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PRELIMINARY HYDROGEOLOGICAL ASSESSMENT

Willow Beach Estates
9330 202 Avenue
Osoyoos, BC

PREPARED FOR:

INFINITY PROPERTIES LTD.
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Langley, BC V2Y 1N2

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1 INTRODUCTION

Active Earth Engineering Ltd. (Active Earth) was retained by Infinity Properties Ltd. (Infinity) to conduct a hydrogeological assessment for the proposed Willow Beach Estates residential development in Osoyoos, BC.

The development area (Site) comprises a 60-lot single family residential community on a 26.5 hectare area parcel on the north end of Lake Osoyoos. An estimated 55,000 m^3 of fill will be imported to raise ground elevations above anticipated flood levels. In most areas, lifts of between 0.5 and 1.5 m are anticipated. The Site abuts a Fish & Wildlife Conservation Area (Conservation Area) to the northwest.

Between 2017 and 2020, Ecoscape Environmental Consultants Ltd. (Ecoscape) completed a comprehensive baseline investigation of surface and groundwater conditions across the Site and Conservation Area. This included monitoring well installation, hydraulic response testing, surveying and groundwater monitoring. Their resultant data set (included as Appendix A) forms the basis for our interpretation of pre-development groundwater conditions.

2 SCOPE OF WORK

The purpose of this (Phase 1) desktop hydrogeological assessment is to characterize pre-development groundwater conditions in this area and provide preliminary comment on the potential impacts of the proposed development. Consideration will be given to changes resulting from infilling activities, the addition of impermeable surfaces, and stormwater infiltration. Groundwater extraction for water supply and wastewater effluent disposal to ground are not part of this assessment.

Pre- and post- development surface water conditions are being addressed by others.

Our work has included the following tasks:

1. Review background information and data collected during previous investigations;
2. Review climate data for the nearest Environment Canada climate station and region-specific literature on climate change;
3. Consult the Regional District of Okanagan-Similkameen's (RDOS') Public Parcel Viewer and Google Earth for information on land use and municipal infrastructure;
4. Review local geology and surficial geology maps;

5. Consult the Province's Wells and Aquifer Database (GWELLS) to obtain information on local aquifers and water wells;
6. Review local hydrometric data, climate change predictions, and watershed mapping; and,
7. Prepare a report presenting a conceptual model of groundwater flow in the vicinity of the development based on the current and future climate and presenting preliminary recommendations for stormwater management and potential impacts to groundwater as a result of the development.

3 DESKTOP REVIEW

3.1 Site Description

The Site is located at 9330 202 Avenue in Osoyoos, BC. It is situated between Hwy 97 - Okanagan Highway (to the west), Osoyoos Lake (to the south) and the Conservation Area (to the north and east). The Site is accessed by Lakehead Campsite Road off of 204 Avenue. The following table presents a summary of Site descriptors:

TABLE A – SITE SUMMARY

Address	Current Civic Address(es)	9330 202 Avenue Osoyoos, BC
	Parcel ID	002-036-967
	Legal Description	Lot 675, Plan KAP2066, District Lot 2450S, Similkameen Div of Yale Land District, Except Plan 22229 43613 H9726
	Area	24 Ha
	Parcel ID	002-036-738
	Legal Description	Lot 1, Plan KAP22229, District Lot 2450S, Similkameen Div of Yale Land District, Portion L 677, FOR WILLOW BEACH MHP BAYS C/REF 70008.012 ET AL, 17714 WILLOW BEACH Manufactured Home Park, MHP Roll # 17-714-06379.000
	Area	5 Ha
	Cartographic Coordinates	49° 4' 37.19" North 119° 31' 46.45" West
	Total Area	29 Ha
	Surface Coverage	80% undeveloped 20% buildings/homes

The Site is situated in a valley bottom that slopes very gradually to the southeast towards Osoyoos Lake. Ground elevations range from about 277 to 278 m-asl, with elevations as high as 280 m-asl in already built-up areas. On the shoreline with Osoyoos Lake, beach elevations drop more steeply to Lake level.

3.2 Current and Proposed Land Use

The Site formerly hosted a campground and over 30 single family residential lots accessed by Lakehead Campsite Road. Subsequent to the sale of the property circa 2007, several homes have been demolished and lots left vacant.

The proposed development comprises 60 Strata Single Family lots (zoned RS-1 and RS-1S) covering approximately 4.57 Ha (Figure 1). It is serviced by Lakehead Campsite Road (0.64 Ha) and adjoined by Open Space / Parkland (1.75 Ha) and Strata Common Property (1.75 Ha). It intends to preserve 19.07 Ha of Conservation Area to the northwest.

The preliminary approach for stormwater management is to direct surface water runoff to roadside ditches or swales and ultimately to Osoyoos Lake. The development will be supplied by a municipal water system.

Currently, drinking water is sourced from a well(s) owned and operated by the Willow Beach Mobile Home Park[1]. Sewage effluent is treated by individual septic fields, and storm water is piped to the Town of Osoyoos' storm sewer system along 95th Street[2].

[1] Communication with Mr. Rob Birtles, Team Leader, Drinking Water Systems Program, Environmental Public Health, Interior Health on February 8, 2021
[2] Communication with Mr. Andrew McKillop, Town of Osoyoos Public Works, February 5, 2021

3.3 Climate

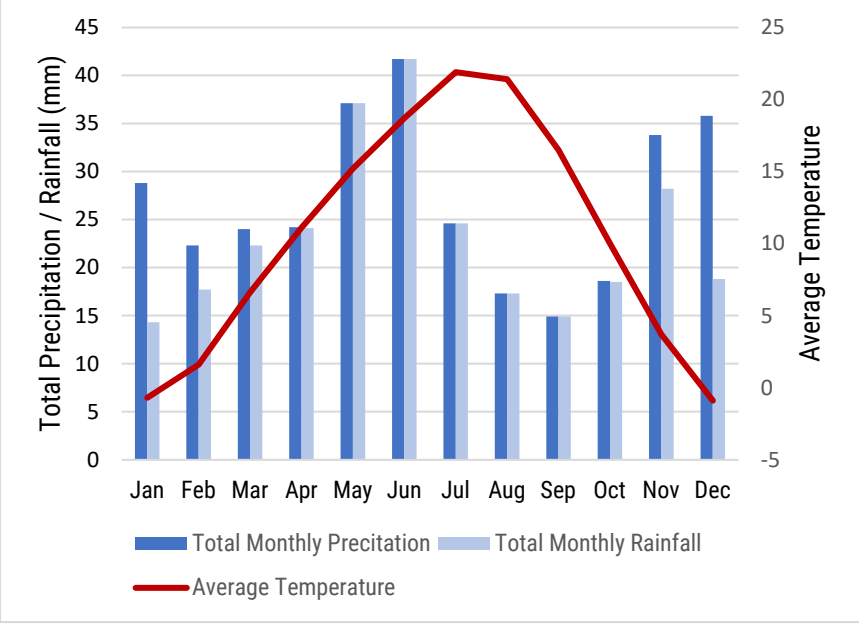
Climate normals for the period 1981 to 2010 were obtained from the Osoyoos West Station (ID 1125865), located approximately 8.5 km southeast of the Site. Average temperatures and precipitation amounts are summarized in the table below.

TABLE B – CLIMATE NORMALS (1981 – 2010) FOR OSOYOOS WEST CLIMATE STATION

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average Temperature (°C)	-0.7	1.6	6.6	11.1	15.2	18.7	21.9	21.4	16.5	10.0	3.7	-0.9	**10.4**
Rainfall (mm)	14.3	17.7	22.3	24.1	37.1	41.7	24.6	17.3	14.9	18.5	28.2	18.8	**279.4**
Snowfall (mm)	14.6	4.6	1.7	0.1	0.0	0.0	0.0	0.0	0.0	0.1	5.7	17.0	**43.8**
Total Precipitation (mm)	28.8	22.3	24.0	24.2	37.1	41.7	24.6	17.3	14.9	18.6	33.8	35.8	**323.2**

The area receives approximately 279.4 mm of rainfall and 43.8 mm of snowfall annually. The wettest months are May, June and November, with average monthly rainfall amounts ranging from 28.2 mm (November) to 41.7 mm (June). The maximum monthly precipitation is 41.7 mm in June of which 100% falls as rain.

FIGURE A – CLIMATE NORMALS (1981 – 2010) FOR OSOYOOS WEST CLIMATE STATION



The Regional Districts of the Okanagan, including the Regional District of Okanagan-Similkameen (RDOS), have undertaken numerous collective strategic studies to assess and quantify climate projections for the Okanagan Region. According to the most recent study (February 2020[3]), changes that can be expected over the coming decades, include:

- Warmer temperatures year-round;
- Considerably hotter summers;
- Warmer winters;
- Increased precipitation across all seasons, except summer;
- Drier summers; and,
- Shifting seasons, in that "January's of tomorrow may feel like the Marchs of today."

The report offers climate projections for both the 2050s and the 2080s. Regional changes that may impact future development include warmer winter temperatures, which will have implications for streamflow, as well as increased precipitation, which can lead to more frequent flooding and landslides.

3.4 Bedrock and Surficial Geology

According to the Ministry of Energy Mines and Petroleum Resources (2005)[4], the site is underlain by greenstone and greenschist metamorphic rocks of the Apex Mountain Volcanics.

These rocks are overlain by mixed unconsolidated quaternary deposits located in the Okanagan River floodplain. Sediments underlying the Site consist largely of kame terrace and meltwater channel deposits (Nasmith 1962)[5].

3.5 Hydrogeology and Water Resource Use

3.5.1 Aquifer Description

The Site overlies the Osoyoos Lake to Tugulnuit Lake Aquifer, identified as Aquifer No. 254 in the GWELLS database. It is an unconfined aquifer that covers an area of approximately 29 km^2. The Aquifer is comprised of shallow fluvial and deeper glacio-fluvial deposits, mainly sand and gravels. The depth to groundwater is shallow, with a median depth of

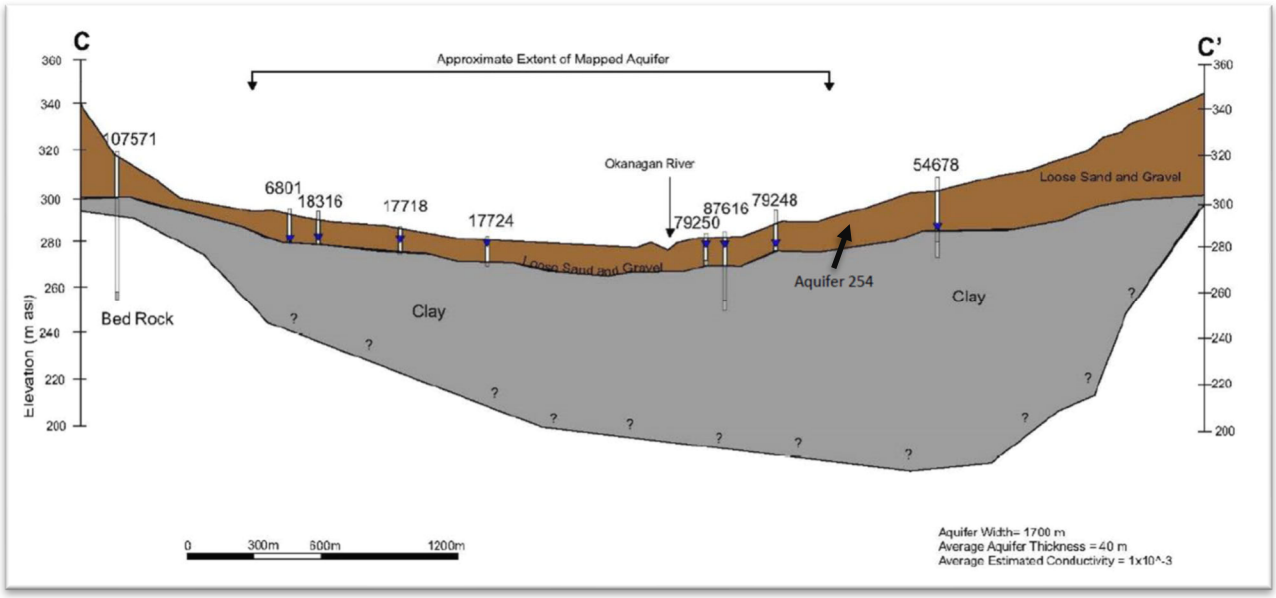
[3] Climate Projects for the Okanagan Region. Regional District of North Okanagan, Regional District of Central Okanagan, RDOS, Pinna Sustainability. February 2020.
[4] Ministry of Energy Mines and Petroleum Resources (2005). Geologic Data – Digital Geology Map of British Columbia. 1:250,000; Washington Data.
[5] Nasmith, H. (1962). Late Glacial History and Surficial Deposits of the Okanagan Valley, British Columbia.

3.0 m-bg. This Aquifer is highly productive and highly vulnerable to surface-sourced contamination.

Recharge to the Aquifer is from direct infiltration of rainfall and snowmelt on the valley floor, infiltrating runoff from upland areas, and surface water losses from the Okanagan River. Other inputs include inflow from upgradient adjoining aquifers (Aquifer Nos. 255 and 256). In 2016, a water budget was prepared for the Oliver Area.[6] Major groundwater outputs include extraction from agricultural and domestic water wells. Aquifer No. 255 is the most heavily used (existing estimated volume used 8,420,340 m^3/year) and Aquifer No. 256 is the least, owing to its lower productivity (710,000 m^3/year). Aquifer No. 254 has an existing estimated volume used of 5,371,470 m^3/year.

A cross-section of the Aquifer presented in the same report. It transects the valley bottom from west (C) to east (C') about 3km north of the Site and is reproduced below.

FIGURE B – STRATIGRAPHIC CROSS-SECTION OF AQUIFER NO. 254



The Aquifer is comprised of sand and gravel (up to 20m in thickness) and overlies a clay aquitard. The Okanagan River is seated in the Aquifer and is likely hydraulically connected to it.

A map of the Aquifer No. 254 more detailed descriptions of the Aquifer are included with Appendix B.

[6] Geller, D and Manwell, B., 2016. Monthly Groundwater Budget Analysis for the Oliver, BC Area (Aquifers 254, 255 and 256). Water Science Series, WSS2016-07. Prov. B.C. Victoria B.C.

3.5.2 Groundwater Users

The BCWRA revealed 16 wells within a 1 km radius of the centre of the Site. Of those 16 wells, one well is correlated with Aquifer No. 254, eight wells are correlated with Aquifer No. 193, one well is correlated with Aquifer No. 238 and six wells have no aquifer information.

The following table summarizes pertinent information for the wells located on Site and within a 500 m radius of the Site boundary. A map of the wells and their well records are presented in Appendix B.

TABLE C – SUMMARY OF WATER WELLS LISTED IN THE BCWRA

Address	Well Tag Number	Yield* (USgpm)	Well Depth (ft)	Depth to Water (ft)	Distance from Site Boundary (m)
204 Avenue Hwy 97	91678	80	96	3	-
204 Avenue Hwy 97	91682	80	66	3	-
204 Avenue Hwy 97	91676	Unknown	Unknown	Unknown	-
Willow Beach Trailer Park	16860	250	10	2	-
95th St & Lakehead Campsite Rd	83816	Unknown	10	Unknown	-
North of Trailer Park	87678	75	604	Unknown	-
RR 1 Osoyoos	19248	0	16	4	-
RR 1 Osoyoos	19500	180	16	8	70
RR 1 Osoyoos	19166	0	20	9	200
Unknown	18253	0	16	10	315
Unknown	79230	Unknown	16	7	355
95th St	79242	Unknown	20	4	360
Hwy 97	57053	0	16	7	395
Unknown	69470	10	500	60	415
Unknown	16722	0	16	Unknown	420
Unknown	14413	0	24	20	455

*Driller's Estimate
GREY SHADING – Well located on Site

Of the 16 wells presented in Table B, 12 wells are listed for private domestic use, one well for irrigation purposes (WTN 19248) and the remaining three wells (WTN 79230, 79242 and 57053) for unknown well uses. Three wells (WTN 91678, 91682 and 91676) are owned by the Willow Beach Trailer Park.

Lithological information included on the well records indicate that surrounding wells are all installed in similar unconsolidated sediments, with the exception of WTN 69470

(bedrock) and possibly WTN 87678 (incomplete lithology). Surrounding overburden wells range in depth from 3.0 to 29.3 m (10 to 96 ft) with reported well yields ranging from 0 to 250 USgpm.

In 2007, Golder Associates constructed several test wells in the west corner of the Site (Figures 2 and 3). Drilling, testing or operational information for these wells was not available at the time of writing this report.

3.6 Hydrology and Water Resource Use

3.6.1 Surface Water Bodies

The nearest mapped watercourses to the Site are the Osoyoos oxbows and wetlands, which lie along the northern edge of the property. These oxbows were formed in the 1950s when the Okanagan River was straightened and channelized for flood control purposes. They are now part of a Fish & Wildlife conservation area. These watercourses provide critical habitat for wildlife and form a narrow wildlife corridor for migrating birds.

FIGURE C – LOCAL SURFACE DRAINAGE FEATURES

The closest Environment Canada hydrometric monitoring station is located approximately 2 km east on the Inkaneep Creek (08NM200). The next closest station is located

approximately 4.9 km north on the Okanagan River (08NM085 – Okanagan River Near Oliver). Station 08NM085 was consulted for real-time hydrometric monitoring data given the proximity of the Okanagan River to the Site.

3.6.2 Surface Water Users

There is one surface water licence holder located on Site and one licence holder located within a 500 m radius. Information on licenced volume, water source, and license holder are summarized in the table below, with a map and license details provided in Appendix B.

TABLE D – SUMMARY OF SURFACE WATER LICENSE HOLDER

Licence No.	Quantity (m^3/year)	Stream Name	Licensee	Status	Distance from Site Boundary (m)
C114486	3,700.44	Osoyoos Lake	Private Individual	Active	-
C058994	277,533	Okanagan River	Fish & Wildlife Section	Active	370

4 PRE-DEVELOPMENT GROUNDWATER CONDITIONS

4.1 Hydrostratigraphy

Ecoscape's borehole logs for wells MW-1 through MW-11 were reviewed to form a conceptual model of the hydrostratigraphy under the Site and adjacent Conservation Area.

In the western half of the Conservation Area (wells MW-1, MW-2, MW-3, MW-10, and MW-11), the hydrostratigraphy generally consists of:

TOPSOIL (0.5 m thick); overlying

Silty SAND / SILT / Clayey SILT (0.5 to 1.0 m thick); overlying

SAND Aquifer (0.5 to 3.0 m thick); overlying

SILT / Clayey SILT (at least 8.0 m thick)

The SAND unit in the above sequence is interpreted to be synonymous with Aquifer No. 254. It is semi-confined by the overlying Silty SAND/SILT/Clayey SILT unit and its bottom is defined by a SILT/Clayey SILT unit.

In the eastern half of the Conservation Area (wells MW-4 and MW-5) the Aquifer is considerably thicker (18 to 25 m) and is interbedded with Silty SAND layers at MW-5. Aquifer is underlain by less permeable sediments (silty SAND/clayey SAND, sandy SILT).

The hydrostratigraphy underlying the development Site is illustrated in the cross section in Figure 5 (see Section Line in Figure 4), and is summarized as follows:

FILL / TOPSOIL (0.5 m thick); overlying

SAND Aquifer (3.5 to 4.0m thick); overlying

SILT (19.5 m thick); overlying

CLAY (4.5 m thick), overlying SAND.

This sequence is generally consistent with the hydrostratigraphy on the east side of the Conservation Area. The only exception is at MW-8, where GRAVEL is the predominant sediment type and SILT is generally absent. This area is interpreted to be a coarser-grained zone within Aquifer No. 254. It may be a former alluvial fan deposited by a meltwater stream draining the adjacent upland area or a higher energy meltwater channel flowing down the side of the valley. Golder Wells TW07-01, TW07-04, and TW07-05 most likely targeted this more permeable zone.

4.2 Groundwater Elevations

All shallow monitoring wells installed by Ecoscape are screened within the shallow SAND Aquifer at depths of between 2 and 4 m. Monitoring wells MW4-D, MW5-D, and MW8-D are screened within same Aquifer at greater depths of between 10 and 11 m.

Water levels were measured manually by Ecoscape on eleven occasions between September 2017 and April 2020. Groundwater was encountered at depths ranging from 0.5 to 2.3 m during these events.

The following table summarizes the surveyed well elevations, most recent depth to groundwater measurements (November 2019 and April 2020 monitoring events) and the calculated groundwater potentiometric elevations:

TABLE E – GROUNDWATER ELEVATIONS SUMMARY

Well ID	Ground Elevation (m-geod.)	Water Below Ground (m-bg)		Groundwater Elevation (m-geod.)	
		Nov. 1/19	Apr. 22/20	Nov. 1/19	Apr. 22/20
MW-1	278.05	1.03	1.17	277.88	277.74
MW-2	278.48	1.52	1.50	277.79	277.80
MW-3	278.46	1.52	1.51	277.76	277.76
MW-4S	278.18	1.26	1.23	277.73	277.76
MW-4D	278.21	1.10	1.33	277.92	277.69
MW-5S	278.21	1.28	1.27	277.72	277.73
MW-5D	278.22	0.98	1.17	278.06	277.87

Well ID	Ground Elevation (m-geod.)	Water Below Ground (m-bg)		Groundwater Elevation (m-geod.)	
		Nov. 1/19	Apr. 22/20	Nov. 1/19	Apr. 22/20
MW-6	278.36	1.39	1.48	277.80	277.71
MW-7	278.86	2.06	2.14	277.76	277.68
MW-8S	278.71	1.52	1.52	277.99	277.99
MW-8D	278.75	1.53	1.54	278.03	278.01
MW-9	278.99	1.62	1.98	278.20	277.84
MW-10	278.23	1.18	1.27	277.87	277.78
MW-11	278.20	1.18	1.20	277.87	277.85

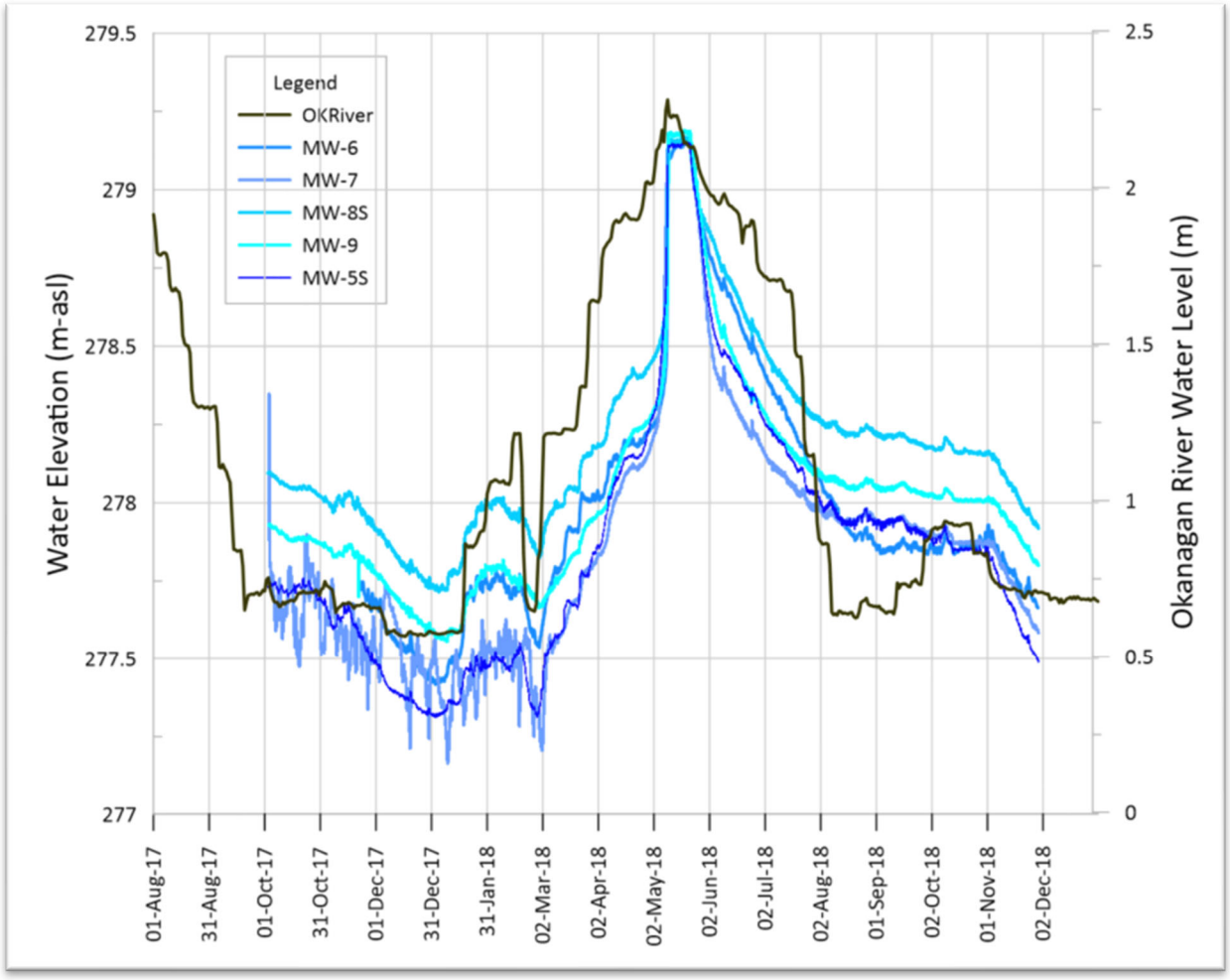
Greyed cells – Monitoring wells situated within the development area

Groundwater elevations at all monitoring wells were continuously monitored at 2-hour intervals using Solinst dataloggers between October 2017 and November 2018. A graphical summary of this data in relation to total daily precipitation amounts and mean daily temperatures (from Environment and Climate Change Canada's Osoyoos West Station) is presented at the end of Appendix A as Figure A-1.

4.3 Groundwater – Surface Water Interaction

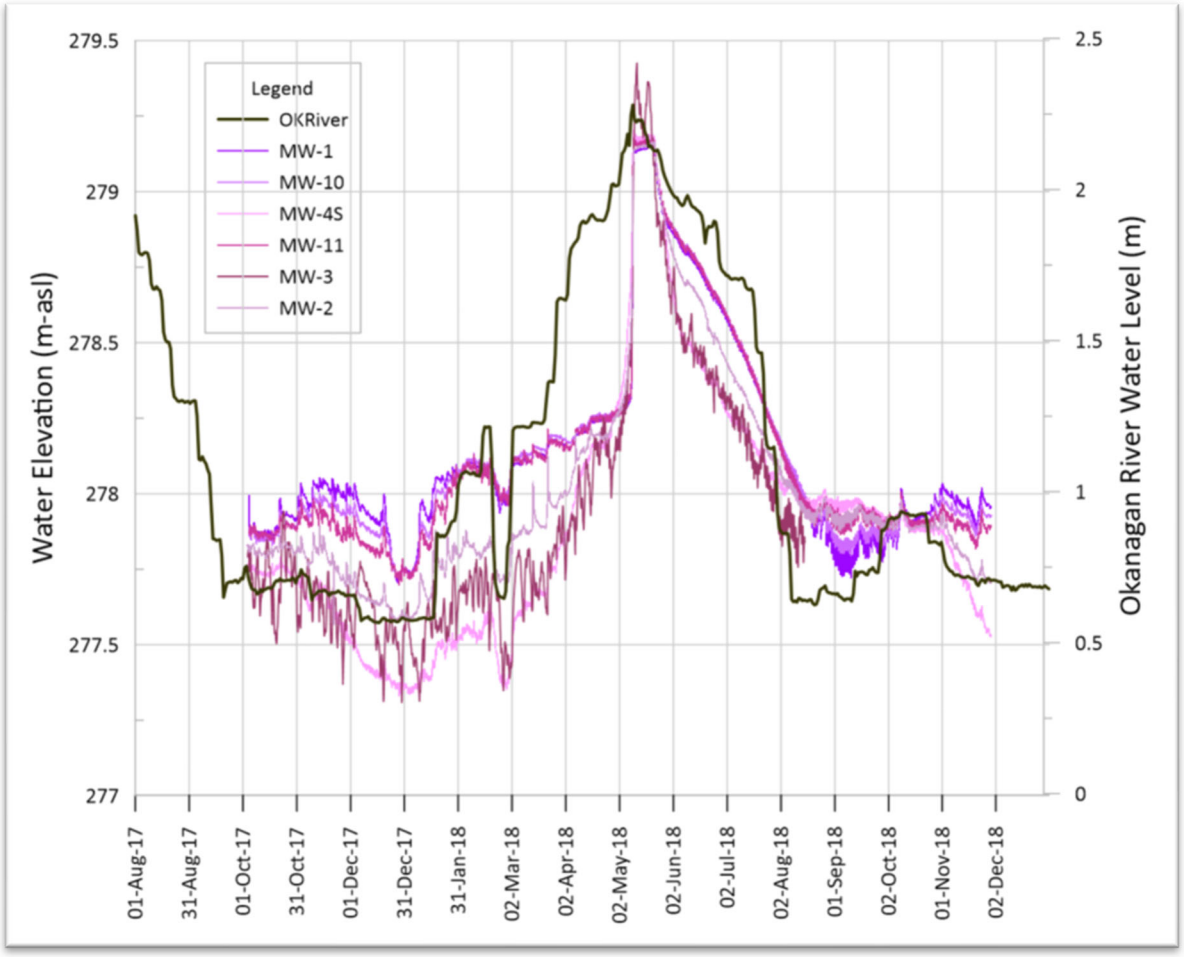
Groundwater elevations beneath the Site (MW-5 through MW-8) have been plotted in relation to Okanagan River water levels (Station 08NM085, near Oliver) in Figure D below. These appear to be strongly correlated, particularly during periods of high river stage. During overland flooding that occurred in May/June 2018, groundwater levels rose sharply and coalesced into the same value. Outside of these peak periods, groundwater levels fall as the Aquifer drains to the Lake and River and reach an annual low in December.

FIGURE D – GROUNDWATER HYDROGRAPHS IN VICINITY OF DEVELOPMENT SITE



Groundwater levels in the Conservation Area (MW-1, -2, -3, -4, -10 and -11) exhibit the same general response to River water levels, as shown in Figure E, below.

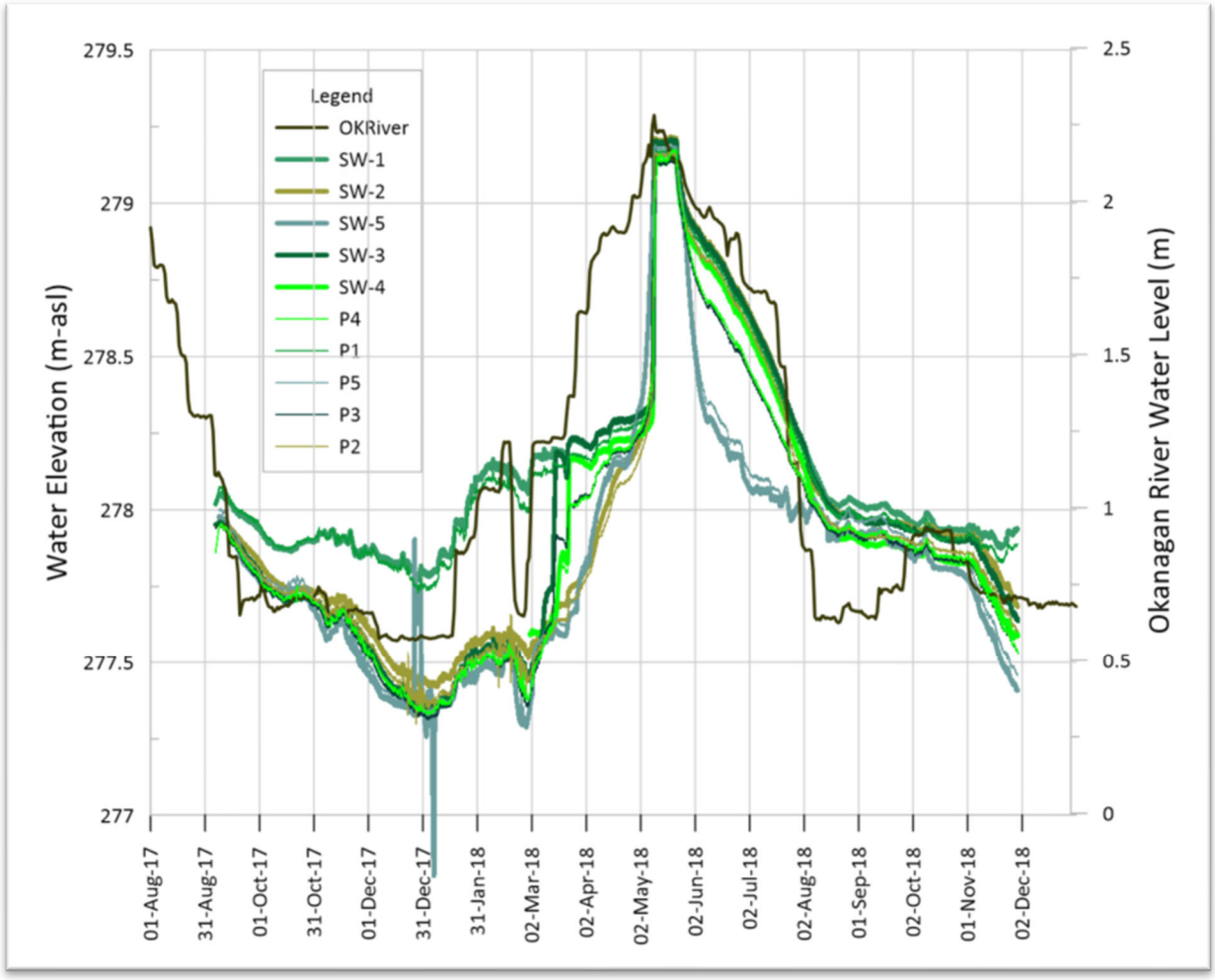
FIGURE E – GROUNDWATER HYDROGRAPHS IN CONSERVATION AREA



Water level hydrographs at surface water stations SW-1, SW-2 and SW-5 are very similar to the groundwater level hydrographs. The stepped signature of rising water levels at SW-3 and SW-4 suggests that levels may be manually controlled for flood mitigation. At SW-1, post-flood water elevations fell more abruptly than at the other surface water stations, possibly because of its location furthest from the Okanagan River.

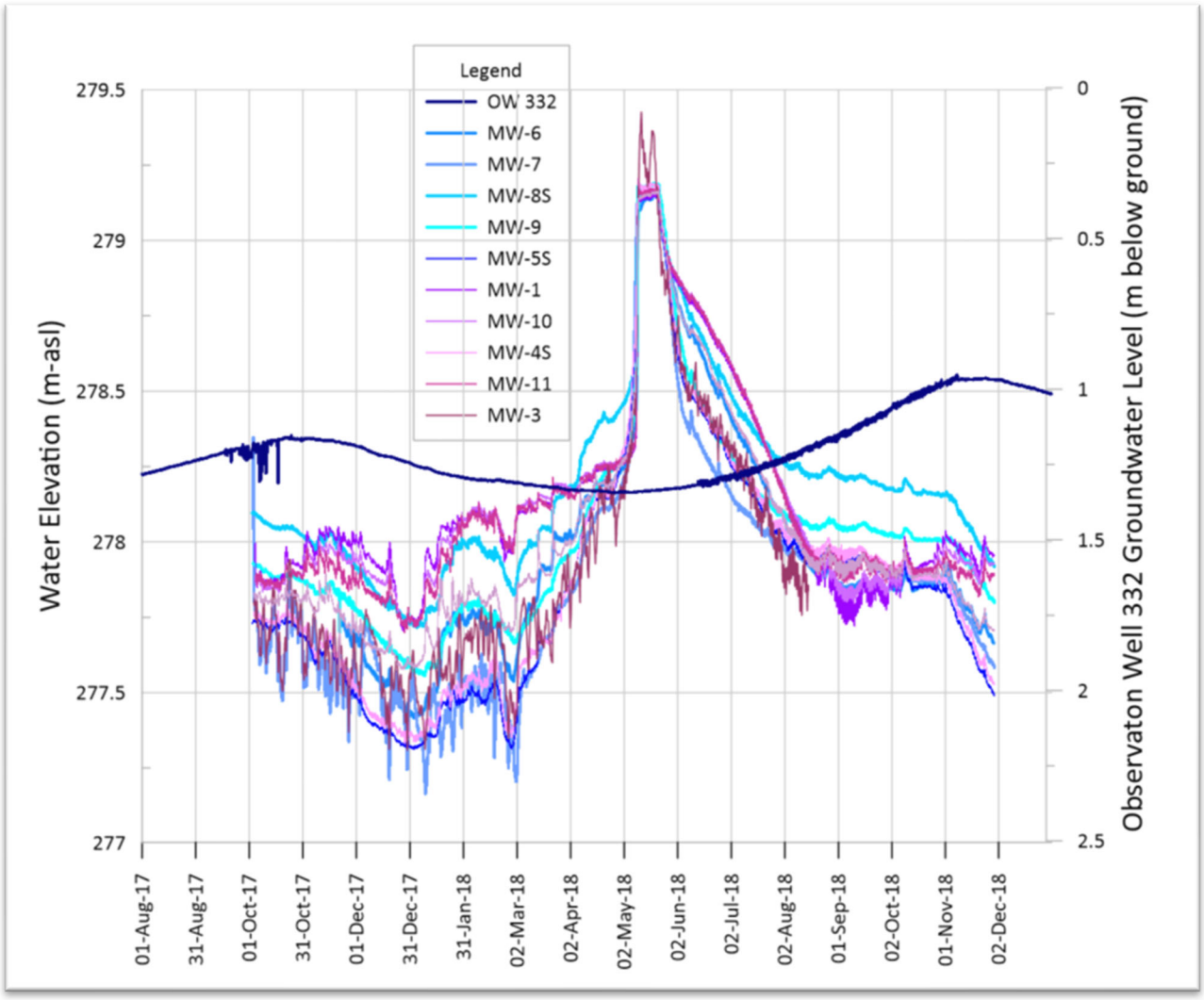
Groundwater levels recorded in the piezometer (P) installed at each surface water station (thinner line) closely followed the surface water signature. At all but the SW-5/P5 pair, the small downward gradient points to surface water losses to groundwater.

FIGURE F – HYDROGRAPHS AT PAIRED SURFACE / GROUNDWATER STATIONS



Groundwater level variations at the Site were compared to those recorded in the Provincial Groundwater Well Network observation well 332 (OW332) located approximately 7.7 km up valley. This well is screened in Aquifer No. 254 at a depth interval of 77.4 to 91.4 ft. Water levels in this well are highest in November and are lowest in May. This is very different from groundwater variations at the Site and Conservation Area, which affirms that they are strongly influenced by surface water levels.

FIGURE G – COMPARISON GROUNDWATER HYDROGRAPHS AT SITE AND AT OBS 332



4.4 Hydraulic Conductivity

In-situ hydraulic response testing (slug tests) were carried out by Ecoscape at select well locations in March 2018. The following table presents the hydraulic conductivity estimates determined from the testing:

TABLE F – HYDRAULIC CONDUCTIVITY ESTIMATES

Well ID	Description	Screened Depth Interval (m)	Hydraulic Conductivity (m/s)	Mean Hydraulic Conductivity (m/s)
MW-6	SAND tr. SILT	3.96 – 4.87	4.8×10^{-7}	4.8×10^{-7}
MW-7	SAND some SILT	3.77 – 4.68	1.2×10^{-6} to 9.55×10^{-7}	1.1×10^{-6}
MW-8D	SAND with GRAVEL	10.14 – 11.05	2.94×10^{-4} to 3.59×10^{-4}	3.2×10^{-4}
MW-9	SAND	3.69 – 4.60	6.6×10^{-5} to 8.17×10^{-5}	7.4×10^{-5}
			Geomean of Hydraulic Conductivity	**9.8×10^{-5}**

The hydraulic conductivity estimates were determined using Aqtesolv, and the analyses are included in Appendix B. Analyses were carried out using the Hvorslev method.

The hydraulic conductivity of the Aquifer varies in relation to grain size and silt content, starting in the range of 10^{-7} m/s to 10^{-6} m/s for SAND with notable silt content, increasing to 10^{-5} m/s for clean SAND and finally 10^{-4} m/s for SAND and GRAVEL.

4.5 Groundwater Velocity and Flow

Figures 2 and 3 present contoured equipotential surface maps for the November 1, 2019 and April 22, 2020 monitoring events. Groundwater flow is predominantly northeastward in November, possibly as a result of groundwater drainage into the River. In April, the hydraulic gradient flattens considerably, and groundwater flow shifts direction towards Osoyoos Lake. This may be a result of surcharge of the Aquifer by surface water inputs.

In general, the hydraulic gradient is very small and groundwater velocities down and cross valley are estimated to be on the order of 2 to 9 m/year, based on the following equation:

$$v = \frac{K\ dh/dl}{n}$$

where K = hydraulic conductivity (9.8×10^{-5} m/s)
dh/dl = hydraulic gradient (0.00018 to 0.00070)
n = effective porosity of SAND (0.25)

Groundwater elevations measured in the shallow and deep well pairs were very close and indicative of very small vertical gradients. There is a slight component of upward groundwater flow from the lower portion of the Aquifer that is typical of groundwater in valley bottoms.

TABLE G – VERTICAL HYDRAULIC GRADIENT MEASUREMENTS

Well Pair	Vertical Hydraulic Gradient	
	November 1, 2019	April 22, 2020
MW-4S	0.03 (upwards)	0.01 (downwards)
MW-4D		
MW-5S	0.05 (upwards)	0.02 (upwards)
MW-5D		
MW-8S	0.01 (upwards)	0.00
MW-8D		

5 POST-DEVELOPMENT GROUNDWATER CONDITIONS

The following sections present our preliminary expectations with respect to the impacts of the development on the groundwater flow regime beneath the Site and in the adjacent Conservation Area.

5.1 Impermeable Surfaces

The development is expected to roughly double the impermeable surface area created by roofs, roadways, and parking areas compared to the pre-existing residential / campground development. To compensate, some runoff from paved surfaces will be discharged to roadside ditches or swales. At the time of writing this report, a preliminary stormwater management plan had not yet been developed.

The impact of reduced infiltrative area to the Aquifer is expected to be negligible as groundwater is interpreted to be largely sourced from the Okanagan River and from up valley, with very minimal contributions from incident rainfall and snowmelt on the valley floor.

5.2 Infilling

Osoyoos' Official Community Plan Bylaw No. 1230 sets the flood plain level of Osoyoos lake to be 280.7 m-asl, and the flood plain level for all other watercourses as 1.5m above their high water mark. The underside of floor systems used for dwelling purposes, business, or storage of goods susceptible to damage by floodwater, or the top of any pad supporting space or room used for these purposes, must be constructed above these levels.

Cut and fill calculations provided by the client indicate that approximately 55,000 m^3 of fill would be imported to the Site to raise the ground surface by up to 1.5 m in some areas (Figure 4, Appendix C). The impact of the fill is expected to be negligible owing to the small

footprint of the Site relative to the size of the Aquifer. It is also not expected to impact groundwater quality provided that the fill is sourced from a registered facility and meets Contaminated Sites Regulation residential land use standards.

Modifying the existing grade is expected to have an impact on surface water drainage in and around the development. Such changes should be evaluated by a civil engineer, including the potential for trapping of floodwaters in the Conservation Area upgradient of the Site. We expect that the preliminary stormwater management plan will include measures to mitigate such changes. No changes to groundwater flow are anticipated due to soil filling above the watertable.

5.3 Stormwater Infiltration

Stormwater infiltration strategies should consider the shallow water table and the seasonal fluctuation thereof. Depths to groundwater vary from 2 m below current grade to above grade during flood conditions. Infiltration will be more challenging in the April to July window, when groundwater elevations are highest.

The importation of fill will increase the thickness of the unsaturated zone above the water table and potentially augment the amount of stormwater that can be infiltrated. Further in-situ hydraulic characterization (i.e. infiltration testing) of native materials and placed fill is recommended to determine the degree of mounding that could be expected under different hydraulic loading rates.

5.4 Water Supply

Impacts to the Aquifer from increased groundwater extraction from the existing water supply well(s) currently operated by Willow Beach Mobile Home Park are out of the scope of this assessment.

Any pre-existing water supply wells that are not in use should be decommissioned in accordance with the Groundwater Protection Regulation under the *Water Sustainability Act*, including reporting to the Province. Similarly, groundwater monitoring wells installed as part of Ecoscape's investigation should ultimately be decommissioned. This will eliminate any potential pathways for downward conveyance of contaminants into the Aquifer.

5.5 Wastewater Disposal

All sewage effluent will be conveyed off-Site for treatment and eventual discharge to the Lake. Therefore, there is not expected to be any development-related impacts to groundwater levels or quality from effluent dispersal to ground.

We understand that the existing lots are on individual septic systems. Unused septic disposal fields no longer contain septic effluent, therefore do not present a health hazard unless disturbed. Should the disposal field need to be removed for construction purposes, the soil should be tested for hydrocarbons and heavy metals based on the requirements of the Contaminated Sites Regulation[7] (CSR). Should the soil exceed the requirements of the CSR for above-mentioned parameters, the soil shall be disposed at a facility licensed to take the material. Should the soil meet the requirements of the CSR, it shall be disposed of at a municipal landfill.

The septic tank shall be decommissioned by pumping out the sewage and disposing at a sewage treatment plant. The septic tank shall be filled with sand and may be left in place if not a hindrance to construction. Should the septic tank require removal, it shall be disposed at a municipal landfill following removal of the sewage. All piping from the disposal field shall be disposed at a municipal landfill.

5.6 Climate Change

The magnitude and timing of seasonal groundwater level variations is expected to change slightly in response to climate change. Current modelling points to warmer, wetter winters and an increase in the length and intensity of the summer drought period. This may result in:

- Higher groundwater elevations during the November to February window due less retention of precipitation as snow;
- Higher groundwater elevations during the freshet and flood season (March to June); and
- Lower groundwater elevations in late summer (September). This will be less apparent owing to surcharge in groundwater levels during the June to August window.

[7] Waste Management Act, Contaminated Sites Regulation, [includes amendments up to B.C. Reg. 13/2019, January 24, 2019], Consolidation current to January 26, 2021.

6 CONCLUSIONS AND RECOMMENDATIONS

Active Earth has completed a desktop analysis of pertinent regional and site-specific hydrogeological data. The following points summarize our interpretation of pre-development groundwater conditions at the Site and adjacent Conservation Area:

1 The local aquifer is identified as Aquifer No. 254. It consists of a permeable SAND layer that generally extends to 4 m depth and is seated in SILT. In some places, the Aquifer extends to 20 m and is interbedded with SILT layers. In undisturbed areas, it is capped by a thin (1.5m) covering of clay, silt, and/or peat.

2 The groundwater table is shallow, very flat, and fluctuates by about 2 m over the year: from a seasonal minimum elevation of 277.3 m-asl (December) to elevations above ground surface (May/June). Groundwater flow rates are very small, and the direction of flow varies from northeastward towards the Okanagan River to southeastward towards Lake Osoyoos.

3 Recharge to this part of the Aquifer is interpreted to be predominantly from surface water losses (Okanagan River) and groundwater flow into the area from up valley. Lesser amounts are sourced from incident rainfall and snowmelt. Groundwater levels are highly influenced by surface water levels during the freshet period.

4 The water levels in the oxbow lakes and storage ponds generally fluctuate in tandem with groundwater levels, with the exception of ponds at SW-3 and SW-4, which may be manually controlled for flood mitigation.

5 The shallow depth and relatively limited thickness of the Aquifer leaves limited groundwater storage available and renders this area vulnerable to flooding during the freshet period between April and June.

6 No information on groundwater quality was considered as part of this study.

Based on the information available to date, the post-development groundwater flow regime in and adjacent to the Site is expected to be relatively unchanged. The following points summarize our expectations and recommendations:

1 The increase in non-infiltrative surface area will be compensated for by other sources of recharge and by measures to infiltrate stormwater to the degree that is practical.

2 Stormwater infiltration measures should consider seasonally high groundwater elevations in the April to July window, and potentially sooner as a result of a changing climate.

3 The importation of fill to raise the development above flood water levels is not expected to measurably impact the groundwater flow regime, given the small footprint of the

development relative to that of the Aquifer and the placement of fill largely above the water table. Further in-situ hydraulic characterization (i.e. infiltration testing) of native materials and placed fill is recommended to confirm the degree of mounding that could be expected under different hydraulic loading rates.

4 The change in Site grade may impact surface water drainage in the vicinity. Further evaluation post-development runoff patterns, particularly during flood episodes, is encouraged as part of the pending stormwater management plan.

5 Imported fill materials should meet residential land use standards and not pose a potential source of contamination to the Aquifer.

6 Pre-existing private septic systems should be properly decommissioned as noted in this report prior to infilling activities.

7 Impacts of increased groundwater withdrawals from the existing water supply well(s) have not been evaluated. Any pre-existing water supply wells that are out of use should be decommissioned in accordance with the Groundwater Protection Regulation. Ultimately, the same applies to groundwater monitoring wells that are no longer in use.

8 Sewage effluent is assumed to be relayed to an off-Site Municipal treatment facility and discharged to the Lake.

7 LIMITATIONS

The use of this report by anyone is subject to the following conditions and limitations:

1. This report has been prepared at the request of the client and for the specific use referred to herein. The client, Infinity Properties Ltd., may rely on this report. It is not reasonable for any other party to rely on the contents of this report without first obtaining written authorization from the client and Active Earth Engineering Ltd.
2. Liability is expressly denied to any person other than the parties indicated above and those who obtain written consent. Accordingly, Active Earth Engineering Ltd. does not accept responsibility for any damage suffered by any such person as a result of decisions made or actions based on this report. Diligence by all intended users is assumed.
3. This report is believed to provide a reasonable representation of the hydrogeological conditions at the Site. The conclusions made in this report reflect Active Earth's best judgment in light of the information available at the time of reporting. Should additional information become available or Site conditions change, the conclusions and recommendations of this report may be subject to change.
4. Active Earth Engineering Ltd. has agreed to conduct an assessment and prepare this report as requested by the client named in the report for the use specified by the client, which is stated in the report. The client has agreed that the performance of this work and the report format are appropriate for the intended use.
5. Written consent from Active Earth Engineering Ltd. must be obtained before any part of the report can be used for any purpose by anyone other than the client and other intended users identified in the report. Liability to any other party or for any other use is expressly denied regardless of who pays Active Earth Engineering Ltd.'s fee. Written consent and approval of Active Earth Engineering Ltd. must also be obtained before the report (or any part of it) can be altered or conveyed to other parties or the public through prospectus, offering memoranda, advertising, public relations, news, sales or other media.

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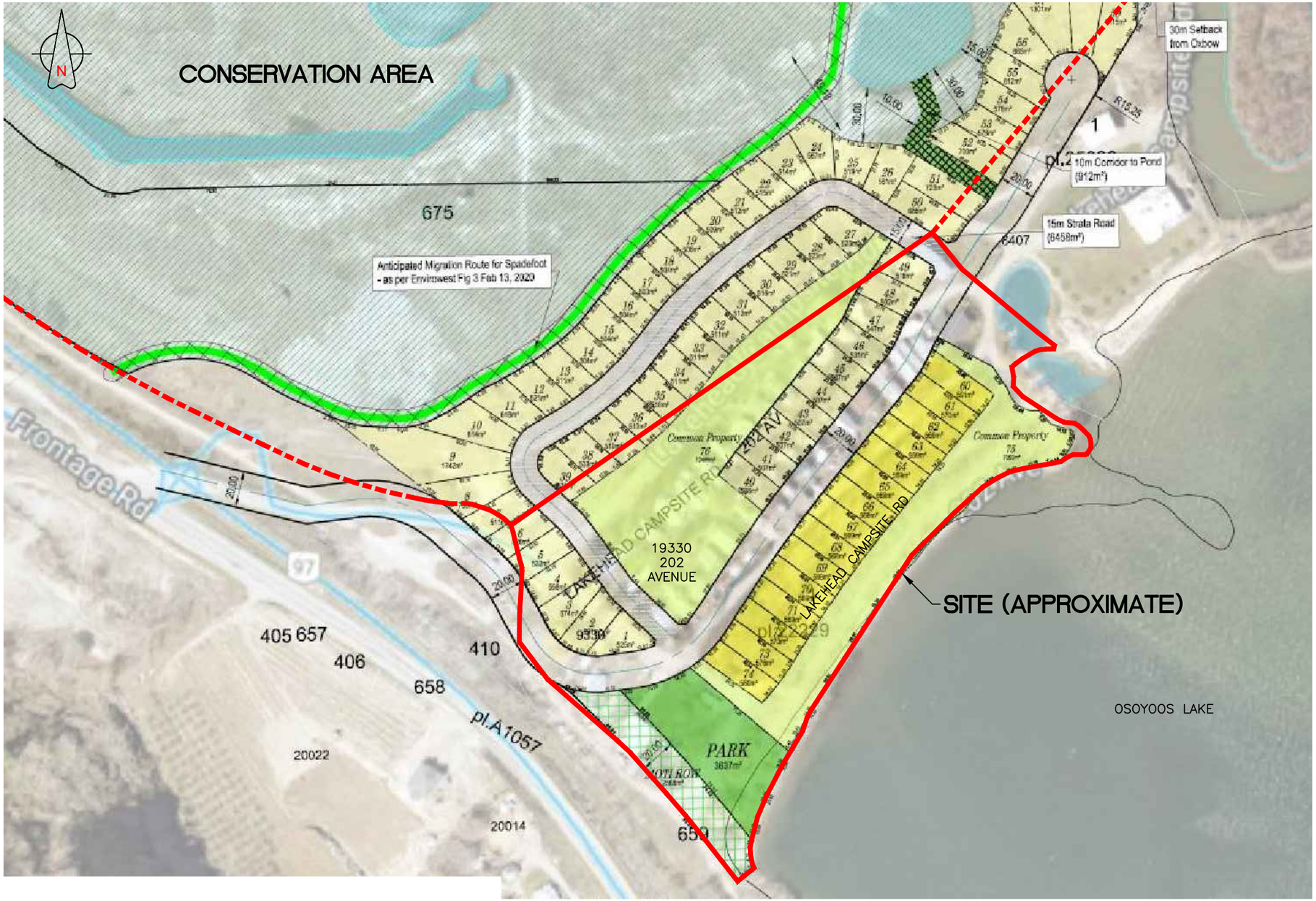
FIGURES



LEGEND

APPROXIMATE SITE BOUNDARY

APPROXIMATE CONSERVATION AREA BOUNDARY

1:2500 0 50 150m

REFERENCE: MCELHANNEY CONSULTING SERVICES – PROJECT 2422-03074-0

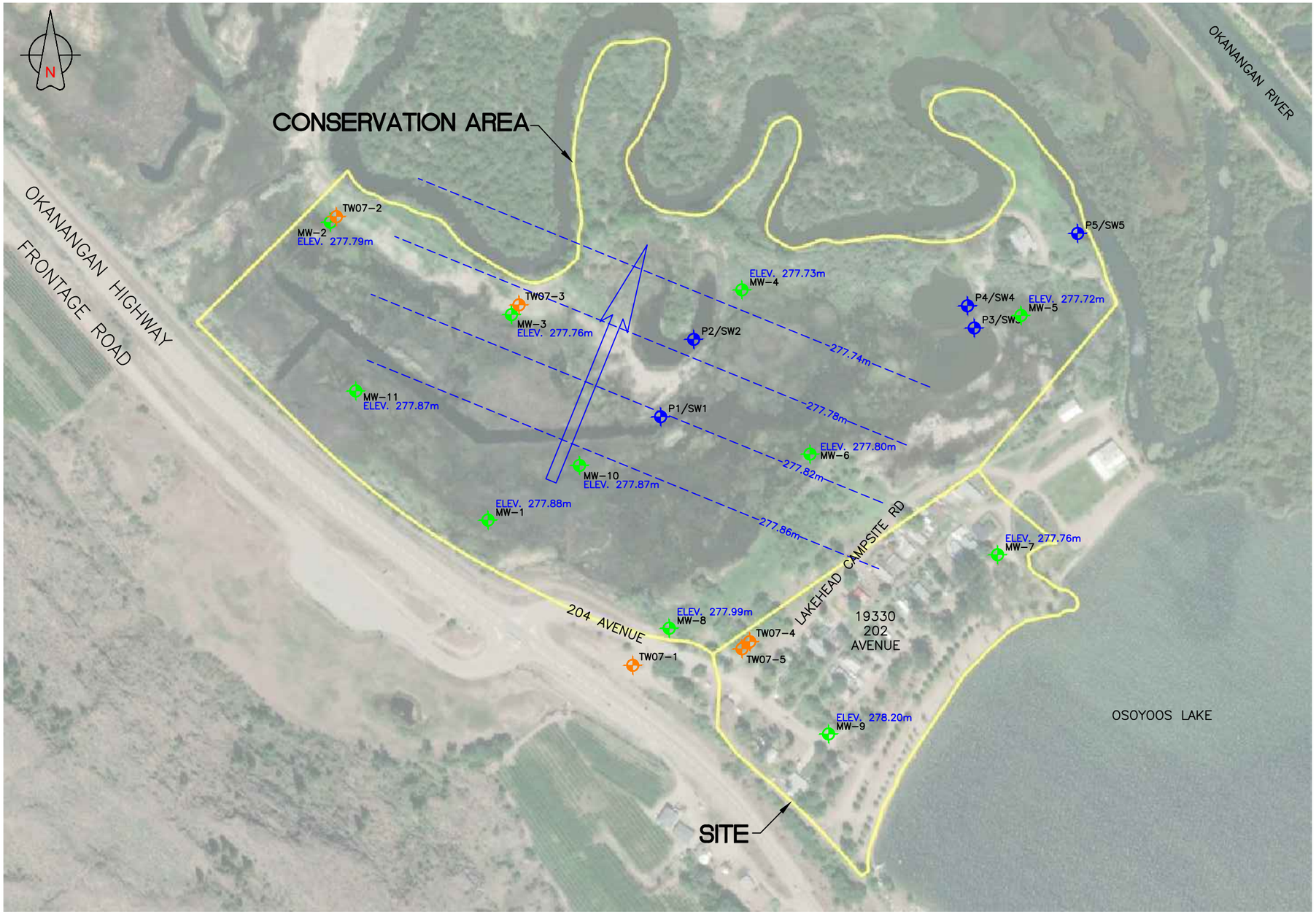
PATH:

ACTIVE EARTH ENGINEERING LTD

CLIENT NAME: WILLOW BEACH DEVELOPMENTS	PROJECT LOCATION: OSOYOOS, BC

SITE PLAN
9330 202 AVENUE

DWN BY: GM	DWG NAME: -1	DATE: 2021-02-04	FIGURE 1
CHK'D: SY	PLOT:	CADFILE: 2305	



LEGEND

- APPROXIMATE SITE BOUNDARY
- NESTING STILLING WELL & PIEZOMETER
- MONITORING WELL
- GOLDER TEST WELL (2007)
- GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC CONTOURS
- ELEV X.XXXm GROUNDWATER ELEVATION (GEODETIC)

NOV 1, 2019

1:4000

0 80 240m

REFERENCE: REGIONAL DISTRICT OF OKANAGAN–SIMILKAMEEN – PARCEL VIEWER

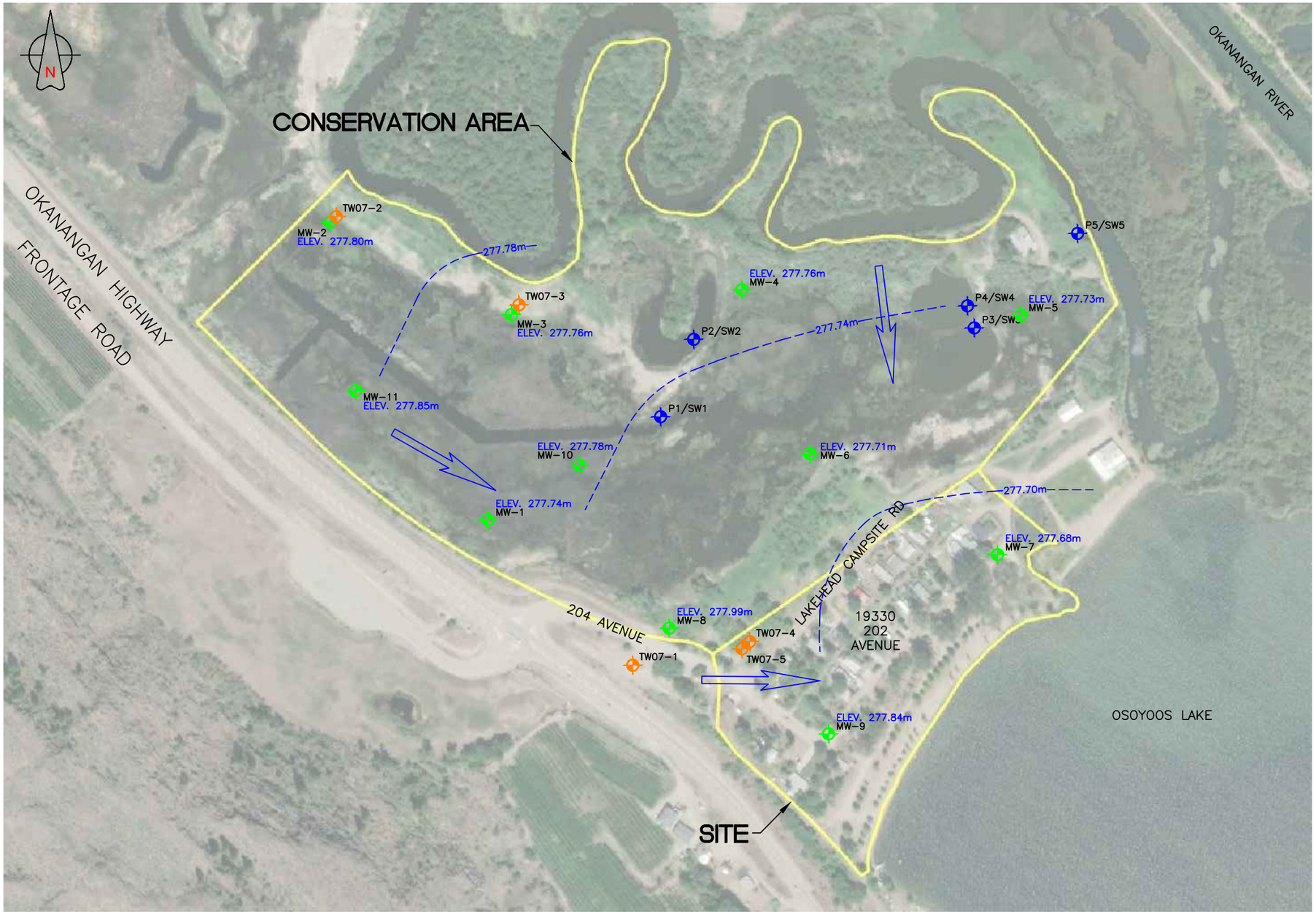
PATH:

ACTIVE EARTH ENGINEERING LTD

CLIENT NAME:	PROJECT LOCATION:
WILLOW BEACH DEVELOPMENTS	OSOYOOS, BC

GROUNDWATER FLOW MAP (NOVEMBER 2019)
9330 202 AVENUE

DWN BY: GM	DWG NAME: –2	DATE: 2021–01–27	FIGURE 2
CHK'D: SY	PLOT:	CADFILE: 2305	



LEGEND

- APPROXIMATE SITE BOUNDARY
- NESTING STILLING WELL & PIEZOMETER
- MONITORING WELL
- GOLDER TEST WELL (2007)
- GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC CONTOURS
- ELEV X.XXXm GROUNDWATER ELEVATION (GEODETIC)

APRIL 22, 2020

1:4000 0 80 240m

REFERENCE: REGIONAL DISTRICT OF OKANAGAN–SIMILKAMEEN – PARCEL VIEWER

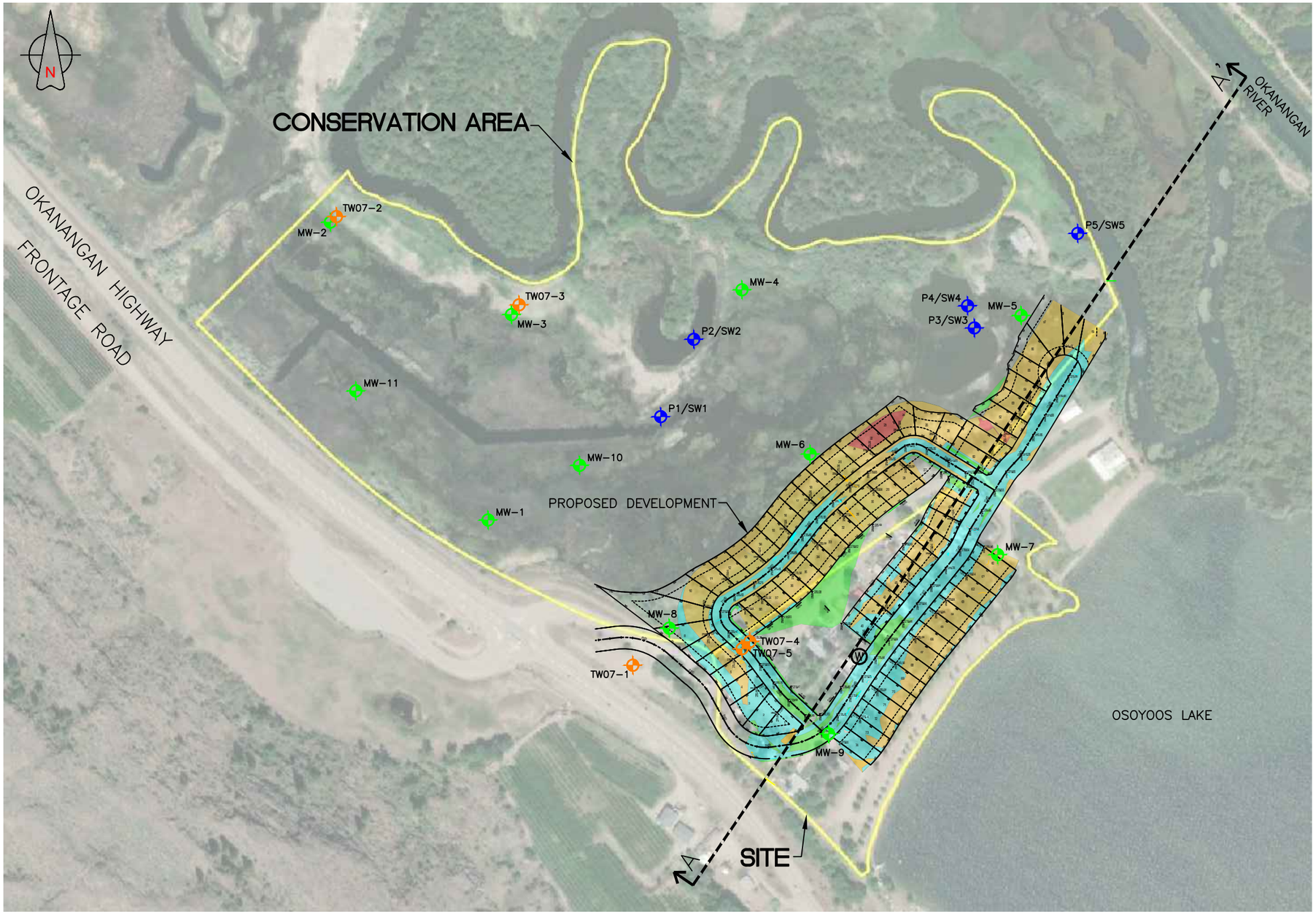
PATH:

ACTIVE EARTH ENGINEERING LTD

CLIENT NAME:	PROJECT LOCATION:
WILLOW BEACH DEVELOPMENTS	OSOYOOS, BC

GROUNDWATER FLOW MAP (APRIL 2020)
9330 202 AVENUE

DWN BY: GM	DWG NAME: –3	DATE: 2021–01–27	FIGURE 3
CHK'D: SY	PLOT:	CADFILE: 2305	



LEGEND

- APPROXIMATE SITE BOUNDARY
- NESTING STILLING WELL & PIEZOMETER
- MONITORING WELL
- GOLDER TEST WELL (2007)
- WATER WELL

1:4000

0 80 240m

PROPOSED FILL LEGEND

- APPROXIMATE AREA OF PROPOSED FILL (0–0.5m)
- APPROXIMATE AREA OF PROPOSED FILL (0.5–1.0m)
- APPROXIMATE AREA OF PROPOSED FILL (1.0–1.5m)
- APPROXIMATE AREA OF PROPOSED FILL (> 1.5m)

REFERENCE: REGIONAL DISTRICT OF OKANAGAN–SIMILKAMEEN – PARCEL VIEWER

PATH:

ACTIVE EARTH ENGINEERING LTD

CLIENT NAME: WILLOW BEACH DEVELOPMENTS	PROJECT LOCATION: OSOYOOS, BC

SECTION LOCATION & FILL PLAN
9330 202 AVENUE

DWN BY: GM	DWG NAME: –4	DATE: 2021–02–04	FIGURE 4
CHK'D: SY	PLOT:	CADFILE: 2305	

A

A'

OKANAGAN HIGHWAY (97)

SITE

MW8S/D
MW9

87678 (~8m)

MW6

MW7

MW5S/D

P5/SW5
SITE

PROPOSED DEVELOPMENT

VERTICAL SCALE 1:50
(EXAGGERATION 25x)
ELEVATION (DEPTH) (m)

288m
287m
286m
285m
284m
283m
282m
281m
280m
279m
278m
277m
276m
275m
274m
273m
272m
271m
270m
269m
268m

FILL AREA

EXISTING GRADE
NEW GRADE

FILL AREA

FLOOD ELEVATION
(JUNE)

OXBOW

OXBOW

OKANAGAN RIVER

SAND
(AQUIFER)

SAND

SILT

?

?

SOIL LEGEND

- SAND & GRAVEL (FILL)
- INTERMIXED SAND, SILT, CLAY, ORGANICS (FILL)
- TOPSOIL
- SILTY CLAY
- PEAT
- SAND
- SAND, SOME GRAVEL
- GRAVEL & SOME SAND
- SANDY SILT

1:2500

0 50 150m

LEGEND

- MONITORING WELL
- GROUNDWATER ELEVATION
- EXISTING GRADE
- NEW GRADE

PATH:

ACTIVE EARTH
ENGINEERING LTD

CLIENT NAME: WILLOW BEACH DEVELOPMENTS	PROJECT LOCATION: OSOYOOS, BC

CROSS SECTION A-A'
9330 202 AVENUE

DWN BY: GM	DWG NAME: –5	DATE: 2021–02–04	FIGURE 5
CHK'D: SY	PLOT:	CADFILE: 2305	

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APPENDIX A

Ecoscape Borehole Logs, Aqtesolv Slug Test Plots, Water Level Data and Data Collection Notes

ECOSCAPE REP Mike Schutten DRILLING COMPANY: Mud Bay Drilling DRILLING RIG: Sonic DB320 DRILLING METHOD: Hollow Stem Auger HOLE DIAMETER (CM): 15.0 WATER ELEVATION (masl): 278.03	COMPLETION DATE: 10/4/2017 GROUND SURFACE ELEV (masl) 278.14 TOP OF RISER ELEV (masl) 279.00 UTM COORDINATES (NAD 1983 11N) Northing 5438947.00 Easting 315136.00	ECOSCAPE Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE Wet, black, TOPSOIL, sandy silt and organic matter Wet, dark grey SILT (ML), some sand and trace clay Wet, dark grey SAND (SP), medium grained Moist, dark grey clayey SILT (ML), soft	0 1 2 3 4		Monument Concrete 2-inch ID Schedule 40 PVC riser Sand Bentonite Sand 2-inch ID Schedule 40, No. 10 screen PVC Endcap

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-1 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.01 Page 1 of 2 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Moist, dark grey clayey SILT (ML), soft	5 6 7 8 9 10 11		Bentonite

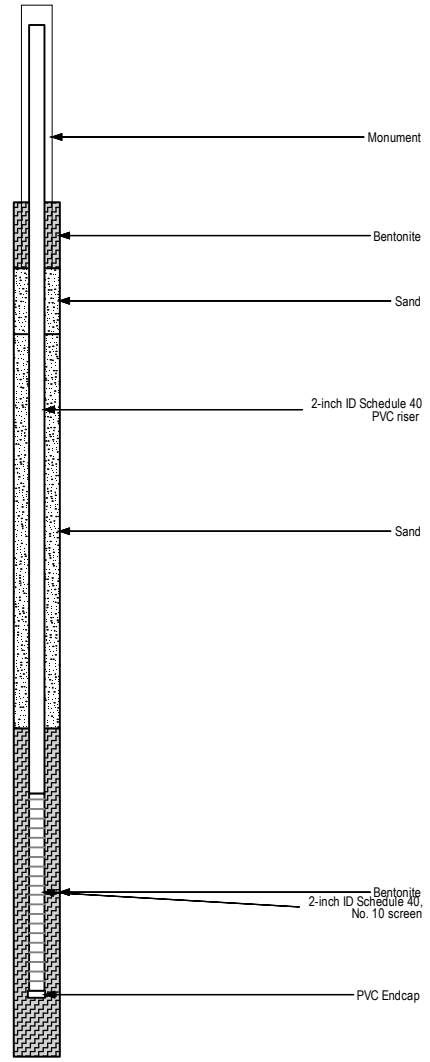
CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-1 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.01 Page 2 of 2 Issued:

ECOSCAPE REP Mike Schutten
DRILLING COMPANY: Mud Bay Drilling
DRILLING RIG: Sonic DB321
DRILLING METHOD: Hollow Stem Auger
HOLE DIAMETER (CM): 15.0
WATER ELEVATION (masl): 277.51

COMPLETION DATE: 10/3/2017
GROUND SURFACE ELEV (masl) 278.20
TOP OF RISER ELEV (masl) 279.02
UTM COORDINATES (NAD 1983 11N)
Northing 5439236.00 Easting 314979.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Wet, black, TOPSOIL, sandy silt and organic matter	0		
Wet, brown, silty SAND (SM), oxidized at 0.5m depth			
Wet, dark grey silty SAND (SP), fine to medium grained	1		
Wet, dark grey SAND (SP), medium grained	2		
	3		
Wet, dark grey SAND (SM) and silt			
Wet, dark grey SAND (SP), medium grained, some silt	4		



CLIENT:
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-2

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.02
Page 1 of 1
Issued:

ECOSCAPE REP Mike Schutten
DRILLING COMPANY: Mud Bay Drilling
DRILLING RIG: Sonic DB322
DRILLING METHOD: Hollow Stem Auger
HOLE DIAMETER (CM): 15.0
WATER ELEVATION (masl): 277.70

COMPLETION DATE: 10/3/2017
GROUND SURFACE ELEV (masl) 278.40
TOP OF RISER ELEV (masl) 279.22
UTM COORDINATES (NAD 1983 11N)
Northing 5439147.00 Easting 315148.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE Wet, black, TOPSOIL, sandy silt and organic matter Wet, dark grey silty SAND (SM), fine to medium grained, some clay Wet, dark grey SAND (SP), medium grained	0 1 2 3 4		Monument Concrete Sand 2-inch ID Schedule 40 PVC riser Bentonite Sand 2-inch ID Schedule 40, No. 10 screen PVC Endcap

CLIENT:
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-3

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

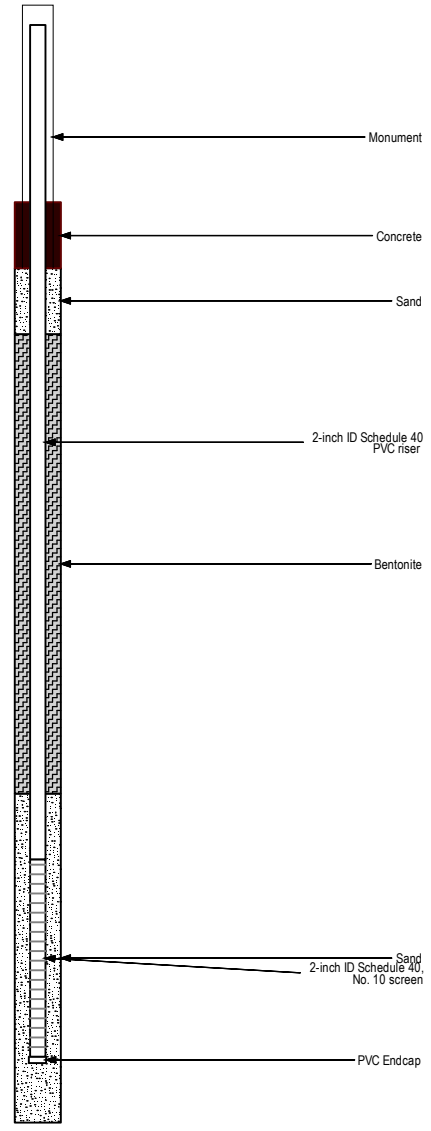
Ecoscape Job No. 17-2013.03
Page 1 of 1
Issued:

ECOSCAPE REP Mike Schutten
DRILLING COMPANY: Mud Bay Drilling
DRILLING RIG: Sonic DB323
DRILLING METHOD: Hollow Stem Auger
HOLE DIAMETER (CM): 15.0
WATER ELEVATION (masl): 277.67

COMPLETION DATE: 10/3/2017
GROUND SURFACE ELEV (masl) 278.12
TOP OF RISER ELEV (masl) 278.93
UTM COORDINATES (NAD 1983 11N)
Northing 5439153.00 Easting 315347.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Moist, light grey organic CLAY (OH), mottled, trace rootlets	0		
Wet, dark grey silty SAND (SM), some organics	1		
Wet, dark grey SAND (SP), fine to medium grained, some silt, scattered woody debris	2		
Wet, dark grey SAND (SP), medium grained, woody debris at 5.20 m depth	3		
	4		



CLIENT:
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-4S

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.04

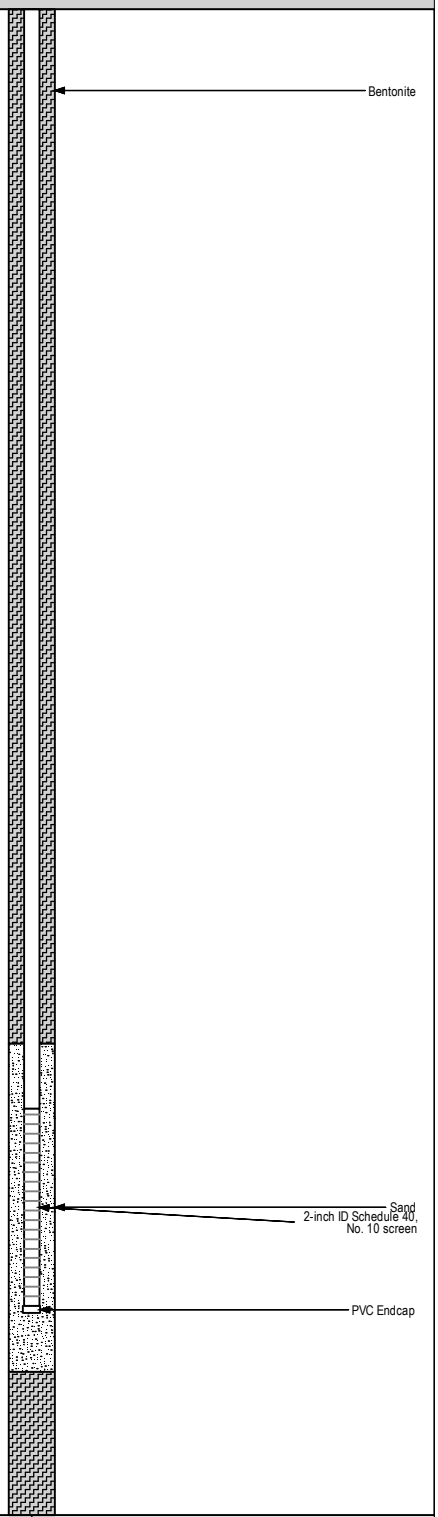
Issued:

ECOSCAPE REP Mike Schutten DRILLING COMPANY: Mud Bay Drilling DRILLING RIG: Sonic DB324 DRILLING METHOD: Hollow Stem Auger HOLE DIAMETER (CM): 15.0 WATER ELEVATION (masl): 277.57	COMPLETION DATE: 10/3/2017 GROUND SURFACE ELEV (masl) 278.12 TOP OF RISER ELEV (masl) 278.93 UTM COORDINATES (NAD 1983 11N) Northing 5439153.00 Easting 315351.00	ECOSCAPE Environmental Consultants Ltd.

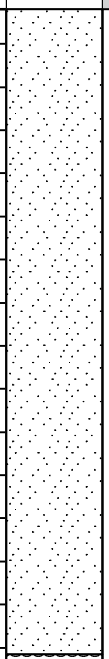
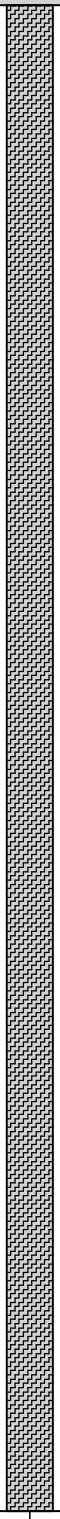
SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE Moist, light grey organic CLAY (OH), mottled, trace rootlets Wet, dark grey silty SAND (SM), some organics Wet, dark grey SAND (SP), fine to medium grained, some silt, scattered woody debris Wet, dark grey SAND (SP), medium grained, woody debris at 5.20 m depth	0 1 2 3 4		Monument Concrete Sand 2-inch ID Schedule 40 PVC riser

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-4D Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.05 Page 1 of 5 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey SAND (SP), medium grained, woody debris at 5.20 m depth	5		Bentonite
	6		
	7		
Wet, dark grey SAND (SP) coarse grained	8		
Wet, dark grey SAND (SP), fine to medium grained	9		
	10		Sand 2-inch ID Schedule 40, No. 10 screen PVC Endcap
	11		



CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-4D Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.05 Page 2 of 5 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey SAND (SP), fine to medium grained	12		
	13		
	14		
Black PEAT (PT)			
Wet, dark grey SAND (SP), fine to medium grained	15		
Moist to wet, dark grey SAND (SM) and silt	16		
Moist to wet, dark grey SAND (SP), medium grained	17		
	18		

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-4D Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.05 Page 3 of 5 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Moist to wet, dark grey SAND (SP), medium grained	19		
Moist to wet, dark grey silty SAND (SM), woody debris scattered throughout	20		
Moist, dark grey clayey SAND (SC), moderately stiff			
Moist to wet, dark grey silty SAND (SM)	21		Bentonite
Moist to wet, dark grey sandy SILT (ML), woody debris at 22.8 m depth	22		
	23		
Moist to wet, dark grey clayey SILT (ML), some fine grained sand	24		
	25		

CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-4D

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.05

Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey clayey SILT (ML), trace gravel	26		
	27		
Wet, dark grey clayey SILT(ML)	28		
	29		
	30		
	31		
	32		

CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-4D

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.05

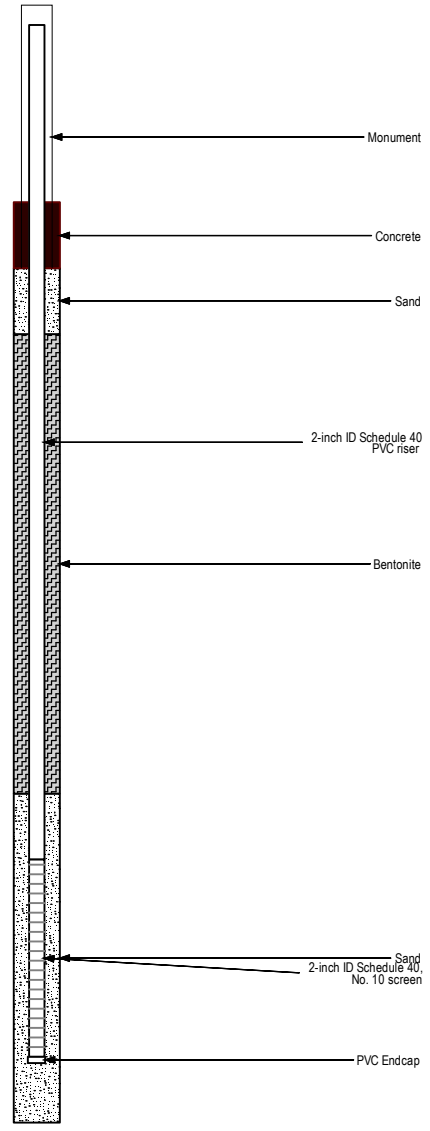
Issued:

ECOSCAPE REP Mike Schutten
DRILLING COMPANY: Mud Bay Drilling
DRILLING RIG: Sonic DB325
DRILLING METHOD: Hollow Stem Auger
HOLE DIAMETER (CM): 15.0
WATER ELEVATION (masl): 277.71

COMPLETION DATE: 10/2/2017
GROUND SURFACE ELEV (masl) 278.20
TOP OF RISER ELEV (masl) 278.99
UTM COORDINATES (NAD 1983 11N)
Northing 5439131.00 Easting 315608.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Moist, brown and grey FILL, intermixed sand, silt, clay and organics, mottled	0		
Moist to wet, dark grey, silty CLAY (CL), stiff	1		
Black PEAT (PT)			
Wet, dark grey SAND (SP), medium grained	2		
	3		
	4		



CLIENT:
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-5S

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.06

Issued:

ECOSCAPE REP Mike Schutten

DRILLING COMPANY: Mud Bay Drilling

DRILLING RIG: Sonic DB326

DRILLING METHOD: Hollow Stem Auger

HOLE DIAMETER (CM): 15.0

WATER ELEVATION (masl): 277.61

COMPLETION DATE: 10/2/2017

GROUND SURFACE ELEV (masl) 278.20

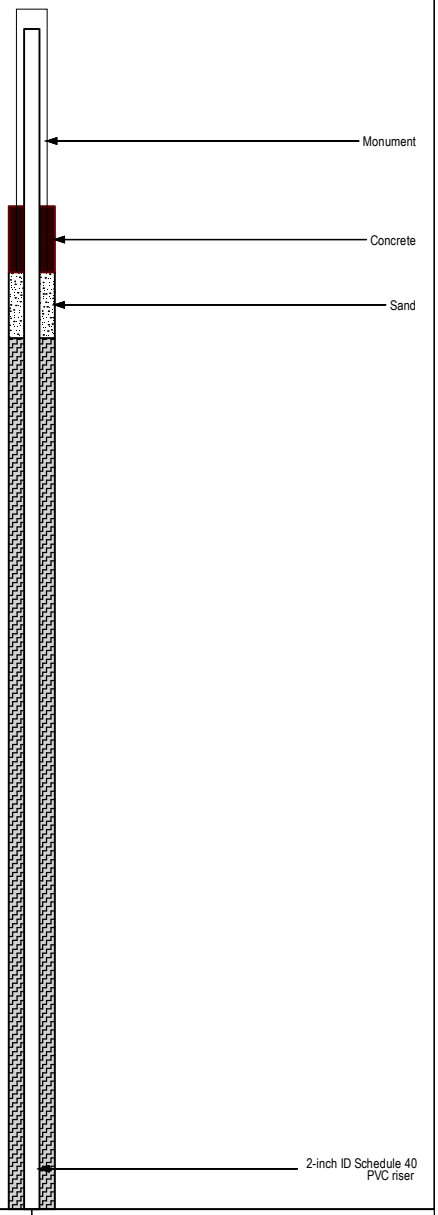
TOP OF RISER ELEV (masl) 279.01

UTM COORDINATES (NAD 1983 11N)

Northing 5439128.00 Easting 315611.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Moist, brown and grey FILL, intermixed sand, silt, clay and organics, mottled	0		
Moist to wet, dark grey, silty CLAY (CL), stiff	1		
Black PEAT (PT)			
Wet, dark grey SAND (SP), medium grained	2		
	3		
	4		



CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-5D

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.07

Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey SAND (SP), medium grained			
Moist to wet, dark grey SILT (ML), some sand and clay, moderately stiff	5		Bentonite
Wet, dark grey SAND (SP), medium grained	6		
	7		
Wet, dark grey silty SAND (SM), fine grained			
Wet, dark grey SAND (SP) medium grained	8		
	9		
	10		Sand 2-inch ID Schedule 40, No. 10 screen PVC Endcap
	11		
Wet, dark grey silty SAND (SM), fine grained, woody debris at 11.6 m depth			

CLIENT:

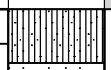
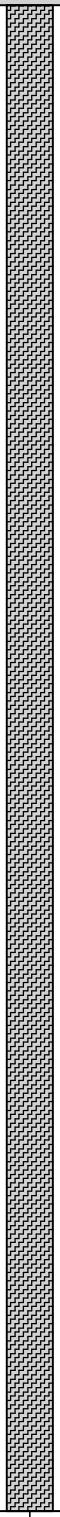
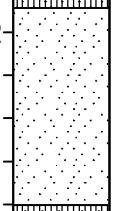
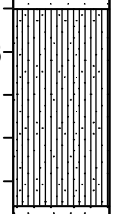
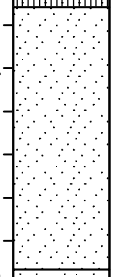
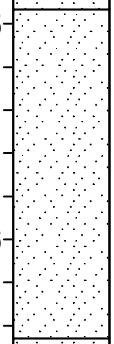
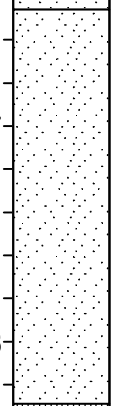
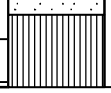
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-5D

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.07

Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey silty SAND (SM), fine grained, woody debris at 11.6 m depth			
Wet, dark grey SAND (SP), medium grained	12		
Wet, dark grey silty SAND (SM), fine to medium grained	13		
Wet, dark grey SAND (SP), fine to medium grained, trace silt	14		
Wet, dark grey SAND (SP), fine to medium grained	15		
Wet, dark grey SAND (SP), fine to medium grained, some silt	16		
Moist to wet, dark grey SILT (ML), some sand and clay, moderately stiff	17		
	18		

CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-5D

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.07

Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Moist to wet, dark grey SILT (ML), some sand and clay, moderately stiff	19		
Wet, dark grey SAND (SP), fine to medium grained	20		Bentonite
	21		
	22		
Wet, dark grey SAND (SM) and silt, woody debris throughout	23		
Wet, dark grey SAND (SP), fine grained, some silt	24		
Wet, dark grey, silty SAND (SM), fine grained, woody debris at 26.7 m depth	25		

CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-5D

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.07

Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey, silty SAND (SM), fine grained, woody debris at 26.7 m depth	26		
Wet, dark grey SAND (SP), medium grained	27		
Wet, dark grey silty SAND (SM), fine grained	28		
Wet, dark grey SAND (SP), fine to medium grained	29		
Wet, dark grey silty SAND (SM), fine grained	30		
Wet, dark grey SAND (SP), fine to medium grained	31		
	32		

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-5D Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.07 Page 5 of 5 Issued:

ECOSCAPE REP Mike Schutten
DRILLING COMPANY: Mud Bay Drilling
DRILLING RIG: Sonic DB327
DRILLING METHOD: Hollow Stem Auger
HOLE DIAMETER (CM): 15.0
WATER ELEVATION (masl): 277.40

COMPLETION DATE: 10/2/2017
GROUND SURFACE ELEV (masl) 278.07
TOP OF RISER ELEV (masl) 278.90
UTM COORDINATES (NAD 1983 11N)
Northing 5439009.00 Easting 315411.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE Moist, brown sand and gravel (FILL) Wet, dark grey SAND (SP), medium grained, trace silt	0 1 2 3 4		Monument Concrete Sand 2-inch ID Schedule 40 PVC riser Bentonite Sand 2-inch ID Schedule 40, No. 10 screen PVC Endcap

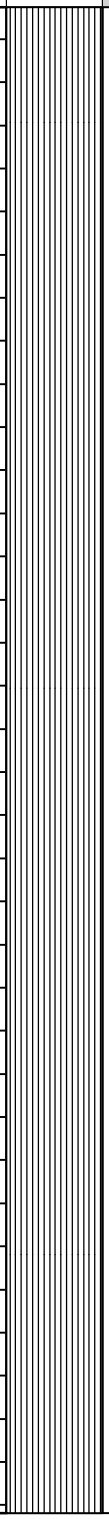
CLIENT:
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-6

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.08

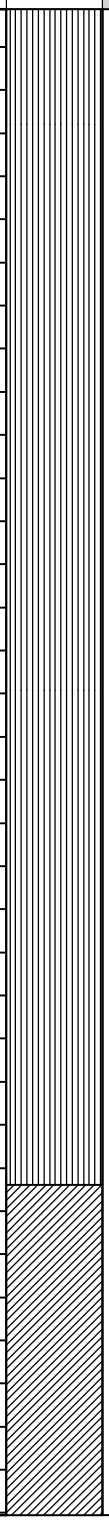
Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey SILT (ML) and clay, trace fine grained sand	5 6 7 8 9 10 11		

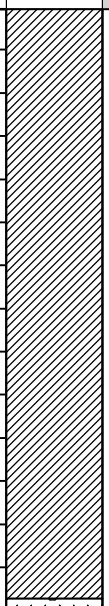
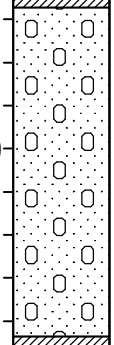
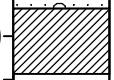
CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-6 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.08 Page 2 of 5 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey SILT (ML) and clay, trace fine grained sand	12		
	13		
	14		
Wet, dark grey SILT (ML) and clay	15		
	16		
	17		
	18		

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-6 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.08 Page 3 of 5 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey SILT (ML) and clay	19 20 21 22 23 24		
Wet, dark grey silty CLAY (CL)	25		

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-6 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.08 Page 4 of 5 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey silty CLAY (CL)	26 27 28		
Wet, dark grey GRAVEL (GW) and sand	29		
Wet, dark grey silty CLAY (CL)	30 31 32		

CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION
MW-6

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.08

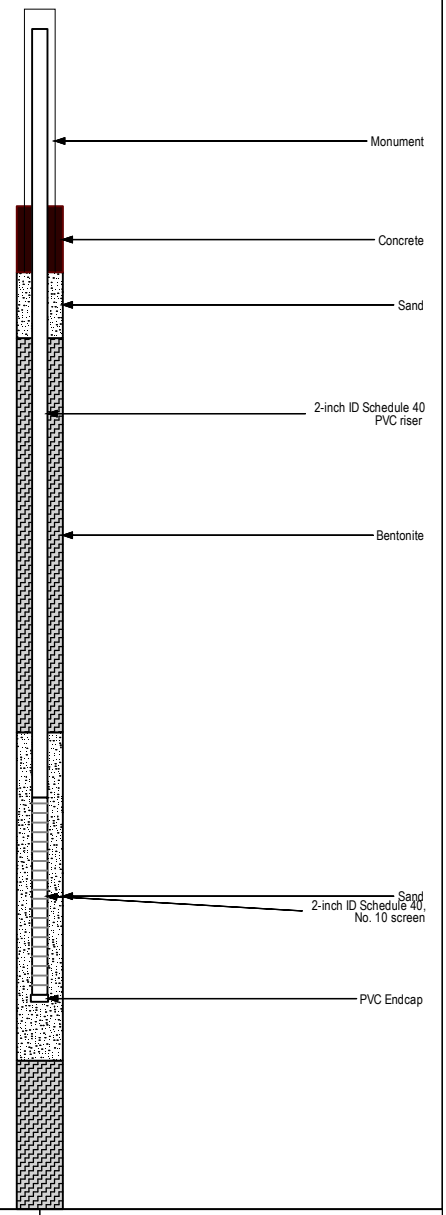
Issued:

ECOSCAPE REP Mike Schutten
DRILLING COMPANY: Mud Bay Drilling
DRILLING RIG: Sonic DB328
DRILLING METHOD: Hollow Stem Auger
HOLE DIAMETER (CM): 15.0
WATER ELEVATION (masl): 278.90

COMPLETION DATE: 10/3/2017
GROUND SURFACE ELEV (masl) 280.00
TOP OF RISER ELEV (masl) 280.96
UTM COORDINATES (NAD 1983 11N)
Northing 5438904.00 Easting 315570.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Moist, brown TOPSOIL, silty sand and organic matter	0		
Moist to wet, light brown SAND (SP), medium grained	1		
	2		
Wet, dark grey SAND (SP), medium grained	3		
Wet, dark grey SAND (SP), fine grained, some silt	4		
Black PEAT (PT)			



CLIENT:
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-7

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.09

Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey sandy SILT (ML)	5		
Wet, dark grey SILT (ML), some sand, decreasing with depth, woody debris at 7.0 m depth	6		
	7		
	8		Bentonite
	9		
	10		
	11		

CLIENT:

Infinity Properties Inc.

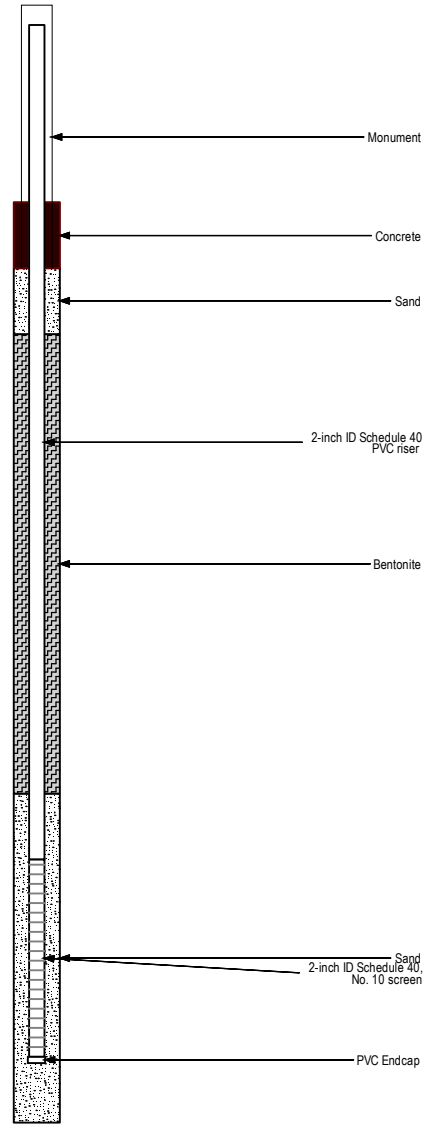
LOG & RECORD OF WELL CONSTRUCTION MW-7

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.09
Page 2 of 2
Issued:

ECOSCAPE REP Mike Schutten	COMPLETION DATE: 10/2/2017	ECOSCAPE Environmental Consultants Ltd.
DRILLING COMPANY: Mud Bay Drilling	GROUND SURFACE ELEV (masl) 278.75	
DRILLING RIG: Sonic DB329	TOP OF RISER ELEV (masl) 279.55	
DRILLING METHOD: Hollow Stem Auger	UTM COORDINATES (NAD 1983 11N)	
HOLE DIAMETER (CM): 15.0	Northing 5438854.00 Easting 315245.00	
WATER ELEVATION (masl): 278.13		

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Moist, brown TOPSOIL, silty sand and organic matter	0		
Moist to wet, grey GRAVEL (GW), some sand			
	1		
Wet, grey GRAVEL (GW) and coarse grained sand			
	2		
Wet, grey SAND (SW), coarse grained, some gravel			
	3		
Wet, grey GRAVEL (GW) and coarse grained sand			
Wet, dark grey SAND (SP), medium grained, some silt			
Wet, grey GRAVEL (GW) and coarse grained sand			
	4		



CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-8S

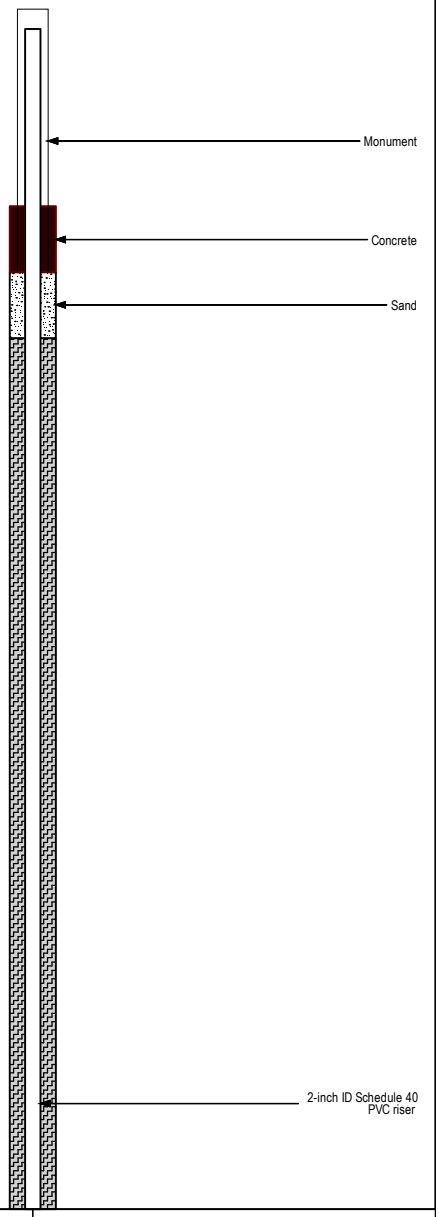
Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.10

Issued:

ECOSCAPE REP Mike Schutten DRILLING COMPANY: Mud Bay Drilling DRILLING RIG: Sonic DB330 DRILLING METHOD: Hollow Stem Auger HOLE DIAMETER (CM): 15.0 WATER ELEVATION (masl): 278.12	COMPLETION DATE: 10/4/2017 GROUND SURFACE ELEV (masl) 278.75 TOP OF RISER ELEV (masl) 279.55 UTM COORDINATES (NAD 1983 11N) Northing 5438857.00 Easting 315247.00	ECOSCAPE Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Moist, brown TOPSOIL, silty sand and organic matter	0		
Moist to wet, grey GRAVEL (GW), some sand	1		
Wet, grey GRAVEL (GW) and coarse grained sand	2		
Wet, grey SAND (SW), coarse grained, some gravel	3		
Wet, grey GRAVEL (GW) and coarse grained sand			
Wet, dark grey SAND (SP), medium grained, some silt			
Wet, grey GRAVEL (GW) and coarse grained sand	4		



CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-8D Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.11 Page 1 of 2 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, grey GRAVEL (GW) and coarse grained sand	5 6 7 8 9 10 11		Bentonite Sand 2-inch ID Schedule 40, No. 10 screen PVC Endcap

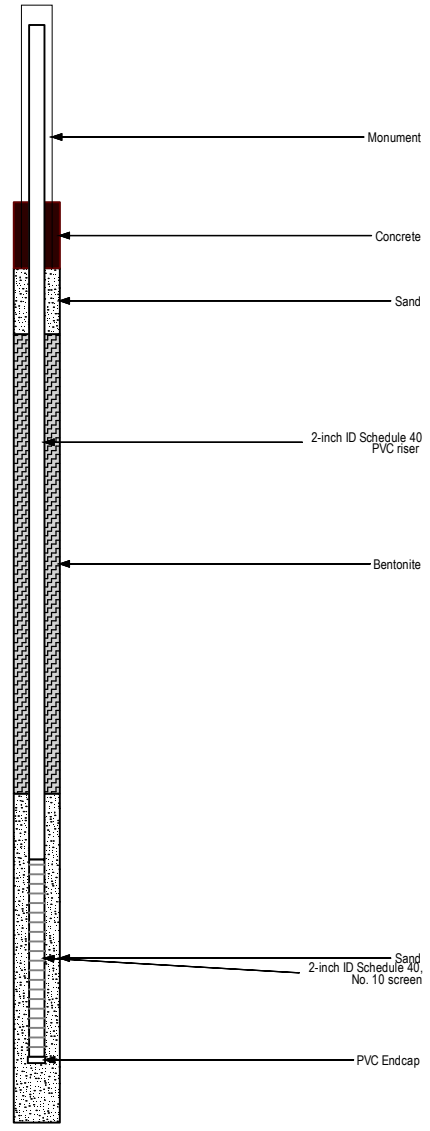
CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-8D Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.11 Page 2 of 2 Issued:

ECOSCAPE REP Mike Schutten
DRILLING COMPANY: Mud Bay Drilling
DRILLING RIG: Sonic DB331
DRILLING METHOD: Hollow Stem Auger
HOLE DIAMETER (CM): 15.0
WATER ELEVATION (masl): 278.93

COMPLETION DATE: 10/3/2017
GROUND SURFACE ELEV (masl) 280.00
TOP OF RISER ELEV (masl) 280.82
UTM COORDINATES (NAD 1983 11N)
Northing 5438751.00 Easting 315423.00

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Dry to moist, dark brown TOPSOIL, silty sand, medium grained, organic matter	0		
Moist to wet, brown SAND (SP), medium grained, mottled	1		
Wet, light grey SAND (SP), medium grained, some silt			
Wet, dark grey SAND (SP), medium grained	2		
	3		
	4		



CLIENT:
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-9

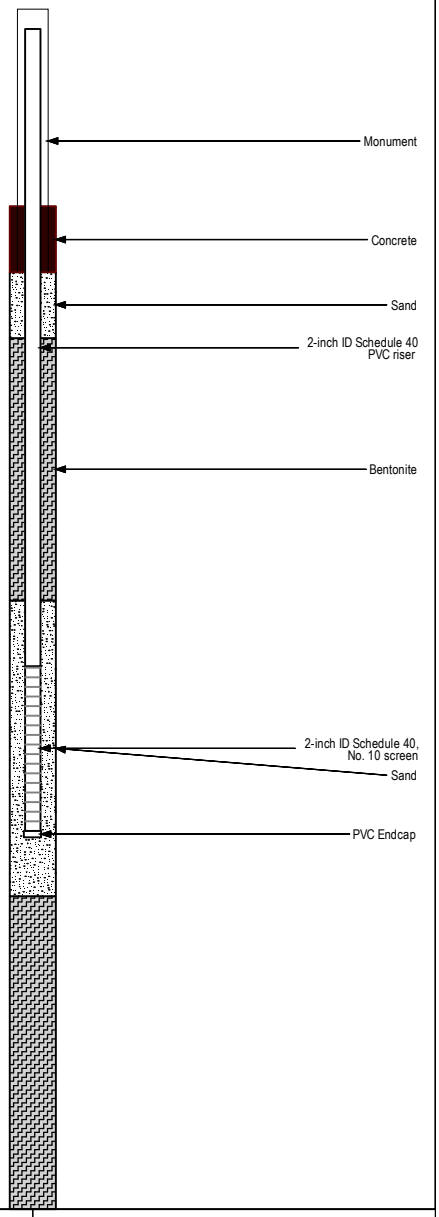
Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.12
Page 1 of 1
Issued:

ECOSCAPE REP Mike Schutten	COMPLETION DATE: 10/4/2017
DRILLING COMPANY: Mud Bay Drilling	GROUND SURFACE ELEV (masl) 278.15
DRILLING RIG: Sonic DB332	TOP OF RISER ELEV (masl) 278.97
DRILLING METHOD: Hollow Stem Auger	UTM COORDINATES (NAD 1983 11N)
HOLE DIAMETER (CM): 15.0	Northing 5439006.00 Easting 315200.00
WATER ELEVATION (masl): 277.74	

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Wet, black, TOPSOIL, sandy silt and organic matter	0		
Wet, grey FILL, intermixed sand, silt and organic matter	1		
Wet, black buried TOPSOIL			
Wet, dark grey SAND (SP), medium grained	2		
Wet, dark grey clayey SAND (SC), some silt	3		
Wet, dark grey clayey SILT (ML)	4		



CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-10 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.13 Page 1 of 3 Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey clayey SILT (ML)	5 6 7 8 9 10 11		Bentonite

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-10 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.13 Page 2 of 3 Issued:

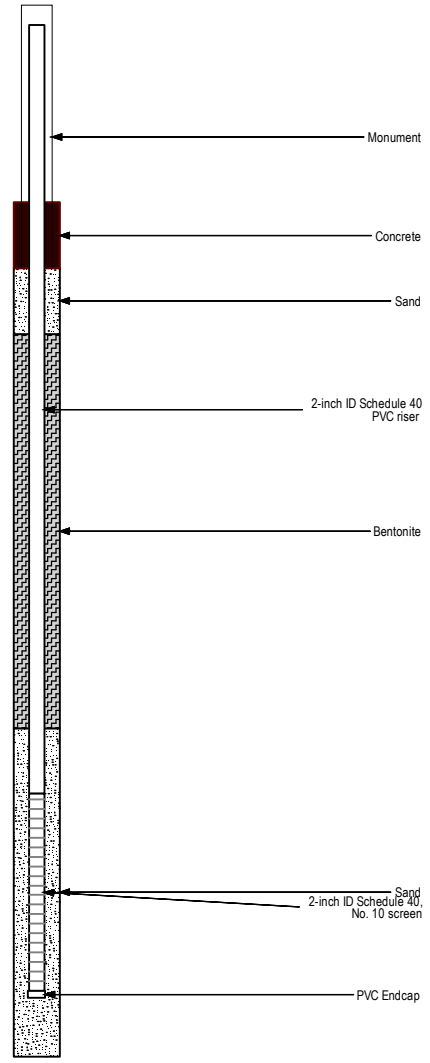
SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Wet, dark grey clayey SILT (ML)	12		
	13		
	14		
	15		
	16		
	17		
	18		

CLIENT: Infinity Properties Inc.	LOG & RECORD OF WELL CONSTRUCTION MW-10 Baseline Hydrogeological Assessment Willow Beach, Osoyoos, BC	Ecoscape Job No. 17-2013.13 Page 3 of 3 Issued:

ECOSCAPE REP Mike Schutten	COMPLETION DATE: 10/4/2017
DRILLING COMPANY: Mud Bay Drilling	GROUND SURFACE ELEV (masl) 278.12
DRILLING RIG: Sonic DB333	TOP OF RISER ELEV (masl) 278.97
DRILLING METHOD: Hollow Stem Auger	UTM COORDINATES (NAD 1983 11N)
HOLE DIAMETER (CM): 15.0	Northing 5439080.00 Easting 315008.00
WATER ELEVATION (masl): 277.78	

ECOSCAPE
Environmental Consultants Ltd.

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
GROUND SURFACE			
Wet, black TOPSOIL, silt, clay and organic matter	0		
Wet, light grey clayey SILT (ML), stiff, mottled			
Wet, dark grey SAND (SP), fine grained, some silt	1		
Wet, dark grey SAND (SP), medium grained	2		
Wet, dark grey SAND (SP), fine grained			
Wet, dark grey SAND (SP), fine grained, some silt	3		
Moist to wet, dark grey clayey SILT (ML), organic material from 5.0 to 6.0 m depth	4		



CLIENT:

Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION MW-11

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.14

Issued:

SOIL DESCRIPTION	DEPTH (m)	LITHOLOGY	WELL CONSTRUCTION
Moist to wet, dark grey clayey SILT (ML), organic material from 5.0 to 6.0 m depth	5 6 7 8 9 10 11		

CLIENT:

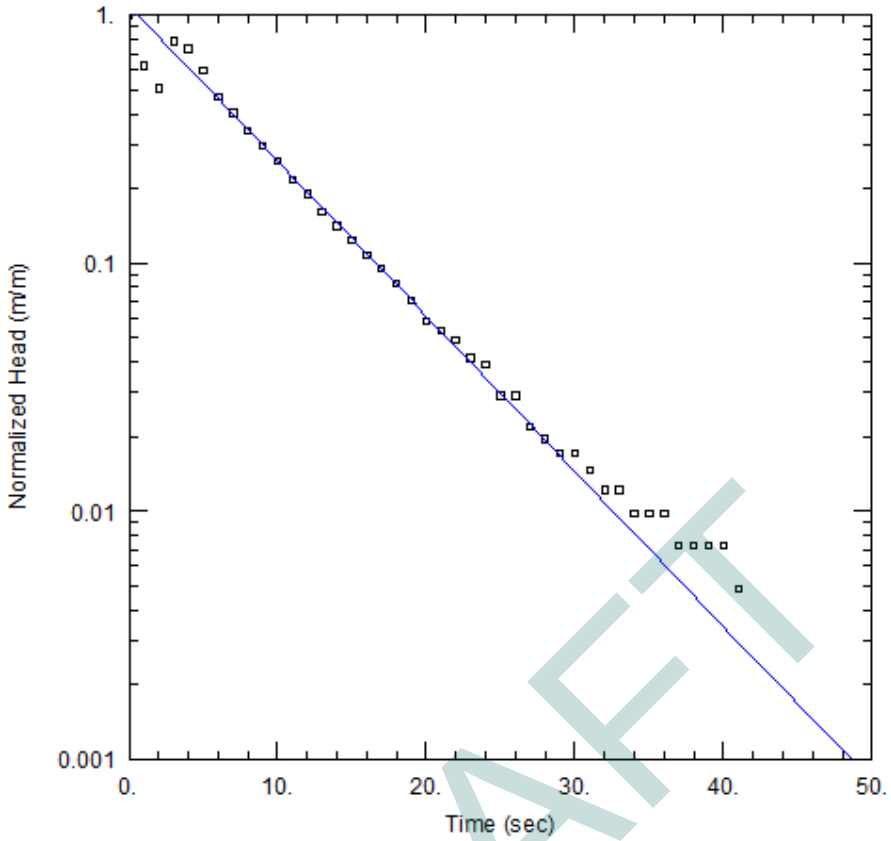
Infinity Properties Inc.

LOG & RECORD OF WELL CONSTRUCTION
MW-11

Baseline Hydrogeological Assessment
Willow Beach, Osoyoos, BC

Ecoscape Job No. 17-2013.14

Issued:



FALLING HEAD TEST

Data Set:
Date: 04/23/18 Time: 14:35:44

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW4S
Test Date: March 7, 2018

AQUIFER DATA

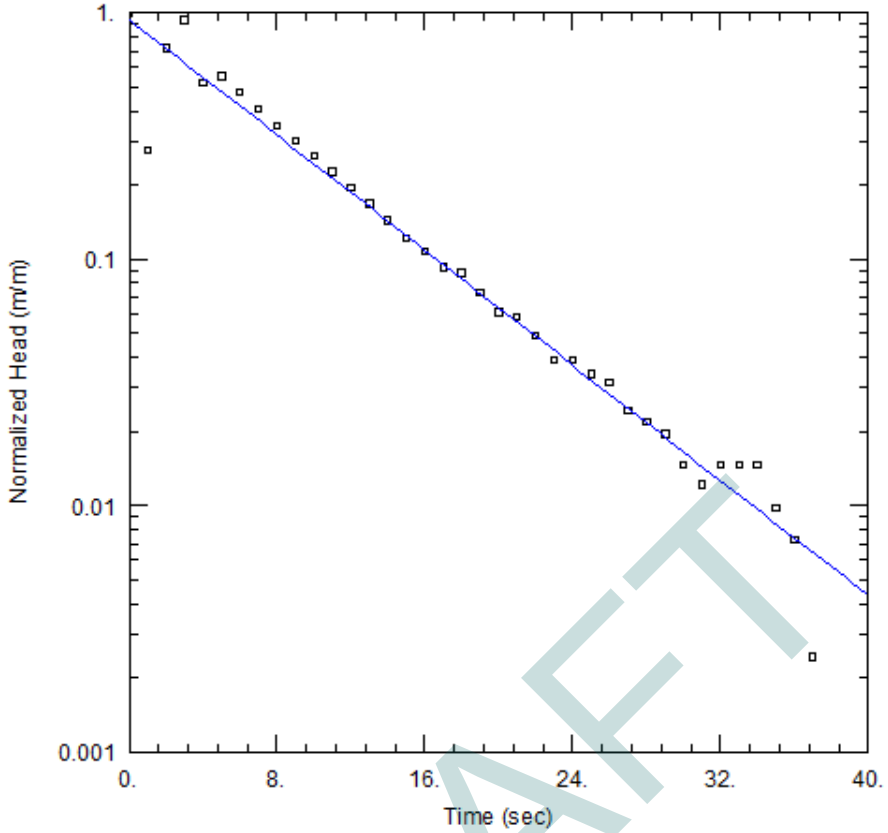
Saturated Thickness: 3.42 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.42 m
Casing Radius: 0.025 m
Static Water Column Height: 3.42 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0002122 m/sec
y0 = 0.4489 m



RISING HEAD TEST

Data Set:
Date: 04/23/18 Time: 14:53:01

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW4S
Test Date: March 7, 2018

AQUIFER DATA

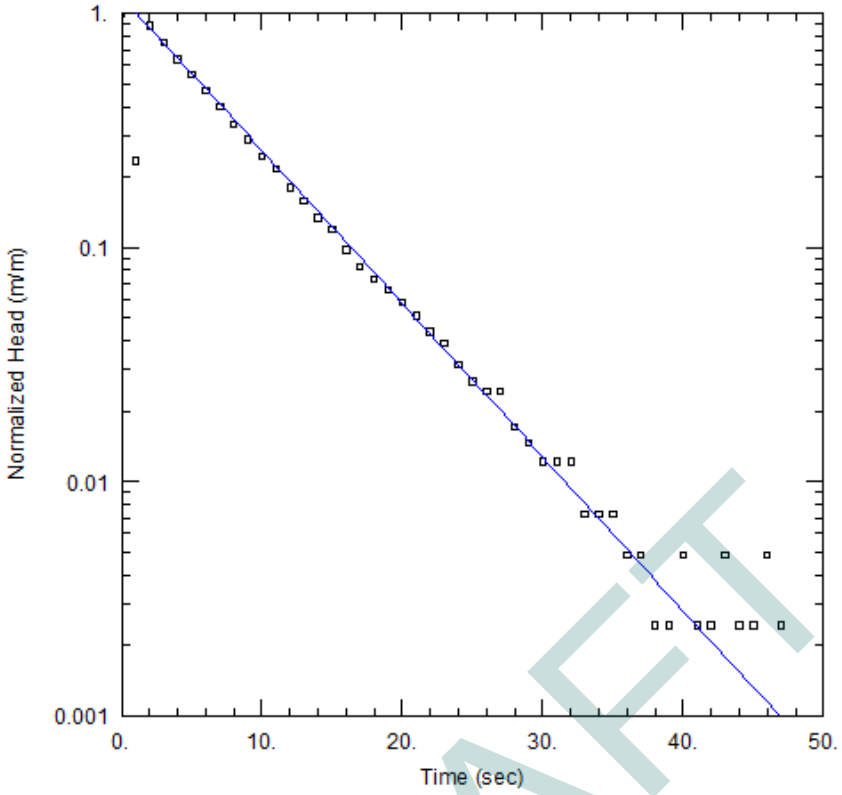
Saturated Thickness: 3.42 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.42 m
Casing Radius: 0.025 m
Static Water Column Height: 3.42 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0001981 m/sec
y0 = 0.3836 m



FALLING HEAD TEST

Data Set:
Date: 04/23/18 Time: 15:00:02

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW4S
Test Date: March 7, 2018

AQUIFER DATA

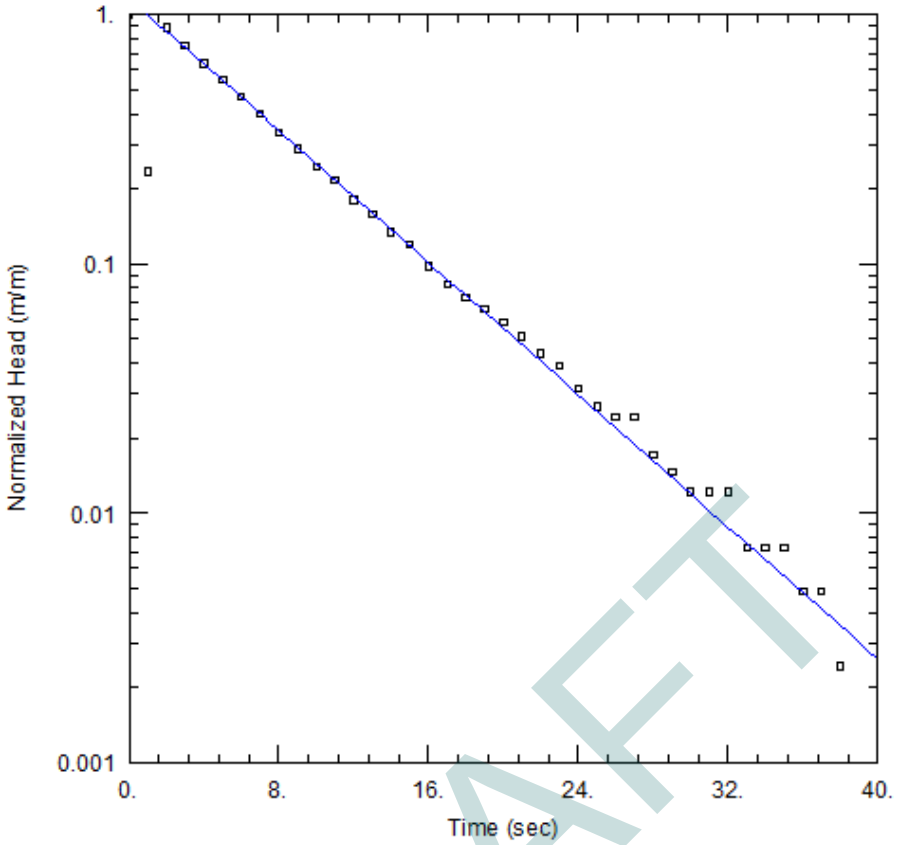
Saturated Thickness: 3.42 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.42 m
Casing Radius: 0.025 m
Static Water Column Height: 3.42 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0002222 m/sec
y0 = 0.4839 m



RISING HEAD TEST

Data Set:
Date: 04/23/18 Time: 15:04:25

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW4S
Test Date: March 7, 2018

AQUIFER DATA

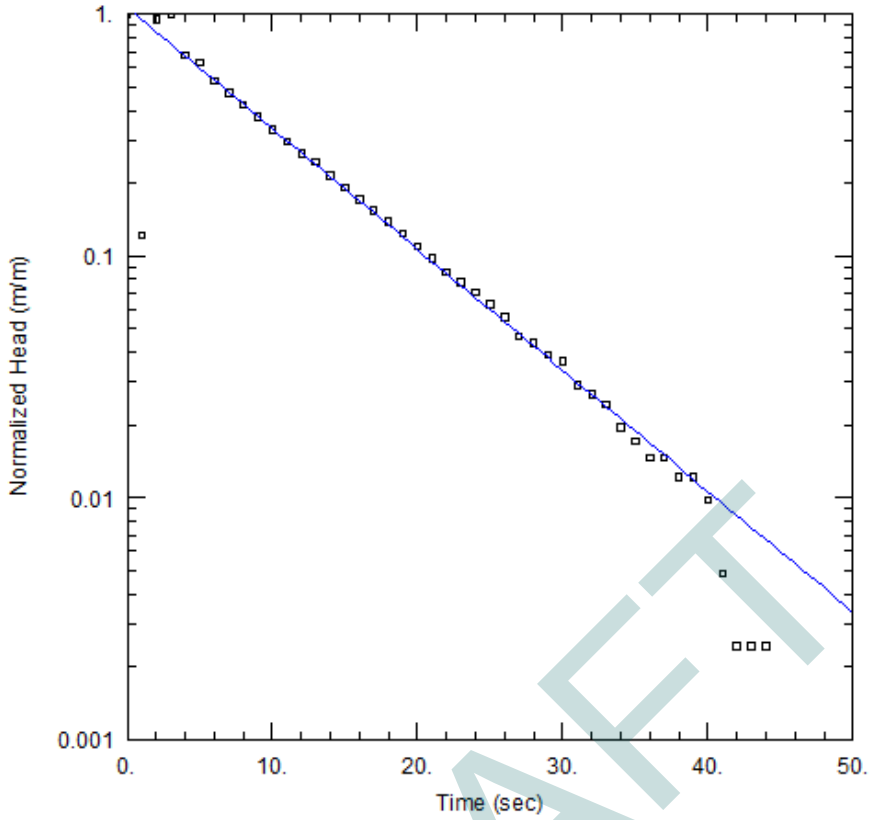
Saturated Thickness: 3.42 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW4S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.42 m
Casing Radius: 0.025 m
Static Water Column Height: 3.42 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0002245 m/sec
y0 = 0.4759 m



FALLING HEAD TEST

Data Set:
Date: 04/23/18 Time: 15:26:40

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW5S
Test Date: March 7, 2018

AQUIFER DATA

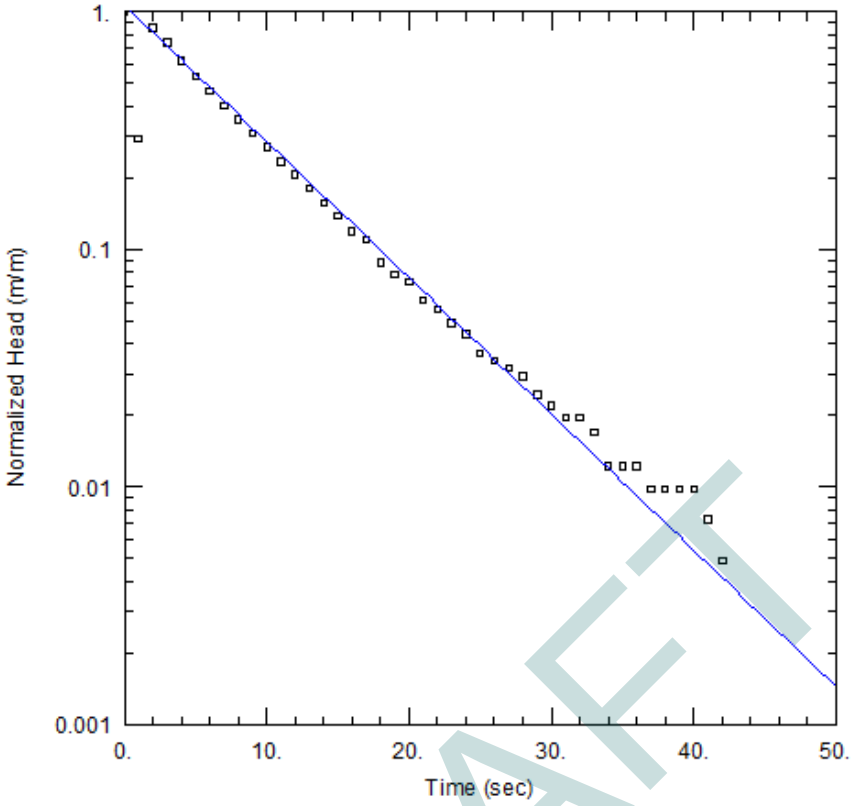
Saturated Thickness: 3.514 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.514 m
Casing Radius: 0.025 m
Static Water Column Height: 3.514 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0001696 m/sec
y0 = 0.4363 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 11:46:11

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW5S
Test Date: March 7, 2018

AQUIFER DATA

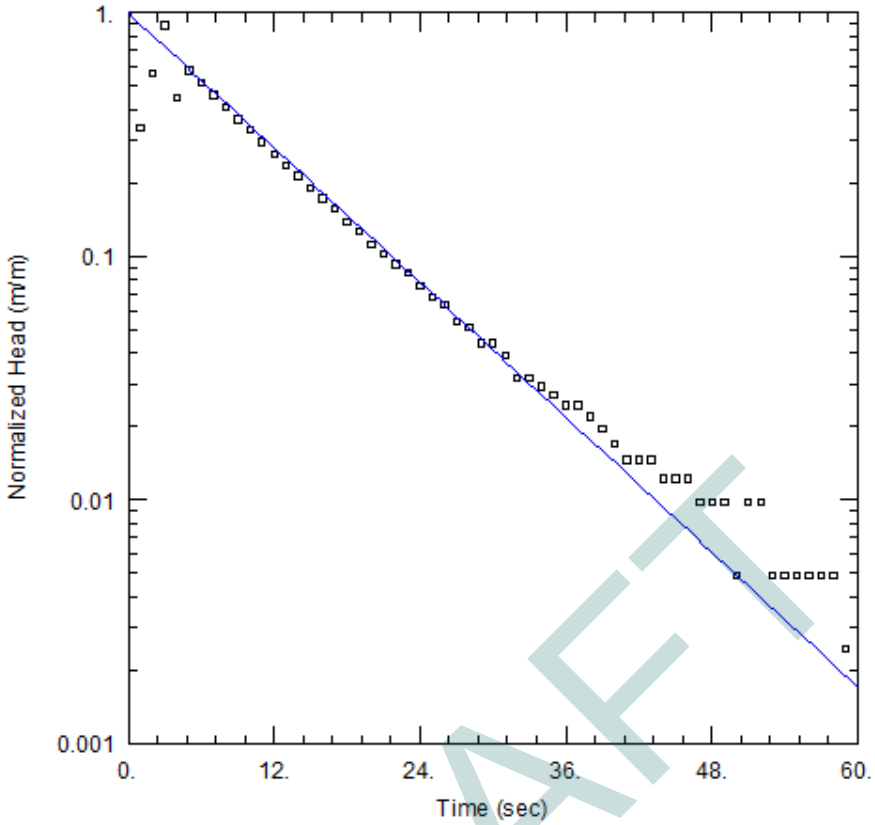
Saturated Thickness: 3.514 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.514 m
Casing Radius: 0.025 m
Static Water Column Height: 3.514 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0001946 m/sec
y0 = 0.4379 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 11:50:35

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW5S
Test Date: March 7, 2018

AQUIFER DATA

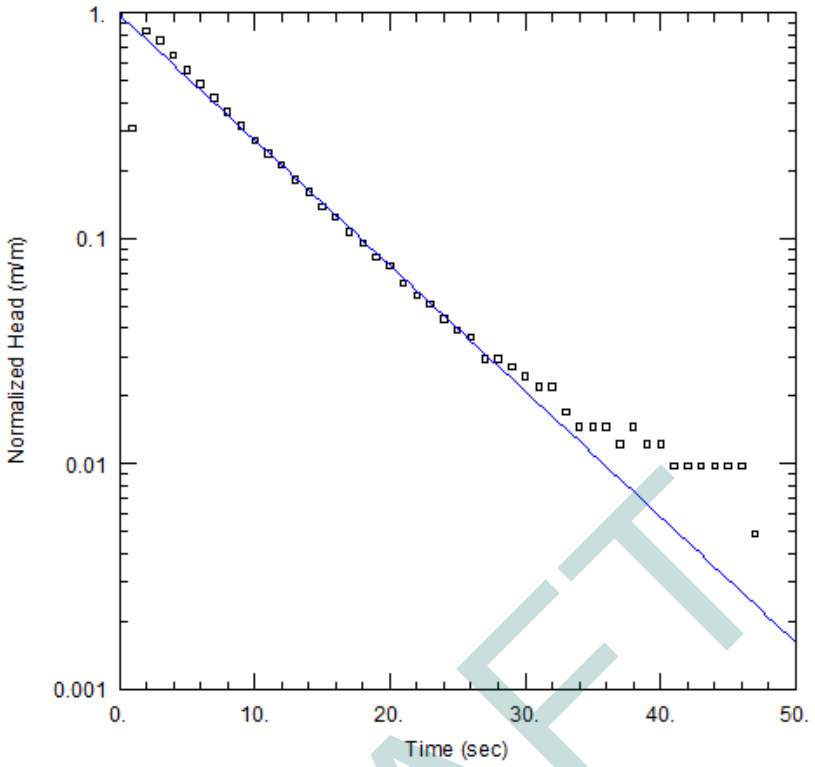
Saturated Thickness: 3.514 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.514 m
Casing Radius: 0.025 m
Static Water Column Height: 3.514 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0001565 m/sec
y0 = 0.4099 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 13:50:28

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW5S
Test Date: March 7, 2018

AQUIFER DATA

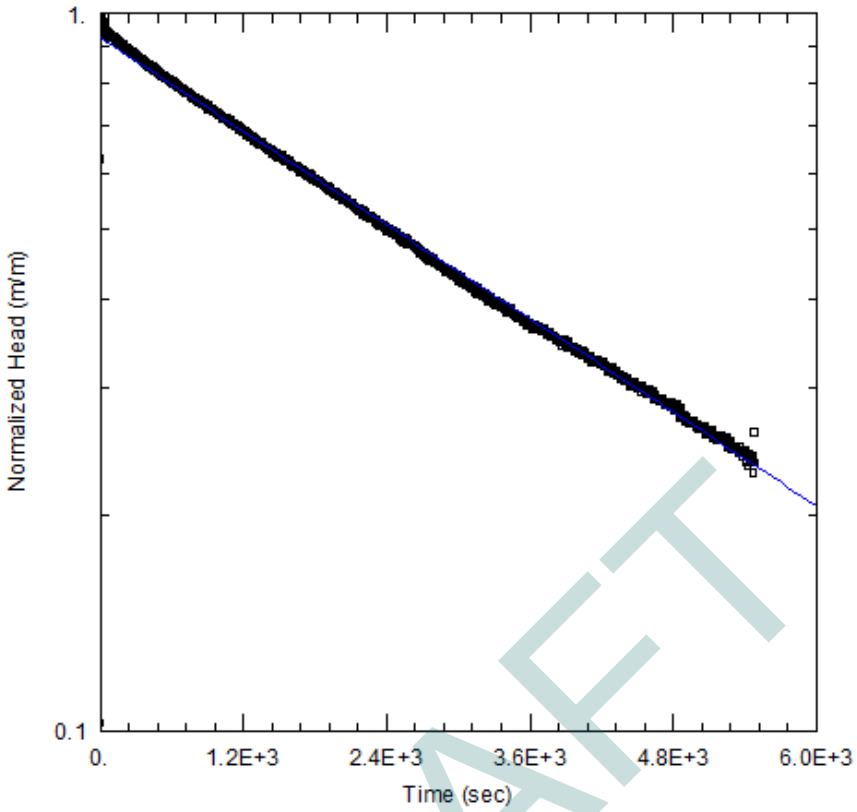
Saturated Thickness: 3.514 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW5S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.514 m
Casing Radius: 0.025 m
Static Water Column Height: 3.514 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.000189 m/sec
y0 = 0.4049 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 14:03:40

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW6
Test Date: March 7, 2018

AQUIFER DATA

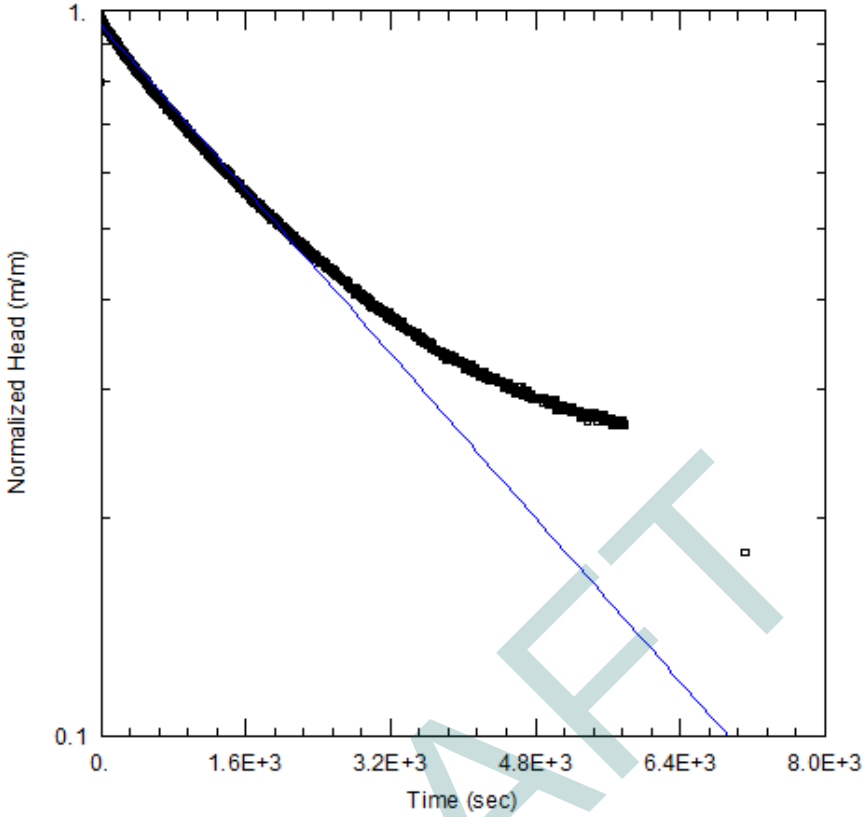
Saturated Thickness: 3.44 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW6)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.44 m
Casing Radius: 0.025 m
Static Water Column Height: 3.44 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 3.691E-7 m/sec
y0 = 0.3795 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 14:12:39

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW6
Test Date: March 7, 2018

AQUIFER DATA

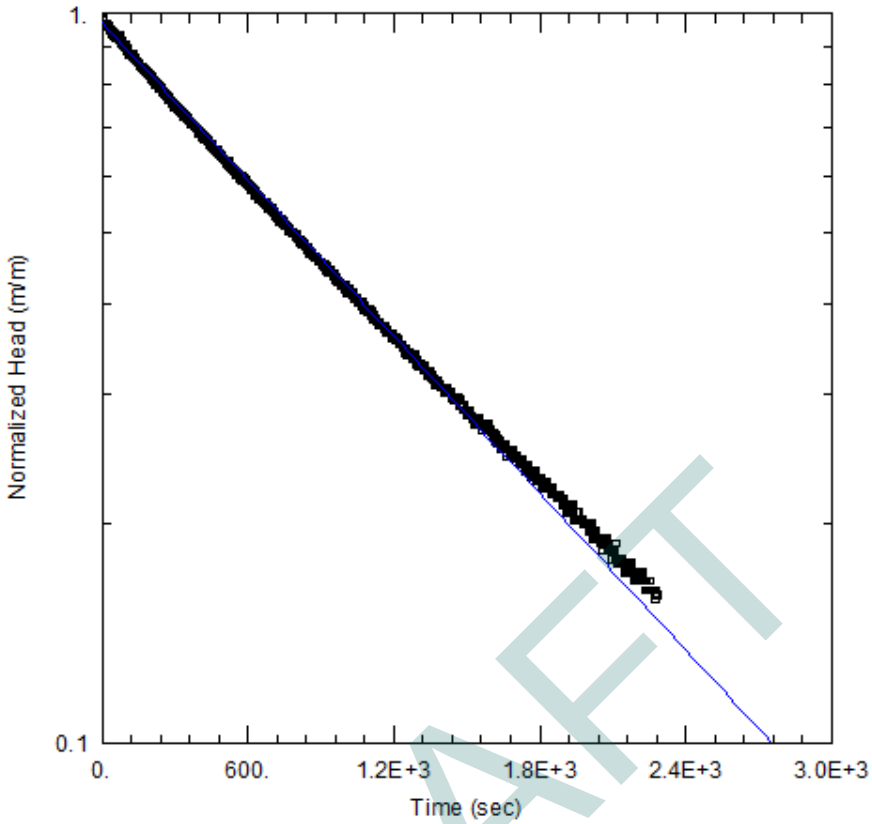
Saturated Thickness: 3.54 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW6)

Initial Displacement: 0.43 m
Total Well Penetration Depth: 3.54 m
Casing Radius: 0.025 m
Static Water Column Height: 3.54 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.804E-7 m/sec
y0 = 0.4114 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 14:38:11

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW7
Test Date: March 7, 2018

AQUIFER DATA

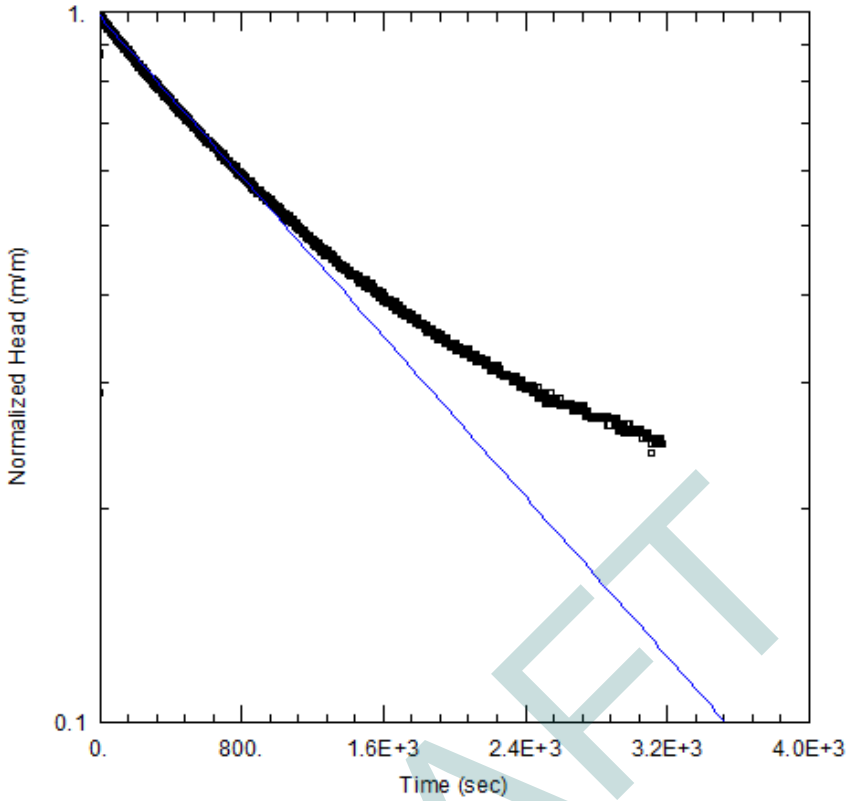
Saturated Thickness: 2.425 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW7)

Initial Displacement: 0.42 m
Total Well Penetration Depth: 2.425 m
Casing Radius: 0.025 m
Static Water Column Height: 2.425 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.216E-6 m/sec
y0 = 0.4085 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 14:42:29

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW7
Test Date: March 7, 2018

AQUIFER DATA

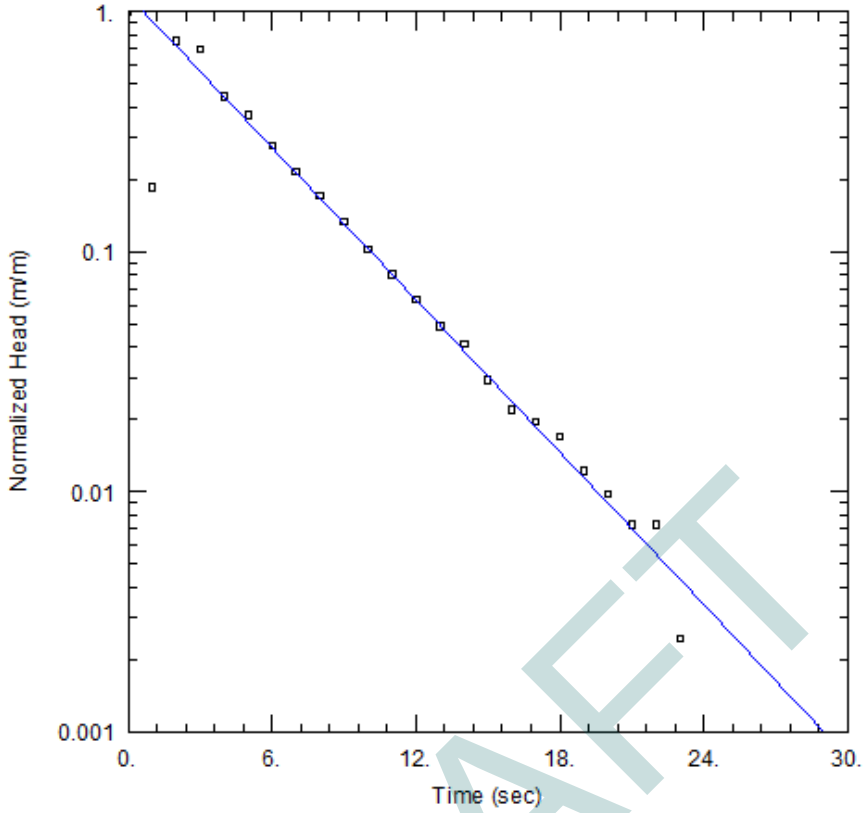
Saturated Thickness: 2.503 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW7)

Initial Displacement: 0.43 m
Total Well Penetration Depth: 2.503 m
Casing Radius: 0.025 m
Static Water Column Height: 2.503 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 9.557E-7 m/sec
y0 = 0.4244 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:00:49

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW8S
Test Date: March 7, 2018

AQUIFER DATA

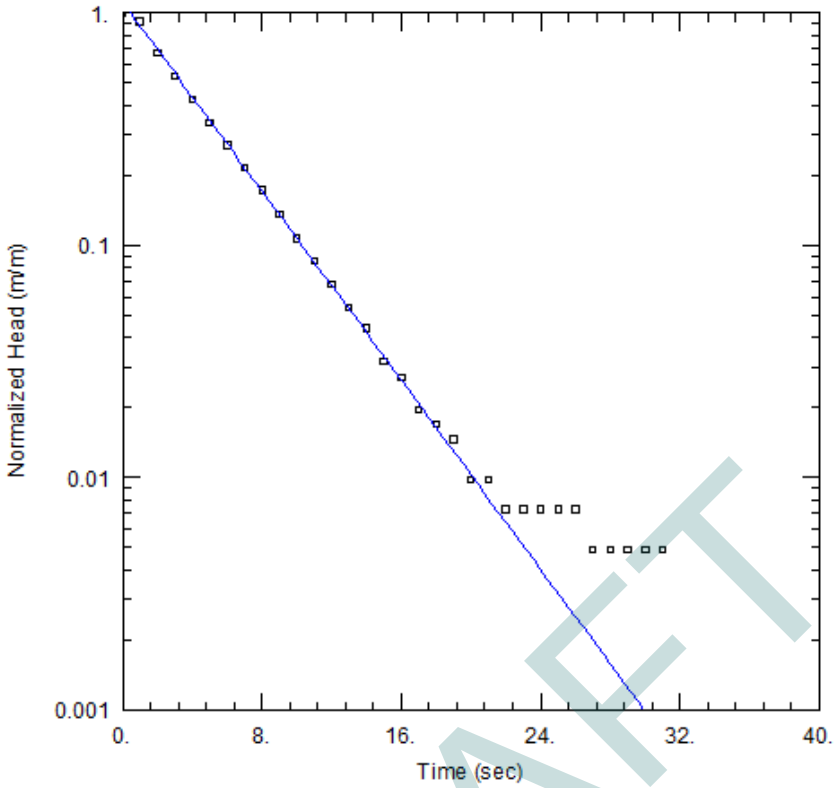
Saturated Thickness: 3.075 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW8S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.075 m
Casing Radius: 0.025 m
Static Water Column Height: 3.075 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0003591 m/sec
y0 = 0.4824 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:02:36

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW8S
Test Date: March 7, 2018

AQUIFER DATA

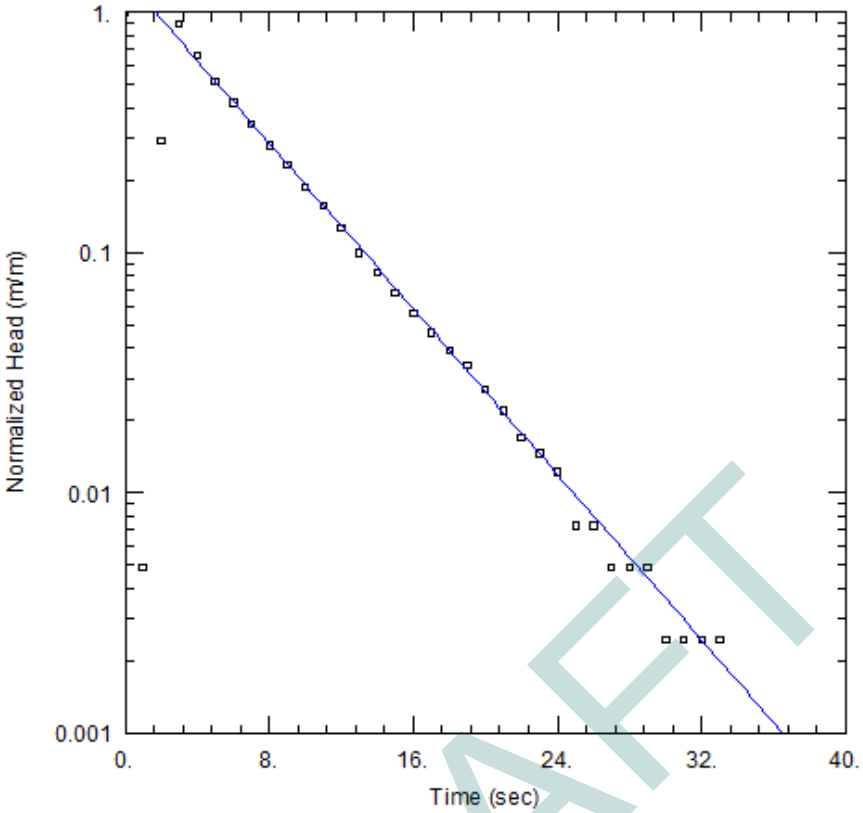
Saturated Thickness: 3.075 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW8S)

Initial Displacement: 0.41 m Static Water Column Height: 3.075 m
Total Well Penetration Depth: 3.075 m Screen Length: 0.91 m
Casing Radius: 0.025 m Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev
K = 0.0003451 m/sec y0 = 0.4578 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:04:27

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW8S
Test Date: March 7, 2018

AQUIFER DATA

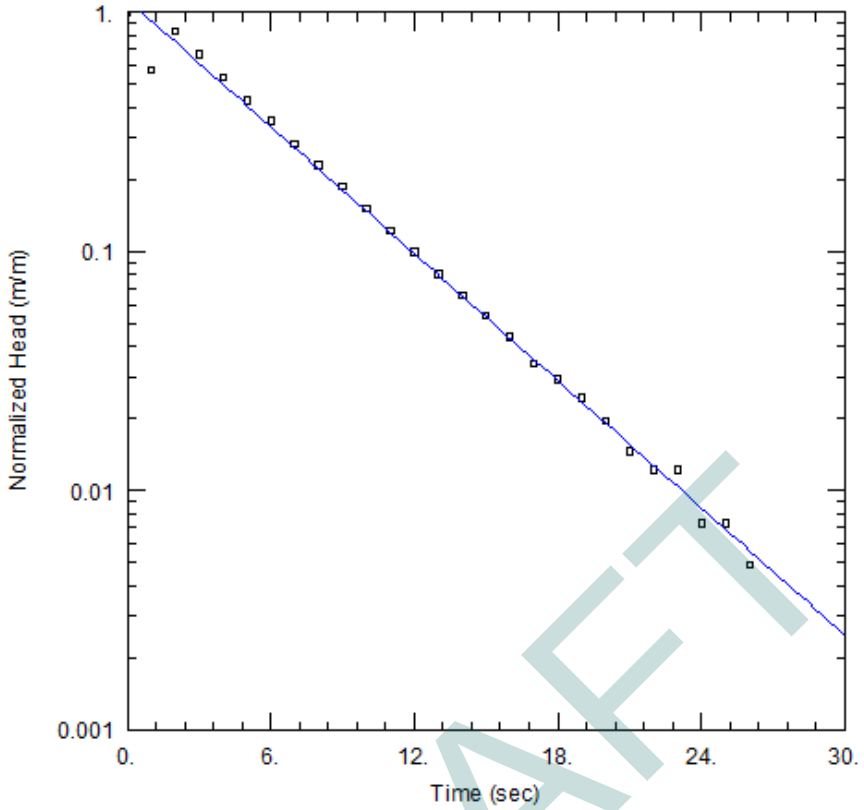
Saturated Thickness: 3.075 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW8S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.075 m
Casing Radius: 0.025 m
Static Water Column Height: 3.075 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0002921 m/sec
y0 = 0.5725 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:07:23

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW8S
Test Date: March 7, 2018

AQUIFER DATA

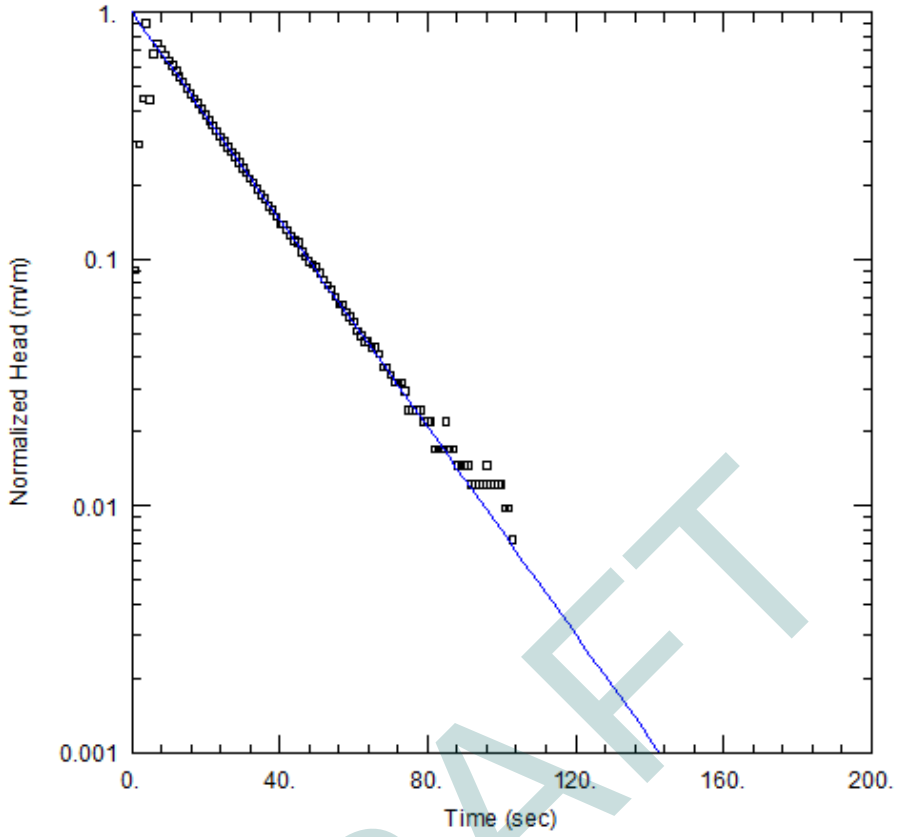
Saturated Thickness: 3.075 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW8S)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 3.075 m
Casing Radius: 0.025 m
Static Water Column Height: 3.075 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.0003005 m/sec
y0 = 0.464 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:19:48

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: Mw9
Test Date: March 7, 2018

AQUIFER DATA

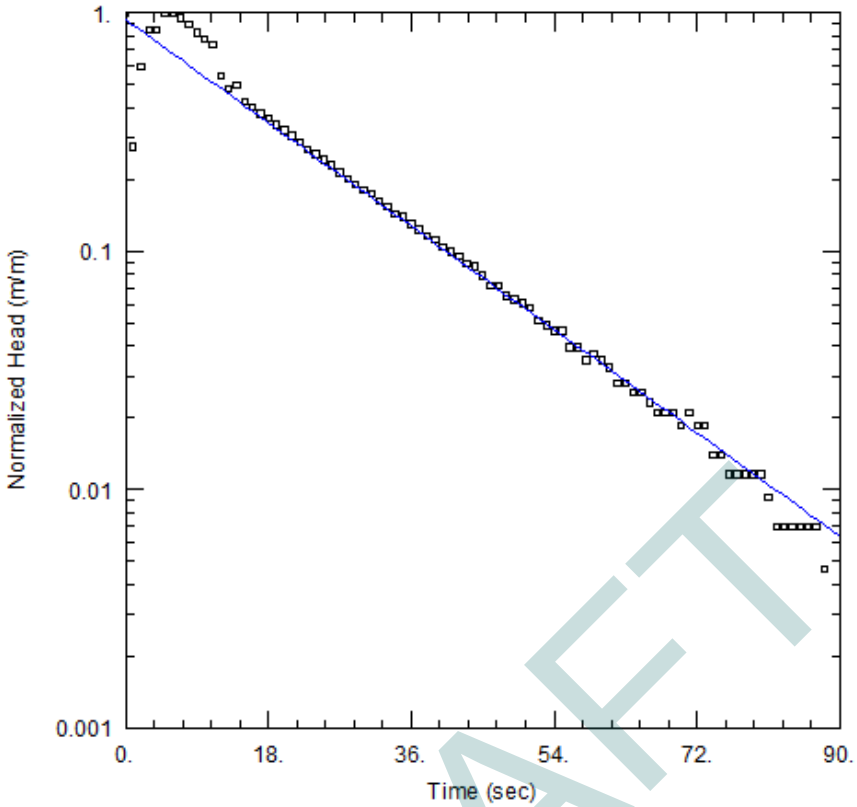
Saturated Thickness: 2.53 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW9)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 2.53 m
Casing Radius: 0.025 m
Static Water Column Height: 2.53 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 7.132E-5 m/sec
y0 = 0.4136 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:22:37

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW9
Test Date: March 7, 2018

AQUIFER DATA

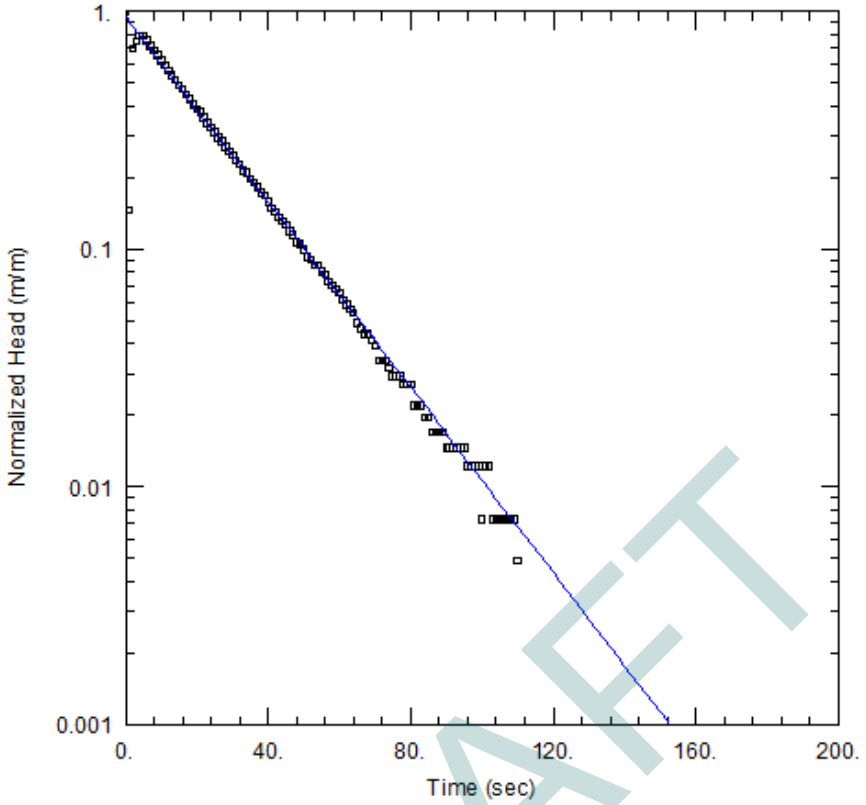
Saturated Thickness: 2.53 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW9)

Initial Displacement: 0.43 m
Total Well Penetration Depth: 2.53 m
Casing Radius: 0.025 m
Static Water Column Height: 2.53 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 8.17E-5 m/sec
y0 = 0.4034 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:25:03

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW9
Test Date: March 7, 2018

AQUIFER DATA

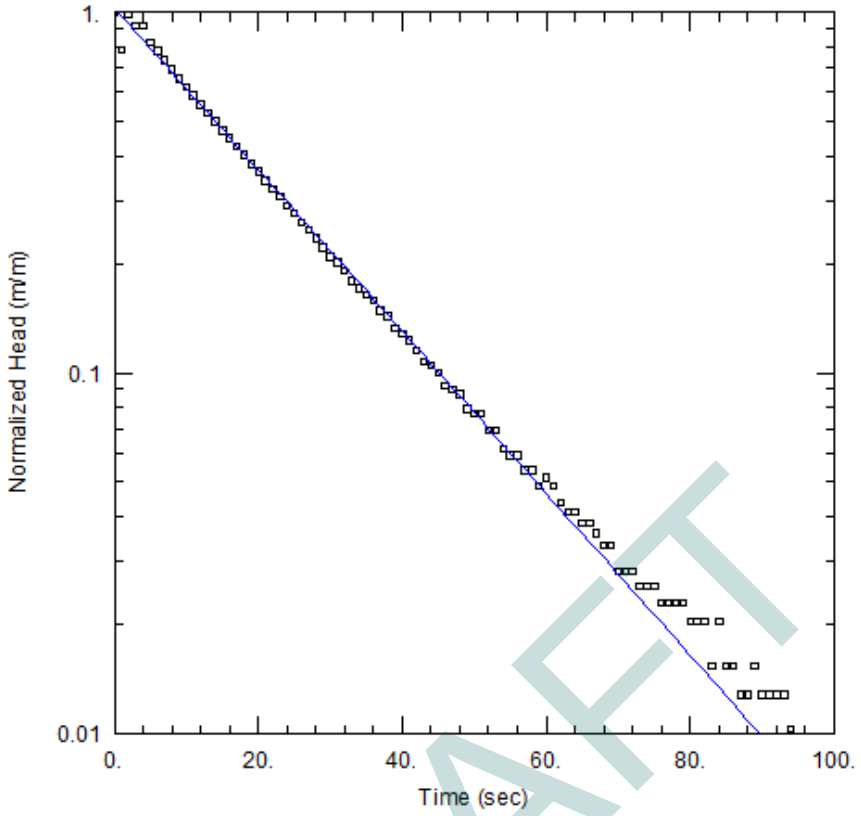
Saturated Thickness: 2.53 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW9)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 2.53 m
Casing Radius: 0.025 m
Static Water Column Height: 2.53 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 6.61E-5 m/sec
y0 = 0.3889 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:28:22

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW9
Test Date: March 7, 2018

AQUIFER DATA

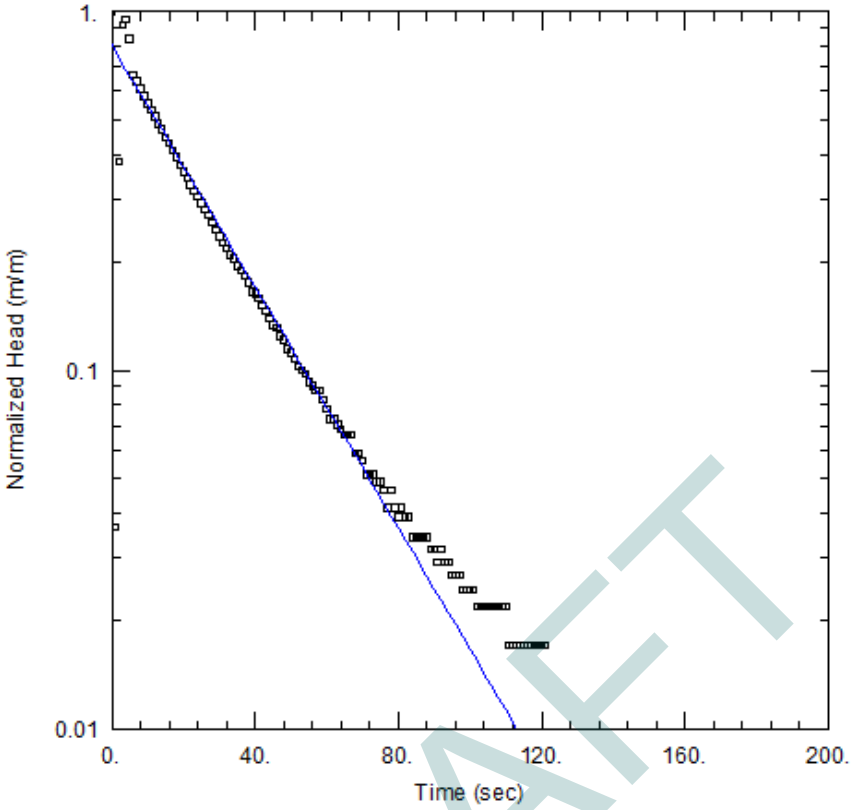
Saturated Thickness: 2.53 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW9)

Initial Displacement: 0.39 m
Total Well Penetration Depth: 2.53 m
Casing Radius: 0.025 m
Static Water Column Height: 2.53 m
Screen Length: 0.91 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 7.616E-5 m/sec
y0 = 0.4024 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:46:46

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW10
Test Date: March 7, 2018

AQUIFER DATA

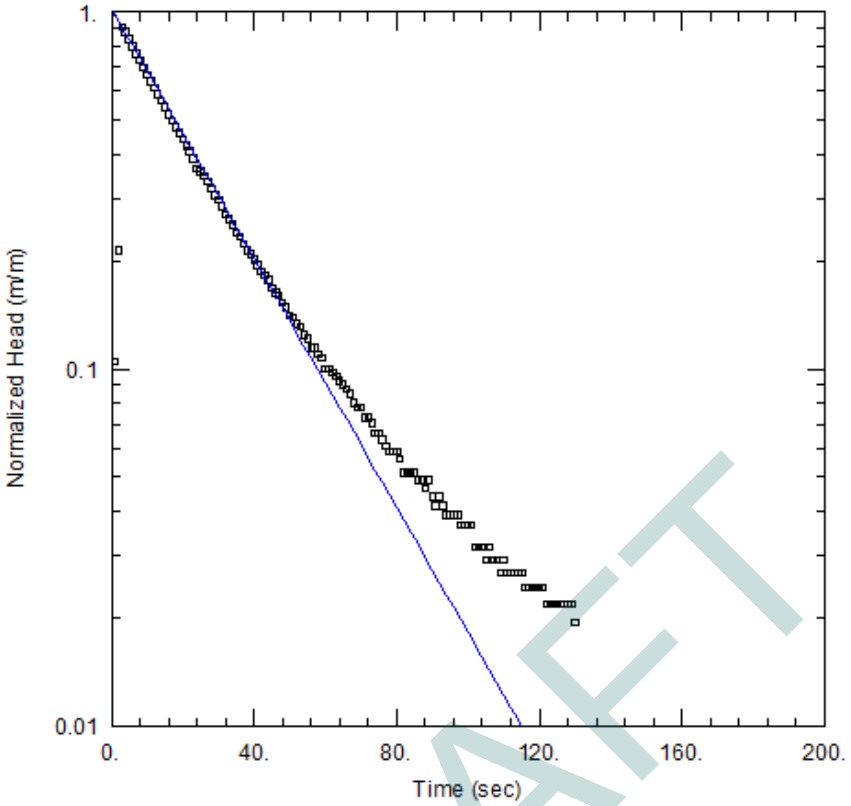
Saturated Thickness: 2.842 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW10)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 2.842 m
Casing Radius: 0.025 m
Static Water Column Height: 2.842 m
Screen Length: 0.76 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.445E-5 m/sec
y0 = 0.3308 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:48:52

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW10
Test Date: March 7, 2018

AQUIFER DATA

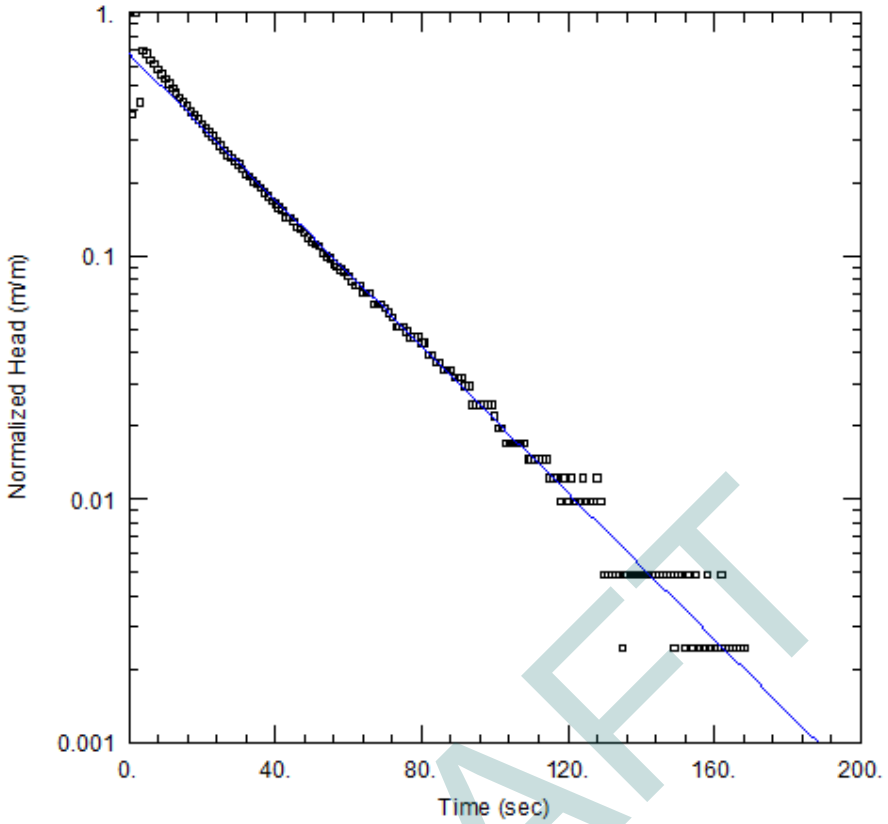
Saturated Thickness: 2.842 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW10)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 2.842 m
Casing Radius: 0.025 m
Static Water Column Height: 2.842 m
Screen Length: 0.76 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.655E-5 m/sec
y0 = 0.4206 m



FALLING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:51:47

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW10
Test Date: March 7, 2018

AQUIFER DATA

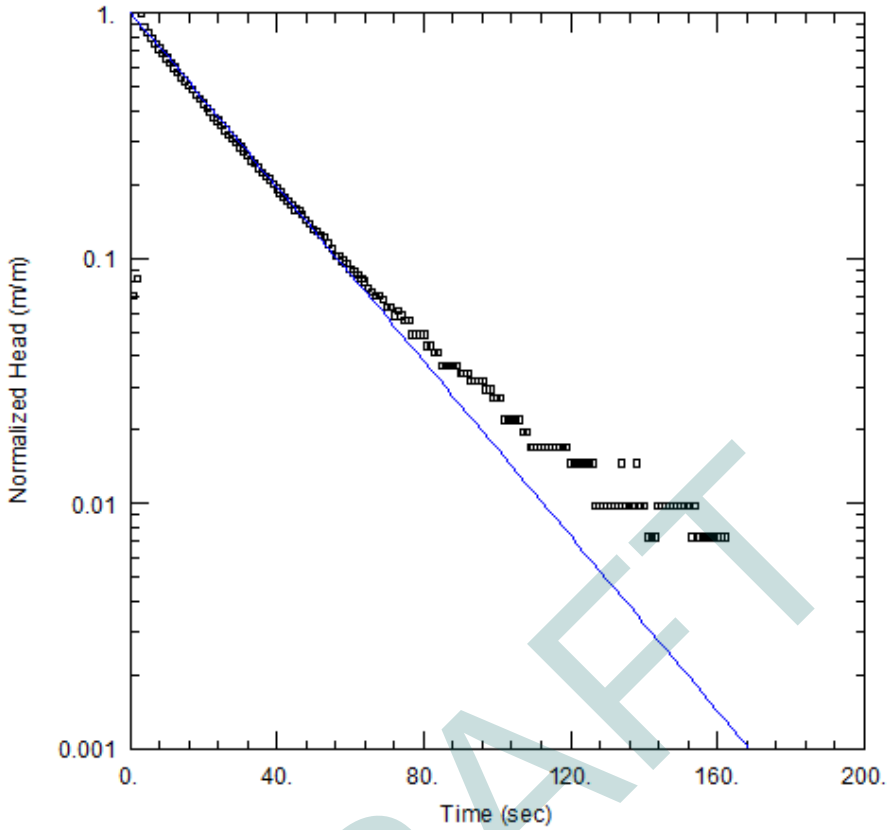
Saturated Thickness: 2.842 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW10)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 2.842 m
Casing Radius: 0.025 m
Static Water Column Height: 2.842 m
Screen Length: 0.76 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.867E-5 m/sec
y0 = 0.2789 m



RISING HEAD TEST

Data Set:
Date: 04/25/18 Time: 15:54:45

PROJECT INFORMATION

Project: 17-2013.01
Location: Willow Beach, Osoyoos
Test Well: MW10
Test Date: March 7, 2018

AQUIFER DATA

Saturated Thickness: 2.842 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW10)

Initial Displacement: 0.41 m
Total Well Penetration Depth: 2.842 m
Casing Radius: 0.025 m
Static Water Column Height: 2.842 m
Screen Length: 0.76 m
Well Radius: 0.025 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.764E-5 m/sec
y0 = 0.4165 m

Willow Beach Water Level Database

PROJECT / CLIENT Infinity Properties
SITE ADDRESS Osoyoos

Well ID	Northing	Easting	Logger Serial Number	Riser Geodetic Elevation (masl)	Ground Surface Geodetic Elevation	Depth to Well Bottom (mbtr)	Stickup (m)	Depth to Well Bottom below Surface (mbgs)	Screen Length (m)	Top of Screen (mbtr)
P1	315292.4522	5439065.662	20183748	279.159	-	2.46	-	-	0.2	2.16
SW1	315292.3365	5439065.698	20183750	278.809	-	1.70	-	-	1.70	na
P2	315318.8321	5439138.594	20183753	278.933	-	2.85	-	-	0.20	2.550
SW2	315318.7355	5439138.653	20183749	278.906	-	1.90	-	-	1.90	na
P3	315566.5723	5439117.78	20196491	279.007	-	2.87	-	-	0.20	2.565
SW3	315566.6484	5439117.788	20196520	278.957	-	2.09	-	-	2.09	na
P4	315557.4711	5439152.214	20183752	279.450	-	3.39	-	-	0.20	3.09
SW4	315557.601	5439151.907	20183751	279.425	-	2.20	-	-	2.20	na
P5	315667.265	5439207.341	20196519	279.132	-	3.03	-	-	0.20	2.73
SW5	315667.2421	5439207.336	20196493	278.964	-	1.85	-	-	1.85	na
TW07-2	314973.0056	5439243.397	20196404	278.982	278.484	20.10	-	-	1.2	18.9
TW07-3	315160.6288	5439149.889	20196403	279.178	278.458	29.20	-	-	1.2	28
TW07-5	315338.713	5438829.742	20196400	279.268	279.046	9.10	-	-	1.2	7.9
MW-1	315103.4924	5438958.858	20158216	278.912	278.052	2.97	0.86	2.11	0.46	2.51
MW-2	314974.87	5439244.988	20183494	279.304	278.484	4.45	0.82	3.63	0.91	3.54
MW-3	315160.7031	5439152.922	20158214	279.278	278.458	4.50	0.82	3.68	0.91	3.59
MW-4S	315349.4342	5439150.914	20183493	278.989	278.179	4.80	0.81	3.99	0.91	3.89
MW-4D	315349.3086	5439151.86	20196399	279.021	278.211	11.69	0.81	10.88	0.91	10.78
MW-5S	315614.3134	5439133.378	20183491	279.000	278.210	4.95	0.79	4.16	0.91	4.04
MW-5D	315615.0904	5439133.918	20196397	279.036	278.226	11.68	0.81	10.87	0.91	10.77
MW-6	315415.9386	5439004.488	20183452	279.188	278.358	4.87	0.83	4.04	0.91	3.96
MW-7	315564.475	5438899.829	20183495	279.816	278.856	4.68	0.96	3.72	0.91	3.77
MW-8S	315277.1215	5438857.25	20183451	279.507	278.707	4.59	0.80	3.79	0.91	3.68
MW-8D	315276.8876	5438856.24	20196398	279.554	278.754	11.05	0.80	10.25	0.91	10.14
MW-9	315428.2793	5438759.063	20183453	279.813	278.993	4.60	0.82	3.78	0.91	3.69
MW-10	315205.0346	5438999.43	20183490	279.049	278.229	3.76	0.82	2.94	0.76	3.00
MW-11	315012.8124	5439086.173	20183492	279.050	278.200	4.43	0.85	3.58	0.91	3.52

	Depth to Water Below Top of Riser (mbtr) - Manual Water Level Measurements										
Well ID	06-Sep-17	03-Oct-17	04-Oct-17	21-Nov-17	07-Mar-18	14-Mar-18	29-Nov-18	21-Mar-19	22-May-19	01-Nov-19	22-Apr-20
P1	1.15	-	-	1.26	-	1.02	1.27	1.41	1.32	1.32	1.33
SW1	0.79	-	-	0.91	-	0.62	0.87	0.80	0.90	0.86	0.90
P2	1.74	-	-	1.29	-	1.31	1.33	1.47	1.07	1.19	1.25
SW2	0.96	-	-	1.23	-	1.25	1.22	1.37	1.01	1.03	1.16
P3	1.07	-	-	1.40	-	1.27	1.48	1.64	1.23	1.37	1.50
SW3	1.01	-	-	1.34	-	1.15	1.32	1.46	1.11	1.17	1.35
P4	1.59	-	-	1.84	-	1.81	1.92	1.95	1.59	1.74	1.79
SW4	1.49	-	-	1.80	-	1.82	1.84	1.96	1.58	1.65	1.76
P5	1.98	-	-	1.55	-	1.53	1.68	1.75	1.32	damaged	damaged
SW5	1.10	-	-	1.41	-	1.37	1.56	1.53	1.12	damaged	damaged
TW07-2	0.30	-	0.60	0.58	0.56	0.49	0.62	0.65	0.55	0.61	0.61
TW07-3	0.43	-	-	0.74	0.71	0.66	0.76	0.79	0.66	0.74	0.73
TW07-5	1.04	-	1.20	1.29	1.33	-	1.39	1.42	1.17	1.29	1.29
MW-1	-	-	0.97	0.88	-	0.77	0.95	1.07	1.19	1.03	1.17
MW-2	-	-	1.51	1.54	1.43	-	1.60	1.53	1.47	1.52	1.50
MW-3	-	-	1.52	1.58	1.52	-	1.67	1.61	1.36	1.52	1.51
MW-4S	-	-	1.26	1.40	1.40	-	1.47	1.45	1.10	1.26	1.23
MW-4D	-	-	1.36	1.49	1.49	-	0.77	1.22	1.24	1.10	1.33
MW-5S	-	1.28	-	1.43	1.46	-	1.51	1.46	1.12	1.28	1.27
MW-5D	-	1.40	-	1.55	1.53	-	0.54	0.80	0.87	0.98	1.17
MW-6	-	1.50	-	1.44	1.44	-	1.53	1.54	1.38	1.39	1.48
MW-7	-	-	2.06	2.18	2.26	-	2.23	2.30	1.93	2.06	2.14
MW-8S	-	1.42	-	1.51	1.52	-	1.59	1.63	1.40	1.52	1.52
MW-8D	-	-	1.43	1.52	1.53	-	1.60	1.64	1.42	1.53	1.54
MW-9	-	-	1.89	1.99	2.08	-	2.01	2.11	1.84	1.62	1.98
MW-10	-	-	1.19	1.07	0.94	-	1.12	1.07	1.29	1.18	1.27
MW-11	-	-	1.19	1.13	0.94	-	1.16	1.07	1.24	1.18	1.20

Notes

mbtr meters below top of riser
masl meters above sea level
mbgs meters below ground surface

Willow Beach Baseline Hydrogeological Data Collection Notes and Instructional

Scope

The following tasks were completed by Ecoscape as part of the baseline hydrogeological investigation:

- On September 6, 2017, installed five (5) piezometers paired with five (5) stilling wells at Quintal Oxbow, Pond 1, Pond 2, the unnamed oxbow lake, and the man-made drainage channel to help evaluate recharge/discharge function at the surface water bodies on Site
- October 2- 4, 2017 - Drilled (14) boreholes completed as monitoring wells using a licensed drilling contractor;
- November 21, 2017 - Surveyed location and elevation of monitoring wells, piezometers, and stilling wells, and downloaded level logger data;
- March 7 and March 14, 2018 - Hydraulic conductivity testing via single well response tests (i.e., slug tests) at select monitoring well locations, and downloaded level logger data;
- November 29, 2018, March 21, 2019, May 22, 2019, November 1, 2019 and April 22, 2020 – measured water levels and downloaded level logger data

Piezometers and Stilling Wells

Five (5) piezometers paired with five (5) stilling wells were installed in each water body on September 6, 2017, as shown on the Site Plan. The purpose of the nested piezometers and stilling wells was to determine the water level in each water body, and to assess vertical hydraulic gradients and any potential hydraulic connections between shallow groundwater and the water bodies.

Piezometers were installed manually by "driving" 0.05 m (2-inch) Schedule 40 PVC to targeted depths. Each piezometer was constructed with a 0.2 m section of #25 slotted PVC screen. Stilling wells extending to the bottom of the water body were affixed to each piezometer, and were constructed of Schedule 40 PVC with 1.5 m sections of #25 slotted PVC screen.

Piezometer completion details are summarized as follows:

- At P1, located in the drainage channel, a 20 cm screen was installed from approximately 0.11 m to 0.31 m below the channel bottom.
- At P2, located in the Unnamed Oxbow, a 20 cm screen was installed from approximately 0.62 m to 0.82 m below the bottom of the oxbow.
- At P3, located in Pond 2, a 20 cm screen was installed from approximately 0.43 to 0.63 m below the pond bottom.
- At P4, located in Pond 1, a 20 cm screen was installed from approximately 0.86 to 1.06 m below the bottom of the pond.
- At P5, located in the Quintal Oxbow, a 20 cm screen was installed from approximately 0.71 m to 0.91 m below the bottom of the oxbow.

Drilling Investigation, Monitoring Well Installation, and Level Logger Installation

Subsurface stratigraphy was investigated by drilling fourteen (14) boreholes at the locations shown on the Site plan.

The boreholes were drilled on October 2 to 4, 2017 by Mudbay Drilling using a track-mounted Sonic DB320 drill rig. A continuous core of the encountered sediments was collected within an inner core tube, and was made available for retrieval at the ground surface. Boreholes were advanced to depths ranging from 3.66 m to 31.09 m bgs.

Borehole logs were prepared for each drilling location, containing descriptions of soil type, colour, texture, and moisture content, along with other observations. Borehole logs have been provided to the client.

To facilitate depth to water measurements, the boreholes were converted to monitoring wells by installing 0.05 m (2-inch) diameter flush-threaded Schedule 40 PVC pipe with No. 10 slotted sections at the well terminus. Each well screen was sealed at the bottom using a threaded cap, and each well was sealed at the top with a lockable J-plug cap. Boreholes extending deeper than the monitoring well were plugged with a bentonite seal until approximately 0.3 m below the well bottom. The annulus of the screened section was backfilled with washed silica sand to approximately 0.3 m above top of screen, and was hydraulically isolated by way of bentonite seal above the screen to approximately 0.6 m from the surface, in accordance with the BC Groundwater Protection Regulation. Approximately 0.3 m of silica sand was installed above the bentonite seal to ensure adequate drainage around the well and wells were protected with a steel stick-up monument secured with concrete.

All newly installed monitoring wells and three (3) existing test wells installed by Golder in 2007 (i.e., TW07-02, TW07-03 and TW07-05) were instrumented with Onset® Hobo® Data Loggers (level logger). The level loggers were suspended into the water column within the wells and set to record water level fluctuations at two-hour intervals. The level loggers are not vented to the atmosphere, and therefore record total pressure (i.e., atmospheric + height of water column). As such, data obtained from the level loggers were corrected for atmospheric pressure using data obtained from a level logger suspended in the air at SW-4.

Static water level measurements were manually taken from the top of well riser at each monitoring well, stilling well and piezometer, on four separate occasions, using an electric water level tape, to verify the accuracy of information collected by the level loggers.

Manual water levels obtained from the wells are summarized in the well database provided to the client.

Slug Tests

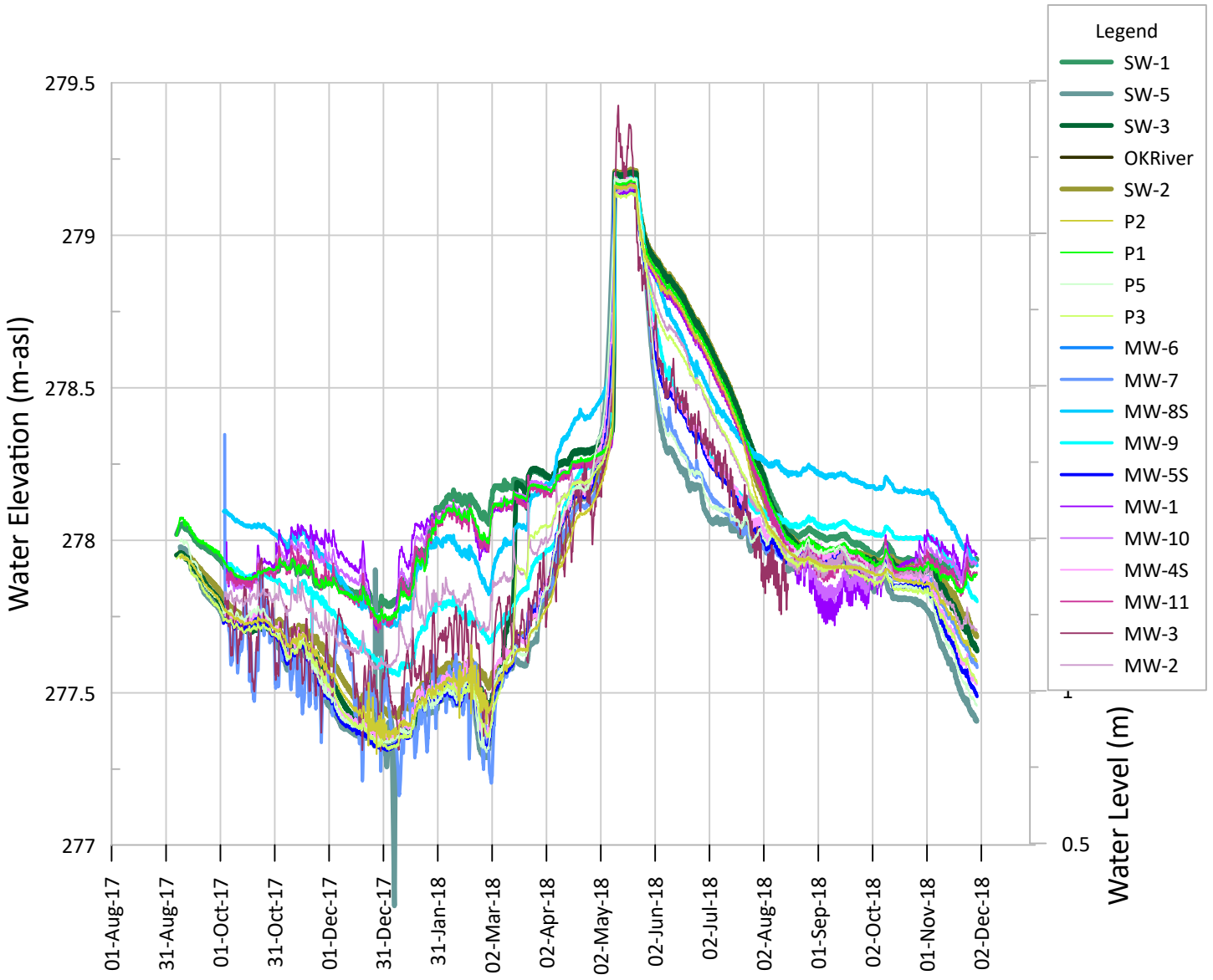
To evaluate the in-situ hydraulic conductivity of the screened intervals, falling head and rising head slug tests were conducted at MW1, MW4S, MW5S, MW6, MW7, MW8S, MW9 and MW10. The falling-head slug tests involved the addition of a slug to the subject monitoring well followed by a measurement of the rate of change in water level over time. Rising-head tests were completed by removing the slug from the well and once again measuring the rate of change in water level over time.

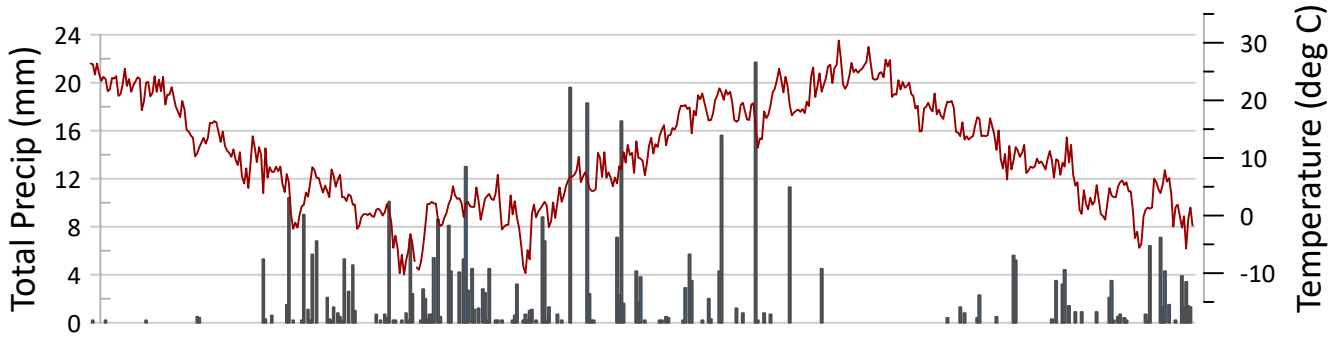
Water levels for the slug tests were measured automatically using a data logger. Slug tests were repeated twice for each monitoring well except for MW6 and MW7, and water level response data was analyzed using the Hvorslev (1951) method or Bouwer and Rice (1976) method. K values were estimated using Aqtesolv™ software.

Slug test data and plots were provided to the client.

Miscellaneous Notes

- The logger in TW07-2 was vandalized/tampered with on October 27, 2017 and was reset on November 21, 2017.
- The logger cable in TW07-05 was cut sometime between October 4 and November 21, 2017, and the logger was lost. A new logger was installed on March 14, 2018 at this location.
- The logger cable in TW07-03 was cut sometime between November 21, 2017 and March 7, 2018, and the logger was lost. A new logger was installed on March 14, 2018 at this location.
- Some anomalous level logger readings were noted at SW4; however, manual measurements are consistent with logger readings at the time manual measurement was taken.
- The logger at MW6 was found to be silted in on November 21, 2017. As such, data logged prior to November 21, 2017 was discarded.





ACTIVE EARTH ENGINEERING LTD		PROJECT	WILLOW BEACH ESTATES, OSOYOOS, BC
CLIENT	INFINITY PROPERTIES LTD.	TITLE	WATER LEVEL MONITORING DATA (ECOSCAPE)
DATE FEB 2021	DWN. KT / CHKD. MP	FILE NO. 2305	DRWG. **A-1**

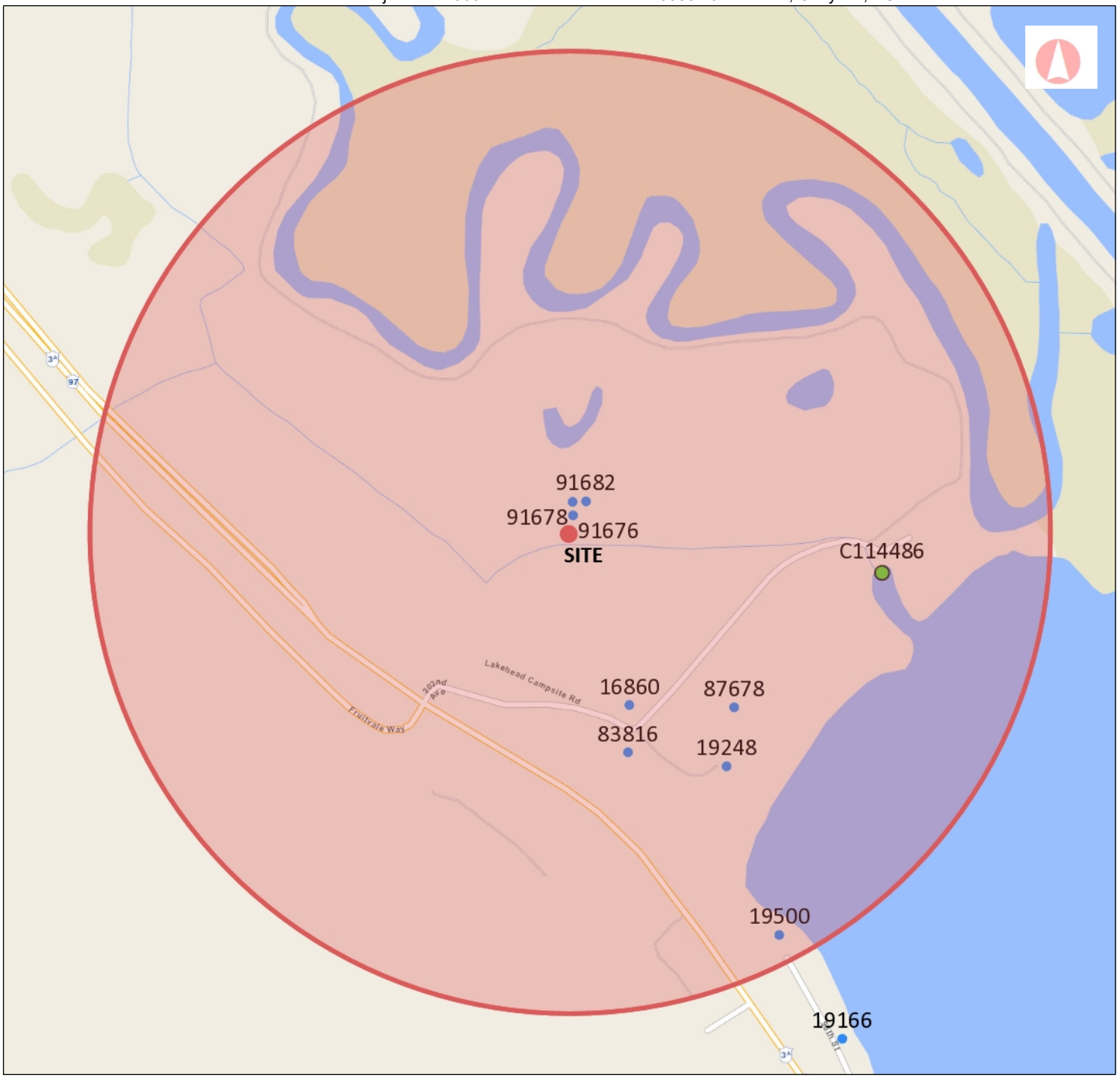
ACTIVE EARTH
ENGINEERING LTD

www.activeearth.ca

APPENDIX B

BC Water Resource Atlas Search Results and Aquifer Report

AE Project No. 2305 - Willow Beach Estates 9330 202 Avenue, Osoyoos, BC



BRITISH COLUMBIA

iMapBC Mapping

Legend

Groundwater Wells - All

ARTESIAN_IND

- Reported Artesian Well
- Well

Water Rights - Licences

POD_STATUS

- Active
- Inactive

500 m radius

0 0.18 0.37 km

1: 9,028

Datum: NAD83

Projection: WGS_1984_Web_Mercator_Auxiliary_Sphere

Key Map of British Columbia

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 91678
Well Identification Plate Number: 16913
Owner Name: GEORGIA LANE DEVELOPMENTS
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:

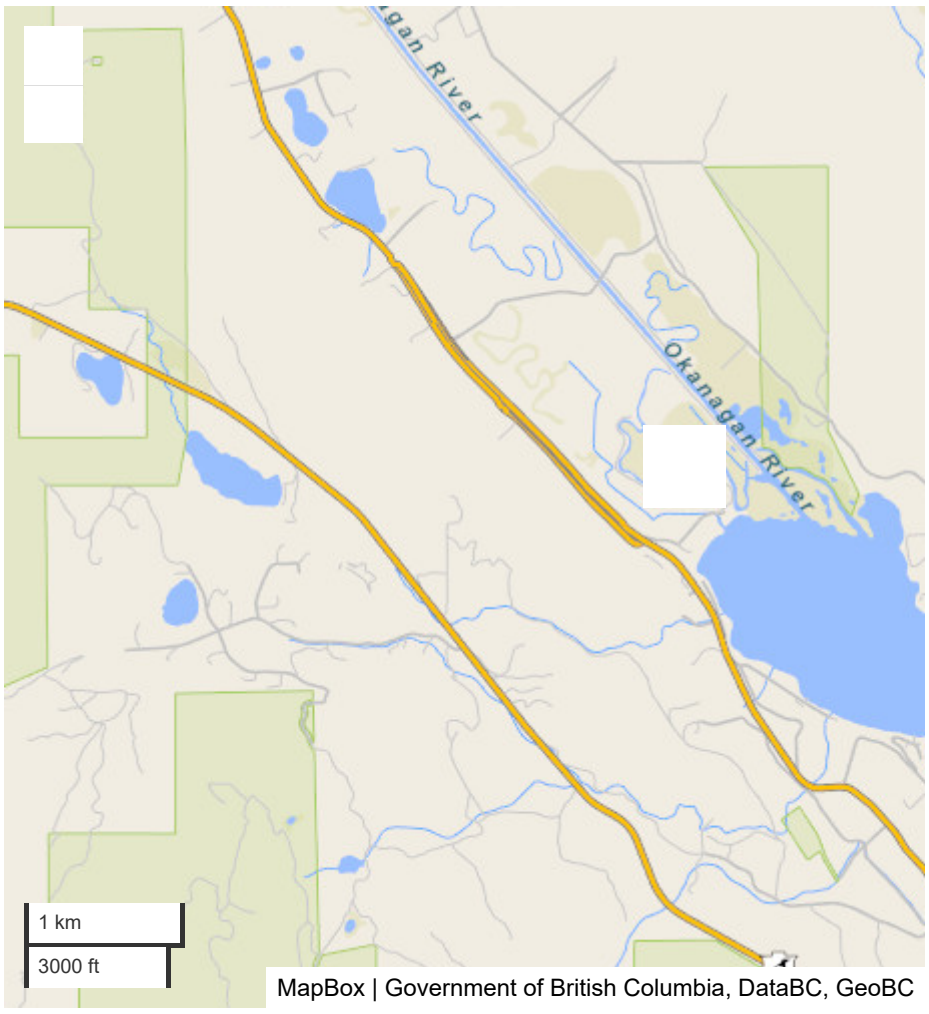
Location Information

Street Address: 204 AVENUE HIGHWAY 97
Town/City: OSOYOOS

Legal Description:

Lot	675
Plan	2066
District Lot	2450
Block	
Section	
Township	
Range	
Land District	54
Property Identification Description (PID)	002036967

Description of Well Location: WILLOW BEACH TRAILER PARK. LAND DISTRICT SIMILKAMEEN YALE.



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

Latitude: 49.076484
Longitude: -119.529457
UTM Easting: 315281
UTM Northing: 5439040
Zone: 11
Coordinate Acquisition Code: unknown, accuracy based on parcel size) ICF cadastre, poor or no location sketch, arbitrarily located in center of parcel

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	2007-03-01	2007-03-02	Cyclone Drilling Ltd.	January 22nd 2008 at 2:37 AM

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
2007-03-01	2007-03-02				

Well Completion Data

Total Depth Drilled: 97.00 feet
Finished Well Depth: 96.00 feet
Final Casing Stick Up: 24.000 inches
Depth to Bedrock:
Ground elevation: 901.00

Static Water Level (BTOC): 3.00 feet
Estimated Well Yield: 80.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: WELL CAP
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	10.00		coarse		grey	Soft	WET.	
10.00	45.00	FINE SAND & RUNNY CLAY.			grey	Soft		
45.00	91.00	RUNNY CLAY.			grey	Soft		
91.00	97.00	GREY, WHITE COARSE SAND & GRAVEL.				Soft		80.0000

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
-2.00	92.00		Steel	6.600	0.219	Installed

Surface Seal and Backfill Details

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

Intake Method: Screen
Type: Pipe size
Material: Stainless Steel
Opening: Continuous Slot
Bottom: Bail

Installed Screens

From	To	Diameter	Assembly Type	Slot Size
92.00 ft	96.00 ft	6.00	K_PACKER	80.00

Well Development

Developed by: Air lifting

Development Total Duration: 4.00 hours

Well Yield

Estimation Method: Air Lifting
Static Water Level Before Test: 3.00
Hydrofracturing Performed: No

Estimation Rate: 80.00
Drawdown:
Increase in Yield Due to Hydrofracturing:

Estimation Duration: 4.00

Well Decommission Information

Reason for Decommission:
Sealant Material:
Decommission Details:

Method of Decommission:
Backfill Material:

Comments

WELL #3. SCREEN 4', KPACKER 2', OVERALL 6'6".

Alternative Specs Submitted: No

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 91682
Well Identification Plate Number: 16912
Owner Name: GEORGIA LANE DEVELOPMENTS
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:

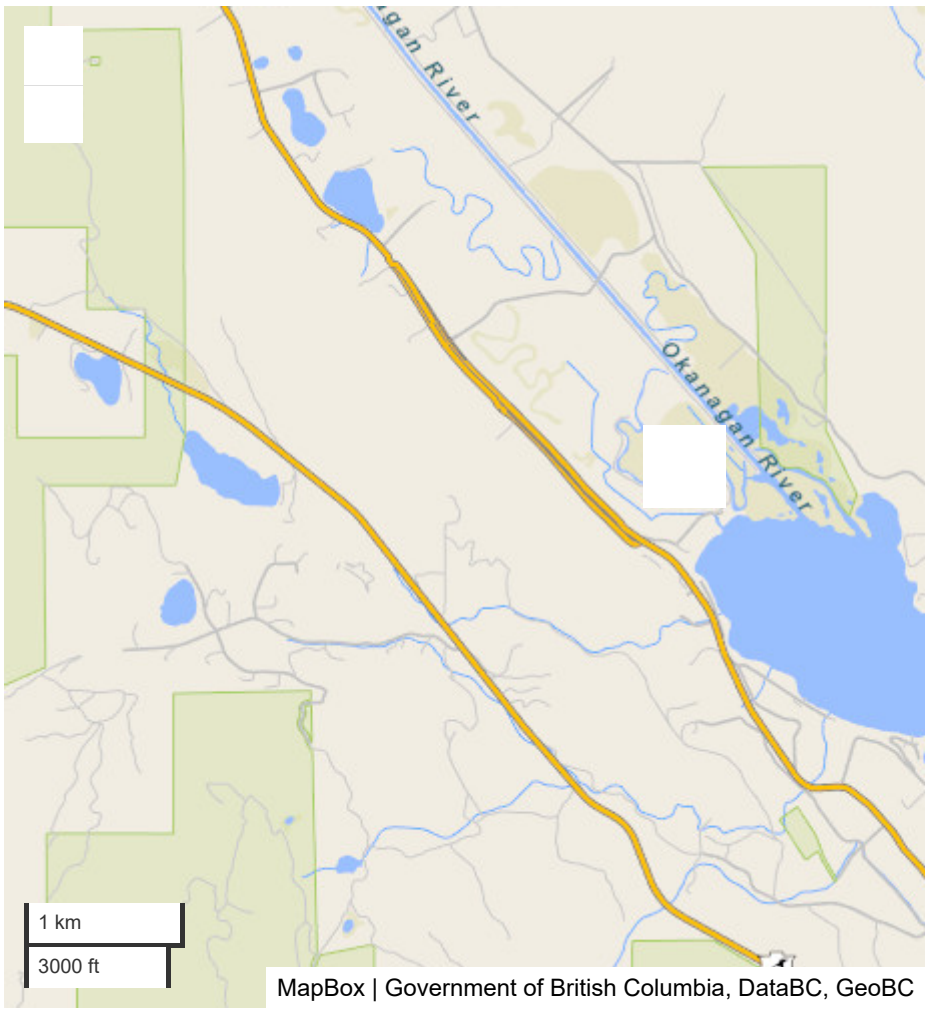
Location Information

Street Address: 204 AVENUE HIGHWAY 97
Town/City: OSOYOOS

Legal Description:

Lot	675
Plan	2066
District Lot	2450
Block	
Section	
Township	
Range	
Land District	54
Property Identification Description (PID)	002036967

Description of Well Location: WILLOW BEACH TRAILER PARK.



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 49.076488 **Longitude:** -119.529266
UTM Easting: 315295 **UTM Northing:** 5439040
Zone: 11 **Coordinate Acquisition Code:** unknown, accuracy based on parcel size) ICF cadastre, poor or no location sketch, arbitrarily located in center of parcel

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	2007-02-26	2007-02-28	Cyclone Drilling Ltd.	January 22nd 2008 at 2:43 AM

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
2007-02-26	2007-02-28				

Well Completion Data

Total Depth Drilled: 200.00 feet
Finished Well Depth: 66.00 feet
Final Casing Stick Up: 24.000 inches
Depth to Bedrock:
Ground elevation: 904.00

Static Water Level (BTOC): 3.00 feet
Estimated Well Yield: 80.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: GPS

Well Cap: WELDED STEEL
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	BROWN GREY.				Soft		
6.00	15.00	MEDIUM SAND & FINE SAND.			grey	Soft	WET.	5.0000
15.00	58.00	CLAY & SILT.			grey	Soft		
58.00	65.00	COARSE SAND & GRAVEL.			vari-coloured	Soft		20.0000
65.00	66.00	CLAY & FINE SAND.			grey	Soft		
66.00	67.00	GREY, BROWN COARSE SAND & GRAVEL.				Soft		20.0000
67.00	105.00	CLAY & SILT.			grey	Soft	SILTY WASH.	
105.00	200.00	CHUNKY CLAY STRINGERS WITH SILT.			grey	Soft		

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
-2.00	62.00		Steel	6.600	0.219	Installed

Surface Seal and Backfill Details

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

Intake Method: Screen
Type: Pipe size
Material: Stainless Steel
Opening: Continuous Slot
Bottom: Bail

Installed Screens

From	To	Diameter	Assembly Type	Slot Size
62.00 ft	66.00 ft	6.00	K_PACKER	60.00

Well Development

Developed by: Air lifting

Development Total Duration: 4.00 hours

Well Yield

Estimation Method: Air Lifting
Static Water Level Before Test: 8.00
Hydrofracturing Performed: No

Estimation Rate: 80.00
Drawdown:
Increase in Yield Due to Hydrofracturing:

Estimation Duration: 3.50

Well Decommission Information

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

Comments

PULLED BACK CASING TO MAKE BOTTOM AT 66' SCREEN IS 4' K-PACKER IS 2' OVERALL IS 6'6". WELL #2.

Alternative Specs Submitted: No

Documents

- WTN 91682_Well Construction.pdf

Disclaimer

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 91676
Well Identification Plate Number: 16999
Owner Name: GEORGIA LANE DEVELOPMENTS
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:

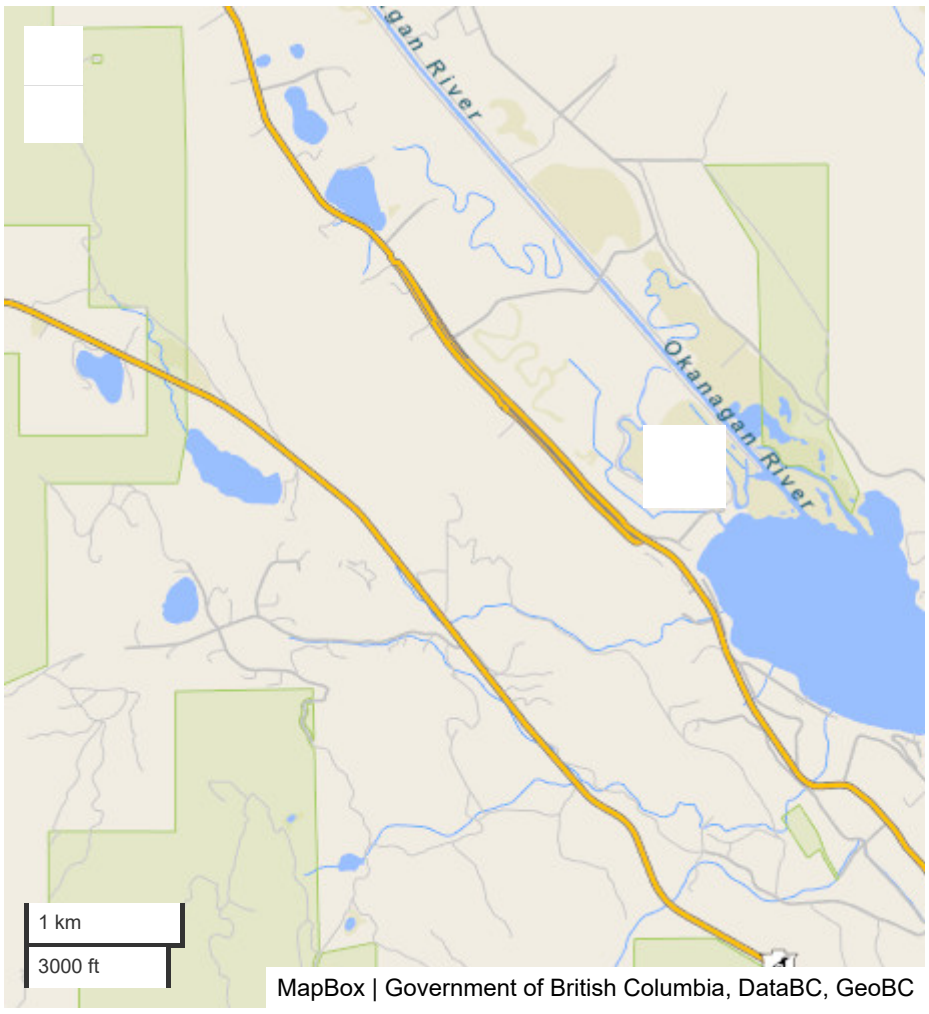
Location Information

Street Address: 204 AVENUE HIGHWAY 97
Town/City: OSOYOOS

Legal Description:

Lot	675
Plan	2066
District Lot	2450
Block	
Section	
Township	
Range	
Land District	54
Property Identification Description (PID)	002036967

Description of Well Location: WILLOW BEACH TRAILER PARK. LAND DISTRICT SIMILKAMEEN YALE.



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

Latitude: 49.076358
Longitude: -119.529451
UTM Easting: 315281
UTM Northing: 5439026
Zone: 11
Coordinate Acquisition Code: unknown, accuracy based on parcel size) ICF cadastre, poor or no location sketch, arbitrarily located in center of parcel

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	2007-02-21	2007-02-26	Cyclone Drilling Ltd.	January 22nd 2008 at 2:33 AM

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
2007-02-21	2007-02-26				

Well Completion Data

Total Depth Drilled: 280.00 feet
Finished Well Depth:
Final Casing Stick Up: 24.000 inches
Depth to Bedrock:
Ground elevation:
Static Water Level (BTOC):
Estimated Well Yield:
Artesian Flow:
Artesian Pressure:
Method of determining elevation: Unknown
Well Cap: UNKNOWN
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	17.00	BROWN, MULTI GRAVEL & COARSE SAND				Soft	SURFACE WATER.	5.0000
17.00	160.00	RUNNY CLAY.			grey	Soft		5.0000
160.00	180.00	SLIGHTLY HARDER CLAY.			grey	Soft		
180.00	190.00				grey	Soft		
190.00	280.00	HARDER DENSE CLAY.			grey	Soft	NO WATER.	

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
-2.00	280.00		Steel	6.600	0.219	Installed

Surface Seal and Backfill Details

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

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

Estimation Method:
Static Water Level Before Test:
Hydrofracturing Performed: No
Estimation Rate:
Drawdown:
Increase in Yield Due to Hydrofracturing:
Estimation Duration:

Well Decommission Information

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

Comments

WELL #1. WELL NOT COMPLETED AT THIS TIME. ALSO AT THIS TIME, WELL TO BE USED FOR MONITORING.

Alternative Specs Submitted: No

Documents

- WTN 91676_Well Construction.pdf

Disclaimer

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 16860
Well Identification Plate Number:
Owner Name: T LIPKOVITS
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:

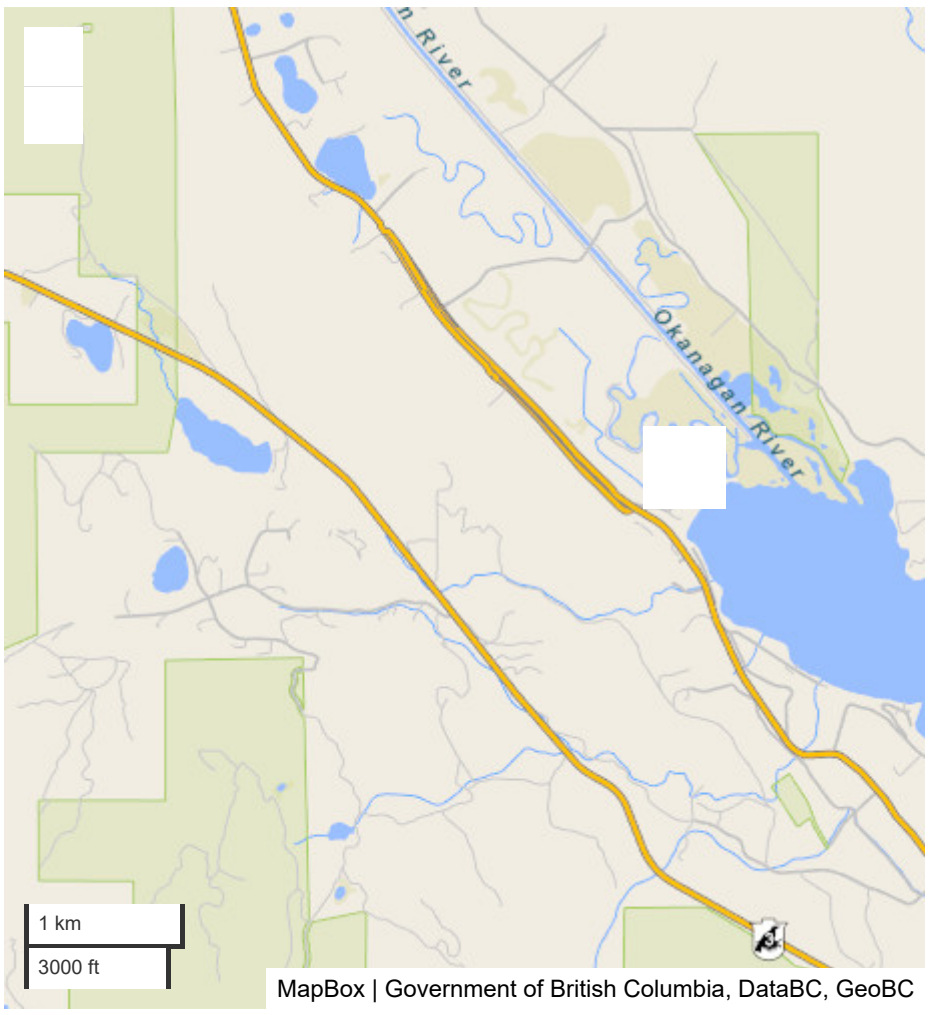
Location Information

Street Address: WILLOWBEACH TRAILER PARK
Town/City: SIMILKAMEEN

Legal Description:

Lot	
Plan	
District Lot	2450
Block	
Section	
Township	
Range	
Land District	54
Property Identification Description (PID)	

Description of Well Location:



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

Latitude: 49.074586 **Longitude:** -119.528649
UTM Easting: 315333 **UTM Northing:** 5438827
Zone: 11 **Coordinate Acquisition Code:** (20 m accuracy) Digitized from 1:5,000 mapping

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	1961-01-01	1961-01-01	Unknown	August 13th 2003 at 2:18 AM

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
1961-01-01	1961-01-01				

Well Completion Data

Total Depth Drilled:
Finished Well Depth: 10.00 feet
Final Casing Stick Up:
Depth to Bedrock:
Ground elevation:
Static Water Level (BTOC): 2.00 feet
Estimated Well Yield: 250.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: Unknown
Well Cap:
Well Disinfected Status: Not Disinfected
Drilling Method: Excavating
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	0.00	gravel						

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
There are no records to show						

Surface Seal and Backfill Details

Surface Seal Material:
Surface Seal Installation Method:
Surface Seal Thickness:
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

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

Estimation Method:
Static Water Level Before Test:
Hydrofracturing Performed: No
Estimation Rate:
Drawdown:
Increase in Yield Due to Hydrofracturing:
Estimation Duration:

Well Decommission Information

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

Comments

No comments submitted

Alternative Specs Submitted: No

Documents

- WTN 16860_Well Record.pdf

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 83816
Well Identification Plate Number: 10091
Owner Name: WILLOW BEACH MHP

Intended Water Use: Water Supply System

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

Aquifer Number: 254

Observation Well Number:
Observation Well Status:
Environmental Monitoring System (EMS) ID: E262241
Alternative specs submitted: No

Licensing Information

Licensed Status: Unlicensed

Licence Number:

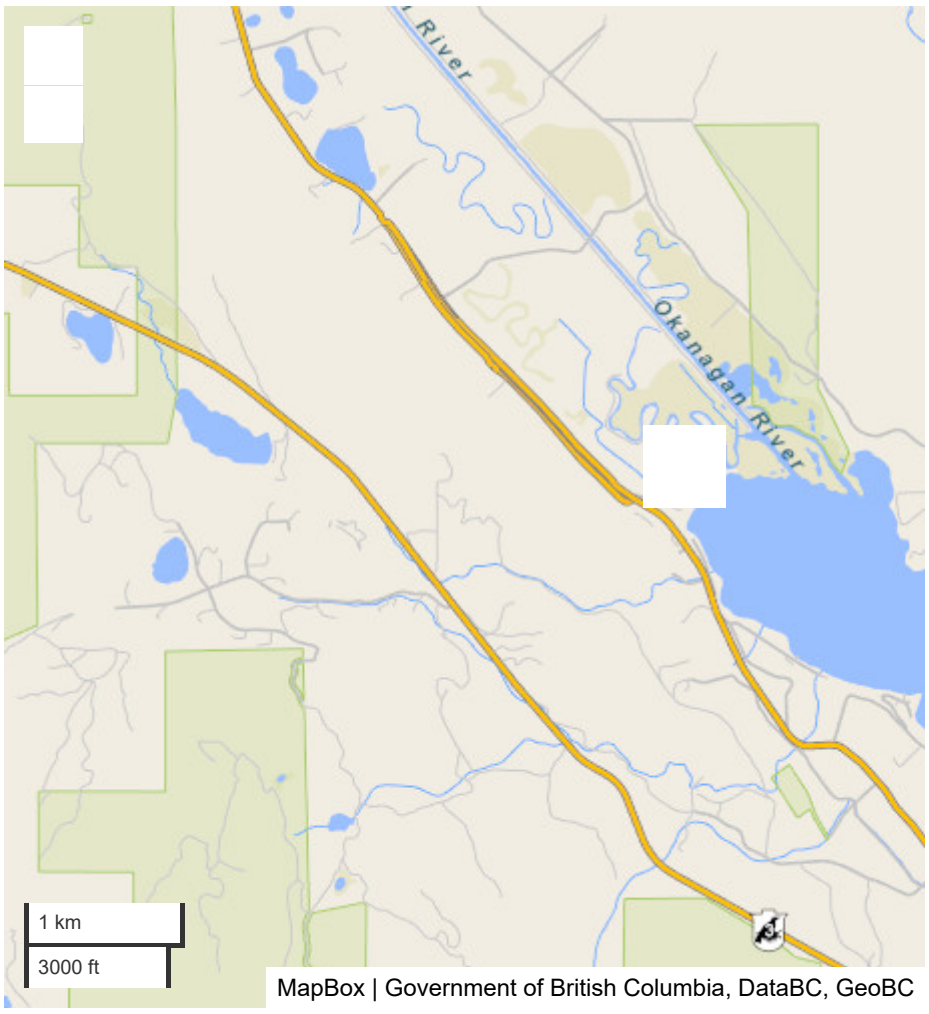
Location Information

Street Address: 95TH ST & LAKEHEAD CAMPSITE RD
Town/City: OSOYOOS

Legal Description:

Lot	
Plan	
District Lot	2450S
Block	
Section	
Township	
Range	
Land District	54
Property Identification Description (PID)	013695860

Description of Well Location:



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 49.074144 **Longitude:** -119.528668
UTM Easting: 315330 **UTM Northing:** 5438778
Zone: 11 **Coordinate Acquisition Code:** (10 m accuracy) ICF cadastre and good location sketch

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record				November 18th 2005 at 5:57 AM

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

Well Completion Data

Total Depth Drilled:
Finished Well Depth: 10.00 feet
Final Casing Stick Up:
Depth to Bedrock:
Ground elevation: 912.10

Static Water Level (BTOC):
Estimated Well Yield:
Artesian Flow:
Artesian Pressure:
Method of determining elevation: Unknown

Well Cap:
Well Disinfected Status: Not Disinfected
Drilling Method: Excavating
Orientation of Well: VERTICAL

Lithology

From (ft bgl)	To (ft bgl)	Raw Data	Description	Moisture	Colour	Hardness	Observations	Water Bearing Flow Estimate (USGPM)
There are no records to show								

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
There are no records to show						

Surface Seal and Backfill Details

Surface Seal Material:
Surface Seal Installation Method:
Surface Seal Thickness:
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

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

Estimation Method:
Static Water Level Before Test:
Hydrofracturing Performed: No

Estimation Rate:
Drawdown:
Increase in Yield Due to Hydrofracturing:

Estimation Duration:

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.

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 87678
Well Identification Plate Number: 22803
Owner Name: GEORGIA LAINE DEVELOPMENT
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:

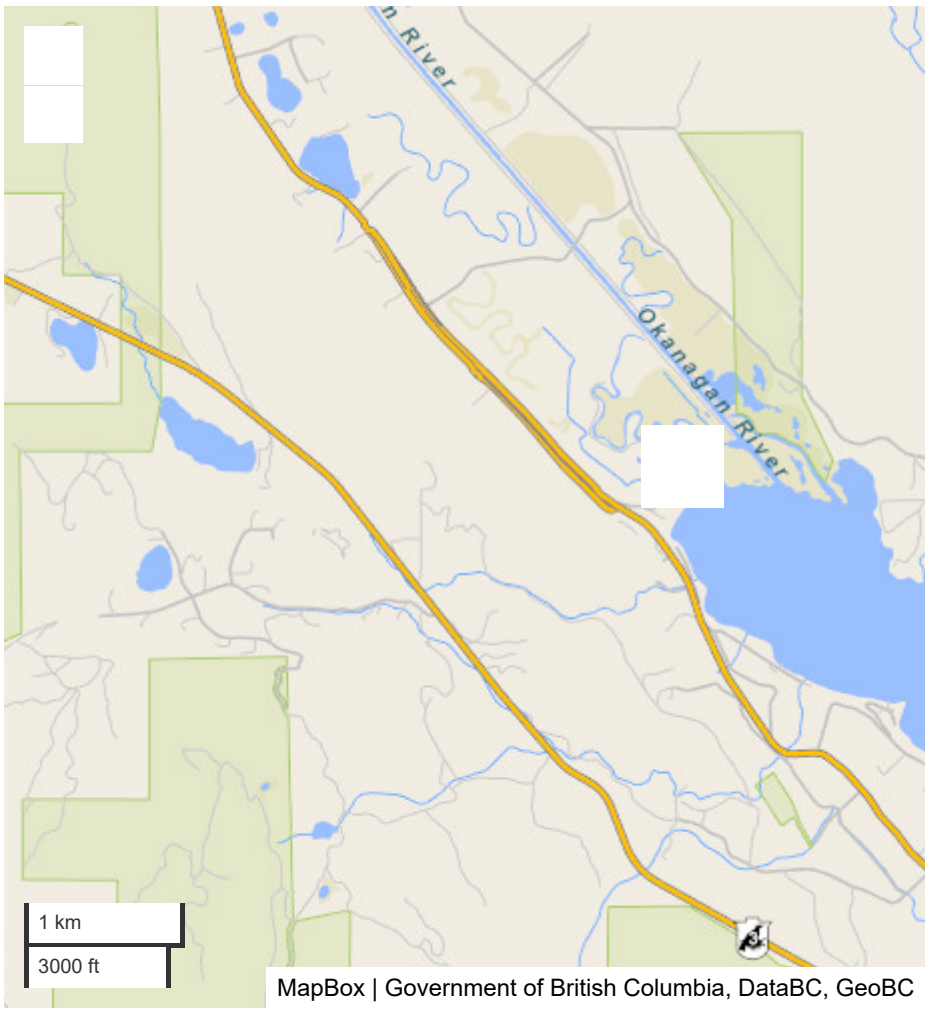
Location Information

Street Address:
Town/City:

Legal Description:

Lot	1
Plan	22229
District Lot	2450.S
Block	
Section	
Township	
Range	
Land District	54
Property Identification Description (PID)	002036738

Description of Well Location: NORTH OF TRAILER PARK & 8' WEST OF SHALLOW WELL



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

Latitude: 49.074564
Longitude: -119.527155
UTM Easting: 315442
UTM Northing: 5438821
Zone: 11
Coordinate Acquisition Code: unknown, accuracy based on parcel size) ICF cadastre, poor or no location sketch, arbitrarily located in center of parcel

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	2007-05-17	2007-05-20	J. R. Drilling	November 5th 2007 at 3:41 AM

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
2007-05-17	2007-05-20				

Well Completion Data

Total Depth Drilled: 604.00 feet
Finished Well Depth: 604.00 feet
Final Casing Stick Up: 14.000 inches
Depth to Bedrock: 578.00 feet
Ground elevation:
Static Water Level (BTOC):
Estimated Well Yield: 75.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: Unknown
Well Cap: VENTED
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	SAND & GRAVEL			black	Soft		
4.00	25.00				brown	Medium		
25.00	32.00	GRAVEL & COARSE SAND			brown	Medium		30.0000
32.00	578.00	SILTY CLAY			grey	Medium		
578.00	604.00				grey	Hard	50-75 GPM 600'-604'	

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
0.00	589.00		Steel	6.000	0.250	Installed

Surface Seal and Backfill Details

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

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: Air lifting
Development Total Duration:

Well Yield

Estimation Method: Air Lifting
Static Water Level Before Test: 0.00
Hydrofracturing Performed: No
Estimation Rate: 75.00
Drawdown:
Increase in Yield Due to Hydrofracturing:
Estimation Duration: 10.00

Well Decommission Information

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

Comments

WATER QUALITY & QUANTITY NOT GUARANTEED BY CONTRACTOR.

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.

Groundwater Wells and Aquifers

Well Summary

Well Tag Number: 19248
Well Identification Plate Number:
Owner Name: LAKE HEAD CAMP SITE
Intended Water Use: Irrigation

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:

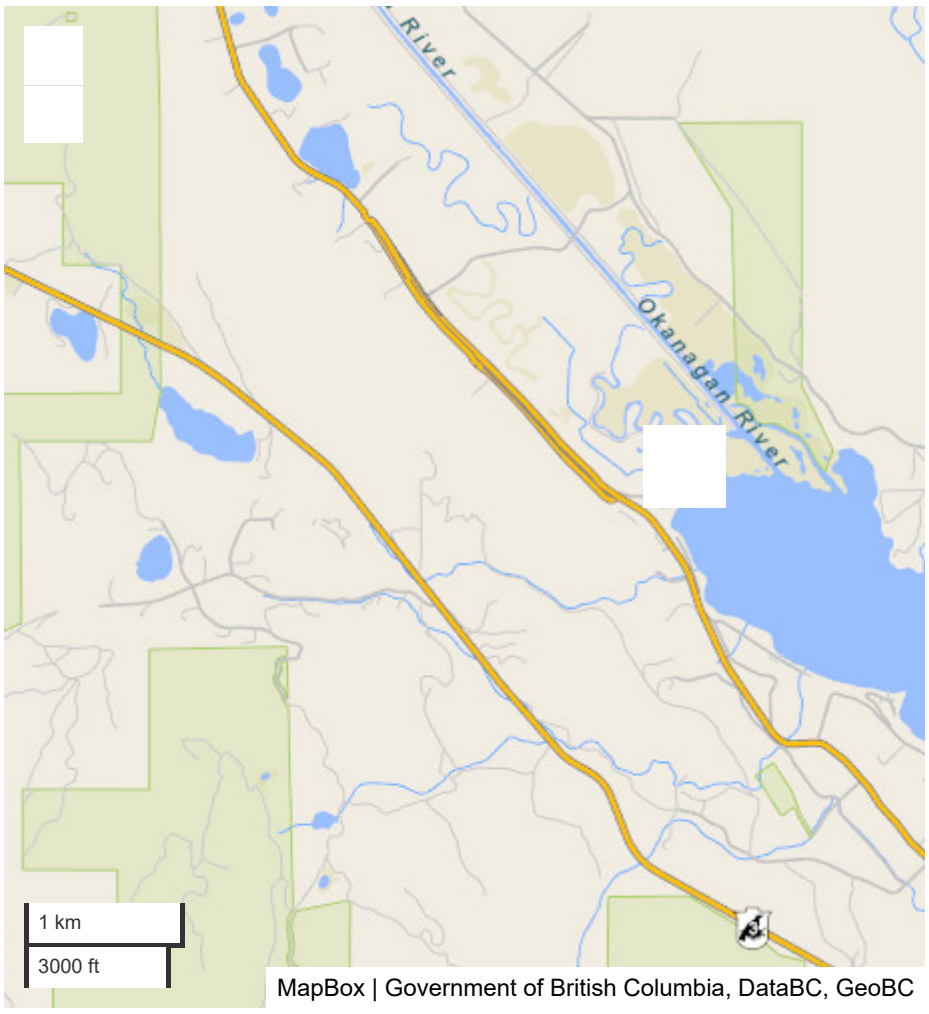
Location Information

Street Address: RR 1 OSOYOOS
Town/City: OSOYOOS

Legal Description:

Lot	
Plan	
District Lot	
Block	
Section	
Township	
Range	
Land District	54
Property Identification Description (PID)	

Description of Well Location:



Geographic Coordinates - North American Datum of 1983 (NAD 83)
Latitude: 49.074013 **Longitude:** -119.527264
UTM Easting: 315432 **UTM Northing:** 5438760
Zone: 11 **Coordinate Acquisition Code:** (20 m accuracy) Digitized from 1:5,000 mapping

Well Activity

Activity	Work Start Date	Work End Date	Drilling Company	Date Entered
Legacy record	1965-05-01	1965-05-01	Osoyoos Tile Works	August 13th 2003 at 2:18 AM

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
1965-05-01	1965-05-01				

Well Completion Data

Total Depth Drilled:
Finished Well Depth: 16.00 feet
Final Casing Stick Up:
Depth to Bedrock:
Ground elevation:
Static Water Level (BTOC): 4.00 feet
Estimated Well Yield: 0.000 USGPM
Artesian Flow:
Artesian Pressure:
Method of determining elevation: Unknown
Well Cap:
Well Disinfected Status: Not Disinfected
Drilling Method: Excavating
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	10.00	sharp sand						
10.00	16.00	silt						

Casing Details

From (ft)	To (ft)	Casing Type	Casing Material	Diameter	Wall Thickness	Drive Shoe
There are no records to show						

Surface Seal and Backfill Details

Surface Seal Material:
Surface Seal Installation Method:
Surface Seal Thickness:
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

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

Estimation Method:
Static Water Level Before Test:
Hydrofracturing Performed: No
Estimation Rate:
Drawdown:
Increase in Yield Due to Hydrofracturing:
Estimation Duration:

Well Decommission Information

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

Comments

No comments submitted

Alternative Specs Submitted: No

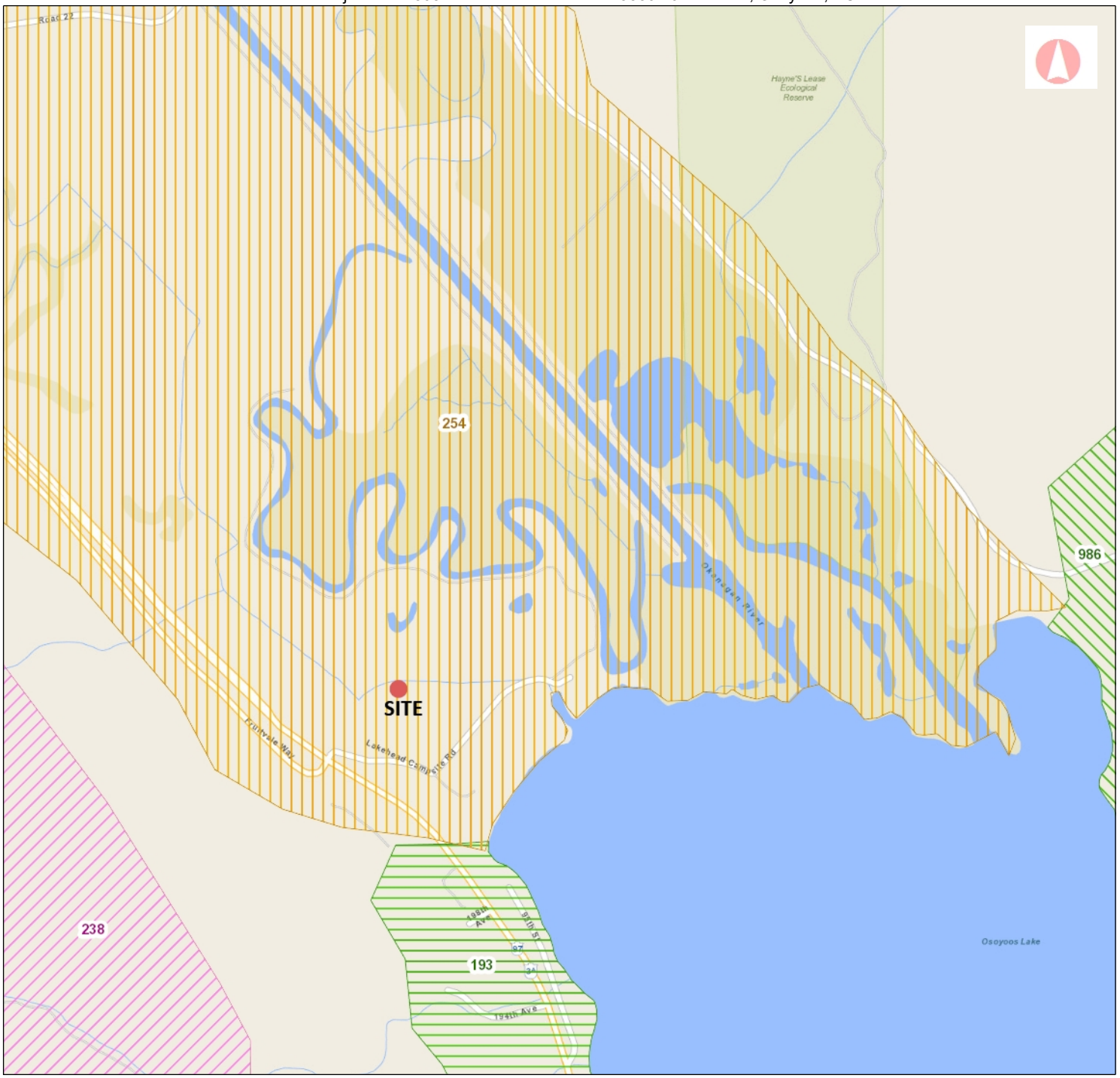
Documents

- WTN 19248_Well Record.pdf

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.

AE Project No. 2305 - Willow Beach Estates 9330 202 Avenue, Osoyoos, BC



BRITISH COLUMBIA

iMapBC Mapping

Legend

Aquifers - Subtype

SUBTYPE

- 1a. Unconfined sand and gravel
- 1b. Unconfined sand and gravel system
- 1c. Unconfined sand and gravel
- 2. Unconfined sand and gravel -
- 3. Unconfined sand and gravel -
- 4a. Unconfined sand and gravel
- 4b. Confined sand and gravel - ;
- 4c. Confined sand and gravel - (
- 5a. Fractured sedimentary rock
- 5b. Karstic limestone
- 6a. Flat-lying to gently-dipping v
- 6b. Fractured crystalline bedroc

0 0.37 0.73 km

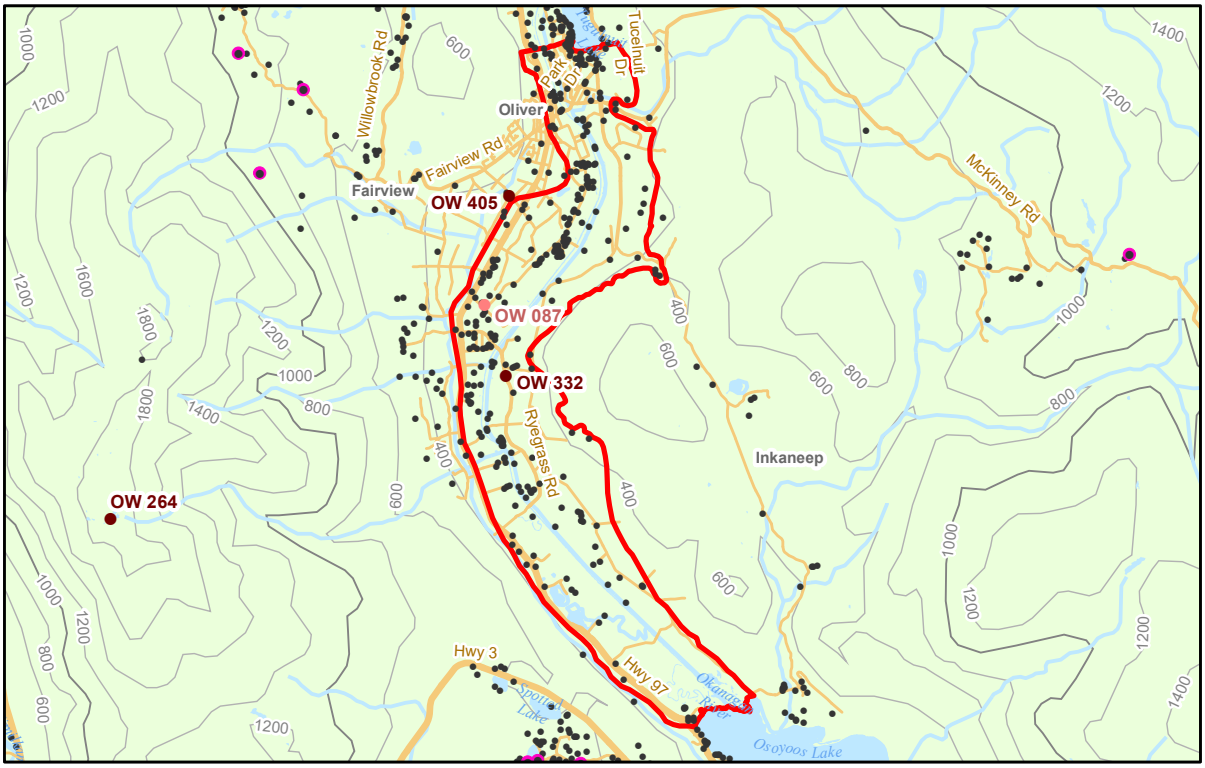
1: 18,056

Datum: NAD83

Projection: WGS_1984_Web_Mercator_Auxiliary_Sphere

Key Map of British Columbia

Aquifer #254



Legend

- Registered Water Well - Artesian
- Registered Water Well
- Active Observation Well
- Inactive Observation Well
- Aquifer Boundary

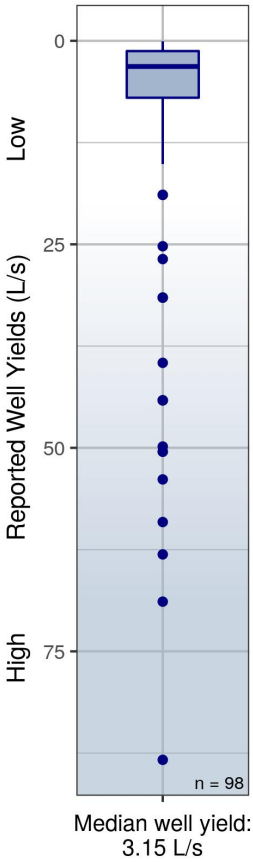
0 1.5 3 km

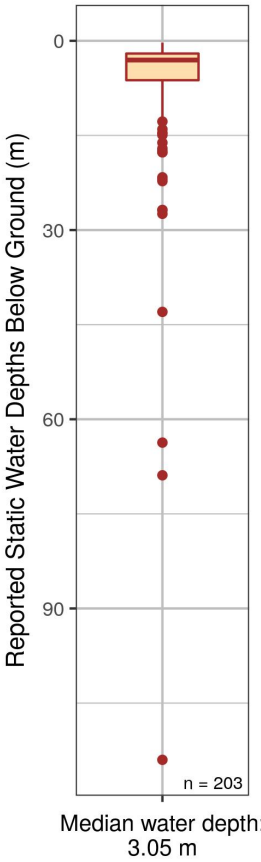
N

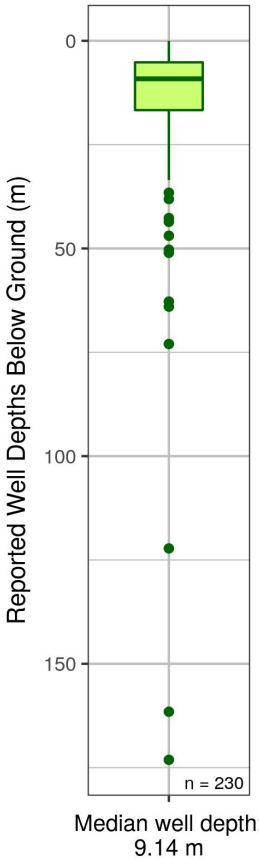
Aquifer Description (Mapping Report - 2016): Predominantly unconfined fluvial or glacio-fluvial sand and gravel Aquifers found along major rivers of higher stream order with the potential to be hydraulically influenced by the river (subtype = 1a).

Aquifer Details	
Region	Thompson-Okanagan
Water District	Penticton
Aquifer Area	29.4 km^2
No. Wells Correlated to Aquifer	231
Vulnerability to Contamination	High
Productivity	High
Aquifer Classification	IIA
Hydraulic Connectivity[1]	Likely
Aquifer Stress Index	More stressed (high certainty)
No. Water Licences Issued to Wells	7
Observation Wells (**Active**, Inactive)	**332**, 87

[1] Based on broad regional assessment





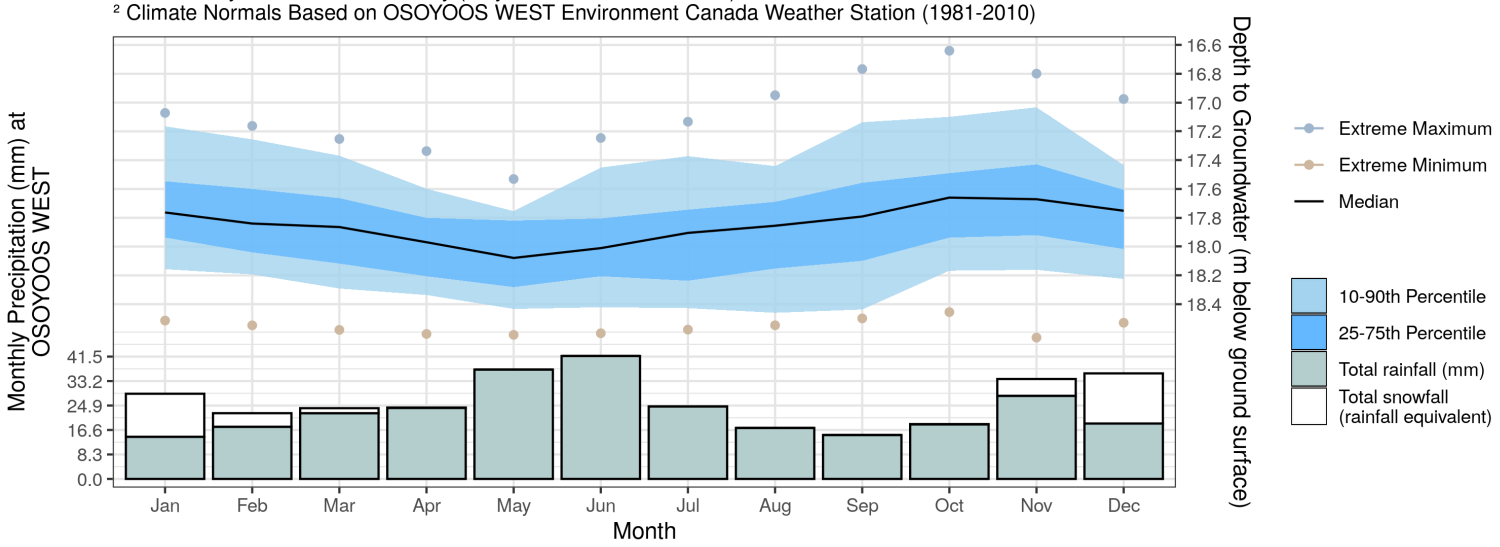


Detailed methods for all figures are described in the companion document (Aquifer Factsheet - Companion Document.pdf).

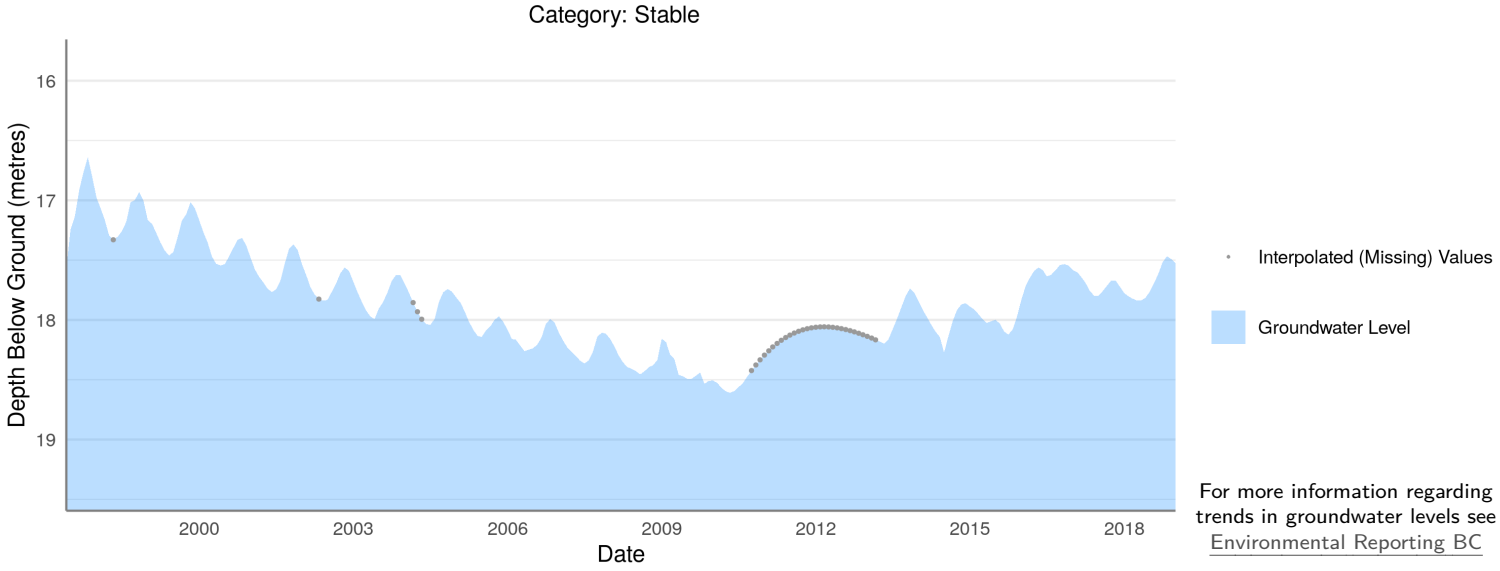
Factsheet generated: 2020-08-06. Aquifers online: https://apps.nrs.gov.bc.ca/gwells/aquifers.

Monthly Groundwater Level[1] with Precipitation from Climate Normals[2]

[1] Full Monthly Water Level Summary (23 years of data; 1997-2020)
[2] Climate Normals Based on OSOYOOS WEST Environment Canada Weather Station (1981-2010)

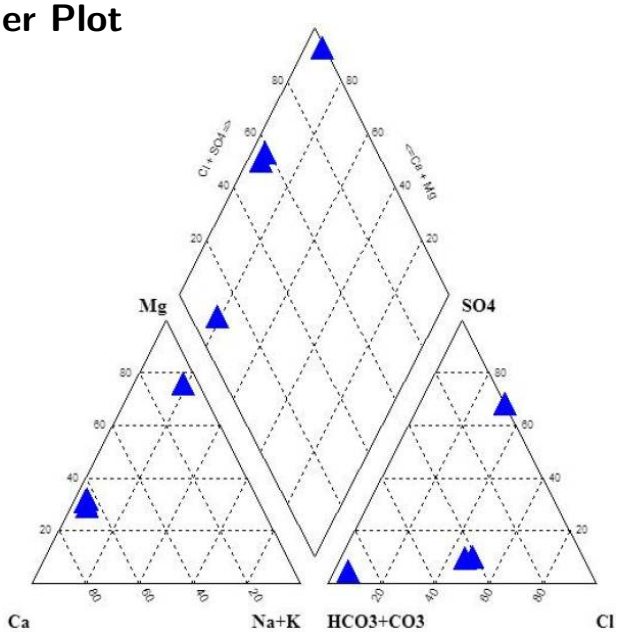


Groundwater Levels and Long-term Trend



For more information regarding trends in groundwater levels see Environmental Reporting BC

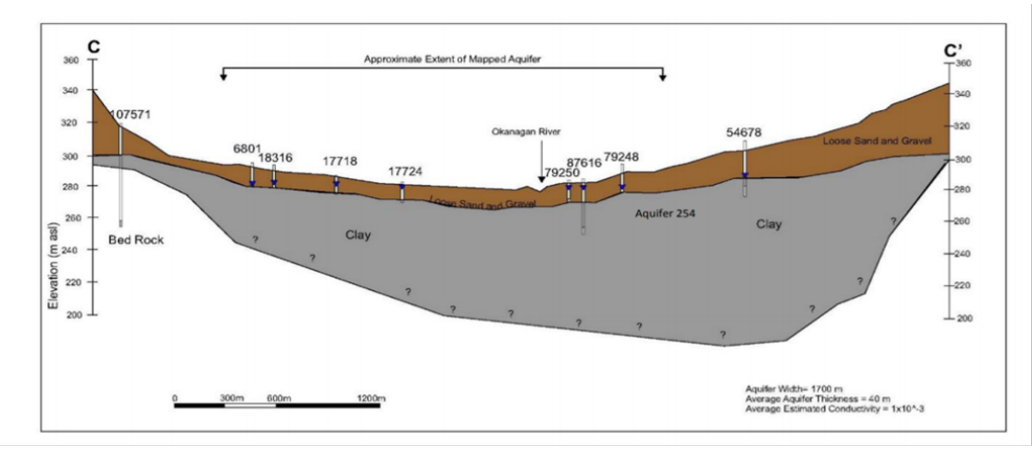
Piper Plot



The groundwater samples are typically of the Ca-Mg-HCO3 & Ca-Mg-Cl-HCO3 type. Ca & Mg are the dominant cations, which indicate a less evolved/short flow path recharge area type of groundwater. The fact that HCO3 is the dominant anion shows the source is primarily recent precipitation in the shallow (IA) Predominantly unconfined fluvial or glacio-fluvial sand and gravel aquifer #254. Cl enrichment could be attributed to anthropogenic activities such application of chemical fertilizers and/or sewage effluents in the area. For EMS water chemistry data, EMSID E232063.

Supplementary Info #1

Water Budget



Aquifer 254 is thought to be the southern continuation of Aquifer 255 and extends south from Tuc-El-Nuit Lake to Osoyoos Lake. The mostly unconfined aquifer is composed of Okanagan River floodplain deposits, and in places, glacio-fluvial deposits and is thought to be connected to adjacent Aquifer 256. Aquifer 254 is believed to have the main characteristics:

- Also a highly productive aquifer supporting a number of municipal wells;
- Located within historically agricultural and urban areas; and
- Likely the second most heavily used aquifer in the study area (Aquifer 254, 255, 256).

Reference: Geller, D. and B. Manwell. 2016. Monthly Water Budgets for Aquifers in the Oliver, B.C. Area (Aquifers 254, 255 and 256). Water Science Series, WSS2016-07. Prov. B.C., Victoria B.C.

AQUIFER CLASSIFICATION WORKSHEET

DATE: 16/07/1996 – Rev. 28/04/2016 (Lowen Hydrogeology Consulting Ltd.)

AQUIFER REFERENCE NUMBER: 0254

DESCRIPTIVE LOCATION OF AQUIFER: Osoyoos Lake to Tugulnuit Lake

NTS MAP SHEET: 82 E 04

BCGS MAP SHEETS: 82E.013.1 / 82E.013.3

CLASSIFICATION: II A **RANKING:** 17

Aquifer Size: 29 km^2

Aquifer Boundaries: The aquifer boundaries follow the quaternary deposits located in the Okanagan River floodplain.

Aquifer Sub-type: 1a
Type – Predominantly unconfined fluvial or glacio-fluvial sand and gravel aquifers found along river or stream valley bottoms.
Subtype – Aquifers found along major rivers of higher stream order with the potential to be hydraulically influenced by the river.

Aquifer Priority Rating for Observation Wells: 64.0

Geologic Formation (overlying materials): Only the western edge of the aquifer is overlain by the toe of the alluvial fans constituting the aquifer 0256. For the greatest part of the aquifer, the sand and gravels are exposed at surface.

Geologic Formation (aquifer): The aquifer encompasses shallow fluvial deposits and deeper glaciofluvial materials. Both of these units are grouped under one aquifer. Livingston (1983) has suggested that high yield wells south of Tugulnuit Lake are constructed within a local aquifer, described as a “torrential gravel aquifer”. The aquifer materials consist mainly of coarse sand and gravel, to silty sand and gravel at depth.

Unconfined: Only 51 wells of 160 displaying a log show a confining layer of silt, till or clay at surface. The maximum confining thickness is 268 ft (81.7 m), the median is 6 ft (1.8 m), the average 0 ft and the geometric mean is 0 ft.

Vulnerability: High. The aquifer material exposed at surface is described as sand and gravel and the water table is shallow.

Productivity: High. Yields are highly variable and range from 1 to 1400 USgpm (0.063 to 88.33 L/s), with an average of 187 USgpm (11.80 L/s), a geometric mean of 57 USgpm (3.60 L/s) and a median of 50 USgpm (3.15 L/s). SOLID production wells south of Oliver are reported with transmissivity values of 1.0×10^6 USgpd/ft. Higher producing wells appear to be associated with an old meandering Okanagan river channel.

Depth to Water: Shallow. Minimum and maximum depths to water are 1 and 374 ft (0.3 and 114.0 m), the median is 10 ft (3.0 m), the average 21 ft (6.4 m) and the geometric mean 12 ft (3.7 m).

Direction of Groundwater Flow: The general groundwater flow likely follows the course of the Okanagan River, flowing to the south towards Osoyoos Lake. The floodplain is commonly nearly flat, resulting in probable low water table gradient. A strong river water level influence close to the river is expected.

Recharge: The aquifer is replenished by direct precipitation and likely runoff water from the uplands located east and west of the aquifer.

Domestic Well Density: Moderate (approximately 8 wells / km^2).

Type of Water Use: Multiple uses. The aquifer is mostly used for domestic purposes, however, some wells are reportedly used for commercial purposes. High capacity production wells were constructed for the SOLID water system (south of Oliver).

Reliance on Source: Conjunctive. Groundwater supplies the majority of domestic needs. The sand and gravel aquifer 0256 overlapping the western part of the aquifer may be used as an alternate source of water. Also, one water licence is reported diverting water from the Okanagan River.

Conflicts between Users: None reported

Quantity Concerns: One well (Tag #18901) reported low quantity of groundwater and was filled in.

Quality Concerns: Reported elevated nitrates in and around Oliver are likely associated with the intense agricultural activity in the area. Major land-use in the area is agricultural and small scale farming. There are also occasional reports of elevated iron, hardness and sulphur in groundwater.

Comments: The well depths range from 8 ft (2.4 m) to 568 ft (173.1 m). The median depth is 30 ft (9.1 m), the average 47 ft (14.3 m) and the geometric mean 31 ft (9.4 m).

References:

- Berardinucci J. and K. Ronneseth, 2002. *Guide to Using the BC Aquifer Classification Maps for the Protection and Management of Groundwater*. BC Ministry of Water, Land and Air Protection, Water Air and Climate Change Branch, Water Protection Section.
- IMapBC: http://maps.gov.bc.ca/ess/sv/imapbc/
- Hodge, W.S., 1992. Water Quality (Nitrate) Reconnaissance Study. Oliver, B.C. Groundwater Section, Water Management Division.
- Livingston, Ed., 1983. Test Drilling and Construction and Testing of 200 mm Diameter Production Well For Osoyoos Indian Band. Prepared for David Nairne and Associates Ltd. by Pacific Hydrology Consultants Ltd.
- Nasmith, H., 1962. Late Glacial History and Surficial Deposits of the Okanagan Valley, British Columbia. Bulletin No. 46. Department of Mines and Petroleum Resources.
- Wei, M., 1985. S.O.L.I.D. System Study. Unpublished memorandum. Ministry of Environment, Water Management Branch.

AQUIFER CLASSIFICATION AND RANKING

AQUIFER LOCATION: Osoyoos Lake to Tugulnuit Lake

AQUIFER REFERENCE NUMBER: 0254

AQUIFER SUB-TYPE: 1a

AQUIFER PRIORITY RATING FOR OBSERVATION WELLS: 64.0

CLASSIFICATION: II A **RANKING VALUE:** 17

***Classification Component*:**

Level of Development	II (Moderate demand / high productivity)
Level of Vulnerability	A (High)

Ranking Component:

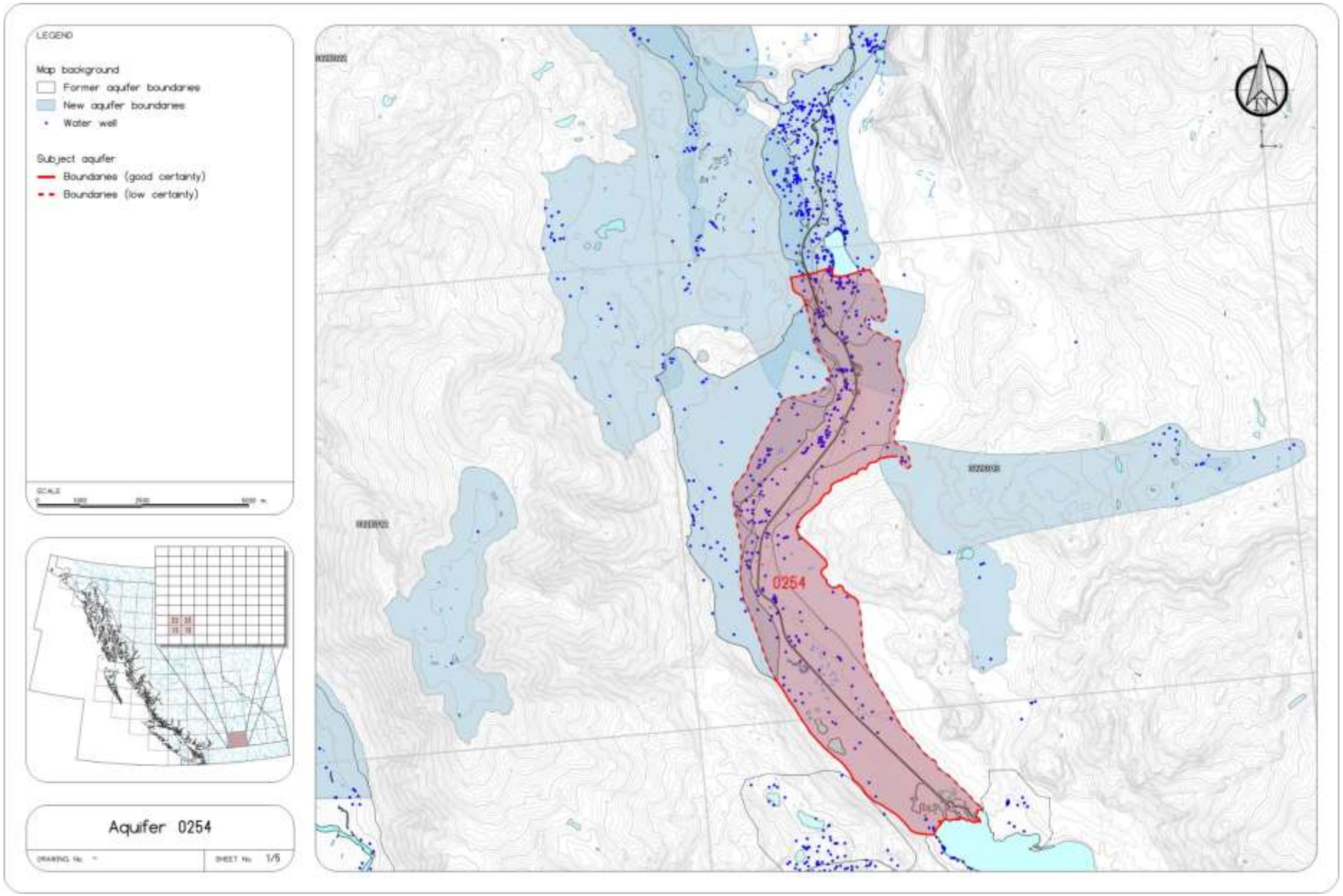
Productivity	3
Vulnerability	3
Size	3
Demand	2
Type of Use	3
Quality Concerns	2
Quantity Concerns	1
Total	**17**

Statistical Summary of Well Data for Aquifer # 0254

Total number of wells available for statistical analysis: **226**

	Well Depth [ft] ([m])	Water Depth [ft] ([m])	Bedrock Depth [ft] ([m])	Yield [USgpm] ([L/s])	Confining Thickness [ft] ([m])
N	225	199	1	99	160
Minimum	8 (2.4)	1 (0.3)	565 (172.2)	1 (0.063)	0
Maximum	568 (173.1)	374 (114.0)	565 (172.2)	1400 (88.33)	268 (81.7)
Median	30 (9.1)	10 (3.0)	-	50 (3.15)	0
Arithmetic mean	47 (14.3)	21 (6.4)	-	187 (11.80)	6 (1.8)
Geometric mean	31 (9.4)	12 (3.7)	-	57 (3.60)	0 m).

Note: The “zero” values were replaced by “0.1” to allow the calculation of the geometric mean.


LEGEND
Map background
Former aquifer boundaries
New aquifer boundaries
Water well
Subject aquifer
Boundaries (good certainty)
Boundaries (low certainty)
SCALE
0254
Aquifer 0254
DRAWING No.
SHEET No. 1/5

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APPENDIX C

Cut and Fill Calculations

Project Number: 2422-03074-00
Date: 8/11/2020
Created by: Karm Poonian
Reviewed by: Raymond Sull
Project: Willow Beach Development
Address: 9330 202 Ave, Osoyoos

Flood level construction **280.7** m

All home elevations to be above flood level. The bottom of the floor joist must be at the flood level
Assumed crawl space can be under the flood level

crawl space **1.22** m 4 ft

driveway slope	**6%**
min driveway slope	**1%**
Building Pad slope	**0%**
rear yard slope	**3%**

front yard setback	**7.5**	m
rear yard setback	**7.5**	m

0.45 m

minimum road profile	**279.03**	m
minimum road profile	**279.45**	m
Governing Min road elevation	**279.45**	m

required to ensure bottom of joist are above flood level
Brad Elenko recommendation
based on centerline top of asphalt elevations

minimum front ridgeline	**279.94**	m
minimum front ridgeline	**279.48**	m
Governing Min Front ridgeline	**279.94**	m

required to ensure we have minimum slope driveway
required to ensure bottom of joist are above flood level

Cut/Fill Calcs	
	m3
Cut	2,470
Fill	57,400
Net Fill	**54,930**

Total lot plan area	57,500	m2
Fill Depth Req.	**0.96**	m

Notes:
1) Did not consider any removal of topsoil
2) Values are based on all roadways and lot grading and **compare top of asphalt surface to existing ground**
3) Extent of cut/fill volume include all lots 1-74 and the fronting roadways
4) Based on planning Sketch 16 Rev 1 dated 2020-06-09
5) Used above mentioned assumption when grading the lots and roadway

General Comments:
1) We are requiring a lot of fill to ensure we are above the flood level
2) To decrease the amount of fill required we can increase the crawl space depth to match existing ground more closely
3) To decrease the amount of fill required we can reduce the driveway slopes as much as possible