Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

Hydrogeological Investigation and Terrain Analysis Proposed 1919 Estates - Formerly Anderson Subdivision

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1.0 INTRODUCTION

Jp2g Consultants Inc. (Jp2g) was retained by the Greer Galloway Group to undertake a hydrogeological investigation and terrain analysis for the proposed Anderson Subdivision. Jp2g Consultants Inc. provided advice regarding the project while the balance of activities was coordinated and carried out by the Greer Galloway Group Inc.

The study property is located at 168 County Road 49 at Part Lots 18 & 19, Concession 19. Geographic Township of Harvey, now in the Municipality of Trent Lakes.

The subdivision proposal consists of a revised concept plan of twenty-two (22) rural residential estate lots and two additional lots proposed for stormwater. Each lot will be between 1.1 and 3.86 acres in area and will have frontage on and be accessed by one of two streets which will be constructed on the west and east halves of the subdivision lands respectively. The street to be constructed on the west half of the property will connect to County Road 49 and will provide access to lots 1 to 11. The street to be constructed on the east half of the property will connect to Moon Line North and will provide access to lots 12 to 24. The site is location is provided in Figure 1 and the location of the residential area and road layout are shown on **Figure 1.** The site and surrounding area are outlined in **Map 1** taken from the Environmental Impact Assessment[1]. Residential dwellings, wells and septic systems will be constructed on each of the lots. The retained lands (north of proposed development property) will currently remain as fields, vacant woodlands, and wetland. The property to north is currently vacant.

The subject lands (entire property) are approximately 48 hectares (119 acres) in land area and are located to the east of County Road 49 and to the west of Moon Line North, within part of Lots 18 & 19, Concession 19 in the Geographic Township of Harvey, now in the Municipality of Trent Lakes. The subject lands are designated as Hamlet on Schedule A-1 to the Official Plan of the Township of Galway-Cavendish and Harvey and are zoned Development (D) on Schedule "A" Map 5 to the Municipality of Trent Lakes By-law No. B2014-070.

The site location is provided in **Figure 1**. The proposed development consists of 22 residential lots that are to be serviced by individual wells and septic systems. The total area of the proposed development is approximately 21.1 hectares that includes the residential and stormwater lots, the wetland that bisects the property, and proposed road allowances. Proposed lot sizes are provided in **Table 1** and proposed lot layouts are provided on **Figures 2** and **3.**

1: *Environmental Impact Assessment, Jp2g Consultants Inc. June 2018*

Table 1: Proposed Lot Sizes

Proposed Lot East Side	Area hectares	Proposed Lot West Side	Area hectares
12	1.56	**1 (Storm water)**	0.46
13	1.02	**2**	0.46
14	0.60	**3**	0.46
15	0.59	**4**	0.46
16	0.58	**5**	0.46
17	0.58	**6**	0.67
18	0.58	**7**	0.45
19	0.54	**8**	0.45
20	0.56	**9**	0.45
21	0.56	**10**	0.45
22	0.57	**11**	0.45
23	0.53		
24 (storm water)	0.55		
Total Residential Lot Area	**8.27**	**Total Residential Lot Area**	**4.76**
Total Storm Water	**0.55**	**Total Storm Water**	**0.46**
Average Residential Lot Size	**0.60**		
Wetland and Road	**7.06**		
Total Area	**21.1**		

1.1 Objectives and Activities

The objective of the study is to assess the water supply and septic system suitability for the proposed development based on private services. This report was prepared following the Ministry's (MOE, MOEE, MOECC, MECP) Hydrogeological Technical Information Requirements for Land Development Applications[2]. The following work activities were completed:

- Desktop review of published geology maps
- Review of surrounding land uses
- Water well record review of nearby residence
- Drilling and testing of four (4) on-site test wells
- Completion of a terrain analysis (Geotechnical Report)[3]

2: Procedure D-5-4; Technical Guideline For Individual On-Site Sewage Systems; Water Quality Risk Assessment, and Procedure D-5-5; Technical Guideline For Private Wells; Water Supply Assessment.
3: Geotechnical Report for Anderson Subdivision, Bobcaygeon Project No. 17-1-6801, Terraspec Engineering Inc. December 2017.

2.0 SITE BACKGROUND INFORMATION

The study site is located approximately 2.5 Kilometres north of the centre of the Town of Bobcaygeon. The site is bordered on the south by an existing residential development (Ellwood Cres.) on the east by strip residential development along Moon Line North, and on the west by County Road 49. The property immediately to the north is vacant land. The study property is currently vacant woodlands, fields and wetlands.

Water well records from nearby wells suggest that most wells are completed in the underlying limestone aquifer. Recommended pumping rates vary between 9 and 45 Lpm (2 and 10 gpm).

Typical conditions that may be added to the subdivision agreement are provided in **Section 9.0** of this report.

3.0 PHYSICAL SETTING

The study site includes approximately 21.1 hectares (including wetland and road) with a lot development area of 13.0 hectares of land. The site is located approximately 2.5 kilometres north of the Bobcaygeon between Moon Line North and County Road 49. The property is characterized by moderately sloping topography falling from County Road 49 east to Moon Line Road.

3.1 Physiography

The western half of the study site is comprised of slightly rolling topography that has been used for agricultural purposes. Running in a northeast to southwest direction is a wetland that bisects the property (**Map 1** EIS). East of this, the property is again rolling and falls slightly to the east.

3.2 Geology

Information on the geology is taken from published geological mapping, the geotechnical report and from nearby water well records. Water well records and Terraspec engineering suggest that the underlying bedrock is comprised primarily of limestone of the Trenton Group. Furthermore, well records indicate that Dolomitic bedrock is present at the far east and western extents of the site.

Soil physiography for the site is defined as till moraines with limestone exposed at the northeast corner of the site. The predominant soil type is gravelly loam till. The soil group is Brown Forest. The geotechnical report confirms silty topsoil overlying silty sand with some gravel and silty sand and gravel. The topsoil at the site varies in thickness of up to 300 mm while the silty sand layer was typically 600mm in thickness. A cross-section of the upper 3 metres is provided in the Geotechnical Report, provided as **Appendix A**.

3.3 Hydrogeology

The hydrogeologic information is taken from test well information and from water well records of nearby wells. Water well records from the 4 on-site test wells are provided in **Appendix B**. The well records in the vicinity of the site confirm the shallow nature of overburden materials and the

varying depth of wells (varying between 6 and 24m) and the anticipated well yields (9 and 45 Lpm). All wells report the provision of a fresh water supply where indicated.

4.0 TERRAIN SUITABILITY FOR SEPTIC SYSTEMS

The suitability of the terrain for the construction of individual septic systems has been examined and a groundwater impact assessment study using a nitrate dilution model to obtain an indication as to the potential impact of septic effluent on the properties adjoining the proposed subdivision has been completed. The net potential infiltration was based on the regional climatic data for the North Peterborough area (Trent University) provided by Canadian Climate Normals. A daily effluent loading of 1,000 litres per day per septic system was assumed. The nitrate dilution calculation is provided and is based on the assumptions provided in **Appendix C.**

With regard to treatment and dispersal of effluent from the leaching beds, a maximum septic system density of about one system per 0.76 hectares (1.88 acres) of land area was determined to be feasible. The septic system density was calculated by assuming 1000L/day sewage disposal containing 40 mg/L nitrate. Infiltration of meteoric water was assumed to dilute the septic effluent. The proposed overall septic density for the full development is about one system per 0.76 hectares (28 lots), therefore, it is concluded that the impact of the proposed development (i.e., 22 lots) on groundwater at the downgradient property boundary is considered acceptable in accordance with Ministry Guideline D-5-4. Nitrate concentrations at the property boundary were calculated to be 7.3mg/L, sufficiently below the maximum allowable concentration of 10.0mg/L. The results of this assessment are presented in in **Appendix C**.

Figure 3 is a preliminary development plan that shows typical well and septic system locations. Based on the soil conditions, partially raised septic systems could be required. Septic design should be assessed on a lot-by-lot basis and construction should be in conformance with regulatory design criteria. Homeowners are not restricted to the use of Class IV conventional septic systems. Alternative systems may be allowed if they are confirmed acceptable by the local building authorities.

5.0 SURFACE WATER IMPACT

Nearby and on-site surface water includes a wetland feature that transects the property. The wetland is approximately 4.9 hectares in size. Appropriate wetland setbacks (30 metres) have been recommended for implementation to ensure that negative surface water impacts are minimized.

The lot sizes are sufficient such that the required separation distances of 18m between a watercourse and the nearest distribution pipes as required in Table 8.2.1.6.B of the Ontario Building Code are met.

6.0 PHOSPHOROUS IMPACT

As stated in Procedure D-5-4, Section 5.3(d) where applicable, the impact of the on-site discharge of sewage effluent into surface water must be evaluated and must address phosphorous and other parameters of concern. There is one (1) significant waterbody on or near the site (the 4.9 ha

wetland feature that transects the site) and three (3) smaller surface water features in the western section of the site located on Lots 7, 10 and 11, and 1 and 2. Phosphorous is the key or limiting nutrient that governs the production of algae, typically when phosphorous levels exceed 20 micrograms per litre (µg/L).

As shown on the **"**Preliminary Development Plan", **Figure 3**, there is a 30 metre water setback required from the edge of the four lots that border the wetland. Moreover, the smaller surface water features in the western portion of the site are subject to minimum 15 metre buffers. This includes all building and structures, including septeic systems. The land area within this water setback will be maintained substantially as a natural vegetated buffer. This water setback and buffer area requiments will be more than adequate to protect surface water impact.

7.0 GROUNDWATER SUPPLY

This section describes the quantity and quality of the groundwater at the proposed subdivision. Descriptions of the aquifer test specifications are provided in **Table 2**. The method of analysis and results are presented. Assessments of the well yields and interference are provided along with recommendations regarding well construction.

7.1 Groundwater Quantity

7.1.1 Test Well Construction

Haliburton Artesian Well Drillers constructed four (4) test wells at the site. The wells were constructed in May 2017. The test wells are located on proposed lots as shown in **Figure 3.** The test wells are located to provide adequate spatial distribution across the site to evaluate water quality as well as water quantity and interference effects. Water well records are provided in **Appendix B**.

All wells were drilled into the underlying limestone/dolomite bedrock to the following approximate depths.

Test Well west side(A104945) Lot 5	30m
Test Well east side (A104944) Lot 20	30m
Test Well east side (A104943) Lot 13	55m
Test Well west side (A104942) Lot 9	43m

All test wells were cased and sealed a minimum of 6.09m into the underlying bedrock.

7.1.2 Recommended Well Construction Procedures

The following are recommended well construction procedures for future wells to be completed at the site:

- Minimum requirements for all wells are to meet current local by law and/or Ministry of the Environment, Conservation and Parks well construction standards of Ontario Regulation 903 as amended.
- All grouting methods at a minimum should comply with the Ministry of the Environment, Conservation and Parks.

- Once the casing has been sealed into the bedrock, the well should be advanced in the bedrock until the sufficient water-bearing zones are encountered.
- The completed well should be developed to maximize the yield
- The well casing should be finished 40 cm above grade and surface grading should direct surface water away from the wellhead.

7.1.3 Pumping Test Results

Constant discharge aquifer tests were completed on all four wells. Each aquifer test was followed by a recovery test. **Table 2** outlines the pumping test specifications.

Table 2: Pumping Test Specifications

Details	Lot 5 west A104945	Lot 20 east A104944	Lot 13 east A104943	Lot 9 west A104942
Pumping Rate (Lpm)	13.6	13.6	13.6	13.6
Litres pumping	4,896	4,896	4,896	4,896
Pump Setting (m)	27	27	52	40
Static Level (m)	10.39	6.54	9.02	9.75
Available Drawdown (m)	16.61	20.46	42.98	30.25
Total Drawdown (m) @ Time (min)	0.13 @ 360	0.37 @ 360	0.93 @ 360	1.78 @ 360
Recovery % at Time (min)	100 @ 5	95 @ 120	100 @ 5	97 @120
Transmissivity m^2/day	N/A	142.9	44.1	68.1
Distance to Observation Wells (m)	Lot 20 – 441 Lot 13 – 773 Lot 9 - 185	Lot 13 – 368 Lot 9 – 550 Lot 5 – 441	Lot 9 – 909 Lot 5 – 185 Lot 20 - 368	Lot 5 – 185 Lot 20 – 550 Lot 13 - 909

Note: Transmissivity could not be properly analysed for the Lot 5 test well as it began recovering during the pumping phase of the test.

In all instances, the pumping rate was calibrated to 13.6 Lpm and the respective wells were pumped for a period of 6 hours resulting in a total discharge of 4,896. This value is slightly less than 5,000 Litres per day. In all instances the pumping to slightly less than 5,000 was a result of shutting the pump off and not a result of any aquifer limitations. Overall, the total drawdowns were very low, ranging between 0.13 and 1.78 metres indicating that a minimum demand of 5,000 litres per day (ie. 6.15 hours of pumping at 13.6 Lpm) or longer duration could be met with complete recovery within a 24-hour period.

Recovery was measured in the four wells to be 95 percent or greater within the first two hours.

Test Well (A104945) Lot 5

The Test Well on Lot 5 was pumped at a rate of 13.6 Lpm for a period of 6 hours. The total volume of water pumped was 4,896 litres and the drawdown measured in the well was 0.13m. The test well recovered to 100% in the subsequent 5 minutes. Although water level measurements were not collected in the non-pumping wells, it is not expected that there would be any net effect due to the

minimal drawdown and immediate recover experienced in the pumping well. The pumping test did not reveal any negative boundaries.

Test Well (A104944) Lot 20

The Test Well on Lot 20 was pumped at a rate of 13.6 Lpm for a period of 360 min (i.e., total volume of 4,896 litres). The total drawdown measured in this well was 0.37 m. The test well recovered to 95% within a two-hour period. There was no well interference measured in the non-pimping wells.

Test Well (A104943) Lot 13

The test well on Lot 13 was pumped at a rate of 13.6 Lpm for a period of 360 minutes. The total volume pumped was 4,896 litres and the total drawdown measured in this well was 0.93 metres. The well recovered to 100% within a five-minute period. There was no well interference recorded in the non-pumping wells.

Test Well (A104942) Lot 9

The test well on Lot 9 was pumped at a rate of 13.6 Lpm for a period of 360 minutes. The total volume pumped was 4,896 litres and the total drawdown measured in this well was 1.78 metres. The well recovered to 97% within a two-hour period. There was no well interference measured in the non-pumping wells.

No negative hydrogeologic boundaries were encountered during the pumping tests. All pumping test data and drawdown and recovery curves are provided in **Appendix D**. Overall, all test wells revealed minimal drawdown with recovery of greater than 95% within a two-hour window subsequent to the cessation of pumping.

Transmissivities calculated for the three wells were quite high, ranging from 44.1 to 142.9 m^2/day. Of note is that transmissivity could not be properly analysed for the Lot 5 test well as it began recovering during the pumping phase of the test. The transmissivities, resultant drawdown, recovery rates and interference effects suggest that an adequate supply of groundwater is available at the proposed development.

7.1.4 Well Interference

There were no noted interference effects on the non- pumping wells while pumping the respective test wells. The largest drawdown measured during the pumping tests was from the Lot 9 Well (1.78 m). This well subsequently recovered to 97 % within two hours after pumping.

Since wells are typically not pumped for extended periods of time, and minimal drawdowns were recorded, interference effects if any should be very minor.

The underlying limestone aquifers long-term safe yield will likely not be exceeded from the proposed development. On the subject property, available drawdown will vary but could be in the range of up to 2 meters based on the results of the pumping tests (6 hours). The proposed well density of one well on average per 0.98 ha will not result in unacceptable lot-to-lot well

interference.

It is noted that the groundwater quantity study did not take into account the use of groundwater source heat pumps. These units should not be used until additional water consumption testing is completed for the bedrock aquifer to assess any potential impacts to groundwater quantity or quality.

7.2 Groundwater Quality

Groundwater samples were collected from the test wells at the site. The sampling results include analysis from samples collected from the recent pumping test activities.

The samples were analysed and compared to the criteria provided in Ministry document D-5-5 (Technical Guidelines For Private Wells). Results of these analyses have been provided for comparison and are discussed below.

7.2.1 Chemical Analysis

Test Well (A104945) Lot 5

One sample was collected from the Lot 5 Test Well during the pumping test completed in May 2017. The sample was collected at the end of the six-hour test. The results of the testing are summarized in **Table 3**.

Table 3: Water Quality Test Well Lot 5

Parameter		ODWQO	
Lot Number	Lot 5	AO/OG	MAC
MECP Well Tag	A104945		
Calcium	113	-	-
Iron (µg/L)	16	300	-
Magnesium	5.38	-	-
Manganese (µg/L)	4.4	50	-
Potassium	1.9	-	-
Fluoride	0.28		1.5
Chloride	20	250	-
Phosphorus	<0.003	-	-
Sulphate	20	500	-
Nitrate (as N)	0.62	-	10
Nitrite (as N)	0.003	1	-
Ammonia	<0.004	-	-
Sodium	12.3	200	20
TDS	366	500	-
Colour (TCU)	<3	5	-
Turbidity (NTU) (Lab)	1.12	5	1
DOC	<1	5	-
pH (pH units)	7.8	6.5 - 8.5	-
Alkalinity (as $CaCO_3$)	266	30 - 500	-
Conductivity (µS/cm)	591	-	-
Hardness	307	80 - 100	-
Bacteria			
TC (cfu/100mL)	0	-	0
EC (cfu/100mL)	0	-	0
Chlorine Residual (Lab)	<0.02	-	-
H_2S	< 0.006	0.05	-

Notes:
All pumping completed at 13.6Lpm
Turbidity measured at the well head to be <1
Residual chlorine 0.0 at the time of bacteriological testing
Red value exceeds aesthetic or operational guideline

Health Related Parameters

All health-related parameters are less than MECP Drinking Water Criteria. The nitrate-nitrite and bacteria results for the Lot 5 Test Well suggest that the water is safe for human consumption. Chlorine residual was measured to be 0.0 mg/L at the time of sampling for bacteriological content.

Aesthetic Parameters

Aesthetic parameters from the samples collected from the Lot 5 Test Well are below the MECP Drinking Water Objectives with the exception of the following:

Parameter	Raw water mg/L	ODWS/OG mg/L
hardness	307	80 - 100

Langelier Saturation Index

An assessment of the Langelier Saturation Index was completed on the raw water for this well. The Langelier Saturation index provides a measure to determine whether the water is corrosive, scale forming or balanced. An acceptable range is -0.5 to +0.5, with the optimum goal of 0 (zero). The water quality from the Lot 5 Test Well revealed values between 0.37 and 0.62 depending on the temperature, suggesting that the water is in the acceptable range. The higher water temperature would render the water slightly scale forming. The addition of treatment could impart some corrosiveness to the water quality.

Test Well (A104944) Lot 20

One sample was collected from the Lot 20 Well. The sample was collected at the end of the six-hour pumping test. The chemical results are provided in **Table 4**.

Table 4: Water Quality Test Well Lot 20

Parameter		ODWQO	
Lot Number	Lot 20	AO/OG	MAC
MECP Well Tag	A104944		
Calcium	90.9	-	-
Iron (µg/L)	23	300	-
Magnesium	2.55	-	-
Manganese (µg/L)	3.1	50	-
Potassium	0.55	-	-
Fluoride	0.07		1.5
Chloride	0.86	250	-
Phosphorus	0.004	-	-
Sulphate	4.5	500	-
Nitrate (as N)	0.069	-	10
Nitrite (as N)	0.003	1	-
Ammonia	0.07	-	-
Sodium	1.37	200	20
TDS	223	500	-
Colour (TCU)	3	5	-
Turbidity (NTU) (Lab)	0.69	5	1
DOC	2	5	-
pH (pH units)	7.54	6.5 - 8.5	-
Alkalinity (as $CaCO_3$)	241	30 - 500	-
Conductivity (µS/cm)	461	-	-
Hardness	238	80 - 100	-
Bacteria			
TC (cfu/100mL)	0	-	0
EC (cfu/100mL)	0	-	0
Chlorine Residual (Lab)	<0.02	-	-
H_2S	< 0.00	0.05	-

Notes:
All pumping completed at 13.6Lpm
Turbidity measured at the well head to be <2
Residual chlorine 0.0 at the time of bacteriological testing
Red value exceeds aesthetic or operational guideline

The water quality from this well demonstrates a potable water supply.

Health Related Parameters

All health-related parameters are less than MECP Drinking Water Criteria. The nitrate-nitrite and bacteria results for the Lot 20 Test Well suggest that the water is safe for human consumption.

Aesthetic Parameters

Aesthetic parameters from the samples collected from the Lot 20 Test Well are below the MECP Drinking Water Objectives with the exception of the following:

Parameter	Raw water mg/L	ODWS/OG mg/L
hardness	238	80 - 100

Langelier Saturation Index

An assessment of the Langelier Saturation Index was completed on the raw water for this well. The Langelier Saturation index provides a measure to determine whether the water is corrosive, scale forming or balanced. An acceptable range is -0.5 to +0.5, with the optimum goal of 0 (zero). The results from the Lot 20 Test Well revealed values between 0.017 and 0.3 depending on the temperature, suggesting that the water is in the acceptable range. The higher water temperature would render the water slightly scale forming.

Test Well (A104943) Lot 13

The Lot 13 Test Well has been sampled on one occasion. The sample was collected during at the end of the 6-hour pumping test. The water quality results from the Lot 13 test well are provided in **Table 5.**

Table 5: Water Quality Test Well Lot 13

Parameter		ODWQO	
Lot Number	Lot 13	AO/OG	MAC
MECP Well Tag	A104943		
Calcium	87.7	-	-
Iron (µg/L)	9	300	-
Magnesium	2.46	-	-
Manganese (µg/L)	0.77	50	-
Potassium	0.602	-	-
Fluoride	<0.06		1.5
Chloride	4	250	-
Phosphorus	0.003	-	-
Sulphate	3.2	500	-
Nitrate (as N)	0.10	-	10
Nitrite (as N)	0.003	1	-
Ammonia	<0.04	-	-
Sodium	2.53	200	20
TDS	260	500	-
Colour (TCU)	3	5	-
Turbidity (NTU) (Lab)	0.62	5	1
DOC	2	5	-
pH (pH units)	7.85	6.5 - 8.5	-
Alkalinity (as $CaCO_3$)	247	30 - 500	-
Conductivity (µS/cm)	464	-	-
Hardness	229	80 - 100	-
Bacteria			
TC (cfu/100mL)	0	-	0
EC (cfu/100mL)	0	-	0
Chlorine Residual (Lab)	<0.08	-	-
H_2S	< 0.006	0.05	-

Notes:
All pumping completed at 13.6Lpm
Turbidity measured at the well head to be <1
Residual chlorine 0.0 at the time of bacteriological testing
Red value exceeds aesthetic or operational guideline

Health Related Parameters

All health-related parameters are less than MECP Drinking Water Criteria. The nitrate-nitrite and bacteriological results for the Lot 13 Test Well suggest that the water is safe for human consumption.

Aesthetic Parameters

Aesthetic parameters from samples collected from the Lot13 Test Well are below the MECP Drinking Water Objectives with the exception of the following:

Parameter	Raw water mg/L	ODWS/OG mg/L
hardness	229	80 - 100

Langelier Saturation Index

An assessment of the Langelier Saturation Index was completed on the raw water for this well. The Langelier Saturation index provides a measure to determine whether the water is corrosive, scale forming or balanced. An acceptable range is -0.5 to +0.5, with the optimum goal of 0 (zero). The results from the Lot 13 Test Well revealed values between 0.31 and 0.58 depending on the temperature, suggesting that the water is in the acceptable range. The higher water temperature would render the water slightly scale forming. Treated water may also be slightly scale forming.

Test Well (A104942) Lot 9

The Lot 9 Test Well has been sampled on one occasion. The sample was collected at the end of the 6-hour pumping test. The water quality results from the Lot 9 test well are provided in **Table 7.**

Table 7: Water Quality Test Well Lot 9

Parameter			
		ODWQO	
Lot Number	Lot 9	AO/OG	MAC
MECP Well Tag	A104942		
Calcium	136	-	-
Iron (µg/L)	313	300	-
Magnesium	14.2	-	-
Manganese (µg/L)	17.8	50	-
Potassium	2.88	-	-
Fluoride	0.96		1.5
Chloride	62	250	-
Phosphorus	<0.003	-	-
Sulphate	43	500	-
Nitrate (as N)	0.006	-	10
Nitrite (as N)	<0.003	1	-
Ammonia	0.07	-	-
Sodium	29	200	20
TDS	503	500	-
Colour (TCU)	<3	5	-
Turbidity (NTU) (Lab)	6.31	5	1
DOC	1	5	-
pH (pH units)	7.42	6.5 - 8.5	-
Alkalinity (as $CaCO_3$)	290	30 - 500	-
Conductivity (µS/cm)	793	-	-
Hardness	398	80 - 100	-
Bacteria			
TC (cfu/100mL)	0	-	0
EC (cfu/100mL)	0	-	0
Chlorine Residual (Lab)	0.54	-	-
H_2S	< 0.006	0.05	-

Notes:
All pumping completed at 13.6Lpm
Turbidity measured at the well head to be <6
Residual chlorine 0.0 at the time of bacteriological testing
Red value exceeds aesthetic or operational guideline

Health Related Parameters

All health-related parameters are less than MECP Drinking Water Criteria. The nitrate-nitrite and bacteriological results for the Lot 9 Test Well suggest that the water is safe for human consumption.

Aesthetic Parameters

Aesthetic parameters from samples collected from the Lot 9 Test Well are below the MECP Drinking Water Objectives with the exception of the following:

Parameter	Raw water mg/L	ODWS/OG mg/L
hardness	229	80 - 100
Iron	3.13	3
TDS	503	500
Turbidity (NTU)	6.1	5

Langelier Saturation Index

An assessment of the Langelier Saturation Index was completed on the raw water for this well. The Langelier Saturation index provides a measure to determine whether the water is corrosive, scale forming or balanced. An acceptable range is -0.5 to +0.5, with the optimum goal of 0 (zero). The results from the Lot 9 Test Well revealed values between 0.074 and 0.35 depending on the temperature, suggesting that the water is in the acceptable range. The higher water temperature would render the water slightly scale forming. Treated water may also be slightly scale forming.

7.3 Water Quality Treatment

Elevated levels of the aesthetic parameters (primarily hardness and iron) are typically present at concentrations below levels which are considered reasonably treatable using current day conventional water treatment units. Typical treatment units could include:

- Water softeners to reduce hardness, iron, and manganese. Water softening by sodium ion exchange may introduce elevated sodium to the system. Where ion exchange water softeners are used, a separate unsoftened water supply could be used for drinking and culinary purposes.
- Greensand filters are an effective means for removing iron and manganese, as well as reducing TDS. The reduction of iron and manganese will, as a by-product, reduce the colour content in the groundwater.
- Any of the above systems could be accompanied by “add-on features” that could include filters and organic traps for VOCs and organics and UV systems for bacteria.

7.4 Discussion

As indicated above, health related parameters indicate a potable water supply. On balance the water may be characterized as being slightly hard and could render the water slightly scale forming. All parameter concentrations suggest that the water may be adequately treated using conventional water treatment systems. Homeowners could consult with water treatment specialists to assess appropriate treatment systems for their respective water supplies should they wish.

Pumping tests have confirmed an adequate supply of water for domestic purposes.

8.0 CONCLUSION AND RECOMMENDATIONS

Based on the terrain and groundwater supply investigations, the proposed site is suitable for development on private services. The following discussion and recommendations are provided.

- A nitrate impact assessment was completed suggesting that the 22 proposed lots will not negatively impact off-site water supplies. The proposed overall septic system density for the full development is approximately one system per 0.76 hectares (i.e., 28 lots) and therefore it is concluded that the impact of the proposed development on groundwater at the downgradient property boundary is considered acceptable in accordance with MECP Guideline D-5-4.

  A 30-metre water setback and vegetated buffer along the perimeter of the wetland is recommended to ensure that the wetland is not adversely impacted because of the proposed development.

- Based on the soil conditions, partially raised septic systems could be required. Septic design should be assessed on a lot-by-lot basis and construction should be in conformance with regulatory design criteria. Homeowners are not restricted to the use of Class IV conventional septic systems. Alternative systems may be allowed if they are confirmed acceptable by the local building authorities.

- The underlying aquifer provides an adequate supply of potable water at the site. If low yields are encountered, they may be compensated with the use of holding tanks sized to meet peak demands. In this instance, storage capacity of 1000 litres would be a reasonable option.

- Water quality from the four on-site test wells has demonstrated that all health-related parameters are less than the Ontario Drinking Water Criteria. Aesthetic or operational guideline parameters are below the Ontario Drinking Water Criteria except for iron and TDS (one location) and hardness at all locations, all of which can be effectively reduced using conventical water treatment units. The slightly mineralized groundwater has been demonstrated to be within an acceptable range in which the water is essentially balanced or slightly scale forming.

- The groundwater availability did not take into account the use of groundwater source heat pumps. Heat pumps should not be used until such time that additional aquifer testing is

completed for increased yields and until the impact to change in groundwater quality has been assessed.

In summary, the aquifer underlying the site and the terrain are suitable for development on private services.

9.0 CONDITIONS ON TITLE

The results of the hydrogeological investigation and terrain analysis have documented acceptable conditions for the proposed development. As a result of the findings, which are favourable for individual wells and septic systems for the development as proposed, we recommend the following:

That the subdivision agreement between the owner and the municipality contain the following provisions, wherein the owner agrees that the following statements will be included in all offers of purchase and sale or lease agreements:

a) The report prepared by Jp2g Consultants Inc. entitled Hydrogeological Investigation and Terrain Analysis dated February 2019 and re issued October 2021, will be made available to lot purchasers as a guide to development.

b) Wells should be constructed in accordance with Ontario Regulation 903, and the recommendations of the hydrogeological report.

c) Treatment of the water may be required to reduce aesthetic and operational guideline parameters to acceptable levels.

d) Heat pumps have not been approved for use in any of the lots within this subdivision and their feasibility should be examined by a qualified hydrogeologist prior to installation in order to avoid potential problems related to water supply and water quality.

e) The Town of Bobcaygeon does not guarantee the quality or quantity of the groundwater. If, at some future date, the quality or the quantity of the groundwater becomes deficient, the Town of Bobcaygeon bears no responsibility, financial or otherwise, to provide solutions to the deficiency, such solutions being the sole responsibility of the “Homeowner.”

f) Lots shall be made suitable for the installation of subsurface sewage disposal systems. Disposal systems are not restricted to typically Class IV Septic Systems, but any alternative system approved by the local building authorities.

g) That prior to final approval, the owner shall prepare a Lot Development and Drainage Plan to the satisfaction of the Town of Bobcaygeon which will identify all building and sewage envelopes, well locations, existing and finished elevations of the lot development envelopes, and drainage works. This plan will be made available to lot purchasers as a guide to development.

Respectfully submitted.

Yours truly,

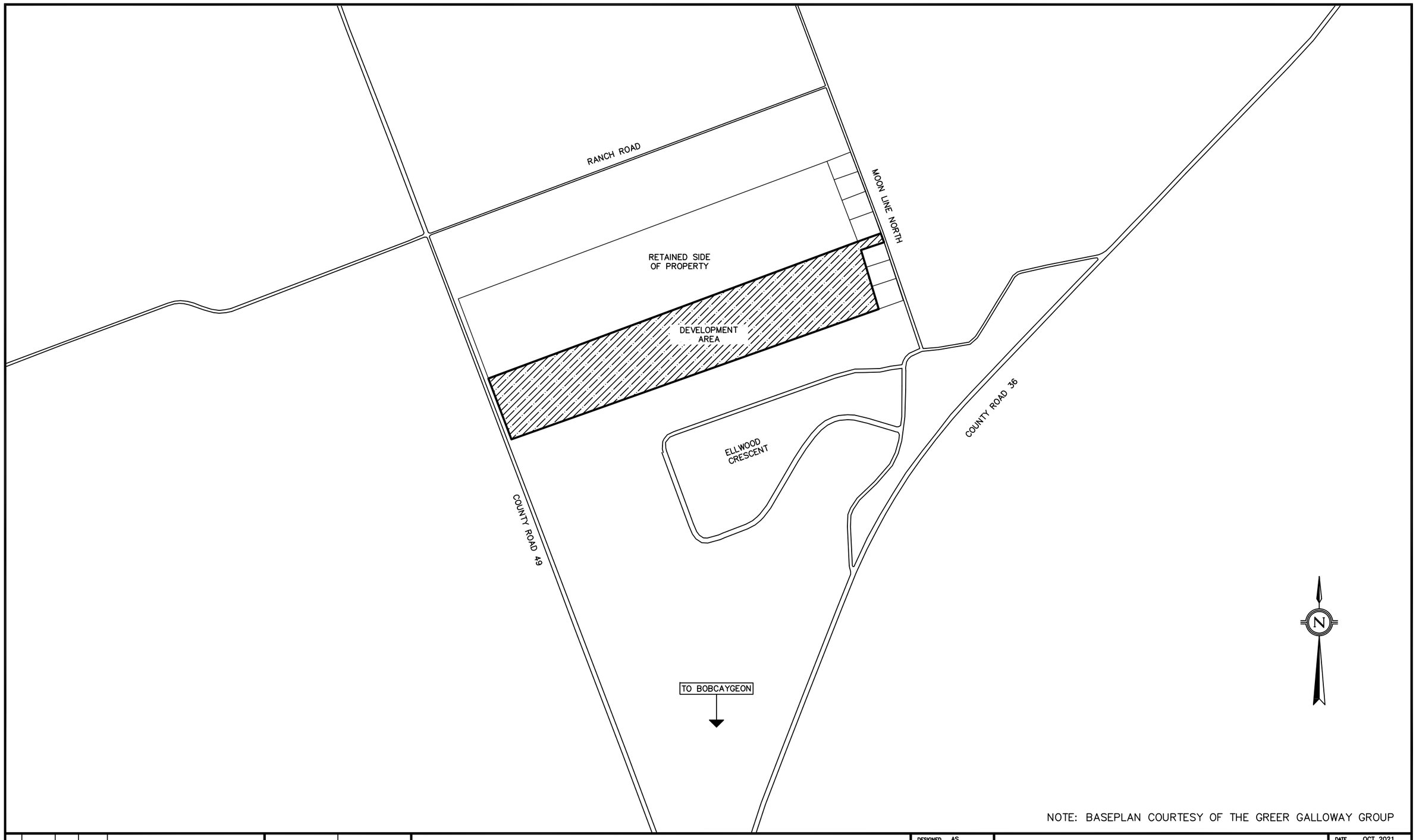
Jp2g Consultants Inc.
Engineers • Planners • Project Managers

Andrea Sare, C.Tech, EP
Environmental Consultant | Environmental Services

Andrew Buzza, P.Geo
Senior Hydrogeologist | Environmental Services

PROFESSIONAL GEOSCIENTIST
ANDREW BUZZA
PRACTISING MEMBER
0942
October 14/2021
ONTARIO

Figures



NOTE: BASEPLAN COURTESY OF THE GREER GALLOWAY GROUP

No.	DATE	BY		REVISIONS

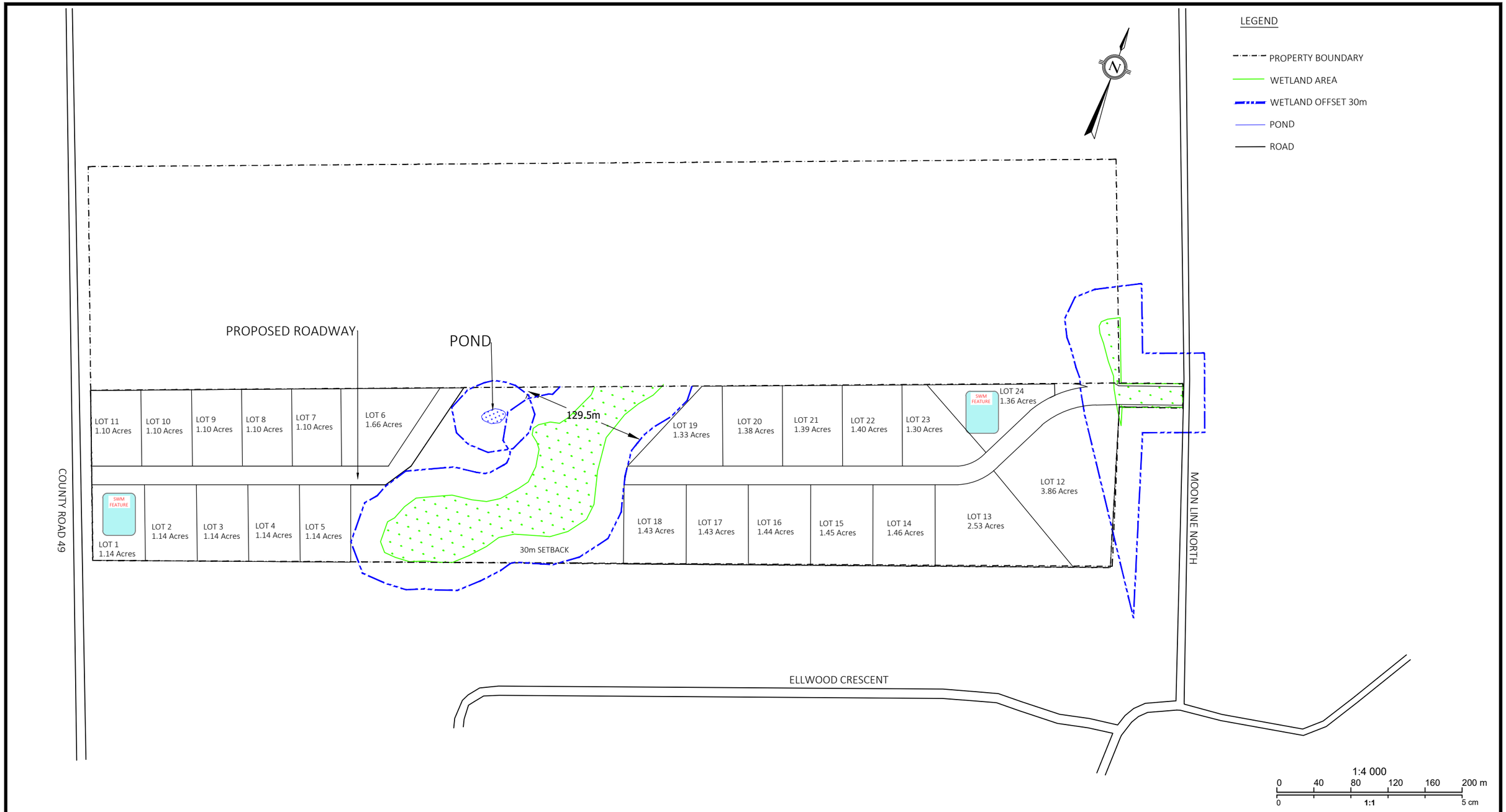
Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

DESIGNED	AS
DRAWN	AS
CHECKED	AB
APPROVED	AB
SCALE	NOT TO SCALE

ANDERSON SUBDIVISION DEVELOPMENT
Part Lots 18 & 19, Concession 19, Geo. TWP of Harvey, Municipality of Trent Lakes, County of Peterborough

SITE LOCATION MAP

DATE	OCT 2021
PROJECT	17-6053B
PLOTTED	07-OCT-2021
FIGURE	1



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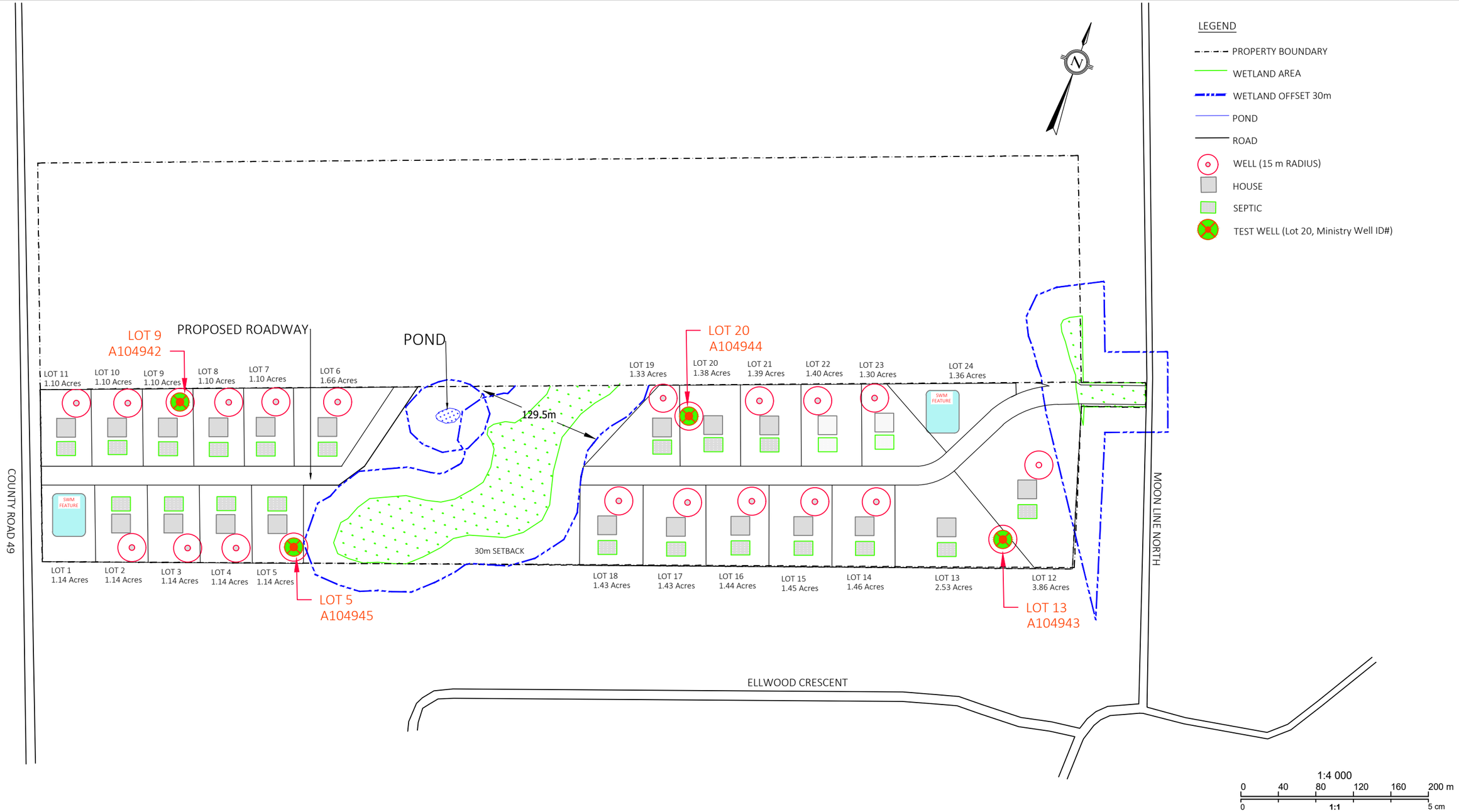
ANDERSON SUBDIVISION DEVELOPMENT

Part Lots 18 & 19, Concession 19, Geo. TWP of Harvey, Municipality of Trent Lakes, County of Peterborough, Ontario

~

PROPOSED DRAFT PLAN OF SUBDIVISION

DESIGNED: AS		PROJECT No.: 17-6053B
DRAFTED: AS		PLOTTED: OCTOBER 12, 2021
CHECKED: AB	APPROVED: AB	REVISION No.: .
SCALE: 1:4000		FIGURE 2



Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

12 INTERNATIONAL DRIVE, PEMBROKE, ON
Phone: (613)735-2507, Fax:(613)735-4513

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ANDERSON SUBDIVISION DEVELOPMENT

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~

PROPOSED DRAFT PLAN OF SUBDIVISION

DESIGNED: AS		PROJECT No.: 17-6053B
DRAFTED: AS		PLOTTED: OCTOBER 18, 2021
CHECKED: AB	APPROVED: AB	REVISION No.: .
SCALE: 1:4000		FIGURE 3

Notes:
1. Aerial Imagery obtained from The Ministry of Natural Resources and Forestry Maps A Map: Natural Heritage Areas Website.
2. Map Layers obtained from Land Information Ontario.

0 75 150 300 Meters

1:7,500

Map 1:
Site & Surrounding Land Use

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

Date: October 2021

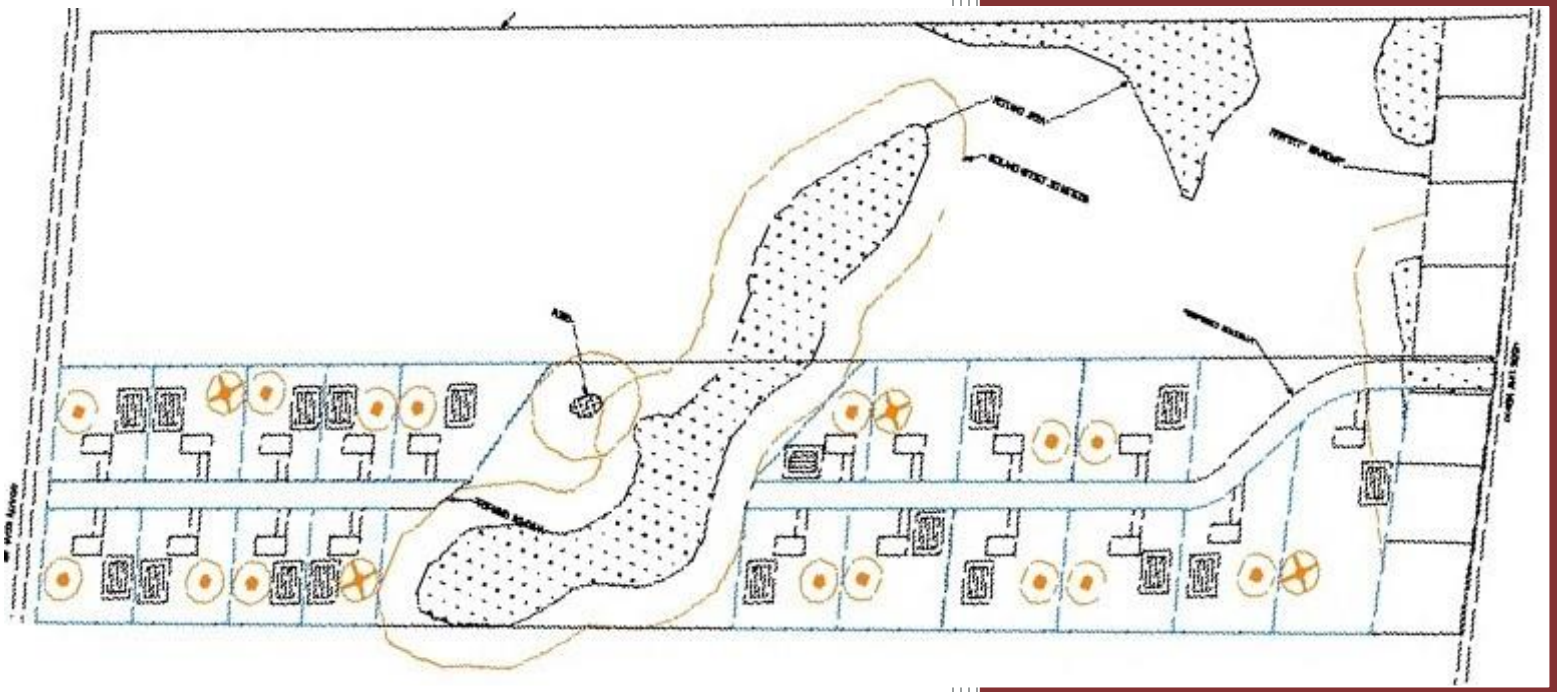
17-6053A

Appendix A
Geotechnical Report

Project No. 17-1-6801

Anderson Subdivision

Geotechnical Report



Terraspec Engineering Inc.
Geotechnical Engineers
973 Crawford Drive
Peterborough, Ontario
K9J 3X1

TABLE OF CONTENTS

APPENDICES

terraspec engineering inc.
geotechnical engineers and materials testing

973 Crawford Drive
Peterborough, Ontario **Phone: (705) 743-7880**
K9J 3X1 **Fax: (705) 743-9592**

December 18, 2017

The Greer Galloway Group Inc.
973 Crawford Drive
Peterborough, Ontario
K9J 3X1

Re: Geotechnical Report for Anderson Subdivision, Bobcaygeon
Project No. 17-1-6801

General Site Data
The project site is located at 168 County Road 49, Bobcaygeon. The site consists mainly of undeveloped land. The site has been proposed for development as a residential subdivision. A site plan indicating the extent of the property and showing the proposed development has been appended to this report.

Investigation
A soils investigation was conducted for the property on November 14, 2017. Ten exploratory test holes were placed on site using a track mounted excavator. Soil laboratory testing consisted of moisture content determination, hydrometer grain size analysis, Atterberg Limits determination, and unit weight determination. The test hole logs and laboratory testing data have been appended to this report. The test hole locations have been indicated on the appended site plan.

Soil Conditions
The soil physiography for this site is defined as till moraines, with limestone plains exposed at the northeast corner of the site. The bedrock consists of limestone of the Trenton Group.
The predominant soil type was gravelly loam till, very stoney. The Soil Group is Brown Forest.
The typical soil layers encountered on site were as follows:

silty topsoil
silty sand trace gravel
silty sand and gravel/cobble till

The topsoil thickness was typically 200 to 300mm.
The silty sand layer on surface was typically 600mm thick, and in a compact condition.

The underlying silty sand and gravel/cobble till subsoil was generally in a dense condition. Atterberg Limits testing indicated that these soils were typically non-plastic.

Bedrock was encountered at the west end of the project, at a typical depth of 2.5m below existing ground surface.

Groundwater was encountered at the west end of the project, at a typical depth of 1 to 1.5m below existing ground surface.

OHSA Soil Types
The subsoils present on site can be classified as Type 3 soils. The Type 3 soils should be treated as Type 4 soils for any construction work that would be required below the water table.

Recommendations

1.1 Cut and Fill Options

It would be feasible to cut the site elevation down if necessary for this project. The underlying till soils are ideal for foundations, however, cutting will bring the new house foundations closer to the natural groundwater elevation, which may affect the feasibility of constructing basements in the new houses.

It would be feasible to fill the site upwards by up to 2m, although it is not expected that this would be necessary at this project site. The topsoil layer is thick at this site and would require complete removal prior to filling on the site. Clean fill should be utilized to raise the grade.

As noted below under **Re-use of Subsoils**, the natural silty sand and gravel/cobble till subsoil on site may be re-used as subgrade fill. Imported fill materials that meet OPSS 1010 SSM specifications, such as sand or silty sand, would also be suitable.

1.2 Permeability and Erosion

The drainage of the natural soils on site can be classified as medium. The hydraulic permeability has been estimated as follows:

silty sand and gravel/cobble till $k=10^{-5}$ cm/sec T time of 15 min/cm

The erodibility of the natural soils was low to moderate, with a Wischmeier K value in the range of 0.30. The present site is typically covered in short grass and bushes. Where possible, existing vegetation should be maintained in an undisturbed state, to provide continued resistance to surface erosion.

A standard application of rip rap over Type 2 non-woven geotextile cloth may be utilized for areas that may require erosion protection measures, such as at the outlets of pipe culverts.

1.3 Foundations

Recommendations for placement of shallow foundations for houses are as follows.

Footings must be placed such that the footings will have a minimum 1.5m of soil cover for frost protection. Spread or strip footings may be placed onto the underlying undisturbed native subsoils, as identified by soil type below. Assuming a finished footing embedment depth of 1.5m, the following native soil bearing capacities will typically be available at the base of the new footings:

silty sand and gravel/cobble till:

Factored ULS bearing capacity:	300 kPa
SLS allowable bearing capacity:	200 kPa

Proposed footing areas should be carefully inspected to ensure that footings are placed only onto undisturbed and competent native subsoils, with minimum bearing capacities as given above. These capacities may need to be reduced where footings are placed onto wet subgrade soils. During construction, an engineering firm should be consulted to confirm the bearing capacity of the foundation soils, and to set the elevation of new basement floors.

Dewatering
Excavations within the silty sand, and silty sand & gravel/cobble till, are not expected to require extensive dewatering. A pumping operation with sump equipment will be sufficient for the placement of footings onto the undisturbed native subsoil.

Care should be taken to prevent ponding or inundation due to rain, and to control excess run-off that could cause erosion. The construction contract should stipulate that the integrity of all natural soil surfaces and soil bearing surfaces must be preserved at all times. Therefore, all excavations on site must be protected from high moisture levels due to rainfall or accumulating groundwater, using appropriate dewatering techniques.

Also, construction traffic can readily distort and soften the surface subgrade. It would be prudent to strengthen the construction haul roads on site with a gravel surface using a material such as 4inch minus rock fill.

Seismic Parameters
The following seismic design parameters may be utilized:

Site Class C Soil Shear Wave Average Velocity (m/s) = $360 < Vs < 760$

The ground acceleration values for the Bobcaygeon area, as given by the OBC, are as follows:

Sa(0.2)=0.19, Sa(0.5)=0.12, Sa(1.0)=0.058, Sa(2.0)=0.017, PGA=0.087.

Geotechnical Parameters
For calculating vertical and lateral earth pressures and other geotechnical parameters, the following unfactored coefficients may be utilized:

native silty sand and gravel/cobble till
phi = 35°
Ka = 0.27, Ko = 0.43, Kp = 3.69
Moist unit weight = 22.0 kN/m3
Coefficient of friction for the concrete/till interface = 0.55

typical imported sandy Granular B Type 1 backfill
phi = 32°
Ka = 0.31, Ko = 0.47, Kp = 3.25
Moist unit weight = 22.3 kN/m3

typical imported gravelly Granular B Type 1 backfill
phi = 35°
Ka = 0.27, Ko = 0.43, Kp = 3.69
Moist unit weight = 23.0 kN/m3

Subdrains
For new houses that will have a basement level, it is recommended that subdrains be placed for the perimeter footings. Subdrain installations should consist of a perforated geotextile-wrapped pipe, placed at the footing depth along the outside perimeter of the footings. The pipe should have a minimum diameter of 150mm and must be graded to a positive outlet away from the foundation. Backfill to the subdrain trench should consist of OPSS 1004 Clear Stone. A free-draining granular material should be placed as backfill to the foundation walls.

Concrete
The frost penetration treatment depth for this site is 1.5m. All concrete placed within the frost penetration treatment depth of 1.5m, or exposed to outside temperature extremes, should generally consist of a 30MPa concrete mix, with adequate (typically 7%) air entrainment. Type 10 concrete cement will be suitable for this project.

Re-use of Subsoils
The native subsoils found on site cannot be used as fill beneath structures. Any fill required beneath new structures must consist of an engineered granular fill, such as OPSS 1010 Granular B Type 1.
The natural silty sand and gravel/cobble till subsoil on site may be re-used as subgrade fill. Imported fill materials that meet OPSS 1010 SSM specifications, such as sand or silty sand, would also be suitable. All fill must be compacted as per Section 1.7.

1.4 Floor Slabs

The following minimum requirements are recommended for standard slab-on-grade floors:

Concrete Slab	127mm
OPSS 1010 Granular A base	150mm
OPSS 1010 Granular B Type 1 subbase	200mm
Over compact native subgrade soil	

The subgrade soil surface to remain should be proof-rolled to ensure that it is acceptable for placement of the base and subbase materials. Remove any deleterious soil or organics such as roots or branches from beneath the new floor area. Deleterious soils may be replaced by an acceptable subgrade fill material, such as OPSS 1010 SSM.

It is recommended that a concrete compressive strength of 25MPa be utilized for floor slabs.

1.5 Pipe Installation

For new underground piping, utilize the following OPSD Standards for pipe installation:

For soil subgrade:

OPSD 802.010	Flexible Pipe	-	Type 3 Earth Excavation
OPSD 802.031	Rigid Pipe	-	Type 3 Earth Excavation, Class B

Utilize the granular bedding and cover depths as specified in the applicable OPSD standards listed above. For normal subgrade conditions, OPSS Granular A may be utilized for pipe embedment and pipe cover material for new piping.

For wet subgrade conditions, a crushed rock should be utilized for pipe embedment and pipe cover material for new piping. A suitable material would be OPSS 1010 Granular B Type 2 with 100% passing the 50mm sieve.

Frost protection for underground piping should be utilized as per the following OPSD standards, with a frost treatment depth of k = 1.5m:

OPSD 803.030	Frost Penetration Line Below Bedding Grade
OPSD 803.031	Frost Penetration Line Above Bedding Grade

1.6 Pavement Design

For the new roadways, remove all organic soil from the subgrade surface. Provide earth grading and cross fall as per OPSD 200.01 to prevent ponding of water on the soil subgrade, and to provide effective drainage of the new pavement structure.

Apply proof-rolling to the subgrade soil to ensure that it is acceptable for placement of the new granular subbase and base materials.

The following minimum pavement designs as per OPSS 1150 specifications are recommended for placement of new pavement:

Pavement Structure for Roadways

40mm	HL3 surface course
50mm	HL8 binder course
150mm	OPSS 1010 Granular A base
300mm	OPSS 1010 Granular B Type 1 subbase
	Over compact native subgrade soil or approved fill

It will also be acceptable to substitute SuperPave hot mix as per OPSS 1151, such as SP12.5 over SP19.0.

The asphalt cement should have a minimum rating of PGAC 58 -34.
Tack coat the hot mix substrate, as per OPSS.PROV 308, prior to placing the surface course lift of hot mix. Stipulate in the contract that all hot mix paving operations shall be carried out in accordance with OPSS 310 specifications.

Since new house building is planned, it would be prudent to place 50mm of HL8 hot mix now, and defer pavement of the 40mm HL3 surface course until the majority of construction has finished. This will provide a better finished pavement and allow for repair of damaged hot mix which could occur during the house-building construction operations.

1.7 Compaction Requirements

All native soil and all granular fill compaction requirements for the project should conform with OPSS 501, Subsection 501.08.02 - Method A, utilizing soil placement in maximum 300mm lifts and a compaction standard of 100% of Standard Proctor Maximum Dry Density.

1.8 Statement of Limitations

This report is intended for the guidance of the project design team. From a construction standpoint, contractors must make their own assessment of the soil and groundwater conditions and how these will affect their proposed construction techniques and schedules.

The recommendations in this report are based on information determined at the test hole locations. Soils and groundwater conditions between and beyond the test holes may differ from those encountered at the test hole locations and conditions may become apparent during construction that could not be detected or anticipated at the time of the soils investigation. If this occurs, we recommend that Terraspec be recalled to the site for further consultation, testing, and analysis.

We also recommend that Terraspec be retained to ensure that all subgrade preparation requirements are met, and to confirm that the soil conditions do not deviate materially from those encountered in test holes. In cases where any of our recommendations are not followed, the company's responsibility is limited to interpreting the information from test hole data.

This report is applicable only to this project, constructed substantially in accordance with details of alignment and elevations quoted in the text.

~ ~ ~

TERRASPEC ENGINEERING INC.
GEOTECHNICAL ENGINEERS

Shane Galloway, B.A.
Manager

N.A. MacKinnon, P.Eng.
Senior Engineer

Test Hole Data
Anderson Subdivision
November 14, 2017

Notes

1. Soil types, strata, and groundwater conditions have been established only at test hole locations.
2. Soils are described according to the MTO Soils Classification System and OPSD 100.06.
3. Dimensions are in millimetres up to 1 metre, then in metres thereafter.

Abbreviations

asph	-	asphalt	&	-	and
blds	-	boulders	w	-	with
blk	-	black	so	-	some
br	-	brown	tr	-	trace
BR	-	bedrock			
cl	-	clay(ey)	S	-	soil sample
cob	-	cobbles	Su	-	vane shear strength (kPa)
conc	-	concrete			
cr	-	crushed			
f	-	fine			
gr	-	gravel(ly)			
gry	-	grey			
med	-	medium			
NFP	-	no further progress			
org	-	organics			
RF	-	rock fill			
sa	-	sand(y)			
si	-	silt(y)			
tps	-	topsoil			

1

0 - 150 br si tps
150 - 600 br si sa & gr -moist, compact
600 - 3.10 lt br si sa & gr/cob -wet, compact
-perched water at 910mm
-water accumulated to a 2.44m depth in the test hole

2

0 - 240 br si tps
240 - 610 br si sa tr gr -moist, compact
610 - 2.30 lt br si sa & gr/cob -moist, compact S1 at 1.3m
2.30 - NFP, flat limestone BR, sound
-perched water at 1.6m

3

0	-	200	br si tps	
200	-	560	br si sa tr gr -moist, compact	
560	-	1.71	lt br si sa & gr tr cob -moist, compact	S2 at 1.6m
1.71	-	2.10	flat shale/limestone fragments -dry, dense	
2.10	-	2.50	gry gr & sa -moist, very dense	
2.50			NFP, flat limestone BR, sound	

-slight perched water at 1.1m

4

0	-	180	br si tps	
180	-	530	br si sa tr gr -dry, compact	
530	-	2.10	lt br si sa & gr/cob -moist, dense	
2.10	-	3.66	lt br si sa & gr/cob w limestone fragments -moist, dense	S3 at 2.1m
			-limestone fragments up to 350mm diameter	

-water not encountered

5

0	-	110	br si tps	
110	-	3.66	lt br si sa & gr/cob -moist, dense	S4 at 610mm
			-some boulders after 650mm	
3.66			NFP, dense boulders	

-water not encountered

6

0	-	300	br si tps	
300	-	800	br si sa tr gr -moist, compact	
800	-	1.80	lt br si cl sa & gr/cob -moist, dense	
1.80	-	3.20	gry si sa & gr -moist, very dense	S5 at 1.9m

-water not encountered

7

0	-	280	br si tps	
280	-	610	br si sa tr gr -moist, compact	
610	-	3.66	gry/br si sa & gr/cob -moist, dense	
			-some limestone fragments after 3m	

-water not encountered

8

0	-	280	br si tps	
280	-	760	br si sa -moist, compact	S6 at 600mm
760	-	3.35	gry/br si sa & gr/cob so blds -moist, dense	
3.35			NFP, dense boulders	

-water not encountered

9

0	-	270	br si tps	
270	-	630	br si sa -moist, compact	
630	-	3.66	gry/br si sa & gr/cob tr blds -moist, dense	S7 at 1.5m

-water not encountered

10

0	-	200	br si tps	
200	-	3.66	br si sa & gr/cob so blds -moist, dense	
			-frequent limestone boulders after 1.8m	

-water not encountered

Laboratory Test Data

Soil Sample	1	2	3	4	
Sieve	% Passing				
37.5mm	100	100	100	100	grain size
26.5mm	85.4	90.9	84.2	94.1	
19.0mm	73.2	79.2	80.7	92.1	
13.2mm	64.4	72.9	71.5	81.4	
9.50mm	55.3	65.3	61.2	70.0	
4.75mm	46.5	52.8	48.3	52.0	
2.36mm	41.9	45.2	42.4	47.0	
1.18mm	37.7	38.0	35.8	40.3	
600um	34.1	31.4	30.4	34.8	
300um	30.3	25.5	25.7	29.8	
150um	25.5	19.7	20.8	24.0	
75um	21.9	15.8	17.2	19.7	
%gravel	53.5	47.2	51.7	48.0	gravel content
%sand	24.6	37.0	31.1	32.3	sand content
ASTM	GM	GM	GM	GM	soil classification
frost rating	Low	Low	Low	Low	susceptibility to frost heave
LL	34.0	17.1	21.0	27.0	liquid limit
PL	21.7	16.3	18.8	18.1	plastic limit
PI	12.3	0.8	2.2	8.9	plastic index
W	38.4	11.7	9.2	13.3	field moisture content

Soil Sample	5	6	7	
Sieve	% Passing			
53.0mm	100	100	100	grain size
37.5mm	92.7	100	97.5	
26.5mm	89.7	100	89.4	
19.0mm	69.2	100	83.1	
13.2mm	55.3	100	72.6	
9.50mm	44.5	100	65.2	
4.75mm	35.8	100	49.4	
2.36mm	31.2	99.2	42.2	
1.18mm	26.0	95.8	34.4	
600um	21.8	89.0	27.8	
300um	18.4	79.0	22.5	
150um	15.3	66.8	17.6	
75um	13.1	58.0	14.4	
%gravel	64.2	0.0	50.6	gravel content
%sand	22.7	42.0	35.0	sand content
ASTM	GM	ML	GM	soil classification
frost rating	Low	Med	Low	susceptibility to frost heave
LL	20.0	15.4	22.8	liquid limit
PL	15.1	14.9	20.8	plastic limit
PI	4.9	0.5	2.0	plastic index
W	9.5	30.3	10.2	field moisture content

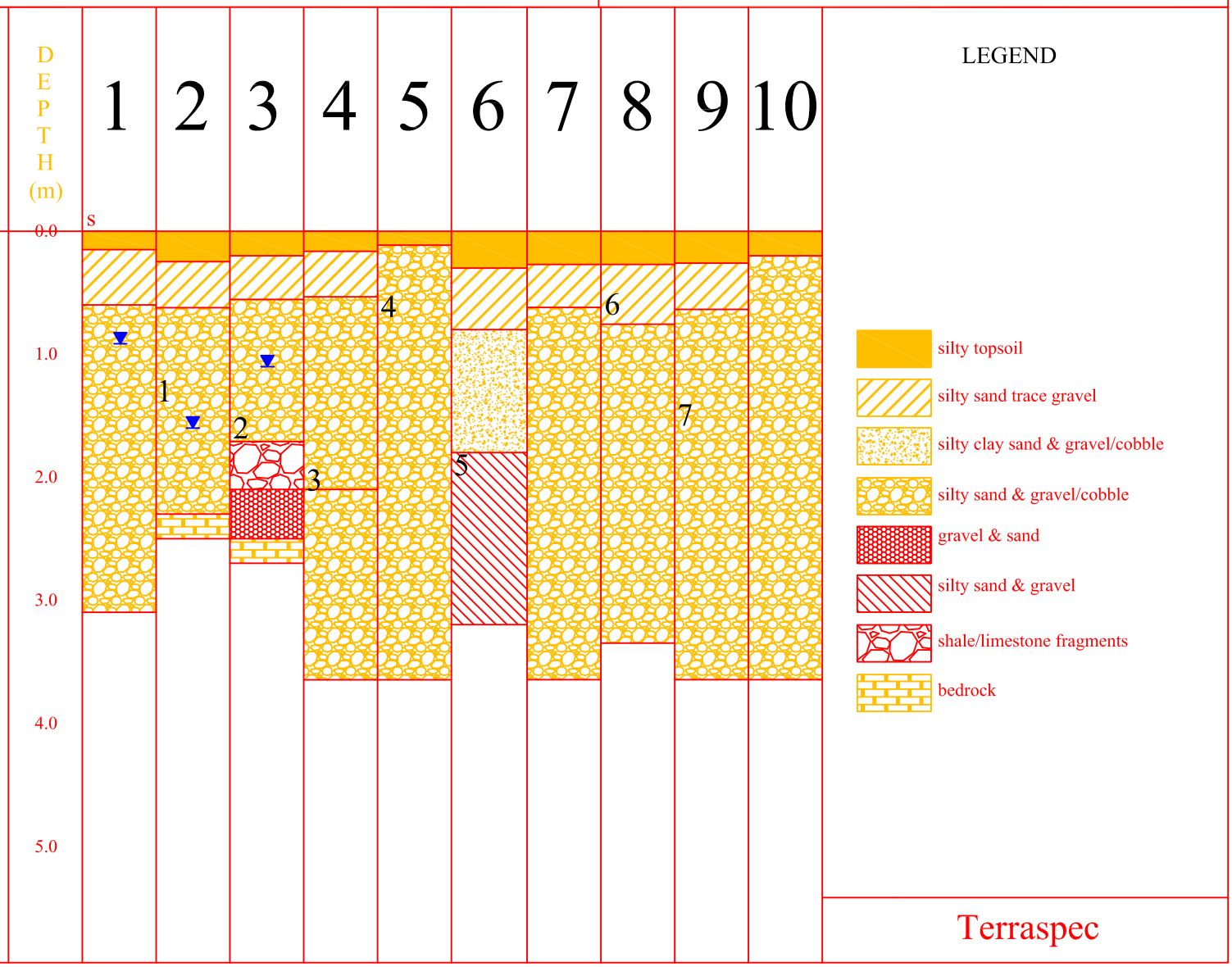
NP = not plastic

TEST HOLE LOG DATA

PROJECT No.: 17-1-6801
CLIENT: GGG Inc.
PROJECT: Anderson Subdivision
DATE: November 14, 2017

SOIL DATA
METHOD: Excavator
s = sample

▼ encountered water elevation



Terraspec

GREER GALLOWAY
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873 CRAWFORD DRIVE
PETERBOROUGH, ONTARIO, K9J 7B1
PHONE: 705-743-6780
FAX: 705-743-8582

LEGEND:

- WETLAND AREA
- WETLAND OFFSET 30m
- POND
- ROAD
- HYDRO
- BELL

DRAWING:

ANDERSON
TOPOGRAPHIC PLAN

PROJECT:

ANDERSON
SUBDIVISION
DEVELOPMENT

NO.	REVISION	DATE
05		
04		
03		
02		
01	CONCEPTUAL DESIGN	2017

DESIGNED BY: TL
DRAWN BY: TL
REVIEWED BY: ISO
APPROVED BY: ISO
PROJECT DATE: AUGUST 2017
SCALE: SCALE 1:1750
PROJECT NO.: 16-1-6801
DRAWING NO.:

Appendix B
On-Site Water Well Records

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below) A104945

Lot 5

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	ANDERSON DEVELOPMENTS		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
168 Kawartha Lakes Cty. Rd. 49	Bobcaygeon	ON	K0M1A0	7058799426

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
#16		19	19

County/District/Municipality	City/Town/Village	Province	Postal Code
Kawartha Lakes	Bobcaygeon	Ontario	K0M1A0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Subdivision Number	Other
NAD 83	17	694911	4937213		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
BLACK	~~TOP SOIL~~	TOP SOIL	SOFT	0	1
BROWN		SAND	FINE SAND	1	16
WHITE	LIMESTONE		POROUS/HARD	16	100

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	BENTONITE	

Method of Construction

☐ Cable Tool ☐ Diamond
☐ Rotary (Conventional) ☐ Jetting
☐ Rotary (Reverse) ☐ Driving
☐ Boring ☐ Digging
☑ Air percussion
☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used
☑ Domestic ☐ Municipal ☐ Dewatering
☐ Livestock ☐ Test Hole ☐ Monitoring
☐ Irrigation ☐ Cooling & Air Conditioning
☐ Industrial
☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6 1/4	STEEL	.188	0	25

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Status of Well

☑ Water Supply
☐ Replacement Well
☐ Test Hole
☐ Recharge Well
☐ Dewatering Well
☐ Observation and/or Monitoring Hole
☐ Alteration (Construction)
☐ Abandoned, Insufficient Supply
☐ Abandoned, Poor Water Quality
☐ Abandoned, other, specify
☐ Other, specify

Water Details

Water found at Depth (m/ft)	☐ Gas	Kind of Water: ☐ Fresh ☐ Untested ☐ Other, specify
90		

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	90	6
90	92	6
12	24	6

Results of Well Yield Testing

After test of well yield, water was:
☑ Clear and sand free
☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM)

Duration of pumping: 1 hrs + ___ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft): 80

Recommended pump rate (l/min / GPM): 3.6

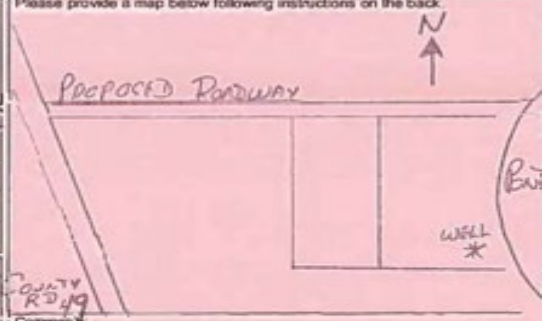
Well production (l/min / GPM): 20

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		34.1		
1	1	34.67	1	34.13
2	2	34.65	2	34.1
3	3	34.67	3	34.1
4	4	34.67	4	
5	5	34.67	5	
10	10	34.70	10	
15			15	
20			20	
25			25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
HALLIBURTON ADTESIAN WELL DRILLERS	6011

Business Address (Street Number/Name)	Municipality
Box 423	DUNDALK

Province	Postal Code	Business E-mail Address
ONT	K0M1S0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)
705-534-7246	RITTIG, RICK

Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
7111		2017/05/24

Comments: No SEPTIC AT THIS TIME

Well owner's information package delivered	Date Package Delivered	Ministry Use Only
☑ Yes ☐ No	2017/05/24	Audit No Z263940

Date Work Completed: 2017/05/24

5506E (2017/11)

Well Owner's Copy

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below): A104944 **Lot 20**

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	ANDERSON DEVELOPMENTS		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
168 Kawartha Lakes Cty. Rd. 49	Bobcaygeon	ON	K0M1A0	7052797914216

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
#8		19	19

County/District/Municipality	City/Town/Village	Province	Postal Code
Kawartha Lakes	Bobcaygeon	Ontario	K0M1A0

UTM Coordinates	Zone	Easting	Northing	Municipal Plan and Sublot Number	Other
NAD 83	17	691525	4937148 0		

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
BRN	TOP SOIL		LOOSE	0	1
BRN	SAND		"	1	19
GRY	LIMESTONE		BOULDERS	19	100

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	22	BENTONITE	

Method of Construction

☐ Cable Tool ☐ Diamond ☐ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☑ Air percussion ☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used ☑ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☐ Test Hole ☐ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6 1/8	STEEL	.188	0	21

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No	Depth (m/ft) From	To

Status of Well

☑ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Water Details

Water found at Depth	Kind of Water	Hole Diameter Depth From	To	Diameter (cm/in)
91 (m/ft) ☐ Gas	☑ Fresh ☐ Untested ☐ Other, specify			
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	0	100	10
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	42	20	6

Results of Well Yield Testing

After test of well yield, water was: ☑ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft): 80

Pumping rate (l/min / GPM): 3.6

Duration of pumping: 1 hrs + ____ min

Final water level end of pumping (m/ft):

If flowing give rate (l/min / GPM):

Recommended pump depth (m/ft): 80

Recommended pump rate (l/min / GPM):

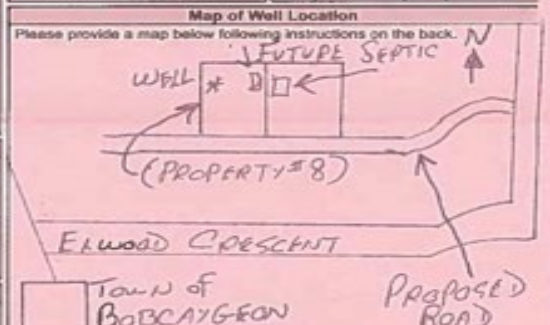
Well production (l/min / GPM): 7

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		21.80		
1	22.9		1	2485
2	22.55		2	21.73
3	22.45		3	21.67
4	22.35		4	21.67
5	22.35		5	21.66
10	22.45		10	21.65
15	22.47		15	21.64
20	22.50		20	21.64
25	22.60		25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments: WELL ONLY NO SEPTIC YET

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
HALIBURTON ARTESIAN WELL DRILLERS	6016

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
Box 423 HALIBURTON	DYSART ET AL	ONT	K0M1S0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
7054457248 6	PUTTIG RICK	7111 2		2017052 6

Well owner's information package delivered: ☑ Yes ☐ No

Date Package Delivered: 2017052 6

Date Work Completed: 2017052 6

Ministry Use Only

Audit No. Z263939

Received

05008E (2014/11)

Well Owner's Copy

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☑ Imperial

Well Tag No. (Place Sticker and/or Print Below): A104943

Lot 13

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	Well Constructed by Well Owner
	ANDERSON DEVELOPMENTS		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
168 Kawartha Lakes Cty Rd. 49	Bobcaygeon	ON	K0M1A0	7059794126

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
*1		19	19

County/District/Municipality	City/Town/Village	Province	Postal Code
Kawartha Lakes	Bobcaygeon	Ontario	K0M1A0

UTM Coordinates: NAD 83 Zone 17 Easting 6196637 Northing 4937485

Municipal Plan and Sublot Number:

Other:

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
BROWN	SAND	GRAVEL	LOOSE	0	26
GREY/WHITE	DOLOMITE			26	180

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	26	BENTONITE	

Method of Construction

☐ Cable Tool ☐ Diamond ☐ Rotary (Conventional) ☐ Jetting ☐ Rotary (Reverse) ☐ Driving ☐ Boring ☐ Digging ☑ Air percussion ☐ Other, specify

Well Use

☐ Public ☐ Commercial ☐ Not used ☑ Domestic ☐ Municipal ☐ Dewatering ☐ Livestock ☐ Test Hole ☐ Monitoring ☐ Irrigation ☐ Cooling & Air Conditioning ☐ Industrial ☐ Other, specify

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6 1/8	STEEL	.188	0	160

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	To

Status of Well

☑ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Water Details

Water found at Depth (m/ft)	Kind of Water	Hole Diameter Depth From	To	Diameter (cm/in)
160 ☐ Gas	☑ Fresh ☐ Untested ☐ Other, specify	0	160	10
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	160	223	6
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify			

Results of Well Yield Testing

After test of well yield, water was: ☑ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft): 160'

Pumping rate (l/min / GPM): 3.6

Duration of pumping: 1 hrs + ____ min

Final water level end of pumping (m/ft): 29.6'

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft): 160'

Recommended pump rate (l/min / GPM): 3.6

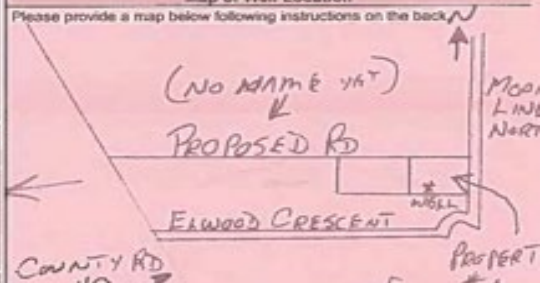
Well production (l/min / GPM): 3.0

Disinfected? ☑ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		26 1/2		
1	30.65		1	30.3
2	31.25		2	29.8
3	31.6		3	29.65
4	31.9		4	29.61
5	32.1		5	29.6
10	32.7		10	
15	32.75		15	
20	32.76		20	
25	32.75		25	
30			30	
40			40	
50			50	
60			60	

Map of Well Location

Please provide a map below following instructions on the back.



Comments: No SEPTIC SYSTEM YET

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
HALIBURTON ARTESIAN WELL DRILLERS	6016

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
BOX 423 HALIBURTON	DISART ETAL	ONT	K0M1S0	

Bus. Telephone No. (inc. area code): 7054457286

Name of Well Technician (Last Name, First Name): RUTTAN, RICK

Well Technician's Licence No.: 1112

Signature of Technician and/or Contractor:

Date Submitted: 2013/05/23

Well owner's information package delivered: ☑ Yes ☐ No

Date Package Delivered: 2013/05/23

Date Work Completed: 2013/05/23

Ministry Use Only — Audit No. Z263938

05068E (2014/11)

Well Owner's Copy

Ontario — Ministry of the Environment and Climate Change

Measurements recorded in: ☐ Metric ☒ Imperial

Well Tag No. (Place Sticker and/or Print Below): A104948

Lot 9

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 1

Well Owner's Information

First Name	Last Name / Organization	E-mail Address	☐ Well Constructed by Well Owner
	ANDERSON DEVELOPMENTS		

Mailing Address (Street Number/Name)	Municipality	Province	Postal Code	Telephone No. (inc. area code)
168 Kawartha Lakes Cty Rd #49	Bobcaygeon	Ont	K0M1A0	7058799426

Well Location

Address of Well Location (Street Number/Name)	Township	Lot	Concession
#12		19	19

County/District/Municipality	City/Town/Village	Province	Postal Code
Kawartha Lakes	Bobcaygeon	Ontario	K0M1A0

UTM Coordinates: NAD 83 Zone 17 Easting 694714 Northing 4937289

Municipal Plan and Sublot Number:

Other:

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
BROWN	SOIL		SOFT	0	3
BROWN	SAND		"	3	7
WHITE		DOLOMITE	"	7	140

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	BENTONITE	

Method of Construction

☐ Cable Tool ☒ Rotary (Conventional) ☐ Rotary (Reverse) ☐ Boring ☒ Air percussion ☐ Other, specify

☐ Diamond ☐ Jetting ☐ Driving ☐ Digging

Well Use

☐ Public ☒ Domestic ☐ Livestock ☐ Irrigation ☐ Industrial ☐ Other, specify

☐ Commercial ☐ Municipal ☐ Test Hole ☐ Cooling & Air Conditioning

☐ Not used ☐ Dewatering ☐ Monitoring

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	Depth (m/ft) To
6 1/8	STEEL	.188	0	22

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From	Depth (m/ft) To

Status of Well

☒ Water Supply ☐ Replacement Well ☐ Test Hole ☐ Recharge Well ☐ Dewatering Well ☐ Observation and/or Monitoring Hole ☐ Alteration (Construction) ☐ Abandoned, Insufficient Supply ☐ Abandoned, Poor Water Quality ☐ Abandoned, other, specify ☐ Other, specify

Water Details

Water found at Depth (m/ft)	Kind of Water	Hole Diameter Depth From (m/ft)	Depth To (m/ft)	Diameter (cm/in)
140 ☐ Gas	☒ Fresh ☒ Untested ☐ Other, specify	138	140	6 1/8
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	+2	22	10
(m/ft) ☐ Gas	☐ Fresh ☐ Untested ☐ Other, specify	+2	20	6

Results of Well Yield Testing

After test of well yield, water was: ☒ Clear and sand free ☐ Other, specify

If pumping discontinued, give reason:

Pump intake set at (m/ft)

Pumping rate (l/min / GPM): 3.6

Duration of pumping: 1 hrs + ____ min

Final water level end of pumping (m/ft)

If flowing give rate (l/min / GPM)

Recommended pump depth (m/ft): 140'

Recommended pump rate (l/min / GPM)

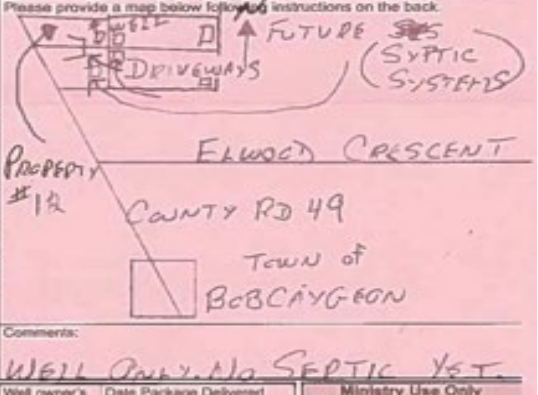
Well production (l/min / GPM): 10

Disinfected? ☒ Yes ☐ No

	Draw Down Time (min)	Draw Down Water Level (m/ft)	Recovery Time (min)	Recovery Water Level (m/ft)
Static Level		32'		
1	37.55		1	34.80
2	37.65		2	34.00
3	37.50		3	33.40
4	37.55		4	33.20
5	37.45		5	33.10
10	37.26		10	32.88
15	37.17		15	32.76
20	37.40		20	32.76
25	37.30		25	32.66
30	37.40		30	32.64
40	37.40		40	
50	37.32		50	1
60	37.18		60	32

Map of Well Location

Please provide a map below following instructions on the back.



Comments: WELL ONLY. No SEPTIC YET.

Well Contractor and Well Technician Information

Business Name of Well Contractor	Well Contractor's Licence No.
HALIBURTON ARTESIAN WELL DRILLERS	6016

Business Address (Street Number/Name)	Municipality	Province	Postal Code	Business E-mail Address
Box 423 Haliburton	Dysart et Al	Ont	K0M1S0	

Bus. Telephone No. (inc. area code)	Name of Well Technician (Last Name, First Name)	Well Technician's Licence No.	Signature of Technician and/or Contractor	Date Submitted
7054572686	RUTTIG RICK	T01112		2017 05 09

Well owner's information package delivered	Date Package Delivered	Date Work Completed
☐ Yes ☐ No	2017 05 09	2017 05 09

Ministry Use Only

Audit No. Z263937

Received

05082E (2014/11)

Well Owner's Copy

Appendix C
Nitrate Dilution

NITRATE DILUTION FOR SEPTIC SYSTEM DESIGN

Climate Data

Precipitation	882.20	mm/year	Climate data transferred from Evapotranspiration and Available Moisture Spreadsheet
Evapotranspiration	591.08	mm/year	
Potential Infiltration	291.12	mm/year	

Site Hydrology

Site Area	**211000.0**	m^2		
Infiltration Reduction Factor	0.5		**Table Entry**	**Manual Entry**
- Topography Component	**Rolling land, 2.8 < Savg < 3.8m/km**		0.2	
- Soil Component	**Medium Clay Loam**		0.2	
- Cover Component	**Cultivated Lands**		0.1	
Net Potential Infiltration	0.15	m/year		

Hydraulics and Chemistry

Background Nitrate Concentration	**0.0**	mg/L	Background Dilusion Potential of the Entire Site
Rainfall Infiltration	30,713,103	L/year	
Natural Nitrate Loading	0.0	mg/year	

Effluent Nitrate Concentration	**40.0**	mg/L	Loading from One Septic System
Volume of Wastewater	**1000**	L/day/system	
	365,000	L/year/system	
Septic System Nitrate Loading	14,600,000	mg/year/system	

Calculation Method	**Calculate the number of allowable lots (i.e. num. of septic systems)**		
Max. allowable nitrate loading at property boundary	**10.0**		Maximum allowable number of septic systems at the site or the concentration at the property boundary with a known number of septic systems
Number of Septic Systems	X		
Total Nitrate Loading from all onsite Septic Systems	408,800,000		
	mg/L		
Max. Number of Septic Systems	**X = 28**		

NITRATE DILUTION FOR SEPTIC SYSTEM DESIGN

Climate Data

Precipitation	882.20	mm/year	Climate data transferred from Evapotranspiration and Available Moisture Spreadsheet
Evapotranspiration	591.08	mm/year	
Potential Infiltration	291.12	mm/year	

Site Hydrology

Site Area	**211000.0**	m^2		
Infiltration Reduction Factor	0.5		**Table Entry**	**Manual Entry**
- Topography Component	**Rolling land, 2.8 < Savg < 3.8m/km**		0.2	
- Soil Component	**Medium Clay Loam**		0.2	
- Cover Component	**Cultivated Lands**		0.1	
Net Potential Infiltration	0.15	m/year		

Hydraulics and Chemistry

Background Nitrate Concentration	**0.0**	mg/L	Background Dilusion Potential of the Entire Site
Rainfall Infiltration	30,713,103	L/year	
Natural Nitrate Loading	0.0	mg/year	

Effluent Nitrate Concentration	**40.0**	mg/L	Loading from One Septic System
Volume of Wastewater	**1000**	L/day/system	
	365,000	L/year/system	
Septic System Nitrate Loading	14,600,000	mg/year/system	

Calculation Method	**Calculate the concentration at the property edge**		
Max. allowable nitrate loading at property boundary		**8.29 mg/L**	Maximum allowable number of septic systems at the site or the concentration at the property boundary with a known number of septic systems
Number of Septic Systems		**22**	
Total Nitrate Loading from all onsite Septic Systems		321,200,000	
		mg/L	
Max. Number of Septic Systems		--	

Appendix D
Pumping Test Results

Pumping Test Data

Project Name ANDERSON DEVELOPMENT **MOECC Well I.D.:** A104943

Project Number 17-1-6801

Test Well Lot 13

Pumping Rate: 3.6 GPM (US)
13.6 LPM

Date 6/8/2017 (m/dd/yyyy)

Drawdown: 3.32 feet
1.012 m

Static Level 29.6 feet TOP OF CASING **95% Recovery Target:** 29.766 feet
9.02 m CASING HEIGHT = 2.83FT 9.073 m

Pump Time	Water Level		Chlorine	Turbidity	Notes:	Recovery Time	Water Level	
	(Feet)	(Meters)	(mg/L)	(NTU)			(Feet)	(Meters)
1 min	30.65	9.34				1	30.3	9.24
2 min	31.25	9.53				2	29.8	9.08
3 min	31.6	9.63				3	29.62	9.03
4 min	31.9	9.72				4	29.61	9.03
5 min	32.1	9.78				5	29.6	9.02
6 min	32.4	9.88				6	0	0.00
7 min	32.5	9.91				7	0	0.00
8 min	32.6	9.94				8	0	0.00
9 min	32.6	9.94				9	0	0.00
10 min	32.7	9.97		12.90		10	0	0.00
12 min	32.75	9.98				12	0	0.00
14 min	32.75	9.98				14	0	0.00
16 min	32.75	9.98				16	0	0.00
18 min	32.75	9.98				18	0	0.00
20 min	32.76	9.99				20	0	0.00
25 min	32.75	9.98				25	0	0.00
30 min	32.8	10.00				30	0	0.00
35 min	32.92	10.03				35	0	0.00
40 min	32.92	10.03				40	0	0.00
50 min	32.92	10.03	<2			50	0	0.00
1 h	32.8	10.00		73.40		60	0	0.00
1 h 10 min	32.77	9.99				70	0	0.00
1 h 20 min	32.75	9.98				80	0	0.00
1 h 30 min	32.75	9.98				90	0	0.00
2 h	32.67	9.96		4.90		120	0	0.00
2 h 30 min	32.65	9.95						
3 h	32.64	9.95		2.75		Next Day:		0.00
3 h 30 min	32.64	9.95						
4 h	32.65	9.95		1.94				
4 h 30 min	32.67	9.96						
5 h	32.65	9.95		1.06				
5 h 30 min	32.65	9.95						
6 h	32.65	9.95	0	0.89				

Project Name ANDERSON DEVELOPMENT **MOECC Well I.D.:** A104944

Project Number 17-1-6801

Test Well Lot 20

Pumping Rate: 3.6 GPM (US)
13.6 LPM

Date 6/7/2017 (m/dd/yyyy)

Drawdown: 1.22 feet
0.372 m

Static Level 21.45 feet TOP OF CASING
6.54 m CASING HEIGHT = 2.65FT

95% Recovery Target: 21.511 feet
6.557 m

Pump Time	Water Level		Chlorine	Turbidity	Notes:	Recovery	Water Level	
	(Feet)	(Meters)	(mg/L)	(NTU)		Time (min)	(Feet)	(Meters)
1 min	22.9	6.98				1	21.85	6.66
2 min	22.55	6.87				2	21.73	6.62
3 min	22.45	6.84				3	21.67	6.61
4 min	22.35	6.81				4	21.67	6.61
5 min	22.35	6.81				5	21.66	6.60
6 min	22.35	6.81				6	21.66	6.60
7 min	22.4	6.83				7	21.65	6.60
8 min	22.43	6.84				8	21.65	6.60
9 min	22.43	6.84				9	21.65	6.60
10 min	22.43	6.84		93.30		10	21.65	6.60
12 min	22.46	6.85				12	21.65	6.60
14 min	22.47	6.85				14	21.65	6.60
16 min	22.53	6.87				16	21.64	6.60
18 min	22.53	6.87				18	21.64	6.60
20 min	22.5	6.86				20	21.64	6.60
25 min	22.6	6.89				25	21.63	6.59
30 min	22.6	6.89				30	21.62	6.59
35 min	22.54	6.87				35	21.62	6.59
40 min	22.55	6.87				40	21.61	6.59
50 min	22.55	6.87	<2			50	21.6	6.58
1 h	22.56	6.88		76.60		60	21.59	6.58
1 h 10 min	22.58	6.88				70	21.57	6.57
1 h 20 min	22.59	6.89				80	21.56	6.57
1 h 30 min	22.6	6.89				90	21.54	6.57
2 h	22.56	6.88		8.21		120	21.51	6.56
2 h 30 min	22.55	6.87						
3 h	22.56	6.88		3.28		Next Day:	21.45	6.54
3 h 30 min	22.59	6.89						
4 h	22.61	6.89		1.77				
4 h 30 min	22.62	6.89						
5 h	22.64	6.90		1.54				
5 h 30 min	22.65	6.90						
6 h	22.67	6.91	0	1.67				

Project Name ANDERSON DEVELOPMENT **MOECC Well I.D.:** A104942

Project Number 17-1-6801

Test Well Lot 9

Pumping Rate: 3.6 GPM (US)
13.6 LPM

Date 5/30/2017 (m/dd/yyyy)

Drawdown: 5.96 feet
1.817 m

Static Level 32.0 feet TOP OF CASING **95% Recovery Target:** 32.058 feet
9.75 m CASING HEIGHT = 1.1FT 9.771 m

Pump Time	Water Level		Chlorine	Turbidity	Notes:	Recovery	Water Level	
	(Feet)	(Meters)	(mg/L)	(NTU)		Time (min)	(Feet)	(Meters)
1 min	37.55	11.45				1	34.8	10.61
2 min	37.65	11.48				2	34	10.36
3 min	37.5	11.43				3	33.4	10.18
4 min	37.55	11.45				4	33.2	10.12
5 min	37.45	11.41				5	33.1	10.09
6 min	37.26	11.36				6	33.02	10.06
7 min	37.17	11.33				7	32.97	10.05
8 min	37.4	11.40				8	32.91	10.03
9 min	37.3	11.37				9	32.9	10.03
10 min	37.4	11.40		128.00		10	32.88	10.02
12 min	37.4	11.40				12	32.84	10.01
14 min	37.22	11.34				14	32.8	10.00
16 min	37.22	11.34				16	32.76	9.99
18 min	37.18	11.33				18	32.67	9.96
20 min	37.18	11.33				20	32.67	9.96
25 min	36.95	11.26				25	32.66	9.95
30 min	36.98	11.27				30	32.64	9.95
35 min	37.91	11.55				35	32.59	9.93
40 min	37.75	11.51				40	32.55	9.92
50 min	37.65	11.48	0			50	32.5	9.91
1 h	37.7	11.49		4.17		60	32.44	9.89
1 h 10 min	37.72	11.50				70	32.4	9.88
1 h 20 min	37.73	11.50				80	32.35	9.86
1 h 30 min	37.82	11.53				90	32.31	9.85
2 h	37.87	11.54		3.50		120	32.15	9.80
2 h 30 min	37.93	11.56						
3 h	37.95	11.57		6.74		Next Day:	32	9.75
3 h 30 min	37.96	11.57						
4 h	37.9	11.55		11.10				
4 h 30 min	37.87	11.54						
5 h	37.89	11.55		8.89				
5 h 30 min	37.87	11.54						
6 h	37.84	11.53	0	5.83				

Project Name ANDERSON DEVELOPMENT **MOECC Well I.D.:** A104945

Project Number 17-1-6801

Test Well Lot 5

Pumping Rate: 3.6 GPM (US)
13.6 LPM

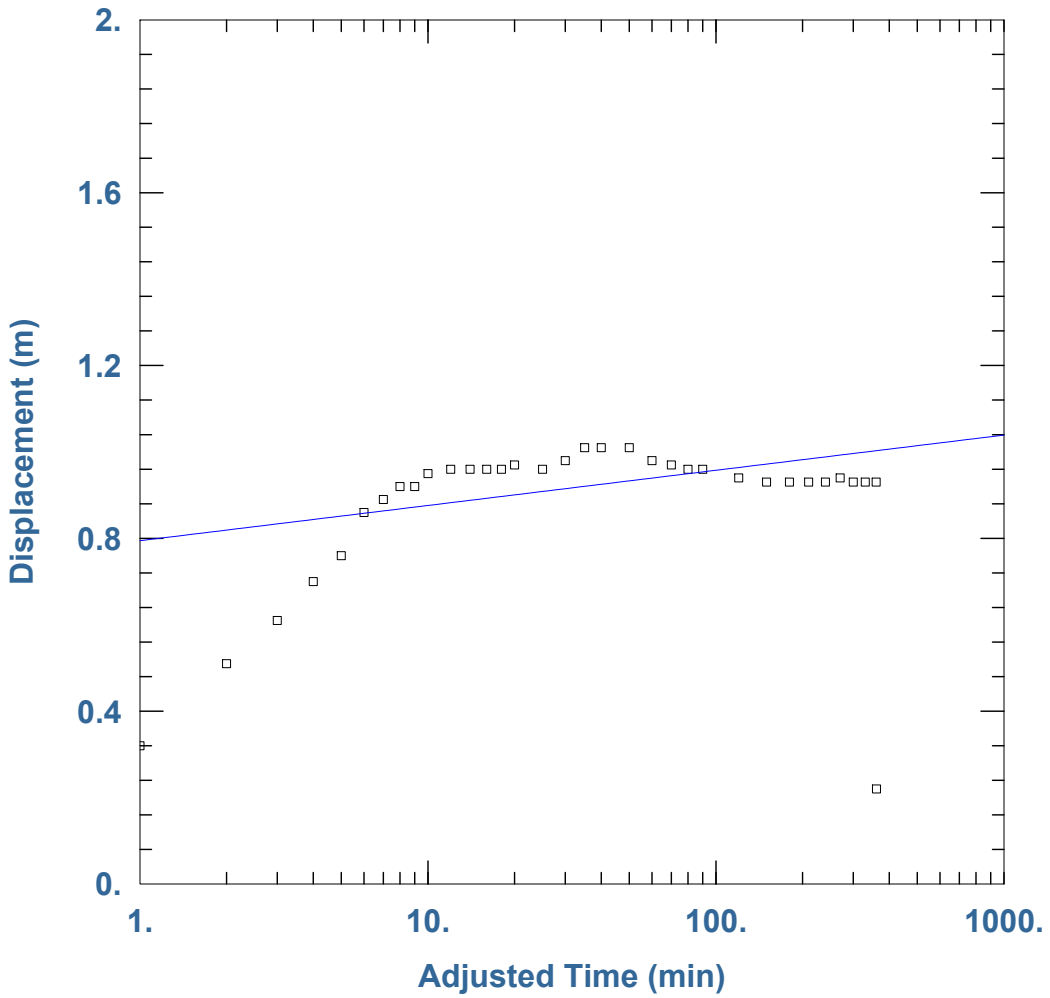
Date 5/31/2017 (m/dd/yyyy)

Drawdown: 0.60 feet
0.183 m

Static Level 34.1 feet TOP OF CASING **95% Recovery Target:** 34.13 feet
10.39 m CASING HEIGHT = 2.2FT 10.403 m

Pump Time	Water Level		Chlorine	Turbidity	Notes:	Recovery Time	Water Level	
	(Feet)	(Meters)	(mg/L)	(NTU)			(Feet)	(Meters)
1 min	34.67	10.57				1	34.13	10.40
2 min	34.65	10.56				2	34.1	10.39
3 min	34.67	10.57				3	34.1	10.39
4 min	34.67	10.57				4	34.1	10.39
5 min	34.67	10.57				5	34.1	10.39
6 min	34.67	10.57				6		0.00
7 min	34.69	10.57				7		0.00
8 min	34.67	10.57				8		0.00
9 min	34.7	10.58				9		0.00
10 min	34.7	10.58		14.60		10		0.00
12 min	34.7	10.58				12		0.00
14 min	34.7	10.58				14		0.00
16 min	34.7	10.58				16		0.00
18 min	34.7	10.58				18		0.00
20 min	34.7	10.58				20		0.00
25 min	34.7	10.58				25		0.00
30 min	34.7	10.58				30		0.00
35 min	34.7	10.58				35		0.00
40 min	34.67	10.57				40		0.00
50 min	34.67	10.57	<2			50		0.00
1 h	34.66	10.56		17.60		60		0.00
1 h 10 min	34.66	10.56				70		0.00
1 h 20 min	34.65	10.56				80		0.00
1 h 30 min	34.65	10.56				90		0.00
2 h	34.6	10.55		30.90		120		0.00
2 h 30 min	34.55	10.53						
3 h	34.53	10.52		6.23				
3 h 30 min	34.52	10.52						
4 h	34.52	10.52		2.55				
4 h 30 min	34.52	10.52						
5 h	34.51	10.52	0.03	1.95	Extra Chlorine Reading			
5 h 30 min	34.51	10.52						
6 h	34.5	10.52	0	0.95				

Pumping Test Results



Proposed Lot 13

Data Set: J:\...\PumpTest_Well 13_Displacement.aqt
Date: 10/29/18 Time: 14:40:43

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 13
Test Date: June 8, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104943	694747	4937289

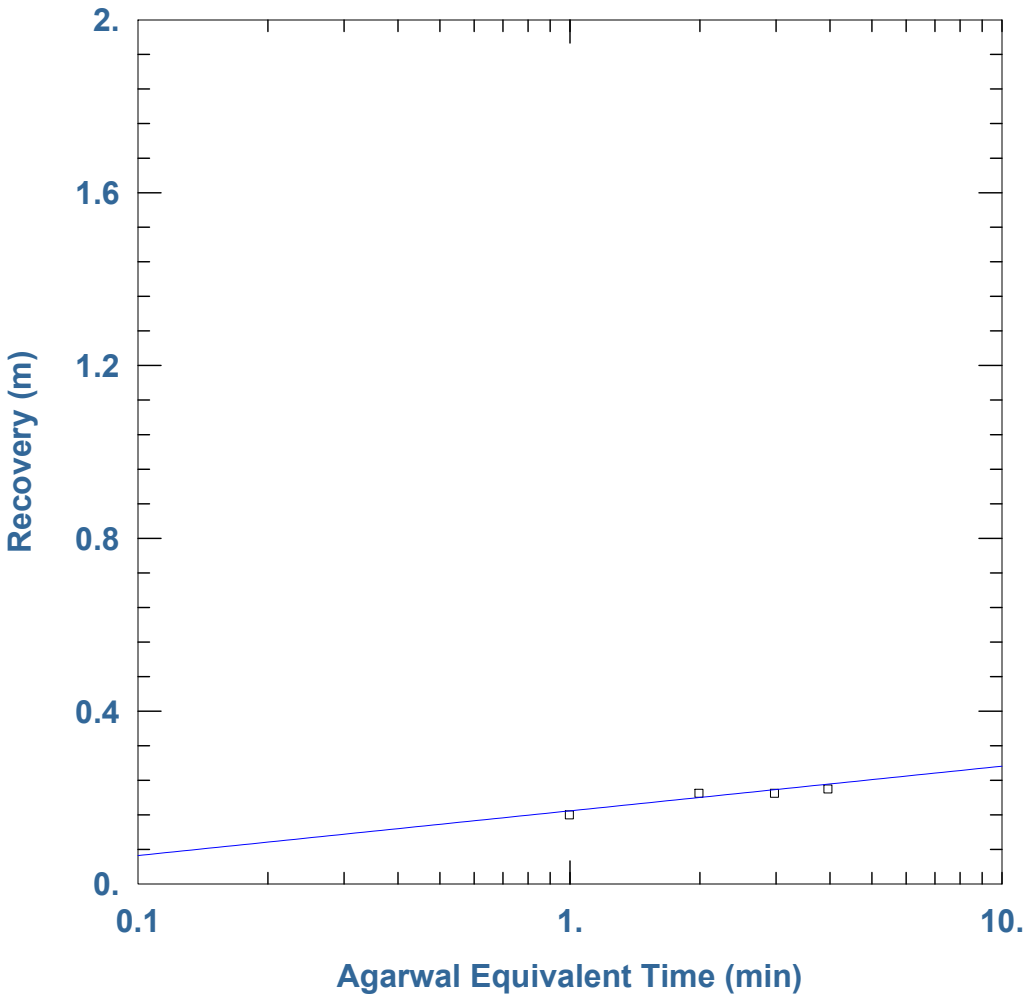
Observation Wells

Well Name	X (m)	Y (m)
A104943	694747	4937289

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 44.14 m^2/day S = 5.241E-10



Proposed Lot 13

Data Set: J:\...\PumpTest_Lot 13_Recovery.aqt
Date: 10/29/18 Time: 14:46:54

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 13
Test Date: June 8, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104943	694747	4937289

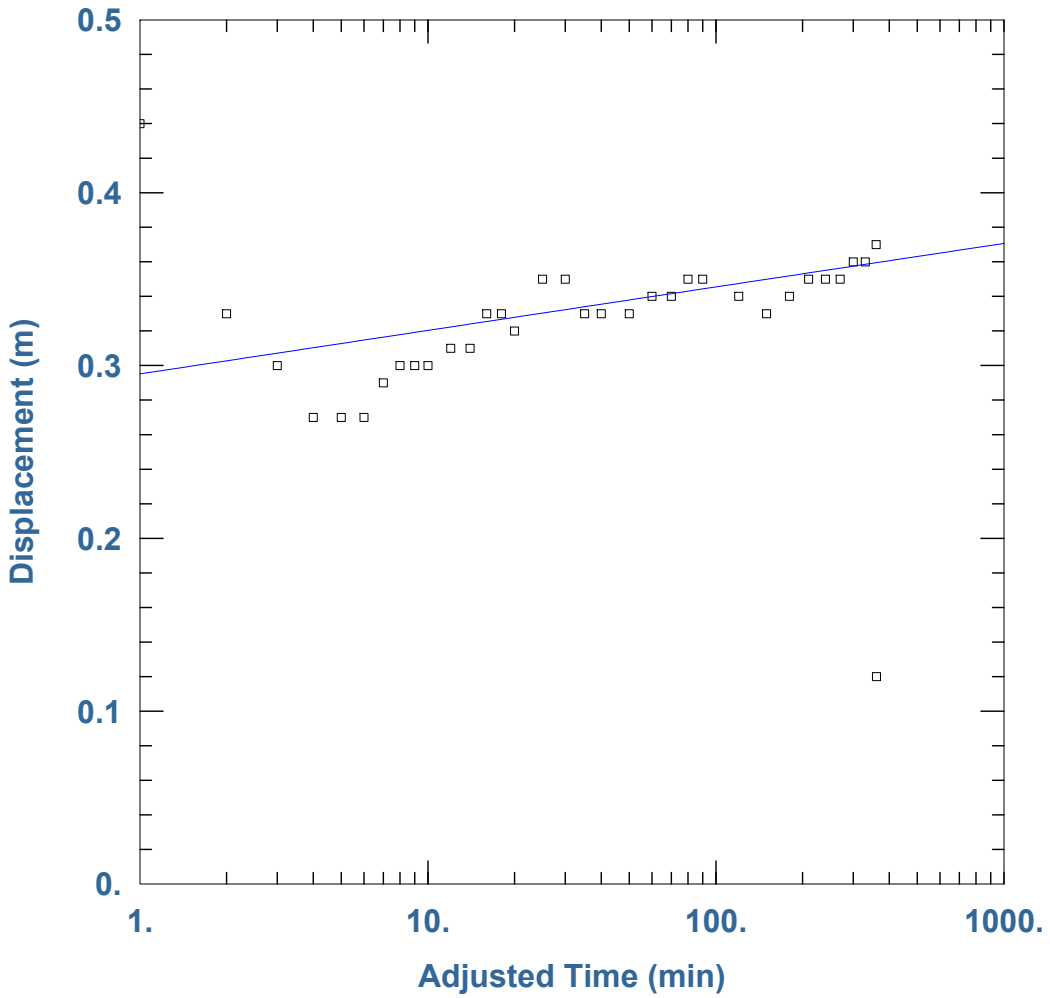
Observation Wells

Well Name	X (m)	Y (m)
▫ A104943	694747	4937289

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 34.76 m^2/day S = 0.05439



Proposed Lot 20

Data Set: J:\...\PumpTest_Well 20_Displacement.aqt
Date: 10/29/18 Time: 14:38:07

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 20
Test Date: June 8, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104944	695259	4937480

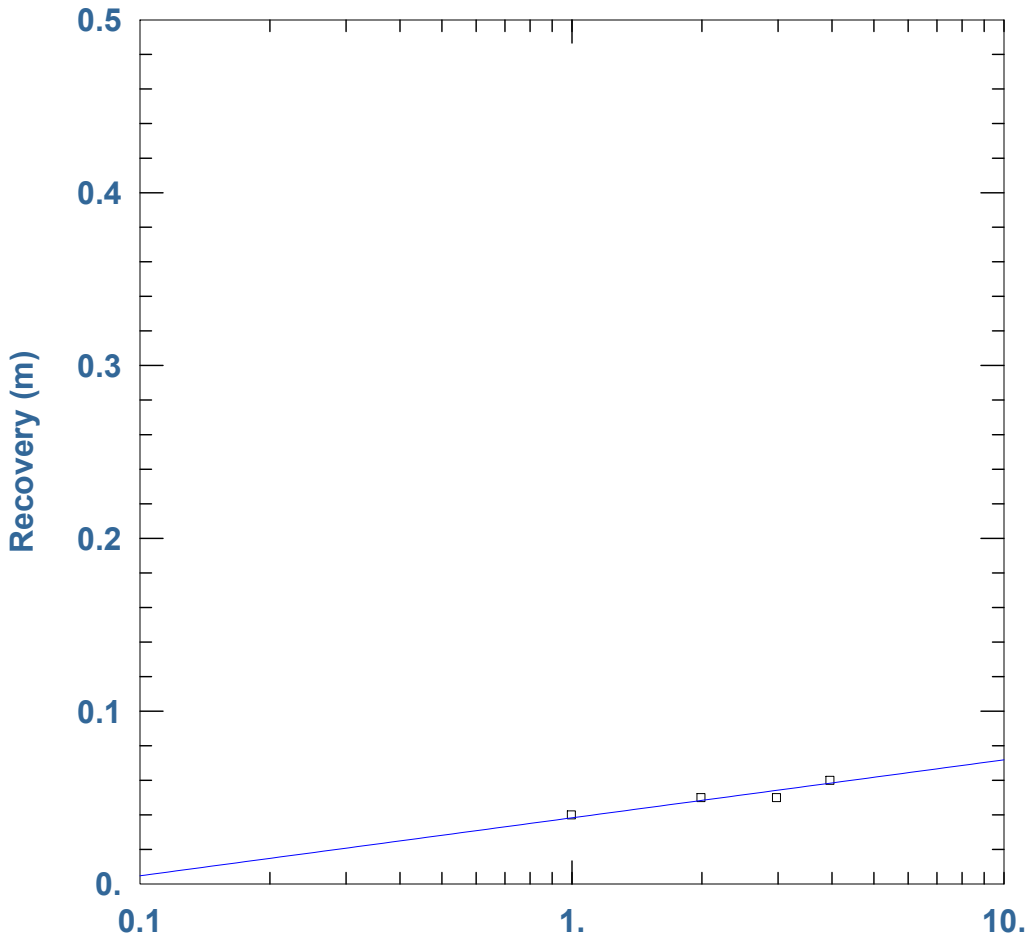
Observation Wells

Well Name	X (m)	Y (m)
A104944	695259	4937480

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 142.9 m^2/day S = 1.809E-11



Proposed Lot 20

Data Set: J:\...\PumpTest_Well 20_Recovery.aqt
Date: 10/29/18 Time: 14:39:02

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 20
Test Date: June 8, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104944	695259	4937480

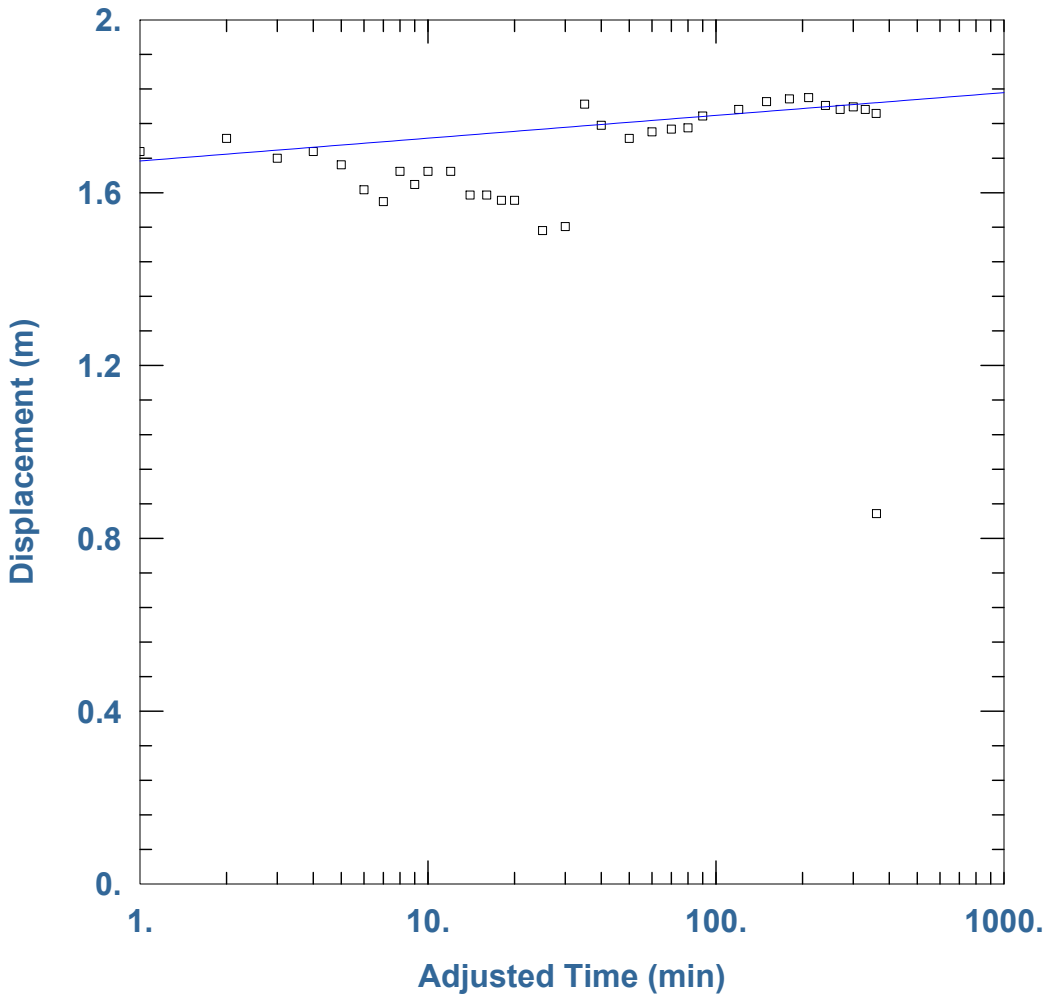
Observation Wells

Well Name	X (m)	Y (m)
A104944	695259	4937480

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 107.2 m^2/day S = 0.5243



Proposed Lot 9

Data Set: J:\...\PumpTest_Well 9_Displacement.aqt
Date: 10/29/18 Time: 14:26:32

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 9
Test Date: May 30, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104942	694747	4937289

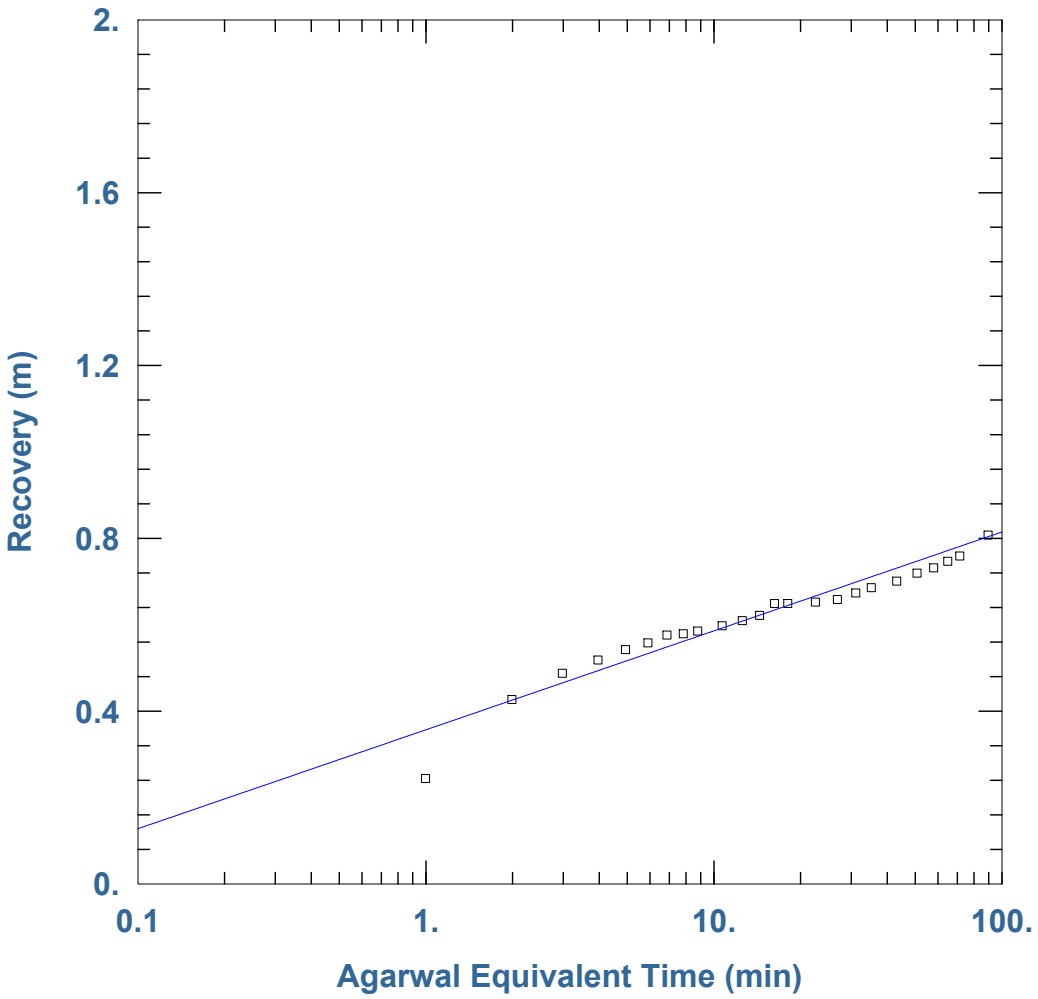
Observation Wells

Well Name	X (m)	Y (m)
A104942	694747	4937289

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 68.14 m^2/day S = 8.917E-32



Proposed Lot 9

Data Set: J:\...\PumpTest_Well 9_Recovery.aqt
Date: 10/29/18 Time: 14:29:10

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 9
Test Date: May 30, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104942	694747	4937289

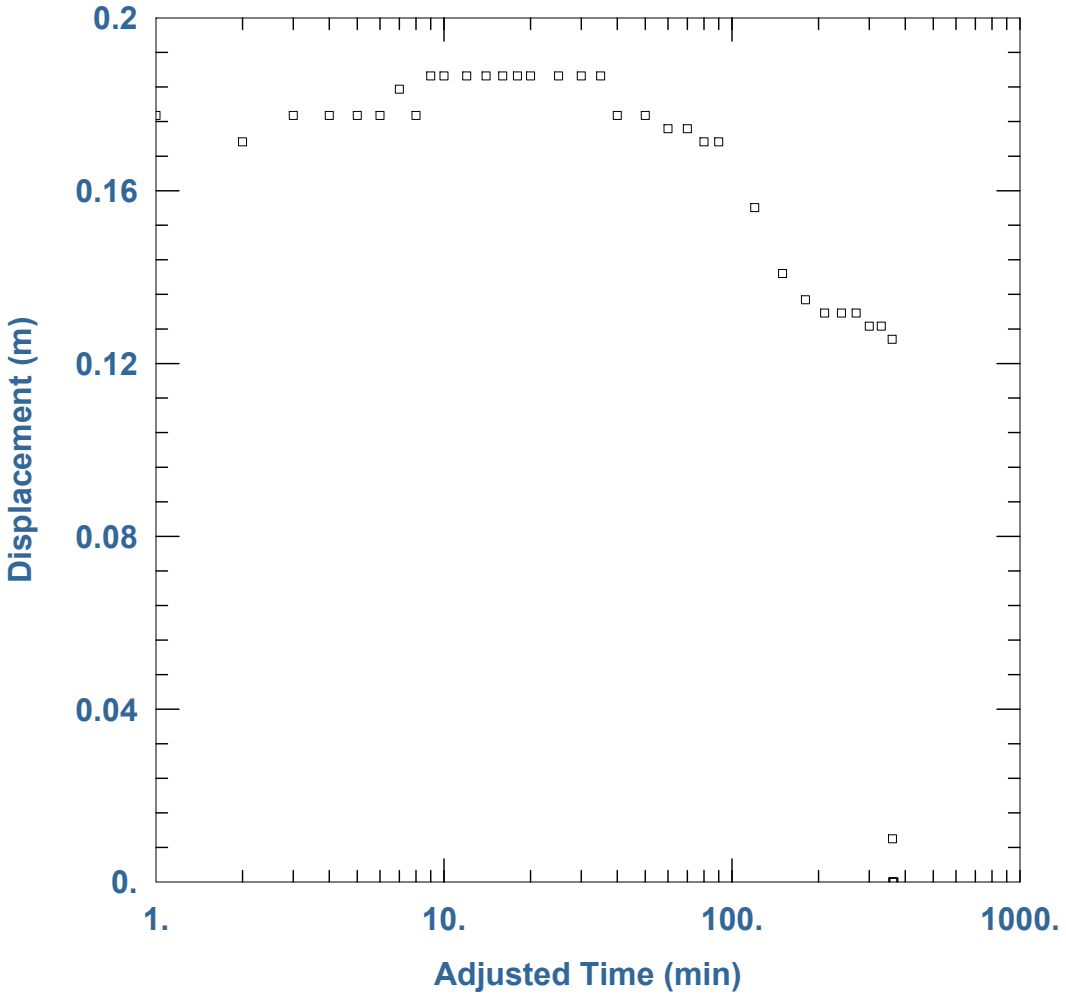
Observation Wells

Well Name	X (m)	Y (m)
A104942	694747	4937289

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 15.7 m^2/day S = 0.02931



Proposed Lot 5

Data Set: J:\...\PumpTest_Well 5_Displacement.aqt
Date: 10/29/18 Time: 14:32:46

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 5
Test Date: May 31, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

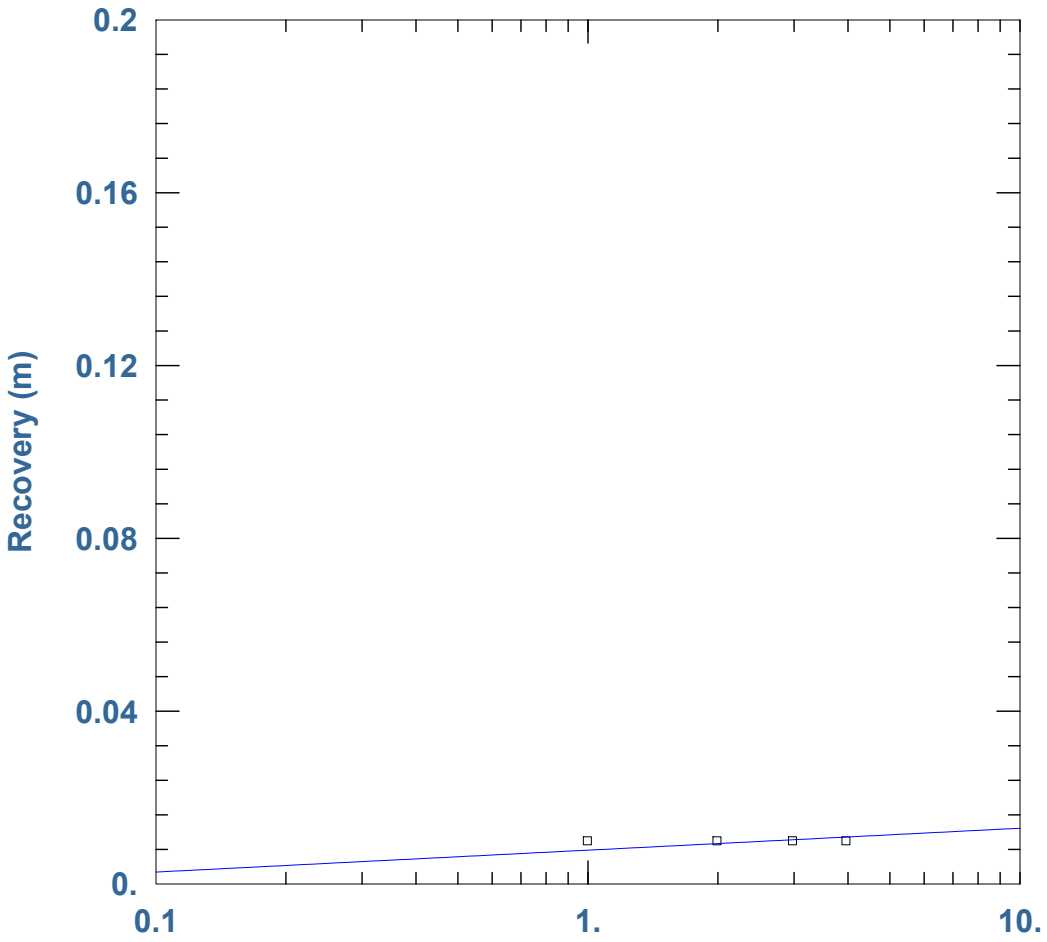
WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104945	694910	4937413

Observation Wells

Well Name	X (m)	Y (m)
▫ A104945	694910	4937413



Proposed Lot 5

Data Set: J:\...\PumpTest_Well 2_Recovery.aqt
Date: 10/29/18 Time: 14:34:28

PROJECT INFORMATION

Company: Jp2g Consultants Inc.
Client: Anderson Developments
Project: 17-6053A
Location: Anderson Subdivision Plan
Test Well: Lot 5
Test Date: May 31, 2017

AQUIFER DATA

Saturated Thickness: 50. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
A104945	694910	4937413

Observation Wells

Well Name	X (m)	Y (m)
▫ A104945	694910	4937413

SOLUTION

Aquifer Model: Confined Solution Method: Cooper-Jacob

T = 708.7 m^2/day S = 1.379