Hydrogeological Assessment and Sewage System Design– 4488 County Road 29, Douro-Dummer, Ontario

March 8, 2024

Prepared for:
Kawartha Utility Services Ltd

Cambium Reference: 18842-001

CAMBIUM INC.

866.217.7900

cambium-inc.com

Table of Contents

List of Tables

List of Appended Figures

List of Appendices

1.0 Introduction

Cambium Inc. (Cambium) was retained by Kawartha Utility Services Ltd., (Client), to complete a hydrogeological assessment and sewage system design for the property located at 4488 County Road 29, Township of Douro-Dummer, Ontario (the Site).

The property is approximately 5.32-hectares (ha) and exists as vacant land. It is understood that the proposed development will consist of a commercial maintenance shop building to be privately serviced for water and wastewater.

1.1 Site Description

The total area of the property is approximately 5.32 ha and currently zoned primarily as Special District 101 Holding Zone (S.D. 101-H), with the southernmost tip of Site zoned as Rural Use (RU) as outlined in the Douro-Dummer Zoning Map (Appendix A). The Site is bordered to the southeast and south by Rural Use (RU) zoning, and to the northeast by Special District 203 Zone (S.D. 203) designated for existing commercial storage uses. The Site is bordered to the west by County Road 29 and to the east by County Road 28.

The regional location of the Site is outlined on Figure 1, the property and surrounding areas are outlined on Figure 2 and the draft Concept Plan is included in Appendix A.

2.0 Methodology

This section outlines the methodology followed to complete the hydrogeological assessment.

2.1 Background Information Review

A review of available relevant background information was undertaken for this study, which included the following resources:

- Physiography of Southern Ontario (Chapman, L.J. and D.F. Putnam, 1984);
- Paleozoic Geology of Southern Ontario, Miscellaneous Release - Data 219, scale 1:50,000. (OGS, 2007)
- Surficial geology of Southern Ontario, Miscellaneous Release - Data 128 revised, scale 1:50,000 (OGS, 2010)
- MECP Water Well Information System (WWIS) website (MECP, 2024a)
- MECP Source Protection Information Atlas (SPIA) (MECP, 2024b)

2.2 Subsurface Investigation

A soil investigation using a backhoe was conducted at the Site on October 25, 2023, to determine the composition and stratigraphy of the existing soils, the depth to the water table, depth to bedrock contact, and the percolation time of the native soils. The excavation areas were chosen in select areas to determine the thickness and composition of the native soil in the vicinity of the proposed sewage system. Kawartha Utility Services provided the excavation equipment and operator. A total of six test pits were excavated to 3.0 m in depth or refusal on bedrock. A total of three hand auger holes were advanced to depths between 0.5 m and 1.0 m on-site for the infiltration tests. Soil samples were collected and logged for soil type encountered. Soil logging included descriptions of moisture content, presence of odour, and signs of impacts such as staining or mottling, in accordance with standard geotechnical soil descriptions and nomenclature. Soil samples were recovered and retained in moisture-

preserving labelled containers for subsequent review and possible laboratory testing. All test pits were checked for groundwater and caving prior to backfilling.

Test pit logs are included in Appendix B and discussed in Section 4.1.

2.2.1 Physical Laboratory Testing

To support the on-site sewage system design, physical laboratory testing, including sieve and hydrometer analyses, was completed on two soil samples to confirm textural classification. Results are presented in Appendix C and discussed in Section 4.1.1.

2.3 In-Situ Infiltration Testing

In-situ soil infiltration tests were conducted at the Site on October 25, 2023, by Cambium personnel using a Guelph Permeameter (GP). The Guelph Permeameter is used to accurately measure in-situ hydraulic conductivity or the field saturated hydraulic conductivity (Kfs) of the native soils.

The GP tests were completed at select locations, refer to Figure 2, at depths ranging from 0.5 m to 1.0 m in native soils below the topsoil layer. A total of three GP tests were conducted.

The field results of the in-situ infiltration testing were processed using SOILMOISTURE ® excel based calculation models which yield the saturated hydraulic conductivity of the soil (in m/s). The saturated hydraulic conductivity results are then cross-referenced against established relationships between hydraulic conductivity (m/s) and infiltration rate (mm/hr), as outlined in the *Supplementary Guidelines to the Ontario Building Code: SG-6 Percolation Time and Soil Descriptions* (OMMAH, 1997).

Results are presented in Appendix D and discussed in Section 4.2.

2.4 Test Well Installation

The supply well for the proposed development was installed by Burgess Well Drilling on November 11, 2023. The location of the supply well (herein referred to as TW1) is illustrated in Figure 2. A well record for the TW1 is included in Appendix E.

Test well TW1 was assigned the well ID # A366720. Soils were described as brown, packed, sand and stones to 1.8 metres below ground surface (mbgs), underlain by grey shale bedrock to 2.4 mbgs, underlain by grey fractured limestone bedrock to completion depth of 36.6 mbgs. Water was encountered at 12.2 mbgs. The well has a 0.15 m diameter steel casing installed from approximately 1 metre above ground surface (mags) to 6.1 mbgs and open hole there after. The static water level after well drilling was 11.3 metres below top of the well pipe (mbtop). The recommended pumping rate, based on a 1-hour pumping test conducted by the driller, was 11.4 L/min (3 US gallons per minute (gpm)).

2.5 TW1 Pumping Test

A pumping test was completed by Cambium staff on November 16, 2023. Prior to testing, Solinst™ pressure transducer Leveloggers were installed in TW1 to electronically measure water levels before, during, and after the test.

A separate logger was used to record atmospheric pressure to compensate for barometric pressure changes. Water levels were also measured manually throughout testing to verify pressure transducer data.

The objective of the constant rate testing was to confirm sustainable well yield and assess aquifer properties. The discharge rate was pre-selected to be 7.5 L/min (2 USGPM) and pumped until the sewage system daily flow volume estimate of 3,975 L/day as described in Section 7.0 was achieved. Rate adjustment and increased pumping duration was required (see Section 6.1). Within the last hour of the pumping test, a water quality sample was collected and submitted for laboratory analysis.

Results of the pumping test are discussed further in Section 6.0.

2.5.1 Monitoring Wells

A well survey was completed of several adjacent properties listed below on October 25, 2023.

- 4512 County Road 29
- 4463 County Road 29

- 1595 Stenner Road
- 1598 Stenner Road

Contact was not made with any of owners of these properties. A letter was left at the properties requesting participation in the monitoring program for the pumping test. There was no response to the letters to date.

There were no monitoring wells identified on-site during the Site reconnaissance visit that could be used for monitoring during the pumping test.

2.6 Groundwater Quality

A groundwater sample was collected from TW1 at 16:30 pm on November 16, 2023, near the end of the pumping test, and submitted to SGS Canada Inc. in Lakefield (SGS) for analysis. The groundwater sample was analyzed for general organic and inorganic chemistry and compared against the parameters outlined in the Ontario Drinking Water Quality Standards (ODWQS; MOE (2006)). The Certificates of Analysis are attached in Appendix F. It is noted that well TW1 was chlorinated by Cambium on the morning of the pump test.

3.0 Geological and Hydrogeological Setting

3.1 Topography and Drainage

A topographic map was prepared using the Ministry of Natural Resources database (MNRF, 2024) which can be found in Appendix A. Topography at the Site is generally flat, having a topographic high at the south and east portions of Site with gradual slopes down to the northwest toward the County Road 29. Drainage at the Site is inferred to follow Site topography northwest off-site.

3.2 Physiographic Region

The Site is located in the physiographic region known as the Peterborough Drumlin Field. The drumlin field is comprised of approximately 300 drumlins as well as many drumlinoid hills and surface flutings of the till sheet. The drumlins are composed of highly calcareous till and it is reported that the till in the Peterborough area has minimal rubble but some occurrences of boulders of Precambrian origin (Chapman, L.J. and D.F. Putnam, 1984). The region is characterized by limestone of the Lindsay and Verulam Formations; in the vicinity of the Site, the physiography is noted as Verulam (OGS, 2007).

3.3 Overburden Geology

According to Miscellaneous Release – Data 128 from the Ontario Geological Survey (OGS, 2010) the Site is characterized as stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain.

3.4 Bedrock Geology

The bedrock of the area consists of Middle Ordovician rocks of the Simcoe Group (OGS, 2007). The Site is composed of rocks from the Verulam Formation, which is described as a sequence of interbedded limestone and shale. The carbonate lithology of this formation varies from very fine-crystalline limestone, virtually fossil-free, to coarse-crystalline bioclastic limestones.

3.5 MECP Water Well Records

Cambium accessed the Ministry of the Environment Conservation and Parks (MECP) Water Well Information System (WWIS) to review water well records within 500 m of the Site.

There were 50 water well records found within approximately 500 m of the Site (Figure 3; Appendix G). Of the well records, 1 well was installed in overburden to a depth of 11.6 metres below ground surface (mbgs); 42 well records that were drilled into bedrock to a geometric mean depth of 14.3 mbgs. The geometric mean depth of the overburden-bedrock contact was encountered at 3.8 mbgs. The wells were installed between the years 1953 and 2015. A total of 45 well records were for water supply wells, 1 well record was for a monitoring/test well, 2 well records was for an abandoned well, 1 well record was for a decommissioned dug well, and 1 well record with no well use information. A summary of the depths, static water levels, and pumping rates for the bedrock wells and overburden wells are shown in Table 1.

Table 1 Summary of Surrounding Water Well Record Information

Well Type		Depth (mbgs)	Water Found at (mbgs)	Static Water Level (mbgs)	Recommended Pumping Rate (L/min)
Bedrock Count = 42	Minimum	4.0	4.0	0	5
	Maximum	36.6	36.6	12	45
	Geomean	14.3	11.5	4	17
Overburden Count = 1	Details	11.6	11.6	8	36

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

- Overburden was reported as primarily as clay. Some well records also recorded isolated gravel and sand horizons.
- Bedrock was described as grey limestone, and in some instances, brown shale rock.

3.6 Vulnerable and Regulated Areas

As per the MECP Source Water Protection Information Atlas (SPIA) the majority of Site is located with a highly vulnerable aquifer (HVA) with a vulnerability score of 6 (MECP, 2024b).

In general, a HVA will consist of granular materials (e.g., sand and/or gravel) or fractured rock that has a high permeability and is near ground surface. The land use practices at the proposed development Site are not expected to cause any contamination to the water resources. The HVA is not expected to be influenced by the proposed development.

Best Management Practices (BMPs) should be implemented so as to avoid or minimize the overland flow of any contaminants from the Site to the natural environment.

As per MNRF Natural Heritage System database the Site does not have any Areas of Environmental Significance or Areas of Natural and Scientific Interest (ANSI). No significant wetlands or woodlands are situated on the Site (Appendix A).

3.7 Hydrogeological Conditions

3.7.1 Shallow Overburden

Shallow surficial soils at the Site generally consist of sandy silt or silt which overlies predominantly sandy silt to sand sediments. Groundwater was not encountered in the shallow overburden sediments in the subsurface investigation. The overburden wells from the MECP WWIS data indicated static water levels ranging from in one well at a depth of 11.6 mbgs.

Shallow overburden monitoring wells were not installed at Site to confirm groundwater levels and groundwater flow direction. However, the shallow groundwater is inferred to flow northwest following topography toward Katchewanooka Lake.

3.7.2 Bedrock

There are multiple bedrock fractures in the area of the Site which are drawn upon for local groundwater supplies. The WWIS data indicates that the depth to these fractures is highly variable and range from 4.0 mbgs to 36.6 mbgs. The average static water level of the bedrock

aquifer is 2.8 mbgs and ranges from 0.3 mbgs to 18.3 mbgs. The supply well installed on-site (TW1) is in the fractured limestone bedrock aquifer. The direction of groundwater flow within the bedrock aquifer was not confirmed as part of this assessment.

4.0 Results of Field Investigations and Testing

This section outlines the results of the field investigations and testing included in the hydrogeological assessment.

4.1 Subsurface Investigation

Cambium completed a test pit investigation at the Site on October 25, 2023, to assess the subsurface conditions at the Site. A total of six test pits were advanced into the overburden, designated as TP101-23 through TP106-23. Test pits were all terminated on bedrock with depths ranging from 1.22 mbgs to 2.51 mbgs. Test pit locations are included on Figure 2. Test pit logs are included in Appendix B.

A summary of general lithological details are presented below:

Topsoil

A surficial layer of topsoil was encountered in all test pits with thicknesses ranging from ground surface to approximately 0.30 mbgs.

Sandy Silt

Underlying the topsoil is a surficial layer of loose sandy silt, with varying mixtures of clay and gravel mixtures that extended to depths ranging from 0.38 mbgs to 0.86 mbgs. The material was noted to be red/brown in colour.

Sand

Underlying the topsoil in TP106-23 is a layer of loose sand, trace silt, that extended to a depth of 0.56 mbgs. The material was noted to be yellow brown in colour and dry.

Sandy Silty Gravel

Beneath the fine sandy silt soils in TP101-23, TP102-23, TP103-23, TP104-23, and TP106-23 is loose sandy silty gravel, with varying amounts of clay and cobble were encountered. The gravelly sand was noted to be brown or brown/grey in colour. This layer extended to the depths ranging from 1.02 mbgs to 2.51 mbgs.

Bedrock

Bedrock was encountered in every test pit during the subsurface investigation. Bedrock near overburden bedrock interaction was described as shale. In test pit TP105-23 shale extended from 0.38 to 1.22 mbgs and in test pit TP106-23 shale was encountered from 1.02 mbgs to 1.47 mbgs. Test pits were all terminated on bedrock at depths ranging between 1.22 mbgs and 2.51 mbgs.

4.1.1 Grain Size Analysis

Laboratory particle size distribution analyses were completed on two samples of the native soil taken from the test pits and depths shown in Table 2. The grain size distribution results are provided in Appendix C.

Table 2 Grain Size Analysis Results

Test Pit	Depth (mbgs)	Soil	% Gravel	% Sand	% Silt	% Clay	T-Times (min/cm)
TP102-23 GS2	0.64-2.51	Sandy, Silty Gravel, trace Clay	39	30	25	6	20
TP104-23 GS1	0.30-0.86	Sandy Silt, some Clay, trace Gravel	1	31	54	14	30

The soil percolation rates ranged from 20 min/cm to 30 min/cm. The geometric mean of the percolation rate was estimated at 25 min/cm. These results indicate a moderate to low infiltration capacity of the native soils, depending on whether the coarse-grained or fine-grained unit is encountered.

4.2 In-Situ Infiltration Testing

The details of the test results are presented in Table 3 below and the calculation and additional details are provided in Appendix D.

Table 3 Infiltration Rates - Guelph Permeameter Method

Test	Test Depth (mbgs)	Tested Soil Type	Head (mm)	Average Field Saturated Hydraulic Conductivity, Kfs (m/s)	Percolation Time (min/cm)	Infiltration Rate (mm/hour)
GP101-23	0.65	Fine sand, trace silt, trace gravel	40 80	$1.53*10^{-6}$	12	52
GP102-23	0.67	Gravelly sand	30 60	$2.93*10^{-6}$	10	61
GP103-23	0.46	Fine sand, trace silt	30 60	$3.13*10^{-7}$	18	34

As shown above, the infiltration rates ranged between 34 mm/hour and 61 mm/hour. The measured infiltration rates are expected for the soils tested at these locations and depths.

5.0 Water Balance Assessment

Following 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 ground or evapotranspiration 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:

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

Where:

P = Precipitation (mm/year)

ET = Evapotranspiration (mm/year)

R = Run-off (mm/year)

I = Infiltration (mm/year)

ΔS = Change in groundwater storage (taken as zero) (mm/year)

It is noted that the water balance described herein does not account for catchment areas that extend off-site. The calculations compare the pre- and post-development water balance changes within the Site boundaries.

The property is currently undeveloped grassy fields. It is understood that the proposed development will include a gravel parking lot and a maintenance building. Based on the available design information, the development area at the Site can be generally categorized into two (2) types as paved area (includes gravel area), and landscaped area. The post-development plan of the proposed development is shown in Figure 4. A summary of the surface areas of the development is listed in Table 4:

Table 4 Pre- and Post-Development Site Statistics

Type of Land Coverage	Pre-Development Areas (m^2)	Post Development Areas (m^2)
Paved Area	0	4,971
Building Roof Area	0	1,652
Landscape/Vegetated Area	53,230	46,607
Total (m^2)	**53,230**	**53,230**

Supporting information referenced herein (including detailed water balance calculations) is attached in Appendix H.

5.1 Water Surplus

Water surplus is calculated by determining the difference between precipitation and evapotranspiration (changes in soil water storage was assumed to be negligible over the course of a year). The volume of water surplus is further sub-divided into portions that infiltrate the on-site soils and that are directed off-site as runoff.

The climatic data including monthly average temperature and precipitation were obtained from Environment Canada, for Peterborough Trent U weather station (Climate Identifier: 6166455) located about 10 km distance from the Site. Data is available for a period of 30 years, from 1981 to 2010. Accordingly, the average annual evapotranspiration was estimated to be about 523 mm/annum using the USGS Thornthwaite Monthly Water Balance methodology (Appendix H), and the average annual precipitation was recorded to be 882 mm/annum. The water surplus of the Site was calculated to be 359 mm/yr.

Evapotranspiration does not occur from structures, paved areas, or gravel surfaces. It was assumed that 10% of precipitation falling on these surfaces is lost directly to evaporation. The remaining depth (i.e., 90% of precipitation) was considered surplus and converted to infiltration and/or runoff.

5.2 Infiltration Rates

The volume of surplus water that infiltrates through pervious surfaces on-site was determined by applying an infiltration factor to the surplus depth. The surplus water that does not infiltrate into pervious surfaces will leave the Site as surface water runoff. The infiltration factor varies from 0 to 1 and is estimated based on topography, soils, and vegetation cover as per the *Stormwater Management Planning and Design Manual* (Ministry of the Environment, 2003).

The rate of infiltration at a Site is expected to vary, based on a number of factors to be considered in any infiltration model. To partition the available water surpluses into infiltration and surface run-off, the Ministry of Environment, Conservation and Parks (MECP) infiltration factor was used. The MECP Storm Water Management Planning and Design Manual (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding run-off component was calculated for the soil moisture storage conditions.

The Site is exhibits rolling to hilly topography. Based on the results of the test pit investigation, the subsurface conditions at the Site consist of predominantly sandy silt soils, and the vegetation cover was determined to be cultivated. Therefore, an infiltration factor of 0.55 was calculated for the site using the MECP method.

The calculation of infiltration and runoff in the stages of pre-development and post-development is provided in Appendix H, and are presented in the tables below.

5.2.1 Pre-Development Water Balance

The water balance for the existing conditions of the Site is summarized in Table 5. The pre-development infiltration rate was calculated to be 10,510 m³/yr and the runoff rate was 8,599 m³/yr.

Table 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	-	-	-	-	-
	Roof Area	-	-	-	-	-
Pervious Areas	Landscape Area	53,230	46,949	27,839	10,510	8,599
	Totals	53,230	46,949	27,839	10,510	8,599

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

5.2.2 Post-Development Water Balance

The post-development water balance is summarized in Table 6. The post-development infiltration rate was calculated to be 9,203 m^3/yr and the runoff rate was 12,787 m^3/yr.

Table 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	4,971	4,384	438	-	3,946
	Roof Area	1,652	1,457	146	-	1,311
Pervious Areas	Landscape Area	46,607	41,107	24,375	9,203	7,529
	Totals	53,230	46,949	24,960	9,203	12,787

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

5.2.3 Water Balance Comparison

The water balances of the pre-development and post-development scenarios are summarized below in Table 7.

Table 7 Water Balance Comparison

	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-off (m^3)
Pre-Development	46,949	27,839	10,510	8,599
Post-Development	46,949	24,960	9,203	12,787
Change in Volume	-	-2,880	-1,308	4,187
Change in %	-	-10	-12	49

According to the above table, there is an infiltration deficit of about 1,308 m³/year compared to the pre-development infiltration. The runoff rate upon development of the Site will increase by 4,187 m³/year.

Table 8 Requirement of Infiltration from Roof Run-off

Volume of Pre-Development Infiltration (m^3/annum)	10,510
Volume of Post-Development Infiltration (m^3/annum)	9,203
Deficit from Pre to Post Development Infiltration (m^3/annum)	1,308
% of Roof Runoff required to match the pre-development infiltration	100

Based on the above calculations, a summary of the water balance could be provided as follows:

- There is a net increase in run-off at the Site of about 4,187m^3/annum, from 8,599 m^3/annum to 12,787 m^3/annum. This increase is a result of the development of the Site with more impervious areas such as roof and paved areas and decrease in pervious landscape areas.
- Post-development landscape area was decreased by about 6,281 m^2, when compared to the pre-development landscape, resulting in less infiltration across the Site.
- Without implementing any mitigation measures, there is a net deficit of about 1,308 m^3 /annum in the post-development infiltration on a yearly basis.
- Based on the estimation, with a diversion of 100% of general roof water for infiltration, the proposed development would maintain pre-development infiltration after the development. Therefore, Cambium would recommend the implementation infiltrating general roof water infiltration or any suitable Low Impact Development (LID) measures at the Site to compensate the infiltration deficit.

5.3 Discussions on LID Measures

It is known that low impact development (LID) practices have received increasing attention as these strategies attempt to capture the runoff and mimic the natural hydrologic cycle.

In general, there are two primary categories of LIDs. The first promotes the infiltration of Stormwater close to the source. These infiltration type LIDs are preferred when hydrogeological and physical conditions are optimal and allow for their emplacement.

The second option captures and slowly releases the water to the groundwater system through the process of storage and filtration by infiltration LIDs. Infiltration targets may be achieved through the incorporation of a variety of stormwater management practices including reduced lot grading, infiltration trenches, grassed swales etc.

Given the proposed Site layout, there is enough space available for the implementation of LID measures, either by means of infiltration galleries or infiltration trenches or any other suitable means. LIDs require 1 metre vertical separation between the LIDs and the water table. Groundwater monitoring was outside the scope of this investigation; however groundwater was not encountered in the overburden to 1 mbgs in the subsurface investigation which is favourable for LIDs.

As there is an infiltration deficit due to the Site development, Cambium recommends implementing any LID measures, using Best Management Practices (BMPs) to enhance the infiltration. However, Cambium is not providing any design of LID facilities, it would be beneficial to consult with design engineers for the LID design recommendations.

6.0 Water Supply Assessment

The pumping test was tailored to in a way to stress the aquifer and assess the ability of the water supply well, TW1, to provide 3,975 L of sustainable volume of water, on a daily basis. The results obtained for the water supply assessment are discussed in the following subsections.

6.1 Hydraulic Pumping Test – TW1

A pumping test was completed by Cambium staff on November 16, 2023. The static water level in TW1 was 12.45 mbtop prior to commencing the pumping test.

The pump was installed at a depth of approximately 36.1 mbtop by Cambium. The available drawdown in the well was therefore approximately 22.9 m (height of static water level above pump).

The hydraulic testing began at 09:05 and continued for a duration of 7 hours 30 minutes. The water withdrawal was altered between 7.5 L/min to 4.5 L/min throughout the first 5 hours of the pumping test (approximately) in order to establish a sustainable discharge rate. The rate changes including reasoning for the rate change are included in the Table 9 below.

Table 9 TW1 Pumping Test Rate Adjustments

Time	Elapsed Pumping Test Time (hour:min)	Flow Rate (L/min)	Comments
09:05	00:00	7.5	Initial pumping rate
12:35	03:30	5	Rate estimated to be unsustainable. Rate reduced.
12:50	03:45	6	Rate increased to find maximum sustainable rate.
13:35	04:30	4.5	Rate estimated to be unsustainable. Rate reduced

At 13:35 the max drawdown was recorded at 33.76 mbtop at 6 L/min. Between 13:35 and 16:35 the water level recovered at 4.5 L/min until the end of the pumping test at 16:35. At the end of the pumping test the water level was 31.60 mbtop.

During the pumping test the water level lowered from 12.45 mbtop to 31.60 mbtop (a drawdown of 19.15 m or 84% of the available drawdown) at the time the test was concluded (16:35). In total, 2,610 L of water was withdrawn from well TW1 during the pumping test.

The pump was shut off at 16:35 and recovery was monitored with a datalogger until 08:38 on November 17, 2023. Recovery to 95% was achieved at 18:15 on November 16, 2023 (a recovery period of 1 hour and 45 minutes). The water level drawdown and recovery curve of the pumping test are outlined in Figure 5.

The volume required for the calculated peak daily sewage flow of 3,975 L was not met due to field constraints. It was determined that the maximum sustained pumping rate is less than 7.5 L/min but greater than 4.5 L/min. If the conservative rate of 4.5 L/min was selected, it would take 14 hours and 44 minutes to withdraw 3,975 L from the well. Figure 5 shows the 4.5 L/min rate still recovering at the end of the pumping test, indicating that steady state conditions of pumping at 4.5 L/min would have less drawdown than what was observed at the end of the completed pumping test. As such, the assumption of the same recovery time of 1 hour and 45 minutes would be conservative. This indicates that 3,975 L of daily water withdrawal from TW1 is achievable and would be considered to be sustainable because the water level would be able to recover within a 24-hour period.

The well was tested at rates from 7 L/min to 4.5 L/min over the duration of the pumping test with the final three hours showing recovery in TW1 while pumping at 4.5 L/min. As such, this flow rate should be considered when the water treatment and distribution system are designed. Water storage may be required to accommodate peak demand use. The pump should also be installed at or below 36.1 mbtop in order to allow for sufficient drawdown in the well.

6.2 Water Quality Results

A groundwater sample was collected from TW1 at the end of the pumping test on November 16, 2023.

The concentrations of all parameters for the November 16, 2023 sample were reported at concentrations less than ODWQS (Ministry of the Environment, 2006) with the exception of

sodium. A complete summary of water quality results and certificates of lab analyses are provided in Appendix F. The results of select parameters are summarized in Table 10.

Table 10 Summary of Select Water Quality Parameter

Parameter	TW1 (Nov 16, 2023)	ODWQS	Criteria	Significance
Total Coliforms	0 cfu/100ml	0 cfu/100ml	MAC (1)	No microbiological presence detected at time of sampling.
Escherichia Coli	0 cfu/100ml	0 cfu/100ml	MAC	No fecal contamination detected at time of sampling.
Hardness	221 mg/L	80-100 mg/L	OG (2)	Hard water, may cause scale deposits.
Sodium	126 mg/L	20 mg/L 200 mg/L	MAC AO (2)	See summary below.

1. *Maximum Acceptable Concentration.*
2. *Aesthetic Objective and Operational Guidelines.*

As shown above, sodium exceeded the operational ODWQS guideline in TW1. Sodium is a health-related parameter. Measured concentrations of sodium were elevated above the limit which serves as a warning to individuals on sodium restricted diets (20 mg/L) in TW1. The sodium concentration of TW1 was 126 mg/L. The concentration of sodium was less than the aesthetic limit and maximum concentration that is treatable (200 mg/L), which indicates that the water is still potable at the measured concentrations.

7.0 Sewage System Design

7.1 Design Sewage Flows

Daily sewage volumes were calculated based on Table 8.2.1.3.B of the Ontario Building Code (OBC) and Site specific information provided by the client in terms of proposed water use. Table 11 below summarizes the design sewage flow anticipated for the Site.

Table 11 Design Sewage Flow

Component	Quantity	OBC Unit Volume	OBC Calculated Flow
Factory - per employee per 8 hour shift	53 Employees	75 L / employee	3,975 L/day

1. *No process waters or showers*

7.2 Proposed Sewage System Design

7.2.1 Primary Treatment – Septic Tank

Primary Treatment will be achieved by a single septic tank. Based on the 3,975 L/day design flow, the proposed septic tank minimum capacity was calculated as follows:

$$Minimum\ Working\ Volume\ Required\ (V) = 3 * Q$$

$$V = (3{,}975) * 3$$

$$V = 11{,}925\ L$$

The sewage design flow generated is considered to be non-residential occupancy, therefore a minimum of three-day retention time is utilized for primary treatment. As such, the following septic tank and associated components have been selected:

- One septic tank: OBC approved two compartment precast concrete septic tank with a working volume of 12,000 L.
- One effluent filter: PolyLok PL122 (or equivalent) effluent filter complete with service handle and a daily flow rating of 13,638 L/day.

7.2.2 Pump Chamber

The septic tank effluent will flow by gravity to the following selected pump chamber:

- One pump chamber: OBC approve single compartment precast concrete tank with a working volume of 3,600 L.

According to OBC section 8.6.1.3.(4), where a pump is required, the pump shall be designed to discharge a dose of at least 75% of the internal volume of the distribution pipe within 15 minutes. The dose volume is calculated as follows:

V_{dose} = 5.9 * L where,

Q = Daily Sewage Design Flow = 3,975 L/day

L = Total length of distribution pipe in metres (see below)

- V_{dose} = 5.9 * (30m * 2 cells)
- V_{dose} = 354 L

The pump selected to dose the leaching bed must be able to satisfy a minimum dose volume of 354 L per pump cycle. The pump will operate on demand utilizing a 2-float tree with the lower float operating as start/stop working and the other acting as an alarm float. The alarm float should be positioned at an appropriate height to allow for adequate response time. On-site float testing shall be completed prior to start-up. All electrical connections must be completed by a certified electrician using two separate circuit breakers, one to operate the pump and one to operate the alarm. Nothing else should be connected to the sewage system circuit breakers.

7.2.3 Distribution Box

The pump chamber will discharge effluent into a distribution box which will distribute effluent to the two filter bed cells. A small distribution box is required that allows one inlet port and two outlet ports. Each outlet to be 100 mm PVC equipped with a 100 mm Polylok equalizer (or equivalent).

7.2.4 Subsurface Disposal

According to the native soil conditions, septic tank effluent will be disposed in a partially raised filter bed containing two cells 5 m apart in accordance with Section 8.7.5 of the OBC. The layout and details of the filter bed are included as Figure 6 to Figure 9.

Filter bed specifications:

- Design flow (Q) = 3,975 L/day
- Native soil T-time (T) = 30 min/cm
- Loading Rate (LR) based on Table 8.7.4.1. in OBC = 8 (L/m^2)/day
- Configuration: partially raised
- Filter and Stone area = Q/50 when Q > 3,000 L/day = 3,975 / 50 = 79.5 m^2
    - Design contains: Two cells of 6.0 m x 7.0 m = 42.0 m^2 x 2 cells = 84.0 m^2
- Distribution pipe: 6 runs of 5.0 m on 1.2 m centres = 30.0 m x 2 cells = 60.0 m of total distribution pipe
- Contact area (filter media sand) = QT/850 = (3,975 x 30) / 850 = 140.2 m^2
    - Design contains 18.0 m x 8 m = 144 m^2
- Mantle area (imported sand fill) = Q/LR = 3,975 / 8 = 496.9 m^2
    - Design contains: 24.2 m x 25.1m = 607.4 m^2
    - Therefore, the required contact area for the loading rate is satisfied based on Table 8.7.4.1 of the OBC.

7.3 Permit Application

A sewage system permit application for the Township of Douro-Dummer is included as Appendix I. The permit application has the necessary designer section completed by Cambium. The remaining sections, Sections A to I are to be completed by the owner and Schedule 2 is to be completed by the installer.

8.0 General Design Requirements

- The risers on all tanks must require tools and/or keys to access.
- The sewage tanks and leaching bed shall meet the minimum setbacks prescribed in Part 8 of the Ontario Building Code.
- All sewage system components must have appropriate protection from vehicular traffic.
- All tanks shall be equipped with cast in place riser to at least 100 mm above ground surface with secured lid and safety screen.
- If venting through the buildings cannot be achieved, then the tanks are required to be equipped with Polylok 308-ACC 610 mm (24 inch) access lid equipped with 0.9 kg (2 lbs) of activated charcoal pellets for odour control.
- On-site flow and control testing shall be completed prior to start-up of the sewage works in order to allow for adjustments to the pump run controls if necessary.

9.0 Electrical Requirements

The intent of this section is to provide the licenced electrician guidance for expected operations for the pumps, floats, control panel, and connections.

The electrical design and installation of electrical equipment wiring and grounding shall be completed according to all requirements of the Ontario Hydro Electrical Safety Code including all appendices and bulletins issued by the Electrical Safety Authority as applicable to this project.

Any alarm float switches required shall have their own circuit breaker. Nothing else should be connected to any alarm circuit breakers. Alarms must consist of an audible alarm and red beacon light located in a conspicuous location to attract attention and elevated to prevent tampering.

Any junction boxes and control panels are required should be mounted on a standard pressure treated wooden post (or equivalent) and secure with concrete to 1.2 metres below grade to prevent frost heave. The junction box must be mounted at an appropriate elevation above grade, outdoor rated, tamper proof, and complete with lockable cover.

10.0 Conclusions and Recommendations

Cambium was retained by Kawartha Utility Services Ltd. to complete a hydrogeological assessment and sewage system design for the property located at 4488 County Road 29, Township of Douro-Dummer, Ontario

The surficial geology of the Site is characterized by sandy silt to silty sand-textured till.

A test pitting investigation was conducted at the Site where a total of six test holes were completed to determine subsurface conditions and determine necessary information for the proposed sewage system design. Test pits were all terminated on bedrock with depths ranging from 1.22 mbgs to 2.51 mbgs. Soils generally consisted of a topsoil layer overlying a sandy silt layer and a sandy silty gravel layer. No groundwater was encountered in any test pits.

The in-situ testing completed at depths ranging from 0.5 m to 1.0 m in native soils below the topsoil layer determined estimated hydraulic conductivities ranged between 3.13×10^{-7} m/sec and 2.93×10^{-6} m/sec with infiltration rates ranged between 34 mm/hour and 61 mm/hour.

The conceptual water balance indicates that there will be an infiltration deficit of about 1,308 m^3/annum in the post-development infiltration upon the full development of the Site. It is expected that this infiltration deficit can be accommodated by the implementation of LID measures, either by means of infiltration galleries or infiltration trenches or any other suitable means provided by others.

The water supply assessment completed on the newly drilled well, TW1. The results of the TW1 pumping test indicates that the daily sewage volume of 3,975 L of daily water withdrawal from TW1 is achievable.

The water sample obtained during the TW1 pumping test exhibited favourable results with sodium (126 mg/L) being the only parameter exceeding the ODWQS criteria. The concentration of sodium was less than the aesthetic limit and maximum concentration that is treatable (200 mg/L).

A daily sewage design flow was calculated using OBC Tables 8.2.1.3.B for the Site which was determined to be 3,975 L/day. A detailed sewage system design was completed having a

minimum septic tank capacity of 12,000 L, a 3,600 L pump chamber to dose the leaching bed, and a partially raised two-cell filter bed having a total footprint of 25.1 m x 24.2 m.

11.0 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.

DocuSigned by:
6C8CA15FD6B4444...

Warren Young, P.Eng.
Coordinator, Hydrogeologist

DocuSigned by:
C9F8935E96D14CC...

Jeremy Tracey, P.Eng.
Project Manager

DocuSigned by:
677F3F2E4427404...

Kevin Warner, M.Sc., P.Geo (Ltd). BCIN
Group Manager-Water & Wastewater

\\cambiumincstorage.file.core.windows.net\projects\18800 to 18899\18842-001 Kawartha Utility Services Ltd. HydroG Assemnt - 4488 County Road 29\Deliverables\REPORT - HydroG\Final\2024-03-08 RPT HydroG Assessment and WW Design- 4488 County Road 29.docx

12.0 References

Chapman, L.J. and D.F. Putnam. (1984). *The Physiography of Southern Ontario: Ontario Geological Survey, Special Volume 2.*

Chapman, L.J. and D.F. Putnam. (1984). *The Physiography of Southern Ontario: Ontario Geological Survey, Special Volume 2.*

MECP. (2024a). Retrieved from Ministry of the Environment, Conservation, and Parks - Water Well Information System: (https://www.ontario.ca/environment-and-energy/map-well-records)

MECP. (2024b, February). Retrieved from Ministry of Environment, Conservation, and Parks - Source Protection Information Atlas: https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA

Ministry of the Environment. (2003). *Stormwater Management Planning and Design Manual .*

Ministry of the Environment. (2006). *Technical Support Document for Ontario Drinking Water Quality Standards, Objectives and Guidelines.* Ministry of the Environment.

MNRF. (2024). Make a Topographic Map. Ontario, Canada.

OGS. (2007). *Paleozoic Geology of Southern Ontario; Miscellaneous Release -- Data 219.* Ontario Geological Survey.

OGS. (2010). *Surficial geology of Southern Ontario; Miscellaneous Release - Data 128 - Revised.* Ontario Geological Survey.

OGS. (2010). *Surficial geology of Southern Ontario; Miscellaneous Release - Data 128 - Revised.* Ontario Geological Survey.

OMMAH. (1997). *Supplementary Guidelines to the Ontario Building Code 1997. SG-6 Percolation Time and Soil Descriptions.* Ontario Ministry of Municipal Affairs and Housing.

13.0 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.

Reliance on Materials and Information

The findings and results presented in reports prepared by Cambium are based on the materials and information provided by the client to Cambium and on the facts, conditions and circumstances encountered by Cambium during the performance of the work requested by the client. In formulating its findings and results into a report, Cambium assumes that the information and materials provided by the client or obtained by Cambium from the client or otherwise are factual, accurate and represent a true depiction of the circumstances that exist. Cambium relies on its client to inform Cambium if there are changes to any such information and materials. Cambium does not review, analyze or attempt to verify the accuracy or completeness of the information or materials provided, or circumstances encountered, other than in accordance with applicable accepted industry practice. Cambium will not be responsible for matters arising from incomplete, incorrect or misleading information or from facts or circumstances that are not fully disclosed to or that are concealed from Cambium during the provision of services, work or reports.

Facts, conditions, information and circumstances may vary with time and locations and Cambium's work is based on a review of such matters as they existed at the particular time and location indicated in its reports. No assurance is made by Cambium that the facts, conditions, information, circumstances or any underlying assumptions made by Cambium in connection with the work performed will not change after the work is completed and a report is submitted. If any such changes occur or additional information is obtained, Cambium should be advised and requested to consider if the changes or additional information affect its findings or results.

When preparing reports, Cambium considers applicable legislation, regulations, governmental guidelines and policies to the extent they are within its knowledge, but Cambium is not qualified to advise with respect to legal matters. The presentation of information regarding applicable legislation, regulations, governmental guidelines and policies is for information only and is not intended to and should not be interpreted as constituting a legal opinion concerning the work completed or conditions outlined in a report. All legal matters should be reviewed and considered by an appropriately qualified legal practitioner.

Site Assessments

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.

Only conditions at the site and locations chosen for study by the client are evaluated; no adjacent or other properties are evaluated unless specifically requested by the client. Any physical or other aspects of the site chosen for study by the client, or any other matter not specifically addressed in a report prepared by Cambium, are beyond the scope of the work performed by Cambium and such matters have not been investigated or addressed.

Reliance

Cambium's services, work and reports may be relied on by the client and its corporate directors and officers, employees, and professional advisors. Cambium is not responsible for the use of its work or reports by any other party, or for the reliance on, or for any decision which is made by any party using the services or work performed by or a report prepared by Cambium without Cambium's express written consent. Any party that relies on services or work performed by Cambium or a report prepared by Cambium without Cambium's express written consent, does so at its own risk. No report of Cambium may be disclosed or referred to in any public document without Cambium's express prior written consent. Cambium specifically disclaims any liability or responsibility to any such party for any loss, damage, expense, fine, penalty or other such thing which may arise or result from the use of any information, recommendation or other matter arising from the services, work or reports provided by Cambium.

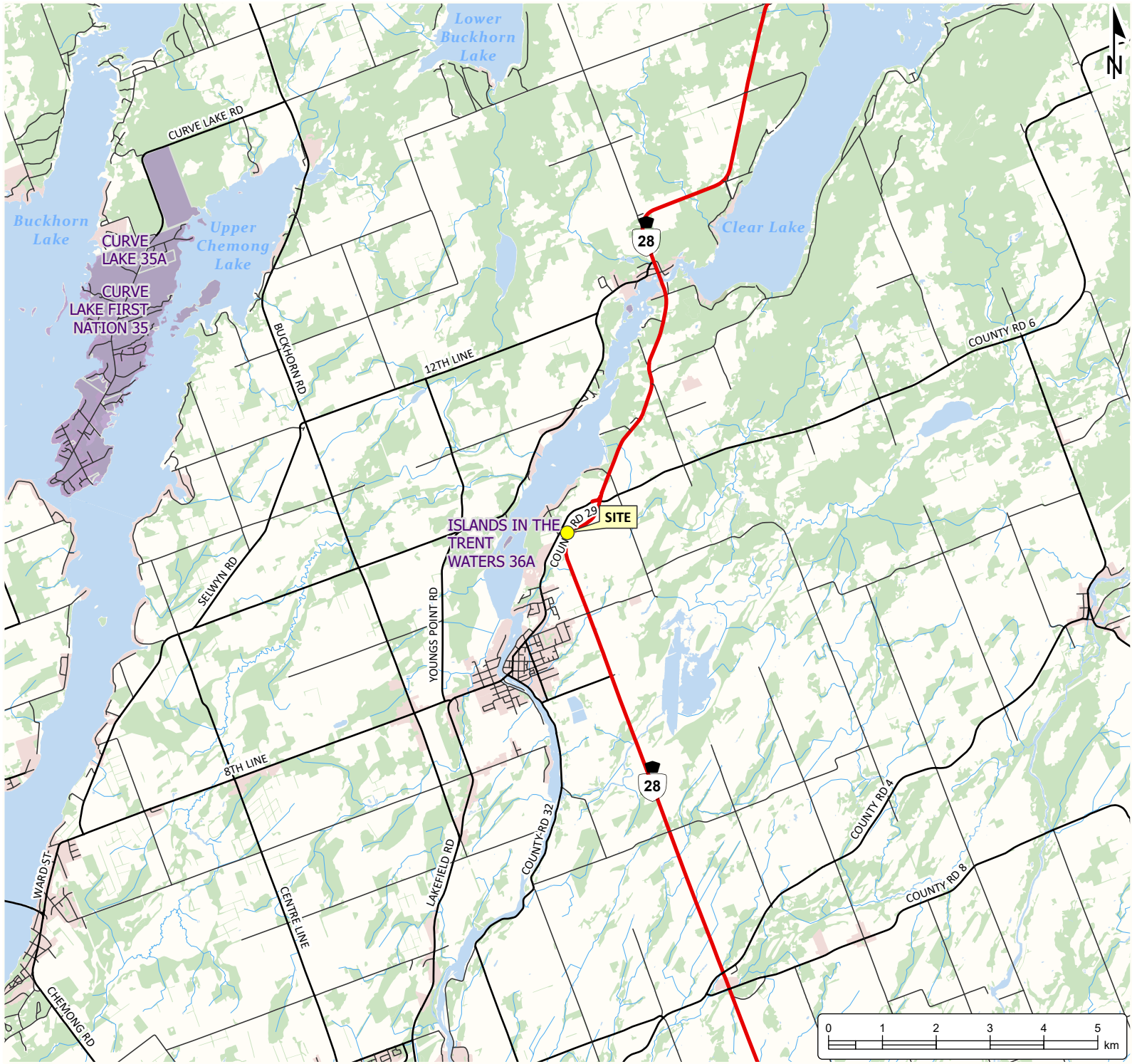
Limitation of Liability

Potential liability to the client arising out of the report is limited to the amount of Cambium's professional liability insurance coverage. Cambium shall only be liable for direct damages to the extent caused by Cambium's negligence and/or breach of contract. Cambium shall not be liable for consequential damages.

Personal Liability

The client expressly agrees that Cambium employees shall have no personal liability to the client with respect to a claim, whether in contract, tort and/or other cause of action in law. Furthermore, the client agrees that it will bring no proceedings nor take any action in any court of law against Cambium employees in their personal capacity.

Appended Figures



HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN

KAWARTHA UTILITY SERVICES LTD.
4488 Country Road 29
Douro-Dummer, Ontario

LEGEND

- Watercourse
- Water Area
- First Nations Reserve
- Wooded Area
- Built Up Area
- Highway
- Major Road
- Minor Road
- Railway
- Watercourse
- Water Area
- First Nations Reserve
- Provincial Park
- Wooded Area
- Built Up Area

Notes:
- This document contains information licensed under the Open Government License - Ontario.
- 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

SITE LOCATION PLAN

Project No.: 18842-001		Date: March 2024	Rev.:
Scale: 1:100,000		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: JT	Figure: 1	

O:\GIS\MXDs\18800-18899\18842-001 Kawartha Utility Services Ltd. Hydro G Assemnt - 4488 County Road 29\2024-02-22 Hydro G and Septic.aprx

HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN

KAWARTHA UTILITY SERVICES LTD.
4488 Country Road 29
Douro-Dummer, Ontario

LEGEND

- Drilled Well
- Test Pit
- Guelph Permeameter Test
- Proposed Building Footprint
- Site (approximate)

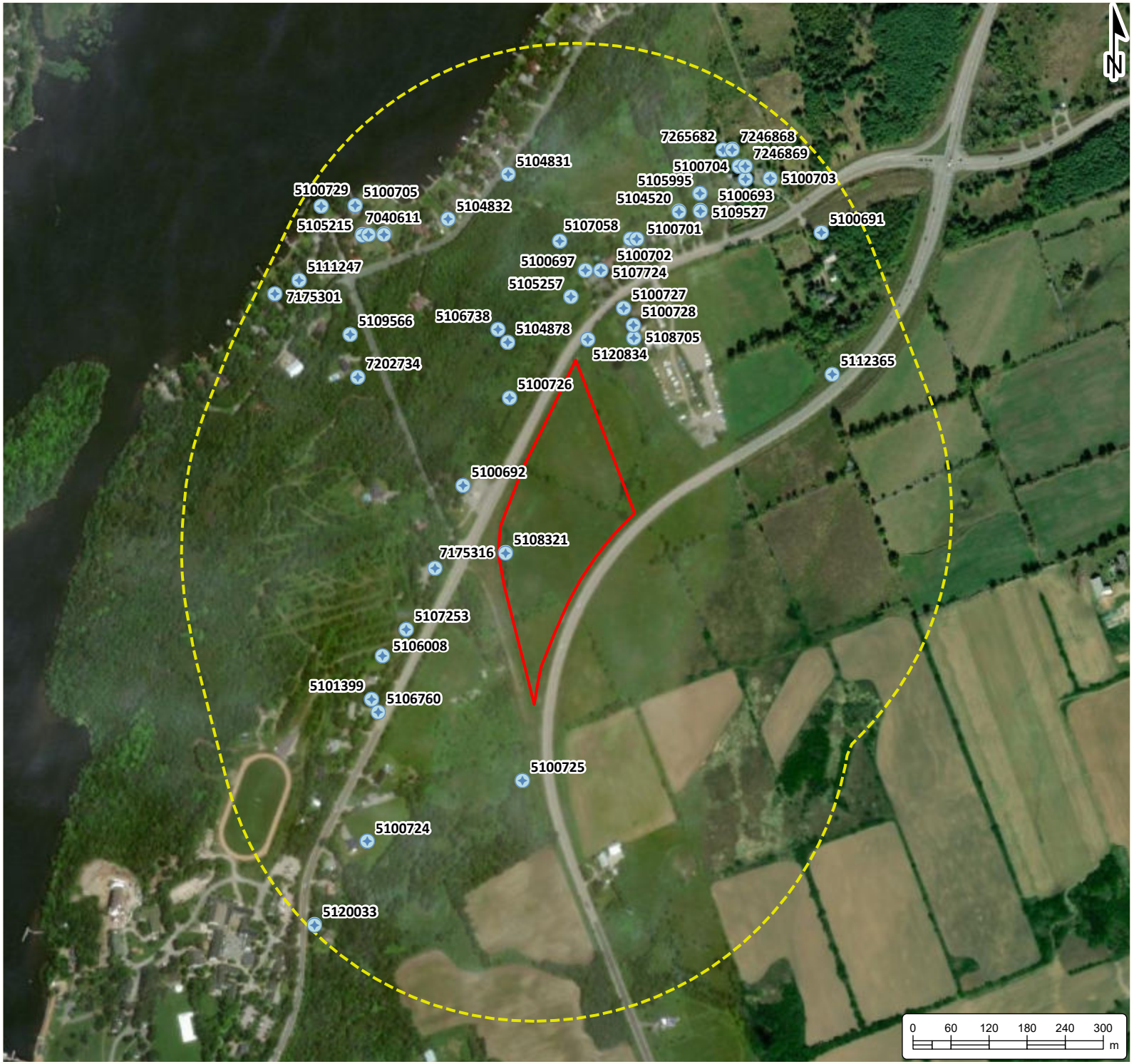
Notes:
- Overlay image was created by EcoVue Consulting Services Inc., project no. 22-2469, drawing no. CP1, titled: Concept Plan, dated August 22, 2023.
- This document contains information licensed under the Open Government License - Ontario.
- Distances on this plan are in metres and can be converted 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

SITE PLAN

Project No.: 18842-001		Date: March 2024	
Scale: 1:1,500		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: JT	Figure:	2

O:\GIS\MXDs\18800-18899\18842-001 Kawartha Utility Services Ltd. Hydro\3 Assemnt - 4488 County Road 29\2024-02-22 Hydro G and Septic.aprx



HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN

KAWARTHA UTILITY SERVICES LTD.
4488 Country Road 29
Douro-Dummer, Ontario

LEGEND

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

Notes:
- This document contains information licensed under the Open Government License - Ontario.
- 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

MECP WELL RECORDS WITHIN 500m

Project No.: 18842-001		Date: March 2024	Rev.:
Scale: 1:8,500		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: JT	Figure: 3	

O:\GIS\MXDs\18800-18899\18842-001 Kawartha Utility Services Ltd. HydroG Assemnt - 4488 County Road 29\2024-02-22 Hydro G and Septic.aprx

	Area (m²)
Roof	1652.5
Paved	4971.0
Landscaped	46606.7
Total	53230.2

HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN

KAWARTHA UTILITY SERVICES LTD.
4488 Country Road 29
Douro-Dummer, Ontario

LEGEND

- Site (approximate)
- Roof Area
- Paved Area
- Landscaped

Notes:
- This document contains information licensed under the Open Government License - Ontario.
- 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.: 18842-001		Date: March 2024 Rev.:	
Scale: 1:2,500		Projection: NAD 1983 UTM Zone 17N	
Created by: MAT	Checked by: JT	Figure: **4**	

O:\GIS\MXDs\18800-18899\18842-001 Kawartha Utility Services Ltd. HydroG Assemnt - 4488 County Road 29\2024-02-22 Hydro G and Septic.aprx

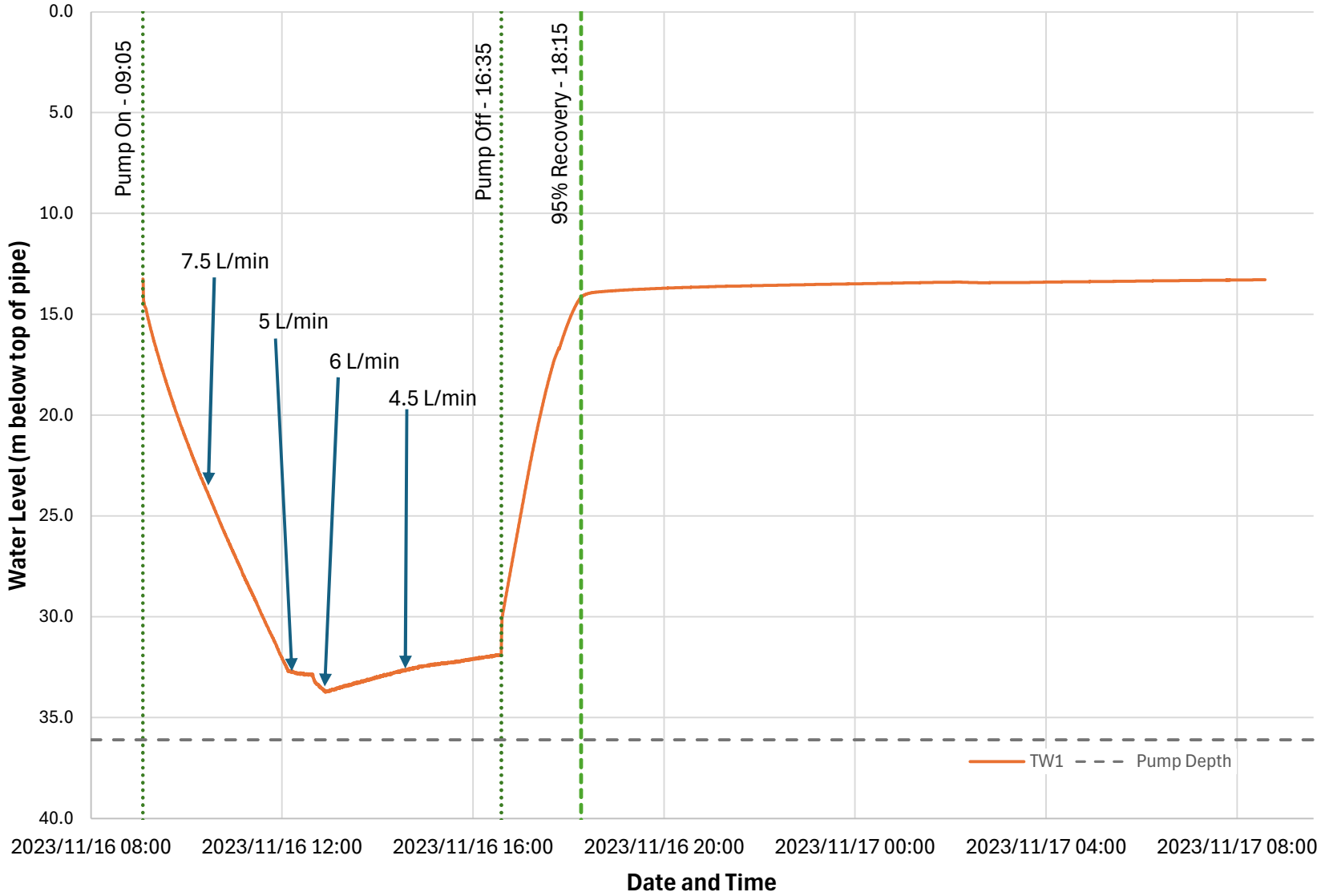
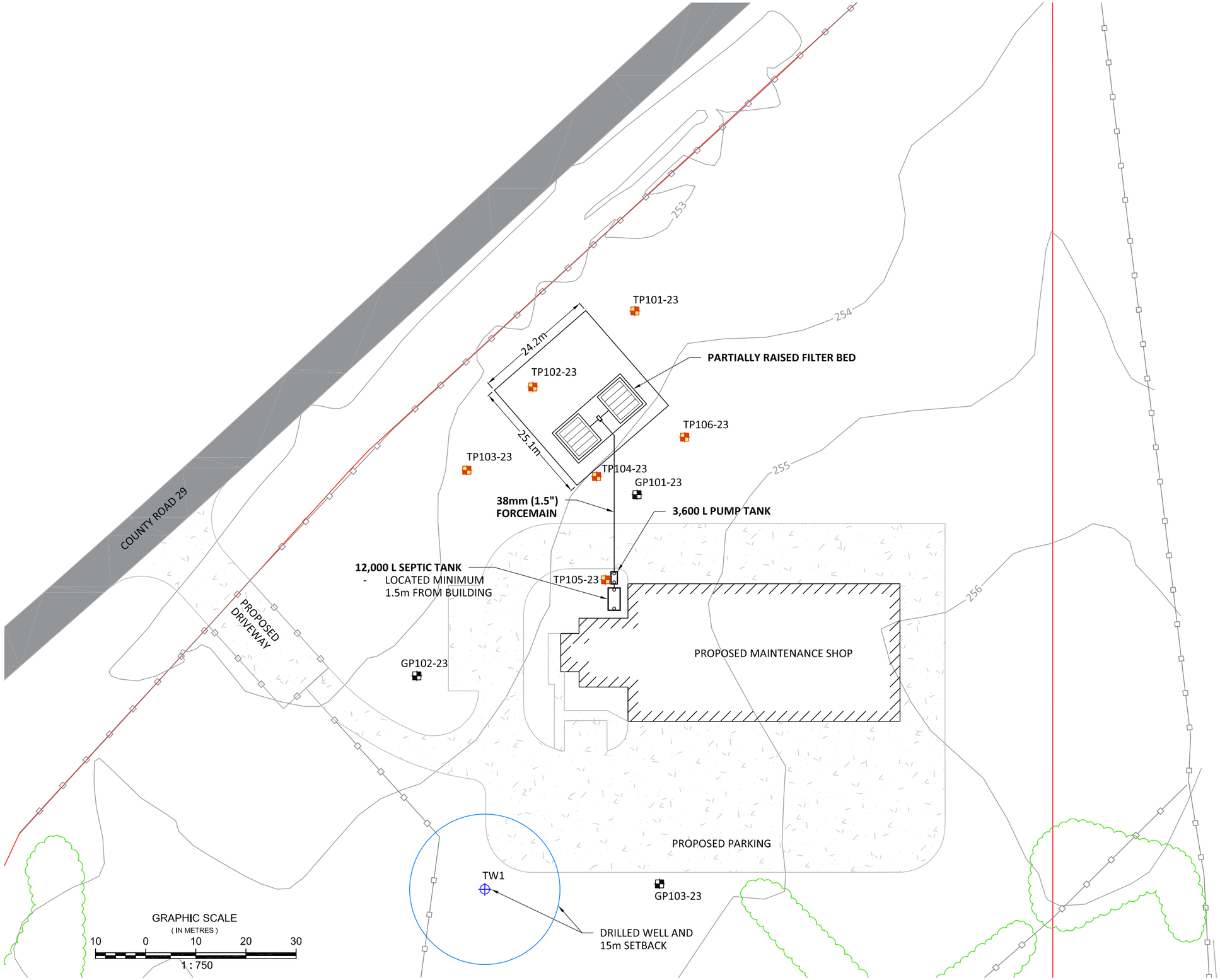


Figure 5 - TW1 Pumping Test Hydrograph



HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN

KAWARTHA UTILITY SERVICES LTD.
4488 County Road 29
Douro-Dummer, Ontario

LEGEND

- Guelph Permeameter
- Test Pit
- Drilled Well
- Contour Line (1.0m intervals)
- Fenceline
- Edge of Bush
- Property Boundary (approximate)
- Driveway/Parking Lot

Notes:
1. Features on this plan were obtained from an existing Concept Plan created by EcoVue Consulting Services, project no. 22-2469, drawing no. CP1, dated August 22, 2023
2. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
3. This plan is for illustrative purposes only.

REVISION	REVISED BY	DATE

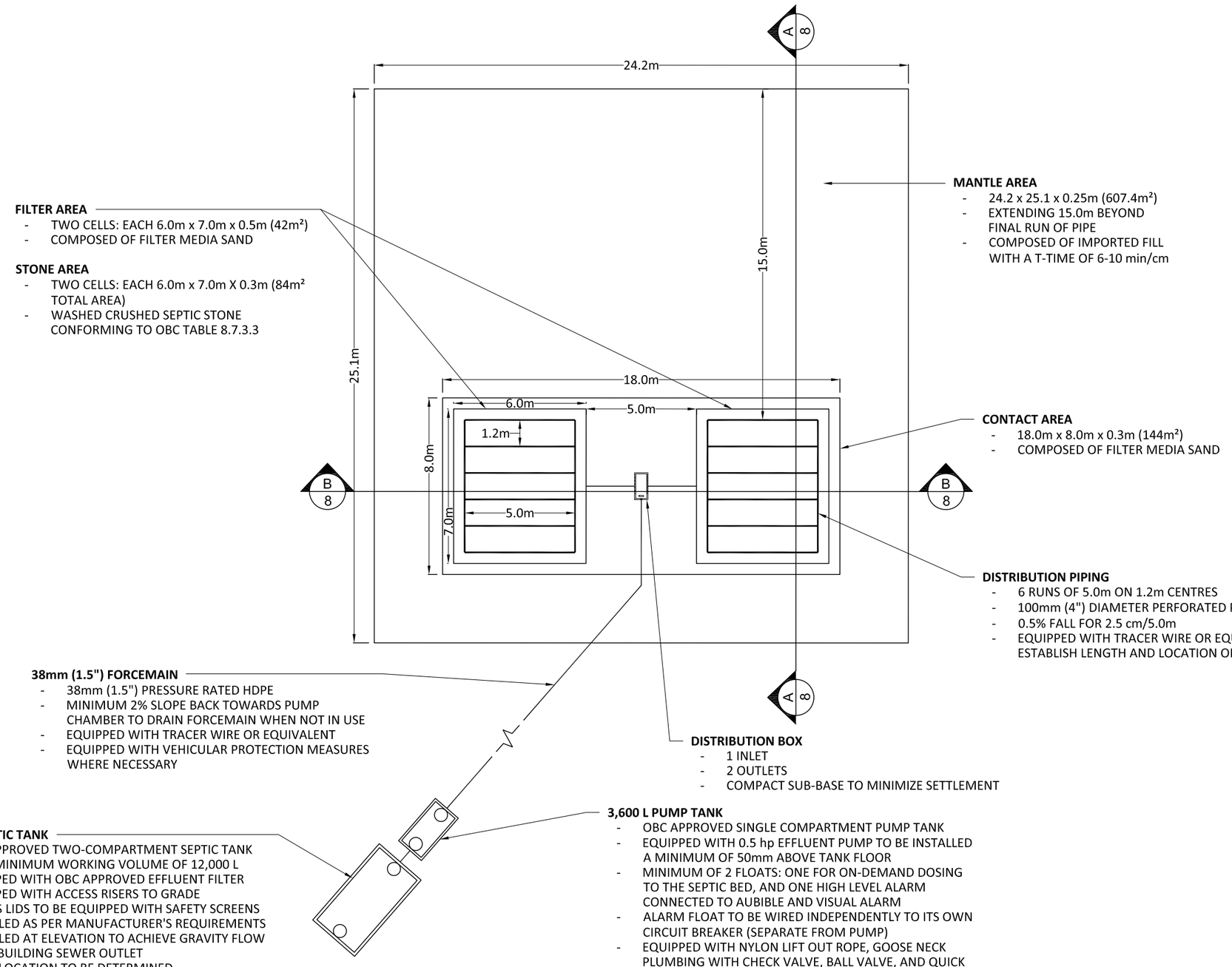
DRAFT

CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: 705-742-7900 Fax: 705-742-7907
www.cambium-inc.com

PROPOSED SEWAGE SYSTEM SITE PLAN

Project No.: 18842-001		Date: March 2024	
		Rev.:	
Horizontal Scale: 1:750		Vertical Scale: N/A	
Drawn By: MAT	Checked By: JT	Figure: 6	

P:\18800 to 18899\18842-001 Kawartha Utility Services Ltd, HydroG Assesmnt - 4488 County Road 29\Graphics\Drawings\CAD\2024-02-15 Septic Design.dwg



FILTER AREA
- TWO CELLS: EACH 6.0m x 7.0m x 0.5m (42m²)
- COMPOSED OF FILTER MEDIA SAND

STONE AREA
- TWO CELLS: EACH 6.0m x 7.0m X 0.3m (84m² TOTAL AREA)
- WASHED CRUSHED SEPTIC STONE CONFORMING TO OBC TABLE 8.7.3.3

MANTLE AREA
- 24.2 x 25.1 x 0.25m (607.4m²)
- EXTENDING 15.0m BEYOND FINAL RUN OF PIPE
- COMPOSED OF IMPORTED FILL WITH A T-TIME OF 6-10 min/cm

CONTACT AREA
- 18.0m x 8.0m x 0.3m (144m²)
- COMPOSED OF FILTER MEDIA SAND

DISTRIBUTION PIPING
- 6 RUNS OF 5.0m ON 1.2m CENTRES
- 100mm (4") DIAMETER PERFORATED PVC
- 0.5% FALL FOR 2.5 cm/5.0m
- EQUIPPED WITH TRACER WIRE OR EQUIVALENT TO ESTABLISH LENGTH AND LOCATION OF RUNS

38mm (1.5") FORCEMAIN
- 38mm (1.5") PRESSURE RATED HDPE
- MINIMUM 2% SLOPE BACK TOWARDS PUMP CHAMBER TO DRAIN FORCEMAIN WHEN NOT IN USE
- EQUIPPED WITH TRACER WIRE OR EQUIVALENT
- EQUIPPED WITH VEHICULAR PROTECTION MEASURES WHERE NECESSARY

DISTRIBUTION BOX
- 1 INLET
- 2 OUTLETS
- COMPACT SUB-BASE TO MINIMIZE SETTLEMENT

12,000 L SEPTIC TANK
- OBC APPROVED TWO-COMPARTMENT SEPTIC TANK WITH MINIMUM WORKING VOLUME OF 12,000 L
- EQUIPPED WITH OBC APPROVED EFFLUENT FILTER
- EQUIPPED WITH ACCESS RISERS TO GRADE
- ACCESS LIDS TO BE EQUIPPED WITH SAFETY SCREENS
- INSTALLED AS PER MANUFACTURER'S REQUIREMENTS
- INSTALLED AT ELEVATION TO ACHIEVE GRAVITY FLOW FROM BUILDING SEWER OUTLET
- EXACT LOCATION TO BE DETERMINED

3,600 L PUMP TANK
- OBC APPROVED SINGLE COMPARTMENT PUMP TANK
- EQUIPPED WITH 0.5 hp EFFLUENT PUMP TO BE INSTALLED A MINIMUM OF 50mm ABOVE TANK FLOOR
- MINIMUM OF 2 FLOATS: ONE FOR ON-DEMAND DOSING TO THE SEPTIC BED, AND ONE HIGH LEVEL ALARM CONNECTED TO AUBIBLE AND VISUAL ALARM
- ALARM FLOAT TO BE WIRED INDEPENDENTLY TO ITS OWN CIRCUIT BREAKER (SEPARATE FROM PUMP)
- EQUIPPED WITH NYLON LIFT OUT ROPE, GOOSE NECK PLUMBING WITH CHECK VALVE, BALL VALVE, AND QUICK DISCONNECT TO ALLOW ACCESS FROM GRADE THROUGH TANK LID
- CONTROL FLOAT SET TO DISCHARGE 342 L PER DOSE, AND WITHIN 15 min.

HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN
KAWARTHA UTILITY SERVICES LTD.
4488 County Road 29
Douro-Dummer, Ontario

Notes:
1. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
2. This plan is for illustrative purposes only.

REVISION	REVISED BY	DATE

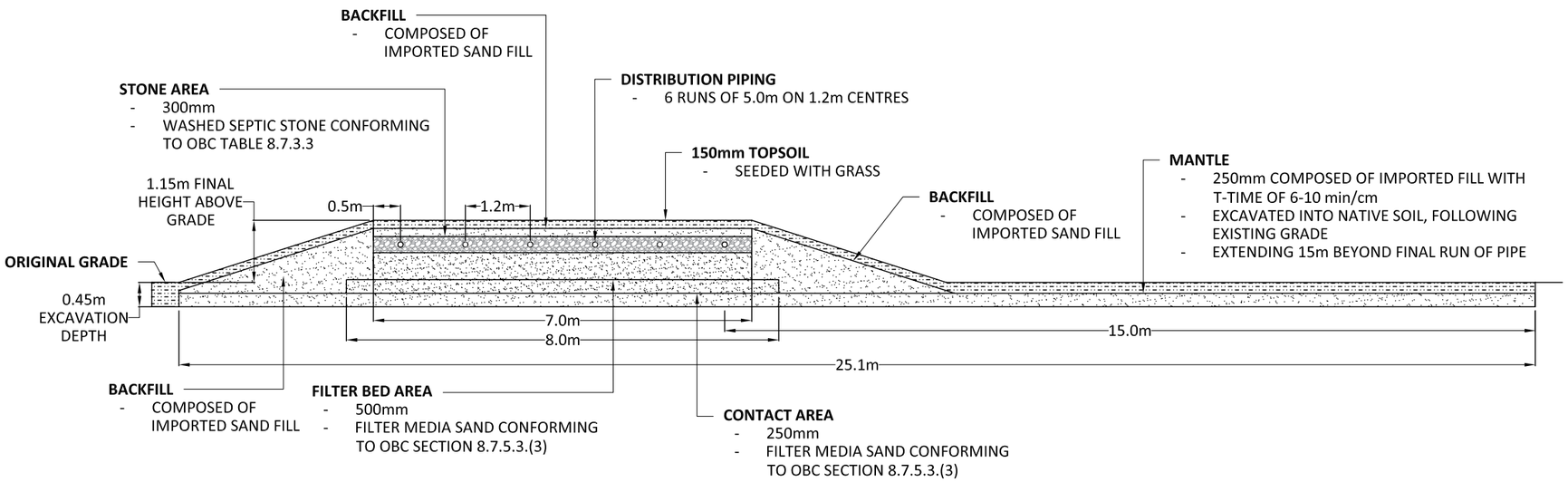
DRAFT

194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: 705-742-7900 Fax: 705-742-7907
www.cambium-inc.com

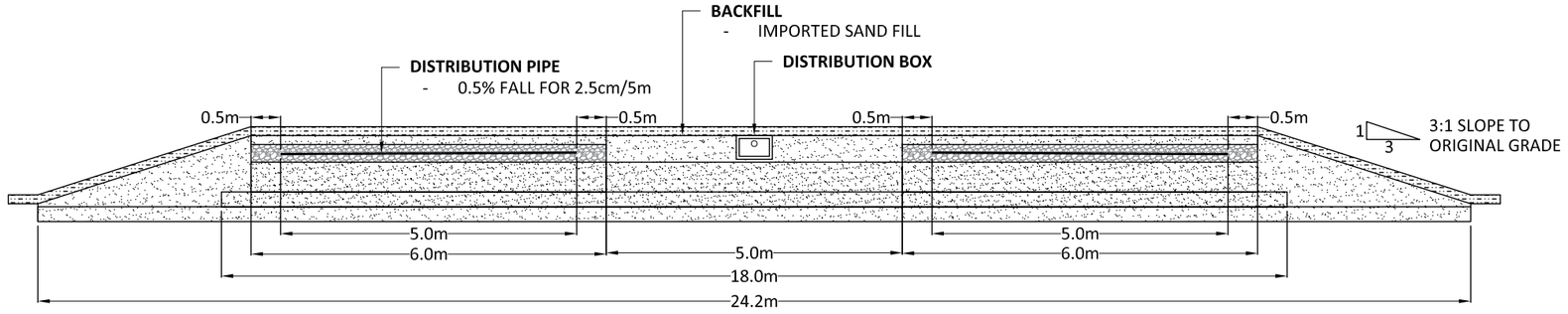
FILTER BED LAYOUT

Project No.:	Date:
18842-001	March 2024
	Rev.:
Horizontal Scale: 1:200	Vertical Scale: N/A
Drawn By: MAT	Checked By: JT
Figure: 7	

DETAIL 1: CROSS SECTION A



DETAIL 2: CROSS SECTION B



HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN
KAWARTHA UTILITY SERVICES LTD.
4488 County Road 29
Douro-Dummer, Ontario

Notes:
1. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.

REVISION	REVISED BY	DATE

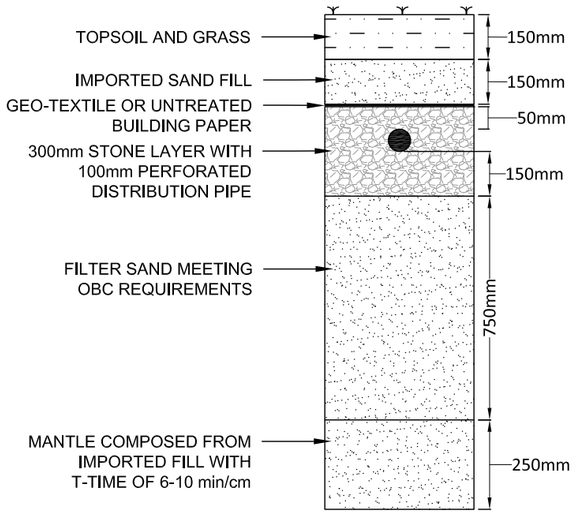
DRAFT

CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: 705-742-7900 Fax: 705-742-7907
www.cambium-inc.com

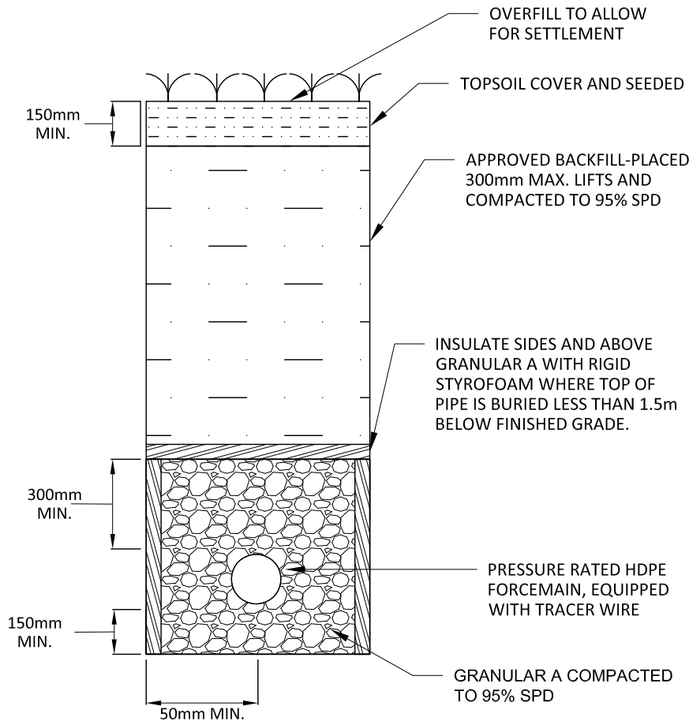
FILTER BED PROFILE

Project No.:	Date:
18842-001	March 2024
	Rev.:
Horizontal Scale: 1:100	Vertical Scale: N/A
Drawn By: MAT	Checked By: JT
Figure: 8	

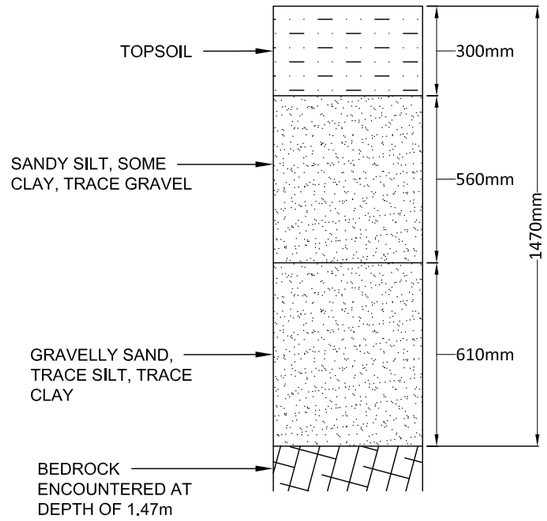
DETAIL 3: FILTER BED SECTION PROFILE



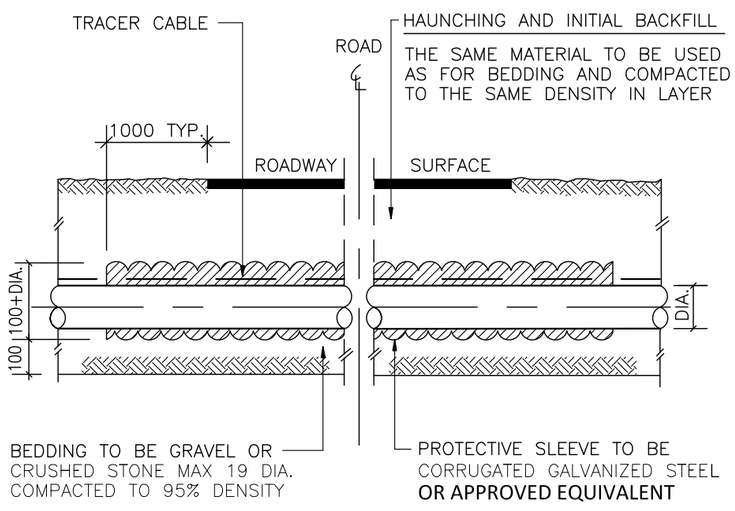
DETAIL 4: 38mm FORCEMAIN TRENCH PROFILE



DETAIL 5: TEST PIT PROFILE TP102-23



DETAIL 6: INSTALLATION OF PIPE UNDER ROAD



NOTES

General:

1. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.
2. Cambium endeavours to design figures that are free from errors but cannot be held responsible for any damages due to errors or omissions. Design figures should not be used for navigation or legal purposes and intended for general reference use only.
3. Installer must be licensed in accordance with all requirements of the Ontario Building Code.
4. Cambium to be provided with gradation documentation for each type of proposed sand prior to construction, or arrange with Cambium to sample and analyze each material.
5. Arrange with Cambium and/or approval agency to inspect the wastewater system during construction.
6. Obtain any required permits and arrange inspections with the approval agency and Electrical Safety Authority for any plumbing and electrical work, respectively.

Wastewater System:

7. No traffic of any kind on the tanks or leaching bed.
8. No structures of any kind are to be built over the wastewater system.
9. Backfill to be completed immediately following construction and review/inspection.
10. Final grading and/or swale construction to be such that surface water is directed away from the leaching bed.
11. Topsoil and grass must be established and maintained following construction of the wastewater treatment system.
12. The wastewater system has not been designed to receive backwash water from water treatment processes. Backwash water must be diverted elsewhere

Construction:

13. Underground utilities must be located and protected prior to excavation.
14. Contractors must report any discrepancies to Cambium prior to commencing work.
15. Contractors must check and verify all dimensions before proceeding with work and be responsible for the same.
16. Soil shall not be worked when wet.
17. Native soil at bottom of excavated areas must be scarified prior to placing sand or gravel.
18. All work must be completed in accordance with relevant codes and guidelines.
19. The project specifications shall be read in conjunction with design drawings.
20. All equipment and materials shall be installed as specified or approved equivalent and meet all relevant codes and guidelines.
21. Tracer wire and/or other means of subsurface detection must be tested prior to backfill.
22. On-site flow testing shall be completed prior to startup of the wastewater system in order to allow for adjustments to the pump run cycle/floats if necessary.
23. Clearing and grubbing will be required in some areas of the leaching bed where there are trees and shrubs.
24. As needed based on topography, the leaching bed will be graded level.

Septic Tank:

25. Tank shall be installed on suitable base in accordance with tank manufacturer requirements.
26. Equivalent plastic tank may be used provided tanks conform to CSA B66 standards, have an equivalent working volume, and are installed per manufacturer's instructions.
27. Equip with an effluent filter of suitable capacity installed on the septic tank discharge sized for the peak flow.
28. Equip with 610 mm access risers to grade to allow access from grade to service the treatment components.
29. Tank to be anchored to the bedrock to avoid shifting or heaving.

Pump Tank:

30. Tanks shall be installed on suitable base in accordance with tank manufacturer requirements.
31. Equip with 610 mm access risers to grade to allow access from grade to service the treatment components.
32. If desired for improved odour control, septic tank and pump chamber access risers can be equipped with lids that contain activated charcoal pellets.
33. The sewage pump discharge shall extend vertically into the access riser sufficient to be within reach from grade and equipped with 51 mm [2"], Schedule 80 PVC ball valve for pump isolation, check valve to eliminate backflow through the pumps, and Schedule 80 PVC quick-disconnect to facilitate pump removal from grade.
34. Attach nylon rope to pump and hook coil at top of riser to allow pump to be easily pulled out.
35. Tank to be anchored to bedrock to avoid shifting or heaving.

Forcemains:

36. Protect forcemains from vehicular traffic.
37. Forcemains to be HDPE pressure-rated for sewage conveyance.
38. Where forcemains or sewer lines cannot be installed below frost level appropriate insulation must be installed.
39. Install tracer wire over all forcemains.

Leaching Beds:

40. Septic stone shall be per Ontario Building Code 8.7.3.3 and shall be washed and free of fine material.
41. A footer shall be installed on the end of the distribution pipe runs.

Control Panels:

42. Lockable NEMA 4X enclosure.
43. Hand/Off/Auto switch for pump.
44. Minimum of two floats: one control float to control dose volume and one high level alarm float.
45. Alarm float will activate an audible and visual alarm.
46. Alarm horn external test/normal/silence switch.
47. Separate circuit breaker for pump.
48. Separate circuit breaker for alarm float.

HYDROGEOLOGICAL ASSESSMENT AND SEWAGE SYSTEM DESIGN
KAWARTHA UTILITY SERVICES LTD.
4488 County Road 29
Douro-Dummer, Ontario

Notes:
1. Distances on this plan are in metres and can be converted to feet by dividing by 0.3048.

REVISION	REVISED BY	DATE

DRAFT

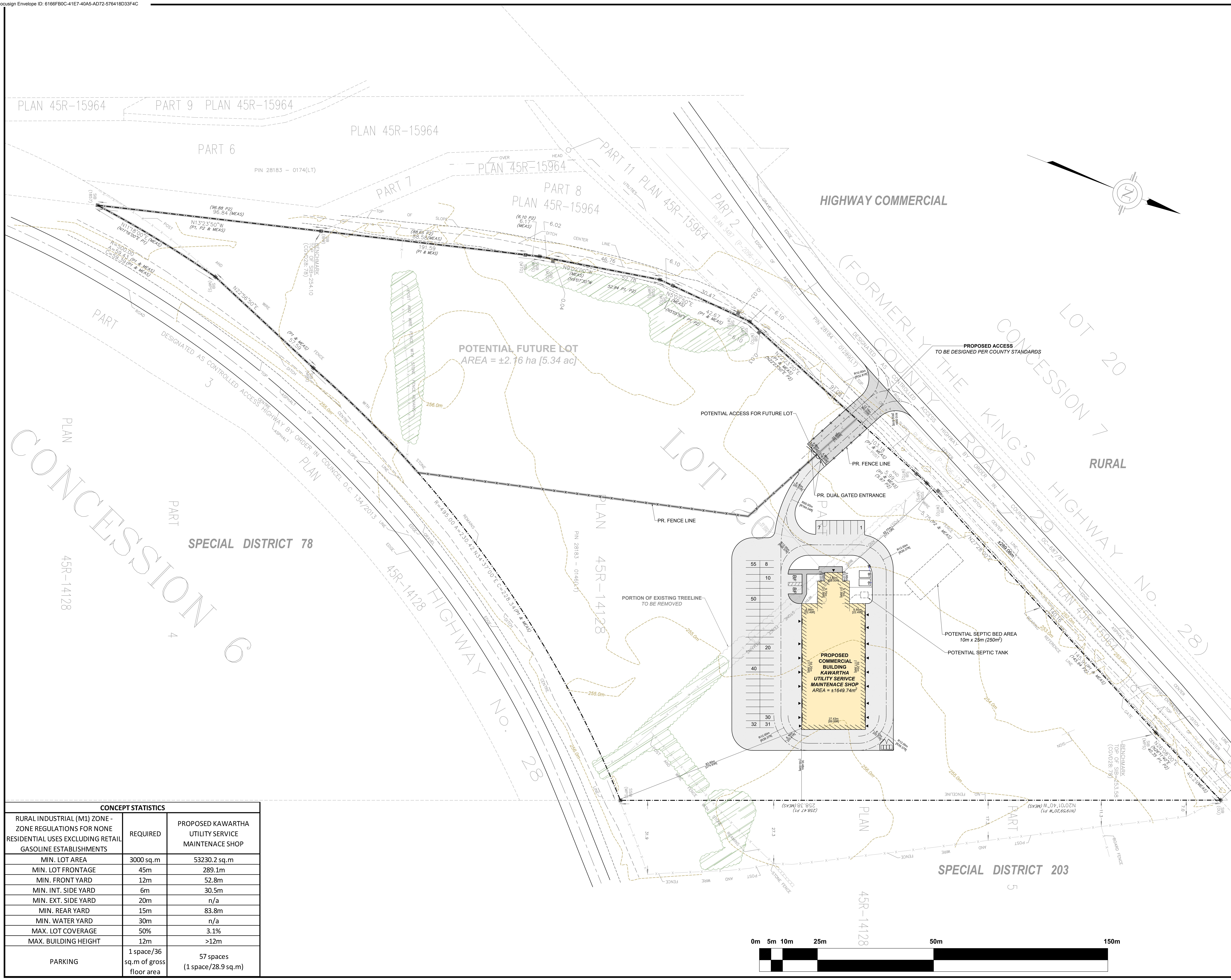
CAMBIUM
194 Sophia Street
Peterborough, Ontario, K9H 1E5
Tel: 705-742-7900 Fax: 705-742-7907
www.cambium-inc.com

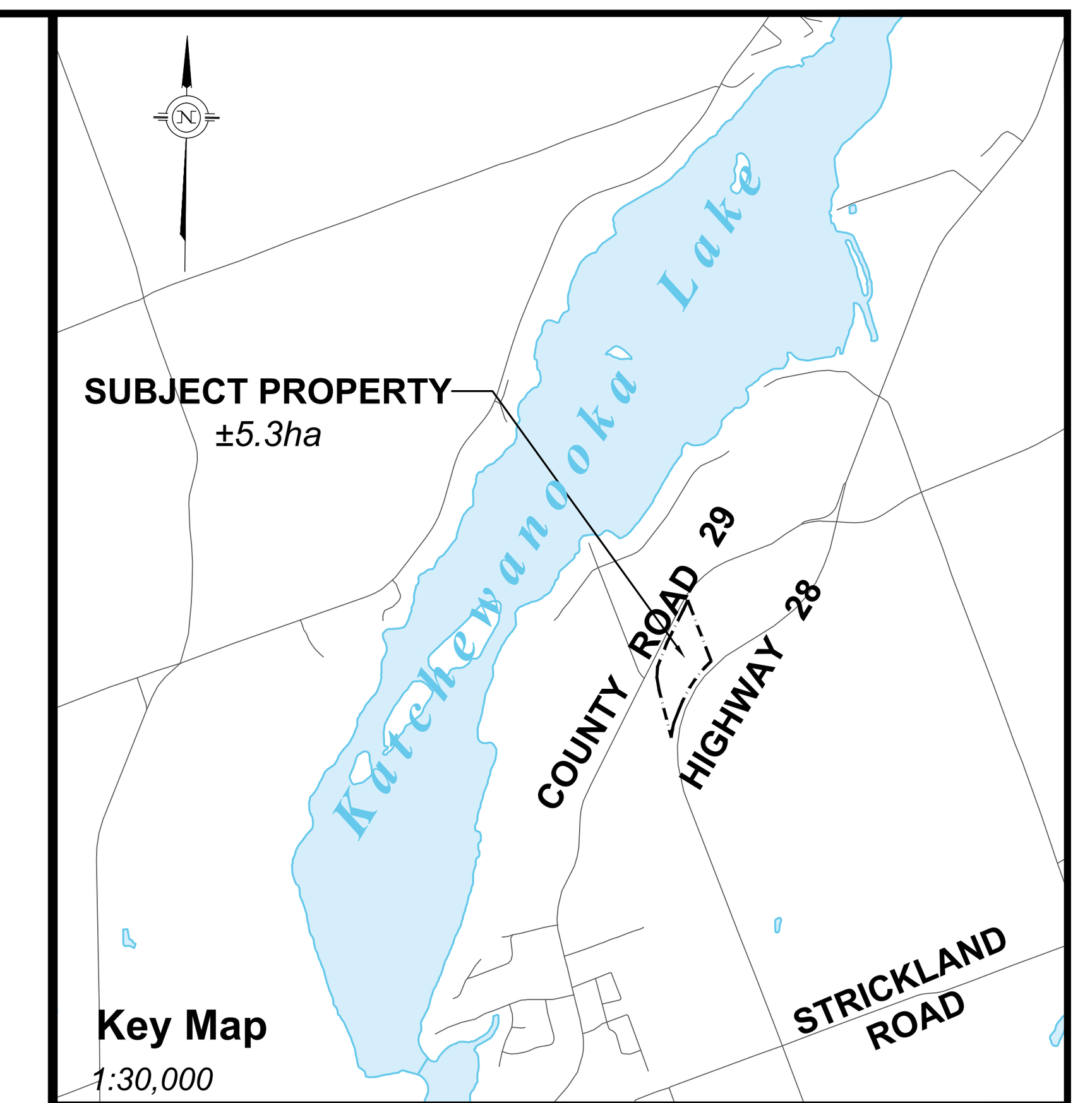
DETAILS AND NOTES

Project No.: 18842-001	Date: March 2024	
	Rev.:	
Horizontal Scale: N/A	Vertical Scale: N/A	
Drawn By: MAT	Checked By: JT	Figure: 9

Appendix A

Proposed Development Plan and Land Information





CONCEPT STATISTICS		
RURAL INDUSTRIAL (M1) ZONE - ZONE REGULATIONS FOR NONE RESIDENTIAL USES EXCLUDING RETAIL GASOLINE ESTABLISHMENTS	REQUIRED	PROPOSED KAWARTHA UTILITY SERVICE MAINTENACE SHOP
MIN. LOT AREA	3000 sq.m	53230.2 sq.m
MIN. LOT FRONTAGE	45m	289.1m
MIN. FRONT YARD	12m	52.8m
MIN. INT. SIDE YARD	6m	30.5m
MIN. EXT. SIDE YARD	20m	n/a
MIN. REAR YARD	15m	83.8m
MIN. WATER YARD	30m	n/a
MAX. LOT COVERAGE	50%	3.1%
MAX. BUILDING HEIGHT	12m	>12m
PARKING	1 space/36 sq.m of gross floor area	57 spaces (1 space/28.9 sq.m)

LEGEND

- DENOTES SURVEY MONUMENT, FOUND
- WIT — DENOTES WITNESS
- MPS — DENOTES MCINTOSH PERRY SURVEYING INC.
- MTO — DENOTES MINISTRY OF TRANSPORTATION OF ONTARIO
- 1857 — DENOTES THARMARAJAH SHANMUGARAJAH THAM SURVEYING LIMITED, O.L.S.
- OU — DENOTES ORIGIN UNKNOWN
- IBW — DENOTES IVAN B. WALLACE LTD, O.L.S.
- DENOTES STONE FENCE
- DENOTES FENCE LINE
- DENOTES GATE
- P1 — DENOTES PLAN 45R - 14128
- P2 — DENOTES PLAN 45R - 15964
- CGVD(28) — DENOTES CANADIAN GEODETIC VERTICAL DATUM OF 1928
- DENOTES SUBJECT PROPERTY BOUNDARY
- DENOTES CONTOUR ELEVATION (1.0m INTERVAL) DERIVED FROM ELEVATION DATA PROVIDED BY JBF SURVEYORS
- PROPOSED OVERHEAD DOOR ENTRANCE
- PROPOSED PEDESTRIAN ENTRANCE
- POTENTIAL FIRE HYDRANT
- POTENTIAL UNDERGROUND WATER STORAGE TANKS FOR FIRE SUPPRESSION (2) *3.05m x 4.88m (70m³)*
- PROPOSED STANDARD PARKING SPACE (3m x 6m TYP.)
- PROPOSED BARRIER FREE PARKING SPACE (3.4m x 6m w/ 1.5m AISLE TYP.)
- PROPOSED BUILDING FOOTPRINT
- PROPOSED DRIVEWAY (ASPHALT)
- PROPOSED DRIVEWAY (GRAVEL)
- PROPOSED PEDESTRIAN WALKWAY (CONCRETE) - 1.8m WIDTH
- PROPOSED LOTS
- PROPOSED GARBAGE/RECYCLING ENCLOSURE
- EXISTING TREE LINE (APPROX.)
- VEHICLE MOVEMENT LANEWAY CENTRE LINE *MIN. WIDTH = 6.1m* *MIN. CENTRE LINE TURNING RADIUS = R12m*

BEARINGS SHOWN HEREON ARE MTM GRID DERIVED FROM THE NORTH WESTERLY LIMIT OF PART 2, PLAN 45R-14128 HAVING A BEARING OF N27°28'00"E

NOTES:

1. SURVEY BASE PLAN PROVIDED BY JBF SURVEYORS, COMPLETED ON AUGUST 19TH, 2022.

EcoVue Consulting Services Inc.
311 George St. N., Suite 200
Peterborough ON K9J 3H3
Tel: 705-876-8340 Fax: 705-742-8343
www.ecovueconsulting.com

DRAWN BY: MC	PROJECT No.: 22-2469
APPROVED BY:	HORIZ. SCALE: 1:700
REVISION DATE: AUGUST 22, 2023	PLOT DATE: AUGUST 22, 2023

KAWARTHA UTILITIES

4488 COUNTY ROAD 29
PART OF LOT 20, CONCESSION 06
GEOG. TWP. OF DOURO
TOWNSHIP OF DOURO-DUMMER
COUNTY OF PETERBOROUGH

CONCEPT PLAN

CP1

Ontario

Ministry of Natural Resources and Forestry

Make-a-Map: Natural Heritage Areas

Natural Heritage Mapping

Map created:2/23/2024

Notes:

Enter map notes

Legend

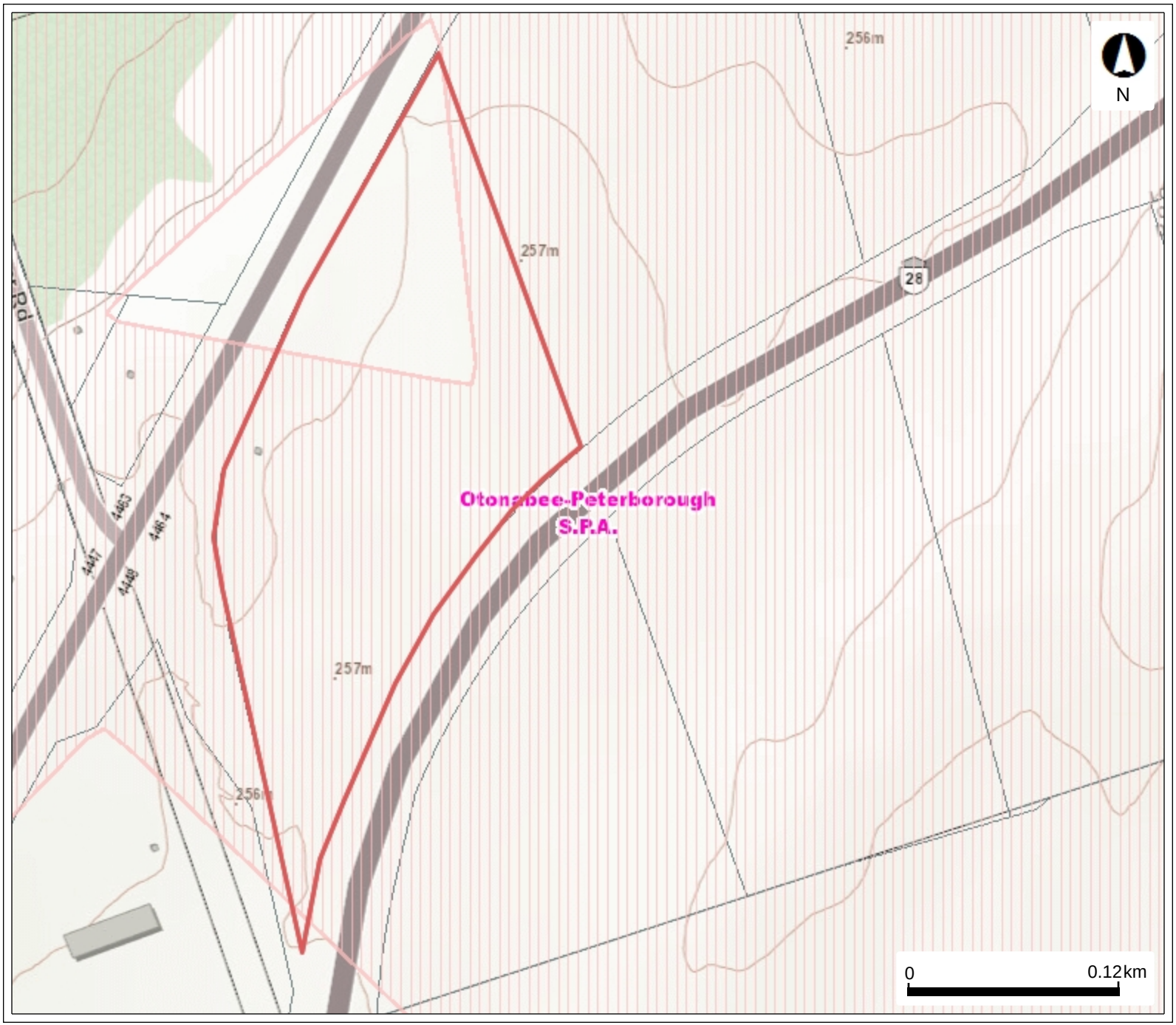
- Assessment Parcel
- Ecoregion
- ANSI
- Earth Science Provincially Significant/sciences de la terre d'importance provinciale
- Earth Science Regionally Significant/sciences de la terre d'importance régionale
- Life Science Provincially Significant/sciences de la vie d'importance provinciale
- Life Science Regionally Significant/sciences de la vie d'importance régionale
- Evaluated Wetland
- Provincially Significant/considérée d'importance provinciale
- Non-Provincially Significant/non considérée d'importance provinciale
- Unevaluated Wetland
- Woodland
- Natural Heritage System

0.3 0 0.16 0.3 Kilometres

Absence of a feature in the map does not mean they do not exist in this area.

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 Natural Resources and Forestry(OMNRF) shall not be liable in any way for the use of, or reliance upon, this map or any information on this map.

SPIA Map



Legend

Significant Groundwater Recharge Area
- N/A
- 0
- 2
- 4
- 6

Highly Vulnerable Aquifers

WHPA-E

Wellhead Protection Area
- A
- B
- C
- C1
- D
- F

Intake Protection Zone 1

Intake Protection Zone 2

Source Protection Areas

Assessment Parcel

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: 2/16/2024
Map Center: 44.44546 N, -78.25702 W

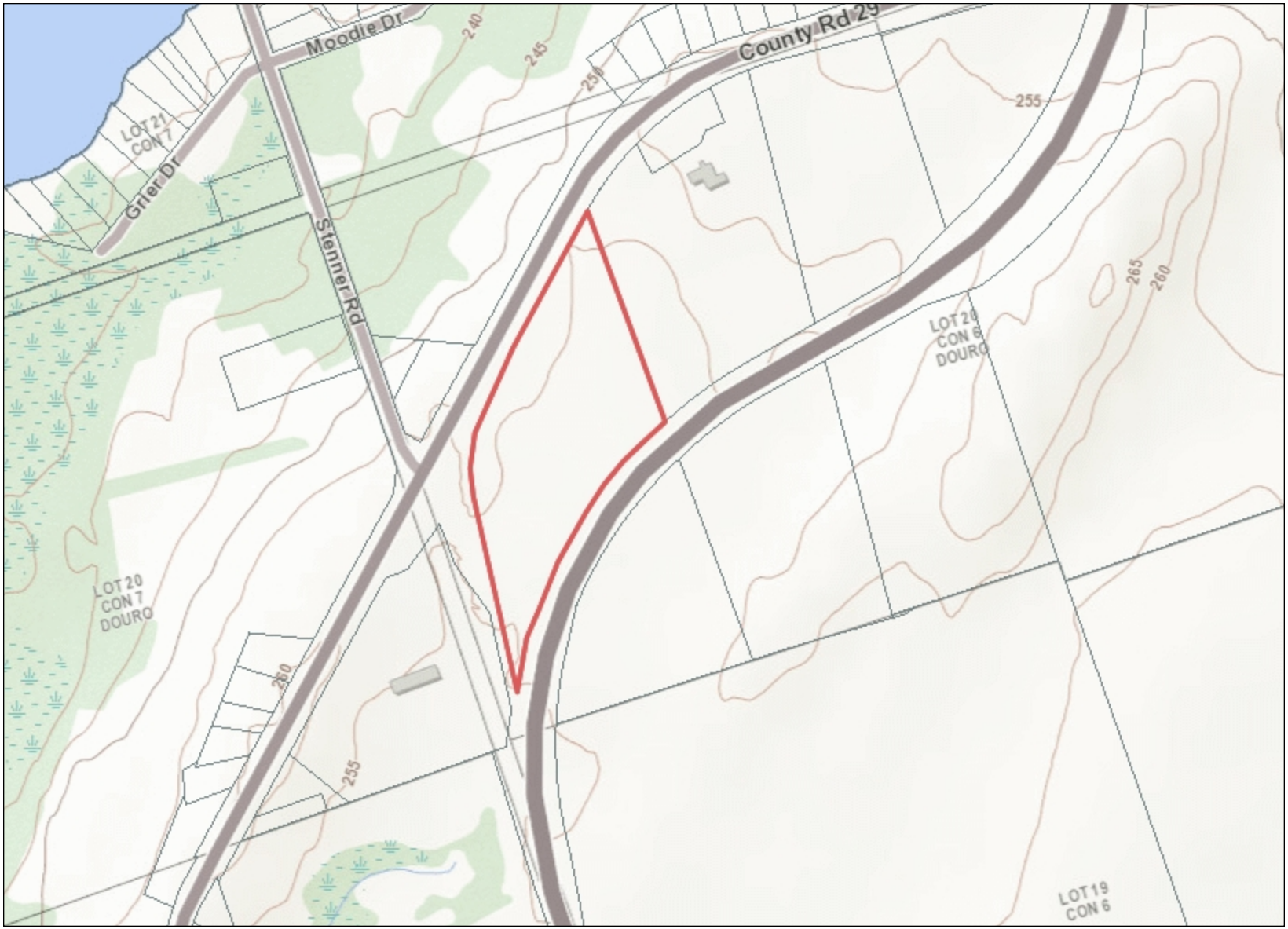
Ontario

MINISTRY OF NATURAL RESOURCES AND FORESTRY

Make a Topographic Map

Topographic Map

Notes:



Legend

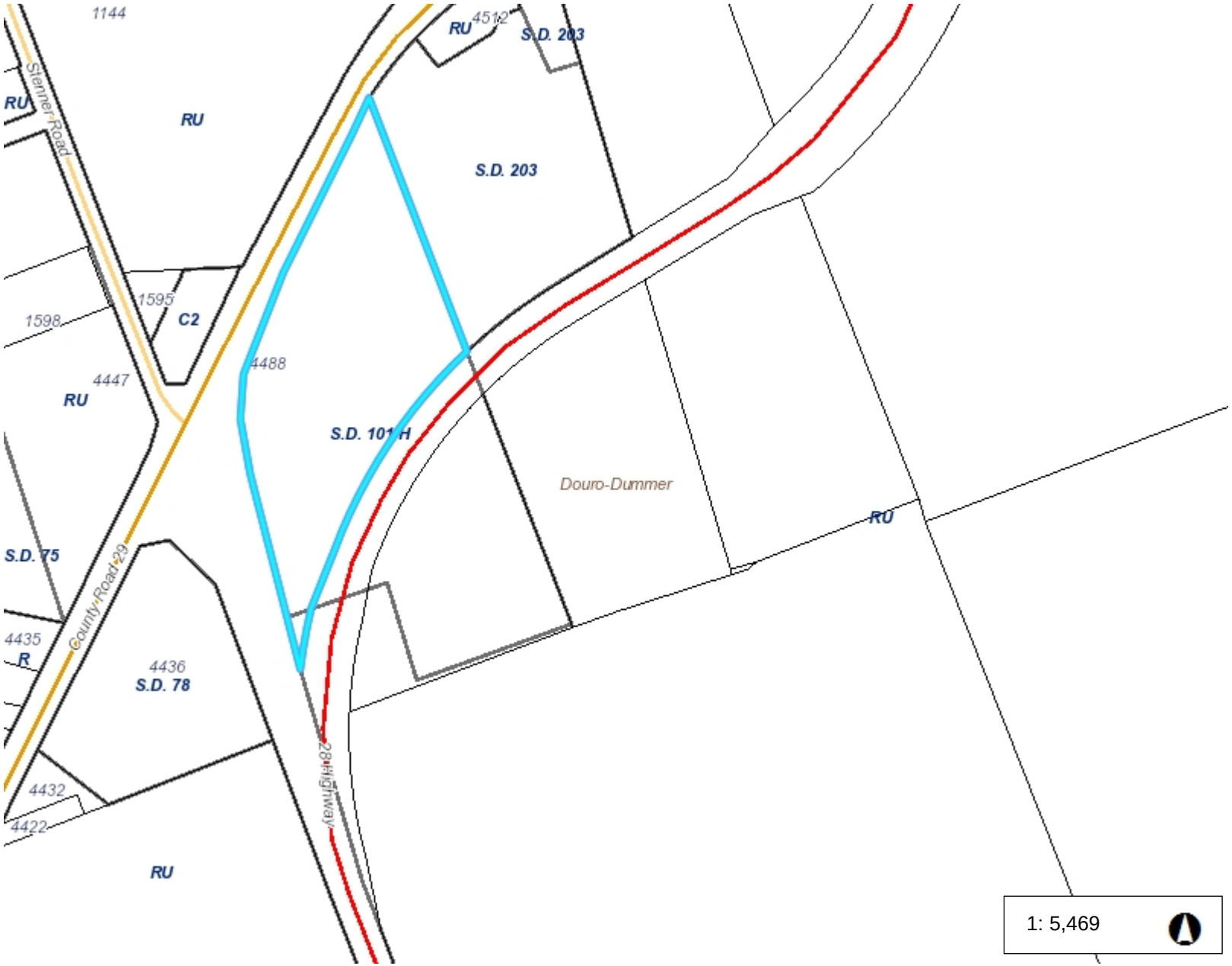
- Building as Symbol
- Building to Scale
- Airport
- Heliport \ Hospital Heliport
- Seaplane Base
- Ferry Route
- Trail
- Bruce Trail
- Greenbelt Route
- Rideau Trail
- Trans Canada Trail
- Voyageur Trail
- Waterfront Trail
- Railway \ Train Station
- Railway with Bridge
- Railway with Tunnel
- Road (Major → Minor)
- Winter Road
- Road with Bridge
- Road with Tunnel
- Primary, Kings or 400 Series Highway
- Secondary Highway
- Tertiary Highway
- District, County, Regional or Municipal Road
- Toll Highway
- One Way Road
- Road with Permanent Blocked Passage
- Road with Address Ranges
- Hydro Line, Communication Line or Unknown Transmission Line
- Natural Gas Pipeline, Water Pipeline or Unknown Pipeline
- Spot Height
- Index Contour
- Contour
- Wooded Area
- Wetland
- Waterbody
- Waterbody Elevation
- Watercourse
- Falls
- Rapids
- Rapids \ Falls
- Rapids
- Rocks
- Lock Gate
- Dam \ Hydro Wall
- Dam \ Hydro Wall
- Provincial \ State Boundary
- International Boundary
- Upper Tier \ District Municipal Boundary
- Lower Tier \ Single Tier Municipal Boundary
- Lot Line
- Indian Reserve
- Provincial Park
- National Park
- Conservation Reserve
- Military Lands

0 0.3 km

Projection: Web Mercator

County of Peterborough

County of Peterborough - Zoning Map



Legend

Roads < 50,000

- PRIV ; Private; PRIV
- City Arterial
- City Collector and Local
- City Owned Unclassified
- Provincial
- County
- Township
- Water Access Only

Outside Roads < 50,000

- Major Roads
- Local Roads

Civic Address

Parcel Fabric

DD Zoning Bylaws

Lakes - Local Scale

Municipal Boundary - Upper Ti

- <all other values>
- COUNTY OF PETERBOROUGH

Municipal Boundary - Single Ti

1: 5,469

Notes

277.8 0 138.91 277.8 Meters

NAD83_CSRS98_UTM_zone_17N

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.
THIS MAP IS NOT TO BE USED FOR NAVIGATION

Appendix B
Test Pit Logs

4488 County Road 29, Douro-Dummer, Ontario
Cambium Reference: 18842-001
October 25, 2023
Technician: J. Munro

TABLE 1: TEST PIT LOGS

Test Pit ID & Location	Depth (mbgs[1])	Material Description	Sample
TP 101-23	0 - 0.30	Topsoil	
	0.30 - 0.66	Brown, sandy silt, some clay, trace gravel, loose, dry	GS1
	0.66 - 1.98	Brown, sandy silty gravel, trace clay, loose, dry	
	1.98	TP terminated on bedrock	GS2
TP 102-23	0 - 0.28	Topsoil	
	0.28 - 0.64	Red/brown, sandy silt, some clay, trace gravel, loose, dry	GS1
	0.64 - 2.51	Brown, sandy silty gravel, trace clay, trace cobble, loose, dry	GS2
	2.51	TP terminated on bedrock	
TP103-23	0 - 0.25	Topsoil	
	0.25 - 0.56	Red/brown, sandy silt, some clay, trace gravel, loose, dry	GS1
	0.56 - 1.78	Brown, ,sandy silty gravel, trace clay, trace cobble, loose, moist	GS2
	1.78	TP terminated on bedrock	
TP104-23	0 - 0.30	Topsoil	
	0.30 - 0.86	Red/brown ,sandy silt, some clay, trace gravel, loose, dry	GS1
	0.86 - 1.47	Brown, gravelly sand, trace cobble, loose, dry	GS2
	1.47	TP terminated on bedrock	
TP105-23	0 - 0.20	Topsoil	
	0.20 - 0.38	Red/brown sandy silt, some clay, loose, dry	GS1
	0.38 - 1.22	Shale	
	1.22	TP terminated on bedrock	
TP106-23	0 - 0.25	Topsoil	
	0.25 - 0.56	Yellow/brown, sand, trace silt, loose, dry	GS1
	0.56 - 1.02	Brown grey, sandy silty gravel, trace clay, loose, dry	GS2
	1.02 - 1.47	Shale	
	1.47	TP terminated on bedrock	

[1]mbgs = metres below ground surface

Appendix C
Grain Size Analysis

Grain Size Distribution Chart

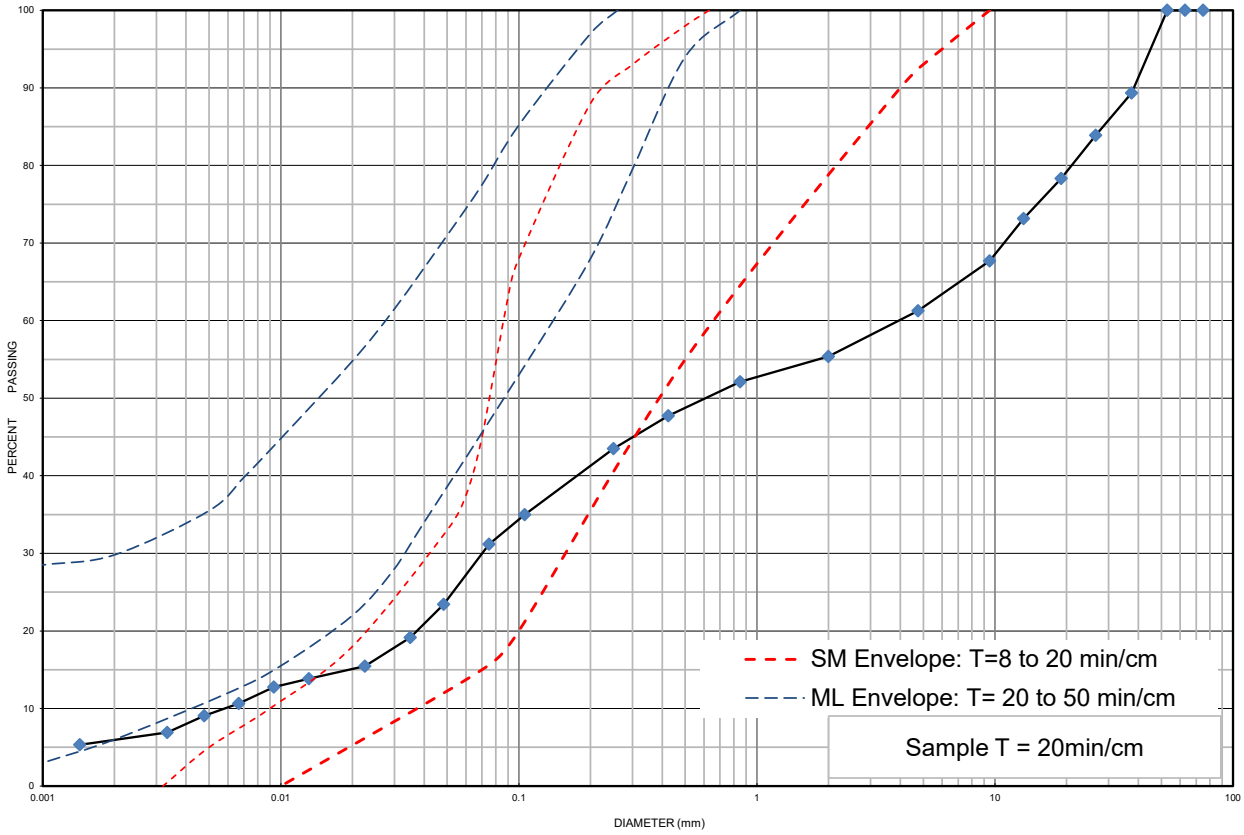
Project Number: *18842-001* **Client:** *Kawartha Utility Services Ltd*

Project Name: *HydroG Assessment - 4488 County Rd 29, Douro-Dummer*

Sample Date: *August 4, 2023* **Sampled By:** *Josh Munro - Cambium Inc.*

Location: *TP102-23 GS2* **Depth:** *0.6 m to 2.5 m* **Lab Sample No:** *S-23-1780*

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
TP102-23	GS2	0.6 m to 2.5 m	39	30	25	6	6.5

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy, Silty Gravel, trace Clay	SM	4.00	0.070	0.006	666.67	0.20

Additional information availabe upon request

Issued By: _____ *Date Issued:* *November 3, 2023*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Grain Size Distribution Chart

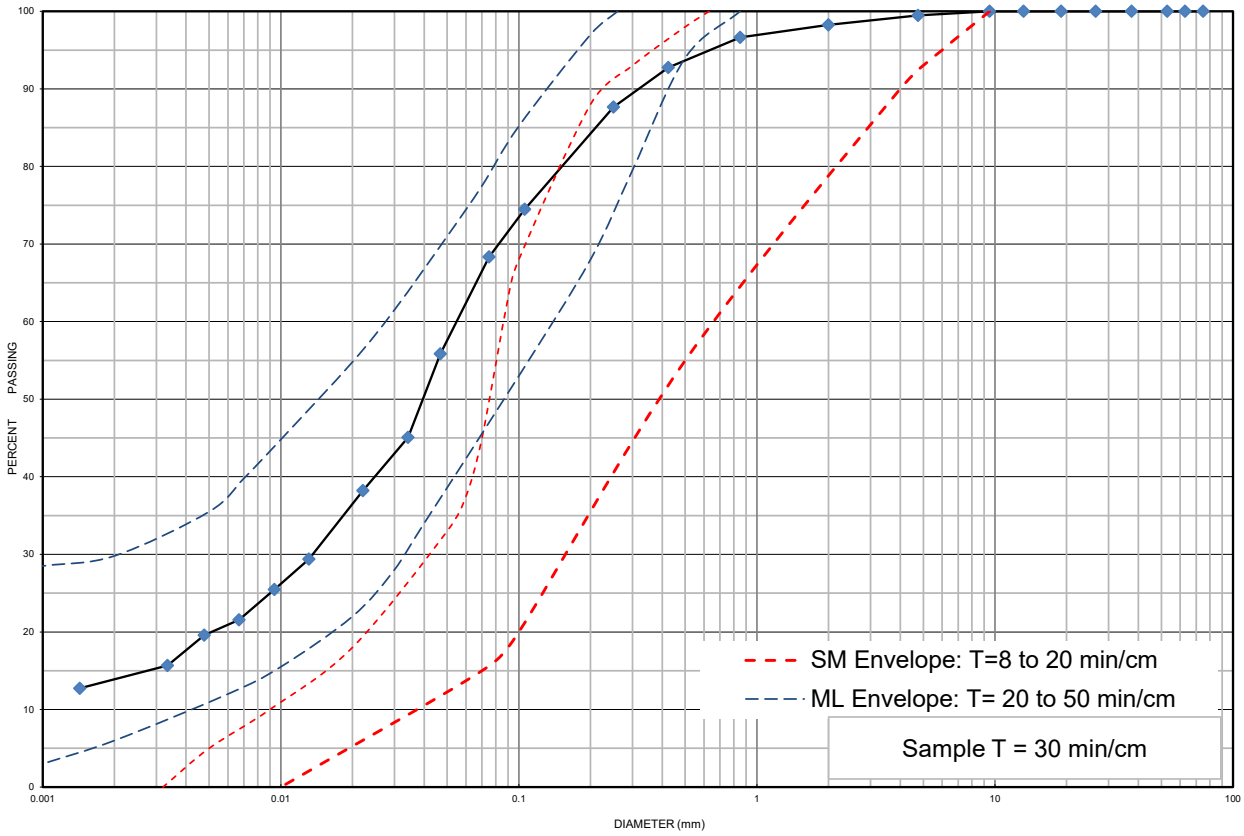
Project Number: *18842-001* **Client:** *Kawartha Utility Services Ltd*

Project Name: *HydroG Assessment - 4488 County Rd 29, Douro-Dummer*

Sample Date: *August 4, 2023* **Sampled By:** *Josh Munro - Cambium Inc.*

Location: *TP104-23 GS1* **Depth:** *0.3 m to 0.8 m* **Lab Sample No:** *S-23-1781*

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
TP104-23	GS1	0.3 m to 0.8 m	1	31	54	14	9.8

Description	Classification	D_{60}	D_{30}	D_{10}	C_u	C_c
Sandy Silt, some Clay, trace Gravel	ML	0.06	0.014	-	-	-

Additional information availabe upon request

Issued By: _____ *Date Issued:* *November 3, 2023*

(Senior Project Manager)

Cambium Inc. (Laboratory)
866.217.7900 | cambium-inc.com
194 Sophia St. | Peterborough | ON | K9H 1E5

Appendix D
Infiltration Testing Calculations

4488 County Road 29, Douro-Dummer, Ontario
Cambium Reference: 18842-001
October 25, 2023
Technician: J. Munro

Location	GP101-23				Location	GP102-23				GP103-23			
GPS Coord					GPS Coord								
Soil	Fine sand, trace silt, trace gravel				Soil	Gravelly sand				Fine sand, trace silt			
Depth	0.65 m		0.65 m		Depth	0.67m		0.67m		0.46 m		0.46 m	
Inner/Dual	Inner		Inner		Inner/Dual	Inner		Inner		Inner		Inner	
	Head	4cm	Head	8cm		Head	3cm	Head	6cm	Head	3cm	Head	6cm
Time (min)	Level	Δh/Δt cm/min	Level	Δh/Δt cm/min	**Time (min)**	Level	Δh/Δt cm/min	Level	Δh/Δt cm/min	Level	Δh/Δt cm/min	Level	Δh/Δt cm/min
0	5		4		0	15		5.5		14		21.5	
1	10.1	5.1	7.3	3.3	1	17.3	2.3	7.4	1.9	14.9	0.9	22	0.5
2	14.5	4.4	12.3	5	2	19	1.7	10.6	3.2	15.4	0.5	22.6	0.6
3	19	4.5	15.7	3.4	3	21.8	2.8	13.9	3.3	15.7	0.3	23.2	0.6
4	23	4	18	2.3	4	24.4	2.6	17	3.1	15.9	0.2	23.9	0.7
5	26.4	3.4	20.1	2.1	5	26.5	2.1	20	3	16.1	0.2	24.6	0.7
6	30.1	3.7	22.2	2.1	6	28.6	2.1	22.8	2.8	16.3	0.2	25.2	0.6
7	33.8	3.7	25.8	3.6	7	30.7	2.1	25.4	2.6	16.6	0.3	25.8	0.6
8	37	3.2	29.1	3.3	8	32.7	2	28.2	2.8	17	0.4	26.6	0.8
9	40.4	3.4	32.1	3	9	35.1	2.4	30.9	2.7	17.3	0.3	27.3	0.7
10	43.6	3.2	35.3	3.2	10	37.3	2.2	33.6	2.7	17.6	0.3	28	0.7
11	46.8	3.2	38.4	3.1	11	39.5	2.2	37.4	3.8	17.9	0.3	28.7	0.7
12	49.6	2.8	41.1	2.7	12	41.7	2.2	40.1	2.7	18.1	0.2	29.4	0.7
13	52.6	3	44	2.9	13	43.9	2.2	43	2.9	18.4	0.3	30	0.6
14	55.5	2.9	46.7	2.7	14	45.9	2	45.7	2.7	18.7	0.3	30.6	0.6
15	58.3	2.8	49	2.3	15	48	2.1	48.3	2.6	19	0.3	31.3	0.7
16	61.3	3	51.5	2.5	16	50	2	51	2.7	19.2	0.2	32	0.7
17	64.2	2.9	54	2.5	17	52.2	2.2	53.8	2.8	19.5	0.3	32.7	0.7
18	66.7	2.5	56.3	2.3	18	54.3	2.1	56.6	2.8	19.8	0.3	33.4	0.7
19	69.2	2.5	58.5	2.2	19	56.2	1.9	59.4	2.8	20.1	0.3	34	0.6
20	71.7	2.5	60.6	2.1	20	58.4	2.2	62.2	2.8	20.4	0.3	34.6	0.6
21	74.2	2.5	62.6	2	21	60.4	2	65	2.8	20.6	0.2	35.3	0.7
22	76.7	2.5	64.6	2	22	62.4	2	67.7	2.7	20.9	0.3	36	0.7
23			66.6	2	23	64.4	2	70.4	2.7	21.2	0.3	36.7	0.7
24			68.6	2	24	66.5	2.1	73.1	2.7	21.5	0.3	37.4	0.7
25			70.6	2	25	68.6	2.1	75.8	2.7	21.8	0.3	38.1	0.7
26			72.6	2	26	70.7	2.1			22.1	0.3	38.7	0.6
27			74.6	2	27	72.8	2.1			22.3	0.2	39.4	0.7
28					28	74.9	2.1			22.6	0.3	40.1	0.7
29					29					22.9	0.3	40.8	0.7
30					30					23.2	0.3		
Slope (cm/min)	2.75		2.14			2.07		2.74		0.27		0.67	
Single Head K (m/sec)	2.06E-06		1.00E-06			3.34E-06		2.52E-06		2.36E-07		3.89E-07	
Average Single Head K	1.53E-06					2.93E-06				3.13E-07			
Infiltration Rate (mm/hr)	**56.0**		**46.3**			**63.7**		**59.1**		**31.6**		**36.0**	
	Geomean		50.9			Geomean		61.3		Geomean		33.7	
Infiltration Rate (mm/hr)	**52**					**61**				**34**			
Percolation Time (min/cm)	**12**					**10**				**18**			

Guelph Permeameter Calculations

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): **2.16**

Enter water Head Height ("H" in cm): **4**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **2.7500**

Res Type	2.16	
H	4	
a	3	
		α^*= **0.12** cm^{-1}
H/a	1.333	
a*	0.12	
		C = **0.685985**
C0.01	0.705	Q = **0.099**
C0.04	0.73	
C0.12	0.686	K_{fs} = **2.06E-04** *cm/sec*
C0.36	0.686	**1.24E-02** *cm/min*
C	0.686	**2.06E-06** *m/sec*
R	2.750	**4.87E-03** *inch/min*
Q	0.099	**8.12E-05** *inch/sec*
pi	3.142	
		Φ_m = **1.72E-03** cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): **2.16**

Enter water Head Height ("H" in cm): **8**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

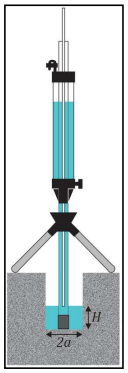
Steady State Rate of Water Level Change ("R" in cm/min): **2.1400**

Res Type	2.16	
H	8	
a	3	
		α^*= **0.12** cm^{-1}
H/a	2.66667	
a*	0.12	
		C = **1.109993**
C0.01	1.07227	Q = **0.07704**
C0.04	1.1283	
C0.12	1.10999	K_{fs} = **1.00E-04** *cm/sec*
C0.36	1.10999	**6.02E-03** *cm/min*
C	1.10999	**1.00E-06** *m/ses*
R	2.140	**2.37E-03** *inch/min*
Q	0.07704	**3.95E-05** *inch/sec*
pi	3.1415	
		Φ_m = **8.36E-04** cm^2/min

Average

K_{fs} = **1.53E-04** *cm/sec*
9.20E-03 *cm/min*
1.53E-06 *m/s*
3.62E-03 *inch/min*
6.03E-05 *inch/sec*

Φ_m = **1.28E-03** cm^2/min



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where $\bar{R}$ is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Guelph Permeameter Calculations

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): **2.16**

Enter water Head Height ("H" in cm): **3**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **4**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **2.0700**

Res Type	2.16		
H	3		
a	3	α*=	0.36 cm^{-1}
H/a	1		
a*	0.36	C =	0.558165
C0.01	0.588	Q =	0.07452
C0.04	0.606		
C0.12	0.558	K_{fs} =	3.34E-04 cm/sec
C0.36	0.558		2.00E-02 cm/min
C	0.558		3.34E-06 m/sec
R	2.070		7.88E-03 inch/min
Q	0.075		1.31E-04 inch/sec
pi	3.142		
		Φ_m =	9.27E-04 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): **2.16**

Enter water Head Height ("H" in cm): **6**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **4**

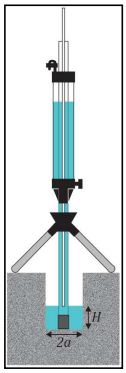
1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **2.7400**

Res Type	2.16		
H	6		
a	3	α*=	0.36 cm^{-1}
H/a	2		
a*	0.36	C =	0.911966
C0.01	0.90429	Q =	0.09864
C0.04	0.94462		
C0.12	0.91197	K_{fs} =	2.52E-04 cm/sec
C0.36	0.91197		1.51E-02 cm/min
C	0.91197		2.52E-06 m/ses
R	2.740		5.96E-03 inch/min
Q	0.09864		9.93E-05 inch/sec
pi	3.1415		
		Φ_m =	7.01E-04 cm^2/min

Average

K_{fs} =	2.93E-04	cm/sec
	1.76E-02	cm/min
	2.93E-06	m/s
	6.92E-03	inch/min
	1.15E-04	inch/sec
Φ_m =	8.14E-04	cm^2/min



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	α^*(cm^{-1})	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where $\bar{R}$ is steady-state rate of fall of water in reservoi (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillar length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is th second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Guelph Permeameter Calculations

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): **2.16**

Enter water Head Height ("H" in cm): **3**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **0.2700**

Res Type	2.16
H	3
a	3
H/a	1
a*	0.12
C0.01	0.588
C0.04	0.606
C0.12	0.558
C0.36	0.558
C	0.558
R	0.270
Q	0.01
pi	3.142

α^*= **0.12** cm^{-1}

C = **0.558165**

Q = **0.00972**

K_{fs} =	2.36E-05	cm/sec
	1.42E-03	cm/min
	2.36E-07	m/sec
	5.59E-04	inch/min
	9.31E-06	inch/sec

Φ_m = **1.97E-04** cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2

(enter "35.22" for Combined and "2.16" for Inner reservoir): **2.16**

Enter water Head Height ("H" in cm): **6**

Enter the Borehole Radius ("a" in cm): **3**

Enter the soil texture-structure category (enter one of the below numbers): **3**

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): **0.6700**

Res Type	2.16
H	6
a	3
H/a	2
a*	0.12
C0.01	0.90429
C0.04	0.94462
C0.12	0.91197
C0.36	0.91197
C	0.91197
R	0.670
Q	0.02412
pi	3.1415

α^*= **0.12** cm^{-1}

C = **0.911966**

Q = **0.02412**

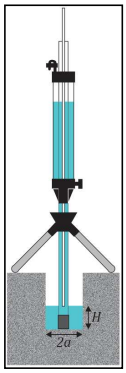
K_{fs} =	3.89E-05	cm/sec
	2.33E-03	cm/min
	3.89E-07	m/ses
	9.18E-04	inch/min
	1.53E-05	inch/sec

Φ_m = **3.24E-04** cm^2/min

Average

K_{fs} =	3.13E-05	cm/sec
	1.88E-03	cm/min
	3.13E-07	m/s
	7.38E-04	inch/min
	1.23E-05	inch/sec

Φ_m = **2.60E-04** cm^2/min



Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where $\bar{R}$ is steady-state rate of fall of water in reservoi (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillar length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is th second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi\left(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1)\right)}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Appendix E

Test Well Record

Ontario — Ministry of the Environment, Conservation and Parks

Well Record

Regulation 903 Ontario Water Resources Act

Well Tag No. (Place Sticker and/or Print Below): Tag# A366720

Page 1 of 1

Measurements recorded in: ☐ Metric ☑ Imperial

Well Owner's Information

First Name: KAWARTHA UTILITY — Last Name/Organization: SERVICES LTD — E-mail Address: — ☐ Well Owner's Information same as Well Location

Mailing Address (Street Number/Name): 4108 HWY 28 — Municipality: LAKEFIELD — Province: ONT — Postal Code: K0L2H0 — Telephone No. (inc. area code):

Well Location

Address of Well Location (Street Number/Name): 4488 County rd 29 — Township: Selwyn — Lot: — Concession:

County/District/Municipality: Peterborough — City/Town/Village: Lakefield — Province: Ontario — Postal Code: K0L2H0

UTM Coordinates Zone: 17 — Easting: 718156 — Northing: 4923064 — NAD 8 3 — Municipal Plan and Suitable Number: — Other:

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	To
Brown	Sand/Stones		Packed	0	6
grey	Shale			6	8
grey	Limestone		Fractured	8	120

Annular Space

Depth Set at (m/ft) From	To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	20	3/8" Bentonite Chip	6 Bags

Method of Construction

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

Well Use

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

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From	To
6¼"	Steel	.188	+3	20'

Construction Record - Screen

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

Status of Well

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

Water Details

Water found at Depth (m/ft)	Kind of Water	Fresh	Untested	Gas	Other, specify
40'		☐	☐	☐	
		☐	☐	☐	
		☐	☐	☐	

Hole Diameter

Depth (m/ft) From	To	Diameter (cm/in)
0	20'	10"
0	120'	6"

Results of Well Yield Testing

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

If pumping discontinued, give reason:

Pump intake set at (m/ft): 120'

Pumping rate (l/min / GPM): 3 gpm

Duration of pumping: 1 hrs + min

Final water level end of pumping (m/ft): 90'

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

Recommended pump depth (m/ft): 115'

Recommended pump rate (l/min/GPM): 3 gpm

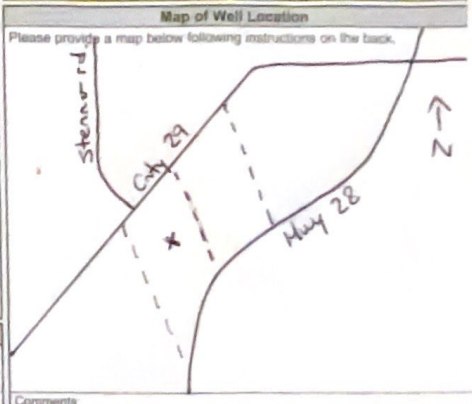
Well production (l/min/GPM): 2.05 gpm

Disinfected? ☑ Yes ☐ No

Draw Down Time (min)	Water Level (m/ft)	Recovery Time (min)	Water Level (m/ft)
Static Level	37'		
1	40	1	89'
2		2	89
3		3	88
4		4	88
5	45'	5	87
10	48'	10	85'
15	50'	15	83'6"
20	53'	20	80'
25	55'	25	78'
30	57'	30	75'
40	62'	40	68'
50	80'	50	59'
60	90'	60	41'

Map of Well Location

Please provide a map below following instructions on the back.



Comments:

Well Contractor and Well Technician Information

Business Name of Well Contractor: Burgess Well Drilling — Well Contractor's Licence No.: 1455

Business Address (Street Number/Name): 467 Emily Park rd — Municipality: Omemee

Province: Ontario — Postal Code: K0L2W0 — Business E-mail Address:

Bus. Telephone No. (inc. area code): — Name of Well Technician (Last Name, First Name): Davidson-Clark, John-Robert

Well Technician's Licence No.: 4606 — Signature of Technician and/or Contractor: — Date Submitted: 20231102

Well owner's information package delivered: ☑ Yes ☐ No — Date Package Delivered: 20231102

Date Work Completed: 20231102

Ministry Use Only — Audit No: Z399842

0506E (2020/06) © Queen's Printer for Ontario, 2020

Ministry's Copy

Appendix F
Water Quality Results

FINAL REPORT

CA14559-NOV23 R

98842.001, 4488 County Road 29

Prepared for

Cambium Inc.

FINAL REPORT

CA14559-NOV23 R

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Cambium Inc.	Project Specialist	Brad Moore Hon. B.Sc
		Laboratory	SGS Canada Inc.
Address	52 Hunter Street East Peterborough, ON K9H 1G5. Canada	Address	185 Concession St., Lakefield ON, K0L 2H0
Contact	Jeremy Tracey	Telephone	705-652-2143
Telephone	705-742-7900	Facsimile	705-652-6365
Facsimile	705-742-7907	Email	brad.moore@sgs.com
Email	jeremy.tracey@cambium-inc.com; file@cambium-inc.com; ESd	SGS Reference	CA14559-NOV23
Project	98842.001, 4488 County Road 29	Received	11/16/2023
Order Number		Approved	11/23/2023
Samples	Ground Water (1)	Report Number	CA14559-NOV23 R
		Date Reported	11/23/2023

COMMENTS

Note: Unionized ammonia calculated using lab results for pH and temperature.

NDOGHPC - No Data: Overgrown with HPC

SIGNATORIES

Brad Moore Hon. B.Sc

TABLE OF CONTENTS

FINAL REPORT

CA14559-NOV23 R

Client: Cambium Inc.
Project: 98842.001, 4488 County Road 29
Project Manager: Jeremy Tracey
Samplers: Josh Munro

MATRIX: WATER

L1 = ODWS_AO / WATER / - - Table 4 - Drinking Water - Reg O.169_03

L2 = ODWS_MAC / WATER / - - Table 1,2 and 3 - Drinking Water - Reg O.169_03

Sample Number	6
Sample Name	Test Well
Sample Matrix	Ground Water
Sample Date	16/11/2023

Parameter	Units	RL	L1	L2	Result
General Chemistry					
Alkalinity	mg/L as CaCO3	2			307
Colour	TCU	3	5		4
Conductivity	uS/cm	2			1070
Temperature @ pH	°C	0			23.3
Total Suspended Solids	mg/L	2			< 2
Turbidity	NTU	0.10	5	1	0.30
UV Transmittance	%T				96.8
Dissolved Organic Carbon	mg/L	1	5		< 1
Total Organic Carbon	mg/L	1			< 1
Ammonia+Ammonium (N)	as N mg/L	0.04			0.48
Organic Nitrogen	mg/L	0.05			0.12
Total Kjeldahl Nitrogen (N)	as N mg/L	0.05			0.60
Metals and Inorganics					
Sulphate	mg/L	0.04	500		13
Nitrite (as N)	as N mg/L	0.003		1	< 0.003
Nitrate (as N)	as N mg/L	0.006		10	< 0.006
Nitrate + Nitrite (as N)	as N mg/L	0.006			< 0.006
Hardness (dissolved)	mg/L as CaCO3	0.05			221
Antimony (dissolved)	mg/L	0.0009		0.006	< 0.0009
Arsenic (dissolved)	mg/L	0.0002		0.01	< 0.0002
Barium (dissolved)	mg/L	0.00008		1	0.0673
Beryllium (dissolved)	mg/L	0.000007			< 0.000007

FINAL REPORT

CA14559-NOV23 R

Client: Cambium Inc.
Project: 98842.001, 4488 County Road 29
Project Manager: Jeremy Tracey
Samplers: Josh Munro

MATRIX: WATER

Sample Number	6
Sample Name	Test Well
Sample Matrix	Ground Water
Sample Date	16/11/2023

L1 = ODWS_AO / WATER / - - Table 4 - Drinking Water - Reg O.169_03

L2 = ODWS_MAC / WATER / - - Table 1,2 and 3 - Drinking Water - Reg O.169_03

Metals and Inorganics (continued)

Parameter	Units	RL	L1	L2	Result
Boron (dissolved)	mg/L	0.002		5	0.700
Cadmium (dissolved)	mg/L	0.000003		0.005	< 0.000003
Calcium (dissolved)	mg/L	0.01			56.1
Chromium (dissolved)	mg/L	0.00008		0.05	< 0.00008
Cobalt (dissolved)	mg/L	0.000004			0.000420
Copper (dissolved)	mg/L	0.0002	1		0.0048
Iron (dissolved)	mg/L	0.007	0.3		0.007
Lead (dissolved)	mg/L	0.00009		0.01	< 0.00009
Magnesium (dissolved)	mg/L	0.001			19.7
Manganese (dissolved)	mg/L	0.00001	0.05		0.0143
Molybdenum (dissolved)	mg/L	0.00004			0.00228
Nickel (dissolved)	mg/L	0.0001			0.0022
Phosphorus (dissolved)	mg/L	0.003			< 0.003
Potassium (dissolved)	mg/L	0.009			5.85
Selenium (dissolved)	mg/L	0.00004		0.05	0.00010
Silver (dissolved)	mg/L	0.00005			< 0.00005
Sodium (dissolved)	mg/L	0.01	200	20	126
Strontium (dissolved)	mg/L	0.00008			1.85
Thallium (dissolved)	mg/L	0.000005			0.000020
Tin (dissolved)	mg/L	0.00006			< 0.00006
Titanium (dissolved)	mg/L	0.00007			0.00017
Uranium (dissolved)	mg/L	0.000002		0.02	0.000661

FINAL REPORT

CA14559-NOV23 R

Client: Cambium Inc.
Project: 98842.001, 4488 County Road 29
Project Manager: Jeremy Tracey
Samplers: Josh Munro

MATRIX: WATER

L1 = ODWS_AO / WATER / - - Table 4 - Drinking Water - Reg O.169_03

L2 = ODWS_MAC / WATER / - - Table 1,2 and 3 - Drinking Water - Reg O.169_03

Sample Number	6
Sample Name	Test Well
Sample Matrix	Ground Water
Sample Date	16/11/2023

Parameter	Units	RL	L1	L2	Result
Metals and Inorganics (continued)					
Vanadium (dissolved)	mg/L	0.00001			0.00029
Zinc (dissolved)	mg/L	0.002	5		0.007
Cation sum	meq/L	-9999			10.13
Anion Sum	meq/L	-9999			10.89
Anion-Cation Balance	% difference	-9999			-3.61
Ion Ratio	none	-9999			0.93
Total Dissolved Solids (calculated)	mg/L	-9999			564
Conductivity (calculated)	uS/cm	-9999			1051
Saturation pH 4°C	pHs @ 4°C	-9999			7.75
Langeliers Index 4° C	@ 4° C	-9999			0.34
Microbiology					
Total Coliform	cfu/100mL	0		0	0
E. Coli	cfu/100mL	0		0	0
Heterotrophic Plate Count (HPC)	cfu/1mL	0			#NDOGHPC

FINAL REPORT

CA14559-NOV23 R

Client: Cambium Inc.
Project: 98842.001, 4488 County Road 29
Project Manager: Jeremy Tracey
Samplers: Josh Munro

MATRIX: WATER

L1 = ODWS_AO / WATER / - - Table 4 - Drinking Water - Reg O.169_03

L2 = ODWS_MAC / WATER / - - Table 1,2 and 3 - Drinking Water - Reg O.169_03

Sample Number	6
Sample Name	Test Well
Sample Matrix	Ground Water
Sample Date	16/11/2023

Parameter	Units	RL	L1	L2	Result
Other (ORP)					
pH	No unit	0.05			8.09
Chloride	mg/L	0.04	250		160
Mercury (total)	mg/L	0.00001			< 0.00001

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	ODWS_AO / WATER / - - Table 4 - Drinking Water - Reg O.169_03 L1	ODWS_MAC / WATER / - - Table 1,2 and 3 - Drinking Water - Reg O.169_03 L2
Test Well					
Sodium (dissolved)	SM 3030/EPA 200.8	mg/L	126		20

FINAL REPORT

QC SUMMARY

Alkalinity

Method: SM 2320 I Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Alkalinity	EWL0434-NOV23	mg/L as CaCO3	2	< 2	0	20	100	80	120	NA		

Ammonia by SFA

Method: SM 4500 I Internal ref.: ME-CA-IENVISFA-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Ammonia+Ammonium (N)	SKA0170-NOV23	mg/L	0.04	0.05	0	10	96	90	110	102	75	125

FINAL REPORT

QC SUMMARY

Anions by IC

Method: EPA300/MA300-Ions1.3 | Internal ref.: ME-CA-IENVIIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Nitrate + Nitrite (as N)	DIO0635-NOV23	mg/L	0.006	<0.006	NA		NA			NA		
Nitrite (as N)	DIO0635-NOV23	mg/L	0.003	<0.003	ND	20	102	90	110	98	75	125
Nitrate (as N)	DIO0635-NOV23	mg/L	0.006	<0.006	ND	20	100	90	110	99	75	125
Chloride	DIO0700-NOV23	mg/L	0.04	<0.04	0	20	99	90	110	103	75	125
Sulphate	DIO0700-NOV23	mg/L	0.04	<0.04	0	20	100	90	110	99	75	125

Carbon by SFA

Method: SM 5310 | Internal ref.: ME-CA-IENVISFA-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Dissolved Organic Carbon	SKA0186-NOV23	mg/L	1	<1	ND	10	95	90	110	78	75	125
Total Organic Carbon	SKA0186-NOV23	mg/L	1	<1	ND	10	95	90	110	78	75	125

QC SUMMARY

Colour

Method: SM 2120 I Internal ref.: ME-CA-IENVIEWL-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Colour	EWL0467-NOV23	TCU	3	< 3	0	10	95	80	120	NA		

Conductivity

Method: SM 2510 I Internal ref.: ME-CA-IENVIEWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Conductivity	EWL0434-NOV23	uS/cm	2	< 2	1	20	98	90	110	NA		

Mercury by CVAAS

Method: EPA 7471A/SM 3112B I Internal ref.: ME-CA-IENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0034-NOV23	mg/L	0.00001	< 0.00001	ND	20	89	80	120	96	70	130

FINAL REPORT

QC SUMMARY

Metals in aqueous samples - ICP-MS

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (dissolved)	EMS0162-NOV23	mg/L	0.00005	<0.00005	ND	20	102	90	110	84	70	130
Arsenic (dissolved)	EMS0162-NOV23	mg/L	0.0002	<0.0002	1	20	101	90	110	100	70	130
Barium (dissolved)	EMS0162-NOV23	mg/L	0.00008	<0.00008	1	20	101	90	110	100	70	130
Beryllium (dissolved)	EMS0162-NOV23	mg/L	0.000007	<0.000007	ND	20	100	90	110	97	70	130
Boron (dissolved)	EMS0162-NOV23	mg/L	0.002	<0.002	0	20	101	90	110	103	70	130
Calcium (dissolved)	EMS0162-NOV23	mg/L	0.01	<0.01	1	20	93	90	110	90	70	130
Cadmium (dissolved)	EMS0162-NOV23	mg/L	0.000003	<0.000003	ND	20	103	90	110	106	70	130
Cobalt (dissolved)	EMS0162-NOV23	mg/L	0.000004	<0.000004	6	20	99	90	110	95	70	130
Chromium (dissolved)	EMS0162-NOV23	mg/L	0.00008	<0.00008	0	20	102	90	110	108	70	130
Copper (dissolved)	EMS0162-NOV23	mg/L	0.0002	<0.0002	0	20	100	90	110	92	70	130
Iron (dissolved)	EMS0162-NOV23	mg/L	0.007	<0.007	ND	20	102	90	110	80	70	130
Potassium (dissolved)	EMS0162-NOV23	mg/L	0.009	<0.009	0	20	96	90	110	81	70	130
Magnesium (dissolved)	EMS0162-NOV23	mg/L	0.001	<0.001	2	20	94	90	110	88	70	130
Manganese (dissolved)	EMS0162-NOV23	mg/L	0.00001	<0.00001	1	20	101	90	110	102	70	130
Molybdenum (dissolved)	EMS0162-NOV23	mg/L	0.00004	<0.00004	1	20	100	90	110	84	70	130
Sodium (dissolved)	EMS0162-NOV23	mg/L	0.01	<0.01	2	20	91	90	110	90	70	130
Nickel (dissolved)	EMS0162-NOV23	mg/L	0.0001	<0.0001	5	20	99	90	110	97	70	130
Lead (dissolved)	EMS0162-NOV23	mg/L	0.00009	<0.00009	ND	20	102	90	110	101	70	130
Phosphorus (dissolved)	EMS0162-NOV23	mg/L	0.003	<0.003	0	20	93	90	110	NV	70	130
Antimony (dissolved)	EMS0162-NOV23	mg/L	0.0009	<0.0009	2	20	107	90	110	71	70	130

FINAL REPORT

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-IENVISPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Selenium (dissolved)	EMS0162-NOV23	mg/L	0.00004	<0.00004	4	20	104	90	110	86	70	130
Tin (dissolved)	EMS0162-NOV23	mg/L	0.00006	<0.00006	ND	20	97	90	110	NV	70	130
Strontium (dissolved)	EMS0162-NOV23	mg/L	0.00008	<0.00008	0	20	99	90	110	97	70	130
Titanium (dissolved)	EMS0162-NOV23	mg/L	0.00007	<0.00005	7	20	96	90	110	NV	70	130
Thallium (dissolved)	EMS0162-NOV23	mg/L	0.000005	<0.000005	ND	20	94	90	110	95	70	130
Uranium (dissolved)	EMS0162-NOV23	mg/L	0.000002	<0.000002	8	20	99	90	110	86	70	130
Vanadium (dissolved)	EMS0162-NOV23	mg/L	0.00001	<0.00001	0	20	102	90	110	81	70	130
Zinc (dissolved)	EMS0162-NOV23	mg/L	0.002	<0.002	ND	20	102	90	110	111	70	130

FINAL REPORT

QC SUMMARY

Microbiology

Method: OMOE MICROMFDC-E3407A | Internal ref.: ME-CA-[ENV]MIC-LAK-AN-001

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High
E. Coli	BAC9304-NOV23	cfu/100mL	-	ACCEPTED	ACCEPTED							
Heterotrophic Plate Count (HPC)	BAC9304-NOV23	cfu/1mL	-	ACCEPTED	ACCEPTED							
Total Coliform	BAC9304-NOV23	cfu/100mL	-	ACCEPTED	ACCEPTED							

pH

Method: SM 4500 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High	Spike Recovery (%)	Recovery Limits (%) Low	Recovery Limits (%) High
pH	EWL0434-NOV23	No unit	0.05	NA	1		100			NA		

QC SUMMARY

Suspended Solids

Method: SM 2540D | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0444-NOV23	mg/L	2	< 2	2	10	93	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F | Internal ref.: ME-CA-[ENVISFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen (N)	SKA0187-NOV23	mg/L	0.05	<0.05	1	10	106	90	110	107	75	125

Turbidity

Method: SM 2130 | Internal ref.: ME-CA-[ENVIEWL-LAK-AN-003

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Turbidity	EWL0440-NOV23	NTU	0.10	< 0.10	10	10	100	90	110	NA		

QC SUMMARY

Method Blank: a blank matrix that is carried through the entire analytical procedure. Used to assess laboratory contamination.

Duplicate: Paired analysis of a separate portion of the same sample that is carried through the entire analytical procedure. Used to evaluate measurement precision.

LCS/Spike Blank: Laboratory control sample or spike blank refer to a blank matrix to which a known amount of analyte has been added. Used to evaluate analyte recovery and laboratory accuracy without sample matrix effects.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate laboratory accuracy with sample matrix effects.

Reference Material: a material or substance matrix matched to the samples that contains a known amount of the analyte of interest. A reference material may be used in place of a matrix spike.

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

Multielement Scan Qualifier: as the number of analytes in a scan increases, so does the chance of a limit exceedance by random chance as opposed to a real method problem. Thus, in multielement scans, for the LCS and matrix spike, up to 10% of the analytes may exceed the quoted limits by up to 10% absolute and the spike is considered acceptable.

Duplicate Qualifier: for duplicates as the measured result approaches the RL, the uncertainty associated with the value increases dramatically, thus duplicate acceptance limits apply only where the average of the two duplicates is greater than five times the RL.

Matrix Spike Qualifier: for matrix spikes, as the concentration of the native analyte increases, the uncertainty of the matrix spike recovery increases. Thus, the matrix spike acceptance limits apply only when the concentration of the matrix spike is greater than or equal to the concentration of the native analyte.

LEGEND

FOOTNOTES

NSS	Insufficient sample for analysis.
RL	Reporting Limit.
↑	Reporting limit raised.
↓	Reporting limit lowered.
NA	The sample was not analysed for this analyte
ND	Non Detect

Results relate only to the sample tested.
Data reported represent the sample as submitted to SGS. Solid samples expressed on a dry weight basis.
"Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.
Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the "Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act and Excess Soil Quality" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated.

SGS Canada Inc. statement of conformity decision rule does not consider uncertainty when analytical results are compared to a specified standard or regulation.

This report supersedes all previous versions.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

No: 037647

SGS Industries & Environment - Lakefield: 185 Concession St., Lakefield, ON K0L 2H0 Phone: 705-652-2000 Fax: 705-652-6365 Web: www.sgs.com/environment
- London: 657 Consortium Court, London, ON, N6E 2S8 Phone: 519-672-4500 Toll Free: 877-848-8060 Fax: 519-672-0361

Page ____ of ____

Laboratory Information Section - Lab use only

Received By: ____ Received By (signature): ____
Received Date: NOV 16 2023 (mm/dd/yy) Custody Seal Present: Yes ☑ No ☐ Cooling Agent Present: Yes ☑ No ☐ Type: Ice
Received Time: 18:30 (hr: min) Custody Seal Intact: Yes ☑ No ☐ Temperature Upon Receipt (°C) 14X3 LAB LIMS #: CA14559-NOV21

REPORT INFORMATION

Company: Cambium Inc.
Contact: Jeremy Tracey
Address: 194 Sophia Street, Peterborough, ON
Phone: 705-742-7900
Fax: ____
Email: Jeremy.Tracey@cambium-inc.com

INVOICE INFORMATION

☑ (same as Report Information)
Company: ____
Contact: ____
Address: ____
Phone: ____
Email: ____

Quotation #: 2022 573 P.O. #: ____
Project #: # 18842-001 Site Location/ID: 4488 County Road 29

TURNAROUND TIME (TAT) REQUIRED

☒ Regular TAT (5-7days)
TAT's are quoted in business days (exclude statutory holidays & weekends).
Samples received after 6pm or on weekends: TAT begins next business day

RUSH TAT (Additional Charges May Apply): ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days
PLEASE CONFIRM RUSH FEASIBILITY WITH SGS REPRESENTATIVE PRIOR TO SUBMISSION

Specify Due Date: ____
*NOTE: DRINKING (POTABLE) WATER SAMPLES FOR HUMAN CONSUMPTION MUST BE SUBMITTED WITH SGS DRINKING WATER CHAIN OF CUSTODY

REGULATIONS

☐ O.Reg 153/04 ☐ O.Reg 406/19
☐ Table 1 ☐ Res/Park Soil Texture: ☐ Coarse
☐ Table 2 ☐ Ind/Com ☐ Fine
☐ Table 3 ☐ Agri/Other ☐ Medium/Fine
☐ Table ____ Appx. ____
Soil Volume ☐ <350m3 ☐ >350m3

Other Regulations:
☐ Reg 347/558 (3 Day min TAT)
☐ PWQO ☐ MMER
☐ CCME ☐ Other: ____
☐ MISA ____
☒ ODWS Not Reportable *See note

Sewer By-Law:
☐ Sanitary
☐ Storm
Municipality: ____

RECORD OF SITE CONDITION (RSC) ☐ YES ☐ NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX	Field Filtered (Y/N)	M&I: Metals & Inorganics (incl CrVI, CN, Hg pH,(B(HWS),EC,SAR-soil) (Cl, Na-water)	M&I: Full Metals Suite (ICP metals plus B(HWS-soil only) Hg, CrVI	M&I: ICP Metals only Sb,As,Ba,Be,B,Cd, Cr,Co,Cu,Pb,Mo,Ni,Se,Ag,Tl,U,V,Zn	SVOC: PAHs only	SVOC: SVOCs all incl PAHs, ABNs, CPs	PCB: PCBs Total ☐ Aroclor ☐	PHC: F1-F4 + BTEX	PHC: F1-F4 only no BTEX	VOC: VOCs all incl BTEX	VOC: BTEX only	Pest: Pesticides Organochlorine or specify other	Other: Analytical Quote # 2022 573	Other: * Please omit HAAP-Phenolics	Other: Fluoride, methanol	Other: Tannin + Lignin *	Other: Sewer Use: Specify pkg:	Other: Water Characterization Pkg General ☐ Extended ☐	SPLP: Specify tests	TCLP: Specify tests	COMMENTS:
1	Test well	11-16-23	16:30	16	GW	N												X						☐ Metals ☐ VOC ☐ 1,4-Dioxane ☐ OCP ☐ ABN	☐ M&I ☐ VOC ☐ PCB ☐ B(a)P ☐ ABN ☐ Ignit.	
2																										
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										
11																										
12																										

Observations/Comments/Special Instructions: Please omit HAAP-Phenolics, fluoride, methanol, Tannin + Lignin

Sampled By (NAME): Josh Munro Signature: JM Date: 11/16/23 (mm/dd/yy) Pink Copy - Client
Relinquished by (NAME): Josh Munro Signature: JM Date: 11/16/23 (mm/dd/yy) Yellow & White Copy - SGS

Revision #: 1.7
Date of Issue: 07 JUNE 2023

Appendix G

MECP Well Records

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: 5100691 **Easting:** 718558 **UTM Zone** 17
Construction Date: 1953-09-01 **Northing:** 4925494 **Positional Accuracy:** unknown UTM

Well Depth:	11.3	**Water Kind**	FRESH	**Pump Rate (LPM):**	14
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	
Water First Found:	10.4	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	2 : 0
Static Level:	3				

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	3.05
2	LIMESTONE	3.05	11.3

Well ID: 5100692 **Easting:** 717991 **UTM Zone** 17
Construction Date: 1967-10-16 **Northing:** 4925099 **Positional Accuracy:** margin of error : 100 m - 300 m

Well Depth:	24.4	**Water Kind**	FRESH	**Pump Rate (LPM):**	9
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	9
Water First Found:	5.18	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	2 : 0
Static Level:	4				

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	2.74
3	LIMESTONE	2.74	24.4

Well ID: 5100693 **Easting:** 718442 **UTM Zone** 17
Construction Date: 1952-01-22 **Northing:** 4925571 **Positional Accuracy:** unknown UTM

Well Depth:	15.9	**Water Kind**	FRESH	**Pump Rate (LPM):**	14
Well Diameter (cm):	20.3	**Final Status**	Water Supply	**Recommended Pump Rate:**	
Water First Found:	15.9	**Primary Water Use:**	Domestic	**Pumping Duration (h:m):**	2 : 0
Static Level:	2				

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	1.52
2	LIMESTONE	1.52	15.9

Well ID: 5100694 **Easting:** 718637 **UTM Zone** 17
Construction Date: 1956-01-13 **Northing:** 4925603 **Positional Accuracy:** unknown UTM

Well Depth:	6.71	**Water Kind**	FRESH	**Pump Rate (LPM):**	36
Well Diameter (cm):	15.2	**Final Status**	Water Supply	**Recommended Pump Rate:**	
Water First Found:	6.71	**Primary Water Use:**	Commerical	**Pumping Duration (h:m):**	2 : 0
Static Level:	1				

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61
2	SHALE	0.61	2.44
3	LIMESTONE	2.44	6.71

Well ID: 5100697
Construction Date: 1961-06-12
Easting: 718188
Northing: 4925429
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 15.5
Well Diameter (cm): 15.2
Water First Found: 10.7
Static Level: 4
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 45
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61
2	LIMESTONE	0.61	15.5

Well ID: 5100701
Construction Date: 1964-08-05
Easting: 718269
Northing: 4925486
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 11.3
Well Diameter (cm): 15.2
Water First Found: 8.23
Static Level: 4
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 18
Recommended Pump Rate: 18
Pumping Duration (h:m): 1 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61
2	LIMESTONE	0.61	2.74
3	LIMESTONE	2.74	11.3

Well ID: 5100702
Construction Date: 1964-08-05
Easting: 718257
Northing: 4925470
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 13.4
Well Diameter (cm): 15.2
Water First Found: 9.14
Static Level: 4
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 14
Recommended Pump Rate: 14
Pumping Duration (h:m): 1 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	1.83
3	SHALE	1.83	2.74
4	LIMESTONE	2.74	13.4

Well ID: 5100703
Construction Date: 1965-02-23
Easting: 718478
Northing: 4925572
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 16.5
Well Diameter (cm): 15.2
Water First Found: 13.7
Static Level: 5
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Livestock
Pump Rate (LPM): 5
Recommended Pump Rate: 18
Pumping Duration (h:m): 0 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	1.83
2	LIMESTONE	1.83	5.79
3	LIMESTONE	5.79	16.5

Well ID: 5100704
Construction Date: 1967-01-31
Easting: 718425
Northing: 4925592
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 10.7
Well Diameter (cm): 15.2
Water First Found: 5.18
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): 3 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61
2	CLAY	0.61	5.18
3	SHALE	5.18	5.49
4	LIMESTONE	5.49	10.7

Well ID: 5100705
Construction Date: 1968-01-22
Easting: 717825
Northing: 4925526
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 3.96
Well Diameter (cm): 15.2
Water First Found: 3.96
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): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.91
2	SHALE	0.91	1.52
3	LIMESTONE	1.52	3.96

Well ID: 5100724
Construction Date: 1965-01-21
Easting: 717836
Northing: 4924542
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 21.3
Well Diameter (cm): 15.2
Water First Found: 13.7
Static Level: 8
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 9
Recommended Pump Rate: 9
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	9.14
3	LIMESTONE	9.14	21.3

Well ID: 5100725
Construction Date: 1953-01-09
Easting: 718086
Northing: 4924628
UTM Zone 17
Positional Accuracy: unknown UTM

Well Depth: 19.8
Well Diameter (cm):
Water First Found: 19.8
Static Level: 1
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Livestock
Pump Rate (LPM): 36
Recommended Pump Rate:
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	PREVIOUSLY DUG	0	3.05
1	PREVIOUSLY DUG	0	3.05
2	LIMESTONE	3.05	19.8
2	LIMESTONE	3.05	19.8

Well ID: 5100726
Construction Date: 1962-07-11
Easting: 718063
Northing: 4925235
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 11.6
Well Diameter (cm): 15.2
Water First Found: 11.6
Static Level: 7
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 36
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	10.7
3	GRAVEL	10.7	11.6

Well ID: 5100727
Construction Date: 1963-10-17
Easting: 718250
Northing: 4925360
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 18
Well Diameter (cm): 15.2
Water First Found: 16.8
Static Level: 7
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 27
Recommended Pump Rate: 14
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	10.1
2	LIMESTONE	10.1	18

Well ID: 5100728
Construction Date: 1967-01-31
Easting: 718259
Northing: 4925340
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 24.4
Well Diameter (cm):
Water First Found: 22.9
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 32
Recommended Pump Rate: 18
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	PREV. DRILLED	0	18
1	PREV. DRILLED	0	18
2	LIMESTONE	18	24.4
2	LIMESTONE	18	24.4

Well ID: 5100729
Construction Date: 1954-02-09
Easting: 717772
Northing: 4925530
UTM Zone 17
Positional Accuracy: unknown UTM

Well Depth: 7.32
Well Diameter (cm): 15.2
Water First Found: 7.32
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 18
Recommended Pump Rate:
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	3.05
3	LIMESTONE	3.05	7.32

Well ID: 5100730
Construction Date: 1964-10-19
Easting: 717573
Northing: 4925260
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 11.6
Well Diameter (cm): 15.2
Water First Found: 10.7
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 27
Recommended Pump Rate: 14
Pumping Duration (h:m): 0 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	3.05
2	LIMESTONE	3.05	5.18
3	LIMESTONE	5.18	11.6

Well ID: 5101399
Construction Date: 1963-01-08
Easting: 717851
Northing: 4924744
UTM Zone 17
Positional Accuracy: unknown UTM

Well Depth: 18
Well Diameter (cm): 15.2
Water First Found: 11.6
Static Level: 8
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 23
Recommended Pump Rate: 23
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	PREVIOUSLY DUG	0	11.6
2	LIMESTONE	11.6	18

Well ID: 5104520
Construction Date: 1969-01-21
Easting: 718335
Northing: 4925513
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 27.1
Well Diameter (cm): 15.2
Water First Found: 26.5
Static Level: 4
Water Kind SULPHUR
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 14
Recommended Pump Rate: 14
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61
2	CLAY	0.61	2.44
3	LIMESTONE	2.44	27.1

Well ID: 5104831
Construction Date: 1970-01-29
Easting: 718065
Northing: 4925573
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 13.1
Well Diameter (cm): 15.2
Water First Found: 10.7
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 5
Recommended Pump Rate: 5
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	3.05
3	CLAY	3.05	4.57
4	LIMESTONE	4.57	13.1

Well ID: 5104832
Construction Date: 1970-01-29
Easting: 717965
Northing: 4925523
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 11.6
Well Diameter (cm): 15.2
Water First Found:
Static Level: 2
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 9
Recommended Pump Rate: 9
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	3.05
3	CLAY	3.05	4.88
4	LIMESTONE	4.88	11.6

Well ID: 5104878
Construction Date: 1970-02-02
Easting: 718065
Northing: 4925323
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 12.2
Well Diameter (cm): 15.2
Water First Found: 12.2
Static Level: 4
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 14
Recommended Pump Rate: 14
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
2	CLAY	0.30	2.44
3	GRAVEL	2.44	3.35
4	LIMESTONE	3.35	12.2

Well ID: 5105215
Construction Date: 1970-10-15
Easting: 717835
Northing: 4925473
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 7.62
Well Diameter (cm):
Water First Found: 7.01
Static Level: 4
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 27
Recommended Pump Rate: 27
Pumping Duration (h:m): 4 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61
1	TOPSOIL	0	0.61
2	MEDIUM SAND	0.61	2.13
2	MEDIUM SAND	0.61	2.13
3	LIMESTONE	2.13	7.62
3	LIMESTONE	2.13	7.62

Well ID: 5105257
Construction Date: 1970-11-23
Easting: 718165
Northing: 4925393
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 22.9
Well Diameter (cm):
Water First Found: 22.3
Static Level: 6
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 9
Recommended Pump Rate: 9
Pumping Duration (h:m): 3 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30

1	TOPSOIL	0	0.30
2	CLAY	0.30	1.83
2	CLAY	0.30	1.83
2	CLAY	0.30	1.83
2	CLAY	0.30	1.83
3	LIMESTONE	1.83	21.3
3	LIMESTONE	1.83	21.3
3	LIMESTONE	1.83	21.3
3	LIMESTONE	1.83	21.3
4	LIMESTONE	21.3	22.9
4	LIMESTONE	21.3	22.9
4	LIMESTONE	21.3	22.9
4	LIMESTONE	21.3	22.9

Well ID: 5105321
Construction Date: 1971-02-03

Easting: 717845
Northing: 4925473

UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 15.2
Well Diameter (cm): 15.2
Water First Found: 9.75
Static Level: 5

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

Pump Rate (LPM): 14
Recommended Pump Rate: 14
Pumping Duration (h:m): 3 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30
2	CLAY	0.30	3.05
2	CLAY	0.30	3.05
3	CLAY	3.05	5.18
3	CLAY	3.05	5.18
4	GRAVEL	5.18	5.49
4	GRAVEL	5.18	5.49
5	LIMESTONE	5.49	15.2
5	LIMESTONE	5.49	15.2

Well ID: 5105995
Construction Date: 1972-06-05

Easting: 718365
Northing: 4925548

UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 14.6
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): 18
Recommended Pump Rate: 18
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	PREV. DRILLED	0	12.2
2	LIMESTONE	12.2	14.6

Well ID: 5106008
Construction Date: 1972-06-19
Easting: 717865
Northing: 4924823
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 22.9
Well Diameter (cm): 15.2
Water First Found: 22.9
Static Level: 8
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 9
Recommended Pump Rate: 9
Pumping Duration (h:m): 2 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30
1	TOPSOIL	0	0.30
2	CLAY	0.30	8.23
2	CLAY	0.30	8.23
2	CLAY	0.30	8.23
2	CLAY	0.30	8.23
2	CLAY	0.30	8.23
2	CLAY	0.30	8.23
3	LIMESTONE	8.23	22.9
3	LIMESTONE	8.23	22.9
3	LIMESTONE	8.23	22.9
3	LIMESTONE	8.23	22.9
3	LIMESTONE	8.23	22.9
3	LIMESTONE	8.23	22.9

Well ID: 5106738
Construction Date: 1974-01-23
Easting: 718044
Northing: 4925329
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 32
Well Diameter (cm): 15.2
Water First Found: 19.8
Static Level: 12
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Commerical
Pump Rate (LPM): 5
Recommended Pump Rate: 5
Pumping Duration (h:m): 3 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	FILL	0	0.30
2	CLAY	0.30	1.52
3	CLAY	1.52	2.44
4	LIMESTONE	2.44	32

Well ID: 5106760
Construction Date: 1974-01-23
Easting: 717862
Northing: 4924721
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 12.5
Well Diameter (cm): 15.2
Water First Found: 12.5
Static Level: 5
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 36
Recommended Pump Rate: 36
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61

2	CLAY	0.61	12.2
3	LIMESTONE	12.2	12.5

Well ID: 5107058 **Easting:** 718143 **UTM Zone** 17
Construction Date: 1974-09-11 **Northing:** 4925471 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth: 22.6 **Water Kind** FRESH **Pump Rate (LPM):** 5
Well Diameter (cm): 15.2 **Final Status** Water Supply **Recommended Pump Rate:** 5
Water First Found: 22.6 **Primary Water Use:** Domestic **Pumping Duration (h:m):** 3 : 0
Static Level: 6

Layer:	Driller's Description:	Top:	Bottom:
1	SAND	0	1.22
2	CLAY	1.22	2.44
3	CLAY	2.44	3.96
4	LIMESTONE	3.96	22.6

Well ID: 5107253 **Easting:** 717905 **UTM Zone** 17
Construction Date: 1975-01-13 **Northing:** 4924865 **Positional Accuracy:** margin of error : 30 m - 100 m

Well Depth: 17.4 **Water Kind** FRESH **Pump Rate (LPM):** 68
Well Diameter (cm): 15.2 **Final Status** Water Supply **Recommended Pump Rate:** 45
Water First Found: 17.1 **Primary Water Use:** Domestic **Pumping Duration (h:m):** 1 : 30
Static Level: 12

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	1.52
2	CLAY	1.52	6.40
3	LIMESTONE	6.40	17.4

Well ID: 5107724 **Easting:** 718215 **UTM Zone** 17
Construction Date: 1975-12-09 **Northing:** 4925423 **Positional Accuracy:** margin of error : 100 m - 300 m

Well Depth: 19.5 **Water Kind** FRESH **Pump Rate (LPM):** 9
Well Diameter (cm): 15.2 **Final Status** Water Supply **Recommended Pump Rate:** 9
Water First Found: 18.6 **Primary Water Use:** Domestic **Pumping Duration (h:m):** 3 : 30
Static Level: 10

Layer:	Driller's Description:	Top:	Bottom:
1	PREV. DRILLED	0	14.9
2	LIMESTONE	14.9	19.5

Well ID: 5108321 **Easting:** 718065 **UTM Zone** 17
Construction Date: 1977-01-18 **Northing:** 4924973 **Positional Accuracy:** margin of error : 100 m - 300 m

Well Depth: 20.4 **Water Kind** FRESH **Pump Rate (LPM):** 18
Well Diameter (cm): 15.2 **Final Status** Water Supply **Recommended Pump Rate:** 18
Water First Found: 18.3 **Primary Water Use:** Industrial **Pumping Duration (h:m):** 1 : 40
Static Level: 8

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	3.05
2	LIMESTONE	3.05	20.4

Well ID: 5108705
Construction Date: 1977-11-16
Easting: 718265
Northing: 4925323
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 18.9
Well Diameter (cm): 15.2
Water First Found: 17.7
Static Level: 8
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 91
Recommended Pump Rate: 45
Pumping Duration (h:m): 1 : 40

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	4.57
2	LIMESTONE	4.57	18.9

Well ID: 5109527
Construction Date: 1979-09-17
Easting: 718365
Northing: 4925523
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 26.5
Well Diameter (cm): 15.2
Water First Found: 25.9
Static Level: 11
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM):
Recommended Pump Rate: 14
Pumping Duration (h:m): 1 : 40

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	1.22
2	SHALE	1.22	3.35
3	LIMESTONE	3.35	26.5

Well ID: 5109566
Construction Date: 1979-10-09
Easting: 717815
Northing: 4925323
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 6.71
Well Diameter (cm): 15.2
Water First Found: 6.40
Static Level: 3
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 32
Recommended Pump Rate: 23
Pumping Duration (h:m): 2 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	TOPSOIL	0	0.61
2	GRAVEL	0.61	6.40
3	LIMESTONE	6.40	6.71

Well ID: 5109788
Construction Date: 1980-06-12
Easting: 717565
Northing: 4925273
UTM Zone 17
Positional Accuracy: margin of error : 100 m - 300 m

Well Depth: 6.1
Well Diameter (cm): 15.2
Water First Found: 5.79
Static Level: 2
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 45
Pumping Duration (h:m): 2 : 30

Layer:	Driller's Description:	Top:	Bottom:
1	GRAVEL	0	5.79
2	SHALE	5.79	6.1

Well ID: 5111247
Construction Date: 1984-12-03
Easting: 717738
Northing: 4925407
UTM Zone 17
Positional Accuracy: unknown UTM

Well Depth: 6.1
Well Diameter (cm): 15.2
Water First Found: 6.1
Static Level: 0
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 45
Recommended Pump Rate: 45
Pumping Duration (h:m): 2 : 30

Layer:	Driller's Description:	Top:	Bottom:

1	SAND	0	0.91
2	CLAY	0.91	5.18
3	LIMESTONE	5.18	5.49
4	LIMESTONE	5.49	6.1

Well ID: 5112365
Construction Date: 1987-06-24
Easting: 718575
Northing: 4925257
UTM Zone 17
Positional Accuracy: unknown UTM

Well Depth: 36.6
Well Diameter (cm):
Water First Found: 36.6
Static Level: 8
Water Kind Not stated
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 14
Recommended Pump Rate: 14
Pumping Duration (h:m): 2 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	PREVIOUSLY DUG	0	24.4
2	LIMESTONE	24.4	36.6

Well ID: 5120834
Construction Date: 2006-09-19
Easting: 718183
Northing: 4925325
UTM Zone 17
Positional Accuracy: margin of error : 10 - 30 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 ID: 7040611
Construction Date: 2007-02-05
Easting: 717868
Northing: 4925491
UTM Zone 17
Positional Accuracy: margin of error : 10 - 30 m

Well Depth: 12.2
Well Diameter (cm): 15.6
Water First Found: 6.1
Static Level: 3
Water Kind
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 64
Recommended Pump Rate:
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	1.83
2	LIMESTONE	1.83	12.2

Well ID: 7175301
Construction Date: 2012-01-19
Easting: 717692
Northing: 4925393
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 11.6
Well Diameter (cm): 15.9
Water First Found: 6.40
Static Level: 3
Water Kind FRESH
Final Status Water Supply
Primary Water Use: Domestic
Pump Rate (LPM): 27
Recommended Pump Rate: 27
Pumping Duration (h:m): 2 :

Layer:	Driller's Description:	Top:	Bottom:
1	CLAY	0	5.49
1	CLAY	0	5.49
2	CLAY	5.49	6.40
2	CLAY	5.49	6.40
3	LIMESTONE	6.40	11
3	LIMESTONE	6.40	11
4	LIMESTONE	11	11.6
4	LIMESTONE	11	11.6

Well ID: 7175316
Construction Date: 2012-01-19
Easting: 717947
Northing: 4924958
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth:
Well Diameter (cm): 10.2
Water First Found:
Static Level: 9

Water Kind
Final Status Abandoned-Ot
Primary Water Use: Domestic

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

Layer:	Driller's Description:	Top:	Bottom:

Well ID: 7202734
Construction Date: 2013-06-07
Easting: 717824
Northing: 4925264
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 15.9
Well Diameter (cm): 15.9
Water First Found: 6.1
Static Level: 2

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

Pump Rate (LPM): 36
Recommended Pump Rate: 27
Pumping Duration (h:m): 1 : 0

Layer:	Driller's Description:	Top:	Bottom:
1	FILL	0	1.22
1	FILL	0	1.22
2	SAND	1.22	5.79
2	SAND	1.22	5.79
3	GRAVEL	5.79	6.1
3	GRAVEL	5.79	6.1
4	LIMESTONE	6.1	15.9
4	LIMESTONE	6.1	15.9

Well ID: 7246869
Construction Date: 2015-08-24
Easting: 718437
Northing: 4925591
UTM Zone 17
Positional Accuracy: margin of error : 30 m - 100 m

Well Depth: 8.84
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	SAND	0	1.83
2	SHALE	1.83	2.74
3	LIMESTONE	2.74	8.84

Appendix H

Water Balance Calculations

Water Balance Calculations

4488 County Road 29, Douro-Dummer, Ontario

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	359	mm/yr
Weather Station Location:	**Peterborough Trent U**					**Latitude:**	**44.4**	**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)*	9.1	10.3	11.8	13.3	14.6	15.3	14.9	13.8	12.3	10.8	9.5	8.7	
Available Water Storage Capacity	0.14	m/m		**Root Depth**	460	mm		**SOILmax**	64.4	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)	-8.4	-6.5	-1.3	6.3	12.8	18.0	20.7	19.4	15.0	8.4	2.4	-4.0	
PRECIPITATION (P)	57.3	48.8	56.5	66.4	88.7	83.0	73.6	87.0	92.4	77.0	85.5	66.0	882
RAIN	22.4	23.1	34.0	60.9	88.7	83.0	73.6	87.0	92.4	75.7	73.3	35.0	749
SNOW	35	26	23	6	0	0	0	0	0	1	12	31	133
MELT FACTOR (F)	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.40	0.00	
PACK	73	99	121	0	0	0	0	0	0	0	7	38	
MELT	0	0	0	127	0	0	0	0	0	1	5	0	133
INPUT (W)	22	23	34	188	89	83	74	87	92	77	78	35	882
POTENTIAL ET (PET)	0	0	0	41	70	97	115	98	65	39	22	0	548
NET INPUT (ΔW)	22	23	34	147	19	-14	-41	-11	27	38	56	35	
SOIL MOISTURE (SOIL)	64	64	64	64	64	52	27	23	50	64	64	64	
ΔSOIL	0	0	0	0	0	-13	-25	-4	27	15	0	0	0
ET	0	0	0	41	70	96	98	91	65	39	22	0	523
SURPLUS=W-ET-DSOIL	22	23	34	147	19	0	0	0	0	23	56	35	359

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

4488 County Road 29, Douro-Dummer, Ontario

1 Climate Information

Precipitation	882	mm/yr
Actual Evapotranspiration	523	mm/yr
Water Surplus	359	mm/yr

2 Infiltration Rates

Table 2 Approach - Infiltration factors

Topography: Rolling to Hilly	0.15
Soil Type: Sandy Silt	0.3
Cover: Cultivated land	0.1
Total Infiltration Factor	**0.55**

Infiltration (Water Surplus * Infiltration Factor)	**197**	mm/yr
Run-off (Water Surplus - Infiltration)	**162**	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 sandy silt

Based on the above, the recharge rate is typically	150-200	mm/yr

3 Pre-Development Property Statistics

	ha	m^2
Total Paved Area	0.00	0
Total Roof Area	0.00	0
Total Landscape Area	5.32	53,230
Total	**5.32**	**53,230**

4 Post-Development Property Statistics

	ha	m^2
Total Paved Area	0.41	4,971
Total Roof Area	0.28	1,652
Total Landscape Area	0.31	46,607
Total	**1.01**	**53,230**

Pre- and Post-Development Water Balance Calculations

4488 County Road 29, Douro-Dummer, Ontario

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	-	-	-	-	-
	Roof Area	-	-	-	-	-
Pervious Areas	Landscape Area	53,230	46,949	27,839	10,510	8,599
	Totals	53,230	46,949	27,839	10,510	8,599

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	4,971	4,384	438	-	3,946
	Roof Area	1,652	1,457	146	-	1,311
Pervious Areas	Landscape Area	46,607	41,107	24,375	9,203	7,529
	Totals	53,230	46,949	24,960	9,203	12,787

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	46,949	27,839	10,510	8,599
Post-Development	46,949	24,960	9,203	12,787
Change in Volume	-	- 2,880	- 1,308	4,187
Change in %	-	- 10	- 12	49

8 Requirement for Infiltration of Roof Run-off

Volume of Pre-Development Infiltration (m^3/yr)	10,510
Volume of Post-Development Infiltration (m^3/yr)	9,203
Deficit from Pre to Post Development Infiltration (m^3/yr)	1,308
Percentage of Roof Runoff required to match the pre-development infiltration (%)	100

Appendix I

Sewage System Permit Application

The Township of Douro-Dummer
894 South St., PO Box 92
Warsaw, ON
K0L 3A0
Phone: 705-652-8392

Application Guide for Sewage System (Septic) Permits

Checklist for complete permit application:

- ☐ Complete Application on **Cloud Permit**
- ☐ Building Permit Application Form (if uploading to Cloud Permit)
- ☐ Schedule 1 (Designer Information)
- ☐ Schedule 2 (Sewage System Installer)
- ☐ Authorization to Act as Agent Form (if applicable)
- ☐ Detailed Siteplan/Lot Layout
- ☐ Test pit dug to minimum 1.5m depth (call Leisha to schedule)
- ☐ Applicable Permit Fee

This application guide is intended to be used for Class 2 (Greywater System), Class 3 (Cesspool), Class 4 (Leaching Bed System), or Class 5 (Holding Tank) applications.

Ensure that you follow the steps that will guide you through the design process for the system and return the entire application guide with the required documentation listed above. If you have any questions, contact staff at the Township office:

Leisha Newton
Building Administrator
705-652-8392 x 211
leishan@dourodummer.on.ca

Don Helleman
Temporary Chief Building Official
705-652-8392 x 216
dhelleman@dourodummer.on.ca

Step 1: Fill in Highlighted areas

Test Pit Excavation date: October 23, 2023

	Applicant Use		Inspector Use	
Depth (m)	Soil Type	"T" Time	Soil Type	"T" Time
0 – 0.3	Topsoil	N/A		
0.3 – 0.6	Sandy silt, some clay, trace gravel	30		
0.6 – 0.9	Sandy silt, some clay, trace gravel	30		
0.9 – 1.2	Gravelly sand, trace silt, trace clay	20		
1.2 – 1.5	Gravelly sand, trace silt, trace clay	20		
1.5 +				

Reference chart for common soil types:

Soil Type (Unified Soil Classification) Coarse Grained with more than 50% larger than #200	Percolation Time, T – mins/cm	Comment
GM – Silty gravels, gravel-sand-silt mixtures	4 – 12	Permeable depending on amount of silt
GC – Clayey gravels, gravel-sand-clay mixtures	12 – 50	T time depends on clay content
SM – Silty sands, sand-silt mixtures	8 – 20	Medium to low permeability
SC – Clayey sands, sand-clay mixtures	12 – 50	Medium to low permeability depending on clay content

Sewage System Design Height:
1.5m – Ground Water Table or bedrock depth = 0 (Minimum raised height of bed)

Water Supply:

- ☑ Drilled Well (with 6m casing depth min.)
- ☐ Dug Well
- ☐ Other: _____

Test Pit Inspection Report

Date of Inspection:	Inspector:
Weather:	Percolation Test Required:
Design T:	Grain Size Analysis Required:
Depth to bedrock:	
Depth to GWT:	

Step 2: Fill in Highlighted Areas

Fixture	Total Count	Units Per	Fixture Units	☐
Bathtub		1.5	=	☐
Shower (1 Head)		1.5	=	☐
Shower (2-3 Heads)		3	=	☐
Lavatory		1.5	=	☐
Water Closet		4	=	☐
Bathroom Group (see note)		6	=	☐
Kitchen Sink		1.5	=	☐
Garburator (see note)			=	☐
Other Sinks		1.5	=	☐
Dishwasher (see note)		1	=	☐
Floor Drain (see note)		2	=	☐
Clothes Washer		1.5	=	☐
Other			=	☐
		Total:	N/A	

Notes:

Bathroom Group: A group consisting of exactly one shower (1 head), one lavatory, and one flush tank water closet. This would usually add up to 7, but a reduction is provided.

Garburator: A domestic style garbage disposal is permitted with no additional fixture load. Commercial style is a fixture load of 3.

Dishwasher: Only include dishwashers that are not connected to the domestic sink.

Floor Drain: This only includes floor drains which connect to the sanitary sewage system.

Step 3: Fill in Highlighted Areas

Existing Bedrooms:	-
New Bedrooms:	-
Total Bedrooms:	-

Note: Include Sleeping Cabins

Existing Area (m²):	-
Proposed Area (m²):	-
Total Area (m²):	-

Note: Exclude basement area

Step 4a: Calculate Total Daily Design Flow for Dwellings

Dwellings:	Volume
1 bedroom dwelling	750 L
2 bedroom dwelling	1100 L
3 bedroom dwelling	1600 L
4 bedroom dwelling	2000 L
5 bedroom dwelling	2500 L

Additional Flow for:	Volume
i) Each bedroom over 5	500 L
ii) a) each 10m² (or part of it) over 200m² up to 400m²	100 L
b) each 10m² (or part of it) over 400m² up to 600m²	75 L
c) each 10m² (or part of it) over 600m²	50 L
iii) each fixture unit over 20 fixture units	50 L

Base (# of Bedrooms): _____

Additional Flow: _____L

Total Daily Flow (Q): _____L

Step 4b: Calculate Total Daily Design Flow for Non-Dwellings

Occupancy Type: Maintenance Shop - OBC Table 8.2.1.3.b (Factory)

Loading Criteria: 75 L/person * 53 staff

Total Daily Flow (Q): 3,975 L/day L

Step 5: Calculate Tank Size (Class 4 System)

Dwellings: Total Daily Flow (Q) x 2 = _____L

Non-Dwellings: Total Daily Flow (Q) x 3 = 11,925 L

Note: Minimum tank size 3600L

Proposed Tank Size: 12,000 L

Step 6: Calculate Filter Bed Size

If Q is 3000L or less:

Q / 75 = _____m²

If Q is more than 3000 L:

Q / 50 = (79.5 m² / 2 beds) = 39.75 m² per bed

If Treatment Unit is proposed:

Q / ___ = _____m²

Extended Contact Area:

Q x T / 850 = 140.2 m²

Step 7: Acknowledgement of Overhead Conductors

As per 3.1.19.1. of the Ontario Building Code,

3.1.19.1 Clearances to Buildings (A sewage system is defined as a building)

(1) A *building* shall not be located beneath existing above ground electrical conductors.

(2) The horizontal clearance measured from the maximum conductor swing to the *building*, including balconies, fire escapes, flat roofs or other accessible projections beyond the face of the *building*, shall,

(a) be not less than 1 m, for electrical conductors carrying voltages 750 V or less, except where necessary to connect to the electrical wiring of the *building*,

(b) be not less than 3 m, for electrical conductors carrying voltages greater than 750 V but not exceeding 46 kV,

(c) be not less than 3.7 m, for electrical conductors carrying voltages greater than 46 kV but not exceeding 69 kV, or

(d) conform to the requirements of CAN/CSA-C22.3 No.1, “Overhead Systems”, for electrical conductors carrying voltages greater than 69 kV.

Signature of Applicant: _____ Date: _____

Application for a Permit to Construct or Demolish

This form is authorized under subsection 8(1.1) of the *Building Code Act,1992*

For use by Principal Authority	
Application number:	Permit number (if different):
Date received:	Roll number:

Application submitted to: DOURO-DUMMER

(Name of municipality, upper-tier municipality, board of health or conservation authority)

A. Project information

Building number, street name			Unit number	Lot/con.
Municipality	Postal code	Plan number/other description		
Project value est. $		Area of work (m^2)		

B. Purpose of application

☐ New construction ☐ Addition to an existing building ☐ Alteration/repair ☐ Demolition ☐ Conditional Permit

Proposed use of building	Current use of building

Description of proposed work

C. Applicant

Applicant is: ☐ Owner or ☐ Authorized agent of owner

Last name	First name	Corporation or partnership	
Street address		Unit number	Lot/con.
Municipality	Postal code	Province	E-mail
Telephone number	Fax	Cell number	

D. Owner (if different from applicant)

Last name	First name	Corporation or partnership	
Street address		Unit number	Lot/con.
Municipality	Postal code	Province	E-mail
Telephone number	Fax	Cell number	

E. Builder (optional)

Last name	First name	Corporation or partnership (if applicable)	
Street address		Unit number	Lot/con.
Municipality	Postal code	Province	E-mail
Telephone number	Fax	Cell number	

F. Tarion Warranty Corporation (Ontario New Home Warranty Program)

i. Is proposed construction for a new home as defined in the *Ontario New Home Warranties Plan Act*? If no, go to section G.	☐ Yes	☐ No
ii. Is registration required under the *Ontario New Home Warranties Plan Act*?	☐ Yes	☐ No

iii. If yes to (ii) provide registration number(s): _____

G. Required Schedules

i) Attach Schedule 1 for each individual who reviews and takes responsibility for design activities.

ii) Attach Schedule 2 where application is to construct on-site, install or repair a sewage system.

H. Completeness and compliance with applicable law

i) This application meets all the requirements of clauses 1.3.1.3 (5) (a) to (d) of Division C of the Building Code (the application is made in the correct form and by the owner or authorized agent, all applicable fields have been completed on the application and required schedules, and all required schedules are submitted).	☐ Yes	☐ No
Payment has been made of all fees that are required, under the applicable by-law, resolution or regulation made under clause 7(1)(c) of the *Building Code Act, 1992*, to be paid when the application is made.	☐ Yes	☐ No
ii) This application is accompanied by the plans and specifications prescribed by the applicable by-law, resolution or regulation made under clause 7(1)(b) of the *Building Code Act, 1992.*	☐ Yes	☐ No
iii) This application is accompanied by the information and documents prescribed by the applicable by-law, resolution or regulation made under clause 7(1)(b) of the *Building Code Act, 1992* which enable the chief building official to determine whether the proposed building, construction or demolition will contravene any applicable law.	☐ Yes	☐ No
iv) The proposed building, construction or demolition will not contravene any applicable law.	☐ Yes	☐ No

I. Declaration of applicant

I _____ declare that:
(print name)

1. The information contained in this application, attached schedules, attached plans and specifications, and other attached documentation is true to the best of my knowledge.
2. If the owner is a corporation or partnership, I have the authority to bind the corporation or partnership.

_____ _____
Date Signature of applicant

Personal information contained in this form and schedules is collected under the authority of subsection 8(1.1) of the *Building Code Act, 1992*, and will be used in the administration and enforcement of the *Building Code Act, 1992*. Questions about the collection of personal information may be addressed to: a) the Chief Building Official of the municipality or upper-tier municipality to which this application is being made, or, b) the inspector having the powers and duties of a chief building official in relation to sewage systems or plumbing for an upper-tier municipality, board of health or conservation authority to whom this application is made, or, c) Director, Building and Development Branch, Ministry of Municipal Affairs and Housing 777 Bay St., 2nd Floor. Toronto, M5G 2E5 (416) 585-6666.

Schedule 1: Designer Information

Use one form for each individual who reviews and takes responsibility for design activities with respect to the project.

A. Project Information

Building number, street name	Unit no.	Lot/con.
4488 County Road 29		

Municipality	Postal code	Plan number/ other description
Douro-Dummer	K0L 2H0	

B. Individual who reviews and takes responsibility for design activities

Name	Firm
Jeremy Tracey	Cambium Inc.

Street address	Unit no.	Lot/con.
194 Sophia Street		

Municipality	Postal code	Province	E-mail
Peterborough	K9H 1E5	ON	jeremy.tracey@cambium-inc.com

Telephone number	Fax number	Cell number
705-742-7900		

C. Design activities undertaken by individual identified in Section B. [Building Code Table 3.5.2.1. of Division C]

☐ House	☐ HVAC – House	☐ Building Structural
☐ Small Buildings	☐ Building Services	☐ Plumbing – House
☐ Large Buildings	☐ Detection, Lighting and Power	☐ Plumbing – All Buildings
☐ Complex Buildings	☐ Fire Protection	☑ On-site Sewage Systems

Description of designer's work: Sewage system design under Part 8 of the Ontario Building Code

D. Declaration of Designer

I Jeremy Tracey declare that (choose one as appropriate):

(print name)

I review and take responsibility for the design work on behalf of a firm registered under subsection 3.2.4.of Division C, of the Building Code. I am qualified, and the firm is registered, in the appropriate classes/categories.

Individual BCIN: P. Eng# 100226672

Firm BCIN: 45353

I review and take responsibility for the design and am qualified in the appropriate category as an "other designer" under subsection 3.2.5.of Division C, of the Building Code.

Individual BCIN: _____

Basis for exemption from registration: _____

The design work is exempt from the registration and qualification requirements of the Building Code.

Basis for exemption from registration and qualification: _____

I certify that:

1. The information contained in this schedule is true to the best of my knowledge.
2. I have submitted this application with the knowledge and consent of the firm.

February 28, 2024 _____

Date Signature of Designer

NOTE:

1. For the purposes of this form, "individual" means the "person" referred to in Clause 3.2.4.7(1) (c).of Division C, Article 3.2.5.1. of Division C, and all other persons who are exempt from qualification under Subsections 3.2.4. and 3.2.5. of Division C.
2. Schedule 1 is not required to be completed by a holder of a license, temporary license, or a certificate of practice, issued by the Ontario Association of Architects. Schedule 1 is also not required to be completed by a holder of a license to practise, a limited license to practise, or a certificate of authorization, issued by the Association of Professional Engineers of Ontario.

Schedule 2: Sewage System Installer Information

A. Project Information

Building number, street name			Unit number	Lot/con.
Municipality	Postal code	Plan number/ other description		

B. Sewage system installer

Is the installer of the sewage system engaged in the business of constructing on-site, installing, repairing, servicing, cleaning or emptying sewage systems, in accordance with Building Code Article 3.3.1.1, Division C?

☐ Yes (Continue to Section C) ☐ No (Continue to Section E) ☐ Installer unknown at time of application (Continue to Section E)

C. Registered installer information (where answer to B is "Yes")

Name			BCIN	
Street address			Unit number	Lot/con.
Municipality	Postal code	Province	E-mail	
Telephone number	Fax		Cell number	

D. Qualified supervisor information (where answer to section B is "Yes")

Name of qualified supervisor(s)	Building Code Identification Number (BCIN)

E. Declaration of Applicant:

I _____ declare that:
(print name)

I am the applicant for the permit to construct the sewage system. If the installer is unknown at time of application, I shall submit a new Schedule 2 prior to construction when the installer is known;

OR

I am the holder of the permit to construct the sewage system, and am submitting a new Schedule 2, now that the installer is known.

I certify that:

1. The information contained in this schedule is true to the best of my knowledge.
2. If the owner is a corporation or partnership, I have the authority to bind the corporation or partnership.

_____ _____
Date Signature of applicant