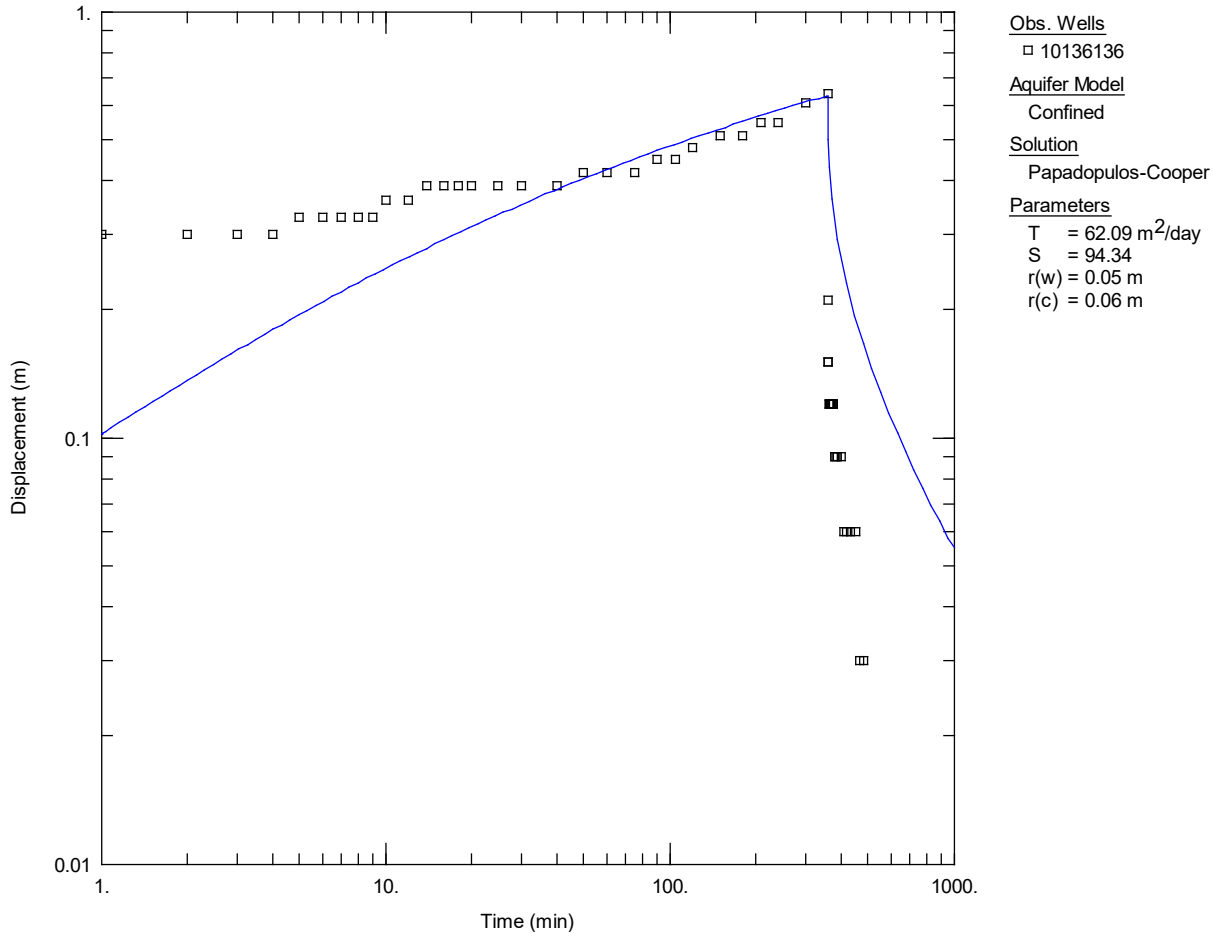
Figure 6. Dual semi-lot plot of drawdown and recovery water levels in the supply well



The rate of drawdown in the supply well is low over the first 100 minutes of the test but begins to increase following 100 minutes of pumping. The water level in the well also recovered quickly following pumping cessation, recovering by 77% in the first two minutes of the recovery period. The increase in drawdown rate during the pumping period is low considering the magnitude of water level change so no aquifer boundary effects are interpreted from the pumping test.

The pumping test data was interpreted with the aid of the program AQTESOLV, developed by Hydrosoft Inc. The Papadopulos-Cooper solution was used for a confined aquifer with radial groundwater flow. A graph showing water level displacement with time and a fitted solution curve is shown in Figure 6. The Papadopulos-Cooper solution curve was fit to late time pumping test data to give the best representation of long-term aquifer performance. An aquifer transmissivity of 62.1 m^2/day is calculated, indicating a high permeability aquifer. This value is within the range for other well tests interpreted in the area in Section 6.

Figure 7. Papadopulos-Cooper solution curve fit to pumping test data



7.4. WELL YIELD (Q_{20})

The twenty-year safe yield of the supply well (Q_{20}) was calculated using the modified Moell method as suggested in Alberta Environments Guide to Groundwater Authorization (February 2023) as follows:

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

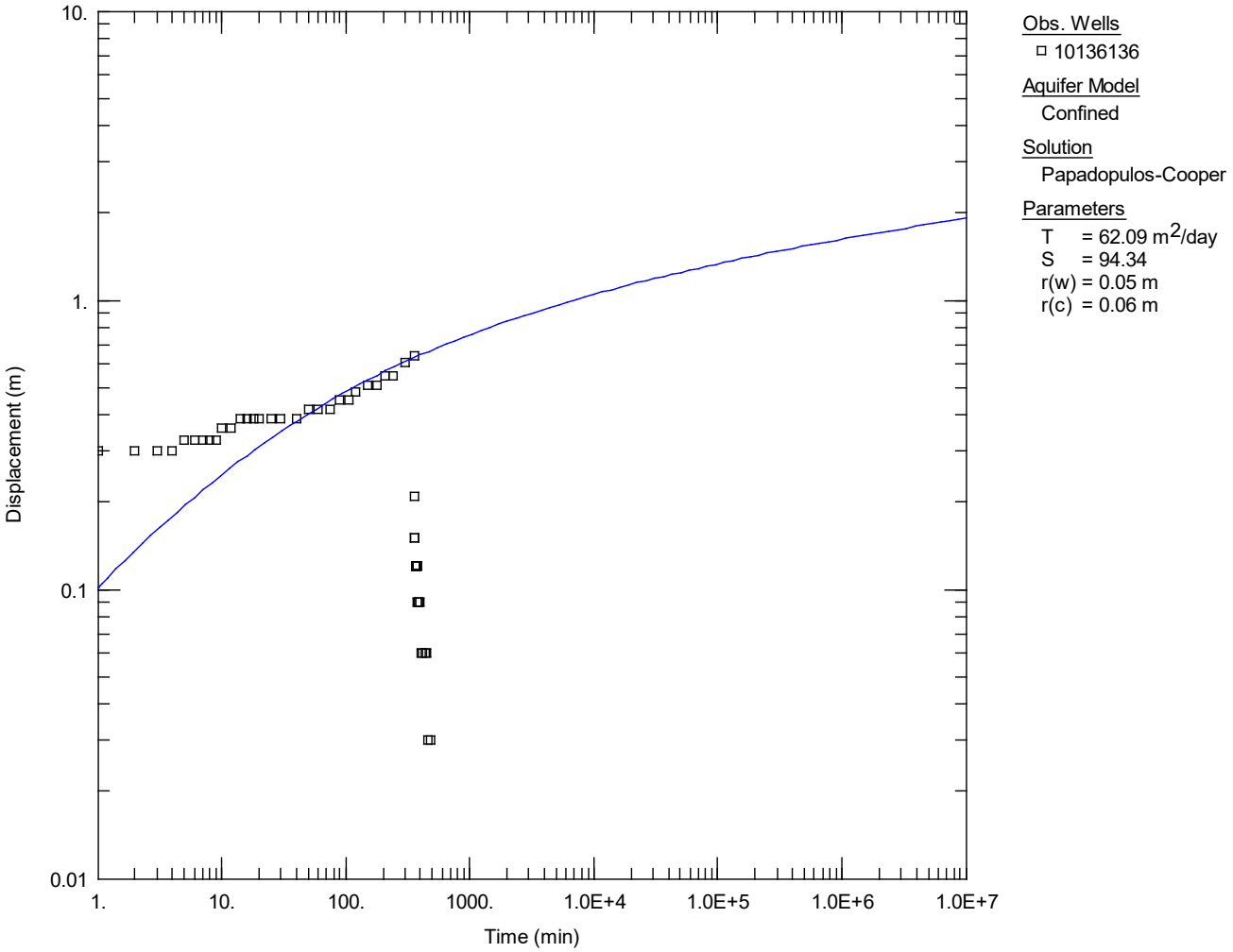
Where:

Q	-	Pump test flow rate = 98.2 m^3/day (15 igpm)
H_a	-	Available Head = 35.7 m - (22.01 m – 0.76 m) = 14.5 m
$S_{100\ min}$	-	Observed drawdown at 100 minutes = 0.45 m
($s_{20yrs} - s_{100\ th}$)	-	Difference between drawdown at 20 years and 100 min (1.92 m – 0.49 m = 1.43 m)

0.7 - Safety factor

The theoretical twenty-year drawdown was determined by extrapolating the Papadopulos-Cooper solution curve as shown in Figure 7.

Figure 8. Papadopulos-Cooper solution extrapolated to 20-years of pumping



Substituting in the above values a twenty-year safe yield (Q_{20}) of 530.2 m^3/day (81.0 imperial gallons per minute or 193,647 m^3/year) was calculated. The analysis indicates the well can sustainably supply more than the 1,250 m^3/year required for domestic use.

7.5. SUITABILITY OF AQUIFER SUPPLY FOR PROPOSED DEVELOPMENT

The bedrock sandstone aquifer permeability in the area appears moderate to high, with high calculated yield rates. A conservative anticipated yield for future supply wells installed in nearby bedrock aquifers could be between 50 and 70 m^3/day (18,263 – 25,568 m^3/year or 7.6 – 10.7 imperial gallons per minute). Sufficient aquifer supplies exist to meet the demands of the *Water Act* (3.4 m^3/day or 1,250 m^3/year) for the new subdivision development. These conservative yield estimates would also likely be suitable to supply the potential commercial development area, based on typical commercial sites requiring water for staff (washrooms, sinks, cafeteria, showers) and building operation (no processing water).

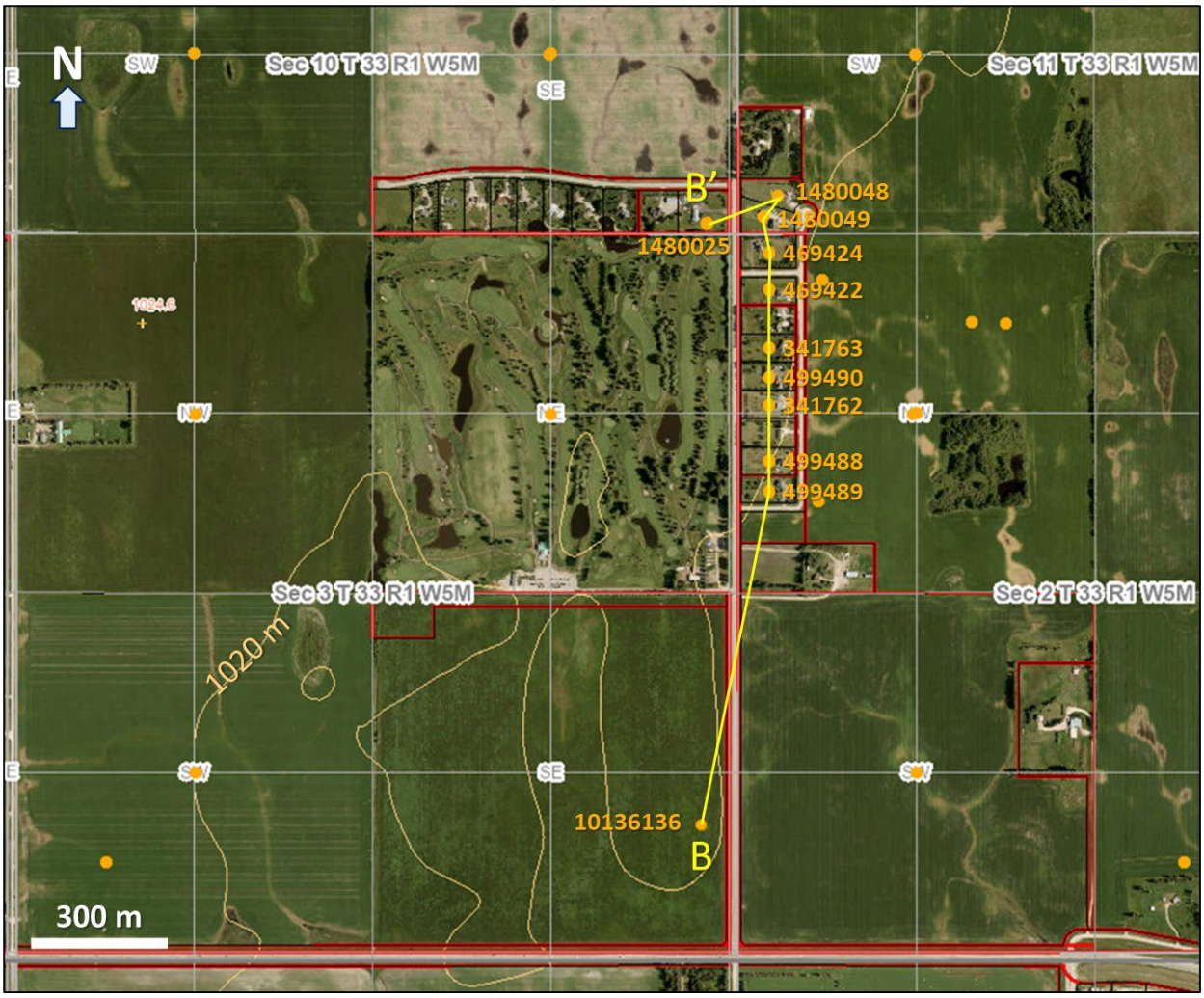
For the well completed on Site (#10136136), at the calculated Q_{20} rate, the well could supply 155 domestic lots at the rate of 1,250 m^3/year. Typical homes use less than half this amount of water per year. For a potential community supply well, typical consumption rates are approximately 400 m^3/year for both residential lots and commercial sites that need water for just sinks and toilets. This well would be able to supply approximately 484 lots at this rate.

8. EFFECT ON EXISTING GROUNDWATER USERS

8.1. NEIGHBOURING GROUNDWATER USERS WITHIN NW-02-33-01W5

There are approximately 10 neighbouring domestic groundwater users adjacent to the proposed development, located in the quarter section to the northeast of the Site in NW-02-33-01W5. Of the 10 neighbouring lots, seven wells were able to be matched to each lot using the lot number listed on the wells Water Well Drilling Report (WWDR). The remaining three lots were not able to be matched to a WWDR. An aerial photo showing the location of the new well on Site relative to the domestic use wells to the northeast is included in the figure below. An additional three wells located in quarter sections not adjacent to the Site were included.

Figure 9. Air photo showing neighbouring well locations and B-B' cross section line



Relevant information from the Water Well Drilling Report for the Site supply well and each of the adjacent 10 wells shown in Figure 9 is shown in Table 4.

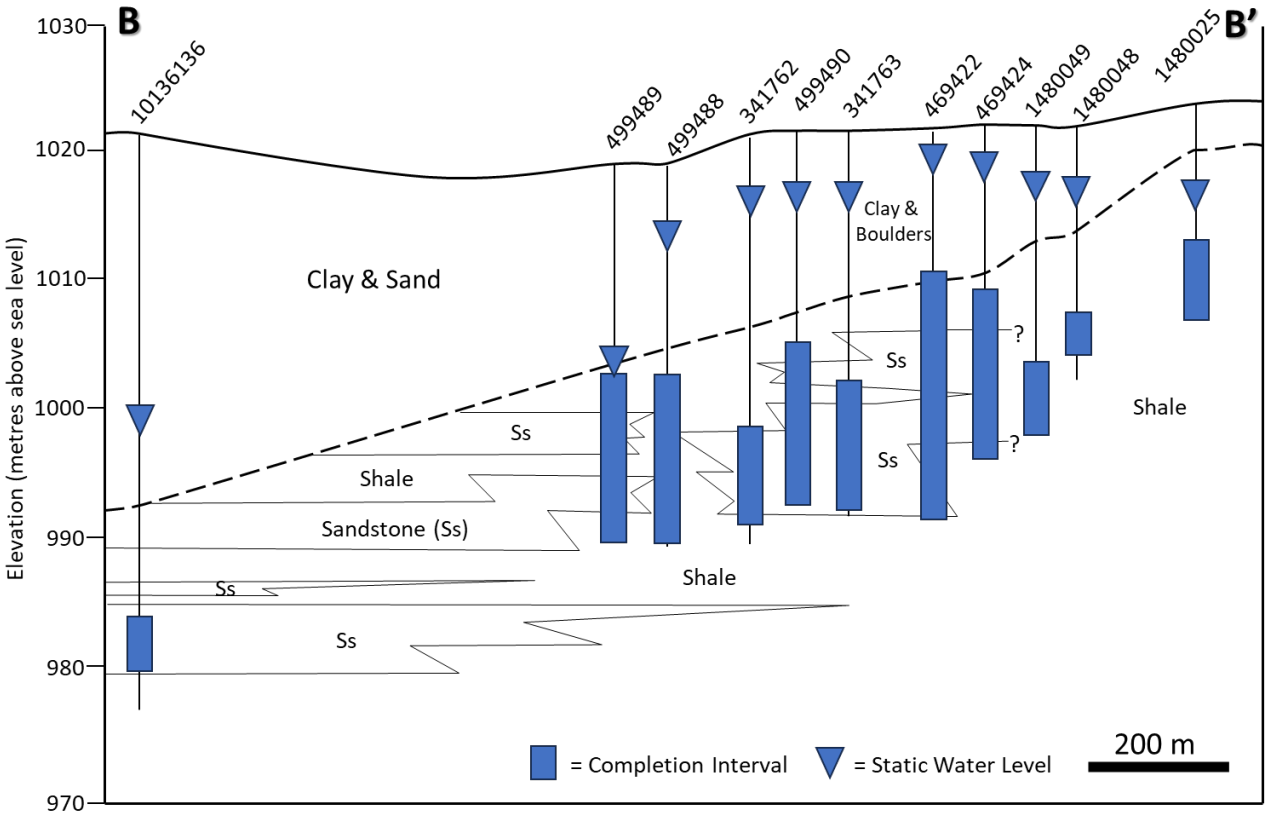
Table 4. Well details of neighbouring wells and Site supply well

GIC Well ID	Well Location	Completion Date	Depth (m)	Production Zone (m)	Static Water Level (m)	Distance to Site Well (m)
10136136	**SE-03-33-01W5**	**2023/12/15**	**42.7**	**35.1 – 39.6**	**22.01**	**N/A**
499489	NW-02-33-01W5	2001/06/20	28.0	15.2 – 28.0	15.85	728
499488	NW-02-33-01W5	2001/06/06	29.0	15.2 – 29.0	5.79	787
341762	NW-02-33-01W5	2002/07/22	29.9	21.3 – 29.9	5.79	915
499490	NW-02-33-01W5	2001/06/05	27.4	15.2 – 27.4	5.79	972
341763	NW-02-33-01W5	2001/10/04	28.0	18.3 – 28.0	6.28	1,030
469422	NW-02-33-01W5	1997/06/16	29.0	10.7 – 29.0	3.20	1,158
469424	NW-02-33-01W5	1997/06/04	24.4	12.2 – 24.4	3.81	1,230
1480049	SW-11-33-01W5	2008/05/27	21.3	16.8 – 21.3	5.18	1,301
1480048	SW-11-33-01W5	2008/05/13	18.3	13.7 – 16.8	5.79	1,359
1480025	SE-10-33-01W5	2003/07/29	15.9	9.8 – 15.9	7.32	1,287

The neighbouring domestic supply wells are completed over shallow depth zones than the Site supply well and also generally have much shallower water levels.

A cross section (Figure 10) was constructed using Water Well Drilling Reports along the line B – B' to illustrate aquifer distribution and to show if the completion zones of these existing domestic wells coincide with the production interval used by the Site supply well (#10136136).

Figure 10. Geologic cross section B – B'



The supply well on Site accesses water from a deeper confined sandstone aquifer unit compared to the existing domestic wells to the northeast of the Site, which access water from shallower confined sandstone or shale aquifer units. The static water level in the Site well (#10136136) is deeper than those of the existing domestic supply wells, indicating the Site well produces from an aquifer zone that is hydraulically isolated from the aquifers accessed by the existing domestic wells. Existing domestic supply wells produce water from either shallow confined sandstone aquifers or shallow confined shale aquifers, with static water levels generally within 7 metes of ground surface.

We can determine from the cross section that production from the Site well should not hinder the production ability of the existing domestic supply wells as they produce water from two different, hydraulically isolated zones.

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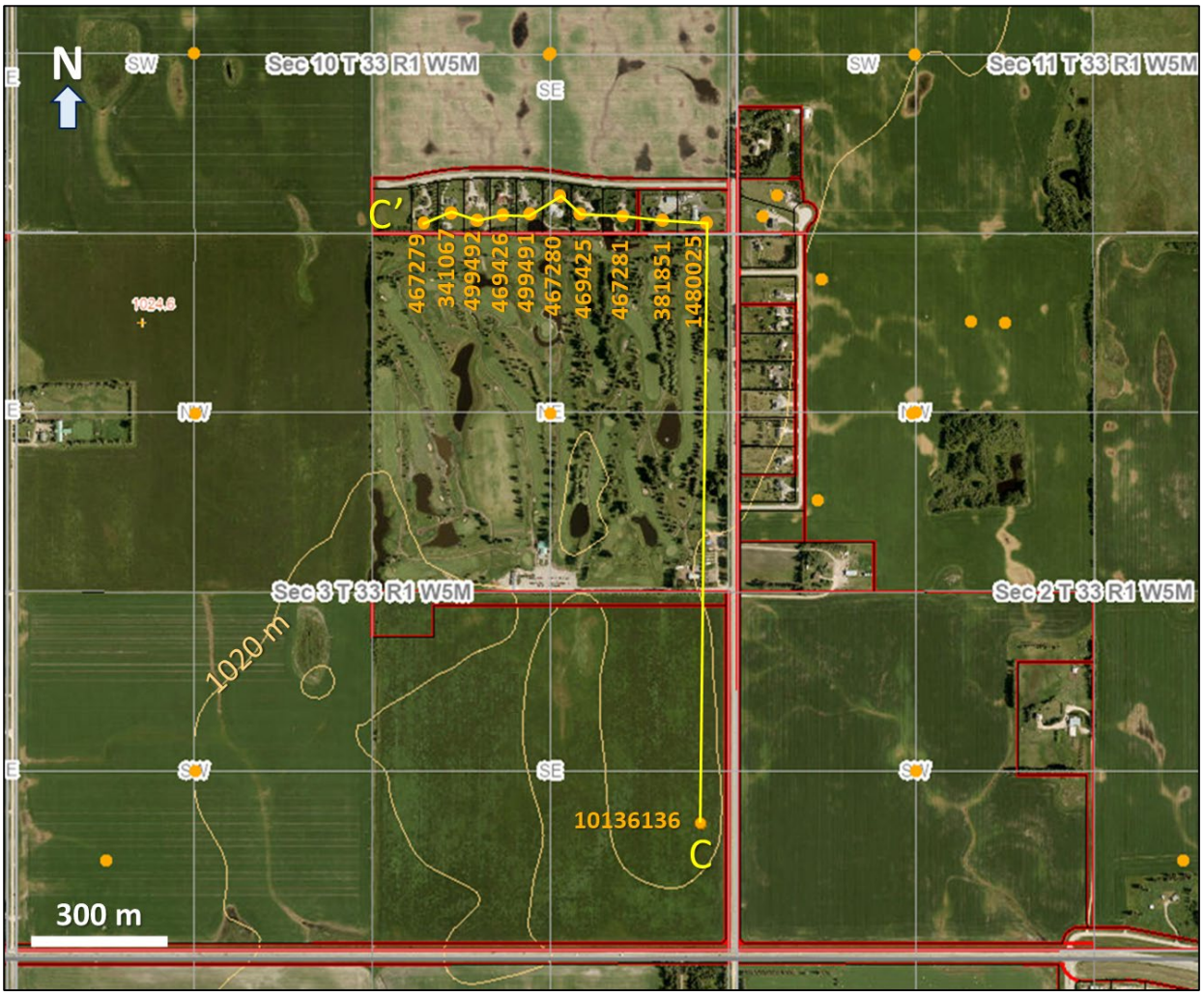
8.2. NEIGHBOURING GROUNDWATER USERS WITHIN SE-10-33-01W5

There are approximately 10 neighbouring domestic groundwater users close to the proposed development, north of the Site in NW-02-33-01W5. Wells were able to be matched to each lot using the lot number listed on the wells Water Well Drilling Report (WWDR). An aerial photo showing the location of the new well on Site relative to the domestic use wells to the north of the Olds Golf Course (and Site) is included in the figure below.

Figure 11. Air photo showing neighbouring well locations and C-C' cross section line



Relevant information from the Water Well Drilling Report for the Site supply well and each of the adjacent 10 wells shown in Figure 11 are shown in Table 5.

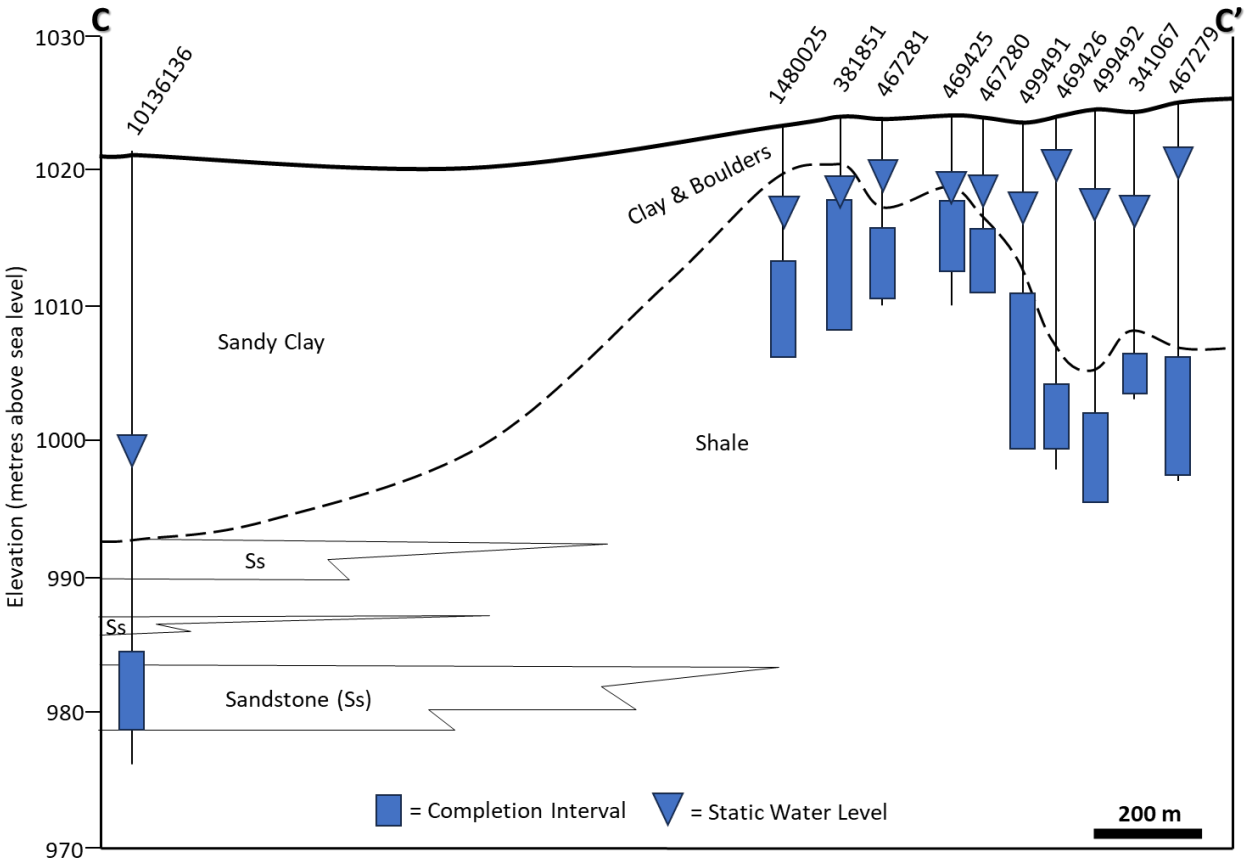
Table 5. Well details of neighbouring wells in SE-10-33-01W5 and Site supply well

GIC Well ID	Well Location	Completion Date	Depth (m)	Production Zone (m)	Static Water Level (m)	Distance to Site Well (m)
10136136	**SE-03-33-01W5**	**2023/12/15**	**42.7**	**35.1 – 39.6**	**22.01**	**N/A**
381851	SE-10-33-01W5	1994/04/08	15.2	6.1 – 15.2	6.40	1,366
341067	SE-10-33-01W5	2001/11/15	19.8	16.8 – 18.9	7.92	1,492
467279	SE-10-33-01W5	1996/09/01	25.9	17.7 – 25.9	5.18	1,498
467280	SE-10-33-01W5	1996/08/29	12.2	7.6 – 12.2	5.79	1,451
467281	SE-10-33-01W5	1996/08/27	12.8	7.6 – 12.2	4.88	1,362
469425	SE-10-33-01W5	1998/07/09	12.2	6.1 – 10.7	5.79	1,374
469426	SE-10-33-01W5	1998/07/02	24.4	18.3 – 22.9	4.57	1,443
499491	SE-10-33-01W5	2001/06/14	21.3	12.2 – 21.3	7.01	1,426
499492	SE-10-33-01W5	2001/06/25	27.4	21.3 – 27.4	7.32	1,457
1480025	SE-10-33-01W5	2003/07/29	15.9	9.8 – 15.9	7.32	1,364

The neighbouring domestic supply wells are completed over shallow depth zones than the Site supply well and also have shallower water levels.

A cross section (Figure 12) was constructed using Water Well Drilling Reports along the line C – C' to illustrate aquifer distribution and to show if the completion zones of these existing domestic wells coincide with the production interval used by the Site supply well (#10136136).

Figure 12. Geologic cross section C – C'



The supply well on Site accesses water from a deeper confined sandstone aquifer unit compared to the existing domestic wells to the north of the Site. The static water level in the Site well (#10136136) is deeper than those of the existing domestic supply wells, indicating the Site well produces from an aquifer zone that is hydraulically isolated from the aquifer accessed by the existing domestic wells within SE-10-33-01W5. Existing domestic supply wells produce water shallow confined shale aquifers, with static water levels generally within 5 metes of ground surface.

We can determine from the cross section that production from the Site well should not hinder the production ability of the existing domestic supply wells as they produce water from two different, hydraulically isolated zones.

8.3. DRAWDOWN INTERFERENCE EFFECTS – SINGLE WELL

Using the Cooper-Jacob equation the expected drawdown through time can be calculated at various radial distances from the supply well as follows:

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

Where:

s	-	Drawdown (m)
S	-	Storativity (S) (5.0 x 10^{-5})
Q	-	Pump rate (3.4 m^3/day)
T	-	Transmissivity (62.1 m^2/day)
t	-	Time (days)
r	-	Radial distance from pumping well (m)

Water level drawdown at various distances from the pumping well are tabulated as a function of time in Table 5.

Table 6. Cooper-Jacob distance drawdown calculations

Distance (m)/ Time (days)	100	300	500	850	1000	1600	3000
1	0.02	0.01	0.01	0.01	0.00	0.00	-
7	0.03	0.02	0.02	0.01	0.01	0.01	0.00
30	0.04	0.03	0.03	0.02	0.02	0.02	0.01
365	0.05	0.04	0.04	0.03	0.03	0.03	0.02
1826	0.06	0.05	0.04	0.04	0.04	0.03	0.03
3652	0.06	0.05	0.05	0.04	0.04	0.04	0.03
7305	0.06	0.05	0.05	0.04	0.04	0.04	0.03

The following assumptions were included in the above calculation: A conservative storativity value of 5.0 x 10^{-5} for a confined aquifer, a continuous consumption rate of 3.4 m^3/day (based on a single lot domestic supply requirement), transmissivity as determined from the pumping test interpretation (62.1 m^2/day), no recharge is occurring, and all wells are screened over the same aquifer.

From the above table, we can infer that the most a neighbouring supply well (<100 metres away) completed in the same aquifer could experience up to 0.06 metres of additional drawdown over a 20-year (7305 day) pumping period. This additional drawdown is considered negligible over a 20-year period.

8.4. DRAWDOWN INTERFERENCE EFFECTS – 45 DOMESTIC WELLS

Using the Cooper-Jacob equation the expected drawdown through time can be calculated at various radial distances from the Site. Aquifer parameters obtained from the pumping test of the well on Site (#10136136) were used to approximate the impact of the 45-lot domestic development, with individual domestic wells on each lot, as follows:

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

Where:

s	-	Drawdown (m)
S	-	Storativity (S) (5.0 x 10^{-5})
Q	-	Pump rate (3.4 m^3/day × 45 lots = 153 m^3/day)
T	-	Transmissivity (62.1 m^2/day)
t	-	Time (days)
r	-	Radial distance from centre of domestic development (m)

Water level drawdown as measured radially from the centre of domestic development area are tabulated below as a function of time.

Table 7. Cooper-Jacob distance drawdown calculations from 45 domestic supply wells

Distance (m)/ Time (days)	100	300	500	850	1000	1600	3000
1	1.10	0.67	0.47	0.26	0.20	0.02	-0.23
7	1.48	1.05	0.85	0.65	0.58	0.40	0.15
30	1.77	1.34	1.14	0.93	0.87	0.68	0.44
365	2.26	1.83	1.63	1.42	1.36	1.17	0.93
1826	2.57	2.14	1.94	1.74	1.67	1.49	1.24
3652	2.71	2.28	2.08	1.87	1.81	1.62	1.38
7305	2.84	2.41	2.21	2.01	1.94	1.76	1.51

The following assumptions were included in the above calculation: A conservative storativity value of 5.0 x 10^{-5} for a confined aquifer, a continuous consumption rate of 153 m^3/day (based on the domestic supply requirement multiplied by the 45 proposed lots), transmissivity as determined from the pumping test interpretation (62.1 m^2/day), no recharge is occurring, and all wells are screened over the same aquifer.

From the above table, we can infer that the most a neighbouring supply well (<100 metres away) completed in the same aquifer could experience up to 2.84 metres of additional drawdown over a 20-year (7305 day) pumping period. This additional drawdown is considered small over a 20-year period and recharge to the aquifer via precipitation and snowmelt would stabilize groundwater levels over time. Additionally, existing domestic supply wells to the north and northeast of the

Site are completed in different aquifer units (Figure 10 and Figure 12) and would not be directly impacted by production from a different aquifer zone.

8.5. DRAWDOWN INTERFERENCE EFFECTS – 45 DOMESTIC WELLS PLUS COMMERCIAL USE

Using the Cooper-Jacob equation the expected drawdown through time can be calculated at various radial distances from the Site. Aquifer parameters obtained from the pumping test of the well on Site (#10136136) were used to approximate the impact of the 45-lot domestic development, with individual domestic wells on each lot, as follows:

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

Where:

s	-	Drawdown (m)
S	-	Storativity (S) (5.0 x 10^{-5})
Q	-	Pump rate [(3.4 m^3/day × 45 lots) + 15 m^3/day] = 168 m^3/day)
T	-	Transmissivity (62.1 m^2/day)
t	-	Time (days)
r	-	Radial distance from centre of domestic development (m)

Water level drawdown as measured radially from the centre of domestic development area are tabulated below as a function of time.

Table 8. Cooper-Jacob distance drawdown calculations from 45 domestic supply wells and commercial use

Distance (m)/ Time (days)	100	300	500	850	1000	1600	3000
1	1.21	0.74	0.52	0.29	0.22	0.02	-
7	1.63	1.16	0.94	0.71	0.64	0.44	0.17
30	1.94	1.47	1.25	1.02	0.95	0.75	0.48
365	2.48	2.01	1.79	1.56	1.49	1.29	1.02
1826	2.83	2.35	2.13	1.91	1.84	1.63	1.36
3652	2.97	2.50	2.28	2.05	1.98	1.78	1.51
7305	3.12	2.65	2.43	2.20	2.13	1.93	1.66

The following assumptions were included in the above calculation: A conservative storativity value of 5.0 x 10^{-5} for a confined aquifer, a continuous consumption rate of 153 m^3/day (based on the domestic supply requirement multiplied by the 45 proposed lots plus the estimated 15 m^3/day required for commercial use), transmissivity as determined from the pumping test interpretation (62.1 m^2/day), no recharge is occurring, and all wells are screened over the same aquifer.

From the above table, we can infer that the most a neighbouring supply well (<100 metres away) completed in the same aquifer could experience up to 3.12 metres of additional drawdown over a 20-year (7305 day) pumping period. This additional drawdown is considered small over a 20-year period and recharge to the aquifer via precipitation and snowmelt would stabilize groundwater levels over time. Additionally, existing domestic supply wells to the north and northeast of the Site are completed in different aquifer units (Figure 10 and Figure 12) and would not be directly impacted by production from a different aquifer zone.

9. WATER QUALITY

A water sample was obtained from the supply well for routine chemistry and microbiology analysis. The water sample was collected from the supply well on December 15th, 2023 by personnel from Black Dog Drilling Inc. and submitted to Central Labs in Red Deer for analysis on the same date as sample collection. The water analysis report from Central Labs is attached in Appendix V and a summary of the results, with a comparison to the Guidelines for Canadian Drinking Water Quality (2022) is as follows:

Table 9. Water quality summary

Parameter	Units	Well ID 10136136	**CDWQ MAC**/AO
pH	pH	7.73	7.0 – 10.5
EC (@ 25˚C)	µS/cm	2,180	--
Calcium	mg/L	48.5	--
Magnesium	mg/L	10.2	--
Sodium	mg/L	*510*	200
Potassium	mg/L	3.87	--
Chloride	mg/L	2.86	250
Nitrate	mg/L	<0.050	**10**
Sulfate	mg/L	*576*	500
Manganese	mg/L	**0.964**	**0.12**

Bicarbonate	mg/L	605	--
Iron	mg/L	*14.4*	0.3
Total Dissolved Solids	mg/L	*1,450*	500
Fluoride	mg/L	**2.09**	**1.5**
T-Alkalinity	mg/L	496	--
Total Coliforms	CFU/100mL	<1	**<1**
Escherichia Coliforms	CFU/100mL	<1	**<1**
AO – Aesthetic Objective **MAC** – Maximum Allowable Concentration			

The water from the supply well exceeds AO guidelines for the concentration of sodium, sulfate, iron and total dissolved solids (TDS). The MAC guideline for manganese concentration and fluoride concentration were exceeded. The water from the supply well is suitable for drinking water use with recommended treatment to reduce manganese and fluoride concentrations. Depending on if the nature of the future water use is for sinks, toilets, shower, kitchen or for drinking water the water from the supply well may be suitable for use without treatment (e.g. for commercial use).

10. CONCLUSIONS AND RECOMMENDATIONS

The water well data available in the area shows that aquifer units are distinct, with permeable aquifer units (sandstone) hydraulically isolated (separated) from each other by low permeability shale bodies. As the aquifers are hydraulically separated from each other, wells completed in one aquifer unit are not in direct competition for the same water resources accessed by wells completed in another aquifer unit.

Aquifer quality in the area is moderate to high, with available pumping tests analyzed to determine a sustainable pumping rate of 100.3 – 551.9 m^3/day. At the calculated Q_{20} rate the well completed on Site could supply 155 domestic lots at the rate of 1,250 m^3/year required by the *Water Act*, which exceeds the 45 proposed domestic lots.

The existing domestic supply wells near the proposed development are completed over shallow shale or interbedded shale-sandstone aquifers from 12 – 30 metres below ground. The Netook North well is completed over a deeper, distinct

sandstone aquifer unit present from 35 – 40 metres below ground. There are no neighbouring wells within NW-02-33-01W5 and SE-10-33-01W5 that are completed over the aquifer accessed by the Netook North supply well. We recommend that future supply wells drilled to service the domestic and commercial water supply needs of the Netook North Site be completed over the deeper, distinct sandstone aquifer in order to not compete with existing neighbouring groundwater users producing from shallower aquifers. The requirement to drill wells within the Netook North development to at least 40 metres should be a condition of subdivision approval.

11. REFERENCES

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12. CLOSURE

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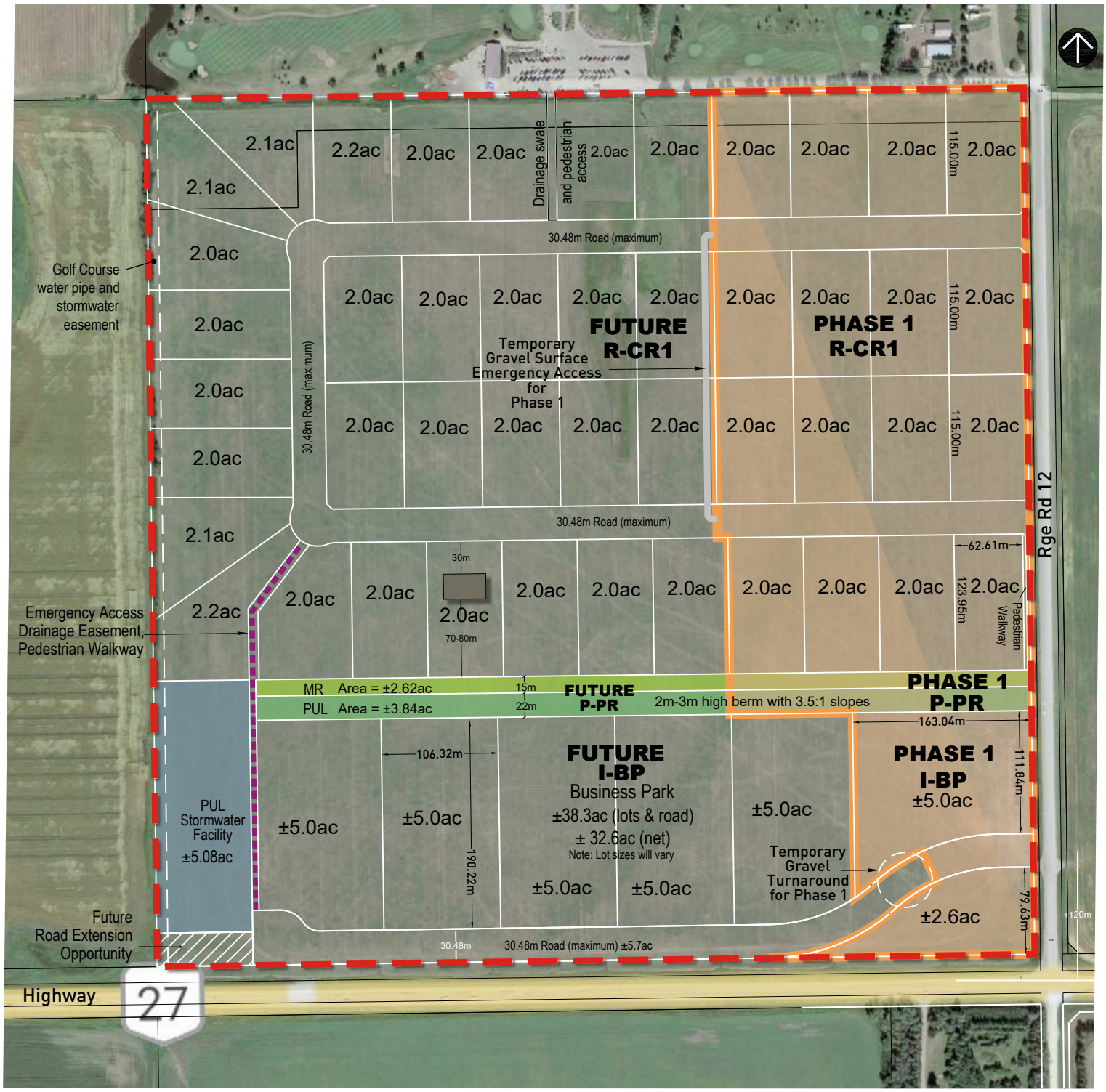
Arletta Water Resources

2024-08-23

Alanna Felske, P.Geo. Junior Hydrogeologist	Ken Hugo, P.Geol., Senior Hydrogeologist

APPENDICES

Appendix I:
Subdivision Map



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Legend

- Concept Plan Area ±63.09ha (±156.02ac)
- Phase 1 Land Use Redesignation and Subdivision ±19.36ha (±47.85ac)

Netook North

1273927 Alberta Ltd.

Concept Plan

SE 3-33-1 W5M

August 2024

Appendix II:
Water Well Reconnaissance Report

Reconnaissance Report

View in Imperial

Export to Excel

Groundwater Wells

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

GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (m)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (m)	TEST RATE (L/min)	SC_DIA (cm)
341762	NW	2	33	1	5	KINSELLA DRILLING LTD.	2002-07-22	29.87	New Well	Domestic		4	20	COPPER CROWN HLDG	5.79	68.19	15.24
341763	NW	2	33	1	5	KINSELLA DRILLING LTD.	2001-10-04	28.04	New Well	Domestic		7	18	COPPER CROWN /SOWERBY, M.	6.28	54.55	15.24
359826	NE	3	33	1	5	DOERING DRILLING LTD.	1991-05-28	29.87	New Well	Domestic		12		OLDS GOLF COURSE	6.10	90.92	13.97
409794	NW	34	32	1	5	DOERING DRILLING LTD.	1974-11-01	40.54	New Well	Domestic		9		HEDGES, D.	0.00	54.55	14.12
409795	13	34	32	1	5	UNKNOWN DRILLER		0.00	Flowing Shot Hole	Industrial				SUN OIL CO			0.00
409796	16	34	32	1	5	DOERING DRILLING LTD.	1978-12-12	41.15	New Well	Domestic & Stock	1	10		ALEXANDER, R.M./ JOYCE K.	0.00	68.19	14.12
409797	NW	35	32	1	5	UNKNOWN DRILLER		24.38	Chemistry	Domestic	1			HOPP, WAYNE			0.00
409798	NW	35	32	1	5	UNKNOWN DRILLER		35.05	Well Inventory	Unknown				ARC #243	10.67		0.00
409799	13	35	32	1	5	UNKNOWN DRILLER		0.00	Flowing Shot Hole	Industrial				SUN OIL CO			0.00
416130	2	2	33	1	5	UNKNOWN DRILLER		36.58	Well Inventory	Domestic				WATKINS, DON			0.00
416131	2	2	33	1	5	KINSELLA DRILLING LTD.		36.58	Well Inventory	Domestic				WATKINS, DON			0.00
416133	SW	2	33	1	5	KINSELLA DRILLING LTD.	1974-04-09	33.53	New Well	Domestic		10		BURTON, W.M.	22.86	90.92	14.12
416134	NW	2	33	1	5	UNKNOWN DRILLER		24.38	Chemistry	Domestic	1			BURTON, W.M.			0.00
416135	14	2	33	1	5	HI-RATE DRILLING 1985 LTD.		195.07	New Well	Unknown		74			40.54	45.46	0.00
416138	7	3	33	1	5	ALL RITE DRILLING LTD.	1978-11-13	43.28	New Well	Industrial		4		CANADIAN SUPERIOR	27.43	90.92	11.43
416139	7	3	33	1	5	ALL RITE DRILLING LTD.	1978-11-14	43.28	New Well-Decommissioned	Industrial		7		CANADIAN SUPERIOR	24.38	90.92	0.00
416140	SW	3	33	1	5	DOERING DRILLING LTD.	1987-10-28	53.34	New Well	Domestic & Stock		7		MCHALCHUK, STEVE	26.76	68.19	13.97
416141	4	3	33	1	5	UNKNOWN DRILLER		33.53	Chemistry	Domestic	1			MICHALCHUK, S.			0.00
416142	NW	3	33	1	5	UNKNOWN DRILLER		24.38	Chemistry	Domestic	1			BUEHLER, R.G.			0.00
416143	NW	3	33	1	5	M.E. LAWSON WATER WELLS	1976-03-18	56.39	New Well	Stock		2		BUEHLER, RAY	10.06	81.83	13.97

Reconnaissance Report

View in Imperial

Export to Excel

GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (m)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (m)	TEST RATE (L/min)	SC_DIA (cm)
416144	NE	3	33	1	5	DOERING DRILLING LTD.	1977-02-28	24.99	New Well	Domestic	2	7		OLDS MENS GOLF CLUB	6.49	90.92	14.12
416148	8	4	33	1	5	UNKNOWN DRILLER		0.00	Flowing Shot Hole	Industrial							0.00
465762	NE	34	32	1	5	UNKNOWN DRILLER		27.43	Well Inventory	Domestic					0.91	363.69	15.24
465763	NE	34	32	1	5	UNKNOWN DRILLER		29.26	Chemistry	Domestic	1			ALEXANDER, JOYCE	18.29		0.00
465764	13	35	32	1	5	DOERING DRILLING LTD.	1978-12-11	42.67	New Well	Domestic		7		HAMMER, GARNET	28.19	90.92	14.12
465765	NW	35	32	1	5	UNKNOWN DRILLER		27.43	Chemistry	Domestic				HAMMER, MARK/ ROBERTA			0.00
469422	NW	2	33	1	5	KINSELLA DRILLING LTD.	1997-06-16	28.96	New Well	Domestic		5	11	COPPER CROWN HLDG #WELL 2	3.20	54.55	14.12
469423	NW	2	33	1	5	KINSELLA DRILLING LTD.	1997-06-19	30.48	New Well	Domestic		6	13	COPPER CROWN HLDG #WELL 3	2.32	54.55	14.12
469424	NW	2	33	1	5	KINSELLA DRILLING LTD.	1997-06-10	24.38	New Well	Domestic		5	9	COPPER CROWN HLDG #WELL 1	3.81	54.55	14.12
477136	SW	2	33	1	5	DOERING DRILLING LTD.	1988-01-18	43.28	New Well	Domestic & Stock		6		BURTON, B.	18.90	181.84	14.12
477137	SW	2	33	1	5	UNKNOWN DRILLER		42.67	Chemistry	Domestic				MCPHERSON, NANCY			0.00
491293	NE	34	32	1	5	M.E. LAWSON WATER WELLS	1998-07-14	39.62	New Well	Domestic		2	13	RICHARDSON BROS (OLDS) LTD	19.20	54.55	13.97
497773	NE	3	33	1	5	DOERING DRILLING LTD.	2001-01-31	47.24	New Well	Other		8	23	OLDS GOLF CLUB ASSOC	21.64	36.37	13.97
497774	NE	3	33	1	5	DOERING DRILLING LTD.	2001-01-27	22.86	New Well	Other		11	23	OLDS GOLF CLUB ASSOC	2.68	46.82	13.97
499488	NW	2	33	1	5	KINSELLA DRILLING LTD.	2001-06-06	28.96	New Well	Domestic		3	5	COPPER CROWN HLDG	5.79	136.38	15.24
499489	NW	2	33	1	5	KINSELLA DRILLING LTD.	2001-06-20	28.04	New Well	Domestic		6	7	COPPER CROWN HLDG LTD	15.85	68.19	15.24
499490	NW	2	33	1	5	KINSELLA DRILLING LTD.	2001-06-05	27.43	New Well	Domestic		6	3	COPPER CROWN HLDG LTD	5.79	68.19	15.24
1023471	14	35	32	1	5	AARON DRILLING INC.	2021-11-24	44.20	New Well	Commercial		6	12	NOBLE EQUIPMENT CO.	20.09	22.73	16.84
1023472	13	35	32	1	5	AARON DRILLING INC.	2021-11-26	42.67	New Well	Commercial		6	9	NOBLE EQUIPMENT CO	20.72	22.73	16.84
1023473	14	35	32	1	5	AARON DRILLING INC.	2021-11-22	42.67	New Well	Commercial		10		NOBLE EQUIPMENT CO			16.84

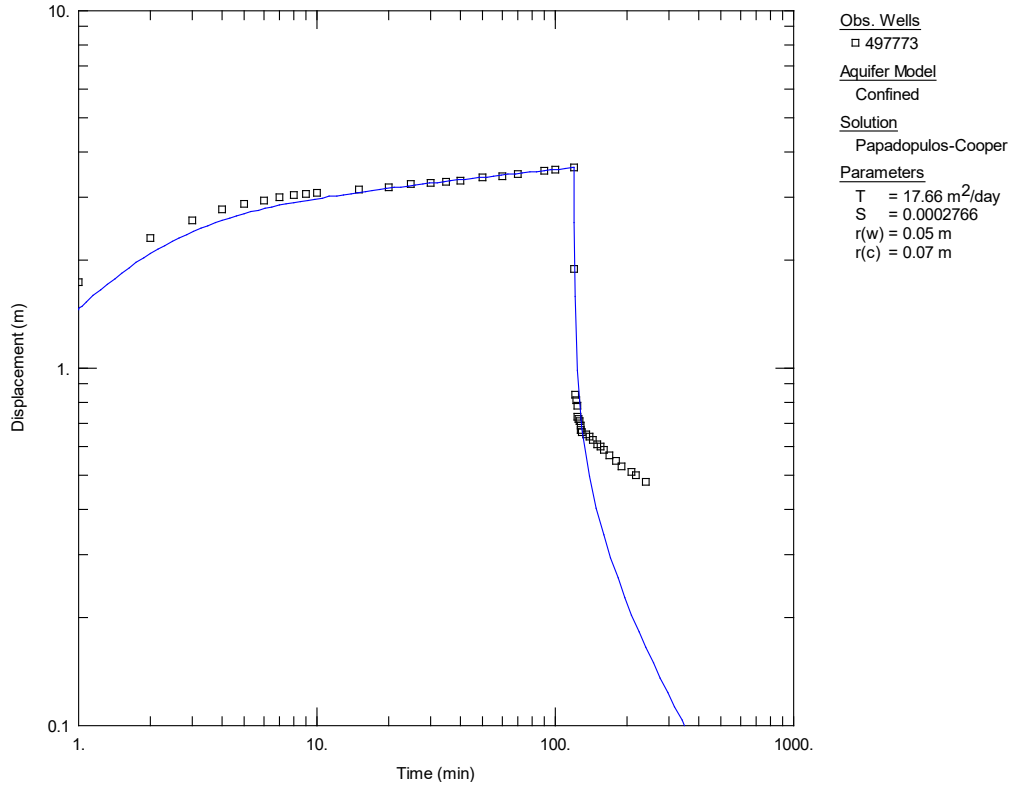
Reconnaissance Report

View in Imperial

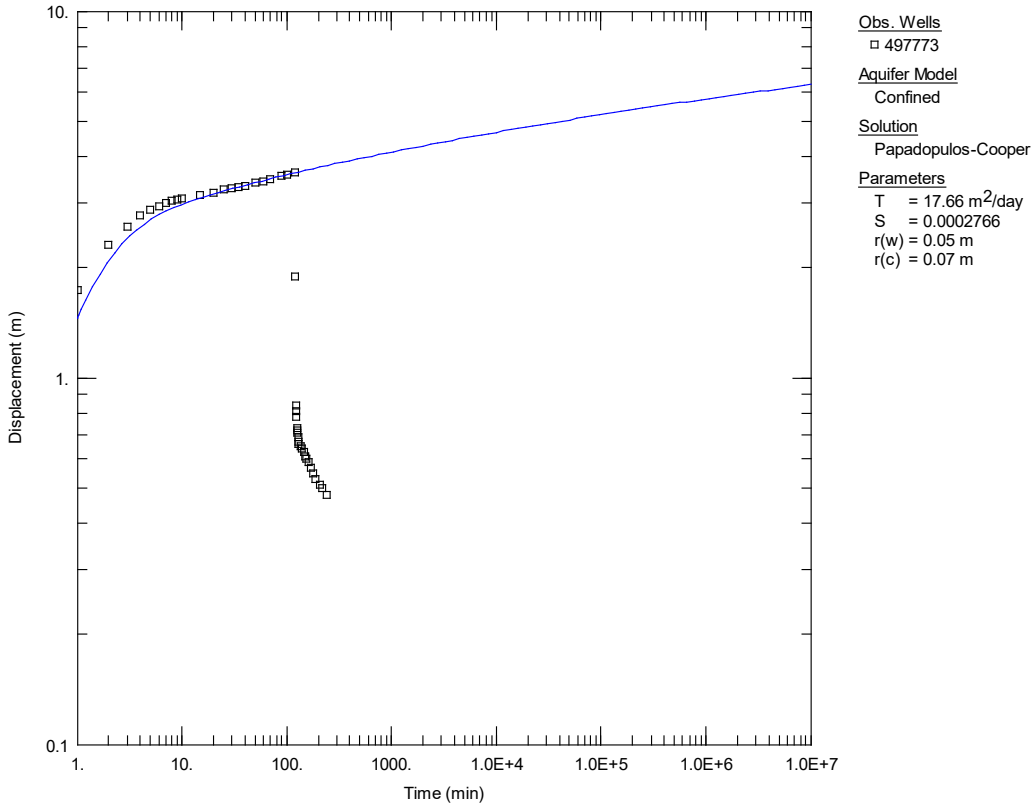
Export to Excel

GIC Well ID	LSD	SEC	TWP	RGE	M	DRILLING COMPANY	DATE COMPLETED	DEPTH (m)	TYPE OF WORK	USE	CHM	LT	PT	WELL OWNER	STATIC LEVEL (m)	TEST RATE (L/min)	SC_DIA (cm)
1060896	14	2	33	1	5	ALKEN BASIN DRILLING LTD.	2004-05-03	24.38	New Well	Industrial		9	4	LEDGE / ENSIGN 49	3.05	318.23	14.13
1060896	14	2	33	1	5	ALKEN BASIN DRILLING LTD.			Existing Well-Decommissioned	Other				LEDGE / ENSIGN 49			
1480048	4	11	33	1	5	M.E. LAWSON WATER WELLS	2008-05-13	18.29	New Well	Domestic		4	3	O'ROURKE DEVELOPMENT	5.79	68.19	14.12
1480049	4	11	33	1	5	M.E. LAWSON WATER WELLS	2008-05-27	21.34	New Well	Domestic		2	3	O'ROURKE DEVELOPMENT	5.18	68.19	14.12
2086519	12	2	33	1	5	BLACK DOG DRILLING & ENV SERV. LTD.	2021-11-08	60.96	New Well	Domestic		8		BROWN, GREG	2.29	181.84	15.24
2086520	13	2	33	1	5	BLACK DOG DRILLING & ENV SERV. LTD.	2021-11-08	30.48	New Well	Domestic		7		BROWN, GREG	4.32	159.11	14.13

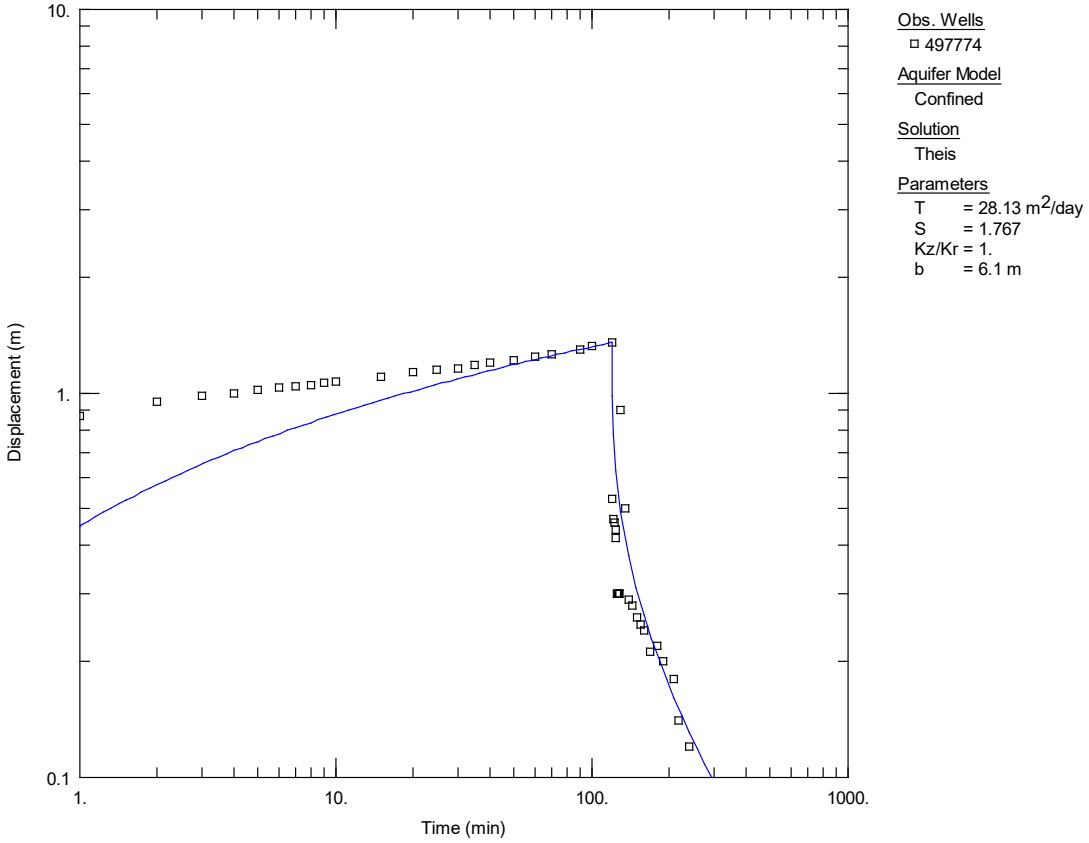
Appendix III:
AQTESOLV Plots



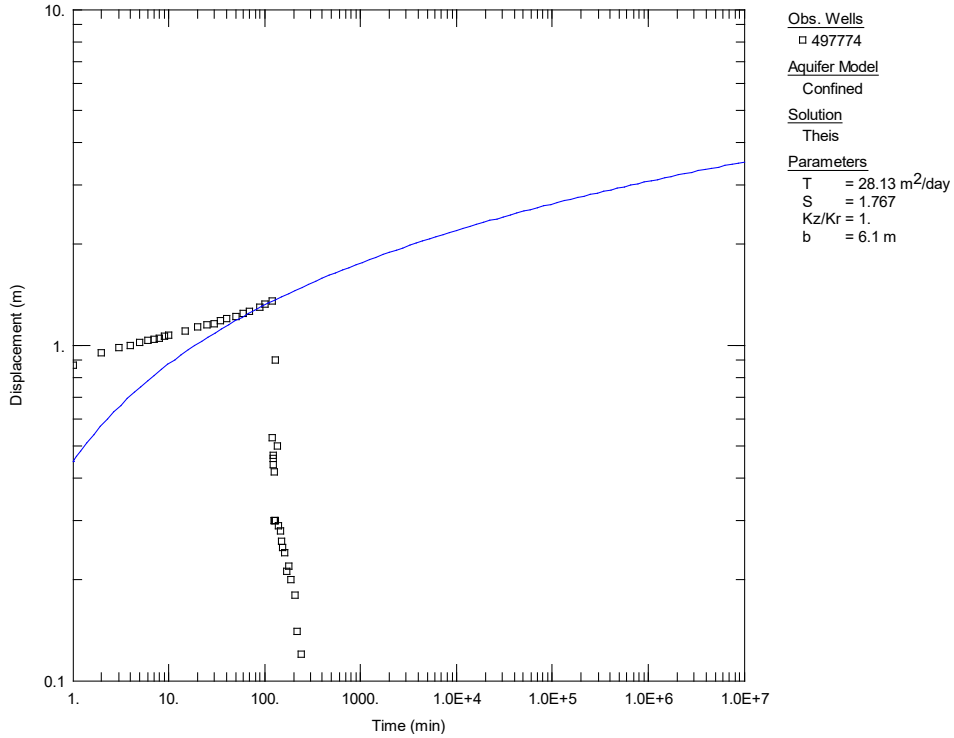
III.A. Pumping test solution fit to data from GIC Well ID 497773



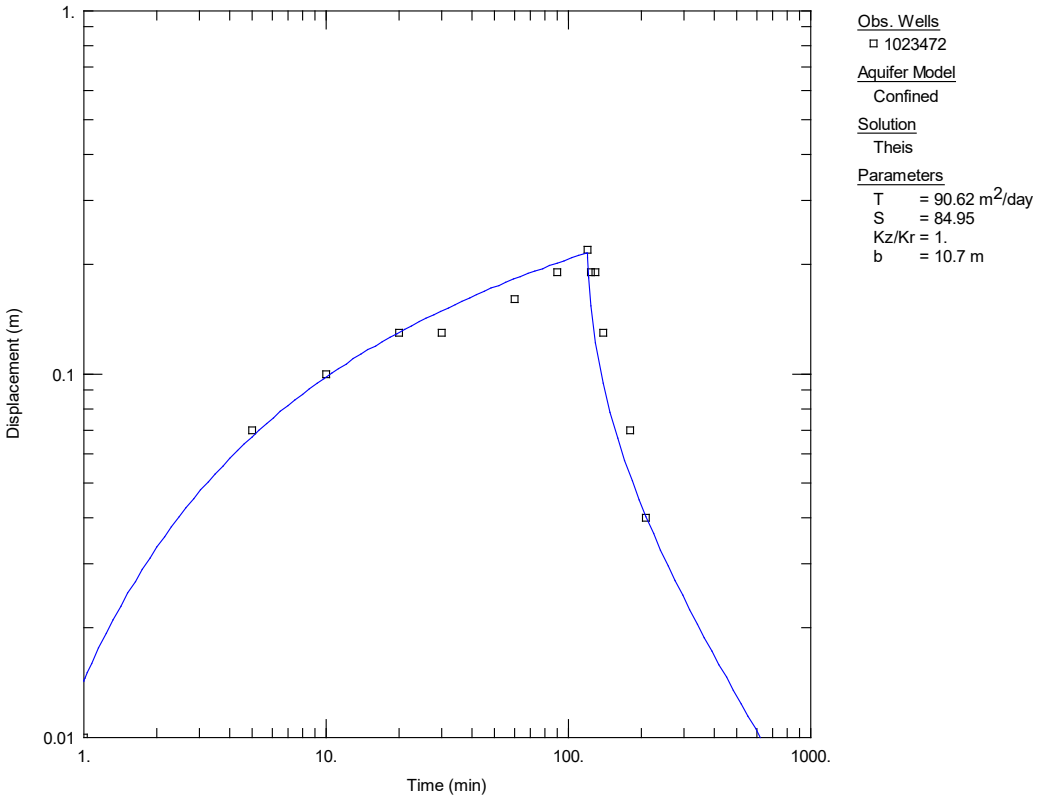
III.B. Solution extrapolated to 20 years of pumping



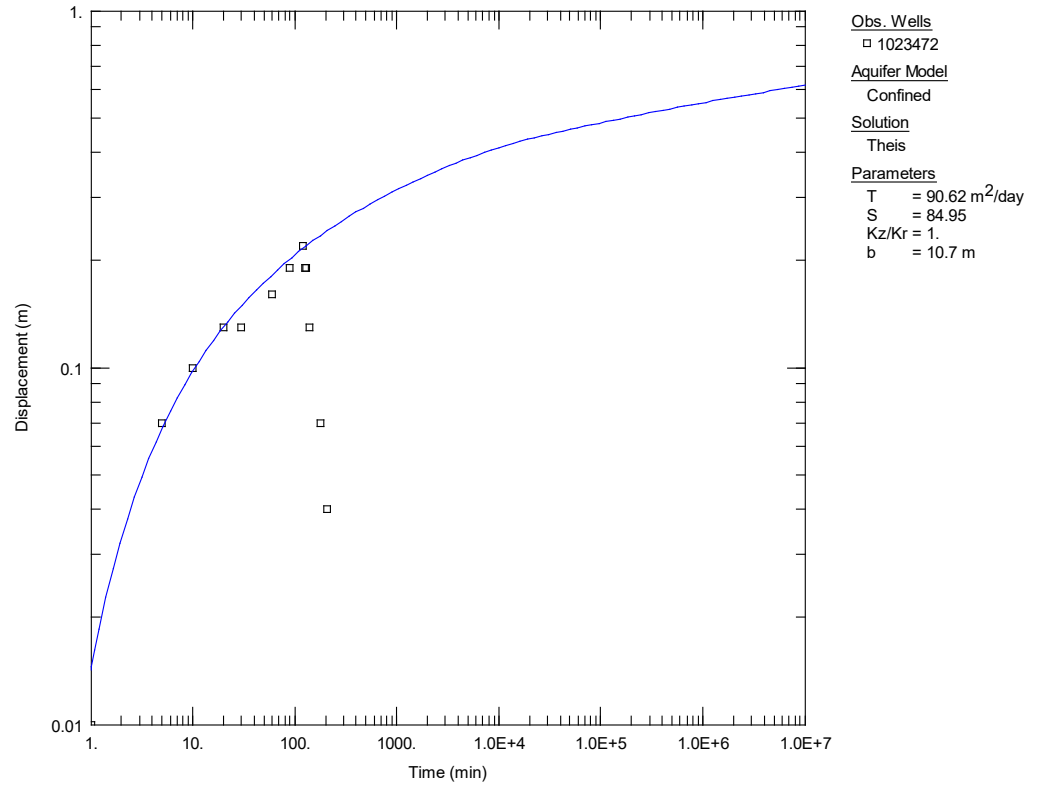
III.C. Pumping test solution fit to data from GIC Well ID 497774



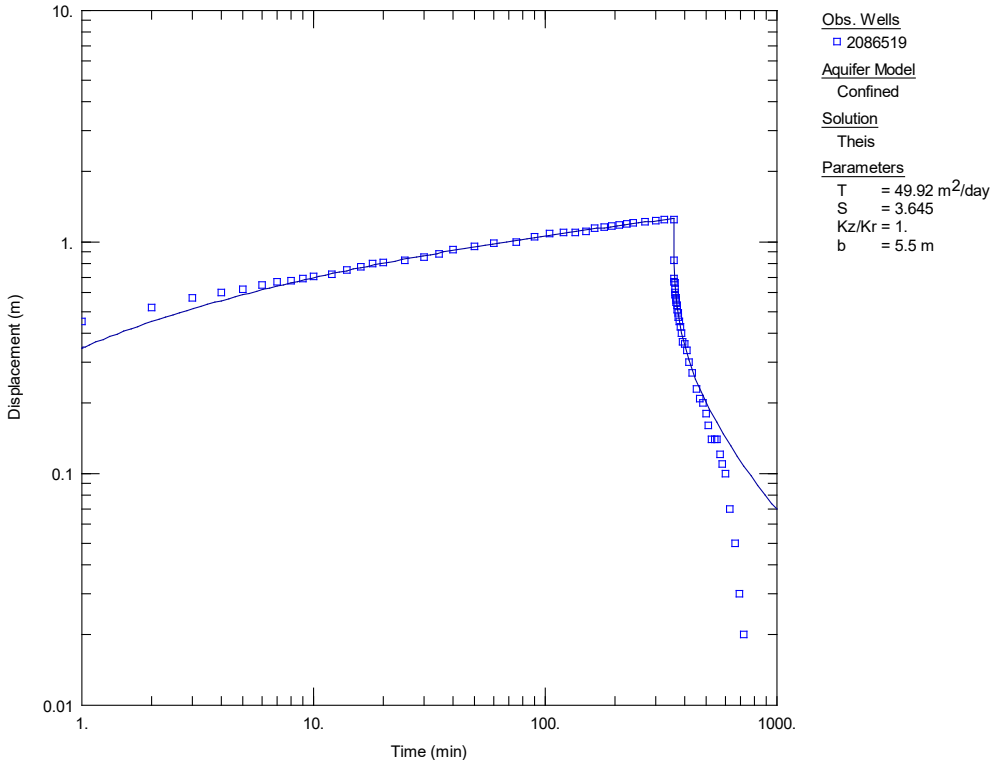
III.D. Solution extrapolated to 20 years of pumping



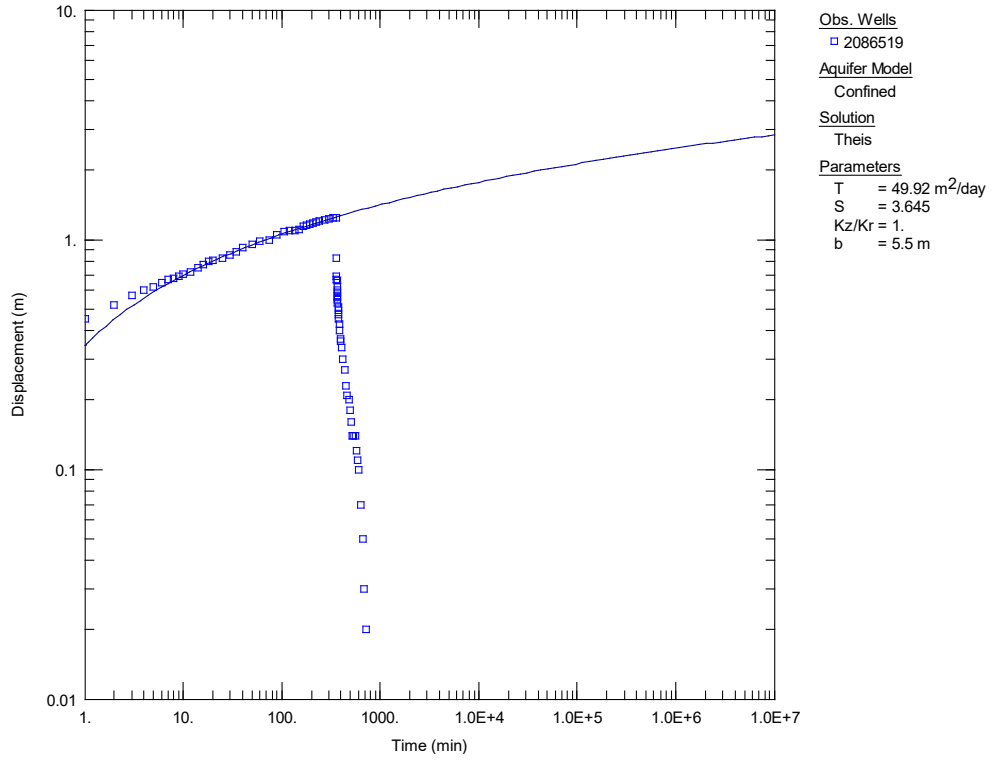
III.E. Pumping test solution fit to data from GIC Well ID 1023472



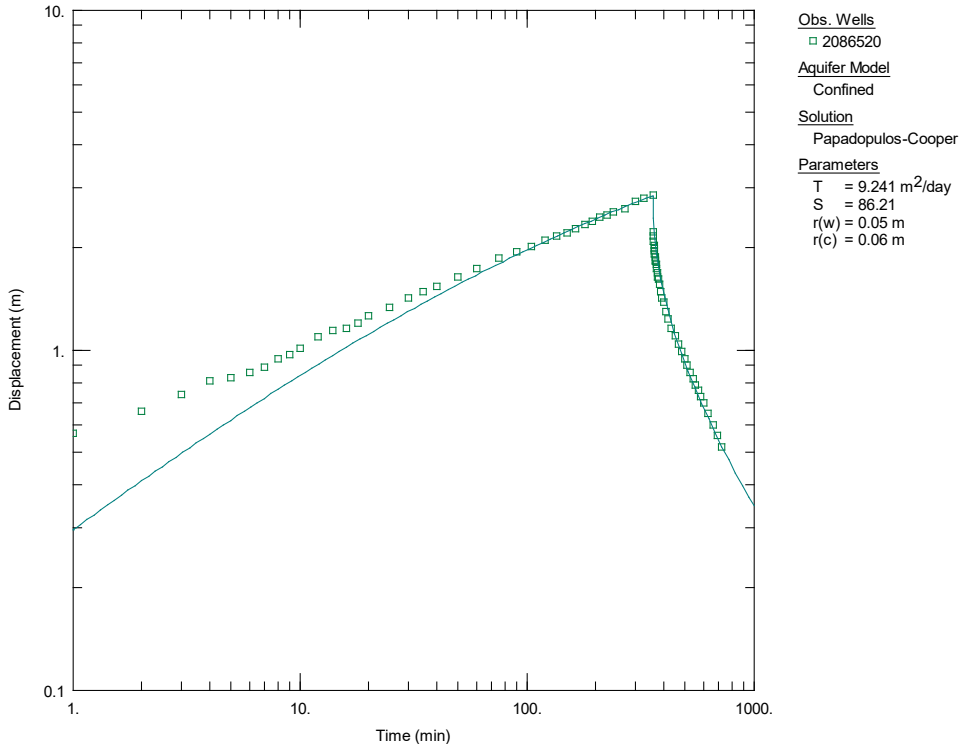
III.F. Solution extrapolated to 20 years of pumping



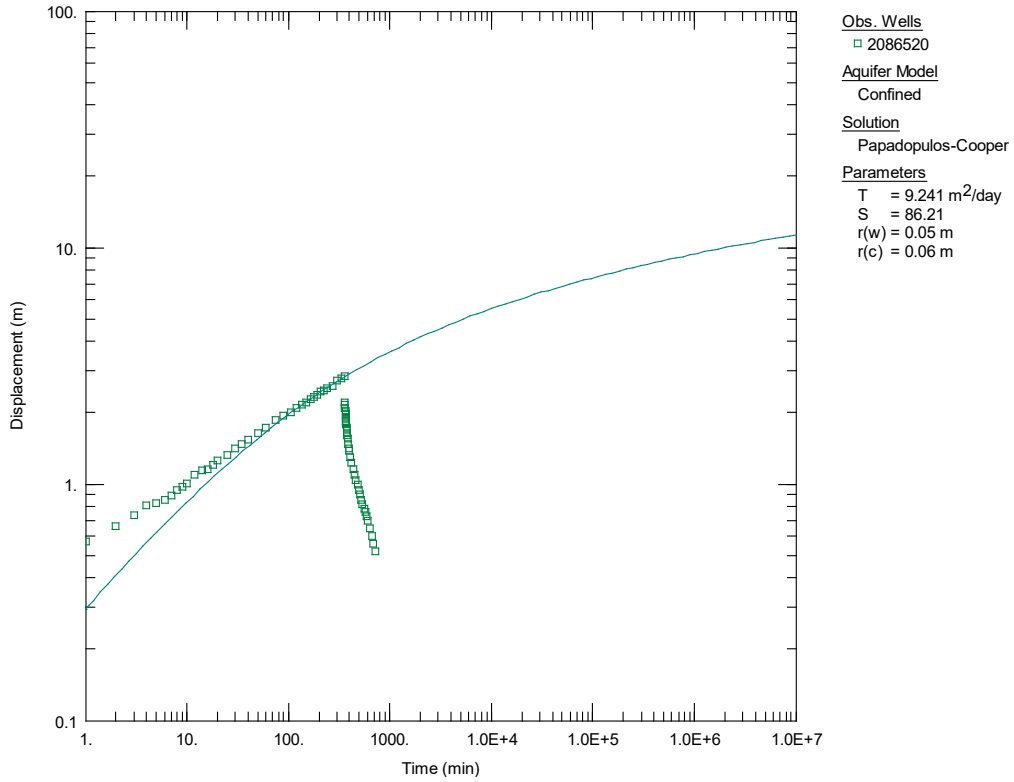
III.G. Pumping test solution fit to data from GIC Well ID 2086519



III.H. Solution extrapolated to 20 years of pumping



III.I. Pumping test solution fit to data from GIC Well ID 2086520



III.J. Solution extrapolated to 20 years of pumping

Appendix IV:
Water Well Drilling Report

Water Well Drilling Report

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.

View in Imperial | Export to Excel

GIC Well ID 10136136
GoA Well Tag No. A9189
Drilling Company Well ID
Date Report Received 2023/12/18

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BROWN, GREG	600, 215-9 AVE SW	CALGARY	ALBERTA	CANADA	T2P 1K3

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	1	3	33	1	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.797691 Longitude -114.050044
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 1016.00 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Drilling Information

Method of Drilling
Rotary - Air

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Metric

Depth from ground level (m)	Water Bearing	Lithology Description
0.61		Topsoil
2.74		Brown Sandy Clay
10.06		Brown Clay
26.82		Gray Sandy Clay
29.57		Gray Sandstone
32.31		Gray Shale
33.53	Yes	Gray Silty Sandstone
35.66		Gray Shale
40.23	Yes	Gray Sandstone
42.67		Gray Shale

Yield Test Summary

Measurement in Metric

Recommended Pump Rate 68.19 L/min

Test Date	Water Removal Rate (L/min)	Static Water Level (m)
2023/12/15	68.19	22.01

Well Completion

Measurement in Metric

Total Depth Drilled	Finished Well Depth	Start Date	End Date
42.67 m	42.67 m	2023/12/14	2023/12/14

Borehole

Diameter (cm)	From (m)	To (m)
22.23	0.00	34.14
12.70	34.14	42.67

Surface Casing (if applicable)
Steel
Size OD : 14.13 cm
Wall Thickness : 0.655 cm
Bottom at : 34.14 m

Well Casing/Liner
Plastic
Size OD : 11.43 cm
Wall Thickness : 0.587 cm
Top at : 18.29 m
Bottom at : 42.67 m

Perforations

From (m)	To (m)	Diameter or Slot Width (cm)	Slot Length (cm)	Hole or Slot Interval(cm)
35.05	39.62	1.270		30.48

Perforated by Drill

Annular Seal Bentonite Chips
Placed from 0.00 m to 34.14 m
Amount 400.00 Pounds

Other Seals

Type	At (m)
Drive Shoe	34.14
Driven	34.14
K-Packer	18.29
Shale Trap	34.75

Screen Type
Size OD : cm

From (m)	To (m)	Slot Size (cm)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
RILEY PEARSON

Certification No
83061A

Company Name
BLACK DOG DRILLING INC.

Copy of Well report provided to owner
Yes

Date approval holder signed
2023/12/18

Water Well Drilling Report

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View in Imperial | Export to Excel

GIC Well ID 10136136
GoA Well Tag No. A9189
Drilling Company Well ID
Date Report Received 2023/12/18

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BROWN, GREG	600, 215-9 AVE SW	CALGARY	ALBERTA	CANADA	T2P 1K3

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	1	3	33	1	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.797691 Longitude -114.050044
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 1016.00 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Amount

Additional Information

Measurement in Metric

Distance From Top of Casing to Ground Level 76.20 cm
Is Artesian Flow
Rate L/min

Is Flow Control Installed
Describe

Recommended Pump Rate 68.19 L/min
Recommended Pump Intake Depth (From TOC) 33.53 m

Pump Installed Depth m
Type Make H.P.
Model (Output Rating)

Did you Encounter Saline Water (>4000 ppm TDS) Depth m
Gas Depth m
Remedial Action Taken

Well Disinfected Upon Completion Yes
Geophysical Log Taken
Submitted to ESRD

Sample Collected for Potability Yes
Submitted to ESRD

Additional Comments on Well

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
RILEY PEARSON

Certification No
83061A

Company Name
BLACK DOG DRILLING INC.

Copy of Well report provided to owner
Yes

Date approval holder signed
2023/12/18

Water Well Drilling Report

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GIC Well ID 10136136
GoA Well Tag No. A9189
Drilling Company Well ID
Date Report Received 2023/12/18

GOWN ID

Well Identification and Location

Measurement in Metric

Owner Name	Address	Town	Province	Country	Postal Code
BROWN, GREG	600, 215-9 AVE SW	CALGARY	ALBERTA	CANADA	T2P 1K3

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	1	3	33	1	5				

Measured from Boundary of
m from
m from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 51.797691 Longitude -114.050044
How Location Obtained
Hand held autonomous GPS 20-30m

Elevation 1016.00 m
How Elevation Obtained
Hand held autonomous GPS 20-30m

Yield Test

Taken From Top of Casing | Measurement in Metric

Test Date	Start Time	Static Water Level
2023/12/15	6:00 AM	22.01 m

Method of Water Removal

Type Pump
Removal Rate 68.19 L/min
Depth Withdrawn From 35.05 m

If water removal period was < 2 hours, explain why

Depth to water level

Pumping (m)	Elapsed Time Minutes:Sec	Recovery (m)
22.01	0:00	22.65
22.31	1:00	22.22
22.31	2:00	22.16
22.31	3:00	22.16
22.31	4:00	22.13
22.34	5:00	22.13
22.34	6:00	22.13
22.34	7:00	22.13
22.34	8:00	22.13
22.34	9:00	22.13
22.37	10:00	22.13
22.37	12:00	22.13
22.40	14:00	22.13
22.40	16:00	22.13
22.40	18:00	22.13
22.40	20:00	22.10
22.40	25:00	22.10
22.40	30:00	22.10
22.40	40:00	22.10
22.43	50:00	22.07
22.43	60:00	22.07
22.43	75:00	22.07
22.46	90:00	22.07
22.46	105:00	22.04
22.49	120:00	22.04
22.52	150:00	22.01
22.52	180:00	22.01
22.56	210:00	22.01
22.56	240:00	22.01
22.62	300:00	22.01
22.65	360:00	22.01

Pump Test Attachments

Greg Brown 6 Hour Pump Test.pdf

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
SHOP	9092.18	L	2023/12/13 3:00 PM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well	Certification No		
RILEY PEARSON	83061A		
Company Name	**Copy of Well report provided to owner**	**Date approval holder signed**	
BLACK DOG DRILLING INC.	Yes	2023/12/18	

Appendix V:
Water Quality Report

CERTIFICATE OF ANALYSIS

REPORTED TO	Black Dog Drilling Inc. Bay 100, Building 107, Kuusamo Drive Red Deer County, AB T4E 2J5	**TEL** **FAX**	(403) 396-6389 (403) 887-0258
ATTENTION	Riley Pearson	**WORK ORDER**	C312086
PO NUMBER		**RECEIVED / TEMP**	2023-12-15 15:48 / 15°C
PROJECT	Water - Riley	**REPORTED**	2023-12-29
PROJECT INFO	SE-03-033-01-W5M		

General Comments:

Central Labs' pledge is to provide quality service with precise and on-time results.

Work Order Comments:

If your coliforms / e.coli results are <1, this indicates that there is none present.

Analysis was completed by a laboratory in Edmonton, Alberta.
AO - aesthetic objective
OG - operational guidance value
MAC - maximum allowable concentration

Report Recipients:

Riley Pearson (riley@blackdogdrilling.com)

Issued By: **Norine Ost For Mitchell C. Golay, B.Sc., B.Ed.**
Business Development Manager

ANALYSIS INFORMATION

REPORTED TO Black Dog Drilling Inc.
PROJECT Water - Riley

WORK ORDER C312086
REPORTED 2023-12-29

Analysis Description	Method Reference (* = modified from) Preparation	Analysis	Location
Alkalinity in Water	N/A	SM 2320B	Red Deer
Anions in Water	N/A	SM 4110	Red Deer
Calcium, dissolved	N/A	EPA 6010D	Red Deer
Cations in Water	N/A	SM 3120B	Red Deer
Chloride	N/A	SM 4110 B (2020)	Red Deer
Chloride in Water	N/A	SM 4110	Red Deer
Conductivity	N/A	SM 2510 B (2021)	Red Deer
Conductivity in Water	N/A	SM 2510B	Red Deer
Fluoride	N/A	SM 4500-F C (2021)	Red Deer
Iron, dissolved	N/A	EPA 6010D	Red Deer
Magnesium, dissolved	N/A	EPA 6010D	Red Deer
Manganese, dissolved	N/A	EPA 6010D	Red Deer
Nitrate by IC	N/A	SM 4110 B (2020)	Red Deer
Nitrite by IC	N/A	SM 4110 B (2020)	Red Deer
pH	N/A	SM 4500-H+ B (2021)	Red Deer
pH in Water @ 25C	N/A	SM 4500-H+ B	Red Deer
Potassium, dissolved	N/A	EPA 6010D	Red Deer
Routine Water Chemistry + Fe/Mn Pkg	N/A	SM 2340 B (2021)	Red Deer
Sodium Adsorption Ratio	N/A	CALC	Red Deer
Sodium, dissolved	N/A	EPA 6010D	Red Deer
Sulfate	N/A	SM 4110 B (2020)	Red Deer
Total Coliforms and E.Coli	N/A	SM 9223B	Red Deer

ANALYSIS INFORMATION

REPORTED TO	Black Dog Drilling Inc.	**WORK ORDER**	C312086
PROJECT	Water - Riley	**REPORTED**	2023-12-29

Method Reference Descriptions:

*** DEFAULT SPECIFIC	Other
EPA 6010D	Other
SM 2320 B* (2021)	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 2320B	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 2340 B (2021)	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 2510 B (2021)	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 2510B	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 3120B	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 4110	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 4110 B (2020)	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 4500-F C (2021)	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 4500-H+ B	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 4500-H+ B (2021)	Standard Methods for the Examination of Water and Wastewater, American Public Health Association
SM 9223B	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

Glossary of Terms:

RDL	Reported Detection Limit
<	Less than the Reported Detection Limit (RDL)
-	unitless
CFU/100mL	colony forming units per 100 millilitres
mg/L	milligrams per Litre
uS/cm	microsiemens per centimeter

SAMPLE ANALYTICAL DATA

REPORTED TO Black Dog Drilling Inc.
PROJECT Water - Riley

WORK ORDER C312086
REPORTED 2023-12-29

Analyte	Result	Guidelines for Canadian Drinking Water Quality (2022)	RDL	Units	Analyzed	Notes
Sample ID: SE-03-033-01-W5M (C312086-01) [Water] Sampled: 2023-12-15 12:00						
Microbiology						
Total Coliforms	< 1	<1	1	CFU/100mL	2023-12-17	
Escherichia coli	< 1	<1	1	CFU/100mL	2023-12-17	
Anions						
Chloride	2.86	AO ≤ 250	0.50	mg/L	2023-12-21	
Nitrate-N	< 0.050	MAC = 10	0.050	mg/L	2023-12-21	
Nitrite-N	< 0.050	MAC = 1	0.050	mg/L	2023-12-21	
Sulfate	576	AO ≤ 500	10.0	mg/L	2023-12-21	
Calculated Parameters						
Hardness, Dissolved (as CaCO3)	163	N/A	0.125	mg/L	N/A	
Ion Balance	116	N/A		mg/L	N/A	
Nitrate+Nitrite (As N)	< 0.0500	N/A	0.0500	mg/L	N/A	
Total Dissolved Solids	1450	AO ≤ 500	10.0	mg/L	N/A	
Sodium Adsorption Ratio	17.4	N/A		-	2023-12-20	
Dissolved Metals						
Calcium	48.5	N/A	0.050	mg/L	2023-12-20	
Iron	14.4	AO ≤ 0.3	0.100	mg/L	2023-12-20	
Magnesium	10.2	N/A	0.030	mg/L	2023-12-20	
Manganese	0.964	AO ≤ 0.02	0.010	mg/L	2023-12-20	
Potassium	3.87	N/A	0.200	mg/L	2023-12-20	
Sodium	510	AO ≤ 200	0.500	mg/L	2023-12-20	
General Parameters						
Alkalinity, Total (as CaCO3)	496	N/A	2.0	mg/L	2023-12-27	
Bicarbonate (HCO3)	605	N/A	2.0	mg/L	2023-12-27	
Carbonate (CO3)	< 2.0	N/A	2.0	mg/L	2023-12-27	
Hydroxide (OH)	< 2.0	N/A	2.0	mg/L	2023-12-27	
Conductivity (EC)	2180	N/A	2.0	uS/cm	2023-12-23	
Fluoride	2.09	MAC = 1.5	0.050	mg/L	2023-12-28	
pH @ 25C	7.73	AO = 7.0-10.5	0.10	pH units	2023-12-27	

Central LABS

"Accuracy & On-Time" http://www.c-labs.ca

B5, 53 Burnt Park Drive Red Deer AB T4P 0J7

Ph: 403-348-TEST(8378) | TF: 1-888-750-5227 | Fax: 403-356-2952 | On-Call: 403-304-6013

CHAIN OF CUSTODY / WORK ORDER # C312086

Invoice # 2301644 Page 1 of 1

Today's Date / Time: Dec 15/23

Project Info: (name, location, ID, #, etc.)

PO #:

Quote #:

INVOICE TO:

Company / Name Black Dog Drilling

Mailing Address:

Phone: 403-704-9005

E-mail:

Fax:

REPORT TO: Same as Invoice ☐

E-mail: Riley@BlackDogDrilling.com

E-mail:

Fax: Mail Out ☐

For full details, see Central Labs Ltd. website at http://www.c-labs.ca/services/

To service you better, complete the customer survey at http://www.surveymonkey.com/s/Y37KYZY

Analysis Sublet - Client Consent

Central Labs uses the services of accredited external laboratories for analyses which cannot be performed by Central Labs due to instrument breakdown or not set up to do the test. By signing below, you have given the consent to use the services of external laboratories when required.

Analysis Time:

E - Emergency 24-36 hrs

N - Normal 5-8 business days

ask about RUSH timing

Analysis & Timing

	Sample Name	Sample Date mm/dd/yy	Sample Time 24 hr	Matrix water / soil / sludge	# Containers	Microtox	Microtox - Charcoal	Total Extractable Hydrocarbons	Potable Water Chemistry	Total Coliforms & E.Coli	IRB / SRB (Iron / Sulphur Bacteria)	Soil Typing (Clay, Silt, Sand)	Sand Particle Size (coarse, med, fine)	Class II Landfill Pkg	Detailed Salinity	BTEX, F1-F4 / CCME Hydrocarbon	CCME Metals - Dissolved	CCME Metals - Total	BTEX, F1-F2 in Water	Mercury in Water	Total Manganese and Iron in water	Sump Suitability	Septic Soils-HydrometerSand	NRCB - Chlorides & Nitrates	CQM - Total Coliforms & E.Coli	See Special Instructions	HOLD
	Water Well	01/15/23	14:11	H2O / Soil / Slg	3				E	E	N															
1	SE-3-33-1W5	12/15/23	12:00	H2O / Soil / Slg	2				N	N																
2				H2O / Soil / Slg																						
3				H2O / Soil / Slg																						
4				H2O / Soil / Slg																						
5				H2O / Soil / Slg																						
6				H2O / Soil / Slg																						
7				H2O / Soil / Slg																						
8				H2O / Soil / Slg																						
9				H2O / Soil / Slg																						

Relinquished by:

Signature:

Print Name: Josh Richardson

Contact #:

Special Instructions:

OFFICE USE

IN	OUT
Date: Dec 15/23	
Time: 15:49	
Temp °C: 15.1°C	
Received by: NO	

white copy-Central Labs yellow copy-client

FORM-09-0000 Rev 7 February 25, 2021