Hydrogeological Assessment Report 1386 & 1394 Greely Lane, Ottawa, Ontario

November 11, 2024

Prepared for:
Cassidy EW Construction Consultant Ltd.

Cambium Reference: 17281-002

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1.0 Introduction

Cambium Inc. (Cambium) was retained by Cassidy EW Construction Consultant Ltd. (the Client) to complete a hydrogeological assessment and terrain analysis for the proposed redevelopment of the land located at 1386 and 1394 Greely Lane, Ottawa, Ontario (the Site).

The purpose of the field work and testing was to obtain information on the general subsurface and groundwater conditions at the Site by means of groundwater monitoring well measurements, as well as field and laboratory tests. This report addresses the hydrogeological aspects of the subsurface conditions at the Site. Cambium has also completed a Geotechnical Investigation (Cambium, 2023a) and a Phase Two Environmental Site Assessment (Cambium, 2023b) prior to the hydrogeological assessment and relevant details of these investigations have been incorporated into this report. Detailed information from the Geotechnical Investigation and the Phase Two Environmental Site Assessment were provided under separate cover.

This report provides the results of the hydrogeological assessment and should be read in conjunction with the “Standard Limitations” in Section 11.0, which forms an integral part of this document. The reader’s attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report. The data, interpretations, and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location, or elevation, or if the project is not initiated within eighteen months of the date of the report, Cambium should be given an opportunity to confirm that the recommendations in this report are still valid.

1.1 Site Description

The Site is an irregularly shaped 0.47 ha (1.15 acres) property that is developed for commercial use. It contains a single-storey commercial car wash building, two temporary sea-can storage units, and an additional single storey metal storage building adjacent to the commercial building. A driveway connects to the adjacent Greely Lane at two locations on the

north side of the site. The remainder of the property is landscaped, with the southern portion of the Site predominantly occupied by a septic bed raised at a higher elevation than the grade. The Site is bound by Greely Lane to the east, Parkway Road to the south, and commercial/light industrial use to the north and west.

Based on discussions with the Client and preliminary site sketches provided to Cambium, it understood that the proposed plan is to construct one 1,110 m^2 (12,000 ft^2) building for light industrial use which will be divided in three 370 m^2 (4,000 ft^2) units with two loading bays, two washrooms, and an estimated 5 employees for each unit. The building will be constructed slab-on-grade with perimeter foundations that will extend to below the local frost penetration depths. The development will include at grade parking and driveways to access delivery doors at the backs of each building.

The proposed finished floor elevations (FFE) have not yet been determined; however, it is anticipated that the grades of the Site will not differ significantly from the current grades of the property, exclusive of the raised septic bed on the southern property. The grade there will be lowered as a result of removal of the septic bed.

The regional location of the Site is identified on Figure 1, the property and surrounding areas are outlined on Figure 2, and a Site plan is included in Appendix A.

2.0 Physical Setting

2.1 Topography and Drainage

Based on regional topographic maps the Site area is relatively flat with a gentle slope to the east-southeast towards the North Castor River. The Site has a raised septic bed located in the southern portion of the property with a topographic high of approximately 100 meters above sea level (masl).

The Site is located within the Castor River quaternary watershed and the North Castor River is located approximately 250 m south-southeast of the Site. North Castor River subsequently flows eastward into South Nation River, which is a tributary to Ottawa River.

Regionally, surface elevation decreases to the east toward Ottawa River. It is assumed that local drainage will follow the local surficial topography and flow towards the south-southeast ultimately discharging into the North Castor River. Based on the location of the nearest water bodies and topographic relief, the inferred that the regional groundwater flow direction is easterly.

2.2 Physiography

The Site is located in the physiographic region known as the Russell and Prescott Sand Plains (Chapman & Putnam, 1984). The Russell and Prescott Sand Plains region covers and area of approximately 1,490 km^2 extending from Ottawa to Hawkesbury. The Sand Plains are a relatively flat region with a clay valley located to the south, which was formed as a delta by the Ottawa River and tributaries of the Champlain Sea. The sand deposits have a thickness of 5 m to 10 m in the northern region of the plains and thin towards the clay plains of the south. The sand plains consist of coarser grained sands to the north grading into fine sand to silt in the south. The region is underlain by stratified red and grey clays (Appendix A).

2.3 Overburden Geology

According to Miscellaneous Release – Data 128 from the Ontario Geological Survey (2010) the predominant overburden of the Site consists of coarse-textured glaciomarine deposits (sand, gravel, minor silt and clay) (Appendix A).

2.4 Bedrock Geology

According to Miscellaneous Release – Data 219 from the Ontario Geological Survey (2007), the bedrock in the area of the Site consists of the Beekmantown Group. The Beekmantown Group consists of two formations: the March and Oxford Formations. The bedrock of the Site consists of the Oxford Formation and is described as dolostone, minor shale and sandstone (Appendix A).

2.5 Vulnerable and Regulated Areas

The Site is situated within the South Nation Source Protection Area, under jurisdiction of the South Nation Conservation Authority, as per the Source Water Protection Information Atlas (SPIA) from the Ministry of the Environment, Conservation and Parks (MECP) (2024a). The Site is within the following areas:

- Intake Protection Zone 3 (IPZ-3) with a vulnerability score of 7
- Significant Ground Water Recharge Area (SGRA) with a vulnerability score of N/A
- Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6

IPZs are areas surrounding water courses and lakes which have surface water intakes for water supply. There is potential that contaminants spilled within IPZs may reach intakes more quickly than the ability to take appropriate action to shut down the intake should a spill occur. IPZ-3s are defined as event-based areas only. They are areas that can contribute contaminants under an extreme event (e.g., high winds or heavy rain) at a concentration that would result in deterioration of untreated source water. Best management practices should be used to minimize the potential for the release of chemicals to the environment during future operations at the Site.

SGRAs are landscape surfaces which allow a high volume of water to infiltrate into the ground. A recharge area is classified as significant if the recharge rate for a particular area is greater than the average watershed recharge rate by 15% or more and the area has a hydrological connection to a surface water body or to an aquifer that is a source of groundwater for a drinking water system (Ministry of the Environment, Conservation and Parks, 2021). SGRAs are delineated using models which consider topography, surficial soil, land cover and climate. The SGRA in the vicinity of the Site does not have a vulnerability score associated with it. Efforts should be made to maintain the Site pre-development water balance as much as practicable following redevelopment. Water balance information is presented in Section 6.0.

HVAs are aquifers that are more sensitive to contamination as a result of the proximity to surface (shallow aquifers). By default, all HVA's have a vulnerability score of 6. Best management practices should be used to minimize the potential for the release of chemicals to the subsurface environment during future operations at the Site.

A review of the Natural Heritage System database from the Ministry of Natural Resources and Forestry (2024) indicates the Site is not located within any Areas of Natural and Scientific Interest.

The Site does not fall under a regulated area, as per the South Nation Conservation Authority or O.Reg. 41/24.

The source protection, natural heritage, and conservation area mapping is attached in Appendix A.

3.0 Subsurface Investigation

Cambium staff completed a borehole investigation at the Site on March 7th to 8th, 2023, to assess subsurface conditions. A total of nine boreholes, designated as BH101-23 through BH109-23, were advanced at the Site to depths ranging from approximately 3.7 to 6.7 meters below ground surface (mbgs). Test pit locations are shown in Figure 3 and test pit logs are included in Appendix B.

3.1 Borehole Logs

Subsurface conditions generally consist of surficial deposits of pavements or topsoil overlying a relatively thin deposit of fill overlying native deposits of clays and silts.

A summary of general lithological details obtained from the investigation is presented below.

Topsoil

Topsoil was encountered from the surface of all boreholes with the exception BH101-23 and BH108-23. The thickness of the topsoil ranges from 0.10 to 0.91 m.

Asphaltic Concrete

Asphaltic concrete was encountered from the surface of BH101-23 and BH108-23 that were advanced in the existing paved areas. The thickness of the asphalt measures 0.08 and 0.05 m in BH101-23 and BH108-23, respectively.

Base Material

Pavement base material was encountered underlying the asphaltic concrete. The base material is composed of brown gravelly sand with some silt. The thickness of the material measures 380 and 560 mm in BH101-23 and BH108-23, respectively.

Fill Material

Fill material other than the pavement structure was encountered at all borehole locations. The fill material varies slightly in composition between borehole locations but is predominantly composed of silty sandy. The material ranges from trace gravel to gravelly, and trace clay was

noted in BH105-23 and BH107-23. Roots were noted within the fill material in BH102-23. The fill material varies in colour between brown and grey depending on location.

The thickness of the fill material ranges from 0.1 to 1.4 m and extends to depth ranging from 0.3 to 1.5 mbgs.

Clayey Silt

Native deposits of grey, sandy, clayey silt were encountered underlying the fill material at all borehole locations at depths ranging from 0.3 to 1.5 mbgs. A notable decrease in clay content was observed in BH103-23 and BH104-23 at a depth of 2.3 mbgs as the material transitions to the non-cohesive underlying deposits.

Boreholes BH108-23 and BH109-23 terminated within the clayey silt deposits at depths of 1.5 mbgs. The deposit was fully penetrated at all other borehole locations. The thickness of the deposits at these locations ranges from 0.9 to 2.3 m, and the deposits extend to depths ranging from 2.3 to 3.2 mbgs.

Silty Sand

A native deposit of grey silty sand was observed in BH101-23 underlying the clayey silt deposit at a depth of 2.6 mbgs. The deposit measures 0.5 m in thickness and extends to a depth of 3.1 mbgs. A seam similar in composition was noted in BH104-23 at a depth of 3.1 mbgs. The seam measured 0.10 m.

Silt

Native deposits of silt were encountered underlying the clayey silt and silty sand in boreholes BH101-23 through BH107-23. The deposit is grey in colour and contains some sand to sandy and trace clay.

The silt deposits were encountered at depths ranging from 2.3 to 3.2 mbgs. Where encountered, all boreholes terminated within the silt at depths ranging from 3.7 to 6.7 mbgs.

Groundwater

Groundwater was observed at all borehole locations during drilling. Unstabilized groundwater level measurements were recorded upon completion of drilling and monitoring wells were installed in three locations (BH105-23, BH106-23, and BH107-23) to enable further characterization. A subsequent monitoring event was completed as part of Phase II ESA work, as well as during hydraulic testing detailed later in this report (Section 4.2). As demonstrated in Table 1, there is significant variability in groundwater levels, which is expected within shallow unconfined aquifers.

Table 1 Summary of Measured Water Levels

Borehole ID	Water Level (mbgs)		
	Post-drilling	March 15, 2023	April 19, 2024
BH101-23	1.1	-	-
BH102-23	1.5	-	-
BH103-23	0.9	-	-
BH104-23	0.6	-	-
BH105-23	2.0	1.3	0.62
BH106-23	1.5	0.9	0.30
BH107-23	1.8	1.1	0.36
BH108-23	0.8	-	-
BH109-23	1.1	-	-

Further well construction details for the three monitoring wells are provided in Table 2.

Table 2 Monitoring Well Construction Details

Well ID	Surface Elevation (masl)	Well Depth (mbgs)	Well Casing Stick-up (mags[1])	Screen Details	
				Top of Screen (mbgs)	Bottom of Screen (mbgs)
BH105-23	100.65	3.06	0.92	0.62	3.06
BH106-23	100.38	2.75	1.00	0.31	2.75
BH107-23	99.86	3.05	0.75	0.61	3.05

[1] meters above ground surface

All monitoring wells with water were developed after installation. Development involved purging ten well volumes of groundwater or three times dry from the wells by hand pumping with Waterra tubing and a foot valve.

3.2 Physical Laboratory Testing

Physical laboratory testing, including grain size distribution analysis, was completed on four soil samples to confirm textural classification identified during field logging and obtain percolation rate estimates. Analysis results are based on the Unified Soil Classification System (USCS) scale. A summary of results is provided in Table 3. Complete laboratory analysis reports are provided in Appendix C.

Table 3 Grain Size Distribution Analysis Results

Sample Location	Depth (mbgs)	Description	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	T-time (min/cm)
BH101-23 SS3	1.5 to 2.1	Sandy Clayey Silt	0	22	57	21	40
BH101-23 SS6	3.8 to 4.4	Silt some Sand trace Clay	0	19	77	4	20
BH104-23 SS4	2.3 to 2.9	Sandy Silt some Clay	0	25	57	18	35
BH104-23 SS6	3.8 to 4.4	Sandy Silt trace Clay	0	22	74	4	20

4.0 Groundwater Investigation

The results obtained for the water supply assessment are discussed in the following subsections.

4.1 Well Inventory Survey

4.1.1 MECP Well Records Assessment

Cambium accessed the MECP Water Well Information System (WWIS) to review water well records within 500 m of the Site (Ministry of the Environment, Conservation and Parks, 2024b). A total of 73 records were identified, 64 of which describe wells installed into bedrock and 9 installed into overburden. The records identified two monitoring/test wells, two abandoned wells, three recharge well and the remaining wells were either water supply wells or unknown use. The locations of wells records identified within 500 m of the Site are illustrated in Figure 3. A summary of water well information, including total depth, static water level, and recommended pumping rate, is presented in Table 4. Further details are provided Appendix D.

One well with well record ID 7448964 is identified to be present at the Site by the WWIS. No details are provided on the record, however.

Table 4 MECP Water Well Information Summary

		Depth (mbgs)	Depth Water Found (mbgs)	Static Water Level (mbgs)	Recommended Pumping Rate (L/min)
Bedrock Wells Count = 64	Minimum	10.67	9.75	1.00	18.00
	Maximum	101.50	100.58	15.00	182.00
	Average	32.18	27.79	4.41	55.90
Overburden Wells Count = 9	Minimum	4.88	13.11	4.00	23.00
	Maximum	50.00	16.76	5.00	46.00
	Average	15.90	14.66	4.23	38.26

A summary of other information outlined in the well records is provided below:

- The general lithology described by the well records is a sequence of overburden overlying limestone which is subsequently underlain by sandstone.
- The overburden is described as predominantly sand which is overlain by a clay layer in some locations. Gravel is also present at depth at some wells.
- The average contact depth between overburden materials and limestone bedrock is 16.5 mbgs (4.0 to 63.4 mbgs).
- Water supply in the area surrounding the Site is primarily derived from the bedrock aquifer. Based on the high static water level recorded compared to the depth that water was found, it is inferred that the bedrock aquifer is at least partially confined.
- The bedrock aquifer is productive, with a geometric mean recommended pumping rate of approximately 56 L/min for bedrock wells.

4.1.2 Door-to-Door Well Survey

A door-to-door survey of all accessible properties within 500 m of the property was conducted by Cambium staff on April 22nd, 2024, to confirm details in the public record and to identify any wells not included in the MECP records assessment. Due to the commercial and industrial development of the surrounding area, a number of properties were not accessible to the general public. Five properties were visited, and in-person interviews were conducted with available office workers regarding the condition and details of their water supply well(s), including the method of construction, water level, pump intake, well, and water level depths, water use, and general water quality and well yield.

If the property was accessible but a representative was not available, a letter was left in the mailbox with a pre-paid return envelope. The letter explained the nature of the proposed project and the survey and provided direct contact information for Cambium's project manager.

Details and responses from the well use survey are provided in Appendix D. Generally, workers indicated that the water supply for the surrounding area is not good quality due to hardness and suspect iron and sulphur.

4.2 Groundwater Quality

Groundwater quality samples were collected BH106-24 during hydraulic testing activities on April 19, 2024.

Samples were submitted for analysis of general organic and inorganic chemistry to Caduceon Environmental Laboratories in Ottawa, which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA). Samples were stored at a temperature between 0 °C and 10 °C prior to and during transport.

Water quality results were compared against Provincial Water Quality Objectives (PWQO) and City of Ottawa Sewer Discharge Bylaw 2003-514 guidelines. Certificates of Analysis for the samples are included in Appendix E. A summary of parameters exceeding the PWQO and Sewer By-law criteria is provided in Table 5, Table 6, and Table 7.

Table 5 Summary of Results Exceeding PWQO Criteria

Parameter	Units	PWQO Criteria	BH106-23	
			2024/04/22 (Total)	2024/08/10 (Dissolved)
Phosphorus	ug/L	10	**8,720**	<10
Arsenic	ug/L	5	**27.5**	1.0
Cadmium	ug/L	0.1	**1.12**	**0.211**
Cobalt	ug/L	0.9	**103**	**1.1**
Copper	ug/L	5	**301**	**5.4**
Lead	ug/L	1	**76.8**	0.08
Thallium	ug/L	0.3	**1.82**	<0.05
Uranium	ug/L	5	**11.4**	4.68
Vanadium	ug/L	6	**327**	0.3
Benzo[a]anthracene	ug/L	0.0004	<0.05*	-
Benzo(g,h,i)perylene	ug/L	0.00002	<0.05*	-
Butyl Benzyl Phthalate	ug/L	0.2	<1*	-
Chrysene	ug/L	0.0001	<0.05*	-
Dibenzo(a,h)anthracene	ug/L	0.002	<0.05*	-
Fluoranthene	ug/L	0.0008	<0.05*	-

Parameter	Units	PWQO Criteria	BH106-23	
			2024/04/22 (Total)	2024/08/10 (Dissolved)
Phenanthrene	ug/L	0.03	<0.05*	-
Formaldehyde	ug/L	0.8	<8*	-
Nonylphenols	ug/L	0.04	<1*	-

Bolded numbers indicate exceedance with respect to applicable guideline value
* Laboratory Reporting Limit exceeds PWQO value

Table 6 Summary of Results Exceeding Storm Sewer By-law Criteria

Parameter	Units	Storm Sewer Criteria	BH106-23	
			2024/04/22 (Total)	2024/08/10 (Filtered/Dissolved)
Total Suspended Solids	mg/L	15	**9,480**	<3
Phosphorus	mg/L	0.4	**8.72**	<0.01
Arsenic	mg/L	0.02	**0.0275**	0.001
Chromium	mg/L	0.08	**0.249**	<0.0011
Copper	mg/L	0.04	**0.301**	0.054

Bolded numbers indicate exceedance with respect to applicable guideline value

Table 7 Summary of Results Exceeding Sanitary Sewer By-law Criteria

Parameter	Units	Sanitary Sewer Criteria	BH106-23	
			2024/04/22 (Total)	2024/08/10 (Filtered/Dissolved)
Total Suspended Solids	mg/L	350	**9,480**	<3

Bolded numbers indicate exceedance with respect to applicable guideline value

Based on the results of the chemical analysis, the following comments on groundwater quality are made.

- Both the unfiltered and filtered samples had numerous parameters measured at concentrations in excess of PWQO criteria. Treatment of excavation water would be required prior to discharge to off-site surface receiving environments.

- The method detection limit concentrations for many total metals and semi-volatile organics were greater than some of the PWQO criteria for these parameters. This is a limitation of laboratory analysis and is not confirmation that the guideline value was exceeded.
- Total suspended solids (TSS), phosphorus, arsenic, chromium, and copper concentrations were above City of Ottawa Storm Sewer Discharge guidelines in the unfiltered sample. The filtered sample had concentrations less than guideline values for all parameters, indicating that filtration is a suitable treatment method to enable discharge to this receptor.
- The filtered water quality sample had concentrations less than City of Ottawa Sanitary Sewer Discharge guideline values for all parameters, indicating that filtration is a suitable treatment method to enable discharge to this receptor.
- It is recommended that a water quality sample of treated water be submitted for laboratory analysis prior to discharge during construction activities to confirm the treatment system adequately reduces elevated parameters to acceptable concentrations.

4.3 Single Well Hydraulic Tests (SWHTs)

Cambium staff visited the Site on April 19th, 2024, to perform in-situ single well hydraulic tests (SWHTs) on select monitoring wells.

Rising head tests were conducted in each well by inducing an instantaneous change in head (water level) in the monitoring wells. Water level changes were achieved by introducing/removing a solid slug.

Water level recovery was monitored using a Solinst Levelogger pressure transducer data logger, with manual measurements collected simultaneously at regular intervals.

The hydraulic conductivity of the geological formations adjacent to the screened portion of each well was estimated via the AquiferTest Pro software using the Hvorslev method (Hvorslev, 1951). A summary of results is presented in Table 8. Detailed analytical reports are provided in Appendix F.

Table 8 Hydraulic Conductivity Estimates derived via SWHTs

Monitoring Well	Screened Lithology	Hydraulic Conductivity, K (m/s)			
		Test 1	Test 2	Test 3	Geometric Mean
BH105-24	Silty sand to Sandy clayey silt	6.4×10^{-9}	3.4×10^{-9}	-	4.6×10^{-9}
BH106-24	Sandy clayey silt	2.2×10^{-7}	1.9×10^{-7}	2.1×10^{-7}	2.1×10^{-7}
BH107-24	Sandy clayey silt to silt	1.9×10^{-9}	-	-	1.9×10^{-9}
Geometric Mean					**1.2×10^{-8}**

Estimated hydraulic conductivities for the tested wells screened within the silty clay unit ranged between 1.9×10^{-9} and 2.2×10^{-7} m/s, with an overall geometric mean value of 1.2×10^{-8} m/s. These values are consistent with published values for the tested materials (unconsolidated silt) (Freeze & Cherry, 1979).

5.0 Dewatering Assessment

The requirements for construction dewatering generally depend on the Site's soil and groundwater conditions including soil type, soil permeability or hydraulic conductivity, local groundwater levels, and the design of the proposed works, such as the foundation/basement elevation or pipe invert level, as well as the size of proposed structure/excavation. The following subsections detail the specific excavation parameters and anticipated dewatering rates for the Site.

5.1 Excavation Design Parameters

It is understood that the footprint of the proposed slab-on-grade building will be approximately 1,110 m^2.

For construction purposes, it is assumed that excavation for footings will occur along a linear perimeter with dimensions of 23 m by 55 m. It is further assumed that during footing emplacement, groundwater will be temporarily lowered to a minimum of 1 m below the frost line to ensure dry conditions during footing construction, to a total depth of 2.5 mbgs.

For permanent operations, due to the high-water levels at the Site, permanent dewatering will be required to ensure water levels beneath the building remain below the frost line level (approximately 1.5 mbgs) throughout the year. A maximum water level of 0.30 mbgs was measured in BH106-23 on April 19, 2024.

5.2 Estimated Dewatering Rate – Construction Phase

An estimated dewatering rate for the construction phase of the proposed development was calculated a modified Dupuit-Forchheimer equation developed for linear excavations according to Powers, Corwin, Schmall, & Kaeck (2007):

$$Q = \frac{\pi K(H^2 - h^2)}{\ln(R_0/r_s)} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

$Where$:

$Q = dewatering\ rate\ (m^3/s)$

$K = hydraulic\ conductivity\ (m/s)$

$H = initial\ hydraulic\ head\ in\ aquifer\ (m)$

$h = target\ hydraulic\ head\ (initial\ hydraulic\ head - target\ drawdown)\ (m)$

$R_0 = distance\ to\ radial\ source\ (from\ excavation\ center)$

$r_s = equivalent\ single\ well\ radius = width\ of\ trench/2\ (m)$

$x = unit\ length\ of\ trench\ (m)$

$L = distance\ to\ line\ source\ (from\ excavation\ center) = R_0/2\ (m)$

A summary of calculated dewatering rates for per 50 m linear excavation, given a target depth to water of 2.5 mbgs, is provided in Table 9. Detailed calculations are provided in Appendix G.

Table 9 Calculated Construction Dewatering Rates

	Hydraulic Conductivity (K)	Radius of Influence (from excavation edge)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	1.9 x10^{-9}	0.3	0.14	0.002
Maximum	2.1 x10^{-7}	3.0	4.70	0.05
Geometric Mean	1.2 x10^{-8}	0.7	0.65	0.01

Using the hydraulic conductivity estimates presented in Table 9, the estimated radius of influence from the edge of the excavation ranges from 0.3 to 3.0 m (average 0.7 m). The estimated dewatering rate ranges from 0.14 m^3/day (140 L/day, or 0.002 L/s) to 4.70 m^3/day (4,700 L/day, or 0.05 L/s), with a geometric mean average value of 0.65 m^3/day (650 L/day, or 0.01 L/s).

Applying a safety factor of 2 to account for uncertainty resulting from heterogeneity of subsurface materials and other unknown factors, the estimated dewatering rate for 50 m sections of footing excavation ranges from 0.28 m^3/day (280 L/day, or 0.004 L/s) to 9.4 m^3/day

(9,400 L/day, or 0.10 L/s), with a geometric mean average value of 1.30 m^3/day (1,300 L/day, or 0.02 L/s).

It is noted that the above equation is designed to represent steady state pumping conditions. In general, at the beginning of the pumping, the pumping rate required to lower Site water levels to acceptable levels may be greater than the rate estimated for steady state conditions as incoming water replaces the volume of excavated soils. Additionally, the above equation does not account for any precipitation that may occur during the construction process.

5.3 Estimated Dewatering Rate – Operational Phase

An estimated dewatering rate for the operational phase of the proposed development was calculated using a modified Dupuit-Forchheimer equation (Powers, Corwin, Schmall, & Kaeck, 2007). Calculations for a square dewatering area with an equivalent radius were employed.

$$Q = \frac{\pi K(H^2 - h^2)}{\ln(R_0/r_s)}$$

$Where$:

$Q = dewatering\ rate\ (m^3/s)$

$K = hydraulic\ conductivity\ (m/s)$

$H = initial\ hydraulic\ head\ in\ aquifer\ (m)$

$h = target\ hydraulic\ head\ (initial\ hydraulic\ head - target\ drawdown)\ (m)$

$R_0 = zone\ of\ influence\ (from\ excavation\ center) = 3000(H - h)\sqrt{K}\ (m)$

$r_s = equivalent\ single\ well\ radius$

For square excavations, the equivalent radius (r_s) can be determined as the radius of a circle with the same area as the excavation, or with the same perimeter as the excavation.

Here, the equivalent area method was used such that

$$r_s = \sqrt{\frac{excavation\ area}{\pi}}$$

A summary of calculated dewatering rates for per 50 m linear excavation, given a target depth to water of 2.5 mbgs, is provided in Table 10. Detailed calculations are provided in Appendix G

Table 10 Calculated Permanent Dewatering Rate

	Hydraulic Conductivity (K)	Radius of Influence (from excavation edge)	Dewatering Rate (Q)	
	m/s	m	m^3/day	L/s
Minimum	1.9×10^{-9}	0.2	0.4	0.005
Maximum	2.1×10^{-7}	1.6	4.6	0.05
Geometric Mean	1.2×10^{-8}	0.4	1.1	0.01

Using the hydraulic conductivity estimates presented in Table 10, the estimated radius of influence from the edge of the building footprint ranges from 0.2 to 1.6 m (average 0.4 m). The estimated dewatering rate ranges from 0.4 m^3/day (400 L/day, or 0.005 L/s) to 4.6 m^3/day (4,600 L/day, or 0.05 L/s), with a geometric mean average value of 1.1 m^3/day (1,100 L/day, or 0.01 L/s).

Applying a safety factor of 2 to account for uncertainty resulting from heterogeneity of subsurface materials and other unknown factors, the estimated permanent dewatering rate for the building footprint ranges from 0.8 m^3/day (800 L/day, or 0.01 L/s) to 9.2 m^3/day (9,200 L/day, or 0.10 L/s), with a geometric mean average value of 2.2 m^3/day (2,200 L/day, or 0.02 L/s).

It is noted that the above calculations are an approximation only, which can be further refined based on results observed during the construction phase of the proposed development. Cambium recommends reassessment of dewatering rates once construction nears the completion stage.

5.4 Assessment of Required Regulatory Permits or Registration

Any construction dewatering or other water taking in Ontario is governed by The Ontario Water Resources Act (Ontario Regulation 387/04 and/or Ontario Regulation 63/16) and/or the Environmental Protection Act (Registrations under Part II.2).

Where construction dewatering is required in amounts in excess of 400,000 L/day, a Permit to Take Water (PTTW) must be obtained. For temporary construction dewatering (six months or less) greater than 50,000 L/day but less than 400,000 L/day, registration through Environmental Activity and Sector Registry (EASR) is required. For dewatering rates less than 50,000 L/day, neither a PTTW or EASR registration is required.

As the maximum estimated dewatering rate for both construction activities and long-term building operation is less than 9,500 L/day, neither PTTW nor EASR registration will be required for the proposed development.

6.0 Water Balance Assessment

A water balance assessment was completed to determine the potential change in groundwater recharge that could occur due to the proposed development. Generally, any property can be categorized into three broad types of areas: paved, roof, and landscape/vegetated. Currently, the Site is undeveloped with all land landscape/vegetated. In the post-development scenario, the amount of paved and roof areas at the Site will usually increase and the amount of landscape/vegetated area will decrease. This has the potential to impact the amount of water that infiltrates into the ground and is available to replenish natural ground- and surface-water systems, which must be considered as part of the development process.

To compare the difference in infiltration that may result from the proposed development, a water balance calculation was completed to determine the amount of surplus water that is currently generated at the Site. Site characteristics such as surficial soil type, topography, and the amount of pervious and impervious areas were then used to estimate the volume of water infiltrating at the Site. Calculations were completed for both pre-and post-development scenarios, so that a comparison could be made to identify potential changes in infiltration as well as mitigation measures which could be employed to reduce development impacts.

Figure 5 presents the post-development plans of the proposed development. As a detailed breakdown of landscape and building details are yet to be determined, the paved, roof, and landscape areas for the developed lots were calculated based on an assumption that each surface type comprises 10%, 50%, and 40% of the total developed lot area, respectively. Table 11 provides a summary of statistics for the total areas for each type of surface at the Site for both pre- and post-development scenarios. Further discussion of each component completed for the water balance assessment is provided in the following subsections.

Table 11 Summary of Pre- and Post-Development Areas

Type of Land Coverage	Pre-Development Areas (m^2)	Post-Development Areas (m^2)
Paved Area	811	2,246
Roof Area	365	1,261
Landscape/Vegetated Area	3,502	1,171
Total (m^2)	**4,678**	**4,678**

6.1 Water Budget and Total Water Surplus

Based on the Thornthwaite and Mather methodology (1957), the water balance is an accounting of water in the hydrologic cycle. Precipitation (P) falls as rain and snow. It can run off towards lakes and streams (R), infiltrate to the groundwater table (I), or evaporate from the ground or be used for transpiration by vegetation (ET). When long-term average values of P, R, I, and ET are used, there is minimal or no net change to groundwater storage (ΔS).

The annual water budget can be expressed as:

$$P = R + I + ET + \Delta S$$

Where:

P = Precipitation (mm/yr)

R = Run-off (mm/yr)

I = Infiltration (mm/yr)

ET = Evapotranspiration (mm/yr)

ΔS = Change in soil water storage (mm/yr)

Total water surplus is defined as the difference between precipitation and evapotranspiration. It is the amount of water per unit area that can either infiltrate into on-site soils or be directed off-site as runoff. An assumption for the calculation of water surplus is that changes in soil water storage are negligible over the course of a year. It is also assumed that the catchment area for

the water balance described above is completely contained within Site boundaries (i.e. the model does not account for catchment areas that extend off-site).

An annual water budget for the Site was calculated using the thirty-year climate normal data (1981-2010) provided by Environment Canada for the Ottawa MacDonald-Cartier International Airport (Climate ID 6106000), located approximately 114 km north (Environment Canada, 2024). A detailed table outlining the calculations is provided in Appendix H. In summary, the average annual precipitation and evapotranspiration at the Site is estimated to be 944 mm/yr and 547 mm/yr, respectively. Therefore, the water surplus at the Site is estimated to be 397 mm/yr.

6.2 Annual Infiltration and Runoff

To determine the amount of water infiltrated into on-site soils annually, the total volume of water available is multiplied by an infiltration factor (IF). The total volume of water available is obtained by multiplying the water surplus value determined from the water balance described above by the total permeable landscape area at the Site. The infiltration factor, which ranges from 0 to 1, is estimated based on topography, soils and cover as per the Stormwater Management Planning and Design Manual (Ministry of the Environment, 2003). As outlined in Table 12, the infiltration factor at the Site was assigned a value of 0.6.

Table 12 Determination of Infiltration Factor

Factor	Value
Topography	Flat land, avg. slope < 0.6 m/km = 0.3
Soil	Silty Loam = 0.2
Cover	Cultivated Land = 0.1
Infiltration Factor (IF)	**0.6**

The annual volume of water that infiltrates at the site is calculated as follows:

$$I\ (m^3/yr) = Water\ Surplus\ (m/yr) * Total\ landscape\ area(m^2/yr) * Infiltration\ Factor$$

The annual infiltration at the Site is expected to vary based on a number of factors (i.e. actual precipitation, variation in soil composition, soil compaction, etc.).

The annual runoff that occurs at the Site varies between permeable and impermeable surfaces. On permeable landscape surfaces, the runoff is calculated as the difference between total precipitation and annual infiltration. On impermeable surfaces where there is no infiltration, the runoff is calculated as 90% of precipitation, with the remaining 10% of precipitation lost directly to evaporation.

Annual infiltration and runoff volumes were calculated for the Site for both pre- and post-development scenarios. Details of the calculations are provided in Appendix H. A discussion of the water balance used to calculate the infiltration and runoff volumes for each scenario is provided in Section 6.3 and Section 6.4.

6.3 Pre-Development Water Balance

The water balance for existing conditions at the Site is summarized in Table 13. The pre-development infiltration rate and runoff rate was calculated to be 834 m³/yr and 1,555 m³/yr, respectively.

Table 13 Pre-Development Water Balance

Land Use		Area (m²)	Precipitation (m³)	Evapotranspiration (m³)	Infiltration (m³)	Run-off (m³)
Impervious Areas	Paved Area	811	766	77	-	689
	Roof Area	365	345	34	-	310
Pervious Areas	Landscape Area	3,502	3,306	1,916	834	556
Total		**4,678**	**4,416**	**2,027**	**834**	**1,555**

6.4 Post-Development Water Balance

A comparison of water balances for the pre-development and post-development scenarios is summarized in Table 15. There is a net infiltration deficit of approximately 555 m³/yr, compared to the pre-development infiltration. The run-off rate upon development of the Site is projected to increase by 1,610 m³/yr.

Table 14 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	2,246	2,120	212	-	1,908
	Roof Area	1,261	1,190	119	-	1,071
Pervious Areas	Landscape Area	1,171	1,105	641	279	186
Total		**4,678**	**4,416**	**972**	**279**	**3,166**

Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

6.5 Water Balance Comparison

A comparison of water balances for the pre-development and post-development scenarios is summarized in Table 15. There is a net infiltration deficit of approximately 555 m^3/yr, compared to the pre-development infiltration. The run-off rate upon development of the Site is projected to increase by 1,610 m^3/yr.

Table 15 Water Balance Comparison

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	4,416	2,027	834	1,555
Post-Development	4,416	972	279	3,166
Change in Volume	-	-1,055	-555	1,610
Change in %	-	-52	-67	104

6.6 Required Infiltration from Roof Runoff

To compensate for the post-development infiltration deficit, a portion of roof run-off water can be captured and directed towards infiltration. As the infiltration deficit volume is 555 m^3 /yr and the total roof run-off volume is projected to be 1,071 m^3/yr, the percentage of roof run-off that is required to be redirected to maintain pre-development infiltration volumes is 52%. These details are summarized in Table 16.

Table 16 Requirement of Infiltration from Roof Runoff

Volume of Pre-Development Infiltration (m^3/yr)	834
Volume of Post-Development Infiltration (m^3/yr)	279
Deficit from Pre to Post Development Infiltration (m^3/yr)	555
Percentage of Roof Runoff required to match the pre-development infiltration (%)	52

6.7 Water Balance Assessment Summary

Based on the calculations detailed in the preceding subsections, a summary of the water balance assessment is as follows:

- Impervious post-development area (roof and pavement) is projected to increase by approximately 2,331 m^2 when compared to pre-development conditions.
- Without implementing any mitigation measures, it is estimated that the reduction of pervious surfaces at the Site will create a net deficit in infiltration of approximately 555 m^3/yr.
- To regain the lost volume of water infiltrated, a diversion of approximately 52% of roof run-off would be required to maintain pre-development water balance conditions (assuming 100% of diverted water is infiltrated).
- Implementation of Low Impact Development measures would enhance the Site's ability to infiltrate diverted roof run-off water into pervious areas. Due to the high groundwater levels however, a civil design engineer should be involved in designing any suitable infiltration measures across the Site.

7.0 Conceptual Wastewater Design

Part 8 of the Ontario Building Code (OBC) details the design, construction, operation, and maintenance of sewage systems. A conceptual peak sewage design flow was calculated following a review of OBC Table 8.2.1.3.B is summarized as follows:

- Warehouse: 150 L/day/loading bay x 4 loading bays = 600 L/day
- Factory: 75 L/employee per 8 hr shift x 16 person occupancy = 1,200 L/day
    - Total sewage design flow = **1,800 L/day**

7.1 Concept Design Details

A daily sewage design flow volume of 1,800 L/day is calculated for the proposed light industrial building.

7.1.1 Septic Tank

All fixtures within the proposed building should be directed to the inlet of the septic tank. Based on the design flow for non-residential occupancy, the proposed septic tank capacity was calculated as follows in accordance with section 8.2.2.3. of the OBC:

Volume (V): $V = 3 * Q$

$V = 3 * 1{,}800\ L$

$V = 5{,}400\ L$

A single two compartment septic tank with capacity of 6,000 L would be suitable to achieve the minimal capacity requirements.

7.1.2 Treatment Unit

It is understood the client wishes to use a Premier Tech Aqua Ecoflo advanced treatment unit. The Ecoflo biofilter model proposed is the ECOFLO STB-650B rated for flows up to 2,500 L/day.

7.1.3 Leaching Bed

Following the subsurface investigation, native soils were observed to be similar, consisting of a surficial layer of topsoil and silty sand fill to depths ranging from 0.3 to 1.0 mbgs overlying sandy clayey silt and sandy silt. Groundwater was encountered between 0.6 and 2.0 mbgs across all boreholes. Soil sample results are summarized in Section 3.2 above and have estimated percolation rates between 20 and 40 min/cm.

Considering the available land constraints and using a conservative estimated percolation rate of 40 min/cm, a partially raised Type A area bed has been conceptually designed below using the following information and calculations:

- Design flow (Q) = 1,800 L/day
- Native Soil T-time (T) = 40 min/cm
- Configuration: partially raised
- Stone area = Q/75 when Q < 3,000 L/day = 1,800/75 = 24 m^2
    - Proposed concept design: 5.6 m x 4.5 m = 25.2 m^2
- Mantle area (imported sand fill) = QT/400 = 1,800 x 40 / 400 = 180 m^2
    - Proposed concept design: 21.6 m x 8.5 m = 183.6 m^2

Based on the filter bed mantle requirement, the total bed footprint would be approximately 21.6 m by 8.5 m, as shown on Figure 6.

The Type A Area Bed will likely require to be raised above original grade. Assuming a raised height of 1.0 m, setback distances shown on Figure 6 were increased accordingly.

The area of the Site appears to provide adequate space for the installation of an on-site sewage system and appears to meet the required setback distances outlined in OBC Tables 8.2.1.6.A and 8.2.1.6.B. However, this should be considered and evaluated during the detailed sewage system design stage. The Site conditions appear feasible to install an on-site sewage system.

8.0 Conclusions and Recommendations

Cambium was retained by the Client to complete a hydrogeological assessment for proposed redevelopment of the land located at 1386 and 1394 Greely Lane, Ottawa, Ontario. Development plans include construction of one 1,110 m^2 (12,000 ft^2) slab-on grade building which will be divided in three 370 m^2 (4,000 ft^2) light industrial use units.

The subsurface investigation completed at the site indicates the lithology is comprised primarily of surficial deposits of pavements or topsoil overlying a relatively thin deposit of fill overlying native deposits of clays and silts. T-times estimated from laboratory analysis of soil samples collected from the native deposits range from 20 to 40 min/cm.

Monitoring wells installed in three locations (BH105-23, BH106-23, and BH107-23) indicate water levels vary across the site and fluctuate seasonally. A minimum water level of 1.3 mbgs was measured in BH105-23 on March 15, 2023, and a maximum water level of 0.30 mbgs was measured in BH106-23 on April 19, 2024. Hydraulic testing (rising head slug tests) provided hydraulic conductivity estimates for the shallow aquifer ranging from 1.9 $x10^{-9}$ to 2.2 $x10^{-7}$ m/s with a geometric mean estimate of 1.2 $x10^{-8}$ m^2/s.

Water Quality Analysis

Analysis of water quality samples from BH106-23 identified a number of parameters with concentrations exceeding PWQO criteria in both unfiltered and filtered samples. All parameters had concentrations below City of Ottawa storm and sanitary sewer discharge guidelines, indicating that filtration is a suitable treatment method to enable discharge to these receptors. Should on-site treatment and discharge to surface (i.e. drainage ditch) be the preferred option for dewatering, it is recommended that a water quality sample of treated water be submitted for laboratory analysis prior to discharge during construction activities to confirm the treatment system adequately reduces elevated parameters to acceptable concentrations.

Dewatering Assessment

Due to the high groundwater levels at the Site, dewatering during both the construction phase and permanent building operation will be required. During construction, it is estimated than an

average dewatering rate of 1.30 m^3/day (1,300 L/day, or 0.02 L/s) will be needed to achieve dry conditions per 50 m section of footing excavation. This rate represents steady state pumping conditions and higher volumes may be required to lower Site water levels to acceptable levels during the initial stage of pumping. Additionally, the estimate does not account for any precipitation that may occur during the construction process.

For permanent operations, it is estimated that an estimated average dewatering rate of 2.2 m^3/day (2,200 L/day, or 0.02 L/s) will be required to ensure water levels beneath the building remain below the frost line level (approximately 1.5 mbgs) throughout the year. It is recommended that dewatering rates be reassessed however, once building construction nears the completion stage.

The maximum estimated dewatering rate for both construction activities and long-term building operation are less than 9,500 L/day. As such, neither a PTTW nor an EASR registration will be required for the proposed development.

Water Balance

It is projected that impervious post-development area (roof and pavement) will increase by approximately 2,331 m^2 when compared to pre-development conditions, which will create a net deficit in infiltration to groundwater of approximately 555 m^3/yr if no mitigation measures are implanted.

To regain the lost volume of water infiltrated, a diversion of approximately 52% of roof run-off would be required to maintain pre-development water balance conditions (assuming 100% of diverted water is infiltrated).

Implementation of Low Impact Development measures would enhance the Site's ability to infiltrate diverted roof run-off water into pervious areas. Due to the high groundwater levels however, a civil design engineer should be involved in designing any suitable infiltration measures across the Site.

Conceptual Wastewater Design

A daily sewage design flow volume of 1,800 L/day was calculated for the proposed light industrial building. Given the site lithology and estimated T-times, a total septic bed footprint of approximately 21.6 m by 8.5 m, with a 6,000 L septic tank and ECOFLO advanced treatment unit, will be required. The bed will be at least partially raised due to Site conditions, with the specific height to be determined during the final building design.

Overall, the Site conditions appear feasible to install an on-site sewage system, and there is adequate space for the installation which appears to meet the required OBC setback distances. However, this should be considered and evaluated during the detailed sewage system design stage.

9.0 Closing

We trust that the information in this submission meets your current requirements. If you have any questions regarding the contents of this report, please contact the undersigned.

Respectfully submitted,

Cambium Inc.

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11.0 Standard Limitations

Limited Warranty

In performing work on behalf of a client, Cambium relies on its client to provide instructions on the scope of its retainer and, on that basis, Cambium determines the precise nature of the work to be performed. Cambium undertakes all work in accordance with applicable accepted industry practices and standards. Unless required under local laws, other than as expressly stated herein, no other warranties or conditions, either expressed or implied, are made regarding the services, work or reports provided.

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A site assessment is created using data and information collected during the investigation of a site and based on conditions encountered at the time and particular locations at which fieldwork is conducted. The information, sample results and data collected represent the conditions only at the specific times at which and at those specific locations from which the information, samples and data were obtained and the information, sample results and data may vary at other locations and times. To the extent that Cambium's work or report considers any locations or times other than those from which information, sample results and data was specifically received, the work or report is based on a reasonable extrapolation from such information, sample results and data but the actual conditions encountered may vary from those extrapolations.

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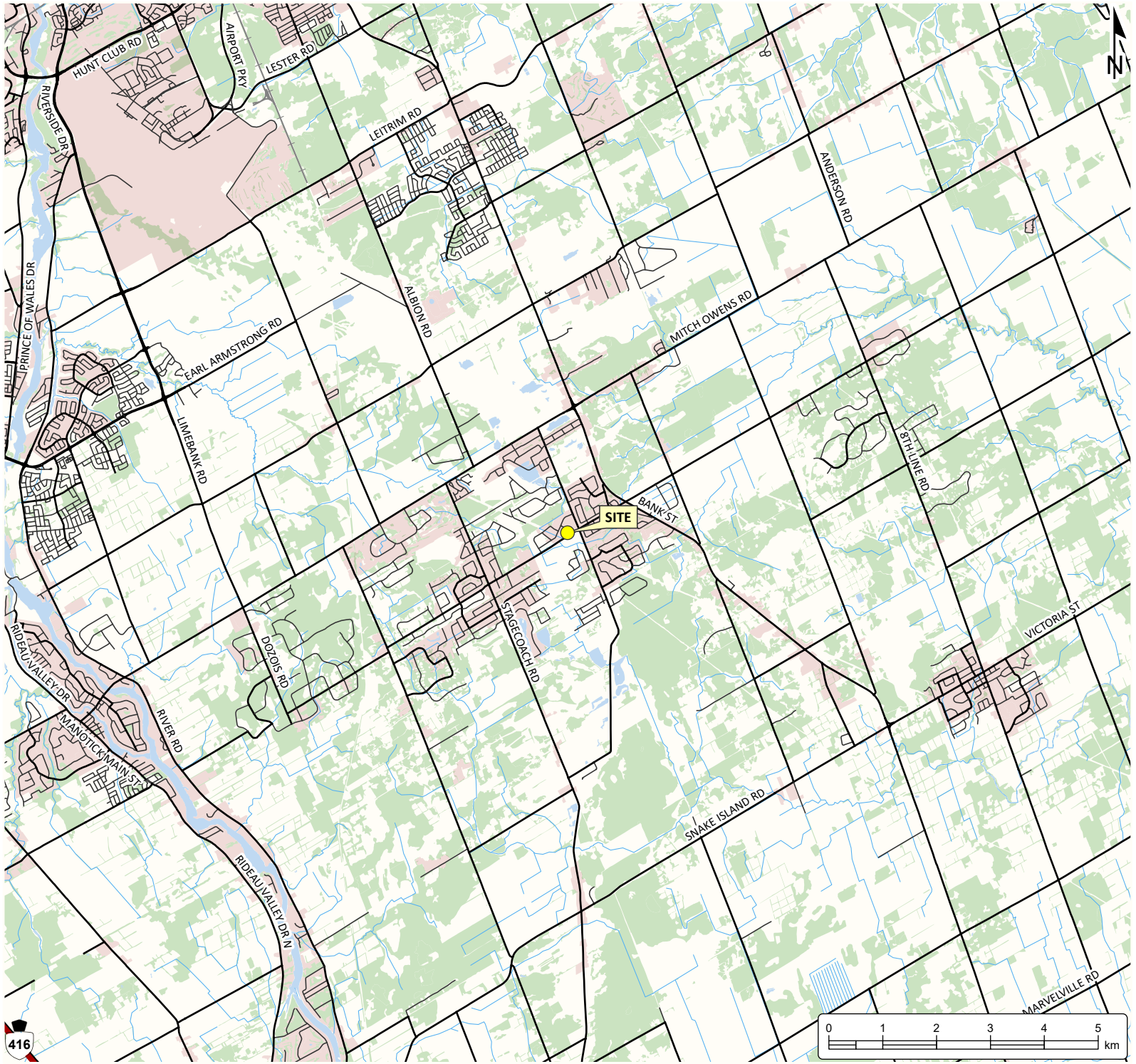
Appended Figures



HYDROGEOLOGICAL ASSESSMENT REPORT

CASSIDY EW CONSTRUCTION CONSULTANT LTD.

1386 and 1387 Greely Lane
Ottawa, Ontario

LEGEND

- Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Built Up Area
- Wooded Area
- Water Area

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SITE LOCATION PLAN

Project No.: 17281-002		Date: August 2024	Rev.:
Scale: 1:100,000		Projection: NAD 1983 UTM Zone 18N	
Created by: NLB	Checked by: KH	Figure: 1	

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HYDROGEOLOGICAL ASSESSMENT REPORT

CASSIDY EW CONSTRUCTION CONSULTANT LTD.
1386 and 1387 Greely Lane
Ottawa, Ontario

LEGEND

- Monitoring Well
- Borehole
- Benchmark
- Site (approximate)

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SITE PLAN WITH BOREHOLE LOCATIONS

Project No.: 17281-002		Date: August 2024 Rev.:	
Scale: 1:600		Projection: NAD 1983 UTM Zone 17N	
Created by: NLB	Checked by: KH	Figure:	2

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HYDROGEOLOGICAL ASSESSMENT REPORT

CASSIDY EW CONSTRUCTION CONSULTANT LTD.
1386 and 1387 Greely Lane
Ottawa, Ontario

LEGEND

- Water Well Record
- 500m Study Area
- Site (approximate)

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MECP WELL RECORDS WITHIN 500m

Project No.: 17281-002		Date: August 2024 Rev.:	
Scale: 1:6,000		Projection: NAD 1983 UTM Zone 18N	
Created by: NLB	Checked by: KH	Figure:	3

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Pre-Development	Area (m²)
Roofed	365
Paved	811
Landscaped	3,502
Total	4,678

HYDROGEOLOGICAL ASSESSMENT REPORT

CASSIDY EW CONSTRUCTION CONSULTANT LTD.
1386 and 1387 Greely Lane
Ottawa, Ontario

LEGEND

- Roofed
- Paved
- Landscaped
- Site (approximate)

Notes:
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PRE-DEVELOPMENT PLAN

Project No.: 17281-002		Date: August 2024 Rev.:	
Scale: 1:600		Projection: NAD 1983 UTM Zone 18N	
Created by: NLB	Checked by: KH	Figure:	4

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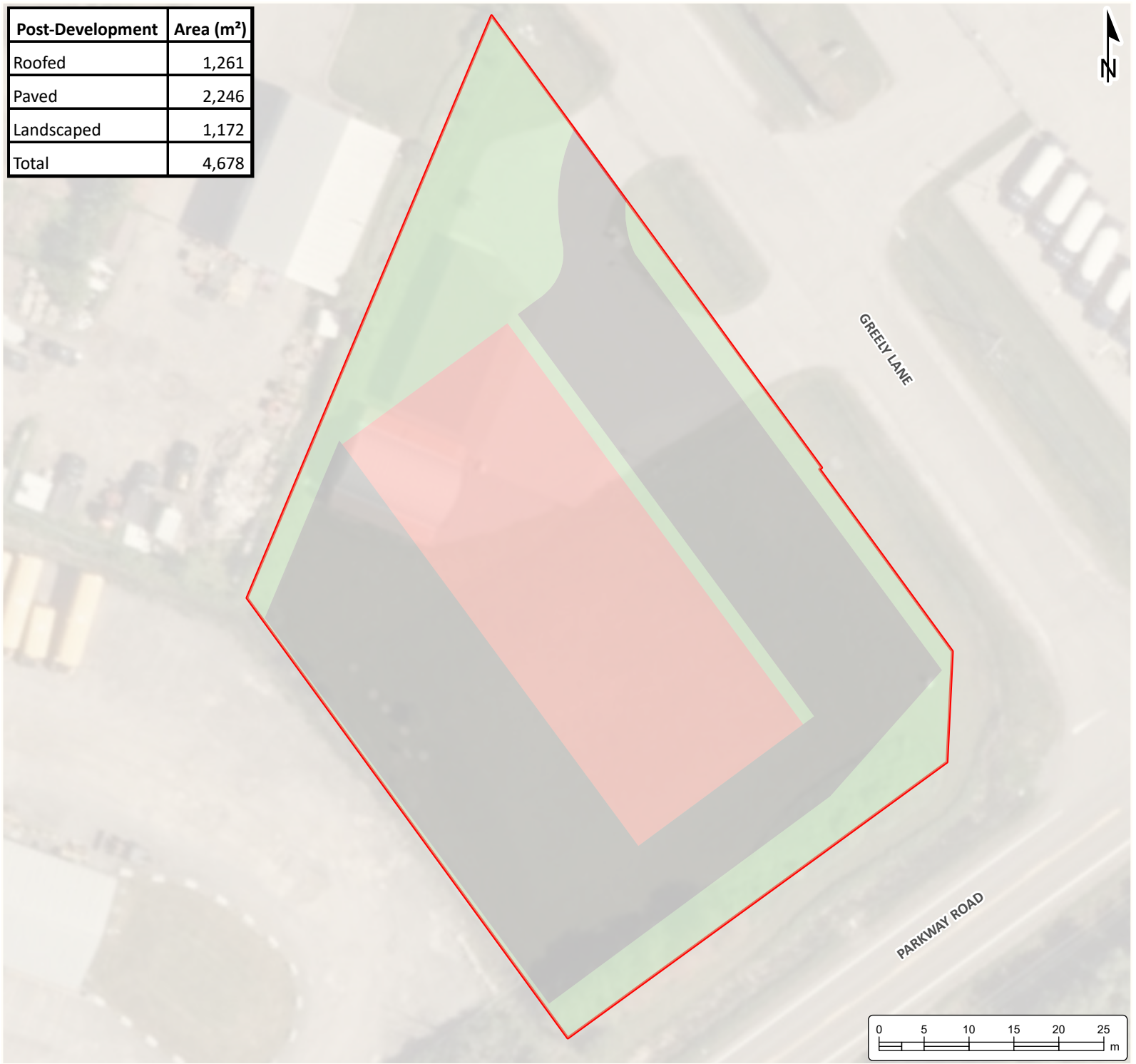
Post-Development	Area (m²)
Roofed	1,261
Paved	2,246
Landscaped	1,172
Total	4,678



HYDROGEOLOGICAL ASSESSMENT REPORT

CASSIDY EW CONSTRUCTION CONSULTANT LTD.
1386 and 1387 Greely Lane
Ottawa, Ontario

LEGEND

- Roofed
- Paved
- Landscaped
- Site (approximate)

Notes:
- 2022 Aerial imagery was obtained from the City of Ottawa ArcGIS Map Service.
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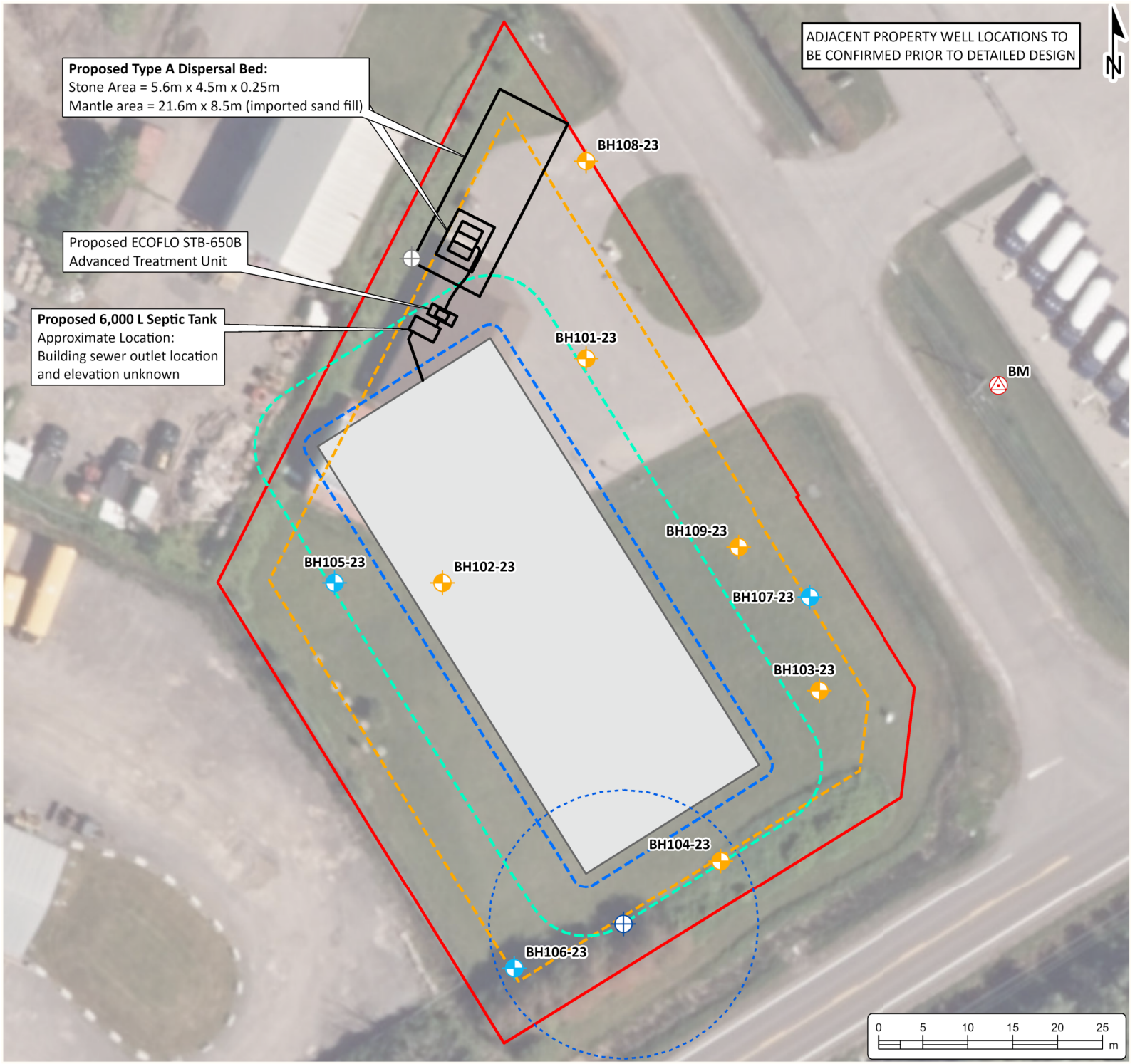
- Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
- Cambium Inc. makes every effort to ensure this map is free from errors but cannot be held responsible for any damages due to error or omissions. This map should not be used for navigation or legal purposes. It is intended for general reference use only.

CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: (705) 742.7900 Fax: (705) 742.7907
www.cambium-inc.com

POST-DEVELOPMENT PLAN

Project No.: 17281-002		Date: August 2024 Rev.:	
Scale: 1:600		Projection: NAD 1983 UTM Zone 17N	
Created by: NLB	Checked by: KH	Figure:	5

O:\GIS\MXDs\17200-17299\17281-002 Cassidy EW Construction Consultant Ltd - HydroG - Greely Lane\2024-06-20 Hydro G.aprx



HYDROGEOLOGICAL ASSESSMENT REPORT

CASSIDY EW CONSTRUCTION CONSULTANT LTD.
1386 and 1387 Greely Lane
Ottawa, Ontario

LEGEND

- Benchmark
- Borehole
- Monitoring Well
- Existing Well Location (To be Decommissioned)
- Proposed Drilled Well (Location to be Confirmed)
- 15m Well Buffer
- 5m Property Line Setback
- 1.5m Building Setback
- 7m Building Setback
- Proposed Building
- Proposed Septic
- Site (approximate)

Notes:
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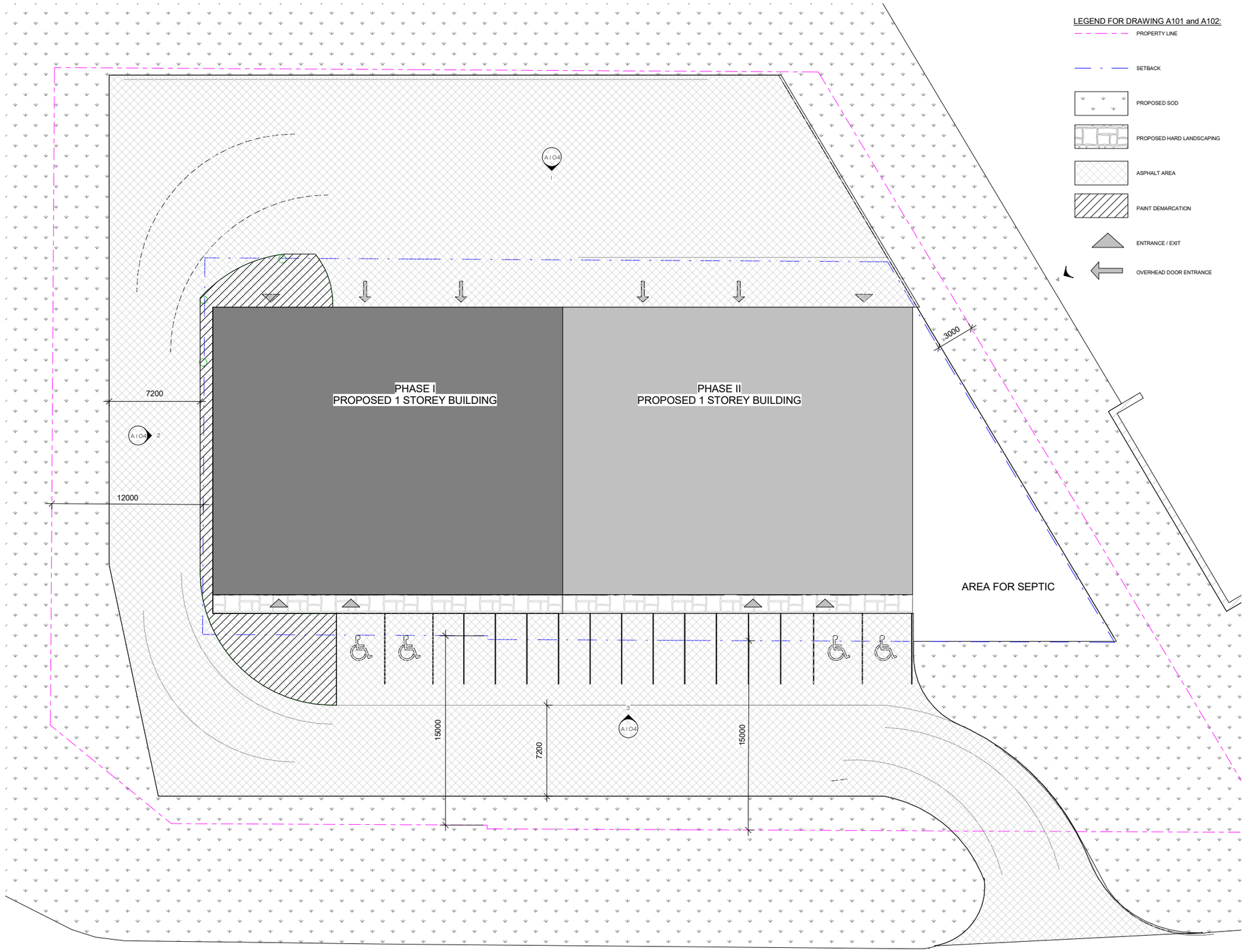
CONCEPTUAL SEWAGE SYSTEM DESIGN

Project No.: 17281-002		Date: November 2024	Rev.:
Scale: 1:600		Projection: NAD 1983 UTM Zone 18N	
Created by: NLB	Checked by: KH	Figure: 6	

O:\GIS\MXDs\17200-17299\17281-002 Cassidy EW Construction Consultant Ltd - HydroG - Greely Lane\2024-11-01 Hydro G.aprx

Appendix A

Property and Land Information



Proposed Site Plan- Phase 2

CONSTRUCTION NORTH

TRUE NORTH

No (N°)	ISSUE/REVISION (ÉMISSION/RÉVISION)	DATE (DD/MM/YY)

BRYDEN GIBSON
ARCHITECTS INCORPORATED
1066 Somerset Street West, Suite 200, Ottawa Ontario, K1Y 4T3
Telephone: 613.724.9914 E-mail: architecture@brydengibson.ca

PROJECT NAME / NOM DU PROJET
1386-1394 GREELY LANE

1386 - 1394 Greely Ln, Greely, ON K4P 1A1

DRAWING TITLE / TITRE DU DESSIN
Proposed Site Plan - Phase 2

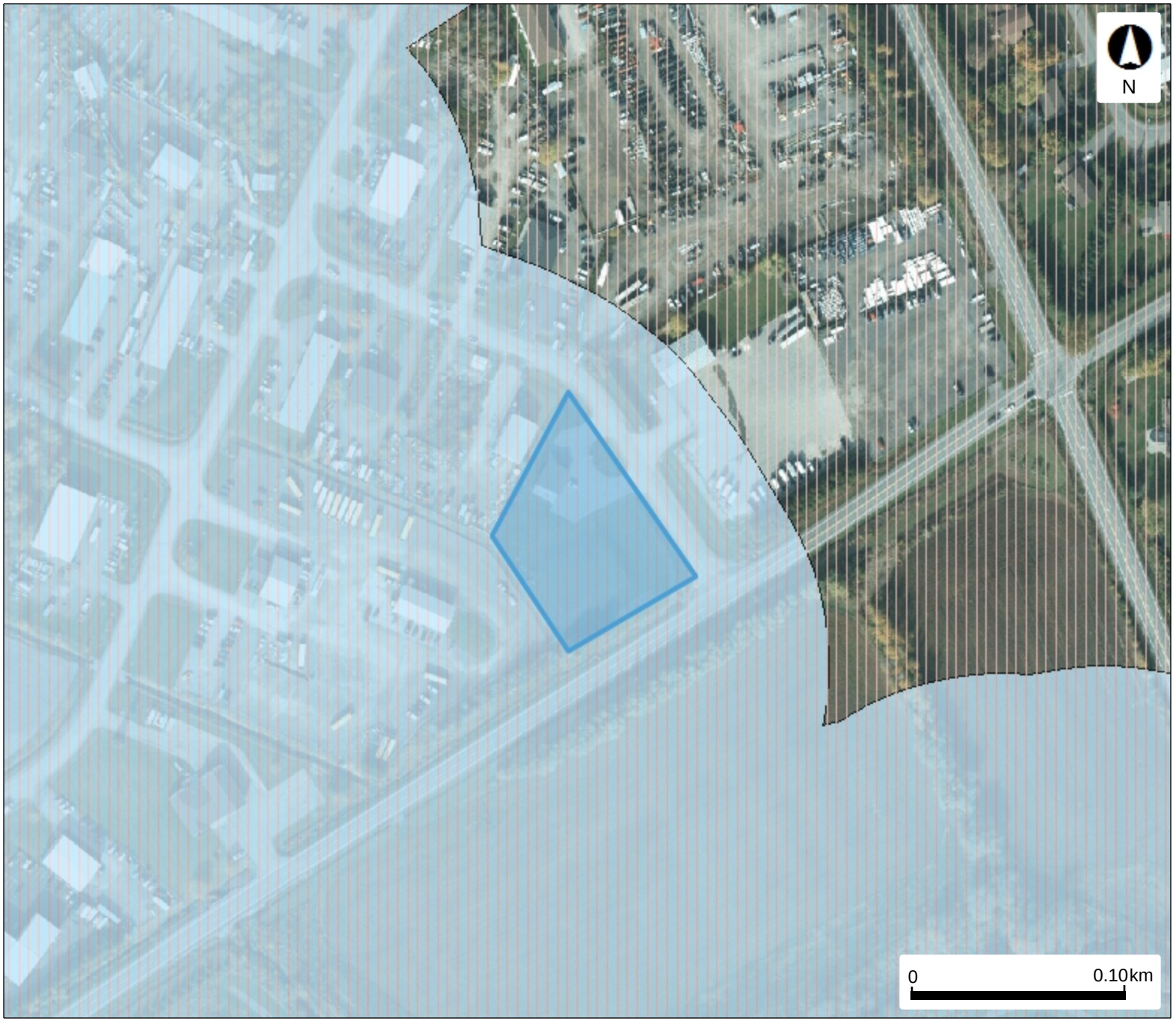
JOB No / N° DE PROJET	DATE / DATE
768-23	22.12.2023
SCALE / ÉCHELLE: As indicated	PRINTING SCALE/ ÉCHELLE D'IMPRESSION
CONCEPTION BY / CONÇUS PAR: SG	IF THIS BAR IS NOT 25 mm LONG. ADJUST YOUR PRINTING SCALE.
DRAWN BY / DESSINÉ PAR: TD	SI CETTE LIGNE NE MESURE PAS 25mm, AJUSTER VOTRE ÉCHELLE D'IMPRESSION.
CHECKED BY / VÉRIFIÉ PAR: SG	

ARCHITECT'S STAMP / SCEAU D'ARCHITECTE

DRAWING No / DESSIN N°: A102

REVISION No / REVISION N°

Source Protection Information Atlas Map



Legend

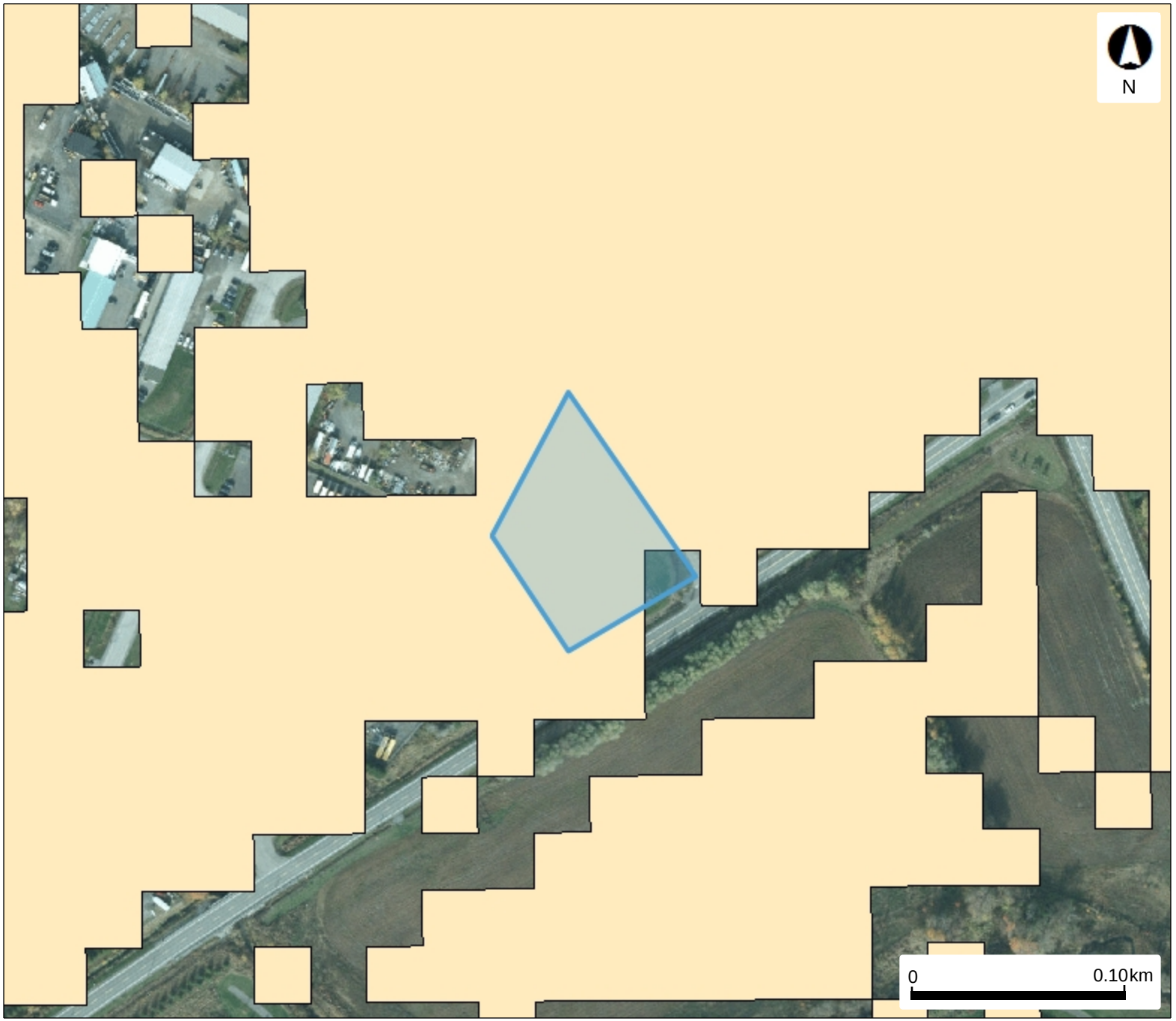
- Highly Vulnerable Aquifers
- Intake Protection Zone 3

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 5/27/2024
Map Center: 45.25878 N, -75.57137 W

Source Protection Information Atlas - SGRA Map



Legend

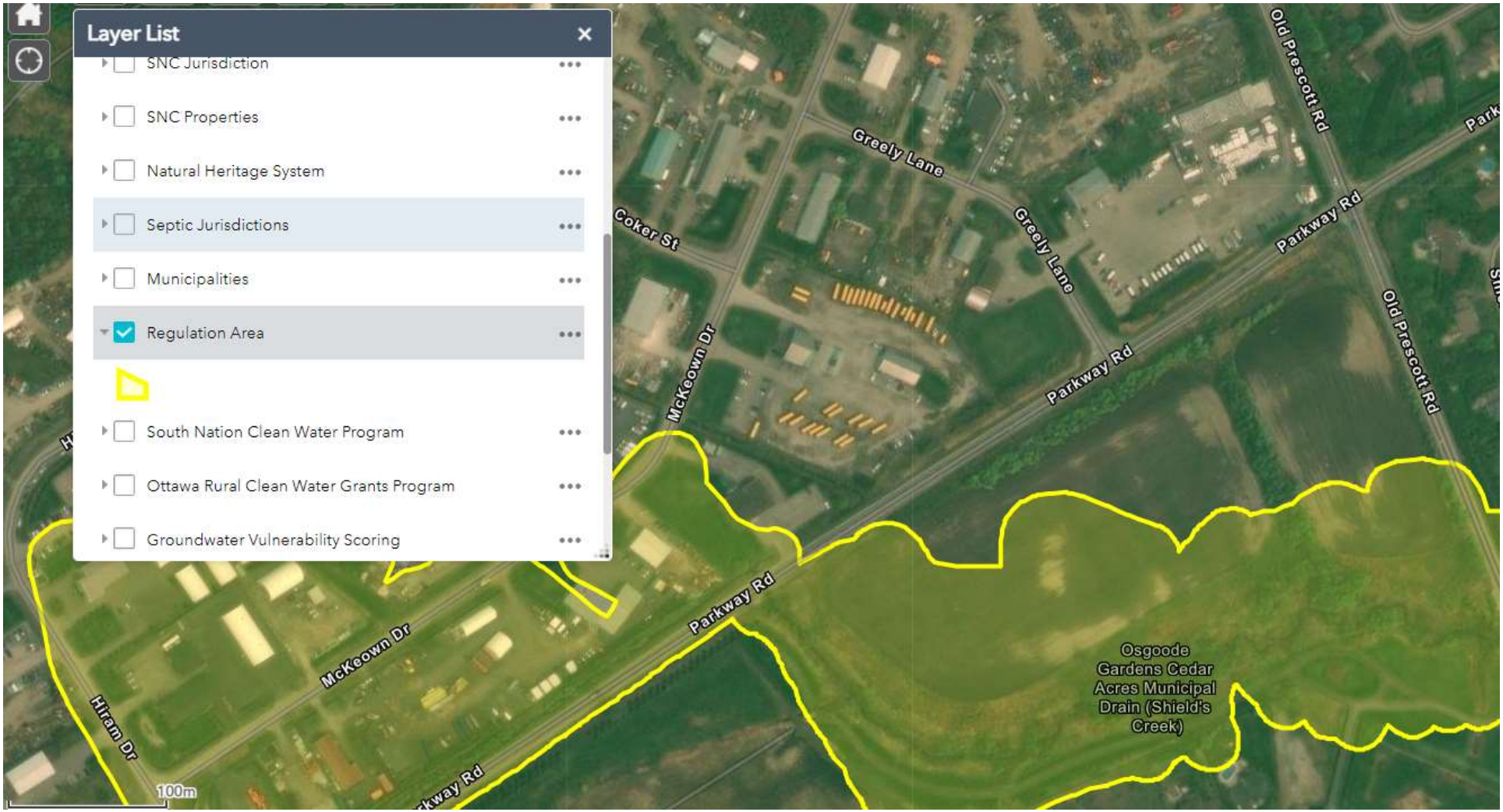
Significant Groundwater Recharge Area

- N/A
- 0
- 2
- 4
- 6

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

Ontario

Map Created: 5/27/2024
Map Center: 45.25878 N, -75.57137 W



Appendix B

Borehole Logs

Client: Cassidy EW Construction **Project Name:** 1386 & 1394 Greely Lane **Log of Borehole:** BH101-23

Contractor: OGS Inc. **Method:** Track Mounted Hollow Stem Auger Page: 1 of 1

Location: Ottawa, ON **Elevation:** 100.75 mREL **Date Completed:** March 8, 2023

Project No.: 17281-001 - B **UTM:** 18 T **N:** 5011868 **E:** 455169

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. / rem V.) (20 40 60 80) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
100.8	0	**ASPHALT:** 75 mm	100.67								
		FILL: (SM) GRAVELLY SAND: brown, moist, some silt [base material]	0.08	1A	SS	100	75	10%	75		
100.2	0.5		100.29	1B	SS			12.7%			
		FILL: (SM) SILTY SAND: grey, moist, gravelly	0.46	2A	SS			18.8%			
99.8	1		99.68						7		
		(ML) sandy CLAYEY SILT: grey, cohesive, w>PL, firm	1.07	2B	SS	83	7	18.8%			
99.2	1.5										1.5m: ATT SS3: 19.8%LL 12.5%PL
				3	SS	75	4	18.8%	4		
98.8	2										
				4A	SS			21%			
98.2	2.5		98.16			67	9		9		
		(SM) SILTY SAND: grey, wet, trace clay	2.59	4B	SS			19.5%			
97.8	3		97.7								
		(ML) SILT: grey, non-cohesive, wet, compact, some sand, trace clay	3.05	5	SS	63	15	17.1%	15		
97.2	3.5										
		-becomes moist, dense									
96.8	4			6	SS	67	46	13.3%	46		
96.2	4.5	-becomes very dense									
				7	SS	88	88	14%	88		
95.8	5										
95.2	5.5	-becomes wet, compact									
				8	SS	67	20	18%	20		
94.8	6		94.65								
		Borehole terminated @ 6.1m due to target depth achieved.	6.1								
94.2	6.5										Borehole caved at 2.1 mbgs. Groundwater encountered at 1.1 mbgs following completion.
93.8	7										
93.8											

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS1B	20	53	27	
SS3	0	22	57	21
SS6	0	19	77	4

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Cassidy EW Construction **Project Name:** 1386 & 1394 Greely Lane **Log of Borehole:** BH102-23

Contractor: OGS Inc. **Method:** Track Mounted Hollow Stem Auger Page: 1 of 1

Location: Ottawa, ON **Elevation:** 100.46 mREL **Date Completed:** March 8, 2023

Project No.: 17281-001 - B **UTM:** 18 T **N:** 5011843 **E:** 455153

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. +, rem V. ⊕) (20 40 60 80) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
100.5	0	**TOPSOIL:** 100 mm	100.36	1A	SS			20.9%			
		FILL: (SM) SILTY SAND: brown, wet, compact, gravelly, with roots	0.1	1B	SS	63	11	13.6%	11		
100	0.5										
			99.49	2A	SS			20%			
99.5	1	**(ML) sandy CLAYEY SILT:** grey, cohesive, w>PL, firm	0.97	2B	SS	92	4	19.5%	4		
99	1.5			3	SS	75	4	19.8%	4		
98.5	2										
		-becomes soft		4	SS	67	3	18.5%	3		
98	2.5										
97.5	3		97.41								
		(ML) SILT: grey, non-cohesive, wet, compact, some sand, trace clay	3.05	5	SS	42	18	15.3%	18		
97	3.5										
		-becomes very dense									
96.5	4			6	SS	71	63	13.4%	63		
96	4.5										
				7	SS	79	69	13.0%	69		
95.5	5										
95	5.5										
				8	SS	75	56	14.4%	56		
94.5	6		94.36								
		Borehole terminated @ 6.1m due to target depth achieved.	6.1								
94	6.5										
93.5	7										
93.5											

Borehole caved at 4.0 mbgs. Groundwater measured at 1.5 mbgs following completion.

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Cassidy EW Construction
Contractor: OGS Inc.
Location: Ottawa, ON
Project No.: 17281-001 - B

Project Name: 1386 & 1394 Greely Lane
Method: Track Mounted Hollow Stem Auger
Elevation: 100.45 mREL
UTM: 18 T **N:** 5011831 **E:** 455195

Log of Borehole: BH103-23
Page: 1 of 1
Date Completed: March 8, 2023

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. +, rem V. ⊕) (20 40 60 80) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
100.4	0	**TOPSOIL:** 300 mm	100.15	1A	SS	67	2	39.1%	2		
100	0.5	**FILL:** (SM) SILTY SAND: grey, wet, trace gravel	0.3	1B	SS			22%			
99.4	1		99.46	2A	SS			22.4%			
		(ML) sandy CLAYEY SILT: grey, cohesive, w>PL, firm	0.99	2B	SS	79	4	19.3%	4		
99	1.5	-becomes stiff		3	SS	88	8	16.7%	8		
98.4	2	-decrease in clay content, becomes CL-ML									
98	2.5			4	SS	92	10	15.6%	10		
97.4	3		97.4								
		(ML) sandy SILT: grey, non-cohesive, wet, compact, trace clay	3.05	5	SS	88	17	14.3%	17		
97	3.5										
96.4	4			6	SS	79	15	14.1%	15		
96	4.5	-becomes dense									
				7	SS	71	39	13.6%	39		
95.4	5										
95	5.5			8	SS	71	47	13.7%	47		
94.4	6		94.35								
		Borehole terminated @ 6.1m due to target depth achieved.	6.1								Borehole caved at 4.9 mbgs. Groundwater measured at 0.9 mbgs following completion.
94	6.5										
93.4	7										
93.5											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Cassidy EW Construction **Project Name:** 1386 & 1394 Greely Lane **Log of Borehole:** BH104-23

Contractor: OGS Inc. **Method:** Track Mounted Hollow Stem Auger Page: 1 of 1

Location: Ottawa, ON **Elevation:** 100.52 mREL **Date Completed:** March 8, 2023

Project No.: 17281-001 - B **UTM:** 18 T **N:** 5011812 **E:** 455184

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. +, rem V. ⊕) (20 40 60 80)	SPT (N) (20 40 60 80)	Well Installation	Log Notes
100.5	0	**TOPSOIL:** 125 mm	100.39 / 0.13	1A	SS			38.1%				
				1B	SS			18.5%				
		FILL: (SM) SILTY SAND: brown, wet, very loose		1C	SS	42	3	31.3%		3		
100	0.5											
			99.55 / 0.97	2A	SS			20.7%				
99.5	1	**(ML) sandy CLAYEY SILT:** grey, cohesive, w>PL, firm		2B	SS	75	4	20%		4		
99	1.5											
				3	SS	79	4	18.2%		4		
98.5	2	-decrease in clay content, becomes CL-ML, soft										2.3m: ATT SS4: 18.5%LL 13.1%PL
98	2.5			4	SS	100	3	18%		3		
97.5	3	-100 mm silty sand seam	97.29 / 3.23									
		(ML) sandy SILT: grey, non-cohesive, wet, compact, trace clay		5	SS	83	10	16.3%		10		
97	3.5											
96.5	4			6	SS	75	26	14.3%		26		
96	4.5											
				7	SS	83	28	13.9%		28		
95.5	5											
95	5.5	-becomes dense										
				8	SS	79	39	13.9%		39		
94.5	6		94.42 / 6.1									
		Borehole terminated @ 6.1m due to target depth achieved.										Borehole caved at 4.6 mbgs. Groundwater measured at 0.6 mbgs following completion.
94	6.5											
93.5	7											
93.6												

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS4	0	25	57	18
SS6	0	22	74	4

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Cassidy EW Construction
Contractor: OGS Inc.
Location: Ottawa, ON
Project No.: 17281-001 - B

Project Name: 1386 & 1394 Greely Lane
Method: Track Mounted Hollow Stem Auger
Elevation: 100.65 mREL
UTM: 18 T **N:** 5011843 **E:** 455141

Log of Borehole: BH105-23
Page: 1 of 1
Date Completed: March 8, 2023

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. / rem V.) (20 40 60 80) / SPT (N) (20 40 60 80)	Well Installation	Log Notes
100.6	0		**TOPSOIL:** 150 mm	100.5 / 0.15	1A	SS			37.1%		Cap	
			FILL: (SM) SILTY SAND: brown, wet, loose, some gravel, trace clay		1B	SS	67	7	19.3%	7	Bentonite Plug Riser	
100.2	0.5											
			-becomes grey, decrease in silt content		2A	SS			12.1%			
99.6	1				2B	SS	63	11	15.4%	11		
99.2	1.5			99.13								
			(ML) sandy CLAYEY SILT: grey, cohesive, w>PL, firm	1.52	3	SS	92	4	19.9%	4	Sand Back PVC Screen	
98.6	2											
				98.21	4A	SS			20%			
98.2	2.5		**(ML) SILT:** grey, non-cohesive, wet, loose, some sand, trace clay	2.44	4B	SS	63	5	18.1%	5		
97.6	3		-becomes compact									
					5	SS	50	16	16.1%	16		
97.2	3.5			96.99							Cap	
			Borehole terminated @ 3.7m due to target depth achieved.	3.66								Groundwater measured at 2.0 mbgs following completion.
96.6	4											
96.2	4.5											
95.6	5											
95.2	5.5											
94.6	6											
94.2	6.5											
93.6	7											
93.7												

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: Cassidy EW Construction **Project Name:** 1386 & 1394 Greely Lane **Log of Borehole:** BH106-23

Contractor: OGS Inc. **Method:** Track Mounted Hollow Stem Auger Page: 1 of 1

Location: Ottawa, ON **Elevation:** 100.38 mASL **Date Completed:** March 7, 2023

Project No.: 17281-001 - B **UTM:** 18 T **N:** 5011800 **E:** 455161

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture 25 50 75	Shear Strength Cu, kPa (nat V. / rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
100.4	0	**TOPSOIL:** 125 mm	100.25	1A	SS			19.4%		Cap	
				1B	SS			51.5%			
		FILL: (SM) SILTY SAND: brown, wet, very loose, trace gravel	0.13	1C	SS	54	3	31.1%	3	Bentonite Plug	
99.9	0.5									Riser	
			99.52	2A	SS			22.9%			
99.4	1	**(ML) sandy CLAYEY SILT:** grey, cohesive, w>PL, soft	0.86	2B	SS	75	3	19%	3		
98.9	1.5	-becomes firm									
				3	SS	100	5	18.3%	5	Sand	
98.4	2									Back PVC Screen	
97.9	2.5			4	SS	92	6	19.1%	6		
97.4	3		97.33								
		(ML) sandy SILT: grey, non-cohesive, wet, compact, trace clay	3.05	5	SS	75	15	15.8%	15		
96.9	3.5		96.72								
		Borehole terminated @ 3.7m due to target depth achieved.	3.66							Cap	
96.4	4										Groundwater measured at 1.5 mbgs following completion.
95.9	4.5										
95.4	5										
94.9	5.5										
94.4	6										
93.9	6.5										
93.4	7										
93.4											

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

CAMBIUM

Client: Cassidy EW Construction **Project Name:** 1386 & 1394 Greely Lane **Log of Borehole:** BH107-23

Contractor: OGS Inc. **Method:** Track Mounted Hollow Stem Auger Page: 1 of 1

Location: Ottawa, ON **Elevation:** 99.86 mREL **Date Completed:** March 8, 2023

Project No.: 17281-001 - B **UTM:** 18 T **N:** 5011845 **E:** 455203

Elevation (m)	Depth	Lithology	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture 25 50 75	Shear Strength Cu, kPa (nat V. / rem V.) 20 40 60 80 / SPT (N) 20 40 60 80	Well Installation	Log Notes
99.9	0		**TOPSOIL:** 75 mm	99.78 / 0.08	1A	SS			53.8%		Cap	
					1B	SS	79	6	24%	6	Bentonite Plug	
			FILL: (SM) SILTY SAND: brown, wet, trace clay	99.56 / 0.3							Riser	
99.4	0.5				1C	SS			17.2%			
			(ML) sandy CLAYEY SILT: grey, cohesive, w>PL, stiff									
98.9	1				2	SS	79	9	15.9%	9		
98.4	1.5		-becomes firm									
					3	SS	100	7	15.4%	7	PVC Screen	
97.9	2			97.57 / 2.29							Sand Pack	
97.4	2.5		**(ML) sandy SILT:** grey, non-cohesive, wet, compact, trace clay		4	SS	75	17	15.1%	17		
96.9	3											
					5	SS	63	16	14.8%	16	Cap	
96.4	3.5			96.2 / 3.66								
			Borehole terminated @ 3.7m due to target depth achieved.									
95.9	4											roundwater measured at 1.8 mbgs following completion.
95.4	4.5											
94.9	5											
94.4	5.5											
93.9	6											
93.4	6.5											
92.9	7											
92.9												

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Client: Cassidy EW Construction **Project Name:** 1386 & 1394 Greely Lane **Log of Borehole:** BH108-23

Contractor: OGS Inc. **Method:** Track Mounted Hollow Stem Auger Page: 1 of 1

Location: Ottawa, ON **Elevation:** 100.8 mREL **Date Completed:** March 8, 2023

Project No.: 17281-001 - B **UTM:** 18 T **N:** 5011890 **E:** 455169

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. / rem V.) (20 40 60 80)	SPT (N) (20 40 60 80)	Well Installation	Log Notes
100.8	0	**ASPHALT:** 50 mm	100.75									
		FILL: (SM) GRAVELLY SAND, brown, wet, some silt [base material]	0.05 / 100.19	1A	SS	100	64	14.2%		64		
100.3	0.5	**FILL:** (SM) SAND and SILT: grey, wet	0.61 / 99.73	1B	SS			31.5%				
99.8	1			2A	SS			16.6%				
		(ML) sandy CLAYEY SILT: grey, non-cohesive, w>PL, firm	1.07 / 99.28	2B	SS	67	3	20.1%		3		
99.3	1.5	Borehole terminated @ 1.5m due to target depth achieved.	1.52									
98.8	2											Borehole remained open. Groundwater measured at 0.8 mbgs following completion.
98.3	2.5											
97.8	3											
97.3	3.5											
96.8	4											
96.3	4.5											
95.8	5											
95.3	5.5											
94.8	6											
94.3	6.5											
93.8	7											
93.8												

GRAINSIZE DISTRIBUTION

SAMPLE	GRAVEL	SAND	SILT	CLAY
SS1B	0	63	37	

1m = 24 units

Logged By: FI **Input By:** BV

Client: Cassidy EW Construction
Contractor: OGS Inc.
Location: Ottawa, ON
Project No.: 17281-001 - B

Project Name: 1386 & 1394 Greely Lane
Method: Track Mounted Hollow Stem Auger
Elevation: 100.34 mREL
UTM: 18 T **N:** 5011847 **E:** 455186

Log of Borehole: BH109-23
Page: 1 of 1
Date Completed: March 7, 2023

Elevation (m)	Depth	Description	Elevation / Depth	Number	Type	% Recovery	SPT (N)	% Moisture (25 50 75)	Shear Strength Cu, kPa (nat V. / rem V.) (20 40 60 80)	SPT (N) (20 40 60 80)	Well Installation	Log Notes
100.3	0	**TOPSOIL:** 915 mm	99.43	1	SS	25	2	44.3%	2			
99.8	0.5											
99.3	1	**FILL:** (SM) SILTY SAND: grey, wet	0.91 / 99.32	2A	SS			28.9%				
		(ML) sandy CLAYEY SILT: grey, non-cohesive, w>PL, soft	1.02 / 98.82	2B	SS	83	3	20.4%	3			
98.8	1.5	Borehole terminated @ 1.5m due to target depth achieved.	1.52									
98.3	2											Borehole remained open. Groundwater measured at 1.1 mbgs following completion.
97.8	2.5											
97.3	3											
96.8	3.5											
96.3	4											
95.8	4.5											
95.3	5											
94.8	5.5											
94.3	6											
93.8	6.5											
93.3	7											
93.4												

GRAINSIZE DISTRIBUTION: SAMPLE | GRAVEL | SAND | SILT | CLAY

1m = 24 units

Logged By: FI **Input By:** BV

Peterborough, Barrie, Oshawa, Kingston, Ottawa

Appendix C

Grain Size Analysis Results

Grain Size Distribution Chart

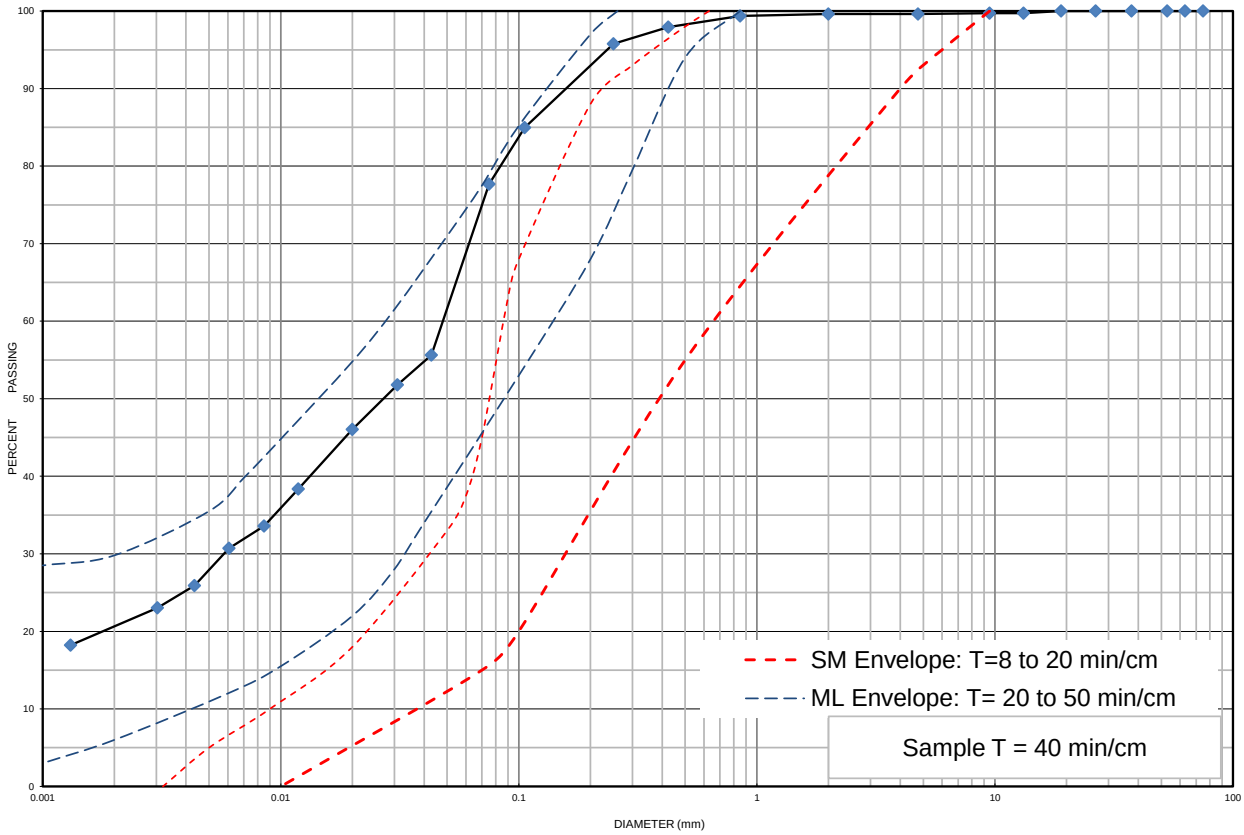
Project Number: *17281-002* **Client:** *Cassidy E.W. Construction Consultant Ltd.*

Project Name: *Hydrogeological Assessment - 1386 & 1394 Greely Lane, Ottawa*

Sample Date: *March 7-8, 2023* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 101-23 SS 3* **Depth:** *1.5 m to 2.1 m* **Lab Sample No:** *S-23-0475*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-23	SS 3	1.5 m to 2.1 m	0	22	57	21	18.8

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Clayey Silt	ML	0.0480	0.0058	-	-	-

Additional information availabe upon request

Issued By: _____ *Date Issued:* *March 20, 2024*

(Senior Project Manager)

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Grain Size Distribution Chart

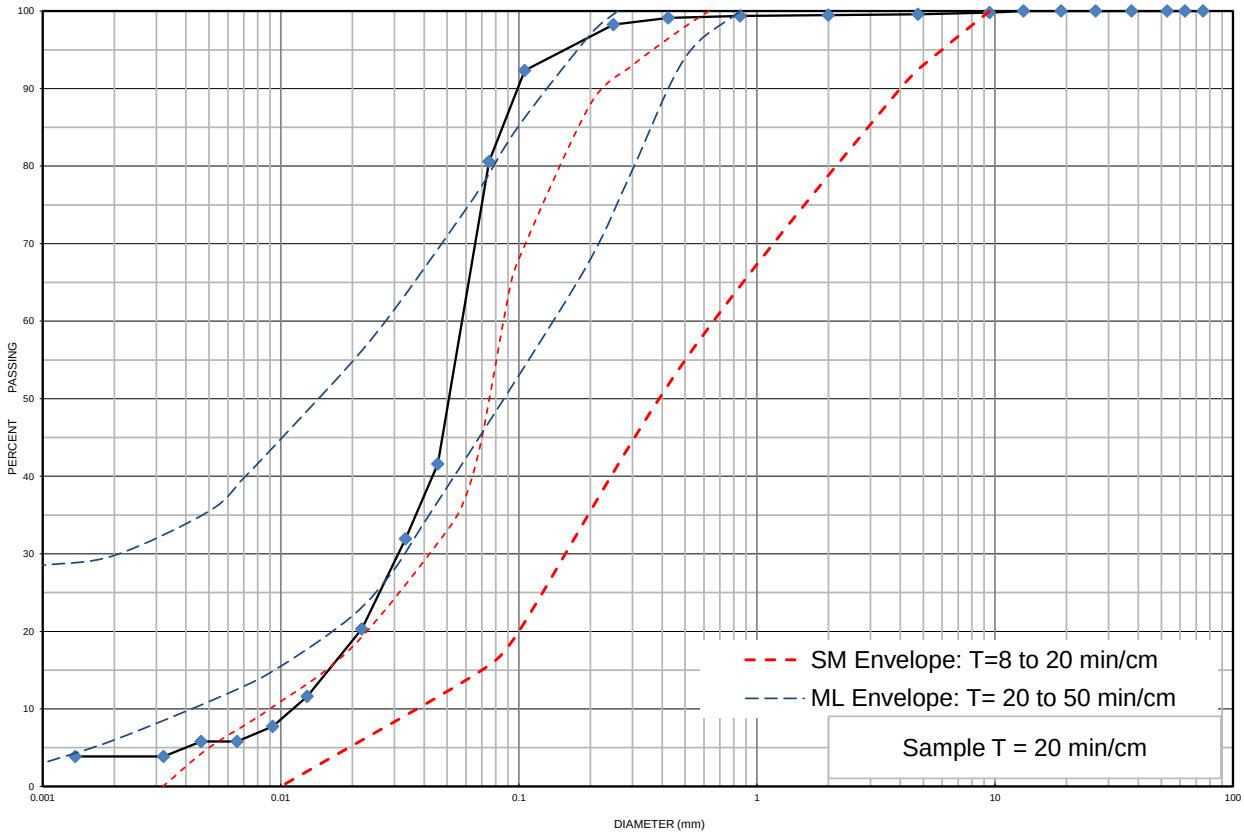
Project Number: *17281-002* **Client:** *Cassidy E.W. Construction Consultant Ltd.*

Project Name: *Hydrogeological Assessment - 1386 & 1394 Greely Lane, Ottawa*

Sample Date: *March 7-8, 2023* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 101-23 SS 6* **Depth:** *3.8 m to 4.4 m* **Lab Sample No:** *S-23-0476*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 101-23	SS 6	3.8 m to 4.4 m	0	19	77	4	13.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Silt some Sand trace Clay	ML	0.057	0.032	0.012	4.75	1.50

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Grain Size Distribution Chart

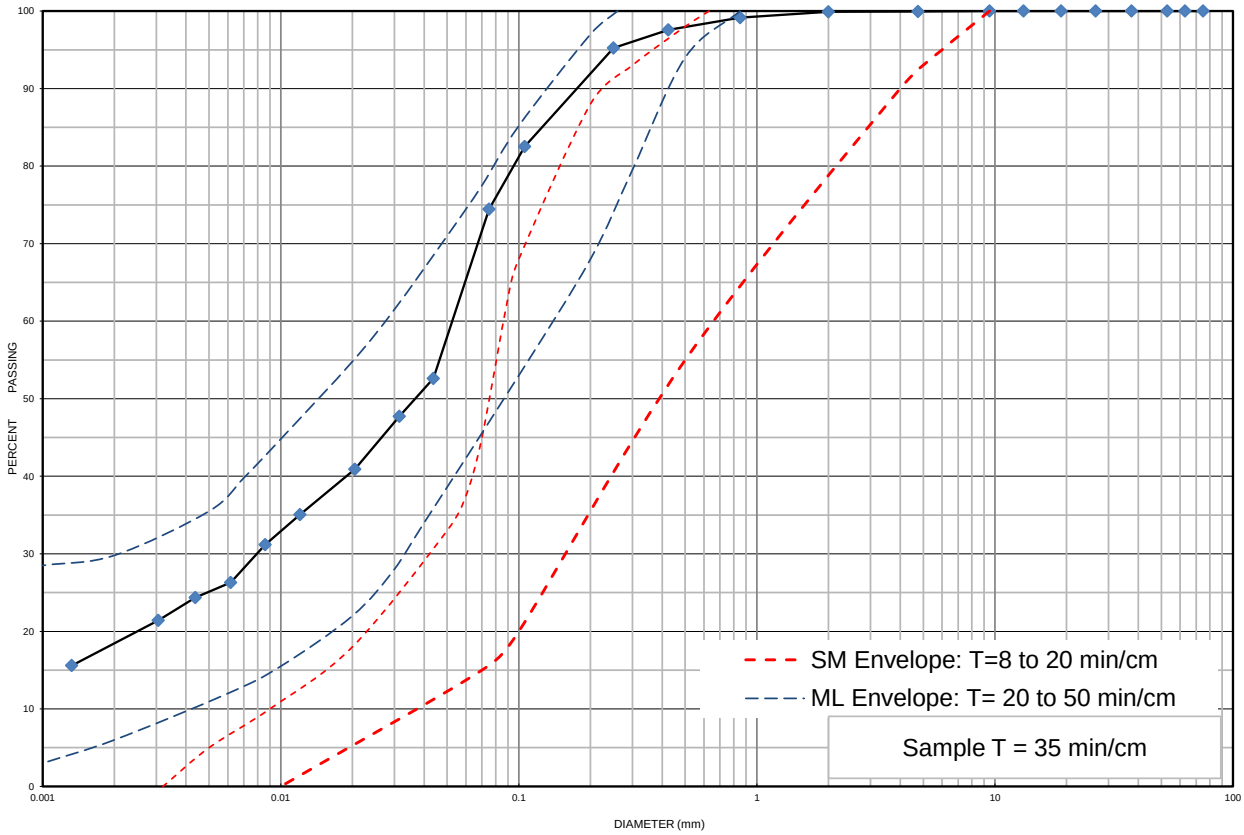
Project Number: *17281-002* **Client:** *Cassidy E.W. Construction Consultant Ltd.*

Project Name: *Hydrogeological Assessment - 1386 & 1394 Greely Lane, Ottawa*

Sample Date: *March 7-8, 2023* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 104-23 SS 4* **Depth:** *2.3 m to 2.9 m* **Lab Sample No:** *S-23-0477*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 104-23	SS 4	2.3 m to 2.9 m	0	25	57	18	18.0

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt some Clay	ML	0.053	0.008	-	-	-

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Grain Size Distribution Chart

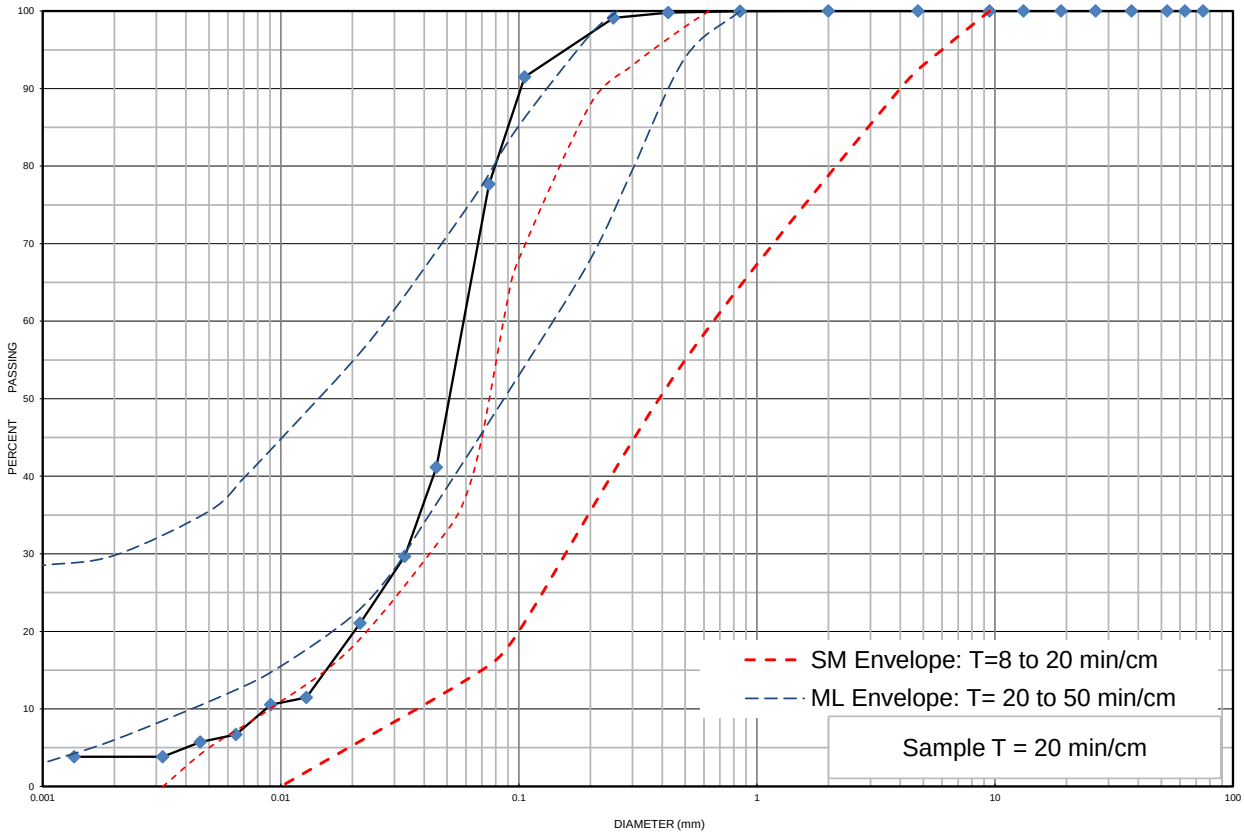
Project Number: *17281-002* **Client:** *Cassidy E.W. Construction Consultant Ltd.*

Project Name: *Hydrogeological Assessment - 1386 & 1394 Greely Lane, Ottawa*

Sample Date: *March 7-8, 2023* **Sampled By:** *Farhan Imtiaz - Cambium Inc.*

Location: *BH 104-23 SS 6* **Depth:** *3.8 m to 4.4 m* **Lab Sample No:** *S-23-0478*

UNIFIED SOIL CLASSIFICATION SYSTEM					
CLAY & SILT (<0.075 mm)	SAND (<4.75 mm to 0.075 mm)			GRAVEL (>4.75 mm)	
	FINE	MEDIUM	COARSE	FINE	COARSE



MIT SOIL CLASSIFICATION SYSTEM								
CLAY	SILT	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	BOULDERS
		SAND			GRAVEL			

Borehole No.	Sample No.	Depth	Gravel	Sand	Silt	Clay	Moisture
BH 104-23	SS 6	3.8 m to 4.4 m	0	22	74	4	14.3

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt trace Clay	ML	0.0590	0.0340	0.0087	6.78	2.25

Additional information availabe upon request

Issued By: _____ *Date Issued:* *March 20, 2024*

(Senior Project Manager)

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Appendix D

Well Inventory Survey Results

Water Well Records Summary Report

Produced by Cambium Inc. using MOECP Water Well Information System (WWIS)

All units in meters unless otherwise specified

Well ID: 1507224
Construction Date: 1965-09-22
Easting: 455211
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 20.7
Well Diameter (cm): 15.2
Water First Found: 16.8
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 23
Recommended Pump Rate: 23
Pumping Duration (h:m): 0 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	MEDIUM SAND	0	4.57
2	LIMESTONE	4.57	20.7

Well ID: 1507232
Construction Date: 1964-07-06
Easting: 454801
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 20.4
Well Diameter (cm): 5.08
Water First Found: 20.4
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 32
Recommended Pump Rate: 23
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	MEDIUM SAND	0	5.49
2	BOULDERS	5.49	14.0
3	LIMESTONE	14.0	20.4

Well ID: 1507234
Construction Date: 1964-07-06
Easting: 454851
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 20.7
Well Diameter (cm): 5.08
Water First Found: 20.7
Static Level: 1
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 23
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	MEDIUM SAND	0	5.49
2	BOULDERS	5.49	14.3
3	LIMESTONE	14.3	20.7

Well ID: 1507313
Construction Date: 1966-12-06
Easting: 455541
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 18.3
Well Diameter (cm): 12.7
Water First Found: 15.2
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 27
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	GRAVEL	0	5.49
2	LIMESTONE	5.49	18.3

Well ID: 1509840
Construction Date: 1968-08-21
Easting: 455391
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 12.8
Well Diameter (cm): 10.2
Water First Found: 12.8
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 23
Pumping Duration (h:m): 0 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.91
2	HARDPAN	0.91	3.96
3	LIMESTONE	3.96	12.8

Well ID: 1510585
Construction Date: 1970-05-28
Easting: 455331
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 32.9
Well Diameter (cm): 15.2
Water First Found: 32
Static Level: 5
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 36
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	1.52
2	GRAVEL	1.52	5.18
3	LIMESTONE	5.18	32.9

Well ID: 1512221
Construction Date: 1973-01-12
Easting: 455604
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 300 m - 1 km

Well Depth: 14.6
Well Diameter (cm): 15.2
Water First Found: 14.0
Static Level: 4
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	2.74
2	SAND	2.74	12.2
3	LIMESTONE	12.2	14.6

Well ID: 1513408
Construction Date: 1973-09-10
Easting: 455523
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 10.7
Well Diameter (cm): 12.7
Water First Found: 9.75
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 36
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 57

Layer:	Driller's Description:	Top:	Bottom:
1	HARDPAN	0	7.62
2	LIMESTONE	7.62	10.7

Well ID: 1513421
Construction Date: 1973-09-26
Easting: 455556
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 300 m - 1 km

Well Depth: 13.1
Well Diameter (cm): 12.7
Water First Found: 13.1
Static Level: 5
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 68
Recommended Pump Rate: 45
Pumping Duration (h:m): 1 : 10

Layer:	Driller's Description:	Top:	Bottom:
1	HARDPAN	0	13.1

Well ID: 1515384
Construction Date: 1976-06-19
Easting: 455451
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 38.1
Well Diameter (cm):
Water First Found: 12.8
Static Level: 6
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 18
Recommended Pump Rate: 18
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	5.79
1	SAND	0	5.79
1	SAND	0	5.79
1	SAND	0	5.79
2	LIMESTONE	5.79	38.1
2	LIMESTONE	5.79	38.1
2	LIMESTONE	5.79	38.1
2	LIMESTONE	5.79	38.1

Well ID: 1515531
Construction Date: 1976-08-13
Easting: 455551
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 16.8
Well Diameter (cm): 15.2
Water First Found: 16.1
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Municipal
Pump Rate (LPM): 91
Recommended Pump Rate: 68
Pumping Duration (h:m): 1 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	GRAVEL	0	8.23
2	HARDPAN	8.23	15.2
3	SANDSTONE	15.2	15.5
4	UNKNOWN TYPE	15.5	16.8

Well ID: 1517024
Construction Date: 1979-07-09
Easting: 455530
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 15.5
Well Diameter (cm): 15.2
Water First Found: 14.6
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 55
Pumping Duration (h:m): 1 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	HARDPAN	0	4.88
2	SAND	4.88	13.7
3	GRAVEL	13.7	14.3
4	LIMESTONE	14.3	15.5

Well ID: 1517148 **Easting:** 455430 **UTM Zone** 18
Construction Date: 1979-10-05 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth:	16.8	**Water Kind**	FRESH	**Pump Rate (LPM):**	91
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	45
Water First Found:	13.7	**Primary Water Use:**	Livestock	**Pumping Duration (h:m):**	1 : 30
Static Level:	2				

Layer:	Driller's Description:	Top:	Bottom:
1	HARDPAN	0	11.6
2	SAND	11.6	13.7
3	LIMESTONE	13.7	16.8

Well ID: 1517152 **Easting:** 455530 **UTM Zone** 18
Construction Date: 1979-10-05 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth:	15.5	**Water Kind**	FRESH	**Pump Rate (LPM):**	114
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	68
Water First Found:	14.9	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	1 : 30
Static Level:	5				

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	10.7
2	HARDPAN	10.7	12.2
3	LIMESTONE	12.2	15.5

Well ID: 1517154 **Easting:** 455530 **UTM Zone** 18
Construction Date: 1979-10-05 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth:	16.2	**Water Kind**	FRESH	**Pump Rate (LPM):**	82
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	45
Water First Found:	14.9	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	1 : 30
Static Level:	6				

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	13.1
2	LIMESTONE	13.1	16.1

Well ID: 1517156 **Easting:** 455530 **UTM Zone** 18
Construction Date: 1979-10-05 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth:	15.2	**Water Kind**	FRESH	**Pump Rate (LPM):**	82
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	36
Water First Found:	14.3	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	2 : 20
Static Level:	5				

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	12.5
2	LIMESTONE	12.5	15.2

Well ID: 1517638 **Easting:** 455630 **UTM Zone** 18
Construction Date: 1981-09-08 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth:	12.5	**Water Kind**	FRESH	**Pump Rate (LPM):**	136
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	23
Water First Found:	12.2	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	1 : 0
Static Level:	4				

Layer:	Driller's Description:	Top:	Bottom:

1	CLAY	0	9.45
2	SHALE	9.45	12.5

Well ID: 1518000
Construction Date: 1982-11-29
Easting: 455630
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 13.1
Well Diameter (cm): 15.2
Water First Found: 12.8
Static Level: 5
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 45
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	1.83
2	QUICKSAND	1.83	12.2
3	SAND	12.2	12.5
4	LIMESTONE	12.5	13.1

Well ID: 1518291
Construction Date: 1983-06-20
Easting: 455630
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 14.6
Well Diameter (cm): 15.2
Water First Found: 14.3
Static Level: 4
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Public
Pump Rate (LPM): 45
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SILT	0	3.66
2	TILL	3.66	11.9
3	STONES	11.9	14.6

Well ID: 1518419
Construction Date: 1983-08-24
Easting: 455430
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 19.8
Well Diameter (cm): 15.2
Water First Found: 19.2
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 136
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	3.35
2	SAND	3.35	9.14
3	HARDPAN	9.14	17.1
4	LIMESTONE	17.1	19.8

Well ID: 1518420
Construction Date: 1983-08-24
Easting: 455430
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 19.8
Well Diameter (cm): 15.2
Water First Found: 19.2
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 68
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	1.22
2	SAND	1.22	6.1
3	HARDPAN	6.1	15.2
4	SAND	15.2	16.8

5	LIMESTONE	16.8	19.8

Well ID: 1518698 **Easting:** 455530 **UTM Zone** 18
Construction Date: 1983-11-24 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth: 22.9 **Water Kind** FRESH **Pump Rate (LPM):** 45
Well Diameter (cm): 15.2 **Final Status** Water Supply **Recommended Pump Rate:** 23
Water First Found: 20.4 **Primary Water Use:** Domestic **Pumping Duration (h:m):** 1 : 0
Static Level: 4

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	2.44
2	SAND	2.44	11.6
3	SAND	11.6	14.6
4	HARDPAN	14.6	18.3
5	LIMESTONE	18.3	22.9

Well ID: 1520434 **Easting:** 455527 **UTM Zone** 18
Construction Date: 1986-02-20 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 100 m - 300 m

Well Depth: 19.5 **Water Kind** FRESH **Pump Rate (LPM):** 68
Well Diameter (cm): 15.2 **Final Status** Water Supply **Recommended Pump Rate:** 68
Water First Found: 15.9 **Primary Water Use:** Domestic **Pumping Duration (h:m):** 0 : 30
Static Level: 5

Layer:	Driller's Description:	Top:	Bottom:
1	GRAVEL	0	1.83
1	GRAVEL	0	1.83
2	CLAY	1.83	7.32
2	CLAY	1.83	7.32
3	CLAY	7.32	13.4
3	CLAY	7.32	13.4
4	LIMESTONE	13.4	19.5
4	LIMESTONE	13.4	19.5

Well ID: 1522346 **Easting:** 455172 **UTM Zone** 18
Construction Date: 1988-06-21 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 100 m - 300 m

Well Depth: 38.4 **Water Kind** FRESH **Pump Rate (LPM):** 91
Well Diameter (cm): 15.2 **Final Status** Water Supply **Recommended Pump Rate:** 91
Water First Found: 29 **Primary Water Use:** Industrial **Pumping Duration (h:m):** 1 : 30
Static Level: 3

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	2.44
2	SAND	2.44	17.1
3	LIMESTONE	17.1	38.4

Well ID: 1522347 **Easting:** 455239 **UTM Zone** 18
Construction Date: 1988-06-21 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 100 m - 300 m

Well Depth: 18.9 **Water Kind** FRESH **Pump Rate (LPM):** 182
Well Diameter (cm): 15.2 **Final Status** Recharge Well **Recommended Pump Rate:** 2E+
Water First Found: 18.3 **Primary Water Use:** Cooling And A **Pumping Duration (h:m):** 0 : 45
Static Level: 3

Layer:	Driller's Description:	Top:	Bottom:

1	SAND	0	2.74
2	SAND	2.74	17.4
3	LIMESTONE	17.4	18.9

Well ID: 1522348
Construction Date: 1988-06-21
Easting: 455254
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 18.9
Well Diameter (cm): 15.2
Water First Found: 18.3
Static Level: 3
Water Kind FRESH
Final Status Recharge Well
Primary Water Use: Cooling And A
Pump Rate (LPM): 182
Recommended Pump Rate: 2E+
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	2.74
2	SAND	2.74	17.4
3	LIMESTONE	17.4	18.9

Well ID: 1522551
Construction Date: 1988-08-18
Easting: 455474
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 19.8
Well Diameter (cm): 15.2
Water First Found: 15.9
Static Level: 3
Water Kind FRESH
Final Status Recharge Well
Primary Water Use: Cooling And A
Pump Rate (LPM): 91
Recommended Pump Rate: 45
Pumping Duration (h:m): 0 : 45

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	2.74
1	SAND	0	2.74
2	TILL	2.74	10.7
2	TILL	2.74	10.7
3	GRAVEL	10.7	14.6
3	GRAVEL	10.7	14.6
4	LIMESTONE	14.6	19.8
4	LIMESTONE	14.6	19.8

Well ID: 1522552
Construction Date: 1988-08-18
Easting: 455484
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 19.8
Well Diameter (cm): 15.2
Water First Found: 17.1
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 45
Pumping Duration (h:m): 0 : 45

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	2.44
1	SAND	0	2.44
2	TILL	2.44	9.75
2	TILL	2.44	9.75
3	GRAVEL	9.75	14.6
3	GRAVEL	9.75	14.6
4	LIMESTONE	14.6	19.8
4	LIMESTONE	14.6	19.8

Well ID: 1529728
Construction Date: 1997-12-22
Easting: 455273
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 100 m

Well Depth: 23.2
Well Diameter (cm): 15.2
Water First Found: 17.1
Static Level: 2
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 227
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	1.22
2	CLAY	1.22	2.74
3	CLAY	2.74	10.4
4	SAND	10.4	15.5
5	LIMESTONE	15.5	18.9
6	LIMESTONE	18.9	23.2

Well ID: 1532070
Construction Date: 2001-07-17
Easting: 455043
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 18.3
Well Diameter (cm): 15.2
Water First Found: 16.8
Static Level: 4
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Commerical
Pump Rate (LPM): 45
Recommended Pump Rate: 45
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	1.52
1	SAND	0	1.52
2	CLAY	1.52	11.9
2	CLAY	1.52	11.9
3	COARSE GRAVEL	11.9	18.3
3	COARSE GRAVEL	11.9	18.3

Well ID: 1533428
Construction Date: 2002-12-17
Easting: 455042
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 68
Well Diameter (cm): 15.2
Water First Found: 65.8
Static Level: 11
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	1.22
1	TOPSOIL	0	1.22
2	SAND	1.22	3.66
2	SAND	1.22	3.66
3	CLAY	3.66	9.14
3	CLAY	3.66	9.14
4	SAND	9.14	17.7
4	SAND	9.14	17.7
5	LIMESTONE	17.7	48.8
5	LIMESTONE	17.7	48.8
6	SANDSTONE	48.8	68

6	SANDSTONE	48.8	68

Well ID: 1533469
Construction Date: 2002-12-23
Easting: 455311
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 102
Well Diameter (cm): 20.3
Water First Found: 101
Static Level: 15
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 41
Recommended Pump Rate: 41
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	18.9
1	SAND	0	18.9
2	LIMESTONE	18.9	57.3
2	LIMESTONE	18.9	57.3
3	LIMESTONE	57.3	69.2
3	LIMESTONE	57.3	69.2
4	SANDSTONE	69.2	102
4	SANDSTONE	69.2	102

Well ID: 1534585
Construction Date: 2004-03-31
Easting: 455214
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 41.8
Well Diameter (cm):
Water First Found: 41.1
Static Level: 3
Water Kind Not stated
Final Status Test Hole
Primary Water Use: Not Used
Pump Rate (LPM): 84
Recommended Pump Rate: 36
Pumping Duration (h:m): 6 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	10.1
1	CLAY	0	10.1
2	SANDSTONE	10.1	15.2
2	SANDSTONE	10.1	15.2
3	LIMESTONE	15.2	41.8
3	LIMESTONE	15.2	41.8

Well ID: 1536286
Construction Date: 2006-04-12
Easting: 454797
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 45.7
Well Diameter (cm):
Water First Found: 43.2
Static Level: 10
Water Kind
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	12.2
1	SAND	0	12.2
2	LIMESTONE	12.2	45.7
2	LIMESTONE	12.2	45.7

Well ID: 1536661
Construction Date: 2006-09-07
Easting: 454807
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 25
Well Diameter (cm):
Water First Found: 16.8
Static Level: 3
Water Kind
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	5.18
1	SAND	0	5.18
1	SAND	0	5.18
1	SAND	0	5.18
2	CLAY	5.18	11
2	CLAY	5.18	11
2	CLAY	5.18	11
2	CLAY	5.18	11
3	LIMESTONE	11	25
3	LIMESTONE	11	25
3	LIMESTONE	11	25
3	LIMESTONE	11	25

Well ID: 1536715
Construction Date: 2006-10-11
Easting: 454725
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 56.7
Well Diameter (cm):
Water First Found: 54.3
Static Level: 10
Water Kind
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	2.74
1	CLAY	0	2.74
2	SAND	2.74	13.1
2	SAND	2.74	13.1
3	LIMESTONE	13.1	46.0
3	LIMESTONE	13.1	46.0
4	SANDSTONE	46.0	56.7
4	SANDSTONE	46.0	56.7

Well ID: 7040754
Construction Date: 2007-02-12
Easting: 454738
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 48.8
Well Diameter (cm):
Water First Found: 19.8
Static Level: 10
Water Kind
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	12.5
1	SAND	0	12.5
1	SAND	0	12.5

1	SAND	0	12.5
2	LIMESTONE	12.5	45.7
2	LIMESTONE	12.5	45.7
2	LIMESTONE	12.5	45.7
2	LIMESTONE	12.5	45.7
3	SANDSTONE	45.7	48.8
3	SANDSTONE	45.7	48.8
3	SANDSTONE	45.7	48.8
3	SANDSTONE	45.7	48.8

Well ID: 7048698
Construction Date: 2007-08-29
Easting: 454767
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 48.8
Well Diameter (cm):
Water First Found: 45.7
Static Level: 9
Water Kind
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	12.2
1	SAND	0	12.2
1	SAND	0	12.2
1	SAND	0	12.2
2	LIMESTONE	12.2	43
2	LIMESTONE	12.2	43
2	LIMESTONE	12.2	43
2	LIMESTONE	12.2	43
3	SANDSTONE	43	48.8
3	SANDSTONE	43	48.8
3	SANDSTONE	43	48.8
3	SANDSTONE	43	48.8

Well ID: 7104239
Construction Date: 2008-04-28
Easting: 455341
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 18.9
Well Diameter (cm):
Water First Found:
Static Level:
Water Kind
Final Status Abandoned-Ot
Primary Water Use:
Pump Rate (LPM):
Recommended Pump Rate:
Pumping Duration (h:m):

Layer:	Driller's Description:	Top:	Bottom:
1		0	18.9

Well ID: 7120715
Construction Date: 2009-03-19
Easting: 455600
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 50
Well Diameter (cm):
Water First Found:
Static Level: 4
Water Kind
Final Status
Primary Water Use:
Pump Rate (LPM): 82
Recommended Pump Rate: 46
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1		0	50

Well ID: 7130148
Construction Date: 2009-09-22

Easting: 455051
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 4.88
Well Diameter (cm): 5.2
Water First Found:
Static Level:

Water Kind
Final Status Monitoring an
Primary Water Use: Monitoring an

Pump Rate (LPM):
Recommended Pump Rate:
Pumping Duration (h:m):

Layer:	Driller's Description:	Top:	Bottom:
1	GRAVEL	0	0.61
1	GRAVEL	0	0.61
1	GRAVEL	0	0.61
1	GRAVEL	0	0.61
2	SAND	0.61	1.5
2	SAND	0.61	1.5
2	SAND	0.61	1.5
2	SAND	0.61	1.5
3	CLAY	1.5	2.74
3	CLAY	1.5	2.74
3	CLAY	1.5	2.74
3	CLAY	1.5	2.74
4	SILT	2.74	4.88
4	SILT	2.74	4.88
4	SILT	2.74	4.88
4	SILT	2.74	4.88

Well ID: 7156846
Construction Date: 2010-12-29

Easting: 454720
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 36.6
Well Diameter (cm): 15.2
Water First Found: 19.8
Static Level: 1

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	8.53
1	SAND	0	8.53
1	SAND	0	8.53
2	SAND	8.53	16.5
2	SAND	8.53	16.5
2	SAND	8.53	16.5
3	LIMESTONE	16.5	36.6
3	LIMESTONE	16.5	36.6
3	LIMESTONE	16.5	36.6

Well ID: 7157870
Construction Date: 2011-01-17

Easting: 455093
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 54.9
Well Diameter (cm): 15.2
Water First Found: 53.0
Static Level: 3

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	17.1
1	SAND	0	17.1
1	SAND	0	17.1
1	SAND	0	17.1
1	SAND	0	17.1
1	SAND	0	17.1
1	SAND	0	17.1
1	SAND	0	17.1
2	LIMESTONE	17.1	54.9
2	LIMESTONE	17.1	54.9
2	LIMESTONE	17.1	54.9
2	LIMESTONE	17.1	54.9
2	LIMESTONE	17.1	54.9
2	LIMESTONE	17.1	54.9
2	LIMESTONE	17.1	54.9
2	LIMESTONE	17.1	54.9

Well ID: 7159015
Construction Date: 2011-02-10

Easting: 455214
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 10 - 30 m

Well Depth:
Well Diameter (cm):
Water First Found:
Static Level:

Water Kind
Final Status Abandoned-Ot
Primary Water Use:

Pump Rate (LPM):
Recommended Pump Rate:
Pumping Duration (h:m):

Layer:	Driller's Description:	Top:	Bottom:

Well ID: 7183294
Construction Date: 2012-06-29

Easting: 455487
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 32
Well Diameter (cm): 15.2
Water First Found: 30.2
Static Level: 4

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	1.83
2	SAND	1.83	12.8
3	LIMESTONE	12.8	30.2
4	LIMESTONE	30.2	32

Well ID: 7183299
Construction Date: 2012-06-29
Easting: 454693
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 61.3
Well Diameter (cm): 15.1
Water First Found: 56.4
Static Level: 5
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 55
Recommended Pump Rate: 55
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	1.52
1	SAND	0	1.52
1	SAND	0	1.52
1	SAND	0	1.52
2	CLAY	1.52	6.40
2	CLAY	1.52	6.40
2	CLAY	1.52	6.40
2	CLAY	1.52	6.40
3	SAND	6.40	18.3
3	SAND	6.40	18.3
3	SAND	6.40	18.3
3	SAND	6.40	18.3
4	LIMESTONE	18.3	34.8
4	LIMESTONE	18.3	34.8
4	LIMESTONE	18.3	34.8
4	LIMESTONE	18.3	34.8
5	SANDSTONE	34.8	54.6
5	SANDSTONE	34.8	54.6
5	SANDSTONE	34.8	54.6
5	SANDSTONE	34.8	54.6
6	SANDSTONE	54.6	56.4
6	SANDSTONE	54.6	56.4
6	SANDSTONE	54.6	56.4
6	SANDSTONE	54.6	56.4
7	SANDSTONE	56.4	61.3
7	SANDSTONE	56.4	61.3
7	SANDSTONE	56.4	61.3
7	SANDSTONE	56.4	61.3

Well ID: 7187406
Construction Date: 2012-09-20
Easting: 455459
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 29.9
Well Diameter (cm): 15.9
Water First Found: 18.3
Static Level: 4
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 82
Recommended Pump Rate: 46
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	2.74

1	TOPSOIL	0	2.74
2	CLAY	2.74	4.87
2	CLAY	2.74	4.87
3	SAND	4.87	9.14
3	SAND	4.87	9.14
4	GRAVEL	9.14	11.3
4	GRAVEL	9.14	11.3
5	LIMESTONE	11.3	29.9
5	LIMESTONE	11.3	29.9

Well ID: 7187693
Construction Date: 2012-09-22
Easting: 455312
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 27.4
Well Diameter (cm): 15.9
Water First Found: 24.7
Static Level: 3
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	11.6
1	SAND	0	11.6
2	LIMESTONE	11.6	24.7
2	LIMESTONE	11.6	24.7
3	LIMESTONE	24.7	27.4
3	LIMESTONE	24.7	27.4

Well ID: 7194027
Construction Date: 2012-12-21
Easting: 455351
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 61
Well Diameter (cm): 15.4
Water First Found: 33.2
Static Level: 9
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	15.2
1	SAND	0	15.2
1	SAND	0	15.2
1	SAND	0	15.2
2	LIMESTONE	15.2	33.2
2	LIMESTONE	15.2	33.2
2	LIMESTONE	15.2	33.2
2	LIMESTONE	15.2	33.2
3	LIMESTONE	33.2	52.4
3	LIMESTONE	33.2	52.4
3	LIMESTONE	33.2	52.4
3	LIMESTONE	33.2	52.4
4	SANDSTONE	52.4	58.5
4	SANDSTONE	52.4	58.5

4	SANDSTONE	52.4	58.5
4	SANDSTONE	52.4	58.5
5	SANDSTONE	58.5	61
5	SANDSTONE	58.5	61
5	SANDSTONE	58.5	61
5	SANDSTONE	58.5	61

Well ID: 7197490
Construction Date: 2013-02-19

Easting: 454766
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 42.7
Well Diameter (cm): 14.9
Water First Found: 36.3
Static Level: 3

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	17.4
1	SAND	0	17.4
1	SAND	0	17.4
1	SAND	0	17.4
2	LIMESTONE	17.4	36.3
2	LIMESTONE	17.4	36.3
2	LIMESTONE	17.4	36.3
2	LIMESTONE	17.4	36.3
3	LIMESTONE	36.3	37.5
3	LIMESTONE	36.3	37.5
3	LIMESTONE	36.3	37.5
3	LIMESTONE	36.3	37.5
4	LIMESTONE	37.5	42.7
4	LIMESTONE	37.5	42.7
4	LIMESTONE	37.5	42.7
4	LIMESTONE	37.5	42.7

Well ID: 7200356
Construction Date: 2013-04-15

Easting: 454958
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 61
Well Diameter (cm): 14.9
Water First Found: 46.9
Static Level: 5

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	13.7
1	SAND	0	13.7
1	SAND	0	13.7
1	SAND	0	13.7
2	LIMESTONE	13.7	42.1
2	LIMESTONE	13.7	42.1
2	LIMESTONE	13.7	42.1

2	LIMESTONE	13.7	42.1
3	SANDSTONE	42.1	46.9
3	SANDSTONE	42.1	46.9
3	SANDSTONE	42.1	46.9
3	SANDSTONE	42.1	46.9
4	SANDSTONE	46.9	55.5
4	SANDSTONE	46.9	55.5
4	SANDSTONE	46.9	55.5
4	SANDSTONE	46.9	55.5
5	SANDSTONE	55.5	61
5	SANDSTONE	55.5	61
5	SANDSTONE	55.5	61
5	SANDSTONE	55.5	61

Well ID: 7204662 **Easting:** 455133 **UTM Zone** 18
Construction Date: 2013-07-16 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth: 91.4 **Water Kind** Untested **Pump Rate (LPM):** 55
Well Diameter (cm): 15.6 **Final Status** Water Supply **Recommended Pump Rate:** 55
Water First Found: 89 **Primary Water Use:** Domestic **Pumping Duration (h:m):** 1 : 0
Static Level: 10

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	3.35
1	SAND	0	3.35
2	SAND	3.35	10.4
2	SAND	3.35	10.4
3	SAND	10.4	18.3
3	SAND	10.4	18.3
4	LIMESTONE	18.3	38.1
4	LIMESTONE	18.3	38.1
5	SANDSTONE	38.1	41.5
5	SANDSTONE	38.1	41.5
6	LIMESTONE	41.5	49.1
6	LIMESTONE	41.5	49.1
7	SANDSTONE	49.1	89
7	SANDSTONE	49.1	89
8	SANDSTONE	89	91.4
8	SANDSTONE	89	91.4

Well ID: 7204663 **Easting:** 454826 **UTM Zone** 18
Construction Date: 2013-07-16 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth: 61 **Water Kind** Untested **Pump Rate (LPM):** 55
Well Diameter (cm): 15.6 **Final Status** Water Supply **Recommended Pump Rate:** 55
Water First Found: 48.2 **Primary Water Use:** Domestic **Pumping Duration (h:m):** 1 : 0
Static Level: 10

Layer:	Driller's Description:	Top:	Bottom:

1	SAND	0	4.27
1	SAND	0	4.27
1	SAND	0	4.27
1	SAND	0	4.27
2	SILT	4.27	11.6
2	SILT	4.27	11.6
2	SILT	4.27	11.6
2	SILT	4.27	11.6
3	SAND	11.6	14.3
3	SAND	11.6	14.3
3	SAND	11.6	14.3
3	SAND	11.6	14.3
4	LIMESTONE	14.3	40.2
4	LIMESTONE	14.3	40.2
4	LIMESTONE	14.3	40.2
4	LIMESTONE	14.3	40.2
5	LIMESTONE	40.2	48.2
5	LIMESTONE	40.2	48.2
5	LIMESTONE	40.2	48.2
5	LIMESTONE	40.2	48.2
6	LIMESTONE	48.2	57.6
6	LIMESTONE	48.2	57.6
6	LIMESTONE	48.2	57.6
6	LIMESTONE	48.2	57.6
7	LIMESTONE	57.6	61
7	LIMESTONE	57.6	61
7	LIMESTONE	57.6	61
7	LIMESTONE	57.6	61

Well ID: 7209271
Construction Date: 2013-10-10

Easting: 454896
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 54.9
Well Diameter (cm): 15.6
Water First Found: 21.0
Static Level: 4

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
2	SAND	6.1	14.6

1	SAND	0	4.27
1	SAND	0	4.27
1	SAND	0	4.27
1	SAND	0	4.27
2	SILT	4.27	11.6
2	SILT	4.27	11.6
2	SILT	4.27	11.6
2	SILT	4.27	11.6
3	SAND	11.6	14.3
3	SAND	11.6	14.3
3	SAND	11.6	14.3
3	SAND	11.6	14.3
4	LIMESTONE	14.3	40.2
4	LIMESTONE	14.3	40.2
4	LIMESTONE	14.3	40.2
4	LIMESTONE	14.3	40.2
5	LIMESTONE	40.2	48.2
5	LIMESTONE	40.2	48.2
5	LIMESTONE	40.2	48.2
5	LIMESTONE	40.2	48.2
6	LIMESTONE	48.2	57.6
6	LIMESTONE	48.2	57.6
6	LIMESTONE	48.2	57.6
6	LIMESTONE	48.2	57.6
7	LIMESTONE	57.6	61
7	LIMESTONE	57.6	61
7	LIMESTONE	57.6	61
7	LIMESTONE	57.6	61

Well ID: 7209271
Construction Date: 2013-10-10

Easting: 454896
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 54.9
Well Diameter (cm): 15.6
Water First Found: 21.0
Static Level: 4

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
1	SAND	0	6.1
2	SAND	6.1	14.6

2	SAND	6.1	14.6
2	SAND	6.1	14.6
2	SAND	6.1	14.6
2	SAND	6.1	14.6
2	SAND	6.1	14.6
3	LIMESTONE	14.6	21.0
3	LIMESTONE	14.6	21.0
3	LIMESTONE	14.6	21.0
3	LIMESTONE	14.6	21.0
3	LIMESTONE	14.6	21.0
3	LIMESTONE	14.6	21.0
4	LIMESTONE	21.0	42.4
4	LIMESTONE	21.0	42.4
4	LIMESTONE	21.0	42.4
4	LIMESTONE	21.0	42.4
4	LIMESTONE	21.0	42.4
4	LIMESTONE	21.0	42.4
5	SANDSTONE	42.4	44.8
5	SANDSTONE	42.4	44.8
5	SANDSTONE	42.4	44.8
5	SANDSTONE	42.4	44.8
5	SANDSTONE	42.4	44.8
5	SANDSTONE	42.4	44.8
6	SANDSTONE	44.8	51.8
6	SANDSTONE	44.8	51.8
6	SANDSTONE	44.8	51.8
6	SANDSTONE	44.8	51.8
6	SANDSTONE	44.8	51.8
6	SANDSTONE	44.8	51.8
7	SANDSTONE	51.8	54.9
7	SANDSTONE	51.8	54.9
7	SANDSTONE	51.8	54.9
7	SANDSTONE	51.8	54.9
7	SANDSTONE	51.8	54.9
7	SANDSTONE	51.8	54.9

Well ID: 7217217
Construction Date: 2014-03-03

Easting: 455459
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 32.3
Well Diameter (cm): 15.2
Water First Found: 30.2
Static Level: 6

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:

1	SAND	0	14.3
1	SAND	0	14.3
2	LIMESTONE	14.3	30.2
2	LIMESTONE	14.3	30.2
3	LIMESTONE	30.2	32.3
3	LIMESTONE	30.2	32.3

Well ID: 7228009
Construction Date: 2014-09-22
Easting: 455435
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 61
Well Diameter (cm): 15.1
Water First Found: 26.2
Static Level: 8
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	15.2
1	SAND	0	15.2
1	SAND	0	15.2
1	SAND	0	15.2
1	SAND	0	15.2
1	SAND	0	15.2
2	LIMESTONE	15.2	26.2
2	LIMESTONE	15.2	26.2
2	LIMESTONE	15.2	26.2
2	LIMESTONE	15.2	26.2
2	LIMESTONE	15.2	26.2
2	LIMESTONE	15.2	26.2
3	LIMESTONE	26.2	40.8
3	LIMESTONE	26.2	40.8
3	LIMESTONE	26.2	40.8
3	LIMESTONE	26.2	40.8
3	LIMESTONE	26.2	40.8
3	LIMESTONE	26.2	40.8
4	LIMESTONE	40.8	54.9
4	LIMESTONE	40.8	54.9
4	LIMESTONE	40.8	54.9
4	LIMESTONE	40.8	54.9
4	LIMESTONE	40.8	54.9
4	LIMESTONE	40.8	54.9
5	SANDSTONE	54.9	59.1
5	SANDSTONE	54.9	59.1
5	SANDSTONE	54.9	59.1
5	SANDSTONE	54.9	59.1
5	SANDSTONE	54.9	59.1

5	SANDSTONE	54.9	59.1
6	SANDSTONE	59.1	61
6	SANDSTONE	59.1	61
6	SANDSTONE	59.1	61
6	SANDSTONE	59.1	61
6	SANDSTONE	59.1	61
6	SANDSTONE	59.1	61

Well ID: 7230319
Construction Date: 2014-10-29
Easting: 455162
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 90.5
Well Diameter (cm): 15.2
Water First Found: 88.7
Static Level: 10
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 55
Recommended Pump Rate: 55
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	9.14
1	SAND	0	9.14
2	GRAVEL	9.14	17.7
2	GRAVEL	9.14	17.7
3	LIMESTONE	17.7	43
3	LIMESTONE	17.7	43
4	LIMESTONE	43	48.2
4	LIMESTONE	43	48.2
5	SANDSTONE	48.2	88.7
5	SANDSTONE	48.2	88.7
6	SANDSTONE	88.7	90.5
6	SANDSTONE	88.7	90.5

Well ID: 7240506
Construction Date: 2015-04-24
Easting: 455080
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 61
Well Diameter (cm): 15.1
Water First Found: 41.8
Static Level: 4
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 36
Recommended Pump Rate: 36
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	16.8
1	CLAY	0	16.8
1	CLAY	0	16.8
1	CLAY	0	16.8
2	LIMESTONE	16.8	41.8
2	LIMESTONE	16.8	41.8
2	LIMESTONE	16.8	41.8
2	LIMESTONE	16.8	41.8
3	LIMESTONE	41.8	51.8
3	LIMESTONE	41.8	51.8

3	LIMESTONE	41.8	51.8
3	LIMESTONE	41.8	51.8
4	SANDSTONE	51.8	59.1
4	SANDSTONE	51.8	59.1
4	SANDSTONE	51.8	59.1
4	SANDSTONE	51.8	59.1
5	SANDSTONE	59.1	61
5	SANDSTONE	59.1	61
5	SANDSTONE	59.1	61
5	SANDSTONE	59.1	61

Well ID: 7243021
Construction Date: 2015-06-15
Easting: 455306
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 54.9
Well Diameter (cm): 15.2
Water First Found: 22.9
Static Level: 2
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	14.9
1	CLAY	0	14.9
1	CLAY	0	14.9
1	CLAY	0	14.9
2	LIMESTONE	14.9	22.9
2	LIMESTONE	14.9	22.9
2	LIMESTONE	14.9	22.9
2	LIMESTONE	14.9	22.9
3	LIMESTONE	22.9	52.4
3	LIMESTONE	22.9	52.4
3	LIMESTONE	22.9	52.4
3	LIMESTONE	22.9	52.4
4	LIMESTONE	52.4	54.9
4	LIMESTONE	52.4	54.9
4	LIMESTONE	52.4	54.9
4	LIMESTONE	52.4	54.9

Well ID: 7243032
Construction Date: 2015-06-15
Easting: 455258
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 48.8
Well Diameter (cm): 15.9
Water First Found: 46.9
Static Level: 3
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 68
Recommended Pump Rate: 68
Pumping Duration (h:m): : 10

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	15.9
1	CLAY	0	15.9
1	CLAY	0	15.9

1	CLAY	0	15.9
2	LIMESTONE	15.9	26.2
2	LIMESTONE	15.9	26.2
2	LIMESTONE	15.9	26.2
2	LIMESTONE	15.9	26.2
3	LIMESTONE	26.2	46.9
3	LIMESTONE	26.2	46.9
3	LIMESTONE	26.2	46.9
3	LIMESTONE	26.2	46.9
4	LIMESTONE	46.9	48.8
4	LIMESTONE	46.9	48.8
4	LIMESTONE	46.9	48.8
4	LIMESTONE	46.9	48.8

Well ID: 7243033
Construction Date: 2015-06-15
Easting: 455335
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 65.5
Well Diameter (cm): 15.2
Water First Found: 57.9
Static Level: 9
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	14.6
1	CLAY	0	14.6
1	CLAY	0	14.6
1	CLAY	0	14.6
2	LIMESTONE	14.6	48.8
2	LIMESTONE	14.6	48.8
2	LIMESTONE	14.6	48.8
2	LIMESTONE	14.6	48.8
3	LIMESTONE	48.8	57.9
3	LIMESTONE	48.8	57.9
3	LIMESTONE	48.8	57.9
3	LIMESTONE	48.8	57.9
4	LIMESTONE	57.9	63.4
4	LIMESTONE	57.9	63.4
4	LIMESTONE	57.9	63.4
4	LIMESTONE	57.9	63.4
5	LIMESTONE	63.4	65.5
5	LIMESTONE	63.4	65.5
5	LIMESTONE	63.4	65.5
5	LIMESTONE	63.4	65.5

Well ID: 7252399 **Easting:** 455519 **UTM Zone** 18
Construction Date: 2015-11-17 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth:	25	**Water Kind**	Untested	**Pump Rate (LPM):**	91
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	91
Water First Found:	17.7	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	1 : 0
Static Level:	3				

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	9.14
1	SAND	0	9.14
1	SAND	0	9.14
1	SAND	0	9.14
2	LIMESTONE	9.14	17.7
2	LIMESTONE	9.14	17.7
2	LIMESTONE	9.14	17.7
2	LIMESTONE	9.14	17.7
3	LIMESTONE	17.7	22.9
3	LIMESTONE	17.7	22.9
3	LIMESTONE	17.7	22.9
3	LIMESTONE	17.7	22.9
4	LIMESTONE	22.9	25
4	LIMESTONE	22.9	25
4	LIMESTONE	22.9	25
4	LIMESTONE	22.9	25

Well ID: 7252400 **Easting:** 455399 **UTM Zone** 18
Construction Date: 2015-11-17 **Northing:** 5E+06 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth:	48.8	**Water Kind**	Untested	**Pump Rate (LPM):**	91
Well Diameter (cm):	15.9	**Final Status**	Water Supply	**Recommended Pump Rate:**	91
Water First Found:	44.2	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	1 :
Static Level:	2				

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	8.84
1	SAND	0	8.84
1	SAND	0	8.84
1	SAND	0	8.84
2	LIMESTONE	8.84	44.2
2	LIMESTONE	8.84	44.2
2	LIMESTONE	8.84	44.2
2	LIMESTONE	8.84	44.2
3	LIMESTONE	44.2	46.9
3	LIMESTONE	44.2	46.9
3	LIMESTONE	44.2	46.9
3	LIMESTONE	44.2	46.9
4	LIMESTONE	46.9	48.8

4	LIMESTONE	46.9	48.8
4	LIMESTONE	46.9	48.8
4	LIMESTONE	46.9	48.8

Well ID: 7255451
Construction Date: 2016-01-06
Easting: 455289
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 64.0
Well Diameter (cm): 15.6
Water First Found: 62.5
Static Level: 8
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	15.9
1	CLAY	0	15.9
1	CLAY	0	15.9
1	CLAY	0	15.9
2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
3	LIMESTONE	48.8	49.1
3	LIMESTONE	48.8	49.1
3	LIMESTONE	48.8	49.1
3	LIMESTONE	48.8	49.1
4	LIMESTONE	49.1	62.5
4	LIMESTONE	49.1	62.5
4	LIMESTONE	49.1	62.5
4	LIMESTONE	49.1	62.5
5	LIMESTONE	62.5	64.0
5	LIMESTONE	62.5	64.0
5	LIMESTONE	62.5	64.0
5	LIMESTONE	62.5	64.0

Well ID: 7265398
Construction Date: 2016-06-21
Easting: 455315
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 73.2
Well Diameter (cm): 15.9
Water First Found: 70.7
Static Level: 8
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	15.9
1	SAND	0	15.9
1	SAND	0	15.9
1	SAND	0	15.9
1	SAND	0	15.9
1	SAND	0	15.9

2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
2	LIMESTONE	15.9	48.8
3	SANDSTONE	48.8	55.5
3	SANDSTONE	48.8	55.5
3	SANDSTONE	48.8	55.5
3	SANDSTONE	48.8	55.5
3	SANDSTONE	48.8	55.5
3	SANDSTONE	48.8	55.5
4	SANDSTONE	55.5	59.1
4	SANDSTONE	55.5	59.1
4	SANDSTONE	55.5	59.1
4	SANDSTONE	55.5	59.1
4	SANDSTONE	55.5	59.1
4	SANDSTONE	55.5	59.1
5	SANDSTONE	59.1	70.7
5	SANDSTONE	59.1	70.7
5	SANDSTONE	59.1	70.7
5	SANDSTONE	59.1	70.7
5	SANDSTONE	59.1	70.7
5	SANDSTONE	59.1	70.7
6	SANDSTONE	70.7	73.2
6	SANDSTONE	70.7	73.2
6	SANDSTONE	70.7	73.2
6	SANDSTONE	70.7	73.2
6	SANDSTONE	70.7	73.2
6	SANDSTONE	70.7	73.2

Well ID: 7296379
Construction Date: 2017-10-03

Easting: 454770
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 67.1
Well Diameter (cm): 15.9
Water First Found: 64.9
Static Level: 7

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	3.05
1	CLAY	0	3.05
1	CLAY	0	3.05
1	CLAY	0	3.05
2	GRAVEL	3.05	17.7

2	GRAVEL	3.05	17.7
2	GRAVEL	3.05	17.7
2	GRAVEL	3.05	17.7
3	LIMESTONE	17.7	46.0
3	LIMESTONE	17.7	46.0
3	LIMESTONE	17.7	46.0
3	LIMESTONE	17.7	46.0
4	SANDSTONE	46.0	63.7
4	SANDSTONE	46.0	63.7
4	SANDSTONE	46.0	63.7
4	SANDSTONE	46.0	63.7
5	SANDSTONE	63.7	64.9
5	SANDSTONE	63.7	64.9
5	SANDSTONE	63.7	64.9
5	SANDSTONE	63.7	64.9
6	SANDSTONE	64.9	67.1
6	SANDSTONE	64.9	67.1
6	SANDSTONE	64.9	67.1
6	SANDSTONE	64.9	67.1

Well ID: 7301342
Construction Date: 2017-12-14
Easting: 455482
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 36.6
Well Diameter (cm): 15.9
Water First Found: 35.4
Static Level: 3
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	10.1
1	SAND	0	10.1
1	SAND	0	10.1
1	SAND	0	10.1
2	LIMESTONE	10.1	36.6
2	LIMESTONE	10.1	36.6
2	LIMESTONE	10.1	36.6
2	LIMESTONE	10.1	36.6

Well ID: 7318099
Construction Date: 2018-09-10
Easting: 455258
Northing: 5E+06
UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 61
Well Diameter (cm): 15.2
Water First Found: 57
Static Level: 8
Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	4.27
1	CLAY	0	4.27

2	SAND	4.27	15.2
2	SAND	4.27	15.2
3	LIMESTONE	15.2	41.8
3	LIMESTONE	15.2	41.8
4	SANDSTONE	41.8	45.7
4	SANDSTONE	41.8	45.7
5	SANDSTONE	45.7	57
5	SANDSTONE	45.7	57
6	SANDSTONE	57	61
6	SANDSTONE	57	61

Well ID: 7324334
Construction Date: 2018-12-11

Easting: 455498
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 18.3
Well Diameter (cm): 15.9
Water First Found: 15.2
Static Level: 5

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 46
Recommended Pump Rate: 46
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	7.31
1	SAND	0	7.31
2	SAND	7.31	11.3
2	SAND	7.31	11.3
3	LIMESTONE	11.3	15.2
3	LIMESTONE	11.3	15.2
4	LIMESTONE	15.2	18.3
4	LIMESTONE	15.2	18.3

Well ID: 7336839
Construction Date: 2019-07-10

Easting: 455307
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 25
Well Diameter (cm): 15.9
Water First Found: 22
Static Level: 2

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	12.5
1	SAND	0	12.5
2	LIMESTONE	12.5	22
2	LIMESTONE	12.5	22
3	LIMESTONE	22	25
3	LIMESTONE	22	25

Well ID: 7341123
Construction Date: 2019-09-06

Easting: 455360
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth:
Well Diameter (cm):
Water First Found:
Static Level:

Water Kind
Final Status Water Supply
Primary Water Use:

Pump Rate (LPM):
Recommended Pump Rate:
Pumping Duration (h:m): :

Layer:	Driller's Description:	Top:	Bottom:

Well ID: 7357357
Construction Date: 2020-04-28

Easting: 455292
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 24.7
Well Diameter (cm): 15.6
Water First Found: 22.9
Static Level: 3

Water Kind Untested
Final Status Water Supply
Primary Water Use: Domestic

Pump Rate (LPM): 91
Recommended Pump Rate: 91
Pumping Duration (h:m): 1 :

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	15.2
1	CLAY	0	15.2
2	LIMESTONE	15.2	24.7
2	LIMESTONE	15.2	24.7

Well ID: 7364564
Construction Date: 2020-08-13

Easting: 455536
Northing: 5E+06

UTM Zone 18
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth:
Well Diameter (cm):
Water First Found:
Static Level:

Water Kind
Final Status
Primary Water Use:

Pump Rate (LPM):
Recommended Pump Rate:
Pumping Duration (h:m):

Layer:	Driller's Description:	Top:	Bottom:

Well Use Survey Summary Report

Number	Street	Spoke to employee	Participated in program	In-person survey results	Paper survey results
1368	Greely Lane	Yes	No	Gave letter to frontdesk and they will pass it along to the owner	Survey not returned
1375	Greely Lane	Yes	No	Gave letter to frontdesk and they will pass it along to the owner	Returned survey indicates the well is approx 40ft deep and installed 31 years ago. No water quality or quanity issues are noted.
1380	Greely Lane	No	No	Left letter in mailbox	Returned survey indicates water is obtained from a well constructed in approx. 1989, and is used for shower, septic, and vehicle washing. A sulfur smell is noted for water quality.
6906	McKeown Drive	Yes	No	Gave letter to frontdesk and they will pass it along to the owner	Survey not returned
6876	McKeown Drive	Yes	No	Gave letter to frontdesk and they will pass it along to the owner	Survey not returned

Appendix E

Groundwater Quality Lab Results

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Canadian owned.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G 107579

REPORT No: 24-010898 - Rev. 1

Report To:
Cambium Environmental - Kingston
625 Fortune Crescent
#1
Kingston, ON K7P 0L5

Attention: Kyle Horner

CADUCEON Environmental Laboratories
2378 Holly Lane
Ottawa, ON K1V 7P1

DATE RECEIVED: 2024-Apr-22
DATE REPORTED: 2024-Jul-30
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 17280-002
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	1	OTTAWA	PCURIEL	2024-Apr-24	A-IC-01	SM 4110B
BOD5 (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-24	BOD-001	SM 5210B
Cond/pH/Alk Auto (Liquid)	1	OTTAWA	SBOUDREAU	2024-Apr-22	COND-02/PH-02/A LK-02	SM 2510B/4500H/ 2320B
Cyanide Total (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-23	CN-001	SM 4500-CN-E
Formaldehyde (Subcontracted)	1	TESTMARK	SISLAM	2024-Apr-26		Subcontracted
Ion Balance (Calc.)	1	OTTAWA	ASCHNEIDER		CP-028	MECP E3196
Chromium VI (Liquid)	1	OTTAWA	STAILLON	2024-Apr-25	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Apr-24	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	1	OTTAWA	APRUDYVUS	2024-Apr-29	D-ICP-01	SM 3120B
ICP/OES (Liquid)	1	OTTAWA	APRUDYVUS	2024-Apr-24	D-ICP-01	SM 3120B
Mercury (Liquid)	1	OTTAWA	TBENNETT	2024-Apr-24	D-HG-02	SM 3112B
NDMA Liquid (Subcontract)	1	SGS_LAKEFIELD	SISLAM	2024-May-30		Subcontracted
Ammonia (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-24	NH3-001	SM 4500NH3
Nonylphenols (Subcontracted)	1	SGS_LAKEFIELD	SISLAM	2024-Apr-30		Subcontracted
OC Pesticides (Liquid)	1	KINGSTON	CSUMMERHAYS	2024-Apr-23	PESTCL-001	EPA 8081
Oil & Grease (Liquid)	1	KINGSTON	MLANE	2024-Apr-25	O&G-001	SM 5520
Phenols (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-25	PHEN-01	MECP E3179
Sulphide (Liquid)	1	KINGSTON	EHINCH	2024-Apr-23	H2S-001	SM 4500-S2
SVOC - Semi-Volatiles (Liquid)	1	KINGSTON	EASIEDU	2024-Apr-24	NAB-W-001	EPA 8270D
TP & TKN (Liquid)	1	KINGSTON	KDIBBITS	2024-Apr-29	TPTKN-001	MECP E3516.2
TSS (Liquid)	1	KINGSTON	MCLOSS	2024-Apr-23	TSS-001	SM 2540D
Turbidity (Liquid)	1	OTTAWA	STAILLON	2024-Apr-23	A-TURB-01	SM 2130B
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	FLENA	2024-Apr-24	C-VOC-02	EPA 8260

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

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Data Specialist

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REPORT No: 24-010898 - Rev. 1

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Alkalinity(CaCO3) to pH4.5	mg/L	5			283
pH @25°C	pH units	-	11.0, 9.0	SAN, STORM	7.85
Turbidity	NTU	0.1			7070
Fluoride	mg/L	0.1	10	SAN	<0.1
Sulphate	mg/L	1	1500	SAN	84
BOD5	mg/L	3	300, 25.0	SAN, STORM	3
Total Suspended Solids	mg/L	3	350, 15.0	SAN, STORM	**9480**
Phosphorus (Total)	mg/L	0.01	10, 0.4	SAN, STORM	**8.72**
Total Kjeldahl Nitrogen	mg/L	0.1	100	SAN	6.3
Ammonia (N)-Total (NH3+NH4)	mg/L	0.05			0.15
Ammonia (N)-unionized	mg/L	0.01			<0.01
Sulphide	mg/L	0.01	2	SAN	0.01
Cyanide (Total)	mg/L	0.005	2, 0.02	SAN, STORM	<0.005
Phenolics	mg/L	0.001	1, 0.008	SAN, STORM	<0.001
Hardness (as CaCO3)	mg/L	0.02			368
Aluminum	mg/L	0.01			0.07
Barium	mg/L	0.001			0.165
Calcium	mg/L	0.02			105
Iron	mg/L	0.005			0.020
Magnesium	mg/L	0.02			25.6
Tungsten	mg/L	0.01			<0.01

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Final Report

REPORT No: 24-010898 - Rev. 1

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Zinc	mg/L	0.005			<0.005
Zirconium	mg/L	0.003			<0.003
Hardness (as CaCO3)	mg/L	-			789
Aluminum (Total)	mg/L	0.01	50	SAN	0.03
Bismuth (Total)	mg/L	0.02	5	SAN	<0.02
Boron (Total)	mg/L	0.005	25	SAN	0.028
Cadmium (Total)	mg/L	0.005	0.02, 0.008	SAN, STORM	<0.005
Calcium (Total)	mg/L	0.02			97.7
Chromium (Total)	mg/L	0.002	5, 0.08	SAN, STORM	<0.002
Cobalt (Total)	mg/L	0.005	5	SAN	<0.005
Copper (Total)	mg/L	0.002	3, 0.04	SAN, STORM	0.008
Iron (Total)	mg/L	0.005			<0.005
Lead (Total)	mg/L	0.02	5, 0.12	SAN, STORM	<0.02
Magnesium (Total)	mg/L	0.02			27.3
Manganese (Total)	mg/L	0.001	0.05, 5	STORM, SAN	0.003
Molybdenum (Total)	mg/L	0.01	5	SAN	<0.01
Nickel (Total)	mg/L	0.01	3, 0.08	SAN, STORM	<0.01
Silver (Total)	mg/L	0.005	5, 0.12	SAN, STORM	<0.005
Tin (Total)	mg/L	0.05	5	SAN	<0.05
Titanium (Total)	mg/L	0.005	5	SAN	<0.005
Tungsten (Total)	mg/L	0.01			<0.01

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REPORT No: 24-010898 - Rev. 1

Parameter	Units	R.L.	Limits	Client I.D. / Sample I.D. / Date Collected	BH106 / 24-010898-1 / 2024-Apr-19
					-
Vanadium (Total)	mg/L	0.005	5	SAN	<0.005
Zinc (Total)	mg/L	0.005	3, 0.04	SAN, STORM	<0.005
Zirconium (Total)	mg/L	0.003			<0.003
Antimony (Total)	mg/L	0.0001	5	SAN	0.0007
Arsenic (Total)	mg/L	0.0001	0.02, 1	STORM, SAN	**0.0275**
Beryllium (Total)	mg/L	0.0001			0.0032
Cadmium (Total)	mg/L	0.000015	0.008	STORM	0.00112
Chromium (Total)	mg/L	0.001	0.08	STORM	**0.249**
Cobalt (Total)	mg/L	0.0001			0.103
Copper (Total)	mg/L	0.0001	0.04	STORM	**0.301**
Lead (Total)	mg/L	0.00002	0.12	STORM	0.0768
Molybdenum (Total)	mg/L	0.0001			0.0076
Nickel (Total)	mg/L	0.0002	0.08	STORM	**0.189**
Selenium (Total)	mg/L	0.001	0.02, 5	STORM, SAN	<0.001
Silver (Total)	mg/L	0.0001	0.12	STORM	0.0011
Thallium (Total)	mg/L	0.00005			0.00182
Uranium (Total)	mg/L	0.00005			0.0114
Vanadium (Total)	mg/L	0.0001			0.327
Chromium (VI)	mg/L	0.01			<0.01
Mercury	mg/L	0.00002	0.001, 0.0004	SAN, STORM	<0.00002
Anion Sum	meq/L	-			16.6

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Final Report

REPORT No: 24-010898 - Rev. 1

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Cation Sum	meq/L	-			15.3
% Difference	%	-			4.03
Ion Ratio	-	-			1.08
Sodium Adsorption Ratio	-	-			4.28
TDS (Ion Sum Calc)	mg/L	1			893
TDS(calc.)/EC(actual)	-	-			0.540
Conductivity Calc	µmho/cm	-			1590
Conductivity Calc / Conductivity	-	-			0.959
Langelier Index(25°C)	-	-			0.800
Saturation pH (25°C)	-	-			7.05
pH (Client Data)	pH units	-			6.97
Temperature (Client Data)	°C	-			9.9

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REPORT No: 24-010898 - Rev. 1

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Benzene	mg/L	0.0005	0.01, 0.002	SAN, STORM	<0.0005
Bromodichloromethane	mg/L	0.002	0.35	SAN	<0.002
Bromoform	mg/L	0.005	0.63	SAN	<0.005
Bromomethane	mg/L	0.0005	0.11	SAN	<0.0005
Carbon Tetrachloride	mg/L	0.0002	0.057	SAN	<0.0002
Chlorobenzene	mg/L	0.0005	0.057	SAN	<0.0005
Chloroethane	mg/L	0.003	0.27	SAN	<0.003
Chloroform	mg/L	0.001	0.08, 0.002	SAN, STORM	<0.001
Chloromethane (Methyl Chloride)	mg/L	0.002	0.19	SAN	<0.002
Dibromochloromethane	mg/L	0.002	0.057	SAN	<0.002
Ethylene Dibromide	mg/L	0.0002	0.028	SAN	<0.0002
Dichlorobenzene,1,2-	mg/L	0.0005	0.088, 0.0056	SAN, STORM	<0.0005
Dichlorobenzene,1,3-	mg/L	0.0005	0.036	SAN	<0.0005
Dichlorobenzene,1,4-	mg/L	0.0005	0.017, 0.0068	SAN, STORM	<0.0005
Dichloroethane,1,1-	mg/L	0.0005	0.2	SAN	<0.0005
Dichloroethane,1,2-	mg/L	0.0005	0.21	SAN	0.0007
Dichloroethylene,1,1-	mg/L	0.0005	0.04	SAN	<0.0005
Dichloroethylene,1,2-cis-	mg/L	0.0005	0.2, 0.0056	SAN, STORM	<0.0005
Dichloroethylene,1,2-trans-	mg/L	0.0005	0.2	SAN	<0.0005
Dichloropropane,1,2-	mg/L	0.0005	0.85	SAN	<0.0005
Dichloropropene,1,3-cis-	mg/L	0.0005	0.07	SAN	<0.0005

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REPORT No: 24-010898 - Rev. 1

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Dichloropropene,1,3-trans-	mg/L	0.0005	0.07, 0.0056	SAN, STORM	<0.0005
Ethylbenzene	mg/L	0.0005	0.057, 0.002	SAN, STORM	<0.0005
Dichloromethane (Methylene Chloride)	mg/L	0.005	0.211, 0.0052	SAN, STORM	<0.005
Styrene	mg/L	0.0005	0.04	SAN	<0.0005
Tetrachloroethane,1,1,2,2-	mg/L	0.0005	0.04, 0.017	SAN, STORM	<0.0005
Tetrachloroethylene	mg/L	0.0005	0.05, 0.0044	SAN, STORM	<0.0005
Toluene	mg/L	0.0005	0.08, 0.002	SAN, STORM	<0.0005
Trichloroethane,1,1,1-	mg/L	0.0005	0.054	SAN	<0.0005
Trichloroethane,1,1,2-	mg/L	0.0005	0.8	SAN	<0.0005
Trichloroethylene	mg/L	0.0005	0.054, 0.0076	SAN, STORM	<0.0005
Trichlorofluoromethane (Freon 11)	mg/L	0.005	0.02	SAN	<0.005
Trimethylbenzene,1,3,5-	mg/L	0.0001	0.003	SAN	<0.0001
Vinyl Chloride	mg/L	0.0002	0.4	SAN	<0.0002
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	mg/L	0.0011	0.32, 0.0044	SAN, STORM	<0.0011
Xylene, o-	µg/L	0.5			<0.5
Oil & Grease (Total)	mg/L	1.0			1.7
Oil and Grease (Mineral)	mg/L	1.0	15	SAN	<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0	150	SAN	1.4

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Final Report

REPORT No: 24-010898 - Rev. 1

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Acenaphthene	µg/L	0.05			<0.05
Acenaphthylene	µg/L	0.05			<0.05
Anthracene	µg/L	0.05			<0.05
Benzo[a]anthracene	µg/L	0.05			<0.05
Benzo(a)pyrene	µg/L	0.01			<0.01
Benzo(b)fluoranthene	µg/L	0.05			<0.05
Benzo(b+k)fluoranthene	µg/L	0.1			<0.1
Benzo(g,h,i)perylene	µg/L	0.05			<0.05
Benzo(k)fluoranthene	µg/L	0.05			<0.05
Butyl Benzyl Phthalate	mg/L	0.001	0.017	SAN	<0.001
Bis(2-Chloroethoxy)methane	mg/L	0.002	0.036	SAN	<0.002
Bis(2-ethylhexyl) Phthalate	mg/L	0.005	0.28	SAN	<0.005
Chrysene	µg/L	0.05			<0.05
Dibenzo(a,h)anthracene	µg/L	0.05			<0.05
Di-n-Butyl Phthalate	mg/L	0.0010	0.057	SAN	<0.0010
Dichlorophenol,2,4-	mg/L	0.0002	0.044	SAN	<0.0002
Diethyl Phthalate	mg/L	0.0010	0.2	SAN	<0.0010
Di-n-Octyl Phthalate	mg/L	0.0010	0.03	SAN	<0.0010
Fluoranthene	mg/L	0.00005	0.059	SAN	<0.00005
Fluorene	µg/L	0.05			<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05			<0.05

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Final Report

REPORT No: 24-010898 - Rev. 1

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Indole	mg/L	0.002	0.05	SAN	<0.002
Methylnaphthalene,1-	mg/L	0.00005	0.032	SAN	<0.00005
Methylnaphthalene,2-(1-)	µg/L	1			<1
Methylnaphthalene,2-	mg/L	0.00005	0.022	SAN	<0.00005
Naphthalene	mg/L	0.00005	0.059, 0.064	SAN, STORM	<0.00005
Phenanthrene	µg/L	0.05			<0.05
Pyrene	µg/L	0.05			<0.05
Total PAH	mg/L	0.0001	0.015, 0.006	SAN, STORM	<0.0001

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Hexachlorobenzene	mg/L	0.00001	0.00004	STORM	<0.00001

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Final Report

REPORT No: 24-010898 - Rev. 1

Subcontracted Analyses

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Formaldehyde	mg/L	-	0.3	SAN	<0.008
Nitrosodimethylamine (NDMA)	mg/L	-	0.4	SAN	<0.0004
Nonylphenol Monoethoxylate	mg/L	-			<0.01
Nonylphenol Diethoxylate	mg/L	-			<0.01
Nonylphenols	mg/L	-	0.0025, 0.001	SAN, STORM	<0.001
Nonylphenol Ethoxylates	mg/L	-	0.025, 0.01	SAN, STORM	<0.01

Revised to include additional dissolved metals at clients request

: City of Ottawa
SAN: Sanitary Sewer By Law
STORM: Storm Sewer By Law

Summary of Exceedances		
Sanitary Sewer By Law		
BH106	**Found Value**	**Limit**
Total Suspended Solids	9480	350
Storm Sewer By Law		
BH106	**Found Value**	**Limit**
Total Suspended Solids	9480	15.0
Phosphorus (Total)	8.72	0.4
Arsenic (Total)	0.0275	0.02
Chromium (Total)	0.249	0.08
Copper (Total)	0.301	0.04
Nickel (Total)	0.189	0.08

Michelle Dubien
Data Specialist

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Canadian owned.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G 107579

REPORT No: 24-010898 - Rev. 2

Report To:
Cambium Environmental - Kingston
625 Fortune Crescent
#1
Kingston, ON K7P 0L5

CADUCEON Environmental Laboratories
2378 Holly Lane
Ottawa, ON K1V 7P1

Attention: Kyle Horner

DATE RECEIVED: 2024-Apr-22
DATE REPORTED: 2024-Aug-07
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 17280-002
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	1	OTTAWA	PCURIEL	2024-Apr-24	A-IC-01	SM 4110B
BOD5 (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-24	BOD-001	SM 5210B
Cond/pH/Alk Auto (Liquid)	1	OTTAWA	SBOUDREAU	2024-Apr-22	COND-02/PH-02/A LK-02	SM 2510B/4500H/ 2320B
Cyanide Total (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-23	CN-001	SM 4500-CN-E
Formaldehyde (Subcontracted)	1	TESTMARK	SISLAM	2024-Apr-26		Subcontracted
Ion Balance (Calc.)	1	OTTAWA	ASCHNEIDER		CP-028	MECP E3196
Chromium VI (Liquid)	1	OTTAWA	STAILLON	2024-Apr-25	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Apr-24	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	1	OTTAWA	APRUDYVUS	2024-Apr-29	D-ICP-01	SM 3120B
ICP/OES (Liquid)	1	OTTAWA	APRUDYVUS	2024-Apr-24	D-ICP-01	SM 3120B
Mercury (Liquid)	1	OTTAWA	TBENNETT	2024-Apr-24	D-HG-02	SM 3112B
NDMA Liquid (Subcontract)	1	SGS_LAKEFIELD	SISLAM	2024-May-30		Subcontracted
Ammonia (Liquid)	1	KINGSTON	JYEARWOOD	2024-Apr-24	NH3-001	SM 4500NH3
Nonylphenols (Subcontracted)	1	SGS_LAKEFIELD	SISLAM	2024-Apr-30		Subcontracted
OC Pesticides (Liquid)	1	KINGSTON	CSUMMERHAYS	2024-Apr-23	PESTCL-001	EPA 8081
Oil & Grease (Liquid)	1	KINGSTON	MLANE	2024-Apr-25	O&G-001	SM 5520
Phenols (Liquid)	1	KINGSTON	JMACINNES	2024-Apr-25	PHEN-01	MECP E3179
Sulphide (Liquid)	1	KINGSTON	EHINCH	2024-Apr-23	H2S-001	SM 4500-S2
SVOC - Semi-Volatiles (Liquid)	1	KINGSTON	EASIEDU	2024-Apr-24	NAB-W-001	EPA 8270D
TP & TKN (Liquid)	1	KINGSTON	KDIBBITS	2024-Apr-29	TPTKN-001	MECP E3516.2
TSS (Liquid)	1	KINGSTON	MCLOSS	2024-Apr-23	TSS-001	SM 2540D
Turbidity (Liquid)	1	OTTAWA	STAILLON	2024-Apr-23	A-TURB-01	SM 2130B
VOC-Volatiles Full (Water)	1	RICHMOND_HILL	FLENA	2024-Apr-24	C-VOC-02	EPA 8260

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

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Data Specialist

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Final Report

REPORT No: 24-010898 - Rev. 2

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Alkalinity(CaCO3) to pH4.5	mg/L	5			283
pH @25°C	pH units	-	8.5	PWQO	7.85
Turbidity	NTU	0.1			7070
Fluoride	mg/L	0.1			<0.1
Sulphate	mg/L	1			84
BOD5	mg/L	3			3
Total Suspended Solids	mg/L	3			9480
Phosphorus (Total)	µg/L	10	10	INTERIM	8720
Total Kjeldahl Nitrogen	mg/L	0.1			6.3
Ammonia (N)-Total (NH3+NH4)	mg/L	0.05			0.15
Ammonia (N)-unionized	µg/L	10.0	20	PWQO	<10.0
Sulphide	mg/L	0.01			0.01
Cyanide (Total)	mg/L	0.005			<0.005
Phenolics	µg/L	1	1	PWQO	<1
Hardness (as CaCO3)	mg/L as CaCO3	0			368
Aluminum	µg/L	10	75	INTERIM	70
Barium	µg/L	1			165
Calcium	µg/L	20			105000
Iron	µg/L	5	300	PWQO	20
Magnesium	µg/L	20			25600
Tungsten	µg/L	10			<10

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Final Report

REPORT No: 24-010898 - Rev. 2

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Zinc	µg/L	5	30	PWQO	<5
Zirconium	µg/L	3			<3
Hardness (as CaCO3)	mg/L as CaCO3	-			789
Aluminum (Total)	µg/L	10			30
Bismuth (Total)	µg/L	20			<20
Boron (Total)	µg/L	5	200	INTERIM	28
Cadmium (Total)	µg/L	5	0.1, 0.2	INTERIM, PWQO	<5
Calcium (Total)	µg/L	20			97700
Chromium (Total)	µg/L	2			<2
Cobalt (Total)	µg/L	5	0.9, 0.0	INTERIM, PWQO	<5
Copper (Total)	µg/L	2	5, 0.0	INTERIM, PWQO	8
Iron (Total)	µg/L	5	300	PWQO	<5
Lead (Total)	µg/L	20	1, 0.0	INTERIM, PWQO	<20
Magnesium (Total)	µg/L	20			27300
Manganese (Total)	µg/L	1			3
Molybdenum (Total)	µg/L	10	40, 0.0	INTERIM, PWQO	<10
Nickel (Total)	µg/L	10	25	PWQO	<10
Silver (Total)	µg/L	5	0.1	PWQO	<5
Tin (Total)	µg/L	50			<50
Titanium (Total)	µg/L	5			<5
Tungsten (Total)	µg/L	10	30	INTERIM	<10

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Final Report

REPORT No: 24-010898 - Rev. 2

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Vanadium (Total)	µg/L	5			<5
Zinc (Total)	µg/L	5	20, 30	INTERIM, PWQO	<5
Zirconium (Total)	µg/L	3	4	INTERIM	<3
Antimony (Total)	µg/L	0.1	20	INTERIM	0.7
Arsenic (Total)	µg/L	0.1	5, 5	INTERIM, PWQO	27.5
Beryllium (Total)	µg/L	0.1	11	PWQO	3.2
Cadmium (Total)	µg/L	0.015	0.1, 0.2	INTERIM, PWQO	1.12
Chromium (Total)	µg/L	1			249
Cobalt (Total)	µg/L	0.1	0.9	INTERIM	103
Copper (Total)	µg/L	0.1	5	INTERIM	301
Lead (Total)	µg/L	0.02	1, 5	INTERIM, PWQO	76.8
Molybdenum (Total)	µg/L	0.1	40	INTERIM	7.6
Nickel (Total)	µg/L	0.2	25	PWQO	189
Selenium (Total)	µg/L	1	100	PWQO	<1
Silver (Total)	µg/L	0.1	0.1	PWQO	1.1
Thallium (Total)	µg/L	0.05	0.3, 0.3	INTERIM, PWQO	1.82
Uranium (Total)	µg/L	0.05	5	INTERIM	11.4
Vanadium (Total)	µg/L	0.1	6	INTERIM	327
Chromium (VI)	µg/L	10	1	PWQO	<10
Mercury	µg/L	0.02	0.2	PWQO	<0.02
Anion Sum	meq/L	-			16.6

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REPORT No: 24-010898 - Rev. 2

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Cation Sum	meq/L	-			15.3
% Difference	%	-			4.03
Ion Ratio	-	-			1.08
Sodium Adsorption Ratio	-	-			4.28
TDS (Ion Sum Calc)	mg/L	1			893
TDS(calc.)/EC(actual)	-	-			0.540
Conductivity Calc	µmho/cm	-			1590
Conductivity Calc / Conductivity	-	-			0.959
Langelier Index(25°C)	-	-			0.800
Saturation pH (25°C)	-	-			7.05
pH (Client Data)	pH units	-			6.97
Temperature (Client Data)	°C	-			9.9

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REPORT No: 24-010898 - Rev. 2

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Benzene	µg/L	0.5	100	INTERIM	<0.5
Bromodichloromethane	µg/L	2	200	INTERIM	<2
Bromoform	µg/L	5	60	INTERIM	<5
Bromomethane	µg/L	0.5	0.9	INTERIM	<0.5
Carbon Tetrachloride	µg/L	0.2			<0.2
Chlorobenzene	µg/L	0.5	15	PWQO	<0.5
Chloroethane	µg/L	3			<3
Chloroform	µg/L	1			<1
Chloromethane (Methyl Chloride)	µg/L	2	700	INTERIM	<2
Dibromochloromethane	µg/L	2	40	INTERIM	<2
Ethylene Dibromide	µg/L	0.2	5, 5	INTERIM, PWQO	<0.2
Dichlorobenzene,1,2-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	2.5	PWQO	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	4	PWQO	<0.5
Dichloroethane,1,1-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethane,1,2-	µg/L	0.5	100	INTERIM	0.7
Dichloroethylene,1,1-	µg/L	0.5	40	INTERIM	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	200	INTERIM	<0.5
Dichloroethylene,1,2-trans-	µg/L	0.5	200	INTERIM	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.7	INTERIM	<0.5
Dichloropropene,1,3-cis-	µg/L	0.5			<0.5

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REPORT No: 24-010898 - Rev. 2

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Dichloropropene,1,3-trans-	µg/L	0.5	7	INTERIM	<0.5
Ethylbenzene	µg/L	0.5	8	INTERIM	<0.5
Dichloromethane (Methylene Chloride)	µg/L	5	100	INTERIM	<5
Styrene	µg/L	0.5	4	INTERIM	<0.5
Tetrachloroethane,1,1,2,2-	µg/L	0.5	70	INTERIM	<0.5
Tetrachloroethylene	µg/L	0.5	50	INTERIM	<0.5
Toluene	µg/L	0.5	0.8, 0.8	INTERIM, PWQO	<0.5
Trichloroethane,1,1,1-	µg/L	0.5	10	INTERIM	<0.5
Trichloroethane,1,1,2-	µg/L	0.5	800	INTERIM	<0.5
Trichloroethylene	µg/L	0.5	20	INTERIM	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5			<5
Trimethylbenzene,1,3,5-	µg/L	0.1	3	INTERIM	<0.1
Vinyl Chloride	µg/L	0.2	600	INTERIM	<0.2
Xylene, m,p-	µg/L	1			<1
Xylene, m,p,o-	µg/L	1.1			<1.1
Xylene, o-	µg/L	0.5	40	INTERIM	<0.5
Oil & Grease (Total)	mg/L	1.0			1.7
Oil and Grease (Mineral)	mg/L	1.0			<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0			1.4

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				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Acenaphthene	µg/L	0.05			<0.05
Acenaphthylene	µg/L	0.05			<0.05
Anthracene	µg/L	0.05	0.0008	PWQO	**<0.05**
Benzo[a]anthracene	µg/L	0.05	0.0004	INTERIM	**<0.05**
Benzo(a)pyrene	µg/L	0.01			<0.01
Benzo(b)fluoranthene	µg/L	0.05			<0.05
Benzo(b+k)fluoranthene	µg/L	0.1			<0.1
Benzo(g,h,i)perylene	µg/L	0.05	0.00002	INTERIM	**<0.05**
Benzo(k)fluoranthene	µg/L	0.05			<0.05
Butyl Benzyl Phthalate	µg/L	1	0.2	INTERIM	**<1**
Bis(2-Chloroethoxy)methane	µg/L	2			<2
Bis(2-ethylhexyl) Phthalate	µg/L	5			<5
Chrysene	µg/L	0.05	0.0001	INTERIM	**<0.05**
Dibenzo(a,h)anthracene	µg/L	0.05	0.002	INTERIM	**<0.05**
Di-n-Butyl Phthalate	µg/L	1	4	PWQO	<1
Dichlorophenol,2,4-	µg/L	0.2	0.2	PWQO	<0.2
Diethyl Phthalate	µg/L	1			<1
Di-n-Octyl Phthalate	µg/L	1	0.6	PWQO	**<1**
Fluoranthene	µg/L	0.05	0.0008	INTERIM	**<0.05**
Fluorene	µg/L	0.05	0.2	INTERIM	<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05			<0.05

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REPORT No: 24-010898 - Rev. 2

Parameter	Units	R.L.	Limits		Client I.D.: BH106 Sample I.D.: 24-010898-1 Date Collected: 2024-Apr-19
					-
Indole	µg/L	2			<2
Methylnaphthalene,1-	µg/L	0.05	2	INTERIM	<0.05
Methylnaphthalene,2-(1-)	µg/L	1			<1
Methylnaphthalene,2-	µg/L	0.05	2	INTERIM	<0.05
Naphthalene	µg/L	0.05	7	INTERIM	<0.05
Phenanthrene	µg/L	0.05	0.03	INTERIM	**<0.05**
Pyrene	µg/L	0.05			<0.05
Total PAH	µg/L	0.1			<0.1

Parameter	Units	R.L.	Limits		Client I.D.: BH106 Sample I.D.: 24-010898-1 Date Collected: 2024-Apr-19
					-
Hexachlorobenzene	µg/L	0.01			<0.01

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Final Report

REPORT No: 24-010898 - Rev. 2

Subcontracted Analyses

				Client I.D.	BH106
				Sample I.D.	24-010898-1
				Date Collected	2024-Apr-19
Parameter	**Units**	**R.L.**	**Limits**		-
Formaldehyde	µg/L	-	0.8	INTERIM	<8
Nitrosodimethylamine (NDMA)	µg/L	-	15	INTERIM	<0.4
Nonylphenol Monoethoxylate	µg/L	-			<10
Nonylphenol Diethoxylate	µg/L	-			<10
Nonylphenols	µg/L	-	0.04	INTERIM	<1
Nonylphenol Ethoxylates	µg/L	-			<10

Revised to change guideline to PWQO

: PWQO Limits
INTERIM: Interim PWQO
PWQO: PWQO

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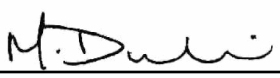
Summary of Exceedances		
Interim PWQO		
BH106	**Found Value**	**Limit**
Phosphorus (Total)	8720	10
Cadmium (Total)	<5	0.1
Cobalt (Total)	<5	0.9
Copper (Total)	8	5
Lead (Total)	<20	1
Arsenic (Total)	27.5	5
Cadmium (Total)	1.12	0.1
Cobalt (Total)	103	0.9
Copper (Total)	301	5
Lead (Total)	76.8	1
Thallium (Total)	1.82	0.3
Uranium (Total)	11.4	5
Vanadium (Total)	327	6
Benzo[a]anthracene	<0.05	0.0004
Benzo(g,h,i)perylene	<0.05	0.00002
Butyl Benzyl Phthalate	<1	0.2
Chrysene	<0.05	0.0001
Dibenzo(a,h)anthracene	<0.05	0.002
Fluoranthene	<0.05	0.0008
Phenanthrene	<0.05	0.03
Formaldehyde	<8	0.8
Nonylphenols	<1	0.04
PWQO		
BH106	**Found Value**	**Limit**
Cadmium (Total)	<5	0.2
Silver (Total)	<5	0.1
Arsenic (Total)	27.5	5
Cadmium (Total)	1.12	0.2
Lead (Total)	76.8	5
Nickel (Total)	189	25
Silver (Total)	1.1	0.1
Thallium (Total)	1.82	0.3
Chromium (VI)	<10	1
Anthracene	<0.05	0.0008
Di-n-Octyl Phthalate	<1	0.6



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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G 106721 **REPORT No: 24-024417 - Rev. 0**

Report To:
Cambium Environmental - Kingston
31 Hyperion Crt
Suite 102
Kingston, ON K7K 7G3

CADUCEON Environmental Laboratories
285 Dalton Ave
Kingston, ON K7K 6Z1

Attention: Natasha Augustine

DATE RECEIVED: 2024-Aug-10
DATE REPORTED: 2024-Aug-16
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 17281-002
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
ICP/MS (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Aug-13	D-ICPMS-01	EPA 200.8
ICP/OES (Liquid)	1	OTTAWA	APRUDYVUS	2024-Aug-14	D-ICP-01	SM 3120B
TSS (Liquid)	1	KINGSTON	DCASSIDY	2024-Aug-15	TSS-001	SM 2540D

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

				Client I.D.	BH106
				Sample I.D.	24-024417-1
				Date Collected	2024-Aug-08
Parameter	**Units**	**R.L.**	**Limits**		-
Total Suspended Solids	mg/L	3			<3
Hardness (as CaCO3)	mg/L as CaCO3	0			380
Aluminum	µg/L	10	75	INTERIM	20
Boron	µg/L	5	200	INTERIM	62
Calcium	µg/L	20			107000
Iron	µg/L	5	300	PWQO	334
Magnesium	µg/L	20			27400
Tungsten	µg/L	10			<10
Zinc	µg/L	5	30	PWQO	<5
Zirconium	µg/L	3			<3

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Data Specialist

CADUCEON Environmental Laboratories Certificate of Analysis

Final Report

REPORT No: 24-024417 - Rev. 0

				Client I.D.	BH106
				Sample I.D.	24-024417-1
				Date Collected	2024-Aug-08
Parameter	**Units**	**R.L.**	**Limits**		-
Antimony	µg/L	0.1	20, 5	INTERIM, PWQO	0.3
Arsenic	µg/L	0.1	5, 0.0	INTERIM, PWQO	1.0
Beryllium	µg/L	0.1	0.0, 11	INTERIM, PWQO	<0.1
Cadmium	µg/L	0.015	0.1, 0.2	INTERIM, PWQO	**0.211**
Chromium	µg/L	1.0			<1.0
Cobalt	µg/L	0.1			1.1
Copper	µg/L	0.1	5	INTERIM	**5.4**
Lead	µg/L	0.02	1, 5	INTERIM, PWQO	0.08
Molybdenum	µg/L	0.1	40	INTERIM	5.0
Nickel	µg/L	0.2	25	PWQO	3.8
Selenium	µg/L	1.00	100	PWQO	<1.00
Silver	µg/L	0.1	0.1	PWQO	<0.1
Thallium	µg/L	0.05	0.3, 0.3	INTERIM, PWQO	<0.05
Uranium	µg/L	0.05	5	INTERIM	4.68
Vanadium	µg/L	0.1	6	INTERIM	0.3

: PWQO Limits
INTERIM: Interim PWQO
PWQO: PWQO

Michelle Dubien
Data Specialist

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REPORT No: 24-024417 - Rev. 0

Summary of Exceedances		
Interim PWQO		
BH106	**Found Value**	**Limit**
Cadmium	0.211	0.1
Copper	5.4	5
PWQO		
BH106	**Found Value**	**Limit**
Iron	334	300
Cadmium	0.211	0.2

Michelle Dubien
Data Specialist

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G 106721 **REPORT No: 24-024417 - Rev. 2**

Report To:
Cambium Environmental - Kingston
31 Hyperion Crt
Suite 102
Kingston, ON K7K 7G3

CADUCEON Environmental Laboratories
285 Dalton Ave
Kingston, ON K7K 6Z1

Attention: Natasha Augustine

DATE RECEIVED: 2024-Aug-10
DATE REPORTED: 2024-Sep-05
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 17281-002
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
ICP/MS (Liquid)	1	OTTAWA	AOZKAYMAK	2024-Aug-13	D-ICPMS-01	EPA 200.8
ICP/OES (Liquid)	1	OTTAWA	APRUDYVUS	2024-Aug-14	D-ICP-01	SM 3120B
TSS (Liquid)	1	KINGSTON	DCASSIDY	2024-Aug-15	TSS-001	SM 2540D

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

					Client I.D.	BH106
					Sample I.D.	24-024417-1
					Date Collected	2024-Aug-08
Parameter	**Units**	**R.L.**	**Limits**			-
Total Suspended Solids	mg/L	3	350, 15.0	SAN, STORM		<3
Hardness (as CaCO3)	mg/L as CaCO3	0.02				380
Aluminum	mg/L	0.01	50	SAN		0.02
Boron	mg/L	0.005	25	SAN		0.062
Calcium	mg/L	0.02				107
Iron	mg/L	0.005				0.334
Magnesium	mg/L	0.02				27.4
Phosphorus	mg/L	0.1				<0.1
Tungsten	mg/L	0.01				<0.01
Zinc	mg/L	0.005	3, 0.04	SAN, STORM		<0.005

Steve Garrett
Director of Laboratory Services

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REPORT No: 24-024417 - Rev. 2

				Client I.D.	BH106
				Sample I.D.	24-024417-1
				Date Collected	2024-Aug-08
Parameter	**Units**	**R.L.**	**Limits**		-
Zirconium	mg/L	0.003			<0.003
Antimony	mg/L	0.0001	5	SAN	0.0003
Arsenic	mg/L	0.0001	1, 0.02	SAN, STORM	0.0010
Beryllium	mg/L	0.0001			<0.0001
Cadmium	mg/L	0.000015	0.02, 0.008	SAN, STORM	0.000211
Chromium	mg/L	0.001	5, 0.08	SAN, STORM	<0.001
Cobalt	mg/L	0.0001	5	SAN	0.0011
Copper	mg/L	0.0001	3, 0.04	SAN, STORM	0.0054
Lead	mg/L	0.00002	5, 0.12	SAN, STORM	0.00008
Molybdenum	mg/L	0.0001	5	SAN	0.0050
Nickel	mg/L	0.0002	3, 0.08	SAN, STORM	0.0038
Selenium	mg/L	0.001	5, 0.02	SAN, STORM	<0.001
Silver	mg/L	0.0001	5, 0.12	SAN, STORM	<0.0001
Thallium	mg/L	0.00005			<0.00005
Uranium	mg/L	0.00005			0.00468
Vanadium	mg/L	0.0001	5	SAN	0.0003

Revised to add Phosphorous result by ICP

: City of Ottawa
SAN: Sanitary Sewer By Law
STORM: Storm Sewer By Law

Steve Garrett
Director of Laboratory Services

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Canadian owned.

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: G 112298

REPORT No: 24-027621 - Rev. 0

Report To:
Cambium Environmental - Kingston
31 Hyperion Crt
Suite 102
Kingston, ON K7K 7G3

CADUCEON Environmental Laboratories
285 Dalton Ave
Kingston, ON K7K 6Z1

Attention: Natasha Augustine

DATE RECEIVED: 2024-Sep-06
DATE REPORTED: 2024-Sep-10
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 17281-002
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
TP & TKN (Liquid)	1	KINGSTON	YLIEN	2024-Sep-10	TPTKN-001	MECP E3516.2

R.L. = Reporting Limit
NC = Not Calculated
Test methods may be modified from specified reference method unless indicated by an *

Parameter			Phosphorus (Total)
		Units	mg/L
		R.L.	0.01
Client I.D.	Sample I.D.	Date Collected	-
BH106	24-027621-1	2024-Sep-05	<0.01

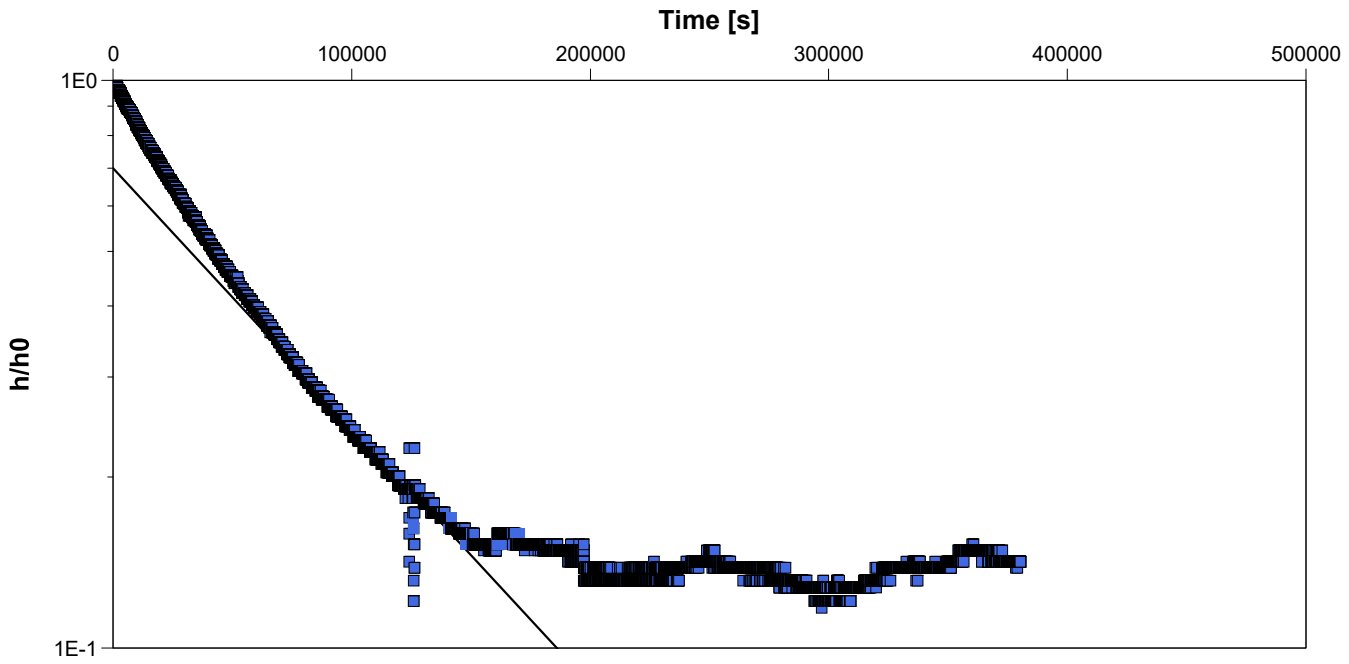
Steve Garrett
Director of Laboratory Services

Appendix F

Single Well Hydraulic Test Results

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 17281-002
	Client: Cassidy EW Construction Consultant Ltd.

Location: 1386 & 1394 Greely Lane	Slug Test: BH105 - Slug Test 1	Test Well: BH105-23
Test Conducted by: MC		Test Date: 4/19/2024
Analysis Performed by: NA	Hvorslev	Analysis Date: 7/11/2024
Aquifer Thickness: 2.62 m		

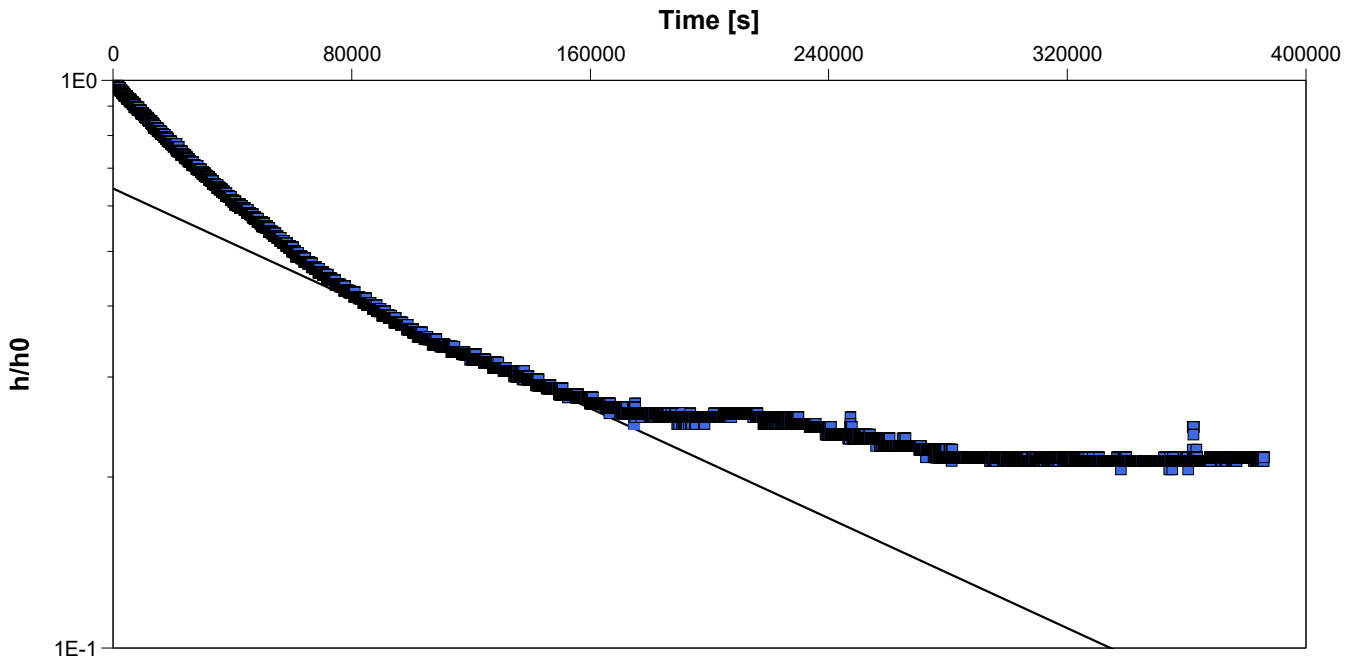


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH105-23	6.35×10^{-9}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 17281-002
	Client: Cassidy EW Construction Consultant Ltd.

Location: 1386 & 1394 Greely Lane	Slug Test: BH105 - Slug Test 2	Test Well: BH105-23
Test Conducted by: MC		Test Date: 4/19/2024
Analysis Performed by: NA	Hvorslev	Analysis Date: 7/11/2024
Aquifer Thickness: 2.62 m		

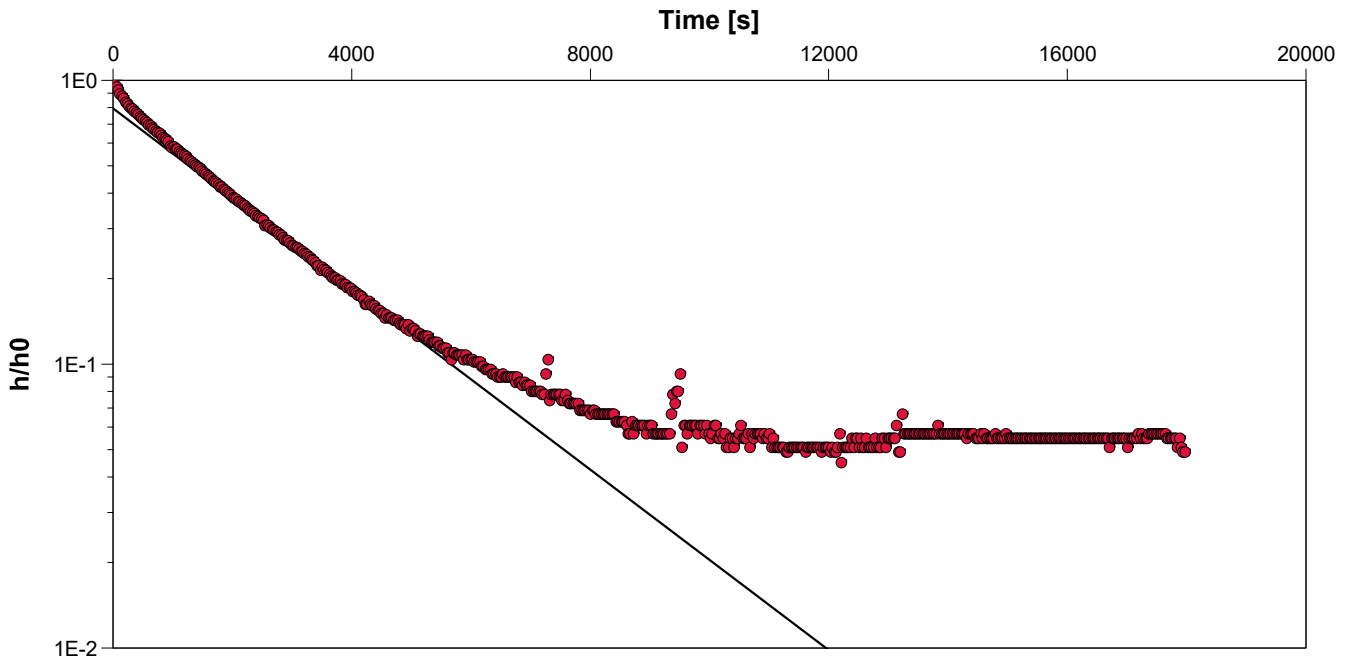


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH105-23	3.38×10^{-9}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 17281-002
	Client: Cassidy EW Construction Consultant Ltd.

Location: 1386 & 1394 Greely Lane	Slug Test: BH106 - Slug Test 1	Test Well: BH106-23
Test Conducted by: MC		Test Date: 4/19/2024
Analysis Performed by: NA	Hvorslev	Analysis Date: 7/11/2024
Aquifer Thickness: 2.46 m		

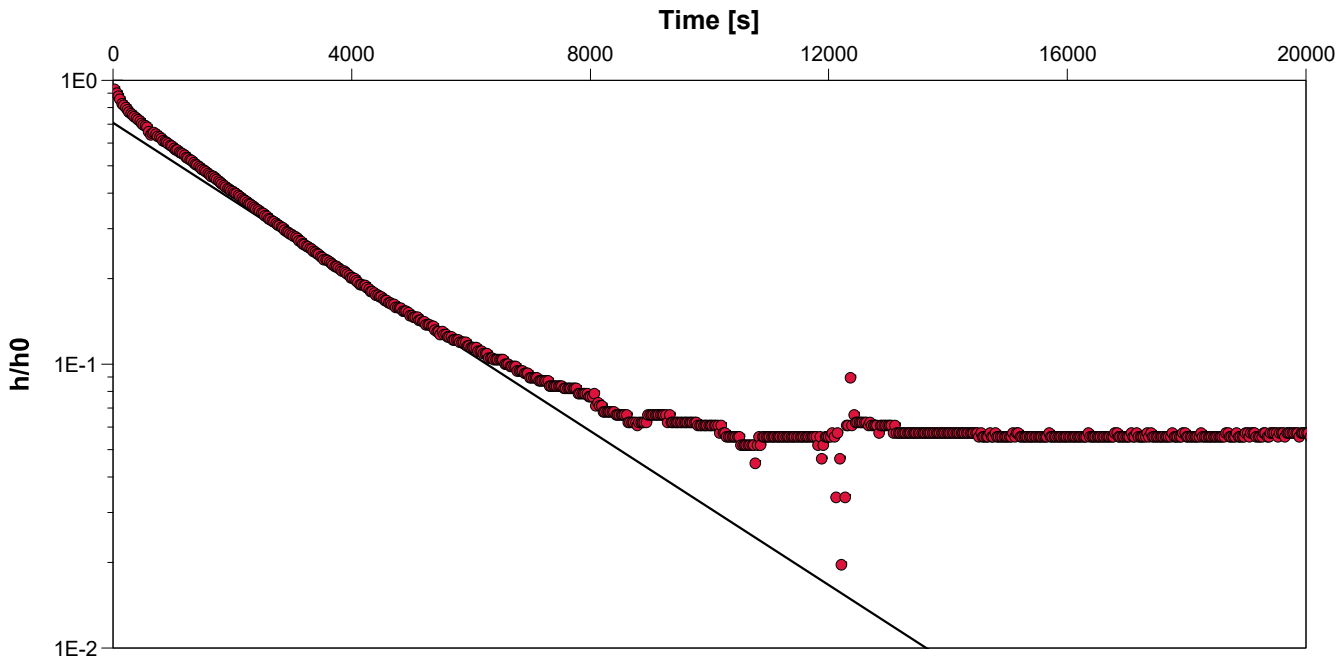


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH106-23	2.22×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 17281-002
	Client: Cassidy EW Construction Consultant Ltd.

Location: 1386 & 1394 Greely Lane	Slug Test: BH106 - Slug Test 2	Test Well: BH106-23
Test Conducted by: MC		Test Date: 4/19/2024
Analysis Performed by: NA	Hvorslev	Analysis Date: 7/11/2024
Aquifer Thickness: 2.46 m		

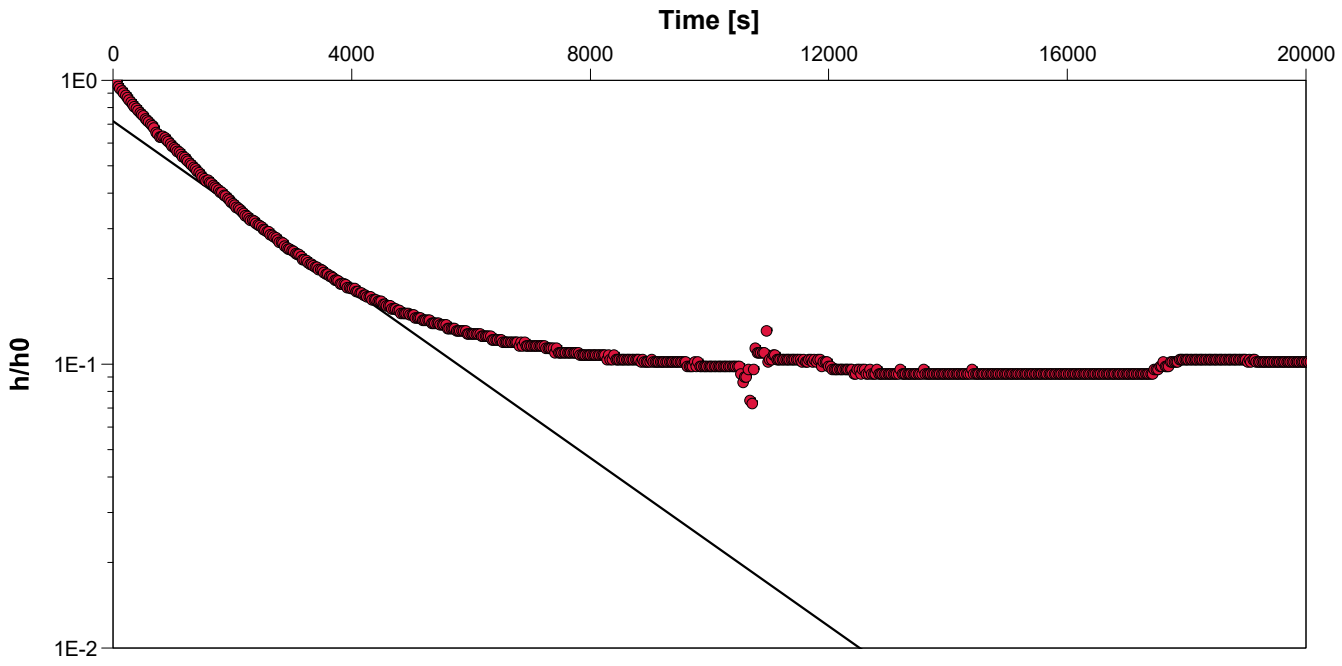


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH106-23	1.90×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 17281-002
	Client: Cassidy EW Construction Consultant Ltd.

Location: 1386 & 1394 Greely Lane	Slug Test: BH106 - Slug Test 3	Test Well: BH106-23
Test Conducted by: MC		Test Date: 4/19/2024
Analysis Performed by: NA	Hvorslev	Analysis Date: 7/11/2024
Aquifer Thickness: 2.46 m		

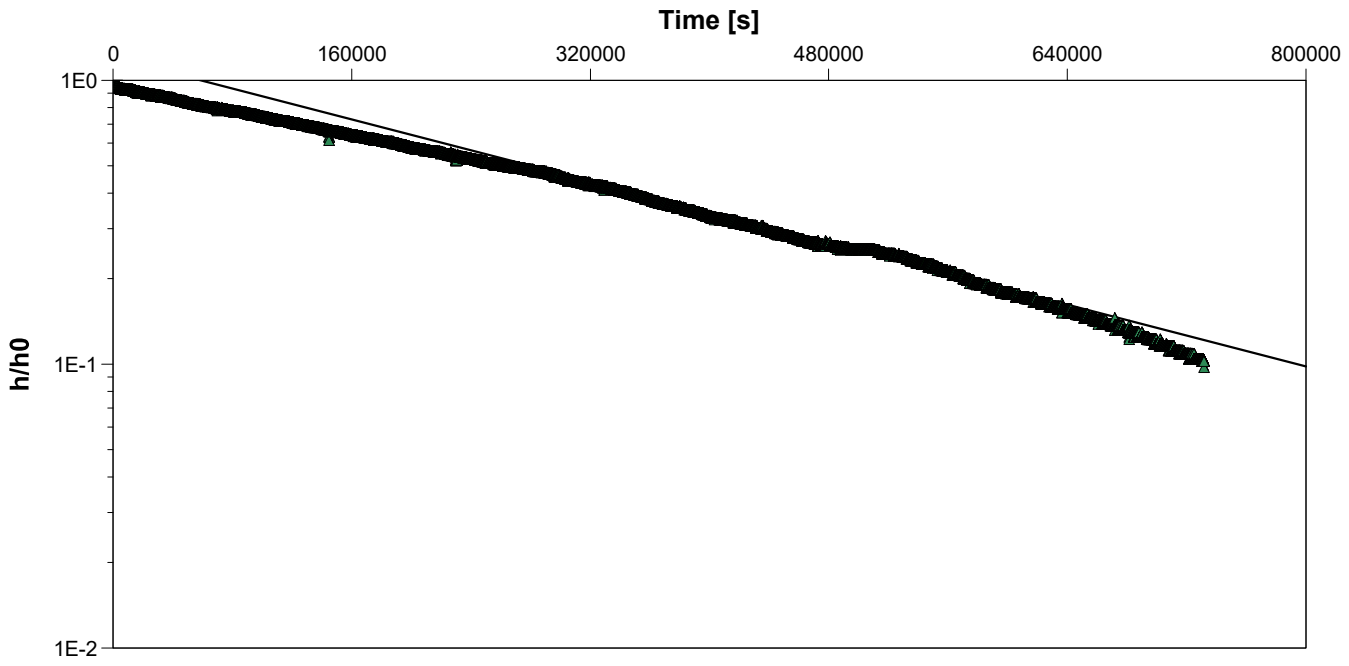


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH106-23	2.07×10^{-7}	

CAMBIUM	**Slug Test Analysis Report**
	Project: Hydrogeological Assessment
	Number: 17281-002
	Client: Cassidy EW Construction Consultant Ltd.

Location: 1386 & 1394 Greely Lane	Slug Test: BH107 - Slug Test 1	Test Well: BH107-23
Test Conducted by: MC		Test Date: 4/19/2024
Analysis Performed by: NA	Hvorslev	Analysis Date: 7/11/2024
Aquifer Thickness: 2.89 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH107-23	1.90×10^{-9}	

Appendix G
Dewatering Calculations

DEWATERING CALCULATIONS - CONSTRUCTION PHASE

Modified Dupuit-Forchheimer Equation: unconfined flow into a linear excavation.
Calculations assume no flow boundary at aquifer base

Excavation Area		Initial Depth to Groundwater	Target Depth to Groundwater	Depth to Base of Aquifer*	Unit Length of Trench (a)	Width of Trench (b)	Hydraulic Conductivity (K)	Drawdown (s)	R	r_w = b/2	R_o	$\ln(R_o/r_w)$	L = R_o/2	H	h = H-s	Q_{ends}	Q_{trench}	Q_{total}		
		mbgs	mbgs	mbgs	m	m	m/s	m	m	m	m	-	m	m	m	m^3/s	m^3/s	m^3/s	L/s	L/d
Elongated Trench @ 50 m Increments	Minimum K	0.30	2.50	3.60	50	2	1.90E-09	2.20	0.29	1.00	1.29	0.25	0.64	3.30	1.10	0.000000	0.000001	**0.000002**	**0.002**	**143**
	Maximum K	0.30	2.50	3.60	50	2	2.06E-07	2.20	2.99	1.00	3.99	1.39	2.00	3.30	1.10	0.000005	0.000050	**0.000054**	**0.05**	**4,702**
	Geometric mean K	0.30	2.50	3.60	50	2	1.22E-08	2.20	0.73	1.00	1.73	0.55	0.86	3.30	1.10	0.000001	0.000007	**0.000008**	**0.01**	**648**

s = target drawdown (initial - target depth to groundwater) (m)
R_o = radius of influence of construction dewatering/pumping, from center of excavation (m)
L = distance to line source (m)
r_s = equivalent single well radius (m)
H = Initial hydraulic head in aquifer (m)
h = hydraulic head at radius of well (m)
Q = construction dewatering rate (m^3/s)
*For base of aquifer, use target depth to groundwater plus 50% of target drawdown (s), unless specific geological conditions dictate otherwise.
For practical use, R is presented as zone of influence for reporting purposes, with the distance defined from edge of excavation.

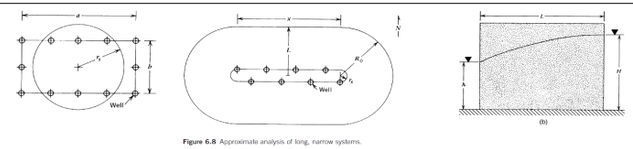


Figure 6.8 Approximate analysis of long, narrow systems.

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

$$Q = \frac{\pi K(H^2 - h^2)}{\ln R_o/r_s} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right] \quad (6.10b)$$

x = unit length of trench

R = 3000*s*sqrt(K)
Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s ***(R >> rs when R/r s > 100)***
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

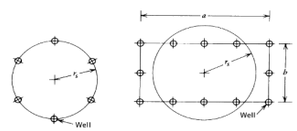
DEWATERING CALCULATIONS - OPERATIONAL PHASE

Modified Dupuit-Forchheimer Equation: unconfined flow into a rectangular excavation.
Calculations assume no flow boundary at aquifer base

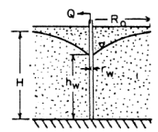
Excavation Area		Initial Depth to Groundwater	Target Depth to Groundwater	Depth to Base of Aquifer*	Excavation Length (a)	Excavation Width (b)	Hydraulic Conductivity (K)	Drawdown (s)	R	$r_w = \sqrt{(ab/\pi)}$	R_o	$\ln(R_o/r_w)$	H	$h_w = H-s$	Q_{total}		
		mbgs	mbgs	mbgs	m	m	m/s	m	m	m	m	-	m	m	m^3/s	L/s	L/d
Rectangular excavation with dimensions axb	Minimum K	0.30	1.50	3.60	23	55	1.9E-09	1.20	0.16	20.07	20.22	0.01	3.30	2.10	**0.000005**	**0.005**	**429**
	Maximum K	0.30	1.50	3.60	23	55	2.1E-07	1.20	1.63	20.07	21.70	0.08	3.30	2.10	**0.000054**	**0.05**	**4,628**
	Geometric mean K	0.30	1.50	3.60	23	55	1.2E-08	1.20	0.40	20.07	20.46	0.02	3.30	2.10	**0.000013**	**0.01**	**1,093**

s = target drawdown (initial - target depth to groundwater) (m)
R_o = radius of influence of construction dewatering/pumping, from center of excavation (m)
r_s = equivalent single well radius (m)
H = Initial hydraulic head in aquifer (m)
h = hydraulic head at radius of well (m)
Q = construction dewatering rate (m^3/s)
*For base of aquifer, use target depth to groundwater plus 50% of target drawdown (s), unless specific geological conditions dictate otherwise.

For practical use, R is presented as zone of influence for reporting purposes, with the distance defined from edge of excavation.



$r_s = \sqrt{\frac{ab}{\pi}}$



Radial flow, water table aquifier

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0/r_w}$$

(from Table 6.1, pg 67)

*Use $r_w = r_s$ for rectangular excavations

Source: Powers, J. Patrick, et al. "Construction dewatering and groundwater control." (2007)

R = 3000*s*sqrt(K)

Source: Kyrieleis, W. and Sichardt, W. "Grundwasserabsenkung bei Fundierungsarbeiten" Springer, Berlin, 1930

R_o = R, if R >> r_s *(R >> rs when R/r_s > 100)*
else, R_o = R + r_s

Source: Cashman and Preene. "Groundwater Lowering in Construction." (2013)

Appendix H

Water Balance Calculations

Water Balance Calculations

1386 and 1394 Greely Lane, Ottawa, ON

THORNTHWAITE-TYPE MONTHLY WATER-BALANCE MODEL

modified from Dingman 2015: Box 6-8 (pg 299) using ET model of Hamon (1963)

		Input Data				Computed Values							
										Surplus	397	mm/yr	
Weather Station Location:	**Greely, ON**					**Latitude:**	**45.3**	**degree**					
Solar Declination (degree)	-20.6	-12.6	-1.5	10.0	19.0	23.1	21.0	13.4	2.6	-9.0	-18.5	-23.0	
DayLength (hr)*	9.0	10.3	11.8	13.4	14.7	15.4	15.0	13.9	12.4	10.8	9.4	8.6	
Available Water Storage Capacity		0.21	m/m		**Root Depth**	460	mm		**SOILmax**	96.6	mm		

MONTHLY WATER BALANCE DATA

Temperatures in C, water-balance terms in mm.

Month:	J	F	M	A	M	J	J	A	S	O	N	D	Year
TEMPERATURE (T)	-10.3	-8.1	-2.3	6.3	13.3	18.5	21.0	19.8	15.0	8.0	1.5	-6.2	
PRECIPITATION (P)	65.4	54.3	64.4	74.5	80.3	92.8	91.9	85.5	90.1	86.1	81.9	76.4	944
RAIN	25.0	18.7	31.1	63.0	80.1	92.8	91.9	85.5	90.1	82.2	64.5	33.5	758
SNOW	40	36	33	12	0	0	0	0	0	4	17	43	185
MELT FACTOR (F)	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.25	0.00	
PACK	96	132	165	0	0	0	0	0	0	0	13	56	
MELT	0	0	0	177	0	0	0	0	0	4	4	0	185
INPUT (W)	25	19	31	240	80	93	92	86	90	86	69	34	944
POTENTIAL ET (PET)	0	0	0	41	73	101	118	101	65	38	21	0	557
NET INPUT (ΔW)	25	19	31	199	8	-8	-26	-16	25	48	48	34	
SOIL MOISTURE (SOIL)	97	97	97	97	97	89	68	58	82	97	97	97	
ΔSOIL	0	0	0	0	0	-8	-21	-10	25	14	0	0	0
ET	0	0	0	41	73	100	113	96	65	38	21	0	547
SURPLUS=W-ET-DSOIL	25	19	31	199	8	0	0	0	0	34	48	34	397

Notes:

Precipitation, Rain, Temperature, and Latitude are inputted parameters

SOILmax = available water storage capacity * root depth

m = month

D = Day length (hrs) $=2*\cos^{-1}(-\tan(\text{Latitude})*\tan(\text{Declination}))/0.2618$ [calculation is in radians]

$SNOW_m = P_m - RAIN_m$

$F_m = 0$ if $T_m <= 0^oC$; $F_m = 0.167*T_m$ if $0^oC<T_m<6^oC$; $F_m = 1$ if $T_m>=6^oC$

$PACK_m = (1-F_m)*(SNOW_m+PACK_{m-1})$

$MELT = F_m*(SNOW_m+PACK_{m-1})$

$W_m = RAIN_m+MELT_m$.

PET = 0 if $T_m<0$; otherwise $PET = 2.98*0.611*\exp(17.3*T_m/(T_m+237))/(T_m+237.2)*$Number of days in month [Hamon ET model (1963)]

$\Delta W_m = W_m - PET_m$

$SOIL = \min\{[\Delta W_m+SOIL_{m-1}], SOILmax\}$, if $\Delta Wm>0$; otherwise $SOIL = SOIL_{m-1}* \exp(\Delta W/SOILmax)$

$\Delta SOIL = SOIL_{m-1}-SOIL_m$

ET = PET if W_m > PET; otherwise, $ET=W_m-\Delta SOIL$

Pre- and Post-Development Water Balance Calculations

1386 and 1394 Greely Lane, Ottawa, ON

1 Climate Information

Precipitation	944	mm/yr
Actual Evapotranspiration	547	mm/yr
Water Surplus	397	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors

Topography: Flat	0.3
Soil Type: Silty Loam	0.2
Cover: Cultivated land	0.1
Total Infiltration Factor	**0.6**

Infiltration (Water Surplus * Infiltration Factor)	**238**	mm/yr
Run-off (Water Surplus - Infiltration)	**159**	mm/yr

Table 3 Approach - Typical Recharge Rates

Coarse Sand and Gravel	>250	mm/yr
Fine to medium sand	200-250	mm/yr
Silty sand to sandy silt	150-200	mm/yr
Silt	125-150	mm/yr
Clayey Silt	100- 125	mm/yr
Clay	<100	mm/yr

Site development area is underlain predominantly by Silty Sand to Clayey Silt

Based on the above, the recharge rate is typically 125-150 mm/yr

3 Pre-Development Property Statistics

	ha	m^2
Total Paved Area	0.08	811
Total Roof Area	0.04	365
Total Landscape Area	0.35	3,502
Total	**0.47**	**4,678**

4 Post-Development Property Statistics

	ha	m^2
Total Paved Area	0.22	2,246
Total Roof Area	0.13	1,261
Total Landscape Area	0.12	1,171
Total	**0.47**	**4,678**

5 Pre-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	811	766	77	-	689
	Roof Area	365	345	34	-	310
Pervious Areas	Landscape Area	3,502	3,306	1,916	834	556
	Totals	4,678	4,416	2,027	834	1,555

Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

6 Post-Development Water Balance

Land Use		Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Impervious Areas	Paved Area	2,246	2,120	212	-	1,908
	Roof Area	1,261	1,190	119	-	1,071
Pervious Areas	Landscape Area	1,171	1,105	641	279	186
	Totals	4,678	4,416	972	279	3,166

Assuming no infiltration occurring in paved and roof areas, and 10% of precipitation to be evaporated from paved and roof areas.

7 Comparision of Pre- and Post -Development

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	4,416	2,027	834	1,555
Post-Development	4,416	972	279	3,166
Change in Volume	-	- 1,055	- 555	1,610
Change in %	-	- 52	- 67	104

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	834
Volume of Post-Development Infiltration (m^3/yr)	279
Deficit from Pre to Post Development Infiltration (m^3/yr)	555
Percentage of Roof Runoff required to match the pre-development infiltration (%)	52