REPORT

Keddleston Groundwater Study

Electoral Area C, Regional District of North Okanagan, BC

Submitted to:

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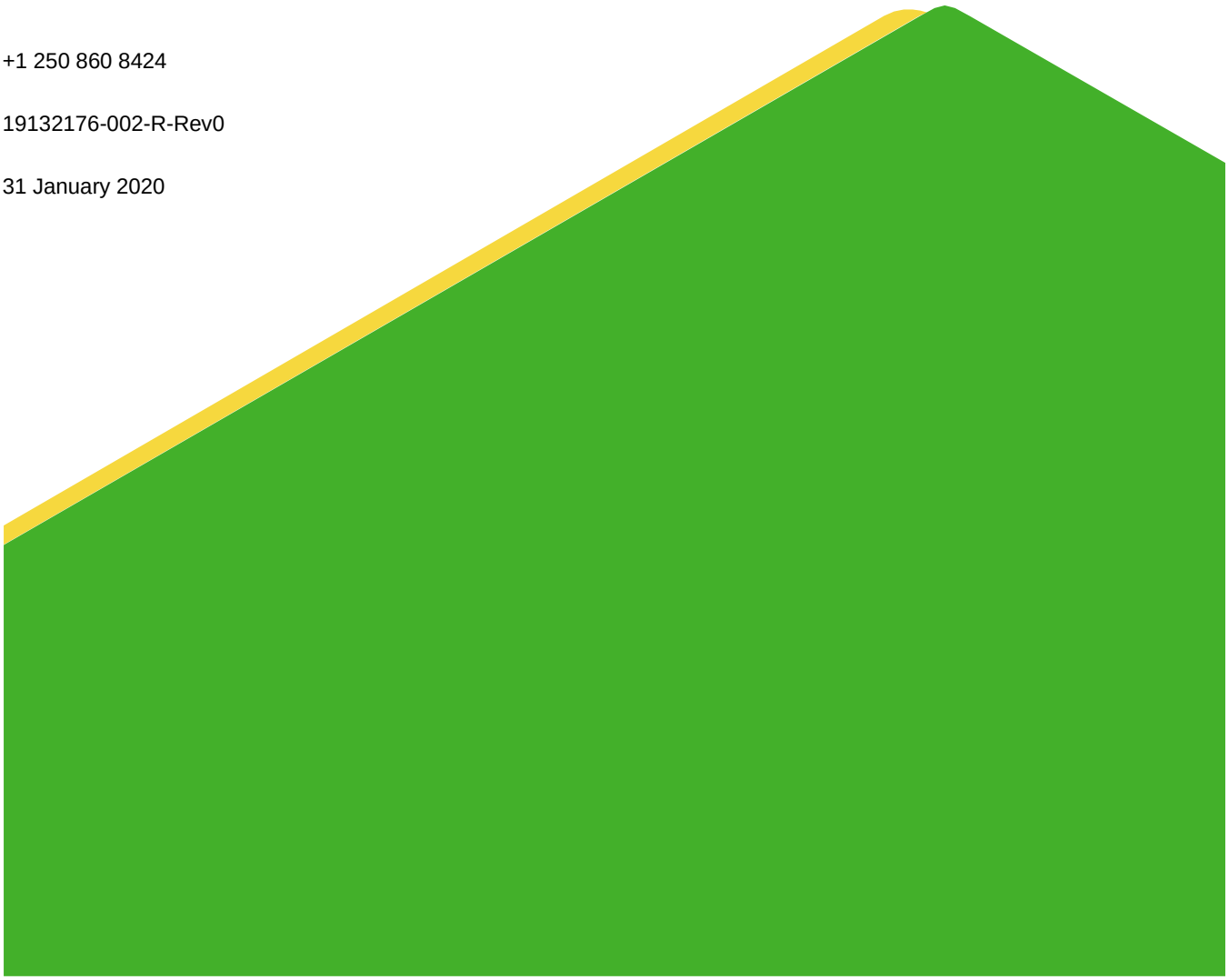
19132176-002-R-Rev0

31 January 2020



Distribution List

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1.0 INTRODUCTION

On behalf of the Regional District of North Okanagan (RDNO), Golder Associates Ltd. (Golder) conducted a groundwater study for the Keddleston area. The purpose of the study was to provide the RDNO with a better understanding of the current groundwater resources in the Keddleston area (specifically, provincially-mapped Aquifers 349, 350 and 351) and the groundwater development potential of the three aquifers, to support the RDNO in making informed decisions with regards to sustainable development in the Keddleston area with respect to groundwater supply.

Authorization to proceed with this study was provided by Mr. Alec Busby of the RDNO on 5 November 2019.

For this groundwater study, a Study Area was defined and included the extents of the Keddleston area (as provided by the RDNO and shown on Figure 1, attached). An inferred “catchment area” was defined for the three aquifers within the Keddleston area (as shown on Figure 2, attached) and includes upland areas that collect precipitation and are inferred to provide recharge to the Study Area aquifers. The catchment area is described in detail in Section 5.2 below.

2.0 SETTING

The Study Area is a semi-rural residential area, approximately 2,066.3 ha in size, and located immediately northeast of Vernon, BC, within portions of Electoral Areas “B” and “C” of the RDNO (Figure 1). At the time of writing, there were 636 lots within the Study Area, with approximately 495 of the lots developed as residential properties, based on property information provided to Golder by the RDNO. The remaining approximately 141 lots are inferred to be undeveloped. According to Agriculture Land Reserve (ALR) mapping (ALR 2019), approximately 260 ha of land within the Study Area is provincially zoned in the ALR (Figure 1). Ongoing development of the Study Area has occurred through the cumulative subdivision of larger sized lots, resulting in an increased density of water supply wells and an overall increase in groundwater extraction.

Domestic water supply to properties within the Study Area is primarily via individual on-site water supply wells, with the following exceptions:

- Approximately 24 residential properties and 5 undeveloped lots located on Aspen Road and Jackpine Road, in the central portion of the Study Area, are serviced by the Aspen Water Utility. The Aspen Water Utility supplies water via two groundwater wells that area located in the Aspen Road area and inferred to be completed in bedrock Aquifer 351.
- Approximately 18 properties in the area of Dixon Dam Road and Herbert Road, in the southwest corner of the Study Area, are serviced by Greater Vernon Water (GVW). GVW supplies water to this portion of the Study Area from the Duteau Creek surface water source located southeast (and outside) of the Study Area extents.
- Approximately 70 properties along the west side of the Study Area, from Glenhayes Road in the north to L & A Road and Grey Canal Road in the south, are serviced by GVW (Duteau Creek source).

Of the approximate 88 properties having a domestic service connection with GVW, one property in the Dixon Dam Road area and a number of properties along the west side of the Study Area also have an agricultural service connection with GVW or utilize their domestic connection with GVW for agricultural purposes, including irrigation. Some of these properties are located in the ALR and/or have “Farm Status” through the RDNO’s internal process or through BC Assessment. Sewage disposal in the Study Area is serviced via individual septic fields.

The distribution of registered water supply wells in the Study Area (colour-coded by aquifer) is shown on Figure 3. The provincial iMapBC website shows that approximately 309 water supply wells are present in the Study Area; however, not all drilled wells (particularly older wells) are registered with the province and, thus, unregistered wells are generally absent from provincial mapping sources. For this study, it has been assumed that water supply to each property is via a single private water supply well completed on that property, except for properties where water is supplied by the Aspen Water Utility or by GVW. For properties serviced by the Aspen Water Utility, it is assumed that water is supplied by the Utility via two community water supply wells; however, the amount of water used by each property is inferred to be equivalent to that used by a residential property with a single private water supply well. For properties connected to GVW, it is assumed that the domestic and/or agricultural water demands for each property are serviced by GVW (with water sourced from outside the Study Area extents). It is noted that one or more properties having a service connection to GVW may also operate a private water supply well; however, detailed well information for each property connected to GVW is not available.

3.0 BACKGROUND AND OBJECTIVE

In March 2007, Golder completed a groundwater availability study that was provided as part of a larger water supply strategic plan for the RDNO (Associated Engineering 2007). The groundwater availability study completed in 2007 by Golder, which is hereafter referred to as “Golder’s 2007 study”, focused on Aquifer 349, a confined aquifer that was inferred to be discontinuous and unconfined in areas, including areas bordering BX Creek, and (a portion of) Aquifer 351, a confined bedrock aquifer. For the purposes of Golder’s 2007 study, the extent of the Keddleston area did not include the northwest portion of Aquifer 351, nor did it include Aquifer 350, a bedrock aquifer located south of BX Creek. At the time of Golder’s 2007 study, anecdotal reports from residents in the Keddleston area suggested that many of the existing water wells had been chronically or periodically under-performing with respect to sustainable yield and residents with wells in Aquifer No. 351 (bedrock) reported more concerns with water quantity and quality than did residents with wells in Aquifer No. 349 (sand and gravel). It was not known whether reduction in the yields of some wells was a result of normal well aging processes. Golder’s 2007 study indicated that Aquifers 349 and 351 had limited capacity for further groundwater development, based on estimated water balance parameters (groundwater recharge and extraction) applied at the time of the 2007 study. As relatively low yields were noted for wells in both aquifers, it was inferred that development of a large capacity well, or well field, would not be feasible in either aquifer for the purpose of a community water supply. It was noted in Golder’s 2007 study that water wells with relatively higher yields were identified in Aquifer 350. Based on the higher reported yields and the bedrock composition (sedimentary rocks) of Aquifer 350, the aquifer was identified as having some potential for development of a community water system; however, it was deemed unlikely that it would have the capacity to serve the existing and potential future demands of the service area, as assessed by Associated Engineering (2007) at the time of the 2007 water supply strategic plan.

Hydrogeological assessments completed by various consultants since circa 2010 for single lot developments in the Keddleston area report that wells that have been completed in Aquifer 349 and 351 generally meet the RDNO’s proof of water requirements of 6.55 m^3/day (RDNO 2013).

The objective of the current groundwater study was to: update the conceptual hydrogeological model of the Study Area; refine parameters used in the previous annual water balance assessment; and assess the groundwater development potential of the Study Area in relation to the following five questions posed by the RDNO regarding future water supply for Keddleston, as presented in the RDNO's Request for Proposal #2019-U21: Keddleston Groundwater Study, issued 30 September 2019:

1) Can future development occur with individual wells without impacting neighbouring properties or the entire area water supply?

2) Is there a spatial consideration to allow for individual wells?

3) Can a community water system within the study area be supported by either an individual well or a number of wells within one or more aquifers?

4) If a community water system is an available option, what is the estimate of sustainable growth based on a preliminary estimate of the capacity available?

5) What are other available options with respect to supplying a community water system?

The current study is intended to assess overall groundwater development potential at the regional scale; a long-term sustainable groundwater supply at individual well locations and the potential for well interferences would need to be assessed with appropriately-designed pumping tests.

4.0 SCOPE AND METHODOLOGY

Golder conducted an information review as follows:

- Surficial and geological information was obtained from the provincial iMapBC website and the BC Geological Survey mapping website.
- Information regarding existing water supply wells within the Study Area, aquifer characteristics for Aquifers 349, 350 and 351, and other general hydrogeological information for the Study Area was obtained from the provincial iMapBC website, from hydrogeological reports provided by the RDNO for the Study Area and/or sourced online, and from interviews conducted with local drillers who have knowledge of drilling conditions in the Study Area.
- Groundwater level data from Ministry of Environment and Climate Change Strategy (MoE) observation wells (Active well 311 and Inactive well 322) were accessed from the provincial Groundwater Observation Well Network website.
- Historical climate data from a nearby weather station, Vernon North, was accessed from the Environment Canada website.
- Current and future zoning/land use plans was referenced from the RDNO mapping website.
- A Leapfrog viewer file for the BX Creek area (Stewart and Allard 2017) was used to generate vertical profiles at locations within the model to aid in the 3D visualization of the subsurface stratigraphy.

Golder developed water balance estimates for the Study Area using published mean groundwater recharge rates for the Study Area and estimated groundwater extraction rates for well users in the Study Area and in the upstream catchment area to the northeast of the Study area. A map was produced showing groundwater availability across the Study Area, based on the water balance estimates for the Study Area.

To aid in the interpretation of hydrogeological conditions in the Study Area, Golder also prepared two cross-sections. The locations of the cross-section lines are shown on Figure 3, attached. Cross-section A-A' is oriented in a northwest-southeast direction (Figure 4), while cross-section B-B' (Figure 5) is oriented in an east-west direction and runs at an oblique angle to cross-section A-A'. Well records used in the construction of the cross-sections are provided in Appendix A.

Based on a review and analysis of the information collected, Golder prepared this report that summarizes the conceptual hydrogeological model for the Study Area (including maps and cross-sections), provides an estimated water balance for the Study Area and discusses the potential for future water supply in the Study Area.

5.0 RESULTS

5.1 Topography and Surface Water

The Study Area is located east of the Swan Lake valley bottom, along the western flank of Silver Star Mountain, and includes the relatively narrow, steep-sided valley through which BX Creek flows (Figure 1). The catchment area includes lands up-gradient of the Study Area to the northeast, towards Silver Star Provincial Park, and southeast towards Dixon Lake (formerly the Dixon Dam and reservoir) (Figure 2).

Elevations in the Study Area range from 450 metres above sea level (masl) at the northwest corner of the Keddleston area to approximately 1,000 masl at the east (top) end of the Keddleston area. Elevations increase to approximately 1,800 masl towards to the top of the catchment area, at Silver Star Provincial Park.

BX Creek enters the Study Area from the east, from its origin in Silver Star Provincial Park, and exits to the southwest into the Swan Lake valley bottom and ultimately into Swan Lake (Figure 1). Several smaller creeks join BX Creek as it passes through the Study Area, including Keddleston and Abbott Creeks, which flow from the north, and Dixon Creek, which empties Dixon Lake from the south. Other unnamed creeks are present in the northwest portion of the Study Area; these generally drain to the west, towards the Swan Lake valley bottom.

5.2 Inferred Catchment Area

The catchment area that is inferred to receive precipitation upstream of, and within, the Study Area and provide recharge to the aquifers within the Study Area includes the provincially-mapped BX Creek topographic catchment as well as a predicted catchment area in the northwest corner of the Study Area, as follows:

- The provincially-mapped BX Creek topographic catchment extends from Silver Star Provincial Park at the headwaters of BX Creek to the (discontinued) streamflow gauge on BX Creek (EC 2019a; Gauge 08NM020) at the margins of the valley bottom (Figure 2). It is noted that the streamflow gauge on BX Creek coincides with the bottom (south) end of the Study Area. For the purposes of this study, the southern-most extent of the Keddleston area was included as part of this catchment area. The total area of the BX Creek topographic catchment, including the southern-most extent of the Keddleston area, is approximately 5,583 ha; with

approximately 3,538 ha present on the north side of BX Creek and approximately 2,045 ha present on the south side of BX Creek.

- The northwest portion of the Study Area and the associated upstream catchment area to the northeast are located outside of the BX Creek topographic catchment area. For the purposes of this study, a topographic catchment area termed “northwest catchment area” was developed for this area (Figure 2). The total area of the northwest topographic catchment is approximately 860 ha.

Surface water runoff (overland flow) within the catchment area is directed to creeks and other water bodies within each respective topographic catchment area. Historical hydrometric information for the streamflow gauge on BX Creek indicates that the streamflow gauge was in operation between 1921 and 1999. Mean monthly discharge over the period of record ranged from a minimum of 0.065 m^3/s (5,616 m^3/day) to a maximum of 0.900 m^3/s (77,760 m^3/day), with a mean of 0.298 m^3/s (25,747 m^3/day) (EC 2019a).

5.3 Geological Setting

5.3.1 Bedrock

The north portion of the Study Area, generally corresponding to the area north of BX Creek, is underlain by Proterozoic to Paleozoic undivided metamorphic rocks of the Shuswap Assemblage, while the south portion of the Study Area, generally corresponding to the area south of BX Creek, is underlain by Upper Triassic sedimentary rocks of the Nicola Group (BCGS 2019) (see Figure A below).

The Okanagan Valley was formed as a result of a major fault along the main axis of the valley and there is evidence for the existence of associated smaller faults along the flanks of the Valley, including stress faults and contraction faults. A normal fault has been mapped along the west side of the Study Area, parallel to the Okanagan Valley fault (see Figure A below). Another normal fault has been mapped at the northeast corner of the Study Area and appears to be correlated to the contact between metamorphic rocks of the Shuswap Assemblage to the north and sedimentary rocks of the Nicola Group to the south (see Figure A below). This fault appears to follow the BX Creek valley; and while the fault is shown to terminate at the northeast corner of the Study Area, it may extend further to the southwest along the metamorphic-sedimentary bedrock contact but is masked by the overlying surficial sediments within the BX Creek valley.

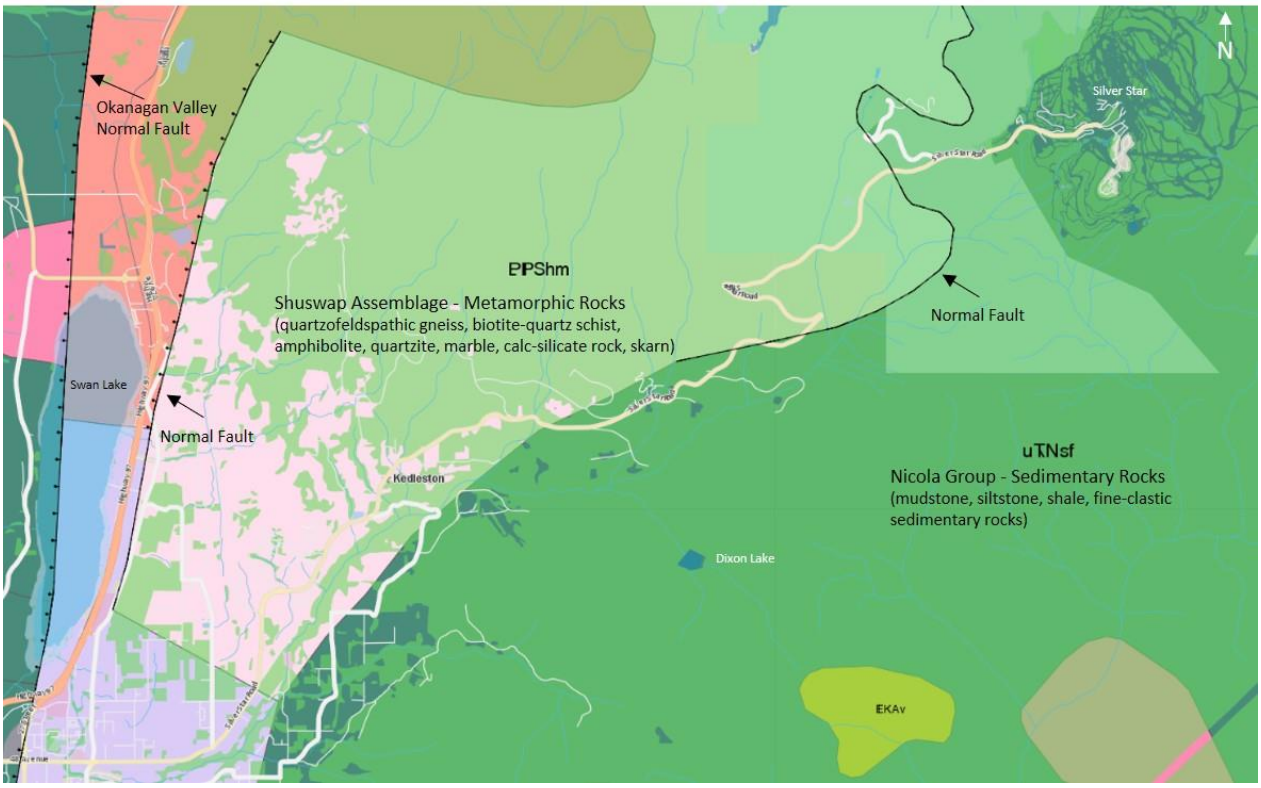

Figure A. Bedrock Geology of Study Area (BCGS 2019).

5.3.2 Unconsolidated Deposits

The bedrock in the Study Area is blanketed by a layer of unconsolidated glacial deposits comprising mostly till with some water-bearing sand, gravel and silt layers. The unconsolidated deposits are thickest on the north side of the BX Creek valley relative to those deposits on the south side of the BX Creek valley (Figure 4 and 5). At increasing distance laterally away from the BX Creek valley, and at increasing elevation towards the top of the catchment area, the surficial unconsolidated deposits trend to a thin veneer over bedrock or are not present. Within the BX Creek valley, glacial sediments have been modified by the erosive action of BX Creek. Alluvial deposits are inferred to be present within the drainage course of the tributaries of BX Creek and of smaller streams within the Study Area.

5.4 Climate

The climate in the Study Area consists of warm, dry summers and cool, moist winters. Golder reviewed climate normals from 1981 to 2010 for the Vernon North weather station, located at 50°20′39.6 N latitude and 119° 16′17 W longitude (EC 2019b). This weather station is located on the west side of Swan Lake, approximately 5 km northwest of the central portion of the Study Area, and at an elevation of approximately 538 masl. Daily average temperatures for the period between 1981 to 2010 ranged from a minimum of -0.2°C in February to a maximum of 21.0°C in July, with an annual daily average of 8.8°C. Total precipitation ranged from 25.2 mm in February to 57.5 mm in November, with an annual average of 487 mm.

5.5 Aquifer Characterization

Golder reviewed available hydrogeological information from the online iMapBC database. It is important to note that the information provided by iMapBC is based on historical records that have not been verified. Therefore, information contained in this database may be incomplete and may contain inaccuracies, especially with regards to reported well locations and the aquifer to which the well has been assigned. Furthermore, many well records in the database state the estimated yield in gallons per minute (gpm) without specifying US or Imperial units of measure. For the purposes of this report, the value was assumed to be reported in USgpm if the unit was not specified. Well yields are as reported by drillers and such yields are usually based on the results of airlift testing, which typically overestimates the long-term yield of the well. Where no formal pumping test data is provided, it is not possible to verify if the reported yields are representative or sustainable. Figure B below provides a spatial representation of reported well yields for the Study Area aquifer.

According to iMapBC, there are three main provincially mapped and classified aquifers in the Study Area: Aquifers 349, 350 and 351. The aquifers are described in the following sections.

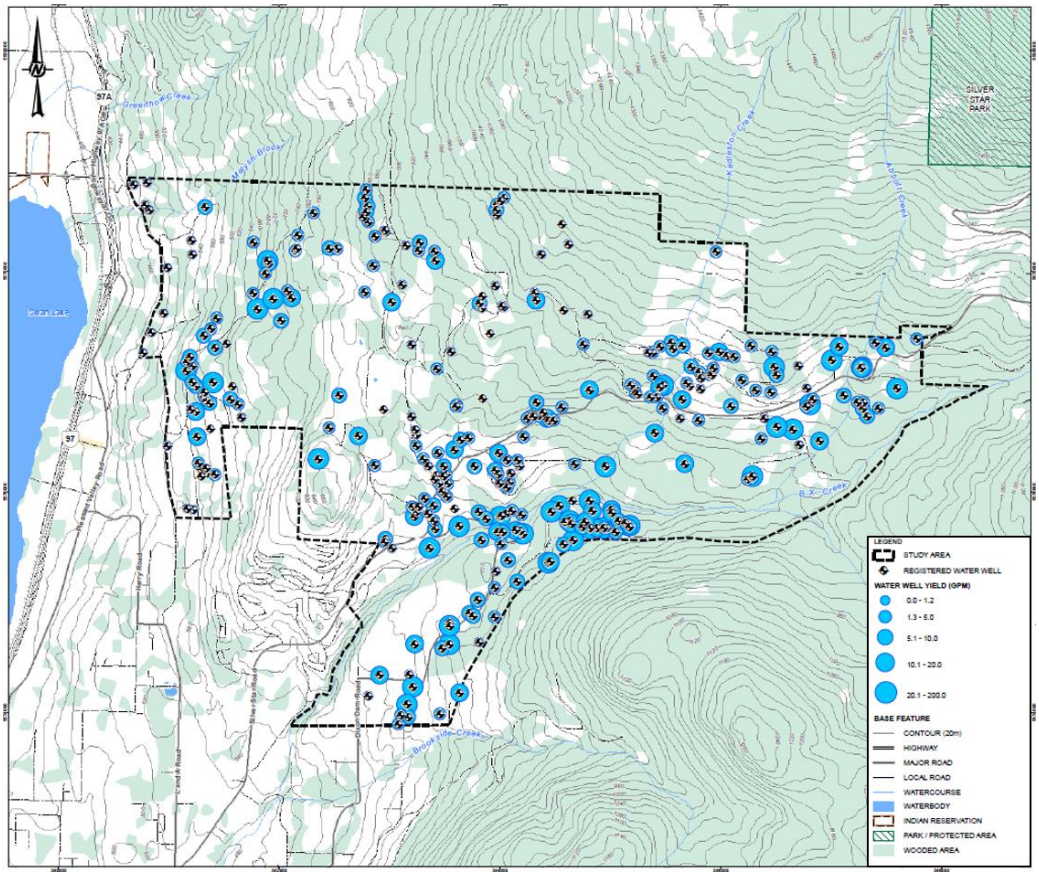

Figure B. Spatial distribution of reported well yields for registered wells in the Study Area

5.5.1 Aquifer No. 349

Aquifer No. 349 is a confined glacio-fluvial sand and gravel aquifer that is classified by the Province as IIC reflecting moderate demand relative to moderate productivity, and low vulnerability to contamination from surficial sources. This aquifer covers an area of approximately 25.5 km^2 and extends from the eastern boundary of the Study Area to the south end of Swan Lake (outside of the Study Area), generally following the BX Creek valley (Figure 2; the green line represents the aquifer extents as defined by ENV). Registered water wells associated with Aquifer 349 are shown in green on Figure 3. It is noted that based on a review of available water well records for wells completed in the north-central portion of Aquifer 349 (i.e., where the northern extent of Aquifer 349 forms a “peak” towards the north), the sand and gravel deposits associated with Aquifer 349 were not identified in this portion of the Study Area. Therefore, the northern extent of Aquifer 349 may not extend as far north as what is defined by ENV. Similarly, the southern extent of Aquifer 349 may not be as extensive as what is defined by ENV, based on a review of available water well records for wells completed along the south-central portion of Aquifer 349.

Within the Study Area, the sand and gravel deposits of Aquifer 349 are found to lie between the base of a thick till unit and the top of the bedrock surface (refer to cross-sections in Figure 4 and 5). The thickness of the sand and gravel deposits vary; and based on available water well records, the thickness ranges from approximately 0.1 m to 15 m, with an average thickness of 3.7 m. While Aquifer 349 appears to be confined in nature, it does not appear to be continuous within the provincially-mapped aquifer boundary. The cross-sections indicate the presence of thin perched sand and gravel layers within the till. The interconnectedness of these perched layers is not known.

Natural recharge to the aquifer is inferred to be predominantly from infiltration of precipitation and snowmelt along the edges of the aquifer on the sides of the valley, with some recharge contribution from bedrock inflows and stream leakage of BX Creek and its tributaries. Research conducted by Smerdon et al. (2009) in the BX Creek watershed (refer to Section 5.9.1 below for details of the research) reported that within the Study Area, BX Creek is a gaining stream (i.e., aquifer discharges to BX Creek); thus, stream leakage from BX Creek into the underlying sand and gravel deposits of Aquifer 349 may be minimal within the Study Area, except possibly during high flows (i.e., freshet) when the creek may provide some degree of recharge the aquifer. Smerdon et al. (2009) estimated that the volumetric flow rate of groundwater through Aquifer 349 at the south end of the Study Area (i.e., at the streamflow gauge) was 3,176 m^3/day (Golder infers that this flow rate is less a groundwater extraction rate of 356 m^3/day). For the current study, Golder corroborated the groundwater recharge estimates for Aquifer 349 from Smerdon et al. (2009) by calculating the approximate flow through the aquifer based on Darcy’s Law. Using a hydraulic conductivity value for sand and gravel of 10^{-4} m/s (Freeze and Cherry 1979), an average aquifer width of 1,250 m, an aquifer thickness of 3.7 m (as above) and a hydraulic gradient of 0.08 m/m (see Section 5.7.1), Golder calculated the groundwater flow through Aquifer 349 to be approximately 3,197 m^3/day, a value that is considered to be consistent with the groundwater flow rate assessed by Smerdon et al. (2009).

Based on a review of well records, there are 88 registered water wells completed in Aquifer 349 in the Study Area. The range of reported well yields was between 0.003 L/s to 3.8 L/s (0.05 USgpm to 60 USgpm), with an average reported yield of 0.6 L/s (10 USgpm). Static water levels in these wells were reported to range from 0.6 m to 73 m below ground surface (mbgs).

Approximately 19 registered wells located in Aquifer 349 and in the central portion and east end of the Study Area were reported to be flowing artesian at the time of drilling, with artesian flow values ranging from 0.0006 L/s to 1.9 L/s (0.01 USgpm to 30 USgpm).

Five wells within Aquifer 349 were reported as being dry. These wells did not have a reported yield value as they were either dry at the time of drilling or had been pumped dry and subsequently decommissioned. Final drilled depths at these locations ranged from 25 mbgs to 49 mbgs. Four of the dry wells were centrally located north to northwest of Tillicum Road and one dry well was present in east portion of the Study area, south of Jackpine Road.

5.5.2 Aquifer No. 350

Aquifer No. 350 is a fractured sedimentary rock aquifer that is classified IIC based on a low productivity under moderate demand and low vulnerability to contamination from surficial sources. This aquifer covers an area of approximately 7 km^2 and has been provincially mapped along the south side of BX Creek. Aquifer 350 is present along the southern boundary of the Study Area (Figure 2; the red line represents the aquifer extents, as defined by ENV). Registered water wells associated with Aquifer No. 350 are shown in red on Figure 3.

Based on a review of available water well records, there are 56 registered wells completed in Aquifer 350 within the Study Area. The range of reported well yields was 0.04 L/s to 3.8 L/s (0.6 USgpm to 60 USgpm), with an average yield of approximately 1.0 L/s (16 USgpm). Yields of wells in Aquifer 350 appear to be slightly higher than those in Aquifer 349. Static water levels in these wells were reported to range from 1.5 mbgs to 46 mbgs.

Natural recharge to Aquifer 350 is inferred to be predominantly from infiltration of precipitation and snowmelt at upstream areas within the catchment (where limited overlying surficial deposits are present), with some recharge contribution from leakage of the groundwater from the overlying unconsolidated aquifer (where Aquifer 349 overlies Aquifer 350) and stream leakage of BX Creek and its tributaries. The confined sand and gravel aquifer (Aquifer 349) overlies a small portion of bedrock Aquifer 350 in the south-central portion of the Study Area.

A number of high producing wells are located in the Dixon Dam Road area, along the south central boundary of the Study Area, and in the Ranch Road area, at the south end of the Study Area. The Dixon Dam Road wells are registered to Pure Canadian Waters Ltd. and Clearly Canadian Beverage, and it is understood that a water bottling company operated in this area in the 1990s and 2000s. It is not known if these wells are currently in use. An additional well in the Dixon Dam Road area exhibited flowing artesian conditions during drilling and reported an artesian flow value of 0.15 L/s (2.4 USgpm). Higher well yields may be related to the bedrock type, which may contain more frequent, wider and/or permeable fractures and/or may be due to the presence of a fault or contact zone between the metamorphic bedrock to the north and the sedimentary bedrock of Aquifer 350.

5.5.3 Aquifer No. 351

Aquifer No. 351 is a confined bedrock aquifer that is classified as IIC reflecting a low demand relative to a low productivity, and a low vulnerability to contamination from surficial sources. This aquifer covers an area of approximately 21.8 km^2 and covers the majority of the Study Area (Figure 2; the purple line represents the aquifer extents, as defined by ENV). Registered water wells associated with Aquifer No. 351 are shown in purple on Figure 3. There are 165 registered water wells completed within this aquifer. The depth to bedrock varies considerably over the extent of this aquifer, from shallow (<1 mbgs) in the northwest to as deep as 87 mbgs in some areas bordering Aquifer No. 349 in the east portion of the Study Area.

Natural recharge to Aquifer 351 is inferred to be predominantly from infiltration of precipitation and snowmelt at upstream areas within the catchment, with some recharge contribution from leakage of the groundwater from the overlying unconsolidated aquifer (where Aquifer 349 overlies Aquifer 351) and stream leakage. The confined sand and gravel aquifer (Aquifer 349) overlies a relatively large portion of bedrock Aquifer 351 in the central portion of the Study Area.

Based on available information, the hydraulic connection between bedrock fractures in Aquifer 350 and Aquifer 351 is not well characterized. Furthermore, it is not known how the fault or contact zone between the two bedrock types along the BX Creek valley, if present in the Study Area, influences the groundwater flow paths within, and between, the aquifers. As part of the research conducted by Smerdon et al. (2009), it was found that the groundwater chemistry within the sand and gravel deposits of Aquifer 349 and the surrounding bedrock fractures of Aquifers 350 and 351 (in the vicinity of Aquifer 349) exhibited similar geochemical compositions, suggestive of a common origin.

The range of reported well yields was 0.01 L/s to 3.8 L/s (0.2 USgpm to 60 USgpm), with an average yield at 0.4 L/s (7 USgpm). It is noted that one well located along the west boundary of the Study Area (and within the region of Aquifer 351) reported a well yield of 100 USgpm; however, this well was completed in granular deposits that may be associated with a separate localized aquifer. Static water level in the Aquifer 351 wells were reported to range from 1.5 mbgs to 143 mbgs.

Approximately 11 registered wells located in the northwest corner of the Study Area were reported to be flowing artesian at the time of drilling, with artesian flow values ranging from 0.0006 L/s to 0.32 L/s (0.01 USgpm to 5 USgpm).

Eleven wells located across Aquifer 351 were reported as being dry. The final drilled depth of these wells ranged from 30 mbgs to 256 mbgs.

5.6 Hydrostratigraphy

The unconsolidated and confined water-bearing sand and gravel deposits of Aquifer 349 are inferred to overlie bedrock on both sides of the BX Creek valley (Figures 2 and 3). Where the unconsolidated and confined sand and gravel deposits overly bedrock, groundwater resources may be found in the sand and gravel deposits and/or in bedrock fractures within the underlying bedrock mass. Groundwater resources may also be found in shallow (unconfined) alluvial deposits associated with tributaries of BX Creek and of smaller streams within the Study Area. A generalized illustration of this multi-aquifer system (also termed “stacked aquifers”) is provided on Figure C below.

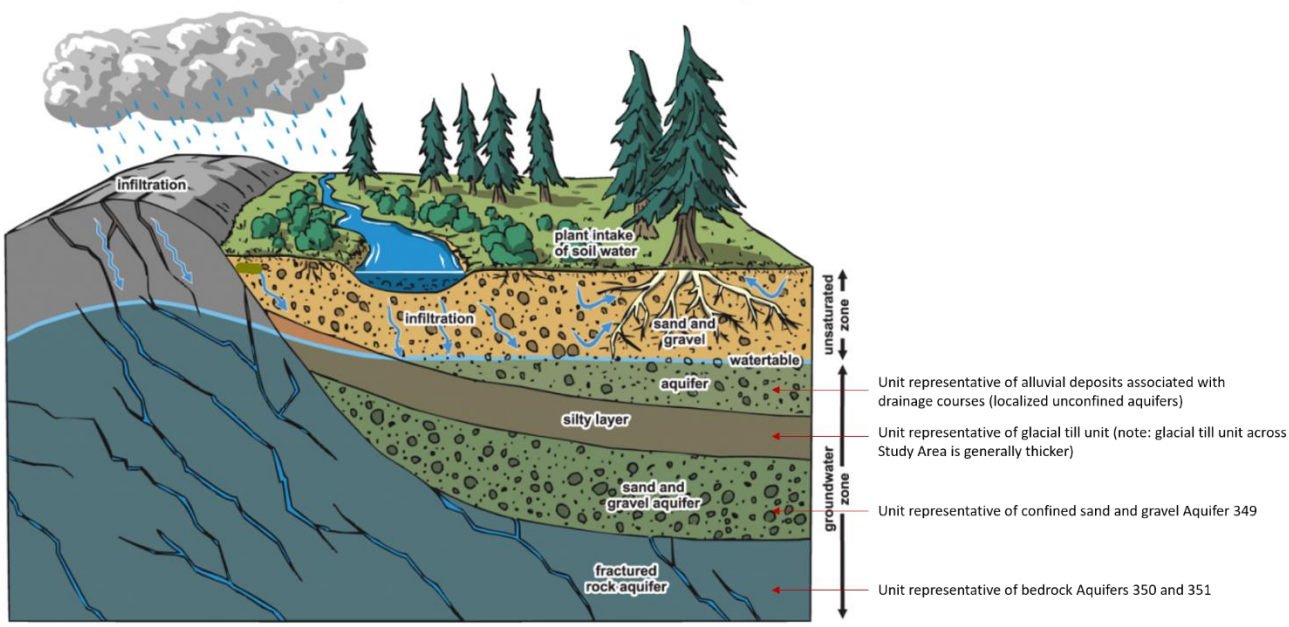

Figure C. Illustration of a multi-aquifer system
(taken from the Regional District of Nanaimo's website: http://rdnwaterbudget.ca/water-101/aquifers-groundwater/).

Based on a review of water well records for the Study Area, it was generally observed that where wells were completed in the water-bearing sand and gravel deposits, the driller did not advance further and thus, the depth to bedrock and associated bedrock fractures, if present at the location drilled, were not confirmed. At a few locations, water well records indicate that the base of the unconsolidated water-bearing sand and gravel deposits was underlain by glacial till (however, the thickness of the glacial till unit and the depth to bedrock were not confirmed at these locations). It is inferred that during drilling of a water supply well within the extents of Aquifer 349, if the driller encountered a sufficient supply of water in the sand and gravel deposits, then the well was completed in these deposits and if a sufficient supply of water was not encountered in the sand and gravel deposits, then the well was drilled into the bedrock until a productive water-bearing fracture(s) was encountered.

In some regions of BC, groundwater can be encountered at the interface between the unconsolidated deposits and the underlying bedrock surface, within a weathered or fractured bedrock zone. However, based on a review of available records for water well within the Study Area, wells were generally not completed within a weathered or fractured zone at the top of the bedrock. Instead, water wells appeared to be completed either in the sand and gravel deposits or at depth within the bedrock.

5.7 Groundwater Flow Direction and Hydraulic Gradient

On a regional scale, groundwater flow is inferred to be to the west-southwest, from the bedrock dominated upland areas east of the Study Area towards the Swan Lake valley bottom west of the Study Area. Estimates of the groundwater flow direction and horizontal hydraulic gradient in each aquifer were made using reported static water levels for selected water wells and summarized in the following sections. The spatial distribution and construction date of the wells were considered when selecting the wells used to evaluate the groundwater flow direction and hydraulic gradient in each aquifer.

5.7.1 Aquifer 349

The groundwater flow direction in Aquifer 349 north of BX Creek is inferred to be south to southwest, towards BX Creek, under a horizontal hydraulic gradient of approximately 0.08 m/m. It is inferred that within the BX Creek valley, the groundwater flow direction within the sand and gravel deposits is to the west in the upper portion of the Study Area and then to the southwest in the lower portion of the Study Area, in the direction of the BX Creek valley. The water wells and reported static water levels used to evaluate the groundwater flow direction and hydraulic gradient in Aquifer 349 are summarized in Table 1 below.

Table 1: Well Information used to evaluate groundwater flow in Aquifer 349

WTN	Approximate Ground Surface Elevation (masl)	Approximate Groundwater Elevation (masl)	Source
111907	1006	994	iMapBC
35032	703	679	iMapBC
104005	918	907	iMapBC
57624	788	774	iMapBC

5.7.2 Aquifer 350

The overall groundwater flow direction in bedrock Aquifer 350 is to the southwest, under a horizontal hydraulic gradient of approximately 0.05 m/m, assuming that fractures intersected by wells completed in Aquifer 350 are sufficiently interconnected. It is noted that several wells were completed at relatively greater depths within Aquifer 350, including WTN 112011 to a depth 152 mbgs and WTN 116458 to a depth of 195 mbgs. Reported static water levels at these deep wells were lower than those reported for surrounding wells that were completed at shallower depths in Aquifer 350, indicative of a downward hydraulic gradient in the bedrock (i.e., groundwater within the shallow bedrock fractures is inferred to be recharging bedrock fractures at depth). The water wells and reported static water levels used to evaluate the groundwater flow direction and hydraulic gradient in Aquifer 350 are summarized in Table 2 below.

Table 2: Well Information used to evaluate groundwater flow in Aquifer 350

WTN	Approximate Ground Surface Elevation (masl)	Approximate Groundwater Elevation (masl)	Source
112011 (deep well)	735	703	iMapBC
112012	628	610	iMapBC
112071	638	630	iMapBC
116465	714	696	iMapBC
116458 (deep well)	711	668	iMapBC
111917	710	664	iMapBC
111918	697	675	iMapBC
82618	757	722	iMapBC
63251	639	629	Golder, 2004

5.7.3 Aquifer 351

The overall groundwater flow direction in bedrock Aquifer 351 is to the west and southwest under a horizontal hydraulic gradient of approximately 0.10 m/m, assuming that fractures intersected by wells completed in Aquifer 351 are sufficiently interconnected. The water wells and reported static water levels used to evaluate the groundwater flow direction and hydraulic gradient in Aquifer 351 are summarized in Table 3 below.

Table 3: Well Information used to evaluate groundwater flow in Aquifer 351

WTN	Ground Surface Elevation (m)	Groundwater Elevation (m)	Source
109889	723	689	iMapBC
109890	691	676	iMapBC
109891	699	687	iMapBC
109892	722	716	iMapBC
113890	683	652	iMapBC
113891	582	554	iMapBC
111951	845	766	iMapBC
113935	581	562	iMapBC
50008	848	844	Western Water, 2012
37988	859	819	iMapBC
49632	657	648	Western Water, 2017
104171	1004	998	iMapBC

5.8 Aquifer Water Levels

5.8.1 MoE Observation Well OW322

MoE Observation Well OW322 (WTN 60266) is located in the Wallace Subdivision, in the central portion of the Study Area, and is completed in Aquifer 349. OW322 is completed in a thin, confined, water-bearing sand and gravel layer between 29.9 mbgs and 30.8 mbgs. According to Wei (1991), this is the area of Keddleston where the till deposits are thickest. Water levels in this well were monitored from 1993 to 2003 (see Figure D below); and the water level trends from this period were discussed in detail in Golder's 2007 Study. Golder's 2007 study reported that during the period from 1993 to 2003, the water level in the aquifer increased by approximately 2 m, with seasonal fluctuations ranging from 0.5 m to 1 m. The seasonal changes were considered small and inferred to likely not affect well production in this aquifer. There was no apparent correlation between the below-normal precipitation observed in 2000 and 2001, as water levels in OW322 continued to increase in 2000 and 2001. However, it may be possible that the lag time for declining water levels in the aquifer to manifest may have been longer than 2 years and further monitoring of this well beyond 2002 would have provided further information. It appears that water levels in OBS Well 322 become flowing artesian after circa 2000. At this time, the cause of the water level rise is not known.

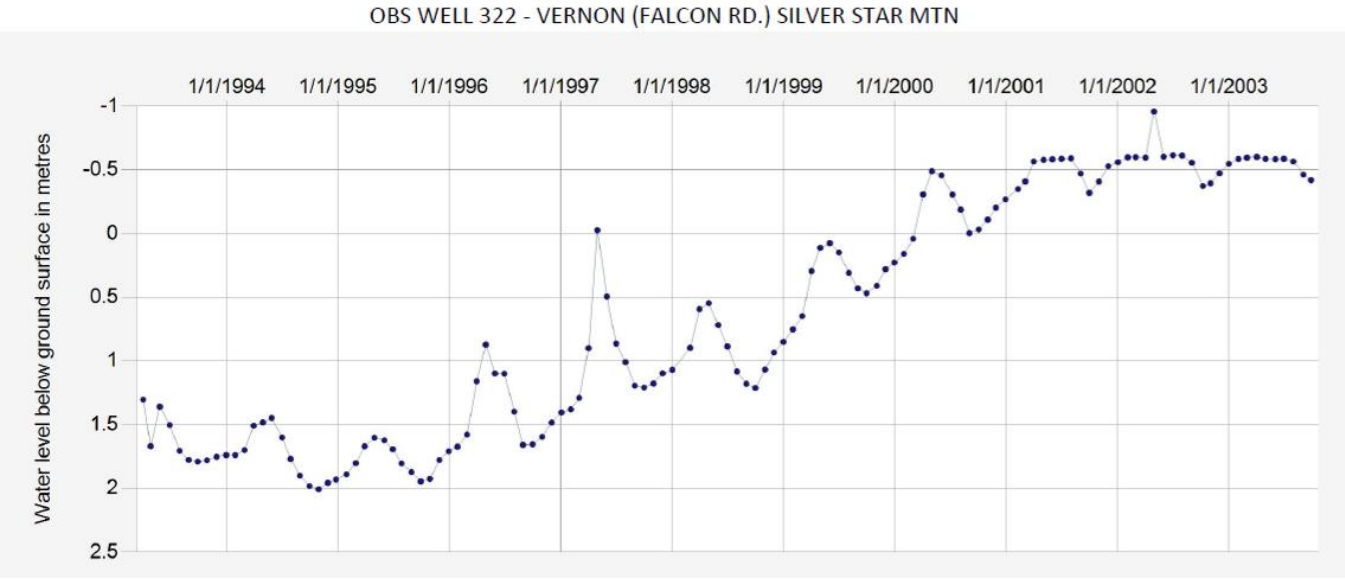

Figure D. Water levels in MoE Observation Well OW322 (MoE 2019).

5.8.2 MoE Observation Well OW311

MoE Observation Well OW311 (WTN 59305) is located on Keddleston Road, immediately north of Silver Star Road, in the central portion of the Study Area. OW311 is completed in bedrock Aquifer 351 to a depth of 93.6 mbgs. Water levels in this well were first monitored in 1991 and continue to be monitored today (see Figure E below). The data indicate that water levels in the bedrock aquifer are correlated with seasonal precipitation, with decreasing water levels occurring over the drier summer through early winter months and increasing water levels occurring over the wetter spring months. Decreasing water levels over the summer months are likely correlated with summer peak demand period. It is noted that water levels generally recover to within 0.1 m of the previous year's peak level.

It is apparent that water level changes have been more significant in OW311, which is completed within the bedrock aquifer, as opposed to OW322, which represents levels in the sand and gravel aquifer. The relatively larger fluctuations in the bedrock aquifer may reflect the lower storage capacity of bedrock.

In both observation wells, the observed changes do not appear to be related to a cumulative increase in pumping in the area, as water levels correlate with seasonal precipitation trends and recover to a relatively consistent high water level annually.

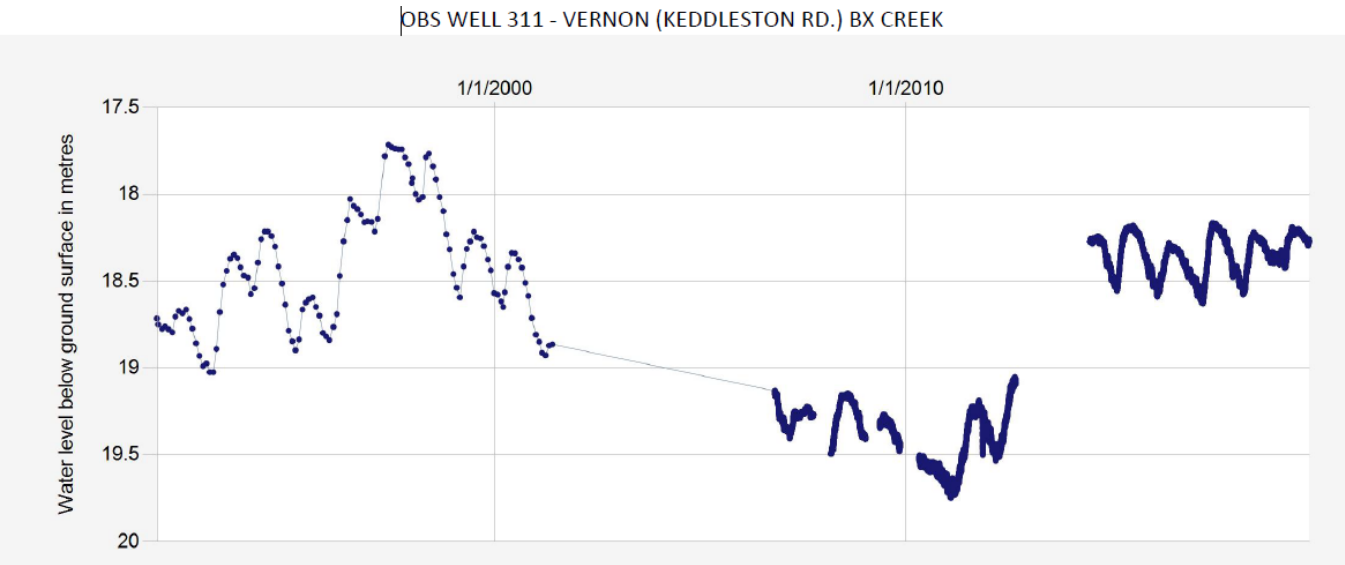

Figure E. Water Levels for MoE Observation Well OW311 (MoE 2019).

5.9 Annual Water Balance

Golder developed a water balance for the Study Area using published mean groundwater recharge rates for the Study Area and estimated groundwater extraction rates for well users in the Study Area and in the upstream catchment area to the northeast of the Study area. The following assumptions have been applied in the development of the water balance:

- groundwater recharge within the Study catchment area is primarily via infiltration of precipitation and snow melt to the subsurface, and precipitation and snowmelt from the entire catchment area is available for recharge of the aquifers in the Study Area
- water that recharges the higher elevation portions of the bedrock aquifers is available for extraction in lower elevation areas (i.e., a portion of the recharge does not report to a deeper regional flow regime)
- the published groundwater recharge rates have considered evapotranspiration and overland flow, and these parameters have not been further assessed in this study
- groundwater availability in the Study Area aquifers is available from the perspective of a water balance and does not consider environmental flow needs (EFNs) in surface water bodies
- there are a total of 495 developed residential properties within the Study Area. It is assumed that of the 495 developed residential properties, 25 of the developed residential properties in the area of Aspen Road and Jackpine Road obtain their water from the Aspen Water Utility and not via single private water wells. However, for water balance estimates made in this study, it has been assumed that the water usage at each residential property serviced by the Aspen Water Utility is similar to that used by a residential property with a single private water supply well. It is further assumed that the domestic and agricultural/irrigation water demands of the approximate 88 properties in the southwest corner and along the west side of the Study Area are serviced by GVW and that these properties do not operate private water supply wells. The domestic

and agricultural/irrigation water usage estimates for these approximate 88 properties are therefore not included in the water balance estimates.

- as only 309 registered wells are shown on the provincial database, an inference was made with respect to the distribution of the inferred current number of wells within the Study Area aquifers, based on the relative percentage of registered water wells within each aquifer. Additionally, at full build (assuming no lot subdivisions), a similar inference based on relative percentage of registered water wells was made with respect to the distribution of 636 wells within the Study Area aquifers
- as BX Creek is a gaining stream within the Study Area, leakage from the stream into the underlying aquifers is considered negligible; this is a conservative assumption with respect to a groundwater balance
- groundwater extraction by upgradient groundwater users within the upper catchment area is inferred to reduce recharge to the BX Creek topographic catchment area. Upgradient groundwater users include 12 residential lots in the Lander Road area and the Sovereign Lake ski resort near the top of the BX Creek catchment area. Groundwater extraction from the wells operating at the Silver Star ski resort are not considered in the estimates as they are generally inferred to be located outside the Study catchment area
- groundwater is currently being extracted for agricultural purposes in the ALR-zoned lands and used to irrigate all of the ALR-zoned lands. For comparison purposes, lower-bound scenarios have been included where groundwater is used to irrigate half of the ALR-zoned lands. Properties within the ALR-zoned lands that have a service connection with GVW (i.e., one property in the Dixon Dam Road area and a number of properties along the west side of the Study Area) have been excluded from the water balance estimates, as it is inferred that these properties obtain agricultural irrigation water from GVW and not private water supply wells.
- groundwater is not currently being extracted for water bottling purposes from bedrock Aquifer 350 in the Dixon Dam Road area.

5.9.1 Annual Groundwater Recharge Estimates

For the water balance, a mean recharge rate of 20 mm/year was used to represent the rate that precipitation recharges the subsurface in the northwest topographic catchment area; and a mean recharge rate of 30 mm/year was used to represent the rate that precipitation recharges the subsurface in the BX Creek topographic catchment area. The recharge rates were based on research conducted by Smerdon et al. (2009) in the BX Creek watershed, where a MIKE-SHE numerical model was developed to assist in predicting groundwater recharge in mountainous terrain. The study area in Smerdon et al. (2009) included the entire BX Creek watershed, from Silver Star Provincial Park at its upper extent to the valley bottom surrounding Swan Lake at its is lower extent; however, the focus of their study generally corresponded with the extents of the combined Study Area and catchment area defined in this study. Smerdon et al. (2009) found that within the BX Creek watershed, the groundwater recharge rate ranged from 0 mm/year to 20 mm/year at lower elevations (i.e., valley bottom) and increased with elevation in the upland areas to rates of 20 mm/year to 50 mm/year at the top of the watershed in Silver Star Provincial Park. The approximate mean recharge rate for the BX Creek watershed was 35 mm/year (Smerdon et al. 2009). It is noted that the current Study Area is not located within the area of the lower recharge rates presented by Smerdon et al. (2009) (i.e., not located within the area identified with recharge rates of 0 mm/year to 20 mm/year).

Although the Study Area and catchment area defined in this study are predominantly located in the upland regions of the BX Creek watershed, slightly lower mean recharge rates of 20 mm/year and 30 mm/year were used in this study, as follows:

- The northwest topographic catchment area lies within the lower range of recharge rates assessed by Smerdon et al. (2009) for the upland areas; thus, a recharge rate of 20 mm/year was used for the northwest topographic catchment area.
- The BX Creek topographic catchment area lies within the middle to high range of recharge rates assessed by Smerdon et al. (2009); however, the catchment area in this study did not include the entire upland area assessed by Smerdon et al. (2009). Thus, a conservative recharge rate of 30 mm/year was used for the BX Creek topographic catchment area.

The recharge rates of 20 mm/year and 30 mm/year are slightly lower than, but in general agreement with, the estimated annual groundwater recharge rate for the Okanagan Basin of approximately 7% of annual precipitation (Summit 2009), using the total annual precipitation at the Vernon North weather station of 487 mm (Environment Canada Climate Normals, 1981 - 2010; EC 2019b) over a total catchment area of 6,442.4 hectares (ha). The recharge rates of 20 mm/year and 30 mm/year also fall within the range of precipitation infiltration rates assessed in Golder-Summit (2009), where the percentage of the total annual precipitation anticipated to infiltrate into an aquifer ranges from 5% at lower elevations (i.e., where the approximate centroid elevation of the aquifer is less than 350 m) to 20% at higher elevations (i.e., where the approximate centroid elevation of the aquifer is greater than 800 m). It is also noted that in Golder (2007), approximately 4% of the mean annual total precipitation of 487 mm, or 19.4 mm/year, was used to represent the rate at which precipitation recharges groundwater. This rate of 19.4 mm/year is in line with the recharge rate of 20 mm/year that was used in this study for the (lower elevation) northwest topographic catchment area; and approximately 65% of the recharge rate of 30 mm/year that was used in this study for the (higher elevation) BX Creek topographic catchment area. It is inferred that application of a groundwater recharge rate of 4% of mean annual total precipitation to the Study Area may be underestimating the recharge of precipitation to groundwater within the higher elevation catchment area. Given that site-specific recharge rates were developed for the BX Creek watershed by Smerdon et al. (2009), recharge rates of 20 mm/year and 30 mm/year for the Study Area and catchment areas are more aligned with the research conducted by Smerdon et al. (2009) and have therefore been used in this study.

The distribution of recharge between areas in-filled with alluvium and the local surrounding bedrock areas is unclear; however, as in Smerdon et al. (2009), it is inferred that within the BX Creek catchment area the majority of infiltration (approximately 74%) is concentrated in the alluvium sand and gravel aquifer (Aquifer 349) and the remaining 26% of infiltration recharges the underlying and adjacent bedrock aquifers (Aquifers 350 and 351). In the northwest catchment area, it is assumed that 100% of infiltration is available for recharge to the bedrock system. Based on the geological setting and to allow for comparison of recharge to Aquifer 350 relative to that of Aquifer 351, it is inferred that the portion of the BX Creek catchment area located south of BX Creek provides the majority of recharge to the bedrock system south of BX Creek (i.e., to Aquifer 350), while the portion of the BX Creek catchment area located north of BX Creek provides the majority of recharge to the bedrock system north of BX Creek (i.e., to Aquifer 350).

5.9.2 Annual Groundwater Extraction Estimates

Without local metering, or an accurate account of how many water wells are in use in the Study Area, it is difficult to quantify the total annual groundwater use in the Study Area. However, groundwater extraction estimates were made using the following sources and assumptions:

- The Study Area is predominantly zoned for residential land use, as per the RDNO's zoning map and an examination of aerial imagery (GoogleEarth, 2018 imagery). Lower-bound and upper-bound estimates of potential groundwater use were estimated as follows:
  - A lower-bound approximation of the annual extraction rate for residential properties was estimated based on an average water use of 0.675 m^3/per person/day (OBWB 2009); the average water use of 0.675 m^3/per person/day includes an average indoor residential use of 0.15 m^3/day and a year-round average outdoor residential landscaping use of 0.525 m^3/day/person (OBWB 2009). Assuming an average number of persons per household of 2.6 (Census 2016; North Okanagan Electoral Area C), the lower-bound approximation of groundwater extraction was estimated to be 1.76 m^3/day.
  - An upper-bound approximation of the annual extraction rate for residential properties was estimated based on the RDNO's proof of water requirement of 6.55 m^3/day per lot (RDNO 2013). It is understood that this proof of water requirement is intended to provide assurance that adequate water is available for residential properties at the time of development and is higher than the anticipated water use.
- Using the online BC Agriculture water calculator (http://www.bcagriculturewatercalculator.ca/), it is estimated that for each 1 ha of agricultural land irrigated over a period of 140 days per year within the Study Area, the total annual irrigation water demand is approximately 1,918 m^3/year/ha (5.25 m^3/day/ha), assuming a forage crop, loam soils and sprinkler irrigation system.
- Groundwater extraction by upgradient groundwater users within the upper catchment area is inferred to include 12 residential properties in the Lander Road area that use groundwater at the lower- and upper-bound rates discussed above. Additionally, it was assumed that total groundwater use at Sovereign Lake ski resort was approximately 54 m^3/day (10 USgpm), representing water used in the lodge washrooms (there is no restaurant or overnight accommodations available at the lodge).

5.9.3 Water Balance Scenarios and Estimates

Table 4 summarizes the input (recharge from precipitation) and output (groundwater use for domestic and irrigation purposes) parameters for the Study Area aquifer, and Table 5 provides different scenarios with respect to the potential groundwater availability in each aquifer within the Study Area. Groundwater potential is discussed in Section 6.0.

Table 4: Summary of Water Balance Estimates for Study Area

Parameter	Value / Unit		Value / Unit	
BX Creek topographic catchment area (including south end of Study Area)	5,583	ha		
Northwest topographic catchment area (northwest portion of Study Area)	859	ha		
Total Catchment Area	6,442	ha		
Recharge Rates (Infiltration of Precipitation/Snowmelt)				
BX Creek topographic catchment area (including south end of Study Area)	30	mm/year		
Northwest topographic catchment area	20	mm/year		
Groundwater Extraction Estimates (Upstream Catchment Area)	***Lower-Bound Estimates***		***Upper-Bound Estimates***	
Groundwater extraction from upgradient groundwater users (in upstream catchment area)	75	m^3/day	133	m^3/day
Groundwater Recharge Estimates				
Groundwater Recharge available to aquifers within the Study Area	4,927	m^3/day	4,985	m^3/day
Groundwater Recharge to Aquifer 349 (assumes 74% of recharge rate infiltrates Aquifer 349 over the BX Creek topographic catchment area)	3,297	m^3/day	3,340	m^3/day
Groundwater Recharge to Aquifer 350 (assumes 26% of recharge rate infiltrates Aquifer 350 over the BX Creek topographic catchment area – South of BX Creek)	424	m^3/day	430	m^3/day
Groundwater Recharge to Aquifer 351 (assumes 26% of recharge rate infiltrates Aquifer 351 over the BX Creek topographic catchment area – North of BX Creek; and 100% of recharge rate infiltrates Aquifer 351 over the northwest catchment area)	1,205	m^3/day	1,215	m^3/day
Groundwater Extraction Estimates (within Study Area)	***Lower-Bound Estimates***		***Upper-Bound Estimates***	
Average Residential Water Use per Household over Study Area	1.76	m^3/day	6.55	m^3/day
Agricultural Irrigation – Aquifer 349	127	m^3/day	255	m^3/day
Agricultural Irrigation – Aquifer 350	183	m^3/day	366	m^3/day
Agricultural Irrigation – Aquifer 351	272	m^3/day	544	m^3/day

Table 5: Summary of Water Balance Scenarios for Study Area

Parameter	Value / Unit		Value / Unit	
	Lower-Bound Estimates of Groundwater Withdrawal		***Upper-Bound Estimates of Groundwater Withdrawal***	
Water Balance Scenarios (Aquifer 349)				
Groundwater withdrawal, assuming 135 wells pumping at current scale of development	364	m^3/day	1,139	m^3/day
- Percentage of water withdrawn relative to groundwater recharge	11	%	35	%
Groundwater withdrawal, assuming 175 wells pumping at full buildout	434	m^3/day	1,401	m^3/day
- Percentage of water withdrawn relative to groundwater recharge	13	%	42	%
Water Balance Scenarios (Aquifer 350)				
Groundwater withdrawal, assuming 85 wells pumping at current scale of development	332	m^3/day	922	m^3/day
- Percentage of water withdrawn relative to groundwater recharge	77	%	217	%
Groundwater withdrawal, assuming 110 wells pumping at full buildout	376	m^3/day	1,086	m^3/day
- Percentage of water withdrawn relative to groundwater recharge	87	%	256	%
Water Balance Scenarios (Aquifer 351)				
Groundwater withdrawal, assuming 187 wells pumping at current scale of development	600	m^3/day	1,769	m^3/day
- Percentage of water withdrawn relative to groundwater recharge	49	%	147	%
Groundwater withdrawal, assuming 263 wells pumping at full buildout	734	m^3/day	2,267	m^3/day
- Percentage of water withdrawn relative to groundwater recharge	60	%	188	%

Based on the review of available hydrogeological information for the Study Area and the water balance estimates provided above, the following inferences regarding groundwater availability in the Study Area can be made:

- The net water balance for the Study Area suggests that, in general, within the Study Area extents, bedrock Aquifer 350 has the least capacity for further development, followed by bedrock Aquifer 351 and, to a lesser degree, sand and gravel Aquifer 349.
- Under the lower-bound scenarios (i.e., average water use and irrigation of half of the ALR-zoned lands), the percentage of groundwater that is withdrawn from each aquifer relative to the estimated recharge to each aquifer is significantly lower than the upper-bound scenario (i.e., RDNO proof-of-water water use and irrigation of all of the ALR-zoned lands).
- The water balance estimates appear to be sensitive to the residential water use value utilized in the estimates. When the lower-bound average residential water use value of 1.75 m^3/day is used, a net positive water balance is obtained; however, when the upper-bound RDNO proof-of-water value of 6.55 m^3/day is used, a net negative water balance is obtained for bedrock aquifers 350 and 351. It is recognized that the RDNO proof-of-water value is more than three times higher than the average residential use value; however, as this is the rate that future developments in the Study Area are required to prove to the RDNO prior to development or subdivision, as applicable, the upper-bound value is considered to be a relevant value for considerations of groundwater potential for future development.
- The water balance estimates appear to be sensitive to the agricultural water use factor. Refinement of the irrigation values for the ALR-zoned lands and other agricultural lands in the Study Area would help to better constrain assessment of the groundwater availability and groundwater potential in the Study Area.
- The net water balance estimates can be further refined for each aquifer by confirming the total number of groundwater well users in each of the aquifers.

6.0 DISCUSSION OF GROUNDWATER POTENTIAL

Based on the results of the relative water balance estimates provided in Table 4. Golder assigned the following risk ratings to the aquifers in the Study Area as follows:

- Sand and gravel Aquifer 349 has a low to medium risk with respect to groundwater availability (i.e., current predicted groundwater withdrawals are less than half of the estimated recharge to the aquifer under the lower- and upper-bound scenarios).
- Bedrock Aquifer 351 has a medium to high risk with respect to groundwater availability; however, is dependent on the residential water use and extent of irrigation on lands overlying Aquifer 351. When the lower-bound estimates of residential water use and irrigation use are applied to the water balance in Aquifer 351, approximately 49% and 60% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively. However, when the upper-bound estimates of residential water use and irrigation use are applied, approximately 147% and 188% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively; these results are indicative that at the higher extraction rates more water is withdrawn from the aquifer than is being recharged. Bedrock Aquifer 350 has a high risk with respect to groundwater availability under both the lower- and upper-bound scenarios. When

the lower-bound estimates of residential water use and irrigation use are applied to the water balance in Aquifer 350, approximately 77% and 87% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively. However, when the upper-bound estimates of residential water use and irrigation use are applied, approximately 217% and 256% of water is predicted to be withdrawn from the aquifer relative to groundwater recharge, based on the current scale of development and full buildout, respectively; indicative that more water is withdrawn from the aquifer than is being recharged.

The results illustrate that groundwater availability is interpreted to be relatively higher in Aquifer 349, in the central portion of the Study Area; however, these results are general and do not necessarily reflect local scale factors. Based on the overall water balance results by aquifer, the potential for groundwater development in Aquifer 349 is generally considered to be feasible throughout the aquifer; but may be limited by aquifer thickness and/or lack of presence of the aquifer deposits in some locations. Bedrock Aquifer 350 is considered to have limited to no capacity for groundwater development, except potentially in the areas of Dixon Dam Road, along the south central boundary of the Study Area and Ranch Road, at the south end of the Study Area. Water balance estimates for Aquifer 350 show that even at the lower-bound groundwater usage values, groundwater use in Aquifer 350 is estimated to be similar to the predicted recharge. The potential for groundwater development in Aquifer 351 is generally considered to be limited; however, there are areas at the bottom (west) end of the aquifer that may have potential to supply groundwater to future developments in that part of the Study Area. As stated above, the current study is intended to assess overall groundwater development potential at the regional scale; a long-term sustainable groundwater supply at individual well locations and the potential for well interferences would need to be assessed with appropriately-designed pumping tests.

7.0 CONCLUSIONS

Based on the results of the current groundwater study, the following conclusions are made in the relation to the five questions posed by the RDNO regarding future water supply for Keddleston:

1) Can future development occur with individual wells without impacting neighbouring properties or the entire area water supply?

   In general, within the Study Area extents, sand and gravel Aquifer 349 is considered to have a higher relative potential to supply future development to individual properties compared to Aquifers 350 and 351. Based on domestic pumping rates and the hydrogeological properties of the sand and gravel aquifer, it is likely that relatively small domestic groundwater extraction rates from individual wells would not have an impact on neighbouring properties, and less of an impact on the entire water supply in Aquifer 349.

   It is inferred that bedrock Aquifer 351 may have limited potential for further development, while bedrock Aquifer 350 is estimated to have very limited to no capacity for further development. However, there are areas within Aquifers 350 and 351 where the potential for future residential development may be greater. Although there are many undeveloped areas within the Study Area where a water supply has not been established, water balance estimates show that groundwater use in Aquifers 350 and 351 is estimated to be similar or greater to the predicted recharge, particularly if ALR-zoned lands are being irrigated and/or if large capacity wells are in use (i.e., at the water bottling facility).

A detailed hydrogeological assessment would be required on a lot-by-lot basis to confirm groundwater availability, sustainability and potential well interference between neighbouring well users, and to assess EFN in nearby surface water bodies.

2) Is there a spatial consideration to allow for individual wells?

   See response in Question 1.

3) Can a community water system within the study area be supported by either an individual well or a number of wells within one or more aquifers?

   As discussed above, sand and gravel Aquifer 349 appears to have a higher relative potential for further development, and a community water system servicing a limited number of lots may be feasible in this aquifer. However, the thickness and presence of the sand and gravel aquifer varies across the Study Area, and this variability may limit the areas available for development of a community water system. Furthermore, it is recommended that refinements be made to the water balance estimates, as recommended in Section 8.0 below, prior to making further estimates of aquifer capacity. A detailed hydrogeological assessment would be required to confirm groundwater availability, sustainability and potential well interference between neighbouring well users, and to assess EFN in nearby surface water bodies.

   Although one or more wells could potentially be developed in the bedrock aquifers at locations that intersect productive bedrock fractures resulting in high well yield(s), based on the water balance estimates for Aquifer 350 and 351, development of a community water system in these aquifers is not considered to be feasible.

4) If a community water system is an available option, what is the estimate of sustainable growth based on a preliminary estimate of the capacity available?

   Based on the water balance estimates for Aquifer 349, approximately 13% and 42% of water is predicted to be withdrawn from Aquifer 349 relative to groundwater recharge, based on full buildout under the lower-bound and upper-bound scenarios, respectively. It is inferred that sustainable growth in terms of groundwater supply in Aquifer 349 may be feasible up to at least full buildout (i.e., approximately 175 lots) within the extents of Aquifer 349. As indicated above, a detailed hydrogeological assessment would be required on a lot-by-lot basis to confirm groundwater availability, sustainability and potential well interference between neighbouring well users, and to assess EFN in nearby surface water bodies within the extents of Aquifer 349.

5) What are other available options with respect to supplying a community water system?

   Drillers interviewed as part of this study noted that wells with higher yields may also be present further east (outside) of the Study Area, in the Forsberg Road area and at the first hairpin turn on Silver Star Road.

   Within the Study Area, there are a number of wells registered to Clearly Canadian Beverage and Pure Canadian Water Ltd. It is not known at this time whether the wells are currently in use. If not, and depending on the water quality, long-term sustainable well yields and potential for well interferences during pumping, as well as the transfer of well ownership, these wells may be a potential option for consideration as a community water source by the RDNO. However, these wells are completed in Aquifer 350, where water balance estimates prior to accounting for pumping of these wells at the (high) rates required to supply large amounts of water predict that groundwater use exceeds groundwater recharge.

   Other options with respect to supplying a community water system include connection to nearby existing water systems outside of the Study Area.

8.0 RECOMMENDATIONS

If the RDNO intends to assess the potential for development of a community water supply in the study area, based on the results of this groundwater study it is recommended that the following parameters used in the water balance estimates for the Study Area be refined:

- groundwater extraction by upgradient groundwater users.
- groundwater use for agricultural purposes in the ALR-zoned lands and other agricultural properties within the Study Area.
- groundwater extraction for commercial operations, such as for water bottling purposes.
- whether properties serviced by GVW for domestic and/or agricultural purposes also operate private water supply wells.
- total number of groundwater well users in the Study Area; this can be completed by conducting a detailed well survey of the Study Area (the results of the well survey would assist in understanding the distribution of wells in each aquifer).
- relative contribution of stream leakage, if any, to the Study Area aquifers and whether stream leakage, particularly into Aquifers 350 and 351, may increase the available groundwater in these aquifers; for the purposes of the water balance, it has been assumed that stream leakage to the aquifers is negligible, and therefore, no additional water from stream leakage was added to the aquifer recharge component in the water balance estimates.

A geological study could also be undertaken to identify major fracture zones in the bedrock within the Study Area, particularly along the BX Creek valley between Aquifer 350 to the south and Aquifer 351 to the north, to aid in locating potential sites for the construction of higher yielding bedrock wells.

If development of one or more groundwater supply wells within the Project Area are not considered feasible to supply a community water supply system, consideration could also be given to investigating the potential of water supply sources outside of the Study Area, including to the immediate east of the Study Area (near Forsberg Road) if future growth will result in an increase in water demand. However, further groundwater development in upgradient areas is expected to impact the water balance and the groundwater that is available in downgradient (lower elevation) portions of the Study Area.

9.0 LIMITATIONS

This report was prepared for the exclusive use of the Regional District of North Okanagan. The assessment was performed according to current professional standards and practices in the groundwater field and has been made using historical and technical data obtained from the sources noted within this report. Except where specifically stated to the contrary, the information contained in this report (including reports, information and data) was provided to Golder Associates Ltd. (Golder) by others and has not been independently verified or otherwise examined by Golder to determine its accuracy or completeness. Golder has relied in good faith on this information and does not accept responsibility of any deficiency, misstatements or inaccuracies contained in the report as a result of omissions, misinterpretation and/or fraudulent acts of the persons interviewed or contacted, or errors or omissions in the reviewed documentation. We accept no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or fraudulent acts of persons interviewed or contacted.

The services performed as described in this report were conducted in a manner consistent with the level of care and skill normally exercised by other members of the engineering and science professions currently practising under similar conditions, subject to the time limits and financial and physical constraints applicable to the services. Hydrogeological investigations and the development of conceptual site models are dynamic and inexact sciences. They are dynamic in the sense that the state of any hydrological-hydrogeological system is changing with time, and in the sense that the science is continually developing new techniques to evaluate these systems. They are inexact in the sense that subsurface conditions are not known between the specific investigation locations, and there is invariably a lack of complete information both spatially and temporally about the geological and hydrogeological conditions. The validity and accuracy of the conceptual model depends on the amount of data available relative to the degree of complexity of the geologic formations, the study area hydrogeology, and on the quality and degree of accuracy of the data entered. Therefore, every conceptual model is a simplification of reality and the model described in this report is not an exception.

The content of this report is based on information collected during the study, our present understanding of site conditions, the assumptions stated in this report, and our professional judgement in light of such information at the time of this report. This report provides a professional opinion and, therefore, no warranty is expressed, implied, or made as to the conclusions, advice and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statutes are subject to change.

The findings and conclusions of this report are valid only as of the date of the report. If new information is discovered in future work, or if the assumptions stated in this report are not met, Golder should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Any use which third parties make of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Golder Associates Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

10.0 CLOSURE

We trust that this report provides you with the information you require at this time. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Golder Associates Ltd.

Danielle Wiesner, EIT
Environmental Engineer

Pana Athanasopoulos, MSc, PGeo
Senior Hydrogeologist

Reviewed by:

Mark Bolton, MSc, PGeo
Associate, Senior Hydrogeologist

DW/PA/MB/lih

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https://golderassociates.sharepoint.com/sites/117390/project files/6 deliverables/issued to client_for wp/19132176-002-r-rev0/19132176-002-r-rev0-keddleston gw study 30jan_20.docx

11.0 REFERENCES

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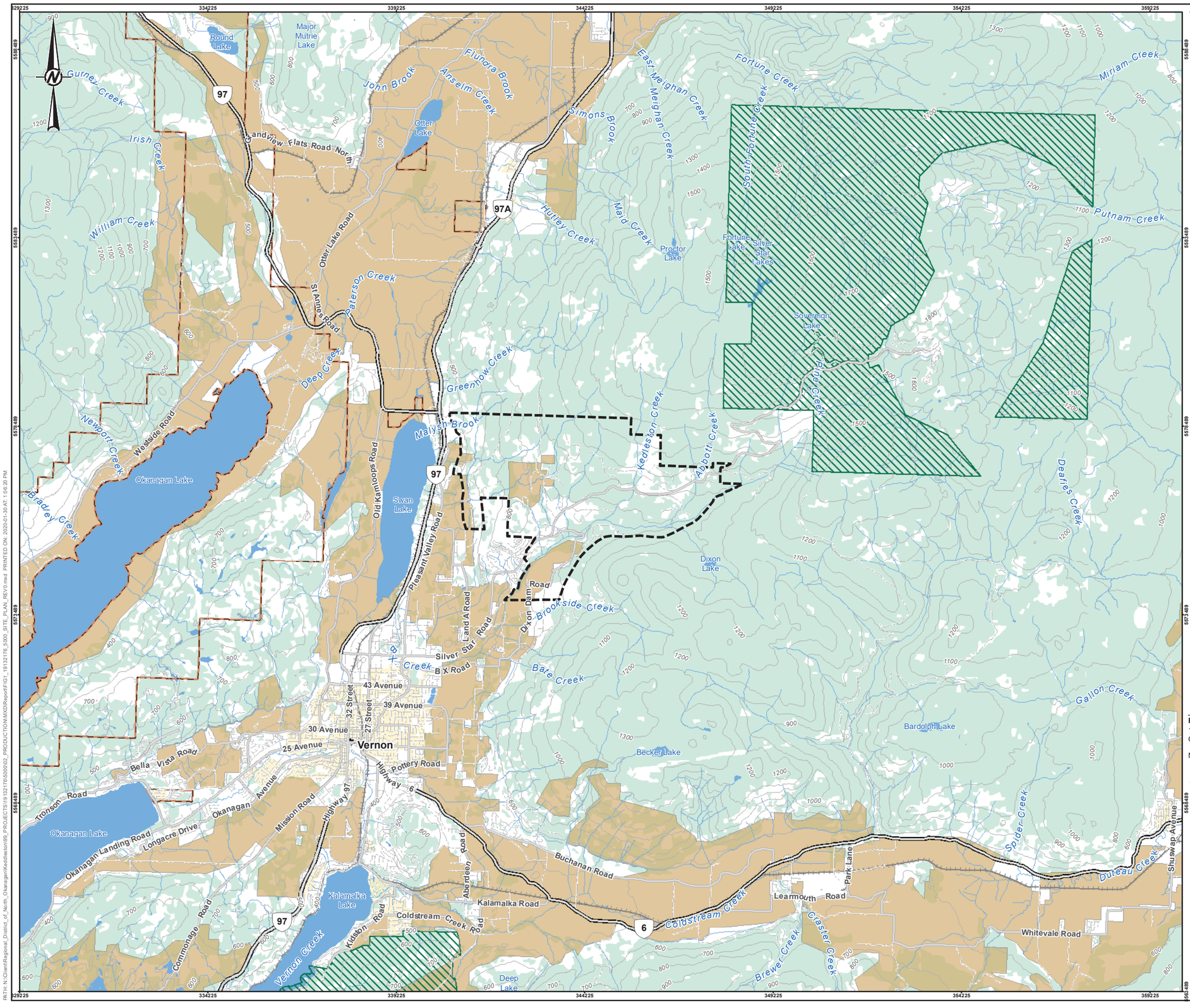
SOURCES OF INFORMATION

Parameter	Source
Catchment areas	Study Area extents and Parcel Map BC (accessed 2019-12-11) Ministry of Citizens Services – DataBC (https://catalogue.data.gov.bc.ca/dataset/4cf233c2-f020-4f7a-9b87-1923252fbc24)
Annual Groundwater Recharge rates	Smerdon et al. (2009)
Average Domestic Water Use per Household (Lot) over Study Area Extents	Average Water Use of 0.675 m3/day: https://www.obwb.ca/wsd/water-usage/residential-water-use 2.6 Person/Household: Statistics Canada; Census Profile, 2016 Census North Okanagan C, Regional district electoral area [Census division], British Columbia Total number of lots in Study Area (636 lots): Study Area extents and Parcel Map BC (accessed 2019-12-11) Ministry of Citizens Services - DataBC (https://catalogue.data.gov.bc.ca/dataset/4cf233c2-f020-4f7a-9b87-1923252fbc24)
Agricultural Irrigation	Online BC Agriculture Water Calculator (http://www.bcagriculturewatercalculator.ca/)

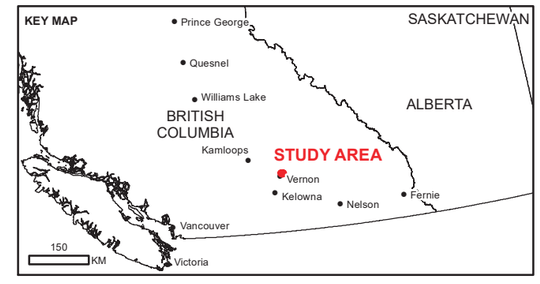


LEGEND

- STUDY AREA

BASE FEATURE

- CONTOUR (20m)
- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- RAILWAY
- WATERCOURSE
- INDIAN RESERVATION
- PARK / PROTECTED AREA
- RESIDENTIAL AREA
- AGRICULTURAL LAND RESERVE
- WOODED AREA



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REFERENCE(S)

1. CONTAINS INFORMATION LICENCED UNDER THE OPEN GOVERNMENT LICENCE – BRITISH COLUMBIA

NAD 1983 UTM ZONE 11N

CLIENT
REGIONAL DISTRICT OF NORTH OKANAGAN

PROJECT
KEDDLESTON GROUNDWATER STUDY

TITLE
STUDY AREA

CONSULTANT
GOLDER

YYYY-MM-DD	2019-11-07
DESIGNED	PA
PREPARED	JG
REVIEWED	PA
APPROVED	MB

PROJECT NO.	CONTROL	REV.	FIGURE
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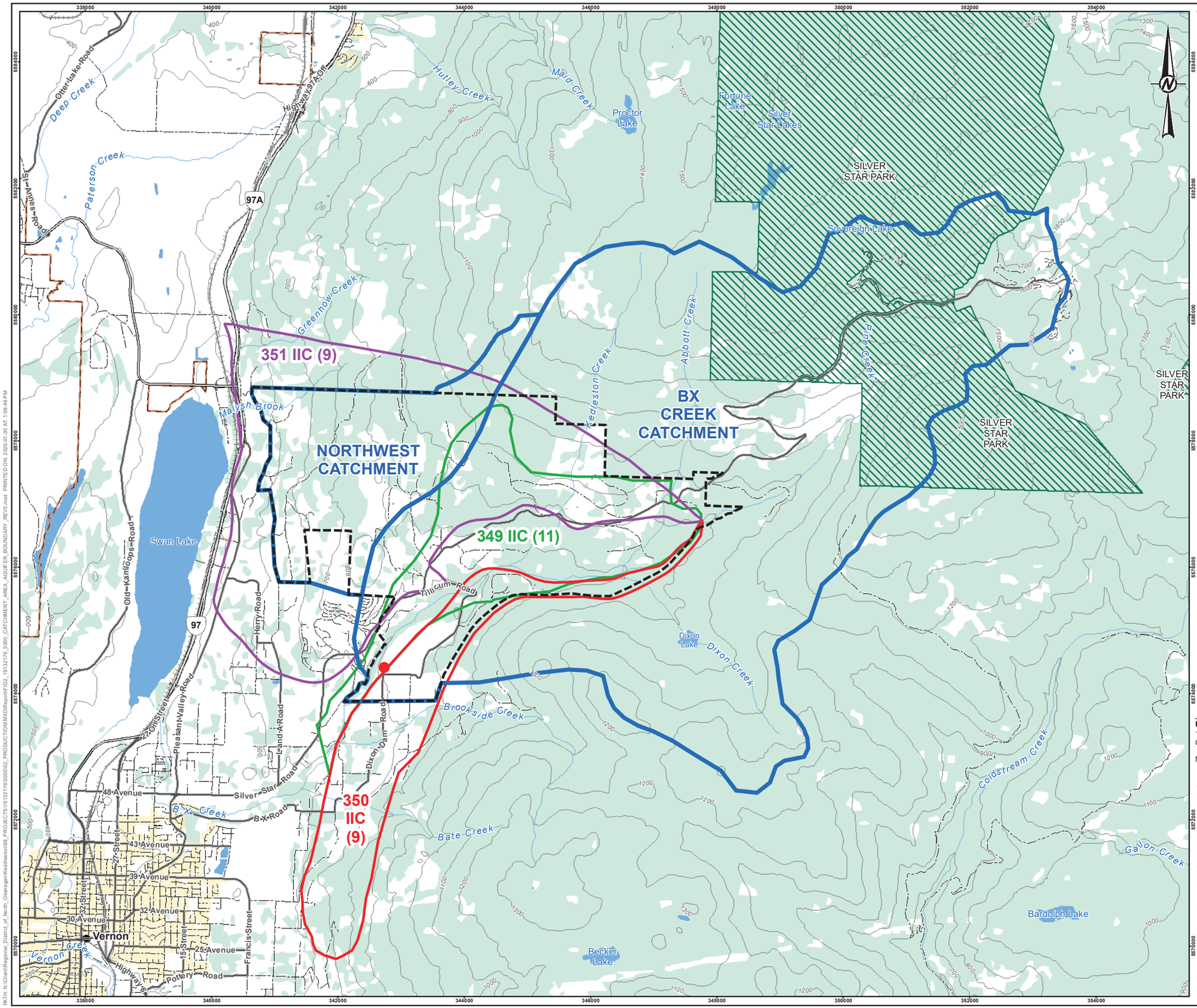

LEGEND

- STUDY AREA
- HYDROMETRIC STATION (B.X. CREEK ABOVE VERNON INTAKE)

AQUIFER EXTENT AND NAME

- 349 IIC (11)
- 351 IIC (9)
- 350 IIC (9)
- CATCHMENT AREA

BASE FEATURE

- CONTOUR (20m)
- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- INDIAN RESERVATION
- PARK / PROTECTED AREA
- WOODED AREA
- RESIDENTIAL AREA

0 1 2

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REFERENCE(S)

1. CONTAINS INFORMATION LICENCED UNDER THE OPEN GOVERNMENT LICENCE – BRITISH COLUMBIA

NAD 1983 UTM ZONE 11N

CLIENT
REGIONAL DISTRICT OF NORTH OKANAGAN

PROJECT
KEDDLESTON GROUNDWATER STUDY

TITLE
CATCHMENT AREAS AND AQUIFER BOUNDARIES

CONSULTANT
GOLDER

YYYY-MM-DD	2019-11-07
DESIGNED	PA
PREPARED	JG
REVIEWED	PA
APPROVED	MB

PROJECT NO.	CONTROL	REV.	FIGURE
19132176	5000	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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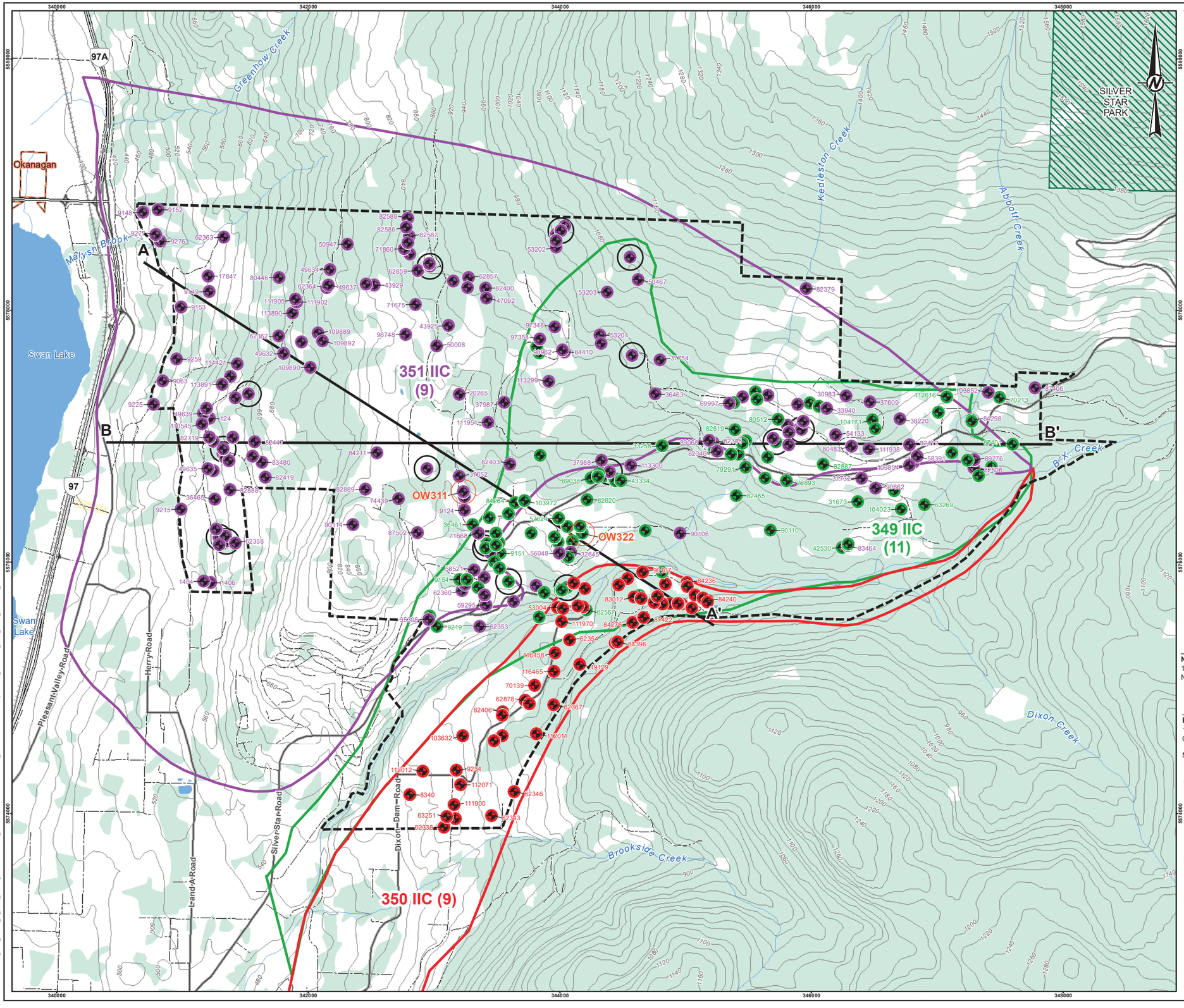

LEGEND

- STUDY AREA
- DRY WELL
- OBSERVATION WELL (OW311 & OW322)

REGISTERED WATER WELL CLASSIFIED BY AQUIFER

- 349 IIC (11)
- 350 IIC (9)
- 351 IIC (9)

AQUIFER NAME AND EXTENT

- 349 IIC (11)
- 350 IIC (9)
- 351 IIC (9)
- SECTION

BASE FEATURE

- CONTOUR (20m)
- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- INDIAN RESERVATION
- PARK / PROTECTED AREA

0 500 1,000

1:30,000 METRES

NOTE(S)

1. ALL PUBLICALLY AVAILABLE REGISTERED WATER WELLS ARE DISPLAYED ON THIS MAP BUT NOT ALL WATER WELLS ARE LABELLED.

REFERENCE(S)

1. CONTAINS INFORMATION LICENCED UNDER THE OPEN GOVERNMENT LICENCE – BRITISH COLUMBIA

NAD 1983 UTM ZONE 11N

CLIENT
REGIONAL DISTRICT OF NORTH OKANAGAN

PROJECT
KEDDLESTON GROUNDWATER STUDY

TITLE
REGISTERED WATER WELL CLASSIFIED BY AQUIFER

CONSULTANT
GOLDER

YYYY-MM-DD	2019-12-20
DESIGNED	PA
PREPARED	JG
REVIEWED	PA
APPROVED	MB

PROJECT NO.	CONTROL	REV.	FIGURE
19132176	5000	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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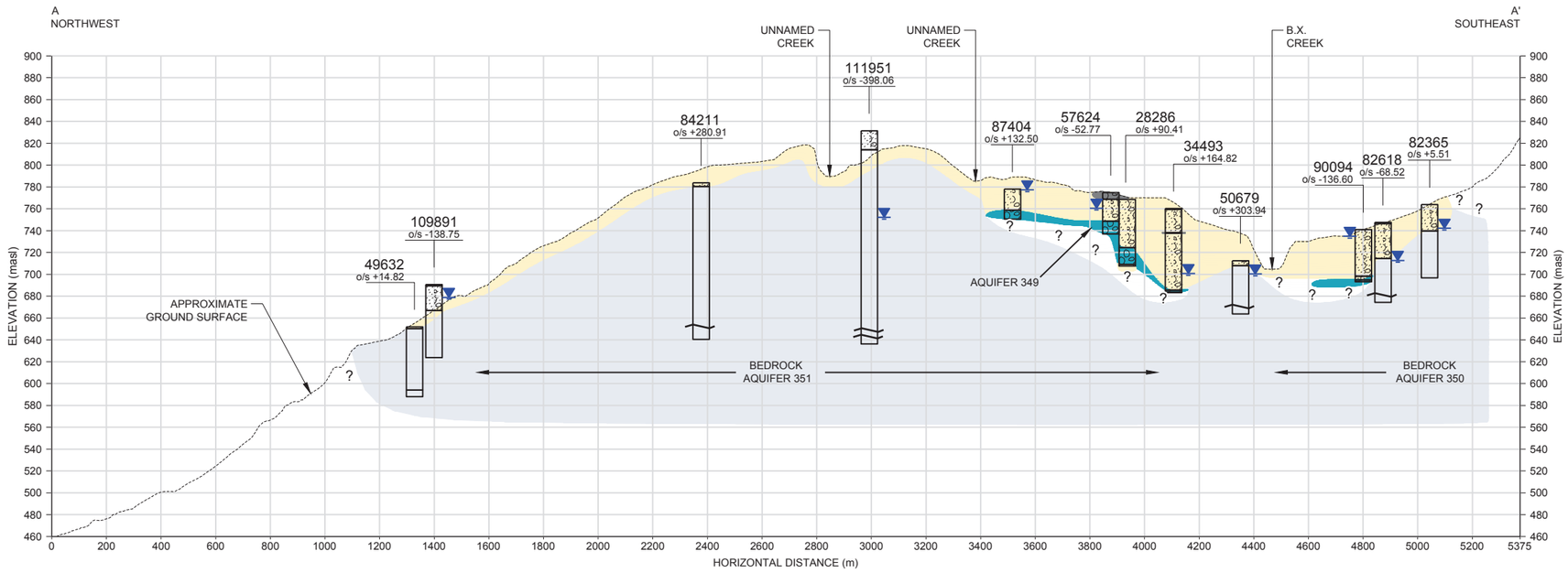

HORZ SCALE 1:20000
VERT SCALE 1:5000

A
3

CROSS-SECTION A-A'

LEGEND

- APPROXIMATE GROUND SURFACE
- LOCATION OFFSET (o/s) — SOIL STRATIGRAPHY
- APPROXIMATE GROUNDWATER ELEVATION BASED ON STATIC WATER LEVEL REPORTED ON DRILLER'S WELL RECORD AT TIME OF DRILLING (WHERE AVAILABLE)
- APPROXIMATE FRACTURE DEPTH, WHERE REPORTED ON DRILLER'S WELL RECORD

TEST HOLE GRAPHICS

- BEDROCK
- SAND
- GRAVEL
- TILL

INFERRED STRATIGRAPHIC LAYER

- BEDROCK
- TILL/CLAY
- AQUIFER 349
- SHALLOW UNCONFINED/ CONFINED DEPOSITS

NOTE

1. GROUND SURFACE IS APPROXIMATE (BASED ON REGIONAL DISTRICT OF THE NORTH OKANAGAN CONTOUR DATA)
2. ? INDICATES THAT THE ELEVATION OF THE BEDROCK SURFACE IS NOT KNOWN; AS PER WELL LOG, DRILLING TERMINATED IN SAND AND GRAVEL AND DID NOT TAG UNDERLYING BEDROCK

THIS DRAWING IS INTENDED FOR CLIENT'S ONE TIME USE ONLY AND IT IS NOT INTENDED OR REPRESENTED BY GOLDER TO BE SUITABLE FOR REUSE BY ANY PARTY, INCLUDING, BUT NOT LIMITED TO, THE CLIENT, ITS EMPLOYEES, AGENTS, SUBCONTRACTORS OR SUBSEQUENT OWNERS ON ANY EXTENSION OF A SPECIFIC PROJECT OR FUTURE PROJECTS, WHETHER CLIENT'S OR OTHERWISE, WITHOUT GOLDER'S PRIOR WRITTEN PERMISSION. ANY MANIPULATION, ADAPTATION, MODIFICATION, ALTERATION, MISUSE OR REUSE UNAUTHORIZED BY GOLDER WILL BE AT CLIENT'S SOLE RISK. GOLDER EXPRESSLY DISCLAIMS ALL LIABILITY AGAINST ALL THIRD PARTIES RELYING, USING OR MAKING DECISIONS ON THIS DRAWING. THIRD PARTIES DO SO AT THEIR OWN RISK. EXCEPT WHERE WRITTEN AGREEMENT STATES OTHERWISE, THIS DRAWING IS THE PROPERTY OF GOLDER ASSOCIATES LTD.

0 100 200
1:5,000 (VERTICAL) METRES

0 500 1,000
1:20,000 (HORIZONTAL) METRES

CLIENT
REGIONAL DISTRICT OF THE NORTH OKANAGAN

CONSULTANT
GOLDER

YYYY-MM-DD	2019-12-30
DESIGNED	PA
PREPARED	RTJ
REVIEWED	PA
APPROVED	MB

PROJECT
KEDDLESON GROUNDWATER STUDY

TITLE
CROSS-SECTION A-A'

PROJECT NO.	PHASE	REV.	FIGURE
19132176	5000	0	4

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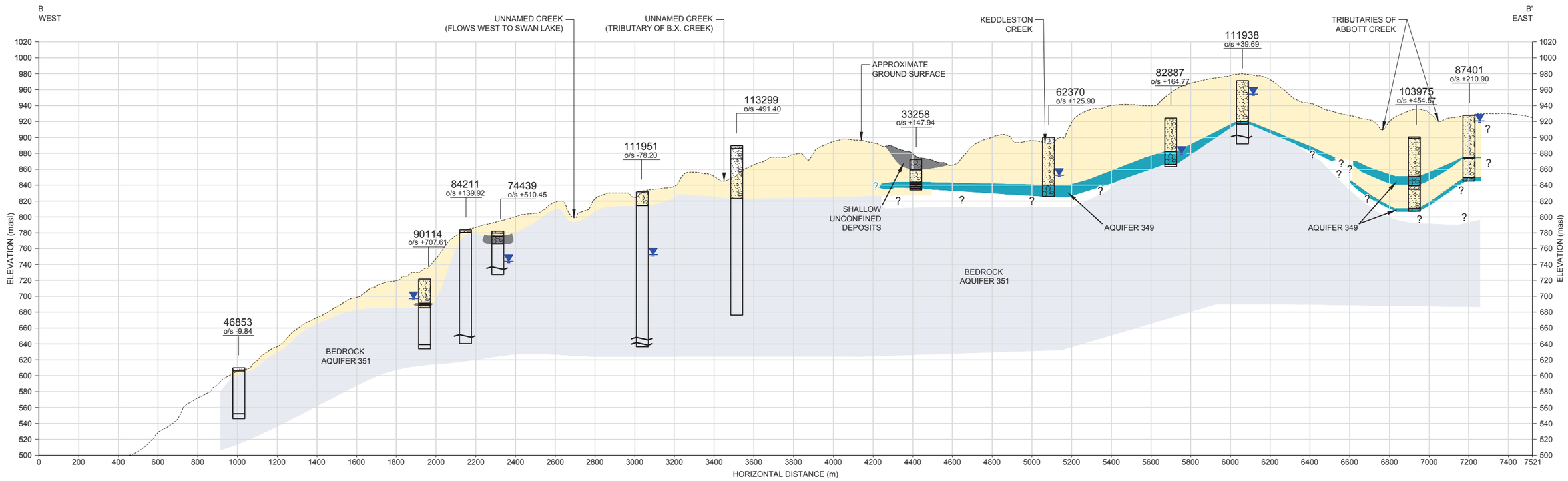

HORZ SCALE 1:20000
VERT SCALE 1:5000

B 3 CROSS-SECTION B-B'

LEGEND

- APPROXIMATE GROUND SURFACE
- LOCATION OFFSET (o/s)
- SOIL STRATIGRAPHY
- APPROXIMATE GROUNDWATER ELEVATION BASED ON STATIC WATER LEVEL REPORTED ON DRILLER'S WELL RECORD AT TIME OF DRILLING (WHERE AVAILABLE)
- APPROXIMATE FRACTURE DEPTH, WHERE REPORTED ON DRILLER'S WELL RECORD

TEST HOLE GRAPHICS

- BEDROCK
- SAND
- GRAVEL
- TILL

INFERRED STRATIGRAPHIC LAYER

- BEDROCK
- TILL/CLAY
- AQUIFER 349
- SHALLOW UNCONFINED/ CONFINED DEPOSITS

NOTE

1. GROUND SURFACE IS APPROXIMATE (BASED ON REGIONAL DISTRICT OF THE NORTH OKANAGAN CONTOUR DATA)
2. ? INDICATES THAT THE ELEVATION OF THE BEDROCK SURFACE IS NOT KNOWN; AS PER WELL LOG, DRILLING TERMINATED IN SAND AND GRAVEL AND DID NOT TAG UNDERLYING BEDROCK

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0 100 200
1:5,000 (VERTICAL) METRES

0 500 1,000
1:20,000 (HORIZONTAL) METRES

CLIENT
REGIONAL DISTRICT OF THE NORTH OKANAGAN

CONSULTANT
GOLDER

YYYY-MM-DD	2019-12-30
DESIGNED	PA
PREPARED	RTJ
REVIEWED	PA
APPROVED	MB

PROJECT
KEDDLESON GROUNDWATER STUDY

TITLE
CROSS-SECTION B-B'

PROJECT NO.	PHASE	REV.	FIGURE
19132176	5000	0	5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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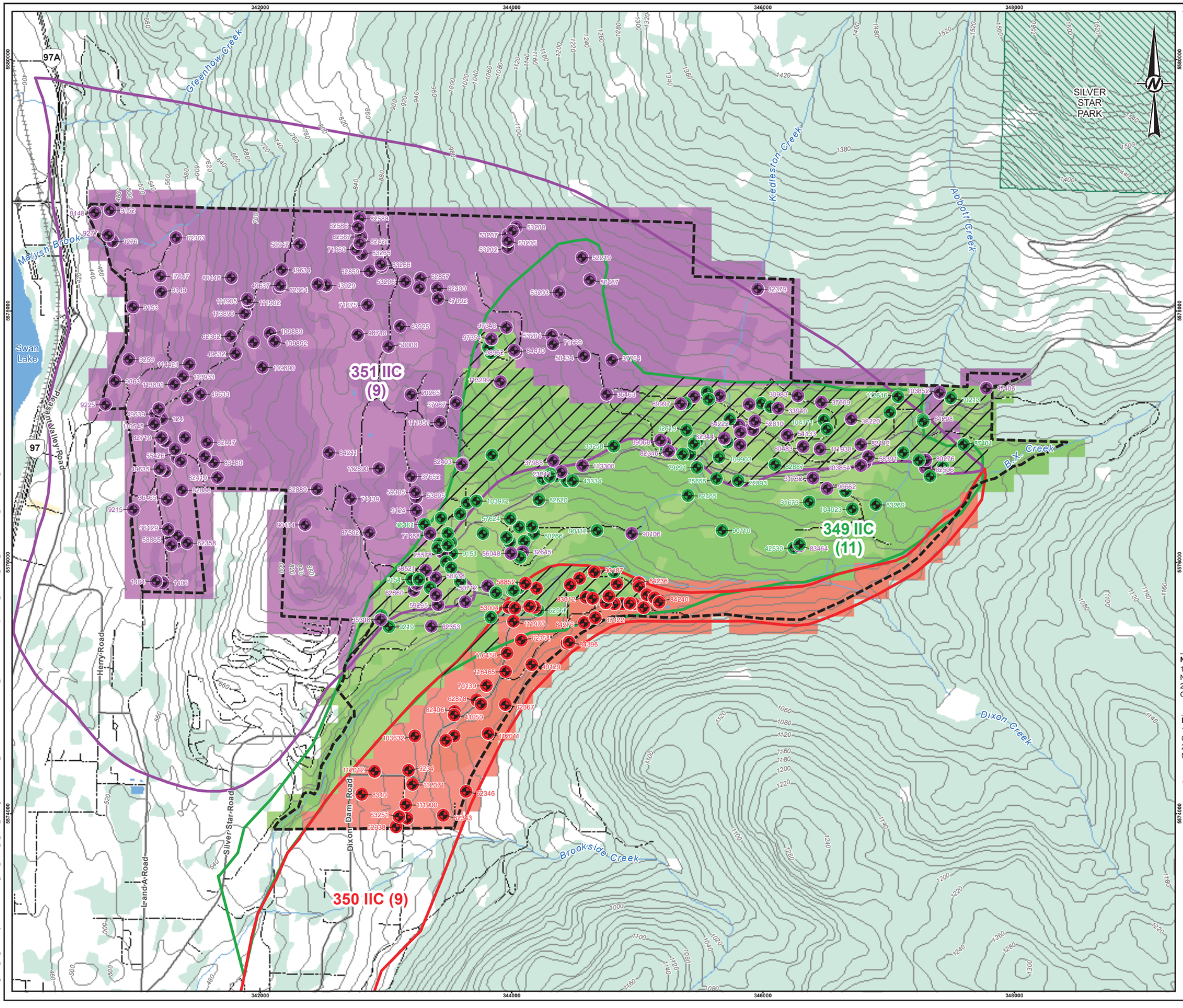

LEGEND

STUDY AREA

REGISTERED WATER WELL CLASSIFIED BY AQUIFER

- 349 IIC (11)
- 350 IIC (9)
- 351 IIC (9)

AQUIFER NAME AND EXTENT

- 349 IIC (11)
- 350 IIC (9)
- 351 IIC (9)
- INFERRED AREAS WHERE UNCONSOLIDATED AQUIFER OVERLIES BEDROCK AQUIFER

AQUIFER GROUNDWATER AVAILABILITY

- LOW TO MEDIUM
- MEDIUM TO HIGH
- HIGH

BASE FEATURE

- CONTOUR (20m)
- HIGHWAY
- MAJOR ROAD
- LOCAL ROAD
- WATERCOURSE
- WATERBODY
- PARK / PROTECTED AREA
- WOODED AREA

0 500 1,000

1:30,000 METRES

NOTE(S)

1. ALL PUBLICALLY AVAILABLE REGISTERED WATER WELLS ARE DISPLAYED ON THIS MAP BUT NOT ALL WATER WELLS ARE LABELLED.
2. INFERRED GROUNDWATER POTENTIAL CLASSIFICATION BASED ON ESTIMATED GROUNDWATER AVAILABILITY AND AQUIFER TYPE; REFER TO REPORT.

REFERENCE(S)

1. CONTAINS INFORMATION LICENCED UNDER THE OPEN GOVERNMENT LICENCE – BRITISH COLUMBIA
2. SERVICE LAYER CREDITS: NAD 1983 UTM ZONE 11N

CLIENT
REGIONAL DISTRICT OF NORTH OKANAGAN

PROJECT
KEDDLESTON GROUNDWATER STUDY

TITLE
GROUNDWATER AVAILABILITY

CONSULTANT
GOLDER

YYYY-MM-DD	2019-11-07
DESIGNED	PA
PREPARED	JG
REVIEWED	PA
APPROVED	MB

PROJECT NO.	CONTROL	REV.	FIGURE
19132176	5000	0	6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

25mm

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APPENDIX A

Well Records

OSOYOOS DIST

OKANAGAN ROTARY WATER WELLS DRILLING

Electric Logging

Vernon, B.C.

Rock Drilling Testholes

LOG OF WELL

Log of Well for Lawson Hawkins ..... Test or Well No. WELL .....

Address Lot 1 Sec 20 Twp 5 Plan 19183 South of silver star Rd. .....

Location Vernon. B.C. .....

Date Well Completed June 25th - 1973 .....

Total Depth to Bottom of Well 50 feet 15,24 m ..... Diameter 0,108m 4¼ inch I.D.

Static Level from Surface of the Ground 25 feet 7,62m .....

Screen ..... Perforated 5 feet ..... Plain End .....

THICKNESS	FROM	TO	FORMATION FOUND IN EACH STRATUM	
1,22m 4'	0'	4'	Rock and gravel in light brown clay	1,22 m
9,53m 28'	4'	32'	Big rocks and gravel in silty brown clay.	9,75 m
1,52m 5'	32'	37'	Big rocks and gravel in greyish clay.	11,28 m
3,96m 13'	37'	50'	Sandy gravel. (water)	15,24 m
			Took out 5 1/2 Gals a minute by air lift.	

Remarks: .....

John Hruschak

Driller

87404

BRITISH COLUMBIA — BC Environment — Water Management Division

WATER WELL RECORD

Date 06/01/23 (YR/MO/DY)

NTS MAP 082L035113 WELL No. ELEV Location Accuracy

UTM Z11 343590E 5576384N UTM Date 19__ Well Type WTN 87404

Owners Name & Address ~~RALPH~~ RALF KINTZEL 7766 CHEW RD VERNON B.C. V1B 3N6

Legal Description & Address LOT 1 PLAN # 26242 SEC 19, TWP 5, ODYD

PID # 005-158-265, ROLL # 172265

Descriptive Location GPS. N. 50° 19' 07.6" W. 119° 11' 49.5" WELL TAG # 15920

1. TYPE OF WORK: 1 ☑ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD: 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☑ Rotary a ☐ mud b ☑ air c ☐ reverse ☐ Other

3. WATER WELL USE: 1 ☑ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Comm. & Ind. ☐ Other

4. DRILLING ADDITIVES NONE

5. MEASUREMENTS from 1 ☑ ground level 2 ☐ top of casing

casing height above ground level 2 ft.

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	17	BROWN CLAY TILL	+2
17	18	BOULDERS	
18	63	GREY CLAY TILL	
63	79	GREY SAND & GRAVEL FINE TO COARSE (DIRTY)	
79	90	BROWN SAND AND GRAVEL	

7. CONSULTANT

Address

8. WELL LOCATION SKETCH

9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete ☐ Other

							units
Hole Diameter							ins
Diameter	6						ins
from	0						ft
to	86						ft
Thickness	0.188						ins
Weight	12.42						lb/ft

Pitless unit ____ ft 1 ☐ above 2 ☐ below ground level

1 ☑ Welded 2 ☐ Cemented 3 ☐ Threaded | 1 ☑ New 2 ☐ Used

Perforations:

Shoe(s): YES 6 INCH

Open hole, from ____ to ____ ft Diameter ____ ins

Grout:

10. SCREEN: 1 ☑ Nominal (Telescope) 2 ☐ Pipe Size

Type 1 ☑ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre ☐ Other

Material 1 ☑ Stainless Steel 2 ☐ Plastic ☐ Other

Set from 86 to 90 ft below ground level

RISER, SCREEN & BLANKS							units
Length	4						ft
Diam. I D	5						ins
Slot Size	0.015						ins
from	86						ft
to	90						ft

Fittings, top KPACKER bottom PLATE

Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☑ Air 4 ☐ Bailing 5 ☐ Pumping ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail 3 ☑ Air Date 06/01/23 (YR/MO/DY)

Rate 7.5 USgpm Temp ____ °C SWL before test ____ ft

Water Level ____ ft after test of ____ hrs

☐ DRAWDOWN in ft				☐ RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
SUBMERSIBLE	80 ft	APPROX 15 USgpm

14. WATER TYPE: 1 ☑ fresh 2 ☐ salty 3 ☑ clear 4 ☐ cloudy

colour ____ smell ____ ; gas 1 ☐ yes 2 ☑ no

15. WATER ANALYSIS: 1 Hardness ____ mg/L 2 Iron ____ mg/L 3 Chloride ____ mg/L 4 pH ____ Field Date ____ Lab Date ____ (YR/MO/DY)

SITE I D No ____

16. FINAL WELL COMPLETION DATA

Well Depth 90 ft Well Yield ESTIMATE 15 US gpm

Static Water Level +2 ft Artesian Flow 2 US gpm Pressure Head ____ ft

Back filled

Well Head Completion CAPPED

SURFACE SEAL INSTALLED FROM 0 - 20

17. DRILLER (PLEASE PRINT) SURNAME SCHIBLI FIRST NAME DAVID

Signature David Schibli

18. CONTRACTOR, Address SCHIBLI DRILLING BOX 729 LUMBY B.C. V0E 2G0

Member, BCWWDA ☑ yes ☐ no ;

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

28286

WELL LOG, CONSTRUCTION RECORD

OWNER Ray Simpson

Address Box 238 VERNON B.C.

Well Location Lumby Rd

Date Started June 13 Date Completed June 21 / 73

PACIFIC WATER WELLS (1969) LTD.
22314 FRASER HIGHWAY
LANGLEY, B.C.
Phone - - - 534-8581

Drilling Method Cable Tool

Driller A J Simmons Helper P McConnell

File North O/K Folio

Signed By

LOG OF FORMATIONS

Depth		Descriptions
0	to 144	till
	to	
144	to 195	gravel water Bearing
	to	
195	to 200	Till
	to	Bed Rock 195
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	

JUL - 5 1973

GENERAL REMARKS

CASING RECORD

Dia. ins. Wt. #/ft. From to

Dia. ins. Wt #/ft. From to

Dia. ins. Wt. #/ft. From to

Shoe Welded Cemented

SCREEN RECORD

Make Material

Slot opening Length

Top ft. Bottom ft.

Fittings Top Fittings Bottom

Gravel Pack Natural

Development Method

ROCK WELL DATA

Open Bore Hole Dia. ins.

From ft. to ft.

PRODUCTION DATA

Static Level flowing ft.

Measured from

Pumping Level ft. at GPM

ft. at GPM

Bail Test 180 ft. at 8 GPM

ft. at GPH

Recommended Pump Setting 120 ft.

Recommended Max. Pump Output 8 GPM GPH

Duration of Test 2 hrs Hrs.

PUMP DATA

Make Type

Model Serial No.

Size HP Drop Pipe ins.

GPM Head ft. RPM

Motor Volts PH

Well Seal

Water Analysis — Hardness PPM

PH Iron PPM

32104

WELL LOG CONSTRUCTION RECORD

OWNER Erin Keig

Address

Well Location Silver Star

Date Started Feb 6 Date Completed Feb 19 1975

Drilling Method Cable tool

Driller J Thomas Helper P McConnell

File O.K. North Folio

Signed By

PACIFIC WATER WELLS (1969) LTD.
22314 FRASER HIGHWAY
LANGLEY, B.C. V3A 4H6
Phone - - - 534-8581

LOG OF FORMATIONS

Depth		Descriptions
0	to 26	Till Boulders
26	to 27	Smoky Water
27	to 80	Till
80	to 86	Till
86	to 90	water Bearing
	to	Dirty gravel clay
	to	shale.
90	to 91	~~90~~ Bedrock.
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	

MAR

GENERAL REMARKS

CASING RECORD

Dia. ins. Wt. #/ft. From to

Dia. ins. Wt #/ft. From to

Dia. ins. Wt. #/ft. From to

Shoe Welded Cemented

SCREEN RECORD

Make Material

Slot opening Length

Top ft. Bottom ft.

Fittings Top Fittings Bottom

Gravel Pack Natural

Development Method

ROCK WELL DATA

Open Bore Hole Dia. ins.

From ft. to ft.

PRODUCTION DATA

Static Level ft.

Measured from

Pumping Level ft. at GPM

ft. at GPM

Bail Test 90 ft. at 2 GPM

ft. at GPH

Recommended Pump Setting ft.

Recommended Max. Pump Output 2. GPM ~~GPH~~

Duration of Test 2. Hrs.

PUMP DATA

Make Type

Model Serial No.

Size HP Drop Pipe ins.

GPM Head ft. RPM

Motor Volts PH

Well Seal

Water Analysis — Hardness PPM

PH Iron PPM

33258

OKANAGAN WATER WELL DRILLING LTD.

Electric Logging

Vernon, B.C.

Rock Drilling Testholes

LOG OF WELL

Log of Well for Cecil Roach Test or Well No. Well

Address Silver star Rd Vernon.B.C.

Location Lot 2 Sec 20 & 29 TWP 5 Plan 23709

Date Well Completed August 21st - 1975

Total Depth to Bottom of Well 119 feet Diameter 4½ inch I.D.

Static Level from Surface of the Ground Flowing 1 1/2 gals a minute.

Screen 4"x 5'x 20 slot SSS Perforated Plain End

THICKNESS	FROM	TO	FORMATION FOUND IN EACH STRATUM
43'	0'	43'	Rock and gravel (dry)
51'	43'	94'	Till, Big rocks,Gravel and sand in grey clay (silty)
1'	94'	95'	Clean sand streak with water.
4'	95'	99'	Silty sand ,Mica and some leaves and wood.
4'	99'	103'	Clean sand and gravel.
7'	103'	110'	Silty sand with grass,wood,and mica. Has odor.
9'	110'	119'	clean beach sand and gravel.
7'	119'	126'	Till,hard blue clay with gravel.
			This flowed at 5 gals a minute.after 4 hours of developi
			it decreased to 1 1/2 gals a minute.
			we took out 20 gals a minute by air lift.
			The water has slight odor,This could be coming from
			above. where the wood and mica is.

Remarks:

John Hrusetsky

Driller

34493

WELL LOG CONSTRUCTION RECORD

OWNER John Ross and Jack Mitchell

Address Box 1359, Vernon, B. C.

Well Location Wallace Rd. off Silver Star Rd

Date Started March 8, 1976 Date Completed March 31, 1976

PACIFIC WATER WELLS (1969) LTD.
22314 FRASER HIGHWAY
LANGLEY, B.C.
PHONE 534-8581

Drilling Method Churn

Driller J. Popoff Helper R. Deptford

File O.K. North Folio

Signed By

LOG OF FORMATIONS

Depth			Descriptions
0	to	3	Gravel
3	to	70	till with boulders
70	to	72	gray, gravelly clay
72	to	74	tight gravel, making
	to		a little water
74	to	139	till with boulders
139	to	245	dense till, some large
	to		rocks
245	to	251	boulders, sandy gravel,
	to		water bearing
251	to	253	till
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		
	to		

GENERAL REMARKS

CASING RECORD

Dia. 6 ins. Wt. 19 #/ft. From 0 to 247

Dia. ins. Wt #/ft. From to

Dia. ins. Wt. #/ft. From to

Shoe X Welded X Cemented

SCREEN RECORD

Make Johnson Material S. S.

Slot opening 30 Length 4 ft.

Top 247 ft. Bottom 251 ft.

Fittings Top leadpacker Fittings Bottom screw plug

Gravel Pack Natural X

Development Method Bailing

ROCK WELL DATA

Open Bore Hole Dia. ins.

From ft. to ft.

PRODUCTION DATA

Static Level 195 ft.

Measured from ground level

Pumping Level ft. at GPM

ft. at GPM

Bail Test 247 ft. at 90 GPH

ft. at GPH

Recommended Pump Setting 247 ft.

Recommended Max. Pump Output 1½ GPM

Duration of Test 1 hour Hrs.

PUMP DATA

Make Type

Model Serial No.

Size HP Drop Pipe ins.

GPM Head ft. RPM

Motor Volts PH

Well Seal

Water Analysis — Hardness PPM

PH Iron PPM

Province of British Columbia Ministry of Environment Water Management Branch

WATER WELL RECORD

Date 81 11 12 (YR MO DY)

Legal Description & Address

Descriptive Location McLeaten Rd. Vernon B.C.

Owners Name & Address D.B.D Holdings Inc. Bob Galloway Vernon B.C.

NTS MAP ELEV WELL No. 5 LOT 4

UTM Z E N UTM Date 19

1. TYPE OF WORK 1 ☒ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☒ Rotary a ☐ mud b ☒ air c ☐ reverse 5 ☐ Other

3. WATER WELL USE 1 ☒ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Commercial & Industrial 5 ☐ Other Red Rock Well

4. DRILLING ADDITIVES

5. MEASUREMENTS from 1 ☐ ground level 2 ☐ top of casing

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	13	Brown Till + Rock.	
13	40	Dark. Blue Rock, White Layers	
40	90	Blue + Green Rock.	
90	140	Blue + White Rock.	
140	170	Soft Blue Rock.	
170	190	Soft White Rock.	
190	210	Hard Dark. Blue Rock.	
		19FT of 6" Surface Cassing.	
		AT 180ft. 1 g.p.m.	
		" 198FT. 7 g.p.m.	
		Flowing 15 g.p.m.	
		Cleaned + Developed.	
		Bottom of Well 210ft	

7. CONSULTANT

Address

8. WELL LOCATION SKETCH

9. CASING: Materials 1 ☐ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete 6 ☐ Other

							units
Hole Diameter							ins
Diameter	6"						ins
from							ft
to							ft
Thickness							ins
Weight							lb/ft

Pitless unit ft 1 ☐ above 2 ☐ below ground level

1 ☐ Welded 2 ☐ Cemented 3 ☐ Threaded 4 ☐ New 5 ☐ Used

Perforations:

Shoe(s):

Open hole, from to ft Diameter 6" ins

Grout:

10. SCREEN: 1 ☐ Nominal 2 ☐ Pipe Size

Type 1 ☐ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre 4 ☐ Other

Material 1 ☐ Stainless Steel 2 ☐ Plastic 3 ☐ Other

Set from to ft below ground level

SCREEN & BLANKS							units
Length							ft
Diam. I D							ins
Slot Size							ins
from							ft
to							ft

Fittings, top bottom

Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☒ Air 4 ☐ Bailing 5 ☐ Pumping 6 ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail Date (YR MO DY)

Rate 75 USgpm Temp °C SWL before test ft

ft after test of hrs mins

TIME in mins & DRAWDOWN in ft				TIME in mins & RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
	180 ft	USgpm

14. WATER TYPE: 1 ☒ fresh 2 ☐ salty 3 ☒ clear 4 ☐ cloudy

colour smell ; gas 1 ☐ yes 2 ☐ no

15. WATER ANALYSIS: 1 ☐ Hardness mg/l

2 ☐ Iron mg/l 3 ☐ Chloride mg/l

4 ☐ pH Field Date

SITE I D No LOT 4 Lab Date (YR MO DY)

16. FINAL WELL COMPLETION DATA

Well Depth 210 ft Water Flowing 15 US gpm

Static Water Level Flowing ft Pressure Head ft

Back filled

Well Head Completion

17. DRILLER PLEASE PRINT SURNAME Young FIRST NAME Ricky

Signature

18. CONTRACTOR, Address

K. + W. Drilling LTD.

3905 - 17 Ave Vernon B.C.

Member, BCWWDA ☐ yes ☐ no ;

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

Province of British Columbia Ministry of Environment Water Management Branch

WATER WELL RECORD

Date 81/11/24 (YR/MO/DY)

Legal Description & Address

Descriptive Location Meldrum Rd. Vernon B.C.

Owners Name & Address D.B.D. Holding Inc. Rick Galloway Vernon B.C.

NTS MAP | ELEV | WELL No. 7 ~~2~~

UTM Z | E | N | UTM Date 19__ Remainder Lot 2 Pl. 2558

1. TYPE OF WORK 1 ☒ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☒ Rotary a ☐ mud b ☒ air c ☐ reverse 5 ☐ Other

3. WATER WELL USE 1 ☒ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Commercial & Industrial 5 ☐ Other

4. DRILLING ADDITIVES

5. MEASUREMENTS from 1 ☒ ground level 2 ☐ top of casing

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	6	Brown Till + Rock. Gravel.	
6	14	Dark. Blue Rock. very Cracked.	
14	40	Dark. Blue with Hard White Layers	
40	90	Green Rock. with White Layers	
90	130	Cracked Brown Rock. With Green Layers	
130	160	Dark. Blue Rock. with Clay Layers.	
160	190	Green + Blue Rock.	
190	210	Bad ly Cracked White + Brown Rock.	
		10 ft. Of 6" CASSing.	
		3 g.p.m AT 100 FT. 75 g.p.m. 150 FT.	
		Pumping 75 g.p.m. By Air Lift.	
		Cleaned + Developed.	
		Flowing 10 g.p.m.	

7. CONSULTANT

Address

8. WELL LOCATION SKETCH

9. CASING: Materials 1 ☐ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete 6 ☐ Other

Hole Diameter							units
Diameter	6"						ins
from							ft
to							ft
Thickness							ins
Weight							lb/ft

Pitless unit ____ ft 1 ☐ above 2 ☐ below ground level

1 ☐ Welded 2 ☐ Cemented 3 ☐ Threaded 4 ☐ New 5 ☐ Used

Perforations:

Shoe(s):

Open hole, from ____ to ____ ft Diameter ____ ins

Grout:

10. SCREEN: 1 ☐ Nominal 2 ☐ Pipe Size

Type 1 ☐ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre 4 ☐ Other

Material 1 ☐ Stainless Steel 2 ☐ Plastic 3 ☐ Other

Set from ____ to ____ ft below ground level

SCREEN & BLANKS							units
Length							ft
Diam. I D							ins
Slot Size							ins
from							ft
to							ft

Fittings, top ____ bottom ____

Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☒ Air 4 ☐ Bailing 5 ☐ Pumping 6 ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail Date (YR/MO/DY)

Rate 75 USgpm Temp ____ °C SWL before test ____ ft

____ ft after test of ____ hrs ____ mins

TIME in mins & DRAWDOWN in ft				TIME in mins & RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
	100 ft	50 USgpm

14. WATER TYPE: 1 ☒ fresh 2 ☐ salty 3 ☒ clear 4 ☐ cloudy

colour ____ smell ____ ; gas 1 ☐ yes 2 ☐ no

15. WATER ANALYSIS: 1 ☐ Hardness ____ mg/ℓ

2 ☐ Iron ____ mg/ℓ 3 ☐ Chloride ____ mg/ℓ

4 ☐ pH ____ Field Date ____ Lab Date (YR/MO/DY)

SITE I D No 7

16. FINAL WELL COMPLETION DATA

Well Depth 210 ft Water Flowing 10 US gpm

Static Water Level Flowing ft Pressure Head ____ ft

Back filled

Well Head Completion

17. DRILLER PLEASE PRINT SURNAME Young FIRST NAME Rick

Signature Rick Young

18. CONTRACTOR, Address

K. + W. Drilling LTD

3905 - 17 th Ave Vernon B.C.

Member, BCWWDA ☐ yes ☒ no ;

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

50679

Province of British Columbia Ministry of Environment Water Management Branch

WATER WELL RECORD

Date 82 | 12 | 1 (YR | MO | DY)

Legal Description & Address LOT 1 PLAN 26635 Sec 17 TPS. OOYD Scale 1:2000

Descriptive Location LOT NO 6 correct Lot #

Owners Name & Address Tillicum Valley Progn. Vernon B.C.

NTS MAP | ELEV | WELL No. 2

UTM Z | E | N | Date 19 82

1. TYPE OF WORK 1 ☐ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☑ Rotary a ☐ mud b ☑ air c ☐ reverse 5 ☐ Other

3. WATER WELL USE 1 ☐ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Commercial & Industrial 5 ☐ Other

4. DRILLING ADDITIVES none

5. MEASUREMENTS from 1 ☐ ground level 2 ☐ top of casing

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	15'	Rock + Brown Till	
15'	160	Bed Rock. quartz + mica layers	
		Water found at. 120ft.-130ft.	

7. CONSULTANT

Address

8. WELL LOCATION SKETCH

9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete 6 ☐ Other

								units
Hole Diameter								ins
Diameter	6"							ins
from								ft
to								ft
Thickness								ins
Weight								lb/ft

Pitless unit ____ ft 1 ☐ above 2 ☐ below ground level

1 ☑ Welded 2 ☐ Cemented 3 ☐ Threaded 4 ☐ New 5 ☐ Used

Perforations:

Shoe(s): 1

Open hole, from ____ to ____ ft Diameter 6" ins

Grout:

10. SCREEN: 1 ☐ Nominal 2 ☐ Pipe Size

Type 1 ☐ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre 4 ☐ Other

Material 1 ☐ Stainless Steel 2 ☐ Plastic 3 ☐ Other

Set from ____ to ____ ft below ground level

SCREEN & BLANKS							units
Length							ft
Diam. I D							ins
Slot Size							ins
from							ft
to							ft

Fittings, top ____ bottom ____

Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☒ Air 4 ☐ Bailing 5 ☐ Pumping 6 ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail Date 82 | 10 | 12 | 1 (YR | MO | DY)

Rate 4 USgpm Temp ____ °C SWL before test ____ ft

____ ft after test of 6 hrs ____ mins

TIME in mins & DRAWDOWN in ft				TIME in mins & RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
	115 ft	4 USgpm

14. WATER TYPE: 1 ☐ fresh 2 ☐ salty 3 ☑ clear 4 ☐ cloudy

colour ____ smell ____ ; gas 1 ☐ yes 2 ☐ no

15. WATER ANALYSIS: 1 ☐ Hardness ____ mg/l

2 ☐ Iron ____ mg/l 3 ☐ Chloride ____ mg/l

4 ☐ pH ____ Field Date ____

SITE I D No ____ Lab Date ____ (YR | MO | DY)

16. FINAL WELL COMPLETION DATA

Well Depth 160 ft Water Flowing ____ US gpm

Static Water Level 40 ft Pressure Head ____ ft

Back filled ____

Well Head Completion welded

17. DRILLER PLEASE PRINT SURNAME Young FIRST NAME Rick

Signature ____

18. CONTRACTOR, Address

Superior Drilling LTD.
Box 401 Vernon B.C.
PH. NO 545-7754

Member, BCWWDA ☐ yes ☒ no ;

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

57624

1050 BARTHOLOMEW
RR6
KELOWNA, B.C.
V1Y 8R3

)4) 764-2338

CAPRI DRILLING

DOMESTIC IRRIGATION EXPLORATION

Wallace Rd. & Silver Star Rd.

№ 0720

Be 'WELL' Satisfied

NAME: MR. Cecil Lapshinoff.
ADDRESS: Wallace RD. Vernon B.C.

WELL LOCATION:
Lot _____ Block _____ Sec. _____
TWP _____ Range _____ Plan _____

PROPOSED USE: Domestic ✓ Industrial _____ Municipal _____
Irrigation _____ Test Well _____ Other _____

TYPE OF WORK: Owner's number of well, (if more than one) _____
New Well ✓ Air Rotary ✓
Deepened _____ Rotary _____
Reconditioned _____ Jetted _____
Cable _____

DIMENSIONS: Diameter of well 6 inches
Drilled 124½ ft Depth of completed well 122 ft.

CONSTRUCTION DETAILS:
CASING INSTALLED 6⅝ " Diam. from 0 ft. to 122 ft.
Threaded _____ " Diam. from _____ ft. to _____ ft.
Welded ✓ _____ " Diam. from _____ ft. to _____ ft.

PERFORATIONS: Yes ___ No ✓
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
perforations from _____ ft. to _____ ft.
perforations from _____ ft. to _____ ft.

SCREENS: Yes ___ No ✓
Manufacturer _____
Type _____ Model No. _____
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

GRAVEL PACKED: Yes ___ No ✓ Size of Gravel _____
Gravel placed from _____ FT. TO _____ FT.

SURFACE SEAL: Yes ✓ No ___ Depth _____ ft.
Material Used In Seal 6⅝ sted Casing
Method of Sealing strata off Drive shoe + Casing Hammer.

PRODUCTION DATA AT TIME OF DRILLING:
Static Level 47 ft From Ground level ft.
Measured from 110 ft. With Air ✓ Pump ___ Other _____
Pumping level 110 ft. at 12 GPM
Recommended Pump Setting 110 to 105 ft.
If Flowing Well — GPM
Recommended Max. Pump Output _____ GPH
Water Clear ✓ Coloured _____ Silt _____ Sand _____
Duration of test 2 hrs HRS.

DATE: SPUDDED Oct 21/87 Completed Oct 22/87
Rig # one Other Equip. Mack Pipe Truck

DEPTH:
Overburdon 122 ft. Tool Push _____
Bedrock — ft. Driller Ric Beckhelt
Total 122 ft. Helper Jim Genereux

FORMATION

DEPTH FROM	DEPTH TO	FORMATION
Ground Level 0	6 ft	Sandy Soil + Gravel
6 ft	11 ft	moist sand + Gravel
11 ft	15 ft	Bolders
15 ft	20 ft	moist sand + Gravel
20 ft	60 ft	Cons. Clay + Gravel
60 ft	61½	wet Gravel + Clay
61½ ft	86 ft	Cons Clay + Gravel
86 ft	89 ft	wet Sand + Gravel
89 ft	113 ft	f water Bearing Gravel + fine Sand
113 ft	124½	water Bearing Course Gravel with fine sand
124½		water Bearing Sand + Gravel with trace of Clay

WELL OWNER
I [signature] Hereby Agree
Work has been completed in accordance with the contract and all material used has been of top quality.
CAPRI DRILLING (1985) LTD. [signature]

GENERAL REMARKS Confirmed Yield of well meets Cord Requirement of 4.4 Gals Per min for 1 hr to 503 Gals Per day Per Bylaw 176

It is here by agreed that FORMATIONS, QUALITY, QUANTITY & TYPE of Water, along with all other remarks, are true only to the best knowledge of the Personnel & Company, and they cannot be held responsible for a mistake in calculation.
The company will not be held responsible for Public Liability or Property Damage caused by flowing well wash outs or any other mishaps.

62370

WELL LOG

CAPRI DRILLING (1985) LTD.

DOMESTIC IRRIGATION EXPLORATION

BOX 306, STN. A
KELOWNA, B.C.
V1Y 7N8

PHONE: (604) 769-3408
(604) 762-1362

Nº [illegible]

Be 'WELL' Satisfied

Name: Raymond + Francis Eastwood.
Address: Jack Pine Rd. Silver Star.
Address: Vernon B.C.

WELL LOCATION: Lot 1 PL 16930 DL 3848
EXCEPT THAT SOUTH OF ROAD

PROPOSED USE: Domestic ✓ Industrial ____ Municipal ____
Irrigation ____ Test Well ____ Other ____

TYPE OF WORK: Owner's number of well, (if more than one) one
New Well ✓ Air Rotary ✓
Deepened ____ Rotary ____
Reconditioned ____ Jetted ____
Liner Installed ____ Pressure Fractured ____

DIMENSIONS: Diameter of well 6" inches
Drilled 244 ft. Depth of completed well 243' ft.

CONSTRUCTION DETAILS:
CASING INSTALLED: 6 5/8" Diam. from 0 ft. to 236' ft.
Threaded ____ " Diam. from ____ ft. to ____ ft.
Welded ✓ ____ " Diam. from ____ ft. to ____ ft.

PREFORATIONS: Yes ☐ No ☒
Type of perforator used ____
SIZE of perforations ____ in. by ____ in.
perforations from ____ ft. to ____ ft.
perforations from ____ ft. to ____ ft.

SCREENS: Yes ☑ No ☐ Top of Packer 232'
Manufacturer Johnson Imperial (2)
Type Stainless Steel Model No. wire wound.
Diam. 6" Slot Size .035 from 235' ft. to 239' ft.
Diam. ____ Slot Size .050 from 239' ft. to 243' ft.

GRAVEL PACKED: Yes ☐ No ☑ Size of Gravel ____
Gravel placed from ____ ft. to ____ ft.

SURFACE SEAL: Yes ☑ No ☐ Depth ____ ft.
Material Used In Seal 6 5/8 steel Casing
Method of Sealing strata off Drive shoe + Casing hammer

PRODUCTION DATA AT TIME OF DRILLING:
Static Level 156' from Surface ft.
Measured from 242' ft. With air lift
Pumping level 242' ft. at 45 GPM
Recommended Pump Setting 225' to 230' ft.
If Flowing Well — GPM
Recommended Max. Pump Output 2700 GPH
Water Clear ✓ Coloured ____ Silty ____ Sandy ____
Duration of test 5 hrs Developing Hrs.

DATE: Spudded May 26/94 Completed June 1/94
Rig # Three Other Equip. Mack Pipe Truck

DEPTH:
Overburdon 243' ft. Tool Push ____
Bedrock — ft. Driller Jim Genereux
Total 243' ft. Roughneck Rory Rogers

FORMATION

DEPTH

FROM	TO	
GROUND LEVEL	2 ft	Sandy top soil with some Clay
2 ft	155 ft	Blue Clay + Gravel till w cobbles + Boulders
155 ft	183 ft	moist Brown Sandy Clay w Gravel
183 ft	197 ft	wet Brown sandy Clay w Gravel
197 ft	201 ft	water bearing Dirty Sand + Gravel w silty Sands
201 ft	202½ ft	Clean Brown med Sands (WB)
202½ ft	208 ft	Cemented Sand + Gravel (WB)
208 ft	233 ft	Dirty Sand + Gravel w silty Sands + trace of Silty Clay (WB)
233 ft	238 ft	Clean med Sand w Gravel (WB)
238 ft	244 ft	Coarse Sand with Gravel (WB)
244 ft		fine Brown Sand with Gravel (WB)

WELL OWNER:
I [signature] Hereby Agree work has been completed in accordance with the contract and all material used has been of top quality.

CAPRI DRILLING (1985) LTD. [signature]

GENERAL REMARKS

IT IS HEREBY AGREED THAT FORMATIONS, QUALITY, QUANTITY AND TYPE OF WATER, ALONG WITH ALL OTHER REMARKS, ARE TRUE ONLY TO THE BEST KNOWLEDGE OF THE PERSONNEL AND COMPANY, AND THEY CANNOT BE HELD RESPONSIBLE FOR A MISTAKE IN CALCULATION.

THE COMPANY WILL NOT BE HELD RESPONSIBLE FOR PUBLIC LIABILITY OR PROPERTY DAMAGE CAUSED BY FLOWING WELL WASH OUTS OR ANY OTHER MISHAPS.

ALL MATERIALS SHALL REMAIN PROPERTY OF **CAPRI DRILLING** UNTIL ACCOUNT IS PAID IN FULL.

WTN 74439

1050 BARTHOLOMEW COURT
RR6
KELOWNA, B.C.
V1Y 8R3

CAPRI DRILLING (1985) LTD.

DOMESTIC IRRIGATION EXPLORATION

PHONE: (604) 764-2338

5 15/16

Be 'WELL' Satisfied

№ 0848

NAME: Dave Turney

ADDRESS: Hitchcock Road Vernon BC

WELL LOCATION:
Lot _____ Block _____ Sec. _____
TWP _____ Range _____ Plan _____

PROPOSED USE: Domestic ✓ Industrial _____ Municipal _____
Irrigation _____ Test Well _____ Other _____

TYPE OF WORK: Owner's number of well, (if more than one) one
New Well ✓ Air Rotary ✓
Deepened _____ Rotary _____
Reconditioned _____ Jetted _____
Cable _____

DIMENSIONS: Diameter of well 6" inches
Drilled 180' ft. Depth of completed well 180' ft.

CONSTRUCTION DETAILS:
CASING INSTALLED: 6 5/8" Diam. from 0 ft. to 62½' ft.
Threaded __ _____" Diam. from _____ ft. to _____ ft.
Welded ✓ _____" Diam. from _____ ft. to _____ ft.

PERFORATIONS: Yes ✓ No ___ 4" PVC. liner installed
Type of perforator used Skill Saw
SIZE of perforations 5/8 in. by 5" in.
perforations from 160' ft. to 120' ft.
perforations from _____ ft. to _____ ft.

SCREENS: Yes ___ No ✓
Manufacturer _____
Type _____ Model No. _____
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

GRAVEL PACKED: Yes ___ No ✓ Size of Gravel _____
Gravel placed from _____ FT. TO _____ FT.

SURFACE SEAL: Yes ✓ No ___ Depth _____ ft.
Material Used In Seal 6 5/8 steel Casing
Method of Sealing strata off Drive Shoe + Casing Hammer

PRODUCTION DATA AT TIME OF DRILLING:
Static Level 126' from surface ft.
Measured from 179' ft. With Air ✓ Pump ___ Other _____
Pumping level 179' ft. at 13 GPM
Recommended Pump Setting 160' ft.
If Flowing Well — GPM
Recommended Max. Pump Output 780 GPH
ter Clear _____ Coloured slite Silt _____ Sand _____
ation of test 2 hrs Developing HRS.

DATE: SPUDDED July 23/92 Completed July 25/92

Rig # TWO Other Equip. _____

DEPTH:
Overburdon 62½' cased ft. Tool Push _____
Bedrock 117±' ft. Driller Jim Genereux
Total 180' ft. Helper Doug + Gord.

FORMATION

DEPTH

FROM	TO	
Ground Level 0	1 ft	Top soil + Gravel
1 ft	8 ft	moist Sand + Gravel w Cobbles
8 ft	11 ft	moist Brown Sandy Clay w Grave
11 ft	21 ft	Blue Clay + Gravel Till
21 ft	39 ft	Sand + Gravel w Cobbles + Belders
39 ft	54 ft	Cemented Sand + Gravel
54 ft	61 ft	Soft weathered Bedrock
61 ft	83 ft	med soft Black + white Granite
83 ft	92 ft	med soft Tan Granite "
92 ft	148 ft	med soft Black + white Granite "
148 ft	161 ft	med soft Tan Granite Bedrock
161 ft	180 ft	med soft Black + white Granite

All Granite formations had Quartz mixed
Water Bearing fractor at 152 ft.

WELL OWNER

I _____ Hereby Agree
Work has been completed in accordance with the contract and all material used has been of top quality.

CAPRI DRILLING (1985) LTD. _____

GENERAL REMARKS

4" PVC. liner installed to Protect Pump from fractored Bedrock + left 6 ft Below Surface

It is here by agreed that FORMATIONS, QUALITY, QUANTITY & TYPE of Water, along with all other remarks, are true only to the best knowledge of Personnel & Company, and they cannot be held responsible for a mistake in calculation.
company will not be held responsible for Public Liability or Property Damage caused by flowing well wash outs or any other mishaps.

82365

BRITISH COLUMBIA

BC Environment

Water Management Division

WATER WELL RECORD

Date 1993/1/8 (YR/MO/DY)

NTS MAP | WELL No. | ELEV | Location Accuracy

UTM Z | E | N | Date 19__ | Well Type

Owners Name & Address PURE CANADIAN WATERS LTD. 4th FLOOR, 3205-32nd ST, VERNON

Legal Description & Address SUB. DIV. OF PART OF LOT 1, PLAN 30623, BC, V1T 2M4 SEC. 17 AND 20, TP. 5, O.D.Y.D.

Descriptive Location LOT 1

1. TYPE OF WORK: 1 ☑ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD: 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☑ Rotary a ☐ mud b ☑ air c ☐ reverse ☐ Other

3. WATER WELL USE: 1 ☑ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Comm. & Ind. ☐ Other

4. DRILLING ADDITIVES —

5. MEASUREMENTS from 1 ☑ ground level 2 ☐ top of casing

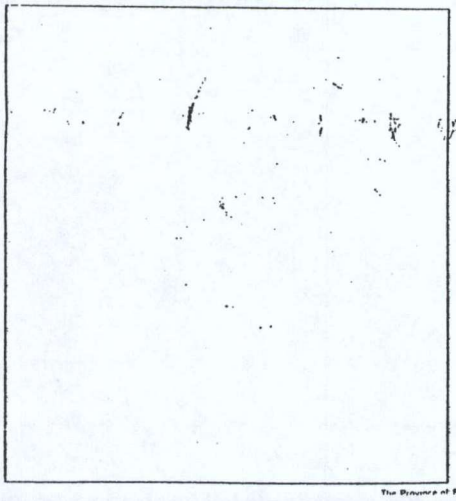
casing height above ground level ____ ft.

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	8	BROWN GRAVELY CLAY	
8	40	GREY GRAVELY CLAY	
40	79	GREY CLAY, ROCKS & BOULDERS	
79	220	GREY GRANITE WITH YELLOWY, WEATHERED ROCK & QUARTZ LAYERS	71

7. CONSULTANT ____

Address ____

8. WELL LOCATION SKETCH



9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete ☐ Other ____

								units
Hole Diameter								ins
Diameter	6							Ins
from	0							ft
to	79							ft
Thickness	.188							ins
Weight	12.92							lb/ft

Pitless unit ____ ft 1 ☐ above 2 ☐ below ground level

1 ☑ Welded 2 ☐ Cemented 3 ☐ Threaded | 1 ☑ New 2 ☐ Used

Perforations: ____

Shoe (s): YES

Open hole, from 79 to 220 ft Diameter 6 ins

Grout: ____

10. SCREEN: 1 ☐ Nominal (Telescope) 2 ☐ Pipe Size

Type 1 ☐ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre ☐ Other ____

Material 1 ☐ Stainless Steel 2 ☐ Plastic ☐ Other ____

Set from ____ to ____ ft below ground level

RISER, SCREEN & BLANKS								units
Length								ft
Diam. I D								ins
Slot Size								ins
from								ft
to								ft

Fittings, top ____ bottom ____

Gravel Pack ____

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☑ Air 4 ☐ Bailing 5 ☐ Pumping ☐ Other ____

12. TEST 1 ☐ Pump 2 ☐ Bail 3 ☑ Air Date 1993/01/09 (YR/MO/DY)

Rate ≈ 60 USgpm Temp ____ °C SWL before test 71 ft

Water Level ____ ft after test of 1 hrs

☐ DRAWDOWN in ft				☐ RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
SUBMEASIBLE	200 ft	APROX. 40 USgpm

14. WATER TYPE: 1 ☑ fresh 2 ☐ salty 3 ☑ clear 4 ☐ cloudy

colour ____ smell ____ ; gas 1 ☐ yes 2 ☑ no

15. WATER ANALYSIS: 1 Hardness ____ mg/L

2 Iron ____ mg/L 3 Chloride ____ mg/L

4 pH ____ Field Date ____

SITE I D No ____ Lab Date ____ (YR/MO/DY)

16. FINAL WELL COMPLETION DATA

Well Depth 220 ft Well Yield APROX. 60 USgpm

Static Water Level 71 ft Artesian Flow ____ US gpm Pressure Head ____ ft

Back filled ____

Well Head Completion 4" 160 P.S.I. P.V.C. LINER INSTALLED FROM 20' TO 220', CAPPED

17. DRILLER (PLEASE PRINT) SURNAME SCHIBLI FIRST NAME DAVID

Signature David Schibli

18. CONTRACTOR, Address

SCHIBLI DRILLING
1038 Mabel Lake Road R.R. #2
Lumby, B.C. V0E 2G0

Member, BCWWDA ☑ yes ☐ no ; ____

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

82618

WELL LOG

CAPRI DRILLING (1985) LTD.

DOMESTIC IRRIGATION EXPLORATION

BOX 306, STN. A
KELOWNA, B.C.
V1Y 7N8

PHONE: (604) 769-3408
(604) 762-1362

NO

Be 'WELL' Satisfied

Name: GIRL GUIDES OF CANADA.
Address: FOR TILLICUM LODGE
Address: TILLICUM Rd. VERNON B.C.

WELL LOCATION: Lot _____ PL _____ DL _____

PROPOSED USE: Domestic ✓ Industrial _____ Municipal _____
Irrigation _____ Test Well _____ Other _____

TYPE OF WORK: Owner's number of well, (if more than one) _____
New Well ✓ Air Rotary ✓
Deepened _____ Rotary _____
Reconditioned _____ Jetted _____
Liner Installed _____ Pressure Fractured _____

DIMENSIONS: Diameter of well 6 inches
Drilled 240 ft. Depth of completed well 240 ft.

CONSTRUCTION DETAILS:
CASING INSTALLED: _____" Diam. from _____ ft. to _____ ft.
Threaded _____" Diam. from _____ ft. to _____ ft.
Welded ✓ 6" Diam. from 0 ft. to 108 ft.

PREFORATIONS: Yes ☐ No ☑
Type of perforator used _____
SIZE of perforations _____ in. by _____ in.
perforations from _____ ft. to _____ ft.
perforations from _____ ft. to _____ ft.

SCREENS: Yes ☐ No ☑
Manufacturer _____
Type _____ Model No. _____
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.
Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

GRAVEL PACKED: Yes ☐ No ☑ Size of Gravel _____
Gravel placed from _____ ft. to _____ ft.

SURFACE SEAL: Yes ☑ No ☐ Depth 108 ft.
Material Used In Seal STEEL DRIVE SHOE
Method of Sealing strata off CASING & CASING DRIVER

PRODUCTION DATA AT TIME OF DRILLING:
Static Level 114. ft.
Measured from _____ ft. With _____
Pumping level 240 ft. at 15 GPM
Recommended Pump Setting 220 ft.
If Flowing Well — GPM
Recommended Max. Pump Output 900 GPH
Water Clear ✓ Coloured _____ Silty _____ Sandy _____
Duration of test 2 Hrs.

DATE: Spudded Dec. 16/91 Completed Dec. 18/91
Rig # ONE Other Equip. _____

DEPTH:
Overburdon 108 ft. Tool Push _____
Bedrock 132 ft. Driller [illegible]
Total 240 ft. Roughneck [illegible]

FORMATION

DEPTH

FROM	TO	
GROUND LEVEL	3	SAND & GRAVEL
3	8	SAND & CLAY & GRAVEL
8	83	TILL SOME BOULDERS
83	97	DARK CLAY
97	108	TILL WITH BOULDERS
108	240	BEDROCK
		FRACTURE @ 220 TO 240

WELL OWNER:

I _____ Hereby Agree work has been completed in accordance with the contract and all material used has been of top quality.

CAPRI DRILLING (1985) LTD. [signature]

GENERAL REMARKS
LOAD CONT - 219 W
FINISHED BIT SIZE 6 1/2

IT IS HEREBY AGREED THAT FORMATIONS, QUALITY, QUANTITY AND TYPE OF WATER, ALONG WITH ALL OTHER REMARKS, ARE TRUE ONLY TO THE BEST KNOWLEDGE OF THE PERSONNEL AND COMPANY, AND THEY CANNOT BE HELD RESPONSIBLE FOR A MISTAKE IN CALCULATION.

THE COMPANY WILL NOT BE HELD RESPONSIBLE FOR PUBLIC LIABILITY OR PROPERTY DAMAGE CAUSED BY FLOWING WELL WASH OUTS OR ANY OTHER MISHAPS.

ALL MATERIALS SHALL REMAIN PROPERTY OF **CAPRI DRILLING** UNTIL ACCOUNT IS PAID IN FULL.

08 AL 034 224

Wtn 84211

BRITISH COLUMBIA ECOCAT BC Environment

Water Management Division

WATER WELL RECORD

Date 02 07 07 (YR MO DY)

NTS MAP | WELL No. | ELEV | Location Accuracy

UTM Z | E | N | UTM Date 19 | Well Type

Owners Name & Address KATHY GALLOWAY C/O 7480 HITCHCOCK RD. VERNON BC V0B 3N8

Legal Description & Address LOT 6 KAP 49151 O.D.Y.D. Sec 19 TP5 ODYD

Descriptive Location

1. TYPE OF WORK: 1 ☑ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD: 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☑ Rotary a ☐ mud b ☑ air c ☐ reverse ☐ Other

3. WATER WELL USE: 1 ☑ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Comm. & Ind. ☐ Other

4. DRILLING ADDITIVES —

5. MEASUREMENTS from 1 ☑ ground level 2 ☐ top of casing

casing height above ground level ft.

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	5	BROWN CLAY & ROCKS	
5	11	GREY CLAY, ROCKS & COBBLES	
11	340	GREY BROWN MICA SHIST WITH QUARTZ LENSES	
340	435	GREY GRANITE	
435	440	GREY GRANITE WITH QUARTZ SEAMS (FRACTURED)	
440	470	GREY GRANITE	

7. CONSULTANT

Address

8. WELL LOCATION SKETCH

9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete ☐ Other

							units
Hole Diameter							ins
Diameter	6						ins
from	0						ft
to	11						ft
Thickness	.188						ins
Weight	12.92						lb/ft

Pitless unit ft 1 ☐ above 2 ☐ below ground level

1 ☑ Welded 2 ☐ Cemented 3 ☐ Threaded | 1 ☑ New 2 ☐ Used

Perforations:

Shoe(s): YES

Open hole, from 11 to 470 ft Diameter 6 ins

Grout:

10. SCREEN: 1 ☐ Nominal (Telescope) 2 ☐ Pipe Size

Type 1 ☐ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre ☐ Other

Material 1 ☐ Stainless Steel 2 ☐ Plastic ☐ Other

Set from to ft below ground level

RISER, SCREEN & BLANKS							units
Length							ft
Diam. I D							ins
Slot Size							ins
from							ft
to							ft

Fittings, top bottom

Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☑ Air 4 ☐ Bailing 5 ☐ Pumping ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail 3 ☑ Air Date 02 06 19 (YR MO DY)

Rate 10 USgpm Temp °C SWL before test ft

Water Level ft after test of 1 hrs

☐ DRAWDOWN in ft				☐ RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
SUBMERSIBLE	450 ft	APROX. 10 USgpm

14. WATER TYPE: 1 ☑ fresh 2 ☐ salty 3 ☑ clear 4 ☐ cloudy

colour smell ; gas 1 ☐ yes 2 ☑ no

15. WATER ANALYSIS: 1 Hardness mg/L 2 Iron mg/L 3 Chloride mg/L 4 pH Field Date Lab Date (YR MO DY)

SITE I D No

16. FINAL WELL COMPLETION DATA

Well Depth 470 ft Well Yield EST. 10 US gpm

Static Water Level ft Artesian Flow US gpm Pressure Head ft

Back filled

Well Head Completion CAPPED

NO LINER

17. DRILLER PLEASE PRINT SURNAME SCHIBLI FIRST NAME MAX

Signature Max Schibli

18. CONTRACTOR, Address SCHIBLI DRILLING BOX 729 LUMBY BC, V0E 2G0

Member, BCWWDA ☑ yes ☐ no ;

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

87401

BRITISH COLUMBIA — BC Environment — Water Management Division

WATER WELL RECORD

Date 06/01/19 (YR/MO/DY)

NTS MAP 082L035123 WELL No. ELEV Location Accuracy

UTM Z11 347598E 5576937N UTM Date 19__ Well Type WTN 87401

Owners Name & Address PAUL STACK 8566 GREENAWAY RD VERNON B.C. V1B 3M6

Legal Description & Address LOT A, DL. 2242, ODYD, PLAN KAP60353

Descriptive Location GPS N. 50° 19' 29.3" W. 119° 08' 27.9" +/- 20' WELLTAG # 15919

1. TYPE OF WORK: 1 ☑ New Well 2 ☐ Reconditioned 3 ☐ Deepened 4 ☐ Abandoned

2. WORK METHOD: 1 ☐ Cable tool 2 ☐ Bored 3 ☐ Jetted 4 ☑ Rotary a ☐ mud b ☑ air c ☐ reverse ☐ Other

3. WATER WELL USE: 1 ☑ Domestic 2 ☐ Municipal 3 ☐ Irrigation 4 ☐ Comm. & Ind. ☐ Other

4. DRILLING ADDITIVES NONE

5. MEASUREMENTS from 1 ☑ ground level 2 ☐ top of casing

casing height above ground level 2 ft.

FROM ft	TO ft	6. WELL LOG DESCRIPTION	SWL ft
0	175	GREY CLAY TILL	+17'
175	178	GREY SAND AND GRAVEL	
178	257	GREY CLAY TILL	
257	271	BROWN SAND & GRAVEL	

7. CONSULTANT

Address

8. WELL LOCATION SKETCH

9. CASING: Materials 1 ☑ Steel 2 ☐ Galvanized 3 ☐ Wood 4 ☐ Plastic 5 ☐ Concrete ☐ Other

							units
Hole Diameter							ins
Diameter	8	6					ins
from	0	0					ft
to	16	267					ft
Thickness	0.025	0.0188					ins
Weight	25	12.42					lb/ft

Pitless unit ____ ft 1 ☐ above 2 ☐ below ground level

1 ☑ Welded 2 ☐ Cemented 3 ☐ Threaded | 1 ☑ New 2 ☐ Used

Perforations:

Shoe (s): YES 6 INCH

Open hole, from ____ to ____ ft Diameter ____ ins

Grout:

10. SCREEN: 1 ☑ Nominal (Telescope) 2 ☐ Pipe Size

Type 1 ☑ Continuous Slot 2 ☐ Perforated 3 ☐ Louvre ☐ Other

Material 1 ☑ Stainless Steel 2 ☐ Plastic ☐ Other

Set from 267 to 271 ft below ground level

RISER, SCREEN & BLANKS							units
Length	4						ft
Diam. I D	5						ins
Slot Size	0.020						ins
from	267						ft
to	271						ft

Fittings, top K PACKER bottom PLATE

Gravel Pack

11. DEVELOPED BY: 1 ☐ Surging 2 ☐ Jetting 3 ☑ Air 4 ☐ Bailing 5 ☐ Pumping ☐ Other

12. TEST 1 ☐ Pump 2 ☐ Bail 3 ☑ Air Date 06/01/19 (YR/MO/DY)

Rate 60 USgpm Temp ____ °C SWL before test ____ ft

Water Level ____ ft after test of ____ hrs

☐ DRAWDOWN in ft				☐ RECOVERY in ft			
mins	WL	mins	WL	mins	WL	mins	WL

13.

RECOMMENDED PUMP TYPE	RECOMMENDED PUMP SETTING	RECOMMENDED PUMPING RATE
SUBMERSIBLE	260 ft	APPROX 60 USgpm

14. WATER TYPE: 1 ☑ fresh 2 ☐ salty 3 ☑ clear 4 ☐ cloudy

colour ____ smell ____ ; gas 1 ☐ yes 2 ☑ no

15. WATER ANALYSIS: 1 Hardness ____ mg/L

2 Iron ____ mg/L 3 Chloride ____ mg/L

4 pH ____ Field Date ____

Lab Date ____ (YR/MO/DY)

SITE I D No ____

16. FINAL WELL COMPLETION DATA

Well Depth 271 ft Well Yield ESTIMATE 60 US gpm

Static Water Level +12.3 ft Artesian Flow 30 US gpm Pressure Head +23 ft

Back filled

Well Head Completion ~~CAP~~ WELL SEAL INSTALLED SEALED BETWEEN 8" AND 6"

17. DRILLER PLEASE PRINT SURNAME SCHIBLI FIRST NAME DAVID

Signature David Schibli

18. CONTRACTOR, Address SCHIBLI DRILLING BOX 729 LUMBY B.C. V0E 2G0

Member, BCWWDA ☐ yes ☐ no ;

The Province of British Columbia accepts no responsibility for the contents or accuracy of this record.

082L·035·113

BRITISH COLUMBIA

☑ **Well Construction Report**
☐ **Well Closure Report**

Stamp company name/address/ phone/fax/email here, if desired.
Integrity Drilling Inc

Ministry well ID plate number: 103321
Ministry Well Tag Number: 90094
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information.

Owner name: Wayne Benoit **Mailing address:** 7957 Wallace Town Vernon Prov BC Postal Code V1B 3N2

Address for well location: Street no. Lot #6 Street name Wallace Town Vernon

(or) **Legal description for well location:** Lot 6 Plan ____ D.L. ____ Block ____ Sec. ____ Twp. ____ Rg. ____ Land District ODYD

(or) **PID for well location:** ____ (and) **Description of well location (attach sketch, if nec):** 53.82'

Zone: ____ (and) **UTM Northing:** ____ m (or) **Latitude:** deg 50° min 18 sec ~~29.77~~ 47.1'

Lot #6 **UTM Easting:** ____ m **Longitude:** deg 119° min 10 sec ~~25.47~~

See reverse for notes & definitions of abbreviations.

Type of work: ☑ new well ☐ alteration ☐ closure

Method of drilling: ☑ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify): ____

Orientation of well: ☑ vertical ☐ horizontal Angle: ____ Ground elevation: 2451 ft asl Method: ____

Class of well (see note 2 on reverse): Water supply Sub-class of well: domestic

For water supply wells, indicate intended water use: ☑ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify): ____

Lithologic description or closure description (see reverse on how to fill out)

From (ft bgl)	To (ft bgl)	Relative Hardness	Colour	Material Description (use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
0	140	m	G-y	till		
140	151	m	BK	silt & gravel		
151	157	m	Br	sand water bearing	10	

Casing details

From (ft bgl)	To (ft bgl)	Dia (in)	Casing Material	Wall Thickness (in)	Drive Shoe	Uncased Hole
0	153	6⅝	steel	.219	✓	

Screen details

From (ft bgl)	To (ft bgl)	Dia (in)	Type (see note 12)	Slot Size
151	153	6"	K-packer & riser	
153	157	6"	screen	15

Intake: ☑ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☑ Telescope ☐ Pipe size
Screen material: ☑ Stainless steel ☐ Plastic ☐ Other (specify): ____
Screen opening: ☑ Continuous slot ☐ Slotted ☐ Perforated
Screen bottom: ☐ Bail ☑ Plug ☐ Plate ☐ Other (specify): ____
Filter pack: Type and size of material: ____
From: ____ ft To: ____ ft Thickness: ____ in

Surface seal: Type: Bentonite Depth (ft): 17
Method of installation: ☑ Poured ☐ Pumped Thickness (in): 11
Backfill: Type: ____ Depth (ft): ____
Liner: ☐ PVC ☐ Other (specify): ____ Thickness (in): ____
From: ____ ft bgl To: ____ ft bgl Perforated: From: ____ ft bgl To: ____ ft bgl

Developed by:

☑ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing
☐ Other (specify): ____ Total duration: 1 hrs
Notes: ____

Well yield estimated by:

☐ Pumping ☑ Air lifting ☐ Bailing ☐ Other (specify): ____
Rate: 25 USgpm Duration: 1 hrs
SWL before test: 20 ft (btoc) Pumping water level: ____ ft (btoc)

Obvious water quality characteristics:

☑ Fresh ☐ Salty ☑ Clear ☐ Cloudy ☐ Sediment ☐ Gas
Colour/odour: ____ Water sample collected: ☐

Well driller (please print):

First name: Darrell Last name: Wangler
Registration no. of driller responsible (if applicable; see note 16): WA0509208
Consultant (if applicable): ____

Final well completion data:

Total depth drilled: 157 ft Finished well depth: 157 ft bgl
Final stick up: 1'2ft in Depth to bedrock: n/a ft bgl
SWL: 20 ft (btoc) Estimated well yield: 25 USgpm
Artesian flow: no USgpm, or artesian pressure: ____ ft
Type of well cap: vermin proof Well disinfected: ☑ Yes ☐ No
Where well ID plate is attached: to casing

Well closure information:

Reason for closure: ____
Method of closure: ☐ Poured ☐ Pumped
Sealant material: ____ Backfill material: ____
Details of closure: ____

Date of work:

Started (YYYY/MM/DD): 06/5/10 Completed (YYYY/MM/DD): 06/5/12
Comments: ____

PLEASE NOTE: The information recorded in this well report describes the conditions at the time of construction, alteration, or closure only. Water quantity and water quality are not guaranteed and may change over time.

Form # 00008888 – WELL OWNER COPY
Sheet ____ of ____

082L-035-113

BRITISH COLUMBIA

☑ **Well Construction Report**
☐ **Well Closure Report**

Stamp company name/address/phone/fax/email here, if desired.
Integrity Drilling Inc

Ministry well ID plate number: 12335
Ministry Well Tag Number: 90114
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information.

Owner name: Wayne Bennett **Mailing address:** 7957 Wallace Town Vernon Prov BC Postal Code V1B 3N2

Address for well location: Street no. Lot #2 Street name Wallace Town Vernon

(or) **Legal description for well location:** Lot ____ Plan ____ D.L. ____ Block ____ Sec. ____ Twp. ____ Rg. ____ Land District ____

(or) **PID for well location:** ____ (and) **Description of well location (attach sketch, if nec):** ____

Zone: ____ (and) **UTM Northing:** ____ m (or) **Latitude:** deg 50° min 19 sec 06.66"
Lot #2 **UTM Easting:** ____ m **Longitude:** deg 119° min 10 sec 865 W
51.91'

See reverse for notes & definitions of abbreviations.

Type of work: ☑ new well ☐ alteration ☐ closure

Method of drilling: ☑ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify): ____

Orientation of well: ☑ vertical ☐ horizontal Angle: ____ Ground elevation: 2458 ft asl Method: ____

Class of well (see note 2 on reverse): Water supply Sub-class of well: domestic

For water supply wells, indicate intended water use: ☑ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify): ____

Lithologic description or closure description (see reverse on how to fill out)

From (ft bgl)	To (ft bgl)	Relative Hardness	Colour	Material Description (use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
0	100	m	br	till		
100	106	m	br	dirty sand (lotha)		silty wash
106	108	m	br	till		
108	109	m	br	dirty sand		
109	118	m	br	till		
118	270	H	W	bedrock		
270	287	H	W	bedrock	50	

Casing details

From (ft bgl)	To (ft bgl)	Dia (in)	Casing Material	Wall Thickness (in)	Drive Shoe	Uncased Hole
0	118	6 5/8	.219 Stel	.219	✓	

Screen details

From (ft bgl)	To (ft bgl)	Dia (in)	Type (see note 12)	Slot Size

Surface seal: Type: Bentonite Depth (ft): 17
Method of installation: ☑ Poured ☐ Pumped Thickness (in): 1
Backfill: Type: ____ Depth (ft): ____
Liner: ☑ PVC ☐ Other (specify): ____ Thickness (in): ____
From: 105 ft bgl To: 287 ft bgl Perforated: From: 250 ft bgl To: 260 ft bgl

Intake: ☐ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☐ Telescope ☐ Pipe size
Screen material: ☐ Stainless steel ☐ Plastic ☐ Other (specify): ____
Screen opening: ☐ Continuous slot ☐ Slotted ☐ Perforated
Screen bottom: ☐ Bail ☐ Plug ☐ Plate ☐ Other (specify): ____
Filter pack: Type and size of material: ____
From: ____ ft To: ____ ft Thickness: ____ in

Developed by:

☑ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing
☐ Other (specify): ____ Total duration: 1 hrs
Notes: ____

Well yield estimated by:

☐ Pumping ☑ Air lifting ☐ Bailing ☐ Other (specify): ____
Rate: ____ USgpm Duration: 1 hrs
SWL before test: 80 ft (btoc) Pumping water level: ____ ft (btoc)

Obvious water quality characteristics:

☑ Fresh ☐ Salty ☑ Clear ☐ Cloudy ☐ Sediment ☐ Gas
Colour/odour: ____ Water sample collected: ☐

Well driller (please print):

First name: Darrell Last name: Wayte
Registration no. of driller responsible (if applicable; see note 16): WD 05072008
Consultant (if applicable): ____

Final well completion data:

Total depth drilled: 287 ft Finished well depth: 287 ft bgl
Final stick up: 2½ ft in Depth to bedrock: 118 ft bgl
SWL: 80 ft (btoc) Estimated well yield: 50 USgpm
Artesian flow: none USgpm, or artesian pressure: ____ ft
Type of well cap: Vermin proof Well disinfected: ☑ Yes ☐ No
Where well ID plate is attached: to casing

Well closure information:

Reason for closure: ____
Method of closure: ☐ Poured ☐ Pumped
Sealant material: ____ Backfill material: ____
Details of closure: ____

Date of work:

Started (YYYY/MM/DD): 06/5/4 Completed (YYYY/MM/DD): 06/5/8
Comments: ____

PLEASE NOTE: The information recorded in this well report describes the conditions at the time of construction, alteration, or closure only. Water quantity and water quality are not guaranteed and may change over time.

Form # 00008888 – WELL OWNER COPY
Sheet ____ of ____

BRITISH COLUMBIA
Ministry of Environment

☑ Well Construction Report
☐ Well Closure Report
☐ Well Alteration Report

SCHIBLI DRILLING
Stamp company name/address/ phone/fax/e-mail here, if desired.

Ministry Well ID Plate Number: WTN103975
Ministry Well Tag Number: 15991
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information. **See reverse for notes & definitions of abbreviations.**

Owner name: TIM AND DIANE WATTS

Mailing address: 8498 SILVERSTAR RD Town VERNON Prov. BC Postal Code V1B3M7

Well Location: Address: Street no. Street name Town

(or) **Legal description:** Lot Plan D.L. Block Sec. Twp. Rg. Land District

(or) **PID:** (and) **Description of well location (attach sketch, if nec.):** EAST 1/2 OF THE SOUTH WEST 1/4 OF DL 2242, ODYD EXCEPT PLANS KAP63862 AND KAP74621

NAD 83: Zone: (see note 2) (and) **UTM Northing:** m **UTM Easting:** m (or) **Latitude (see note 3):** N. 50° 19' 20.9" **Longitude:** W. 119° 08' 41.1" ± 30

Method of drilling: ☑ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify):

Orientation of well: ☑ vertical ☐ horizontal Ground elevation: ft (asl) Method (see note 4):

Class of well (see note 5): **Sub-class of well:**

Water supply wells: indicate intended water use: ☑ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify):

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Material Description (Use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
0	6		BROWN	SAND AND GRAVEL		
6	18		BROWN	CLAY TILL		
18	163		GREY	CLAY TILL		
163	185		GREY	CEMENTED SAND AND GRAVEL		
185	201		BROWN	CEMENTED SAND AND GRAVEL		
201	215		BROWN	CLAY		
215	295		GREY	CLAY TILL		
295			BROWN	CEMENTED SAND AND GRAVEL		
			BROWN	SAND AND GRAVEL		

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material / Open Hole	Wall Thickness in	Drive Shoe
0	302	6	STEEL	0.188	YES

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
302	306	5		0.020

Surface seal: Type: BENTONITE Depth: 20 ft
Method of installation: ☑ Poured ☐ Pumped Thickness: 2 in
Backfill: Type: Depth: ft
Liner: ☐ PVC ☐ Other (specify):
Diameter: in Thickness: in
From: ft (bgl) To: ft (bgl) Perforated: From: ft (bgl) To: ft (bgl)

Intake: ☑ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☐ Telescope ☐ Pipe size
Screen material: ☑ Stainless steel ☐ Plastic ☐ Other (specify):
Screen opening: ☑ Continuous slot ☐ Slotted ☐ Perforated pipe
Screen bottom: ☐ Bail ☐ Plug ☑ Plate ☐ Other (specify):
Filter pack: From: ft To: ft Thickness: in
Type and size of material:

Developed by:

☑ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing
☐ Other (specify): Total duration: 4 hrs
Notes:

Well yield estimated by:

☐ Pumping ☑ Air lifting ☐ Bailing ☐ Other (specify):
Rate: APPROX 6 USgpm Duration: 4 hrs
SWL before test: ft (btoc) Pumping water level: ft (btoc)

Obvious water quality characteristics:

☐ Fresh ☐ Salty ☐ Clear ☑ Cloudy ☐ Sediment ☐ Gas
Colour/odour: NONE Water sample collected: ☐

Well driller (print clearly):

Name (first, last) (see note 19): DAVID SCHIBLI
Registration no. (see note 20): WD 05101403
Consultant (if applicable; name and company):

DECLARATION: Well construction, well alteration or well closure, as the case may be, has been done in accordance with the requirements in the *Water Act* and the Ground Water Protection Regulation.

Signature of Driller Responsible David Schibli

Final well completion data:

Total depth drilled: 306 ft Finished well depth: 306 ft (bgl)
Final stick up: 30 in Depth to bedrock: ft (bgl)
SWL: ft (btoc) Estimated well yield: 6 USgpm
Artesian flow: USgpm, or Artesian pressure: ft
Type of well cap: PLATE Well disinfected: ☐ Yes ☐ No
Where well ID plate is attached: CASING

Well closure information:

Reason for closure:
Method of closure: ☐ Poured ☐ Pumped
Sealant material: Backfill material:
Details of closure (see note 17):

Date of work (YYYY/MM/DD):

Started: 2007/07/09 **Completed:** 2007/07/18
Comments:

PLEASE NOTE: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, as the case may be. Well yield, well performance and water quality are not guaranteed as they are influenced by a number of factors, including natural variability, human activities and condition of the works, which may change over time.

white: Customer copy
canary: Driller copy
pink: Ministry copy

Sheet ____ of ____

082L.035.123

BRITISH COLUMBIA
Ministry of Environment

WTN 104005

☑ **Well Construction Report**
☐ **Well Closure Report**
☐ **Well Alteration Report**

SCHIBLI DRILLING
Stamp company name/address/ phone/fax/e-mail here, if desired.

Ministry Well ID Plate Number:
Ministry Well Tag Number: 15990
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information. **See reverse for notes & definitions of abbreviations.**

Owner name: TIM AND DIANE WATTS
Mailing address: 8498 SILVER STAR RD Town VERNON Prov. B.C. Postal Code V1B 3M7
Well Location: Address: Street no. Street name Town
(or) **Legal description:** Lot Plan D.L. Block Sec. Twp. Rg. Land District
(or) **PID:** (and) **Description of well location (attach sketch, if nec.):** EAST ½ OF THE SOUTHWEST ¼ OF DL 2242, ODYD, EXCEPT PLANS KAP63862 AND KAP74621

NAD 83: Zone: (see note 2) (and) **UTM Northing:** m **UTM Easting:** m (or) **Latitude (see note 3):** N 50° 19' 25.1" **Longitude:** W 119° 09' 45.8" +/- 28'

Method of drilling: ☑ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify):
Orientation of well: ☑ vertical ☐ horizontal Ground elevation: ft (asl) Method (see note 4):
Class of well (see note 5): **Sub-class of well:**
Water supply wells: indicate intended water use: ☑ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify):

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Material Description (Use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
0	22		BROWN	CLAY TILL		
22	48		GREY	CLAY TILL		
48	52		GREY	SAND AND GRAVEL		

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material / Open Hole	Wall Thickness in	Drive Shoe
0	48	6	STEEL	0.188	YES

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
48	52	5		0.020

Surface seal: Type: BENTONITE Depth: 20 ft
Method of installation: ☑ Poured ☐ Pumped Thickness: 2 in
Backfill: Type: Depth: ft
Liner: ☐ PVC ☐ Other (specify):
Diameter: in Thickness: in
From: ft (bgl) To: ft (bgl) Perforated: From: ft (bgl) To: ft (bgl)

Intake: ☑ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☑ Telescope ☐ Pipe size
Screen material: ☑ Stainless steel ☐ Plastic ☐ Other (specify):
Screen opening: ☑ Continuous slot ☐ Slotted ☐ Perforated pipe
Screen bottom: ☐ Bail ☐ Plug ☑ Plate ☐ Other (specify):
Filter pack: From: ft To: ft Thickness: in
Type and size of material:

Developed by:

☑ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing
☐ Other (specify): Total duration: 4 hrs
Notes:

Well yield estimated by:

☐ Pumping ☑ Air lifting ☐ Bailing ☐ Other (specify):
Rate: APPROX 5 USgpm Duration: 4 hrs
SWL before test: ft (btoc) Pumping water level: ft (btoc)

Obvious water quality characteristics:

☐ Fresh ☐ Salty ☑ Clear ☐ Cloudy ☐ Sediment ☐ Gas
Colour/odour: NONE Water sample collected: ☐

Well driller (print clearly):

Name (first, last) (see note 19): DAVID SCHIBLI
Registration no. (see note 20): WD 05101403
Consultant (if applicable; name and company):

DECLARATION: Well construction, well alteration or well closure, as the case may be, has been done in accordance with the requirements in the *Water Act* and the Ground Water Protection Regulation.

Signature of Driller Responsible David Schibli

Final well completion data:

Total depth drilled: 52 ft Finished well depth: 52 ft (bgl)
Final stick up: 30 in Depth to bedrock: ft (hgl)
SWL: 36 ft (btoc) Estimated well yield: 5 USgpm
Artesian flow: USgpm, or Artesian pressure: ft
Type of well cap: PLATE Well disinfected: ☐ Yes ☐ No
Where well ID plate is attached: CASING

Well closure information:

Reason for closure:
Method of closure: ☐ Poured ☐ Pumped
Sealant material: Backfill material:
Details of closure (see note 17):

Date of work (YYYY/MM/DD):

Started: 2007/07/06 **Completed:** 2007/07/09
Comments:

PLEASE NOTE: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, as the case may be. Well yield, well performance and water quality are not guaranteed as they are influenced by a number of factors, including natural variability, human activities and condition of the works, which may change over time.

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pink: Ministry copy

Sheet ____ of ____

0801.035.123 Coordinates place outside parcel boundary Updated to: 11 557681Z 5472407 A

BRITISH COLUMBIA
Ministry of Environment

☑ **Well Construction Report**
☐ **Well Closure Report**
☐ **Well Alteration Report**

SCHIBLI DRILLING
Stamp company name/address/ phone/fax/e-mail here, if desired.

Ministry Well ID Plate Number: 104171
Ministry Well Tag Number: 72455
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information. **See reverse for notes & definitions of abbreviations.**

Owner name: NICHOLE OAKDEN
Mailing address: 8266 ROGERS RD Town VERNON Prov. BC Postal Code V1B 3M7
Well Location: Address: Street no. 8266 Street name ROGERS RD Town VERNON
(or) **Legal description:** Lot 5 Plan 24652 D.L. 3648 Block Sec. Twp. Rg. Land District ODYD
(or) **PID:** 002-133-181 (and) **Description of well location (attach sketch, if nec.):**

NAD 83: Zone: (see note 2) (and) **UTM Northing:** m **UTM Easting:** m (or) **Latitude (see note 3):** N 50° 19' 34.5" **Longitude:** W 119° 00' 24.4" +/- 36'

Method of drilling: ☑ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify):
Orientation of well: ☑ vertical ☐ horizontal Ground elevation: ft (asl) Method (see note 4):
Class of well (see note 5): **Sub-class of well:**
Water supply wells: indicate intended water use: ☑ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify):

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Material Description (Use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
0	8		GREY	CLAY TILL		
8	16		BROWN	CLAY TILL		
16	20		BROWN	SAND AND GRAVEL		
20	45		GREY	CLAY TILL		
45	56		BROWN	SAND AND GRAVEL		
56	161		BLACK	SHALE WITH BROWN LAYERS		

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material / Open Hole	Wall Thickness in	Drive Shoe
0	56	6	STEEL	0.188	YES

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size

Surface seal: Type: BENTONITE Depth: 18 ft
Method of installation: ☑ Poured ☐ Pumped Thickness: 2 in
Backfill: Type: Depth: ft
Liner: ☑ PVC ☐ Other (specify):
Diameter: 4 in Thickness: 160 PSI in
From: 43 ft (bgl) To: 161 ft (bgl) Perforated: From: 121 ft (bgl) To: 161 ft (bgl)

Intake: ☐ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☐ Telescope ☐ Pipe size
Screen material: ☐ Stainless steel ☐ Plastic ☐ Other (specify):
Screen opening: ☐ Continuous slot ☐ Slotted ☐ Perforated pipe
Screen bottom: ☐ Bail ☐ Plug ☐ Plate ☐ Other (specify):
Filter pack: From: ft To: ft Thickness: in
Type and size of material:

Developed by:

☐ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing
☐ Other (specify): Total duration: hrs
Notes:

Well yield estimated by:

☐ Pumping ☑ Air lifting ☐ Bailing ☐ Other (specify):
Rate: APPROX 30 USgpm Duration: hrs
SWL before test: ft (btoc) Pumping water level: ft (btoc)

Obvious water quality characteristics:

☐ Fresh ☐ Salty ☑ Clear ☐ Cloudy ☐ Sediment ☐ Gas
Colour/odour: NONE Water sample collected: ☐

Final well completion data:

Total depth drilled: 161 ft Finished well depth: 161 ft (bgl)
Final stick up: 24 in Depth to bedrock: 54 ft (bgl)
SWL: 17.6 ft (btoc) Estimated well yield: 30 USgpm
Artesian flow: USgpm, or Artesian pressure: ft
Type of well cap: PLATE Well disinfected: ☐ Yes ☐ No
Where well ID plate is attached: CASING

Well closure information:

Reason for closure:
Method of closure: ☐ Poured ☐ Pumped
Sealant material: Backfill material:
Details of closure (see note 17):

Well driller (print clearly):

Name (first, last) (see note 19): DAVID SCHIBLI
Registration no. (see note 20): WDOSICL4103
Consultant (if applicable; name and company):

DECLARATION: Well construction, well alteration or well closure, as the case may be, has been done in accordance with the requirements in the *Water Act* and the Ground Water Protection Regulation.

Signature of Driller Responsible David Schibli

Date of work (YYYY/MM/DD):

Started: 2008/06/12 **Completed:** 2008/06/16
Comments:

PLEASE NOTE: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, as the case may be. Well yield, well performance and water quality are not guaranteed as they are influenced by a number of factors, including natural variability, human activities and condition of the works, which may change over time.

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canary: Driller copy
pink: Ministry copy

Sheet ____ of ____

0806035132

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 109891
Well Identification Plate Number: 38542
Owner Name: ROBERT GALLAWAY
Intended Water Use: Private Domestic

Well Status: New
Well Class: Water Supply
Well Subclass:
Aquifer Number:

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed

Licence Number:

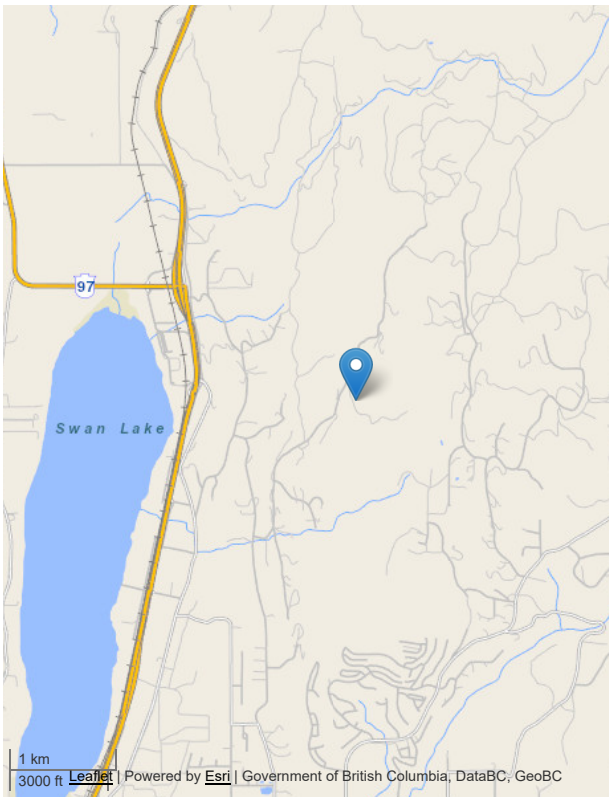
Location Information

Street Address: 7601 MCLENNON ROAD
Town/City: VERNON

Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	
Township	
Range	
Land District	
Property Identification Description (PID)	010911352

Description of Well Location: WELL DESCRIPTION NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 50.330633
Longitude: -119.220767
UTM Easting: 341946
UTM Northing: 5577751
Zone: 11
Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
There has been no activity related to this well.				

Well Work Dates

Start Date of Construction	End Date of Construction	Start Date of Alteration	End Date of Alteration	Start Date of Decommission	End Date of Decommission
2014-09-15	2014-09-17				

Well Completion Data

Total Depth Drilled: 220.00 feet
Finished Well Depth: 220.00 feet
Final Casing Stick Up: 12.000 inches
Depth to Bedrock: 78.00 feet
Ground elevation: 2312.00

Static Water Level (BTOC): 39.00 feet
Estimated Well Yield: 30.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: WELDED CAP
Well Disinfected Status: Not Disinfected
Drilling Method: Air Rotary
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	4.00	SILT			black	Soft		
4.00	78.00	GRAVEL SILT			brown	Medium		
78.00	80.00	BEDROCK			purple	Medium		
80.00	92.00				white	Medium		
92.00	140.00				green	Medium		
140.00	185.00	BLACK & WHITE				Hard	FRACTURED	2.0000
185.00	218.00	GREEN & WHITE MARBLE				Hard		30.0000
218.00	220.00	BLACK & WHITE QUARTZ & CLAY				Soft		

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	80.00		Steel	6.000	0.250	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness: 2.00
Surface Seal Depth:

Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material: PVC
Liner Diameter:
Liner from:

Liner Thickness:
Liner to:

Liner perforations

From	To
180.00 ft	220.00 ft

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:

Development Total Duration: 2.00 hours

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:

Method of Decommission:
Backfill Material:

Comments

No comments submitted

Alternative Specs Submitted: No

Documents

No additional documentation available for this well.

Disclaimer

The information provided should not be used as a basis for making financial or any other commitments. The Government of British Columbia accepts no liability for the accuracy, availability, suitability, reliability, usability, completeness or timeliness of the data or graphical depictions rendered from the data.

BRITISH COLUMBIA
Ministry of Environment

☑ **Well Construction Report**
☐ **Well Closure Report**
☐ **Well Alteration Report**

Stamp company name/address/ phone/fax/e-mail here, if desired.
Dan Gare Drilling

Ministry Well ID Plate Number: 29455
Ministry Well Tag Number: 110545
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information. **See reverse for notes & definitions of abbreviations.**

Owner name: Edelweiss Ranch Ltd
Mailing address: 7360 McLennan Rd Town Vernon Prov. BC Postal Code V1B 3S7
Well Location: Address: Street no. Street name Colebank Road Town
(or) **Legal description:** Lot Plan D.L. Block Sec. Twp. Rg. Land District
(or) **PID:** (and) **Description of well location (attach sketch, if nec.):**

NAD 83: Zone: 11U (see note 2) (and) **UTM Northing:** 0325456 m **UTM Easting:** 5590849 m (or) **Latitude (see note 3):** **Longitude:**

Method of drilling: ☑ air rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ excavating ☐ other (specify):
Orientation of well: ☑ vertical ☐ horizontal Ground elevation: 1782 ft (asl) Method (see note 4): GPS
Class of well (see note 5): Water Supply **Sub-class of well:** Domestic
Water supply wells: indicate intended water use: ☐ private domestic ☐ water supply system ☑ irrigation ☐ commercial or industrial ☐ other (specify):

Lithologic description (see notes 7-14) or closure description (see notes 15 and 16)

From ft (bgl)	To ft (bgl)	Relative Hardness	Colour	Material Description (Use recommended terms on reverse. List in order of decreasing amount, if applicable)	Water-bearing Estimated Flow (USgpm)	Observations (e.g., fractured, weathered, well sorted, silty wash), closure details
0	76		Brown	Sand & Gravel		
76	155			Gravel		
						142'
						Pump Test

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material / Open Hole	Wall Thickness in	Drive Shoe
+3	145	8	Steel	.250	Yes

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size
144	155	8	K-Packer Screen	200

Surface seal: Type: Bentonite Depth: 12 ft
Method of installation: ☑ Poured ☐ Pumped Thickness: 2 in
Backfill: Type: Depth: ft
Liner: ☐ PVC ☐ Other (specify):
Diameter: in Thickness: in
From: ft (bgl) To: ft (bgl) Perforated: From: ft (bgl) To: ft (bgl)

Intake: ☑ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☑ Telescope ☐ Pipe size
Screen material: ☑ Stainless steel ☐ Plastic ☐ Other (specify):
Screen opening: ☑ Continuous slot ☐ Slotted ☐ Perforated pipe
Screen bottom: ☐ Bail ☑ Plug ☐ Plate ☐ Other (specify):
Filter pack: From: ft To: ft Thickness: in
Type and size of material:

Developed by:

☑ Air lifting ☑ Surging ☐ Jetting ☐ Pumping ☐ Bailing
☐ Other (specify): Total duration: hrs
Notes:

Well yield estimated by:

☐ Pumping ☑ Air lifting ☐ Bailing ☐ Other (specify):
Rate: 100? USgpm Duration: hrs
SWL before test: ft (btoc) Pumping water level: ft (btoc)

Obvious water quality characteristics:

☑ Fresh ☐ Salty ☑ Clear ☐ Cloudy ☐ Sediment ☐ Gas
Colour/odour: No Water sample collected: ☐

Final well completion data:

Total depth drilled: 155 ft Finished well depth: 155 ft (bgl)
Final stick up: 36 in Depth to bedrock: ft (bgl)
SWL: 81 ft (btoc) Estimated well yield: USgpm
Artesian flow: USgpm, or Artesian pressure: ft
Type of well cap: Welded Well disinfected: ☑ Yes ☐ No
Where well ID plate is attached: Stick-up

Well closure information:

Reason for closure:
Method of closure: ☐ Poured ☐ Pumped
Sealant material: Backfill material:
Details of closure (see note 17):

Well driller (print clearly):

Name (first, last) (see note 19): Logan Flett
Registration no. (see note 20): 0804250
Consultant (if applicable; name and company): Rick Guiton

Date of work (YYYY/MM/DD):
Started: 2010/07/15 **Completed:** 2010/07/19
Comments:

DECLARATION: Well construction, well alteration or well closure, as the case may be, has been done in accordance with the requirements in the *Water Act* and the Ground Water Protection Regulation.

Signature of Driller Responsible Logan Flett

PLEASE NOTE: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, as the case may be. Well yield, well performance and water quality are not guaranteed as they are influenced by a number of factors, including natural variability, human activities and condition of the works, which may change over time.

white: Customer copy
canary: Driller copy
pink: Ministry copy

Sheet ____ of ____

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 111905
Well Identification Plate Number: 39422
Owner Name: KLAUS HOLLENBACH
Intended Water Use:

Well Status: New
Well Class: Water Supply
Well Subclass:
Aquifer Number:

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed
Licence Number:

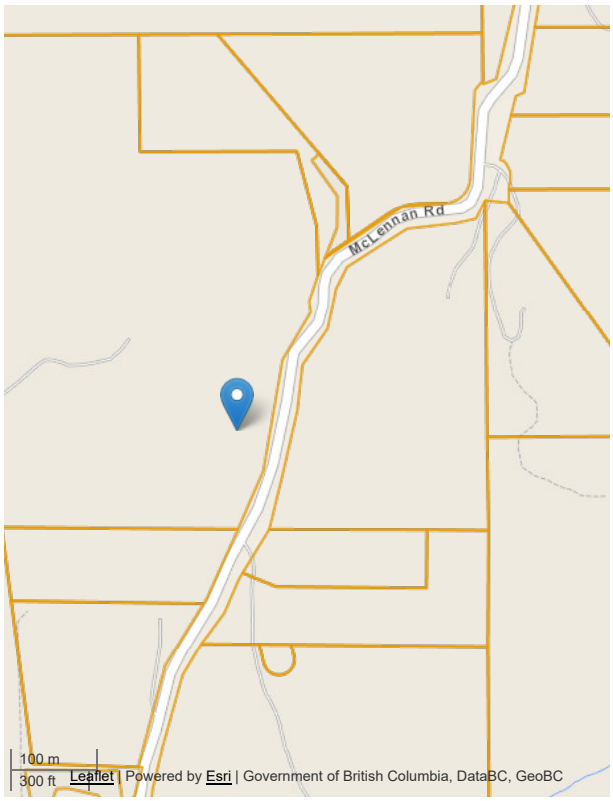
Location Information

Street Address: 7616 MCLENNAN ROAD
Town/City: VERNON

Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	
Township	
Range	
Land District	
Property Identification Description (PID)	

Description of Well Location: SUBDIVISION OF THE #7616



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 50.333699
Longitude: -119.221607
UTM Easting: 341896
UTM Northing: 5578094
Zone: 11
Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
There has been no activity related to this well.				

Well Work Dates

Start Date of Construction	End Date of Construction	Start Date of Alteration	End Date of Alteration	Start Date of Decommission	End Date of Decommission
2014-05-15	2014-05-20				

Well Completion Data

Total Depth Drilled: 420.00 feet
Finished Well Depth: 420.00 feet
Final Casing Stick Up: 21.000 inches
Depth to Bedrock: 7.00 feet
Ground elevation: 2269.00

Static Water Level (BTOC): 101.00 feet
Estimated Well Yield: 30.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: ALUMINUM
Well Disinfected Status: Disinfected
Drilling Method: Air Rotary
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	6.00	CLAY AND ROCKS			brown			
6.00	420.00	BEDROCK					400'=6-10 GPM	
385.00								2.0000
415.00							FRACTURED	28.0000

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	18.00		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness: 1.00
Surface Seal Depth:

Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material: PVC
Liner Diameter:
Liner from:

Liner Thickness:
Liner to:

Liner perforations

From	To
380.00 ft	420.00 ft

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:

Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Method of Decommission:
Sealant Material:
Backfill Material:
Decommission Details:

Comments

LINER PERFORATED=ALSO 220

Alternative Specs Submitted: No

Documents

No additional documentation available for this well.

Disclaimer

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Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 111907
Well Identification Plate Number: 39418
Owner Name: KEVIN FRAME
Intended Water Use: Private Domestic

Well Status: New
Well Class: Water Supply
Well Subclass:
Aquifer Number:

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed

Licence Number:

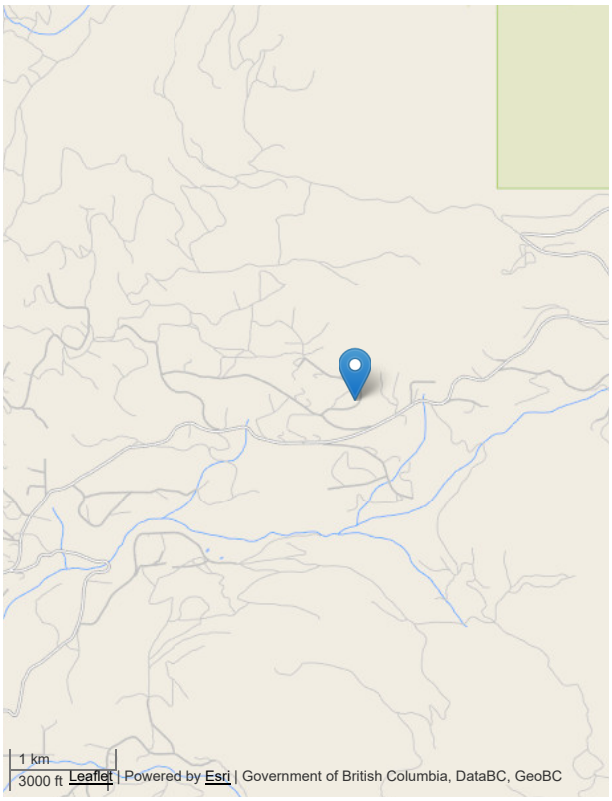
Location Information

Street Address: 8267 ROGERS ROAD
Town/City: VERNON

Legal Description:

Lot	2
Plan	24658
District Lot	3848
Block	
Section	
Township	
Range	
Land District	41
Property Identification Description (PID)	005869940

Description of Well Location: NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 50.325617
Longitude: -119.156429
UTM Easting: 346508
UTM Northing: 5577059
Zone: 11
Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
There has been no activity related to this well.				

Well Work Dates

Start Date of Construction	End Date of Construction	Start Date of Alteration	End Date of Alteration	Start Date of Decommission	End Date of Decommission
2014-05-01	2014-05-05				

Well Completion Data

Total Depth Drilled: 122.00 feet
Finished Well Depth: 121.00 feet
Final Casing Stick Up: 36.000 inches
Depth to Bedrock:
Ground elevation: 3200.00

Static Water Level (BTOC): 41.00 feet
Estimated Well Yield: 10.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: ALUMINUM
Well Disinfected Status: Disinfected
Drilling Method: Air Rotary
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	13.00	CLAY AND ROCKS			brown			
13.00	16.00	BOULDER						
16.00	40.00	CLAY AND ROCKS			brown			
40.00	42.00	GRAVEL						
42.00	90.00	CLAY AND ROCKS			blue			
90.00	96.00	CLAY AND ROCKS			brown			
96.00	115.00	CLAY AND ROCKS			blue		110'=5-8 GPM WITH PUMP PROTECTION	
115.00	121.00	SAND AND GRAVEL			brown			

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	116.50		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness: 1.00
Surface Seal Depth:

Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material:
Liner Diameter:
Liner from:

Liner Thickness:
Liner to:

Liner perforations

From	To
There are no records to show	

Screen Details

Installed Screens

Intake Method:
Screen
Type: Telescope
Material: Stainless Steel
Opening: Continuous Slot
Bottom: Plug

From	To	Diameter	Assembly Type	Slot Size
115.00 ft	117.00 ft	6.00	K_RISER	0.00
117.00 ft	121.00 ft	6.00	SCREEN	12.00

Well Development

Developed by:

Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:

Method of Decommission:
Backfill Material:

Comments

SCREEN TYPE(117-121)=SCREEN & PLUG

Alternative Specs Submitted: No

Documents

No additional documentation available for this well.

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Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 111951
Well Identification Plate Number: 39417
Owner Name: AL REUMAYR
Intended Water Use: Private Domestic

Well Status: New
Well Class: Water Supply
Well Subclass:
Aquifer Number:

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed

Licence Number:

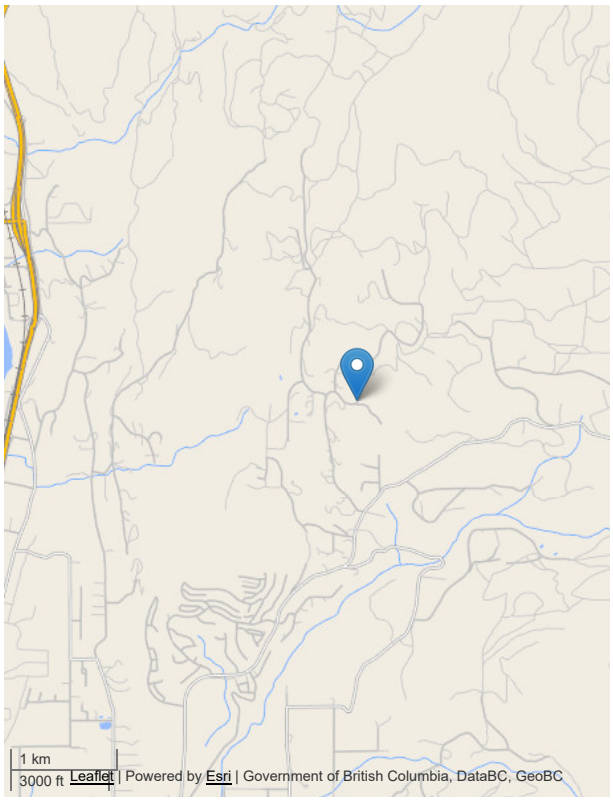
Location Information

Street Address: 7811 WILSON JACKSON ROAD
Town/City: VERNON

Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	
Township	
Range	
Land District	
Property Identification Description (PID)	005905265

Description of Well Location: SOUTHEAST CORNER OF THE PROPERTY



Geographic Coordinates - North American Datum of 1983 (NAD 83)

Latitude: 50.325301
Longitude: -119.199676
UTM Easting: 343429
UTM Northing: 5577114
Zone: 11
Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
There has been no activity related to this well.				

Well Work Dates

Start Date of Construction	End Date of Construction	Start Date of Alteration	End Date of Alteration	Start Date of Decommission	End Date of Decommission
2014-04-24	2014-04-30				

Well Completion Data

Total Depth Drilled: 640.00 feet
Finished Well Depth: 640.00 feet
Final Casing Stick Up: 24.000 inches
Depth to Bedrock: 57.00 feet
Ground elevation: 2752.00

Static Water Level (BTOC): 260.00 feet
Estimated Well Yield: 3.500 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: ALUMINUM
Well Disinfected Status: Disinfected
Drilling Method: Air Rotary
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	7.00	RED/BROWN CLAY AND ROCKS						
7.00	22.00	CLAY AND ROCKS			brown			
22.00	57.00	CLAY AND ROCKS			blue			
57.00	640.00	BEDROCK					575'-600', BEDROCK, 3.25 USGPM; 620'=4-8 GPM WITH PUMP PROTECTION	

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	57.00		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness: 1.00
Surface Seal Depth:

Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material: PVC
Liner Diameter:
Liner from:

Liner Thickness:
Liner to:

Liner perforations

From	To
620.00 ft	640.00 ft

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:

Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Method of Decommission:
Sealant Material:
Backfill Material:
Decommission Details:

Comments

LINER PERFORATED=ALSO 400, 500 & 600

Alternative Specs Submitted: No

Documents

No additional documentation available for this well.

Disclaimer

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37988

WELL LOG CONSTRUCTION RECORD

OWNER Roy Ferguson

Address

Well Location aspen Rd Silver Star

Date Started Date Completed Aug 25-77

Thomas Welldrilling
Box 404 Lumby B

Drilling Method Cable tool

Driller D Thomas Helper C Thomas

File Folio

Signed By

LOG OF FORMATIONS

Depth		Descriptions
0	to 177	till
	to	Boulders
	to	
177	to 195	Bedrock
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	
	to	

GENERAL REMARKS

CASING RECORD

Dia. ins. Wt. #/ft. From to

Dia. ins. Wt #/ft. From to

Dia. ins. Wt. #/ft. From to

Shoe Welded Cemented

SCREEN RECORD

Make Material

Slot opening Length

Top ft. Bottom ft.

Fittings Top Fittings Bottom

Gravel Pack Natural

Development Method

ROCK WELL DATA

Open Bore Hole ~~Dia.~~ Dia. 6 ins.

From 177 ft. to 195 ft.

PRODUCTION DATA

Static Level 130 ft ft.

Measured from Surface

Pumping Level 190 ft. at 10 GPM

ft. at GPM

Bail Test 190 ft. at 10 GPM

ft. at GPH

Recommended Pump Setting 190 ft.

Recommended Max. Pump Output 10 GPM ~~GPH~~

Duration of Test 1 Hrs.

PUMP DATA

Make Type

Model Serial No.

Size HP Drop Pipe ins.

GPM Head ft. RPM

Motor Volts PH

Well Seal

Water Analysis — Hardness PPM

PH Iron PPM

McHARG DRILLING LTD.

82887

SITE 20, COMP. 23, R.R. 3 ☐ SALMON ARM, B.C. ☐ V1E 4M3
TELEPHONE 832-3264 ☐ MOBILE H497066

46

Date Dec. 16 4/88 Jan. 16 4/89 Telephone 545-2503

Owner's Name Solomon & Gundula Mogerman (Mogerman)

Address S11, C32, R.R.3, Vernon, B.C., V1T 6L6

Location Silver Star Rd. Hole No. Two.

0-27 - Clay gravel & sand
27-134 - Boulders & cemented gravel
134-138 - Granite Boulder
138-145 - cemented gravel
145-192 - gravel & sands.
192-200 Bedrock.

Note water bearing gravels & sands from 145'-192'
Also Note unable to drive 6" csg thru granite boulder @ 134'

Total Depth 200 ft

1. Casing Size 6 5/8 Type Steel Set From 0 To 135'
LINER 2. Casing Size 5 1/2 Type Steel Set From 174 To 112'
1. Screen Stainless Steel Length 8' Slot .010
2. Screen ____ Length ____ Slot ____
Set 2 Sections From 182' To 174'
Pump Tested Air Lift GPM* 10 Draw Down 182'
Recommended Pumping Rate Must Be Pump Tested.
Static Water Level 145' Recommended Pump set at 176' ft.

Drilling	200 ft dtg. @ 20.00 per ft	$ 4000.00
Casing		$
Screen(s)	2 - 4' sections ea 320.00	$ 640.00
Drive Shoe	one 6 5/8" Steel ea	$ 70.00
K-Packer	& Bottom & Riser ea	$ 90.00
Developing	8 hrs @ 125.00 per hr.	$ 1000.00
Other	Note (actual rig time - setting screens & gitting well 22 hrs)	$
	only charging above 8 hrs.	$
Total Cost of Well	Note - Until got note back	$ 5800.00
Amount Paid	By Cheque Jan. 19	$ 5000.00
Balance	Paid in full. Thanks.	$ 0

Owner's Signature

McHARG DRILLING LTD.

Per Bob. Wagner

Terms: Cash. 2% per month or 24% per annum charged on overdue accounts.
***ESTIMATE ONLY** — For accuracy, a pump test is required.

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 111938
Well Identification Plate Number: 39450
Owner Name: RICHARD & THOMAS TULL
Intended Water Use: Private Domestic

Well Status: New
Well Class: Water Supply
Well Subclass: Domestic
Aquifer Number:

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID:
Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed

Licence Number:

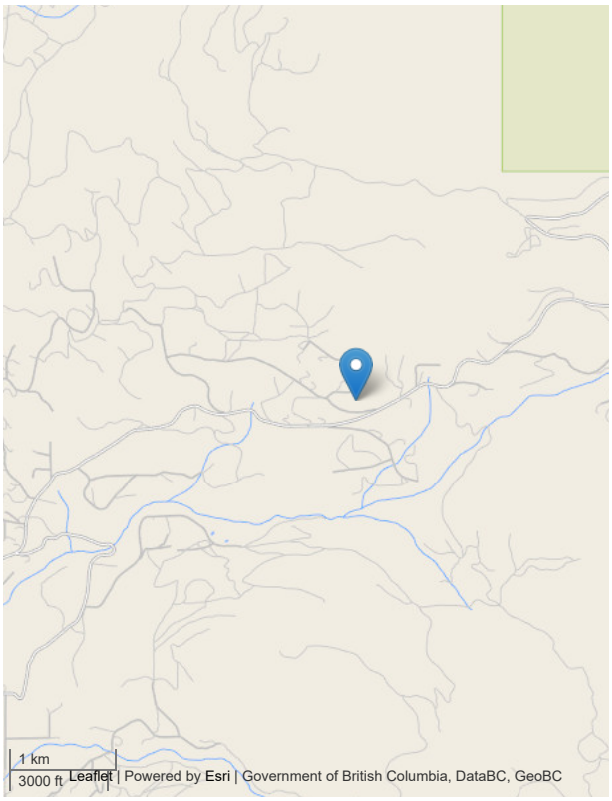
Location Information

Street Address: 8283 ROGER ROAD
Town/City: VERNON

Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	
Township	
Range	
Land District	
Property Identification Description (PID)	006552862

Description of Well Location: NOT PROVIDED



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 50.324183
Longitude: -119.157109
UTM Easting: 346455
UTM Northing: 5576901
Zone: 11
Coordinate Acquisition Code: (10 m accuracy) Handheld GPS with accuracy of +/- 10 metres

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
There has been no activity related to this well.				

Well Work Dates

Start Date of Construction	End Date of Construction	Start Date of Alteration	End Date of Alteration	Start Date of Decommission	End Date of Decommission
2014-09-29	2014-10-02				

Well Completion Data

Total Depth Drilled: 260.00 feet
Finished Well Depth: 260.00 feet
Final Casing Stick Up: 16.000 inches
Depth to Bedrock: 179.00 feet
Ground elevation: 3179.00

Static Water Level (BTOC): 55.00 feet
Estimated Well Yield: 4.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: ALUMINUM
Well Disinfected Status: Disinfected
Drilling Method: Air Rotary
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
0.00	32.00	CLAY AND ROCKS			brown			
32.00	168.00	CLAY AND ROCKS			blue			
168.00	179.00	GRAVEL, SILT AND CLAY			grey			
179.00	260.00	BEDROCK					230'=4 USGPM, VERY FRACTURED; 230'=4-6 GPM WITH PUMP PROTECTION	

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	179.00		Steel	6.000	0.219	Installed

Surface Seal and Backfill Details

Surface Seal Material: Bentonite clay
Surface Seal Installation Method: Poured
Surface Seal Thickness: 1.00
Surface Seal Depth:

Backfill Material Above Surface Seal:
Backfill Depth:

Liner Details

Liner Material: PVC
Liner Diameter:
Liner from:

Liner Thickness:
Liner to:

Liner perforations

From	To
220.00 ft	260.00 ft

Screen Details

Intake Method:
Type:
Material:
Opening:
Bottom:

Installed Screens

From	To	Diameter	Assembly Type	Slot Size
There are no records to show				

Well Development

Developed by:

Development Total Duration:

Well Yield

No well yield data available.

Well Decommission Information

Reason for Decommission:
Method of Decommission:
Sealant Material:
Backfill Material:
Decommission Details:

Comments

LINER PERFORATED=ALSO 140

Alternative Specs Submitted: No

Documents

No additional documentation available for this well.

Disclaimer

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British Columbia — The Best Place on Earth
Ministry of Environment

☒ Well Construction Report
☐ Well Closure Report
☐ Well Alteration Report

AQUA SOURCE DRILLING LTD.
2307 - 39th Ave.
Vernon, B.C. V1T 3B3
Bus: 250-275-0920

Ministry Well ID Plate Number: 50310
Ministry Well Tag Number: 113299
☐ Confirmation/alternative specs. attached
☐ Original well construction report attached

Red lettering indicates minimum mandatory information. See reverse for notes & definitions of abbreviations.

Owner name: Tim A Boulter
Mailing address: 7961 Silver Star Rd Town Vernon Prov. ____ Postal Code V1B 3N2
Well Location (see note 2): Address: Street no. 7961 Street name Silver Star Rd Town Vernon
(or) Legal description: Lot ____ Plan ____ D.L. ____ Block ____ Sec. ____ Twp. ____ Rg. ____ Land District ____
(or) PID: ____ (and) Description of well location (attach sketch, if nec.): well is at NW corner of property near Wilson Jackson Road
NAD 83: Zone: Nad 83 (see note 3) (and) UTM Easting: 119° 11. 590 w. m UTM Northing: 50° 19.701 n. m (or) Latitude (see note 4): 50 19 42 Longitude: 119 11 35 LAL
Method of drilling: ☒ air rotary ☐ dual rotary ☐ cable tool ☐ mud rotary ☐ auger ☐ driving ☐ jetting ☐ other (specify):
Orientation of well: ☒ vertical ☐ horizontal Ground elevation: 3027 ft (asl) Method (see note 5): GPS.
Class of well (see note 6): Closed Loop Geothermal Sub-class of well:
Water supply wells: indicate intended water use: ☐ private domestic ☐ water supply system ☐ irrigation ☐ commercial or industrial ☐ other (specify):

Lithologic description (see notes 8-13) or closure description (see notes 14 and 15)

From ft (bgl)	To ft (bgl)	Clay	Silt	Till	Sand with clay/silt	Sand, fine-med	Sand, med-coarse	Sand with gravel	Siltstone/shale	Sandstone	Conglomerate	Limestone	Basalt	Volcanic	Cyrstalline	Other Surficial/Bedrock	Red	Orange	Brown	Tan	Light Grey	Blue	Green	Dark Grey	Very Hard	Hard	Dense/Stiff	Loose	Dry	Moist	Wet	High Production	Lost circulation	Not Available	Observations (e.g. other geological materials (e.g. boulders), est. water bearing flow (USgpm), or closure details)
0	7			●															●								●		●						
7	12																									●			●						Black + white.
12	54							●											●									●	●						
54	218			●																							●								Black
218	700													●																					<1/4 GPM.

Surficial Material: Clay – Sand with gravel; Bedrock Material: Siltstone/shale – Other Surficial/Bedrock; Colour: Red – Dark Grey; Hardness: Very Hard – Loose; Water Content: Dry – Not Available.

Casing details

From ft (bgl)	To ft (bgl)	Dia in	Casing Material/Open Hole (see note 17)	Wall Thickness in	Drive Shoe
0	236	6	STEEL	.219	✓
236	700	6 1/8	Open Hole.		

Surface seal: Type: Bentonite. Depth: 20 ft
Method of installation: ☐ Poured ☐ Pumped Thickness: 4. in
Backfill: Type: ____ Depth: ____ ft
Liner: ☐ PVC ☐ Other (specify):
Diameter: ____ in Thickness: ____ in
From: ___ ft (bgl) To: ___ ft (bgl) Perforated: From: ___ ft (bgl) To: ___ ft (bgl)

Screen details

From ft (bgl)	To ft (bgl)	Dia in	Type (see note 18)	Slot Size

Intake: ☐ Screen ☐ Open bottom ☐ Uncased hole
Screen type: ☐ Telescope ☐ Pipe size
Screen material: ☐ Stainless steel ☐ Plastic ☐ Other (specify):
Screen opening: ☐ Continuous slot ☐ Slotted ☐ Perforated pipe
Screen bottom: ☐ Bail ☐ Plug ☐ Plate ☐ Other (specify):
Filter pack: From: ____ ft To: ____ ft Thickness: ____ in
Type and size of material:

Developed by:
☐ Air lifting ☐ Surging ☐ Jetting ☐ Pumping ☐ Bailing
Other (specify): ____ Total duration: ____ hrs
Notes:

Well yield estimated by:
☐ Pumping ☐ Air lifting ☐ Bailing ☐ Other (specify):
Rate: ____ USgpm Duration: ____ hrs
SWL before test: ____ ft (btoc) Pumping water level: ____ ft (btoc)

Obvious water quality characteristics:
☐ Fresh ☐ Salty ☐ Clear ☐ Cloudy ☐ Sediment ☐ Gas
Colour/odour: ____ Water sample collected: ☐

Well driller (print clearly):
Name (first, last) (see note 19): Walter Hown
Registration no. (see note 20): 05081001
Consultant (if applicable; name and company):

Final well completion data:
Total depth drilled: 700 ft Finished well depth: 700 ft (bgl)
Final stick up: 24 in Depth to bedrock: 218 ft (bgl)
SWL: ____ ft (btoc) Estimated well yield: <1/4 USgpm
Artesian flow: ____ USgpm, or Artesian pressure: ____ ft
Type of well cap: Vented Well disinfected: ☒ Yes ☐ No
Where well ID plate is attached: To Casing

Well closure information:
Reason for closure:
Method of closure: ☐ Poured ☐ Pumped
Sealant material: ____ Backfill material:
Details of closure (see note 16):

Date of work (YYYY/MM/DD):
Started: 2016 10 21 Completed: 2016 11 01
Comments:

DECLARATION: Well construction, well alteration or well closure, as the case may be, has been done in accordance with the requirements in the Water Act and the Ground Water Protection Regulation.

Signature of Driller Responsible: [signature]

PLEASE NOTE: The information recorded in this well report describes the works and hydrogeologic conditions at the time of construction, alteration or closure, as the case may be. Well yield, well performance and water quality are not guaranteed as they are influenced by a number of factors, including natural variability, human activities and condition of the works, which may change over time.

white: Customer copy
canary: Driller copy
pink: Ministry copy

Sheet ____ of ____

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