REPORT

HYDROGEOLOGICAL INVESTIGATION

1 Clair Road East, Guelph, Ontario

Submitted to:

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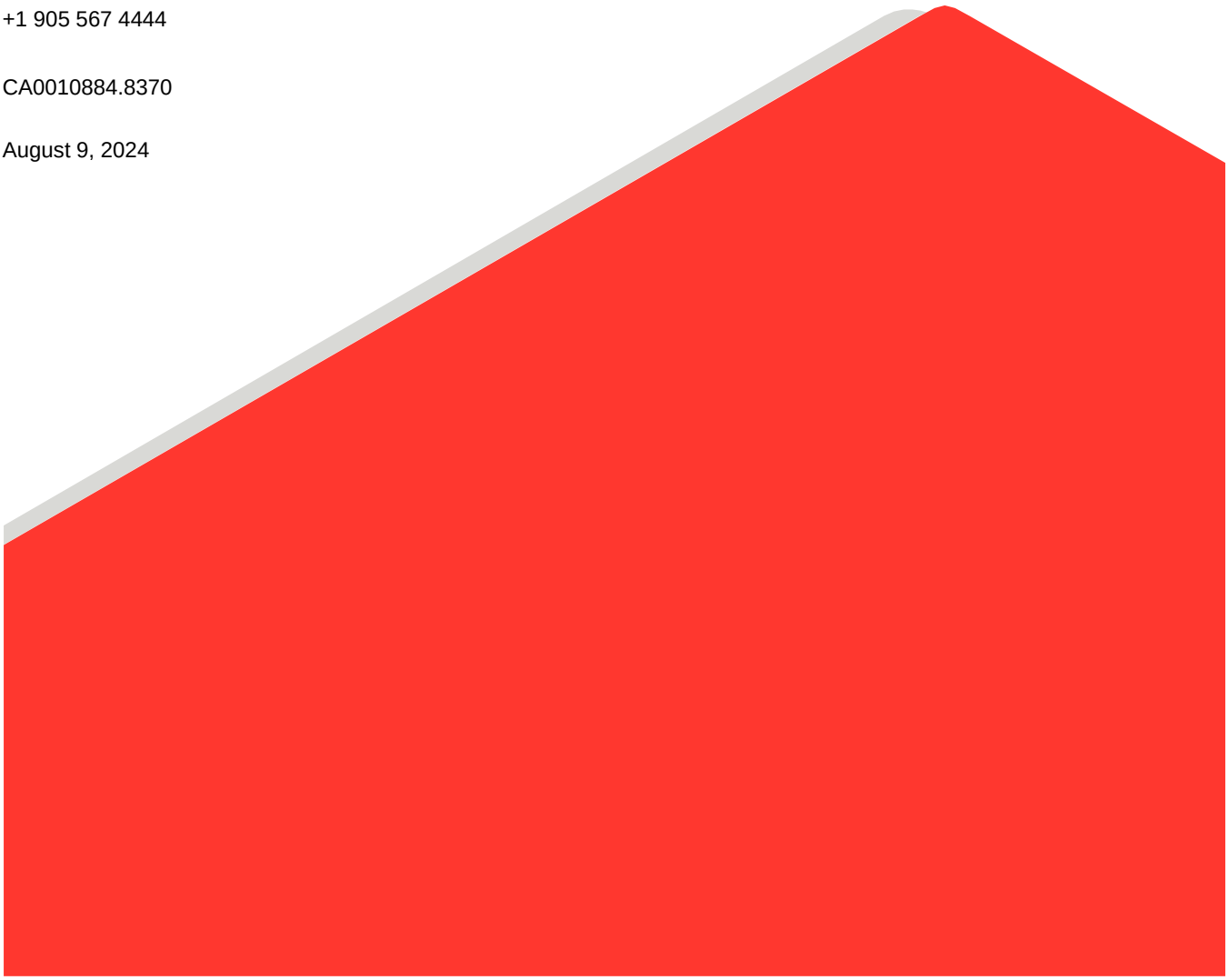

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1.0 INTRODUCTION

1.1 Background and Objectives

WSP Canada Inc. (“WSP”) has been retained by First Capital Asset Management LP (“FCAM” or “the Client”) to complete a Hydrogeological assessment of a proposed mixed-use development (the “project), located at 1 Clair Road East (the “site”) in Guelph, Ontario (see **Figure 1**). The site is approximately 2.21 hectares (ha) in size and resides within an urban developed setting. It is bounded to the northwest by Clair Road East with community services to the north across Clair Road (Guelph Public Library) and commercial businesses to the southwest as part of the Pergola Commons Shopping District. Hawkins Drive and protected woodlot affiliated to the Stormwater management facility bound the site to the northeast, while Poppy Drive bounds the site to the south.

The purpose of the hydrogeological investigation is to characterize soil and groundwater conditions in support of development applications, including a Zoning By-Law Amendment (ZBA), Official Plan Amendment (OPA), and a Site Plan Application (SPA) to permit the construction of the proposed mixed-use development. The proposed development will consist of 4 buildings that contain between ten (10) and fourteen (14) storeys of residential units and retail space (see **Figure 2**). The development is proposing a combination of surface parking and underground parking (two levels). Based on designs provided by SvN Architects and Planners (Drawing A106 Level P2 Parking Plan, dated November 6, 2023, revised July 23, 2024), WSP interprets that the proposed underground parking footprint will have a footprint area of approximately 17,325 $m^{2,}$ with the anticipated floor level of underground parking at an elevation of 333.85 m AMSL.

In accordance with complying with engineering comments provided by the City of Guelph from the first submission Review (OPA/ZBA Submission Material) on December 18, 2023, WSP prepared a supplementary Hydrogeological Assessment with the purpose to meeting the following objectives:

- Conduct future groundwater monitoring events to obtain additional water level data for which seasonal high groundwater elevations can be ascertained. Based on the City's Development Engineering Manual (DEM), one full year of monitoring data is required. Data has been tabulated and provided graphically via hydrograph in future submissions on this file (Section 4.2.7).
- Update AQTESOLV plots for tests completed in partially saturated conditions (Section 4.2.8).
- Provide short-term construction dewatering pumping rates and an estimated Zone of Influence (ZOI) that may be encountered during dewatering. The dewatering assessment will provide references to methodology used and recommendations on whether settlement assessments will be required due to proximity to existing buildings/structures (Section 7.0).
- Review information available on the City's website, or through the Lake Erie Source Protection Region's Information Atlas, and provide Source Water Protection discussion, including site details as it relates to the City's Source Water Protection plan and policies (i.e. WHPAs, Vulnerability Scoring, Issue Contributing Areas where applicable).
- Provide mapping of the physiographic region and features of the study area.
- Provide an interpretation of groundwater flow direction.

- Provide insight into potential recharge and discharge areas within the study area with respect to referencing the Grand River Conservation Authority (GRCA) and the Oak Ridges Moraine Groundwater Program (ORMGP).

1.2 Work Program

The scope of work for the hydrogeological investigation has followed the requirements outlined in the GRCA document entitled “Hydrogeological Assessment Submissions, Conservation Authority Guidelines to Support Development Applications, June 2013”, and includes the following scope of work, which was completed within the Initial Assessment in 2023:

- Review of pertinent background materials to the site, including previous geotechnical, hydrogeological, and environmental reports, as well as published geological mapping and interactive mapping platforms provided by the Ministry of the Environment, Conservation, and Parks (MECP) Source Protection Information Atlas (MECP 2020) to compile soil and groundwater data. A private water well records search was initially carried out in November 2023 and has been updated in May 2024 using the MECP water wells database.
- Field Investigations, including five single well response tests (BH23-1S/D, BH23-2, BH23-3, BH23-4, and B23-5) were carried out on-site on October 18, 2023, to estimate hydraulic conductivity of the soils across the site.
- One groundwater quality sample was collected from BH23-1D on October 18, 2023, and sent to ALS laboratories under chain of custody protocols for analysis to the City of Guelph Sanitary and Storm Sewer By-law (1996-15202) in order to assess pre-development groundwater quality conditions at the site.
- Groundwater level monitoring from available monitoring wells has been carried out on six (6) occasions between October 2023 and June 2024 and is proposed to continue on a monthly schedule until April 2025. Monitoring wells BH20-1S/D, BH23-2, BH23-3, BH23-4, and B23-5 were instrumented with dataloggers in May 2024 to record water level measurements every 30 minutes in order to assess seasonal fluctuations of the water table. Borehole Logs of monitoring wells are provided in **Appendix A.**
- A dewatering assessment has been prepared to provide estimates of short-term construction pumping rates for excavation of underground parking facilities. The assessment provides recommendations on required permitting and next steps for water quality sampling prior to construction. The preliminary assessment prepared during the December 2023 investigation has been revised to account for both lateral and vertical flow in this report to address comments to Support Development Applications.

2.0 REGIONAL PHYSIOGRAPHY AND GEOLOGICAL SETTINGS

2.1 Physiography, Topography, and Drainage

The Site is located in the physiographic region known as the Guelph Drumlin Field, which is dominant in the area north of the Site (Chapman and Putnam, 2007). In the Guelph Drumlin Field, local soils generally consist of stony tills and deep gravel terraces, the latter being typical of glacial meltwater spillways and the former being typical of drumlins and till plans (Chapman and Putnam 1984). In terms of physiographic landforms, mapping from the Ontario Geological Survey (OGS Earth) indicates the site resides fully within the Spillway features. **Figure 3** shows the physiographic landforms present in the vicinity of the Site.

The site is located at the Hanlon Subwatershed of the Grand River Watershed and within the boundary of the GRCA. As shown on **Figure 4** topographic high points occur along the south of the site along Poppy Drive East Road, with the topography sloping to the northwest towards to Central Wetland. The topographic contours throughout the Site range from highs of approximately 345.0 m AMSL near Poppy Dr. E Road (Southeast boundary) and 341.8 m AMSL near Borehole BH23-2 (southwest boundary), to lows of 339 m AMSL near Hawkins Dr. Street and 338.8 m AMSL near Borehole BH23-4 at the northeast portion of the Site.

2.2 Regional Geology and Hydrostratigraphy

Geological conditions within the Region have been mapped by the Ministry of Natural Resources and described in a study of the area carried out by Matrix Solutions Inc. (Matrix, 2017). Based on the Matrix study (2017) and the GRCA surficial mapping portal, overburden and bedrock geology near the Site is summarized as follows, listed from youngest to oldest:

Spillway Deposits: Glaciofluvial outwash and glaciolacustrine deposits of sand gravel with minor silt and clay associated with the spillway channels. (**Figure 5**; Unit 7B)

Ice-Contact Deposits: Predominantly sand and gravel containing lenses of silt and clay left behind by the melting of enclosed ice blocks (i.e., eskers, kames) (**Figure 5**; Unit 6)

Port Stanley Till: An occasionally stony; silty sand to sandy till, forming the till plain and drumlins that characterize the region. Some of the drumlins, however, can of an older clayey still till core that is subsequently covered by a layer of glaciofluvial and glaciolacustrine sediments (i.e.; fine to silty sand, sandy silt, sand and gravel) deposited from melting glacier ice, with the till extending to the bedrock surface. (**Figure 5**; Unit 5B)

Bedrock: The Guelph formation, representing the uppermost bedrock until throughout the region is described as a light brown/beige coloured fossiliferous dolostones and an important aquifer in the Guelph area (Brunton, 2008).

Surficial geology mapping (Ontario Geological Survey- OGS) indicates that the site is dominantly underlain by glaciofluvial outwash and ice-contact gravels with the exception of the south end of the site near Poppy Drive, which is underlain by sandy silt till of the Wentworth till deposit. A review of nearby water well records corroborate the presence of both types of soils, with thick deposits of sand and gravel being indicated by the stratigraphy listed on some well records near the site and till (e.g. stones and clay) being indicated by others. One well record that appears to be attributed to the Site (Well ID 6709321, see **Appendix B)** appears to indicate a stratum of till ("clay gravel") from surface to a depth of about 5 mbgs, overlying a layer of gravel and sand extending down to 16.7 mbgs. Bedrock in the vicinity of the Site is of the Guelph Formation, which is a sedimentary formation composed of limestone, dolostone, sandstone and siltstone. **Figure 5** provides the distribution of surficial soils in the vicinity of the site.

2.3 Regional Hydrogeology

Based on available hydrogeological studies in the area, including Matrix (2017) and Golder Associates (2011), the following aquifer and aquitard systems are interpreted to exist on a regional basis in the vicinity of the Site:

Upper Sand and Gravel Aquifer: an unconfined aquifer system consisting predominantly of outwash sand and gravel deposits. These units were reported to have a horizontal hydraulic conductivity ranging from 7.0 X 10^{-4} m/s to 6.0 x 10^{-6} m/s, with sufficient heterogeneity to estimate a vertical hydraulic conductivity approximately an order of magnitude lower than the horizontal hydraulic conductivity (Totten Sims Hubicki Associates *et al*., 1998).

Lower Till Aquitard: dense sandy to silty glacial till (i.e., Port Stanley Till) that is occasionally interbedded with discontinuous lenses of coarse sand and gravel. This unit is reported to have a hydraulic conductivity ranging from 1.0 x 10^{-4} m/s to 2.0 x 10^{-9} m/s.

Contact zone aquifer: coarse, unconsolidated granular deposits directly overlying, and hydraulically connected to, upper weathered/fractured bedrock. This unit typically forms a thin aquifer having an assumed thickness of four meters (two meters above and below bedrock surface) (Golder, 2011). This aquifer is reported to have a horizontal hydraulic conductivity ranging from 1.0x 10^{-4} m/s to 1.0 10^{-5} m/s with the vertical hydraulic conductivity being one half (0.5) to an order (1.0) of magnitude lower than the horizontal hydraulic conductivity (Golder, 2011).

Bedrock Aquifer: Consisting of medium to thick bedded fossiliferous dolostone of the Guelph Formation. This unit reported to have a horizontal hydraulic conductivity ranging from 8.0 x 10^{-3} m/s to 7.0 x 10^{-9} m/s. The potentiometric surface of the groundwater within the bedrock aquifer is estimated to be approximately 325 to 330 (Jagger Hims 1998).

Regionally, the lands containing the site are characterized by groundwater recharge conditions, Mapping created using the Grand River information Network (GRIN) (GRCA, 2019) Indicates that downward vertical hydraulic gradients are present beneath the site, with annual recharge rates across the property estimated between 100 mm/year and 200 mm/year.

2.4 Water Supply Wells

Water well records on file with the Ministry of the Environment, Conservation and Parks (MECP) for an area extending 500 m from the site limits were examined and plotted in November 2023 (see **Figure 6)**. Based on a review of the MECP Water Well Records (WWRs) database, a total of fifty-nine (59) WWRs were identified within a 500 m radius of the site. A summary of these well records are presented in Table 1, with additional details provided on **Appendix B**. Out of a total of 59 records, sixteen (16) of them are identified as domestic water supply wells, twenty-three (23) are labelled as observation or monitoring wells, while the remaining twenty (20) records are labelled as either abandoned or lack sufficient details to ascertain well function or type. The depth of these wells based on well records are highly variable between 4.0 mbgs and 60.2 mbgs, with an equally wide range in water levels noted on the records. As the site is located within an urban developed area with municipal water, it is likely these water supply wells are no longer used for domestic consumption, however a private well survey would be required to confirm this theory. we interpret that existing wells may no longer be used. A private well survey may be required at the permitting stage to confirm this interpretation.

Table 1: Summary of MECP Well Records

WELL TYPE WELL METHOD	WATER SUPPLY	OBSERVATION WELLS	ABANDONED	UNKNOWN	TOTALS
Drilled Wells	16	23	16	0	55
Dug Wells	0	0	0	0	0
Unknown Type	0	0	0	4	4
Totals	16	23	16	4	59

2.5 Groundwater Recharge and Discharge Conditions

The hydrogeological investigation has carried out a desktop study on assessing areas of potential groundwater discharge in the vicinity of the site. Based on reviews of both the GRCA interactive mapping tool (GRCA Web Map (grandriver.ca)) and the ORMGP mapping portal, the proposed development is not located within a groundwater discharge area. The nearest identified groundwater discharge area is approximately 888 m northwest of the site within the valley system of Gosling Gardens Park. The ORMGP interprets that the Site resides within an area of downward gradients, suggesting the regional area of the site is largely dominated by groundwater recharge.

3.0 SOURCE WATER PROTECTION

The study area lies within the Grand River watershed and is a part of the Lake Erie Source Protection Region (Ministry of the Environment and conservation Parks [MECP], Act 2006). As established under the Ontario Clean Water Act, 2006, S.O., 2006, c. 22, source protection areas and associated land use restrictions exist for all municipal drinking water sources located throughout the Grand River Source Protection Area (i.e., defined by the boundaries of the Grand River Watershed). Within the Source Protection Area (SPA), the MECP has designated four types of vulnerable areas that apply to drinking water sources:

- Wellhead Protection Areas (WHPA)
- Intake Protection Zones (IPZ)
- Highly Vulnerable Aquifers (HVA)
- Significant Groundwater Recharge Areas (SGRA)
- Significant Drinking Water Threats - TI.Public (swpip.ca)

The MECP Source Protection Information Atlas indicates that the site resides within WHPAs and SGRAs (see **Figures 7 and 8**). Source protection details for the site are summarized in Table 2 with further descriptions on regulated areas in Sections 3.1 to 3.5. We note that information provided with regards to source protection areas, development constraints, and threats to drinking water are intended as a summary only. A Source Water Impact Assessment and Mitigation Plan (SWIAMP) may be requested during detail design, which is a comprehensive study on potential impacts to drinking water and serves as a framework to develop a plan to manage risks in regulated areas. It is important to note that delineation of vulnerable areas is based on regional mapping and does not consider site-specific conditions (i.e., type and thickness of the overlying material). The results of the drilling program indicates that the subsurface soils across the Study Area consists of silty sand, sand, and gravel, with a hydraulic conductivity in the order of 10^{-6} m/s. Therefore, the site is assessed as having the potential for infiltration to migrate into deeper aquifers, which is likely the basis for the SGRA regulated area.

Table 2: Source Protection Details on-site

Source Protection Area:	Grand River
Intake Protection Zone (IPZ):	No
Highly Vulnerable Aquifer (HVA):	No
Wellhead Protection Area (WHPA):	YES
Wellhead Protection Area Q1/ Q2:	No
Wellhead Protection Area:	WHPA-C; Score 4
Significant Groundwater Recharge Area:	Yes; Score N/A
Significant Drinking Water Threats (Zone WHPA-C, score 4	Dense Non Aqueous Phase Liquid (DNAPL)

3.1 Wellhead Protection Areas

Wellhead Protection Areas (WHPA) are areas delineated on the ground surface that represents the capture zone for the underlying aquifer in which a given municipal well draws its water. The zone represents the total amount of time it would take for groundwater to flow through the aquifer system and reach the intake of a given municipal well. The zones are defined as follows:

- WHPA-A: 100 m radius around the municipal well.
- WHPA-B: Horizontal time of travel to the municipal well is two years or less.
- WHPA-C: Horizontal time of travel to the municipal well is equal to or less than five years and greater than two years.
- WHPA-D: Horizontal time of travel to the municipal well is equal to or less than 25 years and greater than five years.
- WHPA-E: Area where groundwater is under the direct influence of surface water (GUDI), where horizontal time of travel to the municipal well is two hours or less from the surface water body to the well.

The Site resides with area identified as WHPA-C with a vulnerability score (VS) of 4. Based on the 2017 Provincial Tables of Drinking Water Threats (Clean Water Act 2006, O.Reg. 287/07), threats to drinking water in areas with a vulnerability score of 4 are generally considered low for most chemical and pathogen agents, however constraints are in place for the storage and handling of a Dense Non-Aqueous Phase Liquid (DNAPL). Source Protection Guidelines dictate that the storage or handling of DNAPL in any quantity at grade, above grade, or below grade within WHPA-C (VSp4) constitute a significant risk to drinking water and is not recommended.

3.2 Intake Protection Zone

Intake protection Zones (IPZs) are areas surrounding a municipal surface water intake; the size is determined by how quickly water flows to the intake, measured in hours. There are three categories of IPZ's; IPZ-1 is a 1-km circle around the intake; IPZ-2 is the area where water can reach the intake in 2 hours; and IPZ-3 is a delineated

area around the intake where modelling demonstrates that spills from a specific activity located outside IPZ-1 and IPZ-2 may be transported to an intake and will result in a deterioration of the water quality (CTC 2015). Based on the MECP source protection information atlas (2018), the Site does not intersect a surface water Intake Protection Zone (IPZ), however areas of IPZ-3 are identified at about 830 m to the northeast.

3.3 Highly Vulnerable Aquifers

Highly Vulnerable Aquifers (HVA) are aquifers identified to be particularly susceptible to contamination due to its location near the ground surface or within conditions that allow for accelerated advective flow. Based on the MECP source Protection Information Atlas, the site does not reside within regulated HVA areas. Small areas of HVA are identified approximately 1.2 km north of the site near Gordon Street and Lowes Road (See **Figure 8**).

3.4 Significant Groundwater Recharge Areas

The site is assessed as residing within a Significant Groundwater Recharge Areas (SGRA) having a score of N/A (not available), likely due to the presence of surficial sands at the site, which allow accelerated infiltration. The presence of surficial sands across the site provides an effective recharge zone, which necessitates regulations on potential drinking water threats. The presence of the SGRA at this location is not associated with development constraints.

3.5 Drinking Water Threats

Based on the MECP Source Protection Information Atlas (current as of: April 19, 2024), drinking water threats have been identified. In accordance with the Clean Water Act (2006) and the 2017 Provincial Tables of Circumstance in areas of WHPA-C (VS4), handling & storage of DNAPL of any quantity is identified as a significant threat. Section 59(1) of the Act applies to all land-uses identified within the City of Guelph Official Plan, except solely residential uses, where the handling and storage of dense non-aqueous phase liquids is or would be a significant drinking water threat. While it is unlikely that the mixed-use development would handle or store DNAPL, we note that commercial businesses are expected to comply with section 59 of the Act.

4.0 HYDROGEOLOGICAL EVALUATION

4.1 Monitoring Well Installation

A total of six (6) monitoring wells (BH23-1S, BH23-1D, BH23-2, BH23-3, BH23-4 and BH23-5) were installed on-site between September 28, 2003, and October 4, 2023, in compliance to the *Revised Regulations of Ontario (R.R.O) 1990, Regulation 903: Wells (MOE,1990)* (see **Figure 9**). At one location (BH23-1), a nested pair of monitoring wells (one shallow BH23-1S and one deep BH23-D) were installed in order to assess vertical gradients. Overall, the boreholes were strategically positioned throughout the Site to obtain a spatially representative understanding of soil conditions, groundwater depths and fluctuations, and evaluate local groundwater flow direction.

Monitoring wells were drilled using a standard truck-mounted drill rig supplied and operated by Altech Drilling of Cambridge, Ontario, subcontracted to WSP. The monitoring wells consisted of a 50-mm diameter PVC riser pipe with a slotted screen sealed at a selected depth within the borehole. A sand filter pack surrounded the screen, and above the screen, the borehole and annulus surrounding the riser pipe were backfilled to the surface with bentonite. A summary of the current drilling program is presented below in Table 3. Figure 9 presents the locations of monitoring wells with borehole logs provided in **Appendix A**.

Table 3: Summary of Monitoring Wells on-site

Borehole ID	Ground Surface Elevation (AMSL)	Borehole Depth (mbgs)	Screen Interval (mbgs)
BH23-1D	341.6	15.9	7.6 to 10.7
BH23-1S	341.6	6.1	3.0 to 6.1
BH23-2	341.8	18.9	9.1 to 12.2
BH23-3	340.8	14.3	6.0 to 9.1
BH23-4	338.8	14.2	5.2 to 8.2
BH23-5	339.8	18.9	7.6 to 10.7

AMSL = metres above mean sea level. Mbgs = meter below ground surface

Boreholes were advanced to depths ranging between 6.1 mbgs and 18.9 mbgs with 3-m screens installed in each well. Boreholes were drilled to deeper depths than the screen base in order to assess underlying stratigraphy. Monitoring wells have been used to collect hydrogeological data including water quality sampling, in-situ hydraulic conductivity testing, and groundwater level monitoring. A total of four (4) soil samples were collected during the drilling program and used to provide index and classification tests, water content determinations, grain size distribution analyses and Atterberg Limits. Samples were collected in the field, placed in laboratory-provided containers and transported to the WSP geotechnical laboratory for analysis (see Section 4.22).

The geodetic coordinates and ground surface elevations at the borehole locations were obtained from the topographic plan provided by FCAM, titled, "*Plan of Block 1, Plan 61M-165, City of Guelph, County of Wellington",* prepared by KRCMAR Surveyors Ltd., Ontario Land Surveyors., dated August 10, 2023. The elevations, given on the Record of Borehole sheets and referred to herein, should be considered as approximate.

4.2 Site Geology

The on-site borehole drilling program carried out by WSP has identified a non-native sand and gravel fill layer in all five (5) boreholes drilled on site with thicknesses that range between 0.7 m and 2.2 m (basal elevations ranging between 337.4 m AMSL and 340.2 m AMSL), which are interpreted as ice-contact stratified deposits. Underlying this surficial sand is a native sand and gravel layer that extends to elevations between 334.6 m AMSL (BH23-5 at the north end of the site) and 339.4 m AMSL (BH23-1 at the south end of the site), suggesting a northerly dip direction. The thickness of this sand and gravel layer ranges between 0.9 m and 4.1 m, with an average thickness of 2.4 m across the site. A fine-grained confining layer composed of silty sand till is observed to underly the sand and gravel layer, which extends to an elevation of 329.6 m AMSL in the north of the site (BH23-5) and 334.4 m AMSL in the south of the site (BH23-1). This layer is interpreted as a confining layer to a thick (between 1.5 m and 5.9 m) gravelly sand aquifer with a basal elevation that ranges between 328.3 m AMSL in the south of the site (BH23-1) and 325.0 m AMSL in the north of the site (BH23-5). The average thickness of this unit is 3.8 m. Underlying the sand and gravel aquifer is fine-grained soils composed of silt, silty clay, and silty clay till. Locally, the bedrock surface is reported to occur at an elevation of approximately 320 m AMSL (Golder, 2011), and therefore not observed in the borehole logs. Hydrogeological cross section schematics were prepared for the site in order to graphically compare soil stratigraphy across the site and to demonstrate heterogeneity.

Three cross section profiles [(A-A'), (B-B') and (C-C')] were prepared across the site (see **Figure 10**), which were constructed using geological information obtained from the onsite drilling program and borehole logs (**Appendix A**). These cross sections are not to true scale and are intended to compare soil stratigraphy across the site. These sections demonstrate that sand is thicker to the west of the site, with an overall dip to the north.

4.2.1 Hydraulic Conductivity Testing

Single well hydraulic tests (slug tests) were completed at all five (5) monitoring wells across the site on October 18, 2023. A summary of the results is provided in Table 4, with the full set of calculations are provided in **Appendix C.** The testing methodology included purging three well volumes in each well using a combination of Waterra tubing and foot valves and allowing the water level to recover prior to testing. Hydraulic conductivity tests consisted of both falling head and rising head tests, which involved utilizing both a physical slug and a bailer to displace the water and measuring the recovery. Water levels were recorded by a combination of manual measurements using a Solinst Model 5 water level tape and through the use of electronic dataloggers. Recovery data was analysed using the Bouwer & Rice (1976) method for slug test recovery.

Table 4: Hydraulic Conductivity Estimates from Hydraulic Testing

Area	Monitoring Well ID	Screen (AMSL)	Method	Material Screened	Estimated Hydraulic Conductivity (m/s)
North Building	BH23-1 S	333.98 – 330.9	Rising Head	Silty and Sand (Till), Sand and Gravel, Gravel	NA
	BH23-1 D	338.55 – 335.50	Rising Head	Silty and Sand (Till), Sand and Gravel, Gravel	2.8×10^{-5}
	BH23-2	332.65 – 329.61	Rising Head	Silty and Sand (Till), Sand	3.1×10^{-5}
	BH23-3	334.70-331.65	Rising Head	Silty and Sand (Till), Sand	2.6×10^{-5}
South Building	BH23-4	333.62-330.57	Rising Head	Silty and Sand (Till), Sand and Gravel, Gravel	1.5×10^{-5}
	BH23-5	332.18-329.13	Rising Head	Silty and Sand (Till), Sand	2.0×10^{-4}

***Notes**: AMSL = metres above sea level, m/s = metres per second*

Results demonstrate that hydraulic conductivity ranges between 2.0×10^{-4} m/sec and 3.1×10^{-5} m/sec with a geometric mean of 2.0×10^{-5} m/sec. This is an expected result given the screened materials are composed of sand. While screens in the monitoring wells are interpreted to extend across sand boundaries into glacial till, single well response testing demonstrates that the confined sand aquifer is likely driving the result.

4.2.2 Grain Size Analysis

A total of four (4) soil samples were collected during the borehole drilling program on the October 24, 2023, and sent for particle size distribution analysis to assess grain size ranges. Results of these analyses has been reviewed and used to provide an estimate of hydraulic conductivity using the Hazen's Approximation. We note that estimated hydraulic conductivities using the Hazen's Approximation has been used to compare to single well

response testing for quality assurance and to input to the dewatering assessment. A summary of the results is shown on Table 5, with the full results provided in **Appendix D**.

The estimates of hydraulic conductivity were obtained based on grain size results using the Hazen approximation:

$$K = 0.01 \times C(d10)^2 \ (m/sec)$$

Where:
K = bulk hydraulic conductivity (m/sec);
d10 = grain size at which point 10% of the soil passes the sieve (mm); and,
C = a constant generally set at 1 for these units.
The estimated hydraulic conductivity values generated from this approach have been used to determine K values for the Till material.

Table 5:Hydraulic Conductivity Estimates based on the Hazen Approximation

Area	Well ID	Sample interval (mbgs)	Analysis Method	Material Screened	Estimated Hydraulic Conductivity (m/s)
South Building	BH23-1 D	9.1 - 9.8	Hazen	Sand, some fines	1.0×10^{-6}
	BH23-2	10.7 - 11.3	Hazen	Gravelly Sand	4.9×10^{-5}
		4.6 - 5.2	Hazen	Silty and Sand, some gravel to gravelly (TILL)	1.6×10^{-7}
North Building	BH23-4	6.1 - 6.7	Hazen	Silty and Sand to Sandy Silt (TILL)	3.8×10^{-7}

Hydraulic conductivities estimated using the Hazen's Approach shows a wide range between 4.9×10^{-5} m/sec and 1.6×10^{-7} m/sec, due to soil variability. Samples collected in sand estimate hydraulic conductivity at 7.0×10^{-6} m/sec (geometric mean), while samples collected in till estimate the hydraulic conductivity at 2.5×10^{-7} m/sec (geometric mean).

4.3 Groundwater Monitoring and Sampling

4.3.1 Groundwater Levels and Flow

Groundwater monitoring across the site was carried out by WSP on five (5) events between October 12, 2023, and May 8, 2024, which included manual measurements of water levels in available monitoring wells at the site. Results of groundwater monitoring is summarized in Table 6. Groundwater is generally observed to be reasonably deep, with levels that range between 5.46 mbgs (at BH23-4) to 9.49 mbgs (at BH23-1S), equating to elevations ranging from 330.6 m to 335.6 m AMSL. Groundwater is observed to be the highest in the April and May 2024 events, which is an expected response given the spring is typically associated with increased rain and snow melt. Seasonally high groundwater elevations are noted to range between 333.0 m AMSL and 335.5 m AMSL. While the spring (April and May 2024) shows marginally higher groundwater levels, the site does not yet reflect a typical

pattern of seasonal fluctuations where summer and fall levels decline to 1-2 m below the seasonally high. This is likely due to two reasons; (1) the site is impervious and developed, suggesting that recharge may be reduced, and (2) groundwater elevations at this site are reflective of a deep confined aquifer which may not respond to abrupt changes in precipitation. We also note the monitoring period has been short. Continued monitoring over the long-term may reveal expected seasonal trends.

Table 6: Groundwater Monitoring Results

Monitoring Well ID	Ground Surface Elevation	Oct 12, 2023		Oct 18, 2023		Oct 27, 2023		Apr 04, 2024		May 08, 2024	
	(AMSL)	(mbgs)	(AMSL)	(mbgs)	(AMSL)	(mbgs)	(AMSL)	(mbgs)	(AMSL)	(mbgs)	(AMSL)
BH23-1S	341.6	Dry	-	Dry	-	Dry	-	6.1	335.5	6.4	335.2
BH23-1D	341.6	7.9	333.7	8	333.6	8.1	333.46	8.0	333.6	7.5	334.1
BH23-2	341.8	9.4	332.4	9.2	332.6	9.2	332.56	9.1	332.7	8.8	333.0
BH23-3	340.8	7.5	333.3	7.6	333.2	7.6	333.18	7.5	333.3	7.1	333.7
BH23-4	338.8	5.7	333.1	5.9	332.9	5.9	332.84	5.7	333.1	5.5	333.3
BH23-5	339.8	9.1	330.7	7.9	331.9	8.0	331.81	7.9	331.9	7.6	332.2

Notes: *mbgs= metres below ground surface, AMSL=above mean sea level*

Sandy layers that reside within and above the silty sand till are not interpreted to be perennially saturated. Observations of dry conditions in BH23-1-S along with borehole log descriptions that these layers are moist (not wet) suggest the surface layers are not saturated. However, we note that there is a lack of monitoring infrastructure in these layers and therefore the hydraulic potential of this layer is unknown. Site grading may produce intermittent groundwater in the winter and spring, or a perched system may exist partially in the year. Further investigation is recommended prior to construction.

Groundwater monitoring at the nested pair of monitoring wells (BH23-1) shows a significant difference in groundwater levels (shallow is always higher), and therefore a downwards vertical gradient is interpreted at the site. This is consistent with the regional interpretation by the ORMGP and the GRCA.

The highest groundwater levels from monitoring at the site have been used to produce an interpreted groundwater contour pattern used to identify a flow direction (see **Figure 11**). Groundwater is interpreted to flow to the northwest at a horizontal gradient of 0.026 m/m (a decline of 3 m height in 114.4 m horizontal distance).

4.3.2 Groundwater Quality

One groundwater sample was collected from monitoring well BH23-1D on October 19, 2023, by WSP staff to provide a baseline / background water quality prior to development. Dedicated Waterra polyethylene tubing and foot valves were used for well development and sampling of the groundwater, into laboratory prepared sample bottles. Prior to sampling, three well volumes were purged from the well, and field parameters were measured. Sample bottles were placed in a cooler with ice and transported to the laboratory under chain of custody procedures. The sample was sent to ALS Laboratories under chain of custody on October 19, 2023 (ALS work order number WT2333881). The sample was assessed against City of Guelph Sanitary and Storm Sewer Use By-Law (1996)-15202 (i.e., for quality of water potentially discharged to storm or sanitary sewage works during

dewatering) (Table 8). Results of the laboratory testing were compared to the City Guelph Sanitary and Storm Sewer Use by Law and to the Ontario Drinking Water Quality Standards (ODQWS) (O. Reg. 169/03). The ODWQS defines its health-based standards by the Maximum Acceptable Concentration (MAC) and Interim Maximum Acceptable Concentration (IMAC) of measured parameters, and the Aesthetic Objectives (AO) as limits that may impair taste, odour and colour or water, but do not have any health-related impact on water. Tested parameters were detected above applicable health-related criteria.
Groundwater sampling has showed no exceedances when were compared to the City Guelph Sanitary and Storm Sewer Use by Law, however, when compared to the Ontario Drinking Water Quality Standards (ODQWS) (O. Reg. 169/03), three exceedances were detected of the AO standard of the ODWQS, including Chloride, Total Aluminium, and Total Manganese. A slight exceedance in Total Manganese, measuring 0.0558mg/L compared to the standard of 0.050 mg/L, was observed. Additionally, an exceedance in Total Aluminium (0.14 mg/L) was detected, surpassing the standard of 0.1 mg/L, likely attributable to the clay-rich soils at the site. Similarly, dissolved Aluminium remained above the guideline limit of 0.003 mg/L, indicating that fine clay particles in the soil are likely responsible for the exceedance. Furthermore, an exceedance in chloride concentration of 526 mg/L was identified, exceeding the standard of 250 mg/L. Chlorides serve as reliable indicators of urban development, with chloride salts commonly employed for de-icing during winter (such as sodium chloride) and dust suppression in summer (like calcium or magnesium chloride). Elevated chloride concentrations are typically associated with urbanized areas or regions featuring dense road networks. The prevalence of sodium chloride as the primary form of road salt suggests that elevated chloride levels also imply heightened sodium levels. Wells exhibiting no increase in chloride concentrations are often situated in rural or natural settings, distant from impervious surfaces. Typically, groundwater with rising chloride trends is found within or along the periphery of areas identified as having high aquifer vulnerability. These vulnerable settings are frequently characterized by unconfined sand and gravel aquifers near the surface or by thin or absent overburden material overlaying fractured bedrock aquifers within the watershed.

The groundwater sample analysis has identified one (1) exceedance to the MAC standard of the ODWQS in Coliforms, thermotolerant [fecal] of 5 CFU/100 ml, compared to standard of 1 CFU/100 ml. Table 7 summarizes the exceedances in groundwater sampling, and the full laboratory results and certificate of analysis is provided in **Appendix E**.

Table 7: Summary of Groundwater Chemistry compared to ODQWS Standard

Parameter	ODWS AO/OG	ODWS MAC	Lowest Detection Limit	Units	BH23-1D
Physical Tests (Matrix: Water)					
Solids, total suspended [TSS]	-	-	3	mg/L	9.3
pH	6.5 -> 8.5	-	0.1	pH units	7.93
Anions and Nutrients (Matrix: Water)					
Chloride	250 mg/L	-	0.5	mg/L	**526**
Fluoride	-	1.5 mg/L	0.02	mg/L	<0.100
Kjeldahl nitrogen, total [TKN]	-	-	0.05	mg/L	0.313
Phosphorus, total	-	-	0.002	mg/L	0.0095
Sulfate (as SO4)	500 mg/L	-	0.3	mg/L	54.8
Cyanides (Matrix: Water)					
Cyanide, strong acid dissociable (Total)	0.2 mg/L	0.2 mg/L	0.002	mg/L	<0.0020
Microbiological Tests (Matrix: Water)					
Coliforms, thermotolerant [fecal]		1 CFU/mg/L	1	CFU/100mL	**5**
Total Metals (Matrix: Water)					
Aluminum, total	0.1 mg/L	-	0.003	mg/L	**0.139**
Antimony, total	-	0.006 mg/L	0.0001	mg/L	<0.00010
Arsenic, total	-	0.01 mg/L	0.0001	mg/L	0.00024
Bismuth, total	-	-	0.00005	mg/L	<0.000050
Cadmium, total	-	0.005 mg/L	0.000005	mg/L	0.0000271
Chromium, total	-	0.05 mg/L	0.0005	mg/L	<0.00050
Cobalt, total	-	-	0.0001	mg/L	0.0005
Copper, total	1 mg/L	-	0.0005	mg/L	0.00141
Iron, total	0.3 mg/L	-	0.01	mg/L	0.184

Parameter	ODWS AO/OG	ODWS MAC	Lowest Detection Limit	Units	BH23-1D
Lead, total	-	0.01 mg/L	0.00005	mg/L	0.000412
Manganese, total	0.05 mg/L	-	0.0001	mg/L	**0.0558**
Mercury, total	-	0.001 mg/L	0.000005	mg/L	<0.0000050
Molybdenum, total	-	-	0.00005	mg/L	0.00239
Nickel, total	-	-	0.0005	mg/L	0.00188
Selenium, total	-	0.05 mg/L	0.00005	mg/L	0.000242
Silver, total	-	-	0.00001	mg/L	<0.000010
Tin, total	-	-	0.0001	mg/L	0.00097
Titanium, total	-	-	0.0003	mg/L	0.00274
Vanadium, total	-	-	0.0005	mg/L	<0.00050
Zinc, total	5 mg/L	-	0.003	mg/L	0.0083
Aggregate Organics (Matrix: Water)					
Carbonaceous biochemical oxygen demand [CBOD]	-	-	2	mg/L	<3.0
Oil & grease (gravimetric)	-	-	5	mg/L	<5.0
Oil & grease, animal/vegetable (gravimetric)	-	-	5	mg/L	<5.0
Oil & grease, mineral (gravimetric)	-	-	5	mg/L	<5.0
Phenols, total (4AAP)	-	-	0.001	mg/L	<0.0010

Exceedances in Aesthetic ODWS in **BOLD**

Exceedances in Chemical/Microbiological ODWS in **RED**

Note “- “indicates no data/guideline available.

5.0 DEWATERING ASSESSMENT

5.1 Dewatering Potential

A dewatering assessment was carried out for the proposed development to provide estimates of short-term pumping rates for construction excavations of underground parking facilities at the site. The aim of the assessment is to provide anticipated flow rates during construction and to make recommendations on long-term water management. Additionally, the assessment will provide a recommendation on the likely type of water handling permit that may be required during construction. Based on designs drawings providing by SvN, dated July 23, 2024 (Drawings A103 to A106, A201 to A205, and A301 to A305), which indicate that the development is proposing two separate underground parking facilities, each extending to two levels (lowest parking elevation at 333.85 m AMSL). One underground parking facility is located at the North of the site at Blocks C and D, while the second facility is located at the south end of the site at Blocks A and B (see **Figure 2**). The assessment has estimated a flow rate for each underground parking structure independently in the assumption that they will be constructed as separate phases.

Dewatering potential has been assessed on the depths of excavations, types of soils anticipated to be encountered at the foundation levels, and the interpreted seasonally high groundwater elevations. Table 8 provides a summary comparison of anticipated foundation elevations with seasonally high groundwater to provide an overview of potential dewatering at the site.

Table 8: Summary of Elevations at the Site

Pergola	Elevation (m AMSL)	Comments
Parking Elevation (2UG)	333.85	Excavation elements are anticipated to extend through interbedded layers of silty sand (TILL) and sand and gravel layers with the excavation base anticipated to partially penetrate the confined aquifer.
Groundwater	335.57	The highest groundwater level recorded at all monitoring wells at the site has been used as the initial level.
Excavation Base	331.35	Footings are assumed to be 2 m below the final parking elevation with an additional 0.5 m added for granular material.

Notes: Elevations shown are approximate and intended to show regional trends only. The dewatering assessment is based on location specific elevations. Proposed grades are based on the grading plan provided by first Capital Asset Management LP (SvN Architects + Planners, dated July 23, 2024), while groundwater elevations are based on interpreted contours from historical high-level groundwater as documented in Section 4.2.2. The underground parking elevations are based on 2.5 m below the proposed grade elevations.

Based on groundwater monitoring between October 2023 and May 2024, seasonally high groundwater elevations are observed to range between 333.0 m AMSL and 335.5 m AMSL across the site, however as a conservative measure, the dewatering assessment has used the highest level (335.5 m AMSL) as input to the calculations. Groundwater monitoring has been limited to one seasonal period, and therefore the elevation of 335.5 m AMSL may not be fully reflective of seasonally high conditions, however using the highest water level on-site results in a

potential dewatering base that is up to 4.2 m below groundwater[1]. The assessment has determined that the finished floor parking elevation may extend below groundwater by up to 1.7 m during the spring, however groundwater is anticipated to decline below the base of the parking structure in the summer and fall (seasonally low levels between 330.6 m AMSL and 333.4 m AMSL compared to a parking elevation of 333.85 m AMSL). As a result, long-term water management should be considered to address seasonal increases in groundwater.

As presented in Section 4.1, the soil stratigraphy at the site is an interbedded sequence of silty sand, sand and gravel, silt, silty clay, and glacial till. Excavations are anticipated to extend through surficial sands (average thickness of 2.4 m), before fully penetrating a silty sand till with a thickness between 1.5 m and 5.9 m. The basal elevation of the excavations is interpreted to partially penetrate a confined sand and gravel aquifer across much of the site, with up to approximately 3 m of sand remaining between the dewatering base and the confined aquifer base (interpreted to be the underlying silt between 325.0 m AMSL and 331.1 m AMSL). As a result, this assessment has considered both lateral inflow through till soils as well as vertical seepage through the base of the excavation (sand).

The preliminary dewatering assessment will recommend the type of permitting that may be required for the development. If dewatering rates exceed 50,000 litres/day, permitting will be required. An Environmental Activity and Sector Registry (EASR) is required if the combined rates are less than 400,000 litres/day, while a Permit to Take Water (PTTW) would be required if the rates exceed 400,000 litres/day. The application requirements for a PTTW requires the applicant to address how much water will be withdrawn, over what time-period, where it will be discharged to, the water quality discharge parameters that are to be met, the expected zones of influence and the potential effects on natural features and other water users, among other things. Monitoring and mitigation measures would also be required and would be identified in the application. Permit to Take Water applications are submitted after detailed design and in advance of the construction works. PTTW applications may require up to 90 days for the MECP to complete their review, while EASR registrations can be submitted shortly prior to the start of dewatering without agency review.

5.2 Dewatering Approach and Assumptions

The dewatering assessment approach to estimate short-term pumping rates at excavations to construct underground parking includes estimating flow rates independently for the two parking facilities (north and south structures). This allows the client to consider permitting for each structure should they be constructed as separate phases. Should excavations be carried out concurrently, rates may be summed, however we note that overlapping ZOIs may result in additional impacts than what is presented in this study.

The dewatering assessment has estimated horizontal flow using construction methods by Powers (1992) in an unconfined condition using a hydraulic conductivity input of 2.5×10^{-7} m/s (representative of silty sand till and interbedded silt and sand). As the excavation is interpreted to terminate marginally above or within the confined sandy aquifer with up to 3 m of sand aquifer below the proposed base of parking, the assessment has considered vertical inflows using Darcy's Equation with a hydraulic conductivity of 2.0×10^{-5} m/s (representative of sands).

The assessment has provided dewatering rates under steady-state conditions for the anticipated condition (highest groundwater level recorded at the site and a representative hydraulic conductivity) as well as a Factor of

[1] This assessment has used the highest recorded water level measurement from monitoring at the Site between October 2023 and May 2024. This assessment has not compared yearly precipitation data to ascertain if groundwater levels are representative of typical seasonally high conditions. Should excavation work be carried out during the summer and fall, lower groundwater levels may be encountered which may differ from results presented.

Safety (FoS) approach to account for unforeseen groundwater and soil conditions, based on two times the anticipated rates.

The dewatering assessment has made the following assumptions:

- Hydraulic conductivity inputs into the assessment are based on results from single well response testing from October 2023 and using the Hazen's Approximation approach on soil samples collected during the drilling program. The assessment has used a hydraulic conductivity of 2.5 x 10^{-7} m/s to assess lateral inflow to the excavation, which is the geometric mean from Hazen Approximated hydraulic conductivities derived from soil samples collected between 4.5 m and 6.7 m below ground within the interbedded silty sand till, cobble layers, and sand seams. This hydraulic conductivity is assumed to be representative of soils above the confined aquifer for which horizontal seepage in expected to occur. Vertical flow is assessed using a hydraulic conductivity of 2.0 x 10^{-5} m/s, which is the geometric mean from single well response testing and Hazen Approximated values derived from the confined sand aquifer only. This hydraulic conductivity is considered representative of the underlying confined aquifer. The hydraulic conductivity for vertical flow has been assessed as 1/10^{th} of K_h with a gradient of equal or less than 1;
- Lateral flow through the glacial till and interbedded sand seams are assessed in an unconfined condition, while lateral and vertical flow from the confined aquifer has used a confined condition with an aquifer thickness between 1.5 m (at the north parking facility) and 3.0 m (at the south parking facility), based on borehole logs;
- Excavation footprints for underground parking are estimated at approximately 146.9 m x 44.7 m for the north block and 146.9 m x 84.1 m for south block. The dewatering base is assumed to be a total of 2.5 m below the parking elevation of 333.85 m AMSL;
- While some recommendations on long-term water management have been provided, the assessment understands that the designs have not progressed to include sub-drains, and therefore the assessment has not included flow rates for long-term dewatering systems at this time;
- The assessment has used the highest groundwater level recorded at the site between October 2023 and May 2024 as the initial water level for both the south and north excavations. While we understand that the highest groundwater level at each well on the site showed a range between approximately 332.0 m AMSL and 335.6 m AMSL, we note that monitoring is limited and may not represent seasonally high conditions. Therefore, as a conservative measure, a value of 335.6 m AMSL has been used across the site;
- The assessment does not consider uplift pressures, sanding issues, or later al pressures that may act upon the sides of the excavation. We recommend that a geotechnical engineer be engaged to assess potential buoyancy effects from the confined aquifer;
- We have assumed for this assessment that the north and south parking structures will be excavated in separate phases and therefore the presented pumping rates and ZOIs are reflective of individual elements and not of combined excavations;
- Rates presented are steady state rates. Initial pumping rates may be higher until steady state conditions are achieved; and,
- Potential stormwater input is based on a 1-hr rain event with 25 mm of precipitation falling into the excavation. It does not account for run-in and has been excluded from total combined pumping rates.

5.3 Dewatering Flow Rate Calculations

Estimates of short-term construction pumping rates for underground parking excavations are presented in Table 9, with the full results in **Appendix F**. Results include steady-state rates under anticipated and FoS conditions. The ZOI represents the distance from the edge of the excavation for which groundwater will be impacted.

Table 9: Dewatering Rates for Underground Parking Excavations

SCENARIO DESCRIPTION	NORTH PARKING	SOUTH PARKING
LATERAL FLOW THROUGH THE SILTY SAND TILL AND SANDS ABOVE THE CONFINED AQUIFER		
HYDRAULIC CONDUCTIVITY (m/sec)	2.5×10^{-7}	2.5×10^{-7}
BASAL ELEVATION OF CONFINING LAYER (m AMSL) *	331.64	334.10
EXCAVATION DIMENSIONS (m)	146.9 x 44.7	146.9 x 84.1
INITIAL GROUNDWATER ELEVATION (m AMSL)	335.57	335.57
ANTICIPATED STEADY-STATE RATE (LPD)	22,511	31,600
ZOI (m)	49.6	64.2
LATERAL AND VERTICAL FLOW THROUGH THE CONFINED AQUIFER		
HYRAULIC CONDUCTIVITY (m/sec)	2.0×10^{-5}	2.0×10^{-5}
DEWATERING BASE (m AMSL)	331.35	331.35
EXCAVATION DIMENSIONS (m)	146.9 x 44.7	146.9 x 84.1
INITIAL GROUNDWATER ELEVATION (m AMSL)	331.64	334.10
ANTICIPATED STEADY-STATE RATE (LPD)	78,502	141,064
ZOI (m)	48.3	87.1
POTENTIAL VERTICAL INFLOW (LPD)	261,972	236,197
TOTAL ANTICIPATED STEADY-STATE RATES (LPD)	**362,985**	**408,861**
TOTAL ZOI (M)	**97.9**	**151.3**
FACTOR OF SAFETY (MITIGATED) RATES	**725,970**	**817,722**
POTENTIAL STORMWATER INPUT (LITRES)	164,160	308,857

Notes: *The average basal elevation of the silty sand till overlying the confined sand and gravel aquifer taken from borehole logs (BH23-4 and BH23-5 for the north parking and BH23-1 to BH23-3 for the south parking). Potential Stormwater Input is based on a 1-hour rainfall event with 25 mm of precipitation that enters the excavation.

Steady-state pumping rates to dewatering lateral inflow through the silty sand till and interbedded layers above the confined aquifer for the north and south parking excavations are estimated at 22,511 LPD and 31,600 LPD

respectively under anticipated conditions. The rates are reasonably low given that the soils above the confined aquifer are composed predominantly of silty sand till with small sand interbeds. While there are thicker surficial sands overlying the till, as documented in Section 4.2.2, these layers are not likely to be saturated. The assessment has considered a water level below these sands, and therefore we assume there is no contribution from surficial sands. As excavations penetrate the confined aquifer, the assessment estimates that lateral and vertical flow from the sand and gravels will be approximately 340,474 LPD and 377,262 LPD respectively for the north and south parking excavations.

The combined short-term dewatering steady-state pumping rate at the North Parking area is estimated at **362,985 LPD** under anticipated conditions with a ZOI of 97.9 m from the edge of the excavation. The FoS mitigated rate is assessed as two times the anticipated rate (725,970 LPD). The combined short-term dewatering steady-state pumping rate for the South Parking area is estimated at **408,861 LPD** with a ZOI of 151.3 m from the edge of the excavation.

6.0 CONCLUSIONS AND RECOMMENDATION

A Hydrogeological assessment was prepared in order to address engineering comments provided by the City of Guelph on the 1st Pre-submission Review (OPA/ZBA Submission Material) in a letter dated December 18, 2023, for the property located at 1 Clair Road East (the “site”) in Guelph, Ontario. A comprehensive Hydrogeological Assessment was carried out for the site and offers the following conclusion:

- Based on development designs provided by SvN, the site is proposed to be re-developed into a mixed-use property with residential units, commercial businesses, and retail space. The development is proposing a combination of surface parking and underground parking (2 levels), with outdoor amenity space and recreational areas. The underground parking footprint will cover a combined footprint area of approximately 17,325 m^2 that is composed of two separate structures (one at the north of the development, one at the south) with a basal parking level at an elevation of 333.85 AMSL.
- The site resides within the Grand River Watershed, with the Speed River situated approximately 5.3 km to the west of the site. A small tributary of Grand Creek within the Hanlon subwatershed is situated approximately 1.7 km to the west. The site resides within regulated source protection areas, including significant groundwater recharge and wellhead protection areas, and as a result, development constraints would apply regarding the storage and handling of hazardous materials;
- The site is generally flat, with gently sloping topography to the Southwest. As the site is currently paved, surface runoff is currently directed to catch basins, which flow into the City of Guelph’s Sewer system;
- The site geology has been interpreted as being underlain by surficial sand and gravel fill with a thickness between 0.7 mbgs and 2.2 mbgs. Based on available data, this surficial layer is dry through the summer and fall but may be intermittently saturated in the winter and spring from surface runoff. Groundwater levels have not shown a seasonal high that extends into the surface sands, and therefore at this time, we interpret that intermittent saturation that may exist in the surface deposits is likely due to infiltration. Underlying this surficial sand is an interbedded sequence of native sand and gravel layers along with a confining silty sand till layer that extends to an elevation of 334.6 m AMSL at the south of the site and 329.9 m AMSL in the north of the site. A confined gravelly sand aquifer exists below the till that extends to elevations of 325.0 m, with an average thickness of 3.8 m. Vertical gradients are interpreted as downward and there is no evidence of artesian pressure;

- Groundwater monitoring at the site between October 2023 and May 2024 has shown seasonal high levels (observed in April and May 2024) between 5.5 mbgs and 7.6 mbgs (elevations between 333.0 m AMSL and 335.5 m AMSL), however it should be noted that monitoring wells are limited to the confined aquifer. An elevation of 335.5 m AMSL has been used an input to the dewatering assessment. Groundwater monitoring is due to continue until April 2025 to collect additional data;
- Single well response testing as estimated hydraulic conductivity values representative of the confined sand and gravel aquifer between 2.0 x 10^{-4} m/sec and 3.1 x 10^{-5} m/sec with a geometric mean of 2.0 x 10^{-5} m/sec. Testing has estimated hydraulic conductivity within the glacial till and overlying interbedded sequence of 2.5 x 10^{-7} m/sec. The dewatering assessment has used a value of 2.5 x 10^{-7} m/sec to assess lateral flow through the overburden and 2.0 x 10^{-5} m/sec in the confined aquifer to estimate pumping rates for construction dewatering;
- One groundwater quality sample from monitoring well BH23-1D was collected on October 19, 2023, to identify potential exceedances to the City of Guelph Sewer-Use By-laws guidelines. The results showed no exceedances to the Sanitary and Storm Sewer Use by Law, however three exceedances were identified to the Aesthetic Objectives of the Ontario Drinking Water Quality Standards (O. Reg. 169/03), including Chloride, Total Aluminium, and Total Manganese. One exceedance was detected in Total Coliforms (MAC standard) to the ODWQS; and,
- A dewatering assessment was carried out for two underground parking facilities (each to two levels) in consideration of short-term construction. Anticipated steady-state pumping rates for the north and south parking facilities is estimated at 362,985 LPD and 408,861 LPD respectively, which factors in both lateral and vertical inflows to the excavation. A factor of safety approach (two times the anticipated rates) has been recommended for permitting considerations, which estimates pumping rates at 725,970 LPD and 817,722 LPD respectively for the north and south parking facilities.

Upon completion of the Hydrogeological Assessment, the following recommendations are presented:

- We recommend that groundwater monitoring be continued for a duration that would allow two consecutive seasonal periods in order to refine our interpretation on seasonally high levels and to establish trends. We are aware that groundwater monitoring is due to continue to April 2025, which may provide sufficient data to establish seasonal trends in groundwater. We recommend a re-evaluation of the data at that time;
- We recommend that a scoped field program be carried out in the spring (seasonally high period) to assess the hydraulic potential of the surficial sandy layers. We recommend a test pitting program be carried out to identify if surface sands may result in groundwater management concerns during site grading activities;
- We recommend updating the groundwater quality sampling program closer to construction for analysis to applicable Sewer Use Bylaws;
- We recommend that supplementary soil samples and hydraulic conductivity testing be carried out if additional drilling is carried out on the site from other studies. Existing data is typically limited to the confined aquifer and is spatially limited across the site for a comprehensive assessment. Should additional drilling be carried out as part of another study, we recommend a supplementary investigation in cooperation with this program; and,
- This assessment has not considered buoyancy pressures from terminating the underground parking base within the sand, and a geotechnical engineer should provide an assessment of such matters.

7.0 STANDARD LIMITATIONS

("WSP") prepared this report solely for the use of the intended recipient First Capital Asset Management LP in accordance with the professional services agreement between the parties. In the event a contract has not been executed, the parties agree that the WSP General Terms for Consultant shall govern their business relationship which was provided to you prior to the preparation of this report.

The report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings in the assessment.

The conclusions presented in this report are based on work performed by trained, professional and technical staff, in accordance with their reasonable interpretation of current and accepted engineering and scientific practices at the time the work was performed.

The content and opinions contained in the present report are based on the observations and/or information available to WSP at the time of preparation, using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by WSP and other engineering/scientific practitioners working under similar conditions, and subject to the same time, financial and physical constraints applicable to this project.

WSP disclaims any obligation to update this report if, after the date of this report, any conditions appear to differ significantly from those presented in this report; however, WSP reserves the right to amend or supplement this report based on additional information, documentation or evidence.

WSP makes no other representations whatsoever concerning the legal significance of its findings.

The intended recipient is solely responsible for the disclosure of any information contained in this report. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report.

WSP has provided services to the intended recipient in accordance with the professional services agreement between the parties and in a manner consistent with that degree of care, skill and diligence normally provided by members of the same profession performing the same or comparable services in respect of projects of a similar nature in similar circumstances. It is understood and agreed by WSP and the recipient of this report that WSP provides no warranty, express or implied, of any kind. Without limiting the generality of the foregoing, it is agreed and understood by WSP and the recipient of this report that WSP makes no representation or warranty whatsoever as to the sufficiency of its scope of work for the purpose sought by the recipient of this report.

In preparing this report, WSP has relied in good faith on information provided by others, as noted in the report. WSP has reasonably assumed that the information provided is correct and WSP is not responsible for the accuracy or completeness of such information.

Benchmark and elevations used in this report are primarily to establish relative elevation differences between the specific testing and/or sampling locations and should not be used for other purposes, such as grading, excavating, construction, planning, development, etc.

Design recommendations given in this report are applicable only to the project and areas as described in the text and then only if constructed in accordance with the details stated in this report. The comments made in this report on potential construction issues and possible methods are intended only for the guidance of the designer. The

number of testing and/or sampling locations may not be sufficient to determine all the factors that may affect construction methods and costs. We accept no responsibility for any decisions made or actions taken as a result of this report unless we are specifically advised of and participate in such action, in which case our responsibility will be as agreed to at that time.

Overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

8.0 REFERENCES

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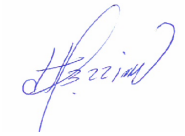
Signature Page

Prepared by



Lisseth Benavente

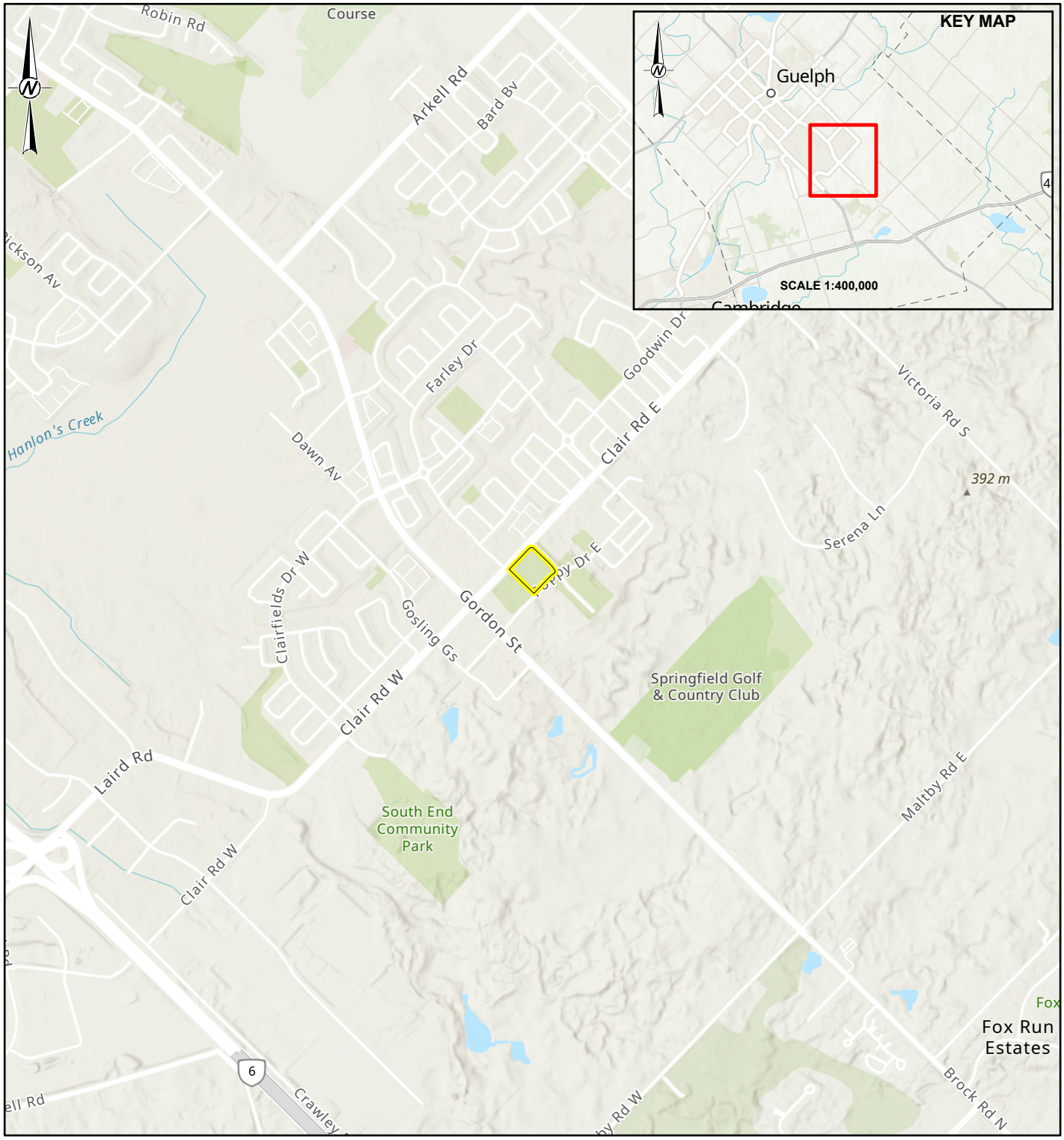
Geo-Environmental Consultant
WSP Canada Inc.

Reviewed by

Leon Halwa, M.Sc., P.Geo.
Senior Hydrogeologist
WSP Canada Inc.

Jay Nash, B.Sc., PMP
Manager of Hydrogeology and Geosciences - GTA
WSP Canada Inc.

FIGURES



LEGEND

SITE BOUNDARY

0 250 500 1,000

1:25,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: CITY OF GUELPH, PROVINCE OF ONTARIO, ESRI CANADA, ESRI, TOMTOM, GARMIN, SAFEGRAPH, GEOTECHNOLOGIES, INC, METI/NASA, USGS, EPA, NPS, US CENSUS BUREAU, USDA, NRCAN, PARKS CANADA, ESRI, NASA, NGA, USGS, ESRI, NASA, NGA, USGS, FEMA, CITY OF GUELPH, PROVINCE OF ONTARIO, ESRI CANADA, ESRI, TOMTOM, GARMIN, SAFEGRAPH, FAO, METI/NASA, USGS, EPA, NPS, NRCAN, PARKS CANADA, ESRI, © OPENSTREETMAP CONTRIBUTORS, HERE, GARMIN, FAO, USGS, EPA, NPS, AAFC, NRCAN
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
SITE LOCATION

CONSULTANT

wsp

YYYY-MM-DD	2024-07-25
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	1

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

25mm

0

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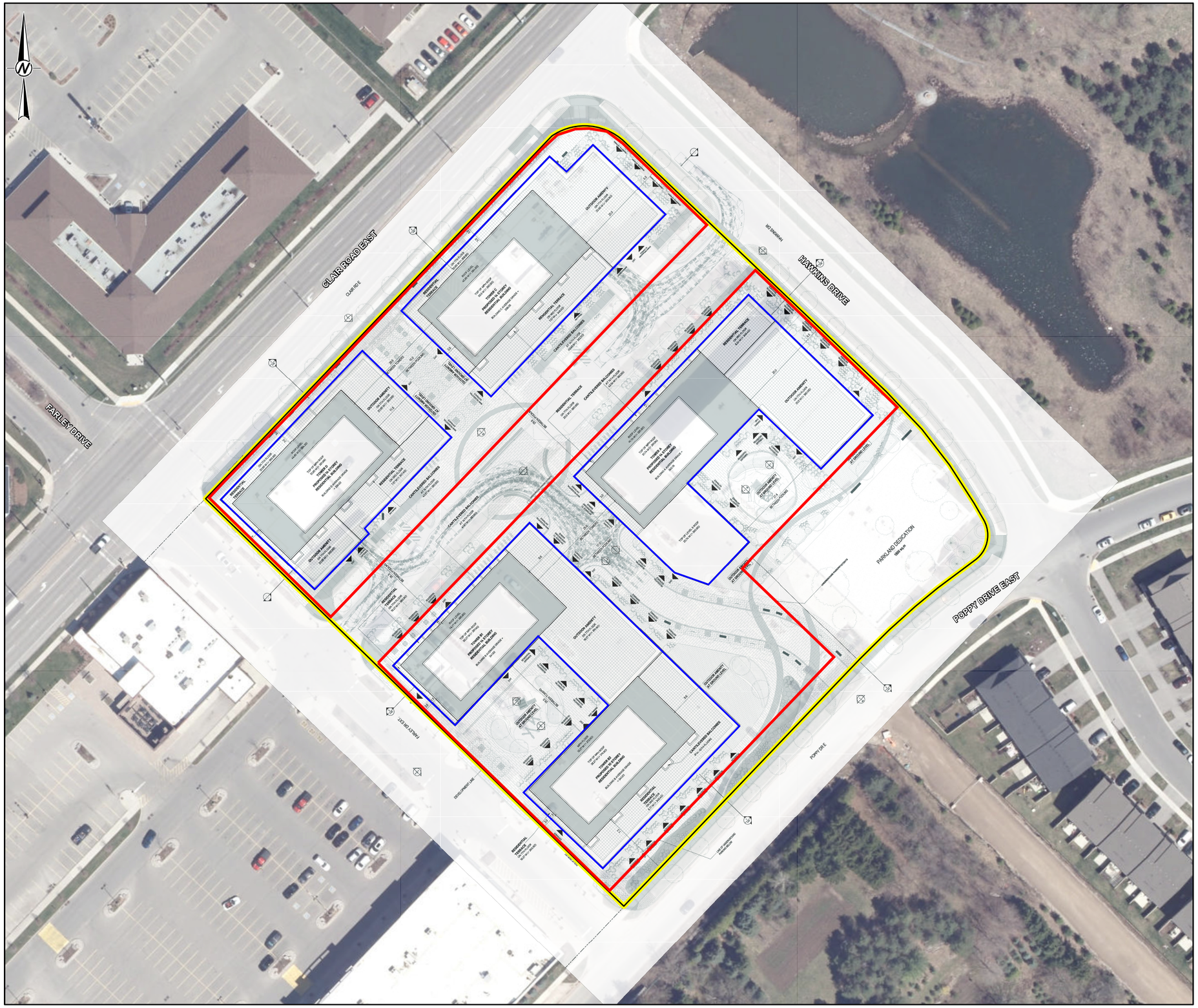


LEGEND

- SITE BOUNDARY
- UNDERGROUND PARKING EXTENT
- BUILDING FOOTPRINT AREA

Notes:

Development plans are based on Architectural Drawings A103 to A106, A201 to A205, and A301 to A305 provided by SvN Architects and Planners dated July 23, 2024.

0 10 20 40

1:1,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. SIGNIFICANT GROUNDWATER RECHARGE AREAS DATA OBTAINED FROM HTTPS://DATA.GRANDRIVER.CA/DOWNLOADS-GEOSPATIAL.HTML
3. BASE MAP: CITY OF GUELPH, MAXAR, MICROSOFT
4.
5 COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT

FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT

HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE

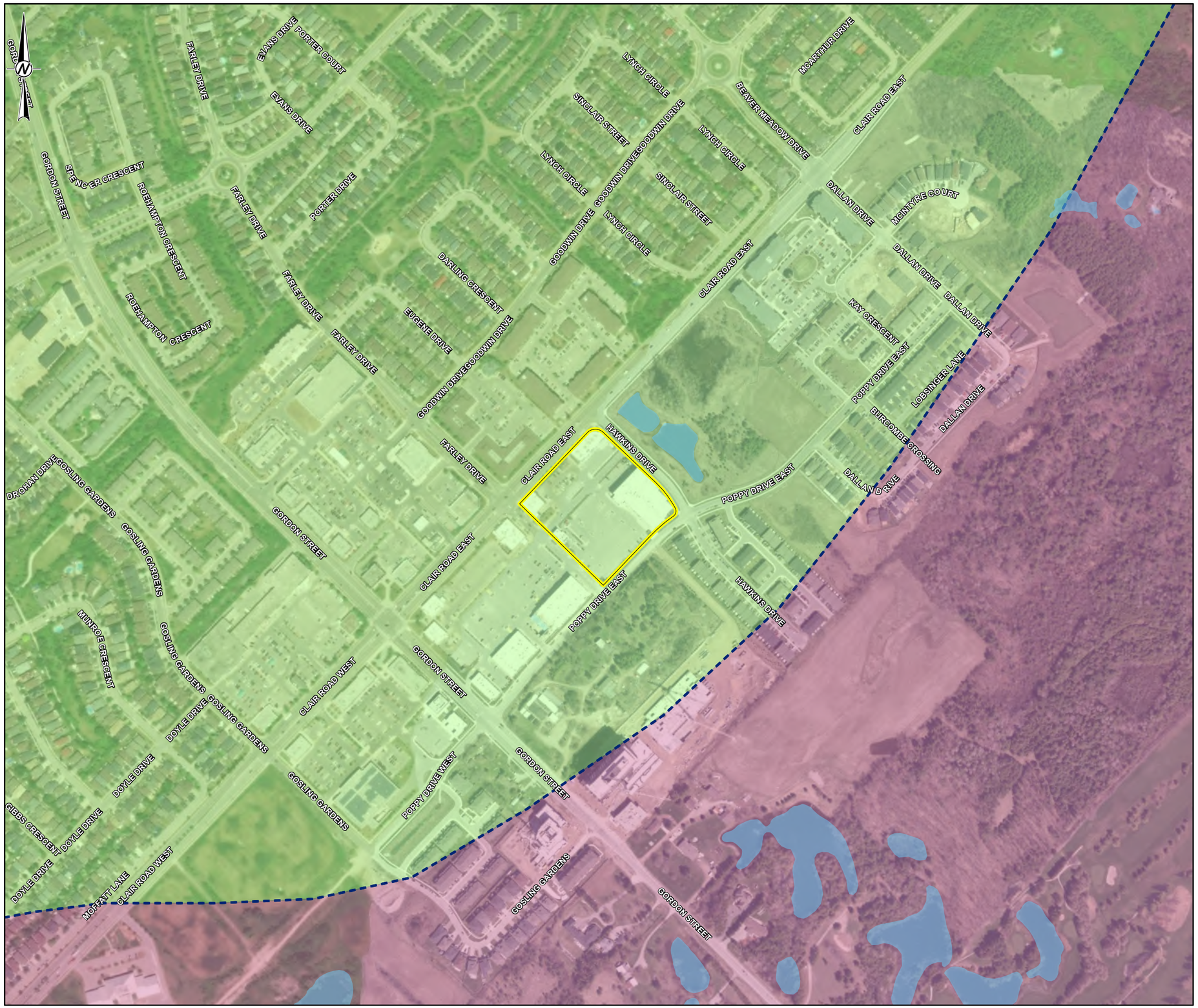
PROPOSED DEVELOPMENT PLAN

CONSULTANT

wsp

YYYY-MM-DD	2024-07-27
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	2



LEGEND

- WATER BODY
- SITE BOUNDARY
- PHYSIOGRAPHIC REGION BOUNDARY

REGIONAL PHYSIOGRAPHY:

- SPILLWAYS
- TILL MORAINES

0 50 100 200

1:5,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: CITY OF GUELPH, MAXAR
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
REGIONAL PHYSIOGRAPHY

CONSULTANT

wsp

YYYY-MM-DD	2024-07-26
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	3

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

0 25mm

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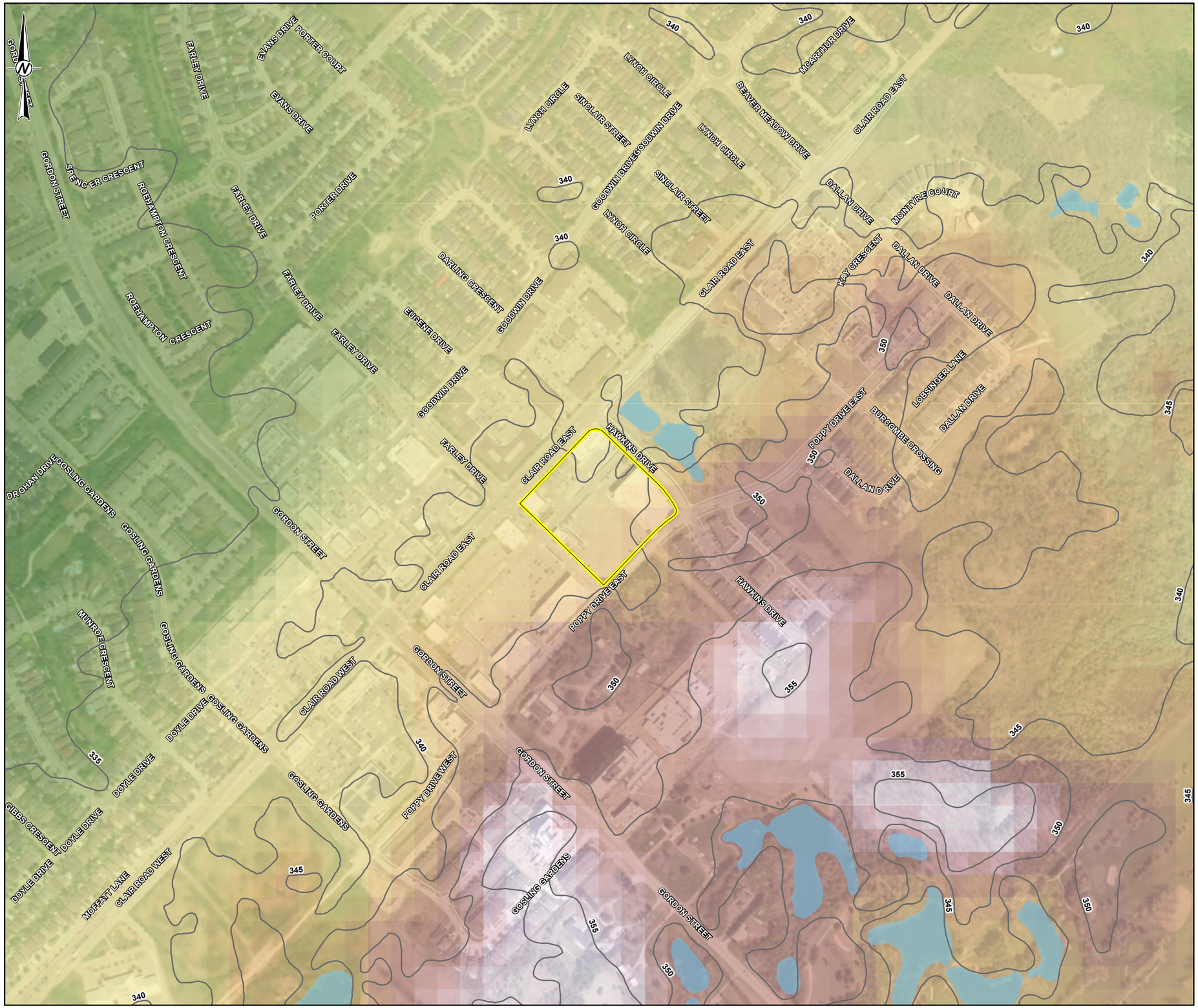

LEGEND

- WATER BODY
- SITE BOUNDARY
- TOPOGRAPHIC CONTOUR (5M INTERVAL)

DIGITAL ELEVATION MODEL (M)

HIGH - 357.606

LOW - 332.827

0 50 100 200

1:5,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: CITY OF GUELPH, MAXAR
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
TOPOGRAPHY

CONSULTANT

wsp

YYYY-MM-DD	2024-07-26
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	4

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

0 25mm

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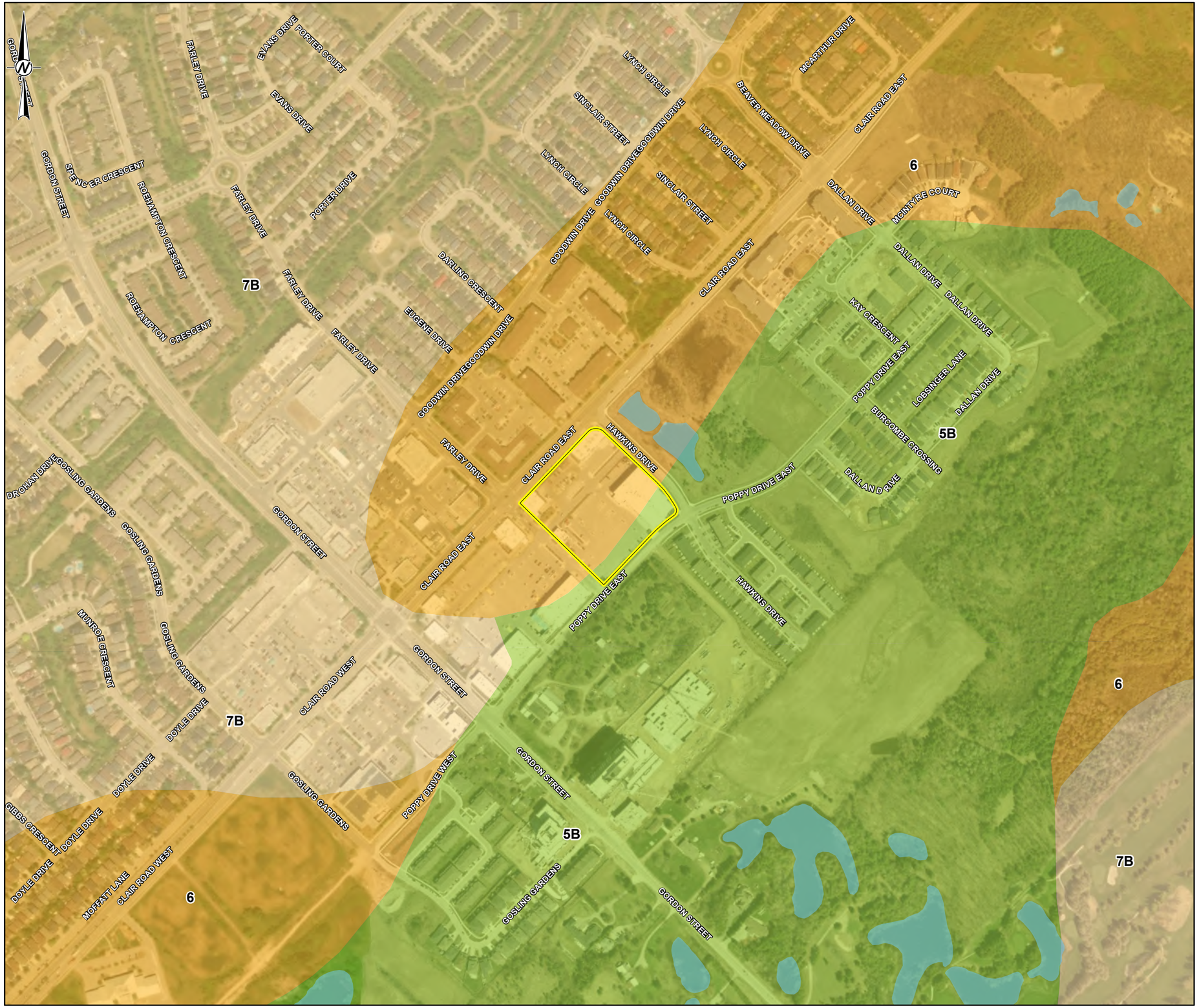


LEGEND

- WATER BODY
- SITE BOUNDARY

SURFICIAL GEOLOGY:

- 5B: STONE-POOR, CARBONATE-DERIVED SILTY TO SANDY TILL
- 6: ICE-CONTACT STRATIFIED DEPOSITS
- 7B: GRAVELLY DEPOSITS

0 50 100 200

1:5,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: CITY OF GUELPH, MAXAR
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
SURFICIAL GEOLOGY

CONSULTANT

wsp

YYYY-MM-DD	2024-07-26
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	5

LEGEND

MECP WATER WELL RECORDS

- WATER SUPPLY
- MONITORING AND TEST HOLE
- OBSERVATION WELLS
- ABANDONED-OTHER
- UNKNOWN WELL STATUS
- WATER BODY
- SITE BOUNDARY
- STUDY AREA (500 METRE RADIUS)

0 50 100 200

1:5,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: CITY OF GUELPH, MAXAR
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

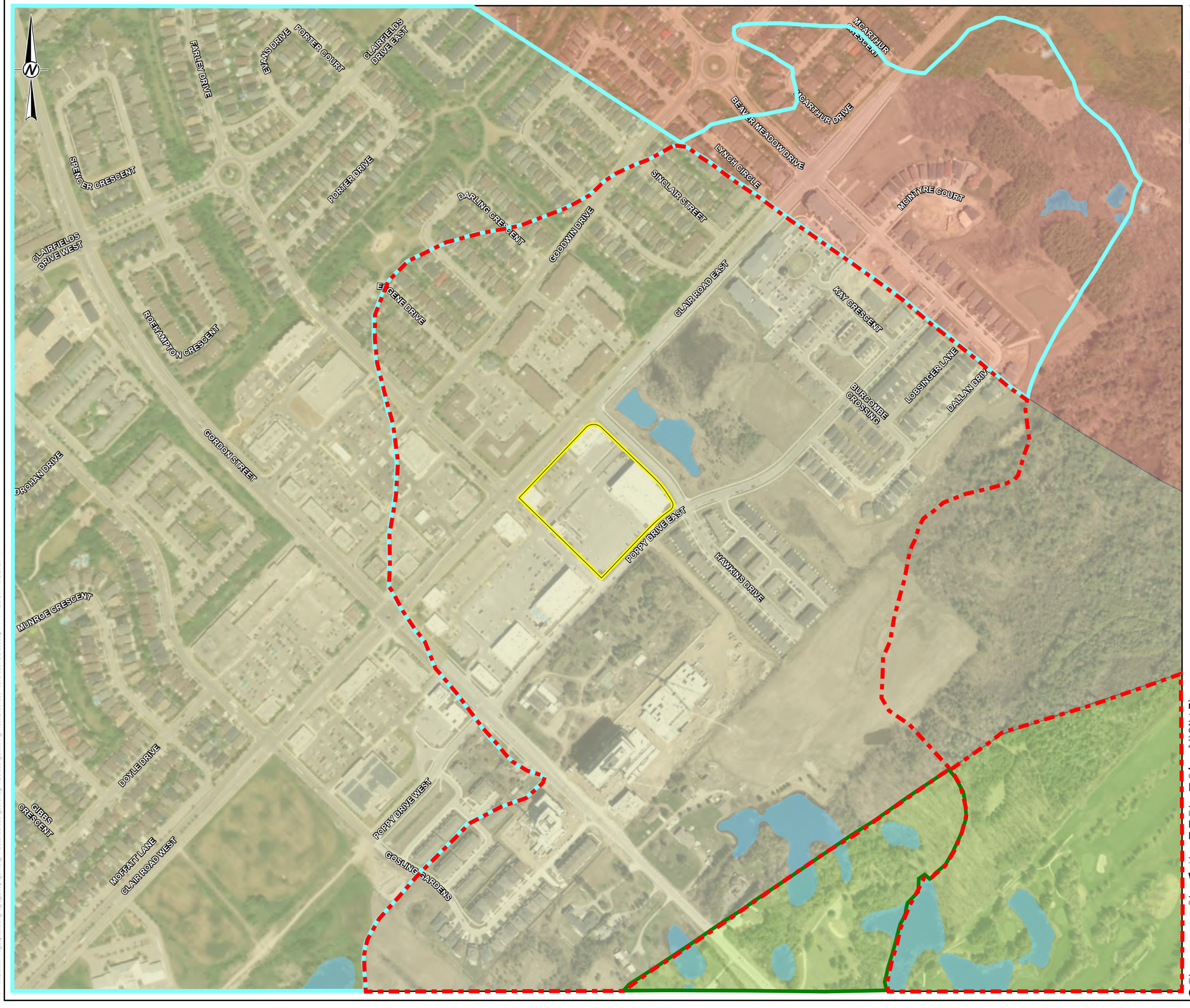
TITLE
WATER SUPPLY WELLS

CONSULTANT

wsp

YYYY-MM-DD	2024-07-26
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	6



LEGEND

- WATER BODY
- SITE BOUNDARY

WELL HEAD PROTECTION AREAS

- WHPA-B (travel time to municipal supply well assessed at less than 2 years)
- WHPA-C (travel time to municipal supply well assessed at between 2 years and 5 years)
- WHPA-D (travel time to municipal supply well assessed at between 5 years and 25 years)

WHPA VULNERABILITY SCORES

- APPROXIMATE AREA OF VULNERABILITY SCORE 2
- APPROXIMATE AREA OF VULNERABILITY SCORE 4
- APPROXIMATE AREA OF VULNERABILITY SCORE 6

NOTE:
Source water regulated areas displayed are based on the Ministry of the Environment, Conservation, and Parks (MECP) Source Protection Information Atlas

(https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA)

0 50 100 200
1:5,000 METRES

REFERENCE(S)
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3. BASE MAP: CITY OF GUELPH, MAXAR
4. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
WELL HEAD PROTECTION AREAS

CONSULTANT
wsp

YYYY-MM-DD	2024-07-26
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	7

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

25mm

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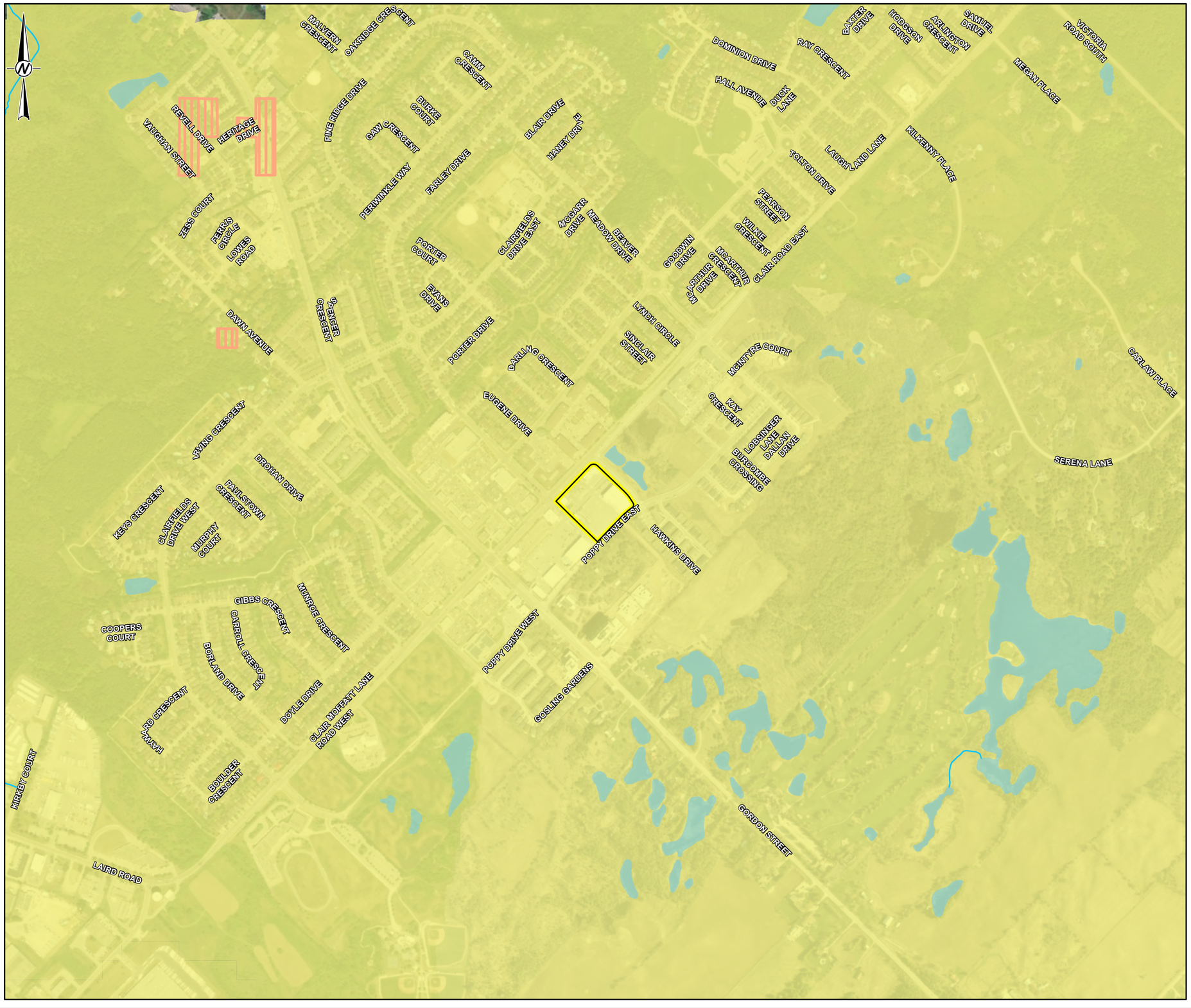

LEGEND

- WATERCOURSE
- SITE BOUNDARY
- WATER BODY
- SIGNIFICANT GROUNDWATER RECHARGE AREAS
- HIGHLY VULNERABLE AQUIFER

NOTE:
Source water regulated areas displayed are based on the Ministry of the Environment, Conservation, and Parks (MECP) Source Protection Information Atlas

(https://www.lioapplications.lrc.gov.on.ca/SourceWaterProtection/index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-CA)

0 100 200 400
1:10,000 METRES

REFERENCE(S)
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2. SIGNIFICANT GROUNDWATER RECHARGE AREAS DATA OBTAINED FROM HTTPS://DATA.GRANDRIVER.CA/DOWNLOADS-GEOSPATIAL.HTML
3. BASE MAP: CITY OF GUELPH, MAXAR
4. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
SIGNIFICANT GROUNDWATER RECHARGE AREAS

CONSULTANT

YYYY-MM-DD	2024-07-27
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	8

LEGEND

- MONITORING WELL
- CROSS_SECTION
- SITE BOUNDARY
- 333.40 MEASURED GROUNDWATER ELEVATION

0 10 20 40

1:1,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: CITY OF GUELPH, MAXAR, MICROSOFT
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
MONITORING WELL LOCATIONS

CONSULTANT

YYYY-MM-DD	2024-07-26
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	9

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

0 25mm

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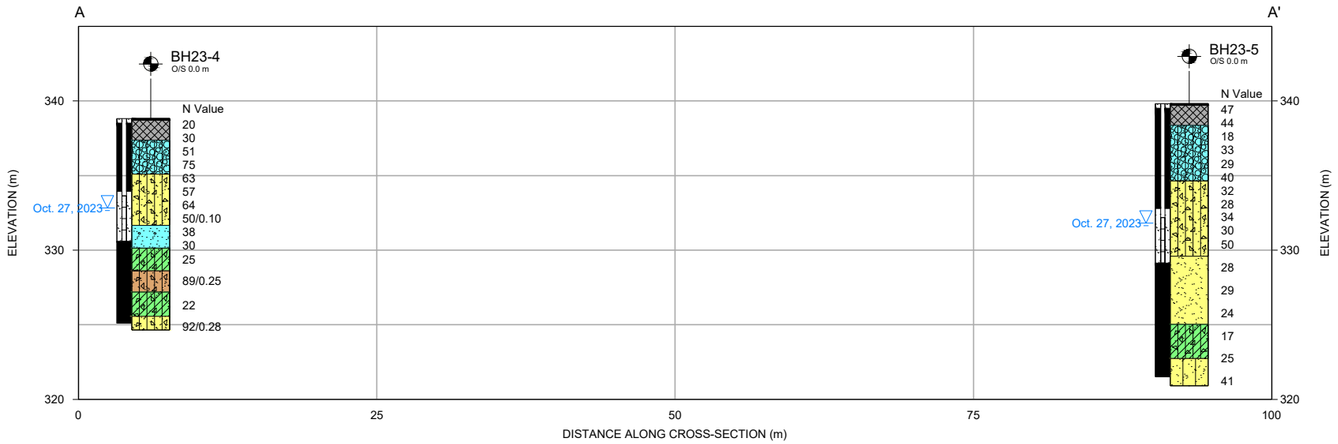


LEGEND

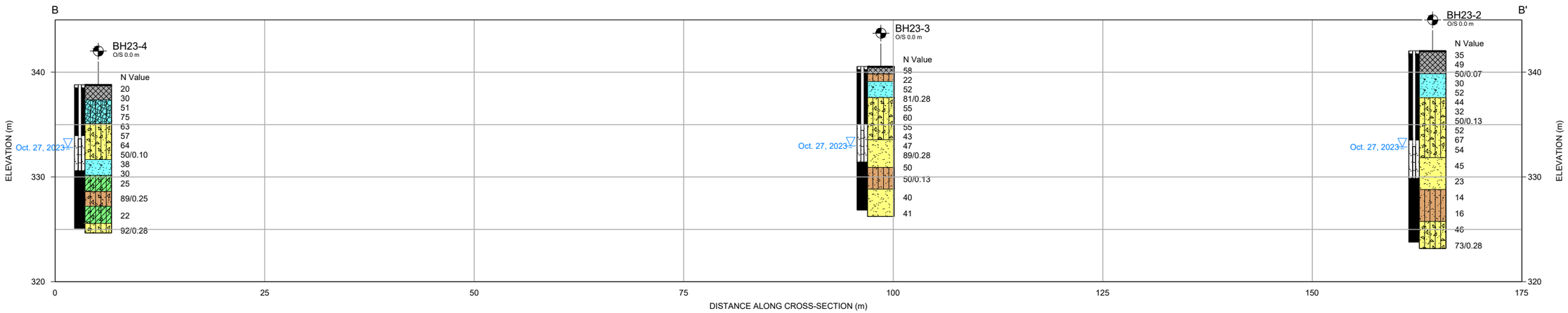
- SITE BOUNDARY
- BOREHOLE
- MONITORING WELL
- MW23-3 — BOREHOLE/MONITORING IDENTIFIER
- GROUNDWATER LEVEL (mASL)
- STRATIGRAPHY
- WELL SCREEN

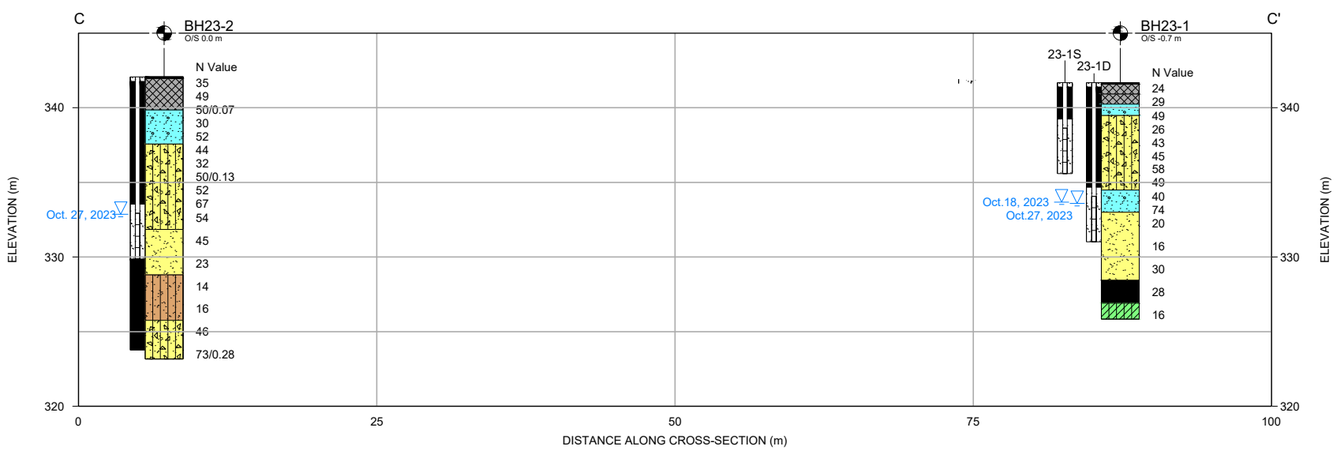
SOIL STRATIGRAPHY

- ASPHALT
- FILL/OVERBURDEN
- ORGANICS/TOPSOIL
- SANDY SILT
- SANDY SILT TILL
- SAND
- SILTY SAND TILL
- SILT
- SILTY SAND AND GRAVEL
- SAND AND GRAVEL
- SILTY CLAY/CLAYEY SILT
- SILTY CLAY TILL

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE.
2. FOR DETAILED STRATIGRAPHY SEE RECORD OF BOREHOLE LOGS.
3. FOR CROSS-SECTION LOCATION SEE FIGURE 2.





0 10 20
1:400 VERTICAL METRES

0 10 20
1:500 HORIZONTAL METRES

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
INTERPRETED SOIL STRATIGRAPHY
CROSS SECTIONS A-A',B-B',C-C'

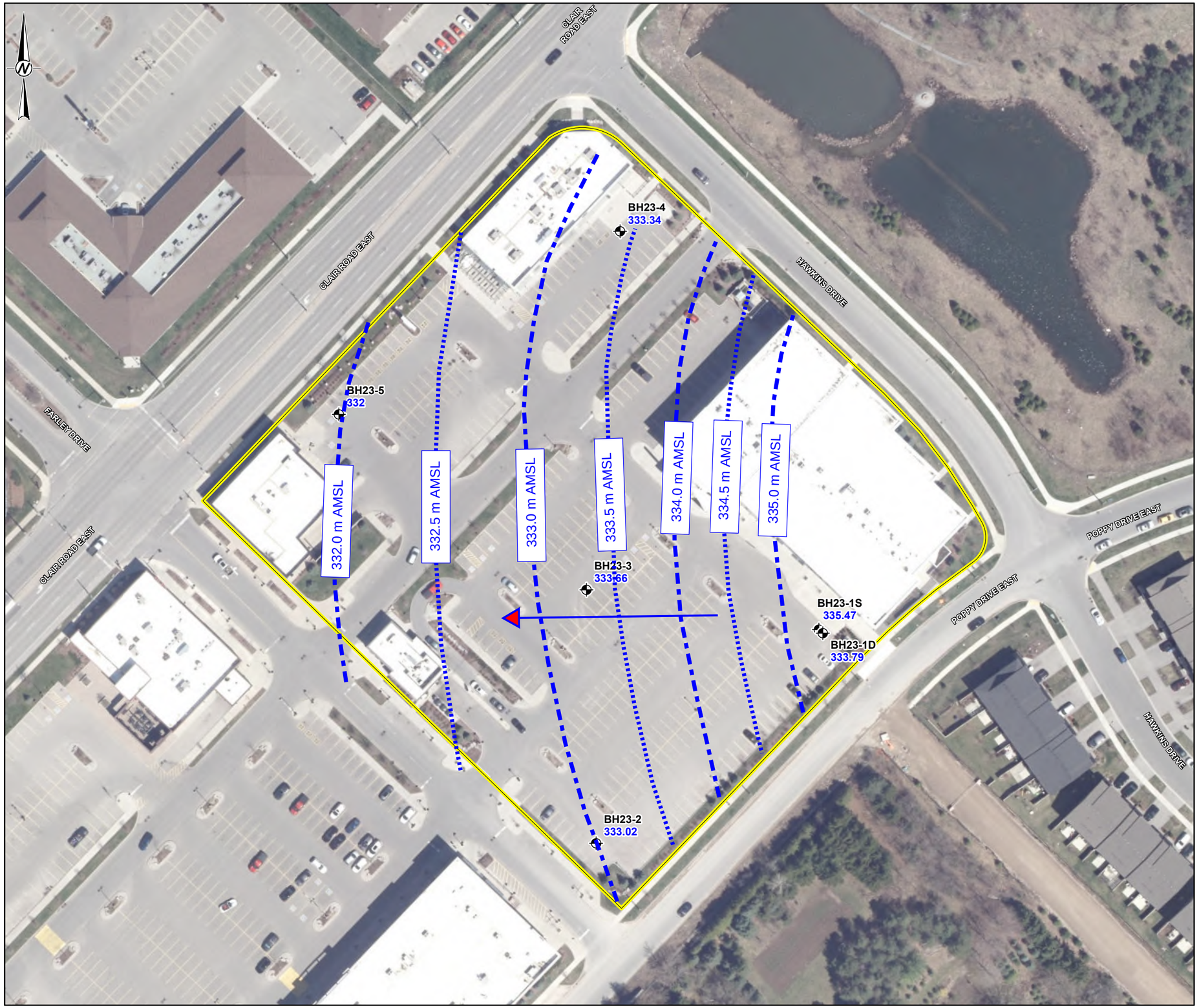
CONSULTANT

YYYY-MM-DD	2024-07-03
DESIGNED	JN
PREPARED	SJL
REVIEWED	XXX
APPROVED	XXX

PROJECT NO.	CONTROL	REV.	FIGURE
CA0010884.8370	0004	A	**10**

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

0 25 mm



LEGEND

- MONITORING WELL
- SITE BOUNDARY
- 333.40 MEASURED GROUNDWATER ELEVATION
- INTERPRETED GROUNDWATER CONTOUR (1M)
- INFERRED GROUNDWATER CONTOUR (0.5M)
- INTERPRETED GROUNDWATER FLOW

0 10 20 40

1:1,000 METRES

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: CITY OF GUELPH, MAXAR, MICROSOFT
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 17N

CLIENT
FIRST CAPITAL MANAGEMENT ASSET LP.

PROJECT
HYDROGEOLOGICAL ASSESSMENT , PROPOSED MIXED-USE DEVELOPMENT, 105 CLAIR ROAD EAST, GUELPH, ONTARIO

TITLE
INTERPRETED GROUNDWATER FLOW

CONSULTANT

YYYY-MM-DD	2024-07-26
DESIGNED	JT
PREPARED	KP
REVIEWED	AD
APPROVED	----

PROJECT NO. CA0010884.8370 | CONTROL 0004 | REV. A | FIGURE **11**

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

0 25mm

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APPENDIX A

Borehole Logs

PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-1

SHEET 1 OF 2

LOCATION: See Borehole Location Plan

BORING DATE: September 28, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected	HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected	HYDRAULIC CONDUCTIVITY, k, cm/s	WATER CONTENT PERCENT Wp W Wl	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		341.60									23-1S 23-1D
0	Diedrich D-120 Trak Mount 200 mm O.D. Hollow Stem Auger	ASPHALT (100 mm)		0.00									
		FILL - (SP) gravelly SAND, some fines; brown; non-cohesive, moist, compact		0.10	1	SS	24	ND					
				340.84									
1		FILL - (SM) SILTY SAND, some gravel to gravelly; brown; non-cohesive, moist, compact		0.76	2	SS	29	ND					
				340.15									
		(SP/GP) SAND and GRAVEL, trace fines; brown; non-cohesive, moist, dense - cobbles/boulders		1.45	3	SS	49	ND					
2				339.39									
		(SM) SILTY SAND, some gravel to gravelly; brown (TILL); non-cohesive, moist, compact to very dense		2.21	4	SS	26	ND					
3					5	SS	43	ND				M	
4					6	SS	45	ND					
5					7	SS	58	ND					
					8	SS	49	ND					
6					9	SS	40	ND					
7				334.41									
		(SP/GP) SAND and GRAVEL, trace fines; brown; non-cohesive, moist, very dense - cobbles		7.19	10	SS	74	ND					Oct.18, 2023 Oct.27, 2023
8				332.91									
		(SP) SAND, some gravel to gravelly, some fines; brown; non-cohesive, , wet, compact to dense		8.69									
9					11	SS	20	ND				MH	
10		*CONTINUED NEXT PAGE*											

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DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-1

SHEET 2 OF 2

LOCATION: See Borehole Location Plan

BORING DATE: September 28, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected; 100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected; 100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp W Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---								23-1S 23-1D
10	Diedrich D-120 Trak Mount; 200 mm O.D. Hollow Stem Auger	(SP) SAND, some gravel to gravelly, some fines; brown; non-cohesive, , wet, compact to dense								
11					12	SS	16	ND		
12										
13					13	SS	30	ND		
				328.34						
		(ML) SILT, trace sand; brown, slight plasticity; non-cohesive, wet, compact		13.26						
14					14	SS	28	ND		
				326.82						
		(CL) SILTY CLAY, some sand, some gravel: brown (TILL); cohesive, w~PL, very stiff		14.78						
15					15	SS	16	ND		
				325.75						
16		END OF BOREHOLE		15.85						
17		NOTES:								
18		1. A 50 mm Dia. monitoring well (BH23-1S) was installed in the borehole upon completion of drilling. Screened from 3.0 m to 6.1 m below ground surface.								
19		2. A 50 mm Dia. monitoring well (BH23-1D) was installed in the borehole upon completion of drilling. Screened from 7.6 m to 10.7 m below ground surface.								
20		3. Groundwater level measured in BH23-1S as follows:								

Date	Depth (m)	Elev. (m)
12-Oct-23	Dry	-
18-Oct-23	Dry	-
27-Oct-23	Dry	-

4. Groundwater level measured in BH23-1D as follows:

Date	Depth (m)	Elev. (m)
12-Oct-23	7.9	333.7
18-Oct-23	8.0	333.6
27-Oct-23	8.1	333.5

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-2

SHEET 1 OF 3

LOCATION: See Borehole Location Plan

BORING DATE: October 2, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected (100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected (100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		341.80						
0		ASPHALT (100 mm)		0.00						
		FILL - (SP/GP) SAND and GRAVEL, trace fines; brown; non-cohesive, moist, dense to very dense		0.10	1	SS	35	ND		Concrete 50 mm Dia Monitoring Well
1		- trace brick fragments			2	SS	49	ND		
					3	SS	50/0.07	ND		
2				339.59						
		(SP/GP) SAND and GRAVEL, trace to some fines; brown; non-cohesive, moist, compact to very dense		2.21	4	SS	30	ND		
3		- Cobbles								
					5	SS	52	ND		
4					6	SS	44	ND		Bentonite
				337.30						
		(SM) SILTY SAND, some gravel to gravelly; brown (TILL); non-cohesive, moist, dense to very dense		4.50	7	SS	32	ND	MH	
5					8	SS	50/0.13	ND		
6					9	SS	52	ND		
7										
8					10	SS	67	ND		
9										Sand
					11	SS	54	ND		Oct. 27, 2023 Screen
10		CONTINUED NEXT PAGE								

Diedrich D-120 Trak Mount
200 mm O.D. Hollow Stem Auger

DEPTH SCALE
1 : 50

LOGGED: AD
CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-2

SHEET 2 OF 3

LOCATION: See Borehole Location Plan

BORING DATE: October 2, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected; 100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected; 100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---								
10	Diedrich D-120 Trak Mount; 200 mm O.D. Hollow Stem Auger			331.59						
		(SP) gravelly SAND, trace fines; brown; non-cohesive, wet, compact to dense		10.21						
11					12	SS	45	ND		MH	Screen
12					13	SS	23	ND			
13				328.54						
		(ML) Sandy SILT, trace gravel, slight plasticity; grey (TILL); non-cohesive, moist, compact		13.26						
14					14	SS	14	ND			
15					15	SS	16	ND			Bentonite
16				325.49						
		(SM/ML) SILTY SAND, some gravel to gravelly; grey (TILL); non-cohesive, moist, dense to very dense		16.31						
17					16	SS	46	ND		
18					17	SS	73/0.28	ND		
				322.90						
19		END OF BOREHOLE		18.90						
20		*CONTINUED NEXT PAGE*								

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-2

SHEET 3 OF 3

LOCATION: See Borehole Location Plan

BORING DATE: October 2, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected; 100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected; 100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		*--- CONTINUED FROM PREVIOUS PAGE ---*								
		NOTE: 1. Groundwater level measured in monitoring well as follows: Date Depth (m) Elev. (m) 12-Oct-23 9.4 332.4 18-Oct-23 9.2 332.6 27-Oct-23 9.2 332.6								
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-3

SHEET 1 OF 2

LOCATION: See Borehole Location Plan

BORING DATE: September 29, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected (100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected (100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		340.80						
0		ASPHALT (100 mm)		0.00						
		FILL - (SP/GP) SAND and GRAVEL, some fines; brown; non-cohesive, moist, very dense		0.10 / 340.07	1	SS	58	ND		Concrete 50 mm Dia Monitoring Well
1		(ML) Sandy SILT; brown, oxidation stains; non-cohesive, moist, compact		0.73 / 339.35	2	SS	22	ND		
		(SP/GP) SAND and GRAVEL, some fines; brown; non-cohesive, moist, very dense - cobbles/boulders		1.45 / 337.83	3	SS	52	ND		
2					4	SS	81/0.28	ND		
3	Diedrich D-120 Trak Mount 200 mm O.D. Hollow Stem Auger	(SM) SILTY SAND, some gravel to gravelly; brown (TILL); non-cohesive, moist, dense to very dense		2.97	5	SS	55	ND		Bentonite
4					6	SS	60	ND		
5					7	SS	55	ND		
					8	SS	43	ND		Sand
6					9	SS	47	ND		
7		(SP) gravelly SAND, trace fines; brown; non-cohesive, wet, dense to very dense		7.01 / 333.79						
					10	SS	89/0.28	ND		Screen Oct. 27, 2023
8										
9					11A			ND		
				331.15		SS	50			Bentonite
		(ML) Sandy SILT; brown; non-cohesive, wet, very dense		9.65	11B			ND		
10		*CONTINUED NEXT PAGE*								

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-3

SHEET 2 OF 2

LOCATION: See Borehole Location Plan

BORING DATE: September 29, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected; 100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected; 100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---								
10	Diedrich D-120 Trak Mount, 200 mm O.D. Hollow Stem Auger	(ML) Sandy SILT; brown; non-cohesive, wet, very dense						ND		
					12	SS	50/0.13	ND		
11				329.07						
		(SP) gravelly SAND; brown; non-cohesive, wet, dense		11.73						Bentonite
12										
					13	SS	40	ND		
13										
					14	SS	41	ND		
14				326.47						
		END OF BOREHOLE		14.33						
15		NOTE:								
		1. Groundwater level measured in monitoring well as follows:								
		Date / Depth (m) / Elev. (m): 12-Oct-23 / 7.5 / 333.3; 18-Oct-23 / 7.6 / 333.2; 27-Oct-23 / 7.6 / 333.2								
16										
17										
18										
19										
20										

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-4

SHEET 1 OF 2

LOCATION: See Borehole Location Plan

BORING DATE: October 4, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ ND = Not Detected (100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ ND = Not Detected (100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT Wp W Wl (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		338.80							
0		ASPHALT (100 mm)		0.00							
		FILL - (SP/GP) SAND and GRAVEL, trace fines; brown; non-cohesive, moist, compact to dense		0.10	1	SS	20	ND			Concrete 50 mm Dia Monitoring Well
1					2	SS	30	ND			
				337.35							
		(SM/GP) SILTY SAND and GRAVEL; brown; non-cohesive, moist, very dense		1.45	3	SS	51	ND			
2		- cobbles/boulders			4	SS	75	ND			Bentonite
3					5	SS	63	ND			
				335.07							
		(SM/ML) SILTY SAND to Sandy SILT, some gravel to gravelly; brown (TILL); non-cohesive, moist to wet, dense to very dense		3.73	6	SS	57	ND			
4					7	SS	64	ND			Sand
5					8	SS	50/0.10	ND			
6		- Becomes wet at a depth of about 5.8 m									Oct. 27, 2023
					9	SS	38	ND		MH	
7				331.64							Screen
		(SP/GP) SAND and GRAVEL; brown; non-cohesive, wet, compact to dense		7.16							
8					10	SS	30	ND			
				330.11							
		(CL) Sandy SILTY CLAY, some gravel: brown (TILL); cohesive, w~PL, very stiff		8.69							
9					11	SS	25	ND			Bentonite
10											
		CONTINUED NEXT PAGE									

Diedrich D-120 Trak Mount
200 mm O.D. Hollow Stem Auger

DEPTH SCALE
1 : 50

LOGGED: AD
CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-4

SHEET 2 OF 2

LOCATION: See Borehole Location Plan

BORING DATE: October 4, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected) 100 200 300 400 / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected) 100 200 300 400	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} / WATER CONTENT PERCENT Wp W Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---								
10	Diedrich D-120 Trak Mount, 200 mm O.D. Hollow Stem Auger			328.59						
		(ML) Sandy SILT, some gravel; grey (TILL); non-cohesive, moist, very dense		10.21						
					12	SS	89/ 0.25	ND		
11				327.17						
		(CL) Sandy SILTY CLAY, some gravel: grey (TILL); cohesive, w~PL, very stiff		11.63						Bentonite
12										
					13	SS	22	ND		
13				325.54						
		(SM/ML) SILTY SAND to Sandy SILT, some gravel; grey (TILL); non-cohesive, moist, very dense		13.26						
					14	SS	92/ 0.28	ND		
14				324.63						
		END OF BOREHOLE		14.17						
15		NOTE:								
		1. Groundwater level measured in monitoring well as follows:								
		Date / Depth (m) / Elev. (m) 12-Oct-23 / 5.7 / 333.1 18-Oct-23 / 5.9 / 332.9 27-Oct-23 / 6.0 / 332.8								
16										
17										
18										
19										
20										

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-5

SHEET 1 OF 3

LOCATION: See Borehole Location Plan

BORING DATE: October 3, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected; 100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected; 100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
0		GROUND SURFACE		339.80						
		ASPHALT (100 mm)		0.00						
		FILL - (SP/GP) SAND and GRAVEL, some fines; brown; non-cohesive, moist, dense		0.10	1	SS	47	ND		Concrete 50 mm Dia Monitoring Well
1					2	SS	44	ND		
				338.35						
		(SM/GP) SILTY SAND and GRAVEL; brown; non-cohesive, moist, compact to dense		1.45	3	SS	18	ND		
2					4	SS	33	ND		
3					5	SS	29	ND		
										Bentonite
4					6	SS	40	ND		
					7	SS	32	ND		
5				334.62						
		(SM) SILTY SAND, some gravel to gravelly; brown (TILL); non-cohesive, moist, compact to very dense		5.18	8	SS	28	ND		
6					9	SS	34	ND		
7										Sand
8					10	SS	30	ND		Oct. 27, 2023
										Screen
9					11	SS	50	ND		
10		*CONTINUED NEXT PAGE*								

Diedrich D-120 Trak Mount
200 mm O.D. Hollow Stem Auger

DEPTH SCALE
1 : 50

LOGGED: AD
CHECKED: AD

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PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-5

SHEET 2 OF 3

LOCATION: See Borehole Location Plan

BORING DATE: October 3, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ (ND = Not Detected; 100 200 300 400) / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ (ND = Not Detected; 100 200 300 400)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl; 10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
10		*--- CONTINUED FROM PREVIOUS PAGE ---*								
	Diedrich D-120 Trak Mount 200 mm O.D. Hollow Stem Auger	(SP) SAND, some gravel to gravelly, trace fines; brown; non-cohesive, wet, compact		329.59 10.21						Screen
11					12	SS	28	ND		
12										
					13	SS	29	ND		
13										
14					14	SS	24	ND		Bentonite
		(CL) Sandy SILTY CLAY, some gravel: grey (TILL); cohesive, w~PL, very stiff		325.02 14.78						
15					15	SS	17	ND		
16										
					16A			ND		
17		(SM) SILTY SAND, some gravel; grey (TILL); non-cohesive, moist to wet, compact to dense		322.73 17.07		SS	25			
					16B			ND		
18								ND		
					17	SS	41	ND		
19		END OF BOREHOLE		320.90 18.90						
20		*CONTINUED NEXT PAGE*								

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

GTA-BHS 001 S:\CLIENTS\FIRST_CAPITAL\105_CLAIR_RD_E_GUELPH_ON\02_DATA\GINT\105_CLAIR_RD_E_GUELPH_ON-GEOTECH.GPJ GAL-MIS.GDT 12/12/23

PROJECT: CA0010884.8370

RECORD OF BOREHOLE: BH23-5

SHEET 3 OF 3

LOCATION: See Borehole Location Plan

BORING DATE: October 3, 2023

DATUM: Geodetic

SPT/DCPT HAMMER: MASS, 64kg; DROP, 760mm

DRILL RIG: Diedrich D120

HAMMER TYPE: AUTOMATIC

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	HEADSPACE COMBUSTIBLE VAPOUR CONCENTRATIONS [PPM] ⊕ *ND = Not Detected* 100 200 300 400 / HEADSPACE ORGANIC VAPOUR CONCENTRATIONS [PPM] □ *ND = Not Detected* 100 200 300 400	HYDRAULIC CONDUCTIVITY, k, cm/s 10^{-6} 10^{-5} 10^{-4} 10^{-3} / WATER CONTENT PERCENT Wp W Wl 10 20 30 40	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
20		*--- CONTINUED FROM PREVIOUS PAGE ---*								
		NOTE: 1. Groundwater level measured in monitoring well as follows: Date Depth (m) Elev. (m) 12-Oct-23 9.1 330.7 18-Oct-23 7.9 331.9 27-Oct-23 8.0 331.8								
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										

DEPTH SCALE

1 : 50

LOGGED: AD

CHECKED: AD

GTA-BHS 001 S:\CLIENTS\FIRST_CAPITAL\105_CLAIR_RD_E_GUELPH_ON\02_DATA\GINT\105_CLAIR_RD_E_GUELPH_ON-GEOTECH.GPJ GAL-MIS.GDT 12/12/23

Ministry of the Environment
Ontario

The Ontario Water Resources Act

WATER WELL RECORD

69/88

1. PRINT ONLY IN SPACES PROVIDED
2. CHECK ☒ CORRECT BOX WHERE APPLICABLE

11 | 6709321 | MUNICIP 67012 | CON.

COUNTY OR DISTRICT	TOWNSHIP, BOROUGH, CITY, TOWN, VILLAGE	CON. BLOCK, TRACT, SURVEY, ETC	LOT 25-27
WELLINGTON	PUSLINCH	8	11

OWNER [redacted]

ADDRESS 18 Heats Cres. Guelph, ONT.

DATE COMPLETED 48-53: DAY 025 MO 07 YR 88

21 | 1 M | NORTHING | RC | ELEVATION | RC | BASIN CODE | II | III | IV

LOG OF OVERBURDEN AND BEDROCK MATERIALS (SEE INSTRUCTIONS)

GENERAL COLOUR	MOST COMMON MATERIAL	OTHER MATERIALS	GENERAL DESCRIPTION	DEPTH - FEET FROM	DEPTH - FEET TO
BROWN	CLAY	SAND, STONES		0	15
"	F. SAND	GRAVEL		15	55
"	CLAY	SAND		55	113
m. BROWN	ROCK			113	160
D. "	"			160	180
m. GREY	ROCK			180	201
			TOTAL DEPTH	201 ft.	

31 | 32

41 WATER RECORD

WATER FOUND AT - FEET	KIND OF WATER
140	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
201	1 ☒ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS
	1 ☐ FRESH 2 ☐ SALTY 3 ☐ SULPHUR 4 ☐ MINERALS 6 ☐ GAS

51 CASING & OPEN HOLE RECORD

INSIDE DIAM INCHES	MATERIAL	WALL THICKNESS INCHES	DEPTH - FEET FROM	DEPTH - FEET TO
6	1 ☒ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC	.188	0	114
6	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☒ OPEN HOLE 5 ☐ PLASTIC		114	201
	1 ☐ STEEL 2 ☐ GALVANIZED 3 ☐ CONCRETE 4 ☐ OPEN HOLE 5 ☐ PLASTIC			

SCREEN

SIZE(S) OF OPENING (SLOT NO.) 31-33 | DIAMETER 34-38 INCHES | LENGTH 39-40 FEET

MATERIAL AND TYPE | DEPTH TO TOP OF SCREEN 41-44 FEET | 30

61 PLUGGING & SEALING RECORD

DEPTH SET AT - FEET FROM	DEPTH SET AT - FEET TO	MATERIAL AND TYPE (CEMENT GROUT, LEAD PACKER, ETC.)
10-13	14-17	
18-21	22-25	
26-29	30-33	80

71 PUMPING TEST

PUMPING TEST METHOD 10: 1 ☒ PUMP 2 ☐ BAILER

PUMPING RATE 11-14: 15 GPM

DURATION OF PUMPING 15-16 HOURS 1 17-18 MINS

STATIC LEVEL	WATER LEVEL END OF PUMPING
19-21: 50 FEET	22-24: 80 FEET

25 WATER LEVELS DURING: 1 ☐ PUMPING 2 ☒ RECOVERY

15 MINUTES	30 MINUTES	45 MINUTES	60 MINUTES
26-28: 50 FEET	29-31 FEET	32-34 FEET	35-37 FEET

IF FLOWING, GIVE RATE 38-41: — GPM

PUMP INTAKE SET AT: FEET

WATER AT END OF TEST 42: 1 ☒ CLEAR 2 ☐ CLOUDY

RECOMMENDED PUMP TYPE: ☐ SHALLOW ☒ DEEP

RECOMMENDED PUMP SETTING 43-45: 90 FEET

RECOMMENDED PUMPING RATE 46-49: 15 GPM

50-53

54 FINAL STATUS OF WELL

1 ☒ WATER SUPPLY 2 ☐ OBSERVATION WELL 3 ☐ TEST HOLE 4 ☐ RECHARGE WELL 5 ☐ ABANDONED, INSUFFICIENT SUPPLY 6 ☐ ABANDONED, POOR QUALITY 7 ☐ UNFINISHED 9 ☐ DEWATERING

55-56 WATER USE

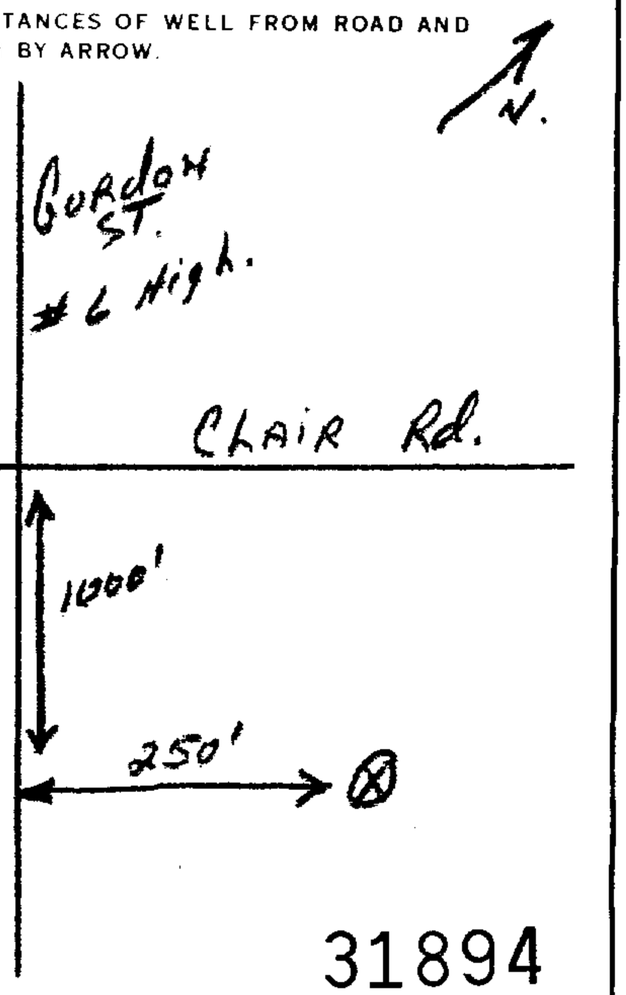
1 ☒ DOMESTIC 2 ☐ STOCK 3 ☐ IRRIGATION 4 ☐ INDUSTRIAL ☐ OTHER 5 ☐ COMMERCIAL 6 ☐ MUNICIPAL 7 ☐ PUBLIC SUPPLY 8 ☐ COOLING OR AIR CONDITIONING 9 ☐ NOT USED

57 METHOD OF CONSTRUCTION

1 ☐ CABLE TOOL 2 ☐ ROTARY (CONVENTIONAL) 3 ☐ ROTARY (REVERSE) 4 ☒ ROTARY (AIR) 5 ☐ AIR PERCUSSION 6 ☐ BORING 7 ☐ DIAMOND 8 ☐ JETTING 9 ☐ DRIVING ☐ DIGGING ☐ OTHER

LOCATION OF WELL

IN DIAGRAM BELOW SHOW DISTANCES OF WELL FROM ROAD AND LOT LINE. INDICATE NORTH BY ARROW.



31894

DRILLERS REMARKS

CONTRACTOR

NAME OF WELL CONTRACTOR: GRAHAM WELL DRILLING LTD
WELL CONTRACTOR'S LICENCE NUMBER: 2336
ADDRESS: RR #5, Rockwood, ONT. N0B-2K0
NAME OF WELL TECHNICIAN: J. HAWKINS
WELL TECHNICIAN'S LICENCE NUMBER: T0427
SIGNATURE OF TECHNICIAN/CONTRACTOR: R. Graham
SUBMISSION DATE: DAY 030 MO. 07 YR 88

OFFICE USE ONLY

DATA SOURCE 58 | CONTRACTOR 59-62: 2336 | DATE RECEIVED 63-68: AUG 15 1988 | 80
DATE OF INSPECTION | INSPECTOR
REMARKS

CSS.ES

MINISTRY OF THE ENVIRONMENT COPY

FORM NO. 0506 (11/86) FORM 9

APPENDIX B

MECP Water Well Records

APPENDIX E

MECP Data Water Well Records

(First Capital Asset Management LP at 1 Clair Road East, Guelph, Ontario)

Well ID	Data Completed	Depth	Static Water Level	Final Status	Use
6702483	September 30, 1950	61.3	25.6	Water-Supply	Domestic
6702484	October 1, 1954	46.0	11.6	Water-Supply	Domestic
6702485	August 6, 1955	54.9	19.5	Water-Supply	Domestic
6702486	November 5, 1957	51.8	18.3	Water-Supply	Domestic
6702636	November 8, 1963	45.1	11.6	Water-Supply	Domestic
6702637	July 2, 1963	24.4	12.2	Water-Supply	Domestic
6702638	February 16, 1951	50.3	17.4	Water-Supply	Domestic
6702639	December 15, 1950	39.6	21.3	Water-Supply	Livestock
6703159	August 8, 1968	47.9	11.0	Water-Supply	Commercial
6704203	February 16, 1972	32.9	10.1	Water-Supply	Domestic
6707721	December 10, 1982	69.2	22.9	Water-Supply	Domestic
6709321	July 25, 1988	61.3	15.2	Water-Supply	Domestic
6710049	October 21, 1989	44.2	21.3	Water-Supply	Domestic
6710383	June 12, 1990	68.9	22.9	Water-Supply	Domestic
7228794	July 24, 2014	43.3	11.0	Water-Supply	Domestic
7039768	November 6, 2006	67.7	18.9	Water-Supply	Domestic
6715767	May 17, 2006	13.6	0.0	Observation-Wells	Not Used
7041091	March 27, 2007	89.9	0.0	Observation-Wells	-
7041092	March 27, 2007	51.8	0.0	Observation-Wells	-
7041093	March 27, 2007	27.4	0.0	Observation-Wells	-
7041094	March 27, 2007	13.7	0.0	Observation-Wells	-
7157282	November 26, 2010	25.9	0.0	Observation-Wells	Monitoring
7157283	December 3, 2010	13.7	0.0	Observation-Wells	Monitoring
7157284	December 2, 2010	26.8	0.0	Observation-Wells	Monitoring
7231333	October 3, 2014	4.6	0.0	Observation-Wells	Monitoring
7231334	October 3, 2014	13.7	0.0	Observation-Wells	Monitoring
7263844	May 15, 2016	6.0	0.0	Observation-Wells	Monitoring

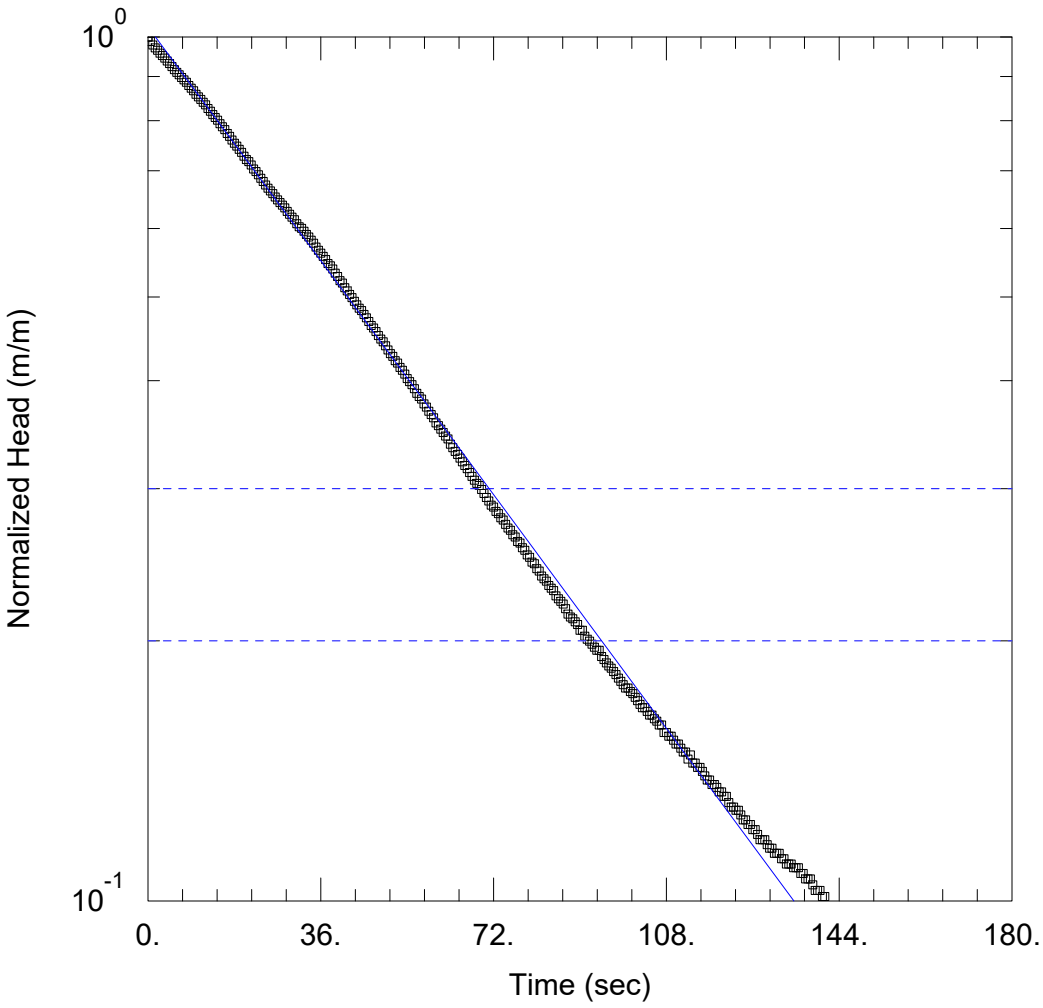
Well ID	Data Completed	Depth	Static Water Level	Final Status	Use
7264054	April 5, 2016	4.0	0.0	Observation-Wells	Monitoring
7264055	April 5, 2016	8.2	0.0	Observation-Wells	Monitoring
7264056	April 24, 2016	4.0	0.0	Observation-Wells	Monitoring
7264057	April 4, 2016	7.9	0.0	Observation-Wells	Monitoring
7278477	August 23, 2016	21.3	13.4	Observation-Wells	Monitoring
7278484	August 22, 2016	29.9	15.9	Observation-Wells	Monitoring
7328911	February 27, 2019	12.2	0.0	Monitoring-and-Test-Hole	Monitoring
7328912	February 7, 2019	12.2	0.0	Monitoring-and-Test-Hole	Monitoring
7330376	March 25, 2019	9.1	0.0	Monitoring-and-Test-Hole	Municipal
7330377	March 25, 2019	18.3	16.8	Monitoring-and-Test-Hole	Monitoring-and-Test-Hole
7330378	March 25, 2019	9.1	0.0	Monitoring-and-Test-Hole	Monitoring-and-Test-Hole
7335550	January 17, 2019	8.2	0.0	-	Monitoring-and-Test-Hole
7332733	December 17, 2018	0.0	0.0	-	-
7219270	-	0.0	0.0	-	-
7267302	April 22, 2014	0.0	0.0	-	-
7311675	April 19, 2018	0.0	0.0	-	-
7118150	December 16, 2008	0.0	0.0	Abandoned-Other	Not Used
7150520	June 22, 2010	0.0	0.0	Abandoned-Other	-
6712225	April 30, 1997	33.5	8.8	Abandoned-Other	Domestic
6713683	April 4, 2001	0.0	0.0	Abandoned-Other	-
6713684	April 4, 2001	0.0	0.0	Abandoned-Other	-
6713685	April 4, 2001	0.0	0.0	Abandoned-Other	-
6713686	April 4, 2001	0.0	0.0	Abandoned-Other	-
6713688	April 4, 2001	0.0	0.0	Abandoned-Other	-
7238744	September 15, 2014	0.0	0.0	Abandoned-Other	-
7255411	December 16, 2015	0.0	0.0	Abandoned-Other	-
7333782	May 7, 2019	12.2	0.0	Abandoned-Other	Monitoring

Well ID	Data Completed	Depth	Static Water Level	Final Status	Use
7333783	May 7, 2019	12.2	0.0	Abandoned-Other	Monitoring
7333784	May 7, 2019	12.2	0.0	Abandoned-Other	Monitoring
7232850	October 23, 2014	0.0	0.0	Abandoned-Other	Domestic
7285955	April 18, 2017	0.0	0.0	Abandoned-Other	Domestic
7191429	October 31, 2012	0.0	8.5	Abandoned-Other	Domestic

Notes: Results documents are based on MECP records present during a November 2023 search

APPENDIX C

Hydraulic Conductivity Testing Analytical Solutions



WELL TEST ANALYSIS

Data Set: C:\...\23-1D.aqt
Date: 06/04/24 Time: 15:15:52

PROJECT INFORMATION

Company: WSP
Client: First Capital Asset Management
Project: CA0010884
Location: 105 Clair Road East, Guelph, O
Test Well: 23-1D
Test Date: 10/18/2023

AQUIFER DATA

Saturated Thickness: 2.62 m Anisotropy Ratio (Kz/Kr): 1.

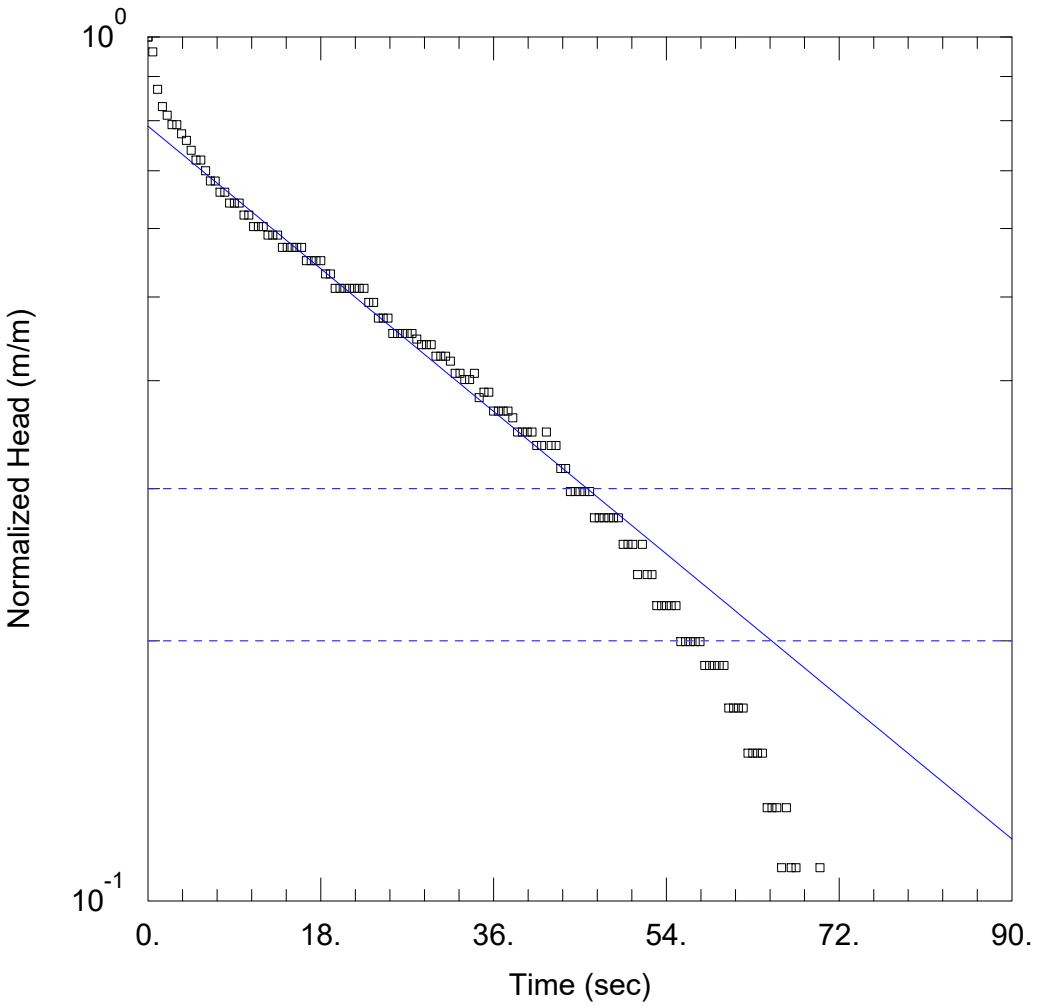
WELL DATA (23-1D)

Initial Displacement: 1.095 m
Total Well Penetration Depth: 2.62 m
Casing Radius: 0.025 m
Static Water Column Height: 2.62 m
Screen Length: 2.62 m
Well Radius: 0.1 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.787E-5 m/sec y0 = 1.125 m



WELL TEST ANALYSIS

Data Set: C:\...\23-2.aqt
Date: 06/04/24 Time: 15:50:25

PROJECT INFORMATION

Company: WSP
Client: First Capital Asset Management
Project: CA0010884
Location: 105 Clair Road East, Guelph, O
Test Well: 23-2
Test Date: 10/18/2023

AQUIFER DATA

Saturated Thickness: 3.04 m Anisotropy Ratio (Kz/Kr): 1.

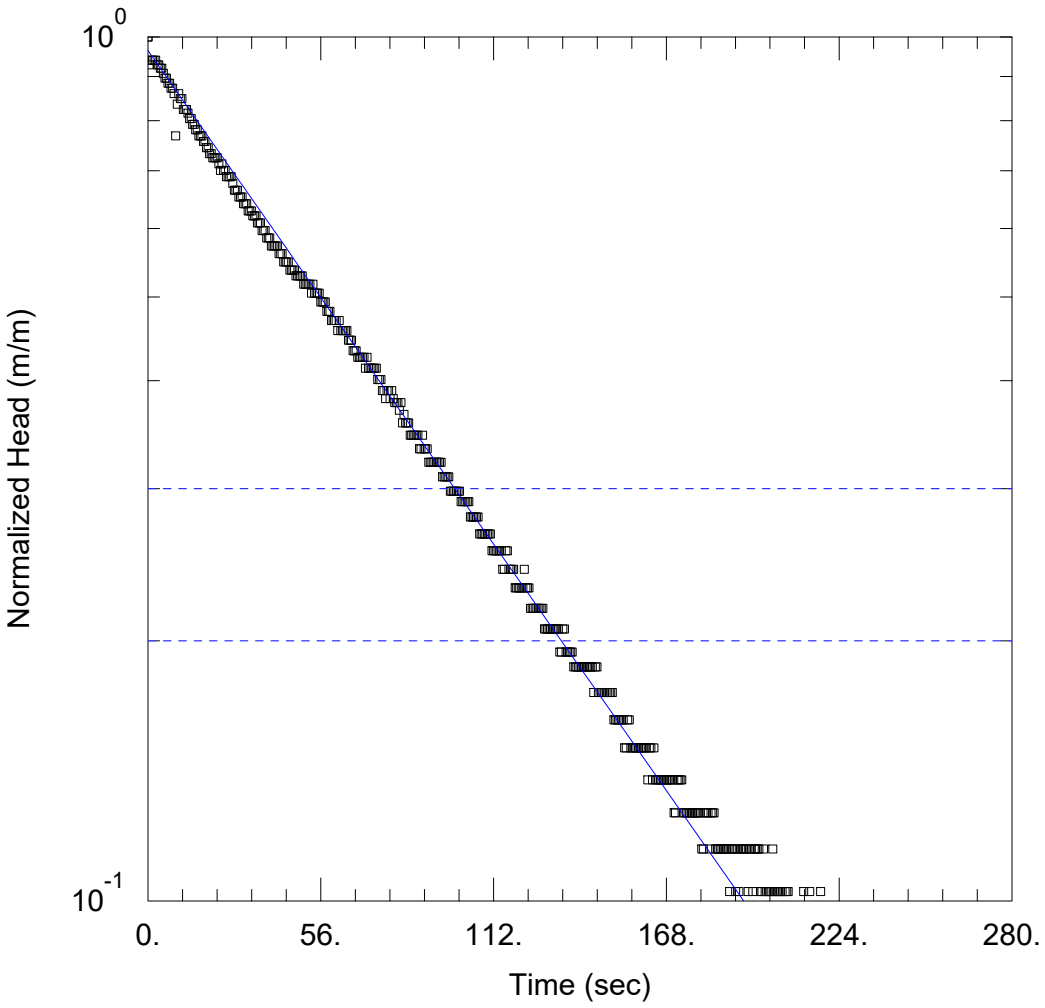
WELL DATA (23-2)

Initial Displacement: 0.0897 m
Total Well Penetration Depth: 3.04 m
Casing Radius: 0.025 m
Static Water Column Height: 3.04 m
Screen Length: 3.04 m
Well Radius: 0.1 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 3.081E-5 m/sec y0 = 0.07072 m



WELL TEST ANALYSIS

Data Set: C:\...\23-3.aqt
Date: 06/04/24 Time: 16:01:13

PROJECT INFORMATION

Company: WSP
Client: First Capital Asset Management
Project: CA0010884
Location: 105 Clair Road East, Guelph, O
Test Well: 23-3
Test Date: 10/18/2023

AQUIFER DATA

Saturated Thickness: 1.59 m Anisotropy Ratio (Kz/Kr): 1.

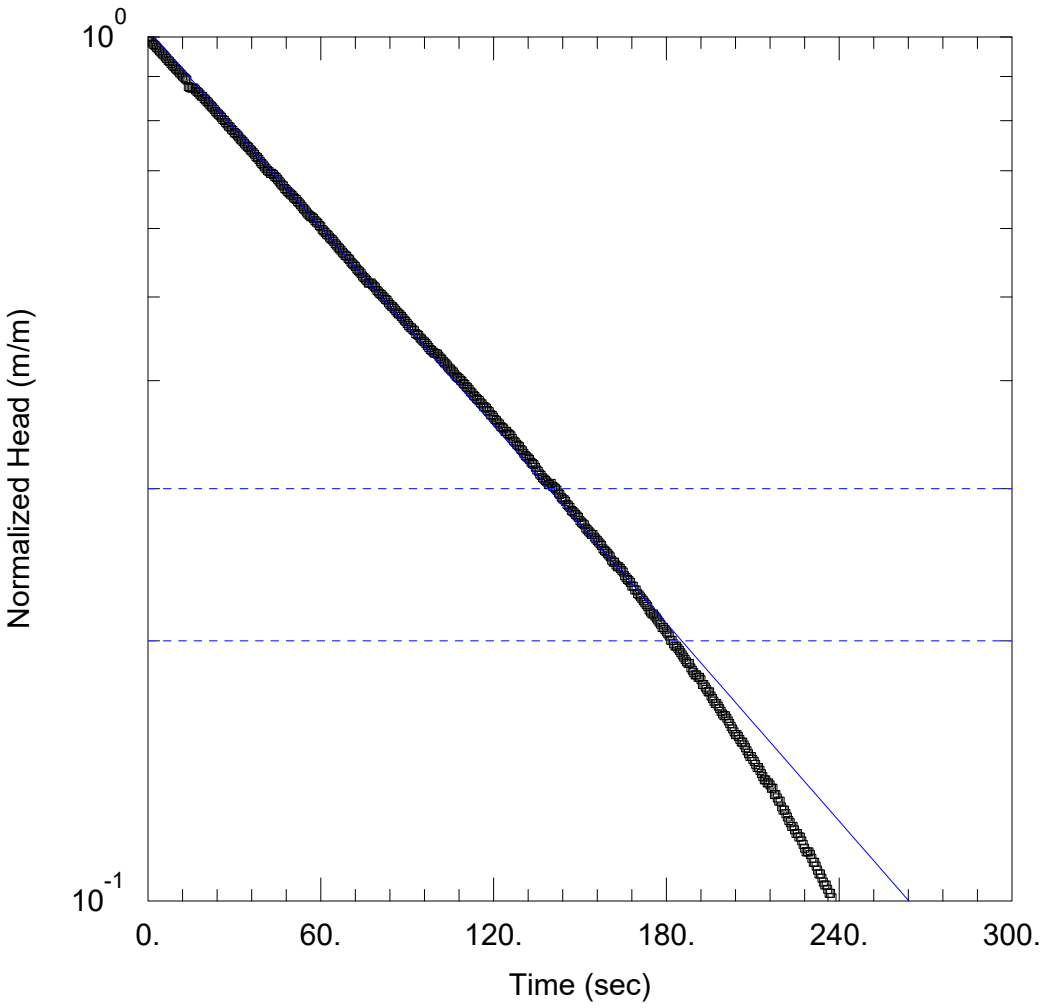
WELL DATA (23-3)

Initial Displacement: 0.1463 m
Total Well Penetration Depth: 1.59 m
Casing Radius: 0.025 m
Static Water Column Height: 1.59 m
Screen Length: 1.59 m
Well Radius: 0.1 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 2.569E-5 m/sec y0 = 0.141 m



WELL TEST ANALYSIS

Data Set: C:\...\23-4.aqt
Date: 06/04/24 Time: 16:01:39

PROJECT INFORMATION

Company: WSP
Client: First Capital Asset Management
Project: CA0010884
Location: 105 Clair Road East, Guelph, O
Test Well: 23-4
Test Date: 10/18/2023

AQUIFER DATA

Saturated Thickness: 2.31 m Anisotropy Ratio (Kz/Kr): 1.

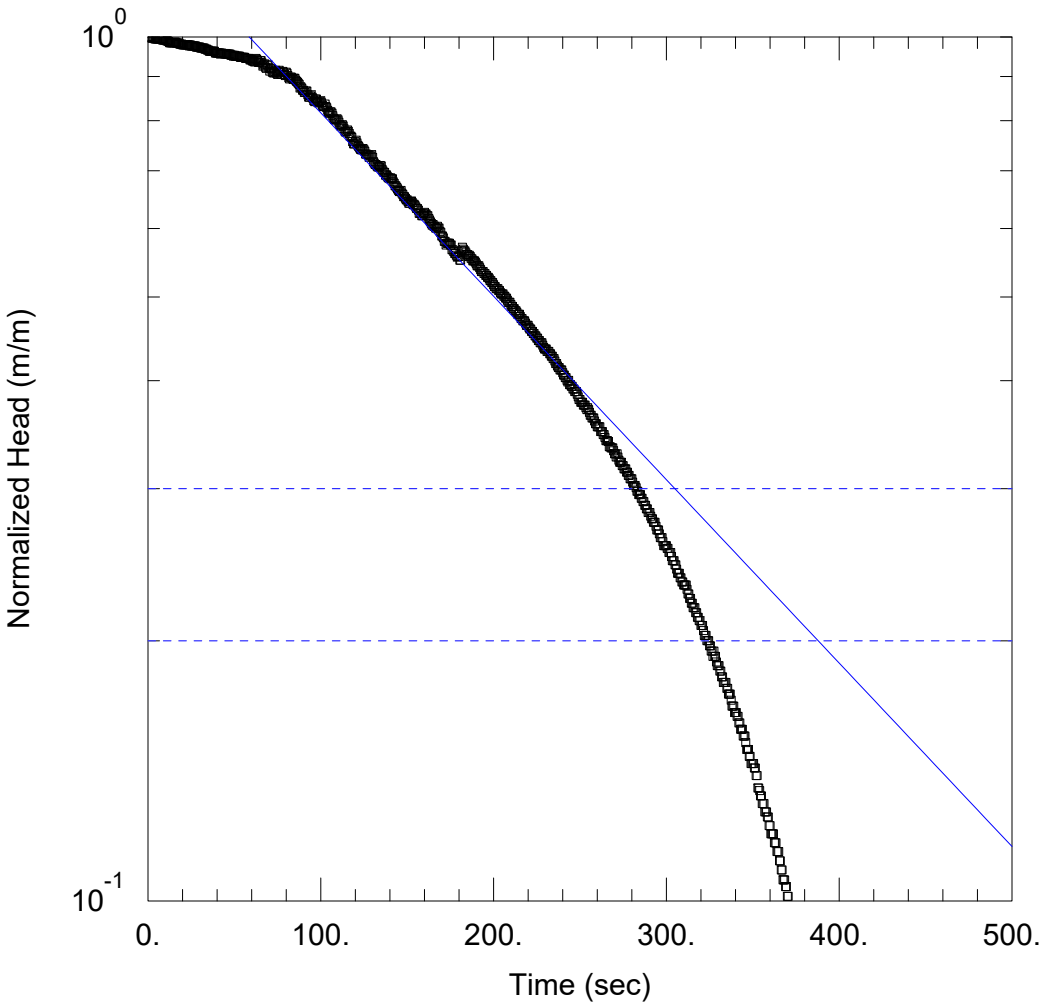
WELL DATA (23-4)

Initial Displacement: 1.52 m
Total Well Penetration Depth: 2.31 m
Casing Radius: 0.025 m
Static Water Column Height: 2.31 m
Screen Length: 2.31 m
Well Radius: 0.1 m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.534E-5 m/sec y0 = 1.549 m



WELL TEST ANALYSIS

Data Set: C:\...\23-5.aqt
Date: 06/04/24 Time: 16:02:04

PROJECT INFORMATION

Company: WSP
Client: First Capital Asset Management
Project: CA0010884
Location: 105 Clair Road East, Guelph, O
Test Well: 23-5
Test Date: 10/18/2023

AQUIFER DATA

Saturated Thickness: 2.78 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (23-5)

Initial Displacement: 0.6373 m
Total Well Penetration Depth: 2.78 m
Casing Radius: 0.025 m
Static Water Column Height: 2.78 m
Screen Length: 2.78 m
Well Radius: 1. m
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0002027 m/sec y0 = 0.8487 m

APPENDIX D

Grain Size Analysis and Curves

PARTICLE SIZE DISTRIBUTION

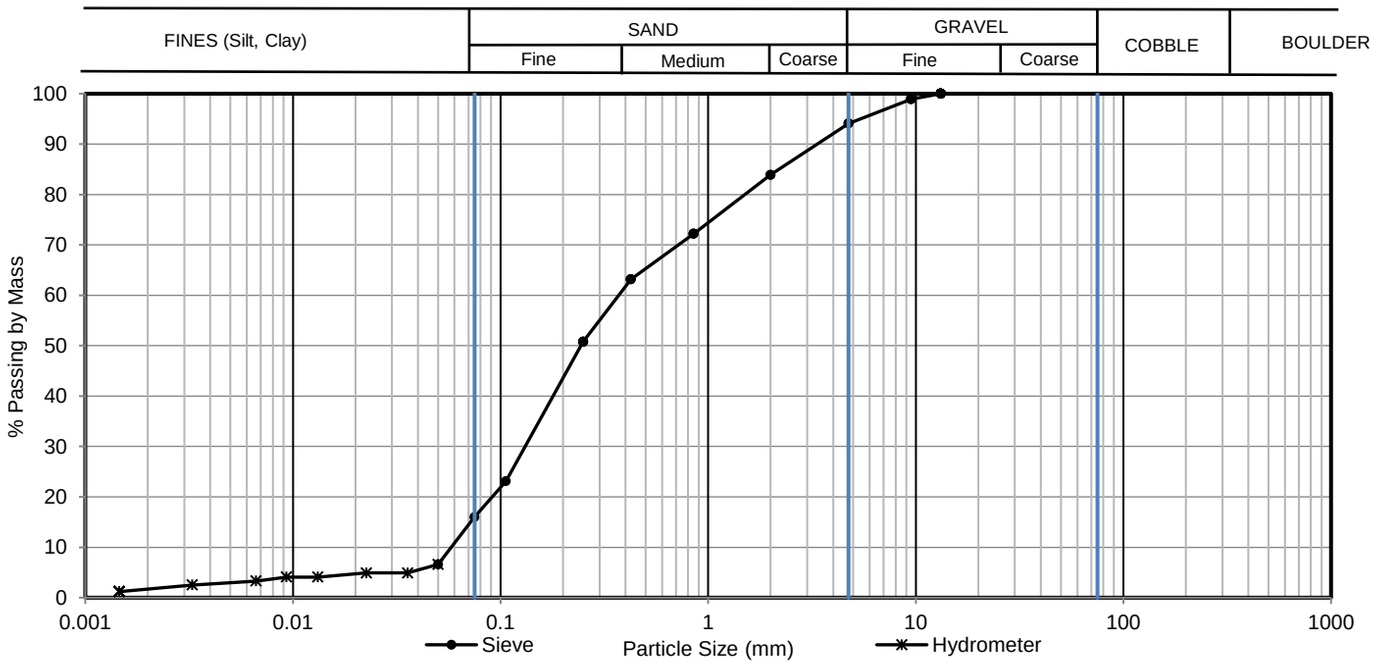
MTO LS-702

Test Request # CA0010884.8370_1
Client: FCAM
Project Name: Pergola Commons
Source:
Soil Description: (SP) SAND, some fines

Project Number: CA0010884.8370
Project Location: 105 Clair Road East, Guelph ON
Sample Location: BH 23-1
Sample No.: 11
Type: SS
Depth (m): 9.1 - 9.8

Specimen Reference: NA
Specimen Depth: NA
Specimen Description: NA
Date of Test: 24 Oct 2023

Grain Size Distribution (%) 16.0 78.1 5.9



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
0.530"	13.2	100.0	0.0500	6.6
3/8"	9.5	98.9	0.0357	4.9
#4	4.75	94.1	0.0226	4.9
#10	2	83.9	0.0132	4.1
#20	0.85	72.2	0.0093	4.1
#40	0.425	63.2	0.0066	3.3
#60	0.25	50.8	0.0033	2.5
#140	0.106	23.1	0.0015	1.2
#200	0.075	16.0		
			0.005 mm	2.98
			0.002 mm	1.71
			D60	0.37
			D30	0.13
			D10	0.06
			Cu	6.00
			Cc	1.00

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with WSP's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of WSP's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: MKMarren **Date:** 24 Oct 2023

Checked by: JTimms **Date:** 02 Nov 2023

Reviewed by: JTaylor **Date:** 07 Nov 2023

WSP Canada Inc.
100 Scotia Court
Whitby, ON L1N 8Y6
Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

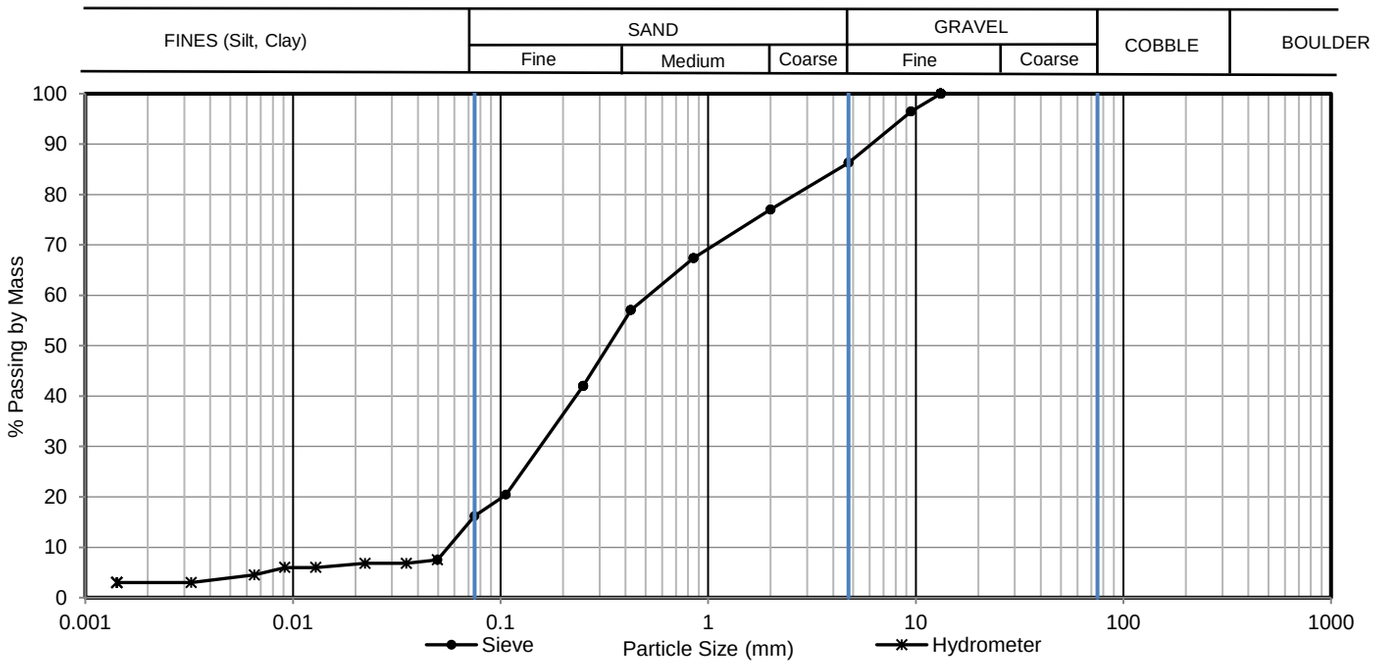
MTO LS-702

Test Request # CA0010884.8370_1
Client: FCAM
Project Name: Pergola Commons
Source:
Soil Description: (SP) gravelly SAND

Project Number: CA0010884.8370
Project Location: 105 Clair Road East, Guelph ON
Sample Location: BH 23-2
Sample No.: 12
Type: SS
Depth (m): 10.7 - 11.3

Specimen Reference: NA
Specimen Depth: NA
Specimen Description: NA
Date of Test: 24 Oct 2023

Grain Size Distribution (%) 16.2 70.1 13.7



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
0.530"	13.2	100.0	0.0497	7.5
3/8"	9.5	96.5	0.0352	6.8
#4	4.75	86.3	0.0223	6.8
#10	2	77.0	0.0129	6.0
#20	0.85	67.4	0.0092	6.0
#40	0.425	57.1	0.0065	4.5
#60	0.25	42.0	0.0032	3.0
#140	0.106	20.4	0.0014	3.0
#200	0.075	16.2		
			0.005 mm	3.93
			0.002 mm	3.00
			D60	0.52
			D30	0.16
			D10	0.06
			Cu	9.00
			Cc	1.00

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with WSP's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of WSP's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: MKMarren **Date:** 24 Oct 2023

Checked by: JTimms **Date:** 09 Nov 2023

Reviewed by: **Date:**

WSP Canada Inc.
100 Scotia Court
Whitby, ON L1N 8Y6
Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

MTO LS-702

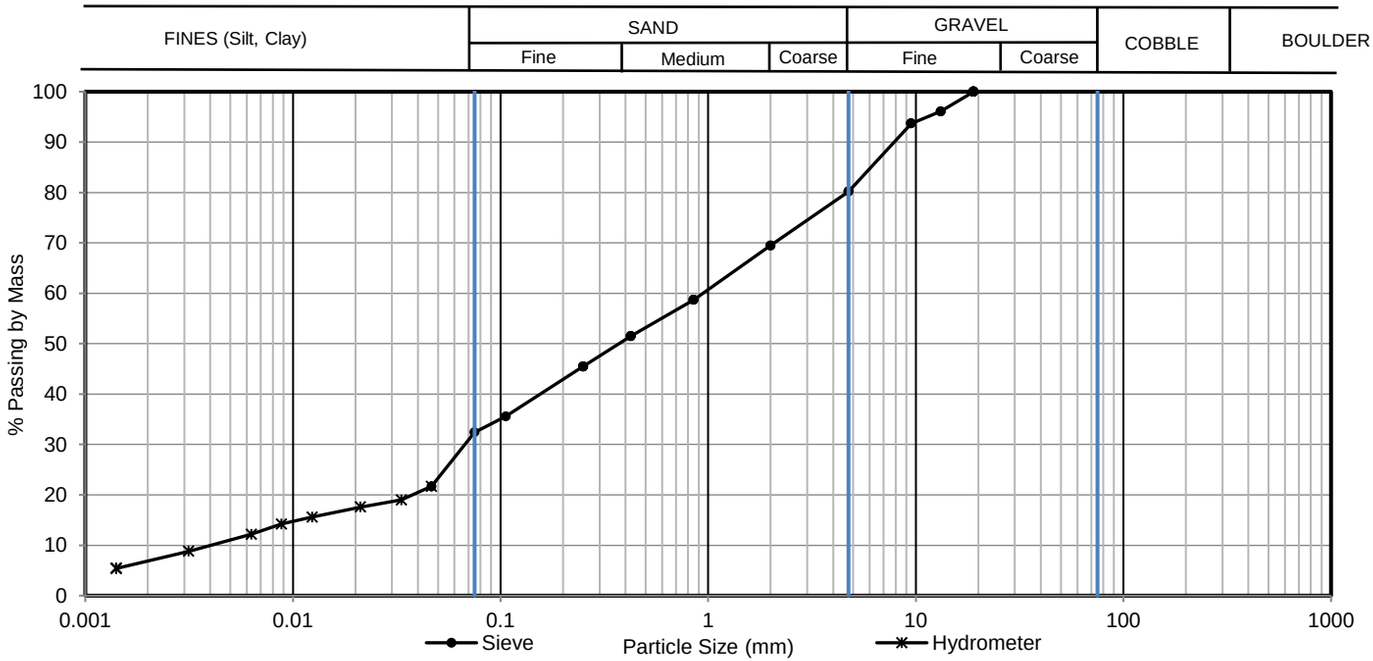
Test Request # CA0010884.8370_1
Client: FCAM
Project Name: Pergola Commons
Source:
Soil Description: (SM) SILTY SAND, some gravel to gravelly TILL

Project Number: CA0010884.8370
Project Location: 105 Clair Rd E
Sample Location: BH 23-2
Sample No.: 7
Type: SS
Depth (m): 4.6 - 5.2

Specimen Reference: NA
Specimen Depth: NA
Specimen Description: NA
Date of Test: 24 Oct 2023

Grain Size Distribution (%)

FINES (Silt, Clay)	SAND			GRAVEL		COBBLE	BOULDER
	Fine	Medium	Coarse	Fine	Coarse		
32.4	47.8			19.8			



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0	0.0465	21.7
0.530"	13.2	96.1	0.0333	19.0
3/8"	9.5	93.7	0.0212	17.6
#4	4.75	80.2	0.0124	15.6
#10	2	69.5	0.0088	14.2
#20	0.85	58.7	0.0063	12.2
#40	0.425	51.5	0.0032	8.8
#60	0.25	45.5	0.0014	5.4
#140	0.106	35.6		
#200	0.075	32.4		
			0.005 mm	11.06
			0.002 mm	6.88
			D60	0.94
			D30	0.07
			D10	0.00
			Cu	230.00
			Cc	1.00

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with WSP's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of WSP's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: MKMarren **Date:** 24 Oct 2023

Checked by: JTimms **Date:** 02 Nov 2023

Reviewed by: JTaylor **Date:** 07 Nov 2023

WSP Canada Inc.
100 Scotia Court
Whitby, ON L1N 8Y6
Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

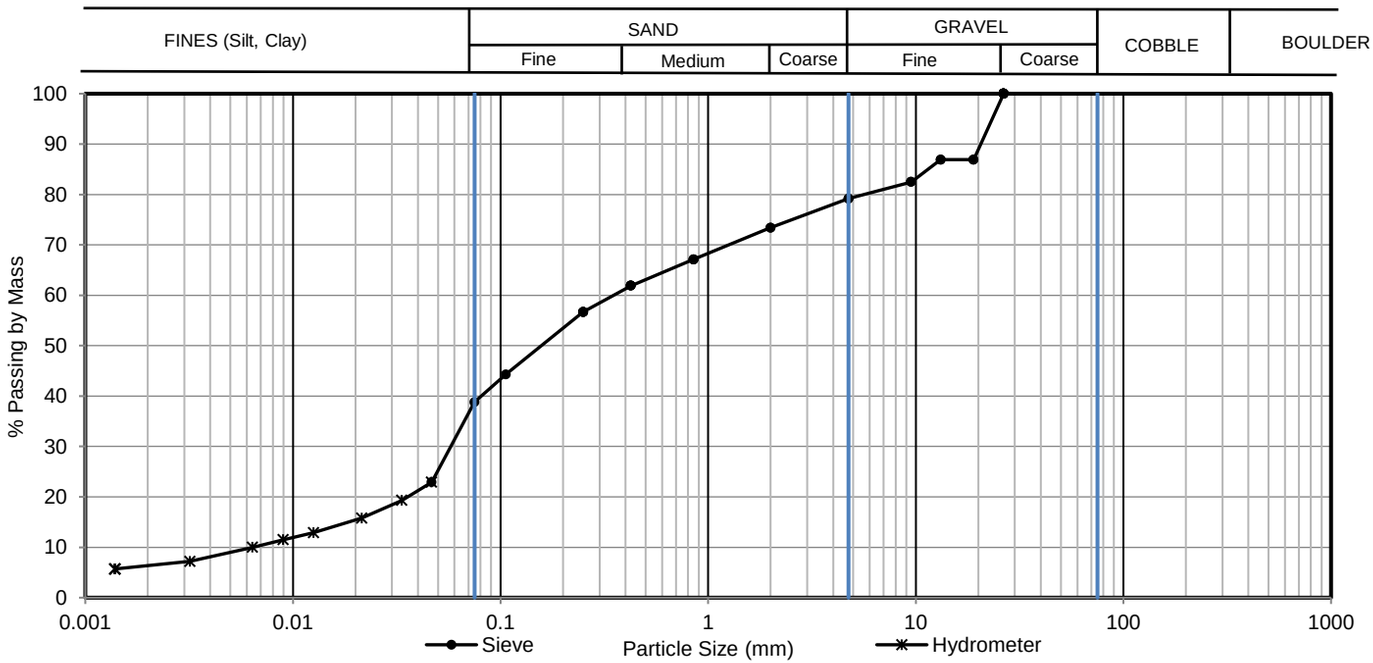
MTO LS-702

Test Request # CA0010884.8370_1
Client: FCAM
Project Name: Pergola Commons
Source:
Soil Description: (SM/ML) SILTY SAND to sandy SILT TILL

Project Number: CA0010884.8370
Project Location:
Sample Location: BH 23-4
Sample No.: 9
Type: SS
Depth (m): 6.1 - 6.7

Specimen Reference: NA
Specimen Depth: NA
Specimen Description: NA
Date of Test: 24 Oct 2023

Grain Size Distribution (%) 38.8 40.4 20.8



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
1.06"	26.5	100.0	0.0466	22.9
3/4"	19	86.9	0.0335	19.3
0.530"	13.2	86.9	0.0215	15.8
3/8"	9.5	82.5	0.0126	12.9
#4	4.75	79.2	0.0090	11.5
#10	2	73.4	0.0064	10.0
#20	0.85	67.1	0.0032	7.2
#40	0.425	61.9	0.0014	5.7
#60	0.25	56.7		
#140	0.106	44.3		
#200	0.075	38.8		
			0.005 mm	9.01
			0.002 mm	6.36
			D60	0.35
			D30	0.06
			D10	0.01
			Cu	55.00
			Cc	2.00

Notes:

Disclaimer:

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Tested by: MKMarren **Date:** 24 Oct 2023

Checked by: JTimms **Date:** 02 Nov 2023

Reviewed by: JTaylor **Date:** 07 Nov 2023

WSP Canada Inc.
100 Scotia Court
Whitby, ON L1N 8Y6
Canada
[+1] 905-723-2727

PARTICLE SIZE DISTRIBUTION

MTO LS-702

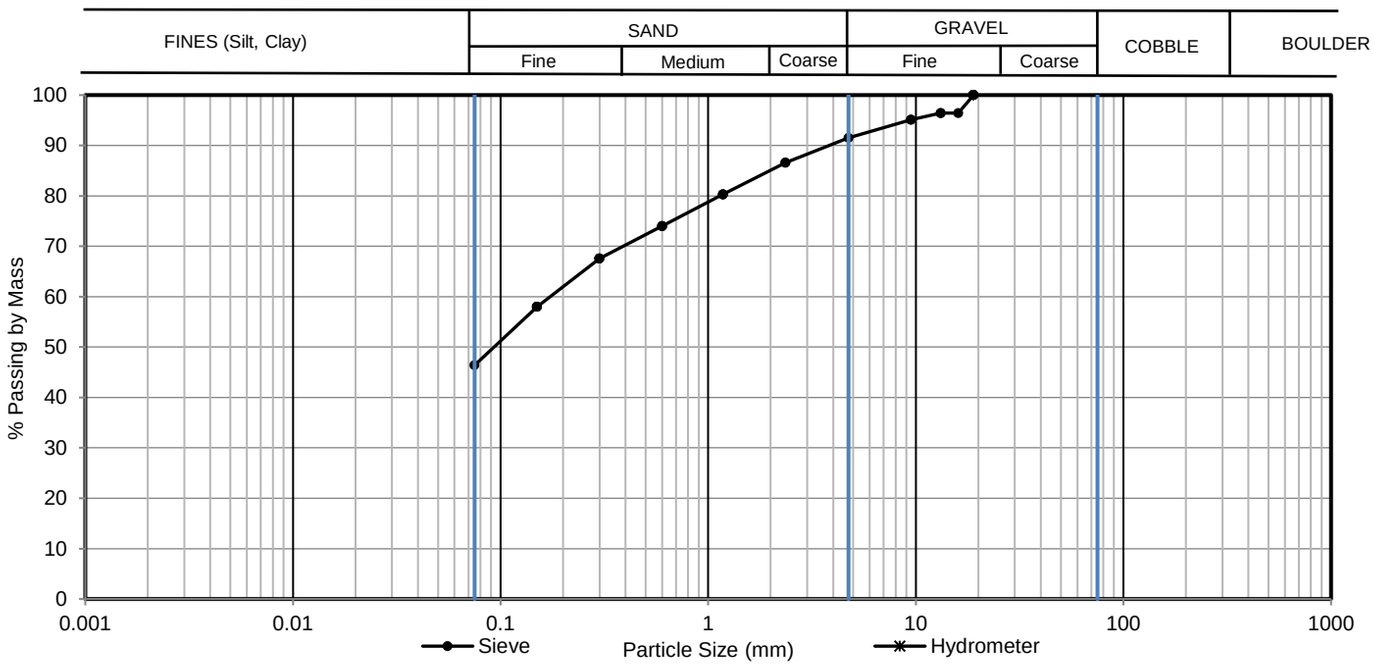
Test Request # CA0010884.8370_1
Client: FCAM
Project Name: Pergola Commons
Source:
Soil Description: (SM) SILTY SAND, some gravel (TILL)

Project Number: CA0010884.8370
Project Location: 105 Clair Road East, Guelph ON
Sample Location: BH 23-1
Sample No.: 5
Type: SS
Depth (m): 3.0 - 3.7

Specimen Reference: NA
Specimen Depth: NA
Date of Test: 23 Oct 2023
Specimen Description: NA

Grain Size Distribution (%)

FINES (Silt, Clay)	SAND			GRAVEL		COBBLE	BOULDER
	Fine	Medium	Coarse	Fine	Coarse		
46.4		45.1		8.5			



Sieve			Hydrometer Sedimentation	
Sieve No.	Particle Size mm	% Passing	Particle Size mm	% Passing
3/4"	19	100.0		
	16	96.4		
0.530"	13.2	96.4		
3/8"	9.5	95.1		
#4	4.75	91.5		
#8	2.36	86.6		
#16	1.18	80.3		
#30	0.6	74.0		
#50	0.3	67.6		
#100	0.15	58.0		
#200	0.075	46.4		
			0.005 mm	
			0.002 mm	
			D60	0.17
			D30	
			D10	
			Cu	
			Cc	

Notes:

Disclaimer:

The laboratory testing services reported herein have been performed in accordance with the terms of a contract with WSP's client, and with the recognized standards indicated in this report, or local industry practice. This laboratory testing services report is for the sole use of WSP's client, relates only to the sample(s) tested and does not represent any (actual or implied) interpretation or opinion regarding specification compliance or materials suitability for any specific purpose.

Tested by: JTimms **Date:** 23 Oct 2023

Checked by: JTimms **Date:** 02 Nov 2023

Reviewed by: JTaylor **Date:** 07 Nov 2023

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APPENDIX E

Laboratory Certificates of Analysis

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CERTIFICATE OF ANALYSIS (GUIDELINE EVALUATION)

Work Order	: **WT2333881**	Page	: 1 of 7
Client	: **WSP Canada Inc.**	Laboratory	: ALS Environmental - Waterloo
Contact	: Lisseth Benavente	Account Manager	: Gayle Braun
Address	: 6925 Century Ave Suite #100 Mississauga ON Canada L5N 7K2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: CA0010884/PHASE: 200	Date Samples Received	: 19-Oct-2023 09:00
PO	: ----	Date Analysis Commenced	: 19-Oct-2023
C-O-C number	: 20-1084021	Issue Date	: 25-Oct-2023 16:29
Sampler	: RAMIN N.		
Site	: 85 CLAIR RD E, GUELPH, ON		
Quote number	: WSP MSA Pricing		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Guideline Comparison

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QC Interpretive report to assist with Quality Review and Sample Receipt Notification (SRN).

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Organics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Inorganics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Metals, Waterloo, Ontario
Zeba Patel		Microbiology, Waterloo, Ontario

No Breaches Found

General Comments

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Refer to the ALS Quality Control Interpretive report (QCI) for applicable references and methodology summaries. Reference methods may incorporate modifications to improve performance.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.
Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Application of guidelines is provided "as is" without warranty of any kind, either expressed or implied, including, but not limited to fitness for a particular purpose, or non-infringement. ALS assumes no responsibility for errors or omissions in the information. Guidelines are not adjusted for the hardness, pH or temperature of the sample (the most conservative values are used). Measurement uncertainty is not applied to test results prior to comparison with specified criteria values.

Key : LOR: Limit of Reporting (detection limit).

Unit	*Description*
CFU/100mL	colony forming units per hundred millilitres
mg/L	milligrams per litre
pH units	pH units

>: greater than.
<: less than.
Red shading is applied where the result or the LOR is greater than the Guideline Upper Limit (or lower than the Guideline Lower Limit, if applicable).
For drinking water samples, Red shading is applied where the result for E.coli, fecal or total coliforms is greater than or equal to the Guideline Upper Limit.

Qualifiers

Qualifier	Description
BODL	Limit of Reporting for BOD was increased to account for the largest volume of sample tested.
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.

Analytical Results Evaluation

Matrix: **Water**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	BH23-1D	----	----	----	----	----	----
				Sampling date/time	19-Oct-2023 00:00	----	----	----	----	----	----
				Sub-Matrix	Water	----	----	----	----	----	----
					WT2333881-001	--------	--------	--------	--------	--------	--------
Physical Tests											
pH	----	E108/WT	pH units		7.93	----	----	----	----	----	----
Solids, total suspended [TSS]	----	E160/WT	mg/L		9.3	----	----	----	----	----	----
Anions and Nutrients											
Chloride	16887-00-6	E235.Cl/WT	mg/L		526 DLDS	----	----	----	----	----	----
Fluoride	16984-48-8	E235.F/WT	mg/L		<0.100 DLDS	----	----	----	----	----	----
Kjeldahl nitrogen, total [TKN]	----	E318/WT	mg/L		0.313	----	----	----	----	----	----
Phosphorus, total	7723-14-0	E372-U/WT	mg/L		0.0095	----	----	----	----	----	----
Sulfate (as SO4)	14808-79-8	E235.SO4/WT	mg/L		54.8 DLDS	----	----	----	----	----	----
Cyanides											
Cyanide, strong acid dissociable (Total)	----	E333/WT	mg/L		<0.0020	----	----	----	----	----	----
Microbiological Tests											
Coliforms, thermotolerant [fecal]	----	E012.FC/WT	CFU/100 mL		5	----	----	----	----	----	----
Total Metals											
Aluminum, total	7429-90-5	E420/WT	mg/L		0.139	----	----	----	----	----	----
Antimony, total	7440-36-0	E420/WT	mg/L		<0.00010	----	----	----	----	----	----
Arsenic, total	7440-38-2	E420/WT	mg/L		0.00024	----	----	----	----	----	----
Bismuth, total	7440-69-9	E420/WT	mg/L		<0.000050	----	----	----	----	----	----
Cadmium, total	7440-43-9	E420/WT	mg/L		0.0000271	----	----	----	----	----	----
Chromium, total	7440-47-3	E420/WT	mg/L		<0.00050	----	----	----	----	----	----
Cobalt, total	7440-48-4	E420/WT	mg/L		0.00050	----	----	----	----	----	----
Copper, total	7440-50-8	E420/WT	mg/L		0.00141	----	----	----	----	----	----
Iron, total	7439-89-6	E420/WT	mg/L		0.184	----	----	----	----	----	----
Lead, total	7439-92-1	E420/WT	mg/L		0.000412	----	----	----	----	----	----
Manganese, total	7439-96-5	E420/WT	mg/L		0.0558	----	----	----	----	----	----
Mercury, total	7439-97-6	E508/WT	mg/L		<0.0000050	----	----	----	----	----	----
Molybdenum, total	7439-98-7	E420/WT	mg/L		0.00239	----	----	----	----	----	----

Analytical Results Evaluation

Matrix: **Water**

Analyte	CAS Number	Method/Lab	Unit	Client sample ID	BH23-1D	----	----	----	----	----	----
				Sampling date/time	19-Oct-2023 00:00	----	----	----	----	----	----
				Sub-Matrix	Water	----	----	----	----	----	----
				WT2333881-001	--------	--------	--------	--------	--------	--------	
Total Metals											
Nickel, total	7440-02-0	E420/WT	mg/L	0.00188	----	----	----	----	----	----	
Selenium, total	7782-49-2	E420/WT	mg/L	0.000242	----	----	----	----	----	----	
Silver, total	7440-22-4	E420/WT	mg/L	<0.000010	----	----	----	----	----	----	
Tin, total	7440-31-5	E420/WT	mg/L	0.00097	----	----	----	----	----	----	
Titanium, total	7440-32-6	E420/WT	mg/L	0.00274	----	----	----	----	----	----	
Vanadium, total	7440-62-2	E420/WT	mg/L	<0.00050	----	----	----	----	----	----	
Zinc, total	7440-66-6	E420/WT	mg/L	0.0083	----	----	----	----	----	----	
Aggregate Organics											
Carbonaceous biochemical oxygen demand [CBOD]	----	E555/WT	mg/L	<3.0 BODL	----	----	----	----	----	----	
Oil & grease (gravimetric)	----	E567/WT	mg/L	<5.0	----	----	----	----	----	----	
Oil & grease, animal/vegetable (gravimetric)	----	EC567A.SG/WT	mg/L	<5.0	----	----	----	----	----	----	
Oil & grease, mineral (gravimetric)	----	E567SG/WT	mg/L	<5.0	----	----	----	----	----	----	
Phenols, total (4AAP)	----	E562/WT	mg/L	<0.0010	----	----	----	----	----	----	

Please refer to the General Comments section for an explanation of any result qualifiers detected.

Please refer to the Accreditation section for an explanation of analyte accreditations.

Summary of Guideline Limits

Analyte	CAS Number	Unit	GUESUB SAN	GUESUB STM					
Physical Tests									
pH	----	pH units	**5.5 - 9.5 pH units**	**6 - 9 pH units**					
Solids, total suspended [TSS]	----	mg/L	**350 mg/L**	**15 mg/L**					
Anions and Nutrients									
Chloride	16887-00-6	mg/L	**1500 mg/L**	**--**					
Fluoride	16984-48-8	mg/L	**10 mg/L**	**--**					
Kjeldahl nitrogen, total [TKN]	----	mg/L	**100 mg/L**	**--**					
Phosphorus, total	7723-14-0	mg/L	**10 mg/L**	**--**					
Sulfate (as SO4)	14808-79-8	mg/L	**1500 mg/L**	**--**					
Cyanides									
Cyanide, strong acid dissociable (Total)	----	mg/L	**2 mg/L**	**--**					
Microbiological Tests									
Coliforms, thermotolerant [fecal]	----	CFU/100mL	**--**	**200 CFU/100mL**					
Total Metals									
Aluminum, total	7429-90-5	mg/L	**50 mg/L**	**--**					
Antimony, total	7440-36-0	mg/L	**5 mg/L**	**--**					
Arsenic, total	7440-38-2	mg/L	**1 mg/L**	**--**					
Bismuth, total	7440-69-9	mg/L	**5 mg/L**	**--**					
Cadmium, total	7440-43-9	mg/L	**1 mg/L**	**0.001 mg/L**					
Chromium, total	7440-47-3	mg/L	**5 mg/L**	**0.2 mg/L**					
Cobalt, total	7440-48-4	mg/L	**5 mg/L**	**--**					
Copper, total	7440-50-8	mg/L	**3 mg/L**	**0.01 mg/L**					
Iron, total	7439-89-6	mg/L	**50 mg/L**	**--**					
Lead, total	7439-92-1	mg/L	**5 mg/L**	**0.05 mg/L**					
Manganese, total	7439-96-5	mg/L	**5 mg/L**	**--**					
Mercury, total	7439-97-6	mg/L	**0.1 mg/L**	**0.001 mg/L**					
Molybdenum, total	7439-98-7	mg/L	**5 mg/L**	**--**					
Nickel, total	7440-02-0	mg/L	**3 mg/L**	**0.05 mg/L**					
Selenium, total	7782-49-2	mg/L	**5 mg/L**	**--**					
Silver, total	7440-22-4	mg/L	**5 mg/L**	**--**					
Tin, total	7440-31-5	mg/L	**5 mg/L**	**--**					
Titanium, total	7440-32-6	mg/L	**5 mg/L**	**--**					
Vanadium, total	7440-62-2	mg/L	**5 mg/L**	**--**					
Zinc, total	7440-66-6	mg/L	**3 mg/L**	**0.05 mg/L**					
Aggregate Organics									
Carbonaceous biochemical oxygen demand [CBOD]	----	mg/L	**300 mg/L**	**15 mg/L**					

Analyte	CAS Number	Unit	GUESUB SAN	GUESUB STM					
Aggregate Organics - Continued									
Oil & grease (gravimetric)	----	mg/L	--	--					
Oil & grease, animal/vegetable (gravimetric)	----	mg/L	**100 mg/L**	--					
Oil & grease, mineral (gravimetric)	----	mg/L	**15 mg/L**	--					
Phenols, total (4AAP)	----	mg/L	**1 mg/L**	--					

Please refer to the General Comments section for an explanation of any qualifiers detected.

Key:

GUESUB	Ontario Guelph Sanitary and Storm Sewer By-Law 15202 (1996)
SAN	Ontario City of Guelph Sanitary Sewer Use By-Law 15202
STM	Ontario City of Guelph Storm Sewer Use By-Law 15202

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QUALITY CONTROL INTERPRETIVE REPORT

Work Order	: **WT2333881**	Page	: 1 of 9
Client	: **WSP Canada Inc.**	Laboratory	: ALS Environmental - Waterloo
Contact	: Lisseth Benavente	Account Manager	: Gayle Braun
Address	: 6925 Century Ave Suite #100 Mississauga ON Canada L5N 7K2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	: ----	Telephone	: +1 519 886 6910
Project	: CA0010884/PHASE: 200	Date Samples Received	: 19-Oct-2023 09:00
PO	: ----	Issue Date	: 25-Oct-2023 16:33
C-O-C number	: 20-1084021		
Sampler	: RAMIN N.		
Site	: 85 CLAIR RD E, GUELPH, ON		
Quote number	: WSP MSA Pricing		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report is automatically generated by the ALS LIMS (Laboratory Information Management System) through evaluation of Quality Control (QC) results and other QA parameters associated with this submission, and is intended to facilitate rapid data validation by auditors or reviewers. The report highlights any exceptions and outliers to ALS Data Quality Objectives, provides holding time details and exceptions, summarizes QC sample frequencies, and lists applicable methodology references and summaries.

Key

Anonymous: Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number: Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO: Data Quality Objective.
LOR: Limit of Reporting (detection limit).
RPD: Relative Percent Difference.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Summary of Outliers

Outliers : Quality Control Samples

- No Method Blank value outliers occur.
- No Duplicate outliers occur.
- No Laboratory Control Sample (LCS) outliers occur
- No Matrix Spike outliers occur.
- No Test sample Surrogate recovery outliers exist.

Outliers: Reference Material (RM) Samples

- No Reference Material (RM) Sample outliers occur.

Outliers : Analysis Holding Time Compliance (Breaches)

- No Analysis Holding Time Outliers exist.

Outliers : Frequency of Quality Control Samples

- Quality Control Sample Frequency Outliers occur - please see following pages for full details.

Analysis Holding Time Compliance

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times, which are selected to meet known provincial and /or federal requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by organizations such as CCME, US EPA, APHA Standard Methods, ASTM, or Environment Canada (where available). Dates and holding times reported below represent the first dates of extraction or analysis. If subsequent tests or dilutions exceeded holding times, qualifiers are added (refer to COA).

If samples are identified below as having been analyzed or extracted outside of recommended holding times, measurement uncertainties may be increased, and this should be taken into consideration when interpreting results.

Where actual sampling date is not provided on the chain of custody, the date of receipt with time at 00:00 is used for calculation purposes.

Where only the sample date without time is provided on the chain of custody, the sampling date at 00:00 is used for calculation purposes.

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Aggregate Organics : Biochemical Oxygen Demand (Carbonaceous) - 5 day										
HDPE [BOD HT-4d]										
BH23-1D	E555	19-Oct-2023	----	----	----		19-Oct-2023	4 days	0 days	✓
Aggregate Organics : Mineral Oil & Grease by Gravimetry										
Amber glass (hydrochloric acid)										
BH23-1D	E567SG	19-Oct-2023	19-Oct-2023	28 days	1 days	✓	23-Oct-2023	40 days	4 days	✓
Aggregate Organics : Oil & Grease by Gravimetry										
Amber glass (hydrochloric acid)										
BH23-1D	E567	19-Oct-2023	19-Oct-2023	28 days	1 days	✓	23-Oct-2023	40 days	4 days	✓
Aggregate Organics : Phenols (4AAP) in Water by Colorimetry										
Amber glass total (sulfuric acid) [ON MECP]										
BH23-1D	E562	19-Oct-2023	20-Oct-2023	28 days	1 days	✓	20-Oct-2023	28 days	2 days	✓
Anions and Nutrients : Chloride in Water by IC										
HDPE [ON MECP]										
BH23-1D	E235.Cl	19-Oct-2023	23-Oct-2023	28 days	5 days	✓	24-Oct-2023	28 days	5 days	✓
Anions and Nutrients : Fluoride in Water by IC										
HDPE [ON MECP]										
BH23-1D	E235.F	19-Oct-2023	23-Oct-2023	28 days	5 days	✓	24-Oct-2023	28 days	5 days	✓
Anions and Nutrients : Sulfate in Water by IC										
HDPE [ON MECP]										
BH23-1D	E235.SO4	19-Oct-2023	23-Oct-2023	28 days	5 days	✓	24-Oct-2023	28 days	5 days	✓

Matrix: **Water**

Evaluation: × = Holding time exceedance ; ✓ = Within Holding Time

Analyte Group : Analytical Method / Container / Client Sample ID(s)	Method	Sampling Date	Extraction / Preparation				Analysis			
			Preparation Date	Holding Times Rec	Holding Times Actual	Eval	Analysis Date	Holding Times Rec	Holding Times Actual	Eval
Anions and Nutrients : Total Kjeldahl Nitrogen by Fluorescence (Low Level)										
Amber glass total (sulfuric acid) [ON MECP]										
BH23-1D	E318	19-Oct-2023	23-Oct-2023	28 days	4 days	✓	24-Oct-2023	28 days	6 days	✓
Anions and Nutrients : Total Phosphorus by Colourimetry (0.002 mg/L)										
Amber glass total (sulfuric acid) [ON MECP]										
BH23-1D	E372-U	19-Oct-2023	22-Oct-2023	28 days	4 days	✓	23-Oct-2023	28 days	5 days	✓
Cyanides : Total Cyanide										
HDPE - total (sodium hydroxide)										
BH23-1D	E333	19-Oct-2023	24-Oct-2023	14 days	6 days	✓	24-Oct-2023	14 days	6 days	✓
Microbiological Tests : Thermotolerant (Fecal) Coliform (MF-mFC)										
Sterile HDPE (Sodium thiosulphate) [ON MECP]										
BH23-1D	E012.FC	19-Oct-2023	----	----	----		20-Oct-2023	48 hrs	34 hrs	✓
Physical Tests : pH by Meter										
HDPE [ON MECP]										
BH23-1D	E108	19-Oct-2023	23-Oct-2023	14 days	5 days	✓	23-Oct-2023	14 days	5 days	✓
Physical Tests : TSS by Gravimetry										
HDPE [ON MECP]										
BH23-1D	E160	19-Oct-2023	----	----	----		23-Oct-2023	7 days	4 days	✓
Total Metals : Total Mercury in Water by CVAAS										
Glass vial total (hydrochloric acid) [ON MECP]										
BH23-1D	E508	19-Oct-2023	20-Oct-2023	28 days	1 days	✓	20-Oct-2023	28 days	1 days	✓
Total Metals : Total Metals in Water by CRC ICPMS										
HDPE total (nitric acid)										
BH23-1D	E420	19-Oct-2023	19-Oct-2023	180 days	1 days	✓	20-Oct-2023	180 days	1 days	✓

Legend & Qualifier Definitions

Rec. HT: ALS recommended hold time (see units).

Quality Control Parameter Frequency Compliance

The following report summarizes the frequency of laboratory QC samples analyzed within the analytical batches (QC lots) in which the submitted samples were processed. The actual frequency should be greater than or equal to the expected frequency.

Matrix: **Water**

Evaluation: ✗ = QC frequency outside specification; ✓ = QC frequency within specification.

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Laboratory Duplicates (DUP)							
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555	1194478	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	1200240	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	1200237	1	4	25.0	5.0	✓
pH by Meter	E108	1200232	1	8	12.5	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1196136	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1200241	1	4	25.0	5.0	✓
Thermotolerant (Fecal) Coliform (MF-mFC)	E012.FC	1196479	0	2	0.0	5.0	✗
Total Cyanide	E333	1203730	1	15	6.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1196134	1	18	5.5	5.0	✓
Total Mercury in Water by CVAAS	E508	1196080	1	17	5.8	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1195791	1	12	8.3	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1196135	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	1199957	1	18	5.5	4.7	✓
Laboratory Control Samples (LCS)							
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555	1194478	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	1200240	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	1200237	1	4	25.0	5.0	✓
Mineral Oil & Grease by Gravimetry	E567SG	1194383	1	7	14.2	5.0	✓
Oil & Grease by Gravimetry	E567	1194382	1	16	6.2	5.0	✓
pH by Meter	E108	1200232	1	8	12.5	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1196136	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1200241	1	4	25.0	5.0	✓
Total Cyanide	E333	1203730	1	15	6.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1196134	1	18	5.5	5.0	✓
Total Mercury in Water by CVAAS	E508	1196080	1	17	5.8	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1195791	1	12	8.3	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1196135	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	1199957	1	18	5.5	4.7	✓
Method Blanks (MB)							
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555	1194478	1	20	5.0	5.0	✓
Chloride in Water by IC	E235.Cl	1200240	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	1200237	1	4	25.0	5.0	✓
Mineral Oil & Grease by Gravimetry	E567SG	1194383	1	7	14.2	5.0	✓
Oil & Grease by Gravimetry	E567	1194382	1	16	6.2	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1196136	1	20	5.0	5.0	✓

Matrix: **Water**

Evaluation: × = *QC frequency outside specification*; ✓ = *QC frequency within specification.*

Quality Control Sample Type			Count		Frequency (%)		
Analytical Methods	*Method*	*QC Lot #*	*QC*	*Regular*	*Actual*	*Expected*	*Evaluation*
Method Blanks (MB) - Continued							
Sulfate in Water by IC	E235.SO4	1200241	1	4	25.0	5.0	✓
Thermotolerant (Fecal) Coliform (MF-mFC)	E012.FC	1196479	1	2	50.0	5.0	✓
Total Cyanide	E333	1203730	1	15	6.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1196134	1	18	5.5	5.0	✓
Total Mercury in Water by CVAAS	E508	1196080	1	17	5.8	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1195791	1	12	8.3	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1196135	1	20	5.0	5.0	✓
TSS by Gravimetry	E160	1199957	1	18	5.5	4.7	✓
Matrix Spikes (MS)							
Chloride in Water by IC	E235.Cl	1200240	1	10	10.0	5.0	✓
Fluoride in Water by IC	E235.F	1200237	1	4	25.0	5.0	✓
Phenols (4AAP) in Water by Colorimetry	E562	1196136	1	20	5.0	5.0	✓
Sulfate in Water by IC	E235.SO4	1200241	1	4	25.0	5.0	✓
Total Cyanide	E333	1203730	1	15	6.6	5.0	✓
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318	1196134	1	18	5.5	5.0	✓
Total Mercury in Water by CVAAS	E508	1196080	1	17	5.8	5.0	✓
Total Metals in Water by CRC ICPMS	E420	1195791	1	12	8.3	5.0	✓
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U	1196135	1	20	5.0	5.0	✓

Methodology References and Summaries

The analytical methods used by ALS are developed using internationally recognized reference methods (where available), such as those published by US EPA, APHA Standard Methods, ASTM, ISO, Environment Canada, BC MOE, and Ontario MOE. Reference methods may incorporate modifications to improve performance (indicated by "mod").

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Thermotolerant (Fecal) Coliform (MF-mFC)	E012.FC ALS Environmental - Waterloo	Water	APHA 9222 D (mod)	Following filtration (0.45 µm), and incubation at 44.5 ±0.2°C for 22-26 hours, colonies exhibiting characteristic morphology of the target organism are enumerated and confirmed.
pH by Meter	E108 ALS Environmental - Waterloo	Water	APHA 4500-H (mod)	pH is determined by potentiometric measurement with a pH electrode, and is conducted at ambient laboratory temperature (normally 20 ± 5°C). For high accuracy test results, pH should be measured in the field within the recommended 15 minute hold time.
TSS by Gravimetry	E160 ALS Environmental - Waterloo	Water	APHA 2540 D (mod)	Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, following by drying of the filter at 104 ± 1°C, with gravimetric measurement of the filtered solids. Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.
Chloride in Water by IC	E235.Cl ALS Environmental - Waterloo	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Fluoride in Water by IC	E235.F ALS Environmental - Waterloo	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Sulfate in Water by IC	E235.SO4 ALS Environmental - Waterloo	Water	EPA 300.1 (mod)	Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.
Total Kjeldahl Nitrogen by Fluorescence (Low Level)	E318 ALS Environmental - Waterloo	Water	Method Fialab 100, 2018	TKN in water is determined by automated continuous flow analysis with membrane diffusion and fluorescence detection, after reaction with OPA (ortho-phthalaldehyde). This method is approved under US EPA 40 CFR Part 136 (May 2021).
Total Cyanide	E333 ALS Environmental - Waterloo	Water	ISO 14403 (mod)	Total or Strong Acid Dissociable (SAD) Cyanide is determined by Continuous Flow Analyzer (CFA) with in-line UV digestion followed by colourmetric analysis. Method Limitation: High levels of thiocyanate (SCN) may cause positive interference (up to 0.5% of SCN concentration).
Total Phosphorus by Colourimetry (0.002 mg/L)	E372-U ALS Environmental - Waterloo	Water	APHA 4500-P E (mod).	Total Phosphorus is determined colourimetrically using a discrete analyzer after heated persulfate digestion of the sample.

Analytical Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Total Metals in Water by CRC ICPMS	E420 ALS Environmental - Waterloo	Water	EPA 200.2/6020B (mod)	Water samples are digested with nitric and hydrochloric acids, and analyzed by Collision/Reaction Cell ICPMS. Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.
Total Mercury in Water by CVAAS	E508 ALS Environmental - Waterloo	Water	EPA 1631E (mod)	Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS
Biochemical Oxygen Demand (Carbonaceous) - 5 day	E555 ALS Environmental - Waterloo	Water	APHA 5210 B (mod)	Samples are diluted and incubated for a specified time period, after which the oxygen depletion is measured using a dissolved oxygen meter. Nitrification inhibitor is added to samples to prevent nitrogenous compounds from consuming oxygen resulting in only carbonaceous oxygen demand being reported by this method. Free chlorine is a negative interference in the BOD method; please advise ALS when free chlorine is present in samples.
Phenols (4AAP) in Water by Colorimetry	E562 ALS Environmental - Waterloo	Water	EPA 9066	This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide (K3Fe(CN)6) and 4-amino-antipyrine (4-AAP) to form a red complex which is measured colorimetrically.
Oil & Grease by Gravimetry	E567 ALS Environmental - Waterloo	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane and the extract is evaporated to dryness. The residue is then weighed to determine Oil and Grease.
Mineral Oil & Grease by Gravimetry	E567SG ALS Environmental - Waterloo	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane, followed by silica gel treatment after which the extract is evaporated to dryness. The residue is then weighed to determine Mineral Oil and Grease.
Animal & Vegetable Oil & Grease by Gravimetry	EC567A.SG ALS Environmental - Waterloo	Water	APHA 5520 (mod)	Animal & vegetable oil and grease is calculated as follows: Oil & Grease (gravimetric) minus Mineral Oil & Grease (gravimetric)

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Digestion for TKN in water	EP318 ALS Environmental - Waterloo	Water	APHA 4500-Norg D (mod)	Samples are digested at high temperature using Sulfuric Acid with Copper catalyst, which converts organic nitrogen sources to Ammonia, which is then quantified by the analytical method as TKN. This method is unsuitable for samples containing high levels of nitrate. If nitrate exceeds TKN concentration by ten times or more, results may be biased low.
Digestion for Total Phosphorus in water	EP372 ALS Environmental - Waterloo	Water	APHA 4500-P E (mod).	Samples are heated with a persulfate digestion reagent.

Preparation Methods	Method / Lab	Matrix	Method Reference	Method Descriptions
Oil & Grease Extraction for Gravimetry	EP567 ALS Environmental - Waterloo	Water	BC MOE Lab Manual (Oil & Grease) (mod)	The entire water sample is extracted with hexane by liquid-liquid extraction.

QUALITY CONTROL REPORT

Work Order	: **WT2333881**	Page	: 1 of 10
Client	: WSP Canada Inc.	Laboratory	: ALS Environmental - Waterloo
Contact	: Lisseth Benavente	Account Manager	: Gayle Braun
Address	: 6925 Century Ave Suite #100 Mississauga ON Canada L5N 7K2	Address	: 60 Northland Road, Unit 1 Waterloo, Ontario Canada N2V 2B8
Telephone	:	Telephone	: +1 519 886 6910
Project	: CA0010884/PHASE: 200	Date Samples Received	: 19-Oct-2023 09:00
PO	: ----	Date Analysis Commenced	: 19-Oct-2023
C-O-C number	: 20-1084021	Issue Date	: 25-Oct-2023 16:33
Sampler	: RAMIN N. ----		
Site	: 85 CLAIR RD E, GUELPH, ON		
Quote number	: WSP MSA Pricing		
No. of samples received	: 1		
No. of samples analysed	: 1		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percent Difference (RPD) and Data Quality Objectives
- Matrix Spike (MS) Report; Recovery and Data Quality Objectives
- Method Blank (MB) Report; Recovery and Data Quality Objectives
- Laboratory Control Sample (LCS) Report; Recovery and Data Quality Objectives

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is conducted in accordance with US FDA 21 CFR Part 11.

Signatories	*Position*	*Laboratory Department*
Jocelyn Kennedy	Department Manager - Semi-Volatile Organics	Waterloo Organics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Waterloo Inorganics, Waterloo, Ontario
Jon Fisher	Production Manager, Environmental	Waterloo Metals, Waterloo, Ontario
Zeba Patel		Waterloo Microbiology, Waterloo, Ontario

General Comments

The ALS Quality Control (QC) report is optionally provided to ALS clients upon request. ALS test methods include comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against predetermined Data Quality Objectives (DQOs) to provide confidence in the accuracy of associated test results. This report contains detailed results for all QC results applicable to this sample submission. Please refer to the ALS Quality Control Interpretation report (QCI) for applicable method references and methodology summaries.

Key :

Anonymous = Refers to samples which are not part of this work order, but which formed part of the QC process lot.
CAS Number = Chemical Abstracts Service number is a unique identifier assigned to discrete substances.
DQO = Data Quality Objective.
LOR = Limit of Reporting (detection limit).
RPD = Relative Percent Difference
# = Indicates a QC result that did not meet the ALS DQO.

Workorder Comments

Holding times are displayed as "---" if no guidance exists from CCME, Canadian provinces, or broadly recognized international references.

Laboratory Duplicate (DUP) Report

A Laboratory Duplicate (DUP) is a randomly selected intralaboratory replicate sample. Laboratory Duplicates provide information regarding method precision and sample heterogeneity. ALS DQOs for Laboratory Duplicates are expressed as test-specific limits for Relative Percent Difference (RPD), or as an absolute difference limit of 2 times the LOR for low concentration duplicates within ~ 4-10 times the LOR (cut-off is test-specific).

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Physical Tests (QC Lot: 1199957)											
WT2333881-001	BH23-1D	Solids, total suspended [TSS]	----	E160	3.0	mg/L	9.3	9.1	0.2	Diff <2x LOR	----
Physical Tests (QC Lot: 1200232)											
WT2333869-001	Anonymous	pH	----	E108	0.10	pH units	8.15	8.12	0.369%	4%	----
Anions and Nutrients (QC Lot: 1196134)											
WT2333338-001	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	0.500	mg/L	1.92	2.09	0.171	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 1196135)											
WT2333525-001	Anonymous	Phosphorus, total	7723-14-0	E372-U	0.0020	mg/L	0.422	0.426	1.05%	20%	----
Anions and Nutrients (QC Lot: 1200237)											
WT2333869-001	Anonymous	Fluoride	16984-48-8	E235.F	0.020	mg/L	0.076	0.079	0.003	Diff <2x LOR	----
Anions and Nutrients (QC Lot: 1200240)											
WT2333869-001	Anonymous	Chloride	16887-00-6	E235.Cl	0.50	mg/L	48.3	49.3	2.00%	20%	----
Anions and Nutrients (QC Lot: 1200241)											
WT2333869-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	0.30	mg/L	48.7	49.4	1.52%	20%	----
Total Metals (QC Lot: 1195791)											
HA2300873-001	Anonymous	Aluminum, total	7429-90-5	E420	0.0030	mg/L	0.0252	0.0252	0.00006	Diff <2x LOR	----
		Antimony, total	7440-36-0	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Arsenic, total	7440-38-2	E420	0.00010	mg/L	0.00020	0.00020	0.000007	Diff <2x LOR	----
		Bismuth, total	7440-69-9	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Cadmium, total	7440-43-9	E420	0.0000050	mg/L	<0.0000050	<0.0000050	0	Diff <2x LOR	----
		Chromium, total	7440-47-3	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Cobalt, total	7440-48-4	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----
		Copper, total	7440-50-8	E420	0.00050	mg/L	0.0226	0.0224	0.912%	20%	----
		Iron, total	7439-89-6	E420	0.010	mg/L	0.120	0.118	0.865%	20%	----
		Lead, total	7439-92-1	E420	0.000050	mg/L	0.000212	0.000211	0.000001	Diff <2x LOR	----
		Manganese, total	7439-96-5	E420	0.00010	mg/L	0.00348	0.00354	1.96%	20%	----
		Molybdenum, total	7439-98-7	E420	0.000050	mg/L	0.000130	0.000133	0.000002	Diff <2x LOR	----
		Nickel, total	7440-02-0	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Selenium, total	7782-49-2	E420	0.000050	mg/L	<0.000050	<0.000050	0	Diff <2x LOR	----
		Silver, total	7440-22-4	E420	0.000010	mg/L	<0.000010	<0.000010	0	Diff <2x LOR	----
		Tin, total	7440-31-5	E420	0.00010	mg/L	<0.00010	<0.00010	0	Diff <2x LOR	----

Sub-Matrix: **Water**

					Laboratory Duplicate (DUP) Report						
Laboratory sample ID	*Client sample ID*	*Analyte*	*CAS Number*	*Method*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD(%) or Difference*	*Duplicate Limits*	*Qualifier*
Total Metals (QC Lot: 1195791) - continued											
HA2300873-001	Anonymous	Titanium, total	7440-32-6	E420	0.00030	mg/L	<0.00030	<0.00030	0	Diff <2x LOR	----
		Vanadium, total	7440-62-2	E420	0.00050	mg/L	<0.00050	<0.00050	0	Diff <2x LOR	----
		Zinc, total	7440-66-6	E420	0.0030	mg/L	0.168	0.168	0.593%	20%	----
Total Metals (QC Lot: 1196080)											
WT2333760-001	Anonymous	Mercury, total	7439-97-6	E508	0.0000500	mg/L	3.47 µg/L	0.00372	6.95%	20%	----
Aggregate Organics (QC Lot: 1194478)											
WT2333885-001	Anonymous	Carbonaceous biochemical oxygen demand [CBOD]	----	E555	2.0	mg/L	2.0	2.1	0.0%	30%	----
Aggregate Organics (QC Lot: 1196136)											
WT2333533-001	Anonymous	Phenols, total (4AAP)	----	E562	0.0010	mg/L	<0.0010	<0.0010	0	Diff <2x LOR	----

Method Blank (MB) Report

A Method Blank is an analyte-free matrix that undergoes sample processing identical to that carried out for test samples. Method Blank results are used to monitor and control for potential contamination from the laboratory environment and reagents. For most tests, the DQO for Method Blanks is for the result to be < LOR.

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Physical Tests (QCLot: 1199957)						
Solids, total suspended [TSS]	----	E160	3	mg/L	<3.0	----
Anions and Nutrients (QCLot: 1196134)						
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	<0.050	----
Anions and Nutrients (QCLot: 1196135)						
Phosphorus, total	7723-14-0	E372-U	0.002	mg/L	<0.0020	----
Anions and Nutrients (QCLot: 1200237)						
Fluoride	16984-48-8	E235.F	0.02	mg/L	<0.020	----
Anions and Nutrients (QCLot: 1200240)						
Chloride	16887-00-6	E235.Cl	0.5	mg/L	<0.50	----
Anions and Nutrients (QCLot: 1200241)						
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	<0.30	----
Cyanides (QCLot: 1203730)						
Cyanide, strong acid dissociable (Total)	----	E333	0.002	mg/L	<0.0020	----
Microbiological Tests (QCLot: 1196479)						
Coliforms, thermotolerant [fecal]	----	E012.FC	1	CFU/100mL	<1	----
Total Metals (QCLot: 1195791)						
Aluminum, total	7429-90-5	E420	0.003	mg/L	<0.0030	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	<0.00010	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	<0.00010	----
Bismuth, total	7440-69-9	E420	0.00005	mg/L	<0.000050	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	<0.0000050	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	<0.00050	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	<0.00010	----
Copper, total	7440-50-8	E420	0.0005	mg/L	<0.00050	----
Iron, total	7439-89-6	E420	0.01	mg/L	<0.010	----
Lead, total	7439-92-1	E420	0.00005	mg/L	<0.000050	----
Manganese, total	7439-96-5	E420	0.0001	mg/L	<0.00010	----
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	<0.000050	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	<0.00050	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	<0.000050	----
Silver, total	7440-22-4	E420	0.00001	mg/L	<0.000010	----
Tin, total	7440-31-5	E420	0.0001	mg/L	<0.00010	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Result	Qualifier
Total Metals (QCLot: 1195791) - continued						
Titanium, total	7440-32-6	E420	0.0003	mg/L	<0.00030	----
Vanadium, total	7440-62-2	E420	0.0005	mg/L	<0.00050	----
Zinc, total	7440-66-6	E420	0.003	mg/L	<0.0030	----
Total Metals (QCLot: 1196080)						
Mercury, total	7439-97-6	E508	0.000005	mg/L	<0.0000050	----
Aggregate Organics (QCLot: 1194382)						
Oil & grease (gravimetric)	----	E567	5	mg/L	<5.0	----
Aggregate Organics (QCLot: 1194383)						
Oil & grease, mineral (gravimetric)	----	E567SG	5	mg/L	<5.0	----
Aggregate Organics (QCLot: 1194478)						
Carbonaceous biochemical oxygen demand [CBOD]	----	E555	2	mg/L	<2.0	----
Aggregate Organics (QCLot: 1196136)						
Phenols, total (4AAP)	----	E562	0.001	mg/L	<0.0010	----

Laboratory Control Sample (LCS) Report

A Laboratory Control Sample (LCS) is an analyte-free matrix that has been fortified (spiked) with test analytes at known concentration and processed in an identical manner to test samples. LCS results are expressed as percent recovery, and are used to monitor and control test method accuracy and precision, independent of test sample matrix.

Sub-Matrix: **Water**

					Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
Analyte	CAS Number	Method	LOR	Unit	Concentration	LCS	Low	High	Qualifier
Physical Tests (QCLot: 1199957)									
Solids, total suspended [TSS]	----	E160	3	mg/L	150 mg/L	89.2	85.0	115	----
Physical Tests (QCLot: 1200232)									
pH	----	E108	----	pH units	7 pH units	100	98.0	102	----
Anions and Nutrients (QCLot: 1196134)									
Kjeldahl nitrogen, total [TKN]	----	E318	0.05	mg/L	4 mg/L	105	75.0	125	----
Anions and Nutrients (QCLot: 1196135)									
Phosphorus, total	7723-14-0	E372-U	0.002	mg/L	0.393 mg/L	95.6	80.0	120	----
Anions and Nutrients (QCLot: 1200237)									
Fluoride	16984-48-8	E235.F	0.02	mg/L	1 mg/L	100	90.0	110	----
Anions and Nutrients (QCLot: 1200240)									
Chloride	16887-00-6	E235.Cl	0.5	mg/L	100 mg/L	101	90.0	110	----
Anions and Nutrients (QCLot: 1200241)									
Sulfate (as SO4)	14808-79-8	E235.SO4	0.3	mg/L	100 mg/L	100	90.0	110	----
Cyanides (QCLot: 1203730)									
Cyanide, strong acid dissociable (Total)	----	E333	0.002	mg/L	0.25 mg/L	99.9	80.0	120	----
Total Metals (QCLot: 1195791)									
Aluminum, total	7429-90-5	E420	0.003	mg/L	0.1 mg/L	98.7	80.0	120	----
Antimony, total	7440-36-0	E420	0.0001	mg/L	0.05 mg/L	96.1	80.0	120	----
Arsenic, total	7440-38-2	E420	0.0001	mg/L	0.05 mg/L	102	80.0	120	----
Bismuth, total	7440-69-9	E420	0.00005	mg/L	0.05 mg/L	97.3	80.0	120	----
Cadmium, total	7440-43-9	E420	0.000005	mg/L	0.005 mg/L	98.4	80.0	120	----
Chromium, total	7440-47-3	E420	0.0005	mg/L	0.0125 mg/L	99.0	80.0	120	----
Cobalt, total	7440-48-4	E420	0.0001	mg/L	0.0125 mg/L	99.7	80.0	120	----
Copper, total	7440-50-8	E420	0.0005	mg/L	0.0125 mg/L	97.9	80.0	120	----
Iron, total	7439-89-6	E420	0.01	mg/L	0.05 mg/L	97.1	80.0	120	----
Lead, total	7439-92-1	E420	0.00005	mg/L	0.025 mg/L	99.5	80.0	120	----
Manganese, total	7439-96-5	E420	0.0001	mg/L	0.0125 mg/L	99.4	80.0	120	----
Molybdenum, total	7439-98-7	E420	0.00005	mg/L	0.0125 mg/L	95.3	80.0	120	----
Nickel, total	7440-02-0	E420	0.0005	mg/L	0.025 mg/L	98.6	80.0	120	----
Selenium, total	7782-49-2	E420	0.00005	mg/L	0.05 mg/L	96.6	80.0	120	----

Sub-Matrix: **Water**

Analyte	CAS Number	Method	LOR	Unit	Laboratory Control Sample (LCS) Report				
					Spike	Recovery (%)	Recovery Limits (%)		
					Concentration	LCS	Low	High	Qualifier
Total Metals (QCLot: 1195791) - continued									
Silver, total	7440-22-4	E420	0.00001	mg/L	0.005 mg/L	88.8	80.0	120	----
Tin, total	7440-31-5	E420	0.0001	mg/L	0.025 mg/L	92.6	80.0	120	----
Titanium, total	7440-32-6	E420	0.0003	mg/L	0.0125 mg/L	95.0	80.0	120	----
Vanadium, total	7440-62-2	E420	0.0005	mg/L	0.025 mg/L	101	80.0	120	----
Zinc, total	7440-66-6	E420	0.003	mg/L	0.025 mg/L	98.4	80.0	120	----
Total Metals (QCLot: 1196080)									
Mercury, total	7439-97-6	E508	0.000005	mg/L	0.0001 mg/L	99.5	80.0	120	----
Aggregate Organics (QCLot: 1194382)									
Oil & grease (gravimetric)	----	E567	5	mg/L	200 mg/L	94.0	70.0	130	----
Aggregate Organics (QCLot: 1194383)									
Oil & grease, mineral (gravimetric)	----	E567SG	5	mg/L	100 mg/L	89.0	70.0	130	----
Aggregate Organics (QCLot: 1194478)									
Carbonaceous biochemical oxygen demand [CBOD]	----	E555	2	mg/L	198 mg/L	106	85.0	115	----
Aggregate Organics (QCLot: 1196136)									
Phenols, total (4AAP)	----	E562	0.001	mg/L	0.02 mg/L	105	85.0	115	----

Matrix Spike (MS) Report

A Matrix Spike (MS) is a randomly selected intra-laboratory replicate sample that has been fortified (spiked) with test analytes at known concentration, and processed in an identical manner to test samples. Matrix Spikes provide information regarding analyte recovery and potential matrix effects. MS DQO exceedances due to sample matrix may sometimes be unavoidable; in such cases, test results for the associated sample (or similar samples) may be subject to bias. ND – Recovery not determined, background level >= 1x spike level.

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Anions and Nutrients (QCLot: 1196134)										
WT2333338-001	Anonymous	Kjeldahl nitrogen, total [TKN]	----	E318	28.2 mg/L	2.5 mg/L	113	70.0	130	----
Anions and Nutrients (QCLot: 1196135)										
WT2333525-001	Anonymous	Phosphorus, total	7723-14-0	E372-U	ND mg/L	0.1 mg/L	ND	70.0	130	----
Anions and Nutrients (QCLot: 1200237)										
WT2333869-001	Anonymous	Fluoride	16984-48-8	E235.F	0.964 mg/L	1 mg/L	96.4	75.0	125	----
Anions and Nutrients (QCLot: 1200240)										
WT2333869-001	Anonymous	Chloride	16887-00-6	E235.Cl	99.5 mg/L	100 mg/L	99.5	75.0	125	----
Anions and Nutrients (QCLot: 1200241)										
WT2333869-001	Anonymous	Sulfate (as SO4)	14808-79-8	E235.SO4	101 mg/L	100 mg/L	101	75.0	125	----
Cyanides (QCLot: 1203730)										
WT2333422-004	Anonymous	Cyanide, strong acid dissociable (Total)	----	E333		----		75.0	125	----
Total Metals (QCLot: 1195791)										
HA2300873-002	Anonymous	Aluminum, total	7429-90-5	E420	0.0866 mg/L	0.1 mg/L	86.6	70.0	130	----
		Antimony, total	7440-36-0	E420	0.0481 mg/L	0.05 mg/L	96.2	70.0	130	----
		Arsenic, total	7440-38-2	E420	0.0508 mg/L	0.05 mg/L	102	70.0	130	----
		Bismuth, total	7440-69-9	E420	0.0471 mg/L	0.05 mg/L	94.2	70.0	130	----
		Cadmium, total	7440-43-9	E420	0.00493 mg/L	0.005 mg/L	98.6	70.0	130	----
		Chromium, total	7440-47-3	E420	0.0129 mg/L	0.0125 mg/L	103	70.0	130	----
		Cobalt, total	7440-48-4	E420	0.0121 mg/L	0.0125 mg/L	96.8	70.0	130	----
		Copper, total	7440-50-8	E420	ND mg/L	0.0125 mg/L	ND	70.0	130	----
		Iron, total	7439-89-6	E420	0.051 mg/L	0.05 mg/L	101	70.0	130	----
		Lead, total	7439-92-1	E420	0.0242 mg/L	0.025 mg/L	96.8	70.0	130	----
		Manganese, total	7439-96-5	E420	0.0126 mg/L	0.0125 mg/L	101	70.0	130	----
		Molybdenum, total	7439-98-7	E420	0.0120 mg/L	0.0125 mg/L	95.9	70.0	130	----
		Nickel, total	7440-02-0	E420	0.0239 mg/L	0.025 mg/L	95.7	70.0	130	----
		Selenium, total	7782-49-2	E420	0.0488 mg/L	0.05 mg/L	97.5	70.0	130	----
		Silver, total	7440-22-4	E420	0.00438 mg/L	0.005 mg/L	87.7	70.0	130	----
		Tin, total	7440-31-5	E420	0.0233 mg/L	0.025 mg/L	93.1	70.0	130	----
		Titanium, total	7440-32-6	E420	0.0118 mg/L	0.0125 mg/L	94.8	70.0	130	----
		Vanadium, total	7440-62-2	E420	0.0247 mg/L	0.025 mg/L	98.6	70.0	130	----

Sub-Matrix: **Water**

					Matrix Spike (MS) Report					
					Spike		Recovery (%)	Recovery Limits (%)		
Laboratory sample ID	Client sample ID	Analyte	CAS Number	Method	Concentration	Target	MS	Low	High	Qualifier
Total Metals (QCLot: 1195791) - continued										
HA2300873-002	Anonymous	Zinc, total	7440-66-6	E420	ND mg/L	0.025 mg/L	ND	70.0	130	----
Total Metals (QCLot: 1196080)										
WT2333760-002	Anonymous	Mercury, total	7439-97-6	E508	ND mg/L	0.001 mg/L	ND	70.0	130	----
Aggregate Organics (QCLot: 1196136)										
WT2333533-001	Anonymous	Phenols, total (4AAP)	----	E562	0.0210 mg/L	0.02 mg/L	105	75.0	125	----

Chain of Custody (COC) / Analytical Request Form

COC Number: 20 - 1084021

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

Environmental Division Waterloo
Work Order Reference
WT2333881

Telephone : +1 519 886 6910

Report To	Contact and company name below will appear on the final report	Reports / Recipients	Turnaround Time (TAT) Request
Company:	WSP E&I Canada Limited	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	☑ Routine [R] if received by 3pm M-F - no surcharges a
Contact:	Lisseth Benavente	Merge QC/QCI Reports with COA ☑ YES ☐ NO ☐ N/A	☐ 4 day [P4] if received by 3pm M-F - 20% rush surcha
Phone:	905-568-2929	☐ Compare Results to Criteria on Report - provide details below if box checked	☐ 3 day [P3] if received by 3pm M-F - 25% rush surcha
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	☐ 2 day [P2] if received by 3pm M-F - 50% rush surcha
Street:	2900 Argentia Rd #15	Email 1 or Fax lisseth.benavente@wsp.com	☐ 1 day [E] if received by 3pm M-F - 100% rush surcha
City/Province:	Mississauga ON	Email 2	☐ Same day [E2] if received by 10am M-S - 200% rush sur may apply to rush requests on weekends, statutory holiday
Postal Code:	L5N 7X9	Email 3	Date and Time Required for all E&P TATs:
Invoice To	Same as Report To ☑ YES ☐ NO	Invoice Recipients	For all tests with rush TATs request
	Copy of Invoice with Report ☑ YES ☐ NO	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Ana
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:		AFE/Cost Center:	PO#
Job #:	CA0010884 / phase: 200	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:	85 clair Rd E, Guelph, ON	Location:	
ALS Lab Work Order # (ALS use only):	WT2333881	ALS Contact: Cayle Braun	Sampler: Ramin Niknam

ALS Sample # (ALS use only)	Sample Identification and/Or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Guelph Sewer, Sanitary-Storm use Package	SAMPLES ON HOLD	EXTENDED STORAGE REQUIRED	SUSPECTED HAZARD (see notes)
	BH23-1D	18-10-23	3:00 PM	GW	9	✓			

Indicate Filtered (F), Preserved (P) or

Drinking Water (DW) Samples[1] (client use)	Notes / Specify Limits for result evaluation by selecting from drop-down below (Excel COC only)
Are samples taken from a Regulated DW System? ☐ YES ☑ NO	Compare to Guelph sewer sanitary - storm By law
Are samples for human consumption/ use? ☐ YES ☑ NO	

SAMPLE RECEIPT DETAILS (ALS use only)

Cooling Method: ☐ NONE ☑ ICE ☐ ICE PACKS ☐ FROZEN ☐ COOLING INITIATED

Submission Comments identified on Sample Receipt Notification: ☐ YES ☐ NO

Cooler Custody Seals Intact: ☐ YES ☐ N/A Sample Custody Seals Intact: ☐ YES ☐ N/A

INITIAL COOLER TEMPERATURES °C				FINAL COOLER TEMPERATURES °C			
				-0.6			

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (ALS use only)			FINAL SHIPMENT RECEPTION (ALS use only)		
Released by: Ramin Niknam	Date: oct 18, 2023	Time: 7:45 P.M	Received by:	Date:	Time:	Received by: AP	Date: 19 Oct 23	Time: 9:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

AUG 2020 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

OCCC - 447 CC-487 SF
B-151 MM-442 N-342

APPENDIX F

Dewatering Calculations

Construction Dewatering Assessment - Unconfined Conditions

from Powers, 1992

North Site underground parking - Anticipated Conditions

Lateral Flow through the Till and Interbedded Sequence

Site North Parking Facility - Till

Input Parameters			**User Entry**		**Calc'd**	
Initial Elevation of Water Table (m)		H	335.6	masl	5.5	m
Final Elevation of Water Table (m)		h	331.6	masl	1.5	m
Base of Aquifer/Datum			330.1	masl	0.0	m
Hydraulic Conductivity (m/s)		K	2.5E-07	m/s	2.5E-07	m/s
Hydraulic Conductivity (m/d)		K		m/d	2.1E-02	m/d
Aquifer Thickness if Confined (m)		B		m	0.0	m
Length of Excavation (m)		a	146.9	m	146.9	m
Width of Excavation (m)		b	44.7	m	44.7	m
Length of Dewatering - Trench Length (m)		X	146.9	m	146.9	m
Linear System Zone of Influence (m)		L		m	2.0	m
Sichardt Constant (well = 3, wellpoint = 1.5 or 2)		C	2.0		2.0	
Ratio a/b	Override a/b? (Y/N) Y	a/b			0.0	

L = Ro / 2 (eq. 6.15, p. 105)

ZOI - Radius of Influence (m) Well radius + ZOI

R_o = C x (H - h) x sqrt (K) (eq. 6.14, p. 104)

$R_o + R_s$	49.6	
R_o	3.9	m

Equivalent Radius of Well (m)

R_s	45.7	m

R_s = sqrt ((a x b)/ pi) (eq. 6.10, p. 102)

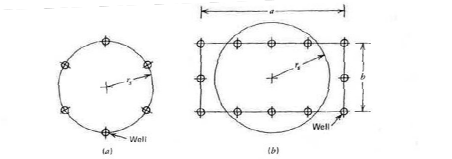


Figure 6.7 Approximation of equivalent radius r_s. (a) Circular systems. (b) Rectangular systems.

Flow Calculations - Q

Radial Flow to a Shaft (a/b <= 1.5) TRUE

Shaft Calculation (m^3/day)

$Q = (\pi \times K \times (H^2 - h^2)) / \ln (R_o / R_s)$ (Eq. 6.3, p. 99)

Q	22.5	m^3/day
Q	22,511	L/day

Long Narrow System - Trench (a/b > 1.5) FALSE

Trench Calculation with Radial Flow at Ends (m^3/day)

$Q = K \times X \times (H^2 - h^2) / L + \pi \times K \times (H^2 - h^2) / \ln(R_o/R_s)$ (eq. 6.8, p. 101)

Q	N/A	m^3/day
Q	N/A	L/day

Drainage Trench from a Line Source (m^3/day)

Q = K x X x (H^2 - h^2) / L (eq. 6.9, p. 102)

Q	N/A	m^3/day
Q	N/A	L/day

Number of Trench Wall Sides with Flow (1 or 2) 2 <-- This is used only in the equation above

Specify 2 walls if an actual trench, specify 1 wall if modelling a wall of a building - equations shown above based on 2 walls

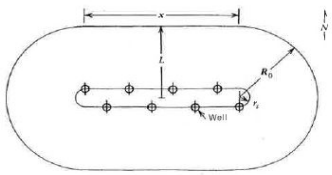
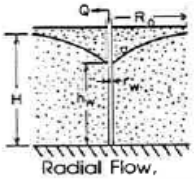
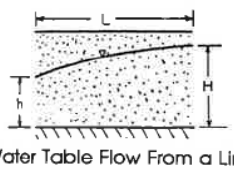


Figure 6.8 Approximate analysis of long narrow systems.





Construction Dewatering Assessment - confined Conditions

from Powers, 1992

North Site underground parking - Anticipated Hydraulic Conductivity (1 x k)

North Block

Site North Parking facility - Sand

Input Parameters			**User Entry**		**Calc'd**	
Initial Elevation of Water Table (m)		H	331.6	masl	1.5	m
Final Elevation of Water Table (m)		h	331.4	masl	1.2	m
Base of Aquifer/Datum			330.1	masl	0.0	m
Hydraulic Conductivity (m/s)		K	2.0E-05	m/s	2.0E-05	m/s
Hydraulic Conductivity (m/d)		K		m/d	1.7E+00	m/d
Aquifer Thickness if Confined (m)		B	1.5	m	1.5	m
Length of Excavation (m)		a	146.9	m	146.9	m
Width of Excavation (m)		b	44.7	m	44.7	m
Length of Dewatering - Trench Length (m)		X	146.9	m	146.9	m
Linear System Zone of Influence (m)		L		m	1.3	m
Sichardt Constant (well = 3, wellpoint = 1.5 or 2)		C	2.0		2.0	
Ratio a/b	Override a/b? (Y/N) Y	a/b			0.0	

L = Ro / 2 (eq. 6.15, p. 105)

ZOI - Radius of Influence (m) Well radius + ZOI

R_o = C x (H - h) x sqrt (K) (eq. 6.14, p. 104)

$R_o + R_s$	48.3	
R_o	2.6	m

Equivalent Radius of Well (m)

R_s = sqrt ((a x b)/ pi) (eq. 6.10, p. 102)

R_s	45.7	m

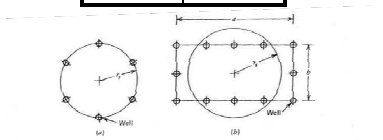


Figure 6.7 Approximation of equivalent radius r_s. (a) Circular systems. (b) Rectangular systems.

Flow Calculations - Q

Radial Flow to a Shaft (a/b <= 1.5) TRUE

Shaft Calculation (m^3/day)

Q = (π x K x (H^2 - h^2)) / ln (R_o / R_s) (Eq. 6.3, p. 99)

Q	78.5	m^3/day
Q	78,502	L/day

Long Narrow System - Trench (a/b > 1.5) FALSE

Trench Calculation with Radial Flow at Ends (m^3/day)

Q = K x X x (H^2 - h^2) / L + π x K x (H^2 - h^2) / ln(R_o/R_s) (eq. 6.8, p. 101)

Q	N/A	m^3/day
Q	N/A	L/day

Drainage Trench from a Line Source (m^3/day)

Q = K x X x (H^2 - h^2) / L (eq. 6.9, p. 102)

Q	N/A	m^3/day
Q	N/A	L/day

Number of Trench Wall Sides with Flow (1 or 2) 2 <-- This is used only in the equation above

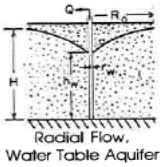
Specify 2 walls if an actual trench, specify 1 wall if modelling a wall of a building - equations shown above based on 2 walls

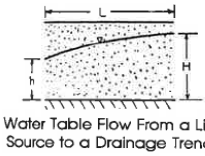
Vertical Flow Contribution from the Sand

Difference in hydraulic head (m)	Δh	0.3	m
Difference between Excavation and Aquifer (m)	ΔL	1.2	m
Vertical Flow (m^3/sec)	Q	3.0E-03	m^3/sec
Darcys Law Q=KiA	Q	261,972	L/day
Total Flow	Q	340,474	L/day

Total Combined Flow (Lateral + Vertical) Q 362,985

Factor of Safety (mitigated) 725,970 L/day





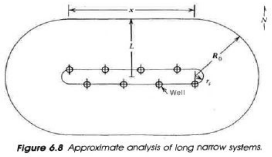


Figure 6.8 Approximate analysis of long narrow systems.

Construction Dewatering Assessment - Unconfined Conditions

from Powers, 1992

South Site underground parking - Anticipated Hydraulic Conductivity (1 x k)

South Block

Site South Parking Facility - Till

Input Parameters		User Entry			Calc'd	
Initial Elevation of Water Table (m)	H	335.6	masl		4.4	m
Final Elevation of Water Table (m)	h	334.1	masl		3.0	m
Base of Aquifer/Datum		331.2	masl		0.0	m
Hydraulic Conductivity (m/s)	K	2.5E-07	m/s		2.5E-07	m/s
Hydraulic Conductivity (m/d)	K		m/d		2.1E-02	m/d
Aquifer Thickness if Confined (m)	B		m		0.0	m
Length of Excavation (m)	a	146.9	m		146.9	m
Width of Excavation (m)	b	84.1	m		84.1	m
Length of Dewatering - Trench Length (m)	X	146.9	m		146.9	m
Linear System Zone of Influence (m)	L		m		0.7	m
Sichardt Constant (well = 3, wellpoint = 1.5 or 2)	C	2.0			2.0	
Ratio a/b Override a/b? (Y/N) Y	a/b				0.0	

L = Ro / 2 (eq. 6.15, p. 105)

ZOI - Radius of Influence (m) Well radius + ZOI

R_o = C x (H - h) x sqrt (K) (eq. 6.14, p. 104)

$R_o + R_s$	64.2	
R_o	1.5	m

Equivalent Radius of Well (m)

R_s	62.7	m

R_s = sqrt ((a x b)/ pi) (eq. 6.10, p. 102)

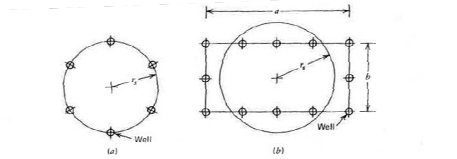


Figure 6.7 Approximation of equivalent radius r_s. (a) Circular systems. (b) Rectangular systems.

Flow Calculations - Q

Radial Flow to a Shaft (a/b <= 1.5) TRUE

Shaft Calculation (m^3/day)

$Q = (\pi \times K \times (H^2 - h^2)) / \ln (R_o / R_s)$ (Eq. 6.3, p. 99)

Q	31.6	m^3/day
Q	31,600	L/day

Long Narrow System - Trench (a/b > 1.5) FALSE

Trench Calculation with Radial Flow at Ends (m^3/day)

$Q = K \times X \times (H^2 - h^2) / L + \pi \times K \times (H^2 - h^2) / \ln(R_o/R_s)$ (eq. 6.8, p. 101)

Q	N/A	m^3/day
Q	N/A	L/day

Drainage Trench from a Line Source (m^3/day)

Q = K x X x (H^2 - h^2) / L (eq. 6.9, p. 102)

Q	N/A	m^3/day
Q	N/A	L/day

Number of Trench Wall Sides with Flow (1 or 2) 2 <-- This is used only in the equation above

Specify 2 walls if an actual trench, specify 1 wall if modelling a wall of a building - equations shown above based on 2 walls

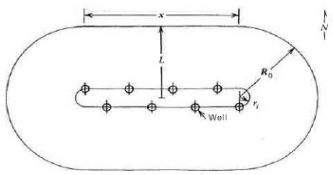
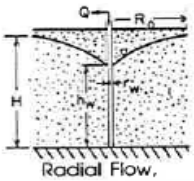
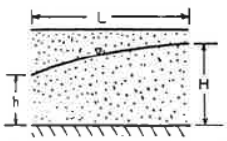


Figure 6.8 Approximate analysis of long narrow systems.



Radial Flow, Water Table Aquifer



Water Table Flow From a Line Source to a Drainage Trench

Construction Dewatering Assessment - confined Conditions

from Powers, 1992

South Site underground parking - Anticipated Hydraulic Conductivity (1 x k)

South Block

Site South Parking Facility- Sand

Input Parameters			**User Entry**		**Calc'd**	
Initial Elevation of Water Table (m)		H	334.1	masl	3.0	m
Final Elevation of Water Table (m)		h	331.35	masl	0.2	m
Base of Aquifer/Datum			331.2	masl	0.0	m
Hydraulic Conductivity (m/s)		K	2.0E-05	m/s	2.0E-05	m/s
Hydraulic Conductivity (m/d)		K		m/d	1.7E+00	m/d
Aquifer Thickness if Confined (m)		B	3.0	m	3.0	m
Length of Excavation (m)		a	146.9	m	146.9	m
Width of Excavation (m)		b	84.1	m	84.1	m
Length of Dewatering - Trench Length (m)		X	146.9	m	146.9	m
Linear System Zone of Influence (m)		L		m	12.2	m
Sichardt Constant (well = 3, wellpoint = 1.5 or 2)		C	2.0		2.0	
Ratio a/b	Override a/b? (Y/N) Y	a/b			0.0	

L = Ro / 2 (eq. 6.15, p. 105)

ZOI - Radius of Influence (m) Well radius + ZOI $R_o + R_s$ 87.1

$R_o = C \times (H - h) \times \sqrt{K}$ (eq. 6.14, p. 104) R_o 24.4 m

Equivalent Radius of Well (m) R_s 62.7 m

$R_s = \sqrt{((a \times b)/\pi)}$ (eq. 6.10, p. 102)

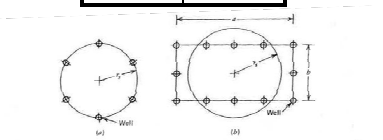


Figure 6.7 Approximation of equivalent radius r_s. (a) Circular systems. (b) Rectangular systems.

Flow Calculations - Q

Radial Flow to a Shaft (a/b <= 1.5) TRUE

Shaft Calculation (m^3/day) Q 141.1 m^3/day

$Q = (\pi \times K \times (H^2 - h^2)) / \ln (R_o / R_s)$ (Eq. 6.3, p. 99) Q 141,064 L/day

Long Narrow System - Trench (a/b > 1.5) FALSE

Trench Calculation with Radial Flow at Ends (m^3/day) Q N/A m^3/day

$Q = K \times X \times (H^2 - h^2) / L + \pi \times K \times (H^2 - h^2) / \ln(R_o/R_s)$ (eq. 6.8, p. 101) Q N/A L/day

Drainage Trench from a Line Source (m^3/day) Q N/A m^3/day

Q = K x X x (H^2 - h^2) / L (eq. 6.9, p. 102) Q N/A L/day

Number of Trench Wall Sides with Flow (1 or 2) 2 <-- This is used only in the equation above

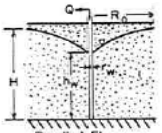
Specify 2 walls if an actual trench, specify 1 wall if modelling a wall of a building - equations shown above based on 2 walls

Vertical Flow Contribution from the Sand

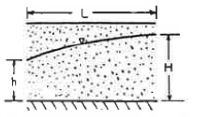
Difference in hydraulic head (m)	Δh	2.75	m
Difference between Excavation and Aquifer (m)	ΔL	0.20	m
Vertical Flow (m^3/sec)	Q	2.7E-03	m^3/sec
Darcys Law Q=KiA	Q	236,197	L/day
Total Flow	Q	377,262	L/day

Total Combined Flow (Lateral + Vertical) Q 408,861

Factor of Safety (mitigated) 817,722



Radial Flow, Water Table Aquifer



Water Table Flow From a Line Source to a Drainage Trench

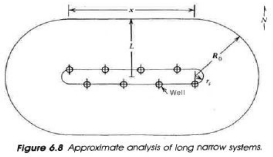


Figure 6.8 Approximate analysis of long narrow systems.

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