Stormwater Management Report

Simcoe County Housing Corporation

20 Rose Street
City of Barrie
County of Simcoe

PEARSON ENGINEERING

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City of Barrie File
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20118

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Stormwater Management Report
20 Rose Street, Barrie

1. Introduction

PEARSON Engineering Ltd. (PEARSON) has been retained by Simcoe County Housing Corporation (SCHC) (Client) to prepare a Stormwater Management (SWM) Report in support of the proposed affordable housing mixed-use development located at 20 Rose Street (Project) in the City of Barrie (City), in the County of Simcoe (County).

The Project site is approximately 1.87 ha in size and is currently zoned as Institutional. The Project site fronts onto Rose Street to the south, the Highway 400 Northbound ramp to the west, the Highway 400 Corridor to the north, and existing residential homes to the east. The Project proposes a 215-unit apartment building with 9 and 11-storey buildings and community agency spaces on level 1 and 2, a separate 3-storey parking structure with additional community agency spaces, surface parking, two driveway connections to Rose Street, and an outdoor amenity area. The residential and parking garage buildings are proposed to be connected by both an underground tunnel and an above ground enclosed bridge. The Project site location can be seen on Figure 1.

1.1. Terms of Reference

The intent of this SWM Report is to:

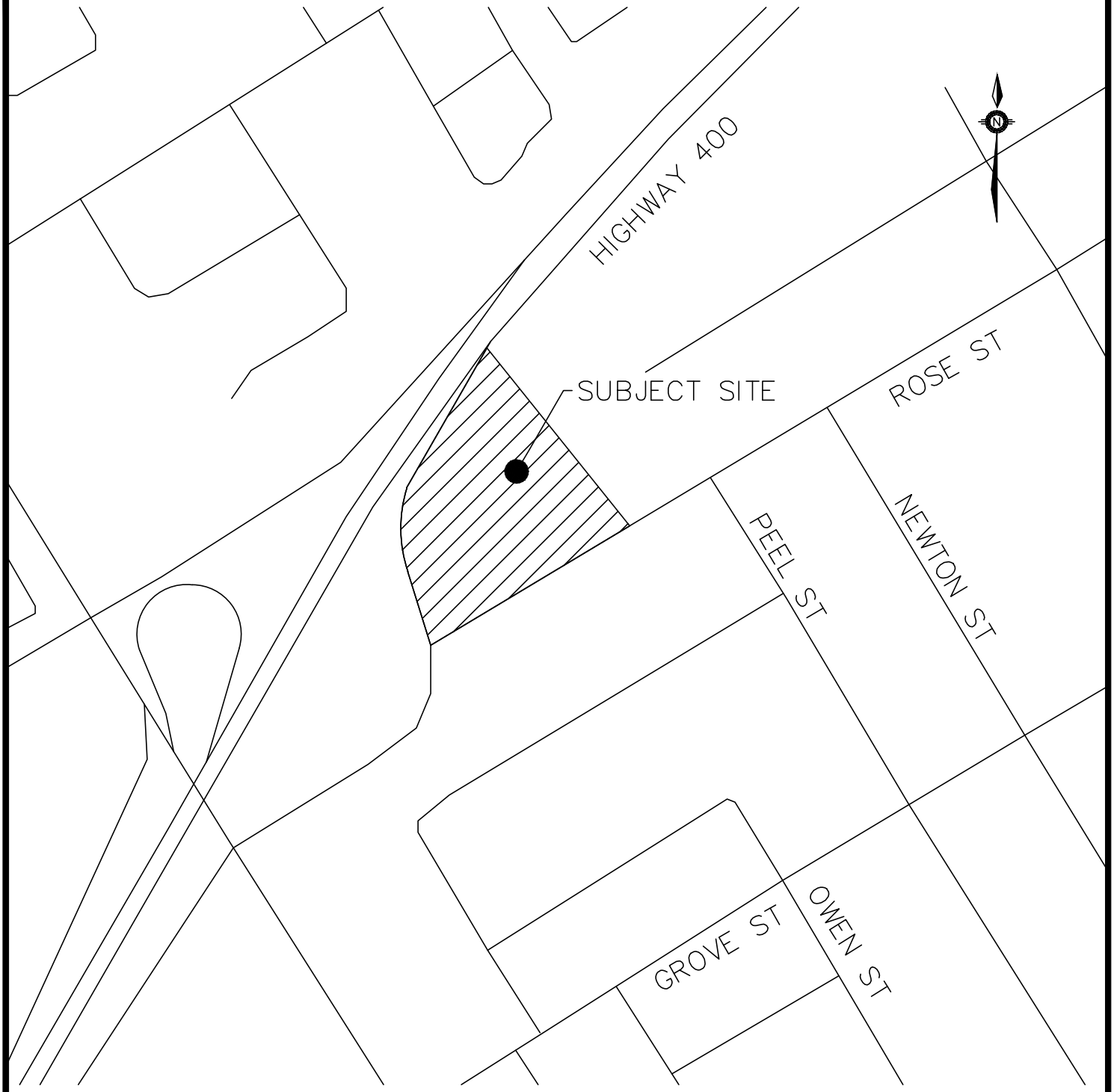
- Identify the existing site characteristics including any external drainage conditions;
- Illustrate the design of the stormwater conveyance and detention system, capable of accommodating both minor and major storm flows from the site;
- Incorporate the appropriate Best Management Practices for controlling on-site erosion and sedimentation during construction while ultimately ensuring that the post-development release of stormwater is of adequate quality; and,
- Summarize this design in a technically comprehensive and concise manner.

2. Stormwater Management

A key component of the development needs to address environmental and related SWM issues. These are examined in a framework aimed at meeting the City, and the Lake Simcoe Regional Conservation Authority (LSRCA), and Ministry of the Environment, Conservation, and Parks (MECP) requirements. SWM parameters have evolved from an understanding of the location and sensitivity of the site's natural systems. This SWM Report focuses on the necessary measures to satisfy the MECP's SWM requirements.

It is understood the objectives of the SWM plan are to:

- Protect life and property from flooding and erosion.
- Maintain water quality for ecological integrity, recreational opportunities etc.
- Protect and maintain groundwater flow regime(s).
- Protect aquatic and fishery communities and habitats.
- Maintain and protect significant natural features.



COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST. CITY OF BARRIE

SITE LOCATION PLAN

PEARSON ENGINEERING
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DESIGNED BY	AMC/TWC	HORIZ SCALE	NTS	PROJECT #	20118
DRAWN BY	TWC	VERT SCALE		DRAWING #	FIG–1
CHECKED BY	MWD	DATE	OCTOBER 2023	REVISION #	0

P:\Autodesk Vault\Working Folders\20118 – SCHC, 20 Rose St., Barrie\LAYOUT SHEETS\20118 – COVER & NOTES.dwg Layout:FIG–1 Plotted Apr 23, 2024 @ 11:47am by acleaves @ PEARSON ENGINEERING LTD.

2.1. Analysis Methodology

The design of the SWM Facilities for this site has been conducted in accordance with:

- The Ministry of the Environment Stormwater Management Planning and Design Manual – March 2003
- City of Barrie, Storm Drainage and Stormwater Management Policies and Design Guidelines – December 2017
- Lake Simcoe Region Conservation Authority Technical Guidelines for Stormwater Management Submissions – April 2022

It is essential to select the appropriate modeling methodology for the storm system design. Given the size of the site, the Modified Rational Method is appropriate for the design for the SWM system.

2.2. Existing Drainage Conditions

Previously, the Project lands consisted of an Ontario Provincial Police (OPP) headquarters building which has since been demolished. The lands are currently a gravel lot with a temporary housing facility installed in 2022 and scheduled for removal in Spring 2024. The topographic survey, completed by Bowers Jones Fournier Surveying Ltd. in May 2021, shows approximately a 5.0 m drop in elevation from the northwest to the southeast of the site resulting in an average slope of approximately 3%. The majority of the runoff from the project site drains overland to Rose Street then easterly down Rose Street. A portion of the site flows overland to a swale located along the west property line. Details of the existing drainage conditions can be seen on Drawing STM-2 in Appendix G.

According to the Geotechnical Investigation Report completed by Peto MacCallum Ltd., dated May 2021, the project site is comprised of various layers of Native Sand to Silty Sand Till. The majority of the site has a surface layer of topsoil/organic layer generally consisting of silt and sand, with an underlying layer of silty sand till. According to the Hydrogeological Investigation Report prepared by GEI Consultants Ltd., dated October 2024, the groundwater measurements taken January and April 2024 ranged at a depth of approximately 5.6 m to 9.8 m below the existing ground surface. Long term groundwater levels monitoring is ongoing on-site for the eight monitoring wells installed. Based on field-saturated hydraulic conductivity results obtained from Guelph Permeameter tests completed, a factored infiltration rate ranging between 9 mm/hr to 17 mm/hr was calculated for the eight boreholes. The Geotechnical Investigation Report has been included in Appendix D and Hydrogeological Investigation in Appendix E.

Given the size of the Project Site, the Modified Rational Method was used to determine the pre-development peak flows. The City of Barrie IDF curve parameters were used for determining the storm intensity values. The following pre-development peak flows have been calculated and are provided in Table 1. Detailed calculations can be found in Appendix A.

Table 1: Pre-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Project Site to West (m^3/s)	0.01	0.01	0.01	0.01	0.01	0.01
Project Site to Rose Street (m^3/s)	0.18	0.23	0.27	0.35	0.42	0.48

2.3. Proposed Drainage Conditions

The post-development storm drainage for the project will generally follow pre-development conditions. The Project site is proposed to drain via a catchbasin and storm sewer system, which was sized for the 5-year storm event. The site's paved areas have been graded to direct stormwater towards catchbasins within the parking lot and drive aisles. A portion of the site located north of the proposed parking lot building will drain uncontrolled to Rose Street via a grass swale along the eastern property line. A second uncontrolled area south of the apartment building will drain southerly directly to Rose Street.

In the event of a storm greater than the 5-year event, the proposed storm sewer will surcharge, forcing stormwater to the surface. The site is graded to provide an overland flow route to CBMH6 located near the eastern driveway entrance. Calculations in Appendix C demonstrate that four catchbasin grates are required to convey the 100-year storm into the storm sewer system. The flows released from the site will be controlled using an orifice tube upstream of STM OGS before outletting through the OGS to the proposed storm sewer system on Rose Street. The orifice tube will cause stormwater to backup into the proposed quantity control underground storage chamber and pond onsite. A proposed 4.5 m wide concrete weir located in the amenity space will convey the major system flows southerly to Rose Street. The proposed post-development storm drainage patterns can be found on Drawing STM-2 in Appendix H. The release rate will not exceed the peak pre-development runoff rate that currently drains to Rose Street.

The rooftop area of the apartment buildings and the parking garage/commercial building will be conveyed to infiltration chambers sized for the 25 mm storm. In the event of a storm greater than the 25 mm storm, an overflow system will be provided allowing stormwater to drain to the site's storm sewer system. A portion of the site located north of the proposed building will drain uncontrolled to Rose Street via a grass swale along the eastern property line. A second uncontrolled area south of the building will drain southerly directly to Rose Street.

Since the current nearest storm sewer to the project site is located at the intersection of Rose Street and Newton Street approximately 190 m east of the site, a 300 mm storm sewer from Newton Street is proposed to be extended during construction to the project storm outlet at the southeast end of the site as seen in Drawings SS-1, STM-2, and the Rose Street Plan and Profiles. The City of Barrie plans to reconstruct the Rose Street right-of-way in the future and have requested the extended storm sewer be sized to capture runoff from Rose Street and the adjacent catchment areas. A catchment plan and external pipe sheet are provided to demonstrate that the proposed storm sewer extension can adequately convey future flows.

2.4. Downstream Storm Sewer Analysis and Reconstruction

A PCSWMM analysis was completed for the storm sewer system on Newton Street utilizing the model provided by the City of Barrie. The City's model was simulated using the 5-year Chicago storm, and the 5-year, 6-hour, 12-hour, and 24-hour SCS storms, which determined that the 5-year 6-hour SCS storm resulted in the highest hydraulic grade line (HGL) in the system.

The original City PCSWMM model includes the project site within Subcatchment S-100121466. The model has the flows from the project site and the remainder of S-100121466 being conveyed overland east on Rose Street and south on Peel Street, then entering the storm sewer system at the intersection of Grove Street and Peel Street.

A review of the grading on Rose Street determined that under existing conditions, the area north of Rose Street including the project site (located within PCSWMM subcatchment S-100121466) drains to Rose Street and flows overland easterly on the north side of the road prior to entering the City's storm sewer system at the intersection of Rose Street and Newton Street. Cross-sections of the Rose Street right-of-way provided in Appendix A demonstrates that the 5-year flow can be conveyed by the north half of Rose Street and that flows do not overtop at the intersection of Rose Street and Peel Street, thus are conveyed all the way to Newton Street where it enters the storm system via catchbasins.

As discussed in Section 4.3 above, a 300 mm storm sewer is proposed on Rose Street from Newton Street to the subject site complete with manholes and catchbasins to meet municipal standards. The proposed 300 mm storm sewer will have a slope of 3%, is approximately 190 m long and is designed to convey minor system flows from the project site and external catchment area to the City's existing sewer system on Newton Street.

The Newton Street storm sewer is part of the Sophia Creek Subwatershed. The existing storm sewer on Newton Street extends south from Rose Street to Grove Street, and east along Grove Street to Davidson Street. The sewer then extends south on Davidson to an existing 1,560 mm x 1,850 mm box culvert located at the Davidson and Gunn Street intersection. The major storm system flow is conveyed within the road right of way on this route and enters the City's storm sewer system through double catchbasins located at the Davidson St./Gunn St. intersection.

The City's storm model shows that the existing storm system from Rose Street to Gunn Street flows at between 33% - 187% capacity. The 5-year hydraulic grade line (HGL) is below the surface within this reach but greater storm events up to the 100-year storm are safely conveyed on the road surface within the road right of way.

The PCSWMM model was updated with the portion of subcatchment S-100121466 north of Rose Street conveyed to the Newton Street storm sewer system with surveyed inverts for some of the downstream manholes on Davidson Street and Grove Street (MH100114061 MH 100114860) to more accurately reflect existing conditions. Under the field verified existing conditions the manhole where runoff enters the storm sewer system is surcharged while the remainder of the pipes flow at 42% to 197% full.

The PCSWMM model was updated with the proposed conditions including the post-development project site and its controls as well as the proposed storm sewer system on Rose Street connecting to Newton Street. Under the proposed conditions the downstream pipes flow at 41% to 187% full. The 5-year HGL is still the below surface within this reach. Post-development PCSWMM modeling results can be seen in Appendix F.

2.5. Stormwater Quantity Control

The proposed development will increase the imperviousness of the site and as such the post-development peak flows will increase. It is important to quantify the increase in stormwater runoff rates and attenuate these increases. The calculated post-development runoff coefficient of 0.74 for the project site is greater than the pre-development runoff coefficient of 0.43. Runoff coefficient calculations can be found in Appendix C.

A 200 mm diameter orifice tube is proposed downstream of STM MH 3. Calculations in Appendix C demonstrate that 217 m^3 of storage is required to control the 100-year storm event to allowable values. 140 m^3 of storage is provided in underground chambers and 77 m^3 is provided within the pipes and through surface ponding. The orifice tube causes stormwater to backup into the offline storage chambers and will only release a maximum of the 5-year pre-development peak flow to the proposed storm sewer on Rose Street. Storm events greater than the 5-year storm will surcharge to the surface and will be released through the 4.5 m wide major storm control weir to Rose Street.

Table 5 below summarises the post-development peak flows. By comparing Table 4 and Table 5, it can be seen that the post-development peak flows for all storm events are smaller than or equal to the pre-development peak flows.

Table 2: Post-Development Peak Flows

	2 Year Storm	5 Year Storm	10 Year Storm	25 Year Storm	50 Year Storm	100 Year Storm
Controlled to Rose Street (m^3/s)	0.07	0.10	0.15	0.25	0.31	0.36
Uncontrolled to Rose Street (m^3/s)	0.03	0.04	0.05	0.06	0.07	0.07
Total Project Site to Rose Street (m^3/s)	**0.10**	**0.14**	**0.20**	**0.31**	**0.38**	**0.43**

2.6. Stormwater Quality Control

The MECP in March 2003 issued a "Stormwater Management Planning and Design Manual". The Stormwater Quality Control objective will be to ensure Enhanced Protection quality control as stated in the MECP manual. To achieve enhanced protection, permanent and temporary control of erosion and sediment transport are proposed and are discussed in the following sections.

2.6.1. Permanent Quality Control

The development's active parking facilities and paved surfaces pose a risk to stormwater quality through the collection of grit, salt, sand and oils. The MECP standard stipulates a Total Suspended Solids (TSS) removal of at least 80% for Enhanced Protection Level according to Table 3.2 in the MECP SWM Planning & Design Manual. A treatment train solution is utilized to provide 80% TSS removal over the project site.

The catchbasins include sumps which will settle larger sediment particles. Heavy metals have an affinity to adsorb to sediment particles in runoff and the OGS unit is proposed to remove accumulated sediment from the stormwater. Stormwater will be conveyed by the storm sewer system and will flow through an OGS unit prior to draining to the existing stormwater sewer system. The proposed PMSU 2015-4-C OGS will treat the post-development flows with a TSS removal rate of approximately 80.0%, exceeding MECP standards. The OGS is sized to treat the controlled area of 0.14 ha with a runoff coefficient of 0.83.

Regular inspections and proper maintenance of the proposed OGS unit will ensure the TSS removal rate will be achieved as well as protect the downstream watercourse from oil, grease, and heavy metals. Detailed information regarding the OGS unit can be seen in Appendix A.

2.6.2. During Construction Activities

During construction, earth grading and excavation will create the potential for soil erosion and sedimentation. It is imperative that effective environmental and sedimentation controls are in place and maintained throughout the duration of construction activities to ensure stormwater runoff's quality.

Therefore, the following recommendations shall be implemented and maintained during construction to achieve acceptable stormwater runoff quality:

- Installation of silt fence along the entire perimeter of the site to reduce sediment migration onto surrounding properties.
- Installation of a construction entrance mat to minimize transportation of sediment onto roadways.
- Restoration of exposed surfaces with vegetative and non-vegetative material as soon as construction schedules permit. The duration in which surfaces are disturbed / exposed shall not exceed 30 days.
- Reduce stormwater drainage velocities where possible.
- Minimize the amount of existing vegetation removed.

The Environmental Protection and Removals Plan can be seen in Appendix I.

2.7. Volume Control

Since the project site meets the definition of Major Development as per LSRCA Guidelines, considerations were taken to meet the volume control criteria detailed in section 2.2.2. The LSRCA guidelines state that for a new development that creates 500 m^2 or more of impervious surfaces, 25 mm of runoff over the total impervious area of the site is to be retained and treated on site, with flexible alternatives if this criterion cannot be met.

The site's proposed impervious area consists of asphalt drive aisles, concrete walkways and buildings and is found to be approximately 12,714 m^2. The corresponding 25 mm storm yields a runoff volume of 318 m^3. Due to the soil characteristics and site layout, 25 mm over the project site is not feasible and therefore the alternative volume control requirements for 5 mm over the total impervious area on the site will be used to achieve Volume Control, resulting in a required volume of 64 m^3.

The Geotechnical Investigation conducted in May 2021 by Peto MacCallum presented the inferred contour pattern of the groundwater elevation on the site. There is greater separation to groundwater at the north end of the site so it was determined that At the site of the rooftop soakaway pit, the proposed grades throughout the site offer between a one and three metres of separation between the groundwater table and the ground surface. The inferred groundwater table contours can be seen on the Groundwater Contour Map by GEI in Appendix G.

Due to the layout of the site and the groundwater contours, it is only possible to achieve the required 1 m separation to groundwater on the northern portion of the site, due to this only the apartment buildings rooftop runoff can be infiltrated. Infiltrating 25 mm over the apartment building's rooftop results in the provided infiltration volume of 42.6 m^3. The Volume Control Calculations can be found in Appendix A.

3. Water Balance

Since the post-development state will increase the imperviousness of the site, considerations were taken in regard to groundwater recharge. Under pre-development conditions, the project site consists of an existing gravel lot with a temporary housing facility, and as per the water balance calculations provided in GEI's Hydrogeological Assessment, dated October 2024, the project site under pre-development conditions will infiltrate approximately 2,109 m^3 annually over the entire site. With the increased imperviousness of the site, this recharge will be reduced to 1,582 m^3, resulting in a deficit volume of 527 m^3. Based on preliminary findings, GEI has advised that the saturated hydraulic conductivity of the soil is estimated to be approximately 2 x 10^{-5} cm/s. This correlates to an unfactored infiltration rate of 30 mm/hr. Using a factor of safety of 2.5, gives a design factored infiltration rate of 12 mm/hr Refer to the Hydrogeological Investigation Report prepared by GEI Consultants, dated October 2024 attached in Appendix E for more information.

In order to infiltrate an additional 527 m^3 annually, a yearly rainfall depth of 425 mm from the rooftop of the proposed residential building is required to be infiltrated. This percentage of annual rainfall occurs for rain events of 5 mm or less resulting in a storage volume of 19 m^3. However, the City of Barrie guidelines outline a requirement to provide retention for the first 5 mm of rainfall over the site area resulting in a required storage volume of 93 m^3. Due to the site's layout, 1m of separation to groundwater can only be achieved on the northern portion of the site, and the requirement to have all infiltration chambers above the HGL of the 100-year storm, only runoff from the residential building's rooftop can be infiltrated. Greenstorm Chambers have been proposed which will infiltrate 42 m^3 from the residential building, which is equivalent to 2.3 mm over the project site. This meets the LSRCA's water balance criteria but fail to provide 5 mm retention across the project site. Water balance calculations can be seen in Appendix C.

4. Phosphorus Budget

Local conservation authorities have determined the importance of reducing phosphorus levels in water courses in this area. Best efforts are to be employed to reduce phosphorus levels being contributed from the site to pre-development levels or better.

The existing site consists of an existing institutional property and generates approximately 3.40 kg of phosphorus annually. The development of the project will reduce the amount of phosphorus contributed from the site to 2.47 kg without any phosphorus treatment. As the site proposed an OGS, underground storage and infiltration chambers, the phosphorus levels will be further reduced.

According to the LSRCA Phosphorus Loading Development Tool, the typical phosphorus reduction for underground infiltration chambers is 60%, 25% for underground storage tanks, and 20% for the OGS treatment unit. Therefore, the controlled post-development phosphorus can be reduced to 1.47 kg. The following Table 3 details the anticipated phosphorous loadings for the pre-development and post-development conditions.

Table 3: Phosphorus Loadings

	Total P (kg)
Pre-Development	3.40
Uncontrolled Post-Development	2.47
Controlled Post-Development	1.47

Detailed phosphorus calculations can be found in Appendix B.

5. Conclusions

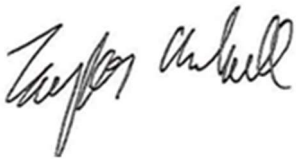
Quantity control for the development is provided in the Greenstorm underground storage units and surface ponding allowing post-development peak flows to be released at the allowable values through an orifice tube.

Quality control via underground infiltration chambers and an OGS unit is provided in order to maintain the quality of stormwater and to satisfy the MECP Enhanced level requirements. Rooftop infiltration will be utilized in order to accomplish water balance for the site.

A treatment train approach has been implemented in-order to reduce the phosphorous loading for the site.

All of which is respectfully submitted,

Pearson Engineering Ltd.



Taylor Arkell, P.Eng.
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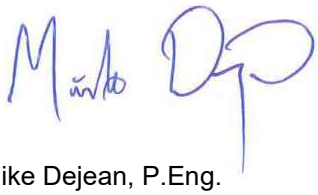

Mike Dejean, P.Eng.
Partner, Manager of Engineering Services

Appendix A

Stormwater Management Calculations

20 Rose Street, Barrie
Calculation of Runoff Coefficients

Runoff Coefficient	=	0.15	0.95	0.95	0.60	0.95		Weighted
Surface Cover	=	Grass	Asphalt	Building	Gravel	Concrete		Runoff Coefficient
Pre-Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	17258	9478	5207	2573	0	0		0.51
2	1397	1397	0	0	0	0		0.15
Pre Total	18655	10875	5207	2573	0	0		0.48
Post-Development	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	13769	861	5803	5642	140	1323		0.90
2	4886	3965	651	0	0	270		0.30
Post Total	18655	4826	6454	5642	140	1593		0.74

20 Rose Street, Barrie
Pre-Development Peak Flows

Storm (yrs)	City of Barrie Coeff A	Coeff B	Coeff C
2	**675.586**	**4.681**	**0.780**
5	**843.019**	**4.582**	**0.763**
10	**976.898**	**4.745**	**0.760**
25	**1133.123**	**4.734**	**0.756**
50	**1251.473**	**4.847**	**0.753**
100	**1383.628**	**4.905**	**0.754**

Modified Rational Method
$Q = C_iCIA / 360$

Where:

- Q - Flow Rate (m^3/s)
- Ci - Peaking Coefficient
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)

Area Number	Project Site to Rose Street Area 1		Project Site to West Area 2	
Area	1.73	ha	0.14	ha
Runoff Coefficient	0.51		0.15	
Time of Concentration	10	min	10	min
Return Rate	2	year	2	year
Peaking Coefficient (C_i)	1.0		1.0	
Rainfall Intensity	83.1	mm/hr	83.1	mm/hr
Pre-Development Peak Flow	0.20	m^3/s	0.00	m^3/s
Return Rate	5	year	5	year
Peaking Coefficient (C_i)	1.0		1.0	
Rainfall Intensity	109.1	mm/hr	109.1	mm/hr
Pre-Development Peak Flow	0.27	m^3/s	0.01	m^3/s
Return Rate	10	year	10	year
Peaking Coefficient (C_i)	1.0		1.0	
Rainfall Intensity	126.4	mm/hr	126.4	mm/hr
Pre-Development Peak Flow	0.31	m^3/s	0.01	m^3/s
Return Rate	25	year	25	year
Peaking Coefficient (C_i)	1.1		1.1	
Rainfall Intensity	148.3	mm/hr	148.3	mm/hr
Pre-Development Peak Flow	0.40	m^3/s	0.01	m^3/s
Return Rate	50	year	50	year
Peaking Coefficient (C_i)	1.2		1.2	
Rainfall Intensity	164.1	mm/hr	164.1	mm/hr
Pre-Development Peak Flow	0.48	m^3/s	0.01	m^3/s
Return Rate	100	year	100	year
Peaking Coefficient (C_i)	1.25		1.25	
Rainfall Intensity	180.4	mm/hr	180.4	mm/hr
Pre-Development Peak Flow	0.55	m^3/s	0.01	m^3/s

20 Rose Street, Barrie
Post-Development Peak Flows

City of Barrie

Storm (yrs)	Coeff A	Coeff B	Coeff C
5	675.586	4.681	0.780
10	843.019	4.582	0.763
25	976.898	4.745	0.760
50	1133.123	4.734	0.756
100	1251.473	4.847	0.753
	1383.628	4.905	0.754

Modified Rational Method
$Q = C_i C I A / 360$

Where:

- Q - Flow Rate (m^3/s)
- Ci - Peaking Coefficient
- C - Rational Method Runoff Coefficient
- I - Storm Intensity (mm/hr)
- A - Area (ha.)

Area Number	Controlled Area Area 1		Uncontrolled Area Area 2	
Area	1.38	ha	0.49	ha
Runoff Coefficient	0.90		0.30	
Time of Concentration	10	min	10	min
Return Rate	2	year	2	year
Peaking Coefficient (C_i)	1.00		1.00	
Rainfall Intensity	83.1		83.1	
Post-Development Peak Flow	0.28	m^3/s	0.03	m^3/s
Return Rate	5	year	5	year
Peaking Coefficient (C_i)	1.00		1.00	
Rainfall Intensity	109.1		109.1	
Post-Development Peak Flow	0.37	m^3/s	0.04	m^3/s
Return Rate	10	year	10	year
Peaking Coefficient (C_i)	1.00		1.00	
Rainfall Intensity	126.4		126.4	
Post-Development Peak Flow	0.43	m^3/s	0.05	m^3/s
Return Rate	25	year	25	year
Peaking Coefficient (C_i)	1.10		1.10	
Rainfall Intensity	148.3		148.3	
Post-Development Peak Flow	0.51	m^3/s	0.06	m^3/s
Return Rate	50	year	50	year
Peaking Coefficient (C_i)	1.20		1.20	
Rainfall Intensity	164.1		164.1	
Post-Development Peak Flow	0.56	m^3/s	0.07	m^3/s
Return Rate	100	year	100	year
Peaking Coefficient (C_i)	1.25		1.25	
Rainfall Intensity	180.4		180.4	
Post-Development Peak Flow	0.62	m^3/s	0.07	m^3/s

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20 Rose Street, Barrie
Stage-Storage-Discharge Table

Elevation (m)	Area (m^2)	Tank Volume (m^3)	Tank Volume (m^3)	Storm System Volume (m^3)	Cum. Vol. (m^3)	Orifice 1 Head (m)	Orifice 1 Flow (m^3/s)	Weir Head (m)	Weir Flow (m^3/s)	Total Flow (m^3/s)	
263.28	0	0.0	0.0	0.0	0	0.00	0.000	0.00	0.000	0.000	
263.30	0	0.0	0.0	0.4	0	0.00	0.000	0.00	0.000	0.000	
263.40	0	0.0	0.0	1.8	2	0.00	0.000	0.00	0.000	0.000	
263.51	0	0.0	0.0	1.8	4	0.00	0.000	0.00	0.000	0.000	
263.60	0	0.0	0.0	0.5	4	0.02	0.008	0.00	0.000	0.000	
263.70	0	0.0	0.0	2.2	7	0.12	0.021	0.00	0.000	0.021	
263.80	190	0.0	0.0	2.2	9	0.22	0.029	0.00	0.000	0.029	
263.90	190	19.0	0.0	2.3	30	0.32	0.035	0.00	0.000	0.035	
264.00	190	19.0	0.0	2.3	51	0.42	0.040	0.00	0.000	0.040	
264.10	190	19.0	0.0	2.5	73	0.52	0.045	0.00	0.000	0.045	
264.20	190	19.0	0.0	0.7	93	0.62	0.049	0.00	0.000	0.049	
264.30	190	19.0	0.0	0.7	112	0.72	0.053	0.00	0.000	0.053	
264.40	190	19.0	0.0	0.5	132	0.82	0.057	0.00	0.000	0.057	
264.50	190	19.0	0.0	0.7	152	0.92	0.060	0.00	0.000	0.060	
264.60	190	19.0	0.0	0.7	171	1.02	0.063	0.00	0.000	0.063	→ 2-Year: 264.69
264.70	190	19.0	0.0	0.7	191	1.12	0.066	0.00	0.000	0.066	
264.80	190	19.0	0.0	0.7	211	1.22	0.069	0.00	0.000	0.069	
264.90	0	9.5	0.0	0.7	221	1.32	0.072	0.00	0.000	0.072	
265.00	0	0.0	0.0	0.5	222	1.42	0.074	0.00	0.000	0.074	
265.10	0	0.0	0.0	0.5	222	1.52	0.077	0.00	0.000	0.077	
265.20	0	0.0	0.0	0.5	222	1.62	0.080	0.00	0.000	0.080	
265.30	0	0.0	0.0	0.5	223	1.72	0.082	0.00	0.000	0.082	
265.40	0	0.0	0.0	0.5	223	1.82	0.084	0.00	0.000	0.084	
265.50	0	0.0	0.0	1.2	225	1.92	0.087	0.00	0.000	0.087	
265.60	0	0.0	0.0	1.2	226	2.02	0.089	0.00	0.000	0.089	
265.70	0	0.0	0.0	1.2	227	2.12	0.091	0.00	0.000	0.091	
265.80	0	0.0	0.0	1.2	228	2.22	0.093	0.00	0.000	0.093	
265.90	0	0.0	0.0	1.2	229	2.32	0.095	0.00	0.000	0.095	
266.00	0	0.0	0.0	1.2	230	2.42	0.097	0.00	0.000	0.097	
266.10	0	0.0	0.0	0.5	231	2.52	0.099	0.00	0.000	0.099	→ 5-Year: 266.12
266.20	0	0.0	0.0	0.5	231	2.62	0.101	0.00	0.000	0.101	
266.30	0	0.0	0.0	0.5	232	2.72	0.103	0.00	0.000	0.103	
266.40	0	0.0	0.0	0.5	232	2.82	0.105	0.00	0.000	0.105	
266.50	0	0.0	0.0	0.5	233	2.92	0.107	0.00	0.000	0.107	
266.60	0	0.0	0.0	0.0	233	3.02	0.109	0.00	0.000	0.109	
266.70	3	0.0	0.2	0.0	233	3.12	0.111	0.05	0.086	0.196	→ 10-Year: 266.70
266.80	102	0.0	5.3	0.0	238	3.22	0.112	0.15	0.444	0.557	25-Year: 266.73
266.90	104	0.0	10.3	0.0	248	3.32	0.114	0.25	0.956	1.070	50-Year: 266.74
											100-Year: 266.75

Orifice Tube	
Diameter	150 mm
Invert Elevation	263.51
Orifice Constant	0.80
Orifice Centroid	263.59
Orifice Flow Formula	$0.80\pi(D/2{,}000)^2 \times (2x9.81xH)^{0.5}$

Major Storm Control Weir	
Width	4.50 m
Invert of Weir	266.65 m
Weir Flow Formula	$1.7WH^{1.5}$

MH #	u.s inv	d.s inv	Pipe
1	268.96	268.64	300
2	269.34	269.15	300
3	269.29	269.15	300
4	268.99	268.89	375
5	268.87	268.64	375
6	268.57	268.23	375
14	263.51	263.28	525

PEARSON ENGINEERING

20 Rose Street, Barrie
Quantity Control Volume Calculations

DATE: 13-Sep-24
FILE: 20118
CONTRACT/PROJECT: 20 Rose Street, Barrie
COMPLETED BY: AR

Modified Rational Method Parameters

Pre Development Area (ha)	Post Development Area (ha)	Time of Concentration (min)	Time Increments (min)	Pre-Development Runoff Coefficient	Post-Development Runoff Coefficient
1.73	1.38	10	1	0.51	0.90

Note: Refer to page Calculation of Runoff Coefficients for detailed calculations of Modified Rational Method parameters.

Pre-Development Runoff Rate

	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
C	0.51	0.51	0.51	0.51	0.51	0.51
C_I	1.00	1.00	1.00	1.10	1.20	1.25
I	83.10	109.11	126.38	148.26	164.13	180.44
A	1.73	1.73	1.73	1.73	1.73	1.73
Q	0.20	0.27	0.31	0.40	0.48	0.55

Note: $Q = 0.00278 C C_I I A$

Rainfall Station	Barrie

SWM Pond Design Input

Storm Event (yrs)	Chicago Storm Coefficient A	Chicago Storm Coefficient B	Chicago Storm Coefficient C	Allowable Outflow (m3/s)	Post Development Runoff Coefficient
2	675.586	4.681	0.780	0.07	0.90
5	843.019	4.582	0.763	0.10	0.90
10	976.898	4.745	0.760	0.15	0.90
25	1133.123	4.734	0.756	0.25	0.99
50	1251.473	4.847	0.753	0.31	1.00
100	1383.628	4.905	0.754	0.36	1.00

Results

Storm Event	Storage m^3	Time min
2	189	44
5	231	39
10	233	32
25	234	24
50	235	22
100	235	20

Note: Storage volume calculated as per Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996

Time	2 Year					5 Year					10 Year					25 Year					50 Year					100 Year				
(min)	Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference	Intensity mm/hr	Inflow m^3/s	Outflow m^3/s	Storage m^3	Difference
1	174.27	0.60	0.07	14	25	227.01	0.78	0.10	13	33	258.70	0.89	0.15	5	37	302.61	1.14	0.25	-13	45	331.07	1.27	0.31	-26	50	362.68	1.39	0.36	-37	54
2	153.57	0.53	0.07	40	20	200.18	0.69	0.10	46	26	228.99	0.79	0.15	42	29	267.98	1.01	0.25	32	35	293.96	1.12	0.31	24	38	322.32	1.23	0.36	17	42
3	137.74	0.47	0.07	59	16	179.71	0.62	0.10	72	21	206.15	0.71	0.15	71	23	241.35	0.91	0.25	67	28	265.28	1.01	0.31	62	31	291.07	1.11	0.36	59	33
4	125.20	0.43	0.07	75	13	163.50	0.56	0.10	92	17	187.98	0.64	0.15	94	19	220.15	0.83	0.25	95	23	242.37	0.93	0.31	93	25	266.07	1.02	0.36	92	27
5	114.99	0.39	0.07	89	11	150.31	0.52	0.10	109	14	173.13	0.59	0.15	113	16	202.83	0.76	0.25	118	19	223.60	0.86	0.31	118	20	245.55	0.94	0.36	118	22
6	106.50	0.37	0.07	100	10	139.35	0.48	0.10	124	12	160.74	0.55	0.15	129	14	188.37	0.71	0.25	137	16	207.89	0.80	0.31	138	17	228.38	0.87	0.36	140	18
7	99.32	0.34	0.07	110	8	130.07	0.45	0.10	136	11	150.23	0.52	0.15	142	12	176.11	0.66	0.25	153	13	194.53	0.74	0.31	155	14	213.76	0.82	0.36	158	15
8	93.16	0.32	0.07	118	7	122.10	0.42	0.10	146	9	141.19	0.48	0.15	154	10	165.55	0.62	0.25	166	11	183.02	0.70	0.31	170	12	201.14	0.77	0.36	173	13
9	87.80	0.30	0.07	125	6	115.18	0.39	0.10	156	8	133.31	0.46	0.15	164	9	156.35	0.59	0.25	177	10	172.97	0.66	0.31	182	10	190.14	0.73	0.36	186	10
10	83.10	0.29	0.07	132	6	109.11	0.37	0.10	164	7	126.38	0.43	0.15	173	8	148.26	0.56	0.25	187	8	164.13	0.63	0.31	192	9	180.44	0.69	0.36	196	9
11	78.94	0.27	0.07	137	5	103.72	0.36	0.10	171	6	120.23	0.41	0.15	181	7	141.08	0.53	0.25	195	7	156.26	0.60	0.31	200	7	171.82	0.66	0.36	205	7
12	75.22	0.26	0.07	142	5	98.91	0.34	0.10	178	6	114.74	0.39	0.15	187	6	134.66	0.51	0.25	202	6	149.23	0.57	0.31	207	6	164.10	0.63	0.36	212	6
13	71.88	0.25	0.07	147	4	94.59	0.32	0.10	183	5	109.79	0.38	0.15	193	5	128.88	0.49	0.25	208	5	142.89	0.55	0.31	214	5	157.14	0.60	0.36	218	5
14	68.86	0.24	0.07	151	4	90.68	0.31	0.10	188	5	105.31	0.36	0.15	199	5	123.64	0.47	0.25	214	4	137.14	0.52	0.31	219	4	150.83	0.58	0.36	223	4
15	66.12	0.23	0.07	155	3	87.13	0.30	0.10	193	4	101.23	0.35	0.15	204	4	118.88	0.45	0.25	218	4	131.90	0.50	0.31	223	3	145.08	0.55	0.36	227	3
16	63.61	0.22	0.07	158	3	83.88	0.29	0.10	197	4	97.50	0.33	0.15	208	4	114.52	0.43	0.25	222	3	127.11	0.49	0.31	226	3	139.81	0.53	0.36	230	2
17	61.31	0.21	0.07	161	3	80.90	0.28	0.10	201	3	94.07	0.32	0.15	211	3	110.51	0.42	0.25	225	3	122.70	0.47	0.31	229	2	134.97	0.52	0.36	232	2
18	59.19	0.20	0.07	164	3	78.15	0.27	0.10	205	3	90.91	0.31	0.15	215	3	106.81	0.40	0.25	227	2	118.64	0.45	0.31	231	2	130.51	0.50	0.36	234	1
19	57.23	0.20	0.07	167	2	75.61	0.26	0.10	208	3	87.99	0.30	0.15	218	3	103.39	0.39	0.25	229	2	114.87	0.44	0.31	233	1	126.37	0.48	0.36	235	0
20	55.42	0.19	0.07	169	2	73.25	0.25	0.10	211	3	85.27	0.29	0.15	220	2	100.22	0.38	0.25	231	1	111.37	0.43	0.31	234	1	122.52	0.47	0.36	235	0
21	53.73	0.18	0.07	171	2	71.05	0.24	0.10	213	2	82.74	0.28	0.15	222	2	97.26	0.37	0.25	232	1	108.11	0.41	0.31	234	0	118.94	0.45	0.36	235	-1
22	52.15	0.18	0.07	173	2	69.00	0.24	0.10	215	2	80.38	0.28	0.15	224	2	94.50	0.36	0.25	233	0	105.07	0.40	0.31	235	0	115.59	0.44	0.36	235	-1
23	50.67	0.17	0.07	175	2	67.09	0.23	0.10	217	2	78.17	0.27	0.15	226	1	91.91	0.35	0.25	233	0	102.21	0.39	0.31	234	-1	112.45	0.43	0.36	234	-1
24	49.29	0.17	0.07	176	1	65.29	0.22	0.10	219	2	76.09	0.26	0.15	228	1	89.48	0.34	0.25	234	0	99.53	0.38	0.31	234	-1	109.51	0.42	0.36	233	-2
25	47.99	0.16	0.07	178	1	63.60	0.22	0.10	221	2	74.14	0.25	0.15	229	1	87.20	0.33	0.25	234	0	97.01	0.37	0.31	233	-1	106.74	0.41	0.36	231	-2
26	46.77	0.16	0.07	179	1	62.01	0.21	0.10	223	1	72.30	0.25	0.15	230	1	85.04	0.32	0.25	233	-1	94.63	0.36	0.31	232	-1	104.12	0.40	0.36	229	-2
27	45.61	0.16	0.07	180	1	60.50	0.21	0.10	224	1	70.56	0.24	0.15	231	1	83.01	0.31	0.25	233	-1	92.39	0.35	0.31	230	-2	101.65	0.39	0.36	227	-3
28	44.52	0.15	0.07	182	1	59.08	0.20	0.10	225	1	68.92	0.24	0.15	232	1	81.08	0.31	0.25	232	-1	90.26	0.35	0.31	229	-2	99.31	0.38	0.36	224	-3
29	43.48	0.15	0.07	183	1	57.73	0.20	0.10	226	1	67.36	0.23	0.15	232	0	79.26	0.30	0.25	231	-1	88.25	0.34	0.31	227	-2	97.10	0.37	0.36	221	-221
30	42.50	0.15	0.07	184	1	56.45	0.19	0.10	227	1	65.88	0.23	0.15	232	0	77.53	0.29	0.25	229	-1	86.33	0.33	0.31	224	-2	94.99	0.36	0.00	0	0
31	41.57	0.14	0.07	184	1	55.24	0.19	0.10	228	1	64.48	0.22	0.15	233	0	75.88	0.29	0.25	228	-2	84.51	0.32	0.31	222	-3	92.99	0.36	0.00	0	0
32	40.68	0.14	0.07	185	1	54.08	0.19	0.10	229	1	63.14	0.22	0.15	233	0	74.32	0.28	0.25	226	-2	82.78	0.32	0.31	219	-3	91.08	0.35	0.00	0	0
33	39.84	0.14	0.07	186	1	52.98	0.18	0.10	229	1	61.86	0.21	0.15	233	0	72.82	0.27	0.25	225	-2	81.13	0.31	0.31	217	-217	89.27	0.34	0.00	0	0

PEARSON ENGINEERING

20 Rose Street, Barrie
Quality Control Calculations

	Area	% of Site Area	TSS Removal Efficiency	Weighted TSS Removal
	(ha)	(%)	(%)	(%)
Grass	0.48	26%	100%	26%
Rooftop	0.56	30%	80%	24%
Controlled Conc. & Asphalt	0.73	39%	0%	0%
Subtotal	**1.77**	**95%**		**50%**
% TSS Removal by OGS	= % TSS Remaining x 62.6% Removal Efficiency for OGS = 50% TSS Remaining x 62.6% Removal			31%
Uncontrolled Conc. & Asphalt	0.09	5%	0%	0%
Total	**1.87**	**100%**		**81%**

20 Rose Street, Barrie
Volume Control Sizing Calculations

As the site meets the definition of Major Development, find the required volume control storage as per LSRCA Guidelines Section 2.2.2. The control requirement volume is calculated over 25 mm of the total impervious area on the site:

Storage Volume	=	13,829		x	0.025
Area Storage Volume Required	=	345.7	m^3		

However, due to the site layout and soil conditions, it is proposed to calculate the required volume needed for over 5 mm of the total impervious area of the site:

Area Storage Volume Required	=	13,829		x	0.005
	=	69.1	m^3		

Find storage volume provided in Rooftop Infiltration Chambers:

Total Volume Provided	=	42.6	m^3	(From Water Balance Calculation Sheet)

Find total equivalent rainfall depth provided in Rooftop Soakaway Pits:

$$\text{Total Equivalent Rainfall Depth} = \frac{\text{Rooftop Infiltration Volume}}{\text{Impervious Area Over Site}}$$

$$= \frac{42.6\ m^3}{13{,}829\ m^2}$$

$$= 3.1\ mm$$

PEARSON ENGINEERING

20 Rose Street, Barrie
Pipe Runoff Coefficient

Runoff Coefficient	=	0.15	0.95	0.95	0.60	0.95		Weighted
Surface Cover	=	Grass	Asphalt	Building	Gravel	Concrete		Runoff Coefficient
POST DEVELOPMENT	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
1	1622	471	1151	0	0	0		0.72
2	1022	0	0	1022	0	0		0.95
3	1166	0	0	1166	0	0		0.95
4	1398	38	1360	0	0	0		0.93
5	1245	432	813	0	0	0		0.67
6	802	300	502	0	0	0		0.65
7	488	206	282	0	0	0		0.61
8	318	0	318	0	0	0		0.95
9	1088	0	0	1088	0	0		0.95
10	816	32	784	0	0	0		0.92
11	2366	0	0	2366	0	0		0.95
12	1437	646	593	58	140	0		0.56
13	2140	842	651	492	0	155		0.64
14	2361	2246	0	0	0	115		0.19
Post Total	18269	5213	6454	6192	140	270		0.72

Q = 0.0028*C*I*A (m^3/s)
C = Runoff Coeffecient
I = Rainfall Intensity = A/(Time+B)^C
A= Area (ha)

20 Rose Street, Barrie
Storm Sewer Design
5-Year Storm Event

DATE: 24-Sep-24
FILE: 20118
CONTRACT/PROJECT: 20 Rose Street, Barrie

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	Percent FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	(%)
1	CB 1	CBMH 2	31.9	0.65	0.17	0.11	0.11	10.00	0.39	109.11	0.03	1.00	300	0.10	1.37	35%
2	CAP	MH 1	18.9	0.95	0.10	0.10	0.10	10.00	0.23	109.11	0.04	1.00	300	0.10	1.37	43%
3	CAP	MH 1	14.1	0.95	0.12	0.11	0.11	10.00	0.17	109.11	0.05	1.00	300	0.10	1.37	47%
4	MH 1	CBMH 1	9.3	0.92	0.14	0.13	0.24	10.39	0.10	106.94	0.08	1.00	375	0.18	1.59	48%
-	CBMH 1	CBMH 2	23.4	0.00	0.00	0.00	0.24	10.49	0.25	106.41	0.08	1.00	375	0.18	1.59	48%
5	CBMH 2	CBMH 3	32.0	0.67	0.13	0.08	0.44	10.73	0.34	105.10	0.13	1.00	375	0.18	1.59	73%
6	CBMH 3	CBMH 4	15.3	0.65	0.08	0.05	0.49	11.07	0.15	103.38	0.14	1.10	375	0.18	1.67	77%
7	CBMH 4	CBMH 5	35.4	0.65	0.05	0.03	0.52	11.22	0.29	102.61	0.15	1.70	375	0.23	2.07	65%
8	CBMH 5	DCBMH 1	40.9	0.95	0.03	0.03	0.55	11.51	0.35	101.22	0.16	1.50	375	0.21	1.94	72%

9	CAP	DCBMH 1	5.3	0.95	0.11	0.10	0.66	10.00	0.04	109.11	0.20	1.30	450	0.33	2.04	61%
10	DCBMH 1	DCBMH 2	3.3	0.95	0.08	0.07	1.28	11.86	0.02	99.57	0.35	1.50	525	0.53	2.43	67%
-	DCBMH 2	MH 2	20.2	0.00	0.00	0.00	1.28	11.88	0.14	164.99	0.59	1.20	600	0.67	2.38	87%
-	MH 2	MH 3	11.6	0.00	0.00	0.00	1.28	12.02	0.09	163.95	0.58	1.00	600	0.61	2.17	95%
11	CAP	MH 3	38.8	0.95	0.24	0.22	0.22	10.00	0.16	180.44	0.11	5.00	450	0.64	4.01	18%
12	DICB 1	MH3	3.4	0.56	0.14	0.08	0.08	0.00	0.03	417.14	0.09	1.60	300	0.12	1.73	74%
12	MH 3	OGS	10.0	0.00	0.00	0.00	1.51	12.11	0.06	98.42	0.10	3.80	300	0.19	2.67	54%
-	OGS	MH 101	6.7	0.00	0.00	0.00	1.51	12.17	0.06	98.14	0.10	2.20	300	0.14	2.03	70%

Note: Highlighted Cell contains the 5 year flow that is controlled through the orifice tube.

20 Rose Street, Barrie
Catch Basin Capacity Calculations

Depth of Ponding (m^2)	DCBMH Capacity (m^3/s)	50% DCBMH Capacity (m^3/s)
0.00	0	0
0.01	0.001	0.001
0.02	0.003	0.001
0.03	0.005	0.003
0.04	0.010	0.005
0.05	0.016	0.008
0.06	0.026	0.013
0.07	0.037	0.018
0.08	0.053	0.027
0.09	0.071	0.035
0.10	0.091	0.045
0.11	0.108	0.054
0.12	0.126	0.063
0.13	0.142	0.071
0.14	0.155	0.077
0.15	0.168	0.084
0.16	0.182	0.091
0.17	0.193	0.097
0.18	0.211	0.106
0.19	0.228	0.114
0.20	0.244	0.122

Area Number	1,4-8,10		1,4-8,10	
Area	0.67	ha	0.67	ha
Runoff Coefficient	0.77		0.77	
Time of Concentration	10	min	10	min
Return Rate	2	year	100	year
Runoff Coefficient	0.77		1.00	
Rainfall Intensity	109.1	mm/hr	180.4	mm/hr
Post Development Pe	0.12	m^3/s	0.26	m^3/s

Assuming a 50% blockage and 0.15m of ponding, a single DCBMH has a capacity of 0.084 m. Therefore two DCBMHs are proposed

Required Inlet Capacity	=	0.26	-	0.12
Required Inlet Capacity	=	0.14	m^3/s	
Max. Ponding	=	0.13	m	
Proposed Inlet Capactiy Flow	=	0.14	m^3/s	

PEARSON ENGINEERING

20 Rose Street, Barrie
Pipe Runoff Coefficient - Future Rose Street Reconstruction

Runoff Coefficient	=	0.15	0.95	0.95	0.55	0.95		Weighted
Surface Cover	=	Grass	Asphalt	Building	Lot	Concrete		Runoff Coefficient
POST DEVELOPMENT	Total Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)	Area (m^2)		
EXT-1	4511	1537	1373	0	1459	142		0.55
EXT-2	3875	984	1146	0	1597	148		0.58
EXT-3	11766	5115	914	0	5625	112		0.41
EXT-4	2847	53	1360	0	1371	116		0.76
Post Total	22999	7689	4793	0	10052	518		0.51

Q = 0.0028*C*I*A (m^3/s)
C = Runoff Coeffecient
I = Rainfall Intensity = A/(Time+B)^C
A= Area (ha)

20 Rose Street, Barrie
Futre Rose Street Storm Sewer Design
5-Year Storm Event

DATE: 24-Sep-24
FILE: 20118
CONTRACT/PROJECT: 20 Rose Street, Barrie

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	Percent FULL (%)
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	
EXT-1	-	MH 101	90.0	0.55	0.45	0.25	0.25	10.00	-	109.11	0.07	-	-	-	-	-
EXT-2	MH 101	MH 102	33.2	0.58	0.39	0.23	0.47	10.00	0.24	109.11	0.24	1.70	450	0.37	2.34	65%
EXT-3	MH 102	MH 103	37.2	0.41	1.18	0.48	0.96	10.24	0.15	107.77	0.39	5.00	450	0.64	4.01	61%
-	MH 103	MH 104	34.1	0.00	0.00	0.00	0.96	10.39	0.17	106.92	0.38	3.40	450	0.53	3.31	73%
EXT-4	MH 104	MH 105	65.0	0.76	0.28	0.22	1.17	10.56	0.32	106.00	0.45	3.60	450	0.54	3.40	82%
	MH 105	MH 106	20.2	0.00	0.00	0.00	1.17	10.88	0.09	104.33	0.44	4.00	450	0.57	3.59	77%

Note: Highlighted Cell contains the 5 year flow that is controlled through the orifice tube from the project site (0.10 m^3/s)

Appendix B

Phosphorous Budget Calculations

20 Rose Street, Barrie
Phosphorus Budget Tool

	Residential	Commercial	Pasture	Forest
Phosphorus Export (kg/ha/year)	1.32	1.82	0.07	0.05

Note: Phosphorus Export Coeffecients determined as per Table 2 in Hutchinson Environmental Sciences Ltd.'s Phosphorus Budget Tool in Support of Sustainable Development for the Lake Simcoe Watershed Document, dated March 2012.

Pre-Development Condition:

	Residential	Commercial	Pasture	Forest
Area (ha):	0.00	1.87	0.00	0.00
Total P (kg):	0.00	3.40	0.00	0.00

Total Pre-Development P (kg/year): 3.40

Post-Development Condition (No Treatment Facilities):

Total Area	Residential	Commercial	Pasture	Forest
Area (ha):	1.87	0.00	0.00	0.00
Total P (kg):	2.47	0.00	0.00	0.00

Total Post-Development P (kg/year): 2.47

Post-Development Condition (Controlled):

	Residential	Commercial	Pasture	Forest
Untreated Area				
Area (ha):	0.49	0.00	0.00	0.00
Total P (kg):	0.64	0.00	0.00	0.00
Area Draining to Underground Infiltration				
Area (ha):	0.56	0.00	0.00	0.00
Total P (kg):	0.74	0.00	0.00	0.00
Underground Infiltration Treatment				
Underground Infiltation Trench Proficiency (%):		60		
P Removed (kg):		0.45		
P Remaining (kg):		0.30		
Area Draining to Quantity Control Storage & OGS Treatment Unit				
Area (ha):	0.81	0.00	0.00	0.00
Total P (kg):	1.07	0.00	0.00	0.00
Underground Storage Treatment				
Underground Storage Proficiency (%):		25		
P Removed (kg):		0.34		
P Remaining (kg):		1.03		
OGS Treatment				
P Remaining from Underground Storage (kg):		1.03		
OGS Proficiency (%):		20		
P Removed (kg):		0.21		
P Remaining (kg):		0.82		
Total Post-Development P (kg/year) :		**1.47**		

Appendix C

Water Balance Calculations

PEARSON ENGINEERING

20 Rose Street, Barrie
Post Development Water Balance (With Infiltration)

Catchment Designation	Site				
	Grassed	Impervious	Building (with Infiltration)	Total	
Area	4826	8187	3276	16289	
Pervious Area	4826	0	0	4826	
Impervious Area	0	8187	3276	11463	
Infiltration Factors					
Topography Infiltration Factor	0.2	0	0		(From MOE Table 3.1 for Rolling Land)
Soil Infiltration Factor	0.2	0	0		(From MOE Table 3.1 for Medium combinations of clay and loam)
Land Cover Infiltration Factor	0	0	0		
MOE Infiltration Factor	0.4	0	0		
Actual Infiltration Factor	0.4	0	0		
Run-Off Coeffiecient	0.6	1	1		
Runoff from Impervious Surfaces	0	0.95	0.95		
Inputs (per Unit Area)					
Precipitation	932.9	932.9	932.9	932.9	(Precipitation values from Environment Canada)
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	932.9	932.9	932.9	932.9	
Outputs (per Unit Area)					
Precipitation Surplus	371.9	886.3	886.3	733.9	
Net Surplus	371.9	886.3	886.3	733.9	
Evapotranspiration	561.0	46.6	46.6	199.0	
Infiltration	148.8	0.0	0.0	44.1	
Rooftop Infiltration	0.0	0.0	**424.5**	85.4	Depth of rainfall over the rooftop required to be infiltrated to achieve water balance.
Total Infiltration	148.8	0.0	424.5	129.4	
Runoff Pervious Areas	223.1	0.0	0.0	66.1	
Runoff Impervious Areas	0.0	886.3	461.8	538.3	
Total Runoff	223.1	886.3	461.8	604.4	
Total Outputs	932.9	932.9	932.9	932.9	
Difference (Inputs - Outputs)	0.0	0.0	0.0	0.0	
Inputs (Volumes)					
Precipitation	4502	7638	3056	15196	
Run-On	0	0	0	0	
Other Inputs	0	0	0	0	
Total Inputs	4502	7638	3056	15196	
Outputs (Volumes)					
Precipitation Surplus	1795	7256	2903	11954	
Net Surplus	1795	7256	2903	11954	
Evapotranspiration	2707	382	153	3242	
Infiltration	718	0	0	718	
Rooftop Infiltration	0	0	1391	1391	
Total Infiltration	718	0	1391	2109	
Runoff Pervious Areas	1077	0	0	1077	
Runoff Impervious Areas	0	7256	1513	8768	
Total Runoff	1077	7256	1513	9845	
Total Outputs	4502	7638	3056	15196	
Difference (Inputs - Outputs)	0	0	0	0	

Note: Highlighted cells are input cells.

20 Rose Street, Barrie
Water Balance Calculations

Annual Rainfall Depth Required to Infiltrate the Annual Water Balance Deficit:

Annual Infiltration Deficit	=	527	m^3	(From Hydrogeological Investigation, GEI, May 2024)
Required Rainfall Depth	=	424.5	mm	(From Post-Development Water Balance (With Infiltration))

Find Percent of Annual Rainfall that Required Rainfall Depth represents:

Annual Rainfall for Study Area	=	932.9	mm
% Annual Rainfall	=	424.5 / 932.9	mm / mm
	=	46%	

From MECP's Figure C-2, 46% of annual rainfall occurs for storm events of 5 mm or less.

Find storage volume required for rainfall events of 1 mm to Rooftop Infiltration Gallery

Roof Top Area	=	3800	m^2		
Rainfall Depth	=	5	mm		
Storage Volume Req'd	=	A		x	D
	=	3800		x	5
	=	19	m^3		

Minimum Infiltration Volume as per City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines Section 4.1.3 is as follows:

Storage Volume Req'd	=	Site Area		x	5 mm
	=	18,655		x	0.005
	=	93	m^3		

Therefore, City of Barrie guidelines governs over water balance/infiltration requirements.

Due to site constraints the proposed Stormcon GreenStorm modules only provide 42 m^3 of infiltration storage

Modules Provided	=	105	Chambers		
Storage Provided	=	42.6	m^3		
Equivalent Depth Over Impervious Area	=	43		/	18655
	=	2.29	mm		

Appendix D

Geotechnical Investigation Report, Peto MacCallum Ltd., May 2021

Peto MacCallum Ltd.
CONSULTING ENGINEERS

GEOTECHNICAL INVESTIGATION
PROPOSED SIMCOE COUNTY HOUSING FACILITY
14 ROSE STREET
BARRIE, ONTARIO

for

THE CORPORATION OF THE COUNTY OF SIMCOE

PETO MacCALLUM LTD.
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Distribution:
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1 cc: PML Barrie

PML Ref.: 21BF014
Report: 1
May 2021

Peto MacCallum Ltd.
CONSULTING ENGINEERS

May 3, 2021

PML Ref.: 21BF014
Report: 1

Mr. Brad Spiewak, P.Eng.
The Corporation of The County of Simcoe
1110 Highway 26
Midhurst, Ontario
L9X 1N6

Dear Mr. Spiewak

Geotechnical Investigation
Proposed Simcoe County Housing Facility
14 Rose Street
Barrie, Ontario

Peto MacCallum Ltd. (PML) is pleased to present the results of the Geotechnical investigation recently completed at the above noted project site. Authorization for the work described in this report was provided by Mr. B. Spiewak, through provision of Purchase Order No. 4500086779.

Simcoe County is proposing to redevelop the former OPP facility at 14 Rose Street in Barrie. The existing buildings will be demolished and the new housing facilities constructed. The design has not been completed at this time. The current concept has an eight to ten storey slab-on-grade residential building planned, with a separate slab-on-grade two storey parking facility. Paved access and at-grade parking are also proposed. The site will have full municipal servicing. Infiltration facilities are also being considers in the design.

The purpose of this investigation was to assess the subsurface conditions at the site, and based on this information, provide comments and Geotechnical engineering recommendations for earthworks, building foundations, site servicing, pavement design and preliminary infiltration parameters.

A Phae Two Environmental Site Assessment was carried out concurrently with the Geotechnical work and is provided under separate cover in Report 2.

A total of 26 boreholes were advanced across the site. Below topsoil or pavement, fill was encountered over a major till deposit. Ground water was encountered locally at depth only in some of the boreholes.

Typical construction methods should be applicable for the site with consideration for the thicker fill and associated with demolition to be carried out.

We trust the information in this report is sufficient for your present purpose. If you have any questions please do not hesitate to call our office.

Sincerely

Peto MacCallum Ltd.

Geoffrey R. White, P.Eng.
Director
Manager, Geotechnical Services

GRW:tc

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BARRIE, COLLINGWOOD, HAMILTON, KITCHENER, LONDON, TORONTO

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Figure 1 – Grain Size Distribution Test Results
List of Abbreviations
Log of Borehole/Monitoring Well Nos. 1 to 10, 12 to 18, 20 to 21, and 24 to 30
Drawing 1 – Borehole/Monitoring Well Location Plan
Appendix A – Statement of Limitations
Appendix B – Engineered Fill

1. INTRODUCTION

Peto MacCallum Ltd. (PML) is pleased to present the results of the Geotechnical investigation recently completed at the above noted project site. Authorization for the work described in this report was provided by Mr. B. Spiewak, through provision of Purchase Order No. 4500086779.

Simcoe County is proposing to redevelop the former OPP facility at 14 Rose Street in Barrie. The existing buildings will be demolished and the new housing facilities constructed. The design has not been completed at this time. The current concept has an eight to ten storey slab-on-grade residential building planned, with a separate slab-on-grade two storey parking facility. Paved access and at-grade parking are also proposed. The site will have full municipal servicing. Infiltration facilities are also being considers in the design. The proposed site concept is shown on Drawing 1, appended.

The purpose of this investigation was to assess the subsurface conditions at the site, and based on this information, provide comments and Geotechnical engineering recommendations for earthworks, building foundations, site servicing, pavement design and preliminary infiltration parameters.

A Phase Two Environmental Site Assessment (ESA) was completed concurrently and will be reported under separate cover in Report 2.

The comments and recommendations provided in this report are based on the site conditions at the time of the investigation, and are applicable only to the proposed works as addressed in the report. Any changes in the proposed plans will require review by PML to re-assess the validity of the report, and may require modified recommendations, additional investigation and/or analysis.

This report is subject to the Statement of Limitations that is included in Appendix A and must be read in conjunction with the report.

2. INVESTIGATION PROCEDURES

The field work for this investigation initially included a program of 30 boreholes. Boreholes 1 to 8, 10, 12, 13, 15 16 and 20 were drilled to 6.5 m depth for the main building. Boreholes 24 to 26, and 28 to 30 were drilled to 5.0 to 6.5 m depth for the parking structure. Boreholes 9, 14, 17, 18, 21 and 27 were drilled to 4.3 to 12.8 m depth in parking and infiltration areas. Boreholes 9, 17 and 18 were deepened from 4.3 to 12.8 m depth for Phase Two ESA purposes. Boreholes 11, 19, 22 and 23 were not drilled due to previous work at the site. Borehole locations are shown on Drawing 1, appended.

PML laid out the boreholes in the field. The ground surface elevation at the borehole locations was obtained with a Sokkia SHC5000 Global Navigation Satellite System (GNSS). Vertical and horizontal accuracy of this unit are 0.1 and 0.5 m, respectively. All elevations in this report are geodetic and expressed in metres.

Co-ordination for clearances of underground utilities was provided by PML with the aid of a private locating service. The boreholes were drilled cognizant of the underground utilities.

The boreholes were advanced using continuous flight solid stem augers, powered by a track mounted D-50 drill rig, equipped with an automatic hammer, supplied and operated by a specialist drilling contractor, working under the full-time supervision of a member of PML's engineering staff.

Where topsoil was encountered at the surface, the thickness was measured in hand dug divots. Where pavement was encountered at the surface, the pavement component thicknesses were measured and samples of the granular materials were collected.

Representative samples of the overburden were recovered at frequent depth intervals for identification purposes using a conventional 51 mm OD split spoon sampler. The sampler excludes particles larger than 38 mm. Standard penetration tests were carried out simultaneously with the sampling operations to assess the strength characteristics of the subsoil. The ground water conditions in the boreholes were assessed during drilling by visual examination of the soil samples, the sampler, and drill rods as the samples were retrieved, and measurement of the water level in the open boreholes, if any.

A monitoring well, comprised of 50 mm diameter PVC pipe with a 1.5 m long screen at the bottom, filter sand, bentonite seal and stick-up protective casing, was installed in six boreholes to permit ground water level monitoring. The details of the monitoring well installation are shown on the applicable Log of Borehole sheets. It should be noted that the well becomes the property of the Owner and will have to be decommissioned by the Owner in accordance with O.Reg. 903. PML would be pleased to assist, if requested.

PML is currently carrying out a year long ground water level monitoring program. Results will be presented under separate cover when the program is completed.

All recovered samples were returned to our laboratory for detailed examination and moisture content determinations. Grain size analyses were carried out on eight samples of the major soil unit. The laboratory test results are provided on Figure 1, appended.

3. SITE SETTING

The site has an irregular triangle shape. The site is located on the north side of Rose Street between the Ramp to Highway 400 and the cul-de-sac on Ottaway Avenue. Highway 400 is to the north. The site is currently occupied by the former OPP facility with residential, properties surrounding most of the site.

The site is located within the physiographic region known as the Simcoe Uplands comprising drumlinzed till plans.

The borehole elevations indicate about 5.0 m of relief across the site, with elevations ranging from 271.65 to 266.55, being relatively flat in the west and central sections, gently sloping down in the eastern section.

4. GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Geology

Bedrock below the overburden is mapped as limestone, dolostone, shale, arkose, and sandstone of the Simcoe Group from the Middle Ordovian period of the Paleozoic era of the Phanerzoic eon. Bedrock is anticipated at depths greater than 60 m based on the Ministry of Environment, Conservation and Parks (MECP) Water Well Records in the area.

4.2 Subsurface Conditions

Reference is made to the appended Log of Borehole sheets for details of the subsurface conditions, including topsoil thicknesses, pavement component thicknesses, soil classifications, inferred stratigraphy and thicknesses, Standard Penetration test N Values (N Values, blows per 300 mm penetration of the split spoon sampler), well installation details, ground water level observations and the results of laboratory moisture content determinations.

Due to the soil sampling procedures and the limited size of samples, the depth/elevation demarcations on the borehole logs must be viewed as “transitional” zones, and cannot be construed as exact geologic boundaries between layers. PML should be retained to assist in defining the geological boundaries in the field during construction, if required.

Topsoil and/or pavement was encountered at the surface, over fill, overlying a major native till deposit. Local sand or silty sand layers were noted in two boreholes. A description of the distribution of the subsurface conditions encountered is provided below.

4.2.1 Topsoil

Topsoil was present at the surface of Boreholes 1 to 3, 6 to 8, 16, 20, 24, 26 to 29 and was 150 to 250 mm thick.

4.2.2 Pavement

Pavement was at the surface in the following boreholes with component thicknesses noted.

BOREHOLE	ASPHALT	GRANULAR BASE	GRANULAR SUBBASE	TOTAL THICKNESS
4	50	140	210	400
5	50	100	200	350
9	80	150	300	530
10	40	120	140	300
12	100	120	180	400
13	40	100	110	250
14	110	200	150	460
15	30	100	140	270
17	100	150	210	460
18	100	120	200	420
21	100	120	230	450
25	130	150	200	480
30	90	180	150	420

4.2.3 Fill

Fill was encountered in all boreholes below the surficial topsoil or pavement, extending to 0.7 to 2.9 m depth (elevation 265.2 to 270.85). The material comprised silty sand to sandy silt with trace gravel. The material had N Values ranging from 2 to 26, indicating variable compaction when placed. The layer was moist, locally very moist or wet, with water contents of 7 to 21%.

4.2.4 Sand/Silty Sand

Below the fill in Borehole 5, a sand unit was noted to 4.0 m depth (elevation 267.6), and below the fill in Borehole 9 a silty sand layer was observed to 2.9 m depth (elevation 267.3). The sand was very

dense (N Value of 52) and the silty sand was compact (N Value of 25). Both materials were moist with moisture contents of 6 to 8 %.

Below the fill or local sand/silty sand layers, a major native silty sand till deposit was revealed to the 4.3 to 12.8 m depth of exploration. The matrix comprises silty sand with trace gravel and clay. Cobbles and boulders were noted during augering. Eight representative samples were submitted for gradation and the results are presented on Figure 1, appended. The material had N Values typically greater than 20 to greater than 50 (compact to very dense), locally 7, 10 or 15 at the top of the unit. The deposit was typically moist with moisture contents 10% or less, locally wet at depth.

4.2.5 Ground Water

The first water strike (ground water first encountered during drilling), the ground water/wet cave levels measured in the boreholes upon completion of augering, and ground water levels measured in the wells, are summarized in the table below, on a borehole by borehole basis.

BOREHOLE	FIRST STRIKE DURING DRILLING DEPTH (m) / ELEVATION	UPON COMPLETION OF AUGERING DEPTH (m) / ELEVATION	WATER LEVEL IN WELL APRIL 30, 2021 DEPTH (m) / ELEVATION
1	No Water	No Water	--
2	No Water	No Water	--
3	No Water	No Water	--
4	No Water	No Water	--
5	No Water	No Water	--
6	No Water	No Water	No Water
7	No Water	No Water	--
8	No Water	No Water	--
9	11.9 / 258.3	11.9 / 258.3	8.7 / 261.5
10	No Water	No Water	--
12	No Water	No Water	--
13	No Water	No Water	--
14	No Water	No Water	--

BOREHOLE	FIRST STRIKE DURING DRILLING DEPTH (m) / ELEVATION	UPON COMPLETION OF AUGERING DEPTH (m) / ELEVATION	WATER LEVEL IN WELL APRIL 30, 2021 DEPTH (m) / ELEVATION
15	No Water	No Water	--
16	No Water	No Water	--
17	10.7 / 259.1	11.6 / 258.2	8.1 / 261.7
18	11.0 / 259.2	11.6 / 258.6	8.4 / 261.8
20	No Water	No Water	--
21	No Water	No Water	--
24	No Water	No Water	--
25	No Water	No Water	--
26	No Water	No Water	No Water
27	No Water	No Water	3.2 / 263.4
28	No Water	No Water	--
29	No Water	No Water	--
30	No Water	No Water	--

The ground water table is believed to be about 8 to 11 m grade. Local perched water in the fill above the till or wet layers in the till, are also present.

Ground water levels will fluctuate seasonally, and in response to variations in precipitation.

5. GEOTECHNICAL ENGINEERING CONSIDERATIONS

5.1 General

Simcoe County is proposing to redevelop the former OPP facility at 14 Rose Street in Barrie. The existing buildings will be demolished and the new housing facilities constructed. The design has not been completed at this time. The current concept has an eight to ten storey slab-on-grade residential building planned, with a separate slab-on-grade two storey parking facility. Paved access and at-grade parking are also proposed. The site will have full municipal servicing. Infiltration facilities are also being considers in the design. The proposed site concept is shown on Drawing 1, appended.

It is understood that a basement in the main building is currently not part of the design. It is noted that the subsurface conditions are favourable for a basement, with the ground water at depth and a basement would help penetrate the fill and upper less dense soil to allow footings to be founded on soil with a higher bearing resistance. Basement recommendations can be provided if required.

5.2 Site Grading and Engineered Fill

The ground floor level of the main building and the parking structure have not been set at this time. For purposes of this report, the ground floor of the main building is assumes to be at elevation 271.8 and the main floor of the parking structure at elevation 270.5.

The existing topsoil, pavement and fill are not suitable to support footings or floor slabs due to concerns with settlement. Further, in the areas where the existing buildings and services will be to be demolished/removed, fill depths greater than those shown in the borehole logs are likely present. All fill associated with the existing buildings and infrastructure will need to be removed entirely (vertically and laterally) within the footprint of the proposed building and parking structure. In this regard, it is recommended that existing topsoil, pavement and fill be removed and replaced with engineered fill. Grades under the building can be raised as required, with engineered fill to required levels. Where grades are to be raised under structures (building, paved areas and site servicing) the fill needs to be constructed as engineered fill.

Reference is made to Appendix B for guidelines for engineered fill construction. The following general highlights are provided:

- Strip existing topsoil or pavement and fill, and other deleterious materials down to competent native soil, subject to geotechnical review during construction. The excavated native soil should be segregated and stockpiled separately for reuse or disposal, subject to geotechnical review;

- Proofroll exposed subgrade using a heavy vibrator roller to targeted 100% Standard Proctor maximum dry density (SPmdd) for the building areas and 95% SPmdd for parking areas, under geotechnical review.

- Following geotechnical review and approval of the subgrade, spread approved material in maximum 200 mm thick lifts and uniformly compacted to 100% SPmdd in building areas and 95% SPmdd in parking areas. If wet subgrade conditions are present the use of Granular B Type II may be required for the first lift or two of engineered fill;

- Organics, topsoil, oversized material (over 150 mm in diameter) or otherwise deleterious materials are not suitable for reuse as engineered fill. The excavated site soil is selectively considered suitable for reuse as engineered fill, subject to moisture content and geotechnical review during construction. In the regard, it is recommended to utilize imported material under the building and on-site soil elsewhere on the site. Imported material should comprise OPSS Granular B or OPSS Select Subgrade Material (SSM). Other sources of imported material should be reviewed by our office to ensure suitability;

- The engineered fill pad must extend at least 1 m beyond the structure to be supported, then outwards and downwards at no steeper than 45° to the horizontal to meet the underlying approved native subgrade. In this regard, strict survey control and detailed documentation of the lateral and vertical extent of the engineered fill limits should be carried out to ensure that the engineered fill pad fully incorporates the structure to be supported;

- Engineered fill construction must be carried out under full-time field review by PML, to approve sub-excavation and subgrade preparation, backfill materials, placement and compaction procedures, and to verify that the specified compaction standards are achieved throughout.

5.3 Foundations

As noted above, for purposes of this report the ground floor of the main building is assumes to be at elevation 271.8 and the main floor of the parking structure at elevation 270.5. Exterior footings would be placed at about elevation 270.3 for the main building and about elevation 269.0 for the parking structure. Interior footings for the main building are assumed at about elevation 271.1. As noted earlier, in-situ fill is not suitable to support footings. Existing fill will have to be removed and replaced with engineered fill. In general, it is anticipated footings would be supported on a combination of native soil and engineered fill.

The available bearing capacity on native soils, on a borehole by borehole basis (boreholes in building areas only) is provided below:

BOREHOLE	DEPTH (m) / ELEVATION	ANTICIPATED SUBGRADE SOIL TYPE	GEOTECHNICAL BEARING RESISTANCE AT SLS (kPa)	FACTORED BEARING RESISTANCE AT ULS (kPa)
Main Building				
1	1.5 / 270.2	Till	200	300
	2.2 / 269.5		350	525
2	0.8 / 270.7	Till	200	300
	1.5 / 270.0		350	525
3	2.2 / 269.4	Till	300	450
4	1.5 / 270.1	Till	250	375
	2.2 / 269.4		350	525
5	3.0 / 268.6	Sand / Till	350	525
6	0.8 / 270.7	Till	200	300
	1.5 / 270.0		350	525
7	1.5 / 270.1	Till	250	375
	2.2 / 269.4		350	525
8	0.8 / 270.7	Till	350	525

BOREHOLE	DEPTH (m) / ELEVATION	ANTICIPATED SUBGRADE SOIL TYPE	GEOTECHNICAL BEARING RESISTANCE AT SLS (kPa)	FACTORED BEARING RESISTANCE AT ULS (kPa)
10	2.2 / 269.3	Till	350	525
12	1.5 / 269.7	Till	350	525
13	1.5 / 269.8	Till	350	525
15	2.2 / 268.7	Till	350	525
16	2.2 / 269.1	Till	350	525
20	0.8 / 269.8	Till	250	375
	1.5 / 269.1		350	525
Parking Structure				
24	1.5 / 267.6	Till	200	300
	2.2 / 266.9		350	525
25	2.2 / 268.0	Till	300	450
	2.9 / 267.3		350	525
26	2.2 / 268.1	Till	350	525
28	1.5 / 266.0	Till	350	525
29	2.2 / 266.0	Till	350	525
30	2.2 / 267.7	Till	150	225
	2.9 / 267.0	Till	350	525

Higher capacities are possible, however the footing/foundation details will need to be confirmed.

As discussed earlier, any upfilling under building to remove existing fill will need to be constructed as engineered fill. Footings founded on engineered fill, constructed with Granular B, can be designed for a net Geotechnical bearing resistance at SLS of 200 kPa and a factored bearing resistance at ULS of 300 kPa.

The bearing resistance at SLS is based on total settlement of 25 mm in the bearing stratum with differential settlement of 75% of this value.

Footings subject to frost action should be provided with a minimum 1.2 m of earth cover or equivalent insulation.

Prior to placement of structural concrete, all founding surfaces should be reviewed by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions revealed in the excavation.

Based on the soil profile revealed in the boreholes, Site Classification D is applicable for Seismic Site Response as set out in Table 4.1.8.4.A of the Ontario Building Code (2012). Based on the type and relative density of the soil cover at the site, there is a low potential for liquefaction of soils to occur.

5.4 Site Servicing

Design details were not finalized at the time of this report. For purposes of this report, inverts are assumed to be as much as 3.0 m below existing grade.

5.4.1 Trench Excavation and Ground Water Control

Trench excavation and ground water control are described later in the report under Excavation and Ground Water Control.

5.4.2 Pipe Support, Pipe Bedding and Cover

Native soil is generally expected at invert levels, which is considered satisfactory for pipe support. Where existing fill or other deleterious material is encountered at the design invert level, such material should be sub-excavated and replaced with an increased thickness of bedding material, subject to geotechnical field review and approval.

OPSS bedding and cover thickness and compaction standards are recommended. Bedding and cover material should comprise OPSS Granular A.

5.4.3 Trench Backfill

Backfill in trenches should comprise select inorganic soil and be placed in maximum 200 mm thick loose lifts compacted to at least 95% SPmdd to minimize post construction settlement in the backfill. Topsoil, organic, excessively wet, frozen, oversized (greater than 150 mm in diameter), or otherwise deleterious material should not be incorporated as trench backfill. The moisture content of the trench backfill should be within 2% of the optimum moisture content in order to achieve the specified compaction and be close to optimum moisture content in the upper 1 m to prevent subgrade instability issues. Ideally the backfill should comprise excavated site soil, in order to minimize differential frost heave.

The excavated soil will comprise the topsoil, fill and native soil. Excavated inorganic site soil should generally be acceptable for reuse, subject to moisture content control (wet material will need to be dried out or mixed with drier soil in order to be suitable for reuse), removal of organics/deleterious material and geotechnical review during construction.

Earthworks operations should be inspected by PML to verify subgrade preparation, backfill materials, placement and compaction efforts and ensure the specified degree of compaction is achieved throughout.

5.5 Excavation and Ground Water Control

It is anticipated that excavation for the buildings and site serving will extend about 3.0 m below existing grade. Excavation will encounter topsoil, pavement, fill, and native sand/silty sand and the till deposit. Th native soils were typically very dense and harder digging and the occurrence of cobbles and boulders should be expected.

Subject to the ground water control as discussed below, the site soils encountered at the site should be considered as Type 3 soil requiring excavation sidewalls to be constructed at no steeper than one horizontal to one vertical (1H:1V) from the base of the excavation in accordance with the Occupational Health and Safety Act.

Excavation side slopes will need to be continuously examined and reviewed for evidence of instability, particularly following periods of heavy rain or thawing. When required, remedial action must be taken to ensure the continued stability of the excavation slope and the safety of the workers.

Within the depth of excavation as discussed above, only local perched water is expected. Based on the soil conditions observed on-site, conventional sump pumping techniques should be sufficient for ground water control. Local sandy areas may yield greater seepage volumes where more concentrated pumping may be required.

Water taking in Ontario is governed by the Ontario Water Resources Act (OWRA) and the Water Takings and Transfer Regulation O. Reg. 387/04. Section 34 of the OWRA requires anyone taking more than 50,000 L/d to notify the MECP. This requirement applies to all withdrawals, whether for consumption, temporary construction dewatering, or permanent drainage improvements. Where it is assessed than more than 50,000 L/d but less than 400,000 L/d of ground water taking is required, the Owner can register online via the Environmental Activity and Sector Registry (EASR) system. Where it is assessed that more than 400,000 L/d of ground water taking is required then a Category 3 Permit-To-Take-Water (PTTW) is required.

Based on the conditions revealed in the boreholes and anticipated excavation depths discussed above, registry on the EASR system or a PTTW are not anticipated. Once details of the site have been established, they should be reviewed by PML to re-establish any dewatering requirements.

It is recommended that a test dig be conducted to permit prospective contractors an opportunity to observe and examine the conditions likely to be encountered, in order that they may assess for themselves the excavation and ground water control requirements.

5.6 Pavement Design and Construction

Grading was not finalized at the time of this report. It is anticipated that the pavement subgrade will predominantly comprise near surface soils which typically consist of moderately to highly frost susceptible silty sand and sandy silt fill or silty sand till. Based on the subgrade conditions, the following pavement structure thicknesses are recommended and should be reviewed when grading/subgrade soils are determined:

	LIGHT DUTY	HEAVY DUTY
Asphalt (mm) (Two Lifts)	90	120
Granular A Base Course (mm)	150	150
Granular B Subbase Course (mm)	350	500
Total Thickness (mm)	590	760

It is recommended that following rough grading to the subgrade level, subgrade preparation should include proofrolling and compacting the exposed subgrade with a heavy compactor to minimum 95% SPmdd under geotechnical review. Any unstable zones identified during this process should be sub-excavated and replaced with compacted select site material, subject to geotechnical field review. Any upfilling or soil replacement should be carried out as engineered fill.

Imported material for the granular base and subbase should conform to OPSS gradation specifications for Granular A and Granular B, and should be compacted to 100% SPmdd. Asphalt should be compacted in accordance with OPSS 310.

If wet or unstable subgrade is encountered, additional excavation, additional granular subbase, the use of Granular B Type II and/or geotextile may be provided, subject to geotechnical review during construction.

For the pavement to function properly, it is essential that provisions be made for water to drain out of and not collect in the base material. The incorporation of subdrains is recommended along pavement edges in conjunction with crowning of the final subgrade to promote drainage towards the pavement edge. Subdrains should be installed at least 300 mm below the subgrade level. Refer to OPSD 216 Series for details regarding pipe, filter fabric or filter sock, bedding and cover material.

Maintenance hole/catchbasins should be backfilled with free draining Granular B and have stub drains extend out from the structure. The above measures will help drain the pavement structure as well as alleviate the problems of differential frost movement between the catchbasins and pavement.

5.7 Preliminary Infiltration Assessment

The grain size analyses of the major till deposit presented on Figure 1 and are quite uniform. Based on the very dense state of the soil and the grain size distribution, the K value is estimated to be on the order of $1x10^{-5}$ to $1x10^{-6}$ cm /sec, not very favourable for infiltration.

5.8 Geotechnical Review and Construction Inspection and Testing

It is recommended that the final design drawings be submitted to PML for geotechnical review for compatibility with site conditions and recommendations of this report.

Earthworks operations should be carried out under the supervision of PML to approve subgrade preparation, backfill materials, placement and compaction procedures and check the specified degree of compaction is achieved throughout.

Prior to placement of structural concrete, all founding surfaces must be inspected by PML to verify the design bearing capacity is available, or to reassess the design parameters based on the actual conditions.

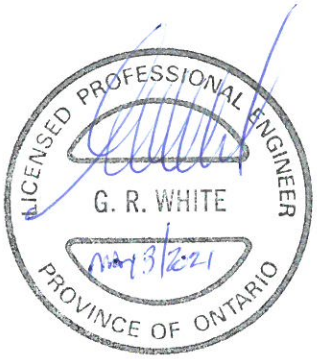
The comments and recommendations provided in the report are based on information revealed in the boreholes. Conditions away from and between boreholes may vary. Geotechnical review during construction should be ongoing to confirm the subsurface conditions are substantially similar to those encountered in the boreholes, which may otherwise require modification to the original recommendations.

6. CLOSURE

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to call our office.

Sincerely

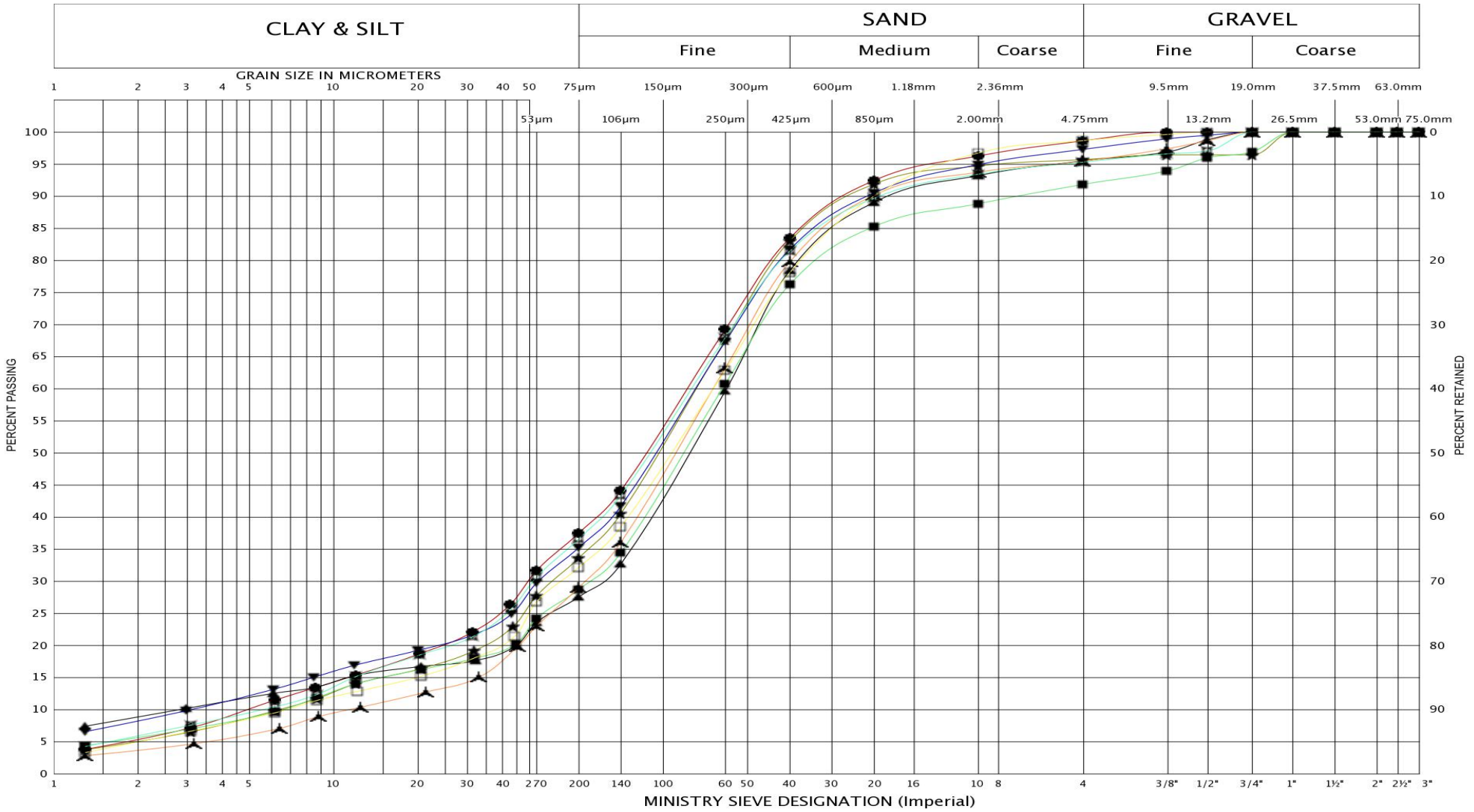
Peto MacCallum Ltd.



Geoffrey R. White, P.Eng.
Director
Manager, Geotechnical Services

GRW:tc

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	3	6	10	17	20	24	27	27
	SAMPLE	4	3	5	12	2	4	3	5
	SYMBOL	□	⊠	●	▲	★	▼	⅄	■

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GRAIN SIZE DISTRIBUTION

TILL: Silty Sand, Trace Gravel, Trace Clay

FIG No.: 1

Project No.: 21BF014

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance N: - The number of blows required to advance a standard split spoon sampler 0.3 m into the subsoil. Driven by means of a 63.5 kg hammer falling freely a distance of 0.76 m.

Dynamic Penetration Resistance: - The number of blows required to advance a 51 mm, 60 degree cone, fitted to the end of drill rods, 0.3 m into the subsoil. The driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described in the following terms:

CONSISTENCY	N (blows/0.3 m)	c (kPa)	DENSENESS	N (blows/0.3 m)
Very Soft	0 - 2	0 - 12	Very Loose	0 - 4
Soft	2 - 4	12 - 25	Loose	4 - 10
Firm	4 - 8	25 - 50	Compact	10 - 30
Stiff	8 - 15	50 - 100	Dense	30 - 50
Very Stiff	15 - 30	100 - 200	Very Dense	> 50
Hard	> 30	> 200		

WTLL	Wetter Than Liquid Limit
WTPL	Wetter Than Plastic Limit
APL	About Plastic Limit
DTPL	Drier Than Plastic Limit

TYPE OF SAMPLE

SS	Split Spoon	ST	Slotted Tube Sample
WS	Washed Sample	TW	Thinwall Open
SB	Scraper Bucket Sample	TP	Thinwall Piston
AS	Auger Sample	OS	Oesterberg Sample
CS	Chunk Sample	FS	Foil Sample
GS	Grab Sample	RC	Rock Core

PH	Sample Advanced Hydraulically
PM	Sample Advanced Manually

SOIL TESTS

Qu	Unconfined Compression	LV	Laboratory Vane
Q	Undrained Triaxial	FV	Field Vane
Qcu	Consolidated Undrained Triaxial	C	Consolidation
Qd	Drained Triaxial		

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LOG OF BOREHOLE NO. 1

17T 603851E 4917184N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.65									
0.20 271.45	TOPSOIL: Dark brown, silty sand, very moist		1	SS	7				15	
	FILL: Brown, silty sand to sandy silt, trace gravel, very moist to wet		2	SS	3	271			20	
1.4 270.3	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	22	270			20	
			4	SS	45	269			20	
			5	SS	57	268			15	
			6	SS	57	267			25	
6.5			7	SS	50	266			25	
265.2	BOREHOLE TERMINATED AT 6.5 m									Upon completion of augering No water No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30 40

NOTES

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LOG OF BOREHOLE NO. 2

17T 603841E 4917198N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.55									
0.22 / 271.33	TOPSOIL: Brown, silty sand, trace wood pieces, moist		1	SS	11	271			15	
0.70 / 270.85	FILL: Brown, silty sand to sandy silt, trace gravel, very moist									
	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		2	SS	25				10	
			3	SS	33	270			20	
			4	SS	43	269			15	
			5	SS	44				20	
						268				
			6	SS	48	267			30	
						266				
6.5			7	SS	50				25	
265.1	BOREHOLE TERMINATED AT 6.5 m									Upon completion of augering No water No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30 40

NOTES

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LOG OF BOREHOLE NO. 3

17T 603868E 4917193N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.55									
0.18	271.37	TOPSOIL: Dark brown, sandy silt, trace gravel, very moist		1	SS	11	271			35	
		FILL: Brown, silty sand to sandy silt, trace gravel, moist to very moist		2	SS	6				20	
				3	SS	10	270			15	
2.1	269.5	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4[1]	SS	41	269			20	
				5	SS	49				15	
							268				
				6	SS	69	267			20	
							266				
6.5	265.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	54				25	Upon completion of augering No water No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ● (20 40 60 80)
PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT
WATER CONTENT (%) (10 20 30 40)

NOTES

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LOG OF BOREHOLE NO. 4

17T 603857E 4917202N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.55									
0.0		PAVEMENT: 50 mm of asphalt, over 140 mm granular base, over 210 mm granular subbase, moist		1A 1B	GS	-				20 20	
0.40	271.15	FILL: Brown, silty sand to sandy silt, trace gravel, moist		2	SS	9	271			20	
1.0											
1.4	270.2	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	25	270			10	
2.0				4	SS	39	269			15	
3.0				5	SS	46	268			10	
4.0											
5.0				6	SS	51	267			20	
6.0							266				
6.5	265.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	45				15	Upon completion of augering No water No cave
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●: 20 40 60 80
PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT; WATER CONTENT (%): 10 20 30 40

NOTES

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CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 5

17T 603850E 4917218N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES
		SURFACE ELEVATION 271.55				
0.0	271.55	PAVEMENT: 50 mm of asphalt, over 100 mm granular base, over 200 mm granular subbase, moist		1A 1B	GS	-
0.35	271.20	FILL: Brown, silty sand to sandy silt, trace gravel, moist		2	SS	12
1.0				3	SS	14
2.0				4	SS	15
2.9	268.7	SAND: Very dense, brown, sand, trace silt, trace gravel, moist		5	SS	52
3.0						
4.0	267.6	SILTY SAND TILL: Very dense to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		6	SS	59
5.0						
6.0						
6.5	265.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	44
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

ELEVATION SCALE: 271, 270, 269, 268, 267, 266

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm)

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 6

17T 603840E 4917233N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) +FIELD VANE △TORVANE ○Qu ▲POCKET PENETROMETER ○Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.50						50 100 150 200 / 20 40 60 80	10 20 30 40		
0.20	271.30	TOPSOIL: Dark brown, silty sand, trace gravel, very moist		1	SS	18	271			5	Stickup casing Concrete
0.70	270.80	FILL: Brown, silty sand to sandy silt, trace gravel, very moist									
		SILTY SAND TILL: Compact to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		2	SS	21				10	
				3	SS	34	270				
				4	SS	43	269			20	Bentonite seal
				5	SS	27	268			20	
				6	SS	41	267			15	
							266				50 mm slotted pipe Filter sand
6.5	265.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	46	265			10	

Upon completion of augering
No water
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	Dry	----
2021-04-30	Dry	----

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 7

17T 603854E 4917237N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.60									
0.15	271.45	TOPSOIL: Dark brown, silty sand, trace gravel, moist		1	SS	5	271				
		FILL: Brown, silty sand to sandy silt, trace gravel, moist		2	SS	7					
1.4	270.2	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	25	270				
				4	SS	37	269				
				5	SS	63/250 mm					
				6	SS	63	268				
							267				
							266				
6.5	265.1			7	SS	46					
		BOREHOLE TERMINATED AT 6.5 m									Upon completion of augering No water No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 8

17T 603837E 4917251N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 271.50					
0.20 / 271.30	TOPSOIL: Dark brown, silty sand, trace gravel, moist		1	SS	7	271
0.70 / 270.80	FILL: Brown, sandy silt, trace gravel, very moist					
	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace clay, cobbles & boulders, moist		2	SS	35	
			3	SS	48	270
			4	SS	35	269
			5	SS	39	268
			6	SS	49	267
						266
6.5 / 265.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	50	265

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 9

17T 603911E 4917221N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE March 22, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 270.20				
0.0	270.20	PAVEMENT: 80 mm of asphalt, over 150 mm granular base, over 300 mm granular subbase, moist		1A / 1B	GS	-
0.53	269.67	FILL: Brown, silty sand, trace gravel, moist		2	SS	6
1.0				3[1]	SS	10
2.0	268.1	SILTY SAND: Compact, brown, silty sand, trace gravel, moist		4	SS	25
2.1 / 2.9	267.3	SILTY SAND TILL: Compact to very dense, brown to grey, silty sand, trace gravel, trace clay, cobbles & boulders, moist to wet		5	SS	48
3.0				6	SS	50/140 mm
4.0				7	SS	89/250 mm
5.0						
6.0				8	SS	37
7.0						
8.0				9	SS	45
9.0						
10.0				10	SS	29
11.0						
11.0				11	SS	55
12.0						
12.8	257.4	BOREHOLE TERMINATED AT 12.8 m		12	SS	56
13.0						
14.0						
15.0						

ELEVATION SCALE: 270, 269, 268, 267, 266, 265, 264, 263, 262, 261, 260, 259, 258

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm): 20, 5, 15, 5, 10, 15, 20, 10, 25, 20, 20, 15, 15

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand
First water strike at 11.9 m

Upon completion of augering
Water at 11.9 m
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-30	8.7	261.5

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 10

17T 603855E 4917267N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 271.50					
0.0							271
0.30	271.20	PAVEMENT: 40 mm of asphalt, over 120 mm granular base, over 140 mm granular subbase, moist		1A 1B	GS	-	
1.0		FILL: Brown, sandy silt, trace gravel, moist		2	SS	5	
1.9	269.6			3	SS	17	270
2.0		SILTY SAND TILL: Dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	41	269
3.0				5	SS	43	
4.0							268
5.0				6	SS	49	267
6.0							266
6.5	265.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	33	265
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 12

17T 603873E 4917268N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 24, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.15								
0.40 / 270.75	PAVEMENT: 100 mm of asphalt, over 120 mm granular base, over 180 mm granualr subbase, moist		1A / 1B	GS	-	271			
1.4	FILL: Brown, sandy silt to silty sand, trace gravel, moist		2	SS	8	270			
269.8	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	41	269			
			4	SS	50				
			5	SS	74	268			
			6	SS	47	267			
6.5			7	SS	46	266			
264.7	BOREHOLE TERMINATED AT 6.5 m					265			Upon completion of augering No water No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 13

17T 603866E 4917281N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 24, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 271.30				
0.25	271.05	PAVEMENT: 40 mm of asphalt, over 100 mm granualar base, over 110 mm granular subbase, moist		1A 1B	GS	-
1.4		FILL: Brown, sandy silt, trace gravel, moist		2	SS	8
	269.9	SILTY SAND TILL: Very dense to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	67
				4	SS	94/250mm
				5	SS	79
				6	SS	49
6.5				7	SS	38
	264.8	BOREHOLE TERMINATED AT 6.5 m				

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

ELEVATION SCALE: 271, 270, 269, 268, 267, 266, 265

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 14

17T 603896E 4917265N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 26, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN DP

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 270.50					
0.0		PAVEMENT: 110 mm of asphalt, over 200 mm granular base, over 150 mm granular subbase, moist		1A 1B	GS	-	270
0.46	270.04	FILL: Brown, sandy silt, trace gravel, moist		2	SS	6	
1.0							
1.4	269.1	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	10	269
2.0				4	SS	41	268
3.0				5	SS	88	
4.0				6	SS	69/250 mm	267
4.3	266.2	BOREHOLE TERMINATED AT 4.3 m					
5.0							
6.0							
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 15

17T 603879E 4917288N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 270.90					
0.27 / 270.63	PAVEMENT: 30 mm of asphalt, over 100 mm granular base, over 140 mm granular subbase, moist		1A	GS	-	
	FILL: Brown, sandy silt, trace gravel, moist		1B			
			2	SS	6	270
			3	SS	10	269
2.1 / 268.8	SILTY SAND TILL: Very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	52	268
			5	SS	53	267
			6	SS	66	266
			7	SS	36	265
6.5 / 264.4	BOREHOLE TERMINATED AT 6.5 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 16

17T 603870E 4917309N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 25, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 271.25					
0.22 / 271.03	TOPSOIL: Dark brown to black, silty sand, moist		1	SS	4	271
	FILL: Brown, silty sand, trace gravel, moist		2	SS	5	
			3	SS	9	270
2.1 / 269.2	SILTY SAND TILL: Dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	45	269
			5	SS	44	268
			6	SS	37	267
			7	SS	40	266
6.5 / 264.8	BOREHOLE TERMINATED AT 6.5 m					265

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 17

17T 603923E 4917222N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 22, 2021
ENGINEER GW
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 269.80					
0.0		PAVEMENT: 100 mm of asphalt, over 150 mm granular base, over 210 mm granular subbase, moist		1A 1B	GS	-	
0.46	269.34	FILL: Brown, sand, trace silt, trace gravel, moist		2[1]	SS	11	269
1.0				3	SS	3	268
2.0	2.1						
	267.7	SILTY SAND TILL: Compact to dense, brown to grey, silty sand, trace gravel, trace clay, cobbles & boulders, moist to wet		4	SS	15	267
3.0				5	SS	32	
4.0				6	SS	42	266
				7	SS	33	265
5.0				8	SS	43	
6.0				9	SS	35	264
7.0							263
8.0				10	SS	19	262
9.0							261
				11	SS	21	
10.0							260
11.0				12	SS	30	259
12.0							258
	12.8			13	SS	47	
	257.0	BOREHOLE TERMINATED AT 12.8 m					257
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm): 5, 5, 10, 10, 15, 20, 20, 20, 25, 20, 15, 15, 15

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount casing
Concrete
Bentonite seal
First water strike at 10.7 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 11.6 m
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	8.3	261.5
2021-04-30	8.1	261.7

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 18

17T 603916E 4917245N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE March 23, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES
		SURFACE ELEVATION 270.20				
0.0		PAVEMENT: 100 mm of asphalt, over 120 mm granular base, over 200 mm granular subbase, moist		1A, 1B	GS	-
0.42	269.78	FILL: Brown, silty sand, trace gravel, moist		2[1]	SS	8
1.0				3[1]	SS	12
2.1	268.1	SILTY SAND TILL: Dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist to very moist		4	SS	36
2.0				5	SS	34
3.0				6	SS	42
4.0				7	SS	45
5.0				8	SS	44
6.0				9	SS	36
7.0				10	SS	24
8.0				11	SS	37
9.0				12	SS	48
10.0						
11.0						
12.0	12.8					
13.0	257.4	BOREHOLE TERMINATED AT 12.8 m				
14.0						
15.0						

ELEVATION SCALE: 270, 269, 268, 267, 266, 265, 264, 263, 262, 261, 260, 259, 258

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm): 10, 10, 15, 10, 20, 15, 20, 20, 20, 20, 15, 20, 15, 10

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount casing
Concrete
Bentonite seal
First water strike at 11.0 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 11.6 m
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	8.4	261.8
2021-04-30	8.4	261.8

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 20

17T 603887E 4917304N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 270.60				
0.23 / 270.37	TOPSOIL: Dark brown, silty sand, trace gravel, moist		1	SS	6
0.70 / 269.90	FILL: Brown, silty sand to sandy silt, trace gravel, moist				
	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		2	SS	25
			3	SS	42
			4	SS	55
			5	SS	58
			6	SS	61
6.5 / 264.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	44

ELEVATION SCALE: 270, 269, 268, 267, 266, 265

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30 40

GAS READINGS (ppm)

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 21

17T 603927E 4917267N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 269.80						50 100 150 200 / 20 40 60 80	10 20 30 40		
0.45 / 269.35	PAVEMENT: 100 mm of asphalt, over 120 mm granular base, over 230 mm granular subbase, moist		1A 1B	GS	-					
	FILL: Brown, silty sand, trace gravel, moist		2	SS	20	269				
			3	SS	20	268				
2.1 / 267.7	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	22	267				
			5	SS	55					
4.3 / 265.5	BOREHOLE TERMINATED AT 4.3 m		6	SS	57	266				Upon completion of augering No water No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 24

17T 603923E 4917295N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 22, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 269.05					
0.0	269.05						
0.18	268.87	TOPSOIL: Dark brown, sandy silt, trace gravel, moist		1	SS	5	268
		FILL: Brown, sandy silt, trace gravel, very moist		2'	SS	4	
1.4	267.7	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	20	267
				4	SS	50	
				5	SS	62	266
				6	SS	41	265
							264
							263
6.5	262.6	BOREHOLE TERMINATED AT 6.5 m		7	SS	26	

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 25

17T 603904E 4917323N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 26, 2021
ENGINEER GW
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN DP

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 270.15					
0.0	270.15	PAVEMENT: 130 mm of asphalt, over 150 mm granular base, over 200 mm granular subbase, moist		1A 1B	GS	-	270
0.48	269.67	FILL: Brown, sandy silt, trace gravel, moist		2	SS	6	269
1.0				3	SS	8	
2.0	268.1	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	29	268
2.1				5	SS	57	267
3.0							
4.0							266
5.0				6	SS	70	
6.0							265
6.5	263.7	BOREHOLE TERMINATED AT 6.5 m		7	SS	44	264
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 26

17T 603895E 4917335N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres) / ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 270.25				
0.20 / 270.05	TOPSOIL: Brown, silty sand, trace gravel, moist		1	SS	2
	FILL: Brown, silty sand to sandy silt, trace gravel, moist to very moist		2	SS	3
			3	SS	5
2.1 / 268.2	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	42
			5	SS	81
			6	SS	66
6.5 / 263.8	BOREHOLE TERMINATED AT 6.5 m		7	SS	55

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stick-up casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand

Upon completion of augering
No water
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	Dry	----
2021-04-30	Dry	----

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 27

17T 603965E 4917268N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLE NUMBER	SAMPLE TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 266.55					
0.0	266.55						266
0.20	266.35	TOPSOIL: Brown, silty sand/sandy silt, trace gravel, moist		1	SS	5	
		FILL: Brown, silty sand, trace gravel, moist		2[1]	SS	8	
1.4	265.2	SILTY SAND TILL: Compact to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	26	265
				4	SS	25	264
				5	SS	31	263
				6	SS	20	
5.0	261.6	BOREHOLE TERMINATED AT 5.0 m		7	SS	60/250 mm	262

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Stick-up casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand

Upon completion of augering
No water
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	2.7	263.9
2021-04-30	3.2	263.4

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 28

17T 603947E 4917292N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 267.45					
0.0	267.45						267
0.25	267.20	TOPSOIL: Brown to dark brown, sandy silt, trace gravel, moist		1	SS	3	
		FILL: Brown, sand, trace silt, trace gravel, moist		2	SS	10	
1.0							
1.4	266.1	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	37	266
2.0				4	SS	45	265
3.0				5	SS	50	264
4.0							263
5.0				6	SS	36	262
6.0							
6.5	261.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	27	261
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 29

17T 603937E 4917306N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 268.15					268
0.0	268.15						
0.24	267.91	TOPSOIL: Brown to black, sandy silt to silty sand, trace gravel, moist		1	SS	4	
		FILL: Brown, silty sand, trace gravel, moist					
1.0				2	SS	20	267
				3	SS	26	
2.0	266.1						266
2.1		SILTY SAND TILL: Very dense to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	52	
3.0				5	SS	44	265
4.0							264
				6	SS	53	
5.0							263
6.0							262
6.5	261.7			7	SS	37	
		BOREHOLE TERMINATED AT 6.5 m					
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 30

17T 603918E 4917331N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 26, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN DP

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 269.90					
0.0	269.90	PAVEMENT: 90 mm of asphalt, over 180 mm granular base, over 150 mm granular subbase, moist		1A 1B	GS	-	
0.42	269.48	FILL: Brown, silty sand, trace gravel, moist		2	SS	14	269
1.0							
1.4	268.5	SILTY SAND TILL: Loose to very dense, brown to grey, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	7	268
2.0				4	SS	13	
3.0							267
				5	SS	59	
4.0							266
5.0				6	SS	36	265
6.0							264
6.5	263.4	BOREHOLE TERMINATED AT 6.5 m		7	SS	65/200 mm	
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

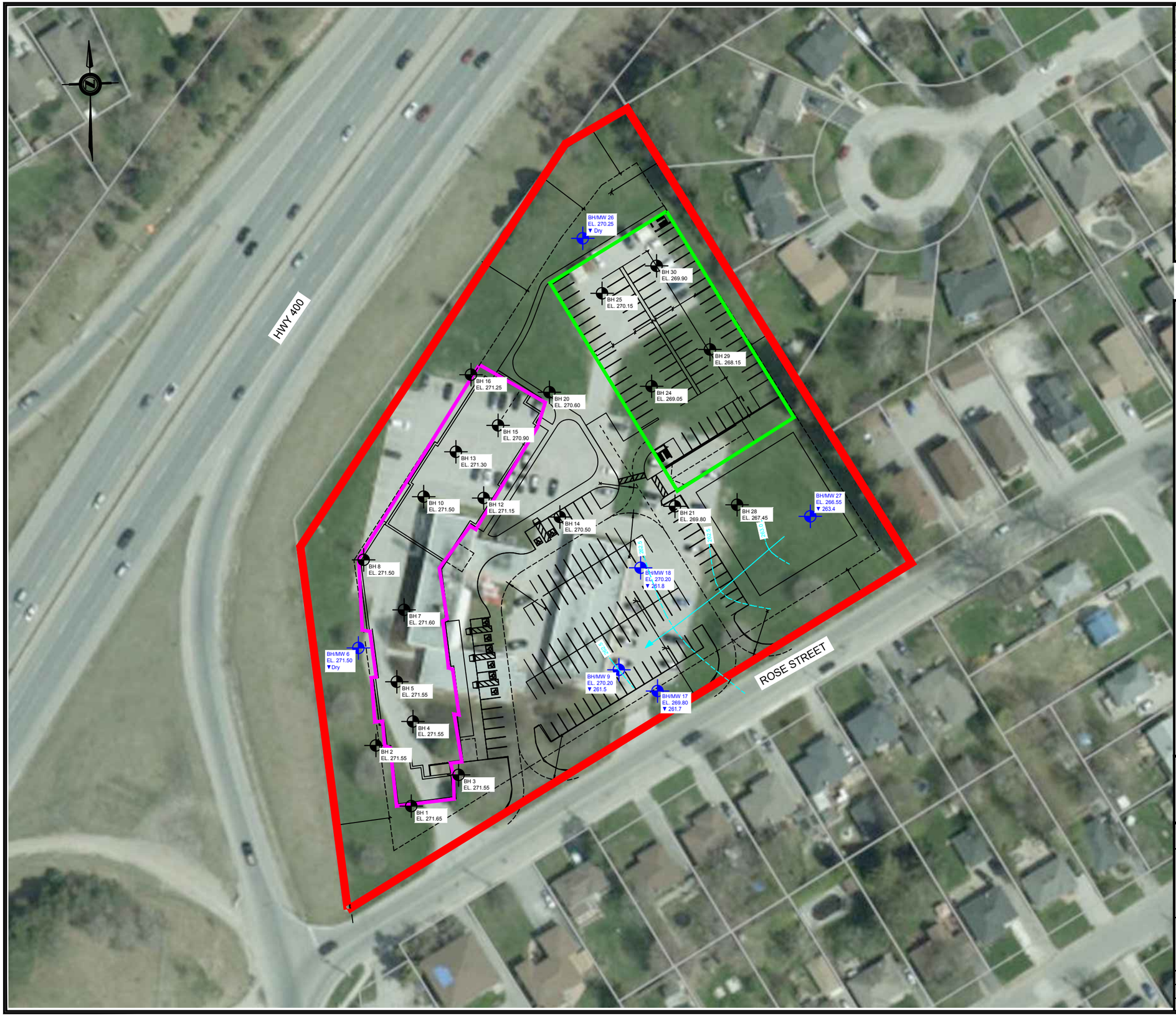
GAS READINGS ppm

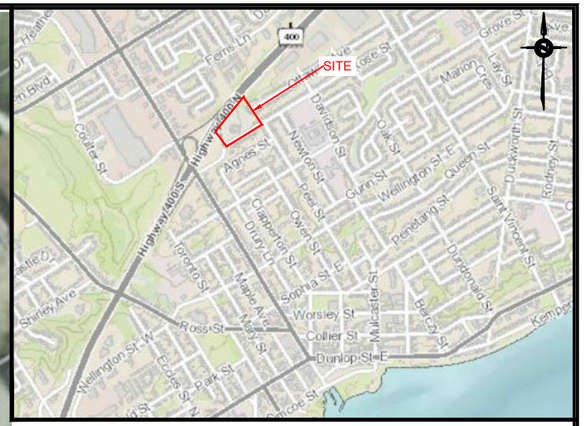
GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES





KEY PLAN
BARRIE, ONTARIO

LEGEND:

- SITE LIMITS
- PROPOSED MAIN BUILDING
- PROPOSED PARKING STRUCTURE
- PROPOSED PAVED PARKING AND ACCESS AREA
- BH 1 EL.271.65 — BOREHOLE LOCATION SURFACE ELEVATION
- BH/MW 6 EL. 271.50 ▼DRY — BOREHOLE/MONITORING WELL LOCATION SURFACE ELEVATION GROUND WATER ELEVATION (APRIL 30, 2021)
- INTERPRETTED GROUND WATER CONTOURS
- INFERRED GROUND WATER FLOW DIRECTION

REFERENCE:
BASE PLAN PRODUCED USING GOOGLE EARTH AUG.2020

0m 15 30 45 60 75
SCALE

BOREHOLE/MONITORING WELL LOCATION PLAN

PROPOSED SIMCOE COUNTY HOUSING FACILITY
20 ROSE STREET
BARRIE, ONTARIO

Peto MacCallum Ltd.
CONSULTING ENGINEERS

		DATE	SCALE	PML REF.	DRAWING NO.
DRAWN	AK	MAY. 2021	AS SHOWN	21BF014	1
CHECKED	AK				
APPROVED	GRW				

APPENDIX A

Statement of Limitations

STATEMENT OF LIMITATIONS

This report is prepared for and made available for the sole use of the client named. Peto MacCallum Ltd. (PML) hereby disclaims any liability or responsibility to any person or entity, other than those for whom this report is specifically issued, for any loss, damage, expenses, or penalties that may arise or result from the use of any information or recommendations contained in this report. The contents of this report may not be used or relied upon by any other person without the express written consent and authorization of PML.

This report shall not be relied upon for any purpose other than as agreed with the client named without the written consent of PML. It shall not be used to express or imply warranty as to the fitness of the property for a particular purpose. A portion of this report may not be used as a separate entity: that is to say the report is to be read in its entirety at all times.

The report is based solely on the scope of services which are specifically referred to in this report. No physical or intrusive testing has been performed, except as specifically referenced in this report. This report is not a certification of compliance with past or present regulations, codes, guidelines and policies.

The scope of services carried out by PML is based on details of the proposed development and land use to address certain issues, purposes and objectives with respect to the specific site as identified by the client. Services not expressly set forth in writing are expressly excluded from the services provided by PML. In other words, PML has not performed any observations, investigations, study analysis, engineering evaluation or testing that is not specifically listed in the scope of services in this report. PML assumes no responsibility or duty to the client for any such services and shall not be liable for failing to discover any condition, whose discovery would require the performance of services not specifically referred to in this report.

STATEMENT OF LIMITATIONS
(continued)

The findings and comments made by PML in this report are based on the conditions observed at the time of PML's site reconnaissance. No assurances can be made and no assurances are given with respect to any potential changes in site conditions following the time of completion of PML's field work. Furthermore, regulations, codes and guidelines may change at any time subsequent to the date of this report and these changes may effect the validity of the findings and recommendations given in this report.

The results and conclusions with respect to site conditions are therefore in no way intended to be taken as a guarantee or representation, expressed or implied, that the site is free from any contaminants from past or current land use activities or that the conditions in all areas of the site and beneath or within structures are the same as those areas specifically sampled.

Any investigation, examination, measurements or sampling explorations at a particular location may not be representative of conditions between sampled locations. Soil, ground water, surface water, or building material conditions between and beyond the sampled locations may differ from those encountered at the sampling locations and conditions may become apparent during construction which could not be detected or anticipated at the time of the intrusive sampling investigation.

Budget estimates contained in this report are to be viewed as an engineering estimate of probable costs and provided solely for the purposes of assisting the client in its budgeting process. It is understood and agreed that PML will not in any way be held liable as a result of any budget figures provided by it.

The Client expressly waives its right to withhold PML's fees, either in whole or in part, or to make any claim or commence an action or bring any other proceedings, whether in contract, tort, or otherwise against PML in anyway connected with advice or information given by PML relating to the cost estimate or Environmental Remediation/Cleanup and Restoration or Soil and Ground Water Management Plan Cost Estimate.

APPENDIX B

Engineered Fill

ENGINEERED FILL

The information presented in this appendix is intended for general guidance only. Site specific conditions and prevailing weather may require modification of compaction standards, backfill type or procedures. Each site must be discussed, and procedures agreed with Peto MacCallum Ltd. prior to the start of the earthworks and must be subject to ongoing review during construction. This appendix is not intended to apply to embankments. Steeply sloping ravine residential lots require special consideration.

For fill to be classified as engineered fill suitable for supporting structural loads, a number of conditions must be satisfied, including but not necessarily limited to the following:

1. Purpose

The site specific purpose of the engineered fill must be recognized. In advance of construction, all parties should discuss the project and its requirements and agree on an appropriate set of standards and procedures.

2. Minimum Extent

The engineered fill envelope must extend beyond the footprint of the structure to be supported. The minimum extent of the envelope should be defined from a geotechnical perspective by:

- at founding level, extend a minimum 1.0 m beyond the outer edge of the foundations, greater if adequate layout has not yet been completed as noted below; and
- extend downward and outward at a slope no greater than 45° to meet the subgrade

All fill within the envelope established above must meet the requirements of engineered fill in order to support the structure safely. Other considerations such as survey control, or construction methods may require an envelope that is larger, as noted in the following sections.

Once the minimum envelope has been established, structures must not be moved or extended without consultation with Peto MacCallum Ltd. Similarly, Peto MacCallum Ltd. should be consulted prior to any excavation within the minimum envelope.

3. Survey Control

Accurate survey control is essential to the success of an engineered fill project. The boundaries of the engineered fill must be laid out by a surveyor in consultation with engineering staff from Peto MacCallum Ltd. Careful consideration of the maximum building envelope is required.

During construction it is necessary to have a qualified surveyor provide total station control on the three dimensional extent of filling.

4. Subsurface Preparation

Prior to placement of fill, the subgrade must be prepared to the satisfaction of Peto MacCallum Ltd. All deleterious material must be removed and in some cases, excavation of native mineral soils may be required.

Particular attention must be paid to wet subgrades and possible additional measures required to achieve sufficient compaction. Where fill is placed against a slope, benching may be necessary and natural drainage paths must not be blocked.

5. Suitable Fill Materials

All material to be used as fill must be approved by Peto MacCallum Ltd. Such approval will be influenced by many factors and must be site and project specific. External fill sources must be sampled, tested and approved prior to material being hauled to site.

6. Test Section

In advance of the start of construction of the engineered fill pad, the Contractor should conduct a test section. The compaction criterion will be assessed in consultation with Peto MacCallum Ltd. for the various fill material types using different lift thicknesses and number of passes for the compaction equipment proposed by the Contractor.

Additional test sections may be required throughout the course of the project to reflect changes in fill sources, natural moisture content of the material and weather conditions.

The Contractor should be particularly aware of changes in the moisture content of fill material. Site review by Peto MacCallum Ltd. is required to ensure the desired lift thickness is maintained and that each lift is systematically compacted, tested and approved before a subsequent lift is commenced.

7. Inspection and Testing

Uniform, thorough compaction is crucial to the performance of the engineered fill and the supported structure. Hence, all subgrade preparation, filling and compacting must be carried out under the full time inspection by Peto MacCallum Ltd.

All founding surfaces for all buildings and residential dwellings or any part thereof (including but not limited to footings and floor slabs) on structural fill or native soils must be inspected and approved by PML engineering personnel prior to placement of the base/subbase granular material and/or concrete. The purpose of the inspection is to ensure the subgrade soils are capable of supporting the building/house foundation and floor slab loads and to confirm the building/house envelope does not extend beyond the limits of any structural fill pads.

8. Protection of Fill

Fill is generally more susceptible to the effects of weather than natural soil. Fill placed and approved to the level at which structural support is required must be protected from excessive wetting, drying, erosion or freezing. Where adequate protection has not been provided, it may be necessary to provide deeper footings or to strip and recompact some of the fill.

9. Construction Delay Time Considerations

The integrity of the fill pad can deteriorate due to the harsh effects of our Canadian weather. Hence, particular care must be taken if the fill pad is constructed over a long time period.

It is necessary therefore, that all fill sources are tested to ensure the material compactability prior to the soil arriving at site. When there has been a lengthy delay between construction periods of the fill pad, it is necessary to conduct subgrade proof rolling, test pits or boreholes to verify the adequacy of the exposed subgrade to accept new fill material.

When the fill pad will be constructed over a lengthy period of time, a field survey should be completed at the end of each construction season to verify the areal extent and the level at which the compacted fill has been brought up to, tested and approved.

In the following spring, subexcavation may be necessary if the fill pad has been softened attributable to ponded surface water or freeze/thaw cycles.

A new survey is required at the beginning of the next construction season to verify that random dumping and/or spreading of fill has not been carried out at the site.

10. Approved Fill Pad Surveillance

It should be appreciated that once the fill pad has been brought to final grade and documented by field survey, there must be ongoing surveillance to ensure that the integrity of the fill pad is not threatened.

Grading operations adjacent to fill pads can often take place several months or years after completion of the fill pad.

It is imperative that all site management and supervision staff, the staff of Contractors and earthwork operators be fully aware of the boundaries of all approved engineered fill pads.

Excavation into an approved engineered fill pad should never be contemplated without the full knowledge, approval and documentation by the geotechnical consultant.

If the fill pad is knowingly built several years in advance of ultimate construction, the areal limits of the fill pad should be substantially overbuilt laterally to allow for changes in possible structure location and elevation and other earthwork operations and competing interests on the site. The overbuilt distance required is project and/or site specified.

Iron bars should be placed at the corner/intermediate points of the fill pad as a permanent record of the approved limits of the work for record keeping purposes.

11. Unusual Working Conditions

Construction of fill pads may at times take place at night and/or during periods of freezing weather conditions because of the requirements of the project schedule. It should be appreciated therefore, that both situations present more difficult working conditions. The Owner, Contractor, Design Consultant and Geotechnical Engineer must be willing to work together to revise site construction procedures, enhance field testing and surveillance, and incorporate design modifications as necessary to suit site conditions.

When working at night there must be sufficient artificial light to properly illuminate the fill pad and borrow areas.

Placement of material to form an engineered fill pad during winter and freezing temperatures has its own special conditions that must be addressed. It is imperative that each day prior to placement of new fill, the exposed subgrade must be inspected and any overnight snow or frozen material removed. Particular attention should be given to the borrow source inspection to ensure only nonfrozen fill is brought to the site.

The Contractor must continually assess the work program and have the necessary spreading and compacting equipment to ensure that densification of the fill material takes place in a minimum amount of time. Changes may be required to the spreading methods, lift thickness, and compaction techniques to ensure the desired compaction is achieved uniformly throughout each fill lift.

The Contractor should adequately protect the subgrade at the end of each shift to minimize frost penetration overnight. Since water cannot be added to the fill material to facilitate compaction, it is imperative that densification of the fill be achieved by additional compaction effort and an appropriate reduced lift thickness. Once the fill pad has been completed, it must be properly protected from freezing temperatures and ponding of water during the spring thaw period.

If the pad is unusually thick or if the fill thickness varies dramatically across the width or length of the fill pad, Peto MacCallum Ltd. should be consulted for additional recommendations. In this case, alternative special provisions may be recommended, such as providing a surcharge preload for a limited time or increase the degree of compaction of the fill.

Appendix E

Hydrogeological Investigation, GEI,

October 2024

GEI Consultants

Consulting Engineers and Scientists

Hydrogeological Investigation

Proposed Social Housing Facility

20 Rose Street, Barrie, ON

Submitted to:
County of Simcoe, Social Housing Development
1110 Highway 26
Midhurst, Ontario
L9X 1N6

Submitted by:
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Project No. 2305493

Issues and Revisions Registry

Identification	Date	Description of Issued and/or Revisions
1st Submission	February 20, 2024	Hydrogeological Investigation
2nd Submission	May 21, 2024	Updated report to include results of May 2024 infiltration testing and manual long-term groundwater monitoring results to date
3rd Submission	October 16, 2024	Updated report to include updated site plan (including the elevator pits and removal of underground tunnel) and results of spring manual long-term groundwater monitoring results to date

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1. Introduction

GEI Consultants Canada Ltd. (GEI) was retained by the County of Simcoe Social Housing Department to complete a subsurface investigation and provide a hydrogeological report in support of the proposed social housing facility on 20 Rose Street in Barrie, Ontario. A site location plan is shown in Figure 1.

The purpose of this hydrogeological investigation was to determine the subsurface groundwater conditions at the site and provide a report with recommendations regarding permitting requirements, infiltration capacity, recharge conditions and dewatering/discharge from the construction of servicing and underground levels associated with the proposed buildings to be constructed on site.

1.1 Site and Project Description

It is GEI's understanding that the site was formerly an OPP facility, however the OPP facility has since been demolished and the site is currently vacant except for some mobile housing units that were assembled for temporary use.

The proposed construction is to include an "L" shaped 9 to 11-storey residential apartment building with a single basement level (up to 4 metres below proposed grade, with an option for a portion to have a sub-basement up to 8 metres below proposed grade) as well as a three-storey mixed commercial and parking structure with two-levels of underground parking (up to 6.5 metres below proposed grade). It is understood that the lowest basement finished floor elevation will not extend below approximately Elev. 264 metres for both buildings. The remainder of the site will consist of on-grade parking, an internal driveway, an outdoor amenity space and landscaping. An aerial image and a proposed site plan of the site are shown in Figures 2A/2B.

GEI has reviewed the following documentation in preparation of this report:

- "*Basement Floor Plan / Rose St. Entrance, Level 1 Floor Plan, and Elevator Sections – County of Simcoe Affordable Housing Development – Barrie, 20 Rose Street, Barrie, Ontario*", Sheets AH-A201, AH-A202, and AH-A403, dated August 1, 2024, by MCL Architects.
- "*Parking Structure Floor Plans and Sections – County of Simcoe Social and Community Services and Housing Development – Barrie, 20 Rose Street, Barrie, Ontario*", Sheets PS-A201 and PS-A404, dated August 1, 2024, by MCL Architects.
- "*Excess Soil and Fill Management Plan, Proposed Social Housing Facility, 20 Rose Street, Barrie, ON*", Project Number: 2305493, dated June 28, 2024, by GEI Consultants Canada Ltd.
- "*Phase One Environmental Site Assessment, Proposed Social Housing Facility, 20 Rose Street, Barrie, ON*", Project Number: 2305493, dated June 20, 2024, by GEI Consultants Canada Ltd.

- "*Phase Two Environmental Site Assessment, Proposed Social Housing Facility, 20 Rose Street, Barrie, ON*", Project Number: 2305493, dated June 24, 2024, by GEI Consultants Canada Ltd.
- "*Hydrogeological Investigation, Proposed Social Housing Facility, 20 Rose Street, Barrie, ON*", Project Number: 2305493, dated May 21, 2024, by GEI Consultants Canada Ltd.
- "*Assessment of Past Uses, 20 Rose Street, Barrie, Ontario*", Project 2305493, dated December 2023, by GEI.
- "*Site Servicing Plan*", County of Simcoe Affordable Housing Department – 20 Rose Street, City of Barrie, dated October 2023, by Pearson Engineering.
- "*Site Grading Plan*", County of Simcoe Affordable Housing Department – 20 Rose Street, City of Barrie, dated October 2023, by Pearson Engineering.
- "*Main Building Plans*", County of Simcoe Social and Community Services and Housing Department, 20 Rose Street, Barrie, Ontario, dated May 24, 2023, by MCL Architects.
- "*Parking Structure Plans*", County of Simcoe Social and Community Services and Housing Department, 20 Rose Street, Barrie, Ontario, dated May 24, 2023, by MCL Architects.
- PDF of supplemental groundwater elevations taken from May 20, 2021, to December 10, 2021. As the PDF is unreferenced, it is assumed these readings were taken by Peto MacCallum Ltd.
- "*Phase Two Environmental Site Assessment, Proposed Simcoe County Housing Facility, 20 Rose Street, Barrie, Ontario*", PML Ref. 21BF014, Report 2 Revised, dated May 2021, by Peto MacCallum Ltd.
- "*Geotechnical Investigation, Proposed Simcoe County Housing Facility, 20 Rose Street, Barrie, Ontario*", Peto MacCallum Ltd. (PML) Ref. 21BF014, Report 1 Revised, dated May 2021, by Peto MacCallum Ltd.
- *"Phase One Environmental Site Assessment, Barrie OPP Detachment, 20 Rose Street, Barrie, Ontario – Infrastructure Ontario"*, GHD Report Reference No.: 11203430, dated October 15, 2019, by GHD Limited (GHD).

1.2 Scope of Work

The main objectives of the hydrogeological investigation were to:

a) Establish the local hydrogeological settings of the site;
b) Assess groundwater quality and compare the results to the applicable City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria, Provincial Water Quality Objective (PWQO), and Ontario Regulation 153/04 (O.Reg.153/04), as amended, Site Condition Standards (SCS);
c) Carry out preliminary and in-situ analysis for infiltration rates based on the subsurface conditions;
d) Carry out analysis for construction dewatering rates based on the subsurface conditions and proposed site works, and discuss the regulatory requirements;
e) Complete a preliminary water balance (pre- and post-construction): and
f) Prepare a hydrogeological investigation report.

To achieve the investigation objectives, GEI proposed and completed the following scope of work:

a) Conduct a background desktop review of pertinent geological and hydrogeological resources, Ministry of Environment, Conservation and Parks (MECP) Water Well Records, previous reports, and proposed site plan drawings.
b) Visit the site and note existing site conditions, site setting, topography, drainage, water features, and potential water wells within 500 m of the site, if any.
c) Utilization of the twenty-six (26) boreholes completed as part of the previous geotechnical and hydrogeological investigations by Peto MacCallum Limited (PML) in 2021. As a part of the previous investigation six (6) monitoring wells were installed, however three (3) monitoring wells were inferred to have been destroyed during recent grading activities. Two (2) of the remaining monitoring wells were installed above the prevailing groundwater table such that information regarding the groundwater elevation could not be obtained. As part of the current investigation, GEI advanced five (5) new deeper boreholes adjacent to select previous borehole locations and installed five (5) new monitoring wells within those boreholes.
d) Measure groundwater levels in all monitoring wells and perform hydraulic conductivity testing in four (4) monitoring wells.
e) Collect and submit two (2) representative unfiltered groundwater samples for laboratory testing to compare against the City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria, PWQO standards for metals and Total Suspended Solids (TSS); subject to sufficient available monitoring well groundwater quantity.
f) Collect and submit two (2) representative filtered groundwater samples for laboratory testing to compare against the PWQO standards for metals and TSS, subject to sufficient available monitoring well groundwater quantity.
g) Test three (3) selected soil samples for particle size distribution (as per Ontario LS standards in reference to ASTM D6913 and D7928).
h) Complete a preliminary water balance (pre- and post-construction).
i) Carry out a dewatering assessment for construction.
j) Complete infiltration analysis based on the in-situ site conditions.
k) Prepare a hydrogeological report.

1.3 Applicable Regulations

1.3.1 Source Water Protection

The site is within jurisdictional boundary of the Lake Simcoe and Region Conservation Authority (LSRCA). The site is within the Lake Simcoe and Couchiching/Black River Source Protection Area, in the South Georgian Bay Lake Simcoe Source Protection Region. The following documents should be used in determination of the regulatory requirements when it comes to maintaining hydrogeological function at this site:

- "*Approved South Georgian Bay Lake Simcoe Source Protection Plan",* amended November 15, 2022, by the South Georgian Bay Lake Simcoe Source Protection Region.

Based on Source Water Protection and Natural Heritage Areas online mapping, the following is noted:

- Wellhead Protection Area (WHPA): The site is located within the WHPA-D Q1 of Barrie Water Supply Wells 220001192 (Figure 3).
- Intake Protection Zone (IPZ): The site is located within IPZ-3 of the Barrie Water Treatment Plant (Figure 4).
- Highly Vulnerable Aquifer (HVA): The site is not located within an HVA (Figure 5).
- Significant Groundwater Recharge Area (SGRA): The site is not located within a SGRA (Figure 6).
- Issue Contributing Area (ICA): The site is located within an ICA for chloride and sodium (Figure 7).
- The site is not located within the Oak Ridges Moraine planning area.
- The site is not located within the Niagara Escarpment planning area.
- The site is not located in or within 500 m of an Area of Natural and Scientific Interest (ANSI).
- The site is not located in or within 500 m of any provincially significant wetlands.

1.3.2 Water Taking – Temporary

The volume of water entering the excavation during construction will be based on both groundwater infiltration and precipitation events. Based on O.Reg. 63/16, the following dewatering limits and requirements are as follows:

- Construction Dewatering less than 50,000 L/day: The takings of both groundwater and stormwater does not require a hydrogeological report, does not require registration on the Environmental Activity and Sector Registry (EASR), and does not require a Permit to Take Water (PTTW) from the MECP.
- Construction Dewatering greater than 50,000 L/day and less than 400,000 L/day: The taking of groundwater and/or stormwater requires a hydrogeological report and registration on the EASR but does not require a PTTW from the MECP.
- Construction Dewatering greater than 400,000 L/day: The taking of groundwater and/or stormwater requires a hydrogeological report and requires a PTTW from the MECP.

1.3.3 Anticipated City of Barrie Comments

The City of Barrie has historically had the following comments about hydrogeologic information for sites located within the city limits, which are provided below along with GEI's responses.

City Comment: Deep construction activities have the potential to impact or intercept the municipal supply aquifer (e.g. deep drilling, installation of deep foundation support, underground parking, dewatering, etc.), including development in areas of known or suspected groundwater contamination.

GEI Response: The City of Barrie is underlain by complex and extensive regional aquifers. The four major aquifers identified beneath Barrie include aquifer A1 (Appendix A, upper and mostly unconfined), A2 (intermediate) and A3 / A4 (lower) aquifers. Aquifer A1 is mostly unconfined, but A2 is typically confined by 5 to 20 metres of fine-grained deposits. The lower aquifers A3 and A4 typically consist of sands and gravels, and most of Barrie's groundwater is supplied by these deep

aquifers. Active City Wells 3A, 5, and 12 are screened within aquifer A4, City Wells 7, 9, 11, 13, 14, 15, 17 and 18 are screened in both aquifers A3 and A4, and City Wells 4, 10 and 16 are screened in aquifer A3. In the Barrie area, the elevation of aquifer A3 ranges from approximately Elev. 150 to 195 m, and the elevation of aquifer A4 ranges from approximately Elev. 115 to 160 m .

The original PML 2021 boreholes extended to depths of about 4.3 to 12.8 m below grade and encountered an upper unconfined aquifer (assumed to be aquifer A1). At the end of 2023 GEI advanced deeper boreholes to a maximum depth of 14.2 m below grade across the site to accommodate the newest site plans. No foundations or servicing are expected to extend significantly greater than approximately 8 metres below proposed grade (Elev. 263.95 metres) where the basement finished floor elevation is currently set at. The development therefore will not extend into the drinking water aquifers A3 or A4, which are an estimated 100 m or more below the deepest extent of the development. Similarly, dewatering activities are expected to be restricted to the upper unconfined Aquifer A1 only (not used for drinking water). Deep foundations (e.g. piles, caissons) are not expected to be required to support new structures at this site as discussed in the geotechnical report by GEI under a separate cover.

City Comment: The applicant is required to provide the following information to screen for risk management requirements:

i. **Anticipated Maximum Depth of Excavation**
ii. **Anticipated Maximum Depth of Foundation**
iii. **Anticipated Percentage of site to be developed**

GEI Response: This information is typically confirmed and provided by the architect or civil engineer.

City Comment: It is noted that based on the information provided above:

a. **A hydrogeological study may be required for the site in accordance with the Terms of Reference.**
b. **The hydrogeological study may require detailed risk management plans within the Mitigation Measures section of the report including a dewatering management plan, a contamination management plan, and/or a recharge management plant.**

GEI Response: This hydrogeological study has been prepared by GEI and follows *"Hydrogeological Assessment Submissions, Conservation Authority Guidelines for Development Applications"* (June 2013) and City of Barrie Hydrogeological Study Terms of Reference (January 2019). Recommended mitigation measures are discussed in Section 5.2.6.

City Comment: Site plan drawings will need to clearly note proposed elevations of foundation supports. Building supports shall be designed to stay above the municipal supply aquifer.

GEI Response: Final site plans showing the foundation types and elevations are typically provided by the architect or structural engineer. As discussed above, the municipal supply aquifers A3 and A4 are located at or below Elev. 195 m in the Barrie area. GEI provided a geotechnical

engineering report under a separate cover, and based on the subsurface conditions, the recommended foundation option was conventional spread and strip footings. The shallow foundations are expected to be made as deep as 8 metres below proposed grade (on a preliminary basis) and will not extend into aquifers A3 or A4. Deep foundations are not expected to be required.

City Comment: Deep drilling and the undertaking of deep construction activities (piles, caissons, excavations, underground parking etc.) can create a transport pathway for contaminant migration to the deep municipal supply aquifer. We request that no drilling or construction activities occur without formal consultation with the City to ensure a plan is in place to address the risks to the drinking water supply aquifer, and off-site contaminant migration.

GEI Response: GEI has advanced deeper boreholes across the site to confirm the deeper stratigraphy and groundwater conditions beneath the site. Based on current subsurface information and the understanding that Aquifer A2 is typically confined by 5 to 20 m of fine-grained deposits, the proposed development is not expected to penetrate into confined aquifer A2 and will not extend into the drinking water supply aquifers A3 and A4. There is very low to negligible risk that contaminants will be transported from the development into the drinking water supply aquifers. In addition, it is not expected that deep construction activities such as piles to support foundations or temporary shoring will be implemented at this site.

2. Background Review and Site Setting

The general site area comprises 20 Rose Street. The surrounding area is predominantly residential, with Rose Street located south of the site, Ontario Highway 400 located north of the site, and a highway on-ramp located west of the site. The site extent is shown in Figures 1 and 2A/2B.

The general site area is irregular in shape and measures approximately 1.87 hectares and is currently vacant with the exception of mobile housing units that were assembled for temporary use. The proposed construction is to include an "L" shaped 9 to 11-storey residential apartment building with a single basement level (up to 4 metres below proposed grade, with an option for a portion to have a sub-basement up to 8 metres below proposed grade) as well as a three-storey mixed commercial and parking structure with two-levels of underground parking (up to 6.5 metres below proposed grade). It is understood that the lowest basement finished floor elevation will not extend below approximately Elev. 264 metres for both buildings. The remainder of the site will consist of on-grade parking, an internal driveway, an outdoor amenity space and landscaping. An aerial image and a proposed site plan of the site are shown in Figures 2A/2B.

2.1 Timeline and Summaries of Previous Investigations, Relevant Reports, and Drawings

2.1.1 "Phase One Environmental Site Assessment, Barrie OPP Detachment, 20 Rose Street, Barrie, Ontario – Infrastructure Ontario", GHD Report Reference No.: 11203430, dated October 15, 2019, by GHD.

GHD Limited (GHD) identified five (5) Areas of Potential Environmental Concern (APECs) in 2019 on the 20 Rose Street property (the site), four (4) of which potentially impacted groundwater:

- APEC #1: Historical Fuel Storage Tanks (Off-Site),
- APEC #3: Vehicle Servicing Garage,
- APEC #4: Fuel Storage Tanks, and
- APEC #5: Transformer Use.

2.1.2 "Geotechnical Investigation, Proposed Simcoe County Housing Facility, 20 Rose Street, Barrie, Ontario", PML Ref. 21BF014, Report 1 Revised, dated May 2021, by Peto MacCallum Ltd.

Peto MacCallum Ltd. (PML) conducted a Phase Two Environmental Site Assessment (ESA) and a geotechnical investigation in 2021. The programs included the advancement of twenty-six (26) boreholes (BHs 1to 10,12 to 18, 20, 21, and 24 to 30) up to a maximum depth of approximately 12.8 m bgs and the installation of six (6) monitoring wells (MWs) 6, 9, 17, 18, 24, and 27). The borehole stratigraphy is discussed

in Section 4.1 of this report, borehole locations are shown on Figures 2A/2B, and copies of these borehole logs are provided in Appendix C.

As of this report, three (3) of these monitoring wells (MWs 9, 17, and 18) are inferred to have been destroyed during recent grading activities.

The PML monitoring well construction details are summarized below.

Borehole / Monitoring Well	Well Screen Depth / Elevation (m) / Elev.	Unit Screened	Current Status
By Others (PML, 2021)			
BH/MW 6	4.6 to 6.1 / 265.4 to 266.9	Silty Sand Glacial Till	Intact
BH/MW 9	10.7 to 12.2 / 258.0 to 259.5	Silty Sand Glacial Till	Destroyed
BH/MW 17	10.7 to 12.2 / 257.6 to 259.1	Silty Sand Glacial Till	Destroyed
BH/MW 18	10.7 to 12.2 / 258.0 to 259.5	Silty Sand Glacial Till	Destroyed
BH/MW 26	4.6 to 6.1 / 264.2 to 265.7	Silty Sand Glacial Till	Intact
BH/MW 27	3.0 to 4.6 / 262.0 to 265.3	Silty Sand Glacial Till	Intact

2.1.3 "Phase Two Environmental Site Assessment, Proposed Simcoe County Housing Facility, 20 Rose Street, Barrie, Ontario", PML Ref. 21BF014, Report 2 Revised, dated May 2021, by Peto MacCallum Ltd.

Following the findings of the GHD 2019 Phase One ESA, PML conducted groundwater sampling to assess APECs identified by GHD. The following groundwater samples were collected from Borehole/Monitoring Wells (BH/MWs) 9,17, and 18 on April 1, 2021:

- BH/MW 9: Unfiltered groundwater sample for analysis of metals, PHCs, and VOCs;
- BH/MW 17: Unfiltered groundwater sample for analysis of PHCs and PCBs,
    - Location of duplicate sample "Dup B" – no PHC analysis;
- BH/MW 18: Unfiltered groundwater sample for analysis metals, PHCs, VOCs, and PAHs;
    - Location of duplicate sample "Dup A".

The groundwater samples collected from BH/MWs 9, 17, and 18 generally met O.Reg.153/04 Table 1 SCS for RPI/ICC property use, except for benzo[a]pyrene. An elevated concentration of benzo[a]pyrene was found in BH/MW 18 from the duplicate

sample (DUP A) with a concentration 0.016 µg/L, exceeding the O.Reg.153/04 Table 1 RPI/ICC SCS of 0.01 µg/L.

It is noted that the primary groundwater sample collected from BH/MW 18 (at the same time of DUP A) was found to have a benzo[a]pyrene concentration below the laboratory's detection limit (< 0.01 µg/). As the average concentration of benzo[a]pyrene of these duplicate groundwater samples from BH/MW 18 is still greater than 0.01 µg/L, the sample does not meet O.Reg.153/04 Table 1 SCS for RPI/ICC property use. Additionally, these groundwater sample from BH/MW 18 did not meet the criteria of O.Reg.153/04 Table 2 SCS for RPI property use (the applicable standard for the site of 0.01 µg/L).

2.1.4 PDF of supplemental groundwater elevations taken from May 20, 2021, to December 10, 2021. As the PDF is unreferenced, it is assumed these readings were taken by Peto MacCallum Ltd.

Previously, groundwater monitoring was conducted by another consultant (PML) for eight (8) months from May to December 2021 and reported in a stand-alone appendix "PDF" type file. A summary is provided below.

Borehole / Monitoring Well	**2021 Groundwater Level / Elevation Depth (m) / Elev.**					
	May 20	**Jun. 25**	**Jul. 14**	**Aug. 10**	**Sept. 8**	**Oct. 10**
By Others (PML, 2021)						
BH/MW 6	Dry / below 265.4	Dry / below 265.4	Dry / below 265.4	2.8 / 268.7	Dry / below 265.4	Dry / below 265.4
BH/MW 9	9.2 / 261.0	9.8 / 260.1	9.1 / 261.1	8.4 / 261.8	8.4 / 261.8	8.5 / 261.8
BH/MW 17	8.2 / 261.6	9.1 / 260.7	7.7 / 262.1	6.5 / 263.3	8.3 / 261.5	8.3 / 261.6
BH/MW 18	8.3 / 261.9	9.1 / 261.1	7.9 / 262.3	7.1 / 263.1	8.5 / 261.7	8.3 / 261.9
BH/MW 26	Dry / below 264.2	Dry / below 264.2	Dry / below 264.2	6.0 / 264.3	Dry / below 264.2	Dry / below 264.2
BH/MW 27	3.2 / 263.4	Dry / below 262.0	1.0 / 265.6*	1.2 / 265.4	3.7 / 262.8	3.8 / 262.8
Borehole / Monitoring Well	**2021 Groundwater Level / Elevation Depth (m) / Elev.**					
	Nov. 8			**Dec. 10**		
By Others (PML, 2021)						
BH/MW 6	Dry / below 265.4			Dry / below 265.4		
BH/MW 9	8.9 / 261.3			Destroyed		
BH/MW 17	8.1 / 261.7			Destroyed		
BH/MW 18	8.1 / 262.1			Destroyed		
BH/MW 26	Dry / below 264.2			Dry / below 264.2		
BH/MW 27	3.6 / 262.9			2.8 / 263.8		
*It was noted that water was found ponded at the surface of the site following a large rain event.						

Based on these groundwater levels, shallow subsurface groundwater appears to flow from west to east. The stabilized groundwater level measurements within the PML monitoring wells were observed May to December of 2021 to be dry or depths of 1.0 m to 9.8 m below current grade, corresponding to Elev. 260.4 to 268.7 m. The shallowest

groundwater level was measured at PML MW 27, at 1.0 m below current grade in July of 2021 and the highest groundwater elevation was measured at PML MW 6 at Elev. 268.7 m, in August of 2021.

Based on the high groundwater levels measured by PML in August 2021, the local groundwater flow appears to be directed south towards Lake Simcoe.

While groundwater levels, especially near the surface, are expected to show seasonal fluctuations and vary in response to prevailing climate conditions, the previous PML 2021 groundwater measurement records mentioned a large rain event prior to the August 2021 measurement such that water was ponded around PML MW 27. Upon review of historical precipitation data, approximately 196.1 mm of precipitation was recorded in the preceding month (July 2021, data sourced from Environment Canada station "Barrie Landfill"), more than double the long-term average precipitation for July of 77.2 mm (average precipitation from Environment Canada station "Barrie WPCC" between 1981 and 2010).

2.1.5 "Site Grading Plan", County of Simcoe Affordable Housing Department – 20 Rose Street, City of Barrie, dated October 2023, by Pearson Engineering.

Based on the Site Grading Plan, the commercial building on the eastern portion of the site will fit inside a footprint of approximately 65.0 m by 40.0 m, and the residential building on the western portion of the site will fit inside a footprint of approximately 81.0 m by 40.5 m.

2.1.6 "Site Servicing Plan", County of Simcoe Affordable Housing Department – 20 Rose Street, City of Barrie, dated October 2023, by Pearson Engineering.

Based on the Site Servicing Plan, the lowest proposed site servicing will occur around Storm water Maintenance Hole 101 with a northeast invert elevation of 263.02 m. Additionally, the Site Servicing Plan indicated the proposed locations and depths of the bases of the three (3) LIDs as ranging between the elevations of Elev. 268.6 to 263.7 m.

Since receiving this report it is understood that only one (1) LID will be incorporated into the site plan, as depicted in Figures 2A and 2B.

2.1.7 "Phase Two Environmental Site Assessment, Proposed Social Housing Facility, 20 Rose Street, Barrie, ON", Project Number: 2305493, dated June 24, 2024, by GEI Consultants Canada Ltd.

GEI returned to the property 20 Rose Street (the site) in April 2024 to assess the soil and groundwater quality on site with the advancement of fourteen (14) new boreholes (BH 201 to BH 214) up to a maximum depth of 12.8 m bgs, and seven (7) test pits (TP 1 to TP 7). Monitoring wells were installed in selected boreholes, BH/MW 207 and

BH/MW 208 to facilitate groundwater sample collection and long-term groundwater monitoring. The soil stratigraphy found from this subsurface investigation was consistent with what was encountered during GEI's original subsurface investigation in December 2023 (as discussed in Section 4.1 of this report) and is available under a separate cover. The new monitoring well locations (BH/MWs 207 and 208) are shown on Figures 2A/2B, and copies of these two (2) borehole logs only are provided in Appendix C.

The new monitoring well construction details are summarized below.

Borehole / Monitoring Well	Well Screen Depth / Elevation (m) / Elev.	Unit Screened	Current Status
GEI, 2024			
BH/MW 207	7.6 to 10.6 / 260.0 to 263.1	Silty Sand Glacial Till	Intact
BH/MW 208	9.1 to 12.2 / 258.2 to 261.3	Silty Sand Glacial Till	Intact

Additionally the Phase 2 ESA did not identify any Contaminants of Concern (COC) in the groundwater based on the completed geoenvironmental groundwater analytical testing program.

2.1.8 "Parking Structure Floor Plans and Sections – County of Simcoe Social and Community Services and Housing Development – Barrie, 20 Rose Street, Barrie, Ontario", Sheets PS-A201 and PS-A404, dated August 1, 2024, by MCL Architects.

Based on the Parking Floor Plan and Sections, the commercial building on the eastern portion of the site will have one (1) elevator pit in the southwestern portion of the building that is approximately 6.5 m by 6.0 m in plan and extend approximately 3.5 m below the lowest basement finished floor elevation (assumed to be at its lowest 264 m).

2.1.9 "Basement Floor Plan / Rose St. Entrance, Level 1 Floor Plan, and Elevator Sections – County of Simcoe Affordable Housing Development – Barrie, 20 Rose Street, Barrie, Ontario", Sheets AH-A201, AH-A202, and AH-A403, dated August 1, 2024, by MCL Architects.

Based on the Basement Floor Plan / Rose St. Entrance, Level 1 Floor Plan, and Elevator Sections, the residential building on the western portion of the site will have four (4) elevator pits throughout the building that range in size from approximately 5.0 m by 2.5 m to 10.0 m by 5.5 m in plan and extend approximately 2.0 to 3.5 m below the lowest basement finished floor elevation (assumed to be at its lowest 264 m).

Additionally, based on the "Basement Floor Plan", in the post-construction scenario 45% of the site is permeable land. The remaining 55% of the land is assumed to be impermeable and consists of a new multiple storey apartment building, a new single storey commercial building, and new parking lots.

2.2 Site Physiographic, Geologic and Hydrogeological Settings

The site is located within the physiographic region denoted as the Simcoe Uplands physiographic region and the local terrain is characterized by till plains (Chapman, L.J. and Putnam, D.F., 2007). The predominant surficial geology of the site is described as till consisting of moderately stoney to stoney silty sand to sand till (Ontario Geological Survey, 2010).

The bedrock underlying the general area corresponds to the Verulam Formation of the Simcoe Group, consisting of limestone and shale. Based on the Drift Thickness of the Barrie Area (Burwasser, G. J., and Ford, M. J., 1974) and MECP Water Well Records in the area, limestone and shale bedrock can be expected approximately 91 to 122 m below existing grade.

2.3 Review of MECP Water Well Records and Existing Water Wells

MECP water well records within 500 m of the site area were obtained from the MECP's online interactive well records map to assess the general nature of the groundwater resource in the near vicinity of the site, and historical/current uses of wells in the area. Ten (10) well records were found on-site and eighty-five (85) well records were found in the surrounding the site, the approximate MECP well locations are shown on Figure 8 and a well records summary table is included in Appendix B.

The on-site well(s) were installed for the following uses:

- Seven (7) of the records indicated monitoring, observation, and test hole use.
  - Installations took place in 2014 and 2021.
  - The wells were screened within sand and sandy till units 3.0 to 12.2 m below grade.
  - No information was provided on the depth of water encountered.
- Three (3) of the records did not indicate the well use and are assumed to be unknown.
  - Installations took place in 2020.
  - No other information was provided in the records.

The off-site well(s) were installed for the following uses:

- Nine (9) of the records indicated domestic and/or livestock use.
  - Installations took place in 1951 to 2005.
  - The wells were screened within sand units 12.8 to 38.4 m below grade.
  - Fresh water was encountered in wells 11.9 to 38.4 m below grade.
- Three (3) of the records indicated commercial use.
  - Installations took place in 1958 to 2006.
  - The wells were screened within silt and sand units 16.8 to 42.4 m below grade.
  - Fresh water was encountered in wells 28.3 to 42.4 m below grade.

    - Water of unknown quality was encountered in one well 27.7 m below grade.
- Forty-eight (48) of the records indicated monitoring and observation and test hole use.
- Twenty-five (25) of the records did not indicate the well use and are assumed to be unknown.

The stratigraphic descriptions within the MECP monitoring well records are typically inaccurate due to the methodology in which they are determined (observations of cuttings without depositional context and possibly some mixture between layers, plus no consistency between descriptions of soils between drillers). While this may be the case, an overall sense of the regional stratigraphy can be determined by looking at commonalities between most stratigraphic descriptions and where the wells were terminated in an aquifer. The well records typically indicate overburden of sand and clay layers with variable gravel. Bedrock was not noted in the records, with the deepest well extending to 42.4 m through overburden without encountering bedrock.

As the surrounding area is fully municipally serviced, it is expected that the domestic wells are not still in use.

2.4 Review of PTTW and EASR Records

Records of PTTW and EASRs were obtained within 500 m of the site area from the Access Environment and MECP's online interactive permits to take water map to assess the general nature of the groundwater resources in the near vicinity of the site, and the scale of historical/current groundwater takings required in the area. It should be noted that while these records indicate approved daily water taking volumes, it does not provide details on target depths for the water takings nor does it provide the actual volumes extracted, which could be less.

No water taking records were found on-site nor surrounding the site within the search radius.

2.5 Site Condition Standards

The MECP has developed a set of Soil, Ground water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (April 15, 2011) and O. Reg. 153/04, as amended. The standards consist of nine tables (Table 1 through Table 9) that provide criteria for maximum concentrations of various contaminants. In general, the applicable O. Reg. 153/04, as amended, SCSs depends on the site location, land use, soil texture, bedrock depth and the applicable potable or non-potable ground water condition at the investigation site.

In order to determine the Site Sensitivity, Sections 41 and 43.1 of O. Reg. 153/04, as amended, were evaluated by GEI as shown in the following table:

Criteria	Result
Current Property Use	Former Barrie Ontario Provincial Police Headquarters
Proposed Property Use	Social Housing
Potable vs. Non-Potable Ground Water	Potable
Proximity of Areas of Natural Significance	> 30 m

Proximity to a Water Body	> 30 m
Shallow Soil Condition	No
Current Land Use	Commercial
Proposed Land Use	Residential
Applicable Site Condition Standard(s) for Proposed Use	Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition (Table 2 Residential/Parkland/Institutional (RPI))

2.6 Visual Inspection of the Site

A visual site inspection was carried out on January 10, 2024, by GEI staff to assess site drainage, topography and the presence of surface water features.

The surrounding area is predominantly residential, with Ontario Highway 400 to the north, Rose Street to the south of site, and a highway on ramp to the west followed by a property with ongoing development.

At the time of the site inspection the conditions were overcast, approximately -2°C, and the topography of the site was observed to have an overall slope towards the east. A general elevation change of 5.0 m was observed from Borehole (BH) 101 (Elev. 271.6) in the western portion of site down to PML BH 27 (Elev. 266.6) in the eastern portion of site.

During the site inspection, no surface water or groundwater discharge features (seeps) were observed on or near the property. Based on the topography of the site, surface runoff is expected to drain towards the southwest near the intersection of Rose Street and the Ontario 400 Highway on-ramp, however a local topographic low was noted in the northeast corner of the site such that precipitation could reasonably be expected to pond in this area following significant rainfall events. No indications of recent ponding water were observed on site (the presence of which could suggest either groundwater at the surface or low permeability soils). Additionally, no phreatophytic vegetation (e.g. cattail and bull rushes) was observed on site, suggesting the existing flora on site does not require an environment with a shallow groundwater table.

Since the initial site visit, the site has been visited monthly in association with the on-going long-term groundwater level monitoring program, with the most recent visual site inspection being carried out in October 2024. At that time, no major change to site drainage, topography and the presence of surface water features, was noted.

3. Procedures and Methodology

It is noted that all elevations in this report are metric and expressed in metres (m). All measurements are also in metric and expressed in millimeters (mm), meters (m) or kilometers (km).

3.1 Borehole Drilling and Monitoring Well Installation

Borehole locations were laid out in the field by GEI staff prior to commencement of drilling operations. The locations of underground utilities were completed with the assistance of public and private locating companies.

Drilling for the site was carried out December 4 to 6, 2023.

- BHs 101, 103, and 105 were advanced a depth of 12.6 m below grade (Elev. 257.3 to 258.9 m). These boreholes were straight augered to 10.7 m below grade before sampling begun.
- BH 102 was advanced a depth of 14.2 m below grade (Elev. 256.8 m). This borehole was straight augered to 13.7 m below grade before sampling begun.
- BH 104 was advanced a depth of 12.2 m below grade (Elev. 259.2 m). This borehole was straight augered to 10.7 m below grade before sampling begun.

The borehole locations were laid out in the field by GEI staff prior to commencement of drilling operations. The locations of underground utilities were co-ordinated with locating companies. Borehole ground surface elevations of the boreholes and coordinates (referencing NAD 83 geodetic datum) were surveyed by GEI with a Topcon FC – 5000 GPS Survey unit. The elevations are provided on the borehole logs in Appendix C. Borehole locations are shown on Figures 2A/2B.

Drilling and sampling of the boreholes was completed using truck mounted drilling equipment operated by a specialty drilling subcontractor retained and supervised by GEI. The boreholes were advanced to predetermined depths through the use of solid stem augers and sampling was conducted using a 51 mm O.D. Split Spoon (SS) sampler. Standard Penetration Test (SPT) “N” Values (N values) were recorded for the sampled intervals as the number of blows required to drive an SS sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, in accordance with ASTM D1586. Boreholes were straight augered for 10.7 to 13.7 m below grade before soil sampling was conducted at 1.5 m intervals.

Monitoring wells were installed in all five (5) of the boreholes by GEI to facilitate long-term groundwater monitoring, each consisting of 50 mm diameter PVC pipe with a 1.5 m long screen and protective casing. Boreholes without wells were backfilled in accordance with O.Reg. 903.

As mentioned in Section 2.1.3, GEI conducted additional drilling for the Phase Two ESA was carried out between April 24 to May 9, 2024.

These new boreholes were advanced by Ontario Soil Drilling under full-time supervision of GEI staff using a truck-mount power probe to a maximum depth of 12.8 m bgs and test pits were advanced by a member of GEI staff by hand to sufficiently assess the APECs identified in the Phase One ESA.

GEI continuously monitored the drilling activities to record the physical characteristics of the soil, depth of soil sample collection and total depth of boreholes. Representative soil samples were recovered at regular intervals using a stainless-steel split spoon sampler in all boreholes.

Two (2) boreholes were instrumented with groundwater monitoring wells at the Site (BH/MW 207 and BH/MW 208). The monitoring wells were installed in general accordance with the Ontario Water Resources Act - R.R.O. 1990, Regulation 903/90 - amended to O.Reg.128/03 and were installed by a licensed well contractor.

These new monitoring wells consisted of a 3 m length, 50 mm diameter PVC screen, and an appropriate length of PVC riser pipe. All pipe connections were factory machined threaded flush couplings. The annular space around the wells was backfilled with sand to an average height of 0.3 m above the top of the screen. A bentonite seal was added from the top of the sand pack to approximately 0.3 m below ground surface.

When the monitoring wells are no longer required, they must be decommissioned in accordance with the procedure outlined in the Ontario Water Resources Act - R.R.O. 1990, Regulation 903 - amended to O.Reg.128/03. Monitoring well completion details are summarized in Table 3.

Measures taken to minimize the potential for cross contamination or the introduction of contaminants during well construction included:

a) The use of well pipe components (e.g., riser pipe and well screens) with factory machine threaded flush coupling joints;
b) Construction of wells without the use of glues or adhesives;
c) Removing the protective plastic wraps from well components at the time of borehole insertion to prevent contact with the ground and other surfaces; and,
d) Cleaning of augers between sampling locations.

Monitoring well construction of the current usable wells is shown on the borehole logs in Appendix C and summarized below.

Borehole / Monitoring Well	Well Screen Depth / Elevation (m) / Elev.	Unit Screened
By GEI		
BH/MW 101	10.7 to 12.2 / 259.3 to 260.8	Silt and Sand Glacial Till
BH/MW 102	11.0 to 12.5 / 258.4 to 259.9	Silt and Sand Glacial Till
BH/MW 103	10.7 to 12.2 / 257.8 to 259.3	Silt and Sand Glacial Till
BH/MW 104	10.7 to 12.2 / 259.2 to 260.7	Silt and Sand Glacial Till
BH/MW 105	10.7 to 12.2 / 258.0 to 259.5	Silt and Sand Glacial Till
BH/MW 207	7.6 to 10.6 / 260.0 to 263.1	Silty Sand Glacial Till
BH/MW 208	9.1 to 12.2 / 258.2 to 261.3	Silty Sand Glacial Till

Boreholes without wells were backfilled in accordance with O.Reg.903.

The GEI field staff examined, and classified characteristics of the soils encountered in the boreholes, including the presence of fill materials, groundwater observations during and upon completion of the drilling, recorded observations of borehole advancement, and processed the recovered samples. All recovered soil samples were logged in the field, carefully packaged, and transported to the laboratory for more detailed examination and classification.

In the laboratory, the samples were classified as to their visual and textural characteristics. All samples were submitted for moisture content determination. Three (3) samples of the underlying strata were submitted for grain size analysis. Grain size analysis results are provided in Appendix D.

3.2 Hydraulic Conductivity Testing

Rising head hydraulic conductivity tests were completed to estimate the horizontal hydraulic conductivity (K) of the soils at the well screen depths. These tests were completed in four (4) monitoring wells on site from January 2 to 10, 2024.

In a rising head test, water is manually purged rapidly from the monitoring well using LDPE tubing and a foot valve to create a near-instantaneous displacement of water within the well. The water level is then measured as it returns to an equilibrium.

The static water level was measured prior to the start of testing, and the initial change in water level was monitored both manually and by using an electronic level logger. The level loggers were left in the monitoring wells to measure recovery of the groundwater to equilibrium, with regular manual measurements recorded for corroboration and correction of the level logger data. The semi-log plots for drawdown versus time for the tests are provided in Appendix E.

3.3 Groundwater Sampling

To establish baseline conditions and assess the most suitable discharge options for pumped groundwater during potential dewatering activities, the following groundwater samples were collected from BH/MWs 102 and 105 on January 3, 2024:

- Two (2) unfiltered groundwater samples were collected and analyzed against the City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria, O.Reg.153/04 PHCs and VOCs, and PWQO for metals and TSS;
- Two (2) filtered groundwater samples were collected and analyzed against PWQO for metals and TSS only.

Analysis for the City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria is intended to evaluate the Site for potential discharge to either of these sewers and the results could be used to support a discharge permit application, if submitted within the allowable timeframe of one (1) year.

The purpose of sampling for PWQO metals and O.Reg.153/04 PHCs and VOCs are the evaluation of the groundwater to discharge to the natural environment. The PWQO guidelines do not include limits for PHCs or VOCs (petroleum hydrocarbons or volatile organic compounds) and of the published O.Reg.153/04 Site Condition Standards, Table 1 is the most stringent set of standards and this is the standard to which this analysis has been compared.

Prior to collection of the samples, a minimum of three (3) standing well volumes of groundwater were purged from each well. The samples were collected and placed into sterile laboratory-supplied vials and/or bottles already pre-charged with analytical test group specific preservatives, as required. New single-use nitrile gloves were used during sample handling. The field-filtered samples were processed through a sterile 45 µm filter prior to collection in the required vials/bottles.

The samples were submitted to CALA-accredited Caduceon for analysis. The results of the groundwater chemistry are presented in the laboratory Certificates of Analysis provided in Appendix F.

3.4 In-Situ Infiltration Testing

Measurement of the field-saturated hydraulic conductivity (Kfs) was carried out using a Guelph Permeameter apparatus (Model 2800K1) on May 6, 2024, at five (5) test pit locations. Test pits were completed in the vicinity of the three (3) originally proposed LIDs areas. It is noted that the current plan is understood to only incorporate one (1) LID (LID #1)

The infiltration testing conducted by GEI conformed to the methodology laid out in the NVCA Stormwater Technical Guide, dated December 2013.

The testing locations were determined using the "Site Servicing Plan", County of Simcoe Affordable Housing Department – 20 Rose Street, City of Barrie" by Pearson Engineering (October 2023). The proposed depth of the base of the LIDs are understood to range between the elevations of Elev. 268.6 to 263.7 m.

The method used on Site is summarized below:

- A Guelph Permeameter was used to determine the saturated hydraulic conductivity in the vertical direction. One infiltration test was completed in each test pit within the native soil on site.
- The testing did not occur during a precipitation event nor within 24 hours of a significant rainfall event, and the temperature was above freezing.
- The saturated hydraulic conductivity was converted to infiltration rate using the approximate relationships provided within Table 7.1 of the NVCA methodology document and by applying the appropriate factor of safety based on Table 7.2 of this same document.

Based on the information included in the plan provided to GEI, it was assumed that the base of the LIDs will be situated 1 to 6 m below the current grade. As grading has not yet occurred on site, test pits were excavated past the surficial fill materials and into the native soils 0.7 to 4.9 m below the current grade. Test pit soils were stratigraphically logged, infiltration tests were performed using the Guelph Permeameter at the bases of these pits, and a soil sample was collected from each for confirmatory grain size analysis.

4. Subsurface Conditions

4.1 Borehole Stratigraphy

The detailed soil profiles encountered in the boreholes are indicated on the attached borehole logs in Appendix C, and the geotechnical laboratory results are included in Appendix D. The borehole locations are shown on Figures 2A/2B and the subsurface profiles interpreted from those logs is included as Figures 9 and 10.

It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the locations. Additionally, the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. These boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided in the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, laboratory testing, measurements prior to and after drilling, and the drilling process itself (speed of drilling, shaking/grinding of the augers, etc.). The passage of time also may result in changes in conditions interpreted to exist at locations where sampling was conducted.

Previously, PML conducted a phase two environmental assessment and a geotechnical investigation in 2021. The programs indicated that the stratigraphy at the Project Area is comprised of topsoil and/or pavement followed by silty sand to sandy silt fill underlain by native silty sand glacial till to a maximum depth of 12.8 m bgs. Fill material was identified in all boreholes to a maximum depth of 2.9 m bgs. Bedrock was not encountered at the Project Area. Details from this investigation are included with the more recent subsurface investigation as described below.

4.1.1 Topsoil

A surficial topsoil layer was identified by PML at the 2021 ground surface in eleven (11) boreholes (BHs 1 to 3, 6 to 8, 16, 20, 26 to 29) ranging in thickness from 150 to 250 mm. Topsoil thickness may vary between boreholes and in other areas of the site.

4.1.2 Pavement

Thirteen (13) boreholes (BHs 4, 5, 9, 10, 12 to 15, 17, 18, 21, 25, 30) were drilled in paved areas in 2021 and the parking structure thicknesses from the previous investigation by PML are provided below.

Borehole	Asphalt (mm)	Granular Base (mm)	Granular Subbase (mm)	Total Thickness (mm)
4	50	140	210	400
5	50	100	200	350
9	80	150	300	530
10	40	120	140	300
12	100	120	180	400
13	40	100	110	250
14	110	200	150	460
15	30	100	140	270
17	100	150	210	460
18	100	120	200	420
21	110	120	230	450
25	130	150	200	480
30	90	180	150	420

4.1.3 Fill

The 2021 PML investigation reported that a fill layer was encountered beneath the topsoil or pavement in twenty-six (26) boreholes (BHs 1 to 10, 12 to 18, 20, 21, and 24 to 30) and was penetrated at 0.7 to 2.9 m depth (Elev. 265.2 to 270.9). The fill was reported to consist of silty sand to sandy silt, was moist to wet with depth (moisture contents ranging from 7 to 21%), and the fill had N values ranging from 2 to 26 blows indicating very loose to compact conditions.

4.1.4 Sand / Silty Sand

During the 2021 PML investigation, the follow conditions were described:

"Below the fill in Borehole 5, a sand unit was noted to 4.0 m depth (elevation 267.6) and below the fill in Borehole 9 a silty sand layer was observed to 2.9 m depth (elevation 267.3). The sand was very dense (N Value of 52) and the silty sand was compact (N Value of 25). Both materials were moist with moisture contents of 6 to 8 %."

PML submitted seven (7) samples of this material for grain size analysis and the results are provided in Appendix D.

4.1.5 Silty Sand to Silt and Sand Glacial Till

During the 2021 PML investigation, the follow conditions were described:

"Below the fill or local sand/silty sand a major silty sand till deposit was revealed to the 4.3 to 12.8 m depth of exploration. The matrix comprises silty sand with trace gravel and clay. Cobbles and boulders were noted during auguring (sic). Eight representative samples were submitted for gradation and the results are presented on Figure 1, appended. The material had N Values typically greater than 20 to greater than 50 (compact to very dense), locally 7, 10 or 15 at the top of the unit. The deposit was typically moist with moisture contents 10% or less, locally wet at depth."

PML submitted one (1) sample of this material for grain size analysis and the results are provided in Appendix D.

During the 2023/2024 GEI subsurface investigation sand and silt glacial with trace gravel and trace clay was observed in BHs 101 to 105 from 10.7 and 13.7 m depth to the 12.2 to 14.2 m depth of exploration (Elev.256.8 to 259.2 m). Three (3) samples of the material was submitted for grain size analysis by GEI and the results are provided in Appendix D. Moisture contents were 9 to 12% and the soil was moist to wet. N values in the unit ranged from 31 to 65 and the soil was dense to very dense.

4.2 Test Pit Stratigraphy

Five (5) test pits were excavated to visually confirm the subsurface conditions at the site and to facilitate the in-situ infiltration testing. Descriptions of the conditions encountered are provided below.

Test Pit	GP1	GP2	GP3	GP4	GP5
Location (UTM – 17T)	603865E 4917249N	603869E 4917238N	603949E 4917256N	603950E 4917267N	603967E 4917273N
	Proposed LID 1 (Prop. Stormcon GreenStorm Rooftop Infiltration Chambers Volume 42 m^3)		Formerly Proposed LID 2 (Prop. Stormcon GreenStorm Chambers Quantity Control Volume 209 m^3)		Formerly Proposed LID 3 (Prop. Stormcon GreenStorm Rooftop Infiltration Chambers 52 m^3)
Existing Ground Surface Elevation	271.2 m	271.1 m	267.5 m	267.4 m	266.5 m
Proposed Bottom of LID Chamber Elevation	268.6 m		263.8 m		263.7 m
Depth below Existing Surface	2.6 m	2.5 m	3.7 m	3.6 m	2.8 m
Soil Encountered	0.0 to 2.0 m: Fill, sand, trace gravel 2.0 to 3.3 m: Fill, silty sand, trace gravel, occasional brick and industrial debris 3.3 to 3.8 m: Silty Sand Glacial Till, trace gravel	0.0 to 4.6 m: Fill, sand, trace gravel 4.6 to 5.0 m: Silty Sand Glacial Till, trace gravel	0.0 to 0.4 m: Topsoil 0.4 to 0.7 m: Silty Sand, trace gravel 0.7 to 1.0 m: Silty Sand Glacial Till (Wet soils encountered near the base of test pit)	0.0 to 0.4 m: Topsoil 0.4 to 0.7 m: Silty Sand, trace gravel, trace organics 0.7 to 1.1 m: Silty Sand Glacial Till, trace gravel (Wet soils encountered near the base of test pit)	0.0 to 0.2 m: Topsoil 0.2 to 0.6 m: Silty Sand, trace organics 0.6 to 1.0 m: Silty Sand Glacial Till, trace gravel (Wet soils encountered near the base of test pit)
Maximum Depth of Test Pit m bgs / Elev. (m)	3.8 m / 267.4 m	5.0 m / 266.1 m	1.0 m / 266.5 m	1.1 m / 266.3 m	1.0 / 265.5 m

4.3 Groundwater Conditions

Unstabilized groundwater level measurements and cave-in measurements were taken upon the completion of drilling of each borehole, as shown on the borehole logs in Appendix C. These measurements were taken to provide a rough estimate of the possible excavation and temporary groundwater control constructability considerations that may arise. Additional groundwater level measurements taken during the remainder of the field investigation are considered more representative of static groundwater conditions as the wells had been developed and had time to recover and stabilize following initial construction.

The current manual groundwater observations are noted on the borehole logs in Appendix C, and a table with all measurements is provided in Appendix L.

To date the manual stabilized groundwater level measurements within the monitoring wells have been observed January to October of 2024 at depths of 1.8 m to 11.4 m below current grade (dry wells), corresponding to below Elev. below 259.2 to Elev. 266.2. The shallowest groundwater level was measured at Monitoring Well 27, at 1.8 m below current grade and the highest groundwater elevation was measured at MW 26 at Elev. 266.2 m, on April 25, 2024.

Typically the highest groundwater levels are recorded during the spring months and based on these groundwater levels measured by GEI to date, the spring month with the general highest groundwater elevations on site was May 2024. However it is noted several wells were recorded having higher groundwater levels measured in August 2024, though none exceeded the highest groundwater elevation was measured on site in the spring (MW 26 at Elev. 266.2 m). The local groundwater flow appears to be directed south towards Lake Simcoe. The maximum groundwater elevations recorded at each well are depicted with the general trend of groundwater flow in the May 2024 groundwater table in Figure 11.

Upon review of historical precipitation data, approximately 115.1 mm of precipitation was recorded in July 2024, prior to the high summer groundwater levels measured in August 2024 (data sourced from Environment Canada station "Barrie Landfill"), which is a variance of less than 50% more than the long-term average precipitation for July of 77.2 mm (average precipitation from Environment Canada station "Barrie WPCC" between 1981 and 2010).

As such, these groundwater levels measured in 2024 are considered to reflect typical seasonal groundwater fluctuations and the highest levels recorded between January to October 2024 are thus considered the most conservative for use in the dewatering calculations and LID design. A high groundwater level surface is provided in Figure 12 to illustrate the highest groundwater level measured between January to October 2024 at each monitoring well location. It is noted that it does not reflect the groundwater table at any one point in time thus assumption on the direction of groundwater flow are considered to be generally to the southeast.

Groundwater levels, especially near the surface, are expected to show seasonal fluctuations and vary in response to prevailing climate conditions. It is anticipated that the regional groundwater flow will generally be southeast towards Lake Simcoe.

Long term groundwater levels monitoring is ongoing at the site. This long-term monitoring, upon completion, will provide input on the seasonal high groundwater table for any building underground levels and the base of infiltration-based LID development measures to be situated/designed appropriately. GEI has been retained to attend the site and conduct manual readings in all eight (8) wells during monthly visits for a year. A letter report under a separate cover will be provided to summarize the groundwater level measurements at the end of the monitoring period.

It is noted that there have been historical groundwater levels in 2021 that higher than what was obtained in the 2024 set of readings. Given the substantial variation in groundwater levels observed between the 2021 data and our current 2024 measurements, it is advisable to rely exclusively on GEI's recent data to ensure accuracy in analysis and decision-making. GEI cannot verify the methodology or accuracy of the 2021 measurements, as we were not involved in that phase of the monitoring, which introduces uncertainty about the reliability of their data.

4.4 Hydraulic Conductivity

In-situ hydraulic conductivity tests were conducted in the four (4) monitoring wells containing water on January 2 and 10, 2024. The data from these tests was inputted into AQTESOLV Pro V4.50.002 (HydroSOLVE, Inc.) and by applying:

a) Hvorslev's solution (1979) where the well screen was fully saturated; or

b) Dagan's solution (1978) where the well was screened across the water table.

Hydraulic conductivity values were calculated from each test. The semi-log plots for the results are provided in Appendix E and are summarized in the table below. It should be noted that the hydraulic conductivity values obtained from the manual level measurements were very similar to the results obtained from the test where the logger data was analyzed.

Borehole / Monitoring Well	Well Screen Location Depth (m) / Elev.	Unit Screened	In-Situ Hydraulic Conductivity (K) (m/s)
BH/MW 101	10.7 to 12.2 / 259.3 to 260.8	Silt and Sand Glacial Till	1.3×10^{-6} m/s
BH/MW 102	11.0 to 12.5 / 258.4 to 259.9	Silt and Sand Glacial Till	1.0×10^{-6} m/s
BH/MW 103	10.7 to 12.2 / 257.8 to 259.3	Silt and Sand Glacial Till	4.9×10^{-6} m/s
BH/MW 105	10.7 to 12.2 / 258.0 to 259.5	Silt and Sand Glacial Till	3.2×10^{-6} m/s

According to Freeze and Cherry (1979), the typical range in hydraulic conductivity are as follows:

- Sand: 10^{-2} m/s to 10^{-6} m/s
- Silty Sand: 10^{-3} m/s to 10^{-7} m/s

- Silt: 10^{-5} m/s to 10^{-9} m/s
- Glacial Till: 10^{-6} m/s to 10^{-12} m/s

From the hydraulic conductivity test results for the well screened across the silt and sand glacial till encountered on site, the result (10^{-6} m/s) fell within the range of the expected values for glacial till (10^{-6} m/s to 10^{-12} m/s), at the greater end of that range.

As such, the highest value, 4.9 x 10^{-6} m/s, is considered an appropriately conservative hydraulic conductivity value to apply for the dewatering calculations across the site.

4.5 Hydrostratigraphy

Based on the stratigraphy identified on site, the stabilized groundwater and hydraulic conductivity observed in the wells, the predominant water-bearing units that are expected to generate groundwater inflow during dewatering are the compact to very dense cohesionless glacial tills consisting of silty sand to sand and silt, generally encountered below the fill and/or sand/silty sand and extending to the maximum 14.2 m depth of exploration (Elev. 256.8 m) in all boreholes.

Some perched water is to be expected in the fill encountered below the pavement structure and/or topsoil, extending to 0.7 to 2.9 m depth (Elev. 265.2 to 270.9).

The compact to very dense unit of soil consisting of sand/silty sand generally encountered below the fill and extending to 2.9 to 4.0 m depth (Elev. 267.3 to 267.6) in BHs 5 and 9 is not expected to be a significant source of groundwater inflow based on observations made during the field investigation.

4.6 Groundwater Chemistry

To assess the suitability for discharge of pumped groundwater to the land surface or to either of two sewer options during dewatering activities, four (4) groundwater samples total, two (2) unfiltered and two (2) filtered, were collected from BH/MWs 102 and 105 on January 3, 2024. It is noted that PML BH/MW 18 was destroyed in 2021 an as such could not be retested for benzo[a]pyrene during this investigation.

For assessment purposes, the analytical results were compared to the City of Barrie Storm and/or Sanitary Sewer Use By Law Criteria, PWQO, and O.Reg.153/04 Table 1, as amended.

The results of the groundwater chemistry are presented in the laboratory Certificates of Analysis provided in Appendix F. A summary of the results is presented in the table below for samples relative to the Halton Region Sewer Use By Law Criteria, PWQO, and O.Reg.153/04, as amended.

Sample Location	Exceedances				
	Barrie Storm Sewer Use By Law Criteria	**Barrie Sanitary Sewer Use By Law Criteria**	**PWQO**	**Interim PWQO**	**O.Reg. 153/04 Table 1 SCS**
BH/MW 102 (Unfiltered)	BOD5, TSS, Zinc, Cadmium, Chromium, Copper, Lead, Nickel	TSS, Phosphorus, Sulphide, COD, Aluminum, Barium, Iron, Manganese, Zinc	Iron, Zinc, Arsenic, Beryllium, Cadmium, Lead, Nickel, Silver, Thallium	Phosphorus, Boron, Zinc, Zirconium, Arsenic, Cadmium, Cobalt, Copper, Lead, Thallium, Uranium, Vanadium	Chloroform
BH/MW 102F (Filtered)	TSS No other exceedances for parameters tested	TSS No other exceedances for parameters tested	No exceedances for parameters tested	No exceedances for parameters tested	Parameters not analyzed
BH/MW 105 (Unfiltered)	TSS, Zinc, Chromium, Copper, Lead, Nickel	Phosphorus, Sulphide, COD, Aluminum, Iron, Manganese	Iron, Zinc, Arsenic, Cadmium, Lead, Nickel, Silver, Thallium	Phosphorous, Zinc, Zirconium, Arsenic, Cadmium, Cobalt, Copper, Lead, Thallium, Vanadium	No exceedances for parameters tested
BH/MW 105F (Filtered)	No exceedances for parameters tested	No exceedances for parameters tested	No exceedances for parameters tested	No exceedances for parameters tested	Parameters not analyzed

The groundwater samples collected from BH/MWs 102 and 105 generally met the City of Barrie Storm Sewer Use By Law Criteria, except for BOD5, TSS, zinc, cadmium, chromium, copper, lead, and nickel.

The unfiltered groundwater samples from BH/MWs 102 and 105 complied with the City of Barrie Sanitary Sewer Use By Law Criteria, except for TSS, phosphorus, sulphide, COD, aluminum, barium, iron, manganese, and zinc.

Meeting the PWQO and Interim PWQO standards, the unfiltered groundwater samples from BH/MWs 102 and 105 exhibited exceedances of PWQO iron, zinc, arsenic, beryllium, cadmium, lead, nickel, silver, and thallium, and Interim PWQO phosphorus, boron, zinc, zirconium, arsenic, cadmium, cobalt, copper, lead, thallium, uranium, and vanadium.

Adhering to O.Reg.153/04 Table 1 SCS for RPI/ICC property use, the unfiltered groundwater samples from BH/MWs 102 and 105 met the criteria, with the exception of chloroform (5 µg/L found in BH/MW102 vs. Table 1 RPI/ICC SCS of 5 µg/L). It is noted that the unfiltered groundwater samples from BH/MWs 102 and 105 met the criteria of O.Reg.153/04 Table 2 SCS for RPI property use (the applicable standard for the site at 30 µg/L).

Through field-filtering, TSS concentrations in the groundwater samples were reduced from 67,600 mg/L to 60,200 mg/L and 19 mg/L to 6 mg/L for BH/MWs 102 and 105, respectively. It's important to note that while field-filtered samples met the PWQO, Interim PWQO, Barrie Storm and Sanitary Sewer Use By Law Criteria for the metal parameters tested, the field-filtered TSS concentration in BH/MW 102 (60,200 mg/L) remained above the Barrie Storm and Sanitary Sewer Use By Law Criteria (15 and 350 mg/L, respectively).

If pumped groundwater will be discharged to the City of Barrie Storm and/or Sanitary Sewer or the surface it must be suitably treated to remove the parameter exceedances prior to discharge (treatment methods to be determined by the dewatering contractor or civil engineer).

It is expected that during construction dewatering, the pumped water is to be first discharged to a sedimentation tank and/or a silt/sediment bag, at a minimum, before being discharged to surface.

4.7 Preliminary Infiltration Rates

Determination of percolation rates are based on the "*Ministry of Municipal Affairs and Housing (MMAH) Supplementary Guidelines SB-6, Percolation Time and Soil Descriptions, September 14, 2012*". The boreholes and grain size analyses (Appendices C and D) indicate that the site is underlain by sand and silty sand (S.M.) below the topsoil, pavement, and/or fill. The geotechnical report provides eight (8) grain sizes of the on-site soils, all of which are very consistent. Based on the grain sizes alone, the saturated hydraulic conductivity of the soil is estimated to be approximately 2 x 10^{-5} cm/s (2 x 10^{-7} m/s). This correlates to an unfactored infiltration rate of 30 mm/hr. Using a factor of safety of 2.5, gives a design factored infiltration rate of 12 mm/hr. This value is preliminary and can be used to facilitate initial assessment of the type, size and location of infiltration features that may be incorporate on this site.

The infiltration rate is not applicable below the groundwater table, and infiltration into earth fill or weathered / disturbed soil is not recommended. Appendix C of *"Low Impact Development Stormwater Management and Planning Design Guide"* (Version 1.0, 2010, by CVC and TRCA) suggests safety factors to be applied to infiltration rates. The safety factor applicable to the site is expected to be 2.5 but must be confirmed once the final location and elevation of LID measures are known.

4.8 In-Situ Infiltration Rates

From the results collected during each test, the field-saturated hydraulic conductivity of the soil was calculated using the one-head method from Soilmoisture Equipment Corp, December, 2012) as follows:

$$K_{fs} = \frac{C_1 Q_1}{2H_1^2 + \pi a^2 C_1 + 2\pi \frac{H_1}{a^*}}$$

Where:
- C_1 = shape factor
- Q = flow rate (cm^3/s)
- H_1 = water column height (cm)
- a = well radius (cm)
- α* = alpha factor (0.01 to 0.36 cm^{-1})

In accordance with the NVCA guidelines, the infiltration rate was determined as per the relationship with the field-saturated hydraulic conductivity provided within the document, *"Ministry of Municipal Affairs and Housing (MMAH) Supplementary Guidelines SB-6, Percolation Time and Soil Descriptions, September 14, 2012",* which is summarized below.

Hydraulic Conductivity, K_{fs} (cm/s)	Percolation Time, T (min/cm)	Infiltration Rate, I (mm/hr)
0.1	2	300
0.01	4	150
0.001	8	75
0.0001	12	50
0.00001	20	30
0.000001	50	12

Infiltration rate is the inverse of percolation time. As provided in Figure C1 of the CVC/TRCA's *"Low Impact Development Stormwater Management Manual*", which the NVCA guideline references, the approximate relationship in which the infiltration rate can be directly calculated from saturated hydraulic conductivity is as follows:

$$K_{fs} = 6 * 10^{-11}(I)^{3.7363}$$

A factor of safety is then applied to the calculated infiltration rate to account for soil variability, gradual accumulation of fine soil sediments during the lifespan of the facility, and compaction during construction. A higher factor of safety should be applied if a soil with a lower infiltration rate is encountered within 1.5 m of the base of the infiltration feature. Based on GEI's subsurface investigation, the silty sand glacial till soils on site generally encountered below the fill and/or sand/silty sand extended to the maximum 14.2 m depth of exploration (Elev. 256.8 m) across the site.

The results of the infiltration tests and the associated grain size analysis are included in Appendix K and are summarized below.

Test Pit	Location	Infiltration Test Depth / Elevation (m)	Tested Soil Type	Field-Saturated Hydraulic Conductivity (cm/s)	Unfactored Infiltration Rate (mm/hr)	Factor of Safety	Factored Infiltration Rate for Design (mm/hr)
GP1	Proposed LID 1 (Prop. Stormcon GreenStorm Rooftop Infiltration Chambers Volume 42 m^3)	3.4 / 267.8	Silty Sand Glacial Till, trace gravel	1.2 x 10^{-5}	26	2.5	10
GP2		4.9 / 266.2	Silty Sand Glacial Till, trace gravel	7.0 x 10^{-5}	42	2.5	17
GP3	Formerly Proposed LID 2 (Prop. Stormcon GreenStorm Chambers Quantity Control Volume 209 m^3)	0.7 / 266.8	Silty Sand Glacial Till	1.2 x 10^{-5}	26	2.5	10
GP4		0.8 / 266.6	Silty Sand Glacial Till, trace gravel	2.0 x 10^{-5}	30	2.5	12
GP5	Formerly Proposed LID 3 (Prop. Stormcon GreenStorm Rooftop Infiltration Chambers 52 m^3)	0.7 / 265.8	Silty Sand Glacial Till, trace gravel	7.8 x 10^{-6}	23	2.5	9

Based on the field-saturated hydraulic conductivity results obtained from the Guelph Permeameter tests, conducted within the native silty sand glacial till encountered on-site, the results (ranging from 10^{-6} to 10^{-5} cm/s) generally aligned with the expected values for the glacial till (2 x 10^{-5} cm/s), consistent with the grain sizes. However, one infiltration test (GP5) yielded a conductivity value one order of magnitude slower. Therefore, the most conservative field-saturated hydraulic conductivity value, 7.8 x 10^{-6} cm/s, is deemed suitable for infiltration design across the site.

The recommended factor of safety is 2.5 as the boreholes show that the glacial till extends an additional 1.5 m below the infiltration feature base elevation and is expected to demonstrate a similar infiltration rate.

It is not recommended to design LIDs to infiltrate into the surficial topsoil layer due to variable soil consistency and the possibility for lower-permeability of the topsoil. Infiltration cannot occur below the groundwater table. It is typical for the base of infiltration features to be kept at least 1 m above the seasonally high groundwater level.

The factored infiltration rate of the native glacial till across the site is 9 to 17 mm/hr, based on the testing above. As these values incorporate a factor of safety of 2.5, the design factor infiltration rate of 12 mm/hr, as discussed in Section 4.7, is still considered appropriate for use across the site.

Any earth fill imported to the site to raise grades beneath LID features must achieve a factored infiltration rate above the design rate for the native soils after placement and compaction. It is recommended to source the soils from site for placement beneath the LID measures and target a factored infiltration rate of 12 mm/hr after placement to account for variability in soil conditions. Otherwise, soils local to the area could be imported or free draining granular material could be used. The in-situ infiltration rate could be verified by additional Guelph Permeameter testing after the earth fill is placed and compacted.

5. Site Dewatering

5.1 Preliminary Construction Dewatering

This section of the report presents hydrogeological assumptions, assessments and recommendations regarding the installation of the watermain.

The recommendations are based on our understanding of the project and the results of the field investigation. The interpretation and recommendations are intended for the use of the design consultant and Owner and shall not be relied upon by any other parties including the construction contractor or used for any purposes other than development of the project design.

Comments on construction methodology and equipment, where presented, are provided only to highlight those aspects that could affect the design of the project. Contractors must make their own assessment of the factual information presented in previous sections of the report, and the implications on equipment selection, construction methodology, and scheduling.

It should be noted that these calculations have been prepared using the drawings provided to GEI. Should the design change, updated drawings will need to be provided and GEI will need to update the calculations to confirm that any recommendations presented here remain valid.

5.1.1 Construction Description and Dewatering Assumptions

The dewatering assessment described in the following sections has assumed open cut excavations or permeable shoring for underground parking on site and the potential extension of municipal servicing across the site. It is GEI's understanding that the proposed work will include construction of a single level of underground parking beneath the residential multi-storey building, two levels of underground parking beneath a commercial building, elevators with pits in both buildings, and potential municipal servicing extensions. It is noted that if an impermeable shoring system is implemented (secant caisson wall or sheet piles), the volume of construction dewatering may be reduced.

Assumed excavation dimensions were estimated from the following drawings:

- Site Grading Plan by Pearson Engineering (October 2023).
- Parking Structure Floor Plans and Sections by MCL Architects (August 1, 2024).
- Basement Floor Plan / Rose St. Entrance, Level 1 Floor Plan, and Elevator Sections by MCL Architects (August, 2024).
- Site Servicing Plan by Pearson Engineering (October 2023).

Site details were inferred from the subsurface conditions discussed in Section 4 of this report, including the groundwater conditions discussed in Section 4.3 and illustrated in the high groundwater level surface is provided in Figure 12 to illustrate the highest groundwater levels

measured between January to October 2024. It has been assumed that below the topsoil/pavement structure and fill, excavations are anticipated to encounter the silty sand to sand and silt glacial till to depth.

GEI understands that the residential apartment building will have a single basement level extending up to 4 m below the proposed grade, with an option for portion reaching a sub-basement level up to 8 m below the proposed grade. The three-storey mixed commercial and parking structure will include two levels of underground parking, extending up to 6.5 m below the proposed grade. The lowest basement finished floor elevation for both buildings is approximately Elev. 264 m.

Based on discussions with the Client and GEI's understanding of the proposed work, the excavation, dewatering, and site condition assumptions are summarized below and explanations are provided in the tables below:

Dewatering Zone	Notes	Excavation Dimensions		Assumed Parameters	
		Length (m)	Width (m)	Low Proposed Excavation (m asl)	High Groundwater Level[3] (m asl)
1 – Commercial / Garage Structure	2 Levels Underground	65.0	40.0	263.5[1]	266.0
2 - Commercial / Garage Elevator Pit	Elevator 7/8	6.5	6.0	260.5 (3.5 m below finished basement floor)	265.2
3 – Apartment Building	Conservatively assumes sub-basement level extends across 50% of the footprint	81.0	40.5	263.5[1]	265.4
4 - Apartment Elevator Pits	Elevators 1/2, 3/4, 5 Lula Lift, and Material Lift	5.0 to 10.0	2.5 to 5.5	260.0 to 262.0 (2.0 to 3.5 m below finished basement floor)	265.4 to 265.6
5 – Site Servicing	Assumed in 100 m lengths	100.0	5.0	262.5[2]	266.0

1. Assumed lowest excavation extending 0.5 m below the lowest basement finished floor elevation.
2. Excavation 0.5 m below STM MH 101 (NE Inv. 263 m), as per "Site Servicing Plan" by Pearson Engineering (Oct 2023)
3. Based on the High Groundwater Contours (between January and October 2024)

Dewatering Zone	Notes	Assumed		
		Target Water Level[1] (m asl)	Aquifer Bottom[2] (m bgs)	Hydraulic Conductivity[3] (m/s)
1 – Commercial / Garage Structure	2 Levels Underground	262.5	260.5	4.9×10^{-6}
2 - Commercial / Garage Elevator Pit	Elevator 7/8	259.5	257.5	4.9×10^{-6}
3 – Apartment Building	Conservatively assumes sub-basement level extends across 50% of the footprint	262.5	260.5	4.9×10^{-6}
4 - Apartment Elevator Pits	Elevators 1/2, 3/4, 5 Lula Lift, and Material Lift	259.5 to 261.0	257.5	4.9×10^{-6}
5 – Site Servicing	Assumed in 100 m lengths	261.5	259.5	4.9×10^{-6}

1. *1.0 m below the lowest proposed excavation (1.5 m below the lowest basement finished floor elevation (Elev. 264 m) to account for concrete slab and drainage layer thickness, local spread footing excavations and lowering of groundwater slightly below base of excavation).*
2. *Assumed 3.0 m below the lowest proposed local excavation.*
3. *Maximum hydraulic conductivity measured on site by GEI at BH/MW 103.*

5.1.2 Radius of Influence

The Radius of Influence (ROI) for the construction dewatering is based on the empirical Sichardt Equation. This equation is used to predict the distance at which the drawdown resulting from pumping becomes negligible. This equation is simplistic and is based on steady state conditions, as well as homogeneous hydrogeological conditions (i.e. uniform infinite aquifer). As such, steady state dewatering may not be achieved during the relatively short-term construction dewatering work, plus homogeneous hydrogeological conditions are not typically encountered outside of a laboratory, so the ROI presented here may be an overestimation of the actual ROI encountered. The Sichardt equation is described as follows and the results are summarized in the table below (and presented in Appendix G:

$$R_0 = 3000\ (\mathrm{H} - \mathrm{h})\sqrt{\mathrm{K}}$$

Where:

K = Hydraulic conductivity (m/s)
H = Static Saturated Head (m)
h = Dynamic Saturated Head (m)
R_0 = Radius of influence (m)

Based on the Sichardt equation, the hydraulic conductivity of 4.9×10^{-6} m/s and the total groundwater drawdown required at this site, the ROIs can be assumed to be 19.6 to 40.8 m from the centre of the excavations for radial flow. Calculation details are provided in Appendix G, and zone-specific ROIs are summarized below:

Dewatering Zone	Notes	Hydraulic Conductivity (m/s)	Static Groundwater Level (m)	Dewatered Groundwater Level (m)	Calculated ROI (m)
		K	H	h	R_0
1 – Commercial / Garage Structure	2 Levels Underground	4.9×10^{-6}	5.6	2.0	23.6
2 - Commercial / Garage Elevator Pit	Elevator 7/8	4.9×10^{-6}	7.8	2.0	38.2
3 – Apartment Building	Conservatively assumes sub-basement level extends across 50% of the footprint	4.9×10^{-6}	4.9	2.0	19.6
4 - Apartment Elevator Pits	Elevators 1/2, 3/4, 5 Lula Lift, and Material Lift	4.9×10^{-6}	7.9 to 8.2	2.0 to 3.5	29.6 to 40.8
5 – Site Servicing	Assumed in 100 m lengths	4.9×10^{-6}	6.5	2.0	29.8

The ROI calculation is a conservative methodology and is calculated based on the assumption of active (steady state) pumping during the construction dewatering. It should be noted that a higher volume of water will be pumped during the first stage of the construction period or when a rain event occurs. It is uncertain whether dewatering efforts would reach steady state prior to the completion of construction of each dewatered segment.

5.1.3 Temporary Dewatering Flow Rates

The Dupuit-Forcheimer method for radial flow from an unconfined aquifer for a fully penetrating excavation was used to obtain a flow rate estimate for the proposed underground parking structures and elevator pits, and is expressed as follows:

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

Where:

Q = Rate of pumping (m³/s)

L = Length of excavation (m)

K = Hydraulic conductivity (m/s)

H = Head beyond the influence of pumping (static groundwater elevation) (m)

h = Head above base of aquifer at the excavation (m)

R_0 = Radius of Influence (m)

r_s = Equivalent well radius (m)

The Dupuit-Forcheimer equation and equivalent well radius method was used to calculate steady-state flow to a linear excavation (servicing) from both sides of a trench and at both ends of the trench through an unconfined aquifer resting on a horizontal impervious surface. This equation which was used to obtain a flow rate estimate while dewatering is expressed as follows for an unconfined aquifer:

$$Q = \left(\frac{\pi K(H^2 - h^2)}{\ln {}^{R_O}/_{r_s}}\right) + 2\left(\frac{xK(H^2 - h^2)}{2R_O}\right)$$

Where: Q = Rate of pumping (m^3/s)
x = Length of excavation (m)
K = Hydraulic conductivity (m/s)
H = Head beyond the influence of pumping (static groundwater elevation) (m)
h = Head above base of aquifer at the excavation (m)
R_o = Radius or zone of influence (m)
r_s = Equivalent well radius (m)

It is expected that the initial dewatering rates will be higher in order to remove groundwater from within the overburden formation. The dewatering rates are expected to decrease once the target water levels are achieved in the excavation footprints as groundwater will have been removed locally from storage resulting in lower seepage rates into the excavations.

Please note that the anticipated dewatering rate may increase if larger excavations are undertaken beyond the assumptions detailed in the preceding section. The calculated dewatering rates below are based on the current assumptions; however, larger excavations would likely elevate the overall dewatering requirements beyond these calculations.

Based on the assumptions provided in this report, the results of the dewatering rate estimates are summarized below, and calculation details are provided in Appendix G:

Location and Scenario	Construction Dewatering Flow Rate without a Safety Factor	Construction Dewatering Flow Rate Including Safety Factor of 2.0	Construction Dewatering Flow Rate Including Safety Factor of 2.0 with a 10 mm Rainfall Event
	L/day		
1 – Commercial / Garage Structure	59,557	119,115	145,155
2 - Commercial / Garage Elevator Pit	30,172	60,345	60,735
3 – Apartment Building	57,542	115,083	147,888

Location and Scenario	Construction Dewatering Flow Rate without a Safety Factor	Construction Dewatering Flow Rate Including Safety Factor of 2.0	Construction Dewatering Flow Rate Including Safety Factor of 2.0 with a 10 mm Rainfall Event
	L/day		
4 – Apartment Elevator Pits	25,140 to 36,440	50,280 to 72,879	50,405 to 73,429
5 – Site Servicing	112,958	225,916	230,916

The total construction dewatering flow rate includes a factor of safety of 2.0 to account for seasonal fluctuations in the groundwater table, initial removal of groundwater from storage and variation in hydrogeological properties beyond those encountered during the course of this study. This total dewatering flow rate also provides additional capacity for the dewatering contractors. A 10 mm rain event was also included in the water taking calculation.

5.1.4 Permit Recommendation

Given that the predicted temporary water taking rates for construction dewatering of the individual dewatering zones are calculated to exceed 50,000 L/day but are below 400,000 L/day, a registration on the EASR will be required from the MECP.

It is recommended to stage construction such that only one (1) zone is dewatered at a type to help ensure total dewatering rates remain below 400,000 L/day, such that a short-term PTTW is not required.

Dewatering more than 50,000 L/day shall not take place until the proposed water taking is registered with the MECP. If dewatering is expected to exceed 400,000 L/day, such that a short-term PTTW will be required.

It will be the responsibility of the contractor to ensure dry conditions are maintained within the excavations at all times. Based on the calculated water taking rate, it is expected that sump pumps and/or keg wells will be required to achieve the recommended drawdowns during earthworks of the two-levels of underground parking. However, the dewatering contractor will be responsible for selecting the dewatering method based on their preferred means and methods after reviewing the information provided in this report. Additional pumping capacity may be required to maintain dry conditions within the excavation during and following significant precipitation events. Additionally, the presence of near-surface fill material could hold significant groundwater.

The maximum flow calculation is intended to provide a conservative estimate to account for unforeseeable conditions that may arise during construction. It should be noted that the dewatering estimates provided in this report are based on assumptions and details available at the time of this report. If changes to the design are implemented (e.g., increase to planned excavation depths, widening of excavations, increased length of trenching etc.), the dewatering estimates must be revised to include and reflect future changes and to ensure that any conclusions or recommendations made by GEI remain valid.

5.1.5 Remedial Dewatering Activities

The dewatering contractor will be responsible for finalizing and implementing the discharge plan, including information such as the exact discharge location, erosion control methods, method of conveyance, treatment systems, temperature of the discharged groundwater, etc. It is the contractor's responsibility to implement a treatment system to ensure that discharged groundwater meets the applicable By-Law Criteria or PWQO. This may be done by examining the hydrogeologic conditions in a test pit (and/or a full-range pumping test by the dewatering subcontractor).

Treatment and disposal of the dewatering discharge should follow best management practices, including sediment and erosion control measures, removal of suspended solids by a decanting tank and/or filter bag, as well as water quality and quantity control monitoring programs, as mentioned earlier. The contractor should be aware that the purpose of the dewatering system is to maintain stable excavation slopes and dry working conditions during excavation.

The extent and details of the dewatering scheme (trench or well dimensions, spacing, pump levels, screen size and wick gradation, etc.) are left solely to the contractor's discretion to achieve the performance objectives for maintaining stable slopes and dry working conditions and will be based on their own interpretation and analysis of site conditions, equipment, experience, and efficiency. The contractor should also appreciate that additional dewatering means and modifications may be required as variations in site conditions are encountered. The recommended groundwater taking and discharge plans are provided in Appendices H and I, respectively.

5.1.6 Impact Assessment for Groundwater Dewatering

The impact assessment for taking groundwater during construction is provided in the Groundwater Taking Plan in Appendix H and includes a review of settlement, impacts to nearby groundwater users or to surface water / environmental features.

5.2 Permanent Building Drainage - Prohibited

The underground levels proposed for the site will extend below the groundwater table. Previous, the City of Barrie has provided the following comments for similar projects:

> *"Permanent dewatering is prohibited in accordance with the City of Barrie's Drinking Water Protection Policy… Site design shall consider that permanent dewatering is prohibited. This includes the application of sump pumps to dewater basements... Alternative design options (i.e., slab on grade construction or full foundation water proofing) are to be explored and implemented."*

Therefore, it is recommended that all underground levels constructed below the groundwater table be designed as fully waterproofed structures. The structures must be designed to resist hydrostatic pressures (including uplift). In this case, construction dewatering must continue until sufficient dead weight is available to resist the uplift pressures. Buoyancy calculations can be

completed by GEI if requested at the detailed design stage, once basement elevations and total number of storeys are finalized for the structures.

There will be no impacts to the City drinking water aquifers, or other nearby water users from and where fully waterproofed structures are constructed.

6. Preliminary Water Balance

6.1.1 Water Balance Components

A water balance is an accounting of the water resources within a given area. The water balance equates the precipitation (P) over a given area to the summation of the change in groundwater storage (S), evapotranspiration/evaporation (ET), surface water runoff (R) and infiltration (I) using the following equation:

$$\mathrm{P} = S + I + ET + R$$

The components of the water balance vary in space and time and depend on climatic conditions as well as the soil and land cover conditions (i.e., rainfall intensity, land slope, soil hydraulic conductivity and vegetation). For example, runoff occurs at a higher percentage during periods of snowmelt when the ground is frozen or during intense rainfall events.

Precise measurement of the water balance components is difficult, and as such, approximations and simplifications are made to characterize the water balance of a property. Field observations of the drainage conditions, land cover and soil types, groundwater levels and local climatic records are important inputs to the water balance calculations.

- Precipitation (P): For the purposes of approximating the annual precipitation at this site, the monthly rainfall between 1981 and 2010 was used based on Environment Canada historical weather data for the Barrie WPCC weather station (Climate ID 61110557, Latitude 44.38 N, Longitude 79.69 W, Elevation 221 m), which is located about 1.4 km southeast of the site.
- Storage (S): Although there are groundwater storage gains and losses on a short-term basis, the net change in groundwater storage on a long-term basis is assumed to be zero.
- Evapotranspiration/Evaporation (PET): The evapotranspiration and evaporation components vary based on the characteristics of the land surface cover (i.e., type of vegetation, soil moisture conditions, perviousness of surfaces, etc.). Potential evapotranspiration refers to the water loss from a vegetated surface to the atmosphere under conditions of an unlimited water supply. Evaporation occurs from a hard surface (such as flat rooftops, asphalt, gravel parking areas, etc.).
- Water Surplus (R + I): The difference between the mean precipitation and evapotranspiration is referred to as the water surplus. The water surplus is divided into two parts: as surface or overland runoff (R) and the infiltration into the surficial soil (I). The infiltration is comprised of two end member components: one component that moves vertically downward to underlying aquifers (referred to as percolation, deep infiltration or net recharge) and a second component that moves laterally through the near surface soil profile or shallow soils as interflow that re-emerges locally to surface (i.e., as runoff) at some short distance and time following precipitation.

6.1.2 Water Balance Approach and Methodology

The analytical approach to calculate the water balance involves monthly soil-moisture balance calculations to determine the pre-development infiltration volumes. The detailed water balance calculation is provided in Appendix J, which is summarized in this and subsequent sections of the report. The following assumptions were used as part of the soil-moisture balance calculations:

- A soil moisture balance approach assumes that soils do not release water as potential recharge while a soil moisture deficit exists.
- During wetter periods, any excess of precipitation over evapotranspiration first goes to restore soil moisture. Considering the nature of the current near surface soils (silty sand) and vegetation cover (shallow rooted crops and urban lawns), a soil moisture storage capacity of 75 mm was assumed.
- Once the soil moisture deficit is overcome, any further excess water can then pass through the soil as infiltration and either become interflow (indirect runoff) or recharge (deep infiltration).

Monthly potential evapotranspiration calculations accounting for latitude, climate and the actual evapotranspiration and water surplus components of the water balance based on the monthly precipitation and soil moisture conditions were calculated. The *MECP SWM Planning and Design Manual* (2003) methodology for calculating total infiltration based on topography, soil type and land cover was used, and a corresponding infiltration factor was calculated for pre- and post-development conditions. The water surplus was multiplied by the infiltration factor to determine both the pre-existing and post-condition annual volumes for run-off and infiltration for the property.

The pre-development scenario was estimated from the site inspection and aerial images, with 60% being permeable and 40% being impermeable. The post-development water balance scenario was estimated based on the “Basement Floor Plan” (MCL Architects, 2023). As final site plans are not yet available, the post-construction scenario was assumed to maintain 45% of the site as permeable land. The remaining 55% of the land is assumed to be impermeable and consists of a new multiple storey apartment building, a new single storey commercial building, and new parking lots. The current site plans are preliminary and may be subject to change. The water balance must be updated following final site configuration to reflect the final site plans.

It is noted that the infiltration and runoff values presented in Appendix J are estimates only. Single values are used for the water balance calculations, but it is important to understand that infiltration rates are dependent upon the hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the margins of error for the calculated infiltration and runoff component values are potentially quite large. These margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post-development conditions.

6.1.3 Pre and Post Development Water Balance

Detailed water balance calculations are included in Appendix J. The pre and post development calculations summarized in this section are preliminary only and must be updated once site plans are finalized.

The table below summarizes the pre and post construction water balance as per the proposed site development plans.

Condition	Permeable Areas	Impermeable Areas	Average Annual Runoff Volume (m^3/year)	Average Annual Infiltration Volume (m^3/year)
Pre-Development Land Use	60%	40%	7,639	2,087
Post-Development Land Use	45%	55%	9,436	1,565

These calculations suggest that, without mitigation such as LID measures, the proposed development will decrease average infiltration by approximately 522 m^3/year (25% decrease). The proposed development will increase runoff by approximately 1,797 m^3/year (24% increase). This means approximately 522 m^3/year of infiltration is required to maintain the water balance. The potential impacts of these changes and recommended mitigation measures are discussed below.

6.1.4 Recommended Mitigation Measures

The three broad categories which typically need to be mitigated and accounted for are:

- Reducing the volume and speed in which additional surface water runoff occurs;
- Increasing the amount of infiltration to match pre-development conditions; and
- Ensuring that the quality of existing surface water features and groundwater will not be adversely impacted.

6.1.5 Runoff Quantity

Urban development of an area affects the natural water balance. The most significant difference is the addition of impervious surfaces as a type of surface cover (e.g., roads, parking lots, driveways, rooftops). Impervious surfaces prevent infiltration of water into the underlying soils and the removal of the vegetation reduces the evapotranspiration component of the natural water balance. The evaporation component from impervious surfaces is relatively minor (estimated to be 15% of precipitation) compared to the evapotranspiration component that occurs with vegetation in this area (up to two thirds of precipitation). So, the net effect of the urbanization of the site is that most of the precipitation that falls onto impervious surfaces increases the surplus water resulting in more direct runoff from developed areas and reduced natural infiltration.

In conjunction with increased runoff, there is a reduction in infiltration to the shallow groundwater system. A reduction in infiltration can potentially lead to a lowering of the local water table and reduce the potential for this seasonal water table intersection and discharge.

Methods which do not necessarily increase infiltration rate, but decrease the volume and concentration of surface water runoff can be considered at this site include (but are not limited to):

- Increasing the topsoil thickness by about two times the normal thickness (up to 30 cm) to retain more water in storage; and
- Implementation of rainwater harvesting which intercepts, diverts and stores roof runoff (i.e., cisterns) for future use.

6.1.6 Mitigation Measures for Maintaining Infiltration

The increases in surface water runoff that will occur with urban development and mitigation of the potential impacts to the local water table due to reduction of infiltration may be minimized by using appropriate stormwater management and using LID measures to promote infiltration. These measures can be implemented on-site.

The basic premise for LID is to try to minimize changes to runoff and infiltration. As outlined in the *MECP SWMP Design Manual* (2003) and *Low Impact Development Stormwater Management Planning and Design Guide* published by the CVC and TRCA (2010), there are a suite of techniques that may be considered to promote infiltration and reduce runoff.

In order to maintain groundwater function at the site the following typical LID measures can be considered as part of typical site developments (can depend on land use):

- Collection of runoff from the building rooftops and redirection to grass areas and overland flow. If feasible, it is recommended that there be a minimum 5 m flow path over pervious areas to allow this mitigation method to be fully effective;
- Provision of gentle slopes in open areas or along grass swales in order to allow time for water infiltration;
- Construction of engineered infiltration measures such as soakaway pits, infiltration galleries or bioswales. Subsurface infiltration methods can only be considered in areas where there is sufficient soil permeability and depth to water table to accommodate the systems within the unsaturated zone (typically the infiltration elevation must be kept 1 m or more above the seasonal high groundwater level).
- Construction of grass channels or filter strips which allow infiltration, discharge at a lower rate and direct roof runoff to overland flow.

Implementation of LID measures will not only allow for infiltration of the surface water into the near-surface groundwater regime but will also allow for increase in natural filtration of surficial runoff, prevent sedimentation transport and potential erosion, and help reduce flooding by increasing the transit time for water on the site. These types of LID techniques promote natural infiltration by providing additional water volumes in the pervious areas. This is particularly effective

in the summer months when natural infiltration would not generally occur because the additional water overcomes the natural soil moisture deficit.

As it is typically a requirement of maintaining the same levels of infiltration post construction, no appreciable change in the groundwater table elevation should occur over the long-term condition.

As LID infiltration measures were designed and will be constructed on site, the in-situ infiltration rates have been measured by excavating test pits and conducting Guelph Permeameter tests in the exact footprints and elevations of the LID measures as described earlier in this report in Section 4.8.

6.1.7 Groundwater Quality

Depending on land use, runoff from urban developments may contain a variety of dilute contaminants such as suspended solids, chloride from road salt, oil and grease, metals, pesticide residues, phosphorous, bacteria and viruses. For groundwater, generally except for the dissolved constituents such as nitrogen and salt, most contaminants are attenuated by filtration during groundwater flow through the soils.

LID measures or end treatments such as oil/grit separators or wet ponds also help to remove suspended solids and other contaminants in runoff prior to infiltration or conveying the flows off the site, especially when a treatment train approach is taken for stormwater management. Any stormwater management facilities must be designed such that the water quality is maintained or improved prior to discharging water from the site or infiltrating water into the ground.

Runoff from rooftops and landscaped areas are typically considered “clean” and can be collected and infiltrated where possible. Infiltration-based practices for runoff from paved areas may be restricted for the proposed commercial development or may require pre-treatment prior to any infiltration.

Provided only clean or pre-treated runoff will be infiltrated, the groundwater quality will not be degraded and will not impact nearby domestic wells or other nearby environmental features.

7. Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, GEI should be contacted to assess the situation and additional testing and reporting may be required.

GEI should be retained for a general review of the final design drawings and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, GEI will assume no responsibility for interpretation of the recommendations in the report.

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

This report was authorized by and prepared by GEI for the County of Simcoe Social Housing Department (as provided in the signed Standard Professional Services Agreement). Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. GEI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

8. Closure

We trust that this information is satisfactory for your purposes. Should you have any questions or comments, please do not hesitate to contact our office.

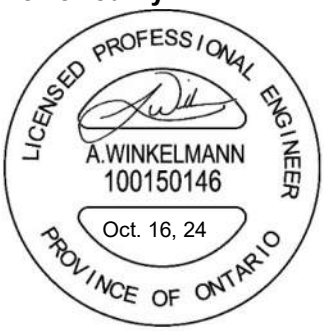
Yours truly,

GEI Consultants

Prepared By:

Sarah Griffith, P.Geo.
Project Hydrogeologist

Reviewed By:



Alexander Winkelmann, P.Eng.
Vice-President, Geotechnical Practice Lead

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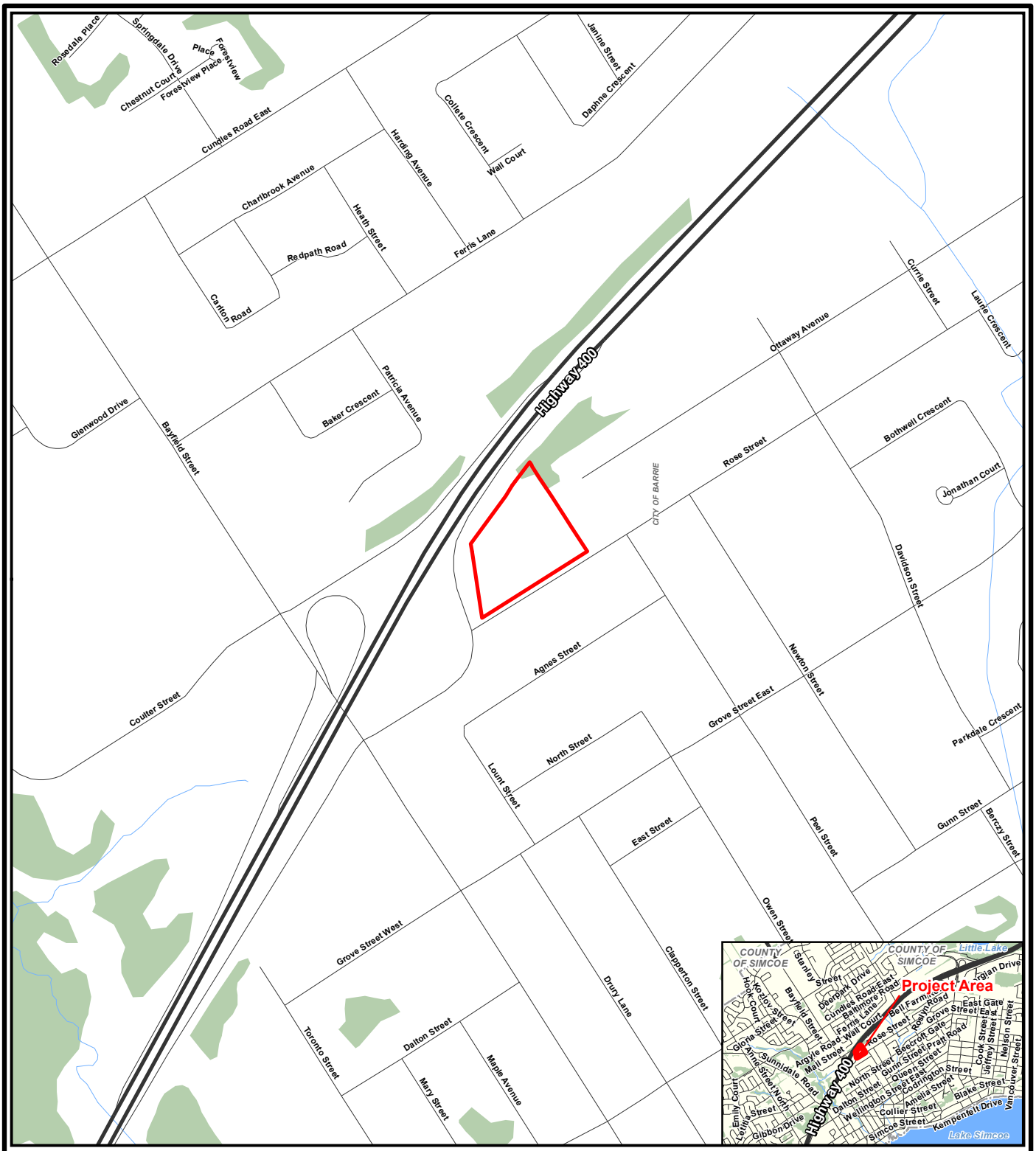
Figures



NOTES:
1. Coordinate System: NAD 1983 UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © Queen's Printer for Ontario, 2023.

Legend

- Site Boundary
- Highway
- Road
- Watercourse
- Waterbody
- Wooded Area

N

0 75 150 m

1:8,000

Hydrogeological Investigation
20 Rose Street, Barrie, Ontario

County of Simcoe, Social Housing Department

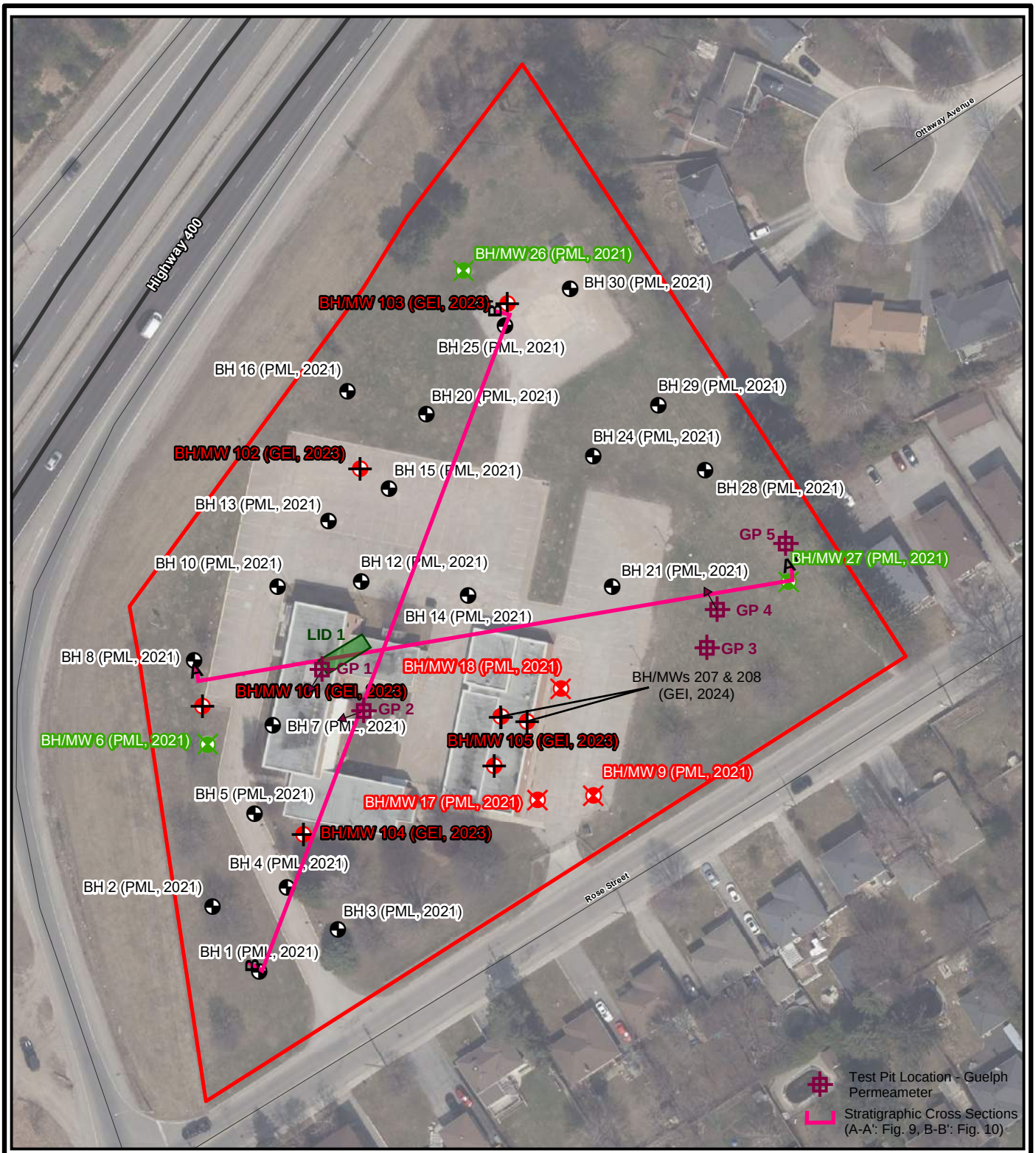
GEI Consultants

Project 2305493

SITE LOCATION PLAN

October 2024

Fig. 1



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Legend

- Site Boundary
- Highway
- Road
- Watercourse
- Waterbody
- Borehole Location by others
- Borehole/Monitoring Well Location GEI - Intact
- Borehole/Monitoring Well Location others - Intact
- Borehole/Monitoring Well Location others - Destroyed

N

0 15 30 m

1:1,200

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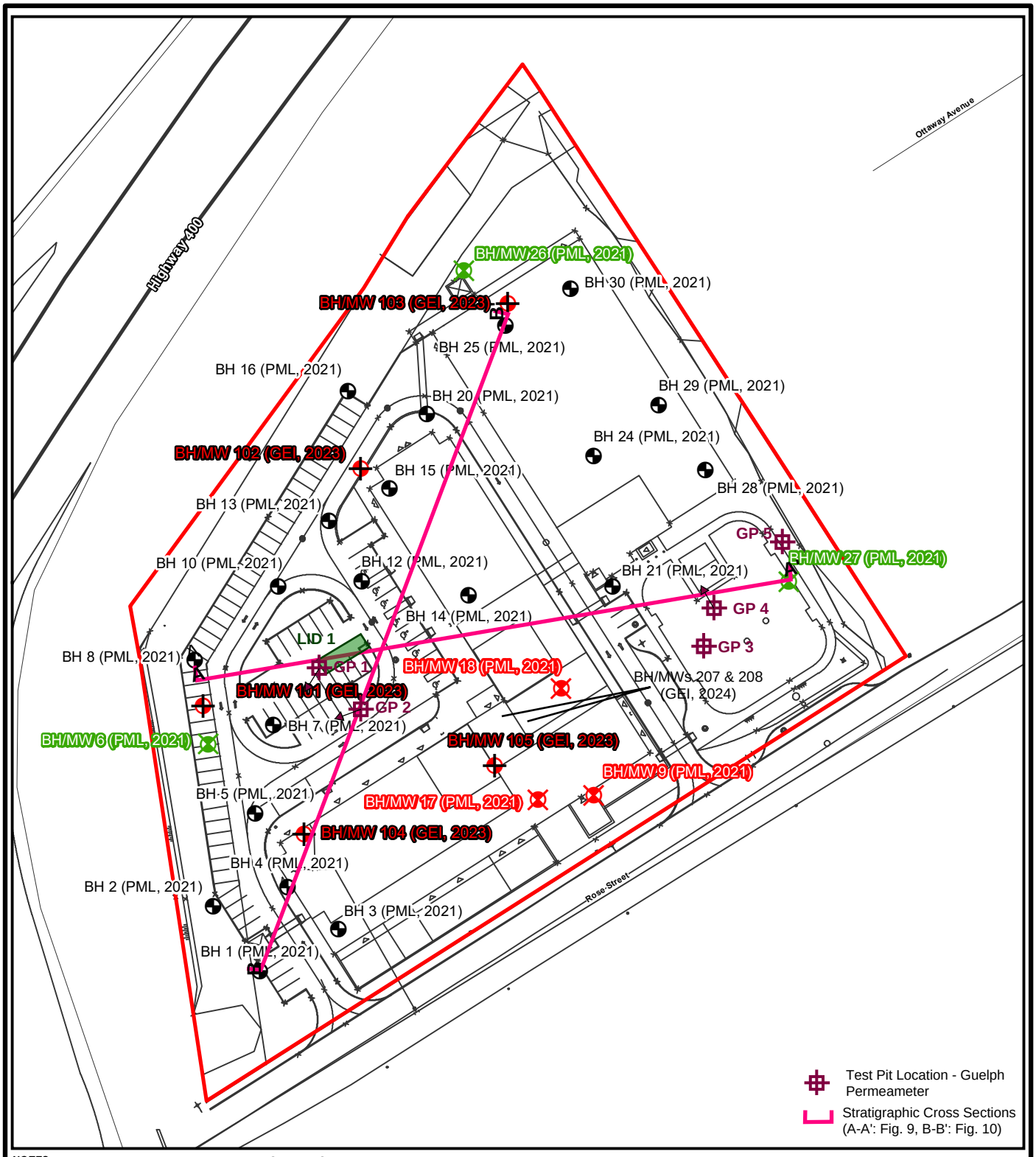
BOREHOLE/MONITORING WELL LOCATION PLAN (Aerial)

October 2024 Fig. 2a



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Legend

- Site Boundary
- Concept Plan (December, 2023)
- Highway
- Road
- Watercourse
- Waterbody
- Borehole Location by others
- Borehole/Monitoring Well Location GEI - Intact
- Borehole/Monitoring Well Location others - Intact
- Borehole/Monitoring Well Location others - Destroyed

N

0 15 30 m

1:1,200

Hydrogeological Investigation
20 Rose Street, Barrie, Ontario

County of Simcoe, Social Housing Department

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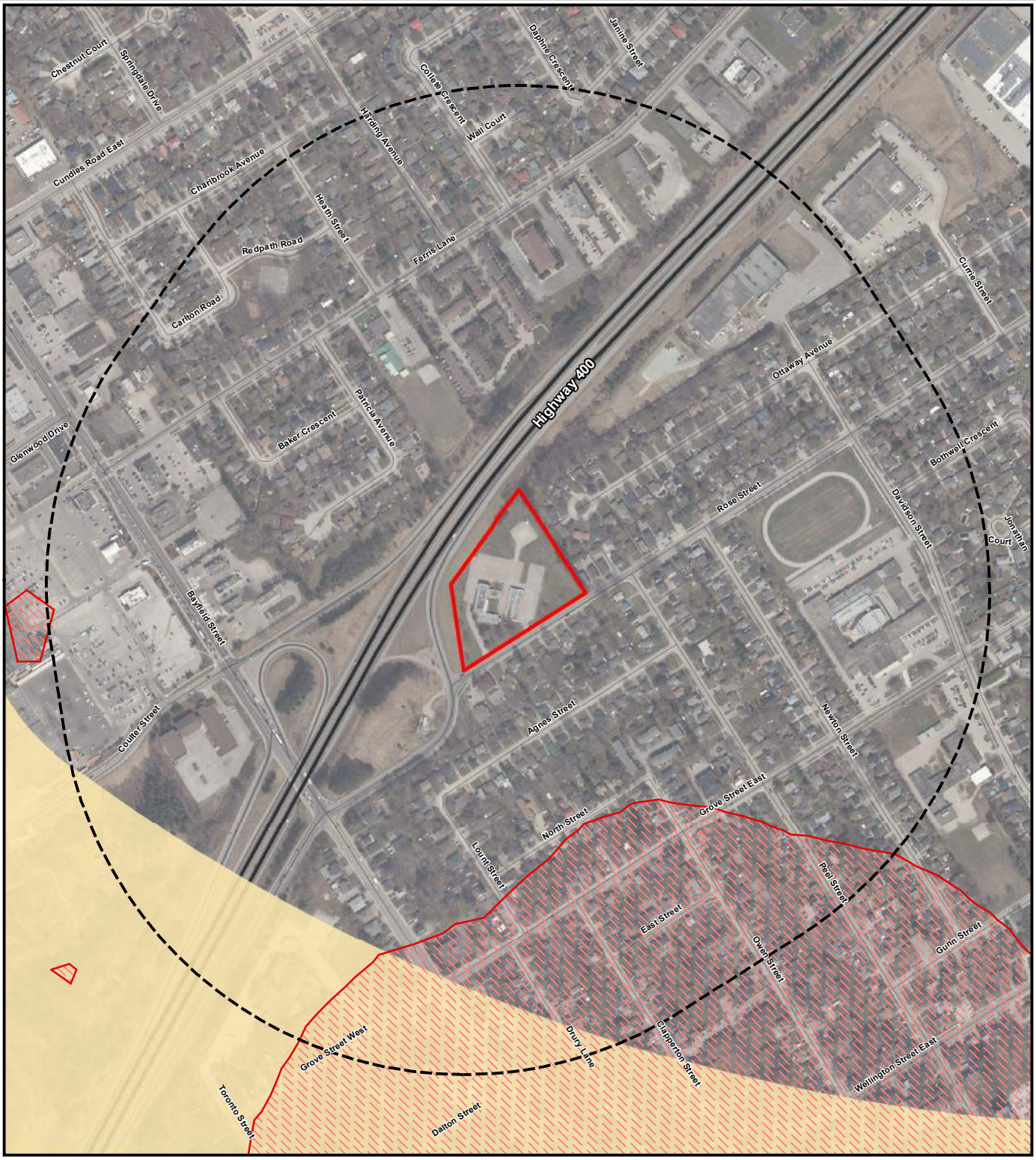
BOREHOLE/MONITORING WELL LOCATION PLAN (Site Plan)

October 2024

Fig. 2b



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Legend

- Site Boundary
- Site Boundary +500m
- Highway
- Road
- Watercourse

Wellhead Protection Area (LSRCA, 2022)

Zone

- A
- B
- C
- C1
- D
- Q1
- Q2

~ Entire figure extent is within a WHPA-Q2 ~

N

0 75 150 m

1:7,000

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WELLHEAD PROTECTION AREAS

October 2024 Fig. 3

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Legend

- Site Boundary
- Site Boundary +500m
- Highway
- Road
- Watercourse

Intake Protection Zone (LSRCA, 2022)

- Intake Protection Zone Q
- **Zone**
- Intake Protection Zone 1
- Intake Protection Zone 2
- Intake Protection Zone 3

N

0 75 150 m

1:7,000

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INTAKE PROTECTION ZONES

October 2024 Fig. 4

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Legend

- Site Boundary
- Site Boundary +500m
- Highway
- Road
- Watercourse
- Highly Vulnerable Aquifer (LSRCA, 2022)

N

0 75 150 m

1:7,000

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HIGHLY VULNERABLE AQUIFERS

October 2024 Fig. 5

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Legend

- Site Boundary
- Site Boundary +500m
- Highway
- Road
- Watercourse

Significant Groundwater Recharge Areas (LSRCA, 2022)

Vulnerability Score

- 2 - 4
- 6

- Site is not within a LSRCA Significant Groundwater Recharge Area -

N

0 75 150 m

1:7,000

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SIGNIFICANT GROUNDWATER RECHARGE AREAS

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Legend

- Site Boundary
- Site Boundary +500m
- Highway
- Road
- Watercourse
- Issue Contributing Area - Sodium, Chloride

N

0 75 150 m

1:7,000

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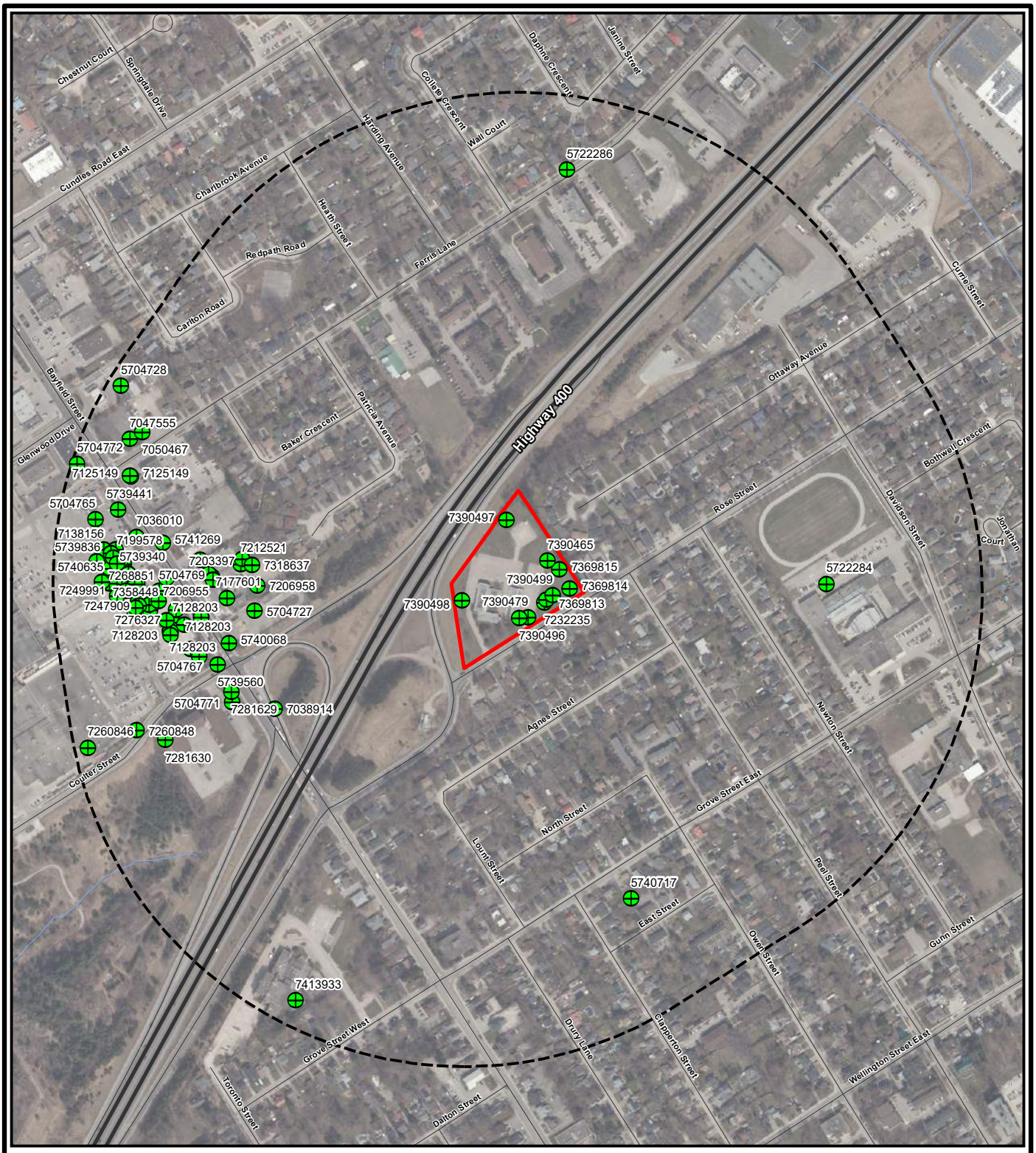
ISSUE CONTRIBUTING AREAS

October 2024 Fig. 7



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Legend

- Site Boundary
- Site Boundary +500m
- Highway
- Road
- Watercourse
- Well Record Location

N

0 75 150 m

1:7,000

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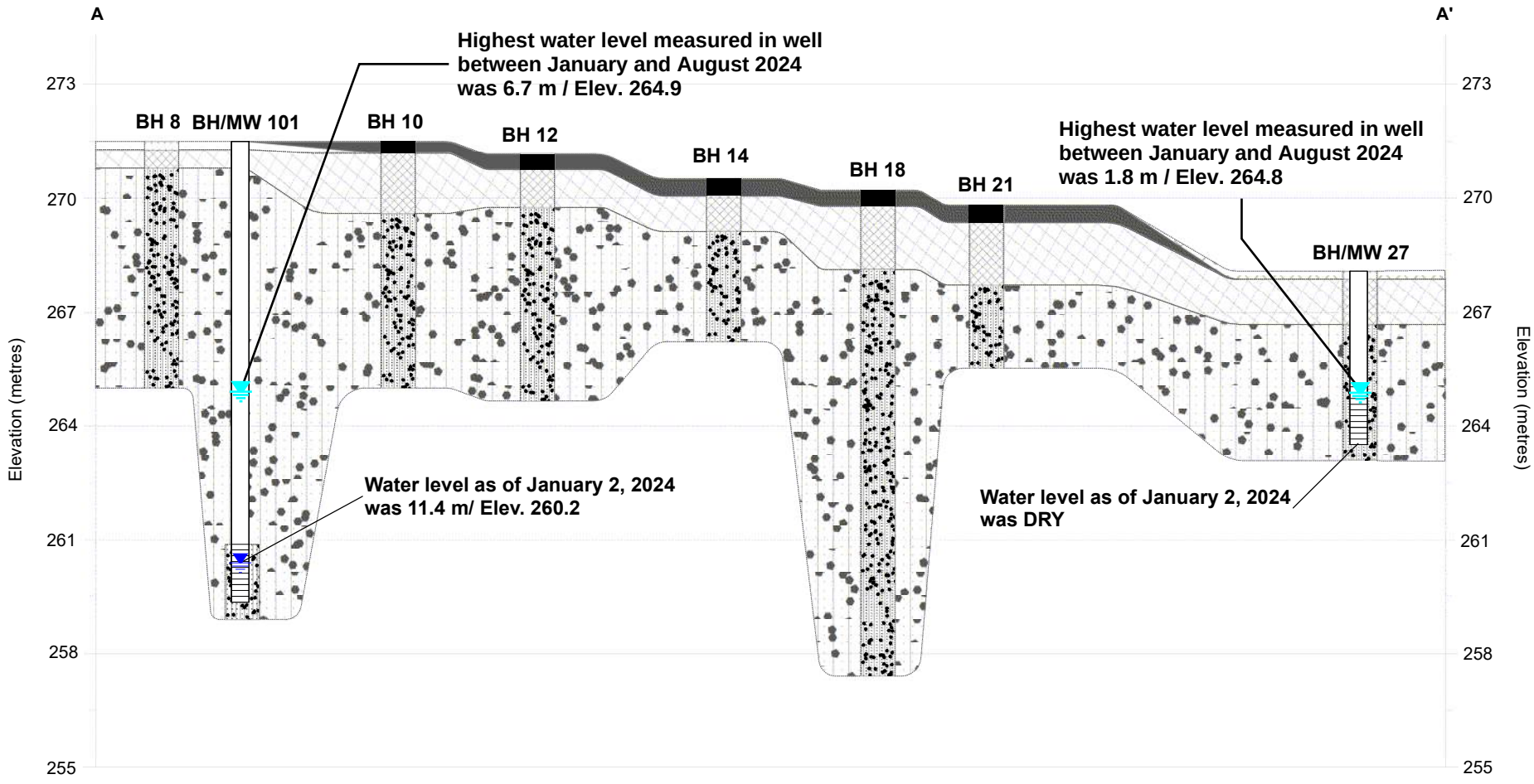
MECP WATER WELL RECORDS

October 2024 Fig. 8



Legend

- Water Level In Monitoring Well
- **Strata**
  - Topsoil
  - Pavement
  - Fill
  - Cohesionless Glacial Till

NOTES:

1. Subsurface conditions known only at borehole locations.
2. Horizontal distances are not to scale

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GEOLOGICAL CROSS SECTION A-A'

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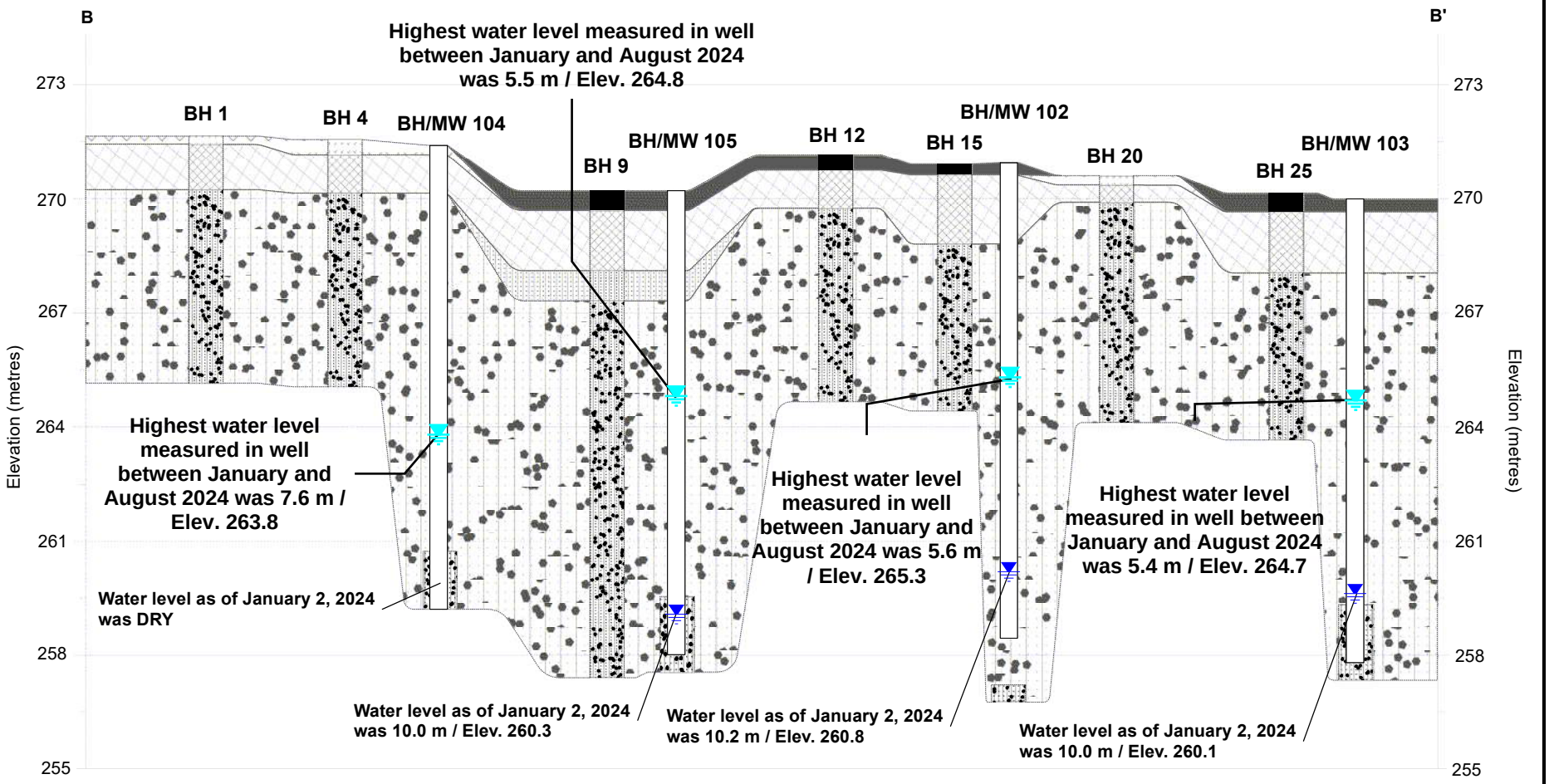
October 2024

Fig. 9



Legend

- Water Level In Monitoring Well
- **Strata**
  - Topsoil
  - Fill
  - Pavement
  - Cohesionless Glacial Till
  - Sandy Silt

NOTES:

1. Subsurface conditions known only at borehole locations.
2. Horizontal distances are not to scale

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Barrie, Ontario

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GEOLOGICAL CROSS SECTION B-B'

Project 2305493 | October 2024 | Fig. 10

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Legend

- Site Boundary
- Highway
- Road
- Approximate Borehole Location
- Approximate Monitoring Well Location
- Ground Water Contour

[xxx.x] Water Levels on May 13, 2024 (in m above mean sea level)

N

0 10 20 m

1:1,200

Phase Two ESA
20 Rose Street, Barrie, Ontario

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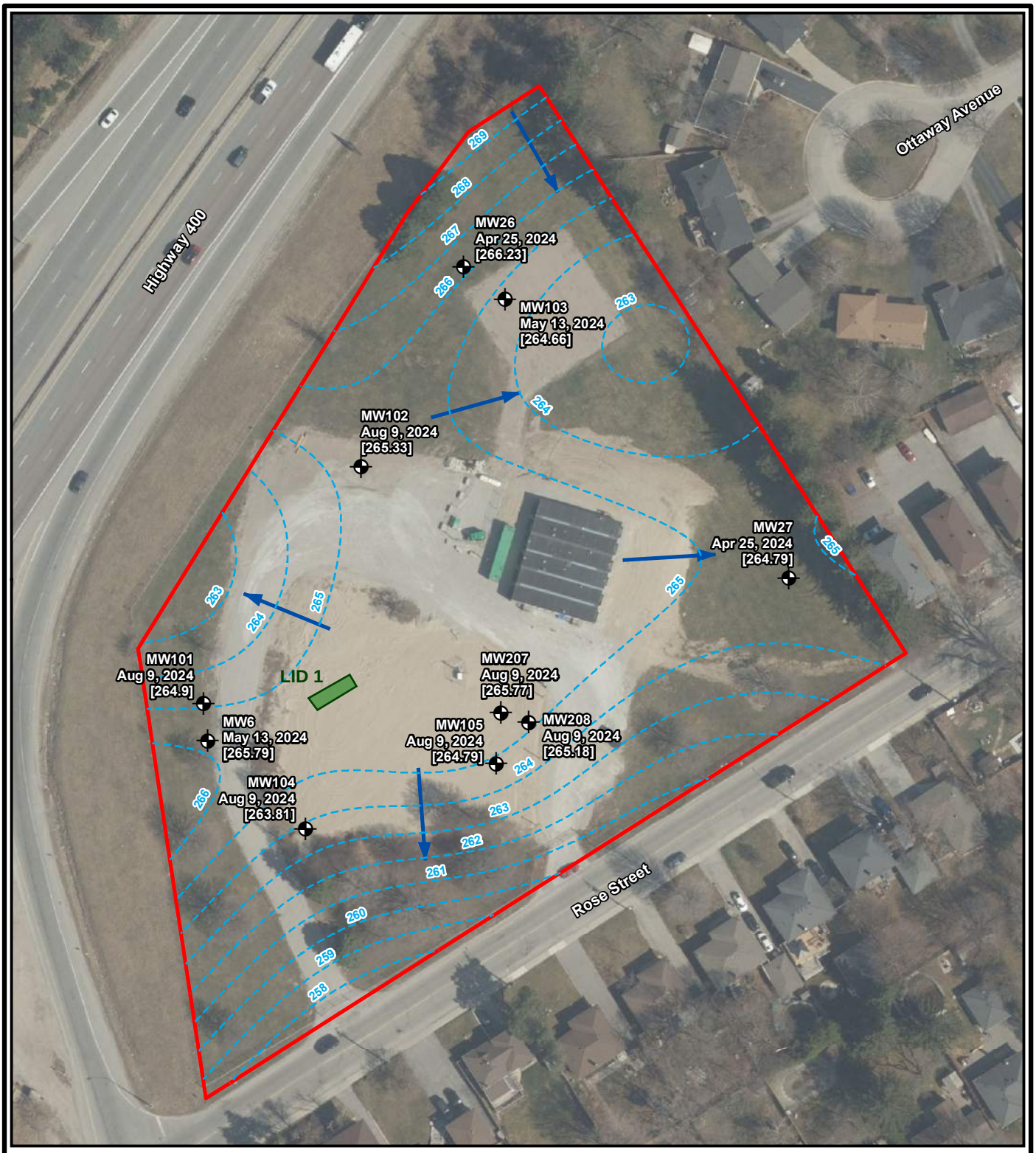
Groundwater Contour Plan

October 2024 Fig. 11



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Legend

- Site Boundary
- Approximate Monitoring Well Location
- Ground Water Contour

Aug 9, 2024 [xxx.xx] — Survey Date and High Groundwater Level (metres AMSL)

N

0 10 20 m

1:1,200

Phase Two ESA
20 Rose Street, Barrie, Ontario

County of Simcoe, Social Housing Department

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HIGH GROUNDWATER CONTOUR (between January and October 2024)

October 2024

Fig. 12

Appendix A

Regional Subsurface Profile

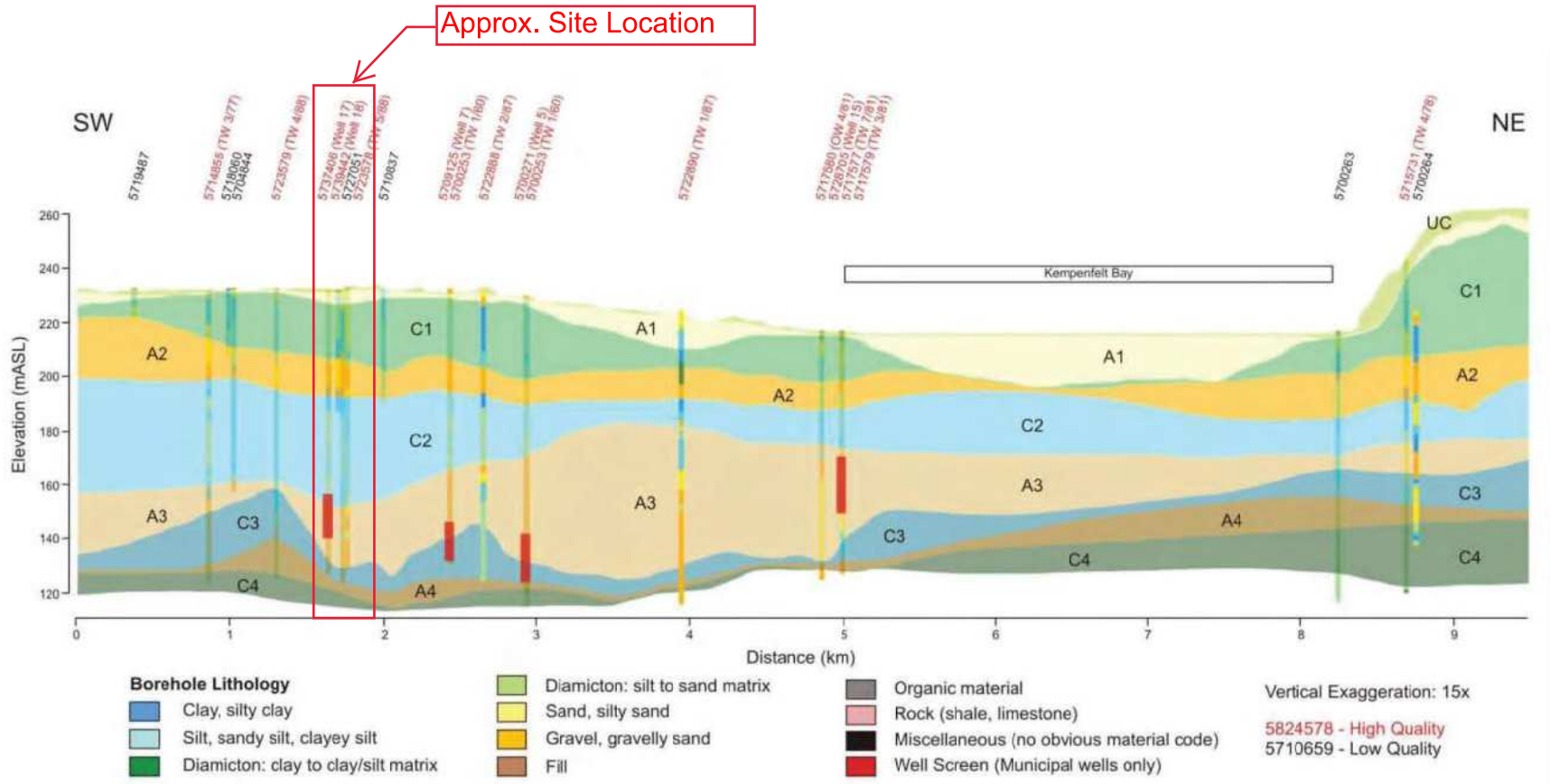

Figure 2-22: Southwest to northeast cross-section through the City of Barrie (AquaResource *et al.*, 2011).

Appendix B

MECP Water Well Records

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY (VESPRA) CON 04 021	17 603576 4917228 W	1956/07 5510	4	FR 0120	72/76/4/2 :0	DO	0106 14	5704727	5704727 ()	LOAM 0001 MSND STNS 0005 HPAN 0084 MSND 0087 HPAN 0092 GRVL 0096 HPAN 0101 MSND 0120
BARRIE CITY (VESPRA) CON 04 021	17 603408 4917511 W	1958/07 2514	6	FR 0139	65/126/1 5/3:30	CO	0136 3	5704728	5704728 ()	MSND 0006 BRWN CLAY 0013 MSND GRVL 0139
BARRIE CITY (VESPRA) CON 05 021	17 603376 4917343 W	1951/06 5510	4	FR 0102		DO	0102 10	5704765	5704765 ()	LOAM 0002 CLAY STNS MSND 0101 MSND 0112
BARRIE CITY (VESPRA) CON 05 021	17 603496 4917180 W	1952/08 1637	2	FR 0079	70/75/5/2 :0	DO	0081 4	5704767	5704767 ()	CLAY HPAN 0012 GRVL 0045 FSND 0051 GRVL 0074 FSND 0079 CSND 0085
BARRIE CITY (VESPRA) CON 05 021	17 603456 4917253 W	1953/05 1637	2	FR 0094	70/90/8/2 :0	ST DO	0107 4	5704769	5704769 ()	LOAM CLAY 0018 HPAN STNS 0048 CSND 0060 HPAN GRVL 0090 FSND 0100 CSND 0112
BARRIE CITY (VESPRA) CON 05 021	17 603298 4917511 W	1953/09 5510	4	FR 0080	67/70/4/0 :30	DO	0080 14	5704770	5704770 ()	LOAM 0002 MSND 0005 CLAY BLDR 0022 CLAY MSND STNS 0053 CLAY MSND 0080 MSND 0094
BARRIE CITY (VESPRA) CON 05 021	17 603548 4917113 W	1954/09 5510	4	FR 0126	54/56/5/1 :0	DO	0118 8	5704771	5704771 ()	LOAM 0001 CLAY BLDR 0053 MSND CLAY 0078 MSND 0116 MSND CLAY 0118 MSND 0126
BARRIE CITY (VESPRA) CON 05 021	17 603353 4917413 W	1959/10 2514	5	FR 0093	78/93/4/2 :0	CO	0087 6	5704772	5704772 ()	PRDG 0080 MSND 0095 BLUE CLAY 0155
VESPRA TOWNSHIP 04 022	17 604294 4917262 L	1986/07 3135	5	FR 0040	13/30/10/ 1:30	DO	0042 4	5722284	5722284 (NA)	CLAY SAND 0040 SAND 0046
VESPRA TOWNSHIP CON 04 021	17 603968 4917782 L	1986/07 3135	5	FR 0039	8/30/10/1 :30	DO	0042 4	5722286	5722286 (18721)	CLAY SAND 0039 SAND 0046
ESSA TOWNSHIP	17 604179 4917874 W	2004/02 7178				NU		5738643	5738643 (Z06334) _NO_TAG	BLCK LOAM SAND 0002 BRWN SAND CLAY SOFT 0077 GRVL SILT 0107 GREY CLAY SILT 0205 GREY SAND SHLE STNS 0280 BRWN SAND CLAY 0300
BARRIE CITY (VESPRA) CON 05 021	17 603407 4917276 W	2004/10 6032	1.97	59		NU	0061 10	5739340	5739340 (Z05398) A005023	BRWN SAND GRVL 0010 BRWN SAND TILL 0049 BRWN SAND 0061 GREY SAND 0071
BARRIE CITY (VESPRA) CON 05 021	17 603507 4917171 W	2004/11 6607	1.97	20			0010 10	5739359	5739359 (Z21602) A015582 A	BRWN SAND DRY 0020

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY (VESPRA) CON 05 021	17 603405 4917355 W	2004/11 6607	1.97	FR 0065			0061 8	5739441	5739441 (Z21603) A016921	BRWN SAND 0070
BARRIE CITY (VESPRA)	17 603530 4917161 W	2004/09 7215	2			NU	0009 10	5739560	5739560 (Z15672) A015582	
BARRIE CITY (VESPRA)	17 603383 4917288 W	2005/04 6607	2	FR 0046		DO	0056 20	5739836	5739836 (Z27727) A026558	BLCK 0000 BRWN GRVL SAND 0002 BRWN SAND 0071 BRWN SILT SAND 0075
BARRIE CITY (VESPRA)	17 603544 4917188 W	2005/07 6607	1.97	74			0065 20	5740068	5740068 (Z32278) A027674	0000 BRWN SAND GRVL 0005 BRWN SAND SILT 0074 BRWN SAND SILT WBRG 0084
BARRIE CITY (VESPRA)	17 603402 4917284 W	2006/01 2576	6	91	65///:	CO	0055 40	5740635	5740635 (Z37438) A033171 A	BRWN CLAY STNS 0018 GREY SILT SAND GRVL 0068 GREY GRVL SAND CMTD 0091 BRWN SAND WBRG 0096
BARRIE CITY (VESPRA)	17 604049 4916867 W	2006/03 7075	2					5740717	5740717 (Z43594) A039223 A	
BARRIE CITY (VESPRA) 05 021	17 603461 4917314 W	2006/09 2576	6		64///:		0048 40	5741269	5741269 (Z55912) A048808	0001 BRWN SAND GRVL 0016 GREY CLAY SLTY GRVL 0065 GREY SAND 0088
BARRIE CITY (VESPRA)	17 603508 4917292 W	2006/10 6607	2	FR 0063			0046 33	5741364	5741364 (Z56632) A051190	BRWN SAND GRVL 0005 BRWN FSND GRVL 0060 GREY FSND 0079
BARRIE CITY (VESPRA) 05 021	17 603428 4917321 W	2006/09 2576	6		64///:		0053 40	7036010	7036010 (Z55911) A048808	BRWN SAND GRVL 0016 GREY CLAY SLTY GRVL 0065 GREY SAND GRVL 0093
BARRIE CITY	17 603602 4917105 W	2006/11 6607	2	59			0059 20	7038914	7038914 (Z56635) A051085	BRWN FILL 0006 BRWN SAND TILL SILT 0059 BRWN FSND 0079
BARRIE CITY	17 603420 4917444 W	2007/06 6607	2	69			0065 15	7047555	7047555 (Z72441) A053575	BRWN FILL 0010 GREY SILT TILL CLAY 0070 BRWN SAND SILT WBRG 0079
BARRIE CITY	17 603435 4917452 W	2007/07 6607	2	75			0065 15	7050467	7050467 (Z70600) A049163	BRWN SILT SAND 0049 GREY SILT SAND TILL 0079
BARRIE CITY	17 603420 4917398 W	2008/08 6607	2	UK 0043		MO		7125149	7125149 (M03040) A069695	BRWN FILL SAND FILL 0005 GREY SAND GRVL DNSE 0030 GREY SAND SLTY DNSE 0047
BARRIE CITY	17 603478 4917229 W	2009/07 7238		UK 0062		TH		7128203	7128203 (M02366) A083375	BRWN SAND GRVL 0010 GREY SILT SAND 0060 BRWN SAND 0080

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY	17 603488 4917210 W	2009/06 7403	1.97	UT 0059		MO		7138155	7138155 (Z096388) A083764	GREY GRVL CGRD 0003 BRWN SAND SILT LOOS 0010 GREY SAND SILT DNSE 0059 GREY SAND LOOS 0071
BARRIE CITY	17 603387 4917305 W	2009/08 7403	4	UT 0059		MO	0052 20	7138156	7138156 (Z096387) A083763	GREY GRVL CGRD 0003 BRWN SAND SILT LOOS 0010 GREY SAND SILT DNSE 0059 GREY SAND LOOS 0072
BARRIE CITY (VESPRA)	17 603412 4917287 W	7423	4.01 11.8	UT 0061		MO		7159134	7159134 (Z128433) A100101	BLCK 0000 BRWN CSND GRVL FILL 0014 GREY SILT FSND DNSE 0049 BRWN FSND SILT GRVL 0054 BRWN FSND SILT WBRG 0071
BARRIE CITY (VESPRA)	17 603542 4917244 W	2012/02 7383						7177601	7177601 (M07888) A124296 P	
BARRIE CITY (VESPRA)	17 603403 4917297 W	2013/03 7238	2	UT 0071		MO	0065 10	7199578	7199578 (Z155436) A143036	GREY SAND 0078
BARRIE CITY (VESPRA)	17 603408 4917291 W	2013/03 7238	2	UT 0071			0065 10	7199579	7199579 (Z164686) A143078	GREY SAND 0078
BARRIE CITY (VESPRA)	17 603523 4917271 W	2013/05 7201						7203397	7203397 (C21996) A088484 P	
BARRIE CITY (VESPRA)	17 603519 4917275 W	2013/07 7201						7206955	7206955 (C22010) A088484 P	
BARRIE CITY (VESPRA)	17 603580 4917260 W	2013/04 7201						7206958	7206958 (M08249) A088484 P	
BARRIE CITY (VESPRA)	17 603559 4917287 W	2013/11 7201	2	UT 0080		MO	0091 10	7212521	7212521 (Z181986) A150878	GREY CSND PCKD 0081 BRWN FSND LOOS 0091
BARRIE CITY (VESPRA)	17 603561 4917293 W	2013/11 7201	2	UT 0080		MO	0081 10	7212522	7212522 (Z181985) A150879	GREY CSND PCKD 0081 BRWN FSND LOOS 0091
BARRIE CITY (VESPRA)	17 603524 4917267 W	2014/06 7531						7231615	7231615 (C20160) A163668 P	
BARRIE CITY (VESPRA)	17 603940 4917239 W	2014/11 7201	0.75			MO	0015 5	7232235	7232235 (Z196702) A088473	BRWN SAND GRVL DRY 0010 BRWN SAND GRVL 0020

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY (VESPRA)	17 603420 4917256 W	2015/07 7238	2			MO	0055 15	7247909	7247909 (Z198711) A185314	SILT SAND DRY 0063 SILT SAND WBRG 0071
BARRIE CITY (VESPRA)	17 603429 4917261 W	2015/07 7238	2			MO	0055 10	7247910	7247910 (Z198712) A185315	SILT SAND DRY 0063 SILT SAND WBRG 0070
BARRIE CITY (VESPRA)	17 603404 4917259 W	2015/08 7238						7249991	7249991 (C24463) A174368 P	
BARRIE CITY (VESPRA)	17 603367 4917056 W	2015/04 7383	2	65		TH	0060 10	7260846	7260846 (Z208425) A182167	FILL SAND GRVL 0015 SAND 0070
BARRIE CITY (VESPRA)	17 603428 4917078 W	2015/05 7383	2			TH	0055 10	7260848	7260848 (Z208426) _NO_TAG	FILL SAND GRVL 0015 SAND 0065
BARRIE CITY (VESPRA)	17 603403 4917285 W	2016/05 7241	2			MT	0013 7	7265046	7265046 (Z233238) A185040	GREY ---- 0006 BRWN SAND GRVL SILT 0020
BARRIE CITY (VESPRA)	17 603399 4917292 W	2016/05 7241	2			MT	0013 7	7265047	7265047 (Z233240) A185041	GREY ---- 0000 BRWN SAND GRVL 0002 BRWN SAND SILT 0020
BARRIE CITY (VESPRA)	17 603418 4917258 W	2016/07 7238	2			MO	0058 10	7268830	7268830 (Z232984) A185379	SAND TILL 0069
BARRIE CITY (VESPRA)	17 603378 4917290 W	2016/07 7238	2			MO	0060 10	7268831	7268831 (Z232983) A202829 A	FILL 0005 SAND GRVL 0015 BRWN SAND GRVL 0040 BRWN SILT GRVL 0050 BRWN SAND GRVL 0065 SAND GRVL WBRG 0072
BARRIE CITY (VESPRA)	17 603394 4917281 W	2016/07 7238	2			MO	0060 10	7268832	7268832 (Z232982) A201629	FILL 0005 BRWN SAND GRVL 0015 SAND GRVL 0030 BRWN SAND GRVL 0060 BRWN SAND GRVL WBRG 0075
BARRIE CITY (VESPRA)	17 603450 4917244 W	2016/07 7238	2			MO	0078 5	7268833	7268833 (Z232981) A201632	---- 0010 SAND GRVL 0030 SAND GRVL 0050 SAND GRVL 0065 SAND WBRG 0082
BARRIE CITY (VESPRA)	17 603394 4917263 W	2016/07 7238	2			MO	0059 10	7268850	7268850 (Z232814) A202839	BRWN SAND SILT TILL 0074
BARRIE CITY (VESPRA)	17 603466 4917269 W	2016/07 7238	2			MO	0058 10	7268851	7268851 (Z232801) A202800	SAND SILT TILL 0068
BARRIE CITY (VESPRA)	17 603442 4917241 W	2016/07 7238	2			MO	0070 10	7268852	7268852 (Z232980) A201631	---- 0012 SAND 0030 SAND GRVL 0040 SAND GRVL 0060 SAND GRVL 0070 SAND WBRG 0080

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY (VESPRA)	17 603418 4917253 W	2016/07 7238	2			MO	0060 10	7268853	7268853 (Z232979) A201630	BRWN FILL 0005 SAND GRVL 0015 BRWN SAND WBRG 0030 SAND 0055 SAND GRVL WBRG 0060 SAND GRVL WBRG 0070
BARRIE CITY (VESPRA)	17 603418 4917256 W	2016/07 7238	2			MO	0070 10	7268854	7268854 (Z232978) A185389	FILL 0010 SAND GRVL WBRG 0020 SAND 0040 SAND GRVL 0055 SAND 0075 SAND GRVL WBRG 0085
BARRIE CITY (VESPRA)	17 603426 4917262 W	2016/07 7238				MO		7268855	7268855 (Z232977) A201630	FILL 0010 SAND 0055 SAND GRVL 0065 SAND GRVL 0075 SAND GRVL WBRG 0080
BARRIE CITY (VESPRA)	17 603410 4917270 W	2016/07 7238	2			MO	0060 10	7268856	7268856 (Z232988) A202840	SAND TILL SILT 0074
BARRIE CITY (VESPRA)	17 603418 4917275 W	2016/07 7238	2			MO	0057 15	7268857	7268857 (Z232986) A174339	SAND TILL SILT 0074
BARRIE CITY (VESPRA)	17 603394 4917263 W	2016/07 7238	2			MO	0059 10	7268858	7268858 (Z232985) A202801	SAND TILL SILT 0069
BARRIE CITY (VESPRA)	17 603401 4917302 W	2016/07 7241	2			MT	0012 10	7269102	7269102 (Z218165) A195143	BRWN GRVL SAND LOOS 0010 BRWN SAND GRVL DNSE 0022
BARRIE CITY (VESPRA)	17 603430 4917238 W	2016/11 7238	2			MO	0065 10	7276327	7276327 (Z243611) A190346	0006 SAND GRVL 0010 SAND GRVL SLTY 0078
BARRIE CITY (VESPRA)	17 603385 4917264 W	2016/10 7238	2			MO	0056 10	7276328	7276328 (Z243610) A190345	0006 SAND GRVL 0010 CSND GRVL SLTY 0069
BARRIE CITY (VESPRA)	17 603404 4917247 W	2016/11 7238	2			MO	0061 10	7276329	7276329 (Z243612) A190347	0006 SAND GRVL 0010 SAND GRVL CSND 0072
BARRIE CITY (VESPRA)	17 603415 4917253 W	2017/01 7238	2			MO	0069 10	7281148	7281148 (Z232787) A213557	SAND GRVL WBRG 0005 BRWN SAND GRVL 0020 BRWN SAND GRVL DRY 0045 BRWN SAND GRVL 0060 BRWN SAND SLTY 0065 BRWN SAND GRVL 0075
BARRIE CITY (VESPRA)	17 603443 4917239 W	2017/01 7238	2			MO	0067 10	7281149	7281149 (Z232784) A213558	SAND 0010 SAND GRVL 0025 SAND 0045 SAND GRVL 0060 SAND GRVL 0072 SAND GRVL SLTY 0077
BARRIE CITY (VESPRA)	17 603426 4917228 W	2017/01 7238	2			MO	0068 10	7281150	7281150 (Z232785) A213559	SAND GRVL 0015 SAND GRVL 0045 GRVL SNDY 0060 SAND BLDR SLTY 0072 SAND GRVL WBRG 0078

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY (VESPRA)	17 603445 4917229 W	2017/01 7238	2			MO	0062 10	7281151	7281151 (Z232786) A213556	BRWN SAND GRVL 0010 BRWN SAND GRVL 0015 BRWN SAND 0030 BRWN SAND GRVL 0050 GREY SAND GRVL 0065 GREY SAND WBRG 0075
BARRIE CITY (VESPRA)	17 603547 4917126 W	2016/11 7383	2			MO	0064 10	7281629	7281629 (Z241869) A212284	
BARRIE CITY (VESPRA)	17 603464 4917066 W	2016/11 7383	2			MO	0037 10	7281630	7281630 (Z241954) A212264	
BARRIE CITY (VESPRA) CON 05 021	17 603444 4917236 W	2017/05 7282						7295524	7295524 (C36143) A219205 P	
BARRIE CITY (VESPRA)	17 603398 4917278 W	2017/11 7238	2	UT 0057		MO	0080 5	7302012	7302012 (Z273124) A229897	SILT SAND 0085
BARRIE CITY (VESPRA)	17 603456 4917240 W	2017/11 7238	2	UT 0063		MO	0063 5	7302013	7302013 (Z273123) A229898	SILT SAND 0068 SAND SILT 0070
BARRIE CITY (VESPRA)	17 603573 4917286 W	2018/08 7215						7318637	7318637 (C42142) A088484 P	
BARRIE CITY (VESPRA)	17 603509 4917221 W	2018/09 7531	2			MO	0020 3	7325837	7325837 (Z305730) A264050	BRWN LOAM LOOS 0001 BRWN SAND SILT GRVL 0010 BRWN SILT SAND GRVL 0023
BARRIE CITY (VESPRA)	17 603509 4917220 W	2018/09 7531	2			MO	0023 3	7325838	7325838 (Z305728) A264049	BRWN LOAM 0001 BRWN SAND GRVL SILT 0010 BRWN SILT SAND GRVL 0022
BARRIE CITY (VESPRA) CON 05 021	17 603402 4917305 W	2018/10 7241	2			TH MO	0015 10	7328284	7328284 (Z295248) A261513	GREY 0001 BRWN SAND GRVL FILL 0003 BRWN SAND SILT 0025
BARRIE CITY (VESPRA)	17 603396 4917301 W	2018/10 7241	2			TH MO	0012 10	7328285	7328285 (Z295249) A261512	GREY 0001 BRWN SAND GRVL FILL 0003 BRWN SAND SILT GRVL 0022
BARRIE CITY (VESPRA)	17 603395 4917281 W	2019/04 7238	2	UT 0058		MO	0047 3	7334320	7334320 (Z309013) A262186	---- 0010 SAND SLTY 0065
BARRIE CITY (VESPRA)	17 603399 4917295 W	2019/04 7241	2			MT	0020 3	7341215	7341215 (Z310607) A265584	GREY ---- 0000 GREY SAND 0002 BRWN SAND SILT 0012 BRWN SAND 0015 GREY SILT SAND 0023

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY (VESPRA)	17 603404 4917288 W	2019/04 7241	2			MT	0017 3	7341216	7341216 (Z310606) A265585	BLCK ---- 0000 GREY SAND 0002 BRWN SAND SILT 0012 BRWN SAND 0018 GREY SAND 0020
BARRIE CITY (VESPRA)	17 603431 4917235 W	2019/10 7675	2	UT 0062		MO	0059 15	7348968	7348968 (Z323837) A268622	---- 0001 SAND GRVL 0074
BARRIE CITY (VESPRA)	17 603466 4917216 W	2019/10 7675	2	UT 0065		MO	0060 10	7348969	7348969 (Z323836) A273291	SAND GRVL 0070
BARRIE CITY (VESPRA)	17 603427 4917232 W	2020/02 7241						7358448	7358448 (Z330655) A285134 P	
BARRIE CITY (VESPRA)	17 603943 4917242 W	2020/08 7241						7369813	7369813 (Z345117) A P	
BARRIE CITY (VESPRA)	17 603972 4917256 W	2020/08 7241						7369814	7369814 (Z345118) A088473 P	
BARRIE CITY (VESPRA)	17 603959 4917280 W	2020/08 7241						7369815	7369815 (Z345119) A P	
BARRIE CITY (VESPRA) CON 04 021	17 604246 4917779 W	2020/12 7241						7379473	7379473 (Z353791) A306289 P	
BARRIE CITY (VESPRA) CON 04 022	17 603944 4917291 W	2021/03 7190	4 2		0///:	MT	0015 5	7390465	7390465 (3QUFWCYC) A316435	BRWN SAND TILL DNSE 0020
BARRIE CITY (VESPRA) CON 04 022	17 603920 4917220 W	2021/03 7190	4 2		0///:	MT	0035 5	7390479	7390479 (NRIHJE5N) A316430	BRWN SAND TILL DNSE 0040
BARRIE CITY (VESPRA) CON 04 022	17 603909 4917219 W	2021/03 7190	4 2		0///:	MT	0035 5	7390496	7390496 (47UC4UOH) A316431	BRWN SAND TILL DNSE 0040
BARRIE CITY (VESPRA) CON 04 022	17 603893 4917342 W	2021/03 7190	4 2		0///:	MT	0035 5	7390497	7390497 (274V4PAJ) A316432	BRWN SAND TILL DNSE 0040
BARRIE CITY (VESPRA) CON 04 022	17 603837 4917241 W	2021/03 7190	4 2		0///:	MT	0010 5	7390498	7390498 (LWGRL7Y9) A316433	BRWN SAND TILL 0015
BARRIE CITY (VESPRA) CON 04 022	17 603951 4917248 W	2021/03 7190	4 2		0///:	MT	0015 5	7390499	7390499 (4UYJJZ6Y) A316434	BRWN SAND TILL DNSE 0020

TOWNSHIP CON LOT	UTM	DATE CNTR	CASING DIA	WATER	PUMP TEST	WELL USE	SCREEN	Well ID Only	WELL	FORMATION
BARRIE CITY (VESPRA)	17 603628 4916739 W	7726						7413933	7413933 (Z349242) A307379 P	

Appendix C

Borehole Logs

RECORD OF BOREHOLE No. 101

Project Number:	**2305493**						
Project Client:	**County of Simcoe, Social Housing**						
Project Name:	**Social Housing Facility**	Drilling Method:	**Mud Rotary Drilling**		Drilling Machine:	**Track Mount**	
Project Location:	**20 Rose Street, Barrie**	Logged By:	**BH**	Northing:	**4917241**	Date Started:	**Dec 4/23**
Drilling Location:	**See Borehole Location Plan**	Reviewed By:	**AW**	Easting:	**603839**	Date Completed:	**Dec 4/23**
Local Benchmark:							

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Shear Strength Testing (kPa): Other Test, Pocket Penetrometer, Field Vane (Intact), Field Vane (Remolded); Penetration Testing: SPT, DCPT	Combustible Organic Vapour (ppm), Combustible Organic Vapour (%LEL), Total Organic Vapour (ppm); Atterberg Limits: PL, LL; Water Content (%)	Instrumentation Installation	GR	SA	SI	CL
	0.0 271.5					0	270							
	Straight Auger to 10.7 m (no sampling)					2	268							
						4	266							
						6	264							
						8	262							
	10.7 260.9					10	260							
	SILT AND SAND GLACIAL TILL: Trace gravel, trace clay, inferred cobbles and boulders, dense to very dense, greyish brown, moist to wet	SS	10	100	64			64	10					
	12.6 258.9	SS	11	100	41	12		41	9					
	Borehole Terminated at 12.6 m													

GEI CONSULTANTS
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Barrie, Ontario L4N 0B7
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www.geiconsultants.com

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Jan 2/24 at depth of: 11.4 m.
Groundwater Elevation: 260.1 m

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :100**

RECORD OF BOREHOLE No. 102

Project Number: **2305493**
Project Client: **County of Simcoe, Social Housing**
Project Name: **Social Housing Facility**
Project Location: **20 Rose Street, Barrie**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Mud Rotary Drilling** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4917292** Date Started: **Dec 6/23**
Reviewed By: **AW** Easting: **603873** Date Completed: **Dec 6/23**

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Shear Strength Testing (kPa): Other Test, Pocket Penetrometer, Field Vane (Intact), Field Vane (Remolded); Penetration Testing: SPT, DCPT	Combustible Organic Vapour (ppm), Combustible Organic Vapour (%LEL), Total Organic Vapour (ppm); Atterberg Limits; Water Content (%)	Instrumentation Installation		GR	SA	SI	CL
	0.0 270.9					0	270								
	Straight Auger to 13.7 m (no sampling)					2	268								
						4	266								
						6	264								
						8	262								
	9.1 261.8 Pressometer Test #5										Ep = X kPa PI = X kPa				
	10.7 260.3 Pressometer Test #6					10	260				Ep = X kPa PI = X kPa				
	12.2 258.7 Pressometer Test #7					12	258				Ep = X kPa PI = X kPa				
	13.7 257.2														
	SILT AND SAND GLACIAL TILL: Trace gravel, trace clay, inferred cobbles and boulders, dense, greyish brown, moist to wet	SS	12	100	31	14		31	12						
	14.2 256.8 Borehole Terminated at 14.2 m														

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Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Jan 2/24 at depth of: 10.2 m.
Groundwater Elevation: 260.7 m

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :100**
Page: **1 of 1**

RECORD OF BOREHOLE No. 103

Project Number: **2305493**
Project Client: **County of Simcoe, Social Housing**
Project Name: **Social Housing Facility**
Project Location: **20 Rose Street, Barrie**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Mud Rotary Drilling** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4917328** Date Started: **Dec 5/23**
Reviewed By: **AW** Easting: **603904** Date Completed: **Dec 5/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
	0.0 270.0					0	
	Straight Auger to 10.7 (no sampling)					2	268
						4	266
						6	264
						8	262
						10	260
	10.7 259.3						
	SILT AND SAND GLACIAL TILL: Trace gravel, trace clay, inferred cobbles and boulders, dense to very dense, greyish brown, moist to wet	SS	10	100	38		
		SS	11	100	57	12	258
	12.6 257.3						
	Borehole Terminated at 12.6 m						

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
40 80 120 160
Penetration Testing
○ SPT ● DCPT
10 20 30 40
38
57

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40
11
12

Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

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Groundwater depth encountered on completion of drilling: 11.9 m.
Cave depth after auger removal: Open
Groundwater depth observed on: Jan 2/24 at depth of: 10.0 m.
Groundwater Elevation: 260.0 m

Borehole details presented do not constitute a thorough understanding of all potential conditions present and require interpretative assistance from a qualified geotechnical engineer. Also, borehole information should be read in conjunction with the geotechnical report for which it was commissioned and the accompanying 'Explanation of Boring Log'.

Scale: **1 :100**

RECORD OF BOREHOLE No. 104

Project Number:	**2305493**						
Project Client:	**County of Simcoe, Social Housing**						
Project Name:	**Social Housing Facility**	Drilling Method:	**Mud Rotary Drilling**		Drilling Machine:	**Track Mount**	
Project Location:	**20 Rose Street, Barrie**	Logged By:	**BH**	Northing:	**4917217**	Date Started:	**Dec 6/23**
Drilling Location:	**See Borehole Location Plan**	Reviewed By:	**AW**	Easting:	**603861**	Date Completed:	**Dec 6/23**
Local Benchmark:							

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING		COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Shear Strength Testing (kPa): Other Test, Pocket Penetrometer, Field Vane (Intact), Field Vane (Remolded); Penetration Testing: SPT, DCPT	Combustible Organic Vapour (ppm), Combustible Organic Vapour (%LEL), Total Organic Vapour (ppm); Atterberg Limits; Water Content (%)	Instrumentation Installation		GR	SA	SI	CL
	0.0 271.4					0	270								
	Straight Auger to 10.7 m (no sampling)					2	268								
						4	266								
						6	264								
	7.6 263.8 Pressometer Test #8					8	262				Ep = X kPa PI = X kPa				
	9.1 262.3 Pressometer Test #9					10	260				Ep = X kPa PI = X kPa				
	10.7 260.7														
	11.1 260.3 SILT AND SAND GLACIAL TILL: Trace gravel, trace clay, inferred cobbles and boulders, very dense, greyish brown, moist to wet	SS	10	100	65			65	10						
	12.2 259.2 Borehole Terminated at 12.2 m					12	258								

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Groundwater depth encountered on completion of drilling: Dry
Groundwater depth observed on: Jan 2/24 at depth of: Dry
Cave depth after auger removal: Open
Groundwater Elevation:

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Scale: **1 :100**
Page: **1 of 1**

RECORD OF BOREHOLE No. 105

Project Number: **2305493**
Project Client: **County of Simcoe, Social Housing**
Project Name: **Social Housing Facility**
Project Location: **20 Rose Street, Barrie**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Mud Rotary Drilling** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4917228** Date Started: **Dec 4/23**
Reviewed By: **AW** Easting: **603902** Date Completed: **Dec 4/23**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING	LAB TESTING	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%)
	0.0 270.2							Shear Strength Testing (kPa): × Other Test; + Pocket Penetrometer; ▲ Field Vane (Intact); △ Field Vane (Remolded); 40 80 120 160. Penetration Testing: ○ SPT ● DCPT; 10 20 30 40	△ Combustible Organic Vapour (ppm); ▲ Combustible Organic Vapour (%LEL); ◇ Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits: PL — LL. ○ Water Content (%); 10 20 30 40		GR SA SI CL
	Straight Auger to 10.7 m (no sampling)					0	270				
						2	268				
						4	266				
						6	264				
	7.6 262.6 Pressometer Test #9					8	262				Ep = X kPa PI = X kPa
	10.7 259.5					10	260				
	Pressometer Test #10	SS	10	100	58			58 →	10		Ep = X kPa PI = X kPa Wet cutting
	SILT AND SAND GLACIAL TILL: Trace gravel, trace clay, inferred cobbles and boulders, very dense, greyish brown, moist to wet					12	258				
	12.6 257.6	SS	11	100	63			63 →	9		
	Borehole Terminated at 12.6 m										

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Groundwater depth encountered on completion of drilling: 10.0 m. Cave depth after auger removal: Open
Groundwater depth observed on: Jan 2/24 at depth of: 10.0 m. Groundwater Elevation: 260.2 m

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Scale: **1 :100**

RECORD OF BOREHOLE No. 207

Project Number: **2305493**
Project Client: **County of Simcoe, Social Housing**
Project Name: **Social Housing Facility**
Project Location: **20 Rose Street, Barrie**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Mud Rotary Drilling** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4917239** Date Started: **Apr 24-25/24**
Reviewed By: **AW** Easting: **603903** Date Completed: **Apr 24-25/24**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing SPT/DCPT)	LAB TESTING (Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits; Water Content (%))	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	0.0					0	270.7				
	FILL: Silty sand, trace gravel loose, brown, moist to wet	SS	1	100	6			6	12		
		SS	2	100	0			0	10		
		SS	3	100	7	2	268	7	14		
	2.3						268.4				
	SILTY SAND GLACIAL TILL: Trace gravel, inferred cobbles and boulders, compact to very dense, brown, moist	SS	4	100	24			24	13		
		SS	5	100	45	4	266	45	10		
		SS	6	70	100+			100+	8		
	- - - Greyish-brown, wet sand seam - - -	SS	7	75	78	6	264	78	9		First Water Strike SS7
		SS	8	100	60	8	262	60	10		
		SS	9	100	53	10	260	53	10		
	- - - Grey - - -	SS	10	75	90			90	9		
	- - - Moist to wet - - -	SS	11	75	58	12	258	58	11		
	12.8						257.9				
	Borehole Terminated at 12.8 m										

Groundwater depth encountered on completion of drilling: 9.8 m. Cave depth after auger removal: 11.6m.
Groundwater depth observed on: May 13/24 at depth of: 5.5 m. Groundwater Elevation: 265.2 m

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Scale **1 :100**
Page: **1 of 1**

RECORD OF BOREHOLE No. 208

Project Number: **2305493**
Project Client: **County of Simcoe, Social Housing**
Project Name: **Social Housing Facility**
Project Location: **20 Rose Street, Barrie**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Mud Rotary Drilling** Drilling Machine: **Track Mount**
Logged By: **BH** Northing: **4917237** Date Started: **Apr 24-25/24**
Reviewed By: **AW** Easting: **603909** Date Completed: **Apr 24-25/24**

Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING (Shear Strength Testing (kPa); Penetration Testing: SPT, DCPT)	LAB TESTING (Combustible Organic Vapour (ppm); Combustible Organic Vapour (%LEL); Total Organic Vapour (ppm); Atterberg Limits; Water Content (%))	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0						0	270				
	FILL: Silty sand, trace gravel, trace organics, compact to very loose, brown, moist	SS	1	100	14			14, 8, 3	11, 13, 17		
		SS	2	100	8						
		SS	3	100	3	2	268				
2.3											
	SILTY SAND GLACIAL TILL: Trace gravel, inferred cobbles and boulders, compact to very dense, brown, moist	SS	4	100	25			25	14		
	- - - Greyish-brown - - -	SS	5	100	57			57	10		
						4	266				
		SS	6	25	100+			100+	10		
						6	264				
		SS	7	100	38			38	9		
		SS	8	20	100+	8	262	100+	11		First Water Strike SS8
	- - - Grey - - -	SS	9	100	45			45	9		
						10	260				
		SS	10	100	46			46	9		
						12	258				
12.8		SS	11	75	80			80	9		
257.6											
	Borehole Terminated at 12.8 m										

Groundwater depth encountered on completion of drilling: 9.8 m. Cave depth after auger removal: 11.6m.
Groundwater depth observed on: May 13/24 at depth of: 5.6 m. Groundwater Elevation: 264.8 m

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Scale **1 :100**

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LOG OF BOREHOLE NO. 1

17T 603851E 4917184N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.65									
0.20 / 271.45	TOPSOIL: Dark brown, silty sand, very moist		1	SS	7	271			15	
	FILL: Brown, silty sand to sandy silt, trace gravel, very moist to wet		2	SS	3				20	
1.4 / 270.3	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	22	270			20	
			4	SS	45	269			20	
			5	SS	57				15	
						268				
			6	SS	57	267			25	
						266				
6.5			7	SS	50				25	
265.2	BOREHOLE TERMINATED AT 6.5 m									Upon completion of augering No water No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; 50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%) 10 20 30 40

NOTES

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LOG OF BOREHOLE NO. 2

17T 603841E 4917198N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.55									
0.22 / 271.33	TOPSOIL: Brown, silty sand, trace wood pieces, moist		1	SS	11	271			15	
0.70 / 270.85	FILL: Brown, silty sand to sandy silt, trace gravel, very moist									
	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		2	SS	25				10	
			3	SS	33	270			20	
			4	SS	43	269			15	
			5	SS	44				20	
						268				
			6	SS	48	267			30	
						266				
6.5 / 265.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	50				25	Upon completion of augering No water No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION ×; STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L; WATER CONTENT (%): 10 20 30 40

NOTES

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LOG OF BOREHOLE NO. 3

17T 603868E 4917193N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.55						50 100 150 200 / 20 40 60 80	10 20 30 40		
0.18	271.37	TOPSOIL: Dark brown, sandy silt, trace gravel, very moist		1	SS	11	271			35	
		FILL: Brown, silty sand to sandy silt, trace gravel, moist to very moist		2	SS	6				20	
				3	SS	10	270			15	
2.1	269.5	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4[1]	SS	41	269			20	
				5	SS	49	268			15	
				6	SS	69	267			20	
							266				
6.5	265.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	54				25	Upon completion of augering No water No cave

NOTES

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LOG OF BOREHOLE NO. 4

17T 603857E 4917202N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.55									
0.0		PAVEMENT: 50 mm of asphalt, over 140 mm granular base, over 210 mm granular subbase, moist		1A 1B	GS	-				20 20	
0.40	271.15	FILL: Brown, silty sand to sandy silt, trace gravel, moist		2	SS	9	271			20	
1.0											
1.4	270.2	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	25	270			10	
2.0				4	SS	39	269			15	
3.0				5	SS	46	268			10	
4.0											
5.0				6	SS	51	267			20	
6.0							266				
6.5				7	SS	45				15	
	265.1	BOREHOLE TERMINATED AT 6.5 m									Upon completion of augering No water No cave
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

NOTES

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LOG OF BOREHOLE NO. 5

17T 603850E 4917218N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / WATER CONTENT (%)	GAS READINGS (ppm)	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.55								
0.0		PAVEMENT: 50 mm of asphalt, over 100 mm granular base, over 200 mm granular subbase, moist		1A	GS	-				
0.35	271.20			1B						
		FILL: Brown, silty sand to sandy silt, trace gravel, moist		2	SS	12	271			
1.0										
				3	SS	14	270			
2.0										
				4	SS	15	269			
2.9										
3.0	268.7	SAND: Very dense, brown, sand, trace silt, trace gravel, moist		5	SS	52	268			
4.0										
	267.6	SILTY SAND TILL: Very dense to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		6	SS	59	267			
5.0							266			
6.0				7	SS	44				
6.5										
	265.1	BOREHOLE TERMINATED AT 6.5 m								Upon completion of augering No water No cave
7.0										
8.0										
9.0										
10.0										
11.0										
12.0										
13.0										
14.0										
15.0										

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L; WATER CONTENT (%) 10 20 30 40

NOTES

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LOG OF BOREHOLE/MONITORING WELL NO. 6

17T 603840E 4917233N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 271.50									
0.20	271.30	TOPSOIL: Dark brown, silty sand, trace gravel, very moist		1	SS	18	271			5	Stickup casing Concrete
0.70	270.80	FILL: Brown, silty sand to sandy silt, trace gravel, very moist									
		SILTY SAND TILL: Compact to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		2	SS	21				10	
				3	SS	34	270				Bentonite seal
				4	SS	43	269			20	
				5	SS	27	268			20	
				6	SS	41	267			15	
							266				50 mm slotted pipe Filter sand
6.5	265.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	46	265			10	

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q (50 100 150 200)
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ● (20 40 60 80)
PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%) (10 20 30 40)

Upon completion of augering
No water
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	Dry	----
2021-04-30	Dry	----

NOTES 1. Sample submitted for chemical testing

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LOG OF BOREHOLE NO. 7

17T 603854E 4917237N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 23, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 271.60				
0.0	271.45	TOPSOIL: Dark brown, silty sand, trace gravel, moist		1	SS	5
		FILL: Brown, silty sand to sandy silt, trace gravel, moist		2	SS	7
1.4	270.2	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	25
2.0				4	SS	37
3.0				5	SS	63/250 mm
4.0						
5.0				6	SS	63
6.0						
6.5	265.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	46
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

ELEVATION SCALE: 271, 270, 269, 268, 267, 266

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm)

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 8

17T 603837E 4917251N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.50						50 100 150 200; 20 40 60 80	10 20 30 40		
0.20 / 271.30	TOPSOIL: Dark brown, silty sand, trace gravel, moist		1	SS	7	271				
0.70 / 270.80	FILL: Brown, sandy silt, trace gravel, very moist									
	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		2	SS	35					
			3	SS	48	270				
			4	SS	35	269				
			5	SS	39	268				
			6	SS	49	267				
						266				
6.5			7	SS	50					
265.0	BOREHOLE TERMINATED AT 6.5 m					265				Upon completion of augering No water No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 9

17T 603911E 4917221N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE March 22, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 270.20				
0.0	270.20	PAVEMENT: 80 mm of asphalt, over 150 mm granular base, over 300 mm granular subbase, moist		1A 1B	GS	-
0.53	269.67	FILL: Brown, silty sand, trace gravel, moist		2	SS	6
1.0				3[1]	SS	10
2.0	268.1	SILTY SAND: Compact, brown, silty sand, trace gravel, moist		4	SS	25
2.1	267.3	SILTY SAND TILL: Compact to very dense, brown to grey, silty sand, trace gravel, trace clay, cobbles & boulders, moist to wet		5	SS	48
3.0				6	SS	50/140 mm
4.0				7	SS	89/250 mm
5.0						
6.0				8	SS	37
7.0						
8.0				9	SS	45
9.0						
10.0				10	SS	29
11.0				11	SS	55
12.0				12	SS	56
12.8	257.4	BOREHOLE TERMINATED AT 12.8 m				
13.0						
14.0						
15.0						

ELEVATION SCALE: 270, 269, 268, 267, 266, 265, 264, 263, 262, 261, 260, 259, 258

SHEAR STRENGTH (kPa)
+FIELD VANE △TORVANE ○ Qu
▲POCKET PENETROMETER ○ Q
50 100 150 200

DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm): 20, 5, 15, 5, 10, 15, 20, 10, 25, 20, 20, 15, 15

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount casing
Concrete
Bentonite seal
50 mm slotted pipe
Filter sand
First water strike at 11.9 m

Upon completion of augering
Water at 11.9 m
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-30	8.7	261.5

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 10

17T 603855E 4917267N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.50									
0.30 / 271.20	PAVEMENT: 40 mm of asphalt, over 120 mm granular base, over 140 mm granular subbase, moist		1A	GS	-					
	FILL: Brown, sandy silt, trace gravel, moist		1B							
			2	SS	5					
1.9 / 269.6	SILTY SAND TILL: Dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	17					
			4	SS	41					
			5	SS	43					
			6	SS	49					
6.5 / 265.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	33					Upon completion of augering No water No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 12

17T 603873E 4917268N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 24, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.15								
0.40 / 270.75	PAVEMENT: 100 mm of asphalt, over 120 mm granular base, over 180 mm granualr subbase, moist		1A / 1B	GS	-	271			
1.4	FILL: Brown, sandy silt to silty sand, trace gravel, moist		2	SS	8	270			
269.8	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	41	269			
			4	SS	50				
			5	SS	74	268			
			6	SS	47	267			
6.5			7	SS	46	266			
264.7	BOREHOLE TERMINATED AT 6.5 m					265			Upon completion of augering No water No cave

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80
PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30 40

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 13

17T 603866E 4917281N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 24, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES
	SURFACE ELEVATION 271.30				
0.25 / 271.05	PAVEMENT: 40 mm of asphalt, over 100 mm granualar base, over 110 mm granular subbase, moist		1A	GS	-
	FILL: Brown, sandy silt, trace gravel, moist		1B		
			2	SS	8
1.4 / 269.9	SILTY SAND TILL: Very dense to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	67
			4	SS	94/250mm
			5	SS	79
			6	SS	49
6.5 / 264.8	BOREHOLE TERMINATED AT 6.5 m		7	SS	38

ELEVATION SCALE: 271, 270, 269, 268, 267, 266, 265

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 14

17T 603896E 4917265N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 26, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN DP

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 270.50									
0.46 / 270.04	PAVEMENT: 110 mm of asphalt, over 200 mm granualar base, over 150 mm granular subbase, moist		1A / 1B	GS	-	270				
1.4 / 269.1	FILL: Brown, sandy silt, trace gravel, moist		2	SS	6					
	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	10	269				
			4	SS	41	268				
			5	SS	88	267				
4.3 / 266.2			6	SS	69/250 mm					
	BOREHOLE TERMINATED AT 4.3 m									Upon completion of augering No water No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 15

17T 603879E 4917288N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 24, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER O Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 270.90						50 100 150 200; 20 40 60 80	10 20 30 40		
0.27 / 270.63	PAVEMENT: 30 mm of asphalt, over 100 mm granular base, over 140 mm granular subbase, moist		1A	GS	-					
	FILL: Brown, sandy silt, trace gravel, moist		1B							
			2	SS	6	270				
			3	SS	10	269				
2.1 / 268.8	SILTY SAND TILL: Very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	52	268				
			5	SS	53	267				
			6	SS	66	266				
6.5 / 264.4	BOREHOLE TERMINATED AT 6.5 m		7	SS	36	265				Upon completion of augering No water No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 16

17T 603870E 4917309N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Solid Stem Augers
BORING DATE March 25, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q; DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L; WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS; GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
	SURFACE ELEVATION 271.25						50 100 150 200; 20 40 60 80	10 20 30 40		
0.22 271.03	TOPSOIL: Dark brown to black, silty sand, moist		1	SS	4	271				
	FILL: Brown, silty sand, trace gravel, moist		2	SS	5	270				
2.1			3	SS	9					
269.2	SILTY SAND TILL: Dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	45	269				
			5	SS	44	268				
						267				
			6	SS	37					
						266				
6.5			7	SS	40	265				
264.8	BOREHOLE TERMINATED AT 6.5 m									Upon completion of augering No water No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 17

17T 603923E 4917222N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 22, 2021
ENGINEER GW
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	NUMBER	TYPE	"N" VALUES	GAS READINGS (ppm)
		SURFACE ELEVATION 269.80				
0.0	269.80	PAVEMENT: 100 mm of asphalt, over 150 mm granular base, over 210 mm granular subbase, moist	1A 1B	GS	-	5 5
0.46	269.34	FILL: Brown, sand, trace silt, trace gravel, moist	2[1]	SS	11	10
1.0			3	SS	3	10
2.1	267.7	SILTY SAND TILL: Compact to dense, brown to grey, silty sand, trace gravel, trace clay, cobbles & boulders, moist to wet	4	SS	15	15
3.0			5	SS	32	20
4.0			6	SS	42	20
5.0			7	SS	33	20
6.0			8	SS	43	25
7.0			9	SS	35	20
8.0			10	SS	19	15
9.0			11	SS	21	15
10.0			12	SS	30	
11.0						
12.0			13	SS	47	15
12.8	257.0	BOREHOLE TERMINATED AT 12.8 m				
13.0						
14.0						
15.0						

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Flushmount casing
Concrete
Bentonite seal
First water strike at 10.7 m
50 mm slotted pipe
Filter sand

Upon completion of augering
Water at 11.6 m
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	8.3	261.5
2021-04-30	8.1	261.7

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 18

17T 603916E 4917245N

PROJECT Proposed Simcoe County Housing Facility
LOCATION 20 Rose Street, Barrie, Ontario
BORING METHOD Continuous Flight Hollow Stem Augers
BORING DATE March 23, 2021
PML REF. 21BF014
ENGINEER GW
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER O Q / DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 270.20						50 100 150 200 / 20 40 60 80	10 20 30 40		
0.0		PAVEMENT: 100 mm of asphalt, over 120 mm granular base, over 200 mm granular subbase, moist		1A 1B	GS	-	270			10 10	Flushmount casing Concrete
0.42	269.78	FILL: Brown, silty sand, trace gravel, moist		2	SS	8	269			15	
1.0				3	SS	12				10	
2.0	2.1						268				
	268.1	SILTY SAND TILL: Dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist to very moist		4	SS	36				20	
3.0				5	SS	34	267			15	
4.0				6	SS	42	266			20	
				7	SS	45				20	
5.0							265				Bentonite seal
6.0				8	SS	44	264			20	
7.0							263				
				9	SS	36				15	
8.0							262				
9.0				10	SS	24	261			20	
10.0							260				
				11	SS	37				15	First water strike at 11.0 m 50 mm slotted pipe Filter sand
11.0							259				
12.0				12	SS	48	258			10	
	12.8										
13.0	257.4	BOREHOLE TERMINATED AT 12.8 m									Upon completion of augering Water at 11.6 m No cave Water Level Readings: Date / Depth(m) / Elev. 2021-04-01 8.4 261.8 2021-04-30 8.4 261.8
14.0											
15.0											

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 20

17T 603887E 4917304N

PROJECT Proposed Simcoe County Housing Facility — **PML REF.** 21BF014

LOCATION 20 Rose Street, Barrie, Ontario — **BORING DATE** March 25, 2021 — **ENGINEER** GW

BORING METHOD Continuous Flight Solid Stem Augers — **TECHNICIAN** AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 270.60					
0.23 / 270.37	TOPSOIL: Dark brown, silty sand, trace gravel, moist		1	SS	6	270
0.70 / 269.90	FILL: Brown, silty sand to sandy silt, trace gravel, moist					
	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		2	SS	25	
			3	SS	42	269
			4	SS	55	268
			5	SS	58	267
			6	SS	61	266
6.5 / 264.1	BOREHOLE TERMINATED AT 6.5 m		7	SS	44	265

SHEAR STRENGTH (kPa): + FIELD VANE △TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200

DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L

WATER CONTENT (%): 10 20 30 40

GAS READINGS (ppm)

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 21

17T 603927E 4917267N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 269.80					
0.0	PAVEMENT: 100 mm of asphalt, over 120 mm granular base, over 230 mm granular subbase, moist		1A 1B	GS	-	
0.45 / 269.35	FILL: Brown, silty sand, trace gravel, moist		2	SS	20	269
1.0			3	SS	20	268
2.0 / 2.1 / 267.7	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	22	267
3.0			5	SS	55	
4.0 / 4.3			6	SS	57	266
265.5	BOREHOLE TERMINATED AT 4.3 m					

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 24

17T 603923E 4917295N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 22, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 269.05					
0.18 / 268.87	TOPSOIL: Dark brown, sandy silt, trace gravel, moist		1	SS	5	
	FILL: Brown, sandy silt, trace gravel, very moist		2'	SS	4	268
1.4 / 267.7	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	20	267
			4	SS	50	
			5	SS	62	266
						265
			6	SS	41	
						264
						263
6.5 / 262.6	BOREHOLE TERMINATED AT 6.5 m		7	SS	26	

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P — NATURAL MOISTURE CONTENT w — LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 25

17T 603904E 4917323N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 26, 2021
ENGINEER GW
BORING METHOD Continuous Flight Hollow Stem Augers
TECHNICIAN DP

DEPTH ELEV (metres)	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
	SURFACE ELEVATION 270.15					270
0.48 / 269.67	PAVEMENT: 130 mm of asphalt, over 150 mm granular base, over 200 mm granular subbase, moist		1A / 1B	GS	-	
	FILL: Brown, sandy silt, trace gravel, moist		2	SS	6	269
			3	SS	8	
2.1 / 268.1	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	29	268
			5	SS	57	267
			6	SS	70	266
6.5 / 263.7	BOREHOLE TERMINATED AT 6.5 m		7	SS	44	265 / 264

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%)
GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 26

17T 603895E 4917335N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES
		SURFACE ELEVATION 270.25				
0.0	270.25					
0.20	270.05	TOPSOIL: Brown, silty sand, trace gravel, moist		1	SS	2
		FILL: Brown, silty sand to sandy silt, trace gravel, moist to very moist		2	SS	3
1.0				3	SS	5
2.0						
2.1	268.2	SILTY SAND TILL: Dense to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	42
3.0				5	SS	81
4.0						
5.0				6	SS	66
6.0						
6.5	263.8	BOREHOLE TERMINATED AT 6.5 m		7	SS	55
7.0						
8.0						
9.0						
10.0						
11.0						
12.0						
13.0						
14.0						
15.0						

ELEVATION SCALE: 270, 269, 268, 267, 266, 265, 264

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS (ppm)

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave
Water Level Readings:

Date	Depth(m)	Elev.
2021-04-01	Dry	----
2021-04-30	Dry	----

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE/MONITORING WELL NO. 27

17T 603965E 4917268N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 266.55									
0.20	266.35	TOPSOIL: Brown, silty sand/sandy silt, trace gravel, moist		1	SS	5	266				Stick-up casing Concrete
		FILL: Brown, silty sand, trace gravel, moist		2[1]	SS	8					
1.4	265.2	SILTY SAND TILL: Compact to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	26	265				Bentonite seal
				4	SS	25	264				
				5	SS	31	263				50 mm slotted pipe Filter sand
				6	SS	20					
5.0	261.6			7	SS	60/250 mm	262				
		BOREHOLE TERMINATED AT 5.0 m									Upon completion of augering No water No cave Water Level Readings: Date Depth(m) Elev. 2021-04-01 2.7 263.9 2021-04-30 3.2 263.4

SHEAR STRENGTH (kPa): +FIELD VANE △TORVANE ○ Qu ▲POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION STANDARD PENETRATION TEST ×
20 40 60 80
PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT
WATER CONTENT (%) 10 20 30 40

NOTES 1. Sample submitted for chemical testing

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 28

17T 603947E 4917292N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 267.45					
0.0	267.45						267
0.25	267.20	TOPSOIL: Brown to dark brown, sandy silt, trace gravel, moist		1	SS	3	
		FILL: Brown, sand, trace silt, trace gravel, moist		2	SS	10	
1.0							
1.4	266.1	SILTY SAND TILL: Compact to very dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	37	266
2.0				4	SS	45	265
3.0				5	SS	50	264
4.0							263
5.0				6	SS	36	262
6.0							
6.5	261.0	BOREHOLE TERMINATED AT 6.5 m		7	SS	27	261
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER O Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS

GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 29

17T 603937E 4917306N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 25, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN AT

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	ELEVATION SCALE
		SURFACE ELEVATION 268.15					
0.0	268.15						268
0.24	267.91	TOPSOIL: Brown to black, sandy silt to silty sand, trace gravel, moist		1	SS	4	
		FILL: Brown, silty sand, trace gravel, moist		2	SS	20	267
1.0				3	SS	26	
2.0	2.1						
	266.1	SILTY SAND TILL: Very dense to dense, brown, silty sand, trace gravel, trace clay, cobbles & boulders, moist		4	SS	52	266
3.0				5	SS	44	265
4.0							264
				6	SS	53	
5.0							263
6.0							262
	6.5			7	SS	37	
	261.7	BOREHOLE TERMINATED AT 6.5 m					
7.0							
8.0							
9.0							
10.0							
11.0							
12.0							
13.0							
14.0							
15.0							

SHEAR STRENGTH (kPa)
+ FIELD VANE △ TORVANE ○ Qu
▲ POCKET PENETROMETER ○ Q
50 100 150 200
DYNAMIC CONE PENETRATION ×
STANDARD PENETRATION TEST ●
20 40 60 80

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L
WATER CONTENT (%)
10 20 30 40

GAS READINGS ppm

GROUND WATER OBSERVATIONS AND REMARKS
GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL

Upon completion of augering
No water
No cave

NOTES

Peto MacCallum Ltd.
CONSULTING ENGINEERS

LOG OF BOREHOLE NO. 30

17T 603918E 4917331N

PROJECT Proposed Simcoe County Housing Facility
PML REF. 21BF014
LOCATION 20 Rose Street, Barrie, Ontario
BORING DATE March 26, 2021
ENGINEER GW
BORING METHOD Continuous Flight Solid Stem Augers
TECHNICIAN DP

DEPTH (metres)	ELEV	DESCRIPTION	STRAT PLOT	SAMPLES NUMBER	TYPE	"N" VALUES	ELEVATION SCALE	SHEAR STRENGTH (kPa) / DYNAMIC CONE PENETRATION / STANDARD PENETRATION TEST	PLASTIC LIMIT / NATURAL MOISTURE CONTENT / LIQUID LIMIT / WATER CONTENT (%)	GAS READINGS ppm	GROUND WATER OBSERVATIONS AND REMARKS / GRAIN SIZE DISTRIBUTION (%) GR SA SI&CL
		SURFACE ELEVATION 269.90									
0.0		PAVEMENT: 90 mm of asphalt, over 180 mm granular base, over 150 mm granular subbase, moist		1A 1B	GS	-					
0.42	269.48	FILL: Brown, silty sand, trace gravel, moist		2	SS	14	269				
1.0											
1.4	268.5	SILTY SAND TILL: Loose to very dense, brown to grey, silty sand, trace gravel, trace clay, cobbles & boulders, moist		3	SS	7	268				
2.0				4	SS	13					
3.0							267				
				5	SS	59					
4.0							266				
				6	SS	36					
5.0							265				
6.0							264				
6.5	263.4	BOREHOLE TERMINATED AT 6.5 m		7	SS	65/200 mm					Upon completion of augering No water No cave
7.0											
8.0											
9.0											
10.0											
11.0											
12.0											
13.0											
14.0											
15.0											

SHEAR STRENGTH (kPa): + FIELD VANE △ TORVANE ○ Qu ▲ POCKET PENETROMETER ○ Q; 50 100 150 200
DYNAMIC CONE PENETRATION × STANDARD PENETRATION TEST ●; 20 40 60 80
PLASTIC LIMIT w_P NATURAL MOISTURE CONTENT w LIQUID LIMIT w_L
WATER CONTENT (%): 10 20 30 40

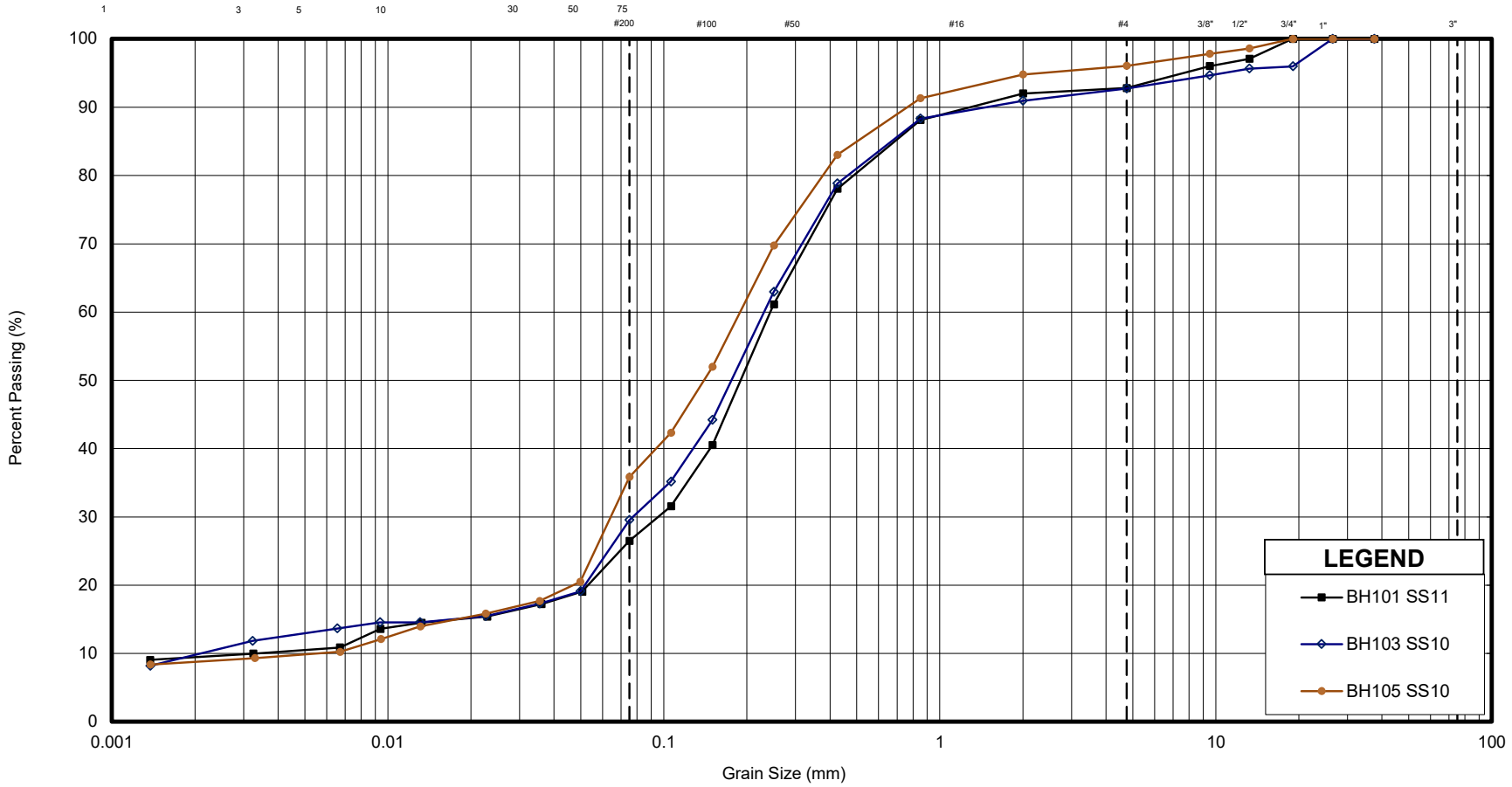
NOTES

Appendix D

Geotechnical Laboratory Testing

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH101 SS11	SAND, Some Silt, Trace Clay, Trace Gravel	7	67	17	9	0.003	0.095	0.243	73.2	11.3
BH103 SS10	SILTY SAND, Some Clay, Trace Gravel	7	63	20	10	0.002	0.077	0.231	109.6	12.3
BH105 SS10	SILTY SAND, Trace Clay, Trace Gravel	4	60	27	9	0.006	0.064	0.189	33.9	3.9

GEI Consultants

GRAIN SIZE DISTRIBUTION - 20 Rose Street, Barrie

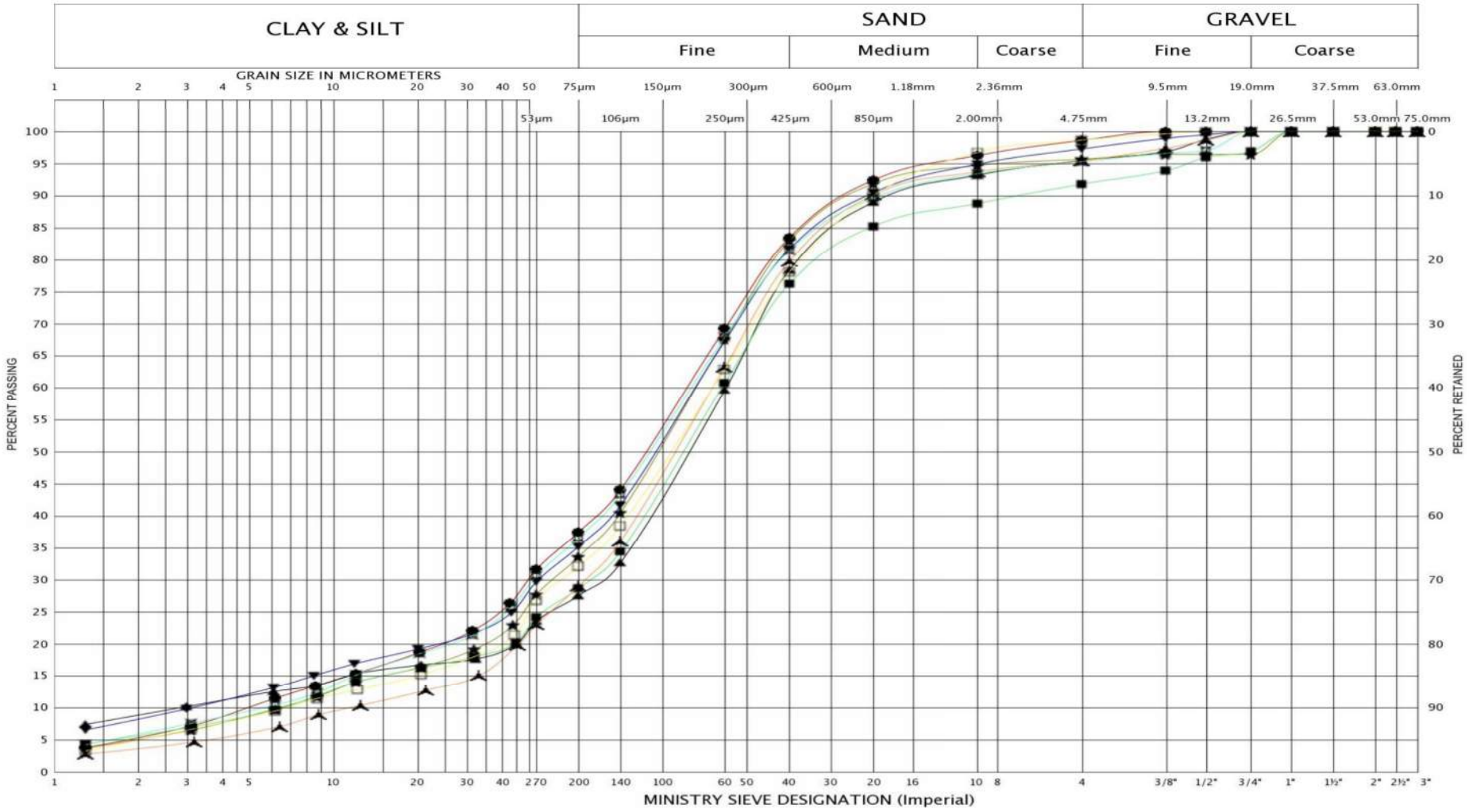
GLACIAL TILL

FIGURE No. D1

REF. No. 2305493

DATE October 2024

UNIFIED SOIL CLASSIFICATION SYSTEM



LEGEND	BH	3	6	10	17	20	24	27	27
	SAMPLE	4	3	5	12	2	4	3	5
	SYMBOL	□	⊠	●	▲	★	▼	⋏	■

PML Peto MacCallum Ltd.
CONSULTING ENGINEERS

GRAIN SIZE DISTRIBUTION

TILL: Silty Sand, Trace Gravel, Trace Clay

FIG No.: 1

Project No.: 21BF014

Appendix E

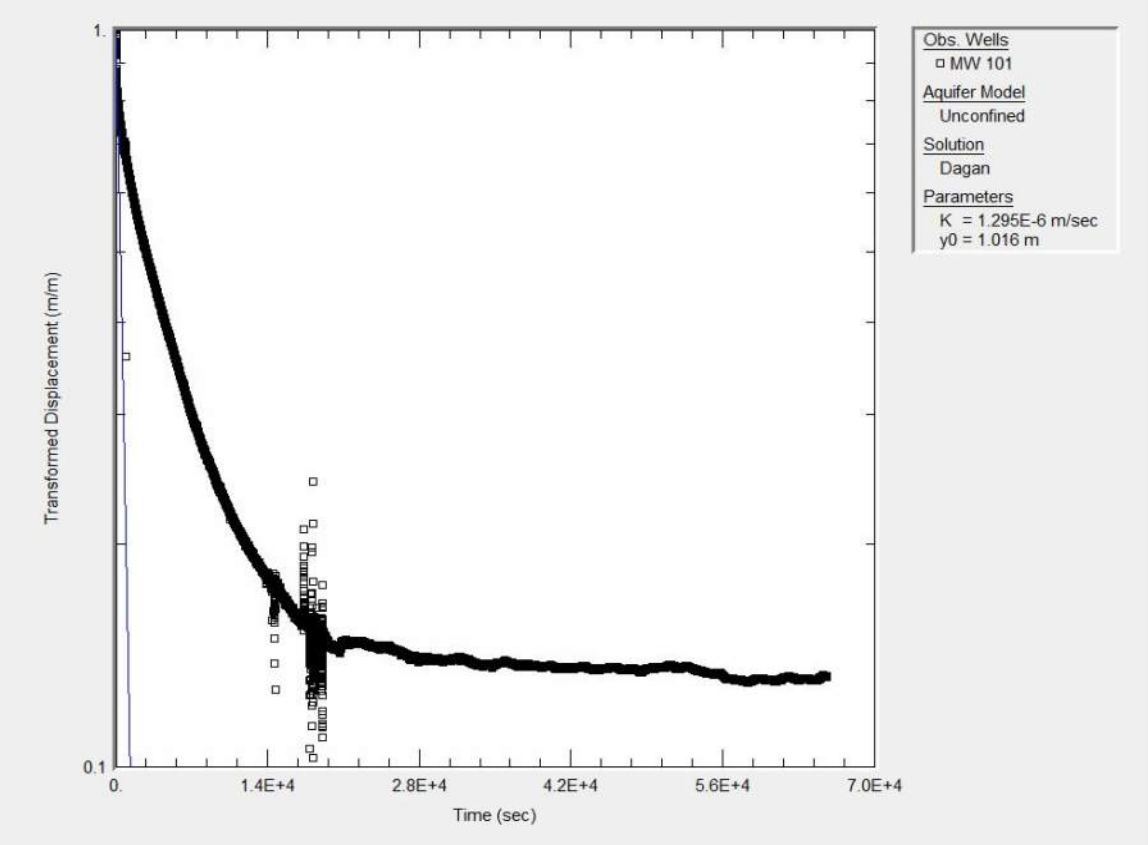
Hydraulic Conductivity Testing

GEI Consultants

Estimation of K by Slug Test, based on Dagan's equation

Date:	January 10, 2024
Conducted by:	A. Gula

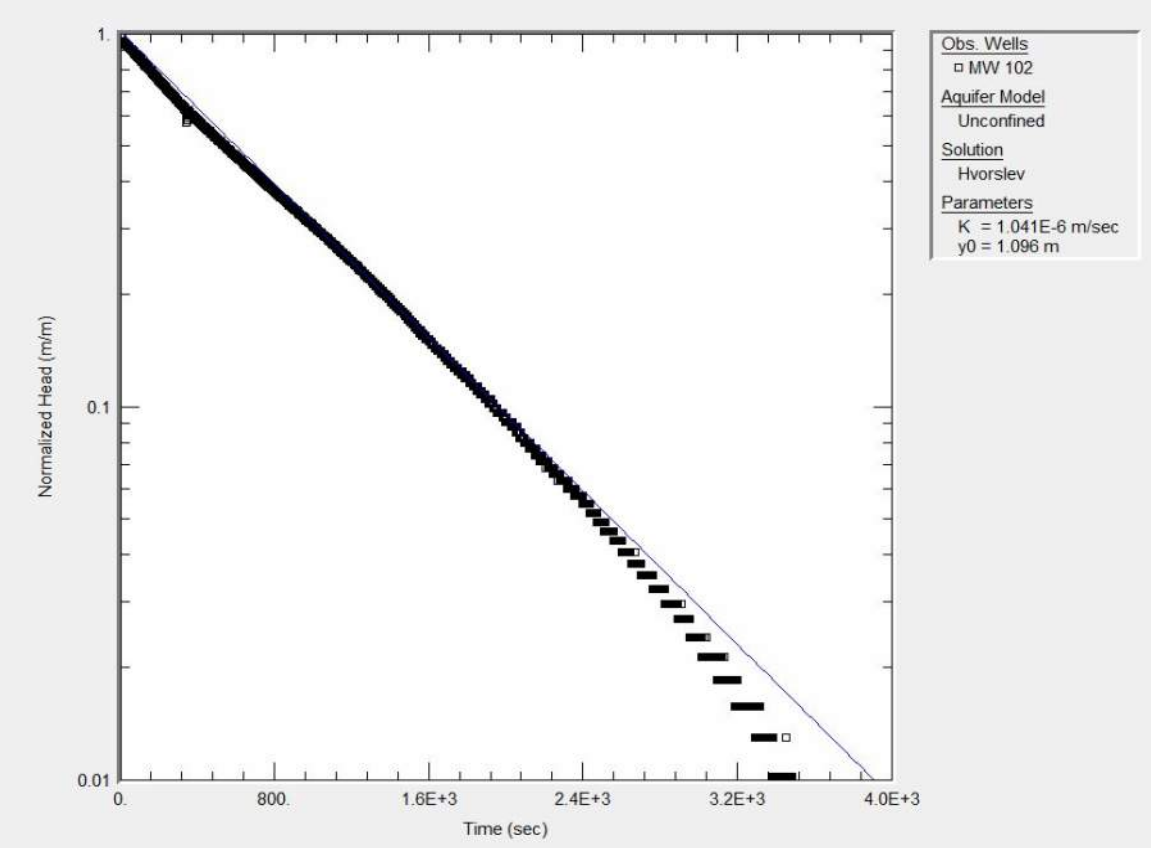
Well Number:	BH/MW 101	
Well Screen Bottom:	12.2	mbgs
Top of Pipe:	0.6	mags
Well Casing Diameter:	5.08	cm
Local Well Elevation:	271.5	masl
Static Water Level:	10.9	mbgs
K = h/(Ho(2L-h/(2L-Ho)) =	**1.3×10^{-6}**	m/s



Estimation of K by Slug Test, based on Hvorslev's equation

Date:	January 2, 2024
Conducted by:	A. Gula

Well Number:	BH/MW 102	
Well Screen Bottom:	12.5	mbgs
Top of Pipe:	0.8	mags
Well Casing Diameter:	5.08	cm
Local Well Elevation:	270.9	masl
Static Water Level:	10.0	mbgs
$K = r^2\ln(L/R)/(2LTo) =$	**$1.0x10^{-6}$**	m/s

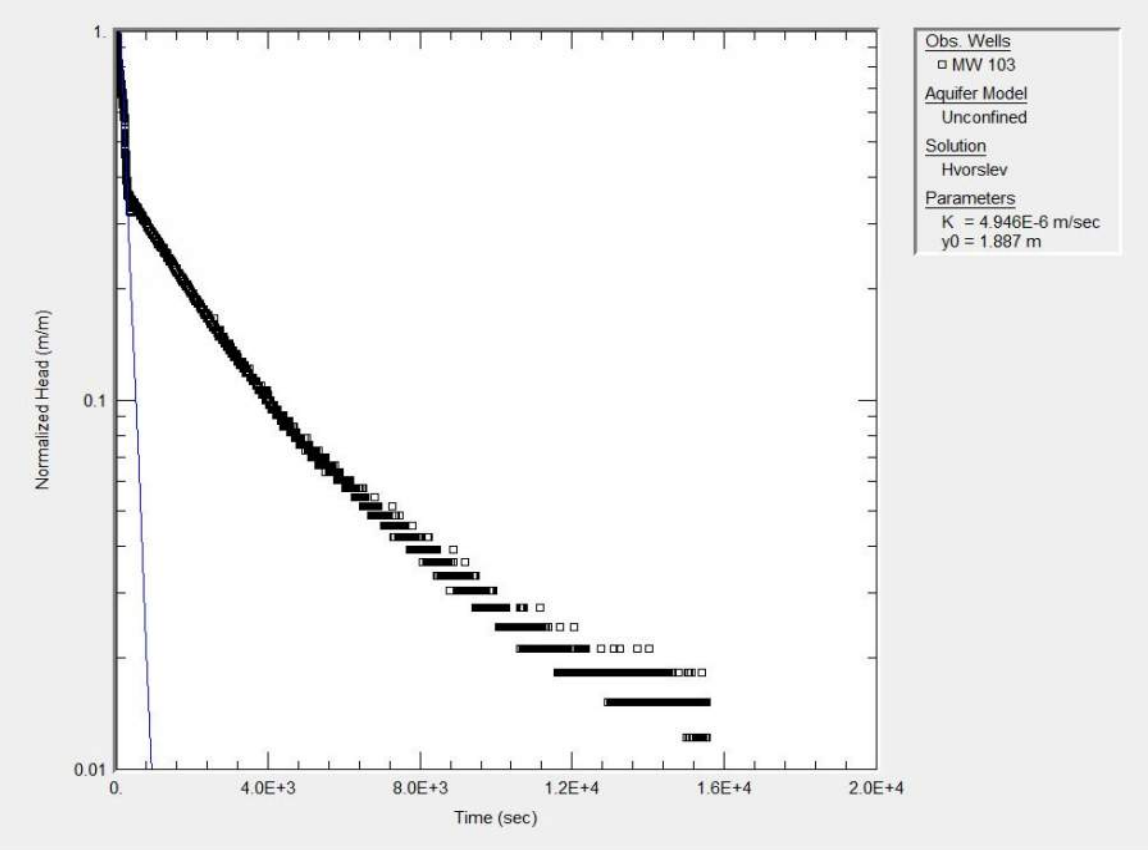


GEI Consultants

Estimation of K by Slug Test, based on Hvorslev's equation

Date:	January 10, 2024
Conducted by:	A. Gula

Well Number:	BH/MW 103	
Well Screen Bottom:	12.2	mbgs
Top of Pipe:	0.6	mags
Well Casing Diameter:	5.08	cm
Local Well Elevation:	270.0	masl
Static Water Level:	9.4	mbgs
$K = r^2\ln(L/R)/(2LTo)$ =	**$4.9x10^{-6}$**	m/s

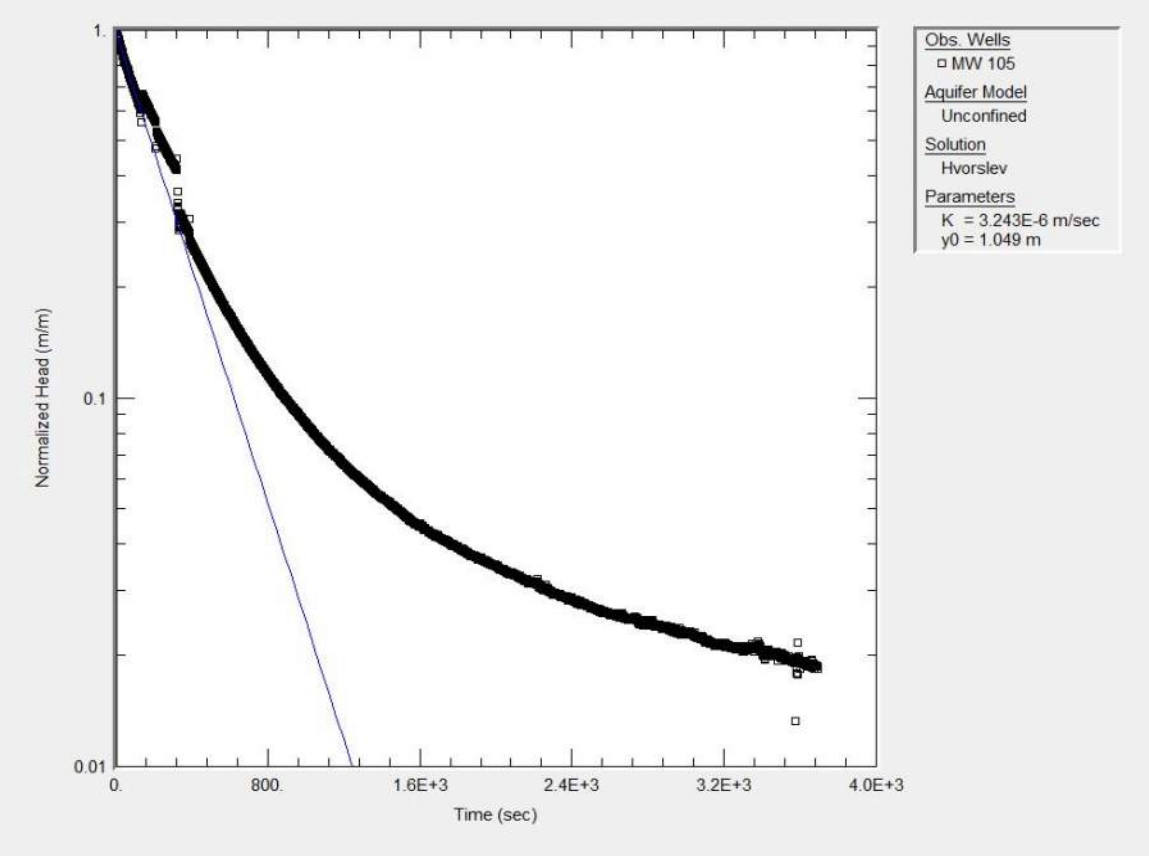


GEI Consultants

Estimation of K by Slug Test, based on Hvorslev's equation

Date:	January 2, 2024
Conducted by:	A. Gula

Well Number:	BH/MW 105	
Well Screen Bottom:	12.2	mbgs
Top of Pipe:	0.9	mags
Well Casing Diameter:	5.08	cm
Local Well Elevation:	270.2	masl
Static Water Level:	9.9	mbgs
$K = r^2\ln(L/R)/(2LTo)$ =	**$3.2x10^{-6}$**	m/s



Appendix F

Water Quality Laboratory Certificate of Analysis

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

CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 24-000429 - Rev. 0

Report To:
GEI Consultants
647 Welham Rd, Unit 14
Barrie, ON L4N 0B7

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Sarah Griffith

DATE RECEIVED: 2024-Jan-03
DATE REPORTED: 2024-Jan-09
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 2305493
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	2	OTTAWA	PCURIEL	2024-Jan-09	A-IC-01	SM 4110B
BOD5 (Liquid)	2	KINGSTON	JWOLFE2	2024-Jan-04	BOD-001	SM 5210B
COD (Liquid)	2	KINGSTON	EHINCH	2024-Jan-08	COD-001	SM 5220D
Cond/pH/Alk Auto (Liquid)	2	OTTAWA	SLOZO	2024-Jan-04	COND-02/PH-02/ALK-02	SM 2510B/4500H/2320B
Cyanide Total (Liquid)	2	KINGSTON	JMACINNES	2024-Jan-05	CN-001	SM 4500-CN-E
Chromium VI (Liquid)	4	OTTAWA	STAILLON	2024-Jan-08	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	4	OTTAWA	AOZKAYMAK	2024-Jan-05	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	4	OTTAWA	NHOGAN	2024-Jan-05	D-ICP-01	SM 3120B
Mercury (Liquid)	4	OTTAWA	TBENNETT	2024-Jan-05	D-HG-02	SM 3112B
ICPMS Precious Metals (Total)	2	OTTAWA	TPRICE	2024-Jan-09	D-ICPMS-01	EPA 6020
OC Pesticides (Liquid)	2	KINGSTON	CSUMMERHAYS	2024-Jan-06	PESTCL-001	EPA 8081
Oil & Grease (Liquid)	2	KINGSTON	MLANE	2024-Jan-05	O&G-001	SM 5520
PHC F1 (Liquid)	2	RICHMOND_HILL	FLENA	2024-Jan-06	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	2	KINGSTON	STHOMPSON	2024-Jan-05	PHC-W-001	MECP E3421
Phenols (Liquid)	2	KINGSTON	JMACINNES	2024-Jan-04	PHEN-01	MECP E3179
Sulphide (Liquid)	2	KINGSTON	EHINCH	2024-Jan-04	H2S-001	SM 4500-S2
SVOC - Semi-Volatiles (Liquid)	2	KINGSTON	EASIEDU	2024-Jan-08	NAB-W-001	EPA 8270D
TP & TKN (Liquid)	2	KINGSTON	KDIBBITS	2024-Jan-08	TPTKN-001	MECP E3516.2
TSS (Liquid)	4	KINGSTON	KKHUTSYYEVA	2024-Jan-04	TSS-001	SM 2540D
VOC-Volatiles Full (Water)	2	RICHMOND_HILL	FLENA	2024-Jan-06	C-VOC-02	EPA 8260

µg/g = micrograms per gram (parts per million) and is equal to mg/Kg
F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)
F2 C10-C16 hydrocarbons in µg/g, (F2-napth if requested)
F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)
F4 C34-C50 hydrocarbons in µg/g
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
Any deviations from the method are noted and reported for any particular sample.
nC6 and nC10 response factor is within 30% of response factor for toluene:
nC10,nC16 and nC34 response factors within 10% of each other:
C50 response factors within 70% of nC10+nC16+nC34 average:
Linearity is within 15%:
All results expressed on a dry weight basis.
Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.
If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in application to the CWS PHC
QC will be made available upon request.

Michelle Dubien
Data Specialist

The analytical results reported herein refer to the samples as received and relate only to the items tested. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

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

Michelle Dubien
Data Specialist

The analytical results reported herein refer to the samples as received and relate only to the items tested. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Final Report

REPORT No: 24-000429 - Rev. 0

Parameter	Units	R.L.	Limits		Client I.D.	MW 102	MW 102F	MW 105	MW 105F
					Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
					Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
						-	-	-	-
pH @25°C	pH units	-	9.5, 9.5	SAN, STORM		7.96		7.81	
Fluoride	mg/L	0.1	10	SAN		<0.7		<0.1	
Chloride	mg/L	0.5	1500	SAN		698		367	
Sulphate	mg/L	1	1500	SAN		58		22	
BOD5	mg/L	3	300, 15	SAN, STORM		24		<3	
Total Suspended Solids	mg/L	3	350, 15	SAN, STORM		67600	60200	19	6
Phosphorus (Total)	mg/L	0.01	10	SAN		52.9		55.7	
Total Kjeldahl Nitrogen	mg/L	0.1	100	SAN		11.0		8.0	
Sulphide	mg/L	0.01	1.0	SAN		<80.0		<8.00	
Cyanide (Total)	mg/L	0.005	1.2	SAN		<0.005		<0.005	
Phenolics	mg/L	0.001	0.1	SAN		<0.001		<0.001	
COD	mg/L	5	600	SAN		1250		700	
Hardness (as CaCO3)	mg/L	-				30000	352	7000	682
Aluminum (Total)	mg/L	0.01	50	SAN		728	0.080	138	0.117
Barium (Total)	mg/L	0.001	5	SAN		12.8		2.36	
Bismuth (Total)	mg/L	0.02	5	SAN		<0.02		<0.02	
Boron (Total)	mg/L	0.005				0.571	0.022	0.135	0.008
Calcium (Total)	mg/L	0.02				9740	102	2340	202
Iron (Total)	mg/L	0.005	50	SAN		933	0.079	190	0.025
Magnesium (Total)	mg/L	0.02				1070	23.5	180	43.0
Manganese (Total)	mg/L	0.001	5	SAN		34.8		6.11	

Michelle Dubien
Data Specialist

The analytical results reported herein refer to the samples as received and relate only to the items tested. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

Parameter	Units	R.L.	Limits		Client I.D.	MW 102	MW 102F	MW 105	MW 105F
					Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
					Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
						-	-	-	-
Tin (Total)	mg/L	0.05	5	SAN		<0.05		<0.05	
Tungsten (Total)	mg/L	0.01				<0.01	<0.01	<0.01	<0.01
Zinc (Total)	mg/L	0.005	2, 0.04	SAN, STORM		**2.56**	0.009	**0.485**	0.005
Zirconium (Total)	mg/L	0.003				0.116	<0.003	0.050	<0.003
Antimony (Total)	mg/L	0.0001	5	SAN		0.0007	0.0003	0.0004	<0.0001
Arsenic (Total)	mg/L	0.0001	1	SAN		0.0377	0.0004	0.0176	0.0001
Beryllium (Total)	mg/L	0.0001				0.0114	<0.0001	0.0042	<0.0001
Cadmium (Total)	mg/L	0.000015	0.7, 0.001	SAN, STORM		**0.00214**	0.000024	0.000920	<0.000015
Chromium (Total)	mg/L	0.001	2, 0.08	SAN, STORM		**0.385**	<0.001	**0.189**	0.002
Cobalt (Total)	mg/L	0.0001	5	SAN		0.197	0.0004	0.0953	0.0004
Copper (Total)	mg/L	0.0001	2, 0.01	SAN, STORM		**0.558**	0.0037	**0.259**	0.0010
Lead (Total)	mg/L	0.00002	0.7, 0.05	SAN, STORM		**0.198**	0.00012	**0.0591**	0.00004
Molybdenum (Total)	mg/L	0.0001	5	SAN		0.0036	0.0110	0.0024	0.0018
Nickel (Total)	mg/L	0.0002	2, 0.05	SAN, STORM		**0.369**	0.0016	**0.162**	0.0028
Selenium (Total)	mg/L	0.001	1	SAN		<0.002	<0.001	<0.002	<0.001
Silver (Total)	mg/L	0.0001	0.4	SAN		0.0007	<0.0001	0.0004	<0.0001
Thallium (Total)	mg/L	0.00005				0.00348	<0.00005	0.00168	<0.00005
Uranium (Total)	mg/L	0.00005				0.0197	0.00134	0.00474	0.00048
Vanadium (Total)	mg/L	0.0001	5	SAN		0.370	0.0006	0.248	0.0010
Gold (Total)	mg/L	0.0007	5	SAN		<0.0013		<0.0013	
Platinum (Total)	mg/L	0.00004	5	SAN		<0.00008		<0.00008	

Michelle Dubien
Data Specialist

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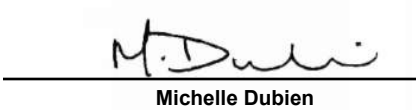
Parameter	Units	R.L.	Limits		Client I.D.	MW 102	MW 102F	MW 105	MW 105F
					Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
					Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
						-	-	-	-
Rhodium (Total)	mg/L	0.00002	5	SAN		0.00004		<0.00004	
Chromium (VI)	mg/L	0.001				<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.00002	0.01	SAN		0.00006	0.00005	<0.00002	<0.00002



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Parameter	Units	R.L.	Limits		Client I.D.	MW 102	MW 105
					Sample I.D.	24-000429-1	24-000429-3
					Date Collected	2024-Jan-03	2024-Jan-03
						-	-
Acetone	µg/L	30				<30	<30
Benzene	mg/L	0.0005	0.01	SAN		<0.0005	<0.0005
Bromodichloromethane	µg/L	2				<2	<2
Bromoform	µg/L	5				<5	<5
Bromomethane	µg/L	0.5				<0.5	<0.5
Carbon Tetrachloride	µg/L	0.2				<0.2	<0.2
Chlorobenzene	µg/L	0.5				<0.5	<0.5
Chloroform	µg/L	1				5	<1
Dibromochloromethane	µg/L	2				<2	<2
Ethylene Dibromide	µg/L	0.2				<0.2	<0.2
Dichlorobenzene,1,2-	mg/L	0.0005	0.05	SAN		<0.0005	<0.0005
Dichlorobenzene,1,3-	µg/L	0.5				<0.5	<0.5
Dichlorobenzene,1,4-	mg/L	0.0005	0.08	SAN		<0.0005	<0.0005
Dichlorodifluoromethane (Freon 12)	µg/L	2				<2	<2
Dichloroethane,1,1-	µg/L	0.5				<0.5	<0.5
Dichloroethane,1,2-	µg/L	0.5				<0.5	<0.5
Dichloroethylene,1,1-	µg/L	0.5				<0.5	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5				<0.5	<0.5
Dichloroethylene,1,2-trans-	µg/L	0.5				<0.5	<0.5
Dichloropropane,1,2-	µg/L	0.5				<0.5	<0.5
Dichloropropene,1,3-cis-	µg/L	0.5				<0.5	<0.5

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Parameter	Units	R.L.	Limits		Client I.D. MW 102	Client I.D. MW 105
					Sample I.D. 24-000429-1	Sample I.D. 24-000429-3
					Date Collected 2024-Jan-03	Date Collected 2024-Jan-03
					-	-
Dichloropropene,1,3-cis+trans-(Calculated)	µg/L	0.5			<0.5	<0.5
Dichloropropene,1,3-trans-	µg/L	0.5			<0.5	<0.5
Ethylbenzene	mg/L	0.0005	0.06	SAN	<0.0005	<0.0005
Hexane	µg/L	5			<5	<5
Dichloromethane (Methylene Chloride)	mg/L	0.005	0.09	SAN	<0.005	<0.005
Methyl Ethyl Ketone	µg/L	20			<20	<20
Methyl Isobutyl Ketone	µg/L	20			<20	<20
Methyl tert-Butyl Ether (MTBE)	µg/L	2			<2	<2
Styrene	µg/L	0.5			<0.5	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5			<0.5	<0.5
Tetrachloroethane,1,1,2,2-	mg/L	0.0005	0.06	SAN	<0.0005	<0.0005
Tetrachloroethylene	mg/L	0.0005	0.06	SAN	<0.0005	<0.0005
Toluene	mg/L	0.0005	0.02	SAN	0.0007	<0.0005
Trichloroethane,1,1,1-	µg/L	0.5			<0.5	<0.5
Trichloroethane,1,1,2-	µg/L	0.5			<0.5	<0.5
Trichloroethylene	mg/L	0.0005	0.05	SAN	<0.0005	<0.0005
Trichlorofluoromethane (Freon 11)	µg/L	5			<5	<5
Vinyl Chloride	µg/L	0.2			<0.2	<0.2
Xylene, m,p-	µg/L	1			<1	<1
Xylene, m,p,o-	mg/L	0.0011	0.3	SAN	<0.0011	<0.0011
Xylene, o-	µg/L	0.5			<0.5	<0.5

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				Client I.D.	MW 102	MW 105
				Sample I.D.	24-000429-1	24-000429-3
				Date Collected	2024-Jan-03	2024-Jan-03
Parameter	Units	R.L.	Limits		-	-
PHC F1 (C6-C10)	µg/L	25			<25	<25
PHC F2 (>C10-C16)	µg/L	50			<50	<50
PHC F3 (>C16-C34)	µg/L	400			<400	<400
PHC F4 (>C34-C50)	µg/L	400			<400	<400
Oil and Grease (Mineral)	mg/L	1.0	15	SAN	<1.0	<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0	150	SAN	2.5	2.9

Michelle Dubien
Data Specialist

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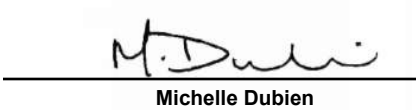
Parameter	Units	R.L.	Limits		Client I.D. MW 102 Sample I.D. 24-000429-1 Date Collected 2024-Jan-03 -	Client I.D. MW 105 Sample I.D. 24-000429-3 Date Collected 2024-Jan-03 -
Acenaphthene	µg/L	0.05			<0.05	<0.05
Acenaphthylene	µg/L	0.05			<0.05	<0.05
Anthracene	µg/L	0.05			<0.05	<0.05
Benzo[a]anthracene	µg/L	0.05			<0.05	<0.05
Benzo(a)pyrene	µg/L	0.01			<0.01	<0.01
Benzo(b)fluoranthene	µg/L	0.05			<0.05	<0.05
Benzo(b+k)fluoranthene	µg/L	0.1			<0.1	<0.1
Benzo(g,h,i)perylene	µg/L	0.05			<0.05	<0.05
Benzo(k)fluoranthene	µg/L	0.05			<0.05	<0.05
Chrysene	µg/L	0.05			<0.05	<0.05
Dibenzo(a,h)anthracene	µg/L	0.05			<0.05	<0.05
Fluoranthene	µg/L	0.05			<0.05	<0.05
Fluorene	µg/L	0.05			<0.05	<0.05
Indeno(1,2,3,-cd)Pyrene	µg/L	0.05			<0.05	<0.05
Methylnaphthalene,1-	µg/L	0.05			<0.05	<0.05
Methylnaphthalene,2-(1-)	µg/L	1			<1	<1
Methylnaphthalene,2-	µg/L	0.05			<0.05	<0.05
Naphthalene	µg/L	0.05			<0.05	<0.05
Phenanthrene	µg/L	0.05			<0.05	<0.05
Pyrene	µg/L	0.05			<0.05	<0.05
Total PAH	mg/L	0.0001	0.005	SAN	0.0002	0.0002



Michelle Dubien
Data Specialist

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				Client I.D.	MW 102	MW 105
				Sample I.D.	24-000429-1	24-000429-3
				Date Collected	2024-Jan-03	2024-Jan-03
Parameter	**Units**	**R.L.**	**Limits**		-	-
Hexachlorobenzene	mg/L	0.00001	0.0001	SAN	<0.00001	<0.00001

: City of Barrie Sewer Use By-Law
SAN: Sanitary Sewer By Law
STORM: Storm Sewer By Law

Michelle Dubien
Data Specialist

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Summary of Exceedances

Sanitary Sewer By Law

MW 102	Found Value	Limit
Total Suspended Solids	67600	350
Phosphorus (Total)	52.9	10
Sulphide	<80.0	1.0
COD	1250	600
Aluminum (Total)	728	50
Barium (Total)	12.8	5
Iron (Total)	933	50
Manganese (Total)	34.8	5
Zinc (Total)	2.56	2
MW 102F	**Found Value**	**Limit**
Total Suspended Solids	60200	350
MW 105	**Found Value**	**Limit**
Phosphorus (Total)	55.7	10
Sulphide	<8.00	1.0
COD	700	600
Aluminum (Total)	138	50
Iron (Total)	190	50
Manganese (Total)	6.11	5

Storm Sewer By Law

MW 102	Found Value	Limit
BOD5	24	15
Total Suspended Solids	67600	15
Zinc (Total)	2.56	0.04
Cadmium (Total)	0.00214	0.001
Chromium (Total)	0.385	0.08
Copper (Total)	0.558	0.01
Lead (Total)	0.198	0.05
Nickel (Total)	0.369	0.05
MW 102F	**Found Value**	**Limit**
Total Suspended Solids	60200	15
MW 105	**Found Value**	**Limit**
Total Suspended Solids	19	15
Zinc (Total)	0.485	0.04
Chromium (Total)	0.189	0.08
Copper (Total)	0.259	0.01

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Lead (Total)	0.0591	0.05
Nickel (Total)	0.162	0.05

Michelle Dubien
Data Specialist

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 24-000429 - Rev. 0

Report To:
GEI Consultants
647 Welham Rd, Unit 14
Barrie, ON L4N 0B7

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Sarah Griffith

DATE RECEIVED: 2024-Jan-03
DATE REPORTED: 2024-Jan-09
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 2305493
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	2	OTTAWA	PCURIEL	2024-Jan-09	A-IC-01	SM 4110B
BOD5 (Liquid)	2	KINGSTON	JWOLFE2	2024-Jan-04	BOD-001	SM 5210B
COD (Liquid)	2	KINGSTON	EHINCH	2024-Jan-08	COD-001	SM 5220D
Cond/pH/Alk Auto (Liquid)	2	OTTAWA	SLOZO	2024-Jan-04	COND-02/PH-02/ALK-02	SM 2510B/4500H/2320B
Cyanide Total (Liquid)	2	KINGSTON	JMACINNES	2024-Jan-05	CN-001	SM 4500-CN-E
Chromium VI (Liquid)	4	OTTAWA	STAILLON	2024-Jan-08	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	4	OTTAWA	AOZKAYMAK	2024-Jan-05	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	4	OTTAWA	NHOGAN	2024-Jan-05	D-ICP-01	SM 3120B
Mercury (Liquid)	4	OTTAWA	TBENNETT	2024-Jan-05	D-HG-02	SM 3112B
ICPMS Precious Metals (Total)	2	OTTAWA	TPRICE	2024-Jan-09	D-ICPMS-01	EPA 6020
Oil & Grease (Liquid)	2	KINGSTON	MLANE	2024-Jan-05	O&G-001	SM 5520
PHC F1 (Liquid)	2	RICHMOND_HILL	FLENA	2024-Jan-06	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	2	KINGSTON	STHOMPSON	2024-Jan-05	PHC-W-001	MECP E3421
Phenols (Liquid)	2	KINGSTON	JMACINNES	2024-Jan-04	PHEN-01	MECP E3179
Sulphide (Liquid)	2	KINGSTON	EHINCH	2024-Jan-04	H2S-001	SM 4500-S2
TP & TKN (Liquid)	2	KINGSTON	KDIBBITS	2024-Jan-08	TPTKN-001	MECP E3516.2
TSS (Liquid)	4	KINGSTON	KKHUTSYYEVA	2024-Jan-04	TSS-001	SM 2540D
VOC-Volatiles Full (Water)	2	RICHMOND_HILL	FLENA	2024-Jan-06	C-VOC-02	EPA 8260

µg/g = micrograms per gram (parts per million) and is equal to mg/Kg
F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)
F2 C10-C16 hydrocarbons in µg/g, (F2-napth if requested)
F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)
F4 C34-C50 hydrocarbons in µg/g
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
Any deviations from the method are noted and reported for any particular sample.
nC6 and nC10 response factor is within 30% of response factor for toluene:
nC10,nC16 and nC34 response factors within 10% of each other:
C50 response factors within 70% of nC10+nC16+nC34 average:
Linearity is within 15%:
All results expressed on a dry weight basis.
Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

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

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.
If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in application to the CWS PHC
QC will be made available upon request.

Christine Burke
Laboratory Manager

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Final Report

REPORT No: 24-000429 - Rev. 0

Parameter	Units	R.L.	Limits		Client I.D.	MW 102	MW 102F	MW 105	MW 105F
					Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
					Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
						-	-	-	-
pH @25°C	pH units	-	8.5	PWQO		7.96		7.81	
Fluoride	mg/L	0.1				<0.7		<0.1	
Chloride	mg/L	0.5				698		367	
Sulphate	mg/L	1				58		22	
BOD5	mg/L	3				24		<3	
Total Suspended Solids	mg/L	3				67600	60200	19	6
Phosphorus (Total)	µg/L	10	10	INTERIM		52900		55700	
Total Kjeldahl Nitrogen	mg/L	0.1				11.0		8.0	
Sulphide	mg/L	0.01				<80.0		<8.00	
Cyanide (Total)	mg/L	0.005				<0.005		<0.005	
Phenolics	µg/L	1	1	PWQO		<1		<1	
COD	mg/L	5				1250		700	
Hardness (as CaCO3)	mg/L as CaCO3	-				30000	352	7000	682
Aluminum (Total)	µg/L	10				728000	80	138000	117
Barium (Total)	µg/L	1				12800		2360	
Bismuth (Total)	µg/L	20				<20		<20	
Boron (Total)	µg/L	5	200	INTERIM		571	22	135	8
Calcium (Total)	µg/L	20				9740000	102000	2340000	202000
Iron (Total)	µg/L	5	300	PWQO		933000	79	190000	25
Magnesium (Total)	µg/L	20				1070000	23500	180000	43000
Manganese (Total)	µg/L	1				34800		6110	

Christine Burke
Laboratory Manager

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Parameter	Units	R.L.	Limits		Client I.D.	MW 102	MW 102F	MW 105	MW 105F
					Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
					Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
						-	-	-	-
Tin (Total)	µg/L	50				<50		<50	
Tungsten (Total)	µg/L	10	30	INTERIM		<10	<10	<10	<10
Zinc (Total)	µg/L	5	20, 30	INTERIM, PWQO		2560	9	485	5
Zirconium (Total)	µg/L	3	4	INTERIM		116	<3	50	<3
Antimony (Total)	µg/L	0.1	20	INTERIM		0.7	0.3	0.4	<0.1
Arsenic (Total)	µg/L	0.1	5, 5	INTERIM, PWQO		37.7	0.4	17.6	0.1
Beryllium (Total)	µg/L	0.1	11	PWQO		11.4	<0.1	4.2	<0.1
Cadmium (Total)	µg/L	0.015	0.1, 0.2	INTERIM, PWQO		2.14	0.024	0.920	<0.015
Chromium (Total)	µg/L	1				385	<1	189	2
Cobalt (Total)	µg/L	0.1	0.9	INTERIM		197	0.4	95.3	0.4
Copper (Total)	µg/L	0.1	5	INTERIM		558	3.7	259	1.0
Lead (Total)	µg/L	0.02	1, 5	INTERIM, PWQO		198	0.12	59.1	0.04
Molybdenum (Total)	µg/L	0.1	40	INTERIM		3.6	11.0	2.4	1.8
Nickel (Total)	µg/L	0.2	25	PWQO		369	1.6	162	2.8
Selenium (Total)	µg/L	1	100	PWQO		<2	<1	<2	<1
Silver (Total)	µg/L	0.1	0.1	PWQO		0.7	<0.1	0.4	<0.1
Thallium (Total)	µg/L	0.05	0.3, 0.3	INTERIM, PWQO		3.48	<0.05	1.68	<0.05
Uranium (Total)	µg/L	0.05	5	INTERIM		19.7	1.34	4.74	0.48
Vanadium (Total)	µg/L	0.1	6	INTERIM		370	0.6	248	1.0
Gold (Total)	mg/L	0.0007				<0.0013		<0.0013	
Platinum (Total)	mg/L	0.00004				<0.00008		<0.00008	

Christine Burke
Laboratory Manager

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Final Report

REPORT No: 24-000429 - Rev. 0

				Client I.D.	MW 102	MW 102F	MW 105	MW 105F
				Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
				Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
Parameter	**Units**	**R.L.**	**Limits**		-	-	-	-
Rhodium (Total)	mg/L	0.00002			0.00004		<0.00004	
Chromium (VI)	µg/L	1	1	PWQO	<1	<1	<1	<1
Mercury	µg/L	0.02	0.2	PWQO	0.06	0.05	<0.02	<0.02

Christine Burke
Laboratory Manager

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Parameter	Units	R.L.	Limits		Client I.D. MW 102	Client I.D. MW 105
					Sample I.D. 24-000429-1	Sample I.D. 24-000429-3
					Date Collected 2024-Jan-03	Date Collected 2024-Jan-03
					-	-
Acetone	µg/L	30			<30	<30
Benzene	µg/L	0.5	100	INTERIM	<0.5	<0.5
Bromodichloromethane	µg/L	2	200	INTERIM	<2	<2
Bromoform	µg/L	5	60	INTERIM	<5	<5
Bromomethane	µg/L	0.5	0.9	INTERIM	<0.5	<0.5
Carbon Tetrachloride	µg/L	0.2			<0.2	<0.2
Chlorobenzene	µg/L	0.5	15	PWQO	<0.5	<0.5
Chloroform	µg/L	1			5	<1
Dibromochloromethane	µg/L	2	40	INTERIM	<2	<2
Ethylene Dibromide	µg/L	0.2	5, 5	INTERIM, PWQO	<0.2	<0.2
Dichlorobenzene,1,2-	µg/L	0.5	2.5	PWQO	<0.5	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	2.5	PWQO	<0.5	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	4	PWQO	<0.5	<0.5
Dichlorodifluoromethane (Freon 12)	µg/L	2			<2	<2
Dichloroethane,1,1-	µg/L	0.5	200	INTERIM	<0.5	<0.5
Dichloroethane,1,2-	µg/L	0.5	100	INTERIM	<0.5	<0.5
Dichloroethylene,1,1-	µg/L	0.5	40	INTERIM	<0.5	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	200	INTERIM	<0.5	<0.5
Dichloroethylene,1,2-trans-	µg/L	0.5	200	INTERIM	<0.5	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.7	INTERIM	<0.5	<0.5
Dichloropropene,1,3-cis-	µg/L	0.5			<0.5	<0.5

Christine Burke
Laboratory Manager

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Parameter	Units	R.L.	Limits		Client I.D. MW 102 Sample I.D. 24-000429-1 Date Collected 2024-Jan-03 -	Client I.D. MW 105 Sample I.D. 24-000429-3 Date Collected 2024-Jan-03 -
Dichloropropene,1,3-cis+trans-(Calculated)	µg/L	0.5			<0.5	<0.5
Dichloropropene,1,3-trans-	µg/L	0.5	7	INTERIM	<0.5	<0.5
Ethylbenzene	µg/L	0.5	8	INTERIM	<0.5	<0.5
Hexane	µg/L	5			<5	<5
Dichloromethane (Methylene Chloride)	µg/L	5	100	INTERIM	<5	<5
Methyl Ethyl Ketone	µg/L	20	400	INTERIM	<20	<20
Methyl Isobutyl Ketone	µg/L	20			<20	<20
Methyl tert-Butyl Ether (MTBE)	µg/L	2	200	INTERIM	<2	<2
Styrene	µg/L	0.5	4	INTERIM	<0.5	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5	20	INTERIM	<0.5	<0.5
Tetrachloroethane,1,1,2,2-	µg/L	0.5	70	INTERIM	<0.5	<0.5
Tetrachloroethylene	µg/L	0.5	50	INTERIM	<0.5	<0.5
Toluene	µg/L	0.5	0.8, 0.8	INTERIM, PWQO	0.7	<0.5
Trichloroethane,1,1,1-	µg/L	0.5	10	INTERIM	<0.5	<0.5
Trichloroethane,1,1,2-	µg/L	0.5	800	INTERIM	<0.5	<0.5
Trichloroethylene	µg/L	0.5	20	INTERIM	<0.5	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5			<5	<5
Vinyl Chloride	µg/L	0.2	600	INTERIM	<0.2	<0.2
Xylene, m,p-	µg/L	1			<1	<1
Xylene, m,p,o-	µg/L	1.1			<1.1	<1.1
Xylene, o-	µg/L	0.5	40	INTERIM	<0.5	<0.5

Christine Burke
Laboratory Manager

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				Client I.D.	MW 102	MW 105
				Sample I.D.	24-000429-1	24-000429-3
				Date Collected	2024-Jan-03	2024-Jan-03
Parameter	Units	R.L.	Limits		-	-
PHC F1 (C6-C10)	µg/L	25			<25	<25
PHC F2 (>C10-C16)	µg/L	50			<50	<50
PHC F3 (>C16-C34)	µg/L	400			<400	<400
PHC F4 (>C34-C50)	µg/L	400			<400	<400
Oil and Grease (Mineral)	mg/L	1.0			<1.0	<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0			2.5	2.9

: PWQO Limits
INTERIM: Interim PWQO
PWQO: PWQO

Christine Burke
Laboratory Manager

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Summary of Exceedances

Interim PWQO

MW 102	Found Value	Limit
Phosphorus (Total)	52900	10
Boron (Total)	571	200
Zinc (Total)	2560	20
Zirconium (Total)	116	4
Arsenic (Total)	37.7	5
Cadmium (Total)	2.14	0.1
Cobalt (Total)	197	0.9
Copper (Total)	558	5
Lead (Total)	198	1
Thallium (Total)	3.48	0.3
Uranium (Total)	19.7	5
Vanadium (Total)	370	6

MW 105	Found Value	Limit
Phosphorus (Total)	55700	10
Zinc (Total)	485	20
Zirconium (Total)	50	4
Arsenic (Total)	17.6	5
Cadmium (Total)	0.920	0.1
Cobalt (Total)	95.3	0.9
Copper (Total)	259	5
Lead (Total)	59.1	1
Thallium (Total)	1.68	0.3
Vanadium (Total)	248	6

PWQO

MW 102	Found Value	Limit
Iron (Total)	933000	300
Zinc (Total)	2560	30
Arsenic (Total)	37.7	5
Beryllium (Total)	11.4	11
Cadmium (Total)	2.14	0.2
Lead (Total)	198	5
Nickel (Total)	369	25
Silver (Total)	0.7	0.1
Thallium (Total)	3.48	0.3

MW 105	Found Value	Limit

Christine Burke
Laboratory Manager

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Iron (Total)	190000	300
Zinc (Total)	485	30
Arsenic (Total)	17.6	5
Cadmium (Total)	0.920	0.2
Lead (Total)	59.1	5
Nickel (Total)	162	25
Silver (Total)	0.4	0.1
Thallium (Total)	1.68	0.3

Christine Burke
Laboratory Manager

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CERTIFICATE OF ANALYSIS

Final Report

C.O.C.: -

REPORT No: 24-000429 - Rev. 1

Report To:
GEI Consultants
647 Welham Rd, Unit 14
Barrie, ON L4N 0B7

CADUCEON Environmental Laboratories
112 Commerce Park Dr Unit L
Barrie, ON L4N 8W8

Attention: Sarah Griffith

DATE RECEIVED: 2024-Jan-03
DATE REPORTED: 2024-Jan-09
SAMPLE MATRIX: Ground Water

CUSTOMER PROJECT: 2305493
P.O. NUMBER:

Analyses	Qty	Site Analyzed	Authorized	Date Analyzed	Lab Method	Reference Method
Anions (Liquid)	2	OTTAWA	PCURIEL	2024-Jan-09	A-IC-01	SM 4110B
BOD5 (Liquid)	2	KINGSTON	JWOLFE2	2024-Jan-04	BOD-001	SM 5210B
COD (Liquid)	2	KINGSTON	EHINCH	2024-Jan-08	COD-001	SM 5220D
Cond/pH/Alk Auto (Liquid)	2	OTTAWA	SLOZO	2024-Jan-04	COND-02/PH-02/ALK-02	SM 2510B/4500H/2320B
Cyanide Total (Liquid)	2	KINGSTON	JMACINNES	2024-Jan-05	CN-001	SM 4500-CN-E
Chromium VI (Liquid)	4	OTTAWA	STAILLON	2024-Jan-08	D-CRVI-01	MECP E3056
ICP/MS Total (Liquid)	4	OTTAWA	AOZKAYMAK	2024-Jan-05	D-ICPMS-01	EPA 6020
ICP/OES Total (Liquid)	4	OTTAWA	NHOGAN	2024-Jan-05	D-ICP-01	SM 3120B
Mercury (Liquid)	4	OTTAWA	TBENNETT	2024-Jan-05	D-HG-02	SM 3112B
ICPMS Precious Metals (Total)	2	OTTAWA	TPRICE	2024-Jan-09	D-ICPMS-01	EPA 6020
Oil & Grease (Liquid)	2	KINGSTON	MLANE	2024-Jan-05	O&G-001	SM 5520
PHC F1 (Liquid)	2	RICHMOND_HILL	FLENA	2024-Jan-06	C-VPHW-01	MECP E3421
PHC F2-4 (Liquid)	2	KINGSTON	STHOMPSON	2024-Jan-05	PHC-W-001	MECP E3421
Phenols (Liquid)	2	KINGSTON	JMACINNES	2024-Jan-04	PHEN-01	MECP E3179
Sulphide (Liquid)	2	KINGSTON	EHINCH	2024-Jan-04	H2S-001	SM 4500-S2
TP & TKN (Liquid)	2	KINGSTON	KDIBBITS	2024-Jan-08	TPTKN-001	MECP E3516.2
TSS (Liquid)	4	KINGSTON	KKHUTSYYEVA	2024-Jan-04	TSS-001	SM 2540D
VOC-Volatiles Full (Water)	2	RICHMOND_HILL	FLENA	2024-Jan-06	C-VOC-02	EPA 8260

µg/g = micrograms per gram (parts per million) and is equal to mg/Kg
F1 C6-C10 hydrocarbons in µg/g, (F1-btex if requested)
F2 C10-C16 hydrocarbons in µg/g, (F2-napth if requested)
F3 C16-C34 hydrocarbons in µg/g, (F3-pah if requested)
F4 C34-C50 hydrocarbons in µg/g
This method complies with the Reference Method for the CWS PHC and is validated for use in the laboratory.
Any deviations from the method are noted and reported for any particular sample.
nC6 and nC10 response factor is within 30% of response factor for toluene:
nC10,nC16 and nC34 response factors within 10% of each other:
C50 response factors within 70% of nC10+nC16+nC34 average:
Linearity is within 15%:
All results expressed on a dry weight basis.
Unless otherwise noted all chromatograms returned to baseline by the retention time of nC50.

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

Unless otherwise noted all extraction, analysis, QC requirements and limits for holding time were met.
If analyzed for F4 and F4G they are not to be summed but the greater of the two numbers are to be used in application to the CWS PHC
QC will be made available upon request.

Christine Burke
Laboratory Manager

The analytical results reported herein refer to the samples as received and relate only to the items tested. Reproduction of this analytical report in full or in part is prohibited without prior consent from Caduceon Environmental Laboratories.

				Client I.D.	MW 102	MW 102F	MW 105	MW 105F
				Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
				Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
Parameter	**Units**	**R.L.**	**Limits**	**Reg 153 - Liquid**	-	-	-	-
pH @25°C	pH units	-			7.96		7.81	
Fluoride	µg/L	100			<700		<100	
Chloride	µg/L	500	790000	T1GW	698000		367000	
Sulphate	µg/L	1000			58000		22000	
BOD5	mg/L	3			24		<3	
Total Suspended Solids	mg/L	3			67600	60200	19	6
Phosphorus (Total)	mg/L	0.01			52.9		55.7	
Total Kjeldahl Nitrogen	mg/L	0.1			11.0		8.0	
Sulphide	mg/L	0.01			<80.0		<8.00	
Cyanide (Total)	µg/L	5			<5		<5	
Phenolics	mg/L	0.001			<0.001		<0.001	
COD	mg/L	5			1250		700	
Hardness (as CaCO3)	mg/L	-			30000	352	7000	682
Aluminum (Total)	mg/L	0.01			728	0.080	138	0.117
Barium (Total)	mg/L	0.001			12.8		2.36	
Bismuth (Total)	mg/L	0.02			<0.02		<0.02	
Boron (Total)	mg/L	0.005			0.571	0.022	0.135	0.008
Calcium (Total)	mg/L	0.02			9740	102	2340	202
Iron (Total)	mg/L	0.005			933	0.079	190	0.025
Magnesium (Total)	mg/L	0.02			1070	23.5	180	43.0
Manganese (Total)	mg/L	0.001			34.8		6.11	

Christine Burke
Laboratory Manager

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Parameter	Units	R.L.	Limits	Reg 153 - Liquid	Client I.D. MW 102	MW 102F	MW 105	MW 105F
					Sample I.D. 24-000429-1	24-000429-2	24-000429-3	24-000429-4
					Date Collected 2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
					-	-	-	-
Tin (Total)	mg/L	0.05			<0.05		<0.05	
Tungsten (Total)	mg/L	0.01			<0.01	<0.01	<0.01	<0.01
Zinc (Total)	mg/L	0.005			2.56	0.009	0.485	0.005
Zirconium (Total)	mg/L	0.003			0.116	<0.003	0.050	<0.003
Antimony (Total)	mg/L	0.0001			0.0007	0.0003	0.0004	<0.0001
Arsenic (Total)	mg/L	0.0001			0.0377	0.0004	0.0176	0.0001
Beryllium (Total)	mg/L	0.0001			0.0114	<0.0001	0.0042	<0.0001
Cadmium (Total)	mg/L	0.000015			0.00214	0.000024	0.000920	<0.000015
Chromium (Total)	mg/L	0.001			0.385	<0.001	0.189	0.002
Cobalt (Total)	mg/L	0.0001			0.197	0.0004	0.0953	0.0004
Copper (Total)	mg/L	0.0001			0.558	0.0037	0.259	0.0010
Lead (Total)	mg/L	0.00002			0.198	0.00012	0.0591	0.00004
Molybdenum (Total)	mg/L	0.0001			0.0036	0.0110	0.0024	0.0018
Nickel (Total)	mg/L	0.0002			0.369	0.0016	0.162	0.0028
Selenium (Total)	mg/L	0.001			<0.002	<0.001	<0.002	<0.001
Silver (Total)	mg/L	0.0001			0.0007	<0.0001	0.0004	<0.0001
Thallium (Total)	mg/L	0.00005			0.00348	<0.00005	0.00168	<0.00005
Uranium (Total)	mg/L	0.00005			0.0197	0.00134	0.00474	0.00048
Vanadium (Total)	mg/L	0.0001			0.370	0.0006	0.248	0.0010
Gold (Total)	mg/L	0.0007			<0.0013		<0.0013	
Platinum (Total)	mg/L	0.00004			<0.00008		<0.00008	

Christine Burke
Laboratory Manager

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				Client I.D.	MW 102	MW 102F	MW 105	MW 105F
				Sample I.D.	24-000429-1	24-000429-2	24-000429-3	24-000429-4
				Date Collected	2024-Jan-03	2024-Jan-03	2024-Jan-03	2024-Jan-03
Parameter	**Units**	**R.L.**	**Limits**	**Reg 153 - Liquid**	-	-	-	-
Rhodium (Total)	mg/L	0.00002			0.00004		<0.00004	
Chromium (VI)	µg/L	1	25	T1GW	<1	<1	<1	<1
Mercury	µg/L	0.02	0.1	T1GW	0.06	0.05	<0.02	<0.02

Christine Burke
Laboratory Manager

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Parameter	Units	R.L.	Limits	Reg 153 - Liquid	Client I.D.	MW 102	MW 105
					Sample I.D.	24-000429-1	24-000429-3
					Date Collected	2024-Jan-03	2024-Jan-03
						-	-
Acetone	µg/L	30	2700	T1GW		<30	<30
Benzene	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Bromodichloromethane	µg/L	2	2	T1GW		<2	<2
Bromoform	µg/L	5	5	T1GW		<5	<5
Bromomethane	µg/L	0.5	0.89	T1GW		<0.5	<0.5
Carbon Tetrachloride	µg/L	0.2	0.2	T1GW		<0.2	<0.2
Chlorobenzene	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Chloroform	µg/L	1	2	T1GW		5	<1
Dibromochloromethane	µg/L	2	2	T1GW		<2	<2
Ethylene Dibromide	µg/L	0.2	0.2	T1GW		<0.2	<0.2
Dichlorobenzene,1,2-	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Dichlorobenzene,1,3-	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Dichlorobenzene,1,4-	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Dichlorodifluoromethane (Freon 12)	µg/L	2	590	T1GW		<2	<2
Dichloroethane,1,1-	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Dichloroethane,1,2-	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Dichloroethylene,1,1-	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Dichloroethylene,1,2-cis-	µg/L	0.5	1.6	T1GW		<0.5	<0.5
Dichloroethylene,1,2-trans-	µg/L	0.5	1.6	T1GW		<0.5	<0.5
Dichloropropane,1,2-	µg/L	0.5	0.5	T1GW		<0.5	<0.5
Dichloropropene,1,3-cis-	µg/L	0.5				<0.5	<0.5

Christine Burke
Laboratory Manager

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Parameter	Units	R.L.	Limits	Reg 153 - Liquid	Client I.D. MW 102 Sample I.D. 24-000429-1 Date Collected 2024-Jan-03 -	Client I.D. MW 105 Sample I.D. 24-000429-3 Date Collected 2024-Jan-03 -
Dichloropropene,1,3-cis+trans-(Calculated)	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Dichloropropene,1,3-trans-	µg/L	0.5			<0.5	<0.5
Ethylbenzene	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Hexane	µg/L	5	5	T1GW	<5	<5
Dichloromethane (Methylene Chloride)	µg/L	5	5	T1GW	<5	<5
Methyl Ethyl Ketone	µg/L	20	400	T1GW	<20	<20
Methyl Isobutyl Ketone	µg/L	20	640	T1GW	<20	<20
Methyl tert-Butyl Ether (MTBE)	µg/L	2	15	T1GW	<2	<2
Styrene	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Tetrachloroethane,1,1,1,2-	µg/L	0.5	1.1	T1GW	<0.5	<0.5
Tetrachloroethane,1,1,2,2-	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Tetrachloroethylene	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Toluene	µg/L	0.5	0.8	T1GW	0.7	<0.5
Trichloroethane,1,1,1-	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Trichloroethane,1,1,2-	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Trichloroethylene	µg/L	0.5	0.5	T1GW	<0.5	<0.5
Trichlorofluoromethane (Freon 11)	µg/L	5	150	T1GW	<5	<5
Vinyl Chloride	µg/L	0.2	0.5	T1GW	<0.2	<0.2
Xylene, m,p-	µg/L	1			<1	<1
Xylene, m,p,o-	µg/L	1.1	72	T1GW	<1.1	<1.1
Xylene, o-	µg/L	0.5			<0.5	<0.5

Christine Burke
Laboratory Manager

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				Client I.D.	MW 102	MW 105
				Sample I.D.	24-000429-1	24-000429-3
				Date Collected	2024-Jan-03	2024-Jan-03
Parameter	Units	R.L.	Limits	Reg 153 - Liquid	-	-
PHC F1 (C6-C10)	µg/L	25	420	T1GW	<25	<25
PHC F2 (>C10-C16)	µg/L	50	150	T1GW	<50	<50
PHC F3 (>C16-C34)	µg/L	400	500	T1GW	<400	<400
PHC F4 (>C34-C50)	µg/L	400	500	T1GW	<400	<400
Oil and Grease (Mineral)	mg/L	1.0			<1.0	<1.0
Oil and Grease (Anim/Veg)	mg/L	1.0			2.5	2.9

Reg 153 - Liquid: Reg 153 - Liquid
T1GW: R153 Tbl. 1 - GW

Summary of Exceedances		
R153 Tbl. 1 - GW		
MW 102	**Found Value**	**Limit**
Chloroform	5	2

Christine Burke
Laboratory Manager

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Appendix G

Construction Dewatering Calculations

GEI Consultants

Construction Dewatering Rate Estimate

Proposed Social Housing Facility

Temporary Construction Dewatering Rates - Commericial Building - Two Level Underground Parking

Description	Symbol	Values	Unit	Explanation
Input Data: Excavation				
Lowest Proposed Excavation		263.5	m asl	Assummed lowest excavation extending 0.5 m below the lowest basement finished floor elevation (Elev. 263.95 m)
Length of Excavation	x	65.0	m	As per “Site Grading Plan" by Pearson Engineering (Oct 2023)
Width of Excavation	a	40.0	m	As per “Site Grading Plan" by Pearson Engineering (Oct 2023)
Equivalent Well Radius	Rs	29	m	Radius of circle with the same area of the excavation = √(x*a/π)
Input Data: Aquifer				
Target Water Level		262.5	m asl	1.0 m below Lowest Propsed Excavation
Aquifer Bottom		260.5	m asl	Assumed 3.0 m below Lowest Proposed Excavation
Hydraulic Conductivity	K	4.9E-06	m/s	Maxmium hydraulic conductivitu measured on site (Monitoring Well 103)
Output				
Top of Aquifer		266.0	m asl	Assummed via Figure 12 High Groundwater Surface Map
Water Level above Aquifer Bottom before dewatering	H	5.6	m	Assummed via lowest Proposed Excavation and Highest Groundwater Level
Target Water Level above Aquifer Bottom after dewatering	h	2.0	m	Assumed 3.0 m below Lowest Proposed Excavation
Radius of Influence	R_0	23.6	m	Sichardt Equation
Precipitation	p	26000	L/day	10 mm rain event
Construction Dewatering Flow Rate - Steady State	Q	60	m^3/day	Construction Dewatering Rate - Dupuit-Forchheimer Equation
Maximum Construction Flow Rate (safety factor of 2)	2Q	119	m^3/day	

Construction Dewatering Flow Rate - Steady State	Q	**59,557**	L/day
Maximum Construction Flow Rate (safety factor of 2)	2Q	**119,115**	L/day
Maximum Construction Flow Rate (safety factor of 2) with 10 mm rainfall event	2Q + p	**145,115**	L/day

GEI Consultants

Construction Dewatering Rate Estimate

Proposed Social Housing Facility

Temporary Construction Dewatering Rates - Commericial Building - Elevator 7/8

Description	Symbol	Values	Unit	Explanation
Input Data: Excavation				
Lowest Proposed Excavation		3.5	m	Assummed lowest excavation extending below the lowest basement finished floor elevation (Elev. 263.95 m)
Lowest Proposed Excavation		260.5	m asl	Assummed lowest excavation extending below the lowest basement finished floor elevation (Elev. 263.95 m)
Length of Excavation	x	6.5	m	As per "Parking Structure Floor Plans and Sections" by MCL Architects (August 2024).
Width of Excavation	a	6.0	m	
Equivalent Well Radius	Rs	3.5	m	Radius of circle with the same area of the excavation = √(x*a/π)
Input Data: Aquifer				
Target Water Level		259.5	m asl	1.0 m below Lowest Propsed Excavation
Aquifer Bottom		257.5	m asl	Assumed 3.0 m below Lowest Proposed Excavation
Hydraulic Conductivity	K	4.9E-06	m/s	Maxmium hydraulic conductivitu measured on site (Monitoring Well 103)
Output				
Top of Aquifer		265.2	m asl	Assummed via Figure 12 High Groundwater Surface Map
Water Level above Aquifer Bottom before dewatering	H	7.8	m	Assummed via lowest Proposed Excavation and Highest Groundwater Level
Target Water Level above Aquifer Bottom after dewatering	h	2.0	m	Assumed 3.0 m below Lowest Proposed Excavation
Radius of Influence	R_0	38.2	m	Sichardt Equation
Precipitation	p	390	L/day	10 mm rain event
Construction Dewatering Flow Rate - Steady State	Q	30	m^3/day	Construction Dewatering Rate - Dupuit-Forchheimer Equation
Maximum Construction Flow Rate (safety factor of 2)	2Q	60	m^3/day	

Construction Dewatering Flow Rate - Steady State	Q	**30,172**	L/day
Maximum Construction Flow Rate (safety factor of 2)	2Q	**60,345**	L/day
Maximum Construction Flow Rate (safety factor of 2) with 10 mm rainfall event	2Q + p	**60,735**	L/day

GEI Consultants

Construction Dewatering Rate Estimate

Proposed Social Housing Facility

Temporary Construction Dewatering Rates - Residential Building - One Level Underground Parking

Description	Symbol	Values	Unit	Explanation
Input Data: Excavation				
Lowest Proposed Excavation		263.5	m asl	Assumed lowest excavation extending 0.5 m below the lowest basement finished floor elevation (Elev. 263.95
Length of Excavation	x	81.0	m	As per “Site Grading Plan" by Pearson Engineering (Oct 2023), assuming sub-basement is 50% of footprint
Width of Excavation	a	40.5	m	As per “Site Grading Plan" by Pearson Engineering (Oct 2023)
Equivalent Well Radius	Rs	32.3	m	Radius of circle with the same area of the excavation = √(x*a/π)
Input Data: Aquifer				
Target Water Level		262.5	m asl	1.0 m below Lowest Propsed Excavation
Aquifer Bottom		260.5	m asl	Assumed 3.0 m below Lowest Propsed Excavation
Hydraulic Conductivity	K	4.9E-06	m/s	Maxmium hydraulic conductivitu measured on site (Monitoring Well 103)
Output				
Top of Aquifer		265.4	m asl	Assummed via Figure 12 High Groundwater Surface Map
Water Level above Aquifer Bottom before dewatering	H	4.9	m	Assummed via lowest Proposed Excavation and Highest Groundwater Level
Target Water Level above Aquifer Bottom after dewatering	h	2.0	m	Assumed 3.0 m below Lowest Proposed Excavation
Radius of Influence	R_0	19.6	m	Sichardt Equation
Precipitation	p	32805	L/day	10 mm rain event
Construction Dewatering Flow Rate - Steady State	Q	58	m^3/day	Construction Dewatering Rate - Dupuit-Forchheimer Equation
Maximum Construction Flow Rate (safety factor of 2)	2Q	115	m^3/day	

Construction Dewatering Flow Rate - Steady State	Q	**57,542**	L/day
Maximum Construction Flow Rate (safety factor of 2)	2Q	**115,083**	L/day
Maximum Construction Flow Rate (safety factor of 2) with 10 mm rainfall event	2Q + p	**147,888**	L/day

GEI Consultants

Construction Dewatering Rate Estimate

Proposed Social Housing Facility

Temporary Construction Dewatering Rates - Residential Building - Multiple Elevators

Description	Symbol	Values				Unit	Explanation
		Elevator 1/2	Elevator 3/4	Elevator 5 Lula Lift	Material Lift		
Input Data: Excavation							
Lowest Proposed Excavation		3.5	3.5	2.0	2.0	m	Assummed lowest excavation extending below the lowest basement finished floor elevation (Elev. 263.95 m)
Lowest Proposed Excavation		260.5	260.5	262.0	262.0	m asl	Assummed lowest excavation extending below the lowest basement finished floor elevation (Elev. 263.95 m)
Length of Excavation	x	10.0	10.0	5.0	6.5	m	As per "Basement Floor Plan / Rose St. Entrance, Level 1 Floor Plan, and Elevator Sections" by MCL Architects (August 2024).
Width of Excavation	a	5.5	5.5	2.5	3.5	m	
Equivalent Well Radius	Rs	4.2	4.2	2.0	2.7	m	Radius of circle with the same area of the excavation = $\sqrt{(x*a/\pi)}$
Input Data: Aquifer							
Target Water Level		259.5	259.5	261.0	261.0	m asl	1.0 m below Lowest Propsed Excavation
Aquifer Bottom		257.5				m asl	Assumed 3.0 m below Lowest Proposed Excavation (Elev. 256.45)
Hydraulic Conductivity	K	4.9E-06				m/s	Maxmium hydraulic conductivitu measured on site (Monitoring Well 103)
Output							
Top of Aquifer		265.4	265.6	265.4	265.4	m asl	Assummed via Figure 12 High Groundwater Surface Map
Water Level above Aquifer Bottom before dewatering	H	7.9	8.2	7.9	7.9	m	Assummed via lowest Proposed Excavation and Highest Groundwater Level
Target Water Level above Aquifer Bottom after dewatering	h	2.0	2.0	3.5	3.5	m	Assumed 3.0 m below Lowest Proposed Excavation
Radius of Influence	R_0	39.5	40.8	29.6	29.6	m	Sichardt Equation
Precipitation	p	550	550	125	228	L/day	10 mm rain event
Construction Dewatering Flow Rate - Steady State	Q	35	36	25	28	m^3/day	Construction Dewatering Rate - Dupuit-Forchheimer Equation
Maximum Construction Flow Rate (safety factor of 2)	2Q	70	73	50	57	m^3/day	

Construction Dewatering Flow Rate - Steady State	Q	**35,069**	**36,440**	**25,140**	**28,281**	L/day
Maximum Construction Flow Rate (safety factor of 2)	2Q	**70,138**	**72,879**	**50,280**	**56,563**	L/day
Maximum Construction Flow Rate (safety factor of 2) with 10 mm rainfall event	2Q + p	**70,688**	**73,429**	**50,405**	**56,790**	L/day

Construction Dewatering Rate Estimate

Proposed Social Housing Facility

Temporary Construction Dewatering Rates - Servicing

Description	Symbol	Values	Unit	Explanation
Input Data: Excavation				
Lowest Proposed Excavation		262.5	m asl	0.5 m below STM MH 101 (NE Inv. 263.02), as per “Site Servicing Plan" by Pearson Engineering (Oct 2023)
Length of Excavation	x	100.0	m	Assummed
Width of Excavation	a	5.0	m	Assummed
Equivalent Well Radius	Rs	12.6	m	Equivalent radius of circle with the same area of the excavation = √(x*a/π)
Input Data: Aquifer				
Target Water Level		261.5	m asl	1.0 m below Lowest Propsed Excavation
Aquifer Bottom		259.5	m asl	Assumed 3.0 m below Lowest Propsed Excavation
Hydraulic Conductivity	K	4.9E-06	m/s	Maxmium hydraulic conductivitu measured on site (Monitoring Well 103)
Output				
Top of Aquifer		266.0	m asl	Assummed via Figure 12 High Groundwater Surface Map
Water Level above Aquifer Bottom before dewatering	H	6.5	m	Assummed via lowest Proposed Excavation and Highest Groundwater Level
Target Water Level above Aquifer Bottom after dewatering	h	2.0	m	Assumed 3.0 m below Lowest Proposed Excavation
Radius of Influence	R_0	29.8	m	Sichardt Equation
Precipitation	p	5000	L/day	10 mm rain event
Construction Dewatering Flow Rate - Steady State	Q	59	m^3/day	Construction Dewatering Rate - Dupuit-Forchheimer Equation
Construction Dewatering Flow Rate - Side Effects (Linear Infrastructure)	EF	54	m^3/day	Construction Dewatering Flow Rate - Equivalent Well Radius
Maximum Combined Construction Flow Rate (safety factor of 2)	2(Q+EF)	226	m^3/day	

Construction Dewatering Flow Rate - Steady State	Q	**112,958**	L/day
Maximum Construction Flow Rate (safety factor of 2)	2Q	**225,916**	L/day
Maximum Construction Flow Rate (safety factor of 2) with 10 mm rainfall event	2Q + p	**230,916**	L/day

Appendix H

Groundwater Taking Plan

This plan, as required under O.Reg.63/16, provides a general outline of the dewatering plan for the site to satisfy the EASR and/or PTTW requirements and that a detailed plan will be generated as needed by the contractor and their dewatering subcontractor that will include detailed treatment and monitoring measures.

Based on the conditions at and around the site, the target receiver for any dewatering discharge will be the natural environment within the Lake Simcoe watershed. It is understood that any discharge will be released at a minimum distance of 30 m from any watercourse(s) and that appropriate measures will be put in place to minimize the potential for discharge to generate erosion and/or contribute sediment into Sophia Creek (identified 400 m northeast/east of the site) and/or Kidds Creek (identified 440 m west of the site). Discharge will be encouraged to recharge back into the subsurface prior to reaching the features.

As the surrounding area is serviced by Storm and/or Sanitary Sewers, either of these options may be possible as a backup receiver for dewatering discharge if for some reason, the watershed is not a viable option. Should discharge be planned for either of the sewer systems, the contractor and/or its dewatering subcontractor will need to ensure that all permissions and/or permits are obtained to allow for discharge to that sewer and that all dewatering discharge meets the appropriate chemistry and discharge flow requirements imposed for that system.

Ultimately the method(s) employed to complete the dewatering will be left up to the contractor and/or its dewatering contractor to determine what will work best for them to achieve the dry working conditions that they require.

Construction Dewatering Discharge Rates and Zones of Influence

The Radius/Radii of Influence was/were estimated in Section 5.1 and the details are summarized below.

Dewatering Zone	Notes	Calculated ROI (m)
		R_0
1 – Commercial / Garage Structure	2 Levels Underground	23.6
2 - Commercial / Garage Elevator Pit	Elevator 7/8	38.2
3 – Apartment Building	Conservatively assumes sub-basement level extends across 50% of the footprint	19.6
4 - Apartment Elevator Pits	Elevators 1/2, 3/4, 5 Lula Lift, and Material Lift	29.6 to 40.8
5 – Site Servicing	Assumed in 100 m lengths	29.8

The estimated water taking rates are below.

Location and Scenario	Construction Dewatering Flow Rate without a Safety Factor	Construction Dewatering Flow Rate Including Safety Factor of 2.0	Construction Dewatering Flow Rate Including Safety Factor of 2.0 with a 10 mm Rainfall Event
	L/day		
1 – Commercial / Garage Structure	59,557	119,115	145,155
2 - Commercial / Garage Elevator Pit	30,172	60,345	60,735
3 – Apartment Building	57,542	115,083	147,888
4 – Apartment Elevator Pits	25,140 to 36,440	50,280 to 72,879	50,405 to 73,429
5 – Site Servicing	112,958	225,916	230,916

Impact Assessment

Land Stability and Settlement

Settlement has the potential to damage buried utilities, building foundations, or cause subsidence in adjacent lands. Settlement of the soil within the zone of influence must be calculated based on the increase in effective stress (10 kPa per m of drawdown) from reducing the pore water pressures. The maximum settlement will occur adjacent to the dewatering system where the maximum drawdown occurs. The amount of settlement will decrease exponentially to zero towards the radius of influence limit.

At this site, it is noted that there are relatively significant groundwater elevation changes that have historically occurred. The majority of the time, the groundwater elevation is expected to be lower than the proposed elevation of groundwater dewatering. As such, the soil has already “felt” this increase in effective pressure and most of the settlement due to the lowering of seasonally high groundwater tables has already occurred, and any additional settlement is expected to be negligible. Based on the above, settlement related impacts to any nearby infrastructure or buildings are not expected.

Another cause of significant dewatering related settlement is due to pumping of fines through the system. It is imperative that any dewatering systems (e.g., well-points, deep wells, sump pumps) shall be installed adequately to ensure no soil is conveyed through the system. Sufficient filtering techniques are incorporated at the entry point to avoid migration fines in the pumping/dewatering system. The turbidity of pumped water should be monitored daily to ensure that only minimal fines are being conveyed through the system.

Potential Impact on Nearby Groundwater Users

No domestic nor public water supply well were found on-site. Nine (9) domestic water supply well records were identified within 500 m of the site, installed from 1951 and 2005. No public water supply well records were identified within 500 m of the site. Three (3) commercial water supply well records were identified within 500 m of the site, installed from 1958 and 2006.

For the nine (9) records indicating domestic and/or livestock use within 500 m of the site, installations took place in 1951 to 2005 with the screened within sand units 12.8 to 38.4 m below grade and fresh water was encountered in wells 11.9 to 38.4 m below grade.

For the three (3) records indicating commercial use within 500 m of the site, installations took place in 1958 to 2006 with wells were screened within silt and sand units 16.8 to 42.4 m below grade. Fresh water was encountered in wells 28.3 to 42.4 m below grade and water of unknown quality was encountered in one well 27.7 m below grade.

It is expected that any domestic and/or commercial water supply wells within 500 m of the site have been abandoned or is no longer in use for domestic and/or commercial supply since he surrounding area is now mostly developed and serviced by the City of Barrie. Furthermore, these wells were recorded greater than 300 m from the site and outside of the estimated radii of influence of 17 to 43 m, so the domestic and/or commercial supply water wells will not be impacted by the temporary dewatering that is occurring near the ground surface only.

Potential Impact on Nearby Waterbodies or Other Surface Water Features

Minimal impacts to groundwater levels or flow directions, deeper aquifers, or other impacts to environmental features are expected due to the construction dewatering being a temporary (short-term) condition, the radius of influence for drawdown being relatively small, and the limited extent of area expected to be dewatered at any time during construction.

As the site is at least 400 m west of Sophia Creek, 440 m east of Kidds Creek, 1.6 km north of Lake Simcoe, not located in nor within 500 m of an ANSI nor wetland, the water removed will ultimately be returned back to the Lake Simcoe watershed, it is not anticipated that the proposed construction dewatering activity will negatively impact the groundwater flow to Sophia Creek, Kidds Creek, nor Lake Simcoe.

Water Quantity, Quality and Groundwater Level Monitoring Program

Discharge Options

Based on the groundwater quality analysis to date, dewatering discharge can be directed to the surface, the City of Barrie Storm and/or Sanitary Sewer provided groundwater quality during dewatering activities comply with the applicable PWQO and/or City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria.

If the groundwater quality of the construction dewatering discharge does not meet the applicable standards treatment options should be evaluated and/or the system should be shut down.

If the dewatering discharge water is treated by filtration (a decantation tank and/or silt bag at a minimum) to remove sediment and fines, the water quality is expected to be improved through the reduction of the concentrations of some parameter exceedances identified during the field investigation. However, additional treatment is likely required for the groundwater to meet the PWQO, the City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria.

The contractor must design and operate a treatment system for the collected discharge using their own means and methods to ensure it meets the applicable standard. In particular, the contractor should be aware of the following parameters that may require additional treatment, beyond basic filtration, depending on the discharge location selected:

- BOD5,
- COD,
- phosphorus,
- sulphide
- TSS

Water Quality Monitoring and Potential Treatment Plan

The monitoring plan for discharge to the surface is outlined on Table G-1.

Groundwater Level Monitoring Program

The ground water level monitoring program is outlined on Table G-2.

Discharge Rate Monitoring

The total groundwater volume pumped must be measured and recorded daily by the dewatering contractor. The water taking rates should be measured using an electronic device, and the daily water volumes must be reported to MECP on the Water Taking and Reporting System (WTRS) or through the Regulatory Self Reporting System. The volume of water taken daily for each dewatered work area shall be reported to the ministry on or before March 31 in each year, for each location from which water was taken in the previous calendar year. If no water is taken, then a “no taking” report must be entered.

The contractor will maintain a record of all water takings. This record will include the dates and duration of water takings, and the total measured volume of water pumped per day for each day that water is taken and will be updated and reported to the Client weekly. Daily precipitation must also be recorded by the contractor. The records must be kept up to date and available at or near the site and provided to the MECP upon request.

Summary of Qualifications

Sarah Griffith, P.Geo.

Ms. Sarah Griffith is a project hydrogeologist with four years of experience of experience specializing in geoenvironmental and hydrogeological investigations.

She has been trained in to complete local scale ground water assessments, well feasibility studies, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, in-situ borehole permeability testing, determination of ground water flow characteristics, surface water sampling, and preparation of hydrogeological reports and compliance monitoring programs in accordance with the applicable MECP requirements.

Alexander Winkelmann, P.Eng.

Mr. Alexander Winkelmann, P.Eng., is a senior geotechnical engineer with 15 years of interdisciplinary professional experience Mr. White specializes in geotechnical engineering, with experience in geoenvironmental project, hydrogeological projects and support for materials inspection and testing.

His hydrogeological experience includes long-term/short-term groundwater and surface water monitoring, local scale groundwater assessments, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, and determination of groundwater flow characteristics.

Date of Plan Preparation

This plan prepared on the date October 16, 2024

TABLE H-1

WATER QUALITY MONITORING PLAN FOR
DEWATERING DISCHARGE TO SURFACE OR STORM AND/OR SANITARY SEWERS[1]

Period	Monitoring Location	Parameters[2]	Monitoring Frequency[3]	Trigger For Mitigation	Mitigation Measures / Comments
Trial Dewatering or at the Start of Construction	Dewatering discharge	PWQO Metals City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria	Once during trial dewatering or on the first day of dewatering (with rushed samples)	Exceeds the PWQO, O.Reg. 153/04, and/or City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria □ No □ Yes – Proceed to Mitigation Measures / Comments	Modify treatment method and/or shut down.
During Construction Dewatering	Dewatering system discharge location	PWQO Metals City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria	Weekly then every four weeks after 3 consecutive weekly compliant samples[3]	Exceeds the PWQO, O.Reg. 153/04, and/or City of Barrie Storm and/or Sanitary Sewer Use By-Law Criteria □ No □ Yes – Proceed to Mitigation Measures / Comments	Modify treatment method and/or shut down.
		Turbidity	Daily until stable (minimum 5 samples) then weekly[3]	Exceeds 8 NTU above the baseline levels of the creek for discharge within 30 m of the creek □ No □ Yes – Proceed to Mitigation Measures / Comments	
		Hydrocarbon sheen in discharge	Daily	Hydrocarbon sheen observed □ No □ Yes – Proceed to Mitigation Measures / Comments	Stop dewatering until the source can be determined and remediate prior to continuing to discharge.
		Total groundwater pumping / discharge rate	Daily with electronic device	Flows exceeds the permitted rate (e.g., due to heavy rainfall event) □ No □ Yes – Proceed to Mitigation Measures / Comments	Temporarily reduce pumping rate or shorten the length of trench being dewatered until rate drops below the permitted rate.
		Record the daily precipitation at the construction site	Daily	N/A	N/A

TABLE H-1

WATER QUALITY MONITORING PLAN FOR
DEWATERING DISCHARGE TO SURFACE OR STORM AND/OR SANITARY SEWERS[1]

Period	Monitoring Location	Parameters[2]	Monitoring Frequency[3]	Trigger For Mitigation	Mitigation Measures / Comments
	Within the ROI from the Dewatering Location / Excavation / Trench	Signs of erosion, sediment, or flooding	Daily	Sedimentation, erosion, flooding observed. □ No □ Yes – Proceed to Mitigation Measures / Comments	Reduce pumping and/or improve sediment/erosion control measures.
		Settlement / Subsidence of nearby land	Daily	Visual indication of settlement/subsidence □ No □ Yes – Proceed to Mitigation Measures / Comments	Reduce pumping and consult both dewatering contractor and geotechnical engineer
		N/A	N/A	Complaint received with respect to water taking and pertains to natural environment. □ No □ Yes – Proceed to Mitigation Measures / Comments	Document and evaluate if actually related to dewatering, implement mitigation measures. Submit complaint and mitigation measures to local MECP office

Notes:
All items and observations during dewatering should be recorded in a log on site, accessible for inspection.
(1) It is recommended that discharge be treated by a sediment control facility such as a decantation tank and filtration bags at a minimum. Means and methods determined by the contractor.
(2) Parameters may be removed from future testing after three consecutive compliant results and with agreement by QP. If dewatering moves to a different location all initial parameters may need to be retested at the discretion of the QP. Additionally, at the discretion of the QP, parameter sets required to be sampled can be added or removed to reflect the planned/approved discharge location (such as sanitary sewer, storm sewer or to the natural environment, etc.).
(3) If dewatering moves to a different location or a non-compliant result is detected, the sampling may need to return to the initial frequency at the QP's discretion.

TABLE H-2

SUMMARIZED GROUNDWATER LEVEL MONITORING PLAN

Period	Monitoring Location	Method	Monitoring Frequency	Trigger For Mitigation	Mitigation Measures / Comments
Trial Dewatering or at the Start of Construction	On-Site Monitoring Wells	Water Level Meter	At a minimum, once prior to dewatering	None.	Together with previous measurement(s) establish baseline water levels.
During Construction	On-Site Monitoring Wells	Water Level Meter	Every two weeks	Water level drops more than 2 m below the target dewatering elevation	Reduce pumping
Post-Construction	On-Site Monitoring Wells	Water Level Meter	Every two weeks for four weeks, then every four weeks until 90% recovery	Water level recovery less than 90% of baseline level	Continue monitoring

Appendix I

Discharge Plan

This plan, as required under O.Reg.63/16, provides a general outline of the discharge plan for the site to satisfy the EASR and a detailed plan will be generated as needed by the contractor and their dewatering subcontractor that will include detailed treatment and monitoring measures.

Based on the conditions at and around the site, the target receiver for any dewatering discharge will be the Lake Simcoe subwatershed. It is understood that any discharge will be released at a minimum distance of 30 m from any watercourse(s) and that appropriate measures will be put in place to minimize the potential for discharge to generate erosion and contribute sediment into Sophia Creek (identified 400 m northeast/east of the site) and/or Kidds Creek (identified 440 m west of the site). Discharge will be encouraged to recharge back into the subsurface prior to reaching Sophia Creek and/or Kidds Creek.

As the surrounding area is serviced by sanitary and Storm and/or Sanitary Sewers, either of these options may be possible as a backup receiver for dewatering discharge if for some reason, the watershed is not a viable option. Should discharge be planned for either of the sewer systems, the contractor and/or its dewatering subcontractor will need to ensure that all permissions and/or permits are obtained to allow for discharge to that sewer and that all dewatering discharge meets the appropriate chemistry and discharge flow requirements imposed for that system.

Ultimately the treatment and discharge method(s) employed during dewatering will be left up to the contractor and/or its dewatering contractor to determine.

Construction Dewatering Discharge Rate

The temporary dewatering discharge rates were estimated in Section 5.1 and the details are summarized below.

Location and Scenario	Construction Dewatering Flow Rate without a Safety Factor	Construction Dewatering Flow Rate Including Safety Factor of 2.0	Construction Dewatering Flow Rate Including Safety Factor of 2.0 with a 10 mm Rainfall Event
	L/day		
1 – Commercial / Garage Structure	59,557	119,115	145,155
2 - Commercial / Garage Elevator Pit	30,172	60,345	60,735
3 – Apartment Building	57,542	115,083	147,888
4 – Apartment Elevator Pits	25,140 to 36,440	50,280 to 72,879	50,405 to 73,429
5 – Site Servicing	112,958	225,916	230,916

Proposed Discharge Method and Location

It is understood that the preferred discharge location would be to the surface or the sewers. Dewatering discharge will be directed by hose or pipe from the dewatering system to any pre-treatment systems (such as a sediment tank and silt bag), and then by hose or pipe to the preferred discharge location.

In the event of a significant rainfall event (100-year storm event), on-site excavation will cease until the dewatering system can be re-evaluated and/or storm water flow subsides.

Erosion and Sediment Control Measures

The construction dewatering setup will include sediment and erosion control measures, and sufficient filtration to ensure removal of suspended solids prior to discharge in accordance with typical Best Management Practices and to be sufficient to meet relevant receptor requirements.

Statements

If discharge is directed to the surface with adherence to the water quantity and quality monitoring program outlined in the Water Taking Plan in Appendix H, no adverse effect on the environment is expected.

The discharge water temperature was considered in determining the method of transfer and discharge and is not expected to have an adverse impact.

Summary of Qualifications

Sarah Griffith, P.Geo.

Ms. Sarah Griffith is a project hydrogeologist with four years of experience of experience specializing in geoenvironmental and hydrogeological investigations.

She has been trained in to complete local scale ground water assessments, well feasibility studies, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, in-situ borehole permeability testing, determination of ground water flow characteristics, surface water sampling, and preparation of hydrogeological reports and compliance monitoring programs in accordance with the applicable MECP requirements.

Alexander Winkelmann, P.Eng.

Mr. Alexander Winkelmann, P.Eng., is a senior geotechnical engineer with 15 years of interdisciplinary professional experience Mr. White specializes in geotechnical engineering, with experience in geoenvironmental project, hydrogeological projects and support for materials inspection and testing.

His hydrogeological experience includes long-term/short-term groundwater and surface water monitoring, local scale groundwater assessments, water budgets, supervising the installation, development, sampling and decommissioning of monitoring wells, and determination of groundwater flow characteristics.

Date of Plan Preparation

This plan prepared on the date October 16, 2024

Appendix J

Preliminary Water Balance

Hydrogeological Investigation
20 Rose Street, Barrie, Ontario
Project No. 2305493
October 2024

Water Balance - No LID Measurements in Place

MONTHLY AND YEARLY WATER BALANCE COMPONENTS (PRE-DEVELOPMENT CONDITION)														
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Potential Evapotranspiration Calculation	Average Temperature: T (^{o}C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	6.9
	Heat Index: i=(T/5)$^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	36.8
	Unadjusted Daily Potential Evapotranspiration: U (mm)	0.0	0.0	0.0	25.2	59.0	88.5	104.1	98.1	74.7	40.6	11.5	0.0	501.7
	Adjusting Factor for U (Latitude 44^{o})	0.81	0.81	1.02	1.13	1.27	1.28	1.30	1.20	1.04	0.94	0.80	0.76	-
	Adjusted Potential Evapotranspiration - PET (mm)	0.0	0.0	0.0	28.5	74.9	113.3	135.3	117.8	77.7	38.1	9.2	0.0	594.8
Pervious Components	Precipitation: P (mm)	82.5	61.8	58.1	62.2	82.4	84.8	77.2	89.9	94.0	77.5	88.9	73.6	932.9
	Adjusted Potential Evapotranspiration: PET (mm)	0.0	0.0	0.0	28.5	74.9	113.3	135.3	117.8	77.7	38.1	9.2	0.0	594.8
	P - PET	82.5	61.8	58.1	33.7	7.5	-28.5	-58.1	-27.9	16.3	39.4	79.7	73.6	338.1
	Change in Soil Moisture Storage (mm)	0.0	0.0	0.0	0.0	0.0	-28.5	-58.1	-27.9	16.3	39.4	0.0	0.0	-
	Water Holding Capacity (max. 75 mm)	250.0	250.0	250.0	250.0	250.0	221.5	163.4	135.5	151.9	191.2	250.0	250.0	-
	Water Surplus Available for Infiltration or Runoff	82.5	61.8	58.1	33.7	7.5	0.0	0.0	0.0	0.0	0.0	20.9	73.6	338.1
	Lawn: Potential Infiltration based on MECP Infiltration Factor (mm)	45.4	34.0	32.0	18.5	4.1	0.0	0.0	0.0	0.0	0.0	11.5	40.5	186.0
	Lawn: Potential Surface Water Runoff (mm)	37.1	27.8	26.1	15.2	3.4	0.0	0.0	0.0	0.0	0.0	9.4	33.1	152.2
Impervious Components	Precipitation: P (mm)	-												932.9
	Potential Evaporation: PE (mm), Assume 15%	-												139.9
	Potential Surface Water Runoff: P - PE (mm)	-												793.0

PRE- AND POST-DEVELOPMENT WATER BALANCE (NO LOW IMPACT DEVELOPMENT MEASURES IN PLACE)										
		Approximate Land Area (m^2)		Impervious Area (m^2)		Pervious Area (m^2)		Runoff (m^3/annum)	Infiltration (m^3/annum)	**Runoff Increase Pre to Post**
Existing Land Use (Pre-Development)	Building Area	1870	10%	100%	1870	0%	0	1483	0	24%
	Parking Lot Area	5610	30%	100%	5610	0%	0	4449	0	**Infiltration Decrease Pre to Post**
	Lawn Area	11220	60%	0%	0	100%	11220	1707	2087	
	TOTAL	18,700	100%	40%	7480	60%	11220	7,639	2,087	25%
Proposed Land Use (Post-Development)	Building Area	5610	30%	100%	5610	0%	0	4449	0	**Infiltration Required to Meet Pre-Development Conditions (m^3)**
	Parking Lot Area	4675	25%	100%	4675	0%	0	3707	0	
	Lawn Area	8415	45%	0%	0	100%	8415	1280	1565	522
	TOTAL	18,700	100%	55%	10285	45%	8415	9,436	1,565	

Notes
1. Both potential infiltration and surface water runoff are independent of temperature
2. Assumption is in January maximum soil moisture storage value is present (75mm)
3. Water Holding Capacity & Infiltration Factors taken from Table 3.1 of MOE SWMPDM, 2003
4. Average Temp. and Precip. taken from Environment Canada station "Barrie WPCC" between 1981 and 2010
5. Adjusting Factor for U based on Lorente, 1961

Infiltration Criteria	Site Description	Infiltration Factor
Topography	Flat Land - Average Slope Less Than 0.6 m/km	0.3
Soils	Tills	0.15
Cover	Cultivated Land/AGR/ANTH/CGL	0.1
	Sum of Infiltration Factors	**0.55**

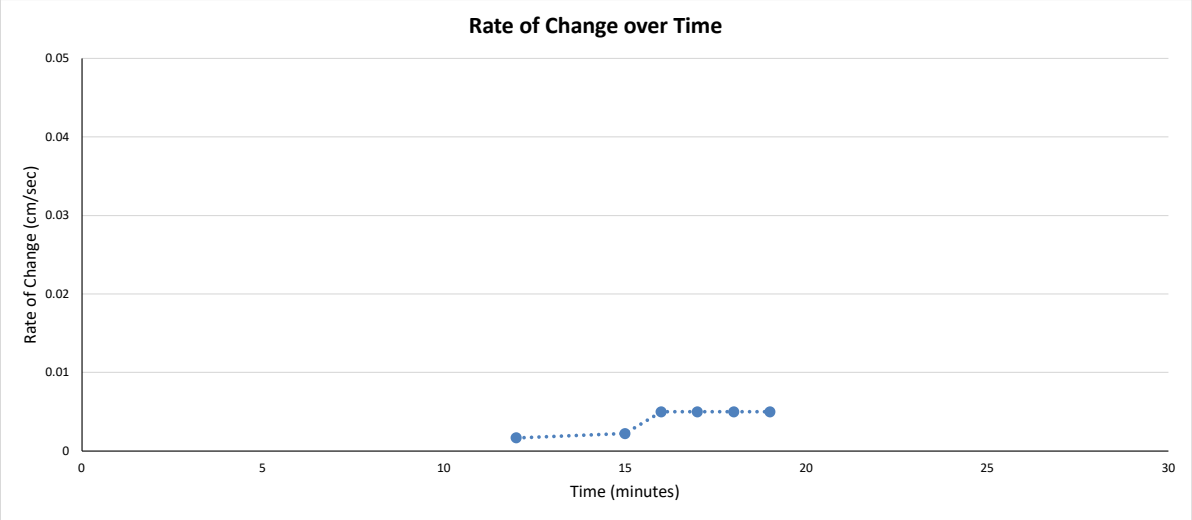
Appendix K

Infiltration Results

Guelph Permeameter
Infiltration Rate Determination

GEI Consultants

Test Location: GP 1 - Silty Sand Glacial Till



INPUT PARAMETERS

α* =	0.12	cm^{-1}
H =	10	cm
a =	3	cm
X =	2.16	cm^2
R =	0.005	cm/sec

SHAPE FACTOR

Shape Factor (1, 2 or 3) =	1
Shape Factor Value (cm^{-1}) =	1.288

CALCULATED PARAMETERS

H_a =	3.33	unitless
Q_1 =	0.0108	cm^3/sec

CALCULATED DESIGN VALUES

k_{fs}=	1.17E-05	cm/sec
Φ_m=	9.75E-05	cm^2/s
Infiltration:	26.05	mm/hr
FOS:	2.50	unitless
Design Infiltration:	10.42	mm/hr

Variable Glossary

α* **1)** is the ratio of gravity to capillarity forces during infiltration or drainage
2) determined from table 1 on page 47 of the manual (or the adjacent table)

H **1)** is the water head in the BH
2) determined by the height that the inner tube is pulled up during field operation

a **1)** is the radius of the borehole
2) determine by the size of the auger

X **1)** is the resevoir constant
2) determined by the reservoir knob at the top of the unit
- if the knob is up X = 35.22 (outer and inner reservoir)
- if the knob is down X = 2.16 (inner reservoir)

R **1)** is the steady state rate of flow per minute
2) is determined by timing the drop of water in the Guelph Permeameter

Equation Glossary

Ha is the ratio of head to borehole radius

Q1 is the flow rate

$C_{(1, 2 or 3)}$ is the shape factor which accounts for the saturated area of the soil
- Select C_1 if α* is ≥ 0.12 cm^{-1}
- Select C_2 if α* = 0.04 cm^{-1}
- Select C_3 if α* = 0.01 cm^{-1}

k_{fs} is the field saturated hydraulic conductivity of the soil

Φ_m is an indicator of the capillary pull exerted by the unsaturated soil on the water

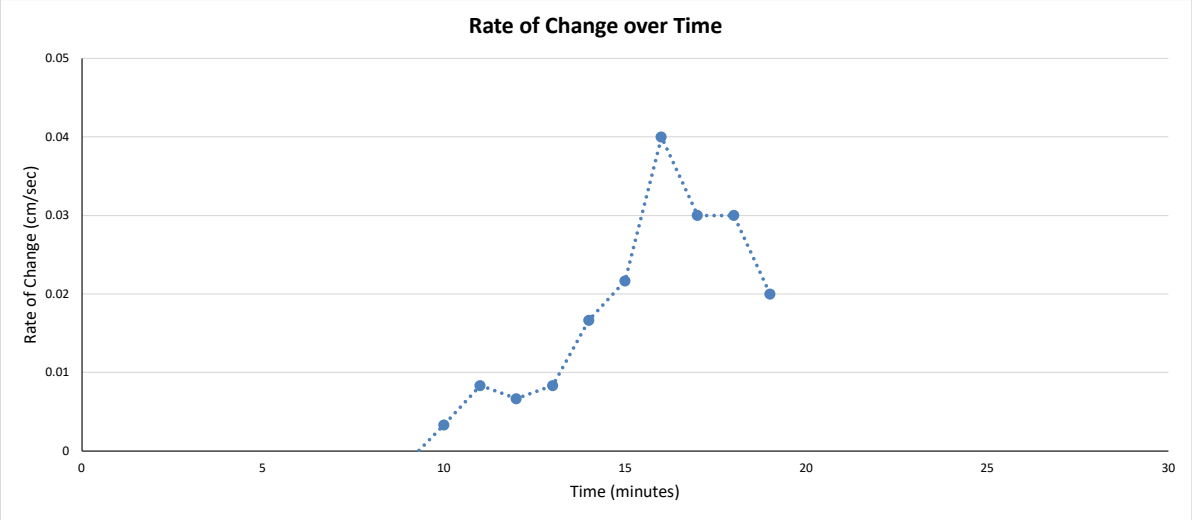
Table 1. Soil texture-structure categories for site-estimation of α* (adapted from Elrick et al., 1989)

Soil Texture - Structure Category	α* (cm^{-1})
Compacted, structureless, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12
Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc.	0.36

Guelph Permeameter
Infiltration Rate Determination

GEI Consultants

Test Location: GP 2 - Silty Sand Glacial Till



INPUT PARAMETERS

α* =	0.12	cm^{-1}
H =	10	cm
a =	3	cm
X =	2.16	cm^2
R =	0.030	cm/sec

SHAPE FACTOR

Shape Factor (1, 2 or 3) =	1
Shape Factor Value (cm^{-1}) =	1.288

CALCULATED PARAMETERS

H_a =	3.33	unitless
Q_1 =	0.0648	cm^3/sec

CALCULATED DESIGN VALUES

k_{fs}=	7.02E-05	cm/sec
Φ_m=	5.85E-04	cm^2/s
Infiltration:	42.09	mm/hr
FOS:	2.50	unitless
Design Infiltration:	16.83	mm/hr

Variable Glossary

α* **1)** is the ratio of gravity to capillarity forces during infiltration or drainage
2) determined from table 1 on page 47 of the manual (or the adjacent table)

H **1)** is the water head in the BH
2) determined by the height that the inner tube is pulled up during field operation

a **1)** is the radius of the borehole
2) determine by the size of the auger

X **1)** is the resevoir constant
2) determined by the reservoir knob at the top of the unit
- if the knob is up X = 35.22 (outer and inner reservoir)
- if the knob is down X = 2.16 (inner reservoir)

R **1)** is the steady state rate of flow per minute
2) is determined by timing the drop of water in the Guelph Permeameter

Equation Glossary

Ha is the ratio of head to borehole radius

Q1 is the flow rate

$C_{(1, 2 or 3)}$ is the shape factor which accounts for the saturated area of the soil
- Select C_1 if α* is ≥ 0.12 cm^{-1}
- Select C_2 if α* = 0.04 cm^{-1}
- Select C_3 if α* = 0.01 cm^{-1}

k_{fs} is the field saturated hydraulic conductivity of the soil

Φ_m is an indicator of the capillary pull exerted by the unsaturated soil on the water

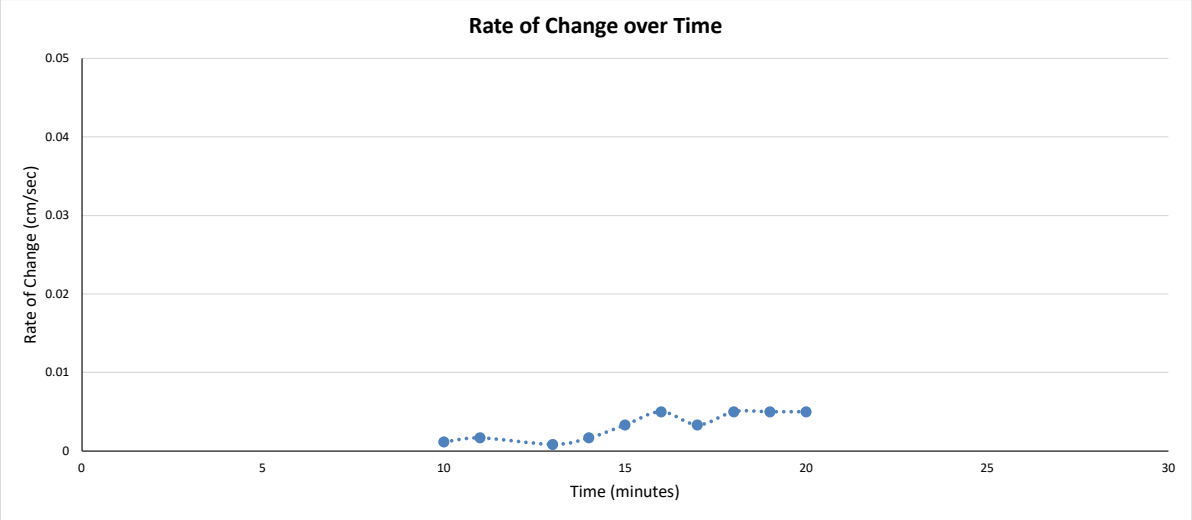
Table 1. Soil texture-structure categories for site-estimation of α* (adapted from Elrick et al., 1989)

Soil Texture - Structure Category	α* (cm^{-1})
Compacted, structureless, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12
Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc.	0.36

Guelph Permeameter
Infiltration Rate Determination

GEI Consultants

Test Location: GP 3 - Silty Sand Glacial Till



INPUT PARAMETERS

α* =	0.12	cm^{-1}
H =	10	cm
a =	3	cm
X =	2.16	cm^2
R =	0.005	cm/sec

SHAPE FACTOR

Shape Factor (1, 2 or 3) =	1
Shape Factor Value (cm^{-1}) =	1.288

CALCULATED PARAMETERS

H_a =	3.33	unitless
Q_1 =	0.0108	cm^3/sec

CALCULATED DESIGN VALUES

k_{fs}=	1.17E-05	cm/sec
Φ_m=	9.75E-05	cm^2/s
Infiltration:	26.05	mm/hr
FOS:	2.50	unitless
Design Infiltration:	10.42	mm/hr

Variable Glossary

α* **1)** is the ratio of gravity to capillarity forces during infiltration or drainage
2) determined from table 1 on page 47 of the manual (or the adjacent table)

H **1)** is the water head in the BH
2) determined by the height that the inner tube is pulled up during field operation

a **1)** is the radius of the borehole
2) determine by the size of the auger

X **1)** is the resevoir constant
2) determined by the reservoir knob at the top of the unit
- if the knob is up X = 35.22 (outer and inner reservoir)
- if the knob is down X = 2.16 (inner reservoir)

R **1)** is the steady state rate of flow per minute
2) is determined by timing the drop of water in the Guelph Permeameter

Equation Glossary

Ha is the ratio of head to borehole radius

Q1 is the flow rate

$C_{(1, 2 or 3)}$ is the shape factor which accounts for the saturated area of the soil
- Select C_1 if α* is ≥ 0.12 cm^{-1}
- Select C_2 if α* = 0.04 cm^{-1}
- Select C_3 if α* = 0.01 cm^{-1}

k_{fs} is the field saturated hydraulic conductivity of the soil

Φ_m is an indicator of the capillary pull exerted by the unsaturated soil on the water

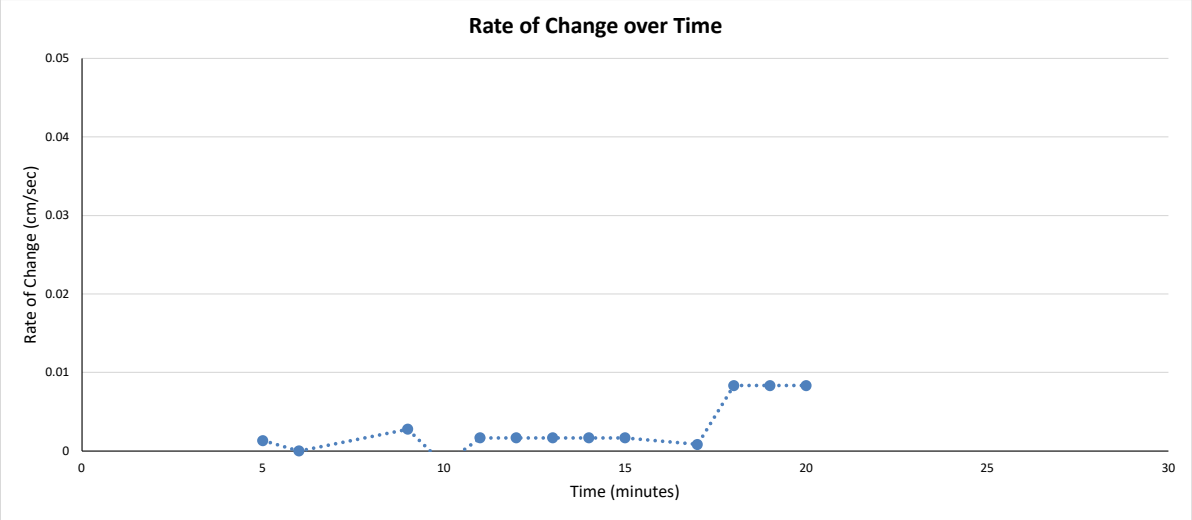
Table 1. Soil texture-structure categories for site-estimation of α* (adapted from Elrick et al., 1989)

Soil Texture - Structure Category	α* (cm^{-1})
Compacted, structureless, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12
Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc.	0.36

Guelph Permeameter
Infiltration Rate Determination

GEI Consultants

Test Location: GP 4 - Silty Sand Glacial Till



INPUT PARAMETERS

α* =	0.12	cm^{-1}
H =	10	cm
a =	3	cm
X =	2.16	cm^2
R =	0.008	cm/sec

SHAPE FACTOR

Shape Factor (1, 2 or 3) =	1
Shape Factor Value (cm^{-1}) =	1.288

CALCULATED PARAMETERS

H_a =	3.33	unitless
Q_1 =	0.018	cm^3/sec

CALCULATED DESIGN VALUES

k_{fs}=	1.95E-05	cm/sec
Φ_m=	1.63E-04	cm^2/s
Infiltration:	29.87	mm/hr
FOS:	2.50	unitless
Design Infiltration:	11.95	mm/hr

Variable Glossary

α* **1)** is the ratio of gravity to capillarity forces during infiltration or drainage
2) determined from table 1 on page 47 of the manual (or the adjacent table)

H **1)** is the water head in the BH
2) determined by the height that the inner tube is pulled up during field operation

a **1)** is the radius of the borehole
2) determine by the size of the auger

X **1)** is the resevoir constant
2) determined by the reservoir knob at the top of the unit
- if the knob is up X = 35.22 (outer and inner reservoir)
- if the knob is down X = 2.16 (inner reservoir)

R **1)** is the steady state rate of flow per minute
2) is determined by timing the drop of water in the Guelph Permeameter

Equation Glossary

Ha is the ratio of head to borehole radius

Q1 is the flow rate

$C_{(1, 2 or 3)}$ is the shape factor which accounts for the saturated area of the soil
- Select C_1 if α* is ≥ 0.12 cm^{-1}
- Select C_2 if α* = 0.04 cm^{-1}
- Select C_3 if α* = 0.01 cm^{-1}

k_{fs} is the field saturated hydraulic conductivity of the soil

Φ_m is an indicator of the capillary pull exerted by the unsaturated soil on the water

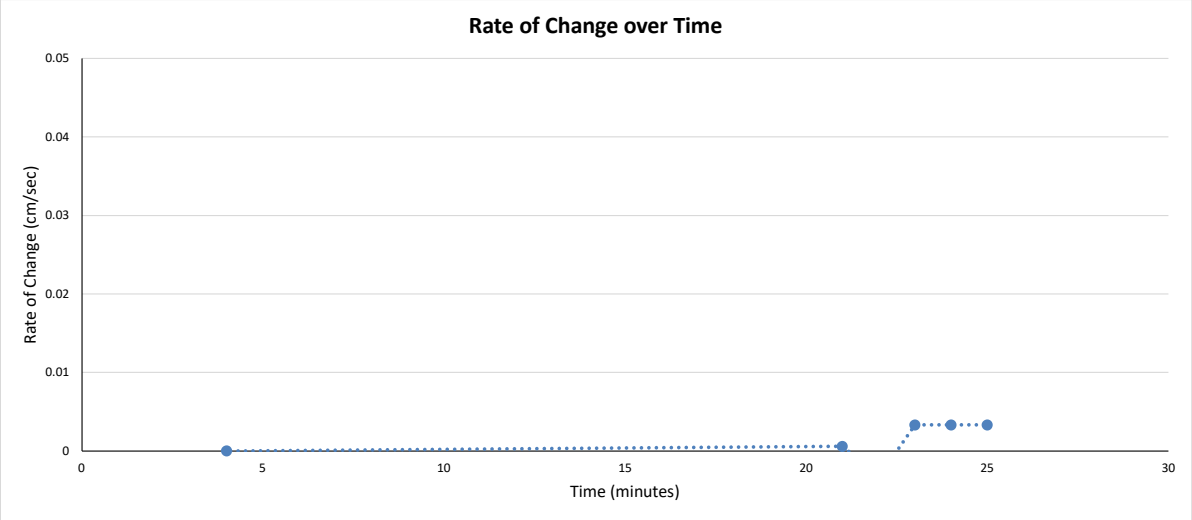
Table 1. Soil texture-structure categories for site-estimation of α* (adapted from Elrick et al., 1989)

Soil Texture - Structure Category	α* (cm^{-1})
Compacted, structureless, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12
Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc.	0.36

Guelph Permeameter
Infiltration Rate Determination

GEI Consultants

Test Location: GP 5 - Silty Sand Glacial Till



INPUT PARAMETERS

α* =	0.12	cm^{-1}
H =	10	cm
a =	3	cm
X =	2.16	cm^2
R =	0.003	cm/sec

SHAPE FACTOR

Shape Factor (1, 2 or 3) =	1
Shape Factor Value (cm^{-1}) =	1.288

CALCULATED PARAMETERS

H_a =	3.33	unitless
Q_1 =	0.0072	cm^3/sec

CALCULATED DESIGN VALUES

k_{fs}=	7.80E-06	cm/sec
Φ_m=	6.50E-05	cm^2/s
Infiltration:	23.37	mm/hr
FOS:	2.50	unitless
Design Infiltration:	9.35	mm/hr

Variable Glossary

α* **1)** is the ratio of gravity to capillarity forces during infiltration or drainage
2) determined from table 1 on page 47 of the manual (or the adjacent table)

H **1)** is the water head in the BH
2) determined by the height that the inner tube is pulled up during field operation

a **1)** is the radius of the borehole
2) determine by the size of the auger

X **1)** is the resevoir constant
2) determined by the reservoir knob at the top of the unit
- if the knob is up X = 35.22 (outer and inner reservoir)
- if the knob is down X = 2.16 (inner reservoir)

R **1)** is the steady state rate of flow per minute
2) is determined by timing the drop of water in the Guelph Permeameter

Equation Glossary

Ha is the ratio of head to borehole radius

Q1 is the flow rate

$C_{(1, 2 or 3)}$ is the shape factor which accounts for the saturated area of the soil
- Select C_1 if α* is ≥ 0.12 cm^{-1}
- Select C_2 if α* = 0.04 cm^{-1}
- Select C_3 if α* = 0.01 cm^{-1}

k_{fs} is the field saturated hydraulic conductivity of the soil

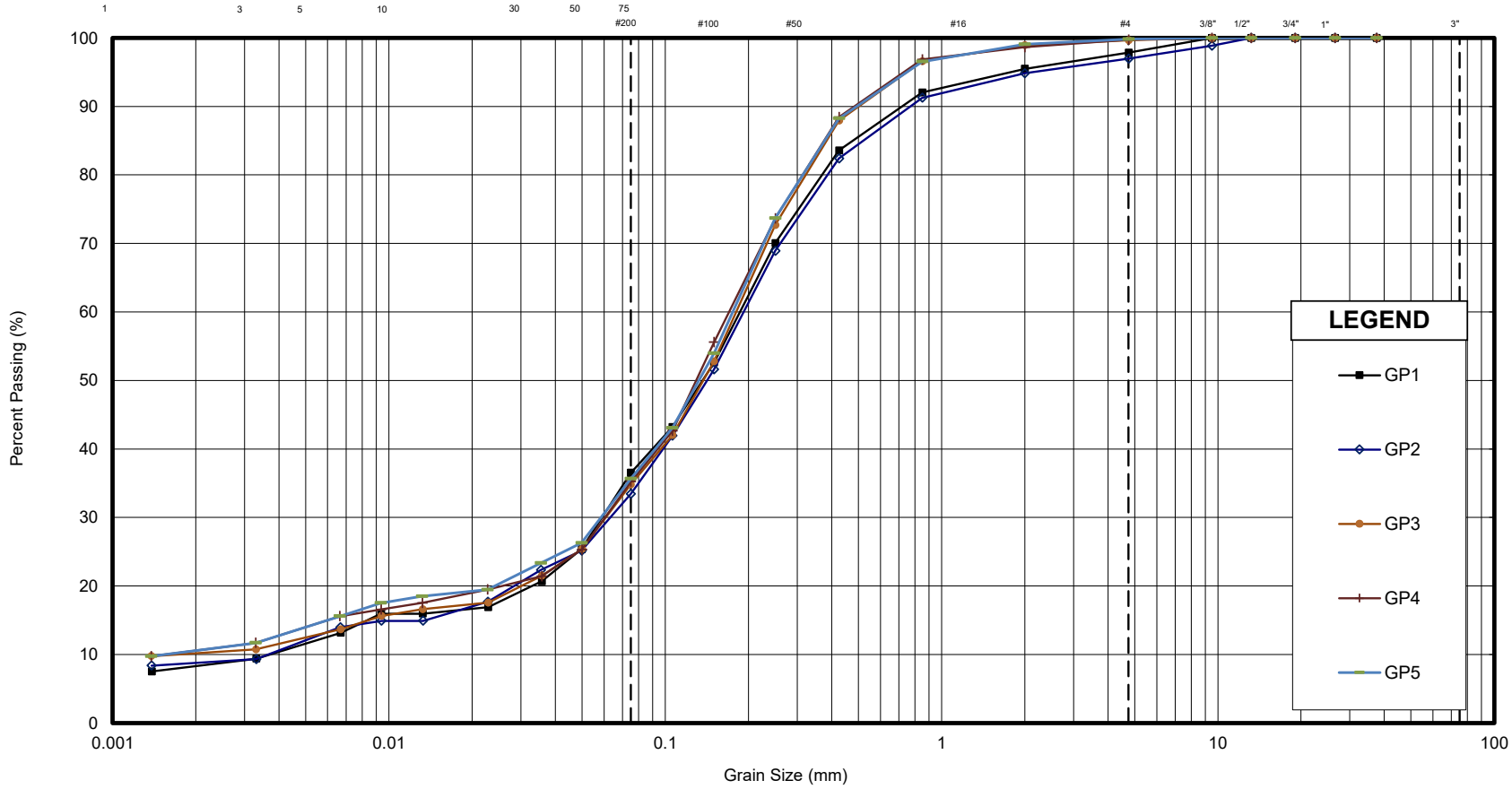
Φ_m is an indicator of the capillary pull exerted by the unsaturated soil on the water

Table 1. Soil texture-structure categories for site-estimation of α* (adapted from Elrick et al., 1989)

Soil Texture - Structure Category	α* (cm^{-1})
Compacted, structureless, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12
Coarse and gravelly sands; may also include some highly structured soils with large and/or numerous cracks, macropores, etc.	0.36

UNIFIED SOIL CLASSIFICATION SYSTEM

CLAY AND SILT	SAND			GRAVEL	
	Fine	Medium	Coarse	Fine	Coarse



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
GP1	SILTY SAND, Trace Clay, Trace Gravel	2	61	28	9	0.004	0.059	0.186	50.3	5.0
GP2	SILTY SAND, Trace Clay, Trace Gravel	3	64	25	8	0.004	0.063	0.192	52.4	5.7
GP3	SILTY SAND, Some Clay	-	65	25	10	0.002	0.061	0.181	106.1	12.1
GP4	SILTY SAND, Some Clay	-	65	24	11	0.002	0.060	0.170	109.8	13.9
GP5	SILTY SAND, Some Clay	-	64	25	11	0.002	0.059	0.175	112.9	12.6

GEI Consultants

GRAIN SIZE DISTRIBUTION - 20 Rose Street

SILTY SAND GLACIAL TILL

FIGURE No. K1

REF. No. 2305493

DATE October 2024

Appendix L

Summary of Groundwater Monitoring Results

ID (UTM 17T)	Northing	Easting	Ground Surface	Maximum Groundwater	2-Jan-24	1-Feb-24	21-Mar-24	25-Apr-24	13-May-24	11-Jun-24	12-Jul-24	9-Aug-24	6-Sep-24	7-Oct-24
MW6	4917233.4	603839.7	271.6	**265.8**	--	--	DRY	265.5	**265.8**	265.3	265.3	265.7	265.3	Dry
MW26	4917335.3	603894.7	270.3	**266.2**	--	--	264.5	**266.2**	266.1	265.4	264.9	265.6	Dry	Dry
MW27	4917268.0	603965.0	266.6	**264.8**	--	Dry	262.7	**264.8**	264.5	264.1	264.7	264.2	263.0	262.0
MW101	4917241.2	603838.8	271.6	**264.9**	260.2	260.9	261.7	264.0	264.7	264.3	264.2	**264.9**	263.7	262.7
MW102	4917292.3	603872.8	271.0	**265.3**	260.9	261.5	262.3	264.4	265.1	264.8	264.7	**265.3**	264.1	263.0
MW103	4917327.8	603904.4	270.1	**264.7**	260.1	260.7	262.0	264.5	**264.7**	264.2	264.2	264.5	263.0	261.7
MW104	4917213.6	603860.5	271.4	**263.8**	Dry	Dry	Dry	261.6	263.0	263.1	263.2	**263.8**	262.6	261.5
MW105	4917228.3	603901.7	270.3	**264.8**	260.3	260.8	261.4	263.5	264.3	264.2	264.4	**264.8**	263.5	262.2
MW207	4917238.6	603902.9	270.7	**265.8**	Not Yet Installed	Not Yet Installed	Not Yet Installed	264.6	265.3	265.1	265.3	**265.8**	264.4	263.0
MW208	4917237.4	603908.5	270.4	**265.2**	Not Yet Installed	Not Yet Installed	Not Yet Installed	264.1	264.7	264.6	264.9	**265.2**	263.8	262.5

Appendix F

PCSWMM Modelling Results

PEARSON ENGINEERING

Original City of Barrie Model
PC SWMM Results - SCS 5yr 6hr

	Storm Sewer ID#	Invert Node	Design Flow CMS	Percent Full	Pipe Invert Elevation Meters	CL Road Elevation Meters	Max. HGL in Invert MH Meters	CL Road - Max HGL
	101309681	100102516	0.04	0.33	254.36	258.05	254.48	3.57
	101310002	100102378	0.085	0.87	253.38	256.92	253.60	3.32
	101310003	100120191	0.11	1.02	252.77	255.74	253.03	2.71
	101310005	100120193	0.12	0.76	252.16	255.35	252.41	2.94
	101310004	100120195	0.14	0.97	251.69	254.65	252.03	2.62
	101305942	100114062	0.16	0.37	251.31	254.14	251.50	2.64
	101305943	100102399	0.25	0.48	249.63	253.13	250.62	2.51
	101305944	100114061	0.24	1.01	249.33	252.88	250.53	2.35
	101306612	100114060	0.21	0.81	248.72	252.56	250.16	2.40
	101310001	100114863	0.33	1.63	247.95	251.49	249.67	1.82
	101310000	100120186	0.37	1.84	247.65	250.94	248.84	2.10
	101306611	100114858	0.41	0.75	247.35	248.66	247.69	0.97

Overland Flow Route

	Overland Flow Route	Design Flow	Elevation	Flow Depth	Flow Velocity			
	101309681-S	0.00	258.05	0.00	0.00			
	101310002-S	0.00	256.92	0.00	0.00			
	101310003-S	0.00	255.74	0.00	0.00			
	101310005-S	0.00	255.35	0.00	0.00			
	101310004-S	0.00	254.65	0.00	0.00			
	101305942-S	0.00	254.14	0.00	0.00			
	101305943-S	0.00	253.13	0.00	0.00			
	101305944-S	0.00	252.88	0.00	0.00			
	101306612-S	0.00	252.56	0.00	0.00			
	101310001-S	0.00	251.49	0.00	0.00			
	101310000-S	0.00	250.94	0.00	0.00			
	101306611-S	0.00	248.66	0.00	0.00			

PEARSON ENGINEERING

Updated Existing City of Barrie Model
PC SWMM Results - SCS 5yr 6hr

	Storm Sewer ID#	Invert Node	Design Flow CMS	Percent Full	Pipe Invert Elevation Meters	CL Road Elevation Meters	Max. HGL in Invert MH Meters	CL Road - Max HGL
	101309681	100102516	0.18	1.51	254.36	258.05	258.06	-0.01
	101310002	100102378	0.168	1.73	253.38	256.92	256.38	0.54
	101310003	100120191	0.17	1.62	252.77	255.74	254.57	1.17
	101310005	100120193	0.17	1.08	252.16	255.35	252.93	2.42
	101310004	100120195	0.17	1.22	251.69	254.65	252.36	2.29
	101305942	100114062	0.18	0.42	251.31	254.14	251.52	2.62
	101305943	100102399	0.25	0.48	249.63	253.13	250.97	2.16
	101305944	100114061	0.23	1.15	249.12	252.88	250.85	2.03
	101306612	100114060	0.25	0.97	248.65	252.56	250.35	2.21
	101310001	100114863	0.34	1.97	247.85	251.49	249.74	1.75
	101310000	100120186	0.38	1.86	247.62	250.94	248.85	2.09
	101306611	100114858	0.42	0.77	247.31	248.66	247.66	1.00

Overland Flow Route

	Overland Flow Route	Design Flow	Elevation	Flow Depth	Flow Velocity			
	101309681-S	0.00	258.05	0.00	0.00			
	101310002-S	0.00	256.92	0.00	0.00			
	101310003-S	0.00	255.74	0.00	0.00			
	101310005-S	0.00	255.35	0.00	0.00			
	101310004-S	0.00	254.65	0.00	0.00			
	101305942-S	0.00	254.14	0.00	0.00			
	101305943-S	0.00	253.13	0.00	0.00			
	101305944-S	0.00	252.88	0.00	0.00			
	101306612-S	0.00	252.56	0.00	0.00			
	101310001-S	0.00	251.49	0.00	0.00			
	101310000-S	0.00	250.94	0.00	0.00			
	101306611-S	0.00	248.66	0.00	0.00			

Note: PCSWMM model updated with S-100121466 portion north of Rose Street entering the storm sewer at Newton St. instead of Peel St.
Note: Updated with new manhole inverts as per Pearson Engineering Survey.

PEARSON ENGINEERING

Proposed Pearson Engineering Model
PC SWMM Results - SCS 5yr 6hr

	Storm Sewer ID#	Invert Node	Design Flow CMS	Percent Full	Pipe Invert Elevation Meters	CL Road Elevation Meters	Max. HGL in Invert MH Meters	CL Road - Max HGL
	101309681	100102516	0.12	1.03	254.36	258.05	256.05	2.00
	101310002	100102378	0.134	1.39	253.38	256.92	254.98	1.94
	101310003	100120191	0.14	1.36	252.77	255.74	253.78	1.96
	101310005	100120193	0.14	0.93	252.16	255.35	252.62	2.73
	101310004	100120195	0.15	1.08	251.69	254.65	252.20	2.45
	101305942	100114062	0.18	0.41	251.31	254.14	251.51	2.63
	101305943	100102399	0.25	0.47	249.63	253.13	250.93	2.20
	101305944	100114061	0.23	1.13	249.12	252.88	250.82	2.06
	101306612	100114060	0.24	0.94	248.65	252.56	250.35	2.21
	101310001	100114863	0.34	1.86	247.88	251.49	249.76	1.73
	101310000	100120186	0.38	1.87	247.62	250.94	248.87	2.07
	101306611	100114858	0.42	0.78	247.31	248.66	247.66	1.00

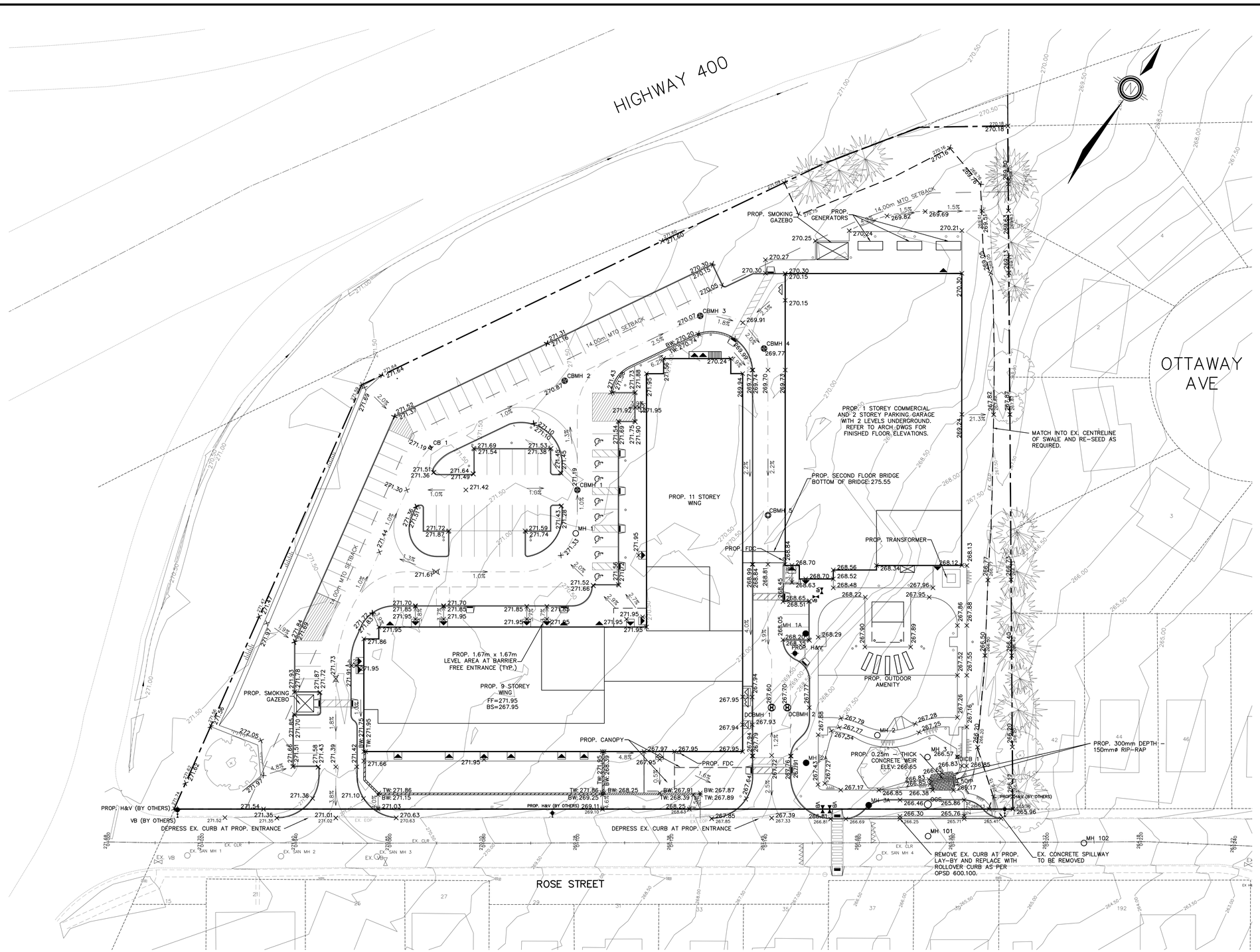
Overland Flow Route

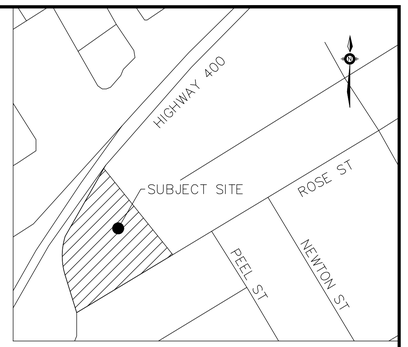
	Overland Flow Route	Design Flow	Elevation	Flow Depth	Flow Velocity			
	101309681-S	0.00	258.05	0.00	0.00			
	101310002-S	0.00	256.92	0.00	0.00			
	101310003-S	0.00	255.74	0.00	0.00			
	101310005-S	0.00	255.35	0.00	0.00			
	101310004-S	0.00	254.65	0.00	0.00			
	101305942-S	0.00	254.14	0.00	0.00			
	101305943-S	0.00	253.13	0.00	0.00			
	101305944-S	0.00	252.88	0.00	0.00			
	101306612-S	0.00	252.56	0.00	0.00			
	101310001-S	0.00	251.49	0.00	0.00			
	101310000-S	0.00	250.94	0.00	0.00			
	101306611-S	0.00	248.66	0.00	0.00			

Note: Updated with new manhole inverts as per Pearson Engineering Survey.

Appendix G

Pearson Engineering Drawings





KEYMAP
NTS

LEGEND

- SITE BOUNDARY
- 254.63 PROPOSED ELEVATION / 254.09 EXISTING ELEVATION
- 1.5% PROPOSED GRADE
- MH EX SAN MANHOLE
- SAN MH PROP SAN MANHOLE
- CB CATCH BASIN
- CBMH CATCH BASIN–MANHOLE
- 1 STORM MANHOLE
- EX. 1 EX. STORM MANHOLE
- LIMIT OF GRADING *PROPERTY LINE IF NOT OTHERWISE SHOWN.
- TRANSFORMER
- MAIN FLOOR (FF) ENTRANCE
- BARRIER FREE (FF) ENTRANCE (C/W 1.67m x 1.67m LEVEL AREA)
- BASEMENT (BS) ENTRANCE
- BARRIER FREE (BS) ENTRANCE (C/W 1.67m x 1.67m LEVEL AREA)
- VEHICLE ENTRANCE
- BARRIER FREE VEHICLE ENTRANCE (C/W 1.67m x 1.67m LEVEL AREA)
- RETAINING WALL
- PROP. FIRE ROUTE

PROP. RETAINING WALL BY OTHERS. RETAINING WALL AND RAILING TO BE DESIGNED BY OTHERS. T/W AND B/W SHOWS TOP OF WALL AND BASE OF WALL AT FINISHED GRADE ELEVATION. RETAINING WALL ELEVATIONS DO NOT ACCOUNT FOR WALL BELOW FINISHED GRADE

SCALE BAR 1:400
0 10 25

CITY OF BARRIE D30-006-2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 01019865474 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENSED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST.
CITY OF BARRIE

SITE GRADING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:400
DRAWN BY	TWC	VERT SCALE	N/A
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	SG-1		
REVISION #	1		

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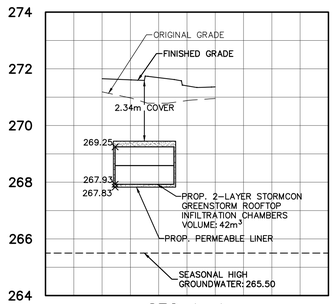
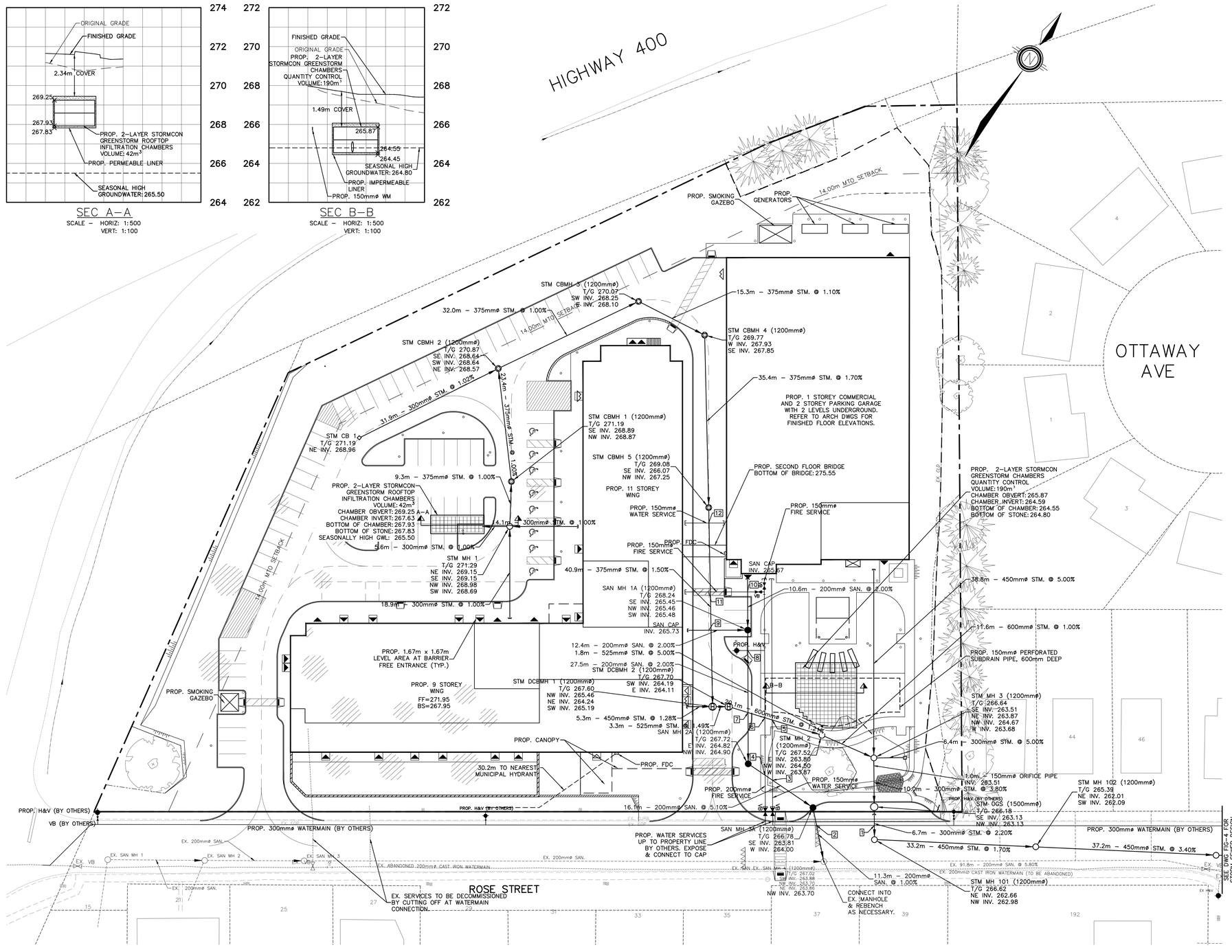


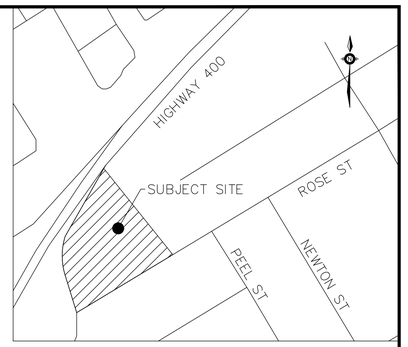
SEC A–A

SCALE – HORIZ: 1:500
VERT: 1:100

SEC B–B

SCALE – HORIZ: 1:500
VERT: 1:100

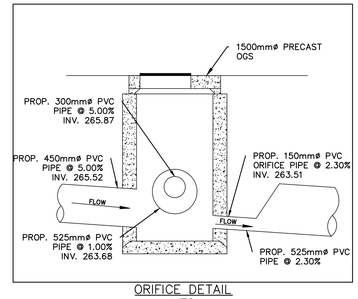




KEYMAP
NTS

LEGEND

- SITE BOUNDARY
- VB — WATER VALVE
- MH — EX STM MANHOLE
- STM MH — PROP. STM MANHOLE
- EX. STM PIPE
- PROP. STM PIPE
- MH — EX SAN MANHOLE
- SAN MH — PROP. SAN MANHOLE
- EX. SAN PIPE
- PROP. SAN PIPE
- SERVICING CAP
- TRANSFORMER
- MAIN FLOOR (FF) ENTRANCE
- BARRIER FREE (FF) ENTRANCE
- BASEMENT (BS) ENTRANCE
- BARRIER FREE (BS) ENTRANCE
- VEHICLE ENTRANCE
- BARRIER FREE VEHICLE ENTRANCE
- TREE PRESERVATION FENCE



ORIFICE DETAIL
NTS

PIPE CROSSINGS

CROSSING LOCATION	ELEVATION	SEPARATION (m)	SAN INV	SAN OBV	STM INV	STM OBV	WM INV	WM OBV
1	266.04	0.50				263.43	263.93	
2	266.50	0.50		263.98			264.48	
3	267.29	0.54		264.71			265.25	
4	267.52	0.54		264.81			265.35	
5	267.87	1.04				264.53	265.57	
6	267.91	1.10				264.55	265.65	
7	267.86	0.52	265.10			264.58		
8	268.16			265.57			266.07	
9	268.08	1.05		264.65	265.70			
10	268.65	0.72		265.72			266.44	
11	268.51	0.50				266.19	266.69	
12	269.04	0.77			267.27			266.50

SCALE BAR 1:400

0 10 25

CITY OF BARRIE D30-006-2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 010198654?4 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST.
CITY OF BARRIE

SITE SERVICING PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:400
DRAWN BY	TWC	VERT SCALE	N/A
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	SS-1		
REVISION #	1		

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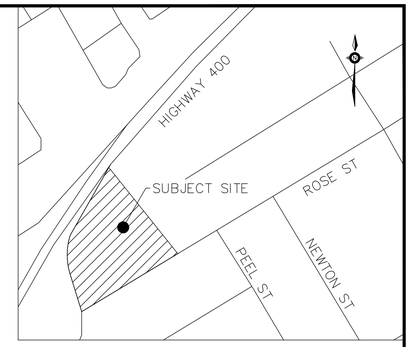

KEYMAP
NTS

LEGEND

- SITE BOUNDARY
- CATCHMENT BOUNDARY
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA: 1 | 0.75 — 1.00 ha — RUNOFF COEFFICIENT; AREA IN HECTARES
- BH17 / BH2.55 / 263.40 — BOREHOLE NO. / EX. GROUND ELEVATION / GROUNDWATER ELEVATION (AS PER PETO MACCALUM LTD. GEOTECHNICAL REPORT DATED MAY 3, 2021)

SCALE BAR 1:400
0 10 25

CITY OF BARRIE D30-006-2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 010191865474 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENSED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST. CITY OF BARRIE

PRE-DEVELOPMENT STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:400
DRAWN BY	TWC	VERT SCALE	N/A
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	STM-1		
REVISION #	1		

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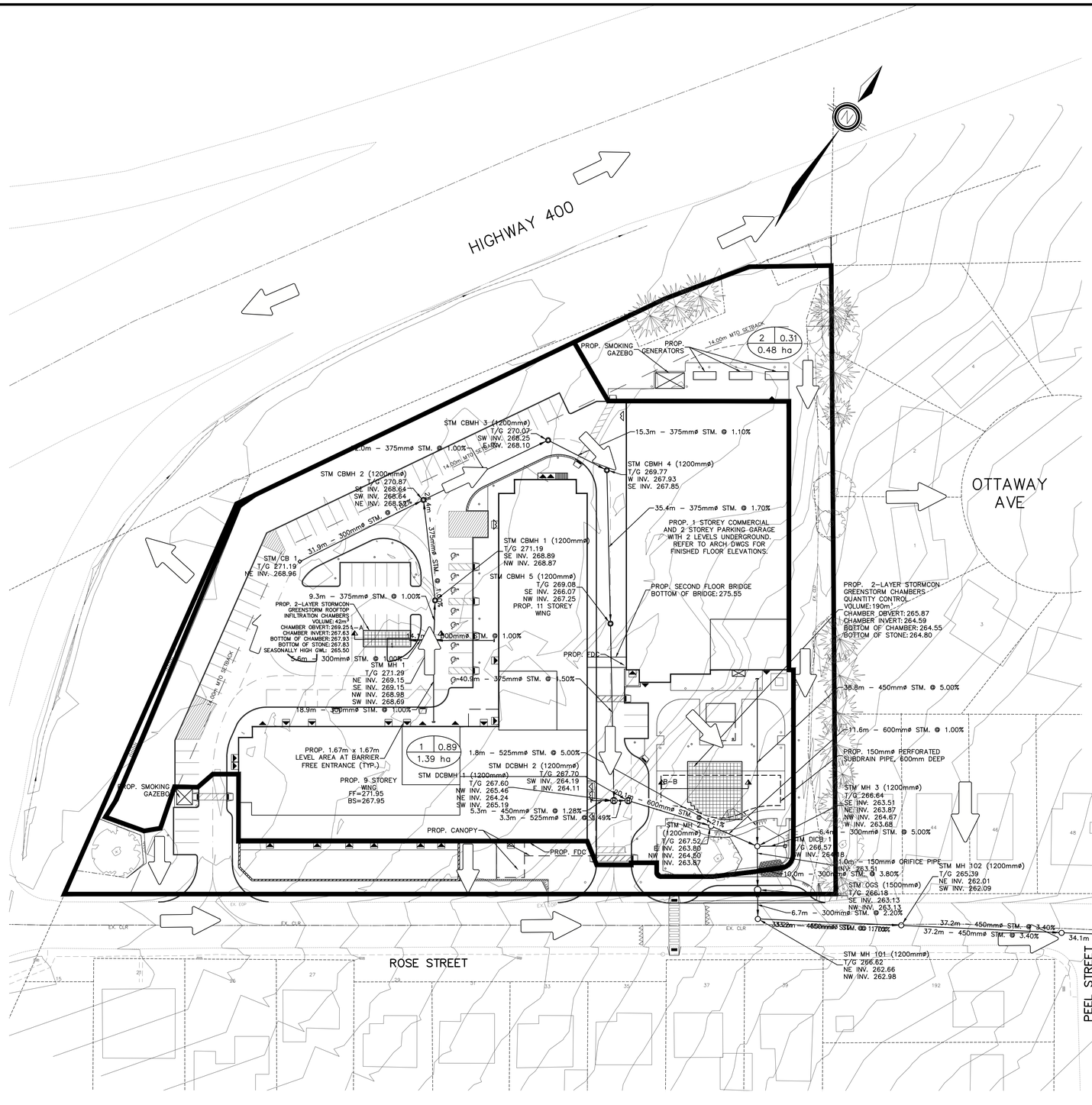

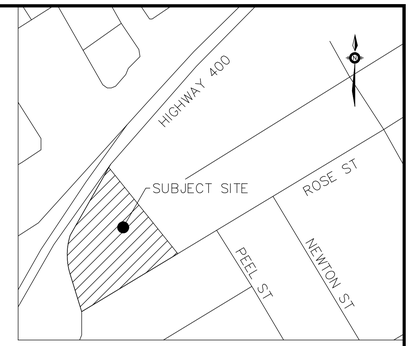

KEYMAP
NTS

LEGEND

- SITE BOUNDARY *PROPERTY LINE IF NOT OTHERWISE SHOWN.
- CATCHMENT BOUNDARY
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA 9 | 0.86 RUNOFF COEFFICIENT; 0.18 ha AREA IN HECTARES

SCALE BAR 1:500

0 10 30

CITY OF BARRIE D30-006-2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 01019865474 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST. CITY OF BARRIE

POST-DEVELOPMENT STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	PROJECT #	20118
DRAWN BY	TWC	DRAWING #	STM-2
CHECKED BY	MWD	REVISION #	1
HORIZ SCALE	1:500		
VERT SCALE	N/A		
DATE	OCTOBER 2023		

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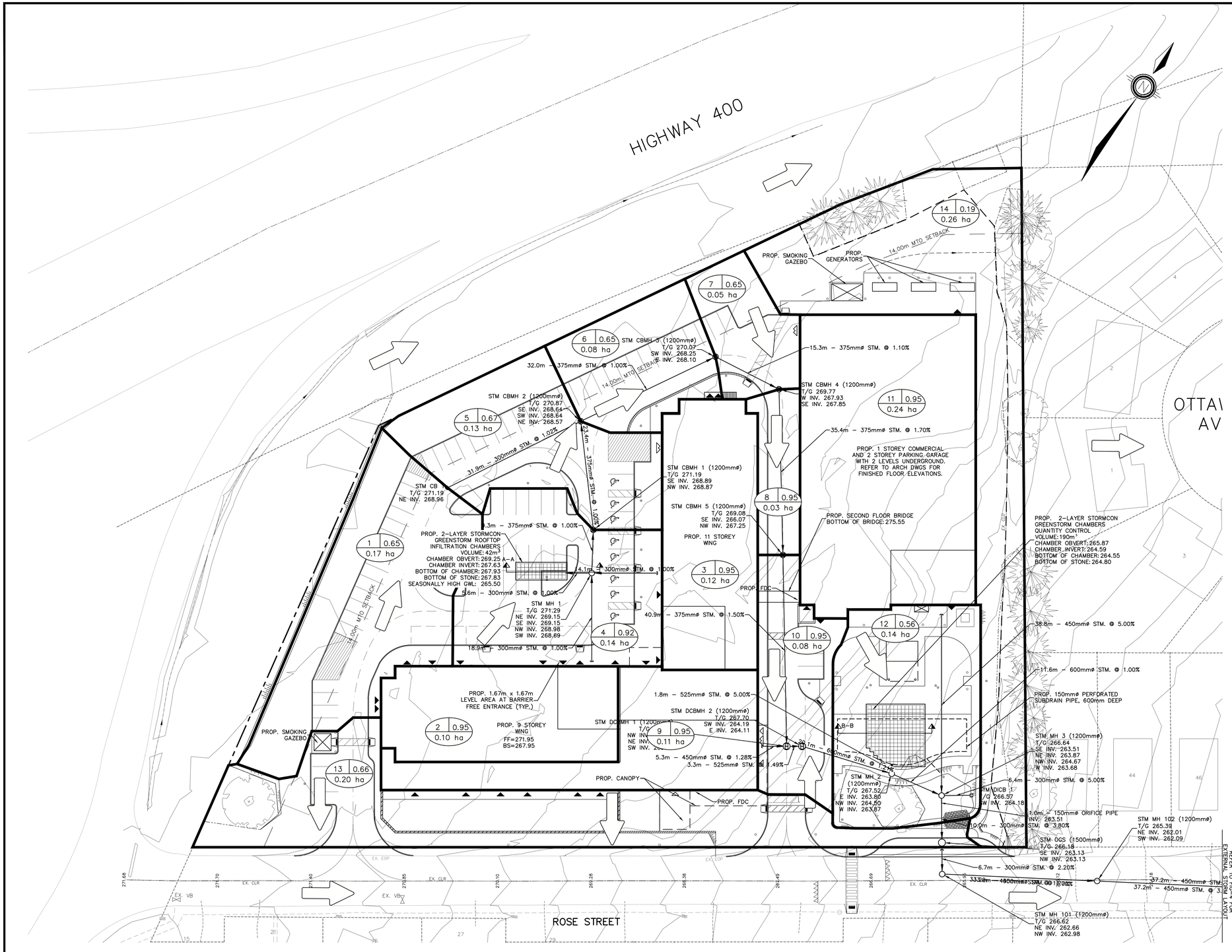

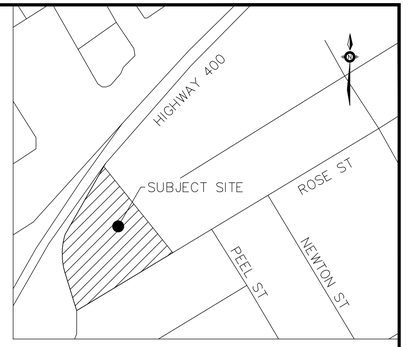

KEYMAP
NTS

LEGEND

- SITE BOUNDARY *PROPERTY LINE IF NOT OTHERWISE SHOWN.
- CATCHMENT BOUNDARY
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA: 9 | 0.86 / 0.18 ha — RUNOFF COEFFICIENT; AREA IN HECTARES
- BH27 / 265.55 / ⊕ 263.40 — BOREHOLE NO., EX. GROUND ELEVATION, GROUNDWATER ELEVATION (AS PER PETO MACCALUM LTD. GEOTECHNICAL REPORT DATED MAY 3, 2021)
- LIMIT OF GRADING *PROPERTY LINE IF NOT OTHERWISE SHOWN.

SCALE BAR 1:400
0 10 25

CITY OF BARRIE D30–006–2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 010198654 74 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST. CITY OF BARRIE

STORM DRAINAGE AREA PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:400
DRAWN BY	TWC	VERT SCALE	N/A
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	STM–3		
REVISION #	1		

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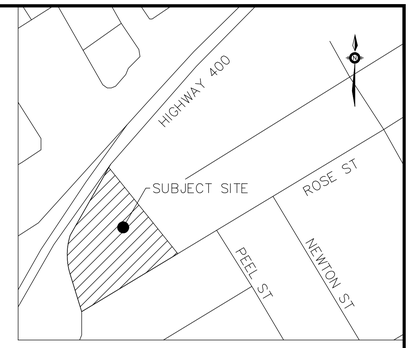

KEYMAP
NTS

LEGEND

- SITE BOUNDARY *PROPERTY LINE IF NOT OTHERWISE SHOWN.
- CATCHMENT BOUNDARY
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA: 9 | 0.86 | 0.18 ha — RUNOFF COEFFICIENT — AREA IN HECTARES

SCALE BAR 1:400
0 10 25

CITY OF BARRIE D30-006-2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 01019865474 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST. CITY OF BARRIE

EXTERNAL STORM CATCHMENT PLAN

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:400
DRAWN BY	TWC	VERT SCALE	N/A
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	STM-4		
REVISION #	1		

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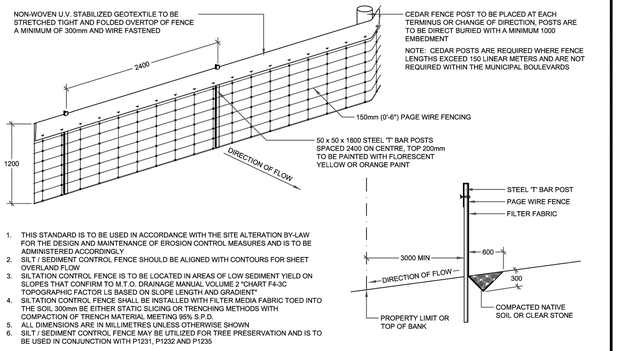
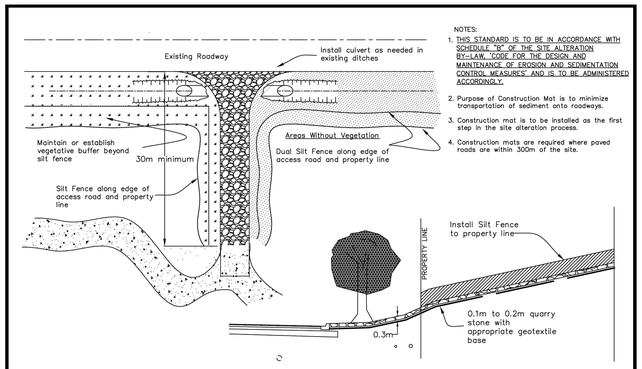


1. THIS STANDARD IS TO BE USED IN ACCORDANCE WITH THE SITE ALTERATION BY-LAW FOR THE DESIGN AND MAINTENANCE OF EROSION CONTROL MEASURES AND IS TO BE ADMINISTERED ACCORDINGLY
2. SILT / SEDIMENT CONTROL FENCE SHOULD BE ALIGNED WITH CONTOURS FOR SHEET OVERLAND FLOW
3. SILTATION CONTROL FENCE IS TO BE LOCATED IN AREAS OF LOW SEDIMENT YIELD ON SLOPES THAT CONFIRM TO M.T.O. DRAINAGE MANUAL VOLUME 2 "CHART F4-3C TOPOGRAPHIC FACTOR LS BASED ON SLOPE LENGTH AND GRADIENT"
4. SILTATION CONTROL FENCE SHALL BE INSTALLED WITH FILTER MEDIA FABRIC TOED INTO THE SOIL 300mm BE EITHER STATIC SLICING OR TRENCHING METHODS WITH COMPACTION OF TRENCH MATERIAL MEETING 95% S.P.D.
5. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN
6. SILT / SEDIMENT CONTROL FENCE MAY BE UTILIZED FOR TREE PRESERVATION AND IS TO BE USED IN CONJUNCTION WITH P1231, P1232 AND P1235

Barrie

FENCE SILTATION CONTROL

REV No.	DATE: APR 2023
3	SCALE: N.T.S.
	P1233

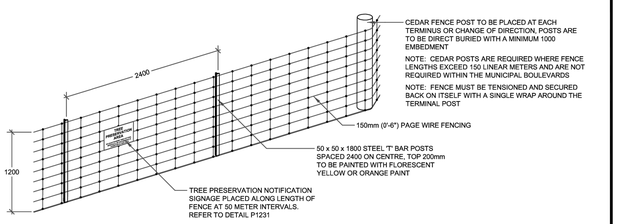


NOTES:
1. THIS STANDARD IS TO BE IN ACCORDANCE WITH SCHEDULE "B" OF THE SITE ALTERATION BY-LAW, "CODE FOR THE DESIGN AND MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL MEASURES" AND IS TO BE ADMINISTERED ACCORDINGLY.
2. Purpose of Construction Mat is to minimize transportation of sediment onto roadways.
3. Construction mat is to be installed as the first step in the site alteration process.
4. Construction mats are required where paved roads are within 300m of the site.

Barrie

Construction Entrance

REV No.	DATE: APR 2023
2	SCALE: N.T.S
	D710



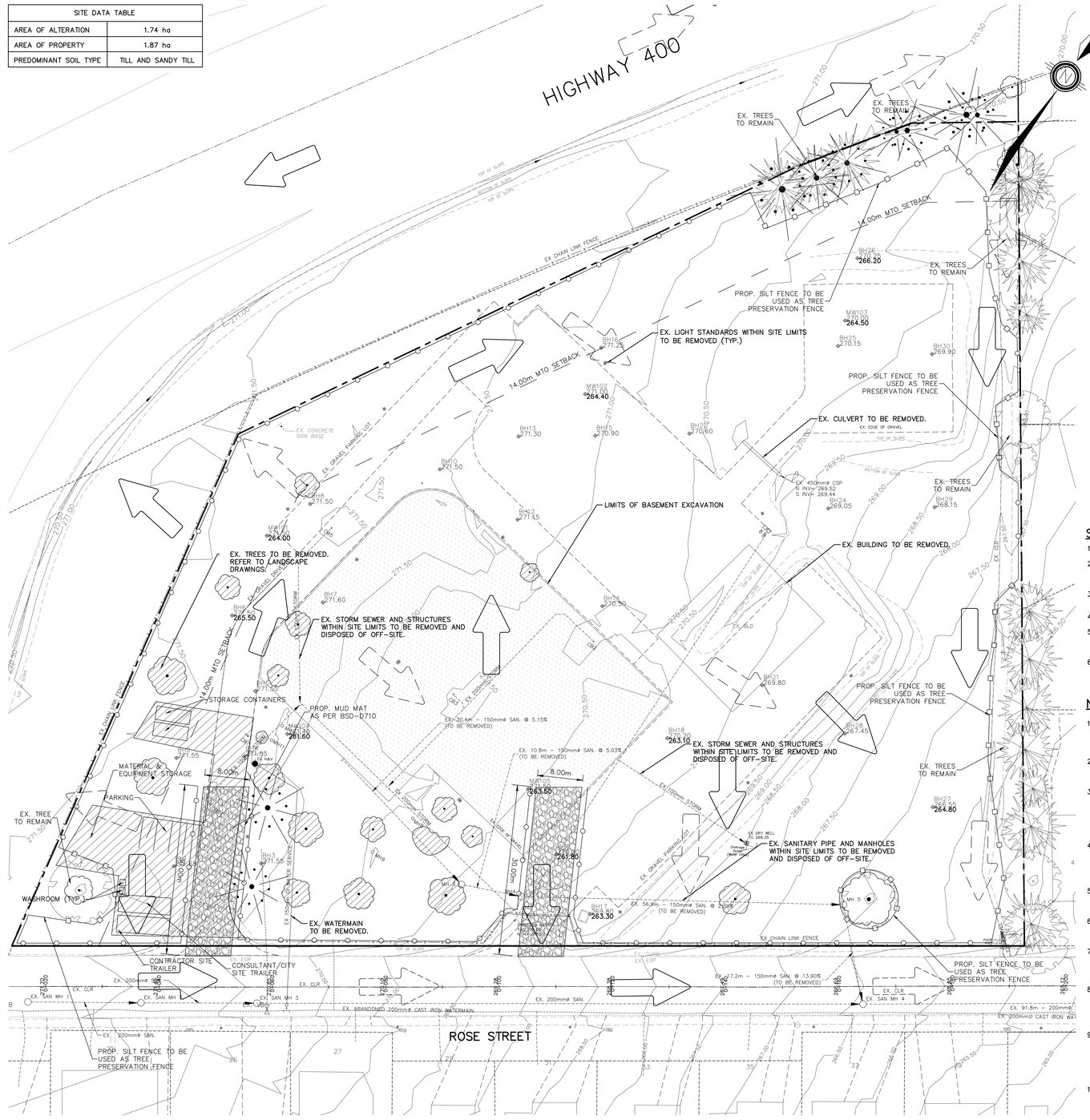
1. THIS DETAIL IS USED IN CONJUNCTION WITH P1233.
2. PAGE WIRE FENCE TO BE ATTACHED TO CEDAR RAIL POSTS WITH 'U' SHAPED GALVANIZED NAILS ON EACH HORIZONTAL STRAND.
3. USE A MINIMUM OF FOUR (4) 100MM, 16 GAUGE GALVANIZED T-POST CLIPS TO ATTACH PAGE WIRE FENCE TO EACH 'T' BAR POST.
4. 'T' BARS ARE TO BE DRIVEN INTO THE GROUND TO A MINIMUM DEPTH OF 600mm.
5. ALL MEASUREMENTS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED.
6. THIS DETAIL TO BE USED IN CONJUNCTION WITH P1230, P1231, P1234 AND P1235.

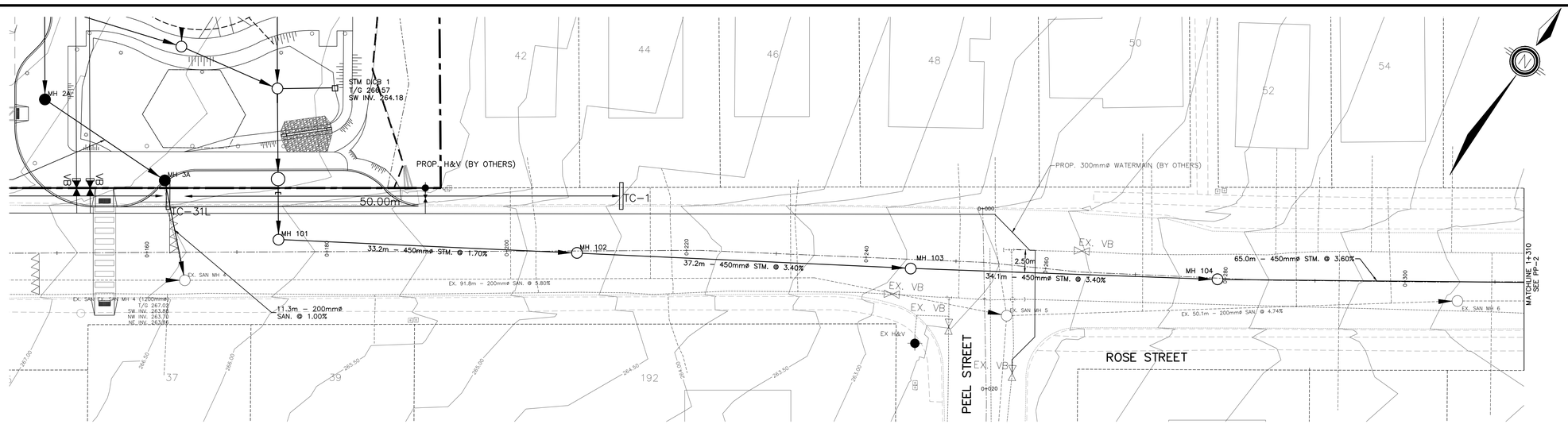
Barrie

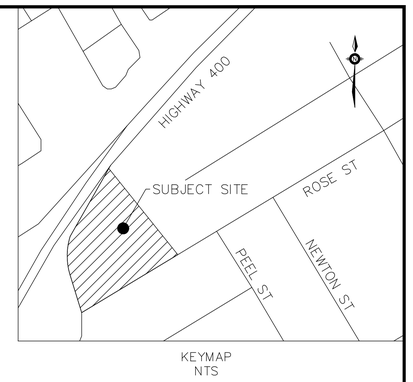
FENCE TREE PRESERVATION

REV No.	DATE: APR 2023
2	SCALE: N.T.S.
	P1232

SITE DATA TABLE	
AREA OF ALTERATION	1.74 ha
AREA OF PROPERTY	1.87 ha
PREDOMINANT SOIL TYPE	TILL AND SANDY TILL


HIGHWAY 400
EX. TREES TO REMAIN
14.00m MTO SETBACK
EX. CHAIN LINK FENCE
PROP. SILT FENCE TO BE USED AS TREE PRESERVATION FENCE
EX. LIGHT STANDARDS WITHIN SITE LIMITS TO BE REMOVED (TYP.)
EX. CULVERT TO BE REMOVED.
EX. EDGE OF GRAVEL
TOP OF SLOPE
BOTTOM OF SLOPE
EX. 450mmø CSP IN INV= 269.52 S INV= 269.44
LIMITS OF BASEMENT EXCAVATION
EX. BUILDING TO BE REMOVED.
EX. TREES TO BE REMOVED. REFER TO LANDSCAPE DRAWINGS.
EX. STORM SEWER AND STRUCTURES WITHIN SITE LIMITS TO BE REMOVED AND DISPOSED OF OFF-SITE.
EX. GRAVEL PARKING LOT
EX. CONCRETE SIGN BASE
STORAGE CONTAINERS
PROP. MUD MAT AS PER BSD-D710
EX. 30.4m - 150mmø SAN. @ 5.15% (TO BE REMOVED)
EX. 10.8m - 150mmø SAN. @ 5.03% (TO BE REMOVED)
EX. 56.3m - 150mmø SAN. @ 2.13% (TO BE REMOVED)
EX. 7.2m - 150mmø SAN. @ 13.90% (TO BE REMOVED)
EX. 91.8m - 200mmø CAST IRON WA
EX. 200mmø CAST IRON WATERMAIN
EX. 200mmø SAN.
EX. 150mmø WATER SERVICE
EX. 100mmø STORM
EX. 600 STORM
EX. 675 STORM
EX. 1050 STORM
EX. 1200 STORM
EX. 1500 STORM
EX. 1800 STORM
EX. 2100 STORM
EX. 2400 STORM
EX. DRY WELL
EX. SANITARY PIPE AND MANHOLES WITHIN SITE LIMITS TO BE REMOVED AND DISPOSED OF OFF-SITE.
EX. WATERMAIN TO BE REMOVED.
EX. TREE TO REMAIN
WASHROOM (TYP.)
CONTRACTOR SITE TRAILER
CONSULTANT/CITY SITE TRAILER
PROP. SILT FENCE TO BE USED AS TREE PRESERVATION FENCE
ROSE STREET
MATERIAL & EQUIPMENT STORAGE
PARKING
8.00m
30.00m
MW101 263.60
MW102 264.40
MW103 264.50
MW104 263.55
MW105 264.00
BH1 271.55
BH2 271.55
BH3 271.50
BH4 271.50
BH5 270.90
BH6 265.50
BH7 271.60
BH8 271.50
BH9 271.50
BH10 271.50
BH11 271.30
BH12 271.35
BH13 271.30
BH14 270.50
BH15 261.60
BH16 271.20
BH17 263.10
BH18 263.30
BH19 261.80
BH20 270.60
BH21 269.80
BH22 267.45
BH23 264.80
BH24 269.05
BH25 270.15
BH26 266.20
BH27 266.55
BH28 268.15
BH29 268.15
BH30 269.90
MH 1
MH 2
MH 3
MH 4
MH 5
EX. 6LD
EX. CLR
EX. SAN MH
EX. SAN MH 3
EX. SAN MH 4
EX. 200mmø SAN.
EX. 200mmø SAN. MH
EX. 1200 STORM MH
EX. 1800 STORM MH
EX. 2400 STORM MH
EX. 1500 STORM MH
EX. 1050 STORM MH
EX. 600 STORM MH
EX. 675 STORM MH
EX. 2100 STORM MH
EX. 100mmø STORM MH
EX. 150mmø WATER SERVICE MH
EX. 200mmø CAST IRON WATERMAIN MH
EX. 200mmø SAN. MH
EX. 450mmø CSP MH
EX. 1200 STORM CB
EX. 1800 STORM CB
EX. 2400 STORM CB
EX. 1500 STORM CB
EX. 1050 STORM CB
EX. 600 STORM CB
EX. 675 STORM CB
EX. 2100 STORM CB
EX. 100mmø STORM CB
EX. 150mmø WATER SERVICE CB
EX. 200mmø CAST IRON WATERMAIN CB
EX. 200mmø SAN. CB
EX. 450mmø CSP CB
EX. 200mmø SAN. MH
EX. 200mmø SAN.

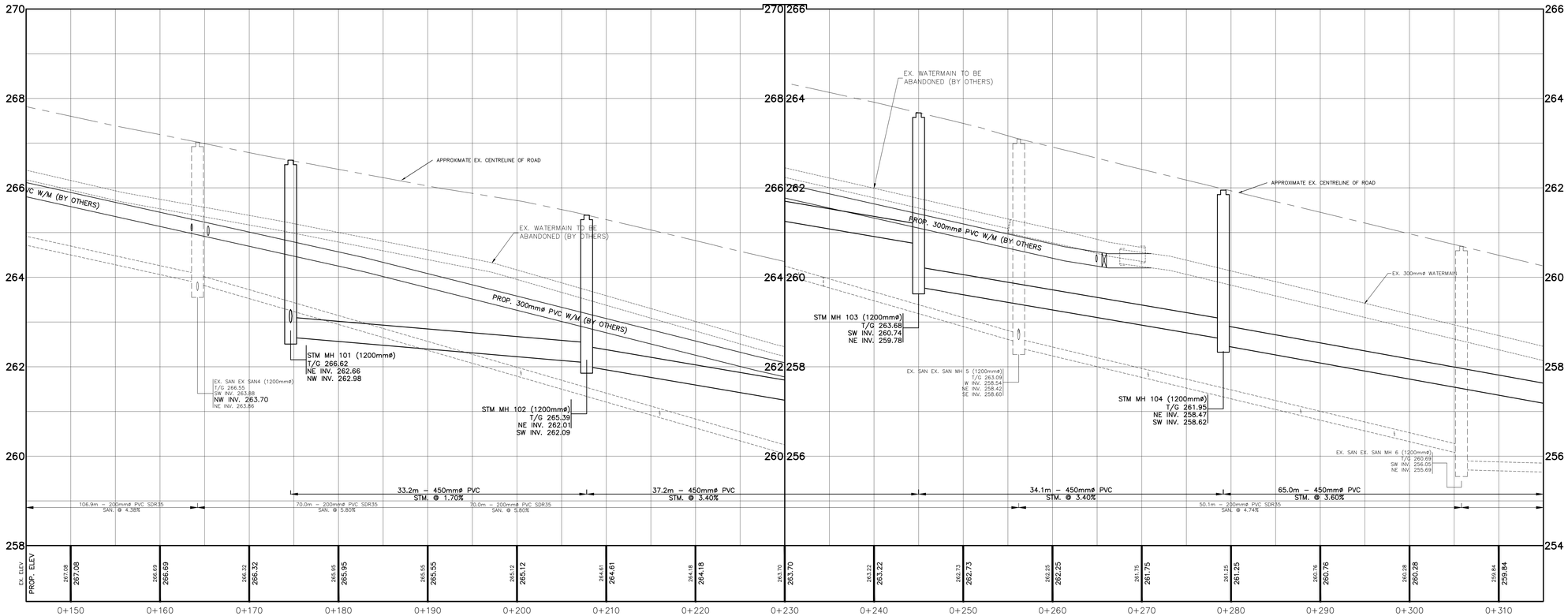




KEYMAP
NTS

LEGEND

- SITE BOUNDARY
- EX SAN MANHOLE
- PROP SAN MANHOLE
- CATCH BASIN
- CATCH BASIN–MANHOLE
- STORM MANHOLE
- EX. STORM MANHOLE
- EX. CATCH BASIN
- EX. FIRE HYDRANT
- SERVICE CAP
- FIRE HYDRANT
- WATER VALVE
- CURB STOP



SCALE BAR 1:250

0 5 15

CITY OF BARRIE D30-006-2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 010198654 74 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST. CITY OF BARRIE

PLAN AND PROFILE ROSE STREET STA. 0+150 TO 0+310

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:250
DRAWN BY	TWC	VERT SCALE	1:50
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	PP–1		
REVISION #	1		

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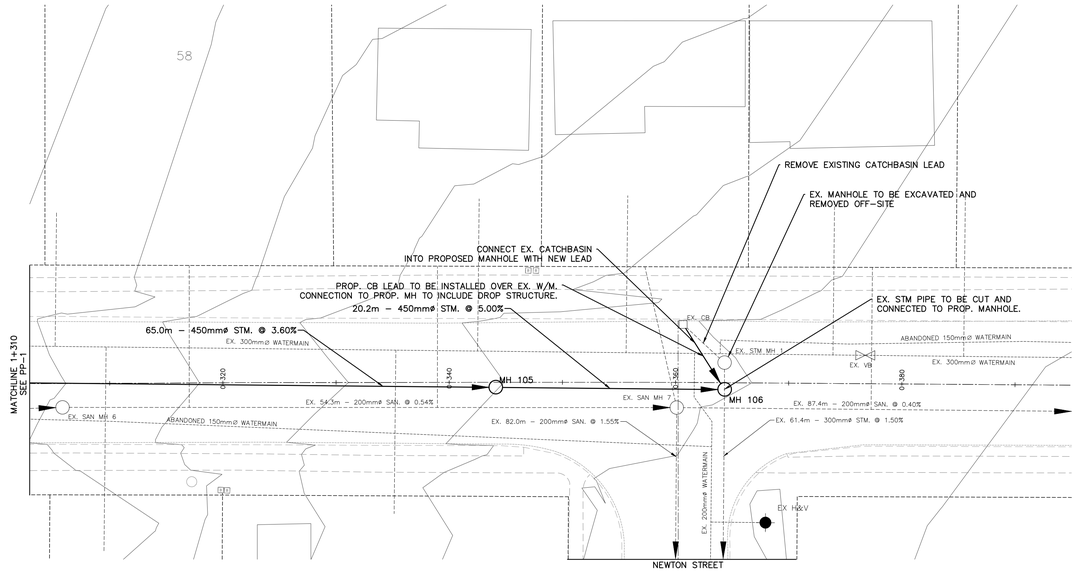

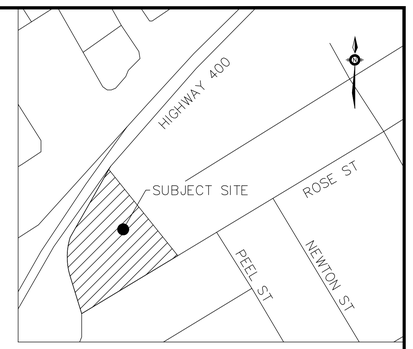

KEYMAP
NTS

LEGEND

- SITE BOUNDARY
- EX SAN MANHOLE
- PROP SAN MANHOLE
- CATCH BASIN
- CATCH BASIN–MANHOLE
- STORM MANHOLE
- EX. STORM MANHOLE
- EX. CATCH BASIN
- EX. FIRE HYDRANT
- SERVICE CAP
- FIRE HYDRANT
- WATER VALVE
- CURB STOP

SCALE BAR 1:250

0 5 15

CITY OF BARRIE D30-006-2024

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 01019865474 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENCED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

COUNTY OF SIMCOE AFFORDABLE HOUSING – 20 ROSE ST.
CITY OF BARRIE

PLAN AND PROFILE
ROSE STREET
STA. 0+310 TO 0+390

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:250
DRAWN BY	TWC	VERT SCALE	1:50
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	PP-2		
REVISION #	1		

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Q = 0.0028*C*I*A (m³/s)
C = Runoff Coefficient
I = Rainfall Intensity = A/(Time+B)^C
A= Area (ha)

20 Rose Street, Barrie
Storm Sewer Design
5-Year Storm Event

DATE: 24-Sep-24
FILE: 20118
CONTRACT/PROJECT: 20 Rose Street, Barrie

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	Percent FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	(%)
1	CB 1	CBMH 2	31.9	0.65	0.17	0.11	0.11	10.00	0.39	109.11	0.03	1.00	300	0.10	1.37	35%
2	CAP	MH 1	18.9	0.95	0.10	0.10	0.10	10.00	0.23	109.11	0.04	1.00	300	0.10	1.37	43%
3	CAP	MH 1	14.1	0.95	0.12	0.11	0.11	10.00	0.17	109.11	0.05	1.00	300	0.10	1.37	47%
4	MH 1	CBMH 1	9.3	0.92	0.14	0.13	0.24	10.39	0.10	106.94	0.08	1.00	375	0.18	1.59	48%
-	CBMH 1	CBMH 2	23.4	0.00	0.00	0.00	0.24	10.49	0.25	106.41	0.08	1.00	375	0.18	1.59	48%
5	CBMH 2	CBMH 3	32.0	0.67	0.13	0.08	0.44	10.73	0.34	105.10	0.13	1.00	375	0.18	1.59	73%
6	CBMH 3	CBMH 4	15.3	0.65	0.08	0.05	0.49	11.07	0.15	103.38	0.14	1.10	375	0.18	1.67	77%
7	CBMH 4	CBMH 5	35.4	0.65	0.05	0.03	0.52	11.22	0.29	102.61	0.15	1.70	375	0.23	2.07	65%
8	CBMH 5	DCBMH 1	40.9	0.95	0.03	0.03	0.55	11.51	0.35	101.22	0.16	1.50	375	0.21	1.94	72%

20118 - SWM rev1.xlsx
2024-09-24

Q = 0.0028*C*I*A (m³/s)
C = Runoff Coefficient
I = Rainfall Intensity = A/(Time+B)^C
A= Area (ha)

20 Rose Street, Barrie
Futre Rose Street Storm Sewer Design
5-Year Storm Event

DATE: 24-Sep-24
FILE: 20118
CONTRACT/PROJECT: 20 Rose Street, Barrie

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	Percent FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	(%)
EXT-1	-	MH 101	90.0	0.55	0.45	0.25	0.25	10.00	-	109.11	0.07	-	-	-	-	-
EXT-2	MH 101	MH 102	33.2	0.58	0.39	0.23	0.47	10.00	0.24	109.11	0.24	1.70	450	0.37	2.34	65%
EXT-3	MH 102	MH 103	37.2	0.41	1.18	0.48	0.96	10.24	0.15	107.77	0.39	5.00	450	0.64	4.01	61%
-	MH 103	MH 104	34.1	0.00	0.00	0.00	0.96	10.39	0.17	106.92	0.38	3.40	450	0.53	3.31	73%
EXT-4	MH 104	MH 105	65.0	0.76	0.28	0.22	1.17	10.56	0.32	106.00	0.45	3.60	450	0.54	3.40	82%
	MH 105	MH 106	20.2	0.00	0.00	0.00	1.17	10.88	0.09	104.33	0.44	4.00	450	0.57	3.59	77%

Note: Highlighted Cell containe the 5 year flow that is controlled through the orifice tube from the project site (0.10 m³/s)

20118 - SWM rev1.xlsx
2024-09-24

Q = 0.0028*C*I*A (m³/s)
C = Runoff Coefficient
I = Rainfall Intensity = A/(Time+B)^C
A= Area (ha)

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	Percent FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	(%)
9	CAP	DCBMH 1	5.3	0.95	0.11	0.10	0.66	10.00	0.04	109.11	0.20	1.30	450	0.33	2.04	61%
10	DCBMH 1	DCBMH 2	3.3	0.95	0.08	0.07	1.28	11.86	0.02	99.57	0.35	1.50	525	0.53	2.43	67%
-	DCBMH 2	MH 2	20.2	0.00	0.00	0.00	1.28	11.88	0.14	164.99	0.59	1.20	600	0.67	2.38	87%
-	MH 2	MH 3	11.6	0.00	0.00	0.00	1.28	12.02	0.09	163.95	0.58	1.00	600	0.61	2.17	95%
11	CAP	MH 3	38.8	0.95	0.24	0.22	0.22	10.00	0.16	180.44	0.11	5.00	450	0.64	4.01	18%
12	DICB 1	MH3	3.4	0.56	0.14	0.08	0.08	0.00	0.03	417.14	0.09	1.60	300	0.12	1.73	74%
12	MH 3	OGS	10.0	0.00	0.00	0.00	1.51	12.11	0.06	98.42	0.10	3.80	300	0.19	2.67	54%
-	OGS	MH 101	6.7	0.00	0.00	0.00	1.51	12.17	0.06	98.14	0.10	2.20	300	0.14	2.03	70%

Note: Highlighted Cell contains the 5 year flow that is controlled through the orifice tube.

20118 - SWM rev1.xlsx
2024-09-24

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF SITE PLAN LOCATED AT 20 ROSE STREET IN THE CITY OF BARRIE AND HAVE PREPARED THIS PLAN TO INDICATE THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADE AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

NO.	REVISION NOTE	DATE	BY
1.	REVISED AS PER CITY OF BARRIE COMMENTS	10/16/24	TWC

BENCHMARK

ELEVATIONS ARE GEODETIC REFERED TO VERTICAL CONTROL MONUMENT No. 01019865474 AND RELATED TO THE CGVD28:78 DATUM, HAVING AN ELEVATION OF 272.0897 METRES.

LICENSED PROFESSIONAL ENGINEER
M.W. DEJEAN
Oct 16, 2024
PROVINCE OF ONTARIO

CITY OF BARRIE D30-006-2024

COUNTY OF SIMCOE AFFORDABLE HOUSING - 20 ROSE ST.
CITY OF BARRIE

STORMWATER PIPE DESIGN SHEETS

PEARSON ENGINEERING
PEARSONENG.COM PH. 705.719.4785

DESIGNED BY	AMC/TWC	HORIZ SCALE	1:250
DRAWN BY	TWC	VERT SCALE	1:50
CHECKED BY	MWD	DATE	OCTOBER 2023
PROJECT #	20118		
DRAWING #	PD-1		
REVISION #	1		

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