MONTECRISTO RANCH ASP

ADDENDUM

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1.0 INTRODUCTION

1.1 MONTECRISTO RANCH AREA STRUCTURE PLAN (ASP) PROPOSAL SUMMARY

LAND OWNER: 1738787 ALBERTA LTD.

Michele and Colin Sheedy

LEGAL DESCRIPTION: Plan 9710876, Lot 9, Plan 8911421, Lot 1

SE 14-20-01 W5M

ELECTORAL DIVISION: # 2

EXISTING PARCEL SIZES: 105.02 acres and 10.5 acres

PHASE 1:

- Boundary Adjustment between Lot 1 and Lot 9 to square up property and allow for trees to be on property with driveway, making Plan 8911421, Lot 1 SE 14-20-01-W5M one (1) 10.51 +/- acres, no change in land use designation.

- Create 2 new lots, one (1) 4.00 +/- acres and one (1) 11.98 +/- acres surrounding the existing residence, outbuildings and shelterbelt.

- The 4.00 +/- acre parcel to be zoned Country Residential Sub-district "A".

- The new 11.98 +/- acre lot would retain the current land use of Direct Control District #27 - Major Home Occupation District.

- 89 acres of balance lands proposed to be re-zoned from Direct Control District #27 - Major Home Based Business District to Agriculture District.

- Development to start in 2018 - 2020 and is subject to Foothills County Council approval.

PHASE 2:

- Create 4 new 3.98 +/- acre Country Residential – A lots.

- 73 acres of balanced lands remain zoned as Agriculture.

- Development of an existing access, an additional new access and a municipal standard internal hammerhead design road will provide access to the 4 new lots and the Agriculture parcel.

- Development estimated start date 2021 – 2025 and is subject to Foothills County Council approval.

1.2 MISSION STATEMENT

The Montecristo Ranch Area Structure Plan (ASP) is intended to provide a short and long term development vision for future land use and development within the Plan Area. The ASP is intended to be used as a tool for a balanced development approach of creating new residential lots and to maintain agriculture land use. This ASP is to assist municipal policy makers, planners, landowners and the developer.

1.3 CONTEXT

The Plan Area is located adjacent to 402 Avenue West on the north side of the avenue and 16th Street West on the west side of the street, which are both chipseal surfaced collector roads. The Plan area is approximately 1.0 kilometer south from the Town of Okotoks from 16th Street West. (See Figure 1.0 – Area Map).

The Plan Area includes two parcels totaling approximately 115.52 acres of land located at the Southeast Quarter of Section 14 Township 20, Range 1, West of the 5th Meridian (see Figure 2.0 – Plan Area, Figure 3.0 Phase 1, Figure 4.0 Phase 2 and Appendix A Land Title Certificates).

Phase 1:

Phase 1 of the plan proposes (see Figure 3.0) a boundary adjustment with the adjacent land (Plan 8911421, Lot 1, SE 14-20-1 W5M) whereby 5 meters of the north boundary of Plan 8911421, Lot 1, SE 14-20-01-W5M is added to proposed Lot 3 and whereby 5 meters of the east boundary of proposed Lot 3 is added to Plan 8911421, Lot 1, SE 14-20-01-W5M. These boundary adjustments are required to maintain and manage the existing mature spruce trees.

Phase 1 would also create 2 new parcels. Lot 2 would be a 4.00 +/- acre Country Residential-A district parcel with access at the southern end from 402 Avenue West.

Lot 3 would remain as an 11.98 +/- acre Direct Control District #27 – Major Home Based Business parcel. Access to this lot would be from the existing panhandle connecting to 402 Avenue West. Within the east portion of the panhandle would be a 6 meter wide Utility Right of Way which will service both new lots with underground electrical infrastructure. The power to the existing house site would be removed from the 89 acre field (removal of 7 power poles).

Lot 3 is flat and then slopes from the south to north. The area has an existing road access, one pasture, mature spruce and poplar trees, house, shop and quonset.

The remaining balance of approximately 89 acres or 85%, was previously an Elk Farm with 9 fenced pastures (5,000 meters of 3 meter height - high tension wire fencing, 3 meter metal posts with concrete), 22 - 3 meter by 6 meter gates and a 30 meter by 60 meter corral. Work would continue to decommission the existing Elk Farm and restore the lands to cultivated status.

Phase 1 is proposed to commence in 2018-2020.

Phase 2:

Phase 2 of the Plan proposes to create 4 Country Residential Sub-district "A" parcels from the balance of the parcel (approximately 16 acres or 15%).

Each of the 4 lots would be +/- 4 acres with a rectangular design approximately 80 meters wide by 200 meters long. The lot configuration will provide a large building envelope, have no conflicting boundaries and create unobstructed site lines.

The recent 16 Street West paving project and future proposed installation of traffic lights at the intersection of Highway 7 and 16 Street West, will have a positive impact on traffic flow on 16 Street West. The new traffic lights will improve safe traffic flow at this intersection, decrease accidents, prevent injuries and save lives. These two projects will improve access to the proposed 4 lots.

The north existing field approach on 16 Street West will be removed.

The second existing field approach which was upgraded with the 16 Street West paving project would provide access to lot 4. Road access for lot 5, lot 6 and balanced lands would be from an internal hammerhead design road. A new approach will provide access to lot 7. All access approaches and roads will be developed to municipal standards from 16 Street West and would utilize approximately 0.4 acres.

The area slopes from east to the west.

The remaining balance of approximately 73 acres which was previously an Elk Farm, has been decommissioned with the removal of all infrastructure (25,000 feet of high tension 8 feet high wire fencing, 1000 steel posts, 40 gates, 9000 square foot corral, 6 power poles and lines). The corral area has been leveled and the entire area restored to cultivated status. The installation of a new underground power service to lot 3 was also completed.

An ASP is required to establish a comprehensive and orderly approach to future development, which addresses land use, access, servicing, environmental and wild life protection. The ASP proposes in Phase 1 a total of two (2) lots (Lot 1 to be considered Country Residential A and Lot 2 to remain as DC #27). The ASP proposes in Phase 2, a total of four (4) Country Residential-A lots and the balance of +/- 73 acres to be rezoned from DC to Agriculture.

1.4 PUBLIC INVOLVEMENT

The Developer has begun the process of contacting neighboring landowners with a view to identifying and understanding concerns or issues related to the development. It is anticipated that reliability of water for existing properties may be a concern. Stakeholders will be advised the ASP will not be adopted unless there is a proven water supply based on Provincial Water Act requirements. Regarding traffic generation, one new residence in Phase 1 is expected to generate approximately 9 vehicle trips per day utilizing 402nd Avenue West and 16st West. Phase 2 is expected to generate approximately an additional 36 vehicle trips per day utilizing 16th street West once fully occupied. These roadways have been constructed to a relatively high standard for a local road use and this amount of additional traffic will have minimal effect on this corridor.

1.5 OPPORTUNITIES AND CONSTRAINTS

A number of issues and technical considerations were evaluated as part of the ASP preparation process and the following opportunities and constraints were identified:

a. Differing lifestyle/livelihood aspirations – Agricultural landholders express difficulties in continuing their farming operations, while existing small land owners around the proposed subdivision wish to retain the country charm of their rural surroundings.

b. Proximity to existing development - Agricultural pursuits continues but there has been some new development in the area with the addition of 14 new country residential lots over the last 20 years.

c. Water Resources – Reliance on groundwater is always a concern for existing residents when new development is proposed. A program of well drilling and pump testing will be required to confirm adequacy and reliability of water supply without impact on adjacent wells.

2.0 THE PLANNING PROCESS

2.1 PURPOSE OF THE PLAN

The ASP was prepared to address Foothills County Policy that finds ad hoc development without comprehensive planning as detrimental. The ASP supports the Foothills County Municipal Development Plan by adding detailed layer to the planning framework for this particular area. The purpose of the ASP is to define a planning and development framework to guide future growth in the Plan Area by establishing a range of appropriate and compatible land uses, planning for comprehensive servicing and addressing access.

The ASP takes into consideration existing land uses, surrounding development, potential future land uses, public input, physical and environmental characteristics, infrastructure requirements and growth trends. At its core, the ASP outlines a vision. The plan structure and the policies contained within are the means by which that vision can be achieved.

The ASP supports the Foothills County Municipal Development Plan by adding another layer of detail to this particular area. The ASP integrates the planning process illustrated as follows:

This ASP has been prepared on the basis of upholding and aligning the ASP with the guidance set forth in higher level planning documents. Specifically, Foothills County Municipal Development Plan has informed the development of policy found throughout this ASP.

2.2 THE LEGISLATION

The ASP has been prepared in accordance with the provincial requirements outline in s.633 of the Municipal Government Act (MGA) (Statutes of Alberta, 1994, Chapter M-26.1).

(1) For the purpose of providing a framework for subsequent subdivision and development of an area of land, council may, by bylaw, adopt an area structure plan.

(2) An area structure plan

(a) Must describe;

(i) The sequence of development proposed for the area,

(ii) The land uses proposed for the area, either generally or with respect to specific ports of an area,

(iii) The density of population proposed for the area either generally or with respect to specific ports of the area, and

(iv) The general location of major transportation routes and public utilities, and

(b) May contain any other matters the council considers necessary.

In addition, the ASP was prepared in accordance with the Foothills County Municipal Development Plan and Land Use Bylaw and complies with the Municipal Guidelines for the preparation of ASP's.

3.0 PLAN VISION AND GOALS

3.1 VISION

The ASP seeks to achieve orderly, economical, beneficial and environmentally sensitive development within the Plan Area. It is intended to be a flexible long-term framework for development. The ASP envisions development which retains existing natural and visual characteristics to both attract new residents, preserve the landscape enjoyed by those individuals currently residing in the area and to maintain agriculture land.

3.2 GOALS

The following goals serve as the foundation for the policy contained within this ASP:

a. Achieve an efficient, sequential pattern of development;
b. Establish a high quality residential area to harmonize development with the natural and built environment;
c. Provide an efficient and safe road network;
d. Preserve, protect, conserve and/or enhance significant natural features of the Plan Area: and,
e. Encourage country residential and agricultural land uses working in harmony with one another.

4.0 LAND USE STRATEGY

The land use strategy is based on a desire to organize development based on topography and existing significant natural features. The strategy allows for the orderly, efficient and affordable development of infrastructure and services.

In all, the proposed development contains:

Phase 1: One (1) Country Residential Sub-district "A" parcel, one (1) Direct Control District #27 – Major Home Based Business District parcel, boundary adjustment between proposed Lot 3 and Plan 8911421, Lot 1 SE 14-20-01-W5M and one (1) Agricultural balance parcel.

Phase 2: Development contains proposed four (4) Country Residential Sub-district "A" lots and one (1) Agricultural balance parcel. The following table breaks down the land use for the plan area.

Area:

Land Use District	**Acreage**
Phase 1	
Country Residential - A District	4.00 +/- acres
Country Residential District	10.51 +/- acres
DC 27	11.98 +/- acres
Agriculture District	89.0 +/- acres
Total	115.5 acres
Phase 2	
Country Residential - A District	4 lots at 3.98 +/- acres
Agriculture District	73.0 +/- acres
Total	89.0 acres

The following policies shall apply:

a. When considering redesignation, subdivision or development applications in the Plan Area, the Foothills County shall confirm that the application conforms to the land use strategy and is compatible with the policies of this plan.
b. Any application to amend the Plan that is contrary to the land use strategy and policies contained within the ASP shall require a formal application for amendment to the ASP.

4.1 COUNTRY RESIDENTIAL LAND USE POLICY

The proposed development of Phase 1 includes two new (2) lots (one CR-A and one DC 27) and an existing 10.51 acre CR parcel with adjusted boundaries, and the Agricultural balance lands. Other than the Agricultural balance, all parcels in phase 1 will access off individual accesses from 402nd Avenue West. An access from 402nd Avenue to the 4.00 +/- acre lot will be constructed in accordance with Foothills County standards.

The following policies shall apply:

a. Country residential lots shall be supplied water by individual groundwater wells drilled and licensed in accordance with the Provincial Water Act.
b. Country residential lots shall have direct access to a surfaced municipal road in accordance with the Municipal Internal Subdivision road policies.
c. Country residential lots shall support residential development in accordance with all Foothills County and Provincial Bylaws, standards and policies.
d. Country Residential lots shall be required to install a private septic system which will meet or exceed the current Standard of Practice for Alberta and the Foothills County.
e. Other than the 10.51 +/- acre CR parcel in the SW corner of the quarter section, no Country Residential lots should be permitted to subdivide further unless an amendment of this ASP is approved by Council which allows for further subdivision of CR lots. The 10.51 +/- acre parcel may be approved for subdivision into a total of two parcels if and when Council supports amendment of the LUB to allow for the subdivision. No specific timeline is

contemplated for the further subdivision of the 10.51 +/- acre CR lot.

4.2 AGRICULTURAL LAND USE POLICY

Historically, the Plan Area has been used as grazing pasture for livestock and has sustained a hay crop in the past. The Foothills County MDP discourages the premature fragmentation of agricultural lands. In this instance, the lands subject to proposed development are in close proximity to and serviced by the same road (402nd Avenue West) utilized by existing country residential developments. The land subject to development is of the same quality and character as the existing developed areas. A large +/- 89 acre portion of the 105 acres in Phase 1 will remain within the Agricultural land use (85%).

For Phase 2, historically, outside of the existing country residential development, the Plan Area has been used as grazing pasture for Elk livestock. In this instance, the lands subject to proposed development are in close proximity to and serviced by the same road (16th Street West) utilized by existing country residential developments. The land subject to development is of the same quality and character as the existing developed areas. A +/- 73 acre balance will remain designated as Agricultural land use district (82%).

The following policy applies:

a. Any further fragmentation of the Agricultural balance lands beyond what is contemplated in this ASP would require an amendment to the ASP.
b. Access to the Agricultural balance will be provided via the existing two farm approaches onto 16th Street West in Phase 1.
c. Access to the Agricultural balance will be provided via the proposed internal subdivision road onto 16th Street West in Phase 2. The north existing farm approach will be removed.

5.0 NATURAL ENVIRONMENT

The biophysical characteristics and environmental significance of lands in the Plan Area should be considered in applications for development.

5.1 GENERAL ENVIRONMENT POLICY

The following general environment policies shall apply:

a. The Foothills County, through its Municipal Development Plan policies, encourages the preservation of significant and/or sensitive natural environments in the development process.
b. The Foothills County may require that a proponent, in support of a proposal for redesignation, subdivision or development, and at their sole expense, prepare and submit the following in form and content satisfactory to the Foothills County, and in accordance with all pertinent Alberta Environment Protection guidelines or requirements of the appropriate Provincial Departments:
    i. A Geotechnical report pursuant to the provisions of the Municipal Development Plan; and
    ii. An Archaeological and/or Historical Resource Impact Assessment pursuant to the provisions of the Municipal Development Plan and to the satisfaction of the provincial department of Alberta Culture.

5.2 TOPOGRAPHY

The land in Phase 1, slopes from the south to the north and to the west. The 4 acre lot of the property is presently used for a hay field. The land in Phase 2 slopes to the west.

The 11.98 +/- acre lot is presently used for a small business operation with a house, shop and quonset. There are no excessive grades in any of the lots proposed within Phase 1 of the ASP.

The following policy applies:

a. The Foothills County may require a geotechnical report prepared by a qualified engineer in areas where topography is a factor of development. The geotechnical report should contain all information required by the Foothills County as described in the policy.
b. Building Sites shall not contain a slope greater than 15% in accordance with municipal policy.

5.3 MUNICIPAL RESERVE

a. Dedication of Municipal Reserve (MR), either by cash-in-lieu of land or by physical dedication of land, or both, in the Plan Area shall be determined by the Foothills County in accordance with the MDP policy and s.666 of the Municipal Government Act.

b. Physical land dedication of Municipal Reserve shall consist of lands that are equivalent to the development lands (i.e. similar in kind to the land being developed).

c. The ASP proposed that cash in lieu of land be provided as a condition of subdivision for phase 1 and that the MR for phase 2 be deferred to the balance lands. Alternatively, Council may direct that the MR for both phase 1 and phase 2 be deferred on the balance lands, or that cash in lieu of lands be provided for both phase 1 and phase 2. Municipal Reserves will be provided as per the Foothills Council policy to the satisfaction of Council.

d. Although no dedication of Environmental Reserve (ER) is anticipated, ER dedication shall be determined by the Foothills County in accordance with Section 664 of the Municipal Government Act.

6.0 INFRASTRUCTURE

Infrastructure includes the hierarchy of road network, public and private water systems, septic systems, solid waste management systems, police, and fire and ambulance service.

6.1 GENERAL INFRASTRUCTURE

The quality of infrastructure is a fundamental part of the well-being of a community and its ability to sustain growth over time. To improve the quality of life in the Foothills County as a whole, it is important that the Foothills County occasionally assess infrastructure as it relates to the planning of communities. The Foothills County has developed a set standard for roads and infrastructure as it relates to the planning of communities. The Foothills County may require an assessment of necessary infrastructure when considering re-designation, subdivision and / or development proposals.

6.2 ROAD NETWORK

6.2.1 EXTERNAL ROADS

Access to the Plan Area is gained from 402nd Avenue West and 16th Street West. The developer will contribute to the maintenance and upgrades of the local roads in accordance with the current sustainability fee policy in place at the time of land use approval for the subject phase.

6.2.1.1 INTERNAL ROADS

Phase 2 of the Plan Area shall be serviced from 16 Street West with individual access points for lot 4 and 7, with an internal road for lot 5, lot 6 and balanced lands containing one point of ingress/egress. The access approaches and roads will not exceed a grade of 7% at any point and will be constructed and paved to meet the Foothills County standards. Approaches to all Country Residential lots and to the Agricultural balance in Phase 2 will be from 16 Street West.

The following policy applies:

6.2.1.2 The internal subdivision hammerhead design road and the two other access approaches shall be constructed to Foothills County standards at the sole expense of the developer. Ownership and maintenance of the internal subdivision road shall be the responsibility of the developer.

6.3 WATER, SEWER AND STORM WATER SERVICING

6.3.1 Water Sources and Resources

Subject to a program of well drilling, testing, hydrogeological analysis and reporting, each newly created lot shall be serviced by an individual groundwater well drilled in accordance with the Provincial Water Act.

Appendix B: Provide some Alberta Environment Water Well Database Records for wells in the vicinity of the development which provides as indication of water availability.

A Storm Water Management Plan can be prepared at the sole expense of the Developer should Council or the Public Works Department deem it necessary. Developers are not permitted to exceed pre-development release rates with post development flows.

The following policies shall apply:

a. All new lots shall be serviced by individual groundwater wells.

b. All storm water management shall be contained within the proposed development area**.** No surface water shall be directed to highway ditches and post-development flows shall not exceed pre-development flows. The Developer may be required to prepare a Storm Water Management Plan at their sole expense should Council or the Public Works Department deem it necessary.

6.3.2 SANITARY SOURCES AND RESOURCES

There are no communal sewage collection and treatment systems servicing the Plan Area. Treatment of sanitary effluent is on-site disposal through septic tile fields as per Provincial legislation. This is typical of domestic use within the Foothills County. To maintain water quality in the aquifer(s), consideration must be given to proper disposal of sanitary and sewer waste from future developments. The new development within the Plan Area will be subject to installation of a septic sewage system in accordance with the required Provincial standards and codes.

The following policies apply:

a. An on-site sewage disposal system shall be required to be installed that will meet or exceed the current Standard of Practice for the Foothills County and Province of Alberta.
b. Methods of Open Discharge from a septic tank shall not be permitted.
c. Non-evaporative lagoons shall not be permitted.

6.3.3 SOLID WASTE DISPOSAL

6.3.1.1 Solid waste and recycling from the development shall be hauled by individual landowners or their contacted service providers to the nearest waste transfer site.

6.3.4 SHALLOW UTILITIES

Shallow utility services include natural gas, telephone and electricity. Atco Gas provides gas service to the area. Electrical service is provided primarily by Fortis. There is a mix of underground and overhead electrical services in the area. Provision of Shallow Utilities in applications for re-designation, subdivision and /or development shall be at the sole expense of the developer to the extent required in the Municipal Standard Development Agreement.

6.4 PROTECTIVE SERVICES

The Foothills County requires that proposals for re-designation, subdivision, and /or development accommodate design elements that consider safety measures and appropriate levels of servicing required for fire, police and ambulance services.

6.4.1 POLICE SERVICES

a. Police Services to the Plan Area shall be provided by the Royal Canadian Mounted Police and Foothills County Special Constables.

6.4.2 FIRE SERVICES

a. The Plan Area is serviced by 911 emergency services, with an emergency locator system set up for each individual property.

b. All parcels in the Plan Area shall assure proper emergency vehicle access in accordance with Foothills County Policy.

7.0 IMPLEMENTATION AND REVIEW

7.1 Plan Implementation

The ASP falls within a hierarchy of applicable plans as outlined in Section 2.0. The Foothills County Municipal Development Plan (MDP) is the guiding document for all development within the Foothills County. The Foothills County Land Use Bylaw (LUB) establishes the land use rules and regulations. The ASP presents a greater level of planning detail within the specific Plan Area and is required to be consistent with both the MDP and LUB.

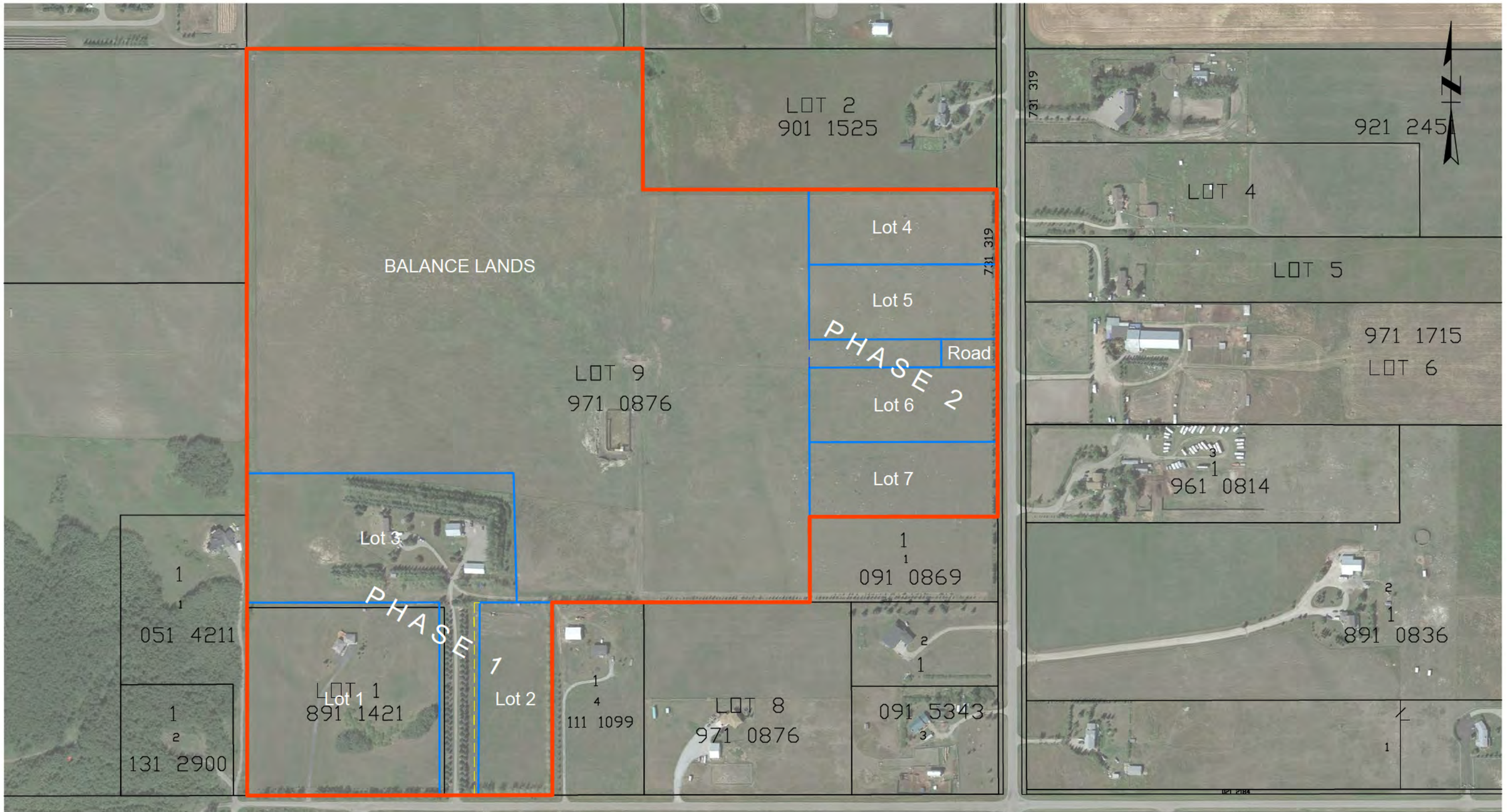
Development in the Plan Area should be acceptable to the community and consistent with policy contained within the ASP. The ASP does not supersede, repeal, replace or otherwise diminish any other statutory plan in effect in the Plan Area.

a. The policies contained within this document shall be reviewed and implemented by Foothills County Council members at their discretion.

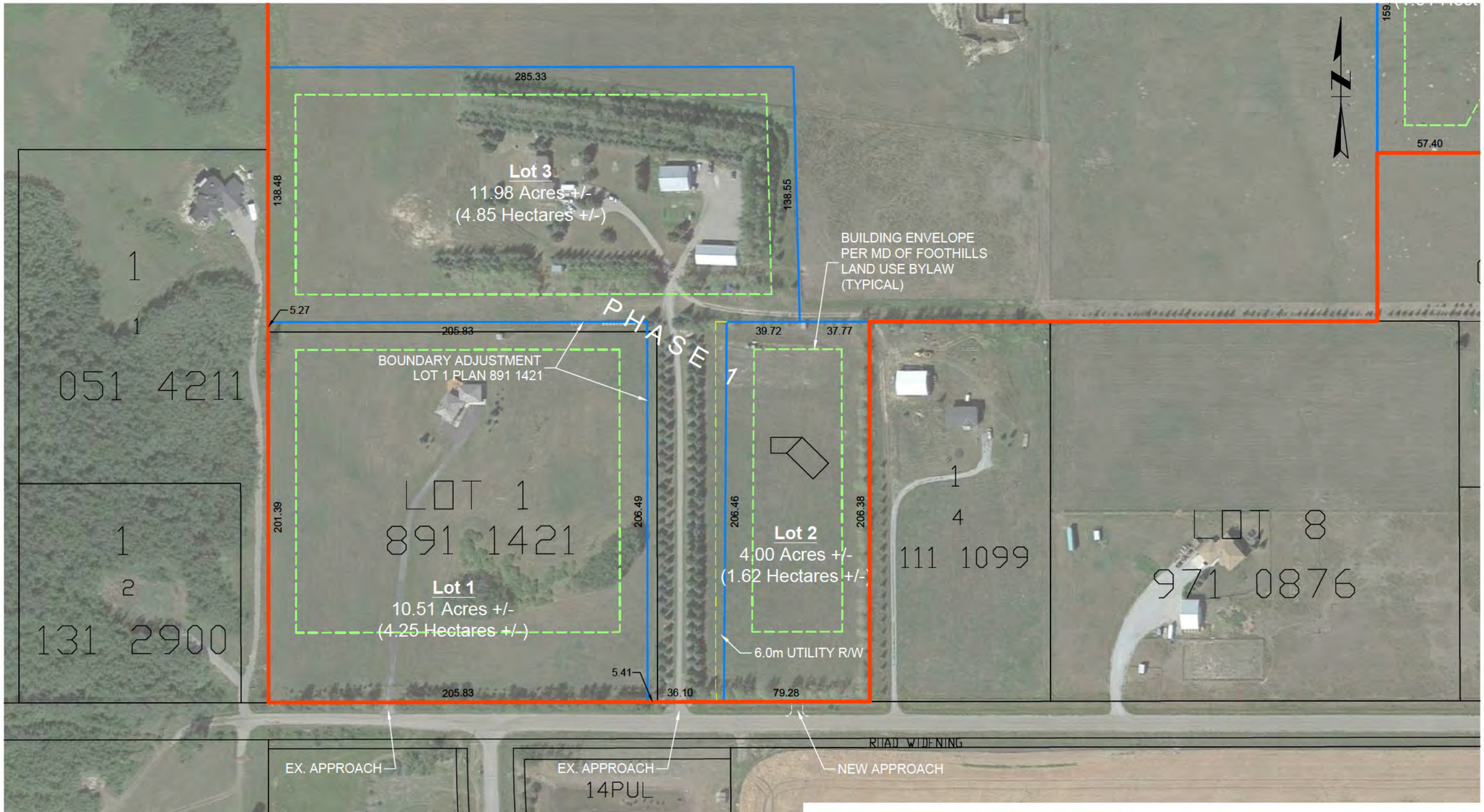
7.2 Plan Review

As the ASP is bylaw of the Foothills County, a formal process as outlined in the Municipal Government Act is required to amend the Plan.

a. The future land use and development outlined in the ASP is intended to address a long-term time horizon. Periodic review and amendment of the ASP may be required in accordance with the Municipal Government Act. The ASP allows for review and amendment should the Foothills County deem that appropriate.



Foothills County	MONTECRISTO RANCH AREA STRUCTURE PLAN - PHASE 2	
HORIZONTAL SCALE: 1:4000 0 20 40 80 160 240 m	WITHIN SE14 20 - 21 - W5M	SUBJECT LANDS
BADKE CONSULTING LTD. (403)982-7773	DRAWN: BCD CHK'D: JDB FILE #: 1570.20	DATE: DEC. 2020 DWG. A REV. 2



Municipal District of Foothills
No. 31

HORIZONTAL SCALE: 1:2000
0 10 20 40 80 120 m

MONTECRISTO RANCH
AREA STRUCTURE PLAN

WITHIN SE14 20 - 21 - W5M | PHASE 1

BADKE CONSULTING LTD.
(403)982-7773

DRAWN: DTC	DATE: JUNE 2018
CHK'D: JDB	DWG. B REV. 3
FILE #: 1570	

BALANCE LANDS
72.79 Acres +/-
(29.46 Hectares +/-)

BUILDING ENVELOPE
PER FOOTHILLS COUNTY
LAND USE BYLAW
(TYPICAL)

30m WIDE FUTURE ROAD
ACQUISITION DEDICATION

LOT 9

971 0876

Lot 4
3.99 Acres +/-
(1.61 Hectares +/-)

Lot 5
3.99 Acres +/-
(1.61 Hectares +/-)

Lot 6
3.98 Acres +/-
(1.61 Hectares +/-)

Lot 7
3.98 Acres +/-
(1.61 Hectares +/-)

PHASE 2

201.33
80.33
80.05
731 319
201.33
80.32
80.05
141.33
60.00
30.00
30.00
141.33
60.00
79.84
80.05
201.33
79.83
80.05
201.33
138.55
39.72
37.77
1
1

EX. FIELD APPROACH
(TO BE REMOVED)

EX. FIELD APPROACH
(TO BE UPGRADED TO
CURRENT STANDARD)

PPD. HAMMERHEAD
CUL-DE-SAC

Road
0.44 Acres +/-
(0.18 Hectares +/-)

16 STREET W

PPD. NEW APPROACH

Foothills County

HORIZONTAL SCALE: 1:2000
0 10 20 40 80 120 m

MONTECRISTO RANCH
AREA STRUCTURE PLAN - PHASE 2

WITHIN SE14 20 - 21 - W5M

PHASE 2

BADKE CONSULTING LTD.
(403)982-7773

DRAWN: BCD
DATE: DEC. 2020
CHK'D: JDB
DWG. B
REV. 2
FILE #: 1570.20

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0038 457 719	9710876;;9	191 208 486 +3

LEGAL DESCRIPTION

PLAN 9710876
LOT 9
CONTAINING 46.36 HECTARES (114.56 ACRES) MORE OR LESS
EXCEPTING THEREOUT:

PLAN	NUMBER	HECTARES	ACRES	MORE OR LESS
SUBDIVISION	0910869	1.84	4.55	
SUBDIVISION	1111099	2.02	4.99	
SUBDIVISION	1912019	6.49	16.04	

EXCEPTING THEREOUT ALL MINES AND MINERALS

ATS REFERENCE: 5;1;20;14;SE
ESTATE: FEE SIMPLE

MUNICIPALITY: FOOTHILLS COUNTY

REFERENCE NUMBER: 191 208 392 +1

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
191 208 486	11/10/2019	SUBDIVISION PLAN		

OWNERS

1738787 ALBERTA LTD.
[redacted]

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
901 216 604	22/08/1990	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		PORTION AS DESCRIBED
091 038 954	10/02/2009	CAVEAT RE : ROAD WIDENING CAVEATOR - THE MUNICIPAL DISTRICT OF FOOTHILLS NO. 31. BOX 5605 HIGH RIVER ALBERTA T1V1M7 AGENT - JUDITH A GORDON.
191 208 490	11/10/2019	CAVEAT RE : DEFERRED RESERVE CAVEATOR - FOOTHILLS COUNTY. BOX 5605 HIGH RIVER ALBERTA T1V1M7

TOTAL INSTRUMENTS: 003

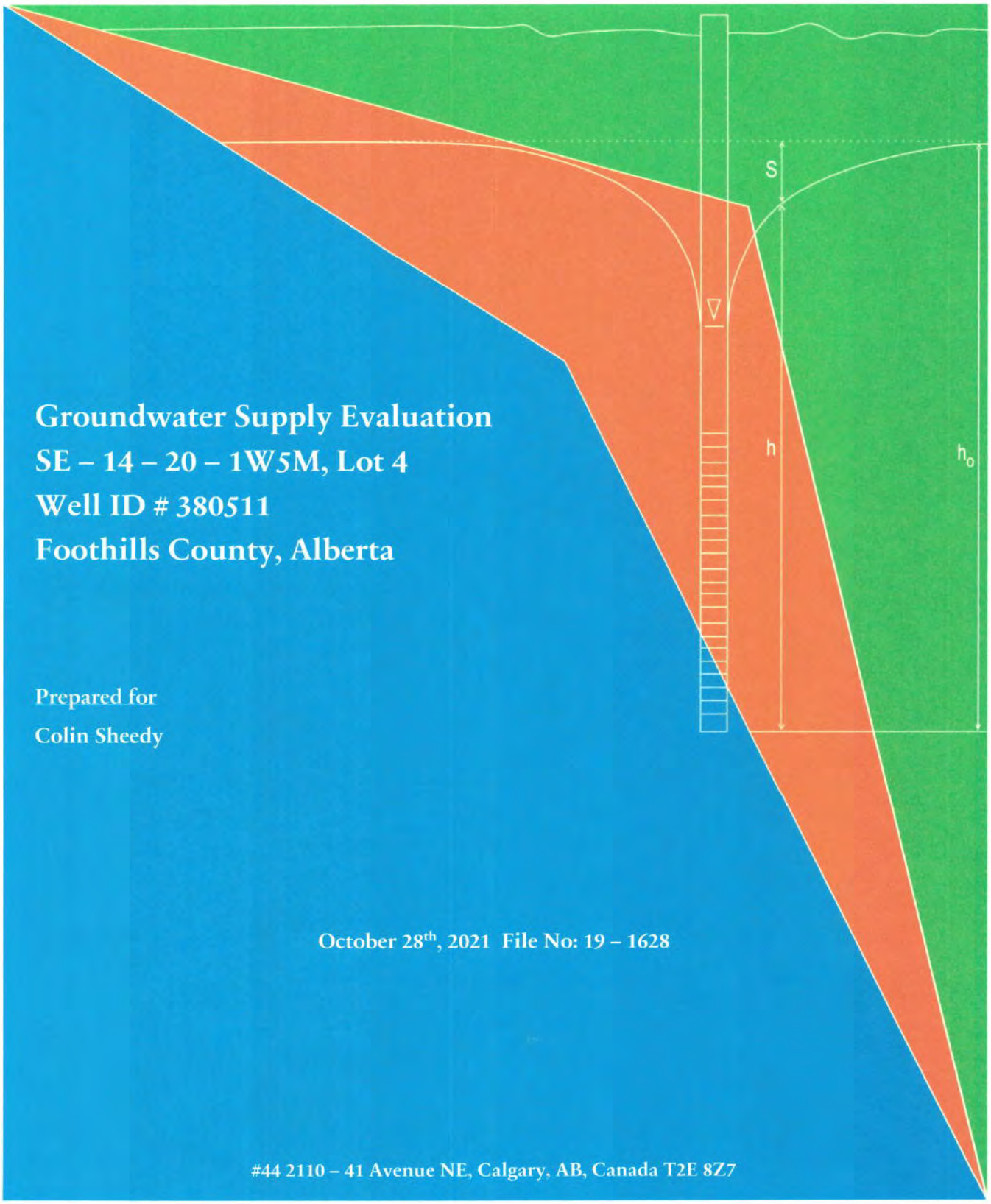
THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 26 DAY OF APRIL, 2021 AT 11:50 A.M.

ORDER NUMBER: 41518060

CUSTOMER FILE NUMBER: DO-Planning

END OF CERTIFICATE

Groundwater Resources
Information Technologies Ltd.



Groundwater Supply Evaluation
SE – 14 – 20 – 1W5M, Lot 4
Well ID # 380511
Foothills County, Alberta

Prepared for

Colin Sheedy

October 28th, 2021 File No: 19 – 1628

#44 2110 – 41 Avenue NE, Calgary, AB, Canada T2E 8Z7

Signatures

Prepared by:

Erik Quartero, P.Geo
Hydrogeologist

Reviewed by:

Ken Hugo, P.Geol
Senior Hydrogeologist
APEGA P15289

Disclaimer

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Executive Summary

Two pumping tests were undertaken on a previously installed water well within a proposed subdivision in SE – 14 – 20 – 1W5 to determine if the aquifer underlying the site can provide water at a sustained rate of at least 3.4 m^3/day, for an annual volume as defined in the *Water Act*, of 1,250 m^3.

The well obtains its water from a bedrock sandstone aquifer at depths of 45.7 – 54.9 meters below ground. No direct connection with surface water is believed to be present and clays and shales overlying the aquifer should aid in preventing surface water contaminants, such as septic field effluents, from migrating to the aquifer.

A pumping test was conducted on the well in March of 2019 and October of 2021 by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 6 imperial gallons per minute or 27.3 liters per minute for a period of 720 minutes in 2019 and 5 igpm for 720 minutes on October 4th of 2021. Water levels were measured for an additional 720 minutes following pumping cessation.

A 20-year safe yield of 143.8 m^3/day (21.9 imperial gallons per minute or 52,523 m^3/year) was calculated based on the 2019 pumping test, and 27.8 m^3/day on based on the 2021 pumping test. This value is in excess of the 1,250 m^3 per year as required by the Water Act and shows the underlying aquifer can supply the necessary amount of water. The discrepancy may be due to some degradation of the well screen with time and a remedial well rehabilitation program is recommended. Due to the age of the well (35 years) and steel liner construction (which is susceptible to rust) a long term well yield cannot be guaranteed.

No adverse effects to existing domestic, licensed, or traditional agricultural groundwater users should result due to production of water from this well for domestic purposes.

A water sample was collected from the well on August 26th 2021 before the second pumping test, for analysis of routine dissolved salts and bacterial constituents. The waster is a sodium bicarbonate type water with slightly elevated Total Dissolved Solids, sodium, and total iron concentrations. Water samples for bacterial content and routine salts are recommended after pumping for some time to rule out bacterial coliforms as well as potentially reduce total iron concentrations.

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APPENDIX

Appendix A – Water well Drilling Report

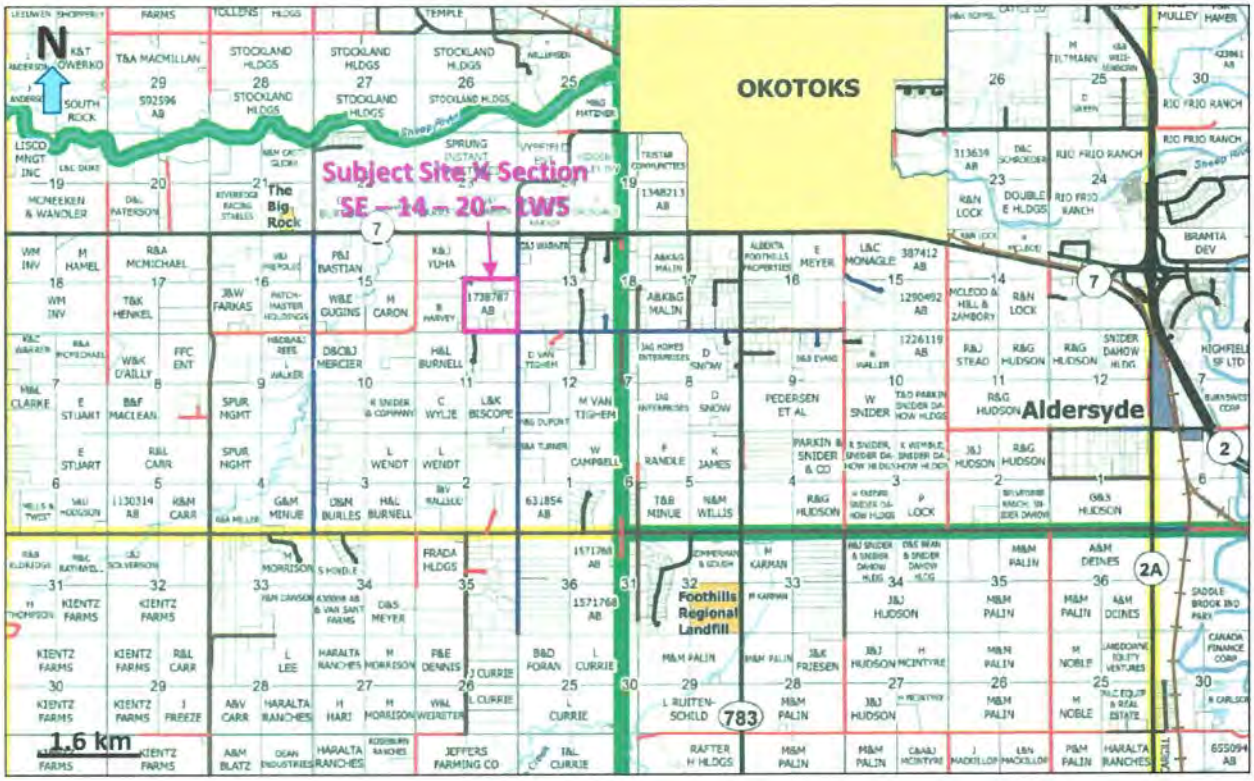
Appendix B – Pumping Test Solution

Appendix C – Water Chemistry Report

[1.0] Introduction

An aquifer analysis was undertaken for a residential supply well located on a proposed 90-acre parcel subdivision in the SE quarter section of 14 – 20 – 1W5 to determine if the well could provide water at a rate of 1,250 m^3/year without causing adverse effects to existing groundwater users. The site is located within Foothills County. A portion of Foothills County landownership map showing the site ¼ section location is as follows:

Figure 1: Foothills County Land Ownership Map and Quarter Section Site Location



The proposed 4-acre lot will be supplied by an individual well located on the parcel. This report is to determine whether an existing well (GIC well ID # 380551) on the parcel is capable of supplying water for a residence.

The location of the well was measured by the landowner and is approximately at 50.6942602 N -114' W.

A site plan of the proposed subdivision showing the well location is as follows:

Figure 2: Air-photo and Quarter Section Location

[2.0] Water well supply needs

The well is proposed to be for a single lot residential use. According to the *Water Act* each residential lot is entitled to water at a rate of 1,250 m^3 annually.

[3.0] Site Description

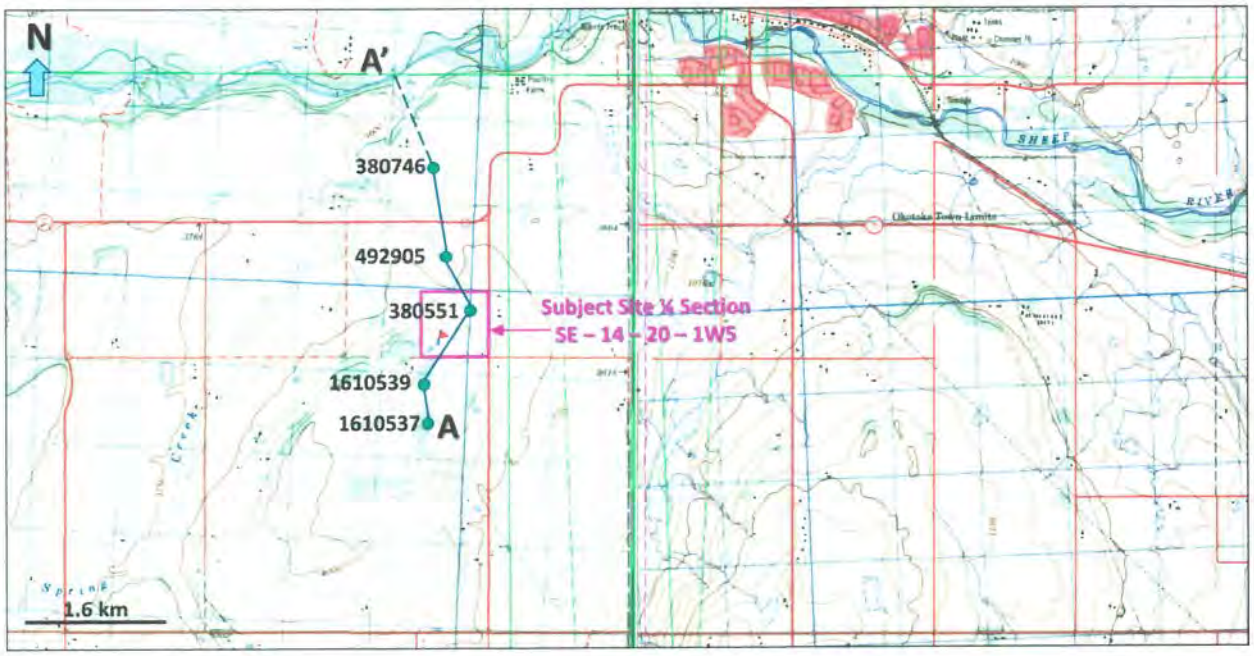
[3.1] Topography

The site is located 3.6 km southwest of the Town of Okotoks and is in a mixed residential and agricultural area with a low density of residential acreages scattered around the site and within the subject site quarter section.

The site is located at an approximate elevation of 1,155 meters above sea level. The Sheep River is located 3.3 km north of the site and is at an approximate elevation of 1,070 meters asl, or 85 meters below the site. Spring Creek is located 2.3 km west of the site and is at an elevation of 1,115 meters asl, or 40 meters below the site.

A topogaphic map with the subject site quarter section is shown as follows:

Figure 3: Topographic Map with Quarter Section Location



[3.2] Surficial Geology

According to the Geological Survey of Canada Map 1925A "Surficial Geology – Turner Valley, Alberta (Jackson, 1998) the area is interpreted to be a rolling till plain up to 7 meters of till of even thickness. Minor amounts of water-sorted material and bedrock exposures are found locally with some areas of undifferentiated sub glacially molded deposits exhibiting streamlined features. Topography is flat to undulating, reflecting the surface of the underlying bedrock and other deposits.

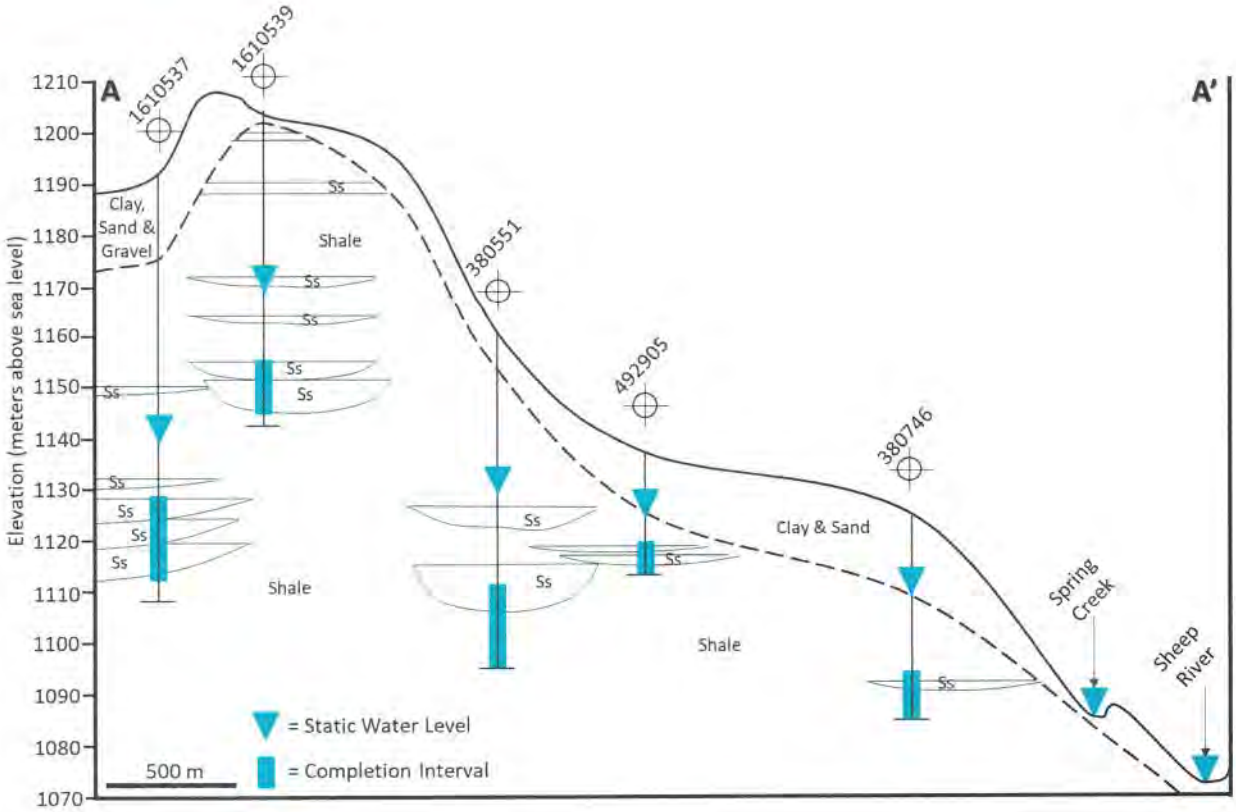
According to area Water Well Drillers Reports the surficial sediments, consisting of clay till, are approximately 5 to 7 meters thick and underlain by sandstone and shale bedrock. No useable aquifers are believed to exist within these upper deposits. The presence of the shale and clays is favourable in preventing contamination from surface source (such as septic field effluent) from entering lower aquifers.

3.3) Bedrock Geology

Wells in the area are likely completed within strata belonging to the Upper Lacombe Member of the Paskapoo Formation. The Upper Lacombe Member is comprised mostly of shale interbedded with sandstone. The target aquifers are sandstone channel deposits with shale overbank deposits acting as aquitards. When several sandstone channels are stacked on top of each other then an exceptional aquifer can be found, but often sufficient water is obtained from individual sandstone aquifers separated by shale units.

A cross section was constructed in Figure 4 using water well records from the area to show relative thickness of surficial quaternary deposits and depth to bedrock, as follows:

Figure 4: Geological Cross Section A-A'



Much of the Upper Lacombe Member consists of thin fluvial sandstone channel aquifers that are relatively isolated from each other by the shale overbank deposits. Water levels in most wells do not correlate with each other, indicating wells are producing from aquifer units which pinch out laterally and are not hydraulically connected to one another. Groundwater levels also do not correlate with the surface water level of Spring Creek or Sheep River nearby, suggesting the producing aquifers are not in good hydraulic connection to these surface water bodies.

[4.0] Area Groundwater Users

[4.1] Non-licensed Water Users

The Alberta Environment and Parks (AEP) water well database lists 99 wells within a 1.6 km (1 mile) radius of the pumping well. Most of these wells are for domestic purposes, with 4 wells also dedicated to stock watering. Well depths range from 19 – 124 meters with most wells on the order of 35 – 78 m deep. Initial static water levels in the area range from 8 – 80 metres below the top of casing.

[4.2] Licensed Water Users

A search of the AEP water licence database was undertaken for the subject section and adjoining 8 sections to determine if any water licences are present in the area. A summary of groundwater licences and registrations in the area is as follows:

Table 1: Groundwater Licenses and Registrations

Location	Registrations	Licenses	Volume (m3/year)	Licensee
11 – 20 – 1W5	1	-	-	Robert Carr
14 – 20 – 1W5	1	-	-	Betty & Don Melvin
15 – 20 – 1W5	1	-	-	Little Rock Farm
23 – 20 – 1W5	1	-	-	James McGregor
24 – 20 – 1W5	2	-	-	Hidden Valley Investments Ltd. Joseph Drisdale & Edward Dorin

Licences for surface waters withdrawals were not included in the Table 1 summary. No licenses for groundwater use were found in the area. The groundwater use in the area can be described as low to moderate, consisting largely of residential acreage use.

[5.0] Pump test

[5.1] Supply Well Details

The production well was installed on site December 5,1985 by personnel from Interprovincial Drilling Contractors. 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 A.

Table 2: Water Well Supply Details

Well	Production Well
Well ID	380551
GPS Location	50° 41' 39.00" N 114° 01' 35.91" W
Well depth (m BGL[1])	65.5
Aquifer zone (m BGL[1])	45.7 – 54.9
Screened Interval (m BGL[1])	50.3 – 65.5
Surface Casing (m BGL[1])	+0.5 – 7.0
Static water level after installation (m BGL[1])	32.00
NPWL (m BGL[1])	

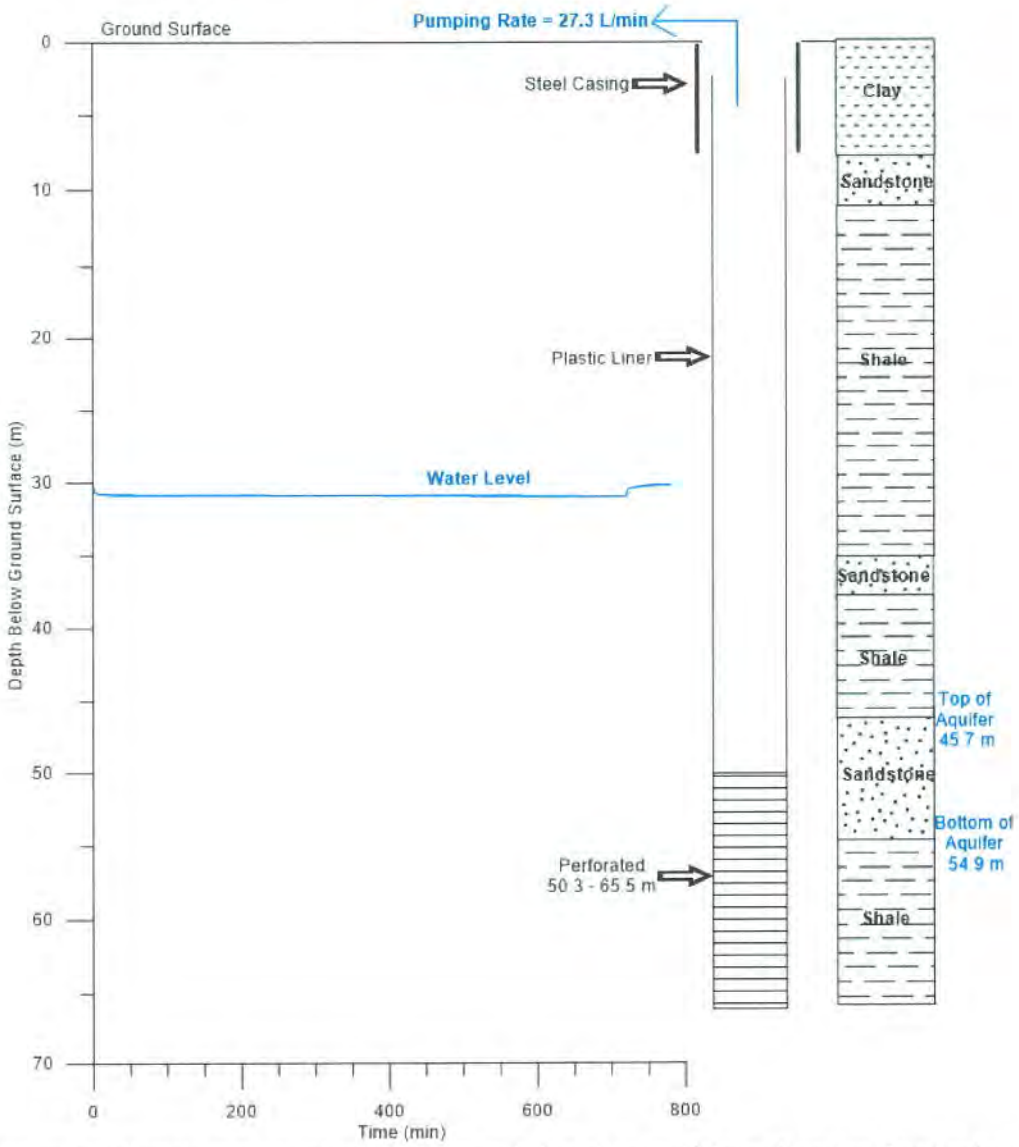
1. m BGL – metres below ground level

[5.2] Details of the Pumping Test

The pumping test was conducted March 15 – 16, 2019 by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 6 imperial gallons per minute (igpm) or 27.3 liters per minute (L/min) for a period of 720 minutes. Water levels were measured for an additional 60 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 as follows:

Figure 5: Pumping Well Schematic and Water Levels During the Pumping Test



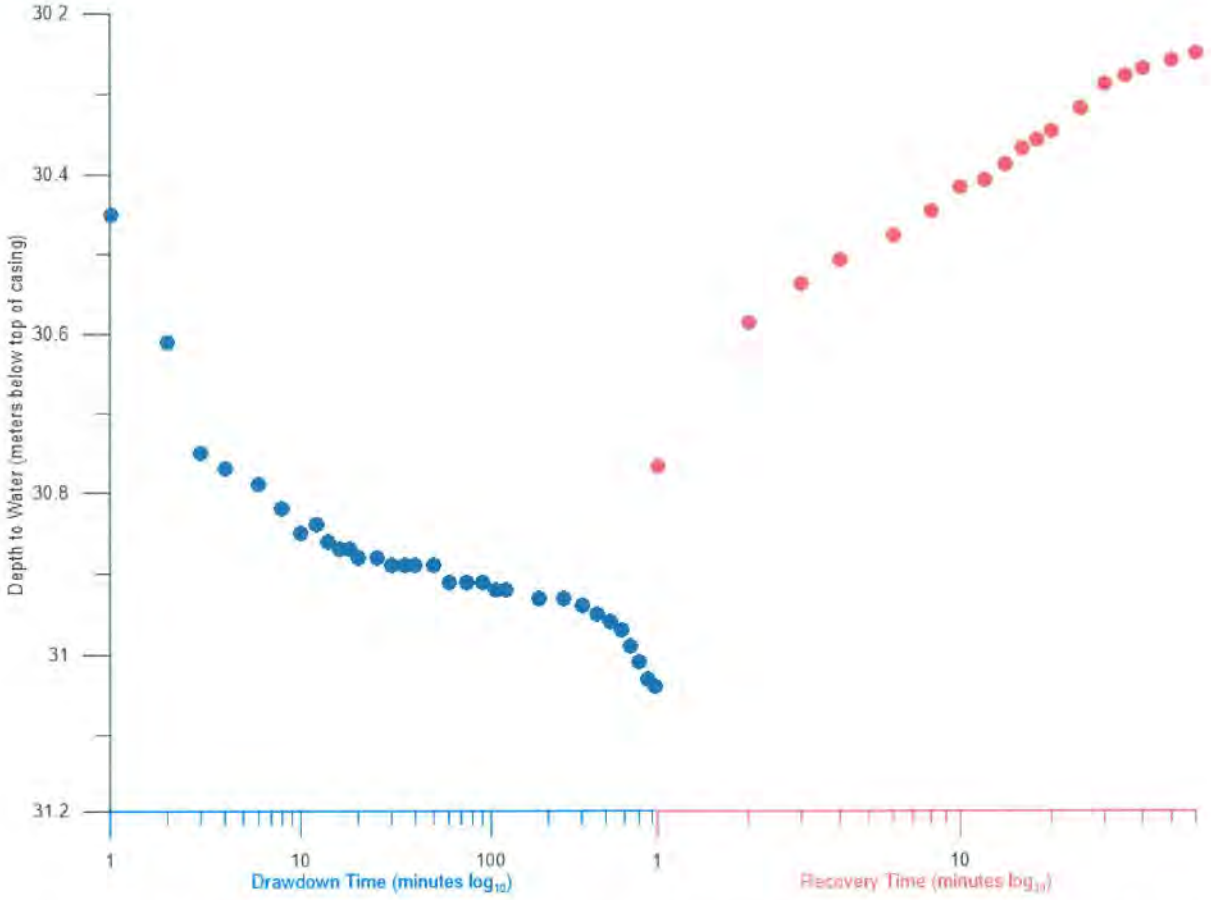
The well had an initial static water level of 30.25 metres below the top of the well casing (btoc) prior to pumping and drew down 0.79 metres to 31.04 metres btoc by the end of the pumping period. Water levels built up to 30.25 metres at the end of the buildup period for a recovery of 100%.

[5.3] Pumping Test Interpretation

A high productivity well is indicated by the low amount of drawdown given the moderate pumping rate.

A dual semi-log graph of the pumping test data is shown in Figure 6 to illustrate the water level data during the pumping test more clearly.

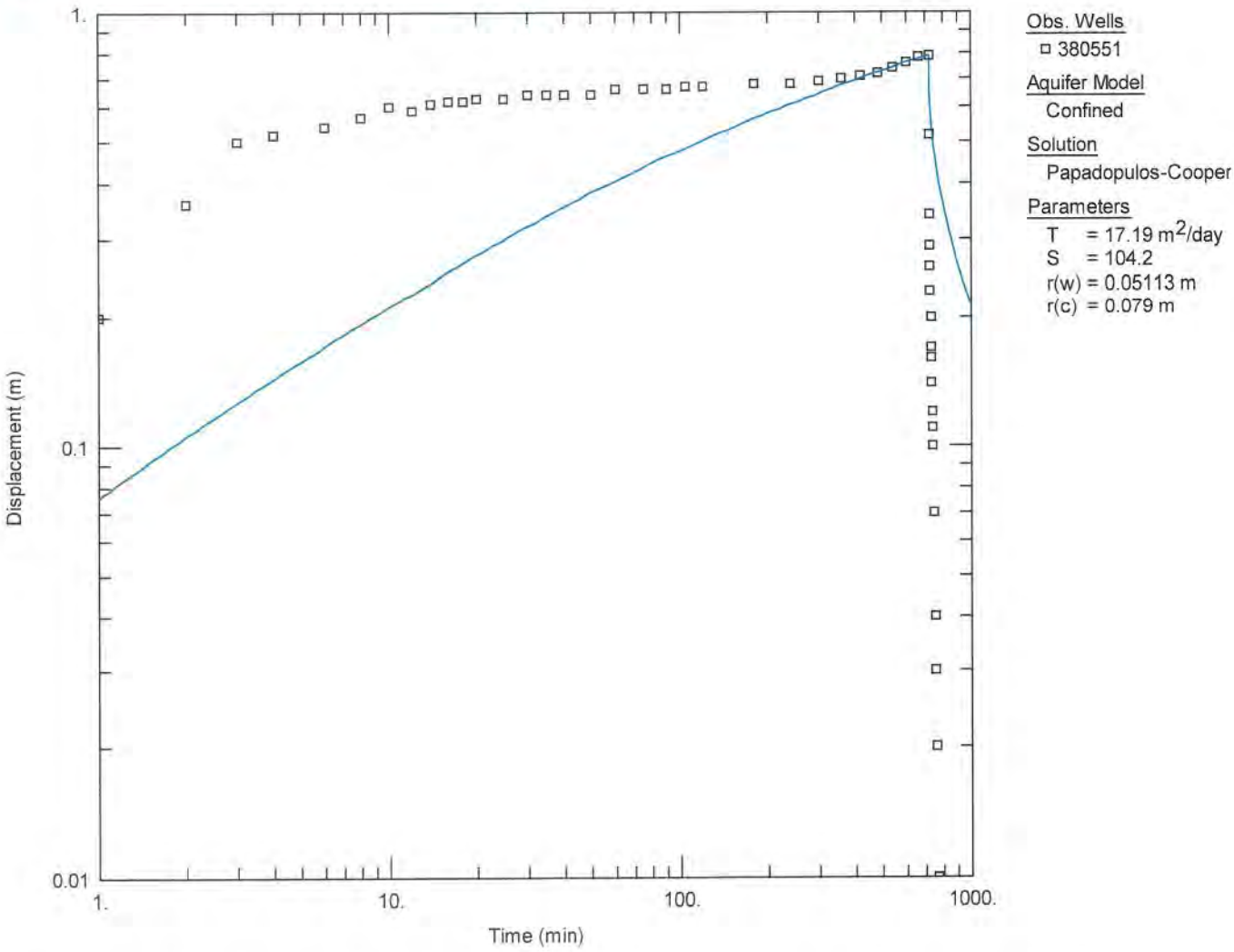
Figure 6: Dual Semi-log Graph of Drawdown and Recovery in the Pumping Well



The slope of both the drawdown and recovery curve indicate a boundary effect as the slope of the drawdown curve increase after approximately 300 minutes from the slope from 10 – 300 minutes.

The pumping test data was interpreted with the aid of the AQTESOLV program developed by Hydrosoft Inc. The Papadopulos-Cooper solution method was used for a confined aquifer with radial groundwater flow. A graph showing water level displacement with time and a fitted curve is as follows:

Figure 7: Papadopulos-Cooper Solution for Pumping Well



A poor fit to the curve is observed, with deviation at early time, potentially due to well bore storage effects and the boundary effect. A transmissivity of 17.2 m^2/day is calculated indicating a moderate productivity well. It is possible that a longer pumping test would show different results as the curve form continues to change.

5.4) 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:

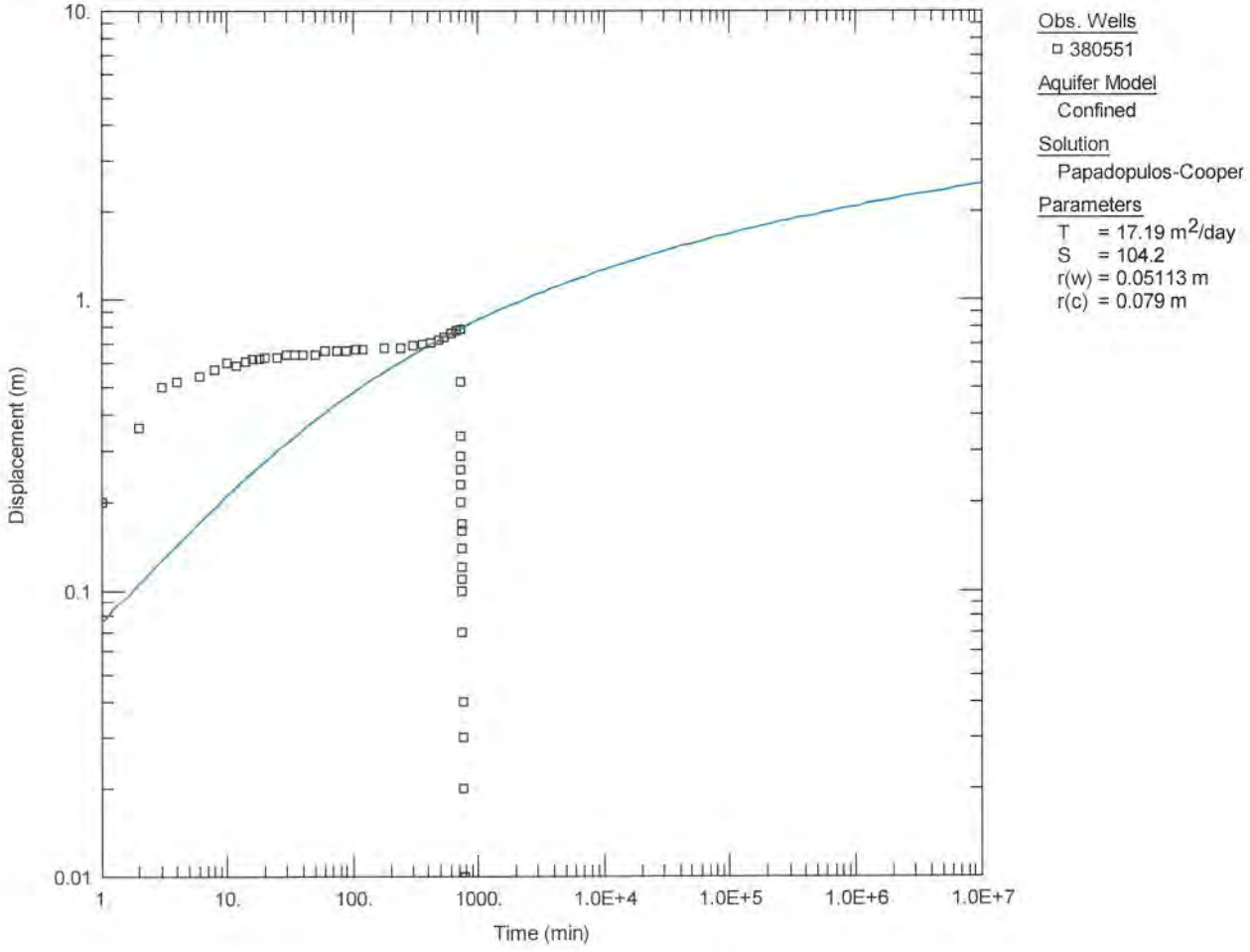
$$Q_{20} = \frac{(0.7 * Q * H_a)}{S_{100\min} + (S_{20yrs} - S_{100th})}$$

Where:

Q	-	Pump test flow rate 39.3 m^3/day (27.3 litres/min)
H_a	-	Available Head = 14.22 m
$S_{100\ min}$	-	Observed drawdown at 100 minutes (0.67 m)
$(S_{20yrs} - S_{100\ th})$	-	Difference between drawdown at 20 years and 100 min (2.53 m – 0.48 m = 2.05 m)
0.7	-	Safety factor

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

Figure 8: Papadopulos-Cooper Solution Extrapolated to 20 years of pumping



Substituting in the above values a 20-year safe yield (Q_{20}) of 143.8 m^3/day (21.9 imperial gallons per minute or 52,523 m^3/year) is calculated. This safe yield value is in excess of the 1,250 m^3/year diversion required for the residential acreage and shows that the well is capable of supplying the necessary amount of water.

The pumping test was repeated in 2021 with a pumping test conducted on October 4th, 202. This pumping test also showed an increase in slop, in this test after approximately 30 minutes compared to the previous increase in slope after 300 minutes. The 2021 pumping test analysis is shown in Appendix B.

A transmissivity of 5.2 m2/day is calculated from this pumping test or approximately 1/3 the transmissivity calculated from the 2019 pumping test data. The well has been inactive and potential screen build up and encrustation may have reduced the wells ability to produce water. Well re-conditioning via acid wash and jetting of the well screen may improve the well's performance and extend the life of the well.

A 20-year safe yield (Q_{20}) of 27.8 m^3/day or 10,143 m^3/year (4.2 igpm) is calculated from this pumping test, which is less than the 2019 pump test yield. The October 2021 analysis shows the well is still capable of providing the 1,250 m^3/year. However, no guarantee can be made of the well's longevity due to the age of the well and completion materials. This analysis shows only that the underlying aquifer can sustain the development for a long period of time.

[6.0] Effect on Water Levels

[6.1] Existing Users

Several of the well sin the proposed subdivision are completed in the same hydrostratigraphic zone. These wells are not in the same production aquifer due to fluvial internal heterogeneities but have similar depth of completion and water levels. Using the Cooper-Jacob equation the expected drawdown in the aquifer/hydrostratigraphic zone at various time and distances due to pumping from the subdivision can be calculated by the following formula:

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

Where

s	-	Drawdown (m)
S	-	Storativity (5.0×10^{-5})
Q	-	Licensed Pump Rate (3.5 m^3/day)
T	-	Transmissivity (41.8 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 3: Cooper-Jacob Distance Drawdown Calculation

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

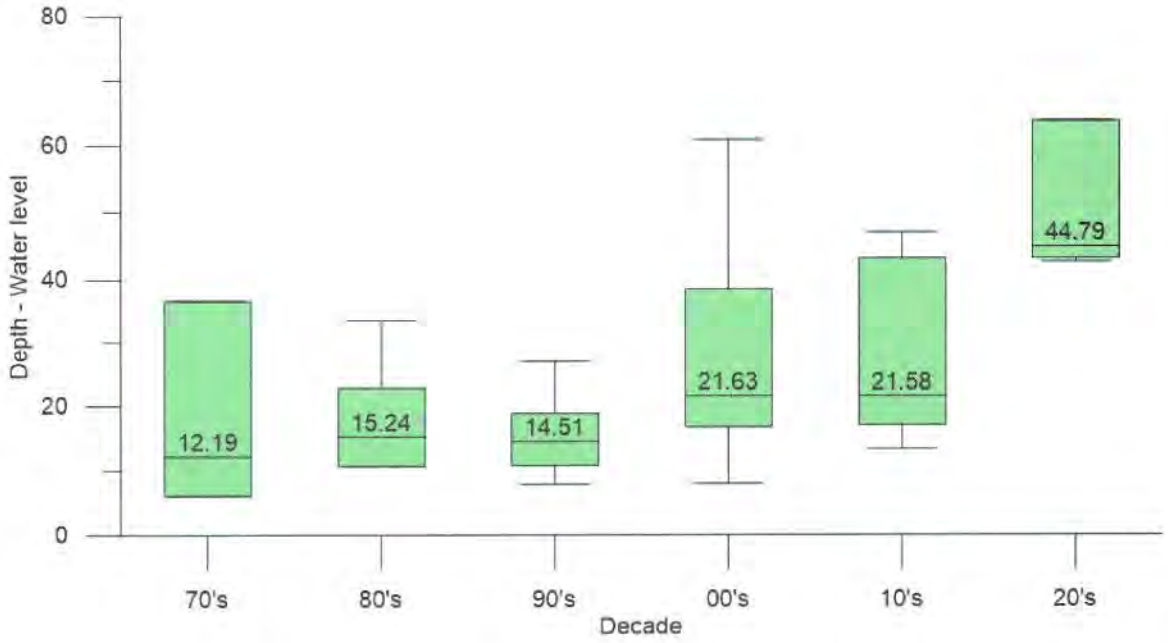
The following assumptions were included in the above calculation: No recharge is occurring, and all wells are screened over the same aquifer. From this table, we can infer that the most a neighboring well (< 300 m) in the same aquifer will experience in additional drawdown will be less than 1 meter over a 20-year pumping period. The average available head in the area is 15 to 25 meters, so additional drawdown of less than 1 meter will likely not be of concern for neighbouring groundwater users.

The available head in the pumping well is 14.22 meters. Thus, the additional drawdown in the well of less than 1 meter after 20 years of pumping would not hinder the wells performance.

6.2) Changes in Water Levels vs Time

Initial static water levels and depths were collected for every well completed within a one-mile radius form the new subdivision. Although there is significant variance in aquifer thicknesses, depths and hydrostratigraphic zones, the initial water level was subtracted form the well depth to produce an approximation of Aquifer hydraulic head (pressure). The plot shows the completion date by decade vs approximate hydraulic head for all the wells within a 1-mile radius.

Figure 9: Whisker plot of Approximate Hydraulic Head After Well Installation



There is a large variance in initial heads, with slight apparent increase visible to demonstrate rising aquifer pressures. The above diagram shows there is no indication the area is severely over utilized with respect to groundwater diversions. However, the increase is likely due to several recent wells drill on the subject site that target deeper aquifers with higher hydraulic heads.

[7.0] Water Quality

Water samples were obtained from the supply well by personnel from Titan Water Systems on August 26th 2021, and submitted to KaizenLAB the next day for analysis. The water chemistry report from KaizenLAB is attached in Appendix C.

The water chemistry in comparison to Canadian Drinking Water standards (CDW) is presented in Table 5 below as follows:

Table 4: Groundwater Chemistry

Parameter	GIC Well ID 178795	Drinking water limits
Depth (ft.)	215	
Lab pH	8.2	6.5-8.5
Lab EC	1040	
Analyte (mg/L)		
Calcium	34.9	
Magnesium	20.0	
Sodium	**201.8**	200 (AO)
Potassium	6.2	
Chloride	86.47	250 (AO)
Fluoride	0.56	1.5 (MAC)
Nitrate N	0.24	10 (MAC)
Sulphates	65.26	500 (AO)
Iron	**1.5**	<0.03 (AO)
Bicarbonate	442.1	
Total Dissolved Solids	**637**	500 (AO)
Ion Balance	89.9	~1
T-Alkalinity	362.6	

The water quality in the area is a sodium bicarbonate type with levels of sodium, iron and Total Dissolved Solids concentrations near or slightly above the aesthetic objective limits set by the CCME. The high iron and ion balance is likely due to the degrading steel production liner that was installed in 1985. Continue use of the well should reduce the amount of total iron found in the water.

It is recommended that a sample from a well installed to supply water on the subdivided lot be collected and analyzed for routine dissolved salts and bacterial parameters after the pumping test and prior to use as a drinking water source.

References

Alberta Environment Guide to Groundwater Authorization, Government of Alberta, 2011, Available: https://open.alberta.ca/dataset/d399d059-d8b6-4c46-9ff2-ef39f359943a/resource/2f385374-2521-4252-8e46-4b51e61c1e41/download/5612701-2013-alberta-environment-guide-groundwater-authorization.pdf

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Shetsen, I. (1987): Quaternary geology, southern Alberta; Alberta Research Council, ARC/AGS Map 207

Appendix A – Water Well Drilling Report

Water Well Drilling Report

View in Metric | Export to Excel

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.

GIC Well ID 380551
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/01/20

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
ENDERSBY, JACK	GEN DEL, OKOTOKS				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	14	20	1	5				

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.692215 Longitude -114.030600
How Location Obtained
Map

Elevation ft
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Cable Tool

Proposed Well Use
Stock

Type of Work
New Well

Formation Log

Measurement in Imperial

Depth from ground level (ft)	Water Bearing	Lithology Description
2.00		Topsoil
22.00		Clay
35.00		Sandstone
115.00		Gray Shale
125.00	Yes	Water Bearing Sandstone
150.00		Gray Shale
180.00	Yes	Water Bearing Sandstone
215.00		Gray Shale

Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 0.00 igpm

Test Date	Water Removal Rate (igpm)	Static Water Level (ft)
1985/12/10	10.00	105.00

Well Completion

Measurement in Imperial

Total Depth Drilled	Finished Well Depth	Start Date	End Date
215.00 ft		1985/12/05	1985/12/10

Borehole

Diameter (in)	From (ft)	To (ft)
0.00	0.00	215.00

Surface Casing (if applicable)
Steel
Size OD : 6.62 in
Wall Thickness : 0.188 in
Bottom at : 23.00 ft

Well Casing/Liner
Steel
Size OD : 5.00 in
Wall Thickness : 0.000 in
Top at : 12.00 ft
Bottom at : 215.00 ft

Perforations

From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)
165.00	215.00	0.250		12.00

Perforated by Torch

Annular Seal
Placed from 0.00 ft to 0.00 ft
Amount

Other Seals

Type	At (ft)

Screen Type
Size OD : 0.00 in

From (ft)	To (ft)	Slot Size (in)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER

Company Name
INTERPROVINCIAL DRILLING CONTRACTORS

Certification No
1

Copy of Well report provided to owner Date approval holder signed

Water Well Drilling Report

View in Metric | Export to Excel

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.

GIC Well ID 380551
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 1986/01/20

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
ENDERSBY, JACK	GEN DEL, OKOTOKS				

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	SE	14	20	1	5				

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.692215 Longitude -114.030600
How Location Obtained
Map

Elevation ft
How Elevation Obtained
Not Obtained

Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate 0.00 igpm
Recommended Pump Intake Depth (From TOC) 0.00 ft
Pump Installed
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
TDS 450 PPM, FE .5 PPM, 17 PPM HARDNESS.

Yield Test

Taken From Ground Level
Depth to water level

Measurement in Imperial

Test Date	Start Time	Static Water Level
1985/12/10	12:00 AM	105.00 ft

Pumping (ft)	Elapsed Time Minutes:Sec	Recovery (ft)
105.00	0:00	170.00
170.00	16:00	105.00
170.00	120:00	

Method of Water Removal
Type Bailer
Removal Rate 10.00 igpm
Depth Withdrawn From 170.00 ft

If water removal period was < 2 hours, explain why

Water Diverted for Drilling

Water Source	Amount Taken	Diversion Date & Time
	ig	

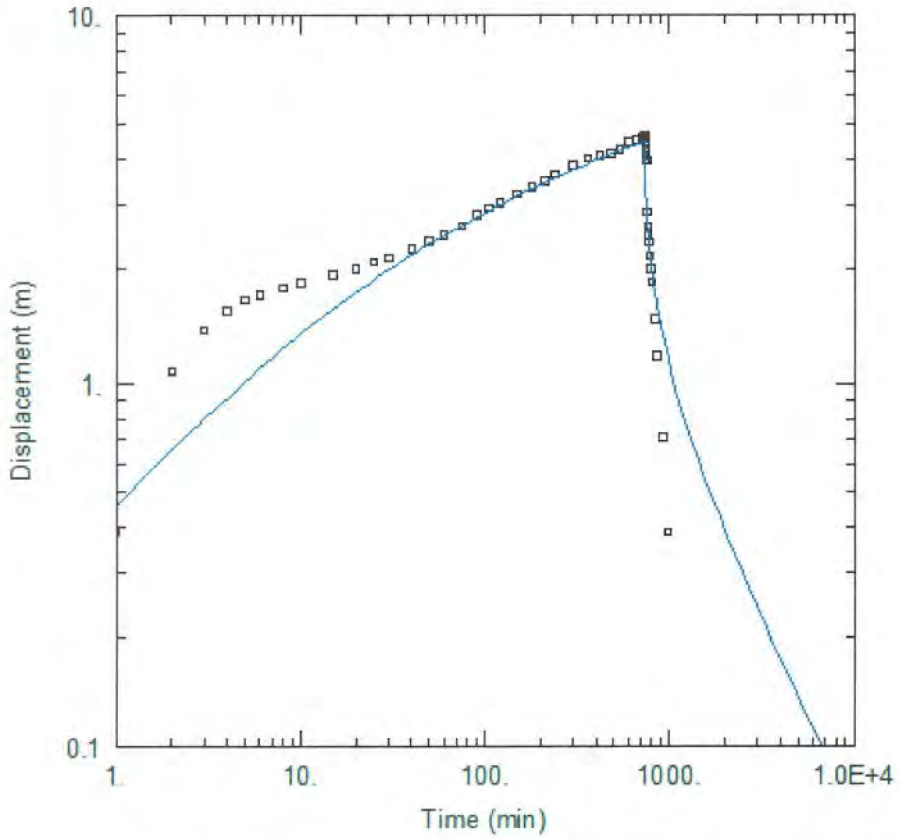
Contractor Certification

Name of Journeyman responsible for drilling/construction of well
UNKNOWN NA DRILLER
Company Name
INTERPROVINCIAL DRILLING CONTRACTORS

Certification No
1
Copy of Well report provided to owner
Date approval holder signed

Appendix B – Pumping Test Solution

Groundwater Resources
Information Technologies Ltd.



WELL TEST ANALYSIS

Data Set:
Date: 10/27/21 Time: 14:44:49

PROJECT INFORMATION

Company: GRIT Ltd
Client: Colin Sheedy
Project: 19-1628
Location: Foothills County
Test Well: 380511

AQUIFER DATA

Saturated Thickness: 9.14 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
380551	0	0

Observation Wells

Well Name	X (m)	Y (m)
▫ 380551	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 3.005 m^2/day S = 5.209
r(w) = 0.063 m r(c) = 0.057 m

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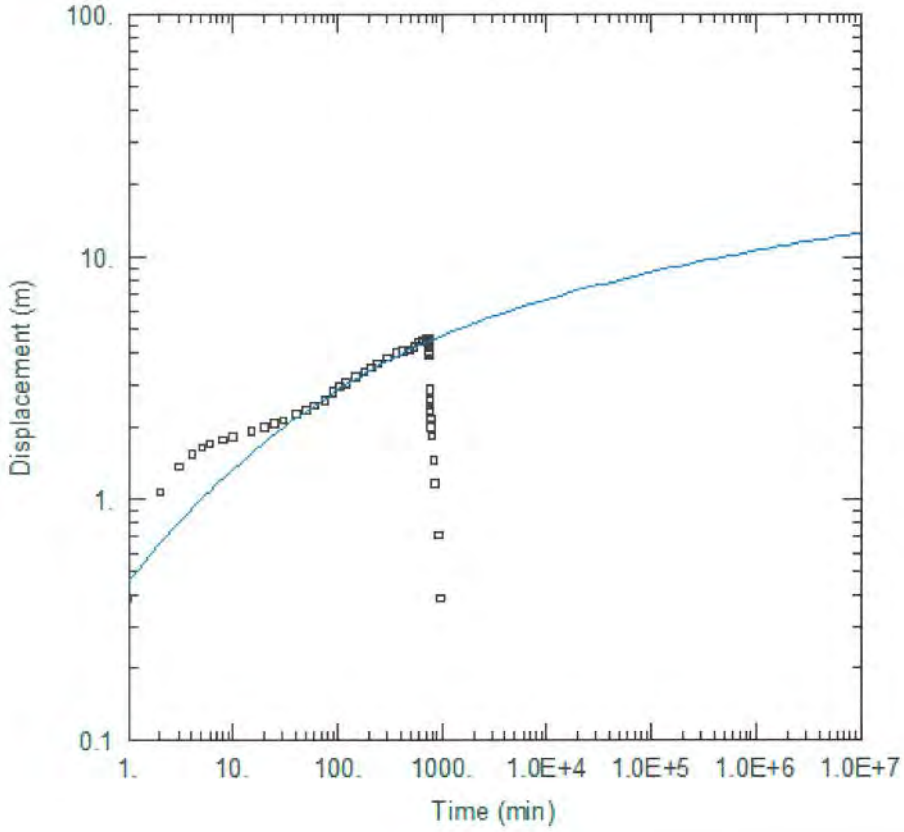


WELL TEST ANALYSIS

Data Set:
Date: 10/27/21 Time: 14:56:05

PROJECT INFORMATION

Company: GRIT Ltd
Client: Colin Sheedy
Project: 19-1628
Location: Foothills County
Test Well: 380511

AQUIFER DATA

Saturated Thickness: 9.14 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
380551	0	0

Observation Wells

Well Name	X (m)	Y (m)
▫ 380551	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Papadopulos-Cooper

T = 3.005 m^2/day S = 5.209
r(w) = 0.063 m r(c) = 0.057 m

Appendix C – Water Chemistry Report

Unit# 288, 2880 45 Ave S.E.
Calgary, AB, T2B 3M1
Phone (403) 297-0868
Fax: (403) 297-0869

KaizenLAB

ANALYTICAL REPORT

TITAN Water Systems
Complete Pumping & Filtration Solutions
www.titanwater.ca

Contact: Troy Niemans
Phone:
Email: [redacted]

KaizenLAB #:	316752_001
SAMPLE INFO:	C. Sheedy #14104
DATE SAMPLED:	26-Aug-2021
DATE RECEIVED:	27-Aug-2021
DATE REPORTED:	01-Sep-2021
LOCATION:	

Parameter Description	Units	Result	Canadian Drinking Water Quality Guidelines*
Routine Water Potability Analysis for Titan Water Systems			
pH		8.2	7.0-10.5 (AO)
Electrical Conductivity (EC)	uS/cm	1040	
Dissolved Calcium	mg/L	34.9	
Dissolved Magnesium	mg/L	20.0	
Dissolved Potassium	mg/L	6.2	
Dissolved Sodium	mg/L	201.8	200 (AO)
Chloride	mg/L	86.47	250 (AO)
Fluoride	mg/L	0.56	1.5 (MAC)
Nitrate-N	mg/L	0.238	10 (MAC)
Nitrite-N	mg/L	<0.005	1 (MAC)
Nitrite-N + Nitrate-N	mg/L	0.238	
Phosphate	mg/L	<0.10	
Sulphate	mg/L	65.26	500 (AO)
Bicarbonate (as HCO3)	mg/L	442.1	
Carbonate (as CO3)	mg/L	<1.5	
Hydroxide (as OH)	mg/L	<0.5	
Alkalinity (total, as CaCO3)	mg/L	362.6	
Alkalinity (phenolphthalein, as CaCO3)	mg/L	<2.0	
Total Iron	mg/L	1.5	2.0 (MAC)
Total Manganese	mg/L	0.051	0.12 (MAC)
Hardness (calculated, as CaCO3)	mg/L	169.7	
Sodium Adsorption Ratio		6.74	
Total Dissolved Solids (calculated)	mg/L	637	500 (AO)
Bromide	mg/L	<0.10	
Ion Balance	%	89.94	

*CDWQG = Canadian Drinking Water Quality Guidelines, Health Canada 2008; MAC = Maximum Acceptable Concentration (affects health), AO = Aesthetic Objective (does not affect health but affects color, taste, etc.).

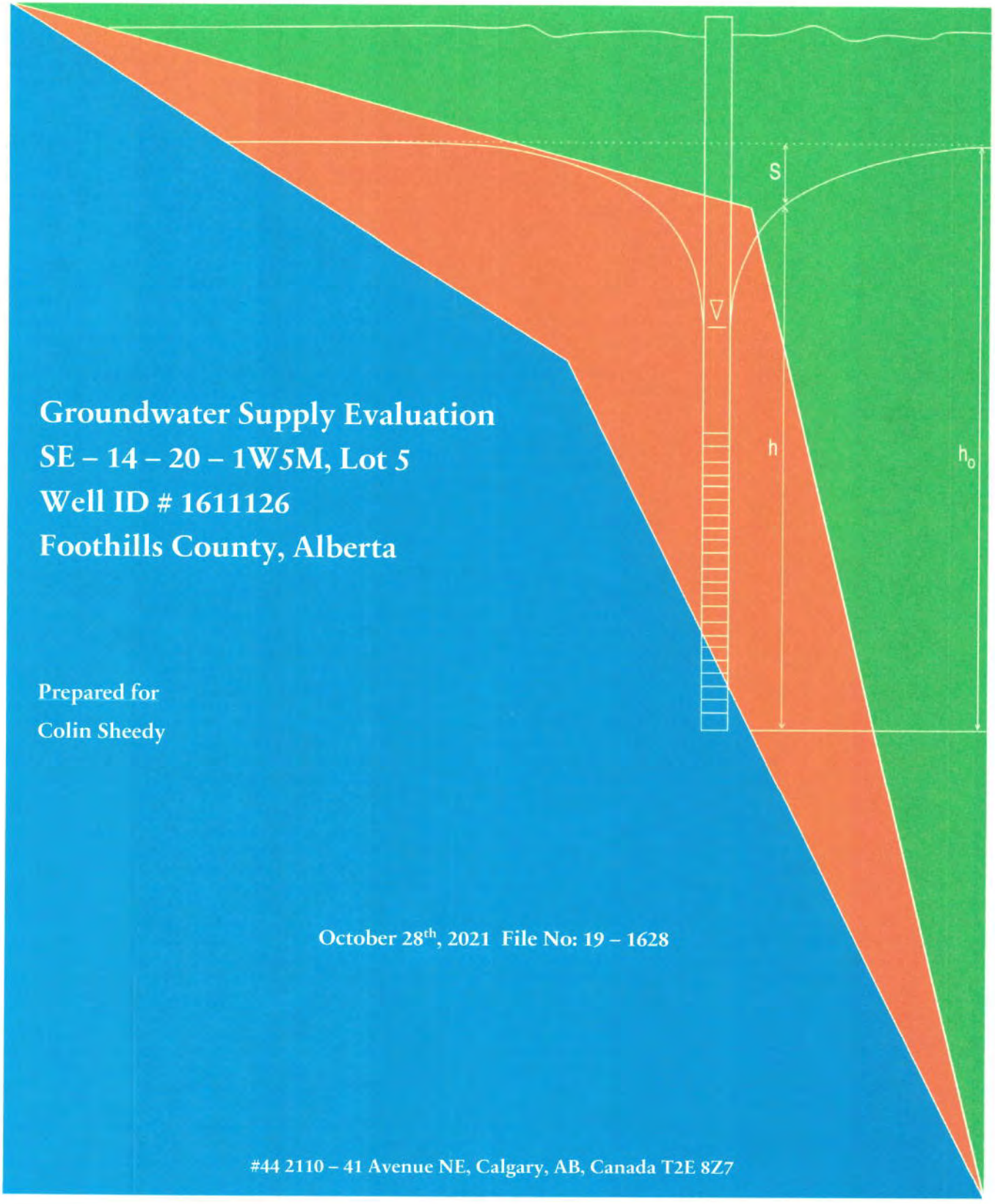
< refers to less than the detection limit
MPN = Most Probable Number of coliform bacteria

Note: The results in this report relate only to the items tested. Information is available for any items in 5.10.2 of ISO/IEC 17025 that cannot be put on a test report.

Final Review by: [redacted]

Zakia Biswas

Groundwater Resources
Information Technologies Ltd.



Groundwater Supply Evaluation
SE – 14 – 20 – 1W5M, Lot 5
Well ID # 1611126
Foothills County, Alberta

Prepared for
Colin Sheedy

October 28th, 2021 File No: 19 – 1628

#44 2110 – 41 Avenue NE, Calgary, AB, Canada T2E 8Z7

Signatures

Prepared by:

Erik Quartero, P.Geo
Hydrogeologist

Reviewed by:

Ken Hugo, P.Geol
Senior Hydrogeologist
APEGA P15289

Disclaimer

This report has been prepared by Groundwater Resources Information Technologies (the consultant) for the exclusive use and benefit of the addressee (the client) and may not be relied upon by any other person or third party, for any other purpose without the prior written consent of the consultant. The consultant is not responsible for any damages that may be suffered as the result of any unauthorized use of, or reliance on, this report. Groundwater Resources Information Technologies Ltd. (GRIT Ltd.) has performed the work as described below 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 practicing 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 or parties that provided information as part of this report. GRIT Ltd. appreciates the opportunity to present these finding on behalf of the Client. If you have any questions regarding the above report, please do not hesitate to contact the above signed.

Executive Summary

A pumping test was undertaken on a newly installed water well within a proposed subdivision in SE – 14 – 20 – 1W5 to determine if the aquifer underlying the site can provide water at a sustained rate of at least 3.4 m^3/day, for an annual volume as defined in the *Water Act*, of 1,250 m^3.

The well obtains its water from a bedrock sandstone aquifer at depths of 44.2 – 68.6 meters below ground. No direct connection with surface water is believed to be present and clays and shales overlying the aquifer should aid in preventing surface water contaminants, such as septic field effluents, from migrating to the aquifer.

A pumping test was conducted on the well on September 24th, 2021 by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 1.35 imperial gallons per minute or 6.13 liters per minute for a period of 720 minutes. Water levels were measured for an additional 720 minutes following pumping cessation.

A 20-year safe yield of 3.97 m^3/day (0.6 imperial gallons per minute or 1,452 m^3/year) was calculated from pumping test and well completion data. This value is in excess of the 1,250 m^3 per year as required by the *Water Act* and shows the well can likely supply the necessary amount of water.

No adverse effects to existing domestic, licensed or traditional agricultural groundwater users should result due to production of water from this well for domestic purposes.

A water sample was collected from the well towards the end of the pumping test for analysis of routine dissolved and bacterial parameters. The lab report is not currently available, and the results should be compared to drinking water criteria prior to use of the water as a potable source.

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APPENDIX

Appendix A – Water Well Drilling Report

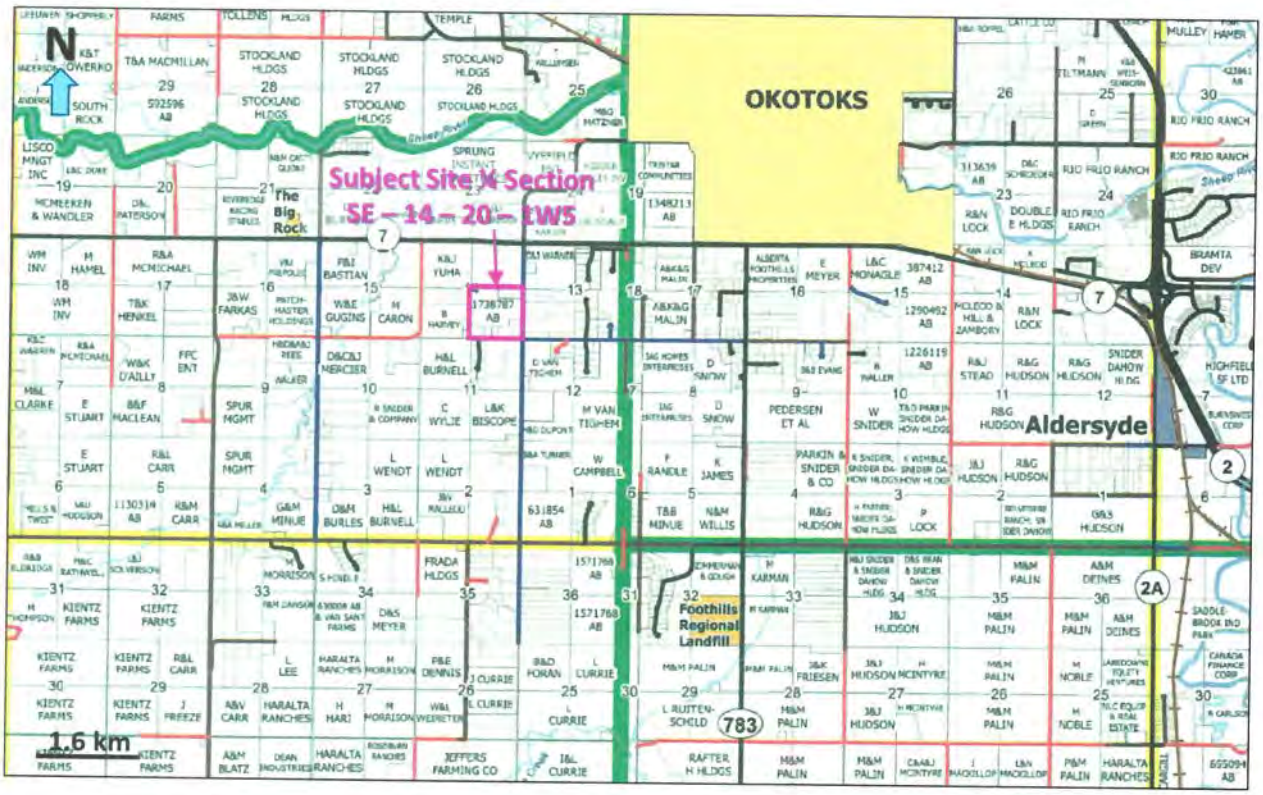
Appendix B – AEP Water Well Database Search Results

[1.0] Introduction

An aquifer analysis was undertaken for a residential supply well located on a proposed 3.99 -acre parcel subdivision in the SE quarter section of 14 – 20 – 1W5 to determine if the well could provide water at a rate of 1,250 m^3/year without causing adverse effects to existing groundwater users.

The site is located within Foothills County. A portion of the Foothills County landownership map showing the site ¼ section location is as follows:

Figure 1: Foothills County Land Ownership Map and Quarter Section Site Location



The proposed 3.99-acre subdivision will be supplied by an individual well located on the parcel. This report is to determine whether a newly installed well (GIC Well ID 1611126) on the proposed subdivision is capable of supplying water to a residence.

The location of the well was measured by personnel from GRIT Ltd. and is at: 50.693561° N, -114.026696° E.

A site plan of the proposed subdivision showing the well location is as follows:

Figure 2: Air-photo and Quarter Section Location

Additional subdivision boundary information is included in Appendix A.

[2.0] Water well supply needs

The well is proposed to be for a single lot residential use. According to the *Water Act* each residential lot is entitled to water at a rate of 1,250 m^3 annually.

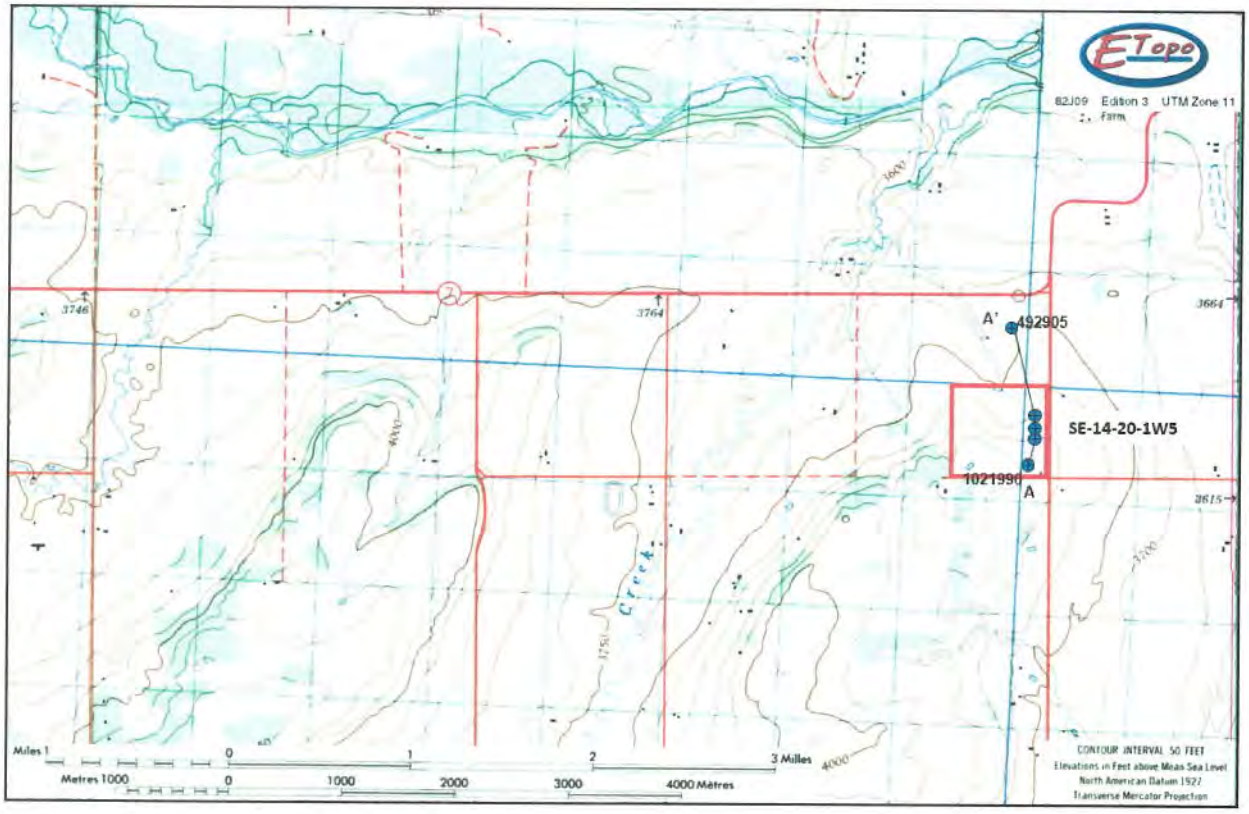
[3.0] Site Description

[3.1] Topography

The site is located 3.6 km southwest of the Town of Okotoks and is in a mixed residential and agricultural area with a low density of residential acreages scattered around the site and within the subject site quarter section.

The site is located at an approximate elevation of 1,170 meters above sea level. The Sheep River is located 2.9 km north of the site and is at an approximate elevation of 1,070 meters asl, or 100 meters below the site. Spring Creek is located 2.1 km west of the site and is at an elevation of 1,110 meters asl, or 60 meters below the site. A topogaphic map with the subject site quarter section is shown as follows:

Figure 3: Topographic Map with Quarter Section Location



[3.2] Surficial Geology

According to the Geological Survey of Canada Map 1925A entitled "Surficial Geology – Turner Valley, Alberta)" (Jackson, 1998) the area is interpreted to be a rolling till plain composed of up to 5 meters of till of even thickness. Minor amounts of water-sorted material and bedrock exposures are found locally with some

areas of undifferentiated sub glacially molded deposits exhibiting streamlined features. Topography is flat to undulating, reflecting the surface of the underlying bedrock and other deposits.

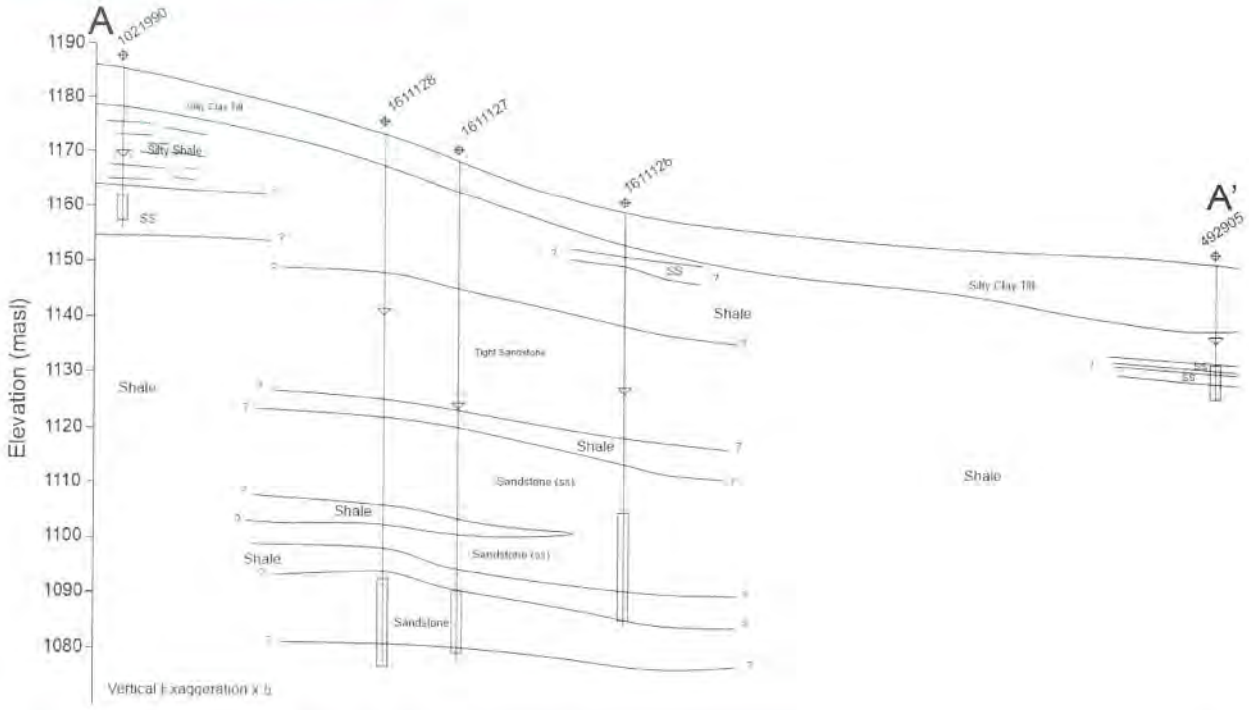
According to area Water Well Drillers Reports the surficial sediments, consisting of clay till, are approximately 5 to 7 meters thick and underlain by sandstone and shale bedrock. No useable aquifers are believed to exist within these upper deposits. The presence of the shale and clays is favourable in preventing contamination from surface source (such as septic field effluent) from entering lower aquifers.

3.3 Bedrock Geology

Wells in the area are likely completed within strata belonging to the Upper Lacombe Member of the Paskapoo Formation. The Upper Lacombe Member is comprised mostly of shale interbedded with sandstone. The target aquifers are sandstone channel deposits with shale overbank deposits acting as aquitards. When several sandstone channels are stacked on top of each other then an exceptional aquifer can be found, but often sufficient water is obtained from individual sandstone aquifers separated by shale units.

A cross section was constructed in Figure 4 using water well records from the area to show relative thickness of surficial quaternary deposits and depth to bedrock, as follows:

Figure 4: Geological Cross Section A-A'



Th new wells for the subdivision appear to be competed significantly deeper depth than those drilled previously. The site is underlain by numerous thick fluvial sandstones with apparent poor porosity. Care must be taken that interference effects are considered for the wells due to the close proximity of wells to each other and underlying strata consisting largely of shales and low permeability sandstones.

[4.0] Area Groundwater Users

[4.1] Non-licensed Water Users

The Alberta Environment and Parks (AEP) water well database lists 99 wells within a 1.6 km (1 mile) radius of the pumping well. Most of these wells are for domestic purposes, with 4 wells also dedicated to stock watering. Well depths range from 19 – 124 meters with most wells on the order of 35 – 78 m deep. Initial static water levels in the area range from 8 – 80 metres below the top of casing.

[4.2] Licensed Water Users

A search of the AEP water licence database was undertaken for the subject section and adjoining 8 sections to determine if any water licences are present in the area. A summary of groundwater licences and registrations in the area is as follows:

Table 1: Groundwater Licenses and Registrations

Location	Registrations	Licenses	Volume (m3/year)	Licensee
11 – 20 – 1W5	1	-	-	Robert Carr
14 – 20 – 1W5	1	-	-	Betty & Don Melvin
15 – 20 – 1W5	1	-	-	Little Rock Farm
23 – 20 – 1W5	1	-	-	James McGregor
24 – 20 – 1W5	2	-	-	Hidden Valley Investments Ltd. Joseph Drisdale & Edward Dorin

Licences for surface waters withdrawals were not included in the Table 1 summary. No licenses for groundwater use were found in the area. The groundwater use in the area can be described as low to moderate, consisting largely of residential acreage use.

[5.0] Pump test

[5.1] Supply Well Details

The production well was installed on site September 22nd , 2021 by personnel from Peter Niemans Water Well Drilling. 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 B.

Table 2: Water Well Supply Details

Well	Production Well
Well ID	1611126
GPS Location	50.693561° N, -114.026696 ° E
Well depth (m BGL[1])	73.2
Aquifer zone (m BGL[1])	44.2 – 68.6
Screened Interval (m BGL[1])	53.3 – 71.6
Surface Casing (m BGL[1])	16.8
Static water level after installation (m BGL[1])	30.54
NPWL (m BGL[1])	30.54

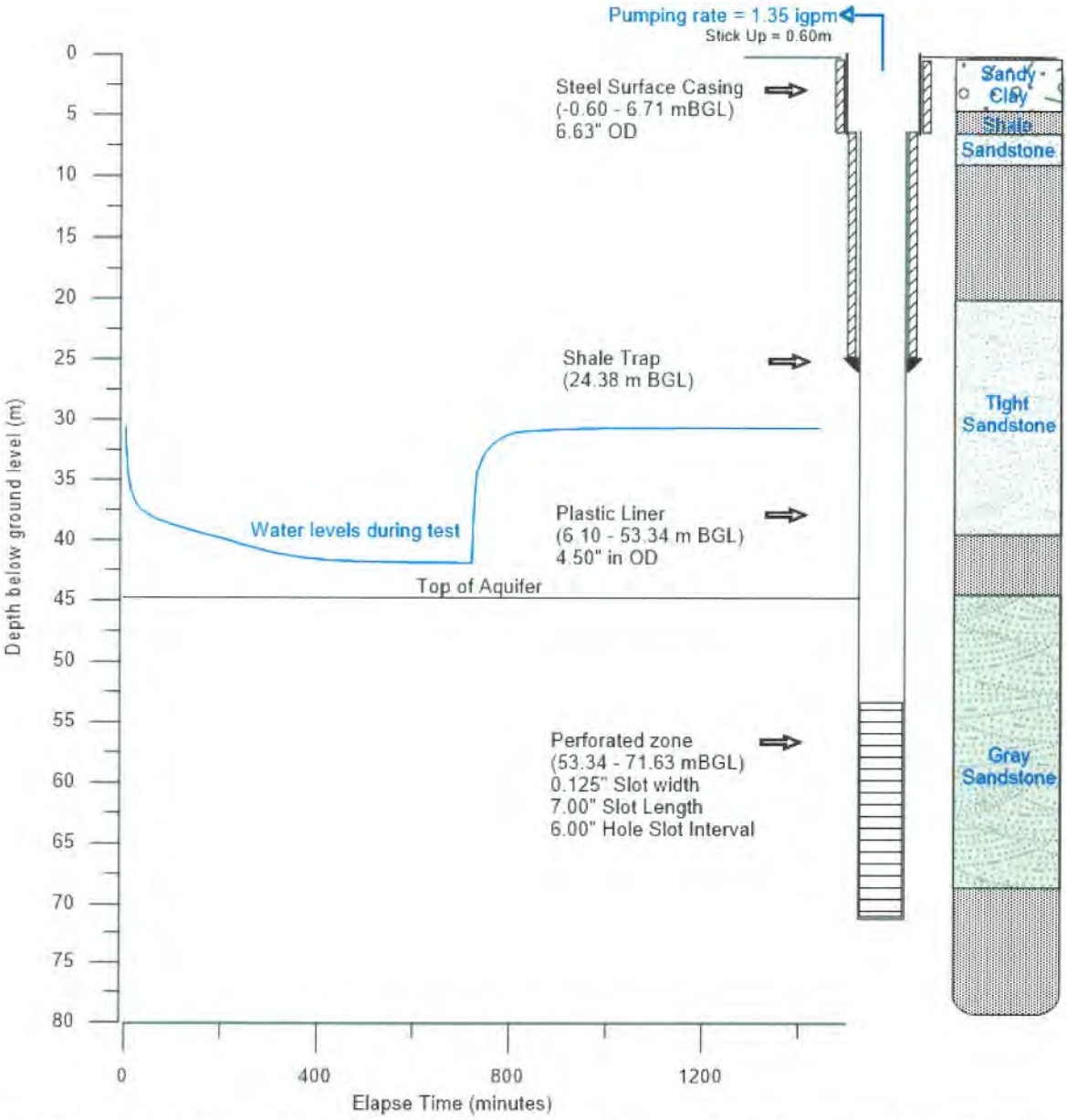
1. m BGL – metres below ground level

[5.2] Details of the Pumping Test

The pumping test was conducted September 24th, 2021 by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 1.35 imperial gallons per minute (igpm) or 6.13 liters per minute (L/min) for a period of 720 minutes. Water levels were measured for an additional 720 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 as follows:

Figure 5: Pumping Well Schematic and Water Levels During the Pumping Test

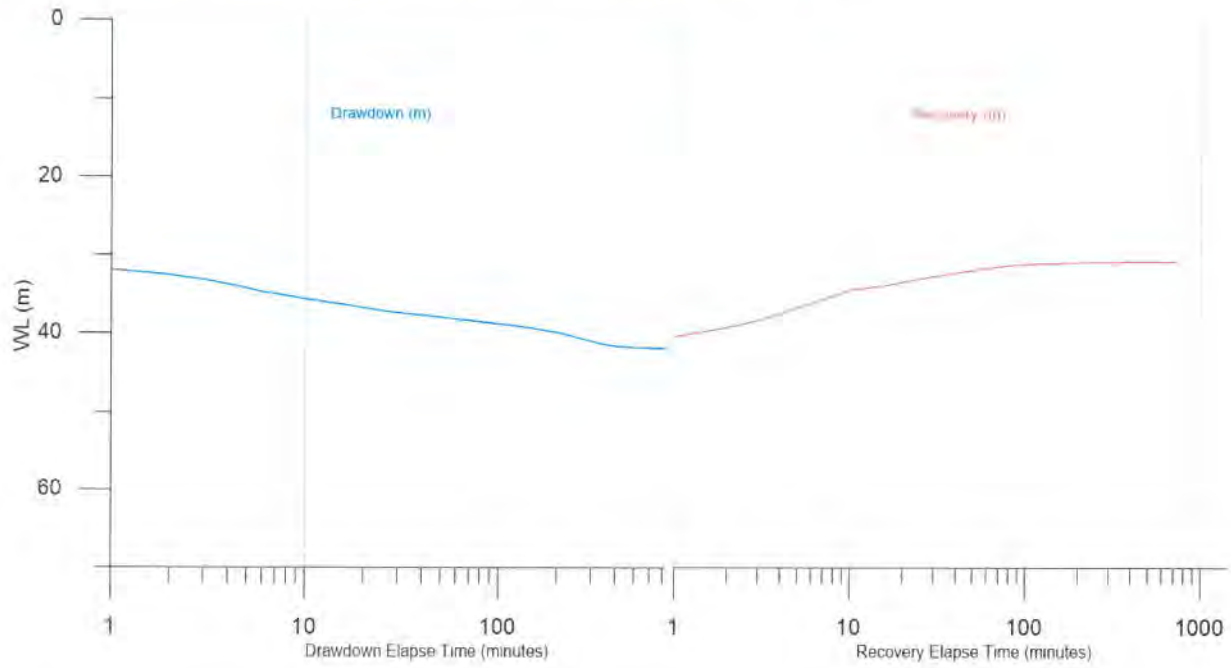


The well had an initial static water level of 30.68 metres below the top of the well casing (m BTOC) prior to pumping and drew down 11.19 metres by the end of the pumping period. Water levels had built up to 30.69 metres at the end of the recovery period to 99 % recovery.

5.3 Pumping Test Interpretation

A moderate productivity well is indicated by the water level and moderate drawdown throughout the pumping test given the low pumping rate. The aquifer is a confined and deep sandstone. A dual semi-log graph of the pumping test data is shown in Figure 6 to illustrate the water level data during the pumping test.

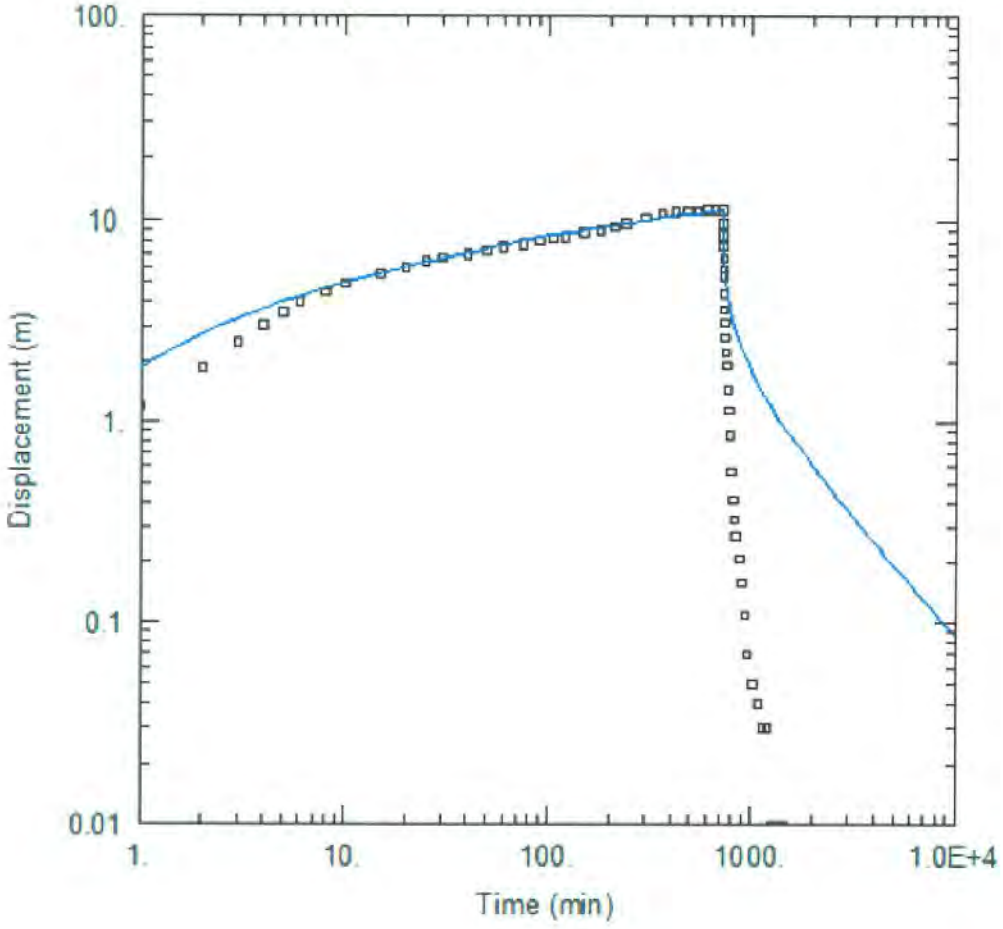
Figure 6: Dual Semi-log Graph of Drawdown and Recovery in the Pumping Well



The well had a relatively stable linear drawdown for the duration of the pumping test. no significant variance in drawdown is observed for the duration of the pumping period. No boundary effects are interpreted for the duration of the pumping test or changes in aquifer properties away form the well bore. The well recovers steadily following pumping cessation.

The pumping test data was interpreted with the aid of the AQTESOLV program developed by Hydrosoft Inc. The Theis solution was used for a confined aquifer with radial groundwater flow. A graph showing water level displacement with time and a fitted curve is as follows:

Figure 7: Theis Solution for Pumping Well



A conservative fit of the pumping test data to the solution is utilized. Indicating the calculated hydraulic parameters are appropriate and will not overestimate the aquifer productivity. A transmissivity of 0.75 m^2/day is calculated indicating a likely suitable well.

5.4 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:

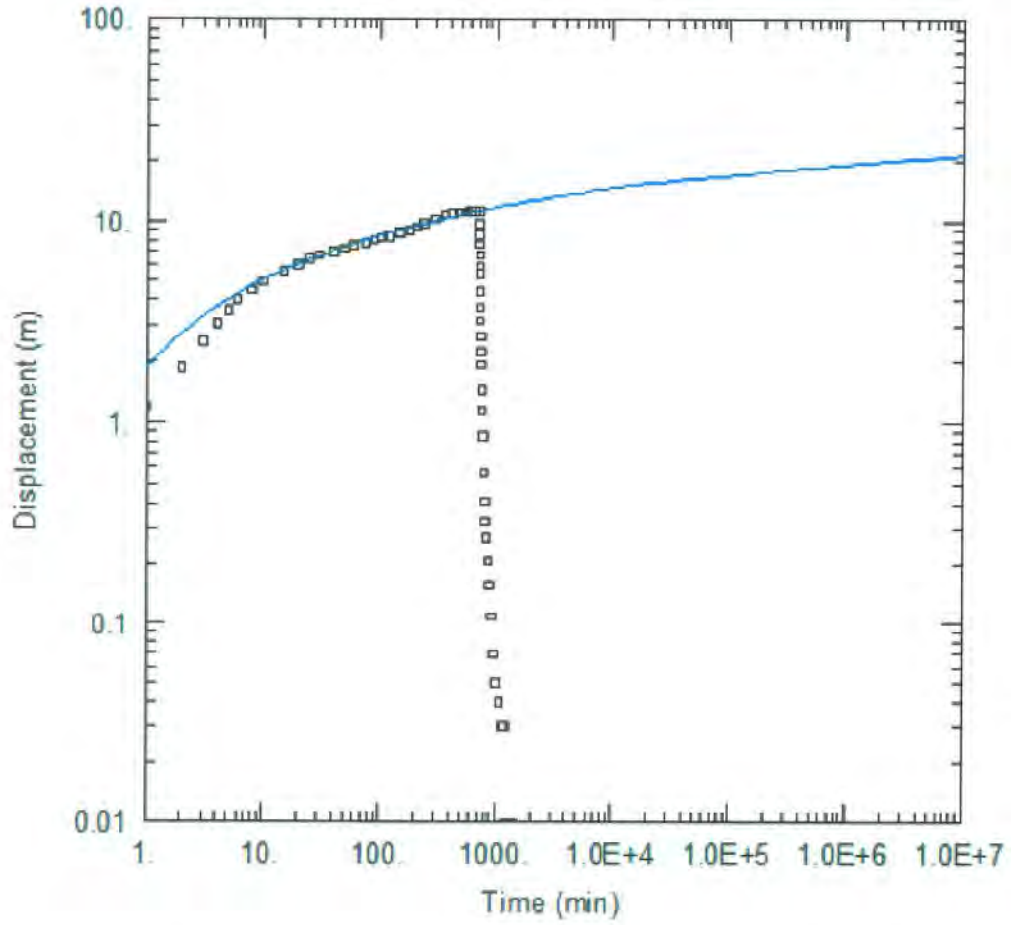
$$Q_{20} = \frac{(0.7 * Q * H_a)}{S_{100\text{min}} + (S_{20yrs} - S_{100th})}$$

Where:

Q	-	Pump test flow rate 8.83 m^3/day (flow rate or 6.13 litres/min)
H_a	-	Available Head = 13.52 m
$S_{100\ min}$	-	Observed drawdown at 100 minutes (m) = 8.2
$(S_{20yrs} - S_{100\ th})$	-	Difference between drawdown at 20 years and 100 min (20.9 m – 8.5 m = 12.4 m)
0.7	-	Safety factor

The theoretical 20 year drawdown is determined by extrapolating the Theis solution curve as follows:

Figure 8: Theis Solution Extrapolated to 20 years of pumping



Substituting in the above values a 20-year safe yield (Q_{20}) of 3.97 m^3/day (0.60 imperial gallons per minute or 1452.1 m^3/year) is calculated. The analysis indicates the well can supply the required 1,250 m^3/year to the domestic development.

[6.0] Effect on Water Levels

[6.1] Existing Users

Several of the wells in the proposed subdivision are completed in the same hydrostratigraphic zone. These wells are not in the same production aquifer due to fluvial internal heterogeneities but have similar depth of completion and water levels. Using the Cooper-Jacob equation the expected drawdown in the aquifer/hydrostratigraphic zone at various time and distances due to pumping from the subdivision can be calculated by the following formula:

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

Where

s	-	Drawdown (m)
S	-	Storativity (5.0×10^{-5})
Q	-	Max pump rate (3.42 m^3/day)
T	-	Transmissivity (0.75 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 3: Cooper-Jacob Distance Drawdown Calculation

Distance (m)	100	300	500	1000	1600	3000
Time (days)						
1	0.44	-	-	-	-	-
2	0.69	-	-	-	-	-
10	1.26	0.48	0.11	-	-	-
100	2.09	1.30	0.94	0.44	0.10	-
500	2.67	1.88	1.51	1.02	0.68	0.23
1000	2.92	2.13	1.76	1.26	0.93	0.48
7300	3.63	2.84	2.48	1.98	1.64	1.19

The following assumptions were included in the above calculation: A conservative storativity value of 5.0×10^{-5} for a confined sandstone aquifer; a continuous consumption rate of 3.4 m^3/day for the lot; transmissivity as determined from the pumping tests of 0.75 m^2/day; 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 from

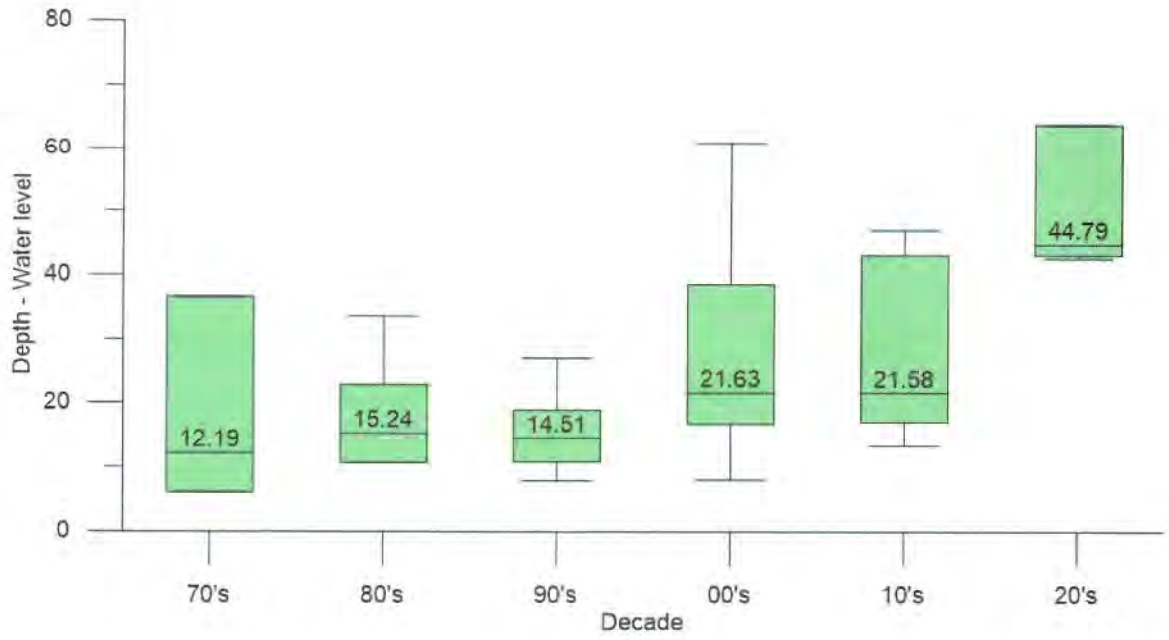
the subdivision will experience in additional drawdown will be on the order of three (3) meters over a 20-year pumping period.

There are several wells in the subdivision completed at a similar depth interval. The nearest wells are located roughly ~120 metres to ~200 metres away form the other supply wells. based on the above table the neighboring wells may experience an additional ~2.5 to 3 metres of drawdown at the full water allocation, actual water usage is expected to be one half to one third of the entitled 1,250 m^3. The supply well is interpreted to be completed in a separate aquifer than those completed in the subdivision to the south, these wells have available hydraulic head on the order of 30-45 meters indicating the additional drawdown should not be a concern if it is to occur.

6.2 Changes in Water Levels vs Time

Initial static water levels and depths were collected for every well completed within a one-mile radius form the new subdivision. Although there is significant variance in aquifer thicknesses, depths and hydrostratigraphic zones, the initial water level was subtracted from the well depth to produce an approximation of aquifer hydraulic head (pressure). The plot shows the completion date by decade vs approximate hydraulic head for all the wells within a 1-mile radius.

Figure 9: Whisker plot of Approximate Hydraulic Head After Well Installation



There is a large variance in initial heads, with slight apparent increase visible to demonstrate rising aquifer pressures. The above diagram shows there is no indication the area is severely over utilized with respect to groundwater diversions. However, the increase is likely due to several recent wells drill on the subject site that target deeper aquifers with higher hydraulic heads.

[7.0] Water Quality

A water sample was collected towards the end of the pumping portion of the test for analysis of routine dissolved salts and bacterial parameters. The lab report is not available at the time of writing of this report but the analysis should be reviewed prior to use of the groundwater from the well as a drinking water source.

References

Alberta Environment Guide to Groundwater Authorization, Government of Alberta, 2011, Available: https://open.alberta.ca/dataset/d399d059-d8b6-4c46-9ff2-ef39f359943a/resource/2f385374-2521-4252-8e46-4b51e61c1e41/download/5612701-2013-alberta-environment-guide-groundwater-authorization.pdf

Alberta Environment and Parks. 2019c. Alberta Water Well Information Database. Available: http://groundwater.alberta.ca/WaterWells/d/

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. Available: http://www.ags.gov.ab.ca/publications/MAP/PDF/MAP_600.PDF

Geological Survey of Canada, 1998. Surficial Geology – Turner Valley, Alberta. GSC Map 1925A, Jackson.

Appendix A – Water Well Drilling Report

Water Well Drilling Report

View in Metric

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.

GIC Well ID 1611126
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2021/10/14

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
SHEEDY, COLIN		OKOTOKS	ALBERTA	CANADA	

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	8	14	20	1	5	2			NEW SUBDIVISION 2ND LOT FROM THE NORTH

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.693932 Longitude -114.026357
How Location Obtained
Map

Elevation ft
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary - Air

Proposed Well Use
Domestic

Type of Work
New Well

Formation Log

Measurement in Imperial

Depth from ground level (ft)	Water Bearing	Lithology Description
3.00		Brown Topsoil
15.00		Brown Sandy Clay
22.00		Brown Shale
26.00		Brown Sandstone
65.00		Gray Shale
130.00		Gray Tight Sandstone
145.00		Gray Shale
225.00	Yes	Gray Sandstone
240.00		Gray Shale

Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 2.00 igpm

Test Date	Water Removal Rate (igpm)	Static Water Level (ft)
2021/09/23	1.85	100.19

Well Completion

Measurement in Imperial

Total Depth Drilled	Finished Well Depth	Start Date	End Date
240.00 ft	240.00 ft	2021/09/21	2021/09/22

Borehole

Diameter (in)	From (ft)	To (ft)
6.00	0.00	240.00

Surface Casing (if applicable)
Steel
Size OD : 6.63 in
Wall Thickness : 0.189 in
Bottom at : 22.00 ft

Well Casing/Liner
Plastic
Size OD : 4.50 in
Wall Thickness : 0.237 in
Top at : 20.00 ft
Bottom at : 240.00 ft

Perforations

From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)
175.00	235.00	0.125	7.00	6.00

Perforated by Saw

Annular Seal Bentonite Granular
Placed from 0.00 ft to 80.00 ft
Amount 4.00 Bags

Other Seals

Type	At (ft)
Drive Shoe	22.00
Shale Trap	80.00

Screen Type
Size OD : in

From (ft)	To (ft)	Slot Size (in)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
DOUG NIEMANS

Certification No
70092A

Company Name
PETER NIEMANS WATER WELL DRILLING

Copy of Well report provided to owner
Yes

Date approval holder signed
2021/10/14

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 Metric

GIC Well ID 1611126
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2021/10/14

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
SHEEDY, COLIN		OKOTOKS	ALBERTA	CANADA	

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	8	14	20	1	5	2			NEW SUBDIVISION 2ND LOT FROM THE NORTH

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.693932 Longitude -114.026357
How Location Obtained
Map

Elevation ft
How Elevation Obtained
Not Obtained

Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level 23.00 in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate 2.00 igpm
Recommended Pump Intake Depth (From TOC) 220.00 ft
Pump Installed 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 Yes
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability Yes Submitted to ESRD

Additional Comments on Well

WELL SUITABLE FOR DOMESTIC USE AND CONSISTENT WITH THE SURROUNDING AREA. FLOW TESTED FOR 2 HOURS AND FOR 12 HOURS FOR Q20 SUBMITTED TO KEN HUGO.

Yield Test

Taken From Top of Casing
Depth to water level

Measurement in Imperial

Test Date 2021/09/23
Start Time 11:00 AM
Static Water Level 100.19 ft

Method of Water Removal
Type PUMP
Removal Rate 1.85 igpm
Depth Withdrawn From 230.00 ft

If water removal period was < 2 hours, explain why

Pumping (ft)	Elapsed Time Minutes:Sec	Recovery (ft)
100.20	0:00	139.53
109.15	1:00	134.61
109.74	2:00	131.10
110.53	3:00	128.12
111.32	4:00	125.33
112.11	5:00	122.80
112.93	6:00	121.06
113.75	7:00	119.42
114.44	8:00	117.88
115.09	9:00	116.31
115.72	10:00	115.32
116.96	12:00	113.52
118.11	14:00	112.24
119.23	16:00	111.19
120.28	18:00	110.24
121.33	20:00	109.51
123.52	25:00	108.20
125.66	30:00	106.92
127.66	35:00	105.64
129.27	40:00	104.49
131.56	50:00	103.18
133.56	60:00	102.53
135.99	75:00	102.20
137.60	90:00	101.90
138.85	105:00	101.71
139.53	120:00	101.54

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
NW 21-18-28 W4	1200.00	ig	2021/09/21 8:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
DOUG NIEMANS

Certification No
70092A

Company Name
PETER NIEMANS WATER WELL DRILLING

Copy of Well report provided to owner
Yes

Date approval holder signed
2021/10/14

PETER NIEMANS WATER WELL CO.

403.652.6602 www.PNWWD.com

FLOW TEST REPORT

WATER LEVELS IN WELL DURING / AFTER PUMPING

PUMPING LEVEL (m)	MINUTES	RECOVERY LEVEL (m)
30.68	0	41.87
31.87	1	40.32
32.55	2	39.16
33.19	3	38.24
33.74	4	37.41
34.25	5	36.61
34.71	6	36.09
35.19	8	35.13
35.64	10	34.35
36.24	15	33.85
36.73	20	33.35
37.13	25	32.91
37.38	30	32.61
37.69	40	32.13
37.94	50	31.83
38.21	60	31.54
38.44	75	31.25
38.65	90	31.09
38.84	105	31.01
39.02	120	30.95
39.36	150	30.89
39.68	180	30.84
39.97	210	30.79
40.37	240	30.75
40.99	300	30.73
41.44	360	30.72
41.67	420	30.71
41.76	480	30.71
41.81	540	30.69
41.84	600	30.69
41.86	660	30.69
41.87	720	30.69

PROJECT: COLIN SHEEDY SUBDIVISION
NAME: COLIN SHEEDY
LOCATION: LOT 2 (2ND LOT FROM NORTH)
WATER OUTLET: MOBILE PUMP
WATER REMOVAL RATE: 1.35 IGPM
APPROX. MAX. REMOVAL:
Pumping level is pump ON. Recovery is OFF.

Latitude 50.693932 Longitude -114.026357

ODOR: NO
COLOUR: CLEAR
SEDIMENT: NO
PUMP DEPTH: 230 FEET
WELL DEPTH: 240 FEET
PRESSURE TANK: N/A
FILTRATION: N/A
CISTERN: N/A
COMMENTS:

$S_{20} = 20.94$

$S_{100\,min} = 8.15$

$S_{avg} = 9.16$

Well tested by: Doug Niemans
Date: SEPT 24 2021
This well at the time it was tested is suitable for typical domestic use.

Appendix B – AEP Water Well Database Search Results

Alberta

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)
349976	SE	14	20	1	5	AARON DRILLING INC.	1997-04-07	26.82	New Well	Domestic		23	17	NATTRESS, FLOYD	18.99	18.18	16.81
349976	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2000-10-14	92.96	Deepened	Domestic		16		FERGIE, MARG			16.81
354322	SE	14	20	1	5	KRIEGER DRILLING LTD.	1989-08-17	59.44	New Well	Domestic		12		NATTRASS, FLOYD	48.77		16.81
354322	SE	14	20	1	5	KRIEGER DRILLING LTD.	1989-08-17	59.44	New Well	Domestic		12	24	NATTRASS, FLOYD	47.24	27.28	16.81
359985	SE	14	20	1	5	KRIEGER DRILLING LTD.	1989-04-19	89.00	New Well	Domestic		23		NATTRASS, FLOYD	73.15	36.37	16.81
380544	8	14	20	1	5	DEN-ALTA DRILLING LTD.	1976-12-14	47.24	Reconditioned	Domestic & Stock		3		WATHER, HARRY	12.19	36.37	14.12
380546	SE	14	20	1	5	INTERPROVINCIAL DRILLING CONTRACTORS	1985-10-24	76.20	New Well-Decommissioned	Unknown		12		ENDERSBY, JACK	30.48	1.14	0.00
380548	SE	14	20	1	5	INTERPROVINCIAL DRILLING CONTRACTORS	1985-10-15	60.96	New Well-Decommissioned	Unknown		10		ENDERSBY, JACK	30.48	1.14	0.00
380551	SE	14	20	1	5	INTERPROVINCIAL DRILLING CONTRACTORS	1985-12-10	65.53	New Well	Stock		8	3	ENDERSBY, JACK	32.00	45.46	16.81
1021990	1	14	20	1	5	AARON DRILLING INC.	2010-09-14	28.96	New Well	Domestic		7	26	FERGIE, CARL	15.09	27.28	16.81
1555708	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-08-02	85.34	Test Hole-Decommissioned	Domestic		21		ENERSBY, JACK			
1555709	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-08-01	91.44	Test Hole-Decommissioned	Domestic		13		ENERSBY, JACK			
1555741	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-08-15	91.44	New Well	Domestic		23	27	MEIER, JACK	49.78	34.10	16.83
1555742	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-09-23	67.06	New Well	Domestic		10	27	ENDERSBY, JACK	47.58	11.37	16.83
1555802	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-09-21	73.15	New Well-Decommissioned	Domestic		17		ENDERSBY, JACK			
1556167	2	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2010-08-09	36.58	New Well	Domestic		11	28	ENDERSBY, JACK	15.84	5.46	16.84
1556167	2	14	20	1	5	NIEMANS DRILLING (1980) LTD.			New Well	Domestic				ENDERSBY			
1611033	2	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2019-03-15	102.11	New Well	Domestic		11	26	SHEEDY, COLIN	59.05	14.55	16.84
1611034	2	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2019-03-09	96.01	New Well	Domestic		11	26	SHEEDY, COLIN	63.75	7.73	16.84
1611035	2	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2019-03-11	96.01	New Well	Domestic		11	26	SHEEDY, COLIN	49.02	5.46	16.84

Alberta

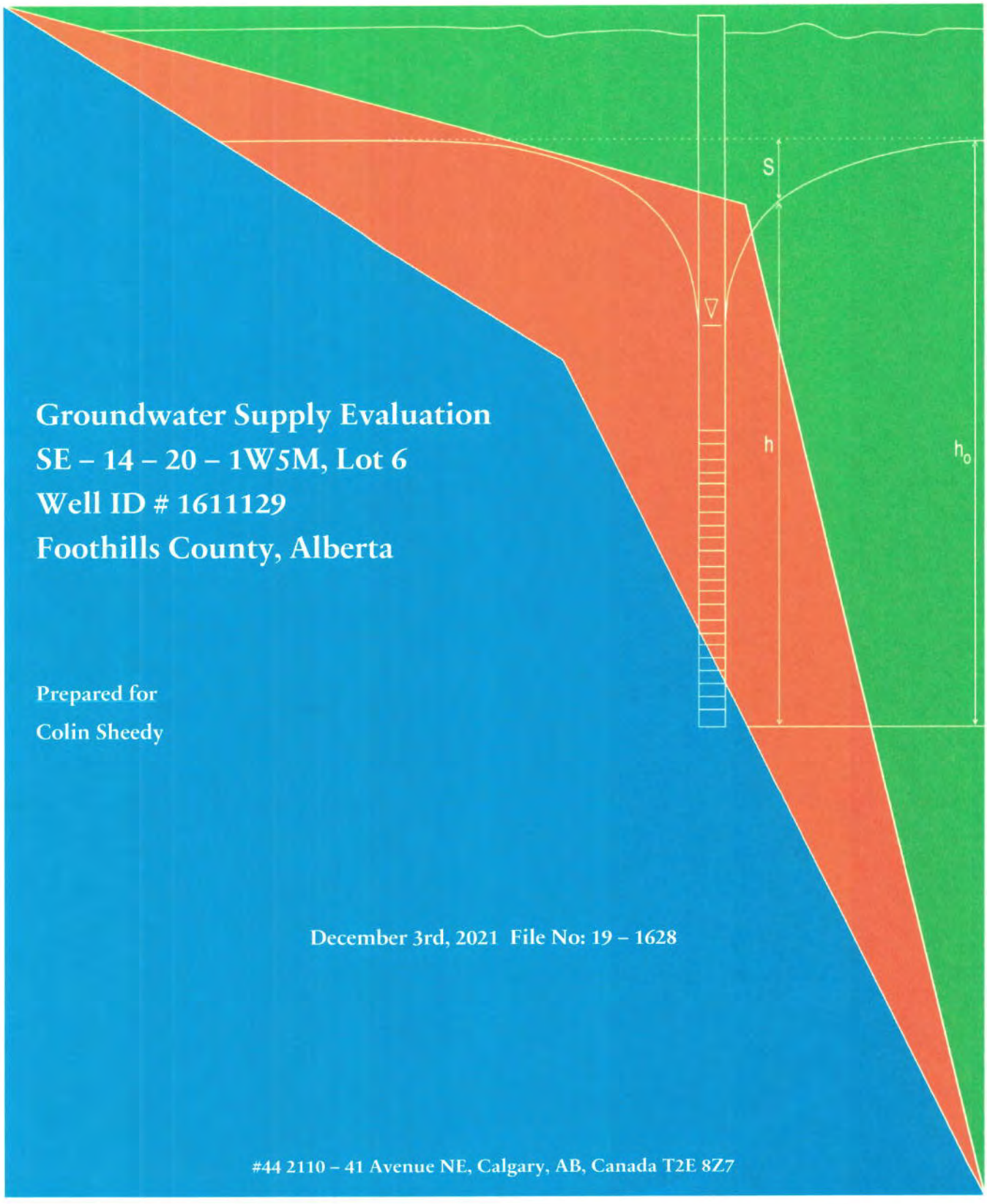
Reconnaissance Report

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)
1611126	8	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2021-09-22	73.15	New Well	Domestic		9	26	SHEEDY, COLIN	30.54	8.41	16.84
1611127	8	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2021-09-23	89.92	New Well	Domestic		13	26	SHEEDY, COLIN	43.42	8.18	16.84
1611128	1	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2021-09-25	96.01	New Well	Domestic		13	26	SHEEDY, COLIN	32.15	8.86	16.76

Groundwater Resources
Information Technologies Ltd.



Groundwater Supply Evaluation
SE – 14 – 20 – 1W5M, Lot 6
Well ID # 1611129
Foothills County, Alberta

Prepared for
Colin Sheedy

December 3rd, 2021 File No: 19 – 1628

#44 2110 – 41 Avenue NE, Calgary, AB, Canada T2E 8Z7

Signatures

Prepared by:

Ken Hugo, P.Geol
Senior Hydrogeologist
APEGA P15289

Disclaimer

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Executive Summary

A pumping test was undertaken on a newly installed water well within a proposed subdivision in SE – 14 – 20 – 1W5 to determine if the aquifer underlying the site can provide water at a sustained rate of at least 3.4 m^3/day, for an annual volume as defined in the *Water Act*, of 1,250 m^3.

The well obtains its water from a bedrock sandstone aquifer at depths of 51.2 – 64.0 meters below ground. No direct connection with surface water is believed to be present and clays and shales overlying the aquifer should aid in preventing surface water contaminants, such as septic field effluents, from migrating to the aquifer.

The pumping test was conducted on the well on November 21, 2021, by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 2.4 imperial gallons per minute for a period of 720 minutes. Water levels were measured for an additional 300 minutes following pumping cessation.

A 20-year safe yield of 1.1 imperial gallons per minute or 2650 m^3/year of water is calculated from the pumping test and well completion data. This value is more than the 1,250 m^3 of water per year as required by the *Water Act* and shows the well can supply the necessary amount of water.

No adverse effects to existing domestic, licensed or traditional agricultural groundwater users should result due to production of water from this well for domestic purposes.

It is recommended that a water sample be collected from the well and analyzed for routine dissolved salts and bacterial content prior to using the water as a potable source.

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APPENDIX

Appendix A – Site Maps and Air Photos

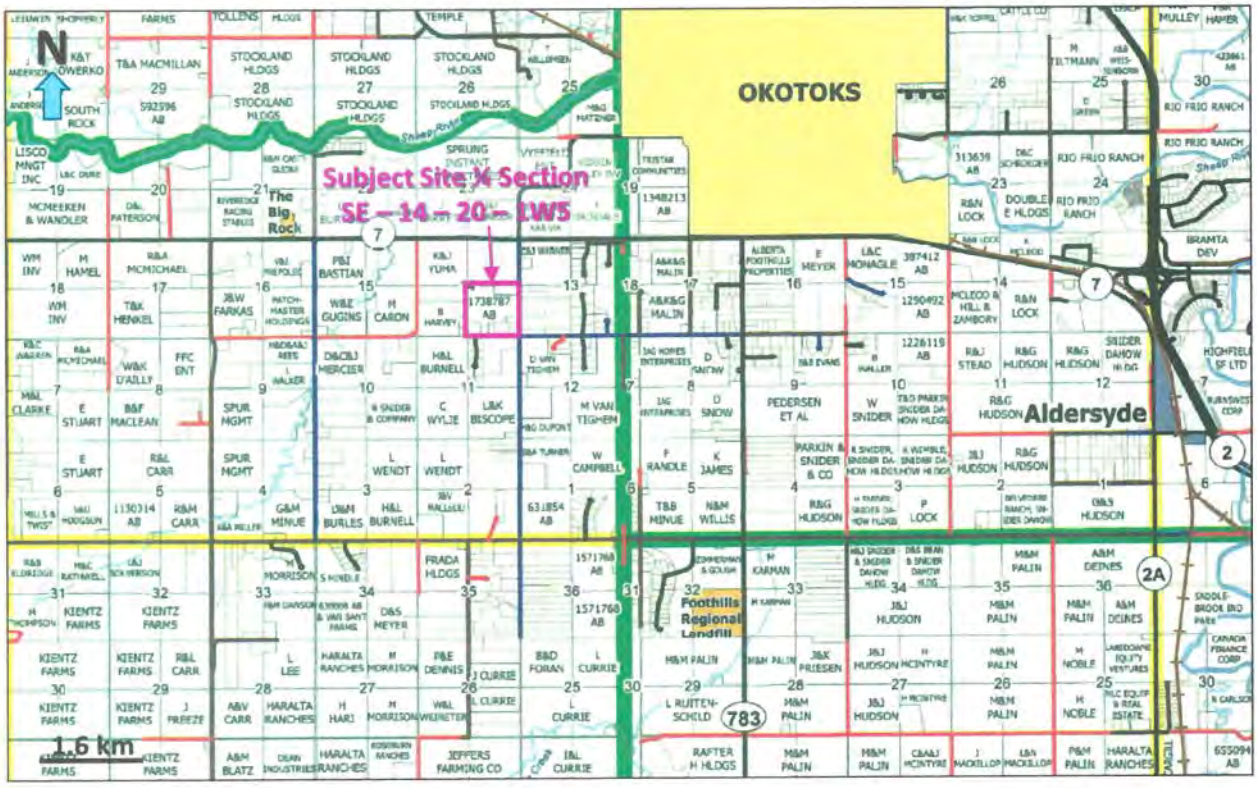
Appendix B – Water Well Drilling Report , Well 1611129

[1.0] Introduction

An aquifer analysis was undertaken for a residential supply well located on a proposed 3.98-acre parcel subdivision in the SE quarter section of 14 – 20 – 1W5 to determine if the well could provide water at a rate of 1,250 m^3/year without causing adverse effects to existing groundwater users.

The site is located within the Municipal District of Foothills No. 31. A portion of Foothills MD landownership map showing the site ¼ section location is as follows:

Figure 1: MD Foothills land Ownership Map and Quarter Section Site Location



The proposed 3.98-acre subdivision will be supplied by an individual well located on the parcel. This report is to determine whether a newly installed well (GIC Well ID 1611129) on the proposed subdivision is capable of supplying water to a residence.

The location of the well was measured by personnel from Peter Niemans Water Well Co. and is at: 50.692746° N, -114.027559° E. A well was previously installed and tested in October of 2021 (Well ID 161127) but analysis of this pumping test showed that the well was not capable of supplying

sufficient quantities of water. This well was decommissioned as part of the well replacement program.

A site plan of the proposed subdivision showing the well locations is as follows:

Figure 2: Air-photo and Quarter Section Location

Additional subdivision boundary information is included in Appendix A.

[2.0] Water well supply needs

The well is proposed to be for a single lot residential use. According to the *Water Act* each residential lot is entitled to water at a rate of 1,250 m^3 annually.

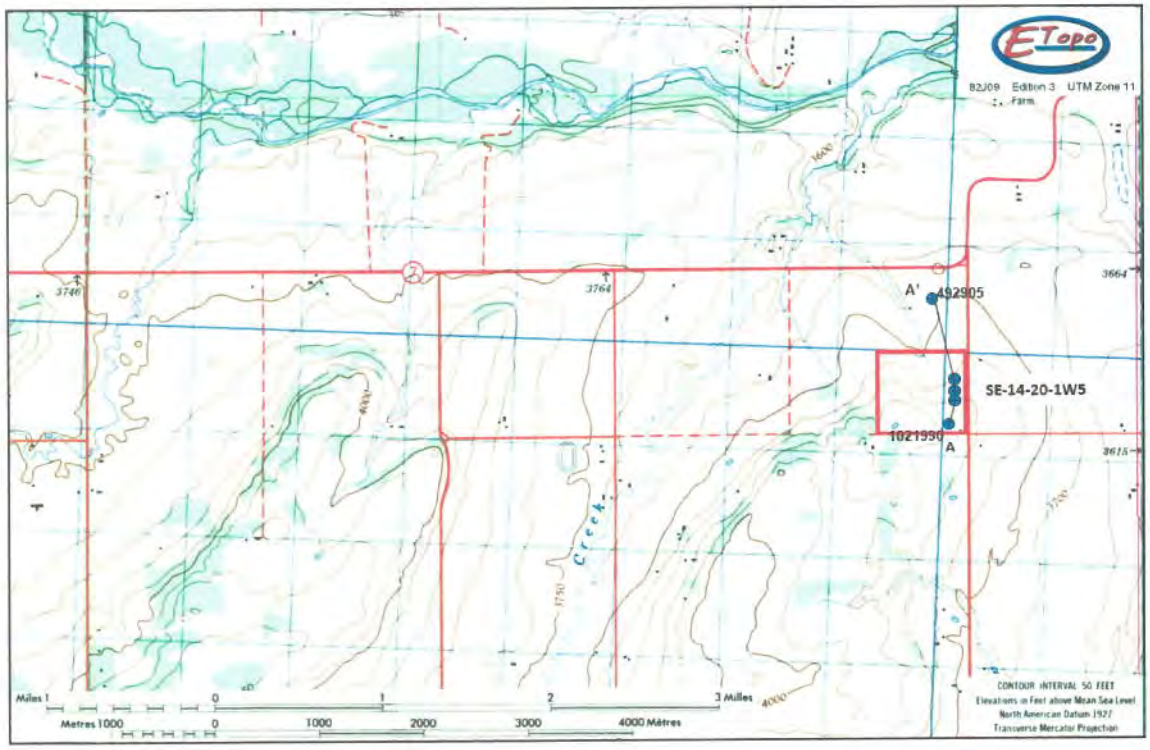
[3.0] Site Description

[3.1] Topography

The site is located 3.6 km southwest of the Town of Okotoks and is in a mixed residential and agricultural area with a low density of residential acreages scattered around the site and within the subject site quarter section.

The site is located at an approximate elevation of 1,170 meters above sea level. The Sheep River is located 2.9 km north of the site and is at an approximate elevation of 1,070 meters asl, or 100 meters below the site. Spring Creek is located 2.1 km west of the site and is at an elevation of 1,110 meters asl, or 60 meters below the site. A topographic map with the subject site quarter section is shown as follows:

Figure 3: Topographic Map with Quarter Section Location



3.2 Surficial Geology

According to the Geological Survey of Canada Map 1925A - Surficial Geology, Turner Valley, Alberta (Jackson, 1998) the area is interpreted to be a rolling till plain of approximately 5 – 6 meters of silt and clay till of even thickness. Minor amounts of water-sorted material and bedrock exposures are found locally with some areas of undifferentiated sub glacially molded deposits exhibiting streamlined features. Topography is flat to undulating, reflecting the surface of the underlying bedrock and other deposits.

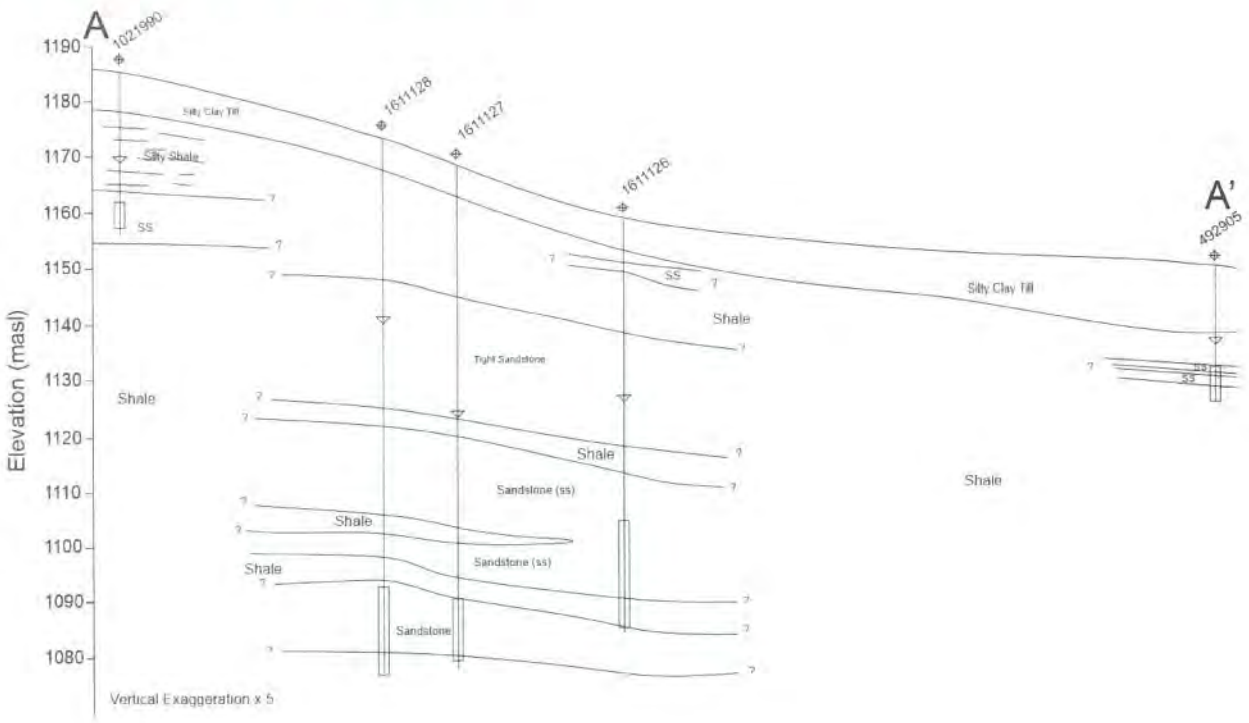
According to area Water Well Drillers Reports the surficial sediments, consisting of clay till, are approximately 5 to 7 meters thick and underlain by sandstone and shale bedrock. No useable aquifers are believed to exist within these upper deposits. The presence of the shale and clays is favourable in preventing contamination from surface source (such as septic field effluent) from entering lower aquifers.

3.3 Bedrock Geology

Wells in the area are likely completed within strata belonging to the Upper Lacombe Member of the Paskapoo Formation. The Upper Lacombe Member is comprised mostly of shale interbedded with sandstone. The target aquifers are sandstone channel deposits with shale overbank deposits acting as aquitards. When several sandstone channels are stacked on top of each other then an exceptional aquifer can be found, but often sufficient water is obtained from individual sandstone aquifers separated by shale units.

A cross section was constructed in Figure 4 using water well records from the area to show relative thickness of surficial quaternary deposits and depth to bedrock, as follows:

Figure 4: Geological Cross Section A-A'



The new wells for the subdivision appear to be competed significantly deeper depth than those drilled previously. The site is underlain by numerous thick fluvial sandstones with apparent poor porosity. Care must be taken that interference effects are considered for the wells due to the close proximity and underlying geology.

[4.0] Area Groundwater Users

[4.1] Non-licensed Water Users

The Alberta Environment and Parks (AEP) water well database lists 99 wells within a 1.6 km (1 mile) radius of the pumping well. Most of these wells are for domestic purposes, with 4 wells also dedicated to stock watering. Well depths range from 19 – 124 meters with most wells on the order of 35 – 78 m deep. Initial static water levels in the area range from 8 – 80 metres below the top of casing.

(4.2) Licensed Water Users

A search of the AEP water licence database was undertaken for the subject section and adjoining 8 sections to determine if any water licences are present in the area. A summary of groundwater licences and registrations in the area is as follows:

Table 1: Groundwater Licenses and Registrations

Location	Registrations	Licenses	Volume (m3/year)	Licensee
11 – 20 – 1W5	1	-	-	Robert Carr
14 – 20 – 1W5	1	-	-	Betty & Don Melvin
15 – 20 – 1W5	1	-	-	Little Rock Farm
23 – 20 – 1W5	1	-	-	James McGregor
24 – 20 – 1W5	2	-	-	Hidden Valley Investments Ltd. Joseph Drisdale & Edward Dorin

Licences for surface waters withdrawals were not included in the Table 1 summary. No licenses for groundwater use were found in the area.

The groundwater use in the area can be described as low to moderate, consisting largely of residential acreage use.

[5.0] Pump test

[5.1] Supply Well Details

The production well was installed on site on November 21 , 2021 by personnel from Peter Niemans Water Well Drilling. 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 A.

Table 2: Water Well Supply Details

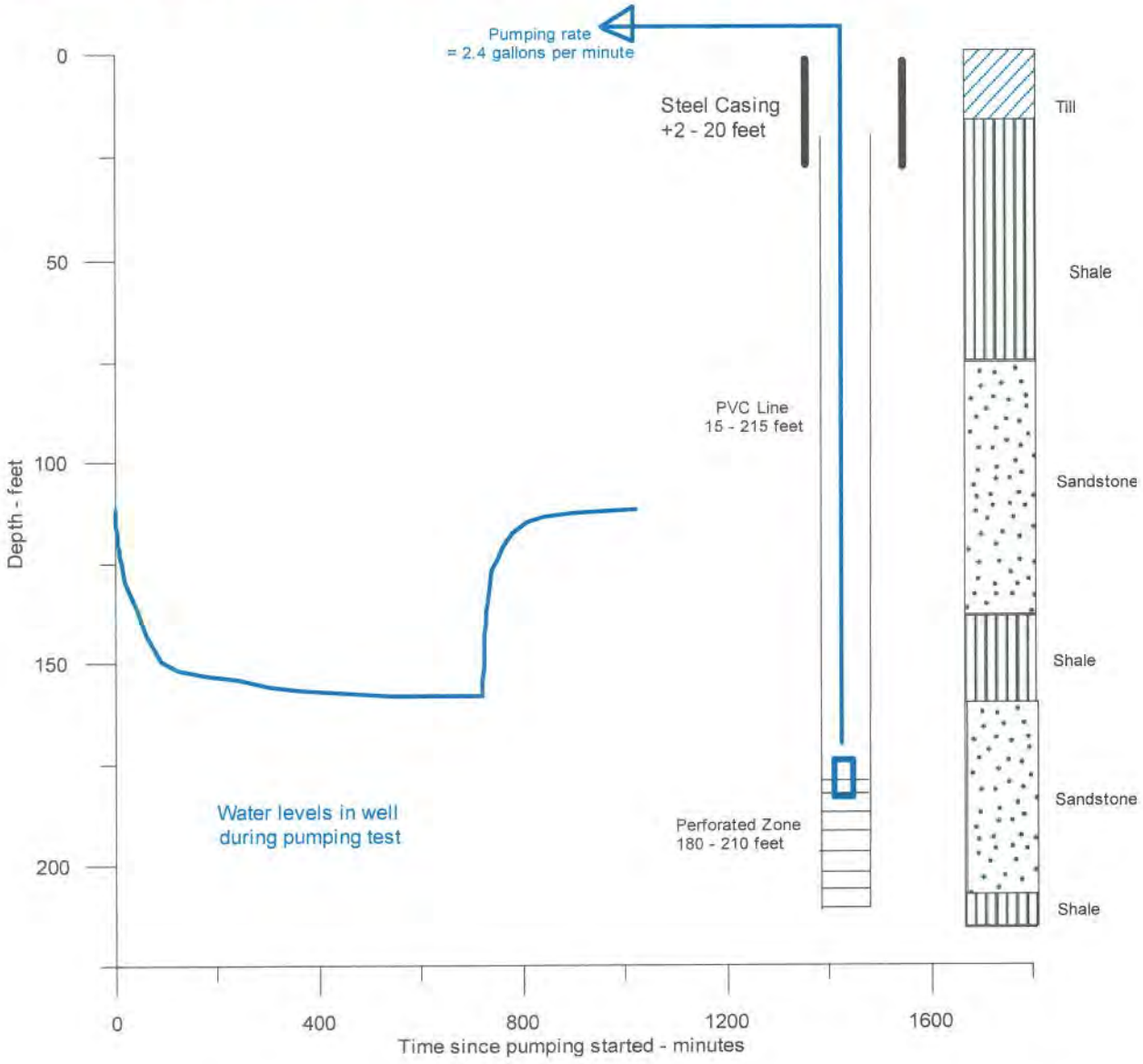
Well	Production Well
Well ID	1611129
GPS Location	50.692746° N, -114.027559 ° E
Well depth (m BGL[1])	65.5
Aquifer zone (m BGL[1])	51.2 – 64.0
Screened Interval (m BGL[1])	54.9 – 64.0
Surface Casing (m BGL[1])	6.1
Static water level after installation (m BGL[1])	34.15
NPWL (m BGL[1])	34.15
1. m BGL – metres below ground level	

[5.2] Details of the Pumping Test

The pumping test was conducted November 21, 2021, by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 2.40 imperial gallons per minute (igpm) or 10.9 liters per minute (L/min) for a period of 720 minutes. Water levels were measured for an additional 300 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 as follows:

Figure 5: Pumping Well Schematic and Water Levels During the Pumping Test

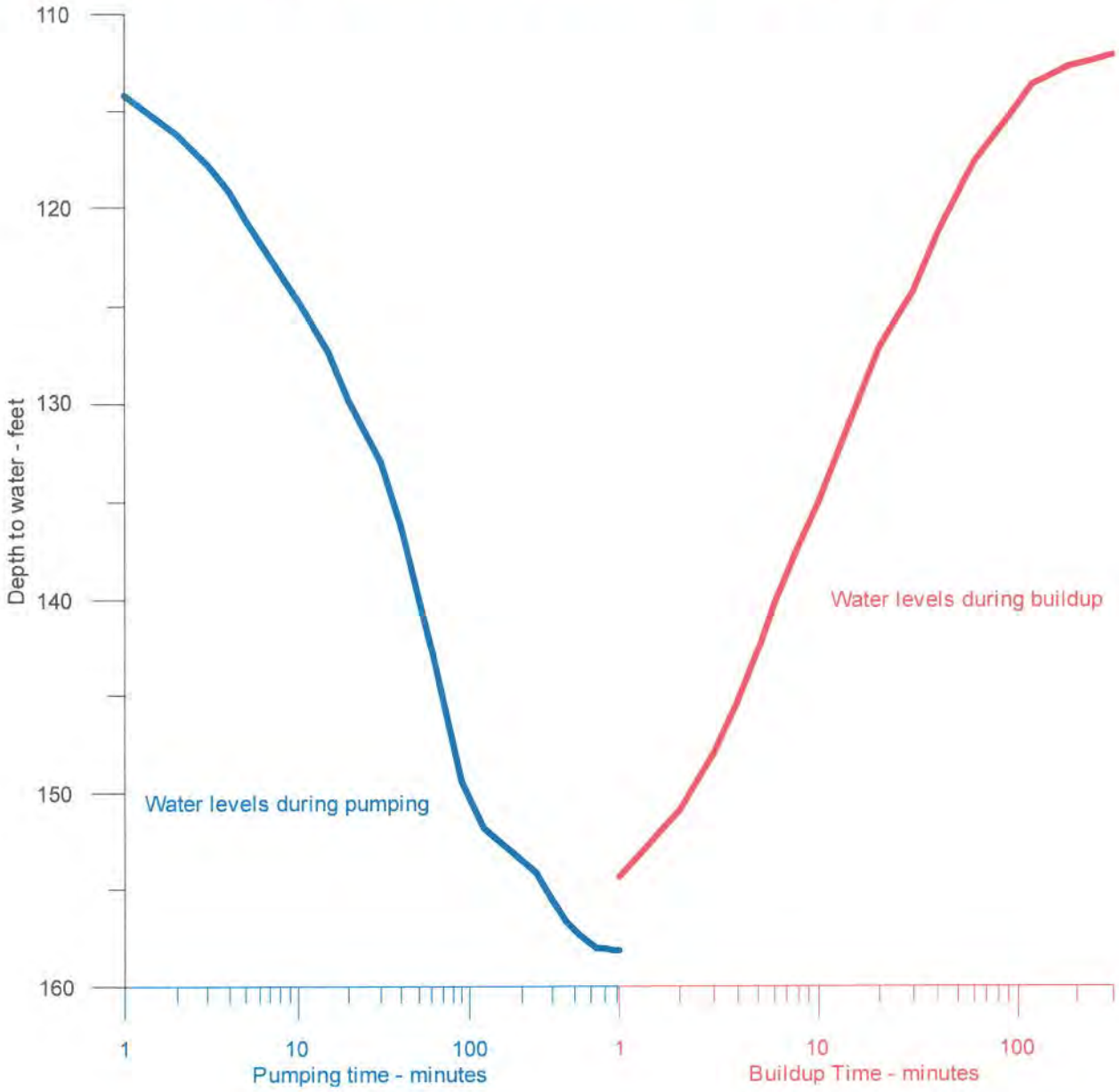


The well had an initial static water level of 34.14 metres below the top of the well casing (m BTOC) prior to pumping and drew down 14.06 metres by the end of the pumping period. Water levels had built up to 34.15 metres at the end of the recovery period to 99 % recovery.

[5.3] Pumping Test Interpretation

A moderate to low productivity well is indicated by the moderate drawdown throughout the pumping test given the low pumping rate. The aquifer is a confined and deep sandstone. A dual semi-log graph of the pumping test data is shown in Figure 6 to illustrate the water level data during the pumping test.

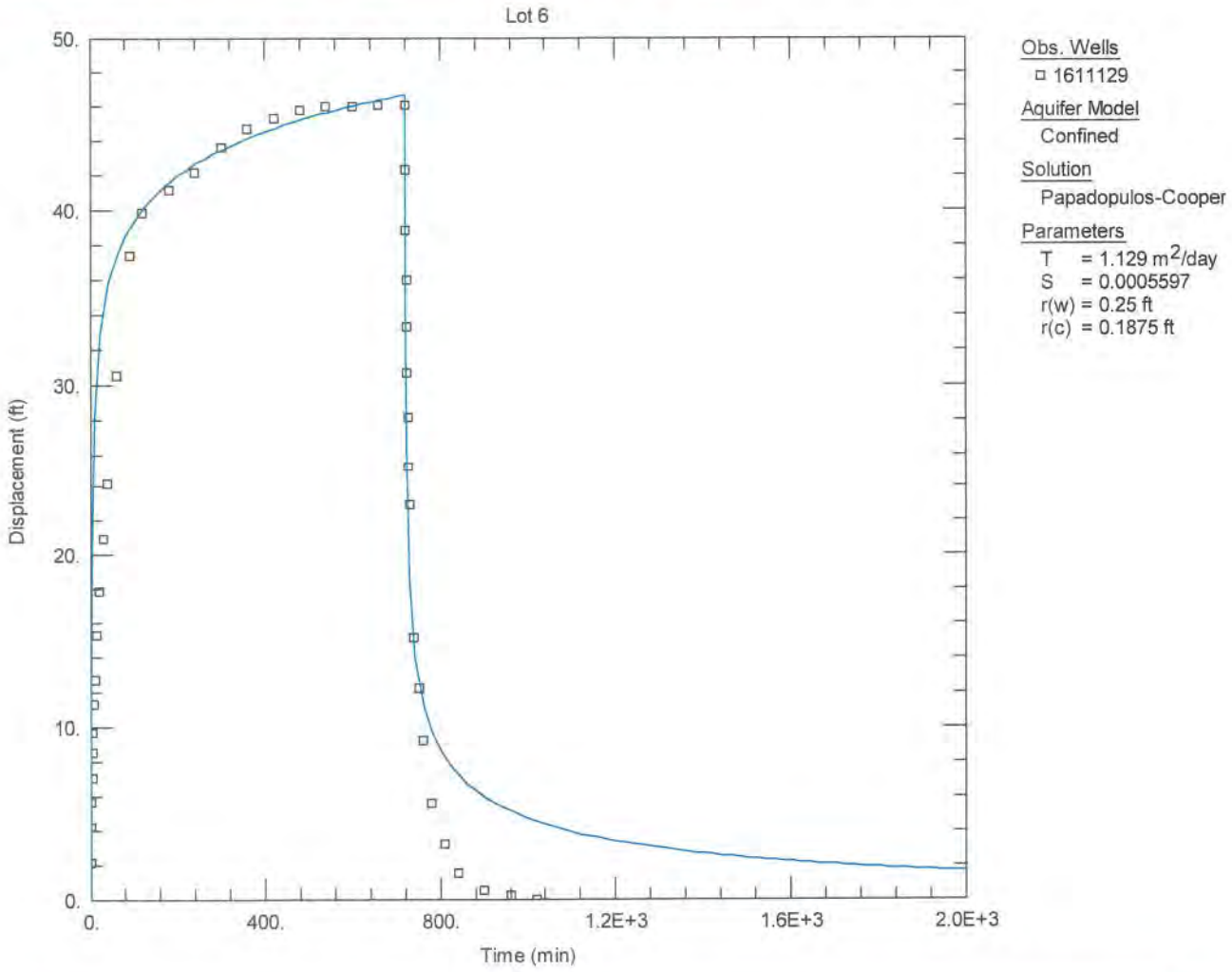
Figure 6: Dual Semi-log Graph of Drawdown and Recovery in the Pumping Well



The well had a relatively stable linear drawdown for the duration of the pumping test with a slight decrease in slope towards the end of the test indicating that the aquifer conditions were improving away from the well bore. No boundary effects are interpreted for the duration of the pumping test or changes in aquifer properties away form the well bore. The well recovers steadily following pumping cessation.

The pumping test data was interpreted with the aid of the AQTESOLV program 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 curve is as follows:

Figure 7: Papadopulos-Cooper Solution for Pumping Well



A good fit of the pumping test data to the solution is utilized indicating the calculated hydraulic parameters are appropriate and will not overestimate the aquifer productivity. A transmissivity of 1.13 m^2/day is calculated indicating moderate to low permeability well.

5.4 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:

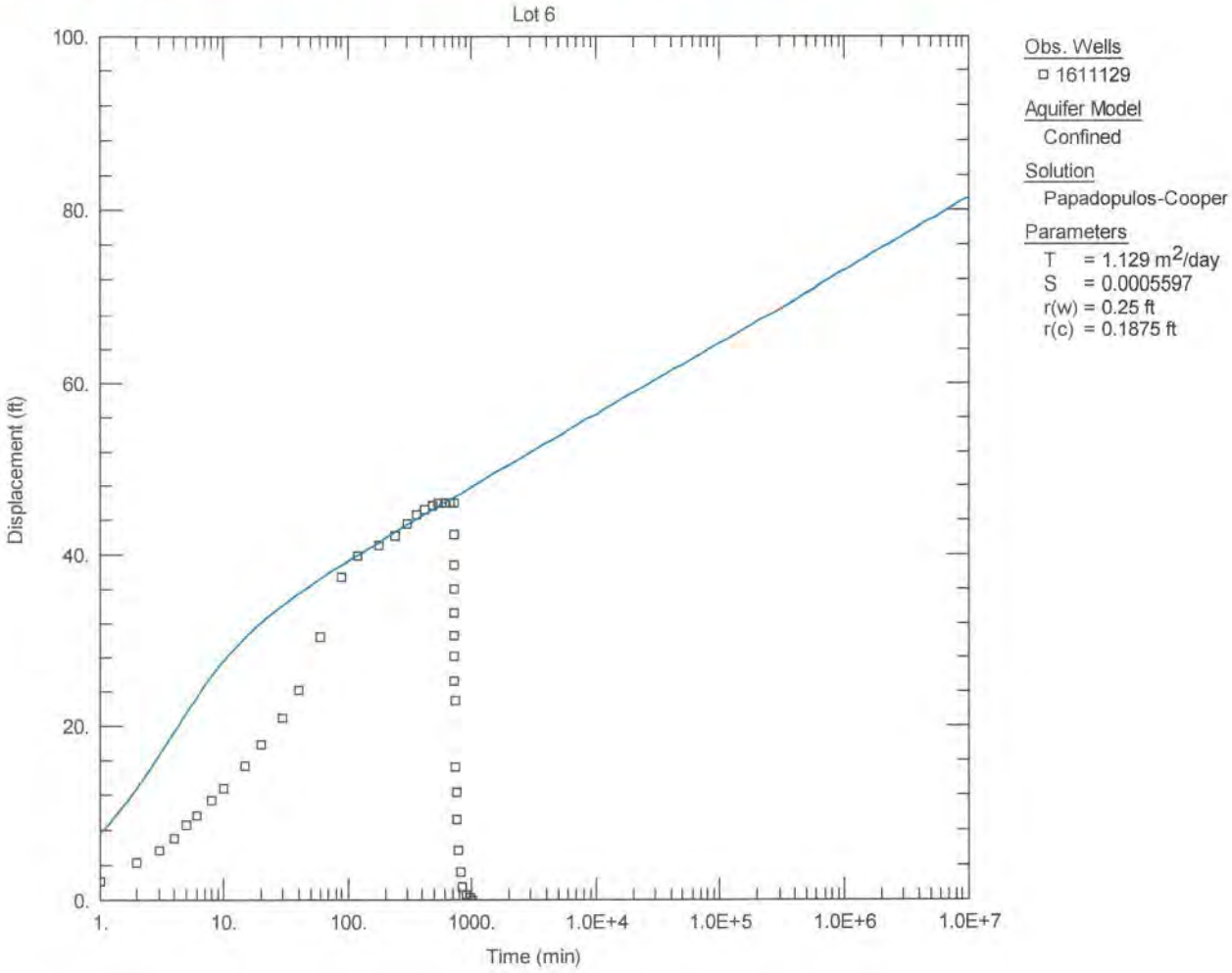
$$Q_{20} = \frac{(0.7 * Q * H_a)}{S_{100\text{min}} + (S_{20yrs} - S_{100th})}$$

Where

Q	-	Pump test flow rate 2.40 imperial gallons per minute (or 10.9 litres/min)
H_a	-	Available Head = 58 feet
$S_{100\ min}$	-	Observed drawdown at 100 minutes (m) = 38 feet
$(S_{20yrs} - S_{100\ th})$	-	Difference between drawdown at 20 years and 100 min (81.5 feet – 31.5 feet = 50 feet)
0.7	-	Safety factor

The theoretical 20 year drawdown is determined by extrapolating the Theis solution curve as follows:

Figure 8: Papadopulos-Cooper Solution Extrapolated to 20 years of pumping



Substituting in the above values a 20-year safe yield (Q_{20}) of 1.1 imperial gallons per minute or 2650 m^3/year) is calculated. The analysis indicates the well can supply the required 1,250 m^3/year to the domestic development.

[6.0] Effect on Water Levels

[6.1] Existing Users

Several of the wells in the proposed subdivision are completed in the same hydrostratigraphic zone. These wells are not in the same production aquifer due to fluvial internal heterogeneities but have similar depth of completion and water levels. Using the Cooper-Jacob equation the expected drawdown in the aquifer/hydrostratigraphic zone at various time and distances due to pumping from the subdivision can be calculated by the following formula:

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

Where

s	-	Drawdown (m)
S	-	Storativity (5.0×10^{-5})
Q	-	Max pump rate (3.42 m^3/day)
T	-	Transmissivity (1.13 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 3: Cooper-Jacob Distance Drawdown Calculation

Time	Well bore	100 m	250 m	500 m	1000 m	1600 m	3000 m
1	3.86	0.41	0	0	0	0	0
30	4.68	1.22	0.78	0.45	0.12	0	0
365	5.28	1.83	1.38	1.05	0.72	0.49	0.19
1826	5.67	2.21	1.77	1.44	1.10	0.88	0.58
3652	5.84	2.38	1.94	1.60	1.27	1.05	0.74
7305	6.00	2.55	2.11	1.77	1.44	1.21	0.91

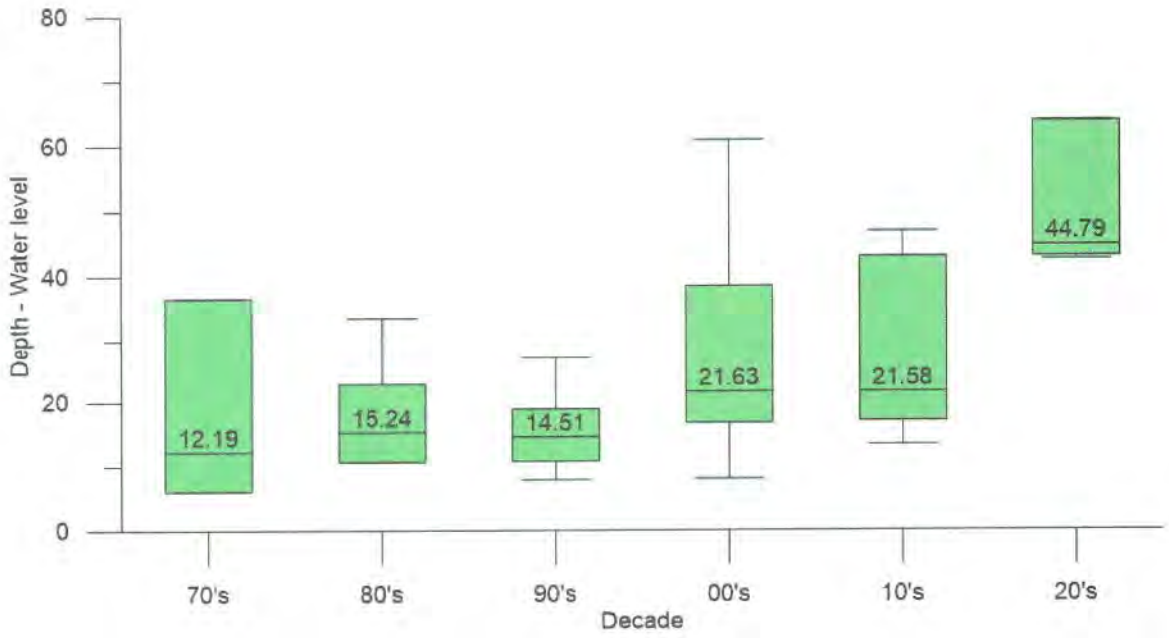
The following assumptions were included in the above calculation: A conservative storativity value of 5.0×10^{-5} for a confined sandstone aquifer; a continuous consumption rate of 3.4 m^3/day for the lot; transmissivity as determined from the pumping tests of 1.13 m^2/day; no recharge is occurring, 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 from the subdivision will experience in additional drawdown will be on the order of three meters over a 20-year pumping period. Given the moderate connectivity of the aquifers and some recharge that is likely to occur, no adverse affects on neighbouring wells due to usage of this well is anticipated.

(6.2) Changes in Water Levels vs Time

Initial static water levels and depths were collected for every well completed within a one-mile radius from the new subdivision. Although there is significant variance in aquifer thicknesses, depths and hydrostratigraphic zones, the initial water level was subtracted from the well depth to produce an approximation of aquifer hydraulic head (pressure). The plot shows the completion date by decade vs approximate hydraulic head for all the wells within a 1-mile radius.

Figure 9: Whisker plot of Approximate Hydraulic Head After Well Installation



There is a large variance in initial heads, with slight apparent increase visible to demonstrate rising aquifer head. The above diagram shows there is no indication the area is severely over utilized with

respect to groundwater diversions. However, the increase is likely due to several recent wells drill on the subject site that target deeper aquifers with higher hydraulic heads.

[7.0] Water Quality

No water quality report is available from this well at the time of writing of this report. It is recommended that a water sample be collected from the well and analyzed for routine dissolved salts and bacterial parameters prior to use of the water from the well as a drinking water supply.

[8.0] References

Alberta Environment Guide to Groundwater Authorization, Government of Alberta, 2011, Available: https://open.alberta.ca/dataset/d399d059-d8b6-4c46-9ff2-ef39f359943a/resource/2f385374-2521-4252-8e46-4b51e61c1e41/download/5612701-2013-alberta-environment-guide-groundwater-authorization.pdf

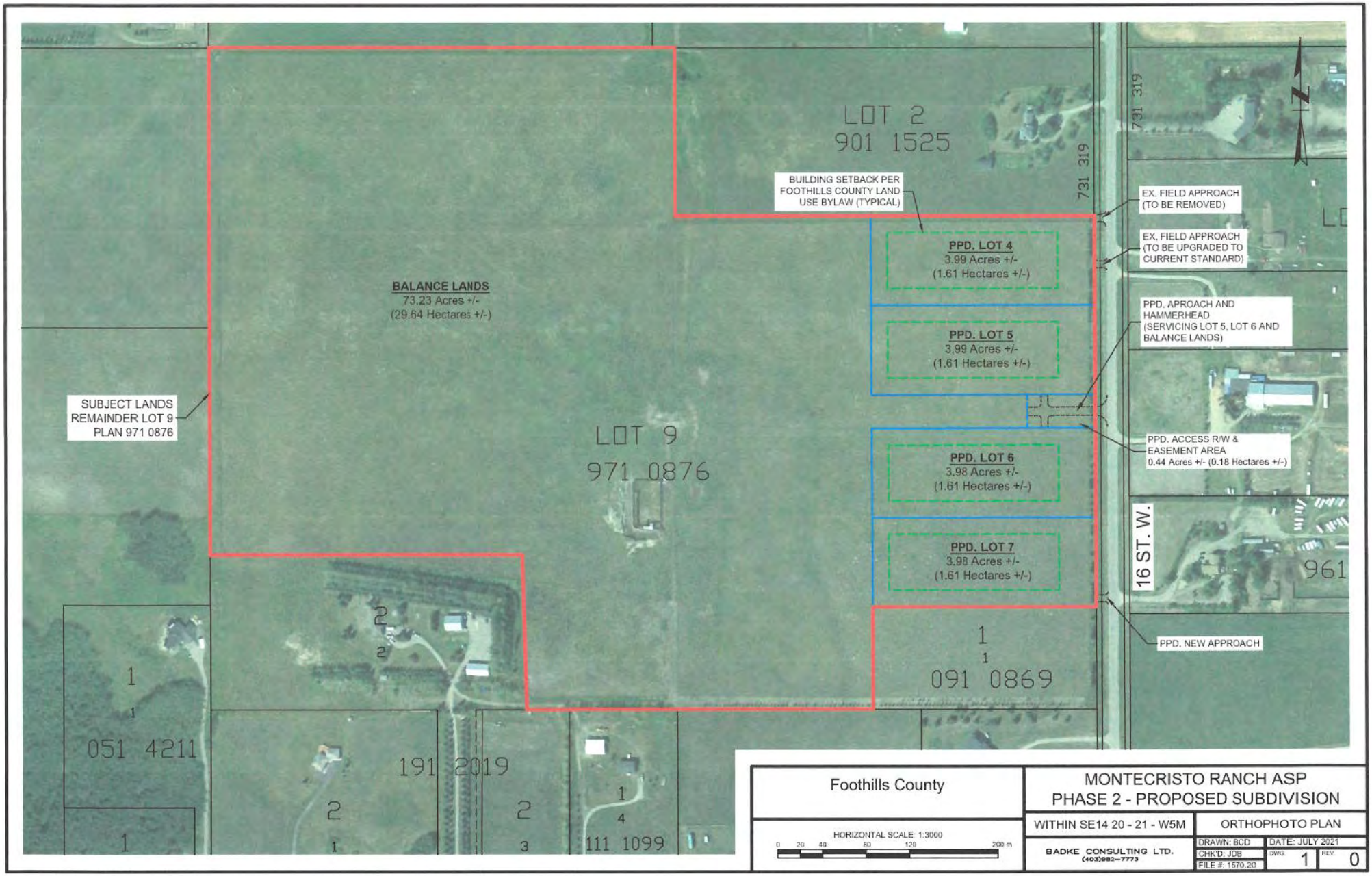
Alberta Environment and Parks. 2019c. Alberta Water Well Information Database. Available: http://groundwater.alberta.ca/WaterWells/d/

Geological Survey of Canada. 1998. Surficial Geology – Turner Valley, Alberta. GSC Map 1925A

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. Available: http://www.ags.gov.ab.ca/publications/MAP/PDF/MAP_600.PDF

Appendix A – Site Maps and Air Photos


LOT 2
901 1525
731 319
731 319
N
BUILDING SETBACK PER FOOTHILLS COUNTY LAND USE BYLAW (TYPICAL)
EX. FIELD APPROACH (TO BE REMOVED)
EX. FIELD APPROACH (TO BE UPGRADED TO CURRENT STANDARD)
PPD. LOT 4
3.99 Acres +/-
(1.61 Hectares +/-)
BALANCE LANDS
73.23 Acres +/-
(29.64 Hectares +/-)
PPD. LOT 5
3.99 Acres +/-
(1.61 Hectares +/-)
PPD. APROACH AND HAMMERHEAD (SERVICING LOT 5, LOT 6 AND BALANCE LANDS)
SUBJECT LANDS
REMAINDER LOT 9
PLAN 971 0876
LOT 9
971 0876
PPD. LOT 6
3.98 Acres +/-
(1.61 Hectares +/-)
PPD. ACCESS R/W & EASEMENT AREA
0.44 Acres +/- (0.18 Hectares +/-)
16 ST. W.
PPD. LOT 7
3.98 Acres +/-
(1.61 Hectares +/-)
961
PPD. NEW APPROACH
1
1
091 0869
1
1
051 4211
191 2019
2
2
2
1
2
3
1
4
111 1099
1
Foothills County
HORIZONTAL SCALE: 1:3000
0 20 40 80 120 200 m
MONTECRISTO RANCH ASP
PHASE 2 - PROPOSED SUBDIVISION
WITHIN SE14 20 - 21 - W5M
ORTHOPHOTO PLAN
BADKE CONSULTING LTD.
(403)982-7773
DRAWN: BCD
DATE: JULY 2021
CHK'D: JDB
FILE #: 1570.20
DWG: 1
REV: 0


Lot 6 Well Locations
Colin Sheedy Subdivision
Legend
Mountain View Equestrian - Horse?
Well
Well 1611129
Well 1611127
Mountain View Equestrian - Horse...
16 St W
Google Earth
Image © 2021 Maxar Technologies
N
200 m

Appendix B – Water Well Drilling Report – Well 1611129

Water Well Drilling Report

View in Metric

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.

GIC Well ID 1611129
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2021/11/26

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
SHEEDY, COLIN		OKOTOKS	ALBERTA	CANADA	

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	8	14	20	1	5	6			LOT 6 OF NEW SUBDIVISION 3RD LOT FROM NORTH

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.692746 Longitude -114.027559
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation ft
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary - Air

Type of Work
New Well

Proposed Well Use
Domestic

Formation Log

Measurement in Imperial

Depth from ground level (ft)	Water Bearing	Lithology Description
2.00		Dark Topsoil
12.00		Brown Clay
16.00		Brown Shale
17.00		Brown Sandstone
22.00		Brown Shale
26.00		Brown Sandstone
71.00		Gray Shale
140.00		Gray Sandstone
168.00		Gray Shale
210.00	Yes	Gray Sandstone
215.00		Gray Shale

Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 3.00 igpm

Test Date	Water Removal Rate (igpm)	Static Water Level (ft)
2021/11/21	2.40	112.04

Well Completion

Measurement in Imperial

Total Depth Drilled	Finished Well Depth	Start Date	End Date
215.00 ft	215.00 ft	2021/11/19	2021/11/20

Borehole

Diameter (in)	From (ft)	To (ft)
6.00	0.00	215.00

Surface Casing (if applicable)
Steel
Size OD : 6.60 in
Wall Thickness : 0.220 in
Bottom at : 20.00 ft

Well Casing/Liner
Plastic
Size OD : 4.50 in
Wall Thickness : 0.237 in
Top at : 15.00 ft
Bottom at : 215.00 ft

Perforations

From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)
180.00	210.00	0.125	7.00	6.00

Perforated by Saw

Annular Seal Bentonite Chips
Placed from 0.00 ft to 100.00 ft
Amount 5.00 Bags

Other Seals

Type	At (ft)
Drive Shoe	20.00
Shale Trap	100.00

Screen Type
Size OD : in

From (ft)	To (ft)	Slot Size (in)

Attachment
Top Fittings
Bottom Fittings

Pack
Type
Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
DOUG NIEMANS

Certification No
70092A

Company Name
PETER NIEMANS WATER WELL DRILLING

Copy of Well report provided to owner
Yes

Date approval holder signed
2021/11/26

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 Metric

GIC Well ID 1611129
GoA Well Tag No.
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Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	8	14	20	1	5	6			LOT 6 OF NEW SUBDIVISION 3RD LOT FROM NORTH

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.692746 Longitude -114.027559
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation ft
How Elevation Obtained
Not Obtained

Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level 24.00 in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate 3.00 igpm
Recommended Pump Intake Depth (From TOC) 195.00 ft
Pump Installed 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 Yes
Geophysical Log Taken
Submitted to ESRD -
Sample Collected for Potability Yes Submitted to ESRD

Additional Comments on Well

RIG AIR TESTED 3 GPM. WELL TESTED FOR 12 HOUR Q20 RESTRICTED AT 2.4 GPM. ALSO PUMP TESTED SEPARATELY TO CONFIRM MAXIMUM FLOW POTENTIAL OF 3 GPM.

Yield Test

Taken From Top of Casing
Depth to water level

Measurement in Imperial

Test Date	Start Time	Static Water Level
2021/11/21	11:00 AM	112.04 ft

Method of Water Removal

Type PUMP
Removal Rate 2.40 igpm
Depth Withdrawn From 205.00 ft

If water removal period was < 2 hours, explain why

Pumping (ft)	Elapsed Time Minutes:Sec	Recovery (ft)
112.04	0:00	158.20
114.17	1:00	154.36
116.21	2:00	150.92
117.72	3:00	148.03
119.13	4:00	145.34
120.57	5:00	142.68
121.72	6:00	140.19
123.36	8:00	137.30
124.70	10:00	135.01
127.36	15:00	131.00
129.89	20:00	127.23
133.01	30:00	124.28
136.22	40:00	121.26
142.55	60:00	117.62
149.44	90:00	115.22
151.90	120:00	113.52
158.20	120:00	
154.20	180:00	112.57
155.68	240:00	112.27
156.73	300:00	112.04
157.41	360:00	
157.81	420:00	
158.04	480:00	
158.10	540:00	
158.14	600:00	
158.17	660:00	

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
NW 21-18-28 W4	1300.00	ig	2021/11/19 8:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
DOUG NIEMANS

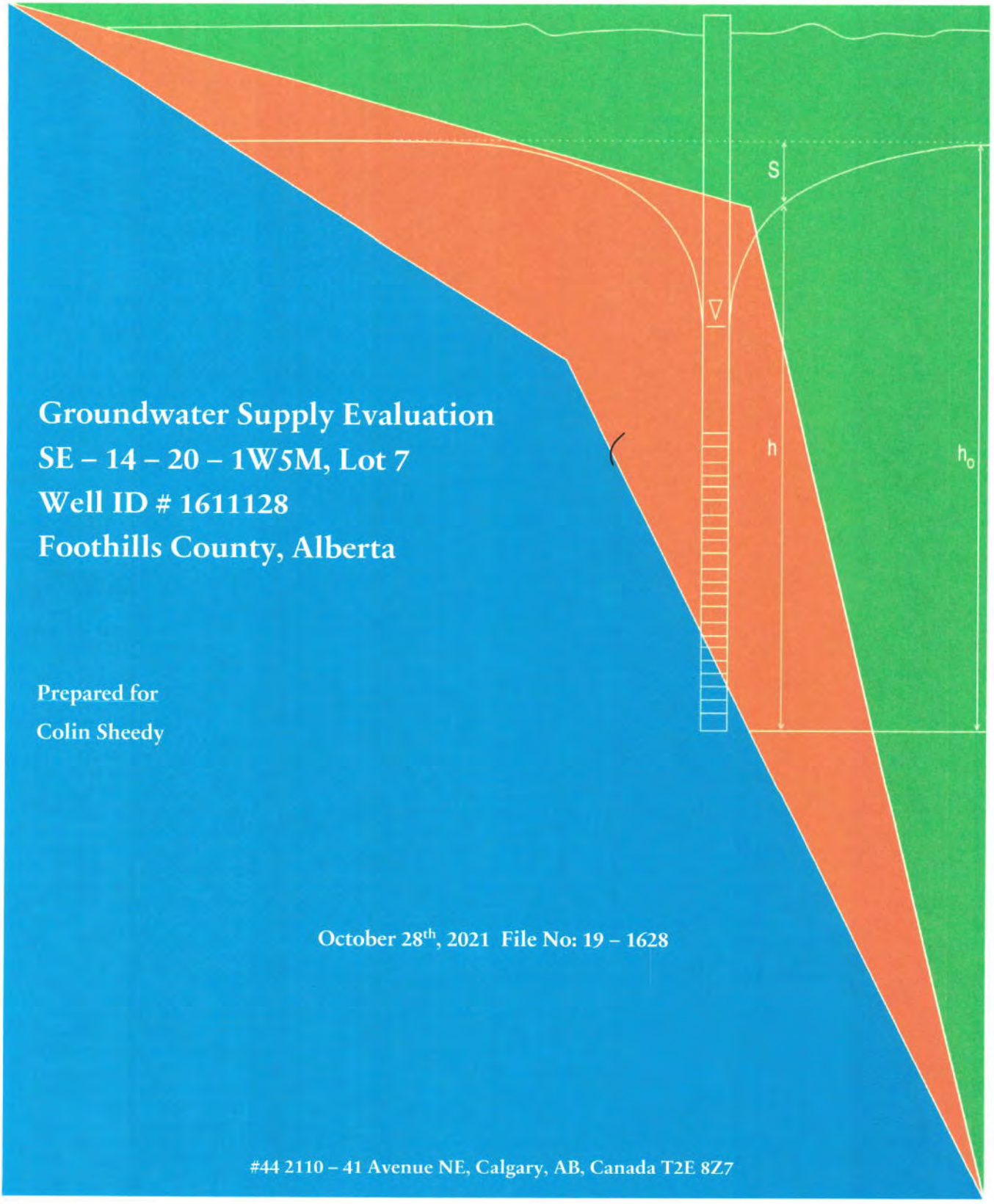
Certification No
70092A

Company Name
PETER NIEMANS WATER WELL DRILLING

Copy of Well report provided to owner
Yes

Date approval holder signed
2021/11/26

Groundwater Resources
Information Technologies Ltd.



Groundwater Supply Evaluation
SE – 14 – 20 – 1W5M, Lot 7
Well ID # 1611128
Foothills County, Alberta

Prepared for
Colin Sheedy

October 28th, 2021 File No: 19 – 1628

#44 2110 – 41 Avenue NE, Calgary, AB, Canada T2E 8Z7

Signatures

Prepared by:

Erik Quartero, P.Geo
Hydrogeologist

Reviewed by:

Ken Hugo, P.Geol
Senior Hydrogeologist
APEGA P15289

Disclaimer

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Executive Summary

A pumping test was undertaken on a newly installed water well within a proposed subdivision in SE – 14 – 20 – 1W5 to determine if the aquifer underlying the site can provide water at a sustained rate of at least 3.4 m^3/day, for an annual volume as defined in the *Water Act*, of 1,250 m^3.

The well obtains its water from a bedrock sandstone aquifer at depths of 78.0 – 91.7 meters below ground. No direct connection with surface water is believed to be present and clays and shales overlying the aquifer should aid in preventing surface water contaminants, such as septic field effluents, from migrating to the aquifer.

A pumping test was conducted on the well on September 24th, 2021 by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 1.5 imperial gallons per minute or 6.81 liters per minute for a period of 720 minutes. Water levels were measured for an additional 720 minutes following pumping cessation.

A 20-year safe yield of 4.2 m^3/day (0.64 imperial gallons per minute or 1,536 m^3/year) was calculated from pumping test and well completion data. This value is in excess of the 1,250 m^3 per year as required by the *Water Act* and shows the well can likely supply the necessary amount of water.

No adverse effects to existing domestic, licensed or traditional agricultural groundwater users should result due to production of water from this well for domestic purposes.

A water sample was collected from the well towards the end of the pumping test for analysis of routine dissolved and bacterial parameters. The lab report is not currently available, and the results should be compared to drinking water criteria prior to use of the water as a potable source.

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APPENDIX

Appendix A – Water Well Drilling Report, Pump Test Interpretations

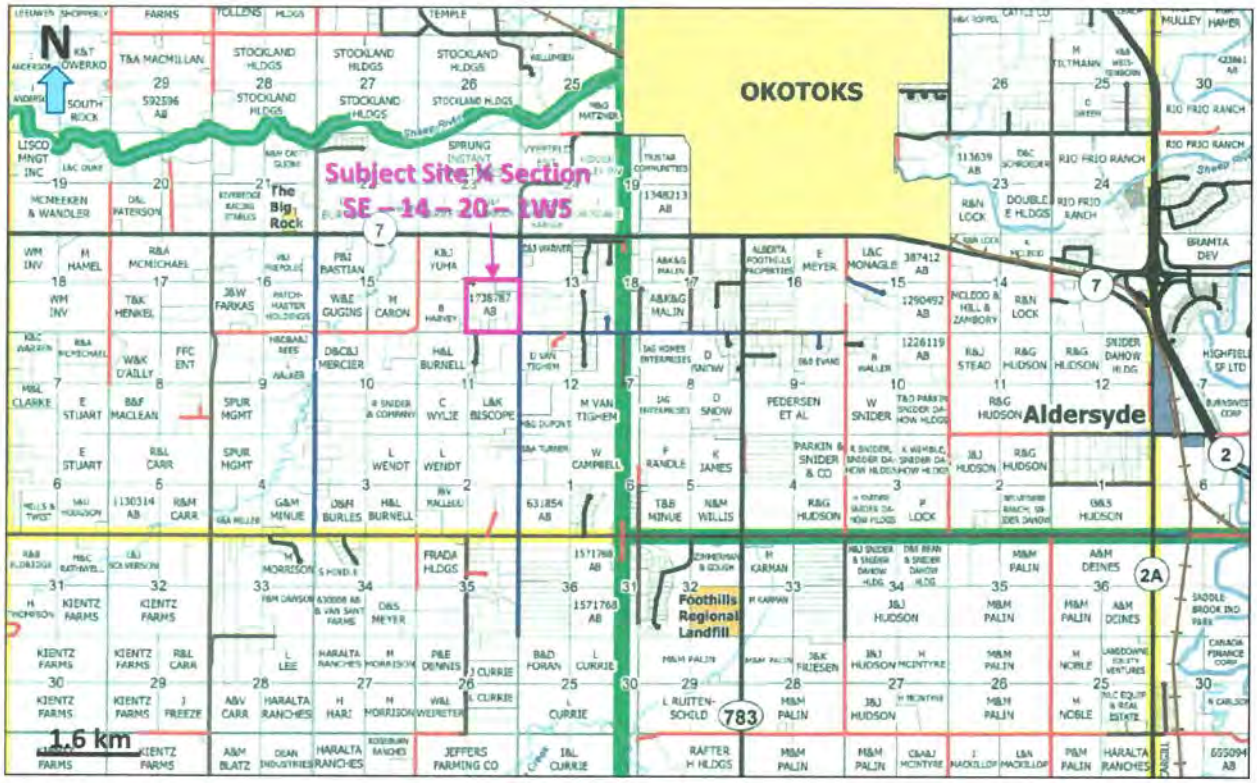
Appendix B – AEP Water Well Database Search Results

[1.0] Introduction

An aquifer analysis was undertaken for a residential supply well located on a proposed 3.99 -acre parcel subdivision in the SE quarter section of 14 – 20 – 1W5 to determine if the well could provide water at a rate of 1,250 m^3/year without causing adverse effects to existing groundwater users.

The site is located within the County of Foothills No. 31. A portion of the County of Foothills landownership map showing the site ¼ section location is as follows:

Figure 1: MD Foothills land Ownership Map and Quarter Section Site Location



The proposed 3.99-acre subdivision will be supplied by an individual well located on the parcel. This report is to determine whether a newly installed well (GIC Well ID 1611128) on the proposed subdivision is capable of supplying water to a residence.

The location of the well was measured by personnel from GRIT Ltd. and is at: 50.691924° N, -114.026786° E.

A site plan of the proposed subdivision showing the well location is as follows:

Figure 2: Air-photo and Quarter Section Location

Additional subdivision boundary information is included in Appendix A.

[2.0] Water well supply needs

The well is proposed to be for a single lot residential use. According to the *Water Act* each residential lot is entitled to water at a rate of 1,250 m^3 annually.

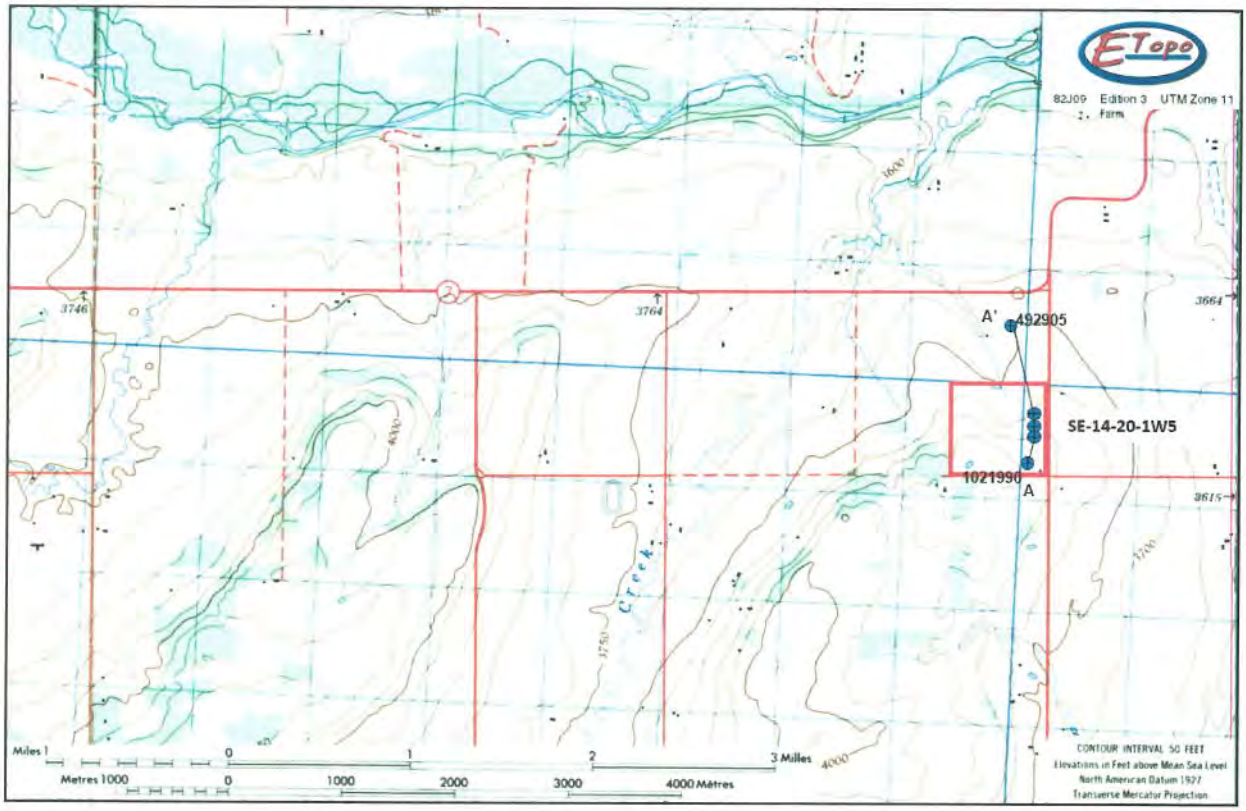
[3.0] Site Description

[3.1] Topography

The site is located 3.6 km southwest of the Town of Okotoks and is in a mixed residential and agricultural area with a low density of residential acreages scattered around the site and within the subject site quarter section.

The site is located at an approximate elevation of 1,170 meters above sea level. The Sheep River is located 2.9 km north of the site and is at an approximate elevation of 1,070 meters asl, or 100 meters below the site. Spring Creek is located 2.1 km west of the site and is at an elevation of 1,110 meters asl, or 60 meters below the site. A topogaphic map with the subject site quarter section is shown as follows:

Figure 3: Topographic Map with Quarter Section Location



3.2 Surficial Geology

According to the Geological Survey of Canada Map 1925A entitled "Surficial Geology Turner Valley, Alberta" (I. Shetsen, 1998) the area is interpreted to be rolling till plain composed of up to 5 meters of till of even thickness. Minor amounts of water-sorted material and bedrock exposures are found locally with some areas of undifferentiated sub glacially molded deposits exhibiting streamlined features. Topography is flat to undulating, reflecting the surface of the underlying bedrock and other deposits.

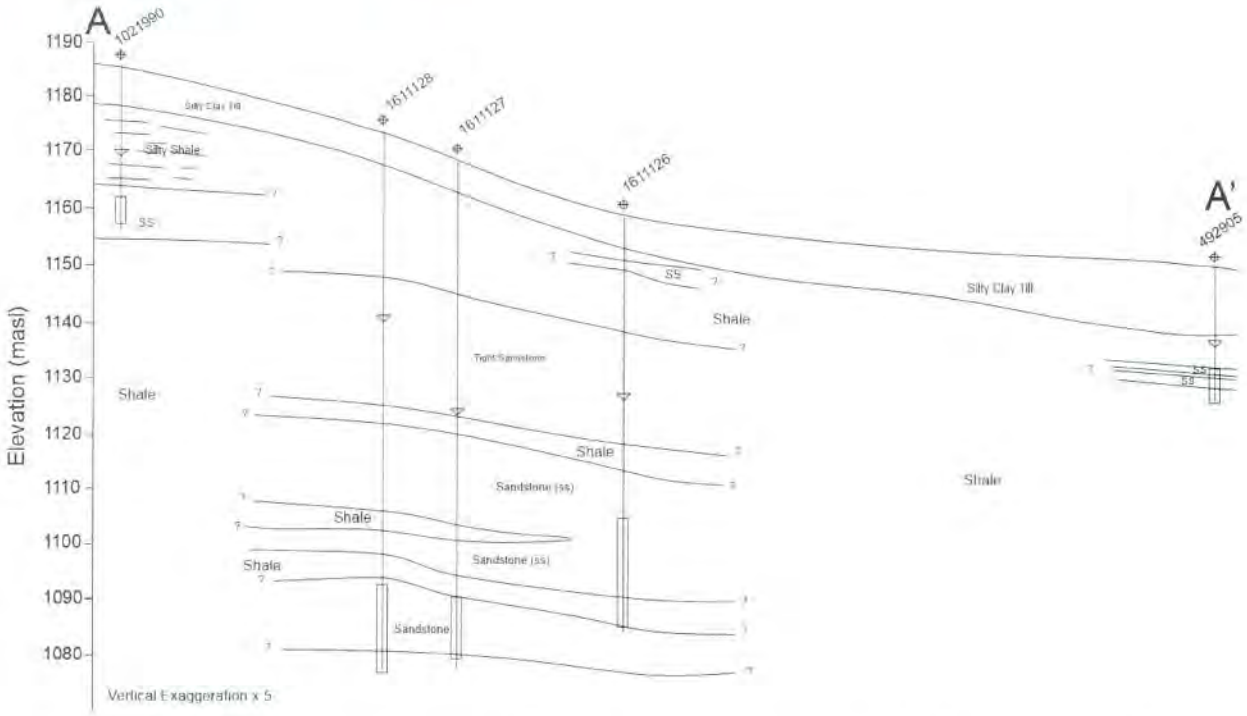
According to area Water Well Drillers Reports the surficial sediments, consisting of clay till, are approximately 5 to 7 meters thick and underlain by sandstone and shale bedrock. No useable aquifers are believed to exist within these upper deposits. The presence of the shale and clays is favourable in preventing contamination from surface source (such as septic field effluent) from entering lower aquifers.

3.3 Bedrock Geology

Wells in the area are likely completed within strata belonging to the Upper Lacombe Member of the Paskapoo Formation. The Upper Lacombe Member is comprised mostly of shale interbedded with sandstone. The target aquifers are sandstone channel deposits with shale overbank deposits acting as aquitards. When several sandstone channels are stacked on top of each other then an exceptional aquifer can be found, but often sufficient water is obtained from individual sandstone aquifers separated by shale units.

A cross section was constructed in Figure 4 using water well records from the area to show relative thickness of surficial quaternary deposits and depth to bedrock, as follows:

Figure 4: Geological Cross Section A-A'



The new wells for the subdivision appear to be competed significantly deeper depth than those drilled previously. The site is underlain by numerous thick fluvial sandstones with poor porosity. Interference effects may occur in areas such as these due to the close proximity of each well and underlying geology.

[4.0] Area Groundwater Users

[4.1] Non-licensed Water Users

The Alberta Environment and Parks (AEP) water well database lists 99 wells within a 1.6 km (1 mile) radius of the pumping well. Most of these wells are for domestic purposes, with 4 wells also dedicated to stock watering. Well depths range from 19 – 124 meters with most wells on the order of 35 – 78 m deep. Initial static water levels in the area range from 8 – 80 metres below the top of casing.

[4.2] Licensed Water Users

A search of the AEP water licence database was undertaken for the subject section and adjoining 8 sections to determine if any water licences are present in the area. A summary of groundwater licences and registrations in the area is as follows:

Table 1: Groundwater Licenses and Registrations

Location	Registrations	Licenses	Volume (m3/year)	Licensee
11 – 20 – 1W5	1	-	-	Robert Carr
14 – 20 – 1W5	1	-	-	Betty & Don Melvin
15 – 20 – 1W5	1	-	-	Little Rock Farm
23 – 20 – 1W5	1	-	-	James McGregor
24 – 20 – 1W5	2	-	-	Hidden Valley Investments Ltd. Joseph Drisdale & Edward Dorin

Licences for surface waters withdrawals were not included in the Table 1 summary. No licenses for groundwater use were found in the area. The groundwater use in the area can be described as low to moderate, consisting largely of residential acreage use.

[5.0] Pump test

[5.1] Supply Well Details

The production well was installed on site September 25th , 2021 by personnel from Peter Niemans Water Well Drilling. 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 B.

Table 2: Water Well Supply Details

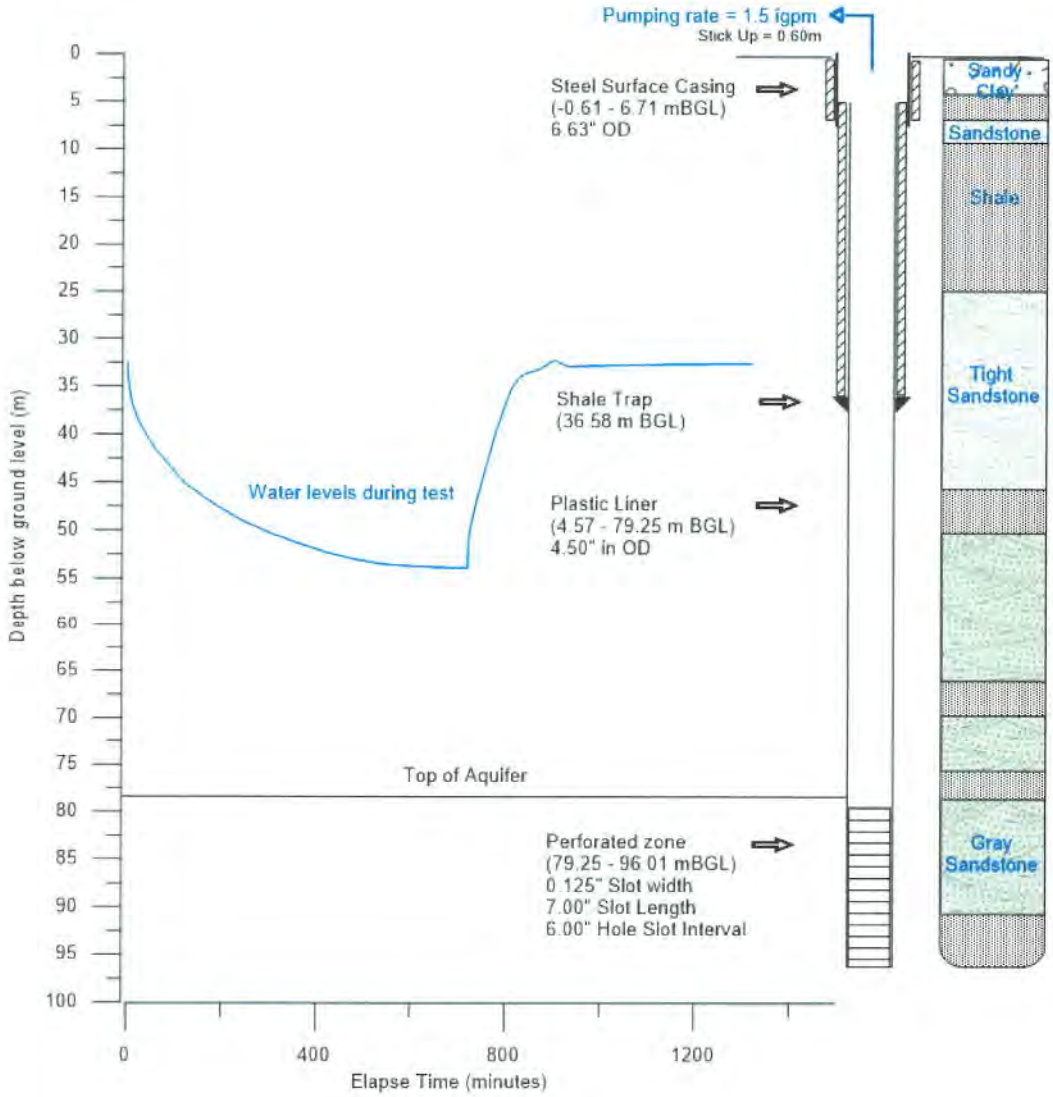
Well	Production Well
Well ID	1611128
GPS Location	50.691924° N, -114.026786 ° E
Well depth (m BGL[1])	96.0
Aquifer zone (m BGL[1])	78.0 – 91.7
Screened Interval (m BGL[1])	79.2 – 96.0
Surface Casing (m BGL[1])	6.7
Static water level after installation (m BGL[1])	32.15
NPWL (m BGL[1])	32.55
1. m BGL – metres below ground level	
2.	

(5.2) Details of the Pumping Test

The pumping test was conducted September 28th, 2021 by personnel from Peter Niemans Water Well Drilling. The supply well was pumped at a rate of 1.5 imperial gallons per minute (igpm) or 6.81 liters per minute (L/min) for a period of 720 minutes. Water levels were measured for an additional 720 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 as follows:

Figure 5: Pumping Well Schematic and Water Levels During the Pumping Test



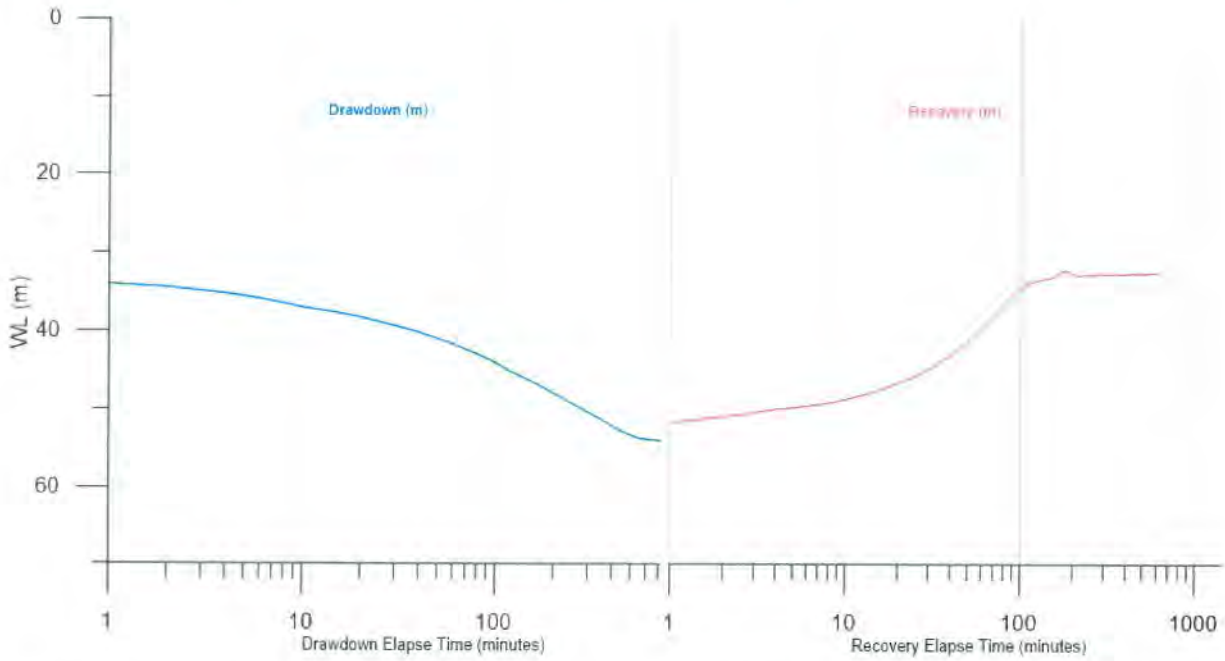
The well had an initial static water level of 32.55 metres below the top of the well casing (m BTOC) prior to pumping and drew down 21.28 metres by the end of the pumping period. Water levels had built up to 32.55 metres at the end of the recovery period to 100 % recovery.

5.3 Pumping Test Interpretation

A low productivity well is indicated by the water level and moderate drawdown throughout the pumping test given the low pumping rate. The aquifer is a confined and deep sandstone.

A dual semi-log graph of the pumping test data is shown in Figure 6 to illustrate the water level data during the pumping test.

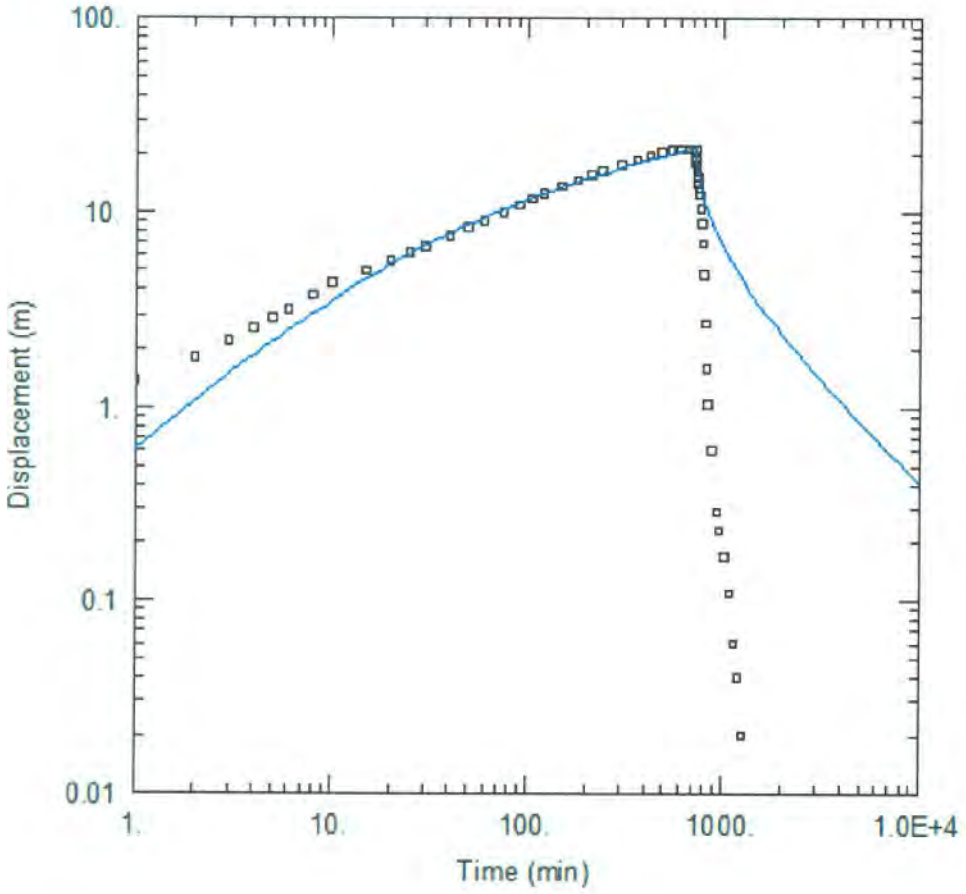
Figure 6: Dual Semi-log Graph of Drawdown and Recovery in the Pumping Well



The well had a relatively stable linear drawdown for the duration of the pumping test. no significant variance in drawdown is observed for the duration of the pumping period. No boundary effects are interpreted for the duration of the pumping test or changes in aquifer properties away form the well bore. The well recovers steadily following pumping cessation.

The pumping test data was interpreted with the aid of the AQTESOLV program 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 curve is as follows:

Figure 7: Papadopulos-Cooper Solution for Pumping Well



A conservative fit of the pumping test data to the solution is utilized such that the calculated hydraulic parameters are appropriate and will not overestimate the aquifer productivity. A transmissivity of 0.14 m^2/day is calculated indicating a likely suitable well.

5.4 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:

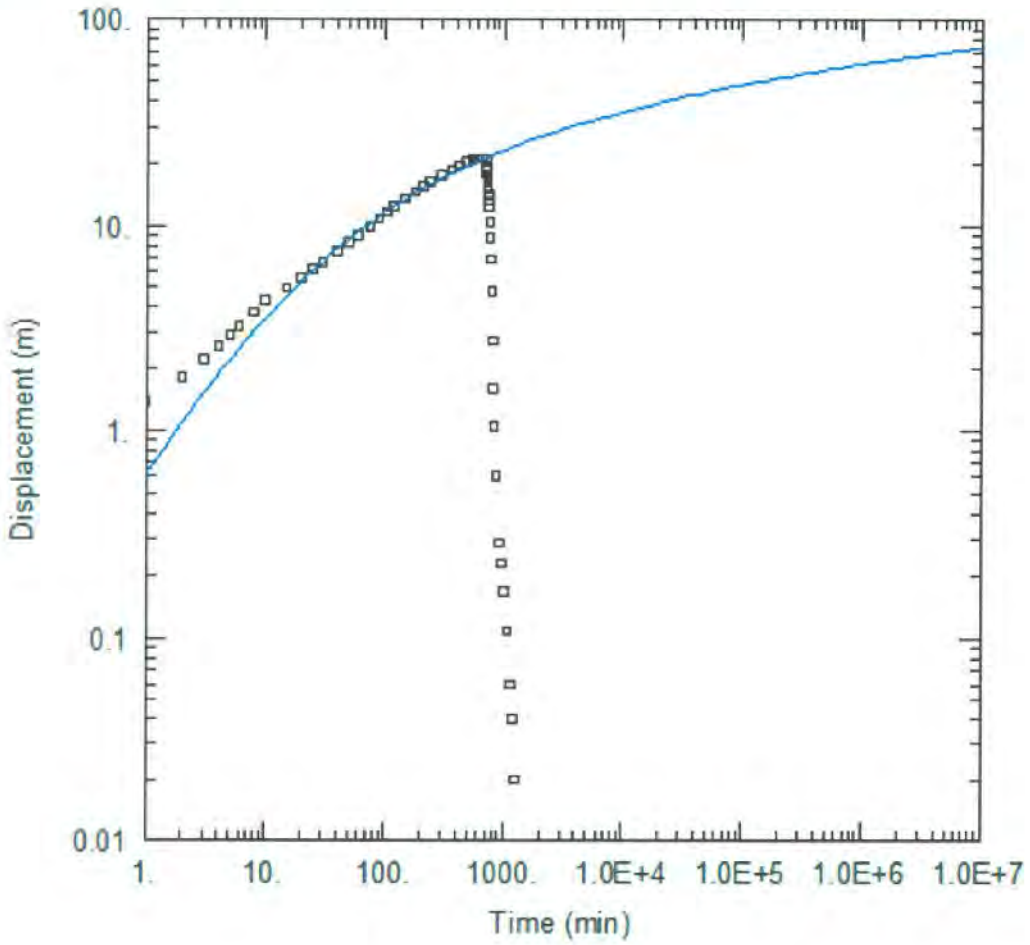
$$Q_{20} = \frac{(0.7 * Q * H_a)}{S_{100\text{min}} + (S_{20yrs} - S_{100th})}$$

Where:

Q	-	Pump test flow rate 9.8 m^3/day (flow rate or 6.81 litres/min)
H_a	-	Available Head = 45.5 m
$S_{100\ min}$	-	Observed drawdown at 100 minutes (m) = 11.2
$(s_{20yrs} - s_{100\ th})$	-	Difference between drawdown at 20 years and 100 min (74.2 m – 11.2 m = 63 m)
0.7	-	Safety factor
2		

The theoretical 20 year drawdown is determined by extrapolating the Theis solution curve as follows:

Figure 8: Papadopulos-Cooper Solution Extrapolated to 20 years of pumping



Substituting in the above values a 20-year safe yield (Q_{20}) of 4.2 m^3/day (0.64 imperial gallons per minute or 1536.1 m^3/year) is calculated. The analysis indicates the well can supply the required 1,250 m^3/year to the domestic development.

[6.0] Effect on Water Levels

[6.1] Existing Users

Several of the wells in the proposed subdivision are completed in the same hydrostratigraphic zone. These wells are not in the same production aquifer due to fluvial internal heterogeneities but have similar depth of completion and water levels. Using the Cooper-Jacob equation the expected drawdown in the aquifer/hydrostratigraphic zone at various time and distances due to pumping from the subdivision can be calculated by the following formula:

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

Where

s	-	Drawdown (m)
S	-	Storativity (5.0×10^{-5})
Q	-	Max pump rate (3.42 m^3/day)
T	-	Transmissivity (0.1422 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 3: Cooper-Jacob Distance Drawdown Calculation

Distance (m)	100	300	500	1000	1600	3000
Time (days)						
1	-	-	-	-	-	-
2	0.47	-	-	-	-	-
10	3.53	-	-	-	-	-
100	7.90	3.73	1.79	-	-	-
500	10.96	6.79	4.84	2.21	0.42	-
1000	12.28	8.10	6.16	3.53	1.74	-
7300	16.06	11.88	9.94	7.30	5.52	3.13

The following assumptions were included in the above calculation: A conservative storativity value of 5.0×10^{-5} for a confined sandstone aquifer; a continuous consumption rate of 3.4 m^3/day for the lot; transmissivity as determined from the pumping tests of 0.1422 m^2/day; 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

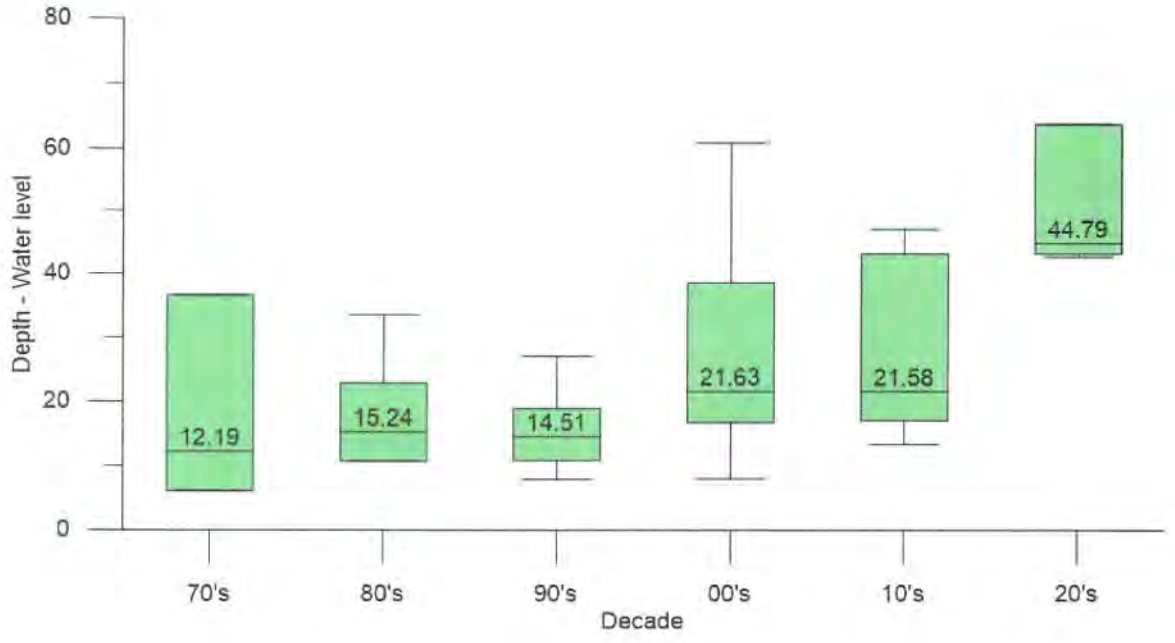
from the subdivision will experience in additional drawdown will be on the order of sixteen (16) meters over a 20-year pumping period.

There are several wells in the subdivision completed at a similar depth interval. The nearest wells are located roughly ~55 metres to the south (Well 1611127) away form the other supply wells. based on the above table the neighboring wells may experience an additional ~20 metres of additional drawdown at the full water allocation, actual water usage is expected to be one half to one third of the entitled 1,250 m^3. The supply well is interpreted to be completed in the same aquifer as this neighboring well but not those further to the north and south on the subject quarter section.

6.2) Changes in Water Levels vs Time

Initial static water levels and depths were collected for every well completed within a one-mile radius form the new subdivision. Although there is significant variance in aquifer thicknesses, depths and hydrostratigraphic zones, the initial water level was subtracted form the well depth to produce an approximation of Aquifer hydraulic head (pressure). The plot shows the completion date by decade vs approximate hydraulic head for all the wells within a 1-mile radius.

Figure 9: Whisker plot of Approximate Hydraulic Head After Well Installation



There is a large variance in initial heads, with slight apparent increase visible to demonstrate rising aquifer pressures. The above diagram shows there is no indication the area is severely over utilized with respect to groundwater diversions. However, the increase is likely due to several recent wells drill on the subject site that target deeper aquifers with higher hydraulic heads.

[7.0] Water Quality

A water sample was collected towards the end of the pumping portion of the test for analysis of routine dissolved salts and bacterial parameters. The lab report is not available at the time of writing of this report but the analysis should be reviewed prior to use of the groundwater from the well as a drinking water source.

References

Alberta Environment Guide to Groundwater Authorization, Government of Alberta, 2011, Available: https://open.alberta.ca/dataset/d399d059-d8b6-4c46-9ff2-ef39f359943a/resource/2f385374-2521-4252-8e46-4b51e61c1e41/download/5612701-2013-alberta-environment-guide-groundwater-authorization.pdf

Alberta Environment and Parks. 2019c. Alberta Water Well Information Database. Available: http://groundwater.alberta.ca/WaterWells/d/

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. Available: http://www.ags.gov.ab.ca/publications/MAP/PDF/MAP_600.PDF

Jackson, L.E. 1998. Surficial Geology – Turner Valley, AB. Geological Survey of Canada Map 1925A

Appendix A – Water Well Drilling Report, Pump Tests Interpretations

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 Metric

GOWN ID

GIC Well ID 1611128
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2021/10/14

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
SHEEDY, COLIN		OKOTOKS	ALBERTA	CANADA	

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	1	14	20	1	5	4			NEW SUBDIVISION 4TH LOT FROM NORTH

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.691924 Longitude -114.026786
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation ft
How Elevation Obtained
Not Obtained

Drilling Information

Method of Drilling
Rotary - Air

Type of Work
New Well

Proposed Well Use
Domestic

Formation Log

Measurement in Imperial

Depth from ground level (ft)	Water Bearing	Lithology Description
3.00		Brown Topsoil
15.00		Brown Sandy Clay
22.00		Brown Shale
29.00		Brown Sandstone
80.00		Gray Shale
152.00		Gray Tight Sandstone
165.00		Gray Shale
217.00		Gray Sandstone
229.00		Gray Shale
249.00		Gray Sandstone
256.00		Gray Shale
301.00	Yes	Gray Sandstone
315.00		Gray Shale

$S_{100} = 11.2$ m

$S_{20} = 74.2$ m

Yield Test Summary

Measurement in Imperial

Recommended Pump Rate 2.00 igpm

Test Date	Water Removal Rate (igpm)	Static Water Level (ft)
2021/09/27	1.95	105.47

Well Completion

Measurement in Imperial

Total Depth Drilled	Finished Well Depth	Start Date	End Date
315.00 ft	315.00 ft	2021/09/24	2021/09/25

Borehole

Diameter (in)	From (ft)	To (ft)
6.00	0.00	315.00

Surface Casing (if applicable)
Steel
Size OD : 6.60 in
Wall Thickness : 0.189 in
Bottom at : 22.00 ft

Well Casing/Liner
Plastic
Size OD : 4.50 in
Wall Thickness : 0.237 in
Top at : 15.00 ft
Bottom at : 315.00 ft

Perforations

From (ft)	To (ft)	Diameter or Slot Width(in)	Slot Length (in)	Hole or Slot Interval(in)
260.00	315.00	0.125	7.00	6.00

Perforated by Saw

Annular Seal Bentonite Granular
Placed from 0.00 ft to 120.00 ft
Amount 6.00 Bags

Other Seals

Type	At (ft)
Drive Shoe	22.00
Shale Trap	120.00

Screen Type
Size OD : in

From (ft)	To (ft)	Slot Size (in)

Attachment
Top Fittings Bottom Fittings

Pack
Type Grain Size
Amount

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
DOUG NIEMANS

Certification No
70092A

Company Name
PETER NIEMANS WATER WELL DRILLING

Copy of Well report provided to owner
Yes

Date approval holder signed
2021/10/14

Water Well Drilling Report

View in Metric

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.

GIC Well ID 1611128
GoA Well Tag No.
Drilling Company Well ID
Date Report Received 2021/10/14

GOWN ID

Well Identification and Location

Measurement in Imperial

Owner Name	Address	Town	Province	Country	Postal Code
SHEEDY, COLIN		OKOTOKS	ALBERTA	CANADA	

Location	1/4 or LSD	SEC	TWP	RGE	W of MER	Lot	Block	Plan	Additional Description
	1	14	20	1	5	4			NEW SUBDIVISION 4TH LOT FROM NORTH

Measured from Boundary of
ft from
ft from

GPS Coordinates in Decimal Degrees (NAD 83)
Latitude 50.691924 Longitude -114.026786
How Location Obtained
Differential corrected handheld GPS 5-10m

Elevation ft
How Elevation Obtained
Not Obtained

Additional Information

Measurement in Imperial

Distance From Top of Casing to Ground Level 24.00 in
Is Artesian Flow
Rate igpm
Is Flow Control Installed
Describe

Recommended Pump Rate 2.00 igpm
Recommended Pump Intake Depth (From TOC) 290.00 ft
Pump Installed 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 Yes
Geophysical Log Taken
Submitted to ESRD
Sample Collected for Potability Submitted to ESRD

Additional Comments on Well

WELL SUITABLE FOR DOMESTIC USE AND CONSISTENT WITH THE SURROUNDING AREA. FLOW TESTED FOR 3 HOURS AND FOR 12 HOURS FOR Q20 SUBMITTED TO KEN HUGO.

Yield Test

Taken From Top of Casing
Depth to water level

Measurement in Imperial

Test Date	Start Time	Static Water Level
2021/09/27	11:00 AM	105.47 ft

Method of Water Removal
Type PUMP
Removal Rate 1.95 igpm
Depth Withdrawn From 300.00 ft

If water removal period was < 2 hours, explain why

Pumping (ft)	Elapsed Time Minutes:Sec	Recovery (ft)
105.48	0:00	178.12
110.24	1:00	171.00
111.06	2:00	168.21
112.76	3:00	166.67
114.50	4:00	165.26
115.81	5:00	164.70
117.16	6:00	160.93
118.67	7:00	163.81
120.08	8:00	163.39
121.59	9:00	162.80
123.03	10:00	162.17
124.80	12:00	160.99
126.25	14:00	159.88
127.56	16:00	158.73
128.84	18:00	157.61
130.09	20:00	156.46
132.71	25:00	153.58
135.17	30:00	150.62
137.63	35:00	147.64
140.06	40:00	144.72
145.01	50:00	138.55
150.10	60:00	132.68
155.35	75:00	124.48
160.93	90:00	118.93
166.01	105:00	115.16
178.12	180:00	110.56

Water Diverted for Drilling

Water Source	Amount Taken		Diversion Date & Time
NW 21-18-28 W4	1200.00	ig	2021/09/24 8:00 AM

Contractor Certification

Name of Journeyman responsible for drilling/construction of well
DOUG NIEMANS

Certification No
70092A

Company Name
PETER NIEMANS WATER WELL DRILLING

Copy of Well report provided to owner
Yes

Date approval holder signed
2021/10/14

PETER NIEMANS WATER WELL CO.

403.652.6602 www.PNWWD.com

FLOW TEST REPORT

WATER LEVELS IN WELL DURING / AFTER PUMPING

PUMPING LEVEL (m)	MINUTES	RECOVERY LEVEL (m)
32.55	0	53.83
33.92	1	51.75
34.35	2	50.95
34.75	3	50.45
35.11	4	50.02
35.44	5	49.82
35.76	6	49.61
36.33	8	49.19
36.87	10	48.75
37.51	15	47.65
38.11	20	46.61
38.69	25	45.69
39.17	30	44.81
40.01	40	42.99
40.83	50	41.22
41.51	60	39.45
42.45	75	37.33
43.32	90	35.29
44.17	105	34.15
45.02	120	33.59
46.12	150	33.15
47.16	180	32.91
48.05	210	32.84
48.88	240	32.78
50.21	300	32.72
51.26	360	32.66
52.25	420	32.61
52.95	480	32.59
53.45	540	32.57
53.66	600	32.55
53.78	660	
53.83	720	

PROJECT: COLIN SHEEDY SUBDIVISION
NAME: COLIN SHEEDY
LOCATION: LOT 4 (4TH FROM NORTH)
WATER OUTLET: MOBILE PUMP
WATER REMOVAL RATE: 1.5 IGPM
APPROX. MAX. REMOVAL:
Pumping level is pump ON. Recovery is OFF.

Latitude 50.691924 Longitude -114.026786

ODOR: NO
COLOUR: CLEAR
SEDIMENT: NO
PUMP DEPTH: 300 FEET
WELL DEPTH: 315 FEET
PRESSURE TANK: N/A
FILTRATION: N/A
CISTERN: N/A
COMMENTS:

Well tested by: Doug Niemans
Date: SEPT 28 2021
This well at the time it was tested is suitable for typical domestic use.

Appendix B – AEP Water Well Database Search Results

Alberta

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)
349976	SE	14	20	1	5	AARON DRILLING INC.	1997-04-07	26.82	New Well	Domestic		23	17	NATTRESS, FLOYD	18.99	18.18	16.81
349976	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2000-10-14	92.96	Deepened	Domestic		16		FERGIE, MARG			16.81
354322	SE	14	20	1	5	KRIEGER DRILLING LTD.	1989-08-17	59.44	New Well	Domestic		12		NATTRASS, FLOYD	48.77		16.81
354322	SE	14	20	1	5	KRIEGER DRILLING LTD.	1989-08-17	59.44	New Well	Domestic		12	24	NATTRASS, FLOYD	47.24	27.28	16.81
359985	SE	14	20	1	5	KRIEGER DRILLING LTD.	1989-04-19	89.00	New Well	Domestic		23		NATTRASS, FLOYD	73.15	36.37	16.81
380544	8	14	20	1	5	DEN-ALTA DRILLING LTD.	1976-12-14	47.24	Reconditioned	Domestic & Stock		3		WATHER, HARRY	12.19	36.37	14.12
380546	SE	14	20	1	5	INTERPROVINCIAL DRILLING CONTRACTORS	1985-10-24	76.20	New Well-Decommissioned	Unknown		12		ENDERSBY, JACK	30.48	1.14	0.00
380548	SE	14	20	1	5	INTERPROVINCIAL DRILLING CONTRACTORS	1985-10-15	60.96	New Well-Decommissioned	Unknown		10		ENDERSBY, JACK	30.48	1.14	0.00
380551	SE	14	20	1	5	INTERPROVINCIAL DRILLING CONTRACTORS	1985-12-10	65.53	New Well	Stock		8	3	ENDERSBY, JACK	32.00	45.46	16.81
1021990	1	14	20	1	5	AARON DRILLING INC.	2010-09-14	28.96	New Well	Domestic		7	26	FERGIE, CARL	15.09	27.28	16.81
1555708	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-08-02	85.34	Test Hole-Decommissioned	Domestic		21		ENERSBY, JACK			
1555709	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-08-01	91.44	Test Hole-Decommissioned	Domestic		13		ENERSBY, JACK			
1555741	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-08-15	91.44	New Well	Domestic		23	27	MEIER, JACK	49.78	34.10	16.83
1555742	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-09-23	67.06	New Well	Domestic		10	27	ENDERSBY, JACK	47.58	11.37	16.83
1555802	SE	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2007-09-21	73.15	New Well-Decommissioned	Domestic		17		ENDERSBY, JACK			
1556167	2	14	20	1	5	NIEMANS DRILLING (1980) LTD.	2010-08-09	36.58	New Well	Domestic		11	28	ENDERSBY, JACK	15.84	5.46	16.84
1556167	2	14	20	1	5	NIEMANS DRILLING (1980) LTD.			New Well	Domestic				ENDERSBY			
1611033	2	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2019-03-15	102.11	New Well	Domestic		11	26	SHEEDY, COLIN	59.05	14.55	16.84
1611034	2	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2019-03-09	96.01	New Well	Domestic		11	26	SHEEDY, COLIN	63.75	7.73	16.84
1611035	2	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2019-03-11	96.01	New Well	Domestic		11	26	SHEEDY, COLIN	49.02	5.46	16.84

Alberta

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)
1611126	8	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2021-09-22	73.15	New Well	Domestic		9	26	SHEEDY, COLIN	30.54	8.41	16.84
1611127	8	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2021-09-23	89.92	New Well	Domestic		13	26	SHEEDY, COLIN	43.42	8.18	16.84
1611128	1	14	20	1	5	PETER NIEMANS WATER WELL DRILLING	2021-09-25	96.01	New Well	Domestic		13	26	SHEEDY, COLIN	32.15	8.86	16.76