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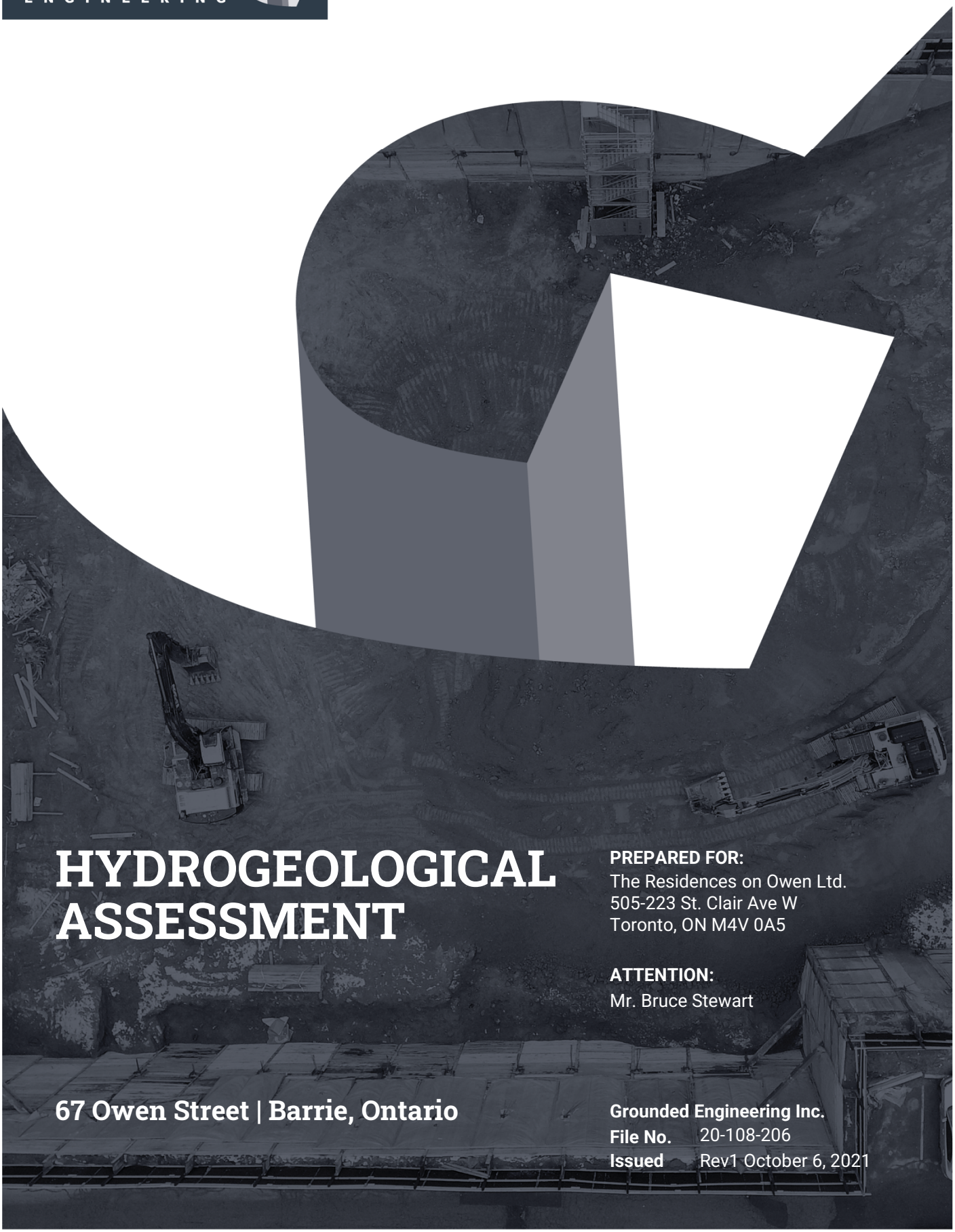

HYDROGEOLOGICAL ASSESSMENT

PREPARED FOR:
The Residences on Owen Ltd.
505-223 St. Clair Ave W
Toronto, ON M4V 0A5

ATTENTION:
Mr. Bruce Stewart

67 Owen Street | Barrie, Ontario

Grounded Engineering Inc.
File No. 20-108-206
Issued Rev1 October 6, 2021

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1 Introduction

1.1 Background

The Residences on Owen Ltd. retained Grounded Engineering Inc., to complete a Hydrogeological Assessment for the property located at the municipal addresses of 55-57 McDonald Street, 61-67 Owen Street and 70-78 Worsley Street in Barrie, Ontario (the Property). For ease of reference, the site will herein be described as "67 Owen Street". The site location is presented in Figure 1.

Based on the architectural drawings dated October 5, 2021 prepared by MCL Architects, it is understood that the Property will be developed with a seniors' residential building with one-level of underground parking beneath the entire site. The proposed development includes 10 storeys of building across the entire Property, with an additional 10 storeys (20 storey tower) concentrated on the southern portion of the site. The underground basement level is set at a lowest Finished Floor Elevation (FFE) of 230.9± m.

The hydrogeological assessment has been prepared for Site Plan application as per the requirement of the Lake Simcoe Conservation Authority. The survey plan is provided in Appendix A.

The hydrogeological assessment was undertaken to evaluate hydrogeological conditions of the proposed development on the Property and to develop a plan to manage risk of potential impacts associated with activities related to the proposed land use.

1.2 Scope of Work

A summary of the scope of work is provided below:

- Background Information Review: Review of available background geologic and hydrogeological information for the Property and surrounding areas. This included a review of the Ministry of the Environment, Conservation and Parks (MECP) well records, watershed information by the Lake Simcoe Region Conservation Authority (LSRCA), and results of previous studies and subsurface investigations.
- Private Well Survey: A well survey was conducted for properties within 500 m of the Property.
- Groundwater Level Monitoring: Groundwater level monitoring was conducted in order to assess the groundwater flow conditions.
- Hydraulic Conductivity Test: In-situ hydraulic conductivity tests were conducted in select monitoring wells to assess hydraulic conductivity of the strata. The underlying soils were assessed in order to determine potential dewatering requirements.

- Water Balance: A water balance and assessment of infiltration rates for existing (pre-development) and post development conditions was completed to determine the feasibility of the proposed development.

2 Site Information

2.1 Site Location and Description

The Property is irregular in shape, with a total Gross Site Area of 0.41 Ha and Net Site Area of 0.39 Ha. The Property is currently occupied by a public paid parking lot in the north and multiple residential and commercial buildings in the south. It is understood that the Property will be developed with a 10 to 20 storey seniors' residential building with one-level of underground parking beneath the entire site. The proposed development includes 10 storeys of building across the entire Property, with an additional 10 storeys (20 storey tower) concentrated on the southern portion of the site. The underground basement level is set at a lowest Finished Floor Elevation (FFE) of 230.9± m. The general site features are presented in Figure 2.

The Property and the immediate neighboring areas are serviced with municipal piped water and sewage services. Surrounding properties include:

- Owen Street, the Barrie Public Library, and a public parking lot to the west;
- McDonald Street and residential properties to the north;
- Residential properties to the east;
- Worsley Street, St. Andrew's Presbyterian Church, and a Service Canada Centre to the south.

The Property information is provided below:

Municipal Address	55-57 McDonald Street, Barrie, Ontario 61-67 Owen Street, Barrie, Ontario 70-78 Worsley Street in Barrie, Ontario
Area	Gross Site Area: 0.41 Hectares Net Site Area: 0.39 Hectares

Legal Description	**55 McDonald Street:** Part Lot 124 S/S Macdonald Street, Plan 2 Barrie As In RO1420694; S/T & T/W Ro1420694; S/T Interest In RO1287454; Barrie **57 McDonald Street:** Pt Lt 124 S/S Macdonald St Pl 2 Barrie As In RO1327580; T/W RO1327580; Barrie **61 Owen Street:** Part Lo 124 S/S Macdonald St Pan 2 Barrie As In RO653238; Barrie **67 Owen Street:** Part Lot 124 S/S Macdonald St Plan 2 Barrie As In RO1287119; Barrie **70-74 Worsley & 53 Owen Streets:** Lots A-C N/S Worsley Street, Plan 240, City of Barrie **76 Worsley Street:** Lot D N/S Worsley Street, Plan 240, City of Barrie **78 Worsley Street:** Lot E N/S Worsley Street, Plan 240, City of Barrie
UTM Coordinates	17 T: 604531 m E, 4916262 m N
Current Land Use	Commercial and Residential
Property Owner Information	The Residences on Owen Ltd. 505-223 St. Clair Ave W Toronto, ON M4V 0A5
Person who has engaged the Qualified Person to conduct the assessment	The Residences on Owen Ltd. 505-223 St. Clair Ave W Toronto, ON M4V 0A5

2.2 Topography & Drainage

The Ministry of Natural Resources and Forestry (MNRF) and Ministry of Energy, Northern Development and Mines (MENDM) database were searched to obtain topographic and geological maps of Ontario for review. The maps are provided in Appendix B and the information obtained are summarized below:

Records	Information
Topographic Maps	The approximate elevation of the Property is 234–235 masl and is gently sloping south.
Hydrology	The nearest water bodies are Sophia Creek located approximately 180 m north of the Property and Lake Simcoe which is located approximately 400 m south of the Property. The approximate depth to groundwater, based on Water Well Records in the local area, is expected to be 11 - 13 m. Regionally, groundwater and surface water is expected to flow to the south/southeast. A municipal wellhead is located approximately 400 m south of the Property, along the shoreline of Lake Simcoe. Groundwater will flow towards the wellhead.
Run Offs	Storm water at the Property is expected to drain towards the catch basins and landscaped areas within the Property and on the municipal roads adjacent to the site.

2.3 Regional Physiography

From a regional perspective, the Property is situated within the physiographic feature known as Sand Plains, characterized by coarse-textured glaciolacustrine deposits of sand, gravel and minor silt and clay content.

The Property is situated within the Lake Simcoe and Couchiching/Black River Source Protection Area and more specifically within the Barrie Creeks Subwatershed which covers an area of approximately 37.5 km^2. The subwatershed has a total watercourse length (including all branches) of 53.8 km which drain into Kempenfelt Bay, a western arm of Lake Simcoe located roughly
400 m south of the property, which is approximately 37.8 km^2 in size.

Additionally, the Property falls within Zones D and C of a Wellhead Protection Area (Well 11 and Well 14 Barrie Water Supply, 220001192).

The source water protection area, wellhead protection area, and watershed maps are presented in Appendix C.

2.4 Regional Geology and Soils

Based on the published information, the regional geology is described as below.

Records	Information
Geological Maps	**Overburden:** The overburden consists of undifferentiated sand, gravel, minor silt and clay (9b coarse-textured glaciolacustrine deposits). More specifically, the overburden at the site can be characterized as such: • Fill – 0 to 3.0 mbgs • Silts and Sands – 1.5 to 22.0 mbgs • Clayey Silt – 9.0 to 23.0 mbgs • Sand – 18.0 to below 25.0 mbgs **Bedrock:** • The bedrock on the site is of the Verulam Formation (Simcoe Group) which is comprised of limestone, dolostone, shale, arkose, sandstone (54a) **Depth to Bedrock:** • Beyond 50 mbgs

It should be noted that the subsurface soil and rock conditions described above represent generalized conditions only and should not be considered site specific. Regional geological mapping is presented in Appendix D.

2.5 Regional Hydrogeology

The Lake Simcoe Region Conservation Authority (LSRCA) has summarized the regional hydrogeologic conditions present within the Barrie Creeks Subwatershed in the Barrie Creeks, Lovers Creek, and Hewitt's Creek Subwatershed Plan (LSRCA, 2012). As per LSRCA (2012), there are four (4) regionally extensive overburden confined aquifers within the subwatershed (A1-A4). The regional stratigraphy also includes an upper confining layer, three (3) lower confining layers (C1-C3).

Based on the information, the below significant hydrostratigraphic units were defined in the vicinity of the Property.

Upper Confining Layer - UC (Aquitard):

The upper confining layer is comprised of coarse-grained lacustrine deposits which are part of a regionally extensive sand plain extending west from the City of Barrie to the City of Angus.

Aquifer 1 – A1 (Aquifer):

The A1 Aquifer is composed of fine to medium grained sand with occasional occurrences of gravel. The A1 aquifer is commonly associated with upland areas. Detailed logging of this unit in the northwest part of the City of Barrie indicates that the A1 aquifer consists of a number of coarsening upward sequences of lacustrine sand with only minor occurrences of silt (LSRCA 2012).

Confining Layer 1 – C1 (Aquitard):

The C1 layer has been cored within the City of Barrie and is described as varved clay and silt.

Aquifer 2 – A2 (Aquifer):

The A2 aquifer is found in the elevation range of approximately 175 to 230 masl within lowland areas but the stratigraphic equivalent extends up to approximately 250 masl to the northeast, under the Oro Moraine. The A2 aquifer can generally be described as being composed of sand, with some clast rich portions. The aquifer is interpreted to extend under Kempenfelt Bay and to the north (towards Midhurst). The lower elevation of the aquifer in the vicinity of Kempenfelt Bay corresponds with the deeper channelized aquifer and suggests that it may represent in-filled former river channels in this area. The A2 aquifer ranges in thickness from approximately 10 to 30 m in most areas. It is regionally extensive but does pinch out in some areas. The aquifer is complex in the central core of Barrie, where it consists of inter-layered sand and silt/clay materials. The eastern part of the A2 aquifer is interpreted to be in direct contact with Kempenfelt Bay, based on the base elevation of the bay and the interpreted aquifer extents near its shores (LRSCA 2012).

2.6 Regional Climate

The Property is located in the climatic region of Southern Ontario known as the Simcoe and Kawartha Lakes region. The following general climate data was obtained from Lake Simcoe Climate Data for the Barrie Creeks Subwatershed, dated April 2017 (Appendix E).

Mean annual precipitation (mm/yr.)	952 mm
Mean annual evapotranspiration	446 mm
Mean annual water surplus	506 mm

The precipitation data was based on Lake Simcoe Climate Data for the Barrie Creeks Subwatershed. It is noted that the above are average values, which are representative in a regional context. There will be seasonal and annual variations in these values. However, the average values will govern long-term ground water recharge and discharge rates. Therefore, average values are appropriate for assessment of hydrogeologic conditions at the site.

2.7 Groundwater Resources

Private well records from the MECP well record database was reviewed for wells located within 500 m radius of the Property. A total of 67 well records were retrieved from the well record database. The MECP well record is presented in Appendix F. A summary of data obtained is presented in the following table.

Total Number of Wells	**67**
Wells completed in Overburden	50 (75%)
Bedrock	2 (3%)
Unknown	15 (22%)
Depth Ranges	
50 ft. or less	39 (58%)
51 ft. to 100 ft.	4 (6%)
101 to 200 ft.	1 (2%)
201 to 300 ft.	7 (10%)
301 to 400 ft.	1 (2%)

Unknown	15 (22%)
Water Use	
Monitoring/Test Holes	49 (73%)
Commercial/Industrial	0 (0%)
Water Supply	5 (8%): 1 - Water Supply Public 1 - Water Supply Cooling and A/C 2 - Water Supply Industrial 1 - Water Supply Municipal
Other/Unknown	7 (10%)
Abandoned	6 (9%): 4 – Other 2 – Supply

The wells are generally used as test holes or for ground water monitoring purposes. There were records of wells used for public, municipal, and industrial water supply. The well records with available construction and installation data indicate that the majority of wells in the Study Area were 50 ft deep or less. The City of Barrie's Public/Municipal Wells 11 and 14 (220001192) are located approximately 400 m south of the Property.

2.8 Private Well Survey

A house to house water well survey within 500 m of the Property was completed on May 5, 2021 to characterize the ground water condition. Based on the private well survey, it was concluded that no sites within a 500 m radius of the Property were on private well water. The results of this inspection are as follows:

- Fire hydrants were observed along Owen Street to the west, McDonald Street to the north, Worsley Street to the south, and Mulcaster Street to the east.
- Fire hydrants were observed along other streets within the Study Area.
- Resident buildings within residential subdivisions were using municipally supplied water as evidenced by water curb stops in lawns and driveways.
- The one (1) domestic well identified during the MECP online well record search was not located during the inspection. GPS Coordinates (Eastings and Northings) and physical descriptions provided within the well log indicate that this well is located approximately 7 km north of the site within the town of Midhurst.
- No domestic water wells were observed at the Property or within the Study Area
- The City of Barrie's Public/Municipal Wells 11 and 14 (220001192) are located approximately 400 m south of the Property.

The Property is located in a developed area within Barrie, Ontario and all properties are municipally serviced. The location of the wells (monitoring, test holes, etc.) within the 500 m Study Area are presented on Figure 3. The private well survey letter distributed to residents within the 500 m Study Area is included within Appendix G.

2.9 Subsurface Investigation

A total of twelve (12) boreholes were advanced on the Property by others as part of the previous geotechnical and environmental investigation completed by Terraprobe Inc. in 2017. Five (5) boreholes (Boreholes 101 to 105) were advanced at the site between July 31st and August 3rd, 2017, as part of the original preliminary subsurface investigation at the site. Six (6) additional deeper boreholes (Boreholes 201 to 206) and one (1) shallow borehole (Borehole 207) were advanced on October 26th to 31st, 2017, for detailed design purposes.

Grounded Engineering advanced an additional five (5) boreholes at the site (Boreholes 301 to 305) from June 15th to 16th, 2021 for the purposes of an updated geotechnical investigation. Borehole logs are presented in Appendix H. The locations of the boreholes are shown on Figure 2. Cross sections are shown on Figure 4-5.

Boreholes	Seventeen (17): • BH101 to BH105 • BH201 to BH207 • BH301 to BH305
Monitoring Wells	Eleven (11): • BH101 to BH105 • BH201-S and BH201-D (nested pair) • BH203, BH205, BH206, BH207
Well Depth (mbgs)	Approximately 3.7 m to 25.0 m

The stratigraphy beneath the investigated areas of the Property generally consists of the following:

Geological Units	Description
Pavement Structure/Topsoil	Surficial asphalt concrete was encountered in Boreholes 101, 102, 103, 201, 202, and 203. The asphalt was 125 to 150 mm thick, and no granular was encountered underneath. Granular type parking lot base and sub-base fill soils were identified below the asphalt topping in Boreholes 101 to 103 with thickness varying between 460 to 600 mm. Boreholes 301, 302, and 303, which were advanced in the existing parking lot at the north portion of the site, encountered a 50 mm thick layer of asphalt 50mm, overlying a 50 mm granular sub-base layer. In the south portion of the site, Borehole 304 encountered 50 mm of granular at the ground surface. Borehole

Geological Units	Description
	305 was advanced at the southern portion of the site and encountered 100 mm of top soil at the ground surface. A 300mm thick topsoil layer was encountered in Borehole 105 at the ground surface.
Earth Fill	Underlying the surficial materials, the boreholes observed a layer of earth fill that extends to depths of 1.5 to 3.0 metres below grade (Elev. 233.5 to 231.3± m). The earth fill varies in composition but generally consists of sand, with varying composition of silt and clay, with gravel, glass rubble, asphalt rubble, brick rubble, and trace organics at various locations and depths. The earth fill is typically brown, and moist. Due to inconsistent placement and the inherent heterogeneity of earth fill materials, the relative density of the earth fill varies between very loose to dense and is on average very loose.
Upper Sands	Underlying the fill materials, all the boreholes encountered an undisturbed sands unit with compositions varying between silty sand, to sand, to sand and silt. This unit was encountered at 1.5 to 3.0 metres below grade (Elev. 233.5 to 231.3 m) and extends down to depths of 9.1 to 21.3 m below grade (Elev. 225.4 to 213.0 m). It is about 8.5 to 16.5 m thick. The sands are brown to grey in colour and are transitioning from moist samples to wet samples with increasing depth. Standard Penetration Test (SPT) results (N-Values) measured in the sands unit range from 3 to greater than 50 blows per 300 mm of penetration (“bpf”), indicating a relative density ranging from very loose to very dense. It was observed that this unit is uniformly very dense below Elev. 229.5 m, except in BH104 where it becomes dense at Elev. 228± m and in BH 305 where it becomes dense at Elev. 224.8± m.
Clays and Silt	Underlying the sands unit, the boreholes encountered an undisturbed native cohesive layer of clay and silt to silty clay, with layering, and trace amounts of sand. This unit was encountered at 9.1 to 21.3 metres below grade (Elev. 225.4 to 213.0± m) and extends down to depths of 18.3 to 23.2 m below grade (Elev. 216.7 to 211.1± m). It is about 2.7 to 12.3 m thick. The clays and silts are generally grey and moist. There are occasional wet sandy seams within this unit. SPT N-values measured in this unit range from 26 to 72 bpf indicating clays with very stiff to hard (on average hard) consistency.
Lower Sands	Underlying the cohesive clays and silts unit, the boreholes encountered an undisturbed lower sands unit. This lower sand unit is confined by the clays and silts unit resulting in pressurized groundwater in the lower sands with a head at Elev. 228± m. This unit was encountered at 18.3 to 23.2 metres below grade (Elev. 216.7 to 211.1 m) and extends beyond the vertical depth of this investigation at 24.6 to 25.0 m below grade (Elev. 210.4 to 209.3± m). The sand is generally grey and wet. SPT N-values measured in this unit were greater than 50 blows per 300 mm of penetration, indicating a very dense relative density.
Bedrock	Although not encountered within the boreholes, the area is underlain by bedrock of the Verulam Formation of the Simcoe Group (Trenton-Black River). The surface of the bedrock formation is anticipated at a depth of about 90 to 120 ± m, based on drift thickness mapping for the area.

2.10 Groundwater Level Monitoring

A total of eleven (11) monitoring wells were installed on the Property by others as part of the previous geotechnical and environmental investigation completed for the site. Ground water level measurements were taken on various dates from August 2017 to May 2021 as part of this and previous investigations.

Observations pertaining to the depth of the water level and caving were made in the open boreholes immediately after completion of drilling and are reported on the borehole logs. The measured water level along with other borehole details are presented in Appendix H. The ground water elevations (masl) are summarized in the following tables. Complete ground water level monitoring data including depth to ground water (mbgs) is also provided in Appendix H.

Borehole No.	**BH101**	**BH102**	**BH103**	**BH104**	**BH105**
Ground Elev. (masl)	234.5	234.5	234.4	234.1	234.3
Well Screen Elev. (masl)	224.0 - 221.0	225.4 - 223.4	223.7 - 220.7	224.6 - 221.6	224.8 - 221.8
Strata Screened	Upper Sand	Upper Sand	Upper Sand/ Clayey Silt	Upper Sand/ Gravelly Sand	Upper Sand/ Gravelly Sand
Date	**Groundwater Elev. (masl)**				
Aug. 8/17	223.1	226.2	225.7	-	222.0
Aug. 11/17	221.7	225.9	225.6	221.3	222.0
Aug. 24/17	225.6	225.9	225.4	221.6	222.1
Sept. 7/17	223.1	226.0	225.4	221.8	222.0
Oct. 25/17	223.0	225.6	225.9	221.4	221.8
Nov. 10/17	224.0	225.7	226.0	221.9	222.0
Dec. 7/17	223.3	225.7	225.5	221.8	221.8
Jan. 17/18	223.2	225.6	225.6	221.8	221.8
May 27/20	224.1	226.6	-	223.2	-
Jun. 3/20	223.8	226.4	226.2	222.7	222.5
Jun. 9/20	223.7	226.4	226.3	222.8	222.8
Jun. 17/20	223.6	226.1	225.9	222.3	222.4
Apr. 14/21	223.8	226.5	225.8	223.7	223.7
May 5/21	223.7	226.1	225.8	222.9	223.0
Max GW Elev.	**225.6**	**226.6**	**226.3**	**223.7**	**223.7**

Borehole No.	BH201S	BH201D	BH202	BH203	BH205	BH206	BH207
Ground Elev. (masl)	235.0	235.0	234.4	234.5	234.3	234.3	234.3
Well Screen Elev. (masl)	228.9 - 225.9	213.7 - 210.7	213.1 - 210.3	213.2 - 210.2	213.0 - 210.0	213.0 - 210.0	231.7 - 230.2
Strata Screened	Sand and Gravel	Lower Sand	Lower Sand	Lower Sand	Clay and Silt, Lower Sand	Silty Clay/ Lower Sand	Sand and Silt
Date	**Groundwater Elev. (masl)**						
Nov. 10/17	-	226.4	225.9	226.0	226.0	-	Dry
Dec. 7/17	227.5	226.9	226.4	226.6	226.2	226.1	Dry
Jan. 17/18	227.3	226.3	225.7	226.0	225.9	225.6	Dry
May 27/20	228.2	227.6	225.0	227.3	226.4	223.6	Dry
Jun. 3/20	228.1	227.2	226.6	226.9	226.1	223.1	Dry
Jun. 9/20	228.0	227.3	226.5	226.9	226.2	223.7	Dry
Jun. 17/20	227.9	227.0	226.3	226.6	225.8	223.4	Dry
Apr. 14/21	227.6	227.4	226.9	227.2	226.5	-	Dry
May 5/21	227.6	227.0	226.5	226.8	226.0	227.2	Dry
Max GW Elev.	**228.2**	**227.6**	**226.9**	**227.3**	**226.5**	**227.2**	**-**

There are two predominant aquifers at the site, the Upper Sand and the Lower Sand units.

The upper sands are unconfined in nature and will yield free-flowing water when penetrated. The groundwater table within the upper sand aquifer was observed to slope from approximately Elev. 228± m (6 mbgs) at the north end of the site to approximately Elev. 226± m (8 mbgs) at the south end of the site. There may also be perched water within the earth fill.

The lower sands unit is confined by the overlying clay and silt deposits. Groundwater levels collected within the monitoring wells observed a lower groundwater table at Elev. 227 to 228± m, indicating a pressure head of about 14 to 16 m. The lower sands will yield free-flowing water when penetrated. Depressurization of this lower aquifer would be required prior to excavation should foundations or shoring systems penetrate this unit.

For design purposes and to account for seasonal fluctuations in the groundwater table, a **design water table of Elev. 228 m** should be assumed in the proposed development area within the north portion of the site and **Elev. 226 m** in the proposed development area in the south**.**

Groundwater levels fluctuate with time depending on the amount of precipitation and surface runoff, and may be influenced by known or unknown dewatering activities at nearby sites.

2.11 Groundwater Quality

A groundwater sample was obtained from BH203 (SW-UF-BH203) and submitted for laboratory analysis on April 14, 2021. The sample was analyzed with respect to the City of Barrie Sanitary Sewers and Sanitary Storm Bylaw (Bylaw 2021-002). The sample was also analyzed with respect to the Provincial Water Quality Objectives (PWQO). The results of the ground water testing are presented in Appendix I and summarized below.

City of Barrie Bylaw	Exceedance
Table 1 – Limits for Sanitary Sewer Discharge	• No exceedances for any Table 1 parameters tested.
Table 2 – Limits for Storm Sewer Discharge	• Total Suspended Solids (Limit 15 mg/L, Result 59 mg/L)
PWQO – Table 2 General	• Anthracene (Limit 8 x 10^{-7} mg/L, Result <0.0001 mg/L) • Benzo(g,h,i)perylene (Limit 2 x 10^{-8} mg/L, Result <0.0002 mg/L) • Chrysene (Limit 1 x 10^{-7} mg/L, Result <0.0001 mg/L) • Dibenz(a,h)anthracene (Limit 2 x 10^{-6} mg/L, Result <0.0001 mg/L) • Fluoranthene (Limit 8 x 10^{-7} mg/L, Result <0.0001 mg/L) • Hexachlorobenzene (Limit 6.5 x 10^{-6} mg/L, Result <0.0001 mg/L) • Perylene (Limit 7 x 10^{-8} mg/L, Result <0.0005 mg/L) • Phenanthrene (Limit 3 x 10^{-5} mg/L, Result <0.0001 mg/L) • Chromium VI (Limit 0.001 mg/L, Result 0.0011 mg/L) • Aluminum (Limit 0.015 mg/L, Result 0.915 mg/L) • Copper (Limit 0.001 mg/L, Result 0.0038 mg/L) • Iron (Limit 0.3 mg/L, Result 1.03 mg/L) • Lead (Limit 0.001 mg/L, Result 0.00172 mg/L) • 4AAP-Phenolics (Limit 0.001 mg/L, Result <0.002 mg/L)

Negative impacts to sewage works may occur in terms of the quality of the ground water discharged. As noted above, the ground water sample exceeded the Limits for Storm Sewer Discharge and met the Limits for Sanitary and Combined Sewer Discharge.

In order to avoid impacts to the sewage works caused by ground water quality, additional treatment will be required before the water can be discharged to the Storm Sewer. Additional treatment will not be required before the water can be discharged to the Sanitary and Combined Sewer.

2.12 Hydraulic Conductivity

2.12.1 In Situ Permeability Test (Single Well Response Test)

In situ single well response tests (SWRT) were conducted in eight (8) monitoring wells on June 9, 2020 to assess the hydraulic conductivity of the underlying soil. The monitoring wells

were installed predominately in the upper and lower sand aquifers with select wells also partially screened between the upper sands and clay and silt unit as well as the clay and silt unit and the lower sands. These tests involve rapid removal of water or addition of a "slug" which displaces a known volume of water from a single well, and then monitoring the water level in the well until it recovers. The results of the slug tests were analyzed using the Bouwer and Rice method (1976).

Data from the SWRT was analyzed using the Bouwer and Rice (1976) or Hvorslev (1951) method. The table below summarized the results of the hydraulic conductivity testing. The analysis graphs of the tests are presented in Appendix J.

Monitoring Well	Well Screen Strata	Hydraulic Conductivity (m/s)
BH101	Upper Sands, Clayey Silt	1.2×10^{-8}
BH102	Upper Sands, Sandy Silt	1.3×10^{-7}
BH103	Upper Sands, Clayey Silt	2.1×10^{-8}
BH201-S	Sand and Gravel	8.4×10^{-7}
BH201-D	Lower Sands	1.4×10^{-5}
BH203	Lower Sands	8.7×10^{-7}
BH205	Clay and Silt, Lower Sands	6.1×10^{-6}
BH206	Silty Clay, Lower Sands	9.1×10^{-6}

Based on the in-situ testing, the upper strata at the Property consists of high permeability soils which are significant in terms of groundwater recharge if penetrated below the groundwater table. The underlying clayey silt to silty clay glacial till is of low permeability and acts as both a cut-off layer to the overlying wet upper sands and a confining layer to the lower wet lower sands. The lower sand unit, similar to the upper sand unit, consists of high permeability, pressurized soils which are significant in terms of groundwater recharge if penetrated.

2.12.2 Grain Size Analysis

Grain size analyses were conducted on representative soil samples through sieve and hydrometer analysis. The analysis is summarized below and presented in Appendix K.

The hydraulic conductivities of various soil types can also be estimated from grain size analyses. An assessment of the grain sizes was conducted using the excel-based tool, HydrogeoSieve XL

(*HydrogeoSieve XL ver.2.2, J.F. Devlin, University of Kansas, 2015*). HydrogeoSieve XL compares the results of the grain size analyses against fifteen (15) different analytical methods.

Given our experience in the area as well as published literature, some of the geometric means provided for the soil were biased low by one or more methods. In these instances, the values determined by these methods were excluded from the mean. The table below illustrates the hydraulic conductivity values estimated from the mean of the analytical methods where the soil met the applicable analysis criteria. The results of the analyses are also presented in Appendix K.

Sample ID	Depth (mbgs)	Percentage				Applicable Analysis Methods	Hydraulic Conductivity (m/s)	Description (MIT System)
		Gravel	Sand	Silt	Clay			
BH101-SS5	3.4	22	61	13	4	Sauerbrei, Kruger, Barr, Alyamani and Sen, Krumbein and Monk	8.1×10^{-6}	Gravelly SAND, some silt, trace clay
BH101-SS10B	11.1	0	4	32	64	Sauerbrei, Alyamani and Sen	3.9×10^{-11}	CLAY and silt, trace sand
BH102-SS10A	10.9	28	44	24	4	Sauerbrei, Barr, Alyamani and Sen, Krumbein and Monk	3.6×10^{-6}	Gravelly silty SAND, trace clay
BH103-SS11	12.5	0	3	47	50	Sauerbrei, Barr, Alyamani and Sen	2.6×10^{-10}	CLAY and silt, trace sand
BH104-SS11	12.5	32	54	11	3	Terzaghi, Sauerbrei, Kozeny-Carmen, Zamarin, Barr, Alyamani and Sen, Krumbein and Monk	7.4×10^{-6}	SAND and gravel, some silt, trace clay
BH201-SS17	21.5	0	89	8	3	Sauerbrei, Barr, Alyamani and Sen, Krumbein and Monk	2.2×10^{-5}	SAND, trace silt, trace clay
BH202-SS4	14	0	1	79	20	Sauerbrei, Barr, Alyamani and Sen	4.5×10^{-9}	Clayey SILT, trace sand
BH203-SS11	12.5	0	1	59	40	Sauerbrei, Barr, Alyamani and Sen	6.0×10^{-10}	SILT and clay, trace sand
BH203-SS18	23	0	84	12	4	Sauerbrei, Barr, Alyamani and Sen, Krumbein and Monk	1.5×10^{-5}	SAND, some silt, trace clay
BH205-SS3	14	32	42	19	7	Sauerbrei, Kruger, Zamarin, Barr, Alyamani and Sen, Krumbein and Monk	2.0×10^{-6}	SAND and gravel, some silt, trace clay
BH205-SS5	17	0	6	85	9	Sauerbrei, Barr, Alyamani and Sen	4.1×10^{-8}	SILT, trace sand, trace clay
BH206-SS10	10.8	57	30	-	-	Terzaghi, Sauerbrei, Zunker, Zamarin, Barr, Alyamani and Sen	2.0×10^{-4}	GRAVEL and sand
BH206-SS15	18.6	0	0	25	75	Sauerbrei, Alyamani and Sen	5.9×10^{-11}	Silty CLAY

Sample ID	Depth (mbgs)	Percentage				Applicable Analysis Methods	Hydraulic Conductivity (m/s)	Description (MIT System)
		Gravel	Sand	Silt	Clay			
BH302-SS6	4.1	27	58	13	12	Terzaghi, Sauerbrei, Kozeny-Carmen, Zamarin, Barr, Alyamani and Sen, Krumbein and Monk	9.4×10^{-6}	Gravelly SAND, some silt, trace clay
BH303-SS7	4.8	12	59	20	9	Sauerbrei, Barr, Alyamani and Sen, Krumbein and Monk	5.4×10^{-7}	SAND, some silt, trace gravel, trace clay
BH304-SS4	2.6	1	41	52	6	Sauerbrei, Barr, Alyamani and Sen	1.8×10^{-7}	SILT and SAND, trace gravel, trace clay
BH305-SS7	4.8	0	87	13	0	Sauerbrei, Barr, Alyamani and Sen	3.3×10^{-5}	SAND, some silt, trace gravel, trace clay

Based on the SWRT and grain size analyses, the representative hydraulic conductivities for each of the strata are as follows:

- Upper Sands: 3.6×10^{-6} m/s
- Silty Clay to Clayey Silt Till: 6.0×10^{-10} m/s
- Lower Sands: 2.2×10^{-5} m/s

According to Freeze and Cherry (1979), the typical hydraulic conductivity of the strata investigated at the site are:

- Sands (Gravelly to Silty): 1×10^{-4} to 1×10^{-7} m/s
- Clayey Silt to Silty Clay: 1×10^{-7} to 1×10^{-11} m/s
- Glacial Till: 1×10^{-6} to 1×10^{-12} m/s

The hydraulic conductivity field results are relatively consistent with the published values associated with the geological materials which were tested.

2.13 Infiltration Rates – Guelph Permeameter Tests

A total of three (3) Guelph Permeameter infiltration tests were completed by Grounded on June 9, 2020. The infiltration tests were completed within both the north and south portions of the Property (see Figure 3). The results of the infiltration tests are presented in Appendix K and summarized below:

Infiltration Location	Approximate Test Depth (mbgs/masl)	Soil Type	Field Saturated K-Value (m/s)	Infiltration Rate* (mm/hr)	Factored Infiltration Rate** (mm/hr)
GP1	0.3 / 234.3	Earth Fill	1.2×10^{-6}	49	19
GP2	0.3 / 234.2	Earth Fill	1.5×10^{-6}	52	21
GP3	0.3 / 235.5	Earth Fill	4.5×10^{-6}	69	28

*Calculated using relationship between infiltration rate and hydraulic conductivity (Figure C11) as defined in the TRCA's Stormwater Management Criteria, Appendix C: Water Balance and Recharge (August 2012)
**Calculated using Table C3: Safety correction factors for calculating design infiltration rates as defined in the TRCA's Stormwater Management Criteria, Appendix C: Water Balance and Recharge (August 2012). Hydraulic conductivity of underlying soil (sands and silts) determined from SWRTs and grain size analyses for the boreholes nearest the infiltration tests.

2.14 Surface Water Features

The site inspection was conducted on April 14, 2021 to assess the presence of any natural environmental features. The topography across the site was generally consistent and notable features are summarized as follows:

- Gently sloped ground from north to south
- Asphalted parking lot in the north portion of the site. Generally landscaped and gravel covered areas in the south portion of the site.
- No ditches, watercourses, or areas of standing water observed.

During the site visit, the ground surface was covered by landscaped vegetation including grass, trees, and shrubs. There was no evidence of phreatophytic vegetation on the Property. There was no standing or ponded water observed on the site.

Given the slightly sloping topography of the site and the presence of Lake Simcoe roughly 400 m to the south, the direction of surface runoff is to the south/southeast.

2.15 Review of Current Regulatory Requirements

Current regulatory requirements associated with water supply and hydrogeology in connection with the proposed development were reviewed. This includes the review of the Lake Simcoe Region Conservation Authority and Lake Simcoe Protection Plan. Relevant information is provided below and presented in Appendix M.

The Property is not located within the Niagara Escarpment Plan Area, Oak Ridges Moraine Plan Area, the Greenbelt Protection Act Area, and Natural Heritage Area.

2.15.1 City of Barrie Official Plan

According to The City of Barrie Official Plan, Schedule J, the site is located in the Lake Simcoe Watershed. Also, Schedule F notes the site is located in the Lake Simcoe Regional Conservation Authority. The information is presented in Appendix M.

2.15.2 Lake Simcoe Region Conservation Authority

According to the Lake Simcoe Region Conservation Authority (LSRCA) website, the Property is not located within an LSRCA regulated area as there are no wetlands, watercourses or steep slopes to be regulated by the Conservation Authority.

2.15.3 Wellhead Protection Areas and Aquifer Vulnerability

Wellhead Protection Area: The Property **is** located within a Wellhead Source Protection Area and straddles two zones, D (Score of 2) in the north and C (Score of 4) in the south.

Vulnerable Scoring Area – Groundwater: The Property **is** located within a Vulnerable Groundwater Scoring Area with a score of 6.

Vulnerable Scoring Area – Groundwater Under Direct Influence**:** The Property is **not** located within a Vulnerable Groundwater Under Direct Influence Scoring Area.

Issue Contributing Area: The Property **is** located within an issue contributing area for sodium and chloride.

Intake Protection Zone**:** The Property is **not** located within an Intake Protection Zone (1, 2, or 3).

Vulnerable Scoring Area – Surface Water**:** The Property is **not** located within a Surface Water Vulnerable Scoring Area.

Significant Groundwater Recharge Area**:** Most of the Property apart from a 0.02 ha area at the north end of the site falls within a Category 6 Significant Groundwater Recharge Area.

Highly Vulnerable Aquifers**:** The Property **is** located in an area with highly vulnerable aquifers.

3 Discussion and Analysis

3.1 Proposed Development Plan

The Property is irregular in shape, with a total Gross Site Area of 0.41 Ha and Net Site Area of 0.39 Ha. The Property is currently occupied by a public paid parking lot in the north and multiple residential and commercial buildings in the south. It is understood that the Property will be developed with a 10 to 20 storey seniors' residential building with one-level of underground

parking beneath the entire site. The proposed development includes 10 storeys of building across the entire Property, with an additional 10 storeys (20 storey tower) concentrated on the southern portion of the site. The underground basement level is set at a lowest Finished Floor Elevation (FFE) of 230.9± m. The proposed development plan is presented in Appendix A.

The following summarizes the proposed land coverage areas for the development:

Land Coverage Type	Areas
Building Envelope	0.35 ha
Hard Surface Paving	0.03 ha
Landscape areas for infiltration	0.03 ha
Total Area	**0.41 ha**

3.2 Summary of Hydrogeologic Conditions

Based on the review of the available site information, the hydrogeologic conditions of the Property is summarized as follows:

- The site is characterized by surficial deposits of topsoil/fill underlain by native cohesionless sand to sandy silt deposits, overlying a cohesive clayey silt to silty clay deposit. Below the clayey silt to silty clay, boreholes observed an additional deposit of cohesionless sands. The sand deposits are of moderate to high permeability and provide for high recharge capability and groundwater movement.
- The groundwater table within the upper sand aquifer was observed to slope from approximately Elev. 228± m (6 mbgs) at the north end of the site to approximately Elev. 224± m (10 mbgs) at the south end of the site.
- The lower sands unit is confined by the overlying clay and silt deposits. Groundwater levels collected within the monitoring wells observed a lower groundwater table at Elev. 227 to 228± m, indicating a pressure head of about 14 to 16 m.
- The general direction of groundwater flow at the site is to the south.
- The Property is located within a Wellhead Protection Area (Zone D in north and Zone C in south) according to the Lake Simcoe Region Conservation Authority and Lake Simcoe Protection Plan.
- The Property falls within a Vulnerable Groundwater Scoring Area (Score of 2 in the north, score of 4 in the south). The Property falls within a Significant Groundwater Recharge Area

with Highly Vulnerable Aquifers. The Property is not located within an Intake Protection Zone or within a Vulnerable Surface Water Scoring Area.

- MECP well records for wells completed in the vicinity of the Property show that there were sixty-seven (67) wells within 500 m of the site used for test holes, monitoring, and municipal/public supply purposes. The City of Barrie's Public/Municipal Wells 11 and 14 (220001192) are located approximately 400 m south of the Property.

The above hydrogeologic features and functions were considered in assessing the potential impact of the proposed development. This information was used to provide mitigating measures to ensure that hydrogeologic function is not adversely affected during the proposed development.

3.3 Water Balance Analysis

A water balance model was prepared for the Property to assess the distribution of rainfall run-off and infiltration for existing (pre- and post-development) conditions (Appendix N). The model is based on Lake Simcoe (Barrie Creeks) Weather Data presented in Section 2.6. The water balance for pre-and post-development conditions is summarized below:

Pre-Development Water Balance

Existing Development	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building	713	679	-	-	679
Hard Surface Paving	1,483	1,412	-	-	1,412
Landscape Area	1,857	1,768	828	371	568
Total	**4,053**	**3,858**	**828**	**371**	**2,659**

The post-development water balance accounts for hard surfaced areas created by buildings and pavements and uses the proposed land use statistic information provided by MCL Architects.

Post-Development Water Balance

Proposed Development	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building	3,452	3,286	-	-	3,286
Hard Surface Paving	347	330	-	-	330
Landscape Area	254	242	113	51	78
Total	**4,053**	**3,858**	**113**	**51**	**3,694**

Water Balance Totals

Development Phase	Precipitation (m^3)	Evapotranspiration (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development	3,858	828	371	2,659
Post-Development	3,858	113	51	3,694

The volume of surface water run-off available from building roof tops was calculated to be 2,958 m^3 (90% of volume captured). This volume of water will be available as a resource, to maintain groundwater recharge and function. The volume of roof run-off available is compared to the difference in infiltration volume between pre-development and post-development, as noted below:

Potential Post-Development Infiltration Deficit (m^3)	Volume of Roof Run-off Available (m^3)	Percentage of Roof Run-off Required to Match Pre-Development Infiltration (%)
321	2,958	11

3.4 Groundwater Control Requirements

For design purposes, a **design water table of Elev. 228 m** should be assumed in the proposed development area within the north portion of the site. For design purposes, a **design water table of Elev. 226 m** should be assumed in the proposed development area within the south portion of the site.

The lowest (P1) FFE is at about Elev. 230.9± m. Therefore,

- Bulk excavation will extend down to approximately Elev. 230.4± m, above the prevailing groundwater table in the north and south portions of the site.
- Foundations made for the proposed P1 level will bear on the upper sands at approximately Elev. 230± m.
- Per the recommendations of Grounded's Geotechnical Report (provided under a separate cover), where zones of weak soils are encountered, the foundations must extend deeper to approximately:
    - Elev. 228± m in the area surrounding BH203
    - Elev. 224.8± m in the area surrounding BH305
- As such, foundation excavations in these weaker zones will extend to the level of the prevailing groundwater table and will penetrate the wet upper sands, which will yield free-flowing water.
- As means, methods, and extent of sub-excavation have not yet been established (i.e. open cut or shored systems), it is assumed that to facilitate the installation of the foundations, positive dewatering across the site to lower the groundwater table prior to excavation will be required.

- In the long term, the P1 level will be above the prevailing groundwater table at the site.

Prior to excavation, positive dewatering to lower the groundwater table by **about 1.2 m** will be required to facilitate construction as well as to maintain the integrity of the subgrade for foundation and slab-on-grade support. The water level must be kept at least 1.2 m below the lowest excavation elevation during construction. Failure to dewater prior to excavation will result in unrecoverable disturbance of the subgrade, which will render advice provided for undisturbed subgrade conditions inapplicable.

Groundwater seepage estimates were conducted for both short term and long term dewatering scenarios. The modeling was conducted using an equivalent well radius approximation (Powers et al, 2007). The calculation for groundwater seepage indicates the short term (construction) and long term (permanent) dewatering requirements as provided below. The results are presented in Appendix O.

The groundwater seepage estimates, which have been provided, represent the steady state groundwater seepage. There will be an initial drawdown of the groundwater before a steady state condition is reached. The rate of the initial drawdown, and therefore discharge, is dependent on the dewatering contractor and how the groundwater is being dealt with at the site. An estimated initial volume of stored groundwater which will require removal before steady state is reached has been provided below.

Please note that if excavation is exposed to the elements, storm water will have to be managed. The short term control of groundwater should consider stormwater management from rainfall events. A dewatering system should be designed to consider the removal of rainfall from excavation. A design storm of 25 mm has been used in the quantity estimates.

Should additional excavation below the base of excavation be required for proper installation of footings, pumping of stored groundwater will need to be considered by the dewatering contractor, and accounted for in the dewatering plan.

Short Term (Construction) Groundwater Quantity – Safety Factor of 1.5 Used

Site Area	Groundwater Seepage		Design Rainfall Event (25 mm)		Total Daily Water Takings	
	L/day	L/min	L/day	L/min	L/day	L/min
North Portion	62,000	43.1	101,500	70.5	309,500	214.9
South Portion	146,000	101.4				

As required by Ontario Regulation 63/16, a plan for discharge must consider the conveyance of storm water from a 100-year storm. The additional volume that will be generated in the occurrence of a 100-year storm event (94mm) is approximately 381,000 L.

The groundwater control system is required to be designed by a dewatering contractor. The groundwater must be dewatered prior to excavation in order to maintain a stable working base in the excavation.

Mitigation measures based on dewatering and infiltration requirements as per the MECP are discussed in Section 3.6.

Long Term (Permanent) Groundwater Quantity – Safety Factor of 1.5 Used					
Groundwater Seepage		Infiltration Design Rainfall Event (25mm)		Total Daily Water Takings	
L/day	L/min	L/day	L/min	L/day	L/min
0	0	2,000	1.4	2,000	1.4

Regulatory Requirements	
Environmental Activity and Sector Registry (EASR) Posting	Required
Short Term Permit to Take Water (PTTW)	Not Required
Long Term Permit to Take Water (PTTW)	Not Required
Short Term Discharge Agreement (City of Barrie)	Required
Long Term Discharge Agreement (City of Barrie)	Required

3.5 Assessment of Potential Impact

It is understood that the Property will be developed with a 10 to 20 storey seniors' residential building with one-level of underground parking beneath the entire site. The proposed development includes 10 storeys of building across the entire Property, with an additional 10 storeys (20 storey tower) concentrated on the southern portion of the site. The underground basement level is set at a lowest Finished Floor Elevation (FFE) of 230.9± m. The Property will be serviced with municipal piped water, storm, and sanitary sewers. The proposed nature of the development does not pose any significant concern with respect to potential impact to groundwater quality in the area.

3.5.1 Short Term Discharge (Construction Dewatering)

The flow of water from the dewatering system must be treated to meet the City of Barrie Storm Sewer Discharge Requirements prior to discharge to the municipal sewer system or Provincial Water Quality Standards prior to overland discharge to meet regulation requirements. No

additional treatment is required should the groundwater be discharged to the City's Sanitary Sewer System. Sampling of the discharge water from the dewatering system is required during initial discharge and on-going basis as required by the Region during active dewatering activities. Visual monitoring of the dewatering discharge should be conducted daily. Adjustment to the dewatering system should be made if an increase in turbidity or sediment is noted.

3.5.2 Long Term Discharge (Post Construction)

A permanent dewatering system would be required if the buildings will be drained structures. Groundwater takings of approximately 1.4 L/min are likely. The flow of water from the dewatering system must be treated to meet the City of Barrie Storm Sewer Discharge Requirements prior to discharge to the municipal sewer system or Provincial Water Quality Standards prior to overland discharge to meet regulation requirements. No additional treatment is required should the groundwater be discharged to the City's Sanitary Sewer System. The permanent building drainage system must be properly installed and screened to ensure sediments and fines will not be removed, which is typically a primary cause of dewatering related settlement.

3.5.3 Zone of Influence (ZOI)

The Zone of Influence (ZOI) was calculated based on the estimated groundwater taking rate and the average hydraulic conductivity recorded at the Property. The stratigraphy of the relevant native soil (for dewatering purposes) located at the Property generally consists of a cohesionless upper sand deposit underlain by a tight clayey silt to silty clay. The ZOI calculated for the Property is as follows:

Equation:

$R_0 = 3000*dH*K^{0.5}$ Where R_0 = Radius of Influence (Zone of Influence)

dH = dewatering thickness (m) in area of largest drawdown

K = hydraulic conductivity (m/s)

Calculation:

The maximum short term ZOI for the Property is:

$R_0 = 3000*2.4\ m\ *(3.6x10^{-6} m/s)^{0.5}$

$R_0 = 14\pm\ m$

The ZOI may reach up to 14± m during construction dewatering. Based on these ZOI distances, dewatering induced impacts on the surrounding environment and infrastructure may be possible. The ZOI is mostly constrained within the area of development and away from watercourses and wetlands.

Dewatering is not required in the long term. As such, a long term ZOI will not be generated for the Property.

3.5.4 Geotechnical Considerations

The Property is bound by Owen Street, the Barrie Public Library, and a public parking lot to the west, McDonald Street and residential properties to the north, residential properties to the east, and Worsley Street, St. Andrew's Presbyterian Church, and a Service Canada Centre to the south. The relevant groundwater table at the site is located within the Upper Sands Unit. The proposed shoring design may consist of permeable soldier-pile and lagging.

As a result of dewatering and draining the soil, changes in groundwater level have the potential to cause settlement based on the change in the effective stresses within the ZOI. Consideration should be given to implement a monitoring and mitigation program during dewatering activities to confirm that there are not potential implications to existing structures on adjacent properties.

3.5.5 Surface Water, Wetlands and Natural Significance

There are no natural waterbodies within the ZOI that will be affected by the proposed construction dewatering or permanent drainage. The nearest water bodies are Sophia Creek located approximately 180 m north of the Property and Lake Simcoe which is located approximately 400 m south of the Property. Regionally, groundwater and surface water is expected to flow to the south/southeast. A municipal wellhead is located approximately 400 m south of the Property, along the shoreline of Lake Simcoe. Groundwater will flow towards the wellhead.

3.5.6 Local Wells and Zone of Influence

The Property is in an area that is serviced by the City of Barrie. The Property and the surrounding area are provided with municipal piped water and sewer supply. The MECP well records were searched through the online Water Well Database for records located on the Property and within a 500 m radius.

Sixty-seven (67) wells were identified within the Study Area, whose uses range from test holes and monitoring wells to municipal/public water supply including The City of Barrie's Public/Municipal Wells 11 and 14 (220001192). Fire hydrants were present throughout the Study Area and the results of the Private Well Survey indicate that the Property and surrounding areas are supplied with water from municipal sources. Dewatering activities at the Property are unlikely to impact any of the wells identified in the Study Area including the City's Municipals Wells.

3.5.7 Contamination Sources

The Property and immediately surrounding area currently consist mostly of residential and commercial occupants. These activities are not expected to provide an area of potential

environmental concern for the Property. Evaluation of the environmental condition of the site has been completed under a separate cover.

3.6 Mitigation Measures to Maintain Hydrogeologic Functions

3.6.1 Maintenance of Groundwater Recharge

The existing groundwater recharge occurs at the at the Property in a broad diffuse manner over the landscaped areas at the site. Mitigation measures are available and should be implemented to maintain recharge rates. There are no wetlands in the immediate vicinity of the Property. The nearest water bodies are Sophia Creek located approximately 180 m north of the Property and Lake Simcoe which is located approximately 400 m

south of the Property. There will be no direct surface runoff from the Property to the water body. The following measures can be incorporated as part of the site development to help regulate run-offs:

- Collection of clean run-offs from the building rooftops and redirection to grass areas and overland flow.
- Planters and green-roofs
- Re-use of grey water at the site
- Provision of an extra thickness of topsoil at the Property (approximately 0.3 m) on open areas to promote water storage in surficial soil and infiltration.

The storm water management measures must specifically address the maintenance of groundwater recharge of the proposed development in order to preserve the recharge into the Barrie Creeks watershed.

3.6.2 Maintenance of Groundwater Transmission Pathways

The upper strata at the Property consists of high permeability soils which are significant in terms of groundwater recharge if penetrated below the groundwater table. The underlying clayey silt to silty clay glacial till is of low permeability and acts as both a cut-off layer to the overlying wet upper sands and a confining layer to the lower wet lower sands. The lower sand unit, similar to the upper sand unit, consists of high permeability, pressurized soils which are significant in terms of groundwater recharge if penetrated.

Significant groundwater flow or transmission zones were encountered on the Property in the upper sands aquifers and lower sands aquifer. The overall continuity of the groundwater flow at the Property should be maintained, where practical. Generally, the groundwater transmission pathways can be maintained through the following means:

- Bedding materials beneath underground services may serve as a subdrain to collect and convey groundwater. To prevent drainage of groundwater along bedding materials, clay trench plugs should be provided at all manhole locations in order to cut off the granular bedding.
- The excavation of any underground services or utilities across permeable layers may interrupt the groundwater flow. It is recommended that trench backfilling be carried out with materials that are similar to the materials that have been excavated.

Groundwater flow may occur into the open shallow excavations if more permeable deposits (such as sand or gravel) are encountered; however, based on the results of the subsurface investigation, active groundwater control (such as from wells or well points) is anticipated during construction, therefore groundwater seepage into the excavation will be controlled. Localized groundwater flow into shallow excavations can be controlled by utilizing localized sumps and pumps at the base of the excavations. In addition to this, it is recommended that any excavations should be staged or constructed in such a manner to avoid the collection of overland drainage.

4 Source Water Impact Assessment and Mitigation Plan (SWIAMP)

4.1 Risk Assessment

4.1.1 Identification of Vulnerable Areas

The location of the Property with respect to the Wellhead Protection Areas (WHPAs) is shown in Appendix M. The City of Barrie's Municipal Water Supply Wells 11 and 14 (220001192) are located within 400 m of the Property. Based on the respective water well records of the water supply wells (Well Record No.: 5719264 and 5700235), these water supply wells are screened within the lower sands unit (deep aquifer) between 17 and 47 m below grade. These water supply wells provide potable water to the municipal system.

The Property is not located within the Niagara Escarpment Plan Area, Oak Ridges Moraine Plan Area, the Greenbelt Protection Act Area, and Natural Heritage Area.

4.1.2 Identification of Anthropogenic Transport Pathways

The relevant aquifer at the Property is the lower sands, which supplies municipal water wells with potable water. Apart from existing monitoring wells screened within this stratum, there are no anthropogenic transport pathways from ground surface to this aquifer. Existing sewer infrastructure and utilities are present at the site at/or above the upper aquifer within the upper sands unit.

4.1.3 Identification of Water Quality Impacts and Threats

The Clean Water Act, 2006, prescribes a number of land uses that are considered to be drinking water threats. The applicable circumstances for activities and conditions to the Property are listed, along with a qualitative evaluation of the threat level, in table below. Per the *Tables of Drinking Water Threats, Clean Water Act, 2006, Ontario Ministry of the Environment (as amended Nov 16, 2009)*, two activities from the list are considered potential drinking water quality threats for the proposed development Property: the Storage of Dense Non Aqueous Phase Liquids and the Handling of Dense Non Aqueous Phase Liquids.

The potential drinking water quality threats are summarized below:

#	WHPA Zone on Property	Intrinsic Vulnerability Score	Identified Prescribed Drinking Water Threat	Short Form Name	Type of Threat (Chemical or Pathogen)	Applicable Circumstances	CWA Rating of the Drinking Water Threat
1	WHPA-C	4	Handling of a Dense Non Aqueous Phase Liquid (DNAPL)	Handling of a DNAPL	Chemical	The below grade handling of a DNAPL in relation to its storage (any quantity). The handling of a DNAPL at or above grade, in relation to its storage (any quantity).	Significant
2	WHPA-C	4	Storage of a Dense Non Aqueous Phase Liquid (DNAPL)	Storage of a DNAPL	Chemical	The storage of a DNAPL at or above grade (any quantity). The storage of a DNAPL completely below grade (any quantity). The storage of a DNAPL partially below grade (any quantity).	Significant

During construction of the proposed buildings, it may be necessary to temporarily handle or store fuels and/or chemicals at the Property. This typically represents a potential threat to ground water quality, as a spill of significant size may potentially impact the local water supply. However, as the drinking water aquifer (lower sands aquifer) is confined from the upper strata and associated

activities at grade, it is unlikely that any spills at surface level would impact the local water supply. As such, this potential threat water quality threat is not relevant to the Property.

4.1.4 Identification of Drinking Water Quantity Impacts and Threats

Currently the area for the proposed development is occupied by a public paid parking lot in the north and multiple residential and commercial buildings in the south. The Property provides minor groundwater recharge into the shallow upper aquifer where softscape area (grassed areas, gravel driveways and parking lots) are present. Post-development, there will be a reduction in recharge and thereby an infiltration deficit generated for the upper sands aquifer.

The lowest (P1) FFE is at about Elev. 230.9± m. Therefore, bulk excavation will extend down to approximately Elev. 230.4± m, about 2.5± m above the highest prevailing groundwater table. Foundations made for the proposed P1 level will bear on the upper sands at approximately Elev. 230± m. Per the recommendations of Grounded's Geotechnical Report (provided under a separate cover), where zones of weak soils are encountered, the foundations must extend deeper to approximately Elev. 228± m in the area surrounding BH203 and Elev. 224.8± m in the area surrounding BH305. As such, foundation excavations in these zones will extend to the level of the prevailing groundwater table and will penetrate the wet upper sands aquifer, which will yield free-flowing water.

An evaluation of the 3rd party dewatering currently taking place around the Property (from MECP well log/PTTW database) was completed for the site. Apart from the Permits to Take Water registered for the municipal water supply wells, there are no active PTTWs within the Study Area. Therefore, there are no additional threats to drinking water quantity as a result of off-site, adjacent site dewatering.

No drinking water quantity impacts and threats were identified on the Property as the relevant aquifer is located within the lower sands unit, confined by the overlying clayey silt to silty clay stratum. Based on the subsurface investigation completed at the Property, earth fill was underlain by an upper sands stratum extending to depths of 9.1 to 21.3 m below grade (Elev. 225.4 to 213.0 m). The clayey silt to silty clay unit was encountered at 9.1 to 21.3 metres below grade (Elev. 225.4 to 213.0± m) and extends down to depths of 18.3 to 23.2 m below grade (Elev. 216.7 to 211.1± m). The lower sands were confined beneath the clayey silt to silty clay and extended beyond the depth of the investigation. Groundwater recharge to the deep aquifer at the site will be precluded due to the following reasons:

- The presence of asphaltic pavement at the development area of the Property
- Significant depth to the deep aquifer, as confirmed by the water well records of the water supply wells
- A moderately thick layer of clayey silt to silty clay (from the subsurface investigation), which will act as a confining layer

Though there will be short-term groundwater control requirements in the upper sands aquifer, there will be no water quantity threats to the underlying lower sands aquifer in which the water supply wells are installed in.

4.2 Risk Management Plan

4.2.1 Water Quality Threats Management

4.2.1.1 Storage of a Dense Non Aqueous Phase Liquid (DNAPL)

During construction it is expected that fuels such as gasoline and diesel, and other chemicals may be temporarily stored on the Property for construction. Due to the following reasons, there is no significant downward pathway into the deep aquifer:

- The presence of asphaltic pavement at the development area of the Property
- Significant depth to the deep aquifer, as confirmed by the water well records of the water supply wells
- A moderately thick layer of clayey silt to silty clay (from the subsurface investigation), which will act as a confining layer

The preventive, mitigation and/or management measures are provided below.

Preventive, Mitigation, Management Measures
• To further prevent and mitigate any spills at the Property, it is recommended to place temporary fuel and chemical storage containers of significant size into secondary containment such that a leak can be contained. Appropriate spill kits should be maintained at various locations throughout the site and an emergency response plan should be developed to outline actions to be taken in case of a spill or leak. • Run-off from parking area/driveways will be directed into storm water catch basins located on the Property. This will prevent downward migration into the aquifer. The detailed design of the storm water management system will be provided to the City as part of the approval process.

No significant impact to the water supply wells is anticipated, as a result of the temporary storage of fuels and chemicals during construction.

The monitoring, communication, and implementation plan, and/or emergency response plan is provided below.

	Description
Monitoring	It is recommended that temporary fuel and chemical storage locations be inspected on a regular basis to ensure integrity of storage containers.
Communication and Implementation Plan	The property owner will be responsible for ensuring that property maintenance staff have, and maintain, an adequate and up-to-date emergency response plan at the property at all times. The emergency response plan will include the information that the site is located in a Wellhead Protection Area.

	Description
Emergency Response Plan	Any spills or leaks related to sewage works located on the Property will be reported to the Spill Action Centre. Contact information for the Spills Action Centre, as well as information detailing the requirement for reporting any spills will occur, will be available at the Property.

4.2.2 Water Quantity Threats Management

4.2.2.1 Dewatering and Depressurization

As short-term groundwater control will be constrained to the upper sands aquifer, there will be no water quantity threats to the underlying aquifer in which the municipal production and public supply wells are installed in.

4.2.2.2 Reduction in Aquifer Recharge

There will be no adverse impact from the proposed development on the aquifer in which the water supply wells are screened in. Reduction in the drinking water aquifer recharge is not anticipated.

5 Conclusions and Recommendations

- The site is characterized by surficial deposits of topsoil/fill underlain by native cohesionless sand to sandy silt deposits, overlying a cohesive clayey silt to silty clay deposit. Below the clayey silt to silty clay, boreholes observed an additional deposit of cohesionless sands. The sand deposits are of moderate to high permeability and provide for high recharge capability and groundwater movement.
- The **design groundwater table** within the upper sand aquifer was observed to slope from approximately Elev. 228± m (6 mbgs) at the north end of the site to approximately Elev. 226± m (8 mbgs) at the south end of the site.
- The lower sands unit is confined by the overlying clay and silt deposits. Groundwater levels collected within the monitoring wells observed a lower groundwater table at Elev. 227 to 228± m, indicating a pressure head of about 14 to 16 m.
- The general direction of groundwater flow at the site is to the south.
- The Property is located within a Wellhead Protection Area (Zone D in north and Zone C in south) according to the Lake Simcoe Region Conservation Authority and Lake Simcoe Protection Plan.
- The Property falls within a Vulnerable Groundwater Scoring Area (Score of 2 in the north, score of 4 in the south). The Property falls within a Significant Groundwater Recharge Area with Highly Vulnerable Aquifers. The Property is not located within an Intake Protection Zone or within a Vulnerable Surface Water Scoring Area.

- MECP well records for wells completed in the vicinity of the Property show that there were sixty-seven (67) wells within 500 m of the site used whose uses range from test holes and monitoring wells to municipal/public water supply including The City of Barrie's Public/Municipal Wells 11 and 14 (220001192).
- There will be a post-development infiltration deficit of approximately 321 m^3 for the Property.
- It is recommended that Low Impact Development measures, such as green roofs, planters, and grey water reuse, be implemented at the Property in order to maintain groundwater recharge and function across the site area.
- The total short-term discharge volume (storm water and groundwater combined) for the site is 309,500 L/day.
- The total long-term discharge volume (groundwater and infiltration from storm water) for the site is 2,000 L/day.

5.1 Signatures

The Hydrogeological Assessment was conducted by Ylena Quan, P.Eng., QP_{ESA} under the supervision of Matthew Bielaski, P.Eng., QP_{ESA-RA}.

We trust that this report meets your requirements at present.

For and on behalf of our team,

GROUNDED ENGINEERING

Ylena Quan, P.Eng., QP_{ESA}
Associate

Mathew Bielaski, P.Eng., QP_{RA-ESA}
Principal

6 References

1. Armstrong, D.K. and Dodge, J.E.P. *Paleozoic Geology Map of Southern Ontario*. Ontario Geological Survey, Miscellaneous Release--Data 219.
2. Chapman, L.J. and Putnam, D.F. 2007. *The Physiography of Southern Ontario*. Ontario Geological Survey, Miscellaneous Release--Data 228.
3. Ontario Geological Survey 2010. *Surficial Geology of Southern Ontario.* Ontario Geological Survey, Miscellaneous Release--Data 128-REV. ISBN 978-1-4435-2483-7
4. Ontario Geological Survey 2006. *Bedrock Topography and Overburden Thickness Mapping, Southern Ontario.* Ontario Geological Survey, Miscellaneous Release—Data 207.
5. Lake Simcoe Region Conservation Authority 2017. *Lake Simcoe Climate Data: A Reference Document to Support the Completion of Water Balance Assessments*
6. Lake Simcoe Region Conservation Authority 2010. *The Barrie Creeks, Lovers Creek, and Hewitt's Creek Subwatershed Management Plan*
7. Ministry of Environment, Conservation and Parks (MECP). *Water Well Information System, Data Catalogue*. Retrieved from: https://data.ontario.ca/dataset/well-records
8. Ministry of Environment, Conservation and Parks (MECP). *Source Protection Information Atlas.* Retrieved from: https://www.gisapplication.lrc.gov.on.ca/SourceWaterProtection/Index.html?viewer=SourceWaterProtection.SWPViewer&locale=en-US
9. Lake Simcoe Region Conservation Authority. *Regulated Areas Map.* Retrieved from: https://maps.lsrca.on.ca/EH5Viewer/index.html?viewer=LSRCARegulations

7 Limitations and Restrictions

The assessment should not be considered a comprehensive investigation that eliminates all risks of encountering environmental problems. The information presented in this report is based on information collected during the completion of the Hydrogeological Assessment by Grounded Engineering Inc. It was based on the conditions on the Hydrogeological Assessment at the time of the site inspection supplemented by a review of historical information to assess the environmental conditions regarding the Property.

There is no warranty expressed or implied by this report regarding the hydrogeologic conditions of the Property. Professional judgement was exercised in gathering and analysing information collected by our staff, as well as that submitted by others. The conclusions presented are the product of professional care and competence and cannot be construed as an absolute guarantee.

If new information regarding the hydrogeological condition of the Property is identified during future work, or outstanding responses from regulatory agencies indicate outstanding issues on file with respect to the Property, Grounded Engineering Inc. should be notified so that we may re-evaluate the findings of this assessment and provide amendments.

7.1 Report Use

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FIGURES

GROUNDED ENGINEERING

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LEGEND

- PROPERTY BOUNDARY
- 500 METRE STUDY AREA

Note

Reference

ArcGIS Online 2021.

Project

HYDROGEOLOGICAL STUDY

67 OWEN STREET, BARRIE, ONTARIO

Figure Title

SITE LOCATION PLAN

North

TRUE

PROJECT

Date

MAY 2021

Scale

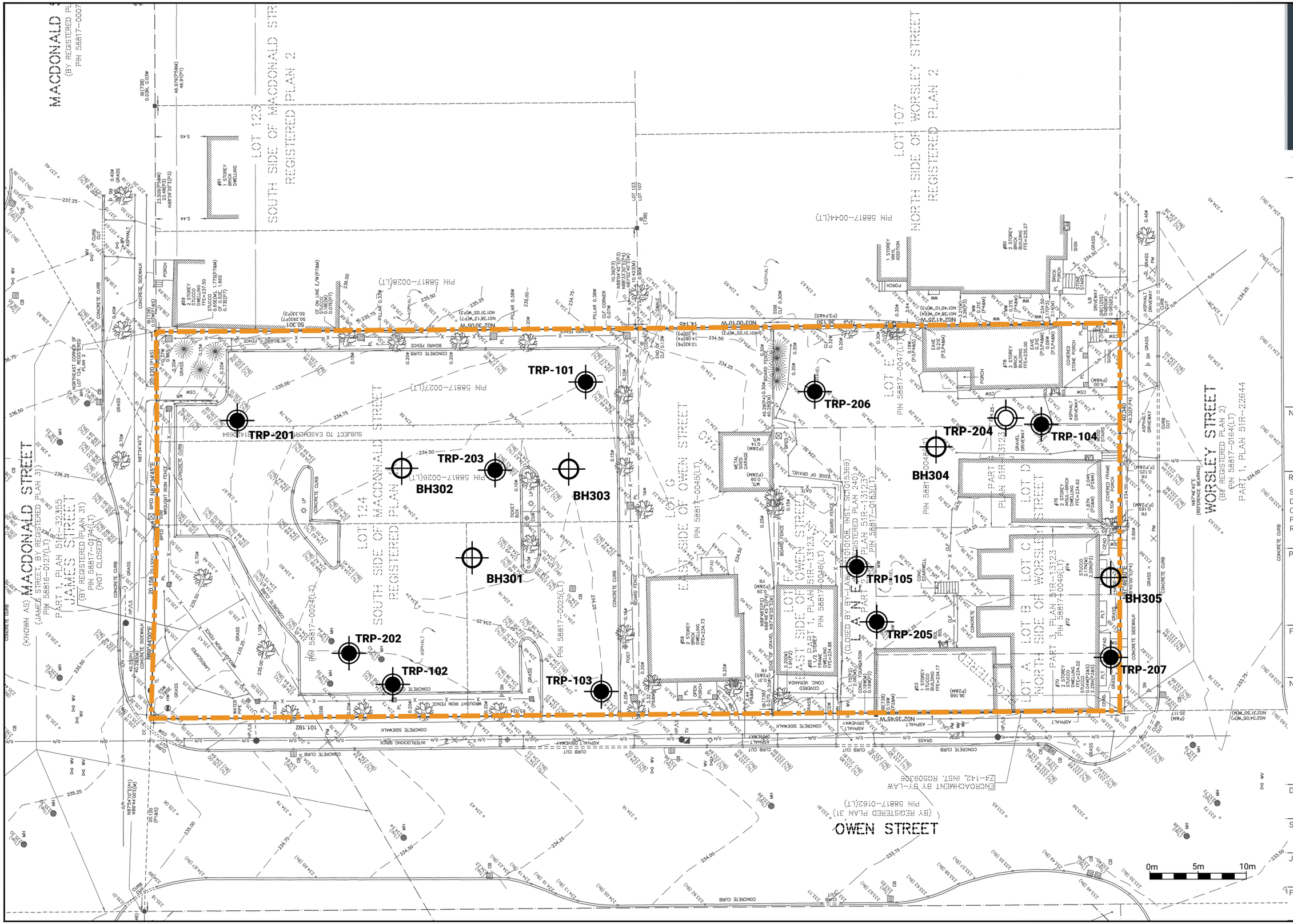
AS INDICATED

Job No

20-108-211

Figure No

FIGURE 1



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LEGEND

- PROPERTY BOUNDARY
- MONITORING WELL BY OTHERS
- BOREHOLE BY OTHERS
- BOREHOLE BY GROUNDED

Note

Reference

Survey Job No. 17-162.
Drawing No. 17-162BT01
Certificate date: Sept. 12, 2017.
Prepared by Krcmar Surveyors Ltd.
Received on May 7, 2021.

Project

67 OWEN STREET, BARRIE, ONTARIO

Figure Title

BOREHOLE AND MONITORING WELL LOCATION PLAN

North

Date

OCTOBER 2021

Scale

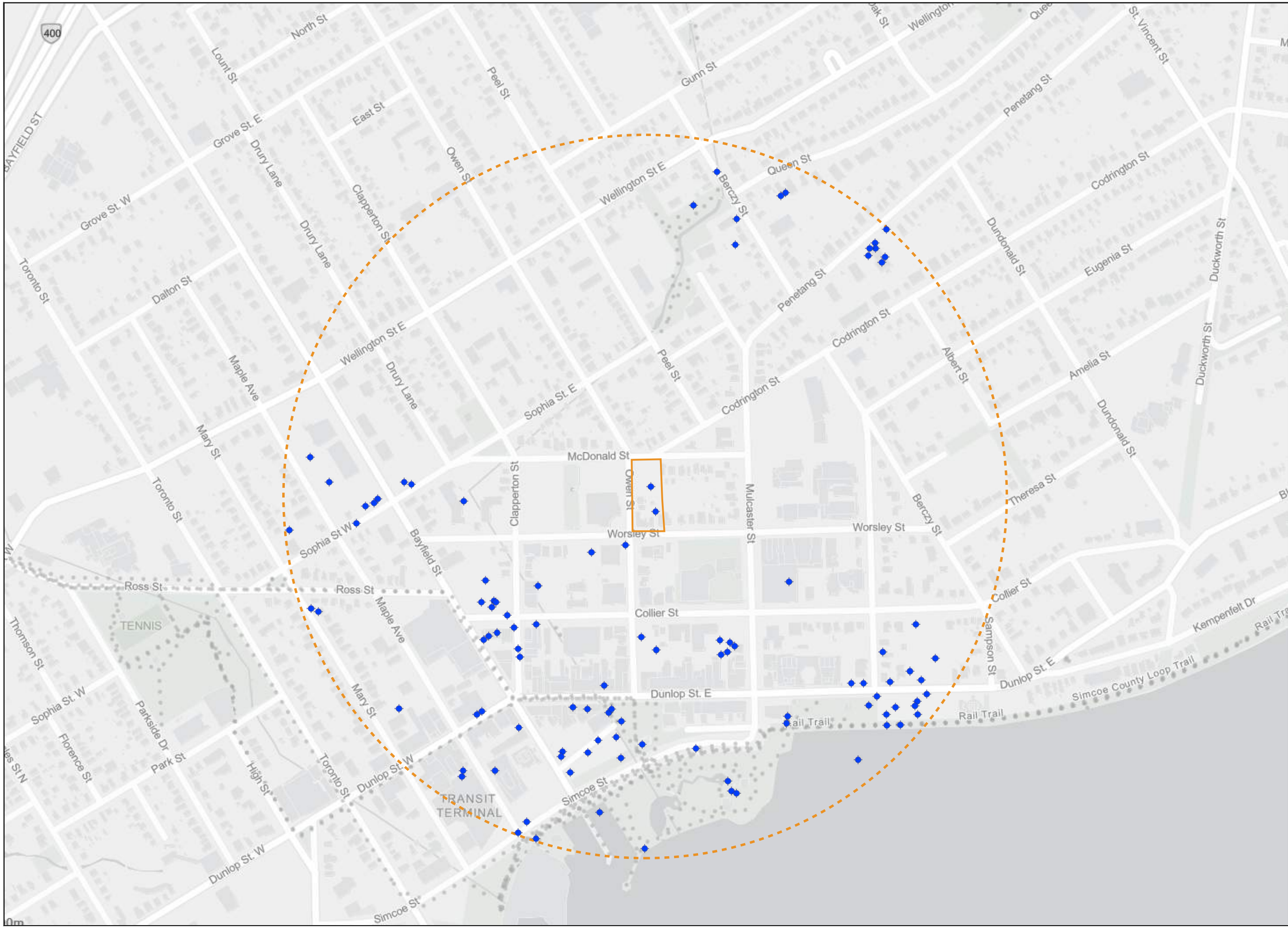
AS INDICATED

Job No

20-108

Figure No

FIGURE 2



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LEGEND

- PROPERTY BOUNDARY
- 500 METRE STUDY AREA
- MECP MONITORING WELL

Note

Reference

ArcGIS Online 2021.

Project

HYDROGEOLOGICAL STUDY

67 OWEN STREET, BARRIE, ONTARIO

Figure Title

MECP WELL LOCATION PLAN

North

TRUE

PROJECT

Date

MAY 2021

Scale

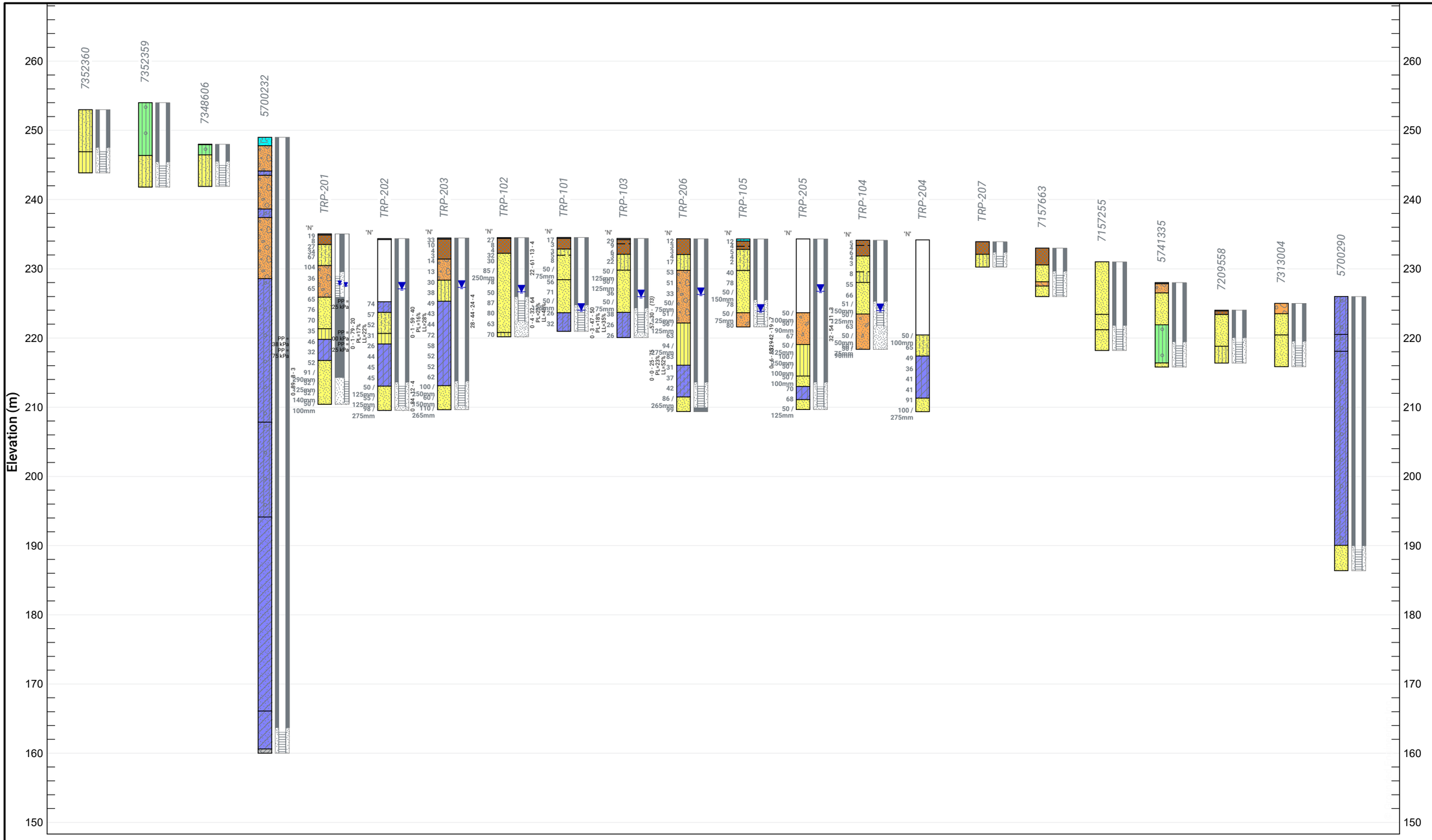
AS INDICATED

Job No

20-108-211

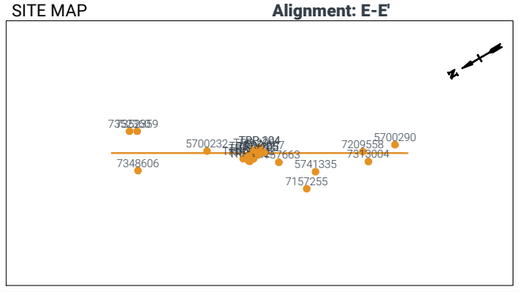
Figure No

FIGURE 3



SITE MAP

Alignment: E-E'



Boreholes Equally Spaced

LITHOLOGY GRAPHIC LEGEND

Topsoil	Bedrock (inferred)	Fill	Silt	Sand and Silt
Sand and Gravel	Sand	Gravel	Silty Sand	Gravelly Sand
Clayey Silt Till	Asphalt	Blank	Clayey Silt	Sandy Gravel
Sandy Clay	Silty Till	Silt and Sand	Sandy Silt	Silt and Clay

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LEGEND

- FILL
- GRAVELS (gravel to gravelly sand)
- SILT TO SAND (not till)
- COHESIONLESS TILLS
- COHESIVE SOILS (clayey silt to clay, incl. tills)
- DISTURBED/REWORKED SOILS

- water level, unstabilized
- water level, stabilized

Project

Figure Title

MECP WELL SECTION

E-E'

Date

MAY 2021

Scale

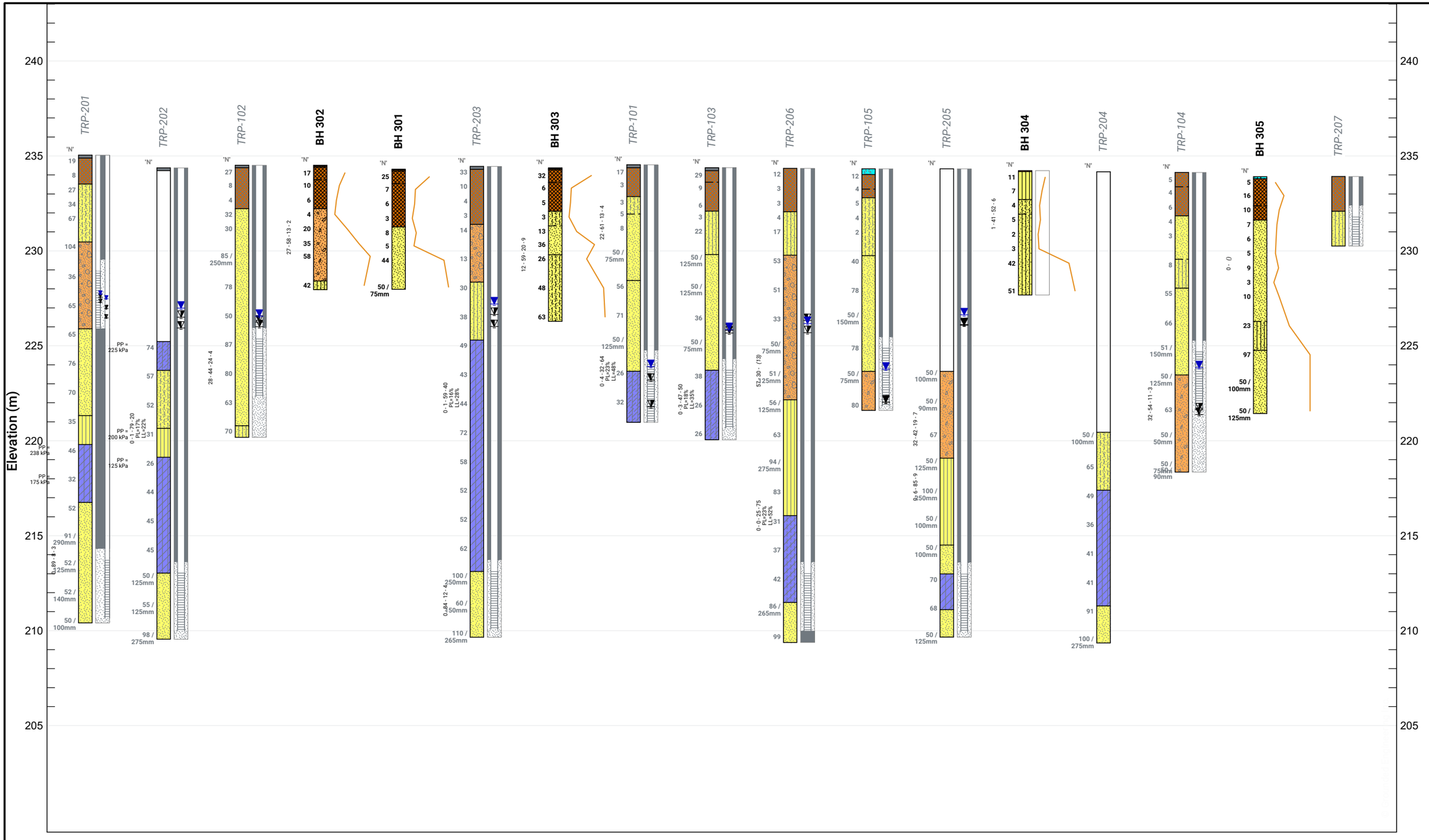
AS INDICATED

Job No

20-108

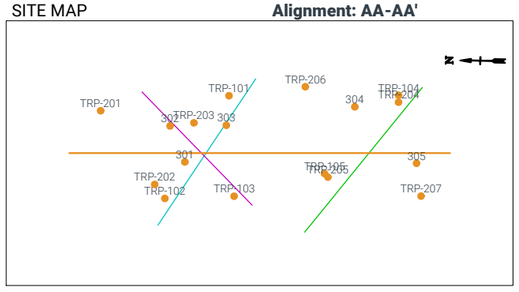
Figure No

FIGURE 4



SITE MAP

Alignment: AA-AA'



Boreholes Equally Spaced

LITHOLOGY GRAPHIC LEGEND

Asphalt	Gravelly Sand	Silt and Sand	Sandy Gravel	Silty Clay
Aggregate	Sand and Silt	Topsoil	Silt and Clay	
Fill	Silty Sand	Clayey Silt	Blank	
Sand	Silt	Sandy Silt	Clay and Silt	

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LEGEND

- FILL
- GRAVELS (gravel to gravelly sand)
- SILT TO SAND (not till)
- COHESIONLESS TILLS
- COHESIVE SOILS (clayey silt to clay, incl. tills)
- DISTURBED/REWORKED SOILS

water level, unstabilized

water level, stabilized

Project

67 OWEN STREET
BARRIE, ONTARIO

Figure Title

SUBSURFACE CROSS-SECTION

AA-AA'

Date: JULY 2021

Scale: AS INDICATED

Job No: 20-108

Figure No

APPENDIX

APPENDIX A

PLAN OF SURVEY
SHOWING TOPOGRAPHICAL INFORMATION OF
LOT 124
NORTH SIDE OF MACDONALD STREET
REGISTERED PLAN 2
AND
LOTS A, B, C, D AND E
NORTH SIDE OF WORSLEY STREET
LOTS F AND G EAST SIDE OF
OWEN STREET AND LANE
(CLOSED BY BY-LAW SC1010108,
INST. SC1015369)
REGISTERED PLAN 240
AND
PART OF JAMES STREET
(NOT CLOSED)
REGISTERED PLAN 31
CITY OF BARRIE
COUNTY OF SIMCOE

SCALE 1:200

0 5 10 15 20m

KRCMAR SURVEYORS LTD. 2017

METRIC: DISTANCES AND SHOWN HEREON ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

BEARING

BEARINGS SHOWN HEREON ARE GRID AND ARE REFERRED TO THE NORTHERLY LIMIT OF PART 1, PLAN 51R-22644 HAVING A BEARING OF N87°46'40"E

ELEVATION

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE RELATED TO CITY OF BARRIE BENCH MARK No. 68U502 HAVING AN ELEVATION OF 237.27D METRES.

LEGEND

■	DENOTES SURVEY MONUMENT FOUND
□	DENOTES SURVEY MONUMENT PLANTED
SIB	DENOTES STANDARD IRON BAR
SSIB	DENOTES SHORT STANDARD IRON BAR
IB	DENOTES IRON BAR
(M)	DENOTES MEASURED
(S)	DENOTES SET
(OU)	DENOTES ORIGIN UNKNOWN
(WIT)	DENOTES WITNESS
(RP)	DENOTES REGISTERED PLAN
(P)	DENOTES PLAN 51R-22644
(P1)	DENOTES PLAN 51R-32355
(P2)	DENOTES PLAN 51R-13123
(P3)	DENOTES SURVEYOR'S REAL PROPERTY REPORT BY BY CDN LAND SURVEYORS INC., O.L.S. DATED JULY 11, 2011
(P4)	DENOTES PLAN OF SURVEY BY RODNEY C. RAIKES, O.L.S. DATED OCTOBER 22, 1986
(P5)	DENOTES BUILDING LOCATION SURVEY BY PAUL R. KITCHEN, O.L.S. DATED JUNE 21, 1984
(P6)	DENOTES BUILDING LOCATION SURVEY BY PAUL R. KITCHEN, O.L.S. DATED OCTOBER 16, 1981
(P7)	DENOTES PLAN OF SURVEY BY R.C. KIRKPATRICK, O.L.S. DATED JANUARY 26, 1981
(1370)	DENOTES KRCMAR SURVEYORS LTD. O.L.S.
(1423)	DENOTES R.R. KRUPOWICZ O.L.S.
(738)	DENOTES R.C. KIRKPATRICK O.L.S.
(1255)	DENOTES R.C. RAIKES O.L.S.
(139D)	DENOTES P.R. KITCHEN O.L.S.
(HEX)	DENOTES HEXAGONAL
(1546)	DENOTES RUDY MACK SURVEYING LTD, O.L.S.
(Tc)	DENOTES TOP OF CURB
(Bc)	DENOTES BOTTOM OF CURB
(Tw)	DENOTES TOP OF WALL
(Bw)	DENOTES BOTTOM OF WALL
(FFE)	DENOTES FINISHED FLOOR ELEVATION
x234.40	DENOTES EXISTING GRADE ELEVATION
MW	DENOTES MONITORING WELL
BPED	DENOTES BELL PEDESTAL
BOL	DENOTES BOLLARD
CB	DENOTES CATCH BASIN
0.1ø	DENOTES CONIFEROUS TREE WITH TRUNK DIAMETER
0.1ø	DENOTES DECIDUOUS TREE WITH TRUNK DIAMETER
	DENOTES DOWN GUY ANCHOR
FH	DENOTES FIRE HYDRANT
GM	DENOTES GAS METER
LS	DENOTES LAMP STANDARD
LP	DENOTES LAMP POST
HP/LS	DENOTES HYDRO POLE WITH LAMP STANDARD
MAIL BOX	DENOTES MAIL BOX
MH	DENOTES MANHOLE
PM	DENOTES PARKING METER
SN	DENOTES SIGN
TL	DENOTES TRAFFIC LIGHT
TV	DENOTES CABLE TV PEDESTAL
WV	DENOTES WATER VALVE
FR	DENOTES TIE TO FRAME
BF	DENOTES BOARD FENCE
PL	DENOTES PILLAR
CF	DENOTES CONCRETE FOUNDATION
CLF	DENOTES CHAIN LINK FENCE
CONC	DENOTES CONCRETE
CPAD	DENOTES CONCRETE PAD
CSW	DENOTES CONCRETE SIDEWALK
PLT	DENOTES PLANTER
MR	DENOTES METAL RAILING
MTL	DENOTES TIE TAKEN TO METAL
WIF	DENOTES WROUGHT IRON FENCE
—x—	DENOTES FENCE
—OH—	DENOTES HYDRO SERVICE (OVERHEAD)

BUILDING TIES ARE TAKEN TO BRICK, UNLESS NOTED OTHERWISE.

TOTAL SITE AREA = 0.4053 ha

MUNICIPAL ADDRESS

#70, #72, #74 AND #78 WORSLEY STREET, BARRIE
#53, #55 AND #59 OWEN STREET, BARRIE

SURVEYOR'S CERTIFICATE

I CERTIFY THAT:

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE 11th DAY OF SEPTEMBER, 2017

DATE SEPTEMBER 12th , 2017

S.N. RAMSAMOOJ
ONTARIO LAND SURVEYOR

ASSOCIATION OF ONTARIO LAND SURVEYORS
PLAN SUBMISSION FORM
2020604

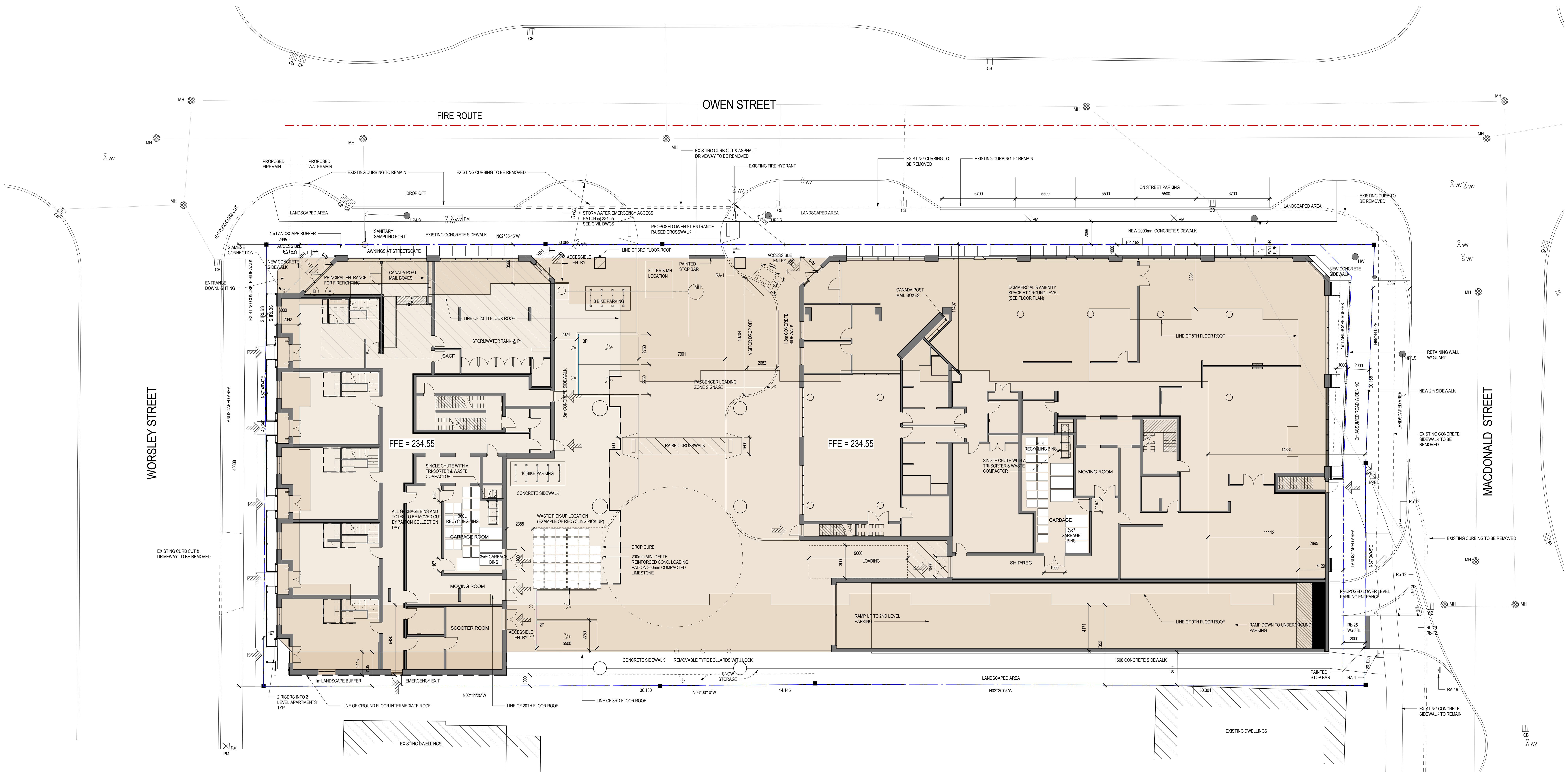
THIS PLAN IS NOT VALID UNLESS IT IS AN EMBOSSED ORIGINAL COPY ISSUED BY THE SURVEYOR in accordance with Regulation 1026, Section 29(3).

PLAN AVAILABLE AT www.ProtectYourBoundaries.ca

FIELD:	R.L.	DRAWN:	S.D.	CHECKED:	S.N.R.	JOB NO:	17-162
DWG NAME:	17-162T01	PLOT INFO:	11:22 21/Aug/2017	WORK ORDER NO:	26307		

1137 Centre Street Thornhill ON L4J 3M6 905.738.0053 F 905.738.9221 www.krcmar.ca

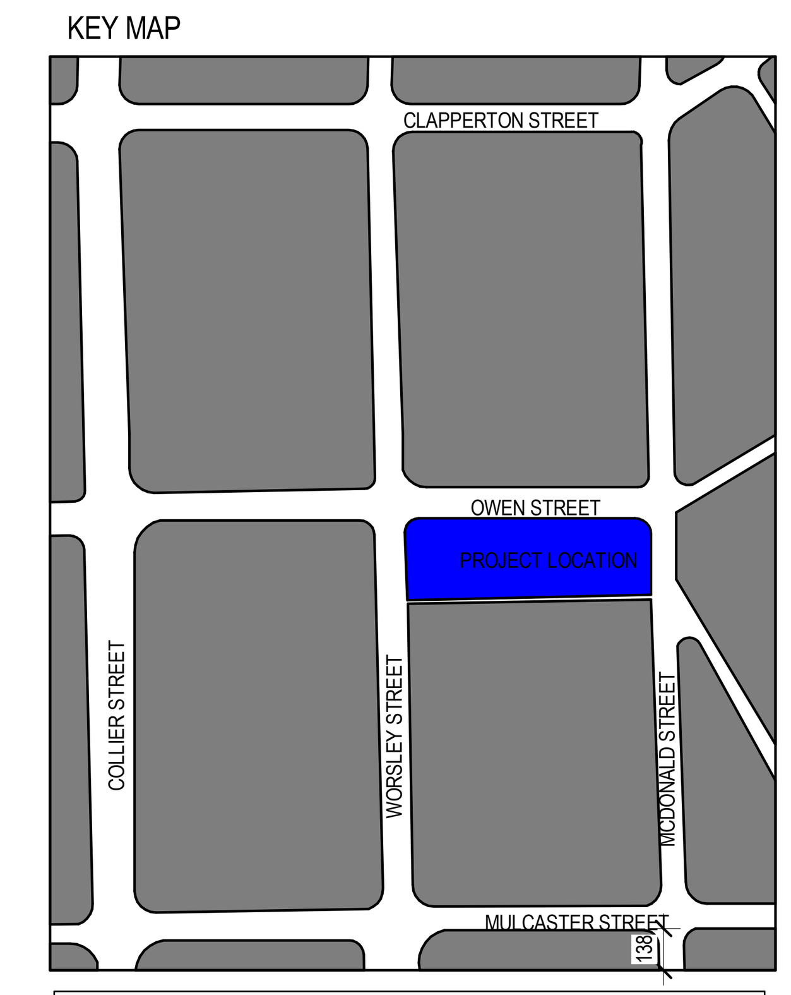
KRCMAR



1
A1.1

SITE PLAN

1 : 200



SITE PLAN LEGEND

- CB — DENOTES EXISTING CATCH BASIN (SEE CIVIL DWGS FOR FINAL LOCATIONS)
- PEDESTRIAN ENTRY DOOR LOCATION
- B.F. PARKING STALL
- DENTOES EXISTING FIRE HYDRANT
- HP/LS — DENOTES EXISTING HYDRO POLE W/ LAMP STANDARD
- MH — DENOTES EXISTING MAN HOLE (SEE CIVIL DWGS FOR FINAL LOCATIONS)
- VISITOR PARKING c/w PAINTED 'V'
- SIAMESE CONNECTION
- BPED — DENOTES EXISTING BELL PEDESTAL
- PM — DENOTES EXISTING PARKING METER
- TL — DENOTES EXISTING TRAFFIC LIGHT
- TV — DENOTES EXISTING CABLE TV PEDETAL
- WV — DENOTES EXISTING WATER VALVE
- GM — DENOTES EXISTING GAS METER

SIGN LEGEND

1. BARRIER FREE VAN PARKING SIGN
2. BARRIER FREE PARKING SIGN
3. SNOW STORAGE SIGN
4. VISITOR PARKING SIGN

- SEE LEGEND ON A1.4

ZONING STANDARDS MATRIX C2-1 (SP-563)	REQUIRED	PROPOSED
LOT AREA	N/A	0.4053ha (4053 sqm)
LOT FRONTAGE	N/A	40.3m
FRONT YARD SETBACK	N/A	1.0m
SIDE YARD ADJOINING, STREET	1.0m	1.0m
SIDE YARD ADJOINING, RESIDENTIAL	3.0m	3.0m
SIDE YARD, ADJOINING COMMERCIAL	1.0m	1.0m
LOT COVERAGE	N/A	87%
BELOW GRADE SETBACK	0m	1.0m
GFA	760%	648% (924% INCL. PK, MECH)
BUILDING HEIGHT	SOUTH BUILDING: 13m WITHIN 3m OF A STREET LINE 67m BEYOND 3m OF A STREET LINE NORTH BUILDING: 13m WITHIN 3m OF A STREET LINE 35m BEYOND 3m OF STREET LINE	SOUTH 13.0m AT 1.0m SETBACK 67.0m AT 3.0m SETBACK ON WORSLEY STREET AND AT 3.56m SETBACK ON OWEN STREET NORTH 13.0m AT 1.0m SETBACK ON OWEN STREET AND AT 3.0m SETBACK ON MACDONALD STREET 30.0m AT 5.8m SETBACK ON OWEN STREET AND AT 4.1m SETBACK ON MACDONALD STREET 35.0m AT 11.4m SETBACK ON OWEN STREET AND 11.1m SETBACK ON MACDONALD STREET
MIN, COVERAGE, COMMERCIAL	20% OF LOT AREA	20% (810 sqm REQUIRED) BAR/LOUNGE = 275 sqm FITNESS = 362.9sqm DINING = 316 sqm TOTAL = 954 sqm

ZONING STANDARDS MATRIX (CONT.)		
PARKING	0.8/ UNIT (1.65/UNIT MAX) = 91 0.5/ ASSISTED LIVING = 80 0 FOR COMMERCIAL/RETAIL TANDEM PARKING INCLUDED	TOTAL = 212 PARKING SPOTS + 4 SURFACE PARKING (TANDEM PARKING NOT INCLUDED)
BARRIER FREE PARKING SPACES	7 REQUIRED (1+3% OF PARKING)	7 (3 TYPE A; 4 TYPE B)
PARKING SIZES	2.7 x 5.5m	2.75 x 5.5m
LOADING SPACES	MIN 3.0m x 9.0m WITH 4m VERTICAL CLEARANCE	1 PROVIDED (SEE SITE PLAN FOR LOCATION)
BIKE PARKING	0.32/UNIT (278 UNITS * 0.32 = 89)	89 (18 @ ENTRANCE; 27 VERTICAL @ 2ND FLOOR; 44 HORIZONTAL @ 2ND FLOOR)
LANDSCAPE BUFFER	1m TO OWEN ST, MACDONALD ST, AND WORSLEY ST 3m ADJOINING RESIDENTIAL ZONE TO THE NORTH 0M TO THE SIDE LOT LINE ADJOINING COMMERCIAL ZONE	1m TO OWEN ST, MACDONALD ST, AND WORSLEY ST 3m ADJOINING RESIDENTIAL ZONE 1m TO THE SIDE LOT LINE ADJOINING COMMERCIAL ZONE
GREEN ROOF AREA	30% OF FOOTPRINT AREA 1057 sqm (11'380 sf) REQUIRED	4TH FLOOR ROOF (664 sqm) 9TH FLOOR ROOF (98 sqm) 10TH FLOOR ROOF (446 sqm)

STATISTICS	
GROSS SITE AREA	0.4053ha (4053 sqm)
ROAD WIDENING	$85m^2$
NET SITE AREA	$3968m^2$
GFA	26'826m^2 APPROX
BUILDING AREA	$3452m^2$
UNIT COUNT	278
DENSITY	(278 UNITS) / 0.4053ha = 686 UPH
PARKING	216

PARKING SCHEDULE (NOT INCLUDING TANDEM PARKING)

LEVEL	STANDARD	H/C	TOTALS	BIKE
UNDERGROUND	54	0	53	0
SURFACE	4	0	4	18
MEZZANINE				
2ND FLOOR	71	3	75	57
3RD FLOOR	80	4	84	14
TOTAL	209	7	216	89

SUITE SCHEDULE

LEVEL	ASSISTED LIVING	APARTMENTS	2 LEVEL APARTMENTS	TOTALS
GROUND	0	0	5	5
INTERMEDIATE	0	3	0	3
2ND FLOOR	0	0	0	0
3RD FLOOR	0	0	0	0
4TH FLOOR	26	0	0	26
5TH FLOOR	27	0	0	27
6TH FLOOR	28	0	0	28
7TH FLOOR	28	0	0	28
8TH FLOOR	28	0	0	28
9TH FLOOR	23	0	0	23
10TH FLOOR	0	10	0	10
11TH FLOOR	0	10	0	10
12TH FLOOR	0	10	0	10
13TH FLOOR	0	10	0	10
14TH FLOOR	0	10	0	10
15TH FLOOR	0	10	0	10
16TH FLOOR	0	10	0	10
17TH FLOOR	0	10	0	10
18TH FLOOR	0	10	0	10
19TH FLOOR	0	10	0	10
20TH FLOOR	0	10	0	10
TOTAL	160	113	5	278

GROSS AREA (APPROX)

LEVEL	AREA
LOWER LEVEL	$830m^2$ ($2652m^2$ PK)
GROUND	$2240m^2$ ($300m^2$ PK)
GROUND FLOOR INTERMEDIATE	$1640m^2$ ($592m^2$ PK)
2ND FLOOR	$3447m^2$ (PK)
3RD FLOOR	$3447m^2$ (PK)
4TH FLOOR	$2177.5m^2$ ($97.4m^2$ TERRACE)
5TH FLOOR	$2177.5m^2$
6THFLOOR	$2177.5m^2$
7TH FLOOR	$2177.5m^2$
8TH FLOOR	$2177.5m^2$
9TH FLOOR	$1898.5m^2$ ($264m^2$ ROOF)
10TH FLOOR	$796m^2$ ($229m^2$ MECH)
11TH FLOOR	$796m^2$
12TH FLOOR	$796m^2$
13TH FLOOR	$796m^2$
14TH FLOOR	$796m^2$
15TH FLOOR	$796m^2$
16TH FLOOR	$796m^2$
17TH FLOOR	$796m^2$
18TH FLOOR	$796m^2$
19TH FLOOR	$796m^2$
20TH FLOOR	$796m^2$
PENTHOUSE MECH	$188.5m^2$
TOTAL	37'468.9m^2 (INCL. PARKING, ACCESSIBLE ROOF, MECH) 26'252m^2 (APPROX)

2	ISSUED FOR SPA	JUNE 28, 2021
1	ISSUED FOR PRECONSULTATION	FEB. 10, 2020

ISSUES/REVISIONS

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ONTARIO ASSOCIATION OF ARCHITECTS
MICHAEL W. McKNIGHT
LICENCE
3808

PROJECT NORTH
N

MCLARCHITECTS
MCKNIGHT CHARRON LIMITED
48 ALLIANCE BLVD., UNIT 110
BARRIE, ONTARIO L4M 5K3
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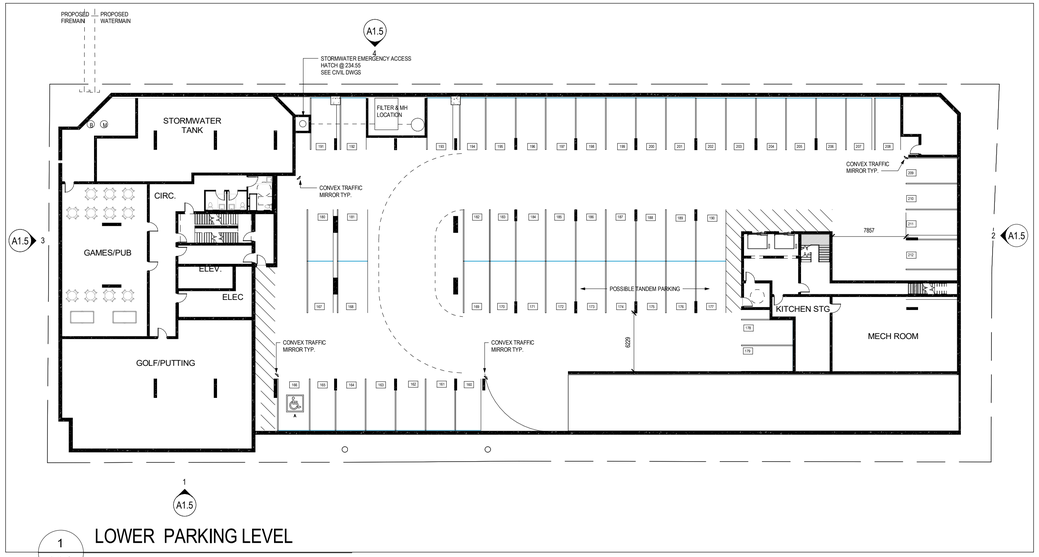
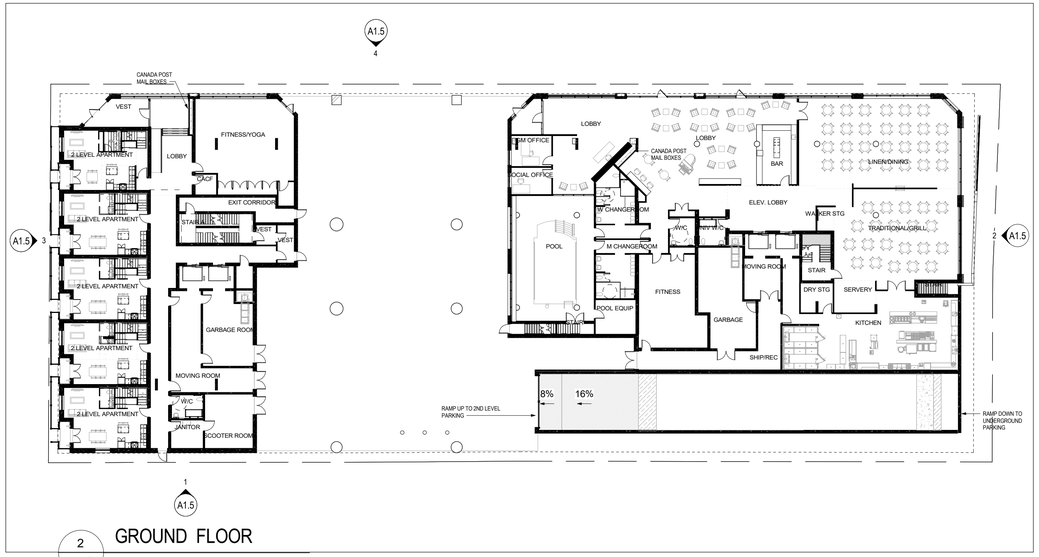
DRAWING TITLE:
SITE PLAN W/ GROUND FLOOR

PROJECT NAME:
OWEN STREET
55-57 MACDONALD STREET, 61-67 OWEN STREET AND 70-78 WORSLEY STREET
BARRIE, ON
(FOR THE EASE OF REFERENCE, THE SITE WILL BE DESCRIBED AS 67 OWEN STREET)
THE RESIDENCES ON OWEN LTD.

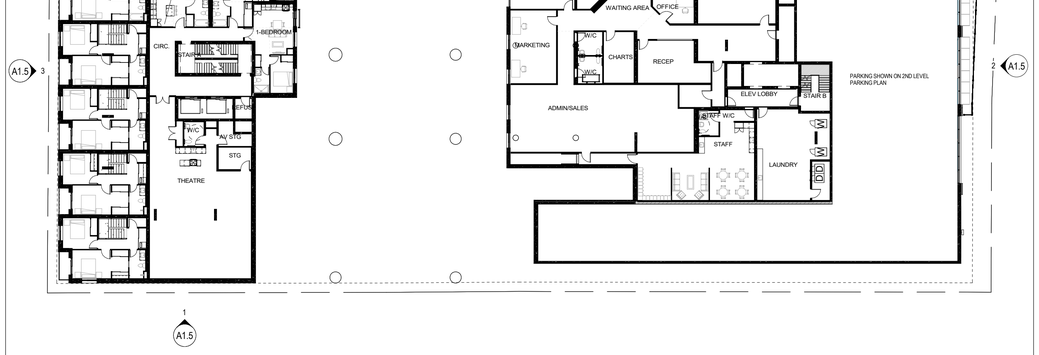
DATE:	10/05/2021	PROJECT #	SHEET #
DRAWN BY:	KSN	PROJECT #	A1.1
SCALE:	As indicated		



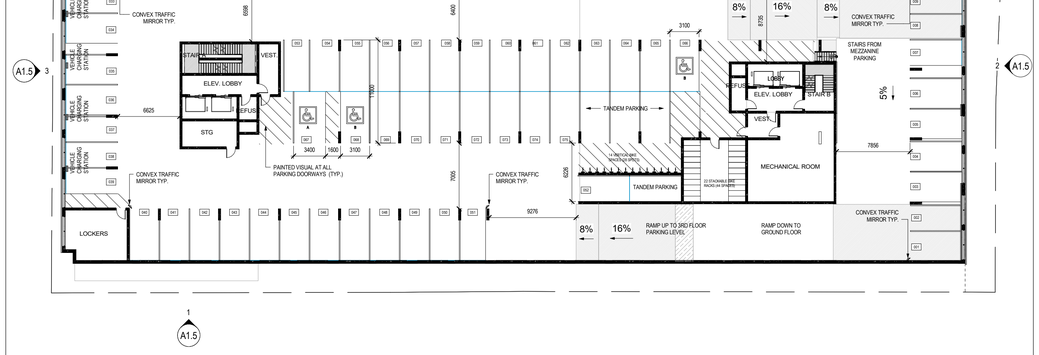
1 LOWER PARKING LEVEL
1 : 300



2 GROUND FLOOR
1 : 300



3 GROUND FLOOR INTERMEDIATE
1 : 300



4 2ND FLOOR (PARKING)
1 : 300

RESIDENTIAL APARTMENT AREAS
GFA JUNIOR 1-BEDROOM = 51 SQM
GFA 1-BEDROOM = 60 - 64 SQM
GFA 2-BEDROOM = 82 SQM
2 LEVEL APARTMENTS = 134 SQM

ASSISTED LIVING AREAS
GFA JUNIOR 1-BEDROOM = 48 - 51 SQM
GFA 1-BEDROOM = 58 – 67 SQM
GFA 2-BEDROOM = 82 – 90 SQM

2	ISSUED FOR SPA	JUNE 28, 2021

ISSUES/REVISIONS

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DRAWING TITLE:
SPA FLOOR PLANS

PROJECT NAME:
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(FOR THE EASE OF REFERENCE, THE SITE WILL BE DESCRIBED AS 67 OWEN STREET)
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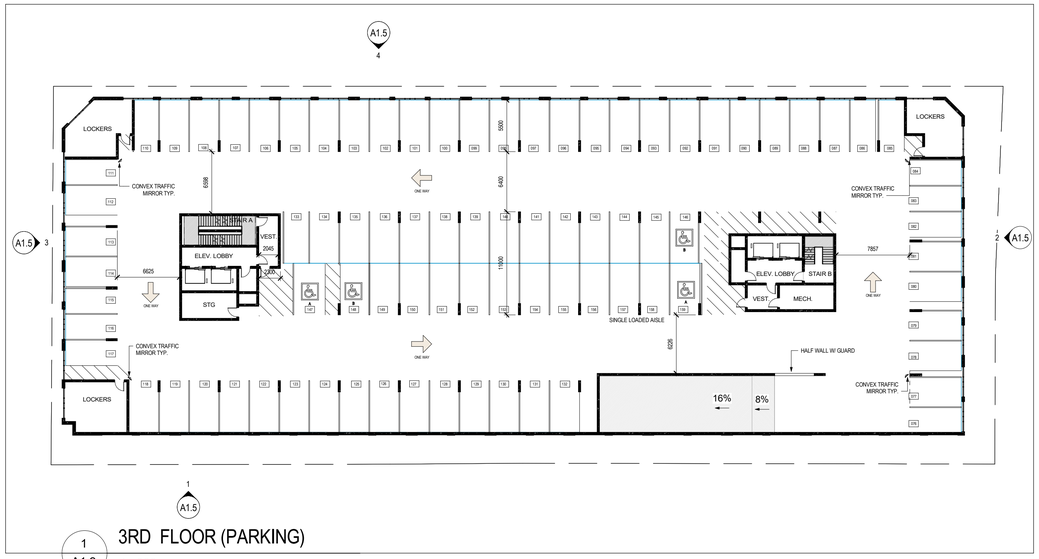
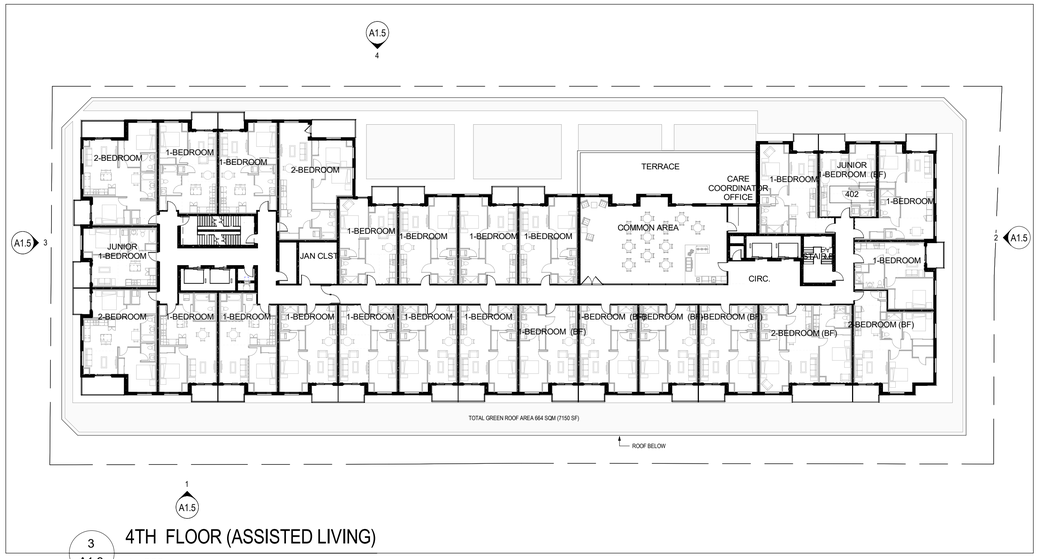
DATE:	10/05/2021	PROJECT #	SHEET #
DRAWN BY:	KSN	PROJECT #	A1.2
SCALE:	As indicated		



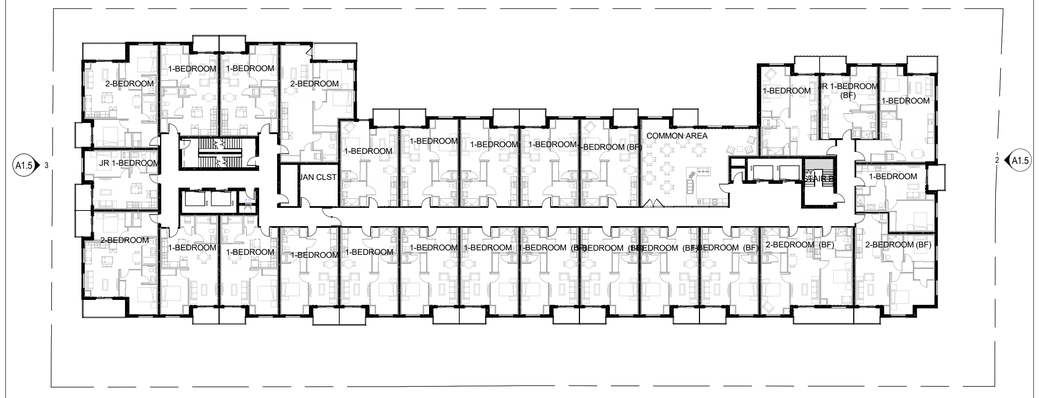
1 A1.3 3RD FLOOR (PARKING)

1 : 300



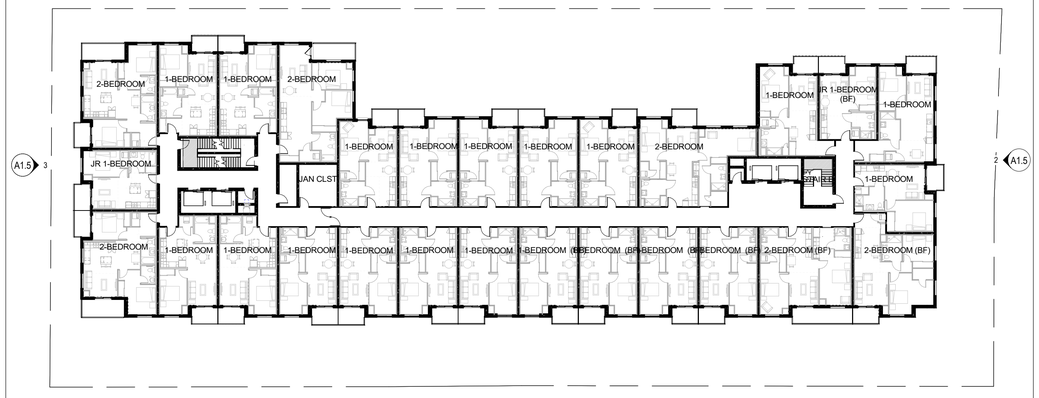
3 A1.3 4TH FLOOR (ASSISTED LIVING)

1 : 300



4 A1.3 5TH FLOOR (ASSISTED LIVING)

1 : 300



2 A1.3 6TH - 8TH FLOOR (ASSISTED LIVING)

1 : 300

RESIDENTIAL APARTMENT AREAS
GFA JUNIOR 1-BEDROOM = 51 SQM
GFA 1-BEDROOM = 60 - 64 SQM
GFA 2-BEDROOM = 82 SQM
2 LEVEL APARTMENTS = 134 SQM

ASSISTED LIVING AREAS
GFA JUNIOR 1-BEDROOM = 48 - 51 SQM
GFA 1-BEDROOM = 59 – 67 SQM
GFA 2-BEDROOM = 82 – 90 SQM

2	ISSUED FOR SPA	JUNE 28, 2021

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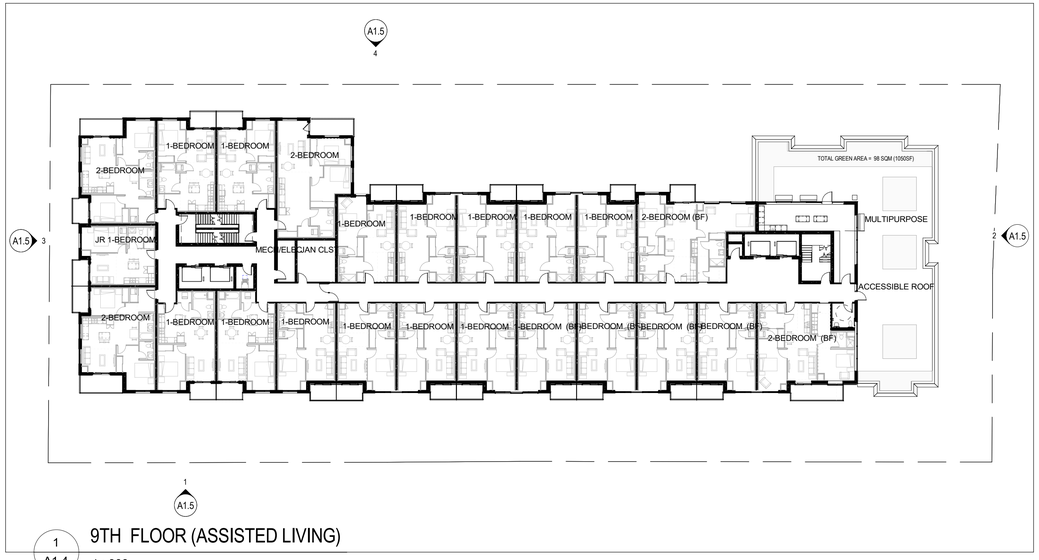
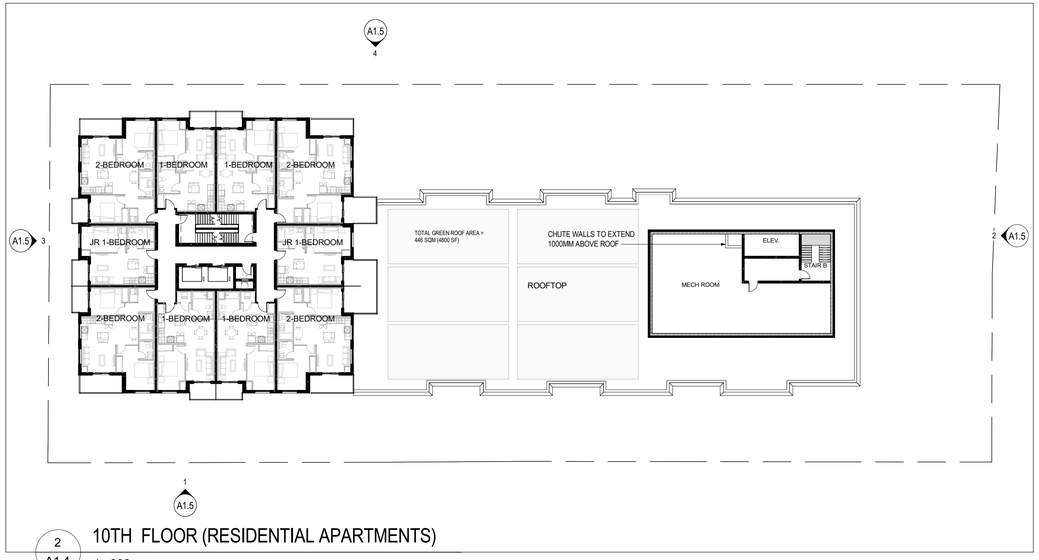
THE RESIDENCES ON OWEN LTD.

DATE:	10/05/2021	PROJECT #	SHEET #
DRAWN BY:	KSN	PROJECT #	A1.3
SCALE:	As indicated		



1 / A1.4 — 9TH FLOOR (ASSISTED LIVING)

1 : 300

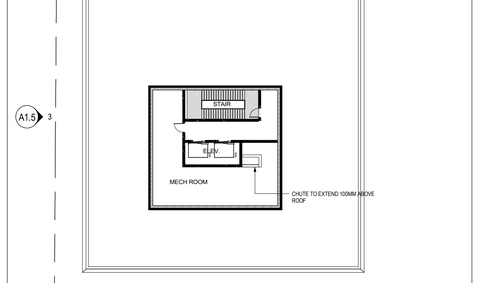


2 / A1.4 — 10TH FLOOR (RESIDENTIAL APARTMENTS)

1 : 300

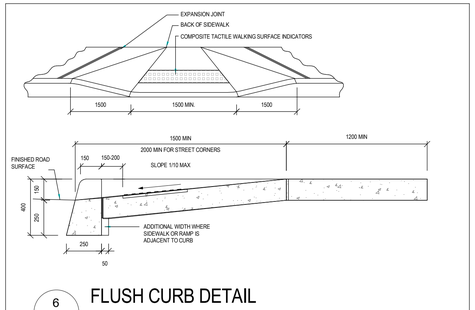
3 / A1.4 — 11 - 20TH FLOOR (RESIDENTIAL APARTMENTS)

1 : 300



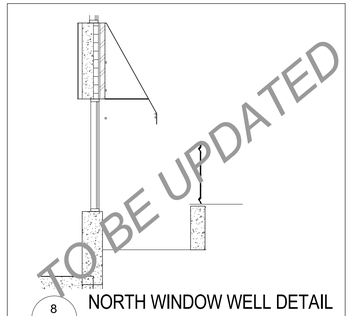
4 / A1.4 — PENTHOUSE ROOF

1 : 300



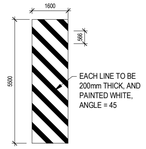
6 / A1.4 — FLUSH CURB DETAIL

1 : 20

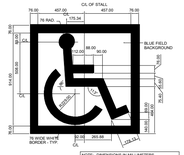


8 / A1.4 — NORTH WINDOW WELL DETAIL

1 : 50



BARRIER FREE PARKING AISLE, CROSSWALK (CW) AND NO PARKING AREA (NPA) DETAIL (TYP.)



BARRIER FREE PARKING STALL PAINT MARKING

NOTE:

1. ALL PAVEMENT MARKINGS AND TRAFFIC SIGNS SHALL CONFORM TO THE ONTARIO TRAFFIC MANUAL.
2. PAVEMENT MARKINGS FOR PARKING STALLS SHALL BE PAINTED WHITE AND CONFORM TO OPSS 1712.
3. PAINT COLOR SPECIFIED ON DRAWING. PAINT TO BE QUICK DRYING WATER BASED LATEX PAINT (WITHOUT GLASS BEADS)

REFER TO THE ONTARIO TRAFFIC MANUAL FOR ALL SIGNAGE AND PAVEMENT MARKINGS DETAILS UNLESS NOTED OTHERWISE.

PROPOSED SIGN & DESIGNATION

5 / A1.4 — BF PARKING AND SIGNAGE

1 : 125

Firm Name: McKnight Charron Limited Architects
48 Alliance Blvd. Unit 110, Barrie, Ontario
Tel: (705) 722-6739 Fax: (705) 726-5418

Certificate of Practice Number: 4206
The Certificate of Practice Number of the holder is the holder's BCDN.

The Architect noted above has exercised responsible control with respect to design activities. The Architect's seal number is the Architect's BCDN.

Name of Project: PROPOSED 21 STOREY APARTMENT BUILDING

Location: 57 OWEN ST, BARRIE, ON

Item	Ontario 2012 Building Code Data Matrix Parts 3 & 9		OBC Reference: Reference are to Division B unless noted [A] for Division A or [C] for Division C.		
1	Project Description	☒ New ☐ Addition ☐ Alteration ☐ Change Of Use	☐ Part 11 11.1 to 11.4	☒ Part 3 1.1.2. [A]	☐ Part 9 1.1.2. [A] & 9.10.2.3
2	Major Occupancy(s)	GROUP C; MINOR OCCUPANCIES: A2 ON GROUND FLOOR, D GROUND FL INTERM.		3.1.2.1.(1)	9.10.2.
3	Building Area (m sq)	Total: 3,452 sq. m		1.4.1.2.[A]	1.4.1.2.[A]
4	Gross Area (m sq)	Total: 26,252 sq. m		1.4.1.2.[A]	1.4.1.2.[A]
5	Number of Storeys	Above Grade: 21 Below Grade: 1		1.4.1.2.[A] & 3.2.1.1.	1.4.1.2.[A] & 9.10.4
6	Number of Streets/Fire Fighter Access: 1			3.2.2.10. & 2.5.	9.10.2.
7	Bulding Classfication: 3.2.2.42 - GROUP C, ANY HEIGHT ANY AREA, SPRINKLERED			3.2.2.2 .83	9.1 .2
8	Sprinkler System Proposed	☒ Entire Building ☐ Selected Compartments ☐ Selected Floor Areas ☐ Basement Only ☐ In Lieu Of Roof Rating ☐ Not Required		3.2.2.20-.83 3.2.1.5 3.2.1.7 Index	9.10.8.2 Index
9	Standpipe Required	☒ Yes ☐ No		3.2.9	N/A
10	Fire Alarm Required	☒ Yes ☐ No		3.2.4	9.10.18
11	Water Service/Supply Is Adequate	☒ Yes ☐ No		3.2.5.7	N/A
12	High Building	☒ Yes ☐ No		3.2.6	N/A
13	Construction Restrictions Actual Construction	☐ Combustible ☒ Non-combustible ☐ Both ☐ Combustible ☒ Non-combustible ☐ Both		3.2.2.20-.83	9.10.6
14	Mezzanine(s) Area (m sq) N/A			3.2.1.1.(3)-(8)	9.10.4.1
15	Occupant Load Based On ☐ M Sq/person ☒ Design Of Building (1 People/Bedroom)			3.1.17	9.9.1.3
	Basement - Amenity	Occupancy: D - People			
	Ground Floor - Offices	Occupancy: D - People			
	Ground Floor - Amenity	Occupancy: D 389 People (428 sqm x 1.10/person)			
	Ground Intermediate - Residential	Occupancy: C 28 People			
	Ground Intermediate - Offices	Occupancy: D - People			
	Ground Intermediate - Amenity	Occupancy: D - People			
	2nd & 3rd Parking	Occupancy: C - People			
	4th Floor	Occupancy: C 62 People			
	5th Floor	Occupancy: C 64 People			
	6th-8th Floor	Occupancy: C 68 People/Floor = 204			
	9th Floor	Occupancy: C 56 People			
	10th-20th Floor	Occupancy: C 28 People/Floor = 308 People			
	Total Bldg Occupancy	- People			
16	Barrier-Free Design	☒ ☐ No (explain)		3.8	9.5.2
17	Hazardous Substances	☐ Yes ☒ No		3.3.1.2 & 3.3.1.19	9.10.1.3 (4)
18	Required Fire Resistance Rating (FRR)	Horizontal Assemblies FRR (Hours) Floors: 2 Hours Roof: N/A Hours Mezzanine: N/A Hours	Listed Design No. Or Description (SG-2) Concrete hollow core and cast-in-place concrete	3.2.2.20-.83 & 3.2.1.4 **3.2.2.42. GROUP C; ANY HEIGHT ANY AREA**	9.10.8 9.10.9
		FRR Of Supporting Members Floors: 2 Hours Roof: N/A Hours Mezzanine: N/A Hours	Listed Design No. Or Description (SG-2)		
	Spatial Separation - Construction Of Exterior Walls (Taken From Largest Fire Compartment)			3.2.3	9.10.14

Wall	Area Of EBF (sq.m)	L.D. (m)	L/H Or H/L	Permitted Max. % Of Openings	Proposed % Of Openings	FRR (Hours)	Listed Design Or Description	Comb. Const.	Comb. Constr. Nonc. Cladding	Non-Comb. Constr.
North Podium	-sq.m	- m	N/A	-%	-%	N/A			EFIS	X
North Tower	-sq.m	- m	N/A	-%	-%	N/A			EFIS	X
South Podium	-sq.m	- m	N/A	-%	-%	N/A				X
South Tower	-sq.m	- m	N/A	-%	-%	N/A				X
East Tower	-sq.m	- m	N/A	-%	-%	N/A				X
East Podium	-sq.m	- m	N/A	-%	-%	N/A				X
West Tower	-sq.m	- m	N/A	-%	-%	N/A				X
West Podium	-sq.m	- m	N/A	-%	-%	N/A				X

RESIDENTIAL APARTMENT AREAS
GFA JUNIOR 1-BEDROOM = 51 SQM
GFA 1-BEDROOM = 60 - 64 SQM
GFA 2-BEDROOM = 82 SQM
2 LEVEL APARTMENTS = 134 SQM

ASSISTED LIVING AREAS
GFA JUNIOR 1-BEDROOM = 48 - 51 SQM
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2	ISSUED FOR SPA	JUNE 28, 2021

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DRAWING TITLE:
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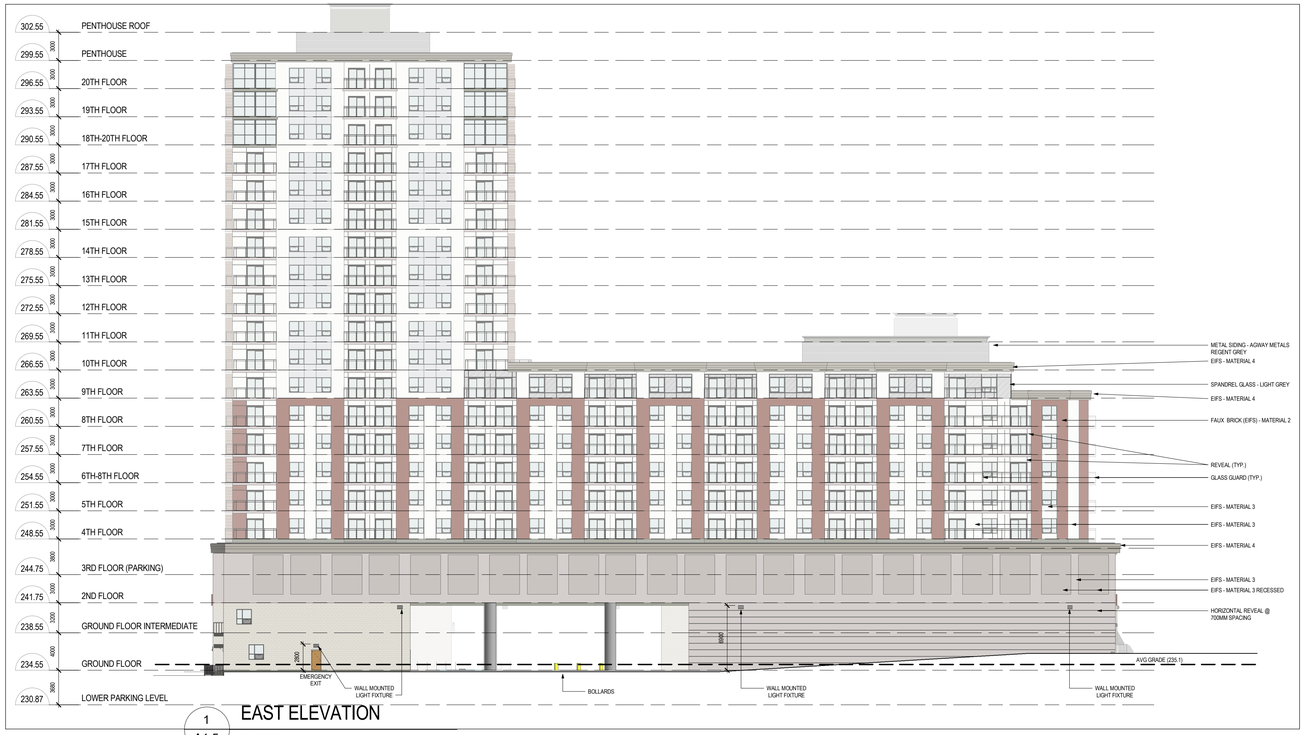
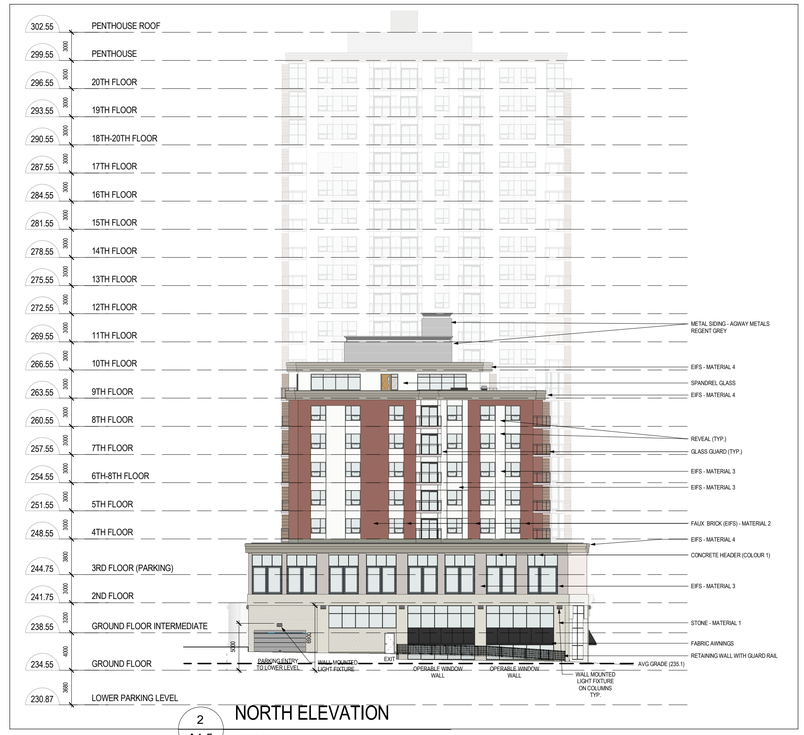
DATE:	10/05/2021	PROJECT #	SHEET #
DRAWN BY:	KSN	PROJECT #	A1.4
SCALE:	As indicated		



1 A1.5 EAST ELEVATION

1 : 300

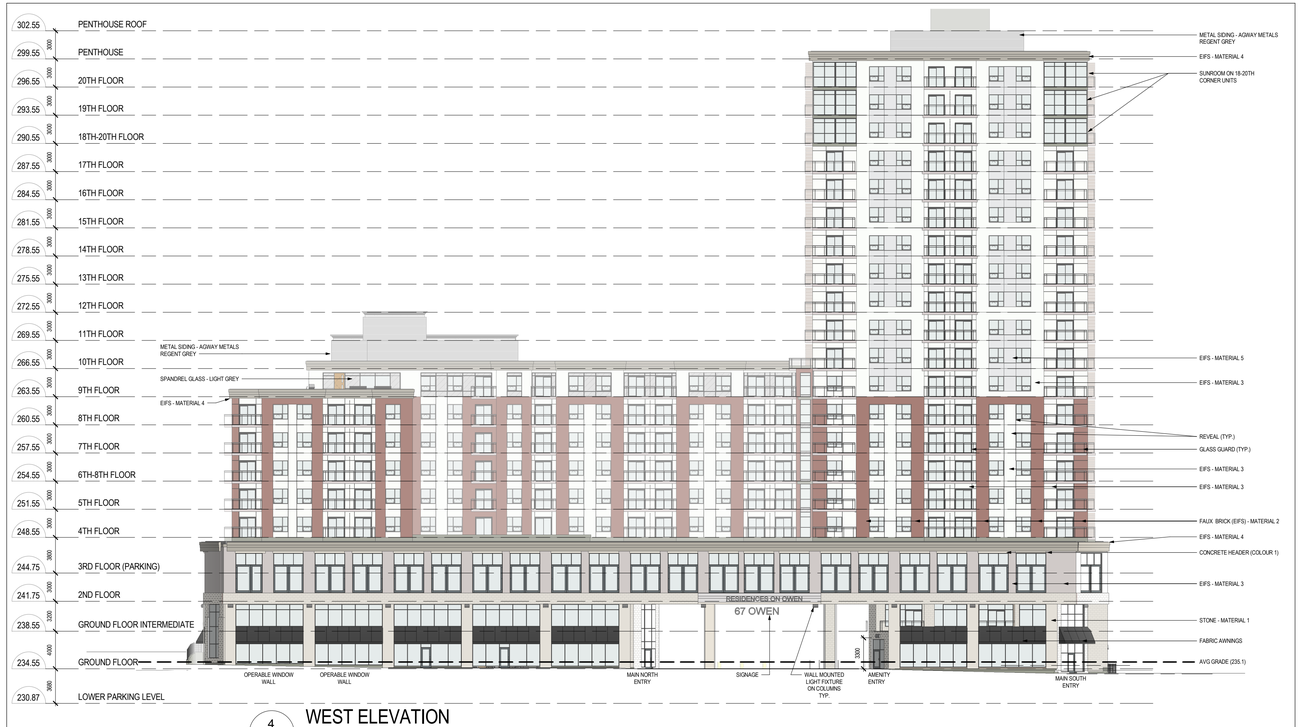


2 A1.5 NORTH ELEVATION

1 : 300

3 A1.5 SOUTH ELEVATION

1 : 300



4 A1.5 WEST ELEVATION

1 : 300

MATERIAL LIST

- MATERIAL 1 - STONE
- MATERIAL 2 - FAUX BRICK (EIFS)
- MATERIAL 3 - EIFS - DRIFTWOOD
- MATERIAL 4 - EIFS - ANTIQUE GRAY
- MATERIAL 5 - EIFS - TWILIGHT GREY

2	ISSUED FOR SPA	JUNE 28, 2021

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DRAWN BY:	KSN	PROJECT #	A1.5
SCALE:	As indicated		

APPENDIX B

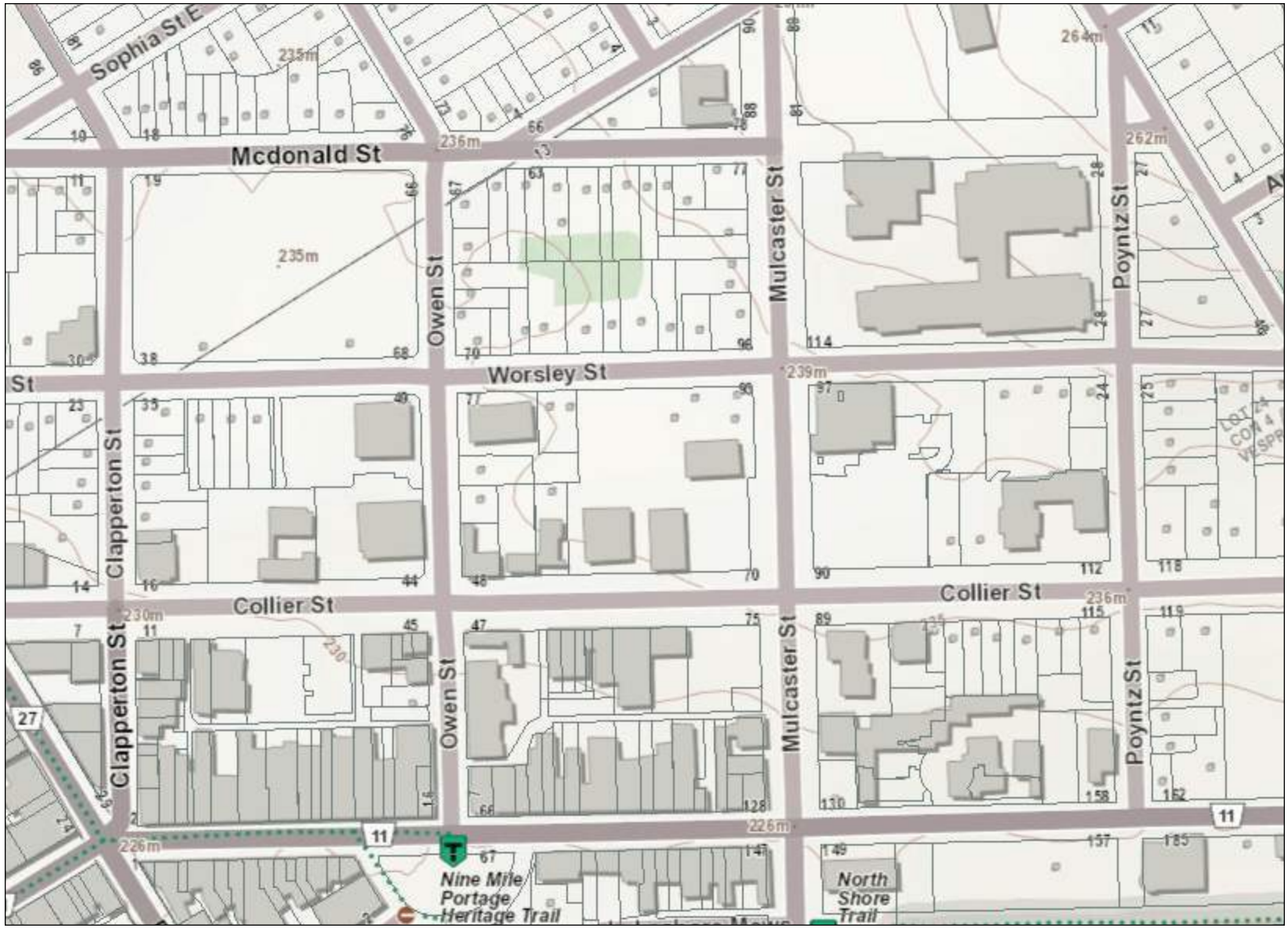
Ontario

MINISTRY OF NATURAL RESOURCES AND FORESTRY

Make a Topographic Map

Topographic Map

Notes:



Legend

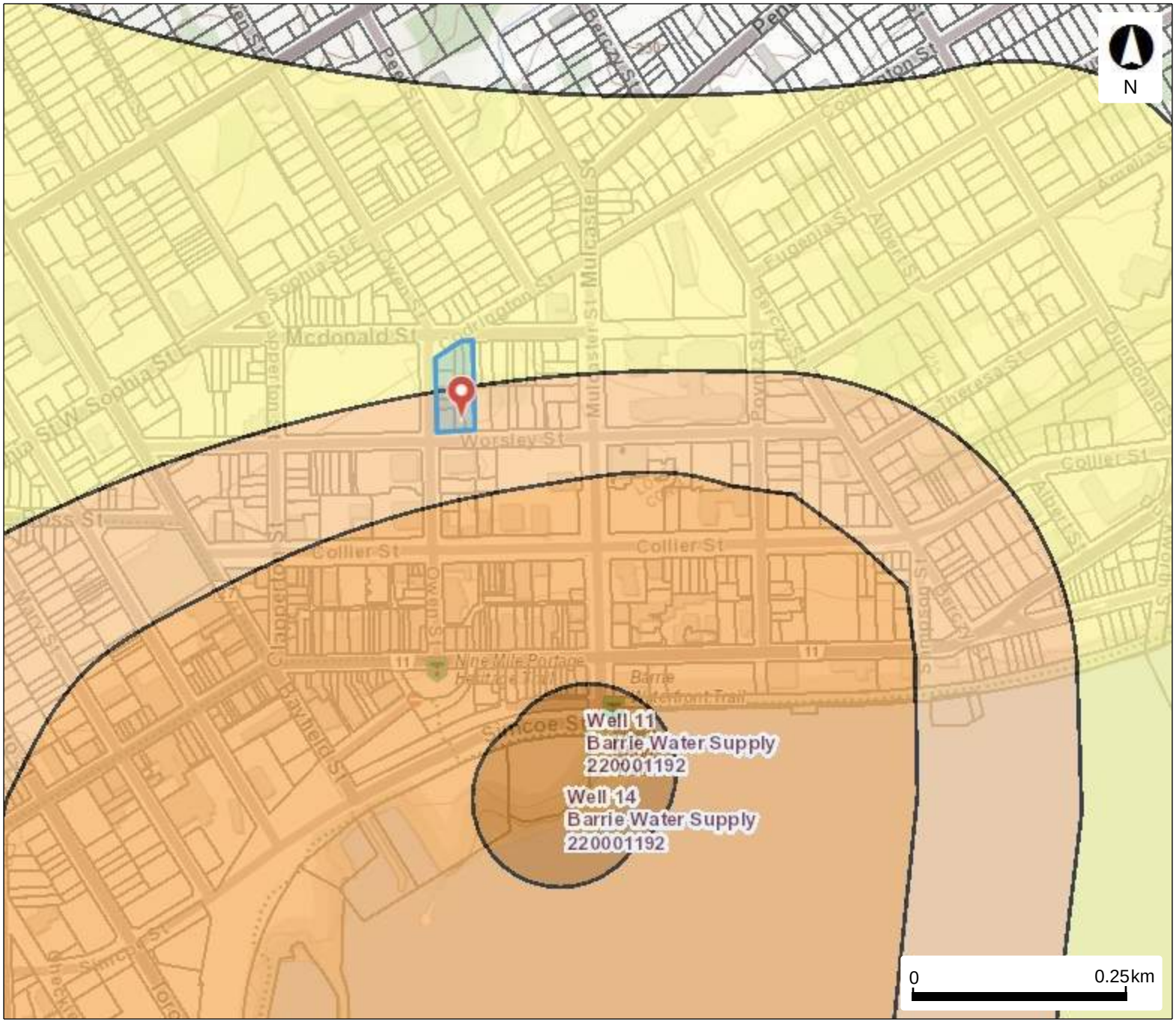
- Building as Symbol
- Building to Scale
- Airport
- Heliport \ Hospital Heliport
- Seaplane Base
- Ferry Route
- Trail Head \ Trail
- Railway \ Train Station
- Railway with Bridge
- Railway with Tunnel
- Road (Major → Minor)
- Winter Road
- Road with Bridge
- Road with Tunnel
- Primary, Kings or 400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

0 0.2 km

Projection: Web Mercator

APPENDIX C

Wellhead Protection Area



Legend

- Wellhead Protection Area Nam
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Event Based Areas
- Assessment Parcel

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

Ontario

Map Created: 5/19/2021
Map Center: 44.39081 N, -79.68561 W

The Barrie Creeks, Lovers Creek and Hewitt's Creek subwatersheds

Figure 2-4

Legend

- Road
- Municipal Boundary
- Watercourse
- Barrie Creeks
- Hewitts Creeks
- Lovers Creeks

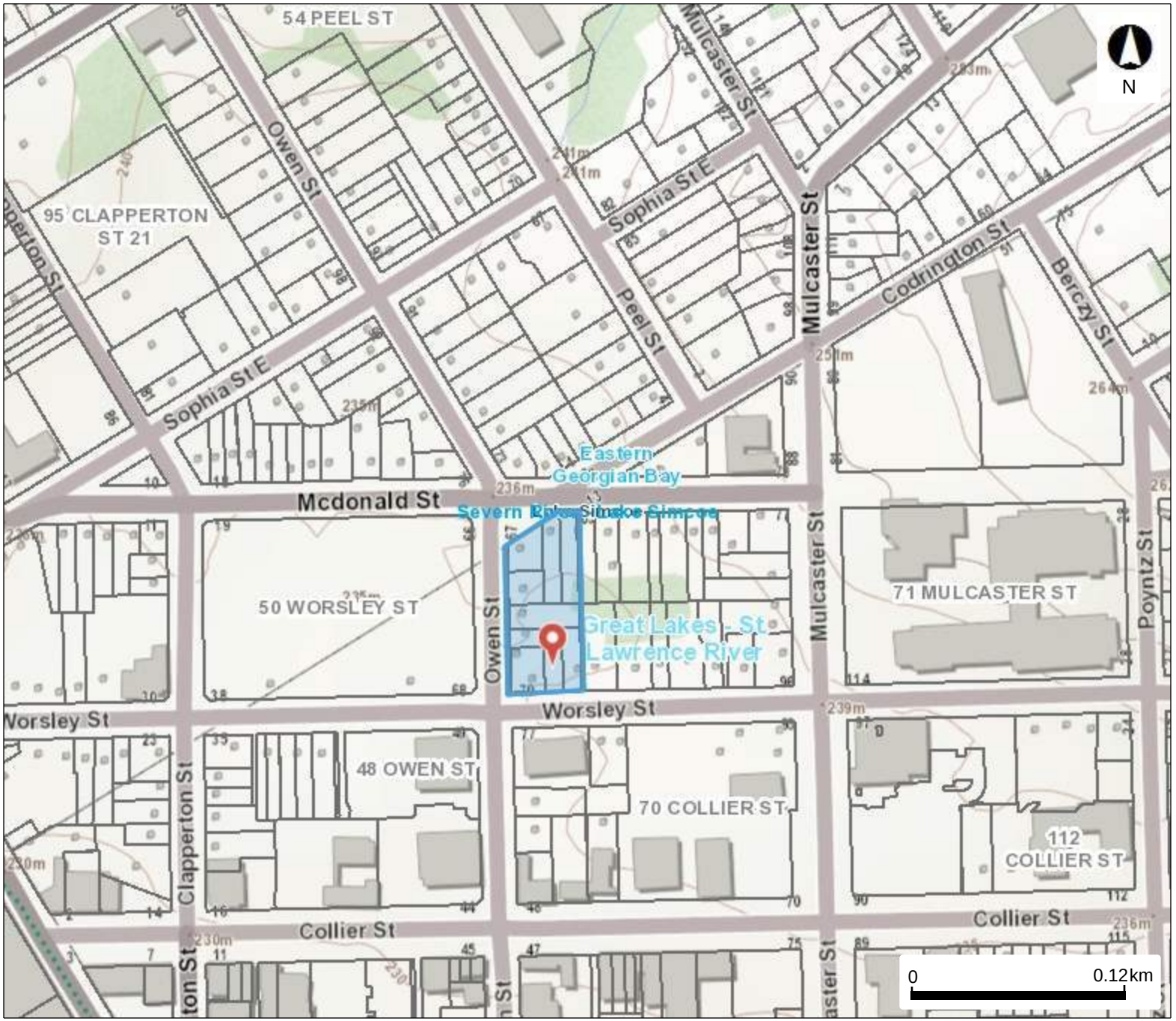
Lake Simcoe Region conservation authority

0 0.5 1 2 3 4 Kilometres

N

This product was produced by the Lake Simcoe Region Conservation Authority and some information depicted on this map may have been compiled from various sources. While every effort has been made to accurately depict the information, data / mapping errors may exist.
This map has been produced for illustrative purposes only.
LSRCA GIS Services DRAFT created July 2010.

Watershed Map



Legend

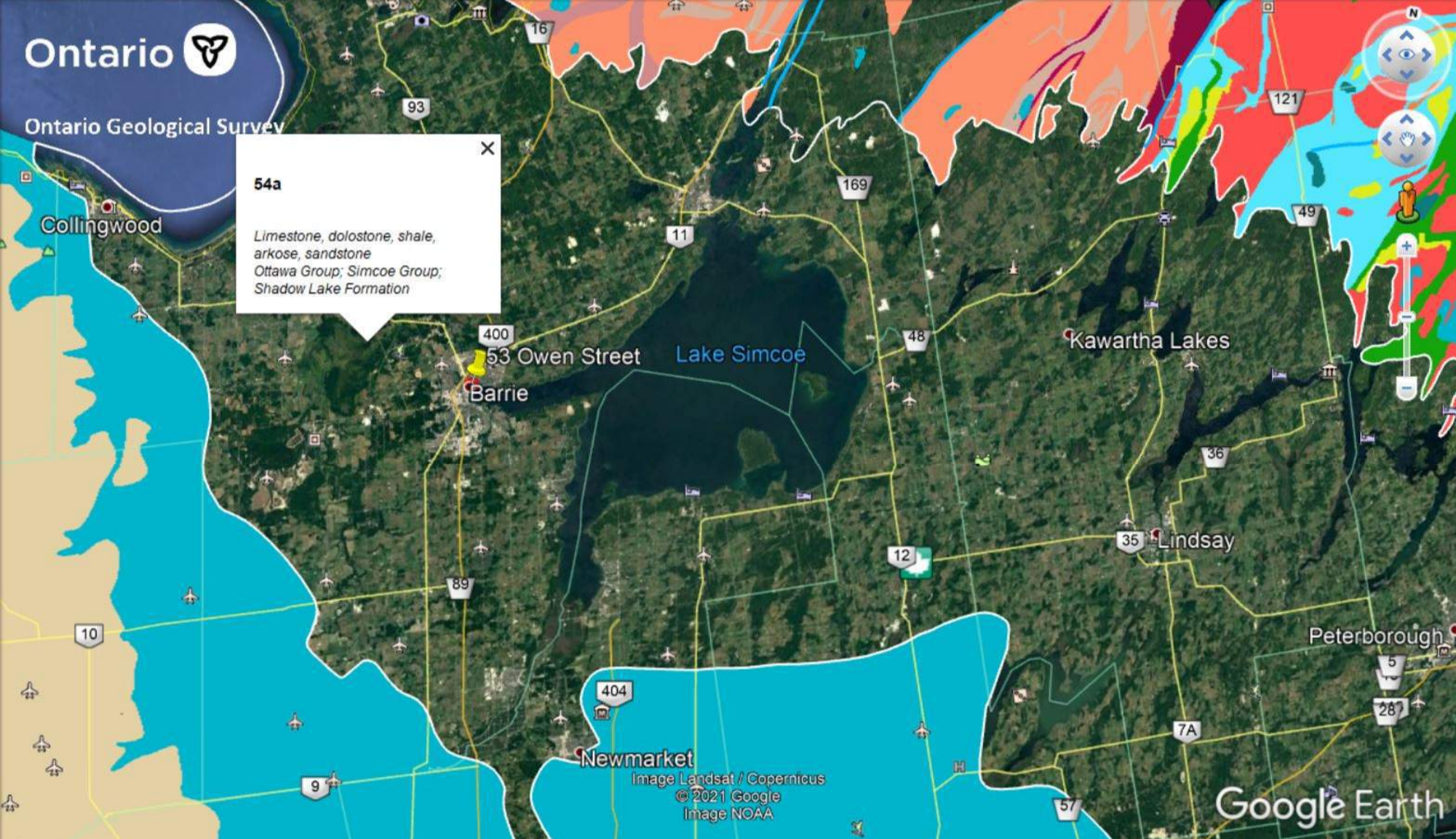
- Tertiary Watersheds
- Primary
- Secondary
- Quaternary
- Wellhead Protection Area Nam
- Assessment Parcel

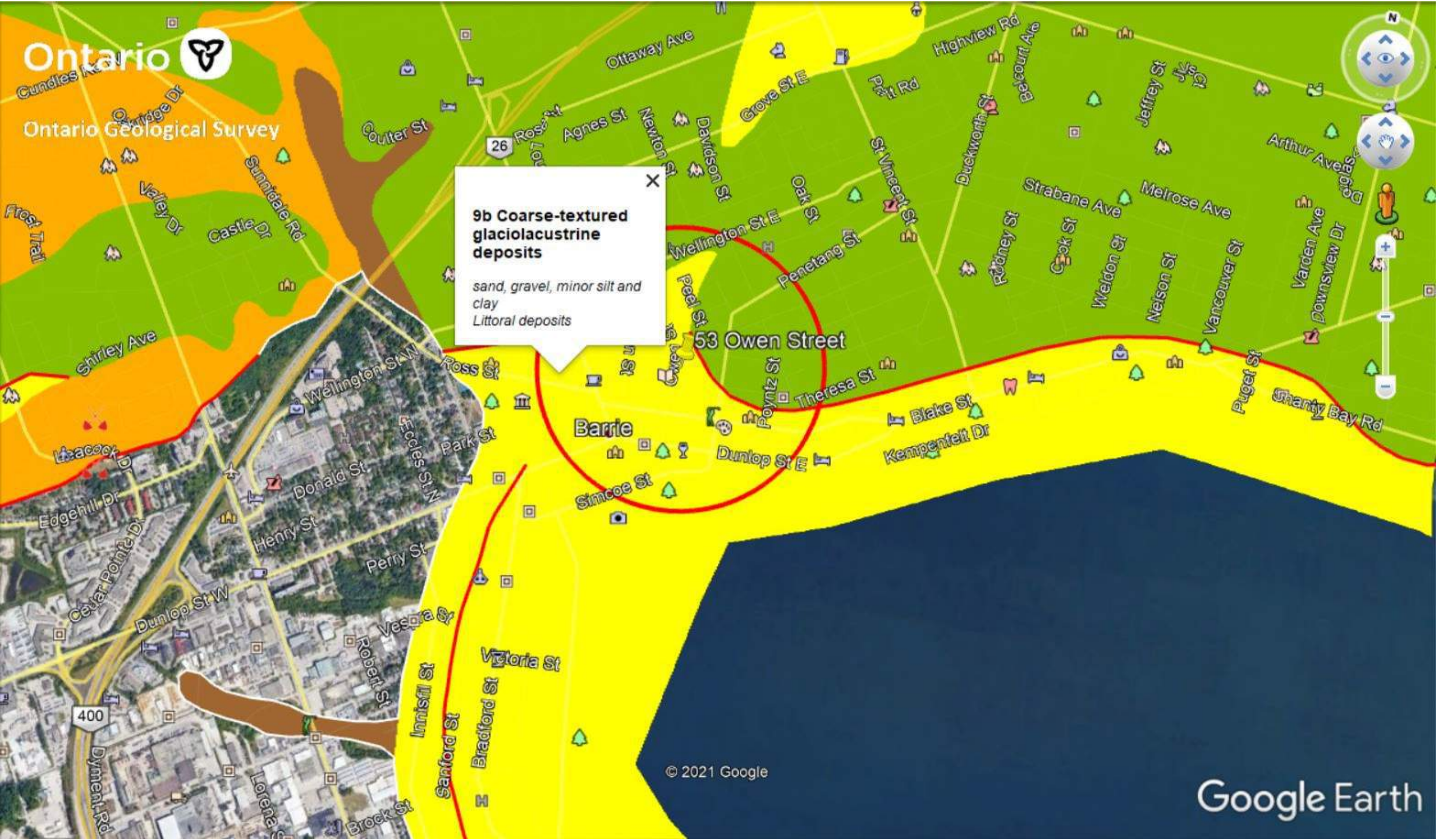
This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Environment, Conservation and Parks (MECP) shall not be liable in any way for the use or any information on this map. of, or reliance upon, this map.

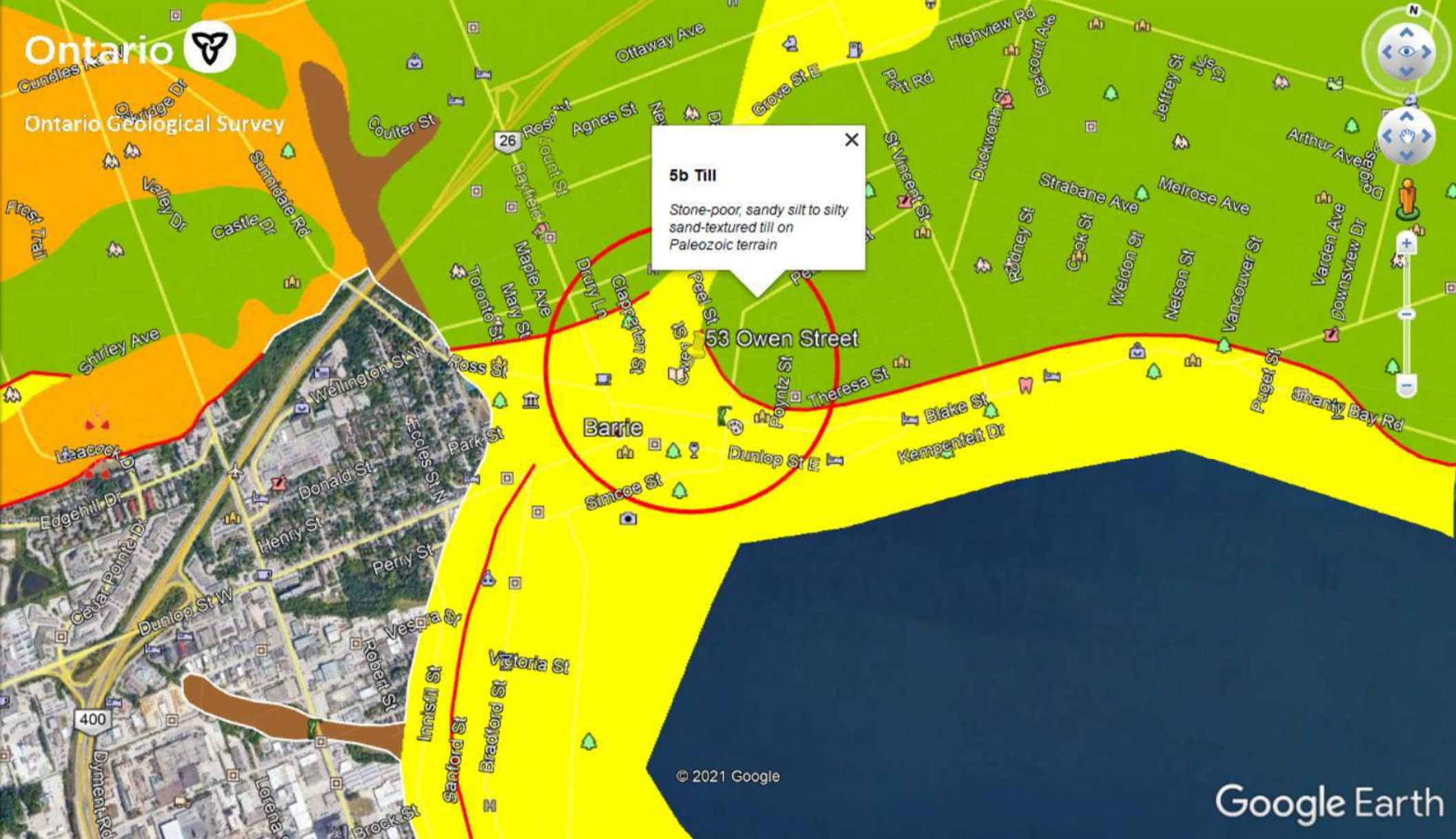
Ontario

Map Created: 5/19/2021
Map Center: 44.39256 N, -79.6872 W

APPENDIX D


Ontario
Ontario Geological Survey
54a
Limestone, dolostone, shale, arkose, sandstone
Ottawa Group; Simcoe Group; Shadow Lake Formation
Collingwood
53 Owen Street
Barrie
Lake Simcoe
Kawartha Lakes
Lindsay
Peterborough
Newmarket
Image Landsat / Copernicus
© 2021 Google
Image NOAA
Google Earth


Ontario
Ontario Geological Survey
9b Coarse-textured glaciolacustrine deposits
sand, gravel, minor silt and clay
Littoral deposits
53 Owen Street
Barrie
Cundles Rd
Ottaway Ave
Grove St E
Highview Rd
Belcourt Ave
Coulter St
Agnes St
Newton St
Davidson St
St Vincent St
Duckworth St
Jeffrey St
Arthur Ave
Strabane Ave
Melrose Ave
Frost Trail
Valley Dr
Castle Dr
Sunnidale Rd
Wellington St E
Penetang St
Oak St
Peel St
Rodney St
Cook St
Weldon St
Nelson St
Vancouver St
Varden Ave
Downsview Dr
Shirley Ave
Wellington St W
Ross St
Poyntz St
Theresa St
Blake St
Puget St
Shanty Bay Rd
Kempenfelt Dr
Dunlop St E
Simcoe St
Park St
Eccles St N
Donald St
Edgehill Dr
Henry St
Perry St
Cedar Pointe Dr
Dunlop St W
Vespra St
Robert St
Victoria St
Innisfil St
Sanford St
Bradford St
Dyment Rd
Brock St
26
400
© 2021 Google
Google Earth


Ontario
Ontario Geological Survey
5b Till
Stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain
53 Owen Street
Barrie
Ottaway Ave
Highview Rd
Coulter St
Agnes St
Grove St E
Duckworth St
Jeffrey St
Arthur Ave
Strabane Ave
Melrose Ave
Rodney St
Cook St
Weldon St
Nelson St
Vancouver St
Varden Ave
Downsview Dr
Sunnidale Rd
Valley Dr
Castle Dr
Frost Trail
Shirley Ave
Toronto St
Mary St
Maple Ave
Drury Ln
Clapperton St
Peel St
Ross St
Wellington St N
Park St
Donald St
Edgehill Dr
Henry St
Perry St
Cedar Pointe Dr
Dunlop St W
Dunlop St E
Simcoe St
Poyntz St
Theresa St
Blake St
Kempenfelt Dr
Puget St
Sharpe Bay Rd
Innisfil St
Sanford St
Bradford St
Victoria St
Vespra St
Robert St
Dyment Rd
Brock St
400
26
© 2021 Google
Google Earth

APPENDIX E

Appendix A: Climate Data Tables

Barrie Creeks Subwatershed

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.74	952	525	427
Fine Sandy Loam	B		952	539	413
Silt Loam	C		952	573	380
Clay	D		952	643	310
Forest					
Fine Sand	A	4.12	952	521	431
Fine Sandy Loam	B		952	540	412
Silt Loam	C		952	434	518
Clay	D		952	598	354
Pasture & Shrubs					
Fine Sand	A	0.40	952	565	387
Fine Sandy Loam	B		952	546	406
Silt Loam	C		952	558	394
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	0.92	952	528	424
Fine Sandy Loam	B		952	636	316
Silt Loam	C		-	-	-
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	0.43	952	556	396
Fine Sandy Loam	B		952	532	420
Silt Loam	C		-	-	-
Clay	D		-	-	-
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.62	952	471	481
Fine Sandy Loam	B		952	456	496
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**952**	**446**	**506**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

APPENDIX F

WELL_ID	AUDIT_NO	TAG	County	Township	Concession	LOT	Received	Lic No of Contractor	Final_Status	Use1	STREET	CITY	SITE
7169806	Z136815	A111575	SIMCOE	BARRIE CITY (V			2011-10-12	7241		Monitoring	48 OWEN ST	Barrie	
7289191	C35945		SIMCOE	BARRIE CITY (V	CON 04	024	2017-06-28	2801					
7128381	Z73382	A045967	SIMCOE	BARRIE CITY			2008-02-08	7075		Other	1 DUNLOP STREET	Barrie	
7169804	Z136813	A111574	SIMCOE	BARRIE CITY (V			2011-10-12	7241		Monitoring	48 OWEN ST	Barrie	
7169805	Z136814	A111577	SIMCOE	BARRIE CITY (V			2011-10-12	7241		Monitoring	48 OWEN ST	Barrie	
7176288	M10866	A120815	SIMCOE	BARRIE CITY (V			2012-02-08	7282					
7269389	C22972		SIMCOE	BARRIE CITY (V			2016-08-18	2801					
7274933	C22975		SIMCOE	BARRIE CITY (V			2016-11-16	2801					
7176638	M10518	A115215	SIMCOE	BARRIE CITY (V			2012-02-14	6607					
7177202	M04862	A083768	SIMCOE	BARRIE CITY (V			2012-02-23	7403					
5735507	219643		SIMCOE	BARRIE CITY			2000-09-21	2576	Abandoned-Other				
7207028	Z158269		SIMCOE	BARRIE CITY (V			2013-08-27	5528	Abandoned-Other	Monitoring	185 DUNCOP ST E	Barrie	
7207029	Z158270		SIMCOE	BARRIE CITY (V			2013-08-27	5528	Abandoned-Other		185 DUNLOP ST E	Barrie	
5735508	219644		SIMCOE	BARRIE CITY			2000-09-21	2576	Abandoned-Other				
5727318	88603		SIMCOE	VESPRA TOWN	CON 04	025	1990-10-11	2801	Abandoned-Supply	Not Used			
7186921	Z147857		SIMCOE	BARRIE CITY (V			2012-09-11	6607	Abandoned-Supply	Monitoring	10 COLLIER ST	BARRIE	
7157663	Z124104	A111574	SIMCOE	BARRIE CITY (V			2011-01-14	7241	Monitoring and Test Hole	Monitoring and Test Hole	48 OWEN STREET	Barrie	WKQ-003369 A0-A02
7209556	Z177929	A154115	SIMCOE	BARRIE CITY (V			2013-10-15	7241	Monitoring and Test Hole	Monitoring and Test Hole	5 GOLLIER ST.	BARRIE	
7209555	Z177930	A150760	SIMCOE	BARRIE CITY (V			2013-10-16	7241	Monitoring and Test Hole	Monitoring and Test Hole	5 COLLIER ST.	BARRIE	
7209557	Z177928	A154279	SIMCOE	BARRIE CITY (V			2013-10-15	7241	Monitoring and Test Hole	Monitoring and Test Hole	5 COLLIER ST.	BARRIE	
7209558	Z177904	A154195	SIMCOE	BARRIE CITY (V			2013-10-15	7241	Monitoring and Test Hole	Monitoring and Test Hole	5 COLLIER STREET	BARRIE	WKQ-006283 A0-A00
7157664	Z126400	A111575	SIMCOE	BARRIE CITY (V			2011-01-14	7241	Monitoring and Test Hole	Monitoring and Test Hole	48 OWEN STREET	Barrie	WKQ-00339 A0-A02
7157665	Z126401	A111577	SIMCOE	BARRIE CITY (V			2011-01-14	7241	Monitoring and Test Hole	Monitoring and Test Hole	48 OWEN STREET	Barrie	WKQ-003369 A0-A02
7124832	Z91182	A080167	SIMCOE	BARRIE CITY			2009-07-02	7190	Observation Wells	Monitoring	143 DUNLOP ST. E	Barrie	PIN 58795-0106(LT)
7118162	Z49976	A047896	SIMCOE	BARRIE CITY			2009-01-15	7190	Observation Wells	Other	2 DUNLOP STREET	Barrie	
7110081	M02617	A060470	SIMCOE	BARRIE CITY			2008-08-19	7201	Observation Wells	Monitoring	DUNLOP & FRED ST.		
5741335	Z46068	A041511	SIMCOE	BARRIE CITY (V			2006-12-01	7314	Observation Wells		COLLIER ST		SOUTHWEST CORNER
5740607	Z43642	A031385	SIMCOE	BARRIE CITY (V			2006-03-28	7215	Observation Wells			BARRIE	
5727319	88604		SIMCOE	VESPRA TOWN	CON 04	025	1990-10-11	2801	Observation Wells	Not Used			
5719338			SIMCOE	BARRIE CITY			1983-09-20	2801	Observation Wells	Not Used			
5718640			SIMCOE	BARRIE CITY			1983-09-20	2801	Observation Wells	Not Used			
7186920	Z147856	A126223	SIMCOE	BARRIE CITY (V			2012-09-11	6607	Observation Wells	Monitoring	10 COLLIER ST	BARRIE	
7230454	Z195411	A168399	SIMCOE	BARRIE CITY (V			2014-10-30	7472	Observation Wells	Monitoring	185 DUNLOP ST E	Barrie	
7265151	Z223921	A202663	SIMCOE	BARRIE CITY (V			2016-06-17	6607	Observation Wells	Monitoring	10-14 COLLIER ST.	BARRIE	
7265150	Z223922	A202665	SIMCOE	BARRIE CITY (V			2016-06-17	6607	Observation Wells	Monitoring	10-14 COLLIER ST.	BARRIE	
7265149	Z223923	A202664	SIMCOE	BARRIE CITY (V			2016-06-17	6607	Observation Wells	Monitoring	10-14 COLLIER ST.	BARRIE	
7265124	Z223920	A179853	SIMCOE	BARRIE CITY (V			2016-06-17	6607	Observation Wells	Monitoring	10-14 COLLIER ST.	BARRIE	
7264495	Z228510	A156769	SIMCOE	BARRIE CITY (V			2016-06-09	7190	Observation Wells	Monitoring	9-23 OWEN STREET	BARRIE	
7185113	Z131705	A106882	SIMCOE	BARRIE CITY (V			2012-08-09	6032	Observation Wells	Monitoring	55 MULCASTER ST	BARRIE	
7230455	Z195410	A168421	SIMCOE	BARRIE CITY (V			2014-10-30	7472	Observation Wells	Monitoring	185 DUNLOP ST E	Barrie	
7204525	Z172389	A148853	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Observation Wells	Monitoring and Test Hole	185 DUNLOP ST E	Barrie	
7230453	Z195412	A168400	SIMCOE	BARRIE CITY (V			2014-10-30	7472	Observation Wells	Monitoring	185 DUNLOP ST E	Barrie	
7230452	Z195413	A168432	SIMCOE	BARRIE CITY (V			2014-10-30	7472	Observation Wells	Monitoring	185 DUNLOP ST EAS	Barrie	
7230451	Z195414	A168433	SIMCOE	BARRIE CITY (V			2014-10-30	7472	Observation Wells	Monitoring	185 DUNLOP ST EAS	Barrie	
7213134	Z169392	A146194	SIMCOE	BARRIE CITY (V			2013-12-17	7190	Observation Wells	Monitoring	4 COLLIER ST	BARRIE	
7254305	Z223280	A196051	SIMCOE	BARRIE CITY (V			2015-12-16	7201	Observation Wells	Monitoring	5 MCDONALD STREE		
7230450	Z195415	A168434	SIMCOE	BARRIE CITY (V			2014-10-30	7472	Observation Wells	Monitoring	185 DUNLOP ST E	Barrie	
5700231			SIMCOE	BARRIE CITY			1948-12-23	2801	Test Hole				
5700232			SIMCOE	BARRIE CITY			1950-11-29	2801	Test Hole				

WELL_ID	AUDIT_NO	TAG	County	Township	Concession	LOT	Received	Lic No of Contractor	Final_Status	Use1	STREET	CITY	SITE
5700237			SIMCOE	BARRIE CITY			1950-11-29	2801	Test Hole				
5700288			SIMCOE	BARRIE CITY			1967-05-24	2801	Test Hole	Not Used			
7277586	Z241706	A211995	SIMCOE	BARRIE CITY (V			2016-12-23	7383	Test Hole	Test Hole	113 BAYFIELD ST	Barrie	
7204526	Z172385	A148724	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Test Hole	Monitoring and Test Hole	185 DUMPLOP STRE	Barrie	
7204527	Z172384	A148721	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Test Hole	Monitoring and Test Hole	185 DUNLOP STREET	Barrie	
7204528	Z172388	A148723	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Test Hole	Monitoring and Test Hole	185 DUNLOP STREET	Barrie	
7204529	Z172382	A148718	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Test Hole	Monitoring and Test Hole	185 DUNLOP STREET	Barrie	
7204530	Z172386	A148719	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Test Hole	Monitoring and Test Hole	185 DUNLOP STREET	Barrie	
7204531	Z172383	A148720	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Test Hole	Monitoring and Test Hole	185 DUNLOP STREET	Barrie	
7204532	Z172387	A148722	SIMCOE	BARRIE CITY (V			2013-07-10	7241	Test Hole	Monitoring and Test Hole	185 DUNLOP STREET	Barrie	
7166918	Z129066	A117960	SIMCOE	BARRIE CITY (V			2011-08-09	7215	Test Hole	Test Hole	BAYFIELD ST 1-15	Barrie	
7157255	M07428	A110288	SIMCOE	BARRIE CITY (V			2011-01-07	6607	Test Hole	Monitoring	10 14 COLLIER ST	BARRIE	
7277585	Z241707	A211996	SIMCOE	BARRIE CITY (V			2016-12-23	7383	Test Hole	Test Hole	113 BAYFIELD ST	Barrie	
5719264			SIMCOE	BARRIE CITY			1984-08-02	2801	Water Supply	Public			
5700290			SIMCOE	BARRIE CITY			1967-01-03	3414	Water Supply	Cooling And A/C			
5700262			SIMCOE	BARRIE CITY			1963-02-11	3414	Water Supply	Industrial			
5700236			SIMCOE	BARRIE CITY			1952-08-11	5510	Water Supply	Industrial			
5700235			SIMCOE	BARRIE CITY			1950-11-29	2801	Water Supply	Municipal			

APPENDIX G

File No. 20-108
May 5, 2021

Attention: Residents

Subject: Private Well Survey

Grounded Engineering Inc. ("Grounded") is retained on behalf of Traditions Seniors Housings Ltd. to conduct a Private Well Survey within 500 m of the proposed development located at 53-59 Owen Street and 70-78 Worsley Street, Barrie, Ontario.

A Private Well Survey of the neighboring properties is required as part of the development application and is completely voluntary for the residents. The purpose of our visit is to conduct interviews with local residents and land owners in regards to water supply wells in operation surrounding the development project. The information we hope to obtain will include:

#	Information Collected
1.	Type of well (i.e. drilled, dug, bored)
2.	Casing material (i.e. metal, concrete, stone, etc.)
3.	Pump type and depth (i.e. Submersible [pump in well]/Jet Pump [pump in house])
4.	Water treatment systems in use (i.e. water softener, reverse osmosis, UV light)
5.	Date well was constructed and depth of well
6.	Use of the well (i.e. residential/agriculture/livestock/commercial, etc.)
7.	Number of residents/people the well supplies water to
8.	Past water quality problems with well (i.e. high bacteria levels, high iron, etc.)
9.	Past water quantity problems with well (i.e. does/has the well run dry in the past and if so, why?)
10.	Is well water consumed, or is water purchased for consumption (i.e. bottled water)
11.	Any past operating problems with well detailing the nature of the problem and when it occurred

If you wish to participate in the survey, please contact Ylena Quan (info below) at Grounded Engineering Inc. within 30 days of receiving this letter. If there is access to your well, and with your permission, our representatitves will measure the depth and level of water in your well. In addition, we will collect a water quality sample from your tap (with your permission). The results of the water quality testing will be provided to you by mail.

The contact information is as below

- Phone number: 647-264-7928
- Email: yquan@groundedeng.ca

If we can be of further assistance, please do not hesitate to contact us.

GROUNDED ENGINEERING

Ylena Quan, P.Eng., QP_{ESA}
Associate

APPENDIX H

Terraprobe

ABBREVIATIONS AND TERMINOLOGY

SAMPLING METHODS

AS	auger sample
CORE	cored sample
DP	direct push
FV	field vane
GS	grab sample
SS	split spoon
ST	shelby tube
WS	wash sample

PENETRATION RESISTANCE

Standard Penetration Test (SPT) resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).

Dynamic Cone Test (DCT) resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.)."

COHESIONLESS SOILS

Compactness	'N' value
very loose	< 4
loose	4 – 10
compact	10 – 30
dense	30 – 50
very dense	> 50

COHESIVE SOILS

Consistency	'N' value	Undrained Shear Strength (kPa)
very soft	< 2	< 12
soft	2 – 4	12 – 25
firm	4 – 8	25 – 50
stiff	8 – 15	50 – 100
very stiff	15 – 30	100 – 200
hard	> 30	> 200

COMPOSITION

Term (e.g)	% by weight
trace silt	< 10
some silt	10 – 20
silty	20 – 35
sand *and* silt	> 35

TESTS AND SYMBOLS

MH	mechanical sieve and hydrometer analysis
w, w_c	water content
w_L, LL	liquid limit
w_P, PL	plastic limit
I_P, PI	plasticity index
k	coefficient of permeability
γ	soil unit weight, bulk
G_s	specific gravity
φ'	internal friction angle
c'	effective cohesion
c_u	undrained shear strength

▽	Unstabilized water level
▼	1st water level measurement
▼	2nd water level measurement
▼	Most recent water level measurement
3.0 +	Undrained shear strength from field vane (with sensitivity)
C_c	compression index
c_v	coefficient of consolidation
m_v	coefficient of compressibility
e	void ratio

FIELD MOISTURE DESCRIPTIONS

Damp	refers to a soil sample that does not exhibit any observable pore water from field/hand inspection.
Moist	refers to a soil sample that exhibits evidence of existing pore water (e.g. sample feels cool, cohesive soil is at plastic limit) but does not have visible pore water
Wet	refers to a soil sample that has visible pore water

LOG OF BOREHOLE 101

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : July 31, 2017	Project : NE Worsley & Owen Streets	Compiled by : JH
Sheet No. : 1 of 1	Location : Barrie, Ontario	Checked by : JC

Position : E: 604545, N: 4916266 (UTM 17T) Elevation Datum : Geodetic

Rig type : Truck-mounted Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	234.5	**GROUND SURFACE**				
		150mm **ASPHALTIC CONCRETE**		1	SS	17
		FILL, sand, some gravel, trace silt, compact, brown, moist		2	SS	3
1		...at 0.8 m, very loose				
	232.8					
	1.7	**SILTY SAND**, trace to some gravel, brown with mottled orange, very loose, moist		3	SS	3
2	231.9			4A	SS	5
	2.6	**SAND**, some gravel, trace to some silt, loose, brown, moist		4B		
3				5	SS	8
4						
		...at 4.6 m, trace boulders		6	SS	50 / 75mm
5						
6	228.4					
	6.1	**SAND**, trace to some gravel, trace to some silt, trace rock fragments, trace boulders, very dense, grey, moist		7	SS	56
7						
		...at 7.6 m, no rock fragments, no boulders		8	SS	71
8						
9		...at 9.1 m, gravelly, trace silt		9	SS	50 / 125mm
10						
	223.6	...at 10.7 m, trace gravel, compact		10A	SS	26
11	10.9	**CLAYEY SILT**, some sand, with thin sand layers, very stiff, grey with mottled orange, moist		10B		
12		...at 12.2 m, hard		11	SS	32
13						
	220.9					
	13.6	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Elevation Scale (m): 234, 233, 232, 231, 230, 229, 228, 227, 226, 225, 224, 223, 222, 221

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30

LL=48

Headspace Vapour (ppm): PID: 20; PID: 15; PID: 0; PID: 0; PID: 0; PID: 0; PID: 0; PID: 0; PID: 0; PID: 5; PID: 0; PID: 5; PID: 10

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

SS2 Analysis: PAH, VOC, PHC

SS3 Analysis: M&I ...at 2.3m, spoon moist to 3.0m

22 61 13 4

...at 4.1m, slight auger grinding

...at 6.1m, auger grinding

...at 7.6m, auger grinding

...at 9.1m, spoon wet to 9.8m

0 4 32 64

10B Analysis: PAH

...at 12.2m, added water

SS11 Analysis: M&I, VOC, PHC

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Aug 8, 2017	11.4	223.1
Aug 11, 2017	12.8	221.7
Aug 24, 2017	9.0	225.6
Sep 7, 2017	11.4	223.1
Oct 25, 2017	11.5	223.0
Nov 10, 2017	10.5	224.0

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 102

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : August 1, 2017	Project : NE Worsley & Owen Streets	Compiled by : JH
Sheet No. : 1 of 1	Location : Barrie, Ontario	Checked by : JC

Position : E: 604515, N: 4916284 (UTM 17T) Elevation Datum : Geodetic

Rig type : Truck-mounted Drilling Method : Hollow stem augers

Depth (m)	Elev Depth (m)	Description	Graphic Log	Sample No.	Type	SPT 'N' Value
0	234.5	**GROUND SURFACE**				
		125mm **ASPHALTIC CONCRETE**		1	SS	27
		FILL, sand, some gravel, trace silt, compact, grey, damp				
1		...at 0.8 m, trace brick, loose, brown, moist		2	SS	8
		...at 1.5 m, dark brown		3	SS	4
2	232.2					
	2.3	**SAND**, some gravel, trace to some silt, dense, brown, moist		4	SS	32
3		...at 3.0 m, brown with mottled orange		5	SS	30
4						
		...at 4.6 m, very dense		6	SS	85 / 250mm
5						
6		...at 6.1 m, dark brown and grey		7	SS	78
7						
		...at 7.6 m, brownish grey		8	SS	50
8						
9		...at 9.1 m, trace rock fragments, grey		9	SS	87
10						
		...at 10.7 m, brown, wet		10A	SS	80
11		...at 10.9 m, trace gravel, grey with mottled orange		10B		
12		...at 12.2 m, grey		11	SS	63
13						
	220.8					
	13.7	**SANDY SILT**, some clay, trace gravel, very dense, grey, wet		12	SS	70
14	220.2					
	14.3	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL 10 20 30

Elevation Scale (m): 234 233 232 231 230 229 228 227 226 225 224 223 222 221

Headspace Vapour (ppm): PID: 5, PID: 15, PID: 10, PID: 10, PID: 5, PID: 0, PID: 0, PID: 5, PID: 10, PID: 13, PID: 15, PID: 5

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

SS2 Analysis: M&I, VOC, PHC

SS3 Analysis: PAH

...at 3.0m, auger grinding to 4.0m

...at 6.1m, spoon moist to wet

...at 9.1m, auger grinding

...at 10.7m, spoon wet 28 44 24 4

...at 12.2m, spoon wet

SS11 Analysis: M&I, VOC, PHC

...at 13.7m, spoon wet

SS12 Analysis: PAH

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Aug 8, 2017	8.3	226.2
Aug 11, 2017	8.6	225.9
Aug 24, 2017	8.6	225.9
Sep 7, 2017	8.5	226.0
Oct 25, 2017	8.9	225.6
Nov 10, 2017	8.8	225.7

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 103

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : August 2, 2017	Project : NE Worsley & Owen Streets	Compiled by : JH
Sheet No. : 1 of 1	Location : Barrie, Ontario	Checked by : JC

Position : E: 604516, N: 4916264 (UTM 17T) — Elevation Datum : Geodetic

Rig type : Truck-mounted — Drilling Method : Hollow stem augers

Depth (m)	Elev Depth (m)	Description	Graphic	Sample No.	Type	SPT 'N' Value
0	234.4	**GROUND SURFACE**				
		150mm **ASPHALTIC CONCRETE**		1	SS	29
	233.6	**FILL**, sand, some gravel, trace asphalt, trace silt, compact, grey, damp				
1	0.8	**FILL**, sandy silt, trace clay, trace gravel, loose, grey, moist		2	SS	9
		...at 1.5 m, grey with mottled orange		3	SS	6
2	232.1					
	2.3	**SAND and SILT**, some gravel, loose, grey and brown with green and mottled orange, moist		4	SS	3
3		...at 3.0 m, compact		5	SS	22
4	229.8					
	4.6	**SAND**, some gravel, trace silt, very dense to dense, brown, moist		6	SS	50 / 125mm
5						
6		...at 6.1 m, brown and dark brown		7	SS	50 / 125mm
7						
		...at 7.6 m, grey		8	SS	36
8						
9				9	SS	50 / 75mm
10	223.7					
	10.7	**CLAYEY SILT**, trace sand, hard to very stiff, grey, moist		10	SS	38
11						
12				11	SS	26
13						
14	220.1			12	SS	26
	14.3	**END OF BOREHOLE**				

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane — 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) — Natural Water Content (MC) — Liquid Limit (LL) — 10 20 30

Elevation Scale (m): 234 233 232 231 230 229 228 227 226 225 224 223 222 221

Headspace Vapour (ppm): PID: 5 | PID: 5 | PID: 15 | PID: 0 | PID: 10 | PID: 10 | PID: 20 | PID: 35 | PID: 15 | PID: 10 | PID: 5 | PID: 5

Instrument Details: Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

- SS2 Analysis: M&I
- SS3 Analysis: PAH, VOC, PHC
- ...at 4.6m, auger grinding
- ...at 8.2m, slight odour
- ...at 10.7m, spoon wet to 11.3m
- SS10 Analysis: PAH, VOC, PHC, DUP 1
- ...at 12.2m, spoon wet — 0 3 47 50
- SS11 Analysis: M&I, DUP 2

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Aug 8, 2017	8.6	225.7
Aug 11, 2017	8.8	225.6
Aug 24, 2017	9.0	225.4
Sep 7, 2017	8.9	225.4
Oct 25, 2017	8.5	225.9
Nov 10, 2017	8.4	226.0

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 104

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : August 3, 2017	Project : NE Worsley & Owen Streets	Compiled by : JH
Sheet No. : 1 of 1	Location : Barrie, Ontario	Checked by : JC

Position : E: 604546, N: 4916217 (UTM 17T) Elevation Datum : Geodetic

Rig type : Truck-mounted Drilling Method : Hollow stem augers / tricone

Depth (m)	Elev Depth (m)	Description	Graphic Log	Sample No.	Type	SPT 'N' Value	Elevation (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	234.1	**GROUND SURFACE**					234					
0	233.3	**FILL**, sand, some silt, trace gravel, trace organics, trace glass, trace brick fragments, loose, dark brown, moist		1	SS	5				PID: 0		
1	0.8	**FILL**, silty sand, trace gravel, brown with mottled orange, loose, moist		2	SS	4	233			PID: 15		SS2 Analysis: VOC, PHC, DUP 1
2	231.8			3	SS	6	232			PID: 0		...at 1.5m, spoon wet to 2.1m
2	2.3	**SAND**, some silt, trace gravel, trace rock fragments, brown with mottled orange, loose, moist		4	SS	4				PID: 10		SS3 Analysis: M&I, DUP 2
3				5	SS	3	231			PID: 10		SS4 Analysis: PAH, DUP 4
4	229.5						230					
5	4.6	**SANDY SILT**, some clay, trace gravel, loose, grey, wet		6	SS	8	229			PID: 5		...at 4.6m, spoon wet
6	228.0											...at 5.3m, heavy grinding on augers
6	6.1	**SAND**, trace to some silt, trace gravel, trace boulders, very dense, grey, moist		7	SS	55	228			PID: 15		
7							227					
8				8	SS	66	226			PID: 0		...at 7.6m, spoon moist to wet ...at 7.6m, slow auger grinding to 9.1m ...at 8.2m, auger grinding
9				9	SS	51 / 150mm	225			PID: 10		...at 9.1m, spoon wet ...at 9.4m, slight auger grinding
10	223.4						224					
11	10.7	**GRAVELLY SAND**, trace silt, trace boulders, very dense, grey, wet		10	SS	50 / 125mm	223			PID: 15		SS10 Analysis: VOC, PHC ...at 10.7m, spoon wet ...at 11.3m, very heavy auger grinding, spoon wet
12				11	SS	63	222			PID: 10		...at 12.2m, spoon wet 32 54 11 3 SS11 Analysis: M&I, PAH
13				12	SS	50 / 50mm	221					
14				13	SS	50 / 75mm	220					
15	218.3			14	SS	50 / 90mm	219					
	15.8	**END OF BOREHOLE**										

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Aug 11, 2017	12.8	221.3
Aug 24, 2017	12.6	221.6
Sep 7, 2017	12.3	221.8
Oct 25, 2017	12.7	221.4
Nov 10, 2017	12.2	221.9

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 105

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : August 2, 2017	Project : NE Worsley & Owen Streets	Compiled by : JH
Sheet No. : 1 of 1	Location : Barrie, Ontario	Checked by : JC

Position : E: 604523, N: 4916238 (UTM 17T) Elevation Datum : Geodetic

Rig type : Truck-mounted Drilling Method : Hollow stem augers

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
	234.3	**GROUND SURFACE**										
0	234.0	300mm **TOPSOIL**		1A	SS	12	234			PID: 0		
	0.3	**FILL**, gravel and sand, trace silt, trace brick fragments, trace organics, compact, brown, moist		1B						PID: 0		
1	233.2			2A	SS	4				PID: 5		
	1.1	...at 0.8 m, loose		2B			233			PID: 15		2B Analysis: M&I
	232.8	**FILL**, silty sand, trace gravel, trace cobbles, brown with mottled orange, loose, moist		3	SS	5				PID: 10		SS3 Analysis: PAH, VOC, PHC
2	1.5	**SILTY SAND**, trace clay, brown with mottled orange, loose, moist		4	SS	4	232			PID: 5		
3		...at 3.0 m, trace gravel, very loose, wet		5	SS	2	231			PID: 5		
4	229.7						230					
	4.6	**SAND**, trace to some silt, trace to some gravel, dense, brown, moist		6	SS	40				PID: 10		
5							229					
6		...at 6.1 m, trace cobbles, light brown		7	SS	78	228			PID: 15		...at 6.1m, spoon wet
7							227					
		...at 7.6 m, very dense, moist		8	SS	50 / 150mm				PID: 5		...at 7.6m, spoon wet
8							226					
9		...at 9.1 m, grey, wet		9	SS	78	225			PID: 10		...at 9.1m, drilling mud added
10	223.6						224					
	10.7	**GRAVELLY SAND**, trace silt, very dense, grey, moist		10	SS	50 / 75mm				PID: 5		SS10 Analysis: PAH
11							223					...at 11.4m, very heavy grinding
12		...at 12.2 m, wet		11	SS	80	222			PID: 10		...at 11.4m, refusal to 12.5m ...at 12.2m, auger grinding
	221.6											
	12.7	**END OF BOREHOLE**										SS11 Analysis: M&I, VOC, PHC

Penetration Test Values (Blows / 0.3m): Dynamic Cone (10, 20, 30, 40)

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane (40, 80, 120, 160)

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) (10, 20, 30)

Unstabilized Water Level

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Aug 8, 2017	12.4	222.0
Aug 11, 2017	12.4	222.0
Aug 24, 2017	12.2	222.1
Sep 7, 2017	12.4	221.9
Oct 25, 2017	12.5	221.8
Nov 10, 2017	12.3	222.0

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 201

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 23, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604540, N: 4916303 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	235.0	**GROUND SURFACE**					235					
		150mm **ASPHALTIC CONCRETE**		1	SS	19				PID: 10		
1		**FILL**, sand, some silt, trace gravel, loose to compact, brown with mottled orange, moist		2	SS	8	234			PID: 10		SS2 Analysis: M&I, PAH, VOC, PHC
	233.5											
2	1.5	**SILTY SAND**, trace gravel, compact to dense, brown, moist		3A	SS	27	233			PID: 5		
				3B						PID: 0		
3				4	SS	34				PID: 0		
				5	SS	67	232			PID: 5		
4	230.4											
5	4.6	**SAND AND GRAVEL**, trace silt, dense to very dense, brown, wet		6	SS	104	231			PID: 0		...at 5.2m, tricone grinding
							230					
6		...at 6.1 m, sand and silt layers		7	SS	36	229			PID: 0		
7							228					
8				8	SS	65	227			PID: 5		
9	225.9						226					
	9.1	**SAND**, trace silt, trace gravel, very dense, brown, wet		9	SS	65				PID: 5		SS9 Analysis: VOC, PHC
10							225					
11				10	SS	76	224			PID: 0		SS10 Analysis: M&I
12				11	SS	70	223			PID: 10		
13	221.3						222					
	13.7	**SILT**, some sand, some clay, dense, grey, moist to wet		12	SS	35	221			PID: 5		SS12 Analysis: PAH
14												
15	219.8						220					
	15.2	**SILT AND CLAY**, hard, grey, wet		13	SS	46		240 kPa		PID: 0		SS13 Analysis: M&I
16							219					
17				14	SS	32	218	175 kPa		PID: 0		

Penetration Test Values (Blows / 0.3m): Dynamic Cone; scale 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; scale 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; scale 10 20 30

Instrument Details: Unstabilized Water Level; W1 W2

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT); GR SA SI CL

(continued next page)

LOG OF BOREHOLE 201

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 23, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604540, N: 4916303 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
		(continued)						Dynamic Cone 10 20 30 40; Unconfined / Pocket Penetrometer / Field Vane / Lab Vane 40 80 120 160	Plastic Limit / Natural Water Content / Liquid Limit PL MC LL 10 20 30		W1 W2		GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
18	216.7	**SILT AND CLAY**, hard, grey, wet *(continued)*					217						
	18.3	**SAND**, trace silt, trace gravel, grey, wet		15	SS	52				PID: 0			
19							216						
20				16	SS	91 / 290mm	215			PID: 5			
21							214						
				17	SS	52 / 125mm				PID: 0			0 89 8 3
22							213						
23				18	SS	52 / 140mm	212			PID: 5			
24							211						
	210.4			19	SS	50 / 100mm				PID: 0			
	24.6	**END OF BOREHOLE**											

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

W1: 50 mm dia. monitoring well installed.
W2: 50 mm dia. monitoring well installed.

W2 WATER LEVELS

Date	Water Depth (m)	Elevation (m)
Nov 10, 2017	8.6	226.4

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 202

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 24, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604519, N: 4916287 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	234.4	**GROUND SURFACE**					234					
		140mm **ASPHALTIC CONCRETE**										
		Straight auger to 9.1m										
1							233					
2							232					
3							231					
4							230					
5							229					
6							228					
7							227					
8							226					
9	225.3											
	9.1	**CLAYEY SILT**, some sand, hard, grey with mottled orange, wet		1	SS	74	225	225 kPa		PID: 0		
10	223.7						224					
	10.7	**SILTY SAND**, very dense, brownish grey, wet		2	SS	57	223			PID: 5		
11												
12		...at 12.2 m, grey		3	SS	52	222			PID: 5		
13							221					
	220.7											
14	13.7	**SILT**, some clay, trace sand, very stiff to hard, grey, wet		4	SS	31	220	200 kPa		PID: 0		0 1 79 20
15	219.2											
	15.2	**CLAY AND SILT**, layered, trace sand, hard, grey, moist		5	SS	26	219	125 kPa		PID: 0		
16							218					
17				6	SS	44	217			PID: 5		

(continued next page)

LOG OF BOREHOLE 202

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 24, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604519, N: 4916287 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
		(continued)						Dynamic Cone 10 20 30 40; Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160	Plastic Limit, Natural Water Content, Liquid Limit PL MC LL 10 20 30				GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
18		**CLAY AND SILT**, layered, trace sand, hard, grey, moist *(continued)*					216						
				7	SS	45				PID: 5			SS7 Analysis: M&I, PAH
19							215						
20				8	SS	45	214			PID: 0			SS8 Analysis: VOC, PHC
21	213.1												
	21.3	**SAND**, trace silt, trace gravel, very dense, grey, wet		9	SS	50 / 125mm	213			PID: 0			SS9 Analysis: M&I
22							212						
23				10	SS	55 / 125mm				PID: 5			
							211						
24													
				11	SS	98 / 275mm	210			PID: 5			
	209.6 24.8												

END OF BOREHOLE

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 10, 2017	8.5	225.9

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 203

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 25, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604537, N: 4916276 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value
0	234.5	**GROUND SURFACE**				
		150mm **ASPHALTIC CONCRETE**		1	SS	33
		FILL, sand, some silt, some gravel, compact to dense, brown, moist		2	SS	10
				3	SS	4
				4	SS	3
3	231.5					
	3.0	**SAND AND GRAVEL**, some silt, compact, brown, wet		5	SS	14
				6	SS	13
6	228.4					
	6.1	**SAND AND SILT**, trace gravel, dense, brown, moist		7	SS	30
				8	SS	38
9	225.4					
	9.1	**CLAY AND SILT**, trace silt partings, trace sand, hard, grey, moist		9	SS	49
				10	SS	43
				11	SS	44
				12	SS	72
				13	SS	58
				14	SS	52

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Elevation Scale (m): 234 233 232 231 230 229 228 227 226 225 224 223 222 221 220 219 218 217

Headspace Vapour (ppm): PID: 5, PID: 10, PID: 0, PID: 5, PID: 0, PID: 0, PID: 5, PID: 0, PID: 0, PID: 10, PID: 5, PID: 0, PID: 0, PID: 5, PID: 0

Instrument Details: Unstabilized Water Level

Lab Data and Comments

SS2 Analysis: VOC, PHC

SS3 Analysis: M&I

SS4 Analysis: PAH

SS9 Analysis: VOC, PHC

SS10 Analysis: M&I, PAH

GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

0 1 59 40

(continued next page)

LOG OF BOREHOLE 203

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 25, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604537, N: 4916276 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments
		(continued)						Dynamic Cone 10 20 30 40; Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160	Plastic Limit, Natural Water Content, Liquid Limit PL MC LL 10 20 30				GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
18		**CLAY AND SILT**, trace silt partings, trace sand, hard, grey, moist *(continued)*					216						
				15	SS	52				PID: 5			
19							215						
20				16	SS	62				PID: 5			
21	213.2						214						
	21.3	**SAND**, some silt, trace clay, very dense, grey, wet		17	SS	100 / 250mm	213			PID: 0			
22							212						
23				18	SS	60 / 150mm				PID: 0			0 84 12 4
							211						
24													
				19	SS	110 / 265mm	210			PID: 0			
	209.7 24.8	**END OF BOREHOLE**											

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 10, 2017	8.5	226.0

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 204

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 30, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604544, N: 4916217 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	234.2 **GROUND SURFACE**	Straight auger to 13.7m					234					
1							233					
2							232					
3							231					
4							230					
5							229					
6							228					
7							227					
8							226					
9							225					
10							224					
11							223					
12							222					
13							221					
14	220.5 / 13.7	**SILTY SAND**, trace gravel, very dense, grey, moist		1	SS	50 / 100mm	220			PID: 5		...at 13.7m, tricone grinding
15		...at 15.2 m, some gravel		2A / 2B	SS	65	219			PID: 0 / PID: 10		2A Analysis: M&I / 2B Analysis: VOC, PHC
16							218					
17	217.4 / 16.8	**CLAY AND SILT**, trace sand, trace silt partings, hard, grey, moist		3	SS	49	217			PID: 5		

Penetration Test Values (Blows / 0.3m): Dynamic Cone 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160

Moisture / Plasticity: Plastic Limit (PL) Natural Water Content (MC) Liquid Limit (LL) 10 20 30

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

(continued next page)

LOG OF BOREHOLE 204

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 30, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604544, N: 4916217 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
		(continued)						Dynamic Cone 10 20 30 40; Unconfined, Pocket Penetrometer, Field Vane, Lab Vane 40 80 120 160	Plastic Limit, Natural Water Content, Liquid Limit PL MC LL 10 20 30			Unstabilized Water Level; GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL
18		**CLAY AND SILT**, trace sand, trace silt partings, hard, grey, moist *(continued)*					216					
				4	SS	36				PID: 0		SS4 Analysis: M&I, PAH
19							215					
20				5	SS	41	214			PID: 5		
21							213					
				6	SS	41				PID: 5		
22							212					
	211.3 / 22.9	**SAND**, some silt, very dense, grey, wet		7	SS	91	211			PID: 5		
23												
24							210					
				8	SS	100 / 275mm				PID: 10		
	209.4 / 24.8											

END OF BOREHOLE

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 205

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 30, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604522, N: 4916237 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev / Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	234.3	**GROUND SURFACE**					234					
		Straight auger to 10.7m										
1							233					
2							232					
3							231					
4							230					
5							229					
6							228					
7							227					
8							226					
9							225					
10							224					
11	223.6 / 10.7	**GRAVELLY SAND**, some silt, trace clay, very dense, grey, moist to wet		1	SS	50 / 100mm				PID: 5		
12				2	SS	50 / 90mm	222			PID: 0		
13							221					
14				3	SS	67	220			PID: 5		32 42 19 7
15	219.1 / 15.2	**SILT**, trace sand, trace clay, trace clay layers, very dense, brown, moist		4	SS	50 / 125mm	219			PID: 10		SS4 Analysis: M&I
16							218					
17		...at 16.8 m, grey		5	SS	100 / 250mm	217			PID: 0		0 6 85 9 SS5 Analysis: VOC, PHC

(continued next page)

LOG OF BOREHOLE 205

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 30, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604522, N: 4916237 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev Depth (m)	Description (continued)	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Headspace Vapour (ppm)	Lab Data and Comments
18		**SILT**, trace sand, trace clay, trace clay layers, very dense, brown, moist *(continued)*		6	SS	50 / 100mm	216	PID: 0	
19	214.5						215		
20	19.8	**SAND**, some silt, very dense, grey, wet		7	SS	50 / 100mm	214	PID: 0	
21	213.0						213		
22	21.3	**CLAY AND SILT**, trace sand, hard, grey, moist		8	SS	70	212	PID: 5	SS8 Analysis: M&I
23	211.1			9A	SS	68	211	PID: 0	9A Analysis: PAH
	23.2	**SAND**, some silt, very dense, grey, wet		9B				PID: 5	
24	209.6			10	SS	50 / 125mm	210	PID: 0	
	24.7								

Penetration Test Values (Blows / 0.3m): Dynamic Cone (10, 20, 30, 40)

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane (40, 80, 120, 160)

Moisture / Plasticity: Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL) (10, 20, 30)

Instrument Details

Unstabilized Water Level

Lab Data and Comments: GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

END OF BOREHOLE

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

50 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 10, 2017	8.3	226.0

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 206

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 26, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 1 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604548, N: 4916244 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth (m)	Elev Depth (m)	Description	Graphic Log	Sample Number	Sample Type	SPT 'N' Value	Elevation (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL MC LL)	Headspace Vapour (ppm)	Instrument Details	Lab Data and Comments
0	234.3	**GROUND SURFACE**					234					
		FILL, sand and silt, trace to some gravel, compact, brown, moist		1	SS	12				PID: 10		
1		...at 0.8 m, very loose		2	SS	3	233			PID: 5		SS2 Analysis: PAH, VOC, PHC, Dup 4
2	232.0			3	SS	3				44 PID: 0		SS3 Analysis: M&I, Dup 5
	2.3	**SAND AND SILT**, trace clay, trace gravel, loose to compact, brown, moist		4	SS	4	232			PID: 5		
3				5	SS	17	231			PID: 10		
4	229.7						230					
	4.6	**SAND AND GRAVEL**, trace silt, very dense, brown, moist to wet		6	SS	53				PID: 0		
5							229					
6				7	SS	51	228			PID: 0		
7							227					
		...at 7.6 m, dense		8	SS	33				PID: 5		SS8 Analysis: M&I, Dup 6
8							226					
9				9	SS	50/ 75mm	225			PID: 0		SS9 Analysis: VOC, PHC ...at 9.1m, tricone grinding
10							224					
		...at 10.7 m, sandy		10	SS	51 / 125mm				PID: 0		57 30 (13)
11							223					...at 11.3m, tricone grinding
12	222.1											
	12.2	**SILT**, some sand to sandy, trace clay, very dense, grey, wet		11	SS	56 / 125mm	222			PID: 5		
13							221					
				12	SS	63				PID: 0		
14							220					
15				13	SS	94 / 275mm	219			PID: 5		SS13 Analysis: M&I, PAH
16							218					
17				14	SS	83	217			PID: 10		

Penetration Test Values (Blows / 0.3m): Dynamic Cone; Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit

Unstabilized Water Level

Lab Data and Comments — GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL

(continued next page)

LOG OF BOREHOLE 206

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 26, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 2 of 2	Location : Barrie, Ontario	Checked by : JC

Position : E: 604548, N: 4916244 (UTM 17T) Elevation Datum : Local Datum

Rig type : Truck-mounted Drilling Method : Hollow stem augers / mud rotary (tricone)

Depth Scale (m)	Elev Depth (m)	Description (continued)	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)	Penetration Test Values (Blows / 0.3m) / Undrained Shear Strength (kPa)	Moisture / Plasticity (PL, MC, LL)	Headspace Vapour (ppm)	Instrument Details	Unstabilized Water Level	Lab Data and Comments (GRAIN SIZE DISTRIBUTION (%) (MIT) GR SA SI CL)
18	216.0	**SILT**, some sand to sandy, trace clay, very dense, grey, wet *(continued)*					216						
	18.3	**SILTY CLAY**, layered, trace sand, hard, grey, moist		15	SS	31			LL=52	PID: 0			0 0 25 75
19							215						
20				16	SS	37				PID: 10			
21							214						
				17	SS	42	213			PID: 0			
22							212						
	211.4												
23	22.9	**SAND**, some silt, very dense, grey, wet		18	SS	86 / 265mm	211			PID: 5			
24							210						
	209.3			19	SS	99				PID: 5			
	25.0	**END OF BOREHOLE**											

Penetration Test Values (Blows / 0.3m): Dynamic Cone; 10 20 30 40

Undrained Shear Strength (kPa): Unconfined, Pocket Penetrometer, Field Vane, Lab Vane; 40 80 120 160

Moisture / Plasticity: Plastic Limit, Natural Water Content, Liquid Limit; PL MC LL; 10 20 30

Borehole contained drill water upon completion of drilling. Unstabilized water level and cave not measured.

file: 1-17-0481-01_borehole_logs.gpj

LOG OF BOREHOLE 207

Terraprobe

Project No. : 1-17-0481-01	Client : Barrie Owen Service Inc.	Originated by : NG
Date started : October 31, 2017	Project : NE Worsley & Owen Streets	Compiled by : RW
Sheet No. : 1 of 1	Location : Barrie, Ontario	Checked by : JC

Position : E: 604517, N: 4916210 (UTM 17T) Elevation Datum : Local Datum

Rig type : Pionjar Drilling Method :

Depth Scale (m)	Elev Depth (m)	Description	Graphic Log	Number	Type	SPT 'N' Value	Elevation Scale (m)
	233.9	**GROUND SURFACE**					
0		**FILL**, sand and silt, some organics, trace gravel, trace rootlets, dark brown, moist		1	SS		
				2	SS		233
1				3	SS		
	232.1						
	1.8	**SAND AND SILT**, trace clay, trace gravel, brown, moist		4	SS		232
2				5	SS		
3				6	SS		231
	230.2						
	3.7	**END OF BOREHOLE**					

Penetration Test Values (Blows / 0.3m) — Dynamic Cone: 10, 20, 30, 40

Undrained Shear Strength (kPa) — Unconfined, Pocket Penetrometer, Field Vane, Lab Vane: 40, 80, 120, 160

Moisture / Plasticity — Plastic Limit (PL), Natural Water Content (MC), Liquid Limit (LL): 10, 20, 30

Headspace Vapour (ppm): PID: 5; PID: 10; PID: 5; PID: 0; PID: 5; PID: 0

Instrument Details

Unstabilized Water Level

Lab Data and Comments

GRAIN SIZE DISTRIBUTION (%) (MIT) — GR SA SI CL

SS2 Analysis: M&I, PAH, VOC, PHC

SS3 Analysis: M&I, PAH

SS6 Analysis: M&I, VOC, PHC

Borehole was dry and open upon completion of drilling.

32 mm dia. monitoring well installed.

WATER LEVEL READINGS

Date	Water Depth (m)	Elevation (m)
Nov 10, 2017	dry	n/a

file: 1-17-0481-01_borehole_logs.gpj

BOREHOLE LOG TERMINOLOGY

GROUNDED ENGINEERING

SAMPLING/TESTING METHODS

SS: split spoon sample

AS: auger sample

GS: grab sample

FV: shear vane

DP: direct push

PMT: pressuremeter test

ST: shelby tube

CORE: soil coring

RUN: rock coring

SYMBOLS & ABBREVIATIONS

MC: moisture content

LL: liquid limit

PL: plastic limit

PI: plasticity index

γ: soil unit weight (bulk)

G_s: specific gravity

S_u: undrained shear strength

▽ unstabilized water level

▼ 1st water level measurement

▼ 2nd water level measurement most recent

▼ water level measurement

ENVIRONMENTAL SAMPLES

M&I: metals and inorganic parameters

PAH: polycyclic aromatic hydrocarbon

PCB: polychlorinated biphenyl

VOC: volatile organic compound

PHC: petroleum hydrocarbon

BTEX: benzene, toluene, ethylbenzene and xylene

PPM: parts per million

FIELD MOISTURE (based on tactile inspection)

DRY: no observable pore water

MOIST: inferred pore water, not observable (i.e. grey, cool, etc.)

WET: visible pore water

COHESIONLESS

Relative Density	N-Value
Very Loose	<4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very Dense	>50

COHESIVE

Consistency	N-Value	Su (kPa)
Very Soft	<2	<12
Soft	2 - 4	12 - 25
Firm	4 - 8	25 - 50
Stiff	8 - 15	50 - 100
Very Stiff	15 - 30	100 - 200
Hard	>30	>200

COMPOSITION

Term	% by weight
trace silt	<10
some silt	10 - 20
silt***y***	20 - 35
sand ***and*** silt	>35

ASTM STANDARDS

ASTM D1586 Standard Penetration Test (SPT)
Driving a 51 mm O.D. split-barrel sampler ("split spoon") into soil with a 63.5 kg weight free falling 760 mm. The blows required to drive the split spoon 300 mm ("bpf") after an initial penetration of 150 mm is referred to as the N-Value.

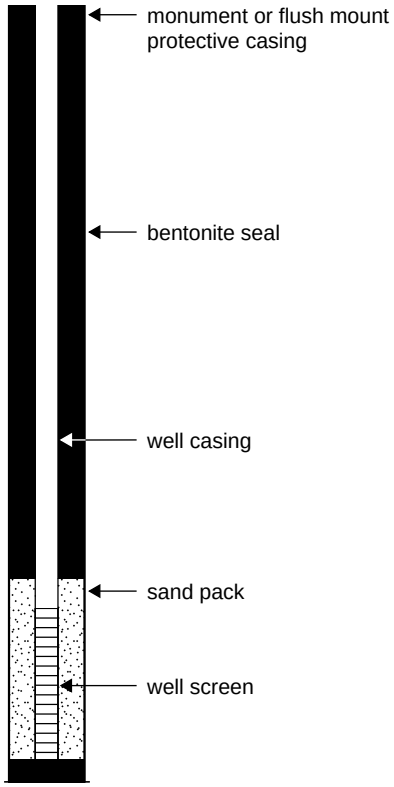
ASTM D3441 Cone Penetration Test (CPT)
Pushing an internal still rod with a outer hollow rod ("sleeve") tipped with a cone with an apex angle of 60° and a cross-sectional area of 1000 mm^2 into soil. The resistance is measured in the sleeve and at the tip to determine the skin friction and the tip resistance.

ASTM D2573 Field Vane Test (FVT)
Pushing a four blade vane into soil and rotating it from the surface to determine the torque required to shear a cylindrical surface with the vane. The torque is converted to the shear strength of the soil using a limit equilibrium analysis.

ASTM D1587 Shelby Tubes (ST)
Pushing a thin-walled metal tube into the in-situ soil at the bottom of a borehole, removing the tube and sealing the ends to prevent soil movement or changes in moisture content for the purposes of extracting a relatively undisturbed sample.

ASTM D4719 Pressuremeter Test (PMT)
Place an inflatable cylindrical probe into a pre-drilled hole and expanding it while measuring the change in volume and pressure in the probe. It is inflated under either equal pressure increments or equal volume increments. This provides the stress-strain response of the soil.

WELL LEGEND



GROUNDED ENGINEERING

Date Started : Jun 15, 2021
Position : E: 604526, N: 4916278 (UTM 17T)
Elev. Datum : Geodetic (NAD83)

BOREHOLE LOG 301

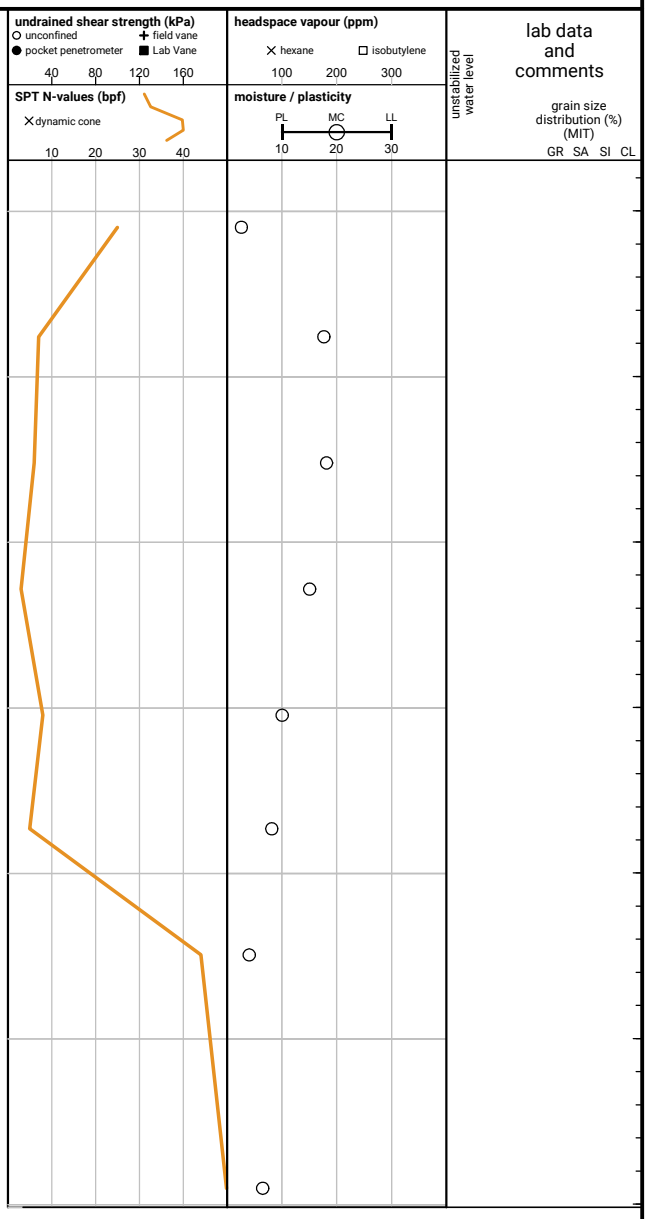
File No. : 20-108 **Project** : 67 Owen Street, Barrie, Ontario **Client** : The Residencies on Owen Ltd.

drill method : *Mini Mole*

elev depth (m)	description	graphic log	number	type	SPT N-value
234.3	**GROUND SURFACE**				
	50mm **ASPHALT**				
	50mm **AGGREGATE**				
	FILL, sand, some silt, some gravel, trace rock fragments (cobbles inferred), compact, brown to grey, moist		1	SS	25
233.5 / 0.8	**FILL**, sandy silt, some clay, trace gravel, loose to very loose, brown with orange, moist to wet		2	SS	7
	...at 1.5 m, trace clay, moist to wet, brown		3	SS	6
			4	SS	3
231.3 / 3.0	**SAND**, some silt, some gravel, trace clay, loose, brown, moist		5	SS	8
			6	SS	5
	...at 4.6 m, grey, rock fragments, inferred cobbles, dense to very dense		7	SS	44
			8	SS	50 / 75mm
228.0 / 6.3	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

Borehole was dry upon completion of drilling.



file: 20-108 53 owen st rev1.gpj

Tech : OM | **PM** : DK | **Rev** :

GROUNDED ENGINEERING

Date Started : Jun 15, 2021
Position : E: 604536, N: 4916283 (UTM 17T)
Elev. Datum : Geodetic (NAD83)

BOREHOLE LOG 302

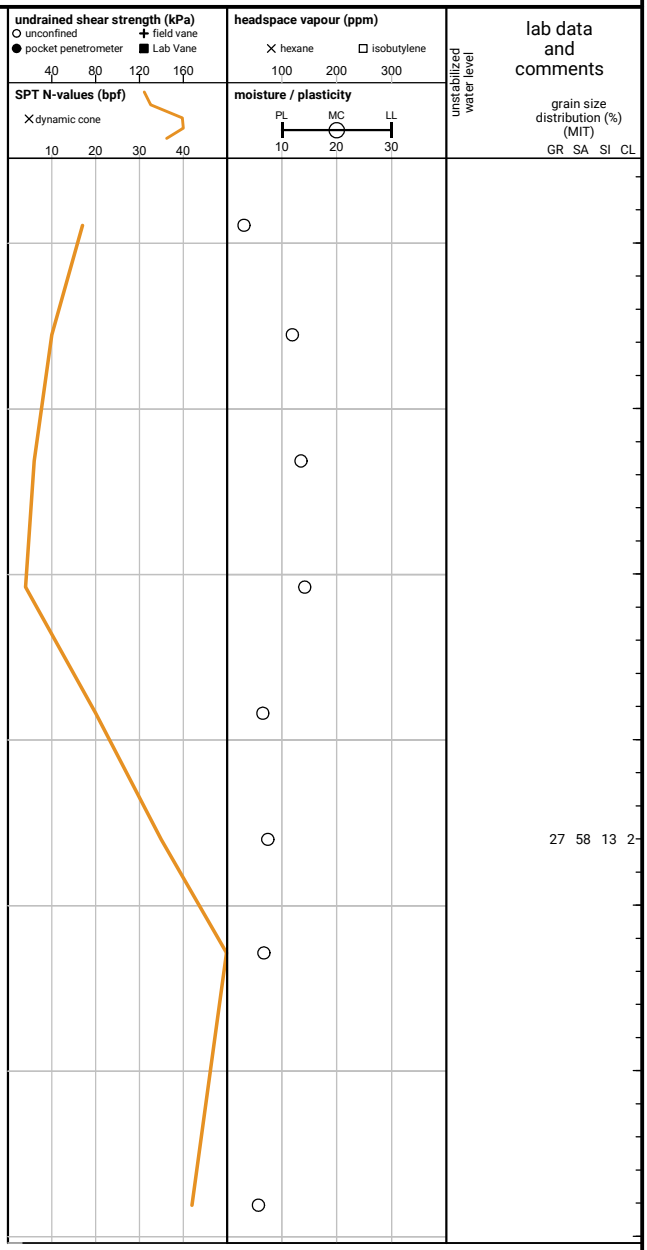
File No. : 20-108 **Project** : 67 Owen Street, Barrie, Ontario **Client** : The Residencies on Owen Ltd.

drill method : *Mini Mole*

elev depth (m)	description	graphic log	number	type	SPT N-value
234.5	**GROUND SURFACE**				
	50mm **ASPHALT**				
	50mm **AGGREGATE**				
	FILL, sand, some silt, some gravel, trace rock fragments (cobbles inferred), compact, brown to grey, moist		1	SS	17
233.7 / 0.8	**FILL**, silty sand, some clay, trace rock fragments, compact to loose, brown to grey, moist		2	SS	10
			3	SS	6
232.2 / 2.3	**GRAVELLY SAND**, some silt, trace rock fragments (cobbles inferred), compact, brown, moist		4	SS	4
			5	SS	20
	...at 3.8 m, dense		6	SS	35
	...at 4.6 m, grey, very dense		7	SS	58
228.4 / 6.1	**SAND AND SILT**, trace clay, trace gravel, dense, grey, moist		8	SS	42
227.9 / 6.6	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

Borehole was dry upon completion of drilling.



file: 20-108 53 owen st rev1.gpj

Tech : OM | **PM** : DK | **Rev** :

GROUNDED ENGINEERING

Date Started : Jun 15, 2021
Position : E: 604536, N: 4916267 (UTM 17T)
Elev. Datum : Geodetic (NAD83)

BOREHOLE LOG 303

File No. : 20-108 **Project** : 67 Owen Street, Barrie, Ontario **Client** : The Residencies on Owen Ltd.

drill method : *Mini Mole*

elev / depth (m)	description	graphic log	number	type	SPT N-value
234.4 / 0.0	**GROUND SURFACE**				
	50mm **ASPHALT**				
	50mm **AGGREGATE**				
	FILL, sand, some silt, trace gravel, dense, brown to grey, moist		1	SS	32
233.6 / 0.8	**FILL**, sand, some silt, some clay, loose, brown with orange, moist to wet		2	SS	6
			3	SS	5
232.1 / 2.3	**SILTY SAND**, trace gravel, very loose, brown, moist		4	SS	3
231.4 / 3.0	**SAND**, some silt, some gravel, trace rock fragments (cobbles inferred), compact to dense, brown, moist		5	SS	13
			6	SS	36
229.8 / 4.6	**SILTY SAND**, some gravel, trace clay, trace rock fragments, compact to dense, grey, wet		7	SS	26
	...at 6.1 m, some silt		8	SS	48
	...at 7.6 m, very dense, moist		9	SS	63
226.3 / 8.1	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

Borehole was dry upon completion of drilling.

depth scale (m): 0 1 2 3 4 5 6 7 8

well details

elevation (m): 234 233 232 231 230 229 228 227

undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40

headspace vapour (ppm)
× hexane □ isobutylene
100 200 300

moisture / plasticity
PL MC LL
10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)
GR SA SI CL
12 59 20 9

file: 20-108 53 owen st rev1.gpj

GROUNDED ENGINEERING

Date Started : Jun 16, 2021
Position : E: 604542, N: 4916230 (UTM 17T)
Elev. Datum : Geodetic (NAD83)

BOREHOLE LOG 304

File No. : 20-108 **Project** : 67 Owen Street, Barrie, Ontario **Client** : The Residencies on Owen Ltd.

drill method : *Mini Mole*

elev depth (m)	description	graphic log	number	type	SPT N-value
234.2	**GROUND SURFACE**				
	50mm **AGGREGATE**				
	FILL, silt, some sand, some clay, trace gravel, trace organics, dense, dark brown, moist		1	SS	11
			2	SS	7
232.7 (1.5)	**FILL**, silty sand, some clay, soft to firm, brown, moist		3	SS	4
231.9 (2.3)	**SILT AND SAND**, trace gravel, trace clay, very loose to loose, brown, moist to wet		4	SS	5
			5	SS	2
			6	SS	3
	...at 4.6 m, sand and silt, some gravel, dense		7	SS	42
	...at 6.1 m, grey		8	SS	51
227.6 (6.6)	**END OF BOREHOLE**				

hollow stem augers OD=215 mm

Borehole was dry upon completion of drilling.

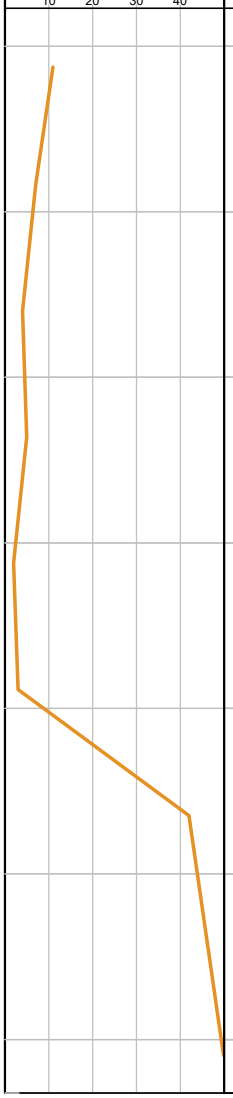
depth scale (m) 0 1 2 3 4 5 6

well details

elevation (m) 234 233 232 231 230 229 228

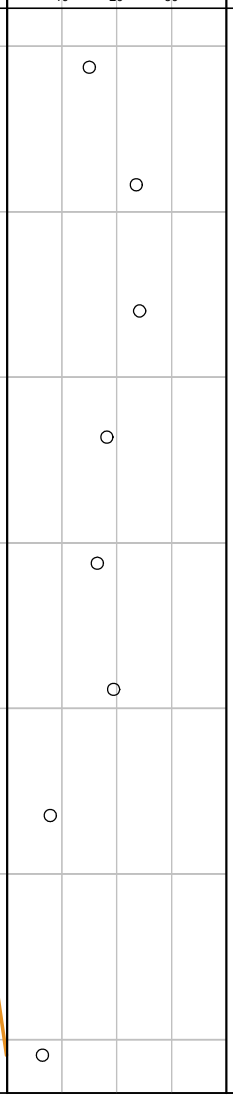
undrained shear strength (kPa)
○ unconfined + field vane
● pocket penetrometer ■ Lab Vane
40 80 120 160

SPT N-values (bpf)
× dynamic cone
10 20 30 40



headspace vapour (ppm)
× hexane □ isobutylene
100 200 300

moisture / plasticity
PL MC LL
10 20 30



unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR	SA	SI	CL
1	41	52	6

file: 20-108 53 owen st rev1.gpj

Tech : OM | **PM** : DK | **Rev** :

GROUNDED ENGINEERING

Date Started : Jun 16, 2021
Position : E: 604526, N: 4916211 (UTM 17T)
Elev. Datum : Geodetic (NAD83)

BOREHOLE LOG 305

File No. : 20-108 **Project** : 67 Owen Street, Barrie, Ontario **Client** : The Residencies on Owen Ltd.

drill method : *Mini Mole*

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
233.9	**GROUND SURFACE**				
	100mm **TOPSOIL**				
	FILL, sand, some silt, some clay, trace gravel, trace rootlets, loose to compact, brown to black, moist		1	SS	5
			2	SS	16
232.4 (1.5)	**FILL**, silty sand, some clay, stiff, brown, moist		3	SS	10
231.6 (2.3)	**SAND**, some silt, trace gravel, loose, brown, moist		4	SS	7
			5	SS	6
			6	SS	5
	...at 4.6 m, no gravel		7	SS	9
			8	SS	3
	...at 6.1 m, grey		9	SS	10
226.3 (7.6)	**SAND AND SILT**, trace clay, trace rock fragments (cobbles inferred), compact, grey, moist		10	SS	23
224.8 (9.1)	**SAND**, some silt, some gravel, very dense, grey, moist		11	SS	97

depth scale (m): 0 1 2 3 4 5 6 7 8 9

well details

elevation (m): 233 232 231 230 229 228 227 226 225 224

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160
SPT N-values (bpf): dynamic cone; 10 20 30 40

headspace vapour (ppm): hexane, isobutylene; 100 200 300
moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT)

GR	SA	SI	CL
0	87	13	0

file: 20-108 53 owen st rev1.gpj

Tech : OM | **PM** : DK | **Rev** :

(continued next page)

GROUNDED ENGINEERING

Date Started : Jun 16, 2021
Position : E: 604526, N: 4916211 (UTM 17T)
Elev. Datum : Geodetic (NAD83)

BOREHOLE LOG 305

File No. : 20-108 **Project** : 67 Owen Street, Barrie, Ontario **Client** : The Residencies on Owen Ltd.

drill method : *Mini Mole*

hollow stem augers OD=215 mm

elev depth (m)	description	graphic log	number	type	SPT N-value
	(continued)				
	SAND, some silt, some gravel, very dense, grey, moist *(continued)*				
	...at 10.7 m, trace silt, trace gravel		12	SS	50 / 100mm
			13	SS	50 / 125mm
221.4 12.5	**END OF BOREHOLE**				

depth scale (m): 10, 11, 12

well details

elevation (m): 223, 222

undrained shear strength (kPa): unconfined, field vane, pocket penetrometer, Lab Vane; 40 80 120 160

SPT N-values (bpf): dynamic cone; 10 20 30 40

headspace vapour (ppm): hexane, isobutylene; 100 200 300

moisture / plasticity: PL MC LL; 10 20 30

unstabilized water level

lab data and comments

grain size distribution (%) (MIT): GR SA SI CL

Borehole was dry upon completion of drilling.

file: 20-108 53 owen st rev1.gpj

Tech : OM | **PM** : DK | **Rev** :

GROUNDED ENGINEERING

Groundwater Level Monitoring Summary

Well ID	Ground Surface Elevation (masl)	Screen Interval (masl)	Terraprobe																Grounded Engineering					
			Aug. 8, 2017		Aug. 11, 2017		Aug. 24, 2017		Sept. 7, 2017		Oct. 25, 2017		Nov. 10, 2017		Dec. 7, 2017		Jan. 17, 2018		May 27, 2020		Jun. 3, 2020		Jun. 9, 2020	
			(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)
BH101	234.5	224.0 - 221.0	11.4	223.1	12.8	221.7	9.0	225.5	11.4	223.1	11.5	223.0	10.5	224.0	11.3	223.2	11.3	223.2	10.5	224.1	10.7	223.8	10.8	223.7
BH102	234.5	225.4 - 223.4	8.3	226.2	8.6	225.9	8.6	225.9	8.5	226.0	8.9	225.6	8.8	225.7	8.8	225.7	8.8	225.7	7.9	226.6	8.1	226.4	8.2	226.4
BH103	234.4	223.7 - 220.7	8.6	225.8	8.8	225.6	9.0	225.4	8.9	225.5	8.5	225.9	8.4	226.0	8.9	225.5	8.9	225.5	-	-	8.2	226.2	8.2	226.3
BH104	234.1	224.6 - 221.6	-	-	12.8	221.3	12.6	221.5	12.3	221.8	12.7	221.4	12.2	221.9	12.3	221.8	12.3	221.8	10.9	223.2	11.4	222.7	11.4	222.8
BH105	234.3	224.8 - 221.8	12.4	221.9	12.4	221.9	12.2	222.1	12.4	221.9	12.5	221.8	12.3	222.0	12.5	221.8	12.5	221.8	-	-	11.8	222.5	11.6	222.8
BH201S (W1)	235.0	228.9 - 225.9	-	-	-	-	-	-	-	-	-	-	-	-	7.5	227.5	7.8	227.2	6.8	228.2	7.0	228.1	7.0	228.0
BH201D (W2)	235.0	213.7 - 210.7	-	-	-	-	-	-	-	-	-	-	8.6	226.4	8.1	226.9	8.7	226.3	7.5	227.6	7.8	227.2	7.8	227.3
BH202	234.4	213.1 - 210.3	-	-	-	-	-	-	-	-	-	-	8.5	225.9	7.9	226.5	8.6	225.8	9.4	225.0	7.8	226.6	7.9	226.5
BH203	234.5	213.2 - 210.2	-	-	-	-	-	-	-	-	-	-	8.5	226.0	7.9	226.6	8.5	226.0	7.2	227.3	7.6	226.9	7.6	226.9
BH205	234.3	213.0 - 210.0	-	-	-	-	-	-	-	-	-	-	8.3	226.0	8.1	226.2	8.4	225.9	7.9	226.4	8.2	226.1	8.2	226.2
BH206	234.3	213.0 - 210.0	-	-	-	-	-	-	-	-	-	-	-	-	8.3	226.0	8.3	226.0	10.7	223.6	11.2	223.1	11.4	223.0
BH207	234.3	231.7 - 230.2	-	-	-	-	-	-	-	-	-	-	Dry	n/a	Dry	n/a	Dry	n/a	Dry	n/a	Dry	n/a	Dry	n/a

mbgs = metres below existing ground surface
masl = metres above sea level
* = unstabilized groundwater level

GROUNDED ENGINEERING

Groundwater Level Monitoring Summary

Well ID	Ground Surface Elevation (masl)	Screen Interval	Grounded Engineering						Minimum Elev. (Lowest)		Maximum Elev. (Highest)		Seasonal Fluctuation
			Jun. 17, 2020		Apr. 14, 2021		May 5, 2021						
		(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(mbgs)	(masl)	(±m)
BH101	234.5	224.0 - 221.0	10.9	223.6	10.7	223.6	10.8	223.7	12.8	221.7	9.0	225.5	1.9
BH102	234.5	225.4 - 223.4	8.4	226.1	8.0	226.1	8.4	226.1	8.9	225.6	7.9	226.6	0.5
BH103	234.4	223.7 - 220.7	8.6	225.9	8.6	225.9	8.6	225.8	9.0	225.4	8.2	226.3	0.4
BH104	234.1	224.6 - 221.6	11.9	222.3	10.4	222.3	11.2	222.9	12.8	221.3	10.4	223.2	1.2
BH105	234.3	224.8 - 221.8	12.0	222.4	10.6	222.4	11.3	223.0	12.5	221.8	10.6	223.0	0.9
BH201S (W1)	235.0	228.9 - 225.9	7.1	227.9	7.4	227.9	7.4	227.6	7.8	227.2	6.8	228.2	0.5
BH201D (W2)	235.0	213.7 - 210.7	8.0	227.0	7.6	227.0	8.0	227.0	8.7	226.3	7.5	227.6	0.6
BH202	234.4	213.1 - 210.3	8.1	226.3	7.5	226.3	7.9	226.5	9.4	225.0	7.5	226.6	1.0
BH203	234.5	213.2 - 210.2	7.9	226.6	7.3	226.6	7.7	226.8	8.5	226.0	7.2	227.3	0.6
BH205	234.3	213.0 - 210.0	8.5	225.8	7.8	225.8	8.3	226.0	8.5	225.8	7.8	226.4	0.4
BH206	234.3	213.0 - 210.0	11.6	222.7	-	-	7.8	226.5	11.6	222.7	8.3	226.5	1.7
BH207	234.3	231.7 - 230.2	Dry	n/a	-	-	-	-	0.0	0.0	0.0	0.0	0.0

mbgs = metres below existing ground surface
masl = metres above sea level
* = unstabilized groundwater level

APPENDIX I

FINAL REPORT

CA14934-APR21 R1

20-108-206, 59 Owen St, Barrie

Prepared for

Grounded Engineering Inc.

FINAL REPORT

First Page

CLIENT DETAILS

Client	Grounded Engineering Inc.
Address	12 Banigan Drive Toronto, Ontario M4H1E9. Canada
Contact	Ylena Quan
Telephone	647-264-7928
Facsimile	
Email	yquan@groundedeng.ca
Project	20-108-206, 59 Owen St, Barrie
Order Number	
Samples	Ground Water (1)

LABORATORY DETAILS

Project Specialist	Jill Campbell, B.Sc.,GISAS
Laboratory	SGS Canada Inc.
Address	185 Concession St., Lakefield ON, K0L 2H0
Telephone	2165
Facsimile	705-652-6365
Email	jill.campbell@sgs.com
SGS Reference	CA14934-APR21
Received	04/15/2021
Approved	04/26/2021
Report Number	CA14934-APR21 R1
Date Reported	04/27/2021

COMMENTS

RL - SGS Reporting Limit

.

Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:021219

7Hdibenzo(c,g)carbazole and Dibenzo(a,i)pyrene LCS; Recovery is outside control limits; the overall quality control for this analysis has been assessed and was determined to be acceptable.

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

TABLE OF CONTENTS

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **SANSEW - General Chemistry**
(WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

General Chemistry

Parameter	Units	RL	L1	L2	Result
Biochemical Oxygen Demand (BOD5)	mg/L	2	300	15	< 4 ↑
Total Suspended Solids	mg/L	2	350	15	59
Total Kjeldahl Nitrogen	as N mg/L	0.5	100		< 0.5
Chemical Oxygen Demand	mg/L	8	600		< 8

PACKAGE: **SANSEW - Metals and Inorganics**
(WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Metals and Inorganics

Parameter	Units	RL	L1	L2	Result
Sulphide	mg/L	0.02	1		< 0.02
Cyanide (total)	mg/L	0.01	1.2		< 0.01
Fluoride	mg/L	0.06	10		0.07
Sulphate	mg/L	2	1500		62
Aluminum (total)	mg/L	0.001	50		0.915
Aluminum (0.2µm)	mg/L	0.001			0.007
Antimony (total)	mg/L	0.0009	5		0.0020
Arsenic (total)	mg/L	0.0002	1		0.0005
Barium (total)	mg/L	0.00002	5		0.202

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **SANSEW - Metals and Inorganics**
(WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
Metals and Inorganics (continued)					
Bismuth (total)	mg/L	0.000007	5		0.000025
Cadmium (total)	mg/L	0.000003	0.7	0.001	0.000014
Chromium (total)	mg/L	0.00008	2	0.08	0.00187
Cobalt (total)	mg/L	0.000004	5		0.000547
Copper (total)	mg/L	0.0002	2	0.01	0.0038
Iron (total)	mg/L	0.007	50		1.03
Lead (total)	mg/L	0.00001	0.7	0.05	0.00172
Manganese (total)	mg/L	0.00001	5		0.0623
Molybdenum (total)	mg/L	0.00004	5		0.00106
Nickel (total)	mg/L	0.0001	2	0.05	0.0013
Phosphorus (total)	mg/L	0.003	10		0.093
Selenium (total)	mg/L	0.00004	1		< 0.00004
Silver (total)	mg/L	0.00005	0.4		< 0.00005
Tin (total)	mg/L	0.00006	5		0.00342
Vanadium (total)	mg/L	0.00001	5		0.00214
Zinc (total)	mg/L	0.002	2	0.04	0.016
Gold (total)	mg/L	0.00001	5		< 0.00001
Platinum (total)	mg/L	0.0001	5		< 0.0001
Rhodium (total)	mg/L	0.00001	5		< 0.00001

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **SANSEW - Microbiology** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
Microbiology					
E. Coli	cfu/100mL	-			0

PACKAGE: **SANSEW - Oil and Grease** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
Oil and Grease					
Oil & Grease (total)	mg/L	2			55
Oil & Grease (animal/vegetable)	mg/L	4	150		44
Oil & Grease (mineral/synthetic)	mg/L	4	15		10

PACKAGE: **SANSEW - Other (ORP)** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
Other (ORP)					
pH	No unit	0.05	9.5	9.5	7.94
Chloride	mg/L	1	1500		92
Chromium VI	mg/L	0.0002			0.0011
Mercury (total)	mg/L	0.00001	0.01		< 0.00001
Mercury (dissolved)	mg/L	0.00001			< 0.00001

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **SANSEW - PAHs** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
PAHs					
Benzo(b+j)fluoranthene	mg/L	0.0001			< 0.0001

PACKAGE: **SANSEW - Phenols** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
Phenols					
4AAP-Phenolics	mg/L	0.002	0.1		< 0.002

PACKAGE: **SANSEW - SVOCs** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002
L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
SVOCs					
PAHs (Total)	mg/L	-	0.005		< 0.001
Perylene	mg/L	0.0005			< 0.0005
Hexachlorobenzene	mg/L	0.0001	0.001		< 0.0001

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **SANSEW - SVOCs - PAHs** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002

L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

SVOCs - PAHs

Parameter	Units	RL	L1	L2	Result
7Hdibenzo(c,g)carbazole	mg/L	0.0001			< 0.0001
Anthracene	mg/L	0.0001			< 0.0001
Benzo(a)anthracene	mg/L	0.0001			< 0.0001
Benzo(a)pyrene	mg/L	0.0001			< 0.0001
Benzo[e]pyrene	mg/L	0.0001			< 0.0001
Benzo(ghi)perylene	mg/L	0.0002			< 0.0002
Benzo(k)fluoranthene	mg/L	0.0001			< 0.0001
Chrysene	mg/L	0.0001			< 0.0001
Dibenzo(a,h)anthracene	mg/L	0.0001			< 0.0001
Dibenzo(a,i)pyrene	mg/L	0.0001			< 0.0001
Dibenzo(a,j)acridine	mg/L	0.0001			< 0.0001
Fluoranthene	mg/L	0.0001			< 0.0001
Indeno(1,2,3-cd)pyrene	mg/L	0.0002			< 0.0002
Phenanthrene	mg/L	0.0001			< 0.0001
Pyrene	mg/L	0.0001			< 0.0001

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **SANSEW - VOCs** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002

L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
VOCs					
1,2-Dichlorobenzene	mg/L	0.0005	0.05		< 0.0005
1,4-Dichlorobenzene	mg/L	0.0005	0.08		< 0.0005
Methylene Chloride	mg/L	0.0005	0.09		< 0.0005
1,1,2,2-Tetrachloroethane	mg/L	0.0005	0.06		< 0.0005
Tetrachloroethylene (perchloroethylene)	mg/L	0.0005	0.06		< 0.0005
Trichloroethylene	mg/L	0.0005	0.05		< 0.0005

PACKAGE: **SANSEW - VOCs - BTEX** (WATER)

L1 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002

L2 = SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	L2	Result
VOCs - BTEX					
Benzene	mg/L	0.0005	0.01		< 0.0005
Ethylbenzene	mg/L	0.0005	0.06		< 0.0005
Toluene	mg/L	0.0005	0.02		< 0.0005
Xylene (total)	mg/L	0.0005	0.3		< 0.0005
m-p-xylene	mg/L	0.0005			< 0.0005
o-xylene	mg/L	0.0005			< 0.0005

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	SANSEW / WATER / - - Barrie Sewer Use - Sanitary Sewers & Combined - BL_2021_002 L1	SANSEW / WATER / - - Barrie Sewer Use - Sanitary Storm - BL_2021_002 L2
SW-UF-BH203					
Total Suspended Solids	SM 2540D	mg/L	59		15

QC SUMMARY

Anions by discrete analyzer

Method: US EPA 325.2 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-026

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO5043-APR21	mg/L	1	<1	0	20	106	80	120	99	75	125
Sulphate	DIO5043-APR21	mg/L	2	<2	0	20	109	80	120	77	75	125

Biochemical Oxygen Demand

Method: SM 5210 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0033-APR21	mg/L	2	< 2	17	30	89	70	130	NV	70	130

Chemical Oxygen Demand

Method: HACH 8000 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chemical Oxygen Demand	EWL0285-APR21	mg/L	8	<8	2	20	110	80	120	99	75	125

QC SUMMARY

Cyanide by SFA

Method: SM 4500 I Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0153-APR21	mg/L	0.01	<0.01	ND	10	90	90	110	90	75	125

Fluoride by Specific Ion Electrode

Method: SM 4500 I Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0283-APR21	mg/L	0.06	<0.06	ND	10	99	90	110	100	75	125

Hexavalent Chromium by SFA

Method: EPA218.6/EPA3060A I Internal ref.: ME-CA-IENVISKA-LAK-AN-012

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	SKA0165-APR21	mg/L	0.0002	<0.0002	ND	20	106	80	120	NV	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0015-APR21	mg/L	0.00001	< 0.00001	ND	20	120	80	120	NV	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0089-APR21	mg/L	0.00005	<0.00005	ND	20	101	90	110	101	70	130
Aluminum (total)	EMS0089-APR21	mg/L	0.001	<0.001	7	20	101	90	110	122	70	130
Aluminum (0.2µm)	EMS0089-APR21	mg/L	0.001	<0.001	7	20	101	90	110	122	70	130
Arsenic (total)	EMS0089-APR21	mg/L	0.0002	<0.0002	5	20	102	90	110	97	70	130
Gold (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	ND	20	100	90	110	NV	70	130
Barium (total)	EMS0089-APR21	mg/L	0.00002	<0.00002	5	20	102	90	110	107	70	130
Bismuth (total)	EMS0089-APR21	mg/L	0.000007	<0.000007	12	20	99	90	110	112	70	130
Cadmium (total)	EMS0089-APR21	mg/L	0.000003	<0.000003	19	20	102	90	110	103	70	130
Cobalt (total)	EMS0089-APR21	mg/L	0.000004	<0.000004	1	20	102	90	110	107	70	130
Chromium (total)	EMS0089-APR21	mg/L	0.00008	<0.00008	8	20	98	90	110	120	70	130
Copper (total)	EMS0089-APR21	mg/L	0.0002	<0.0002	3	20	99	90	110	107	70	130
Iron (total)	EMS0089-APR21	mg/L	0.007	<0.007	5	20	96	90	110	100	70	130
Manganese (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	0	20	101	90	110	105	70	130
Molybdenum (total)	EMS0089-APR21	mg/L	0.00004	<0.00004	0	20	98	90	110	73	70	130
Nickel (total)	EMS0089-APR21	mg/L	0.0001	<0.0001	7	20	103	90	110	73	70	130
Lead (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	4	20	103	90	110	97	70	130
Phosphorus (total)	EMS0089-APR21	mg/L	0.003	<0.003	1	20	95	90	110	NV	70	130
Platinum (total)	EMS0089-APR21	mg/L	0.0001	<0.0001	ND	20	96	90	110	NV	70	130
Rhodium (total)	EMS0089-APR21	mg/L	0.00001	<0.0001	ND	20	97	90	110	NV	70	130
Antimony (total)	EMS0089-APR21	mg/L	0.0009	<0.0009	ND	20	99	90	110	119	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Selenium (total)	EMS0089-APR21	mg/L	0.00004	<0.00004	8	20	101	90	110	98	70	130
Tin (total)	EMS0089-APR21	mg/L	0.00006	<0.00006	17	20	101	90	110	NV	70	130
Vanadium (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	6	20	100	90	110	103	70	130
Zinc (total)	EMS0089-APR21	mg/L	0.002	<0.002	1	20	102	90	110	105	70	130

Microbiology

Method: SM 9222D | Internal ref.: ME-CA-[ENV]MIC-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
E. Coli	BAC9249-APR21	cfu/100mL	-	ACCEPTED	ACCEPTED							

QC SUMMARY

Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (total)	GCM0237-APR21	mg/L	2	<2	NSS	20	123	75	125			

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (animal/vegetable)	GCM0320-APR21	mg/L	4	< 4	NSS	20	90	70	130			
Oil & Grease (mineral/synthetic)	GCM0320-APR21	mg/L	4	< 4	NSS	20	102	70	130			

pH

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0281-APR21	No unit	0.05	NA	0		101			NA		

QC SUMMARY

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0161-APR21	mg/L	0.002	<0.002	ND	10	100	80	120	81	75	125

QC SUMMARY

Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-[ENV]GC-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
7Hdibenzo(c,g)carbazole	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	149	50	140	NSS	50	140
Anthracene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	99	50	140	NSS	50	140
Benzo(a)anthracene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	98	50	140	NSS	50	140
Benzo(a)pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	110	50	140	NSS	50	140
Benzo(b+j)fluoranthene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	132	50	140	NSS	50	140
Benzo[e]pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	128	50	140	NSS	50	140
Benzo(ghi)perylene	GCM0297-APR21	mg/L	0.0002	< 0.0002	NSS	30	104	50	140	NSS	50	140
Benzo(k)fluoranthene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	95	50	140	NSS	50	140
Chrysene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	103	50	140	NSS	50	140
Dibenzo(a,h)anthracene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	103	50	140	NSS	50	140
Dibenzo(a,i)pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	151	50	140	NSS	50	140
Dibenzo(a,j)acridine	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	135	50	140	NSS	50	140
Fluoranthene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	103	50	140	NSS	50	140
Hexachlorobenzene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	100	50	140	NSS	50	140
Indeno(1,2,3-cd)pyrene	GCM0297-APR21	mg/L	0.0002	< 0.0002	NSS	30	102	50	140	NSS	50	140
Perylene	GCM0297-APR21	mg/L	0.0005	< 0.0005	NSS	30	100	50	140	NSS	50	140
Phenanthrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	100	50	140	NSS	50	140
Pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	100	50	140	NSS	50	140

QC SUMMARY

Sulphide by SFA

Method: SM 4500 I Internal ref.: ME-CA-[ENVISFA-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0150-APR21	mg/L	0.02	<0.02	ND	20	91	80	120	NA	75	125

Suspended Solids

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0305-APR21	mg/L	2	< 2	6	10	105	90	110	NA		

Total Nitrogen

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen	SKA0182-APR21	as N mg/L	0.5	<0.5	2	10	104	90	110	87	75	125

QC SUMMARY

Volatile Organics

Method: EPA 5030B/8260C | Internal ref.: ME-CA-[ENVIGC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1,1,2,2-Tetrachloroethane	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	103	60	130	100	50	140
1,2-Dichlorobenzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	99	50	140
1,4-Dichlorobenzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	99	50	140
Benzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	102	50	140
Ethylbenzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	103	60	130	102	50	140
m-p-xylene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	102	50	140
Methylene Chloride	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	101	50	140
o-xylene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	104	50	140
Tetrachloroethylene (perchloroethylene)	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	102	50	140
Toluene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	103	50	140
Trichloroethylene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	102	50	140

QC SUMMARY

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND

FOOTNOTES

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

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

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

No: 021219 Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Oleg Mozhin
Received Date: 04/15/21 (mm/dd/yy)
Received Time: 11:30 (hr : min)
Received By (signature):
Custody Seal Present: Yes [✓] No [ ]
Custody Seal Intact: Yes [✓] No [ ]
Cooling Agent Present: Yes [✓] No [ ] Type: ice pack
Temperature Upon Receipt (°C) 7.__.__
LAB LIMS #: CA14934-APR21

REPORT INFORMATION	INVOICE INFORMATION
Company: GROUNDED ENG.	[X] same as Report Information)
Contact: YLENA QUAM	Company:
Address: 12 BANIGAN DR TORONTO, ONTARIO	Contact:
Phone:	Address:
Fax:	Phone:
Email: YQUAM@GROUNDEDENG.CA	Email:

Quotation #:
P.O. #: YLENA QUAM
Project #: 20-108-206
Site Location/ID: 59 OWEN ST., BARRIE

TURNAROUND TIME (TAT) REQUIRED

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

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

Specify Due Date:

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

REGULATIONS

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

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

Sewer By-Law:
[X] Sanitary
[X] Storm
Municipality: BARRIE

RECORD OF SITE CONDITION (RSC) [ ]YES [ ] NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	SW-UF-BH203	APR/14/21	9:00	21	GW
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

	Field Filtered (Y/N)	M & I: Metals & Inorganics (incl CrVI, CN,Hg pH,(B(HWS),EC,SAR–soil) (Cl, Na-water)	M & I: Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI	M & I: ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni,	SVOC: PAHs only	SVOC: SVOCs all incl PAHs, ABNs, CPs	PCB: PCBs [ ] Total [ ] Aroclor	PHC: F1-F4 + BTEX	PHC: F1-F4 only no BTEX	VOC: VOCs all incl BTEX	VOC: BTEX only	Pest: Pesticides Organochlorine or specify other	Other: [ ]	Other: [ ]	Other: [ ]	Other: [ ]	Other: Appendix 2: 406/19 Leachate Screening Levels Table :	Other: Sewer Use: CITY OF BARRIE Specify pkg + PWQO STANDARDS	Other: Water Characterization Pkg General [ ] Extended [ ]	TCLP: Specify TCLP tests [ ]M&I [ ]VOC [ ]PCB [ ]B(a)P [ ]ABN [ ]Ignit.	COMMENTS:
1																	X	X		
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

Observations/Comments/Special Instructions

Sampled By (NAME): FRANCESCO RUSSO Signature: Date: APR/14/2021 (mm/dd/yy)
Relinquished by (NAME): FRANCESCO RUSSO Signature: Date: ____/____/____ (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - S

Revision #: 1.4
Date of Issue: 22 May. 2020

FINAL REPORT

CA14934-APR21 R1

20-108-206, 59 Owen St, Barrie

Prepared for

Grounded Engineering Inc.

FINAL REPORT

CA14934-APR21 R1

First Page

CLIENT DETAILS		LABORATORY DETAILS	
Client	Grounded Engineering Inc.	Project Specialist	Jill Campbell, B.Sc.,GISAS
		Laboratory	SGS Canada Inc.
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Telephone	647-264-7928	Facsimile	705-652-6365
Facsimile		Email	jill.campbell@sgs.com
Email	yquan@groundedeng.ca	SGS Reference	CA14934-APR21
Project	20-108-206, 59 Owen St, Barrie	Received	04/15/2021
Order Number		Approved	04/26/2021
Samples	Ground Water (1)	Report Number	CA14934-APR21 R1
		Date Reported	05/11/2021

COMMENTS

RL - SGS Reporting Limit

.

Temperature of Sample upon Receipt: 7 degrees C
Cooling Agent Present:Yes
Custody Seal Present:Yes

Chain of Custody Number:021219

7Hdibenzo(c,g)carbazole and Dibenzo(a,i)pyrene LCS; Recovery is outside control limits; the overall quality control for this analysis has been assessed and was determined to be acceptable.

SIGNATORIES

Jill Campbell, B.Sc.,GISAS

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Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **General Chemistry** (WATER)

L1 = PWQOSANSEW / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	Result
General Chemistry				
Biochemical Oxygen Demand (BOD5)	mg/L	2		< 4 ↑
Total Suspended Solids	mg/L	2		59
Total Kjeldahl Nitrogen	as N mg/L	0.5		< 0.5
Chemical Oxygen Demand	mg/L	8		< 8
Metals and Inorganics				
Sulphide	mg/L	0.02		< 0.02
Cyanide (total)	mg/L	0.01		< 0.01
Fluoride	mg/L	0.06		0.07
Sulphate	mg/L	2		62
Aluminum (total)	mg/L	0.001	0.015	0.915
Aluminum (0.2µm)	mg/L	0.001	0.015	0.007
Antimony (total)	mg/L	0.0009	0.02	0.0020
Arsenic (total)	mg/L	0.0002	0.005	0.0005
Barium (total)	mg/L	0.00002		0.202
Bismuth (total)	mg/L	0.000007		0.000025
Cadmium (total)	mg/L	0.000003	0.0001	0.000014
Chromium (total)	mg/L	0.00008	0.1	0.00187
Cobalt (total)	mg/L	0.000004	0.0009	0.000547
Copper (total)	mg/L	0.0002	0.001	0.0038
Iron (total)	mg/L	0.007	0.3	1.03
Lead (total)	mg/L	0.00001	0.001	0.00172

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **Metals and Inorganics** (WATER)

L1 = PWQOSANSEW / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	Result
Metals and Inorganics (continued)				
Manganese (total)	mg/L	0.00001		0.0623
Molybdenum (total)	mg/L	0.00004	0.04	0.00106
Nickel (total)	mg/L	0.0001	0.025	0.0013
Phosphorus (total)	mg/L	0.003		0.093
Selenium (total)	mg/L	0.00004	0.1	< 0.00004
Silver (total)	mg/L	0.00005	0.0001	< 0.00005
Tin (total)	mg/L	0.00006		0.00342
Vanadium (total)	mg/L	0.00001	0.006	0.00214
Zinc (total)	mg/L	0.002	0.02	0.016
Gold (total)	mg/L	0.00001		< 0.00001
Platinum (total)	mg/L	0.0001		< 0.0001
Rhodium (total)	mg/L	0.00001		< 0.00001
Microbiology				
E. Coli	cfu/100mL	0	100	0

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **Oil and Grease** (WATER)

L1 = PWQOSANSEW / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	Result
Oil and Grease				
Oil & Grease (total)	mg/L	2		55
Oil & Grease (animal/vegetable)	mg/L	4		44
Oil & Grease (mineral/synthetic)	mg/L	4		10
Other (ORP)				
pH	No unit	0.05	8.5	7.94
Chloride	mg/L	1		92
Chromium VI	mg/L	0.0002	0.001	0.0011
Mercury (total)	mg/L	0.00001	0.0002	< 0.00001
Mercury (dissolved)	mg/L	0.00001		< 0.00001
PAHs				
Benzo(b+j)fluoranthene	mg/L	0.0001		< 0.0001
Phenols				
4AAP-Phenolics	mg/L	0.002	0.001	< 0.002

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **SVOCs** (WATER)

L1 = PWQOSANSEW / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	Result
SVOCs				
PAHs (Total)	mg/L			< 0.001
Perylene	mg/L	0.0005	7e-008	< 0.0005
Hexachlorobenzene	mg/L	0.0001	6.5e-006	< 0.0001
SVOCs - PAHs				
7Hdibenzo(c,g)carbazole	mg/L	0.0001		< 0.0001
Anthracene	mg/L	0.0001	8e-007	< 0.0001
Benzo(a)anthracene	mg/L	0.0001		< 0.0001
Benzo(a)pyrene	mg/L	0.0001		< 0.0001
Benzo[e]pyrene	mg/L	0.0001		< 0.0001
Benzo(ghi)perylene	mg/L	0.0002	2e-008	< 0.0002
Benzo(k)fluoranthene	mg/L	0.0001	2e-007	< 0.0001
Chrysene	mg/L	0.0001	1e-007	< 0.0001
Dibenzo(a,h)anthracene	mg/L	0.0001	2e-006	< 0.0001
Dibenzo(a,i)pyrene	mg/L	0.0001		< 0.0001
Dibenzo(a,j)acridine	mg/L	0.0001		< 0.0001
Fluoranthene	mg/L	0.0001	8e-007	< 0.0001
Indeno(1,2,3-cd)pyrene	mg/L	0.0002		< 0.0002
Phenanthrene	mg/L	0.0001	3e-005	< 0.0001
Pyrene	mg/L	0.0001		< 0.0001

Client: Grounded Engineering Inc.
Project: 20-108-206, 59 Owen St, Barrie
Project Manager: Ylena Quan
Samplers: Francesco Russo

PACKAGE: **VOCs** (WATER)

L1 = PWQOSANSEW / WATER / - - Table 2 - General - July 1999 PIBS 3303E

Sample Number	8
Sample Name	SW-UF-BH203
Sample Matrix	Ground Water
Sample Date	14/04/2021

Parameter	Units	RL	L1	Result
VOCs				
1,2-Dichlorobenzene	mg/L	0.0005		< 0.0005
1,4-Dichlorobenzene	mg/L	0.0005		< 0.0005
Methylene Chloride	mg/L	0.0005	0.1	< 0.0005
1,1,2,2-Tetrachloroethane	mg/L	0.0005	0.07	< 0.0005
Tetrachloroethylene (perchloroethylene)	mg/L	0.0005	0.05	< 0.0005
Trichloroethylene	mg/L	0.0005	0.02	< 0.0005
VOCs - BTEX				
Benzene	mg/L	0.0005	0.1	< 0.0005
Ethylbenzene	mg/L	0.0005	0.008	< 0.0005
Toluene	mg/L	0.0005	0.0008	< 0.0005
Xylene (total)	mg/L	0.0005		< 0.0005
m-p-xylene	mg/L	0.0005	0.002	< 0.0005
o-xylene	mg/L	0.0005	0.04	< 0.0005

EXCEEDANCE SUMMARY

Parameter	Method	Units	Result	PWQOSANSEW / WATER / - - Table 2 - General - July 1999 PIBS 3303E L1
SW-UF-BH203				
Anthracene	EPA 3510C/8270D	mg/L	< 0.0001	8e-007
Benzo(g,h,i)perylene	EPA 3510C/8270D	mg/L	< 0.0002	2e-008
Benzo(k)fluoranthene	EPA 3510C/8270D	mg/L	< 0.0001	2e-007
Chrysene	EPA 3510C/8270D	mg/L	< 0.0001	1e-007
Dibenz(a,h)anthracene	EPA 3510C/8270D	mg/L	< 0.0001	2e-006
Fluoranthene	EPA 3510C/8270D	mg/L	< 0.0001	8e-007
Hexachlorobenzene	EPA 3510C/8270D	mg/L	< 0.0001	6.5e-006
Perylene	EPA 3510C/8270D	mg/L	< 0.0005	7e-008
Phenanthrene	EPA 3510C/8270D	mg/L	< 0.0001	3e-005
Chromium VI	EPA218.6/EPA3060A	mg/L	0.0011	0.001
Aluminum	SM 3030/EPA 200.8	mg/L	0.915	0.015
Copper	SM 3030/EPA 200.8	mg/L	0.0038	0.001
Iron	SM 3030/EPA 200.8	mg/L	1.03	0.3
Lead	SM 3030/EPA 200.8	mg/L	0.00172	0.001
4AAP-Phenolics	SM 5530B-D	mg/L	< 0.002	0.001

QC SUMMARY

Anions by discrete analyzer

Method: US EPA 325.2 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-026

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chloride	DIO5043-APR21	mg/L	1	<1	0	20	106	80	120	99	75	125
Sulphate	DIO5043-APR21	mg/L	2	<2	0	20	109	80	120	77	75	125

Biochemical Oxygen Demand

Method: SM 5210 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-007

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Biochemical Oxygen Demand (BOD5)	BOD0033-APR21	mg/L	2	< 2	17	30	89	70	130	NV	70	130

Chemical Oxygen Demand

Method: HACH 8000 | Internal ref.: ME-CA-[ENV]EWL-LAK-AN-009

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chemical Oxygen Demand	EWL0285-APR21	mg/L	8	<8	2	20	110	80	120	99	75	125

QC SUMMARY

Cyanide by SFA

Method: SM 4500 I Internal ref.: ME-CA-IENVISFA-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Cyanide (total)	SKA0153-APR21	mg/L	0.01	<0.01	ND	10	90	90	110	90	75	125

Fluoride by Specific Ion Electrode

Method: SM 4500 I Internal ref.: ME-CA-IENVIEWL-LAK-AN-014

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Fluoride	EWL0283-APR21	mg/L	0.06	<0.06	ND	10	99	90	110	100	75	125

Hexavalent Chromium by SFA

Method: EPA218.6/EPA3060A I Internal ref.: ME-CA-IENVISKA-LAK-AN-012

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Chromium VI	SKA0165-APR21	mg/L	0.0002	<0.0002	ND	20	106	80	120	NV	75	125

QC SUMMARY

Mercury by CVAAS

Method: EPA 7471A/SM 3112B | Internal ref.: ME-CA-[ENVISPE-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Mercury (total)	EHG0015-APR21	mg/L	0.00001	< 0.00001	ND	20	120	80	120	NV	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Silver (total)	EMS0089-APR21	mg/L	0.00005	<0.00005	ND	20	101	90	110	101	70	130
Aluminum (total)	EMS0089-APR21	mg/L	0.001	<0.001	7	20	101	90	110	122	70	130
Aluminum (0.2µm)	EMS0089-APR21	mg/L	0.001	<0.001	7	20	101	90	110	122	70	130
Arsenic (total)	EMS0089-APR21	mg/L	0.0002	<0.0002	5	20	102	90	110	97	70	130
Gold (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	ND	20	100	90	110	NV	70	130
Barium (total)	EMS0089-APR21	mg/L	0.00002	<0.00002	5	20	102	90	110	107	70	130
Bismuth (total)	EMS0089-APR21	mg/L	0.000007	<0.000007	12	20	99	90	110	112	70	130
Cadmium (total)	EMS0089-APR21	mg/L	0.000003	<0.000003	19	20	102	90	110	103	70	130
Cobalt (total)	EMS0089-APR21	mg/L	0.000004	<0.000004	1	20	102	90	110	107	70	130
Chromium (total)	EMS0089-APR21	mg/L	0.00008	<0.00008	8	20	98	90	110	120	70	130
Copper (total)	EMS0089-APR21	mg/L	0.0002	<0.0002	3	20	99	90	110	107	70	130
Iron (total)	EMS0089-APR21	mg/L	0.007	<0.007	5	20	96	90	110	100	70	130
Manganese (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	0	20	101	90	110	105	70	130
Molybdenum (total)	EMS0089-APR21	mg/L	0.00004	<0.00004	0	20	98	90	110	73	70	130
Nickel (total)	EMS0089-APR21	mg/L	0.0001	<0.0001	7	20	103	90	110	73	70	130
Lead (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	4	20	103	90	110	97	70	130
Phosphorus (total)	EMS0089-APR21	mg/L	0.003	<0.003	1	20	95	90	110	NV	70	130
Platinum (total)	EMS0089-APR21	mg/L	0.0001	<0.0001	ND	20	96	90	110	NV	70	130
Rhodium (total)	EMS0089-APR21	mg/L	0.00001	<0.0001	ND	20	97	90	110	NV	70	130
Antimony (total)	EMS0089-APR21	mg/L	0.0009	<0.0009	ND	20	99	90	110	119	70	130

QC SUMMARY

Metals in aqueous samples - ICP-MS (continued)

Method: SM 3030/EPA 200.8 | Internal ref.: ME-CA-[ENV]SPE-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Selenium (total)	EMS0089-APR21	mg/L	0.00004	<0.00004	8	20	101	90	110	98	70	130
Tin (total)	EMS0089-APR21	mg/L	0.00006	<0.00006	17	20	101	90	110	NV	70	130
Vanadium (total)	EMS0089-APR21	mg/L	0.00001	<0.00001	6	20	100	90	110	103	70	130
Zinc (total)	EMS0089-APR21	mg/L	0.002	<0.002	1	20	102	90	110	105	70	130

Microbiology

Method: SM 9222D | Internal ref.: ME-CA-[ENV]MIC-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
E. Coli	BAC9249-APR21	cfu/100mL	-	ACCEPTED	ACCEPTED							

QC SUMMARY

Oil & Grease

Method: MOE E3401 | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (total)	GCM0237-APR21	mg/L	2	<2	NSS	20	123	75	125			

Oil & Grease-AV/MS

Method: MOE E3401/SM 5520F | Internal ref.: ME-CA-[ENV]GC-LAK-AN-019

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Oil & Grease (animal/vegetable)	GCM0320-APR21	mg/L	4	< 4	NSS	20	90	70	130			
Oil & Grease (mineral/synthetic)	GCM0320-APR21	mg/L	4	< 4	NSS	20	102	70	130			

pH

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

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
pH	EWL0281-APR21	No unit	0.05	NA	0		101			NA		

QC SUMMARY

Phenols by SFA

Method: SM 5530B-D | Internal ref.: ME-CA-[ENV]SFA-LAK-AN-006

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
4AAP-Phenolics	SKA0161-APR21	mg/L	0.002	<0.002	ND	10	100	80	120	81	75	125

QC SUMMARY

Semi-Volatile Organics

Method: EPA 3510C/8270D | Internal ref.: ME-CA-[ENV]GC-LAK-AN-005

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
7Hdibenzo(c,g)carbazole	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	149	50	140	NSS	50	140
Anthracene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	99	50	140	NSS	50	140
Benzo(a)anthracene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	98	50	140	NSS	50	140
Benzo(a)pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	110	50	140	NSS	50	140
Benzo(b+j)fluoranthene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	132	50	140	NSS	50	140
Benzo[e]pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	128	50	140	NSS	50	140
Benzo(ghi)perylene	GCM0297-APR21	mg/L	0.0002	< 0.0002	NSS	30	104	50	140	NSS	50	140
Benzo(k)fluoranthene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	95	50	140	NSS	50	140
Chrysene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	103	50	140	NSS	50	140
Dibenzo(a,h)anthracene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	103	50	140	NSS	50	140
Dibenzo(a,i)pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	151	50	140	NSS	50	140
Dibenzo(a,j)acridine	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	135	50	140	NSS	50	140
Fluoranthene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	103	50	140	NSS	50	140
Hexachlorobenzene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	100	50	140	NSS	50	140
Indeno(1,2,3-cd)pyrene	GCM0297-APR21	mg/L	0.0002	< 0.0002	NSS	30	102	50	140	NSS	50	140
Perylene	GCM0297-APR21	mg/L	0.0005	< 0.0005	NSS	30	100	50	140	NSS	50	140
Phenanthrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	100	50	140	NSS	50	140
Pyrene	GCM0297-APR21	mg/L	0.0001	< 0.0001	NSS	30	100	50	140	NSS	50	140

QC SUMMARY

Sulphide by SFA

Method: SM 4500 I Internal ref.: ME-CA-IENVISFA-LAK-AN-008

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Sulphide	SKA0150-APR21	mg/L	0.02	<0.02	ND	20	91	80	120	NA	75	125

Suspended Solids

Method: SM 2540D I Internal ref.: ME-CA-IENVIEWL-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Suspended Solids	EWL0305-APR21	mg/L	2	< 2	6	10	105	90	110	NA		

Total Nitrogen

Method: SM 4500-N C/4500-NO3- F I Internal ref.: ME-CA-IENVISFA-LAK-AN-002

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
Total Kjeldahl Nitrogen	SKA0182-APR21	as N mg/L	0.5	<0.5	2	10	104	90	110	87	75	125

QC SUMMARY

Volatile Organics

Method: EPA 5030B/8260C | Internal ref.: ME-CA-[ENV]GC-LAK-AN-004

Parameter	QC batch Reference	Units	RL	Method Blank	Duplicate		LCS/Spike Blank			Matrix Spike / Ref.		
					RPD	AC (%)	Spike Recovery (%)	Recovery Limits (%)		Spike Recovery (%)	Recovery Limits (%)	
								Low	High		Low	High
1,1,2,2-Tetrachloroethane	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	103	60	130	100	50	140
1,2-Dichlorobenzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	99	50	140
1,4-Dichlorobenzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	99	50	140
Benzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	102	50	140
Ethylbenzene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	103	60	130	102	50	140
m-p-xylene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	102	50	140
Methylene Chloride	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	101	50	140
o-xylene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	104	50	140
Tetrachloroethylene (perchloroethylene)	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	102	50	140
Toluene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	104	60	130	103	50	140
Trichloroethylene	GCM0326-APR21	mg/L	0.0005	<0.0005	ND	30	102	60	130	102	50	140

QC SUMMARY

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

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

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

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

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

RL: Reporting limit

RPD: Relative percent difference

AC: Acceptance criteria

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

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

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

LEGEND

FOOTNOTES

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

Samples analysed as received. Solid samples expressed on a dry weight basis. "Temperature Upon Receipt" is representative of the whole shipment and may not reflect the temperature of individual samples.

Analysis conducted on samples submitted pursuant to or as part of Reg. 153/04, are in accordance to the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act" published by the Ministry and dated March 9, 2004 as amended.

SGS provides criteria information (such as regulatory or guideline limits and summary of limit exceedances) as a service. Every attempt is made to ensure the criteria information in this report is accurate and current, however, it is not guaranteed. Comparison to the most current criteria is the responsibility of the client and SGS assumes no responsibility for the accuracy of the criteria levels indicated. This document is issued, on the Client's behalf, by the Company under its General Conditions of Service available on request and accessible at http://www.sgs.com/terms_and_conditions.htm. The Client's attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any other holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents.

-- End of Analytical Report --

Request for Laboratory Services and CHAIN OF CUSTODY

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

No: 021219 Page 1 of 1

Laboratory Information Section - Lab use only

Received By: Oleg Mozhin
Received Date: 04/15/21 (mm/dd/yy)
Received Time: 11:30 (hr : min)
Received By (signature):
Custody Seal Present: Yes [✓] No [ ]
Custody Seal Intact: Yes [✓] No [ ]
Cooling Agent Present: Yes [✓] No [ ] Type: ice pack
Temperature Upon Receipt (°C) 7.__.__
LAB LIMS #: CA14934-APR21

REPORT INFORMATION	INVOICE INFORMATION
Company: GROUNDED ENG.	[X] same as Report Information)
Contact: YLENA QUAM	Company:
Address: 12 BANIGAN DR TORONTO, ONTARIO	Contact:
Phone:	Address:
Fax:	Phone:
Email: YQUAM@GROUNDEDENG.CA	Email:

Quotation #:
P.O. #: YLENA QUAM
Project #: 20-108-206
Site Location/ID: 59 OWEN ST., BARRIE

TURNAROUND TIME (TAT) REQUIRED

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

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

Specify Due Date:

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

REGULATIONS

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

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

Sewer By-Law:
[X] Sanitary
[X] Storm
Municipality: BARRIE

RECORD OF SITE CONDITION (RSC) [ ]YES [ ] NO

ANALYSIS REQUESTED

	SAMPLE IDENTIFICATION	DATE SAMPLED	TIME SAMPLED	# OF BOTTLES	MATRIX
1	SW-UF-BH203	APR/14/21	9:00	21	GW
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

	Field Filtered (Y/N)	M & I: Metals & Inorganics (incl CrVI, CN,Hg pH,(B(HWS),EC,SAR–soil) (Cl, Na-water)	M & I: Full Metals Suite ICP metals plus B(HWS-soil only) Hg, CrVI	M & I: ICP Metals only Sb,As,Ba,Be,B,Cd,Cr,Co,Cu,Pb,Mo,Ni,	SVOC: PAHs only	SVOC: SVOCs all incl PAHs, ABNs, CPs	PCB: PCBs [ ] Total [ ] Aroclor	PHC: F1-F4 + BTEX	PHC: F1-F4 only no BTEX	VOC: VOCs all incl BTEX	VOC: BTEX only	Pest: Pesticides Organochlorine or specify other	Other: [ ]	Other: [ ]	Other: [ ]	Other: [ ]	Other: Appendix 2: 406/19 Leachate Screening Levels Table :	Other: Sewer Use: CITY OF BARRIE Specify pkg + PWQO STANDARDS	Other: Water Characterization Pkg General [ ] Extended [ ]	TCLP: Specify TCLP tests [ ]M&I [ ]VOC [ ]PCB [ ]B(a)P [ ]ABN [ ]Ignit.	COMMENTS:
1																	X	X		
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

Observations/Comments/Special Instructions

Sampled By (NAME): FRANCESCO RUSSO Signature: Date: APR/14/2021 (mm/dd/yy)
Relinquished by (NAME): FRANCESCO RUSSO Signature: Date: ____/____/____ (mm/dd/yy)

Pink Copy - Client
Yellow & White Copy - S

Revision #: 1.4
Date of Issue: 22 May. 2020

APPENDIX J

GROUNDED ENGINEERING

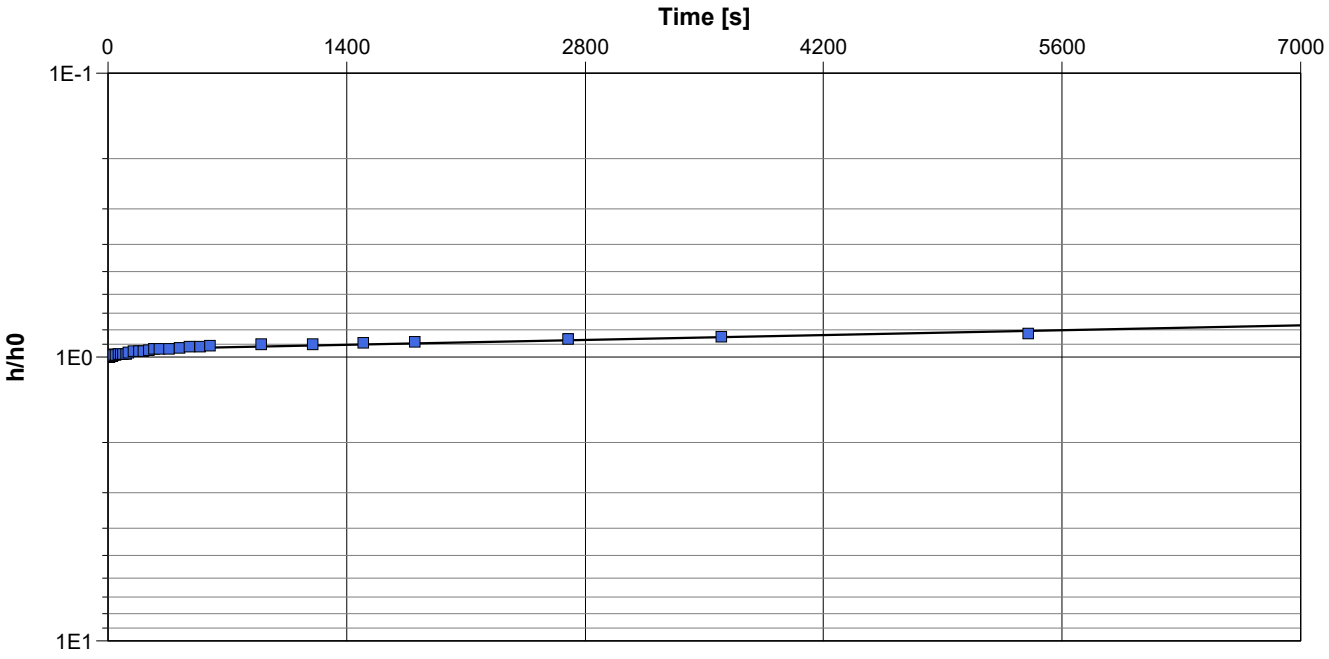
Slug Test Analysis Report

Project: 67 Owen Street, Barrie, ON

Number: 20-108

Client: The Residences on Owen Ltd.

Location: Barrie, Ontario	Slug Test: RHT BH101	Test Well: BH101
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 14.00 m		

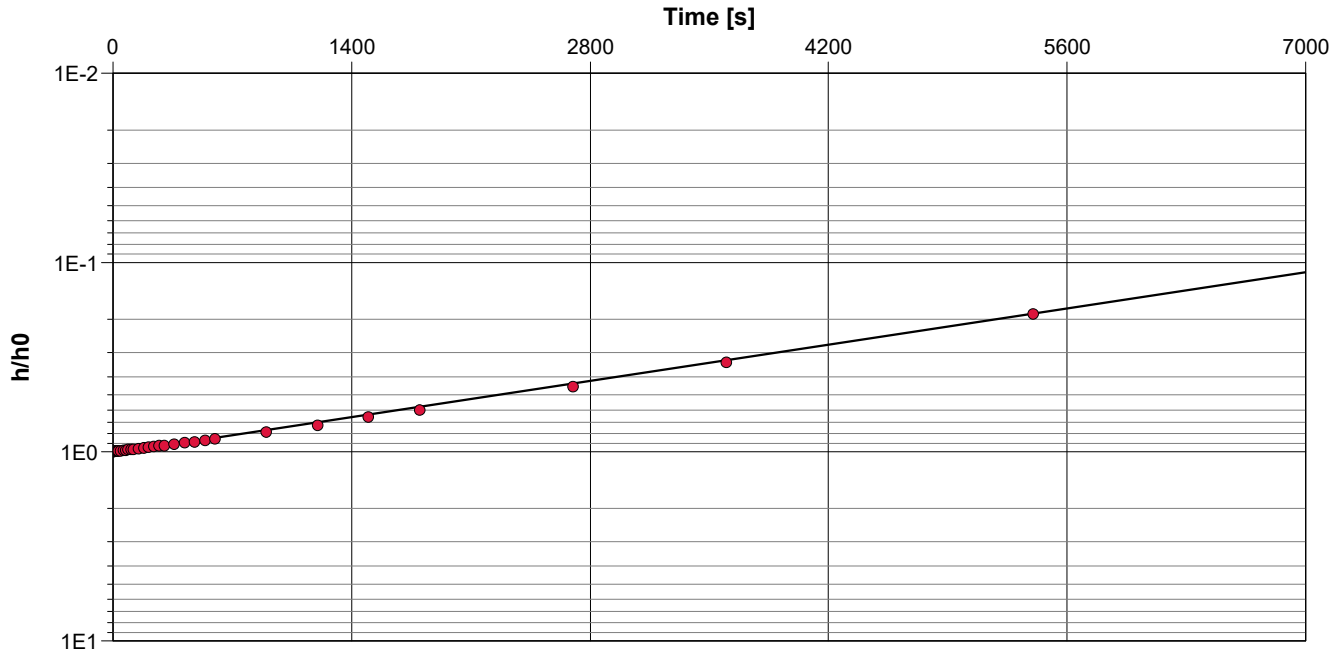


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH101	1.22×10^{-8}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: 67 Owen Street, Barrie, ON
	Number: 20-108
	Client: The Residences on Owen Ltd.

Location: Barrie, Ontario	Slug Test: RHT BH102	Test Well: BH102
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 13.70 m		

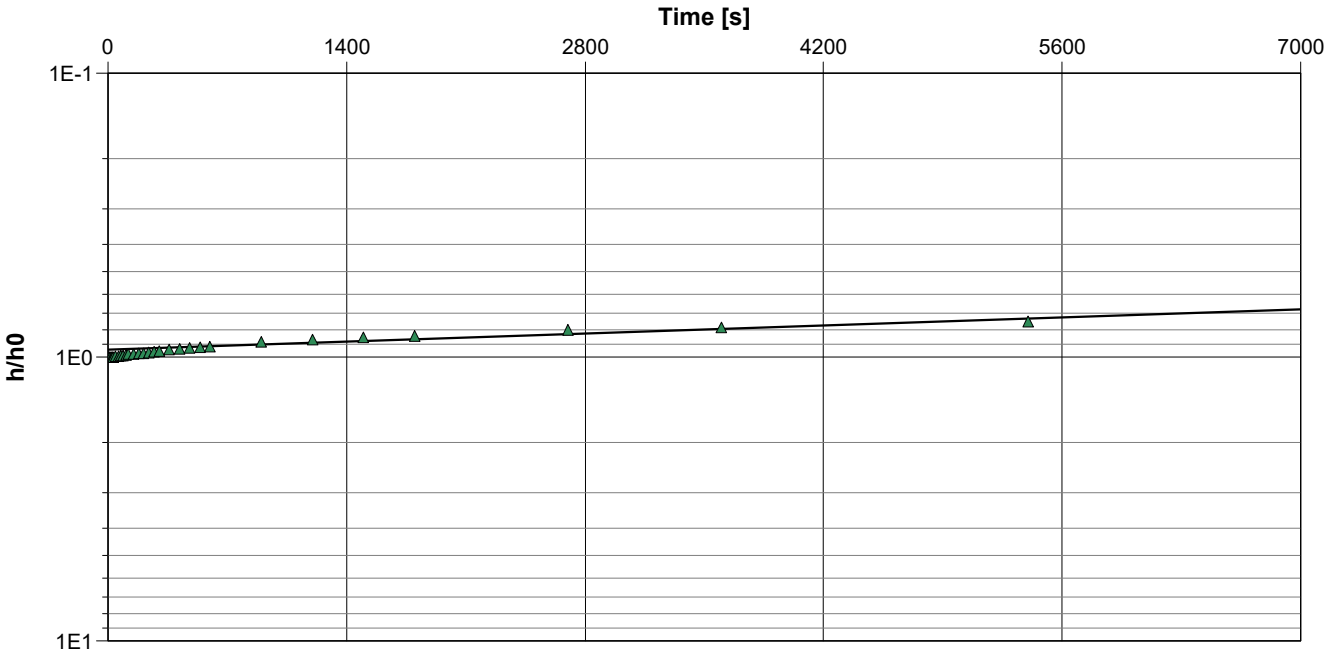


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH102	1.34×10^{-7}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: 67 Owen Street, Barrie, ON
	Number: 20-108
	Client: The Residences on Owen Ltd.

Location: Barrie, Ontario	Slug Test: RHT BH103	Test Well: BH103
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 14.50 m		

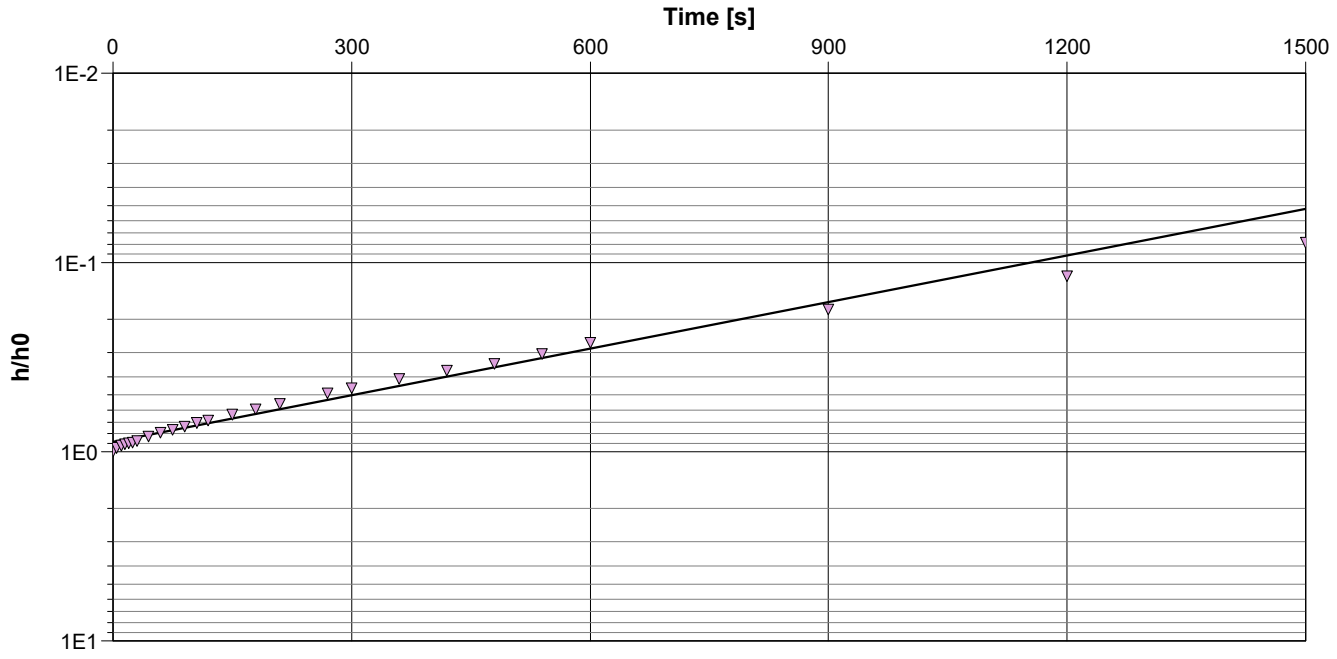


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH103	2.11×10^{-8}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: 67 Owen Street, Barrie, ON
	Number: 20-108
	Client: The Residences on Owen Ltd.

Location: Barrie, Ontario	Slug Test: RHT BH201-S	Test Well: BH201-S
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 9.30 m		

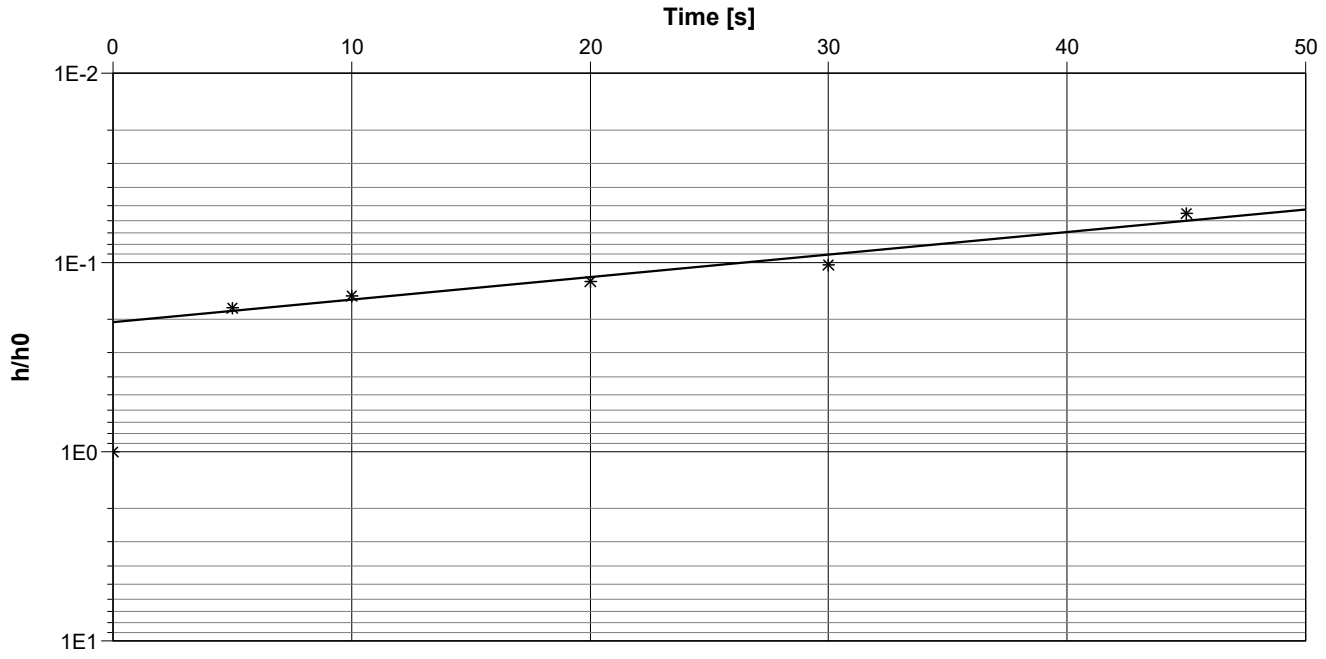


Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH201-S	8.35×10^{-7}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: 67 Owen Street, Barrie, ON
	Number: 20-108
	Client: The Residences on Owen Ltd.

Location: Barrie, Ontario	Slug Test: RHT BH201-D	Test Well: BH201-D
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 6.30 m		

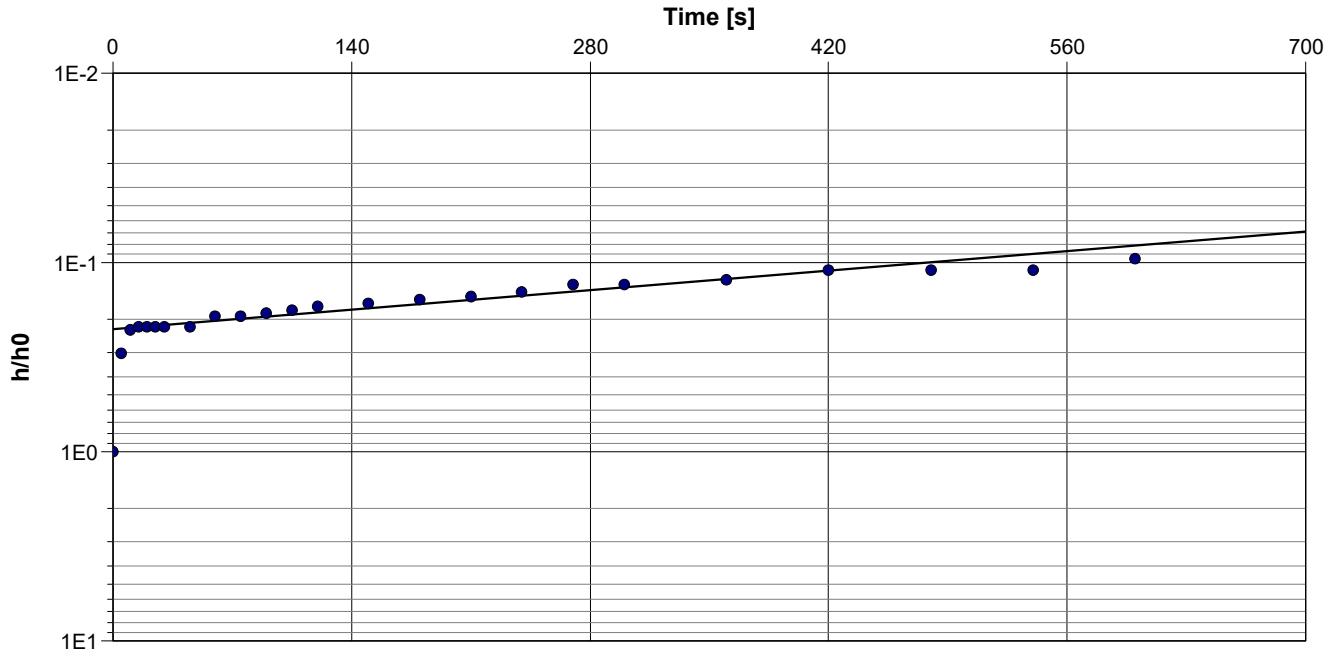


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH201-D	1.39×10^{-5}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: 67 Owen Street, Barrie, ON
	Number: 20-108
	Client: The Residences on Owen Ltd.

Location: Barrie, Ontario	Slug Test: RHT BH203	Test Well: BH203
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 3.50 m		

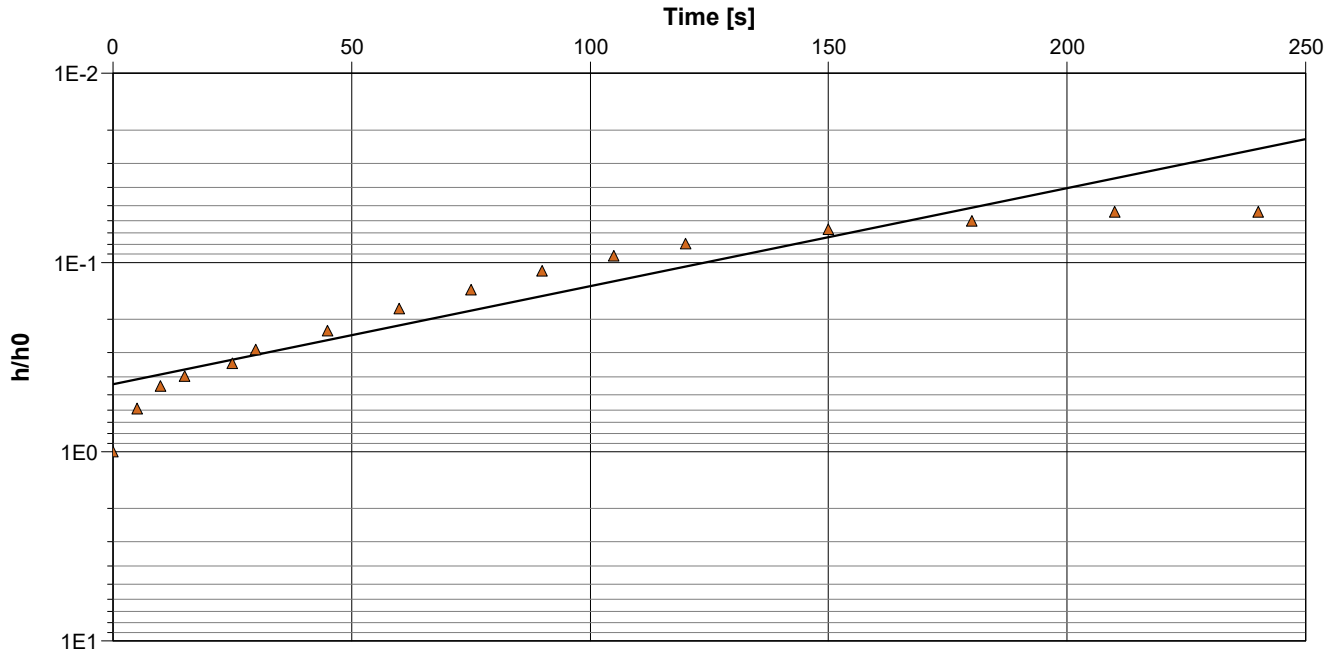


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH203	8.70×10^{-7}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: 67 Owen Street, Barrie, ON
	Number: 20-108
	Client: The Residences on Owen Ltd.

Location: Barrie, Ontario	Slug Test: RHT BH205	Test Well: BH205
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 4.90 m		

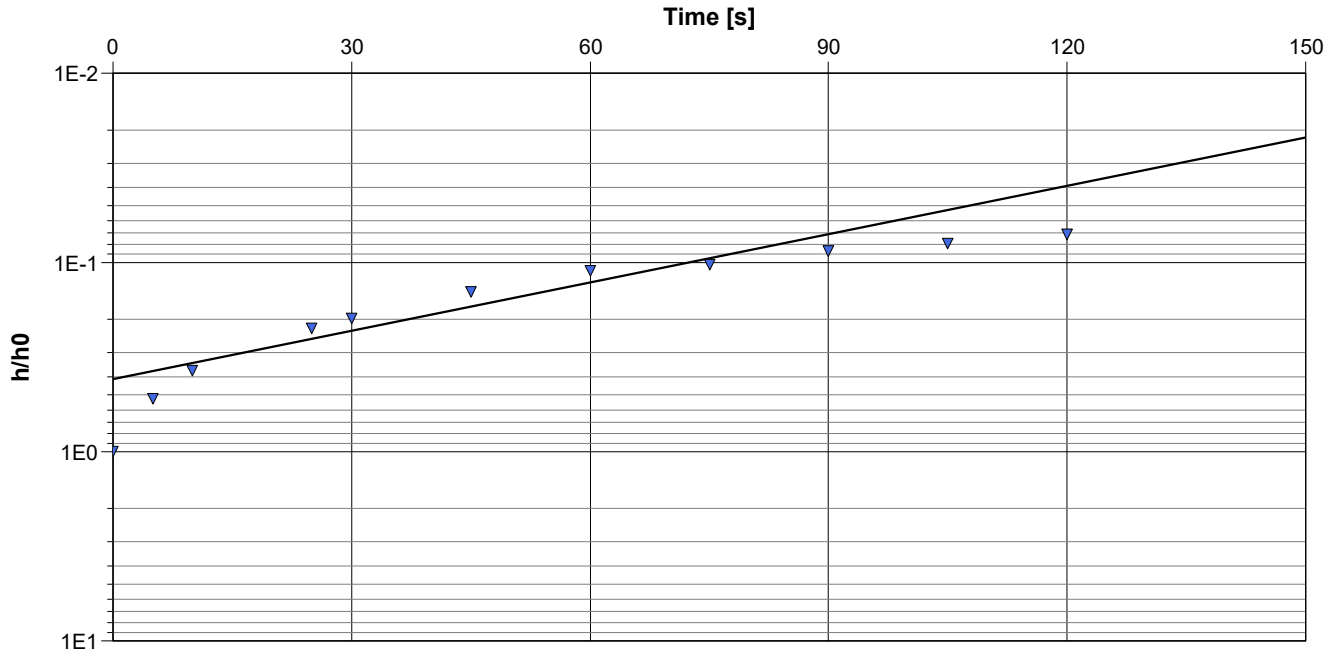


Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
BH205	6.08×10^{-6}	

GROUNDED ENGINEERING	**Slug Test Analysis Report**
	Project: 67 Owen Street, Barrie, ON
	Number: 20-108
	Client: The Residences on Owen Ltd.

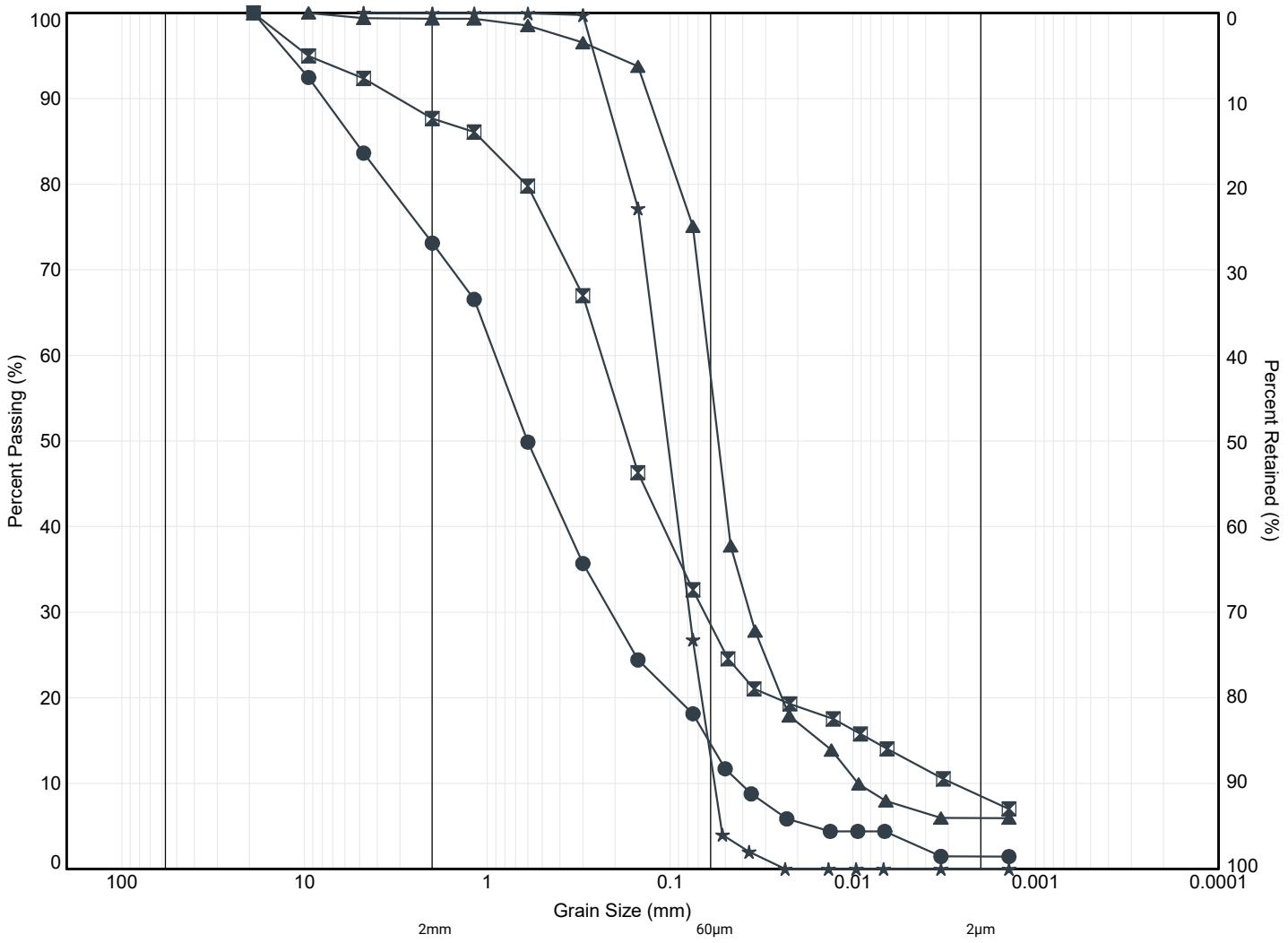
Location: Barrie, Ontario	Slug Test: RHT BH206	Test Well: BH206
Test Conducted by: JN		Test Date: 2020-06-09
Analysis Performed by: YQ	RHT 1	Analysis Date: 2020-06-29
Aquifer Thickness: 13.80 m		



Calculation using Bouwer & Rice

Observation Well	Hydraulic Conductivity [m/s]	
BH206	9.09×10^{-6}	

APPENDIX K



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

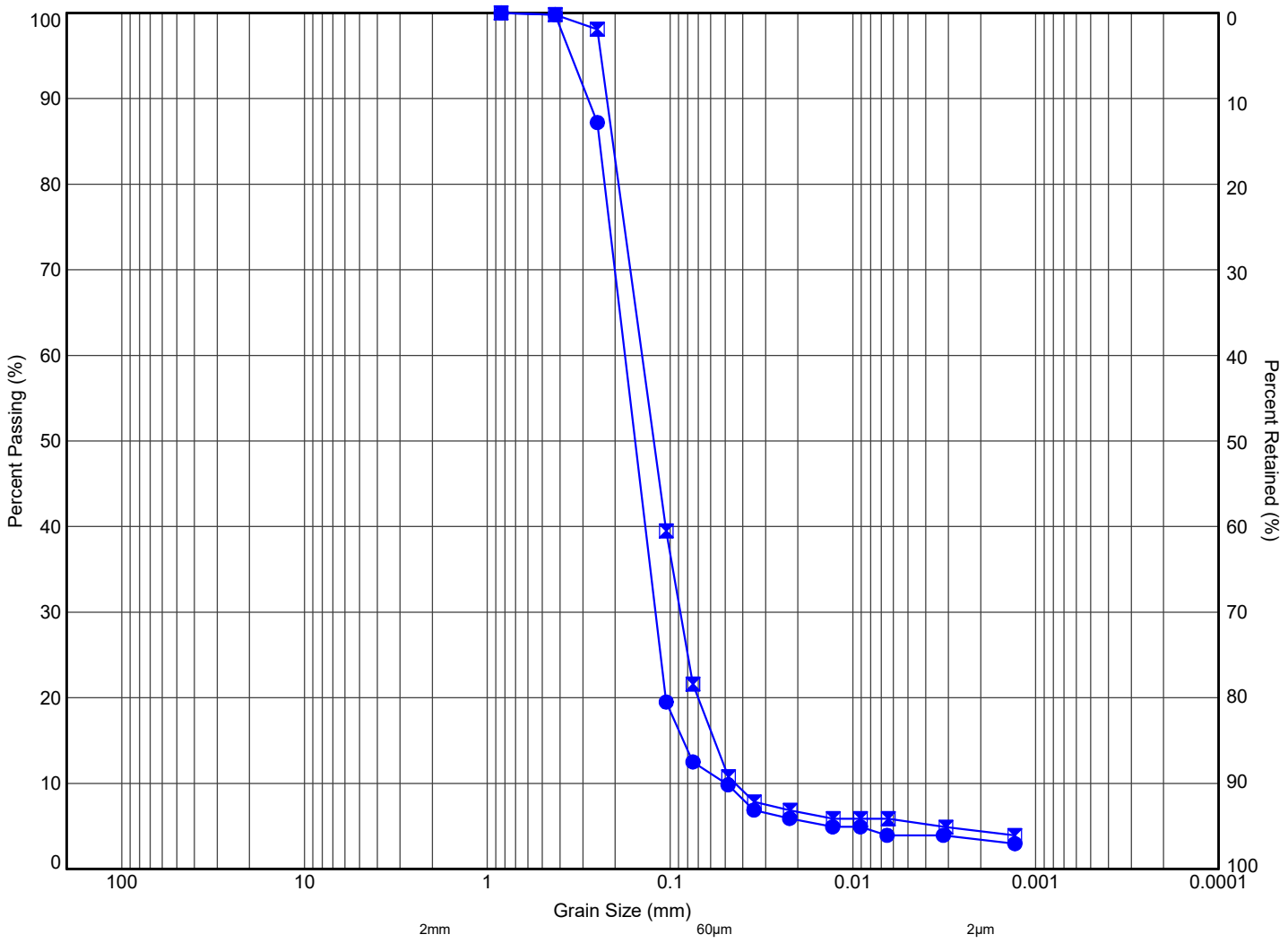
	Borehole	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)
●	**302**	SS6	4.1	230.4	27	58	13	2
⊠	**303**	SS7	4.8	229.6	12	59	20	9
▲	**304**	SS4	2.6	231.6	1	41	52	6
★	**305**	SS7	4.8	229.1	0	87	13	0

GROUNDED ENGINEERING

Title: **GRAIN SIZE DISTRIBUTION**

File No.: **20-108**

file: 20-108 53 owen st rev1.gpj



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

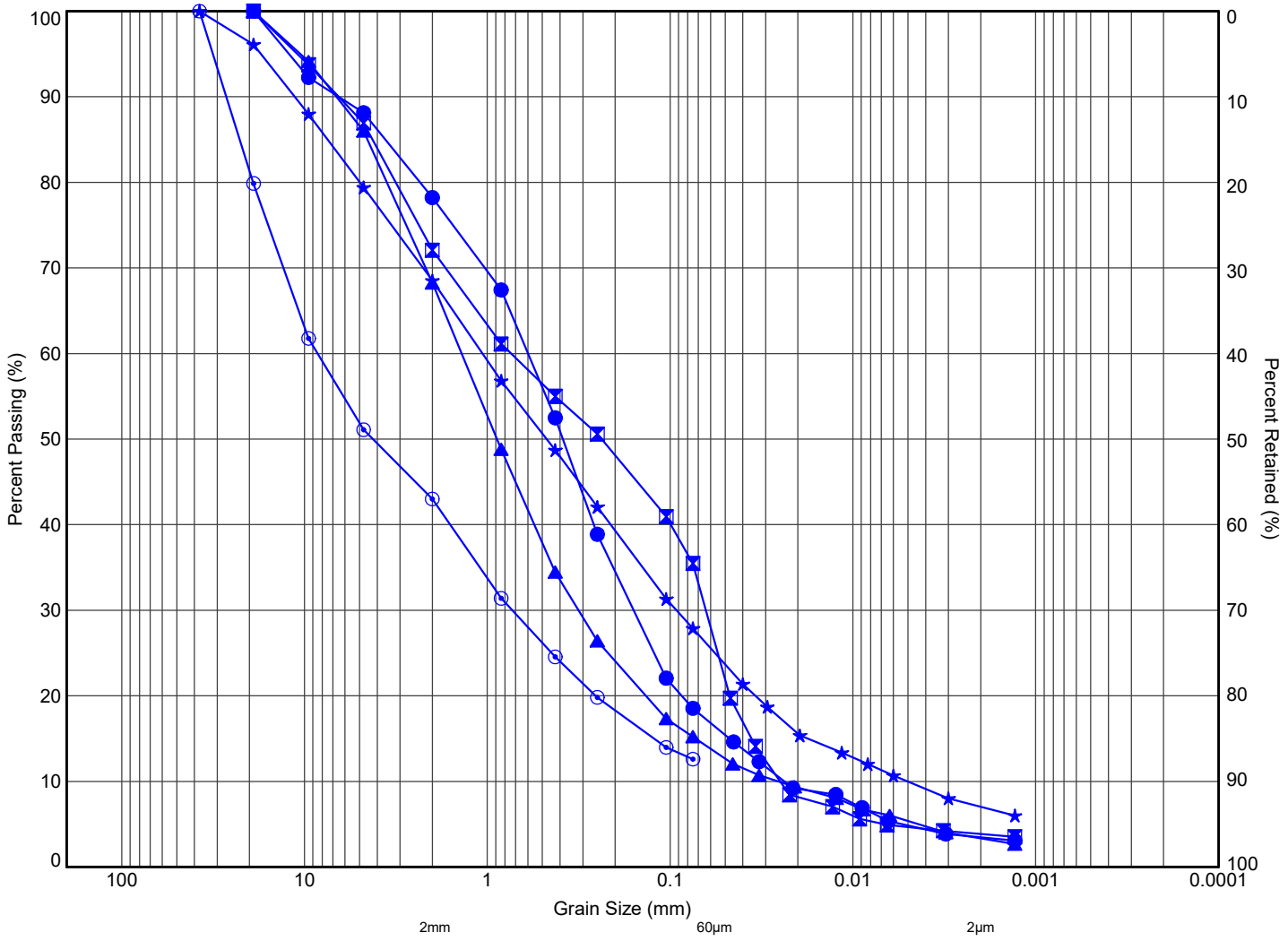
MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**201**	SS17	21.5	213.6	0	89	8	3	
⊠	**203**	SS18	23.0	211.4	0	84	12	4	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **GRAIN SIZE DISTRIBUTION**
SAND

File No.: **1-17-0481-01**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

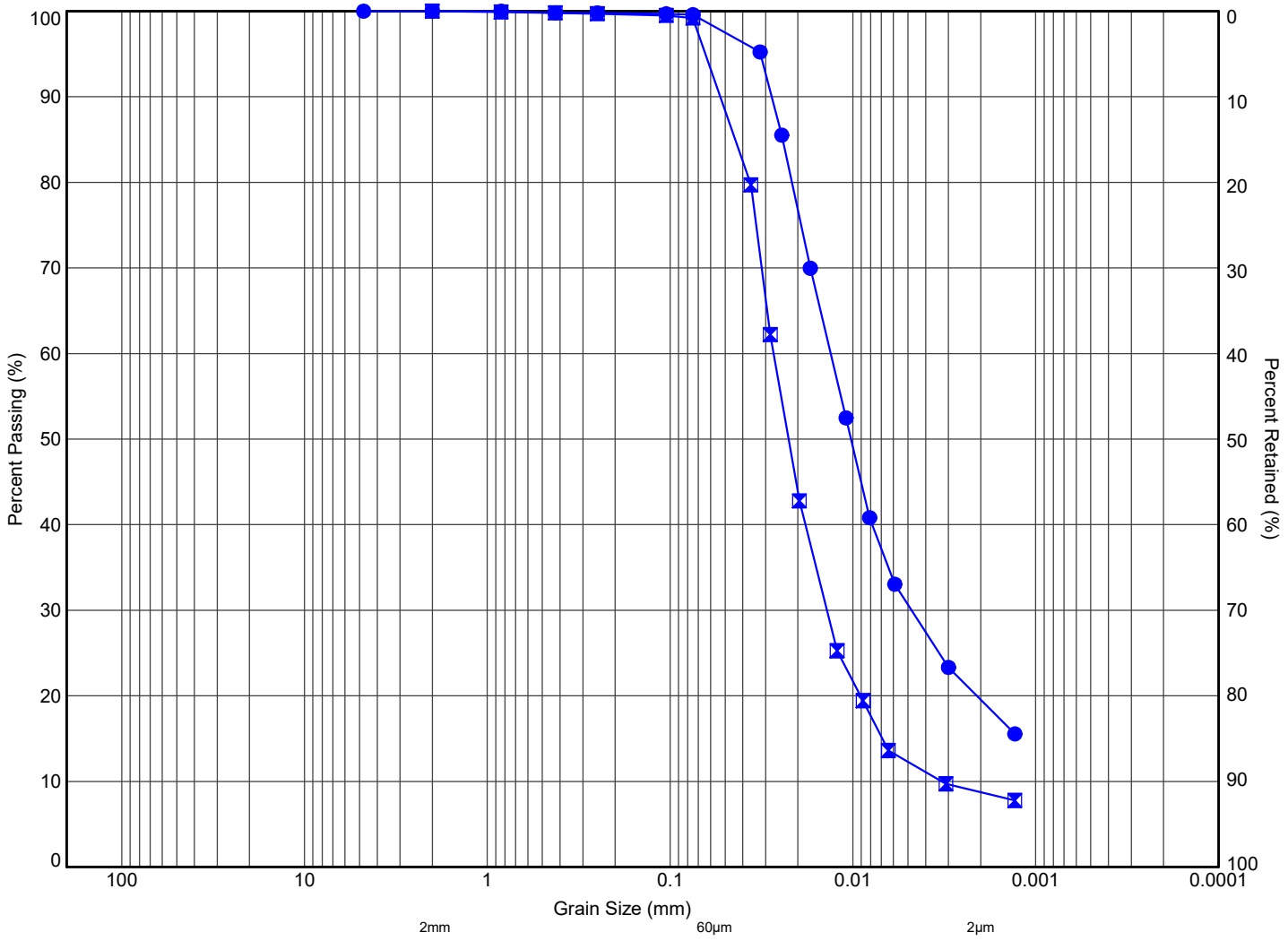
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**101**	SS5	3.4	231.2	22	61	13	4	
⊠	**102**	10A	10.9	223.6	28	44	24	4	
▲	**104**	SS11	12.5	221.6	32	54	11	3	
★	**205**	SS3	14.0	220.3	32	42	19	7	
⊙	**206**	SS10	10.8	223.5	57	30			*(13)*

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SANDY GRAVEL TO GRAVELLY SAND

File No.: **1-17-0481-01**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

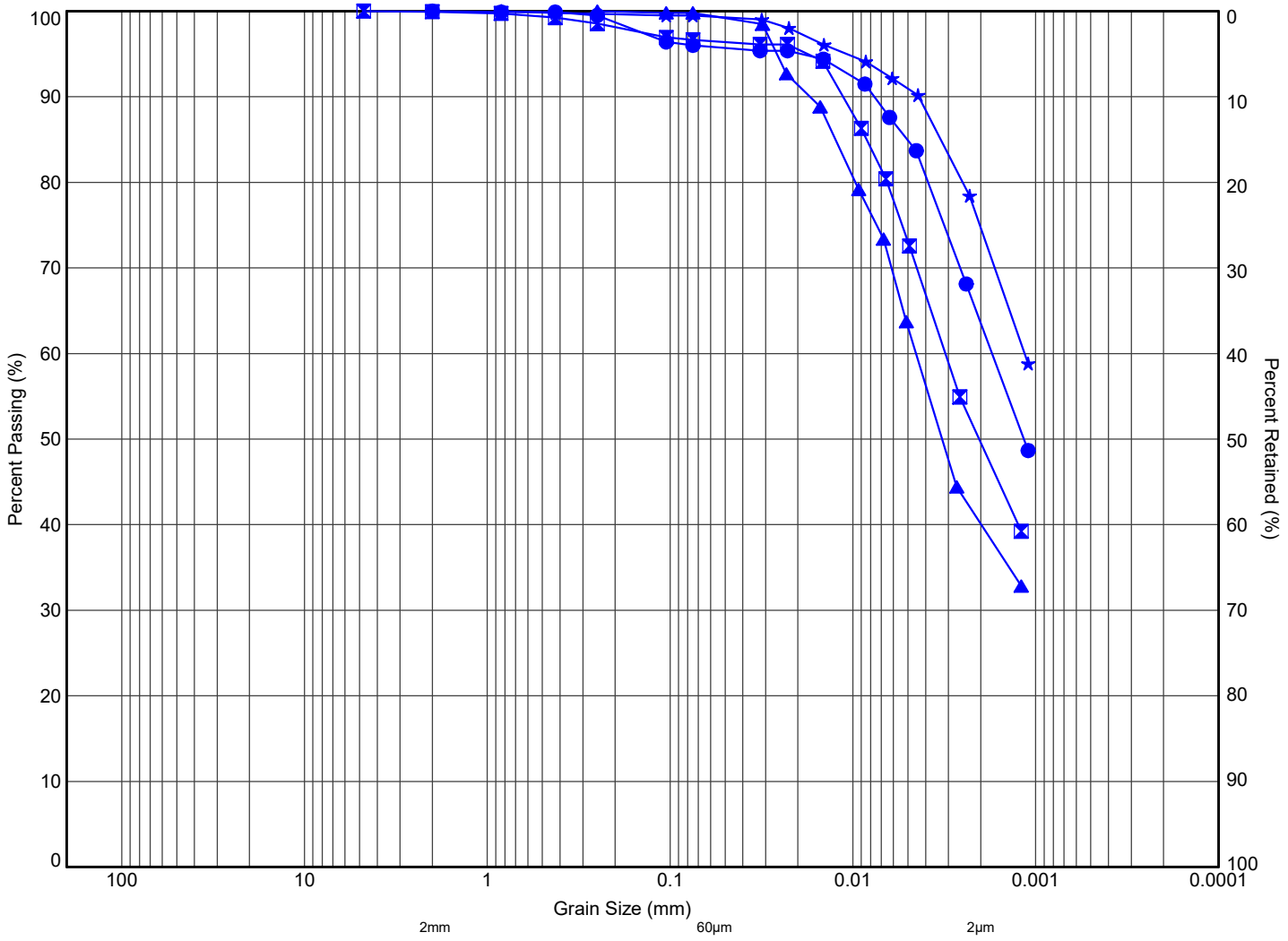
MIT SYSTEM

	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**202**	SS4	14.0	220.3	0	1	79	20	
⊠	**205**	SS5	17.0	217.4	0	6	85	9	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **GRAIN SIZE DISTRIBUTION**
SILT

File No.: **1-17-0481-01**



MIT SYSTEM	COBBLES	GRAVEL			SAND			SILT	CLAY
		COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE		

MIT SYSTEM

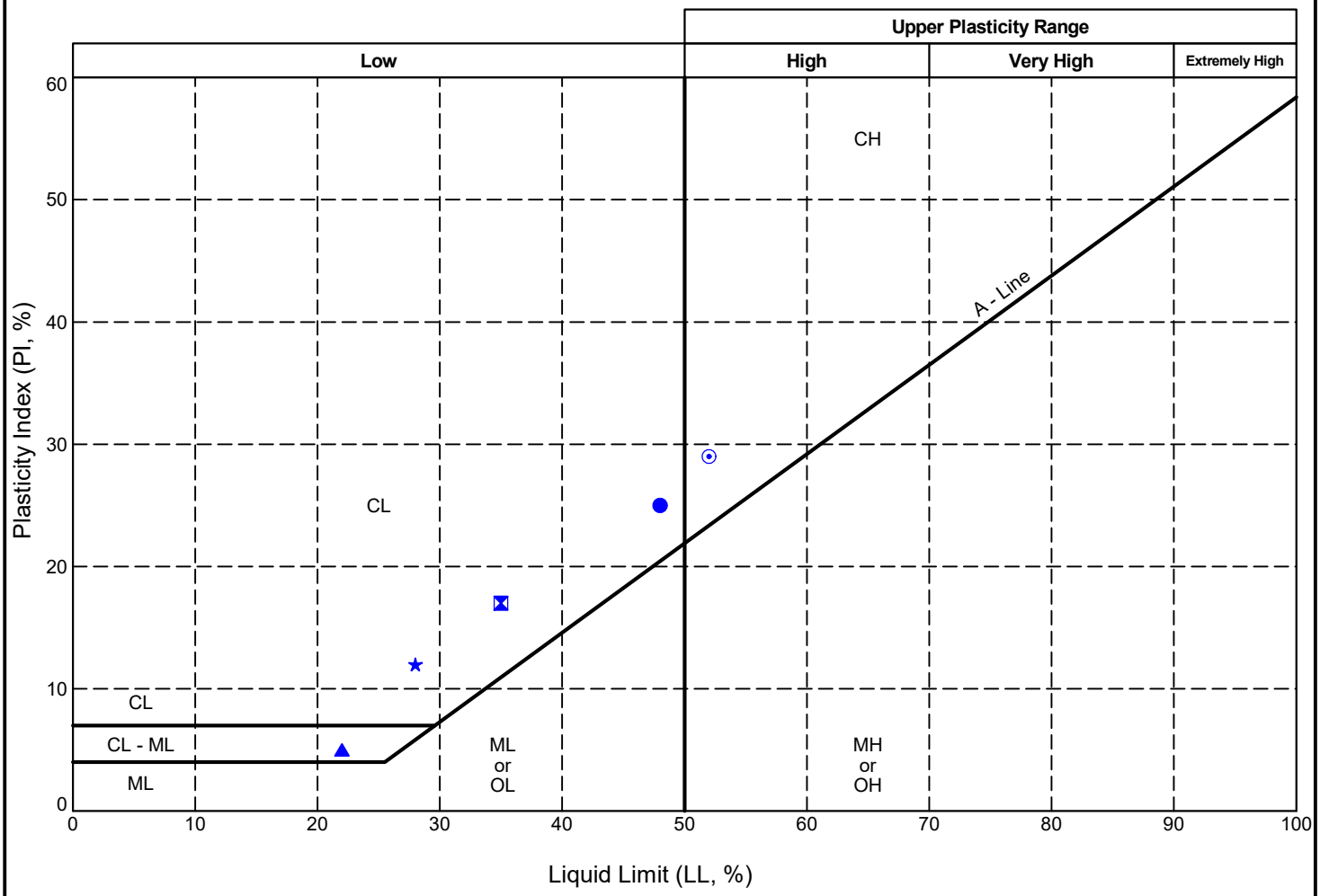
	Hole ID	Sample	Depth (m)	Elev. (m)	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	*(Fines, %)*
●	**101**	10B	11.1	223.5	0	4	32	64	
⊠	**103**	SS11	12.5	221.9	0	3	47	50	
▲	**203**	SS11	12.5	222.0	0	1	59	40	
★	**206**	SS15	18.6	215.8	0	0	25	75	

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title:

GRAIN SIZE DISTRIBUTION
SILTY CLAY TO CLAY AND SILT

File No.: **1-17-0481-01**



	Borehole	Sample	Depth (m)	Elev. (m)	LL (%)	PL (%)	PI (%)
●	101	10B	11.1	223.5	48	23	25
⊠	103	SS11	12.5	221.9	35	18	17
▲	202	SS4	14.0	220.3	22	17	5
★	203	SS11	12.5	222.0	28	16	12
⊙	206	SS15	18.6	215.8	52	23	29

Terraprobe
11 Indell Lane, Brampton Ontario L6T 3Y3
(905) 796-2650

Title: **ATTERBERG LIMITS CHART**

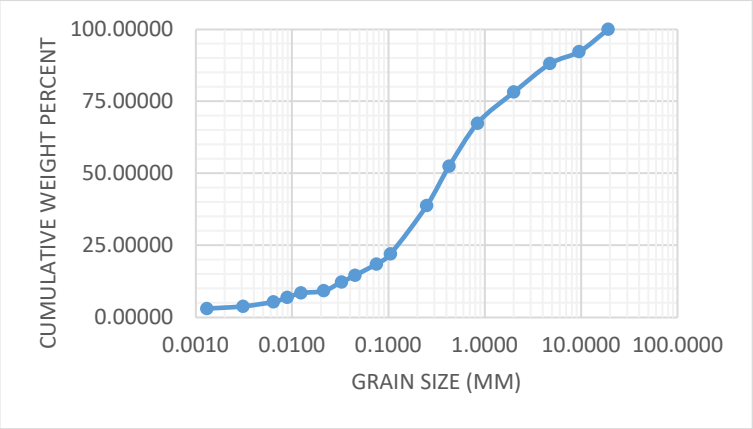
File No.: **1-17-0481-01**

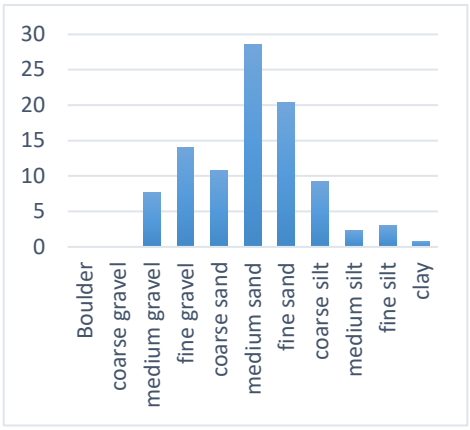
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-101-SS5

Mass Sample (g): 100 T (oC) 20

Poorly sorted gravelly sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
19	0	0	100
9.5	7.75	0.0775	92.25
4.75	4.12	0.0412	88.13
2	9.91	0.0991	78.22
0.84	10.8	0.108	67.42
0.425	14.94	0.1494	52.48
0.25	13.61	0.1361	38.87
0.105	16.81	0.1681	22.06
0.075	3.52	0.0352	18.54
0.045	3.93	0.0393	14.61
0.0326	2.31	0.0231	12.3
0.0213	3.07	0.0307	9.23
0.0124	0.77	0.0077	8.46
0.0089	1.54	0.0154	6.92
0.0064	1.54	0.0154	5.38
0.0031	1.53	0.0153	3.85
0.0013	0.77	0.0077	3.08

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.024	Uniformity Coef.	26.27
d17	0.063	n computed	0.26
d20	0.087	g (cm/s^2)	980.00
d50	0.393	ρ (g/cm^3)	0.9981
d60	0.634	μ (g/cm s)	0.0098
de (Kruger)	0.066	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.028	tau (Sauerbrei)	1.053
de (Zunker)	0.029	$d_{geometric\ mean}$	0.446
de (Zamarin)	0.029	σ_ϕ	3.197
lo (Alyameni)	-0.068		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	0
8 - 16	medium gravel	7.75
2 - 8	fine gravel	14.03
0.5 - 2	coarse sand	10.8
0.25 - 0.5	medium sand	28.55
0.063 - 0.25	fine sand	20.33
0.016 - 0.063	coarse silt	9.31
0.008 - 0.016	medium silt	2.31
0.002 - 0.008	fine silt	3.07
<0.002	clay	0.77

K from Grain Size Analysis Report

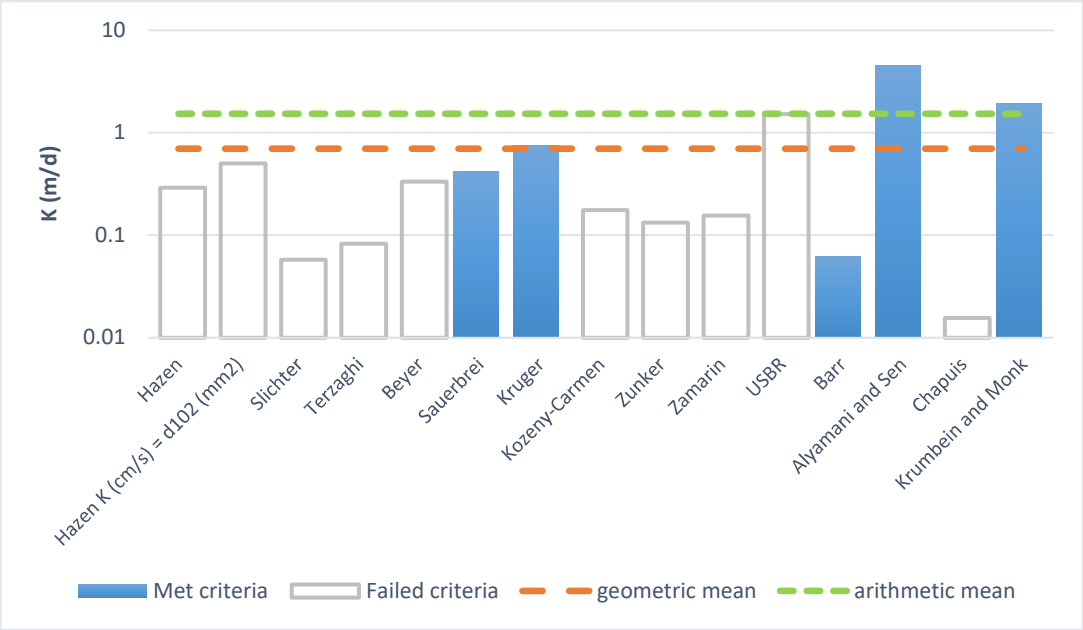
Date: 18-May-21

Sample Name: TRP-101-SS5

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



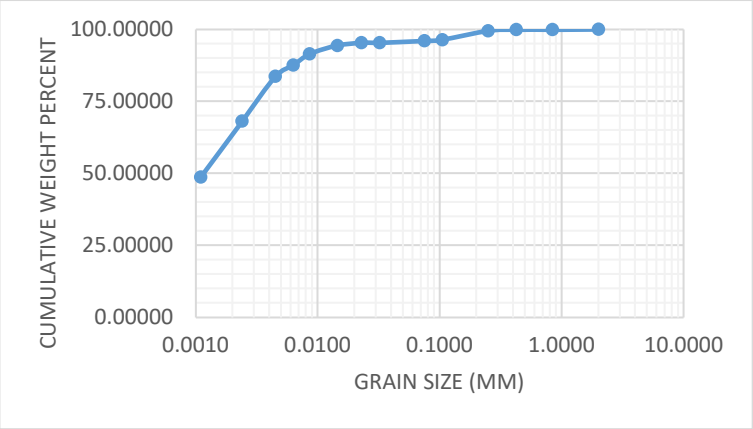
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	3.4E-04	3.4E-06	0.29	
Hazen K (cm/s) = d_{10} (mm)	5.8E-04	5.8E-06	0.50	
Slichter	6.6E-05	6.6E-07	0.06	
Terzaghi	9.5E-05	9.5E-07	0.08	
Beyer	3.8E-04	3.8E-06	0.33	
Sauerbrei	4.8E-04	4.8E-06	0.42	
Kruger	8.8E-04	8.8E-06	0.76	
Kozeny-Carmen	2.0E-04	2.0E-06	0.18	
Zunker	1.5E-04	1.5E-06	0.13	
Zamarin	1.8E-04	1.8E-06	0.15	
USBR	1.8E-03	1.8E-05	1.52	
Barr	7.1E-05	7.1E-07	0.06	
Alyamani and Sen	5.2E-03	5.2E-05	4.51	
Chapuis	1.8E-05	1.8E-07	0.02	
Krumbein and Monk	2.2E-03	2.2E-05	1.94	
geometric mean	8.1E-04	8.1E-06	0.70	
arithmetic mean	1.8E-03	1.8E-05	1.54	

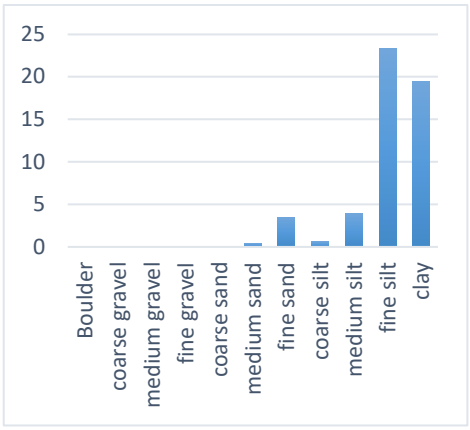
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-101-SS10B

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
2	0	0	100
0.84	0.1	0.001	99.9
0.425	0	0	99.9
0.25	0.4	0.004	99.5
0.105	3.1	0.031	96.4
0.075	0.4	0.004	96
0.0322	0.63	0.0063	95.37
0.0228	0	0	95.37
0.0145	0.98	0.0098	94.39
0.0086	2.91	0.0291	91.48
0.0063	3.9	0.039	87.58
0.0045	3.89	0.0389	83.69
0.0024	15.57	0.1557	68.12
0.0011	19.46	0.1946	48.66

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.000	Uniformity Coef.	8.22
d17	0.000	n computed	0.31
d20	0.000	g (cm/s^2)	980.00
d50	0.001	ρ (g/cm^3)	0.9981
d60	0.002	μ (g/cm s)	0.0098
de (Kruger)	0.006	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.002	tau (Sauerbrei)	1.053
de (Zunker)	0.002	$d_{geometric\ mean}$	0.061
de (Zamarin)	0.002	σ_ϕ	2.048
lo (Alyameni)	0.000		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	0
0.5 - 2	coarse sand	0.1
0.25 - 0.5	medium sand	0.4
0.063 - 0.25	fine sand	3.5
0.016 - 0.063	coarse silt	0.63
0.008 - 0.016	medium silt	3.89
0.002 - 0.008	fine silt	23.36
<0.002	clay	19.46

K from Grain Size Analysis Report

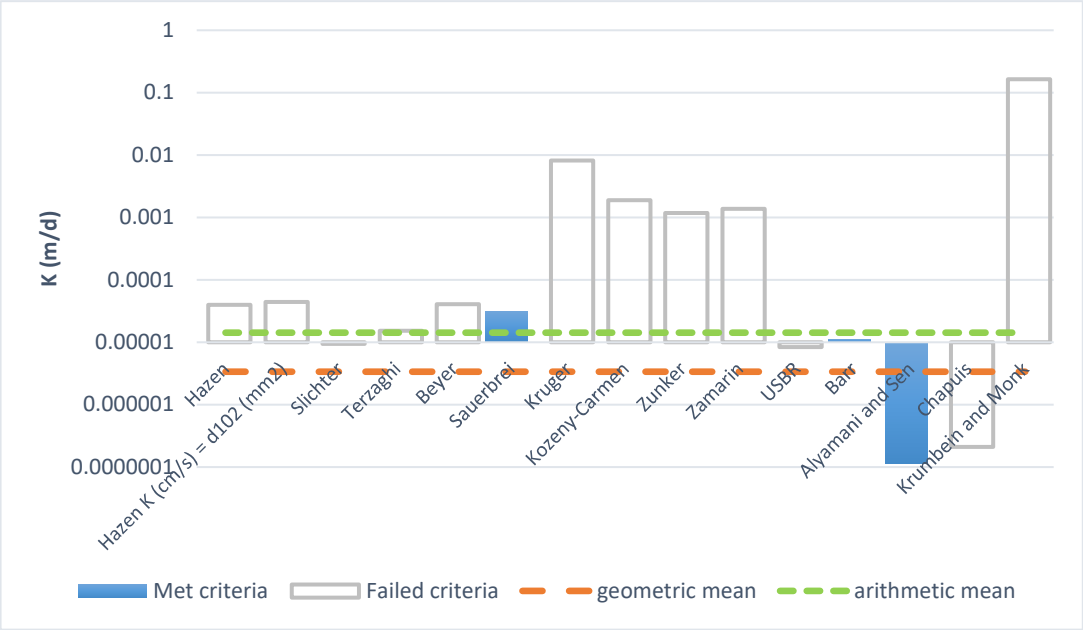
Date: 18-May-21

Sample Name: TRP-101-SS10B

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



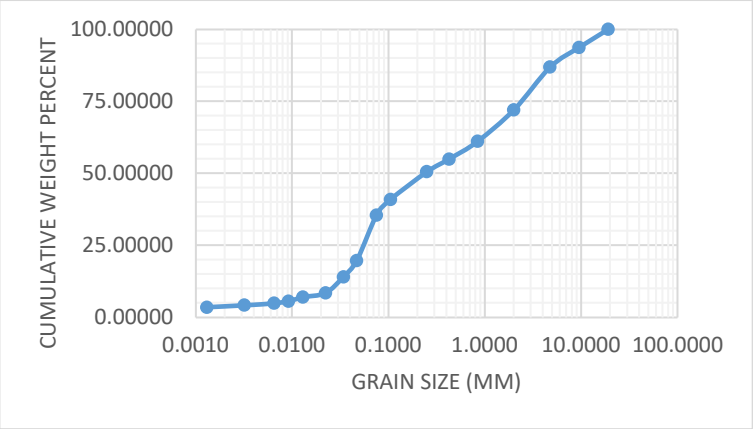
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	4.6E-08	4.6E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	5.1E-08	5.1E-10	0.00	
Slichter	1.1E-08	1.1E-10	0.00	
Terzaghi	1.8E-08	1.8E-10	0.00	
Beyer	4.7E-08	4.7E-10	0.00	
Sauerbrei	3.6E-08	3.6E-10	0.00	
Kruger	9.5E-06	9.5E-08	0.01	
Kozeny-Carmen	2.2E-06	2.2E-08	0.00	
Zunker	1.4E-06	1.4E-08	0.00	
Zamarin	1.6E-06	1.6E-08	0.00	
USBR	9.7E-09	9.7E-11	0.00	
Barr	1.3E-08	1.3E-10	0.00	
Alyamani and Sen	1.3E-10	1.3E-12	0.00	
Chapuis	2.4E-10	2.4E-12	0.00	
Krumbein and Monk	1.9E-04	1.9E-06	0.16	
geometric mean	3.9E-09	3.9E-11	0.00	
arithmetic mean	1.6E-08	1.6E-10	0.00	

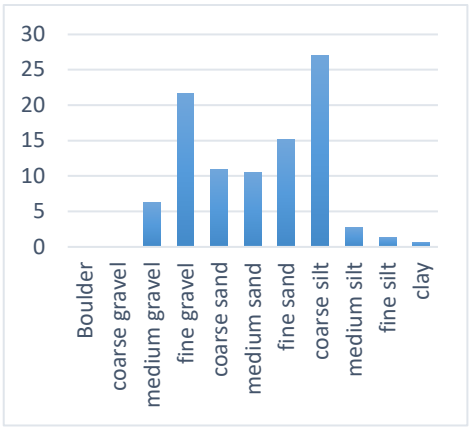
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-102-SS10A

Mass Sample (g): 100 T (oC) 20

Poorly sorted gravelly sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
19	0	0	100
9.5	6.26	0.0626	#REF!
4.75	6.81	0.0681	#REF!
2	14.86	0.1486	#REF!
0.84	10.96	0.1096	#REF!
0.425	6.12	0.0612	#REF!
0.25	4.4	0.044	#REF!
0.105	9.65	0.0965	#REF!
0.075	5.48	0.0548	#REF!
0.0468	15.74	0.1574	#REF!
0.0341	5.63	0.0563	#REF!
0.0222	5.64	0.0564	#REF!
0.0129	1.41	0.0141	#REF!
0.0092	1.41	0.0141	#REF!
0.0065	0.7	0.007	#REF!
0.0032	0.7	0.007	#REF!
0.0013	0.71	0.0071	#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.025	Uniformity Coef.	30.02
d17	0.041	n computed	0.26
d20	0.047	g (cm/s^2)	980.00
d50	0.241	ρ (g/cm^3)	0.9981
d60	0.765	μ (g/cm s)	0.0098
de (Kruger)	0.066	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.027	tau (Sauerbrei)	1.053
de (Zunker)	0.027	$d_{geometric\ mean}$	0.380
de (Zamarin)	0.027	σ_ϕ	3.318
lo (Alyameni)	-0.028		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	0
8 - 16	medium gravel	6.26
2 - 8	fine gravel	21.67
0.5 - 2	coarse sand	10.96
0.25 - 0.5	medium sand	10.52
0.063 - 0.25	fine sand	15.13
0.016 - 0.063	coarse silt	27.01
0.008 - 0.016	medium silt	2.82
0.002 - 0.008	fine silt	1.4
<0.002	clay	0.71

K from Grain Size Analysis Report

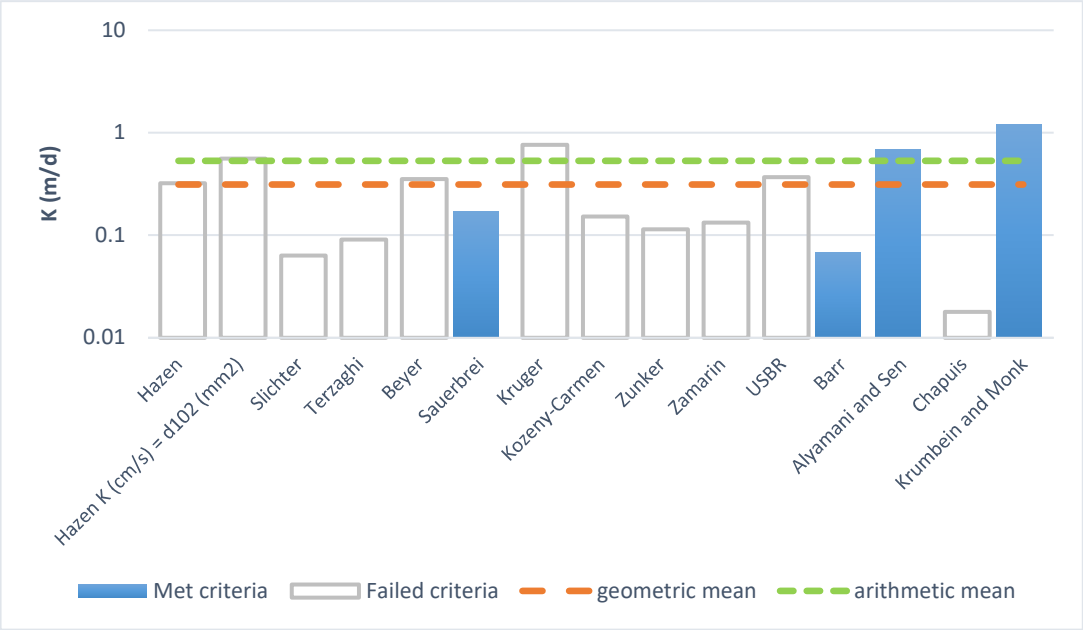
Date: 18-May-21

Sample Name: TRP-102-SS10A

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



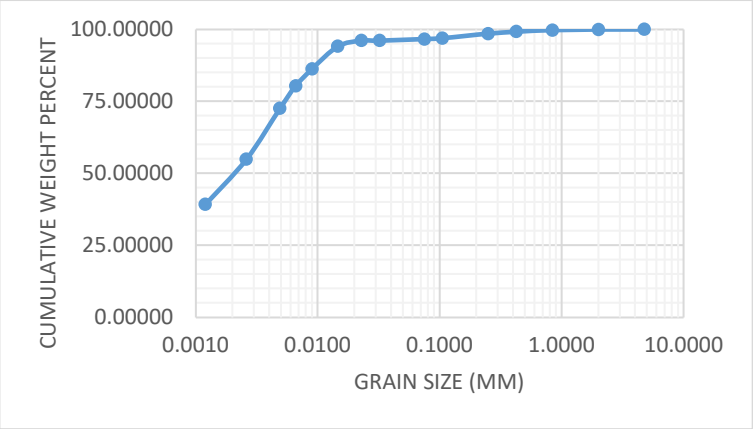
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	3.7E-04	3.7E-06	0.32	
Hazen K (cm/s) = d_{10} (mm)	6.5E-04	6.5E-06	0.56	
Slichter	7.3E-05	7.3E-07	0.06	
Terzaghi	1.0E-04	1.0E-06	0.09	
Beyer	4.1E-04	4.1E-06	0.35	
Sauerbrei	2.0E-04	2.0E-06	0.17	
Kruger	8.8E-04	8.8E-06	0.76	
Kozeny-Carmen	1.8E-04	1.8E-06	0.15	
Zunker	1.3E-04	1.3E-06	0.11	
Zamarin	1.5E-04	1.5E-06	0.13	
USBR	4.3E-04	4.3E-06	0.37	
Barr	7.8E-05	7.8E-07	0.07	
Alyamani and Sen	8.0E-04	8.0E-06	0.69	
Chapuis	2.1E-05	2.1E-07	0.02	
Krumbein and Monk	1.4E-03	1.4E-05	1.21	
geometric mean	3.6E-04	3.6E-06	0.31	
arithmetic mean	6.2E-04	6.2E-06	0.53	

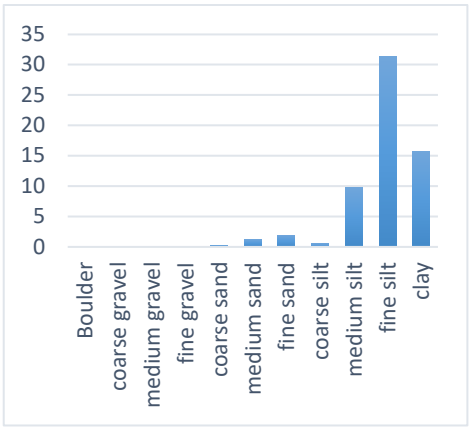
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-103-SS11

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
4.75	0	0	100
2	0.06	0.0006	#REF!
0.84	0.2	0.002	#REF!
0.425	0.5	0.005	#REF!
0.25	0.7	0.007	#REF!
0.105	1.6	0.016	#REF!
0.075	0.3	0.003	#REF!
0.0322	0.53	0.0053	#REF!
0.0228	0	0	#REF!
0.0146	1.96	0.0196	#REF!
0.009	7.85	0.0785	#REF!
0.0066	5.88	0.0588	#REF!
0.0049	7.85	0.0785	#REF!
0.0026	17.65	0.1765	#REF!
0.0012	15.69	0.1569	#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.000	Uniformity Coef.	10.66
d17	0.001	n computed	0.29
d20	0.001	g (cm/s^2)	980.00
d50	0.002	ρ (g/cm^3)	0.9981
d60	0.003	μ (g/cm s)	0.0098
de (Kruger)	0.006	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.002	tau (Sauerbrei)	1.053
de (Zunker)	0.002	$d_{geometric\ mean}$	0.042
de (Zamarin)	0.002	σ_ϕ	2.055
lo (Alyameni)	0.000		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	0.06
0.5 - 2	coarse sand	0.2
0.25 - 0.5	medium sand	1.2
0.063 - 0.25	fine sand	1.9
0.016 - 0.063	coarse silt	0.53
0.008 - 0.016	medium silt	9.81
0.002 - 0.008	fine silt	31.38
<0.002	clay	15.69

K from Grain Size Analysis Report

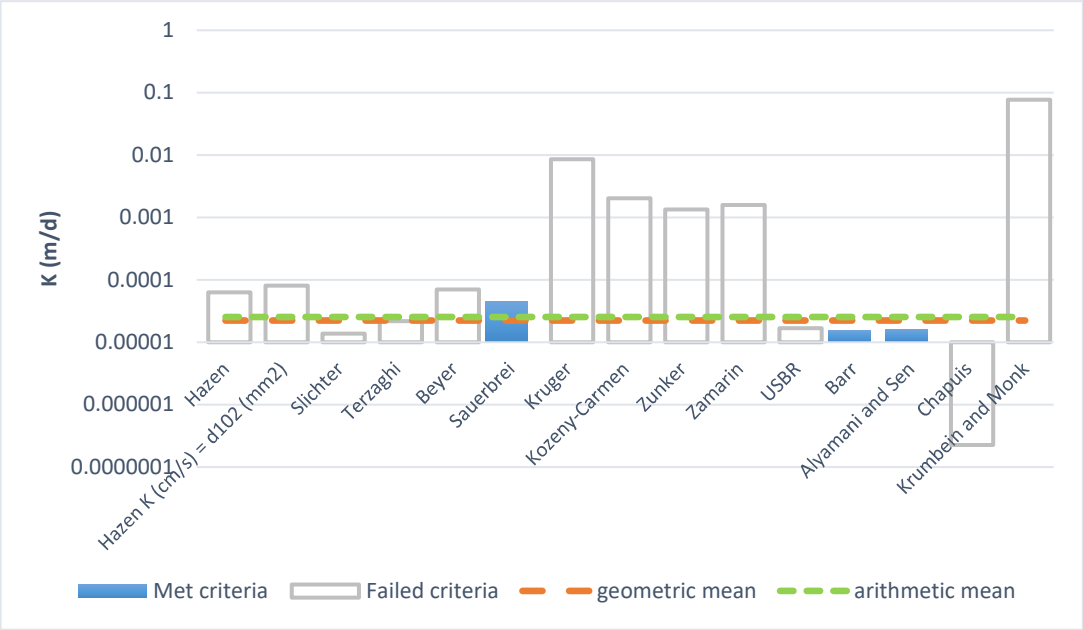
Date: 18-May-21

Sample Name: TRP-103-SS11

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



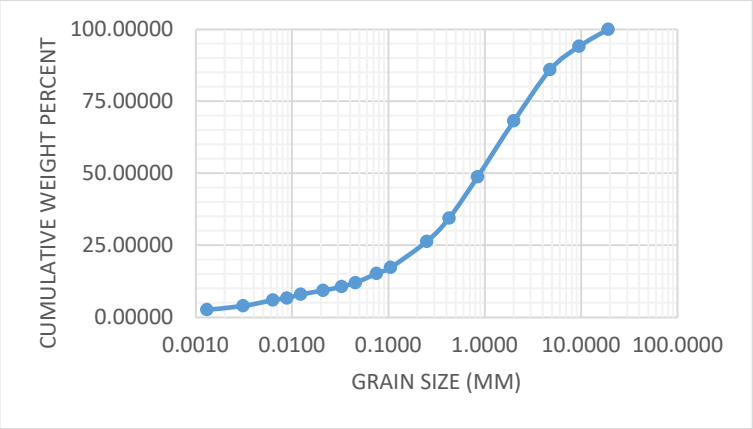
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	7.2E-08	7.2E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	9.4E-08	9.4E-10	0.00	
Slichter	1.6E-08	1.6E-10	0.00	
Terzaghi	2.5E-08	2.5E-10	0.00	
Beyer	8.1E-08	8.1E-10	0.00	
Sauerbrei	5.1E-08	5.1E-10	0.00	
Kruger	9.9E-06	9.9E-08	0.01	
Kozeny-Carmen	2.3E-06	2.3E-08	0.00	
Zunker	1.6E-06	1.6E-08	0.00	
Zamarin	1.8E-06	1.8E-08	0.00	
USBR	1.9E-08	1.9E-10	0.00	
Barr	1.8E-08	1.8E-10	0.00	
Alyamani and Sen	1.9E-08	1.9E-10	0.00	
Chapuis	2.6E-10	2.6E-12	0.00	
Krumbein and Monk	8.9E-05	8.9E-07	0.08	
geometric mean	2.6E-08	2.6E-10	0.00	
arithmetic mean	2.9E-08	2.9E-10	0.00	

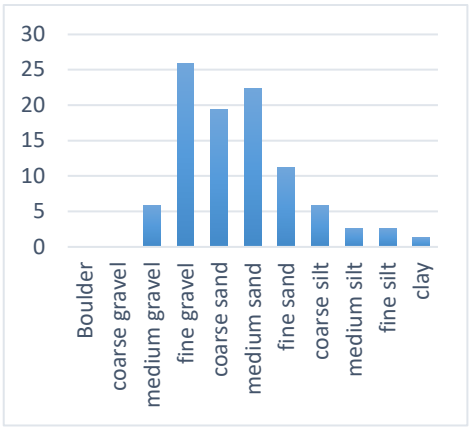
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-104-SS11

Mass Sample (g): 100 T (oC) 20

Poorly sorted gravelly sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
19	0	0	100
9.5	5.87	0.0587	#REF!
4.75	8.13	0.0813	#REF!
2	17.75	0.1775	#REF!
0.84	19.45	0.1945	#REF!
0.425	14.34	0.1434	#REF!
0.25	8.05	0.0805	#REF!
0.105	9.08	0.0908	#REF!
0.075	2.11	0.0211	#REF!
0.0454	3.17	0.0317	#REF!
0.0326	1.34	0.0134	#REF!
0.0209	1.34	0.0134	#REF!
0.0123	1.33	0.0133	#REF!
0.0088	1.34	0.0134	#REF!
0.0063	0.67	0.0067	#REF!
0.0031	2.01	0.0201	#REF!
0.0013	1.34	0.0134	#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.026	Uniformity Coef.	57.12
d17	0.100	n computed	0.26
d20	0.148	g (cm/s^2)	980.00
d50	0.912	ρ (g/cm^3)	0.9981
d60	1.508	μ (g/cm s)	0.0098
de (Kruger)	0.062	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.029	tau (Sauerbrei)	1.053
de (Zunker)	0.030	$d_{geometric\ mean}$	0.707
de (Zamarin)	0.030	σ_ϕ	3.118
lo (Alyameni)	-0.195		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	0
8 - 16	medium gravel	5.87
2 - 8	fine gravel	25.88
0.5 - 2	coarse sand	19.45
0.25 - 0.5	medium sand	22.39
0.063 - 0.25	fine sand	11.19
0.016 - 0.063	coarse silt	5.85
0.008 - 0.016	medium silt	2.67
0.002 - 0.008	fine silt	2.68
<0.002	clay	1.34

K from Grain Size Analysis Report

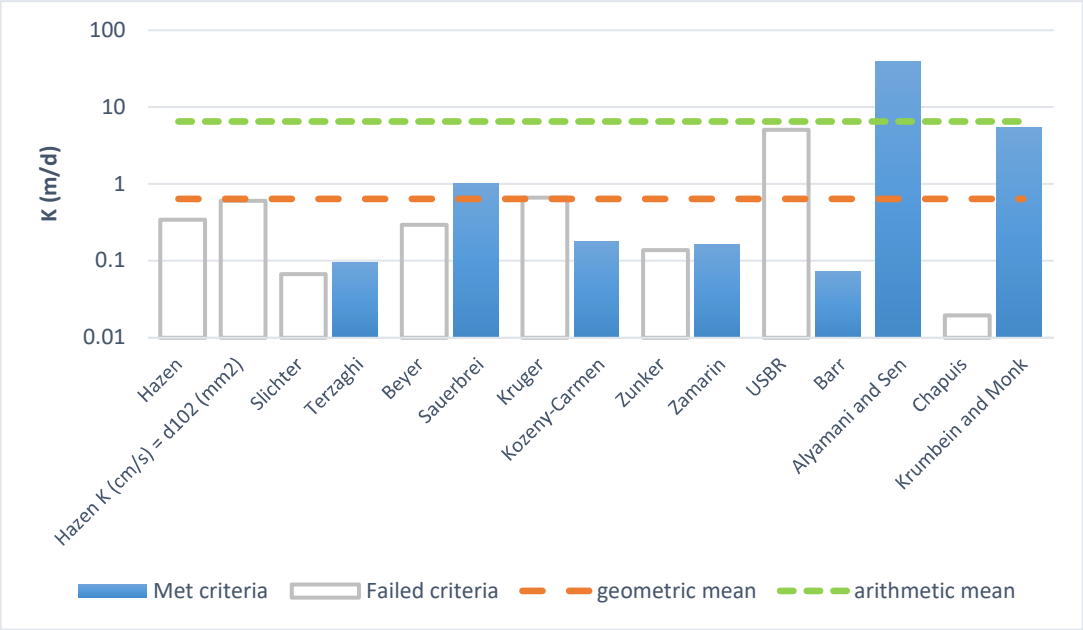
Date: 18-May-21

Sample Name: TRP-104-SS11

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



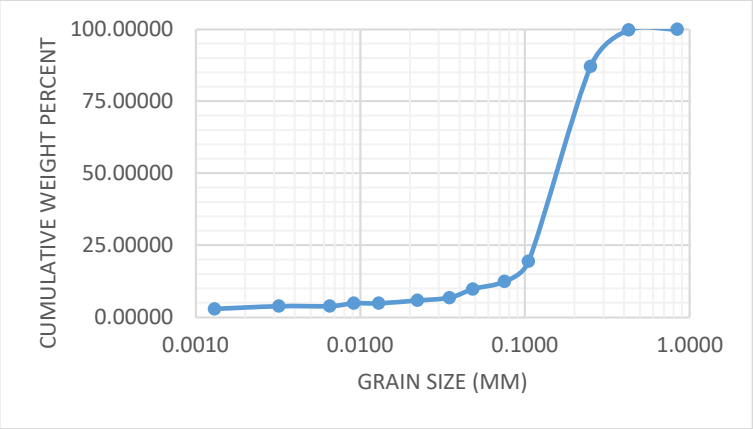
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	3.9E-04	3.9E-06	0.34	
Hazen K (cm/s) = d_{10} (mm)	7.0E-04	7.0E-06	0.60	
Slichter	7.8E-05	7.8E-07	0.07	
Terzaghi	1.1E-04	1.1E-06	0.10	
Beyer	3.4E-04	3.4E-06	0.29	
Sauerbrei	1.2E-03	1.2E-05	1.02	
Kruger	7.6E-04	7.6E-06	0.66	
Kozeny-Carmen	2.1E-04	2.1E-06	0.18	
Zunker	1.6E-04	1.6E-06	0.14	
Zamarin	1.9E-04	1.9E-06	0.16	
USBR	5.9E-03	5.9E-05	5.06	
Barr	8.3E-05	8.3E-07	0.07	
Alyamani and Sen	4.5E-02	4.5E-04	38.80	
Chapuis	2.2E-05	2.2E-07	0.02	
Krumbein and Monk	6.3E-03	6.3E-05	5.42	
geometric mean	7.4E-04	7.4E-06	0.64	
arithmetic mean	7.6E-03	7.6E-05	6.54	

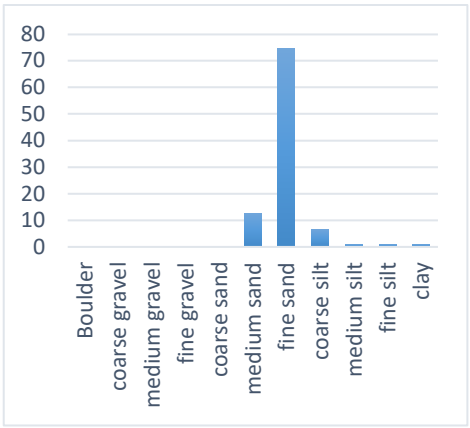
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-201-SS17

Mass Sample (g): 100 T (oC) 20

Moderately well sorted sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
0.84	0	0	100
0.425	0.2	0.002	#REF!
0.25	12.6	0.126	#REF!
0.105	67.7	0.677	#REF!
0.075	7	0.07	#REF!
0.0482	2.67	0.0267	#REF!
0.0348	2.95	0.0295	#REF!
0.0222	0.98	0.0098	#REF!
0.0129	0.98	0.0098	#REF!
0.0091	0	0	#REF!
0.0065	0.99	0.0099	#REF!
0.0032	0	0	#REF!
0.0013	0.98	0.0098	#REF!
			#REF!
			#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.050	Uniformity Coef.	3.84
d17	0.094	n computed	0.38
d20	0.106	g (cm/s^2)	980.00
d50	0.170	ρ (g/cm^3)	0.9981
d60	0.192	μ (g/cm s)	0.0098
de (Kruger)	0.079	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.031	tau (Sauerbrei)	1.053
de (Zunker)	0.032	$d_{geometric\ mean}$	0.150
de (Zamarin)	0.032	σ_ϕ	1.073
lo (Alyameni)	0.020		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	
0.5 - 2	coarse sand	0
0.25 - 0.5	medium sand	12.8
0.063 - 0.25	fine sand	74.7
0.016 - 0.063	coarse silt	6.6
0.008 - 0.016	medium silt	0.98
0.002 - 0.008	fine silt	0.99
<0.002	clay	0.98

K from Grain Size Analysis Report

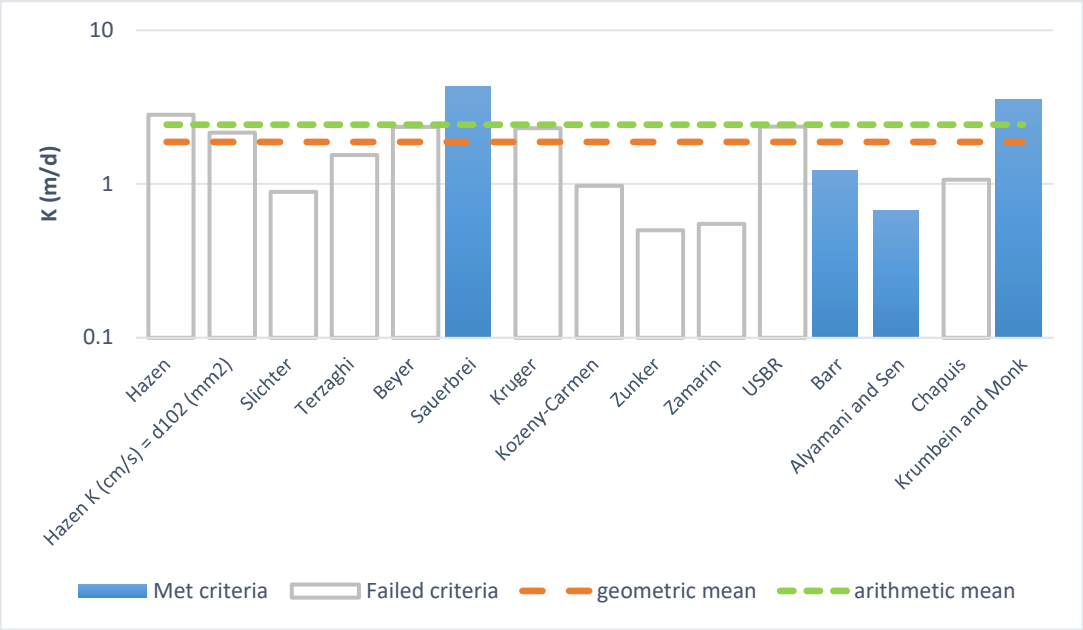
Date: 18-May-21

Sample Name: TRP-201-SS17

Mass Sample (g): 100

T (oC) 20

Moderately well sorted sand low in fines



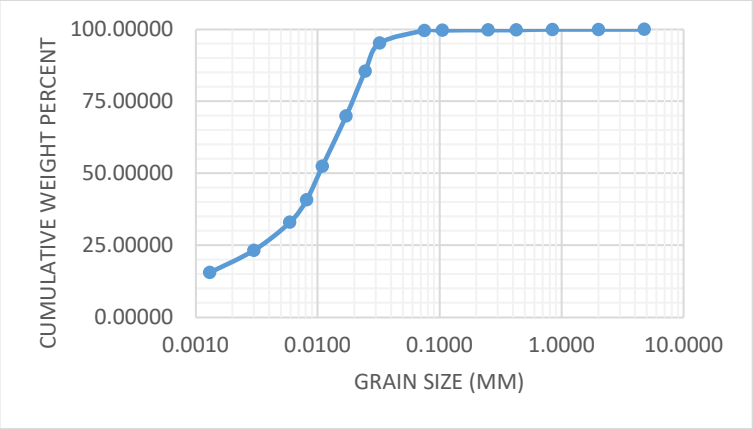
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	3.3E-03	3.3E-05	2.82	
Hazen K (cm/s) = d_{10} (mm)	2.5E-03	2.5E-05	2.15	
Slichter	1.0E-03	1.0E-05	0.89	
Terzaghi	1.8E-03	1.8E-05	1.54	
Beyer	2.7E-03	2.7E-05	2.35	
Sauerbrei	5.0E-03	5.0E-05	4.28	
Kruger	2.7E-03	2.7E-05	2.30	
Kozeny-Carmen	1.1E-03	1.1E-05	0.97	
Zunker	5.8E-04	5.8E-06	0.50	
Zamarin	6.4E-04	6.4E-06	0.55	
USBR	2.7E-03	2.7E-05	2.36	
Barr	1.4E-03	1.4E-05	1.22	
Alyamani and Sen	7.8E-04	7.8E-06	0.68	
Chapuis	1.2E-03	1.2E-05	1.06	
Krumbein and Monk	4.1E-03	4.1E-05	3.55	
geometric mean	2.2E-03	2.2E-05	1.88	
arithmetic mean	2.8E-03	2.8E-05	2.43	

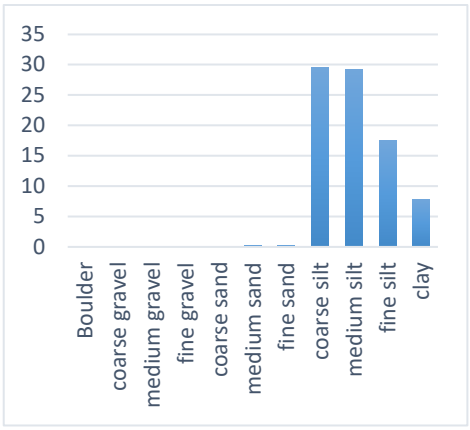
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-202-SS4

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
4.75	0	0	100
2	0.01	0.0001	#REF!
0.84	0	0	#REF!
0.425	0.2	0.002	#REF!
0.25	0	0	#REF!
0.105	0.1	0.001	#REF!
0.075	0.1	0.001	#REF!
0.0322	4.36	0.0436	#REF!
0.0245	9.72	0.0972	#REF!
0.0171	15.55	0.1555	#REF!
0.0109	17.49	0.1749	#REF!
0.0081	11.66	0.1166	#REF!
0.0059	7.77	0.0777	#REF!
0.003	9.72	0.0972	#REF!
0.0013	7.77	0.0777	#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.001	Uniformity Coef.	16.23
d17	0.002	n computed	0.27
d20	0.002	g (cm/s^2)	980.00
d50	0.010	ρ (g/cm^3)	0.9981
d60	0.014	μ (g/cm s)	0.0098
de (Kruger)	0.009	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.005	tau (Sauerbrei)	1.053
de (Zunker)	0.005	$d_{geometric\ mean}$	0.023
de (Zamarin)	0.005	σ_ϕ	1.970
lo (Alyameni)	-0.002		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	0.01
0.5 - 2	coarse sand	0
0.25 - 0.5	medium sand	0.2
0.063 - 0.25	fine sand	0.2
0.016 - 0.063	coarse silt	29.63
0.008 - 0.016	medium silt	29.15
0.002 - 0.008	fine silt	17.49
<0.002	clay	7.77

K from Grain Size Analysis Report

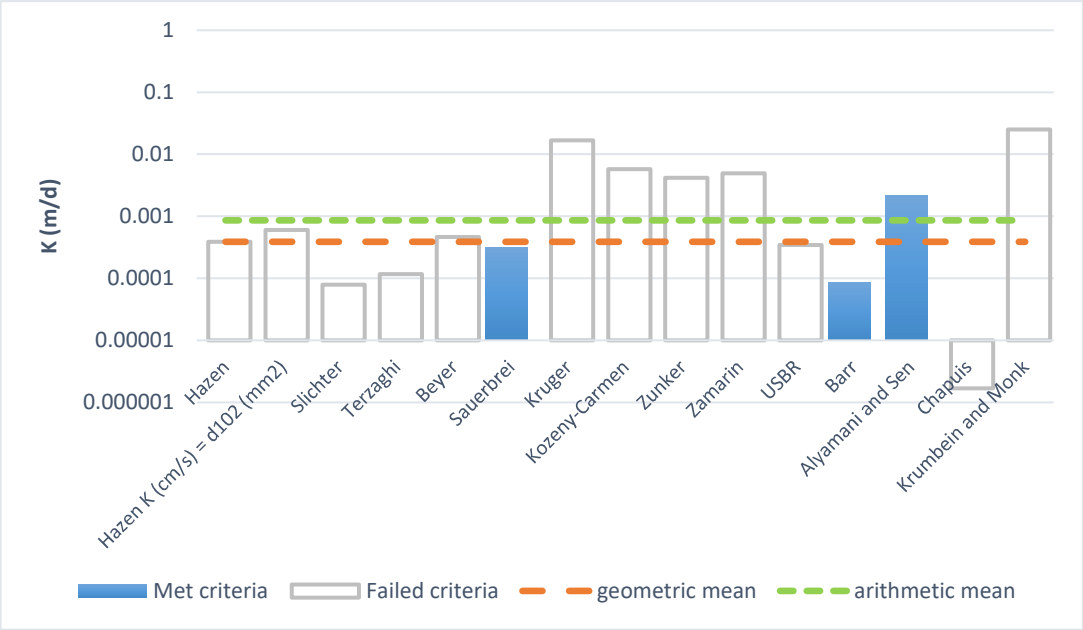
Date: 18-May-21

Sample Name: TRP-202-SS4

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



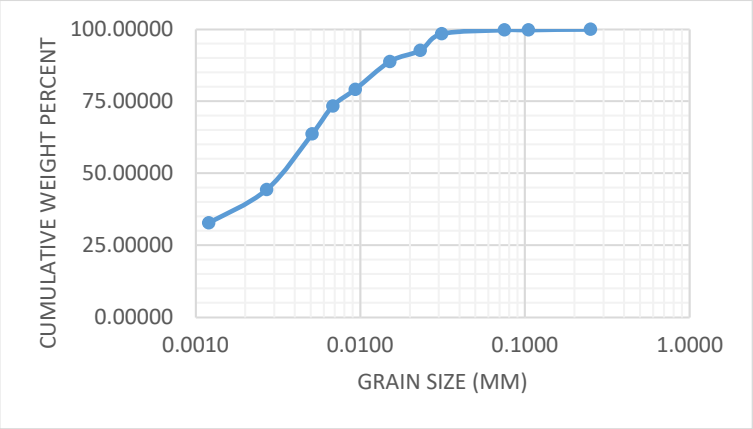
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	4.5E-07	4.5E-09	0.00	
Hazen K (cm/s) = d_{10} (mm)	7.0E-07	7.0E-09	0.00	
Slichter	9.1E-08	9.1E-10	0.00	
Terzaghi	1.4E-07	1.4E-09	0.00	
Beyer	5.4E-07	5.4E-09	0.00	
Sauerbrei	3.7E-07	3.7E-09	0.00	
Kruger	1.9E-05	1.9E-07	0.02	
Kozeny-Carmen	6.7E-06	6.7E-08	0.01	
Zunker	4.8E-06	4.8E-08	0.00	
Zamarin	5.7E-06	5.7E-08	0.00	
USBR	4.0E-07	4.0E-09	0.00	
Barr	9.9E-08	9.9E-10	0.00	
Alyamani and Sen	2.5E-06	2.5E-08	0.00	
Chapuis	1.9E-09	1.9E-11	0.00	
Krumbein and Monk	2.9E-05	2.9E-07	0.03	
geometric mean	4.5E-07	4.5E-09	0.00	
arithmetic mean	1.0E-06	1.0E-08	0.00	

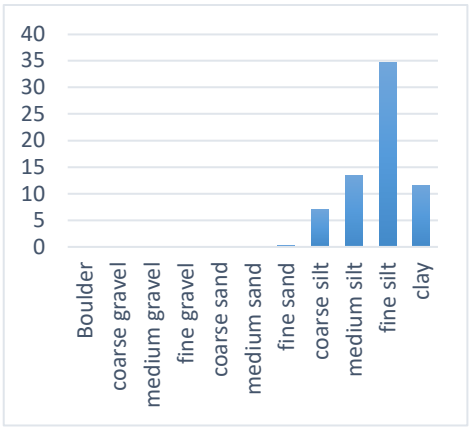
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-203-SS11

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
0.25	0	0	100
0.105	0.2	0.002	#REF!
0.075	0	0	#REF!
0.0312	1.32	0.0132	#REF!
0.0231	5.79	0.0579	#REF!
0.0151	3.86	0.0386	#REF!
0.0093	9.66	0.0966	#REF!
0.0068	5.79	0.0579	#REF!
0.0051	9.66	0.0966	#REF!
0.0027	19.31	0.1931	#REF!
0.0012	11.58	0.1158	#REF!
			#REF!
			#REF!
			#REF!
			#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.000	Uniformity Coef.	12.69
d17	0.001	n computed	0.28
d20	0.001	g (cm/s^2)	980.00
d50	0.003	ρ (g/cm^3)	0.9981
d60	0.005	μ (g/cm s)	0.0098
de (Kruger)	0.007	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.003	tau (Sauerbrei)	1.053
de (Zunker)	0.003	$d_{geometric\ mean}$	0.033
de (Zamarin)	0.003	σ_ϕ	2.182
lo (Alyameni)	0.000		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	
0.5 - 2	coarse sand	
0.25 - 0.5	medium sand	0
0.063 - 0.25	fine sand	0.2
0.016 - 0.063	coarse silt	7.11
0.008 - 0.016	medium silt	13.52
0.002 - 0.008	fine silt	34.76
<0.002	clay	11.58

K from Grain Size Analysis Report

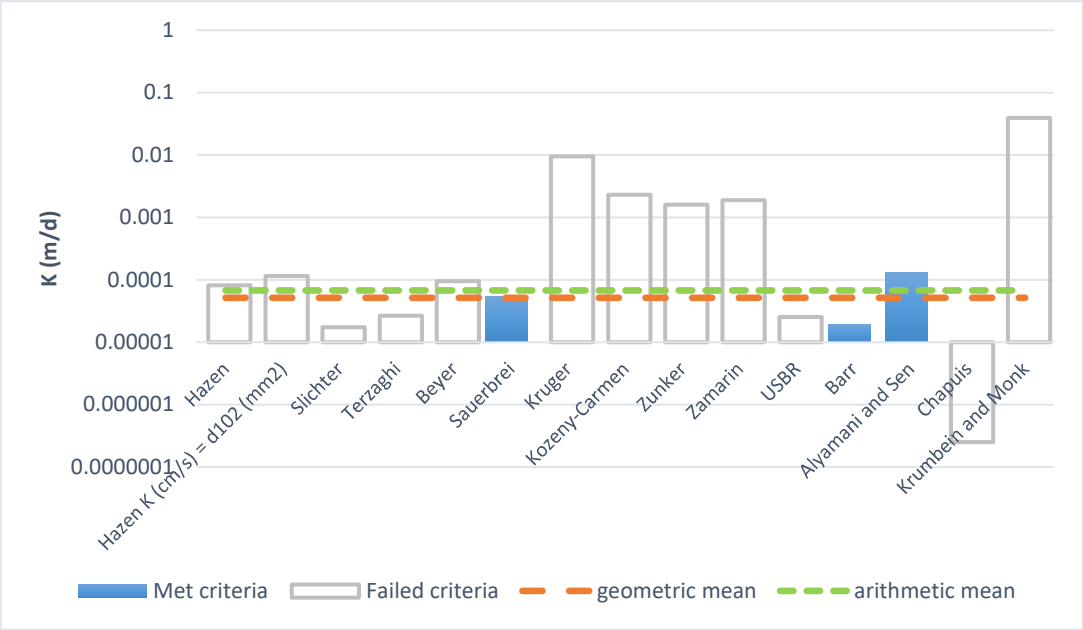
Date: 18-May-21

Sample Name: TRP-203-SS11

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



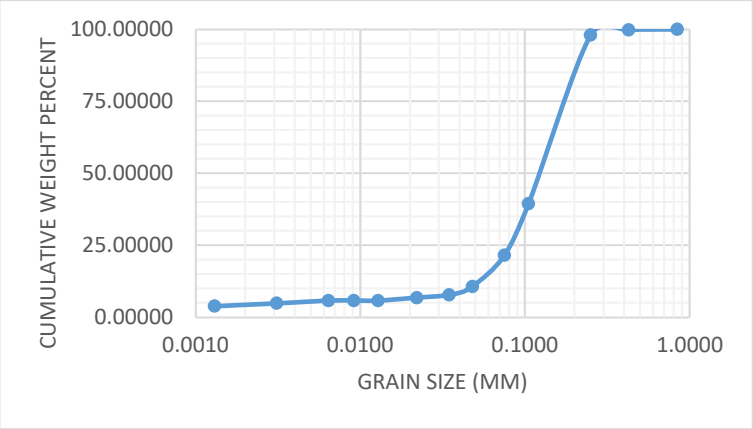
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	9.5E-08	9.5E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	1.3E-07	1.3E-09	0.00	
Slichter	2.0E-08	2.0E-10	0.00	
Terzaghi	3.1E-08	3.1E-10	0.00	
Beyer	1.1E-07	1.1E-09	0.00	
Sauerbrei	6.3E-08	6.3E-10	0.00	
Kruger	1.1E-05	1.1E-07	0.01	
Kozeny-Carmen	2.7E-06	2.7E-08	0.00	
Zunker	1.9E-06	1.9E-08	0.00	
Zamarin	2.2E-06	2.2E-08	0.00	
USBR	2.9E-08	2.9E-10	0.00	
Barr	2.2E-08	2.2E-10	0.00	
Alyamani and Sen	1.5E-07	1.5E-09	0.00	
Chapuis	2.9E-10	2.9E-12	0.00	
Krumbein and Monk	4.5E-05	4.5E-07	0.04	
geometric mean	6.0E-08	6.0E-10	0.00	
arithmetic mean	7.9E-08	7.9E-10	0.00	

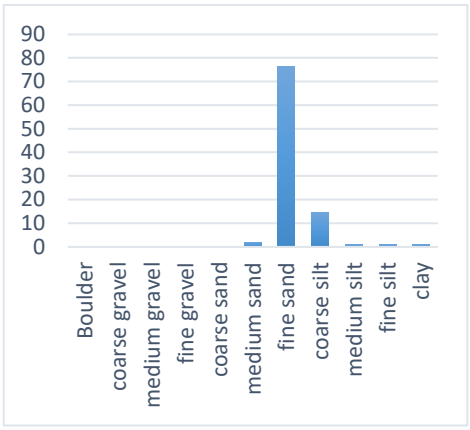
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-203-SS18

Mass Sample (g): 100 T (oC) 20

Moderately well sorted sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
0.84	0	0	100
0.425	0.2	0.002	#REF!
0.25	1.7	0.017	#REF!
0.105	58.6	0.586	#REF!
0.075	17.9	0.179	#REF!
0.0479	10.84	0.1084	#REF!
0.0346	2.93	0.0293	#REF!
0.022	0.98	0.0098	#REF!
0.0128	0.98	0.0098	#REF!
0.0091	0	0	#REF!
0.0064	0	0	#REF!
0.0031	0.98	0.0098	#REF!
0.0013	0.98	0.0098	#REF!
			#REF!
			#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.044	Uniformity Coef.	3.50
d17	0.064	n computed	0.39
d20	0.071	g (cm/s^2)	980.00
d50	0.131	ρ (g/cm^3)	0.9981
d60	0.156	μ (g/cm s)	0.0098
de (Kruger)	0.066	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.025	tau (Sauerbrei)	1.053
de (Zunker)	0.025	$d_{geometric\ mean}$	0.121
de (Zamarin)	0.025	σ_ϕ	1.383
lo (Alyameni)	0.023		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	
0.5 - 2	coarse sand	0
0.25 - 0.5	medium sand	1.9
0.063 - 0.25	fine sand	76.5
0.016 - 0.063	coarse silt	14.75
0.008 - 0.016	medium silt	0.98
0.002 - 0.008	fine silt	0.98
<0.002	clay	0.98

K from Grain Size Analysis Report

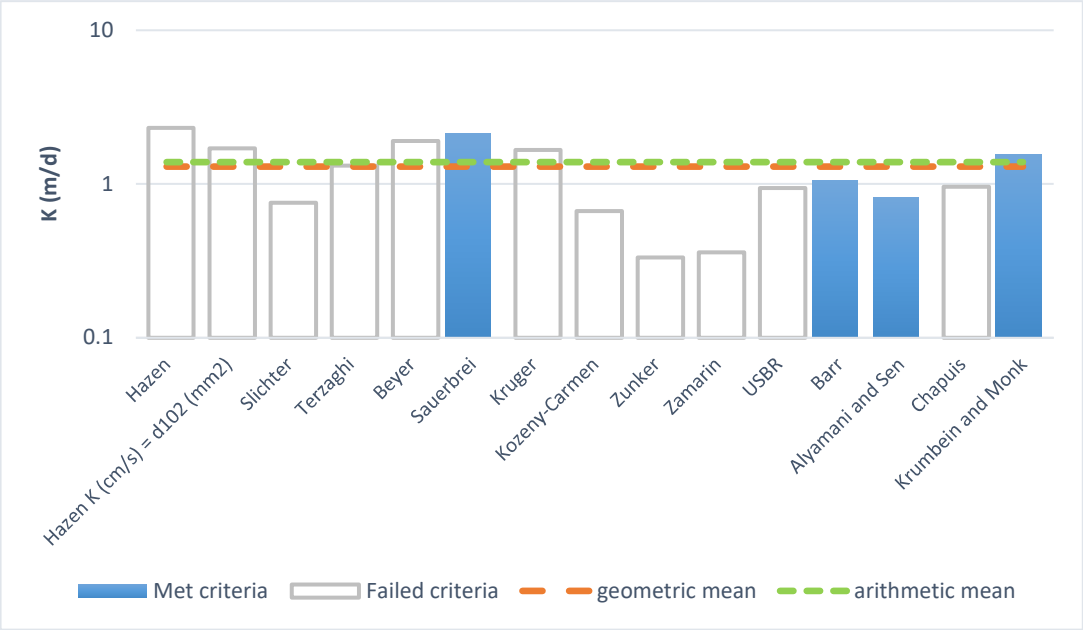
Date: 18-May-21

Sample Name: TRP-203-SS18

Mass Sample (g): 100

T (oC) 20

Moderately well sorted sand low in fines



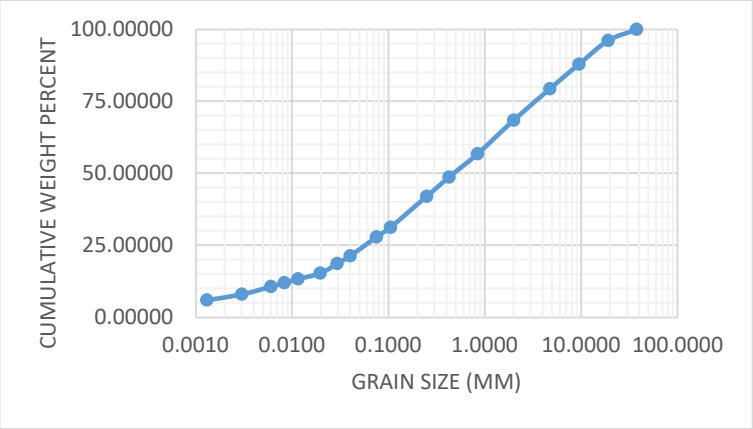
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.7E-03	2.7E-05	2.32	
Hazen K (cm/s) = d_{10} (mm)	2.0E-03	2.0E-05	1.71	
Slichter	8.7E-04	8.7E-06	0.75	
Terzaghi	1.5E-03	1.5E-05	1.31	
Beyer	2.2E-03	2.2E-05	1.90	
Sauerbrei	2.5E-03	2.5E-05	2.13	
Kruger	1.9E-03	1.9E-05	1.66	
Kozeny-Carmen	7.7E-04	7.7E-06	0.67	
Zunker	3.8E-04	3.8E-06	0.33	
Zamarin	4.1E-04	4.1E-06	0.36	
USBR	1.1E-03	1.1E-05	0.94	
Barr	1.2E-03	1.2E-05	1.06	
Alyamani and Sen	9.4E-04	9.4E-06	0.81	
Chapuis	1.1E-03	1.1E-05	0.96	
Krumbein and Monk	1.8E-03	1.8E-05	1.55	
geometric mean	1.5E-03	1.5E-05	1.30	
arithmetic mean	1.6E-03	1.6E-05	1.39	

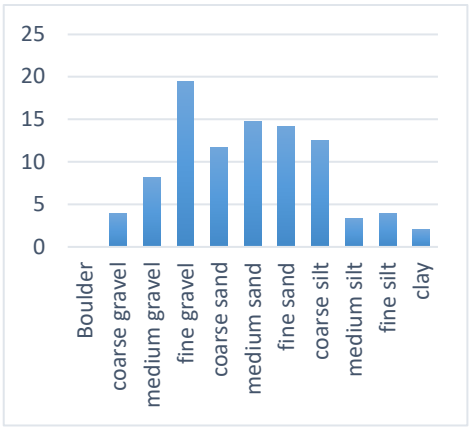
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-205-SS3

Mass Sample (g): 100 T (oC) 20

Poorly sorted gravelly sand low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
37.5	0	0	100
19	3.89	0.0389	#REF!
9.5	8.13	0.0813	#REF!
4.75	8.57	0.0857	#REF!
2	10.88	0.1088	#REF!
0.84	11.72	0.1172	#REF!
0.425	8.09	0.0809	#REF!
0.25	6.64	0.0664	#REF!
0.105	10.76	0.1076	#REF!
0.075	3.43	0.0343	#REF!
0.04	6.51	0.0651	#REF!
0.0294	2.67	0.0267	#REF!
0.0195	3.34	0.0334	#REF!
0.0115	2.01	0.0201	#REF!
0.0083	1.34	0.0134	#REF!
0.006	1.33	0.0133	#REF!
0.003	2.67	0.0267	#REF!
0.0013	2.01	0.0201	6.01

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.005	Uniformity Coef.	221.20
d17	0.024	n computed	0.26
d20	0.035	g (cm/s^2)	980.00
d50	0.491	ρ (g/cm^3)	0.9981
d60	1.156	μ (g/cm s)	0.0098
de (Kruger)	0.041	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.016	tau (Sauerbrei)	1.053
de (Zunker)	0.016	$d_{geometric\ mean}$	0.534
de (Zamarin)	0.016	σ_ϕ	4.225
lo (Alyameni)	-0.116		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	3.89
8 - 16	medium gravel	8.13
2 - 8	fine gravel	19.45
0.5 - 2	coarse sand	11.72
0.25 - 0.5	medium sand	14.73
0.063 - 0.25	fine sand	14.19
0.016 - 0.063	coarse silt	12.52
0.008 - 0.016	medium silt	3.35
0.002 - 0.008	fine silt	4
<0.002	clay	2.01

K from Grain Size Analysis Report

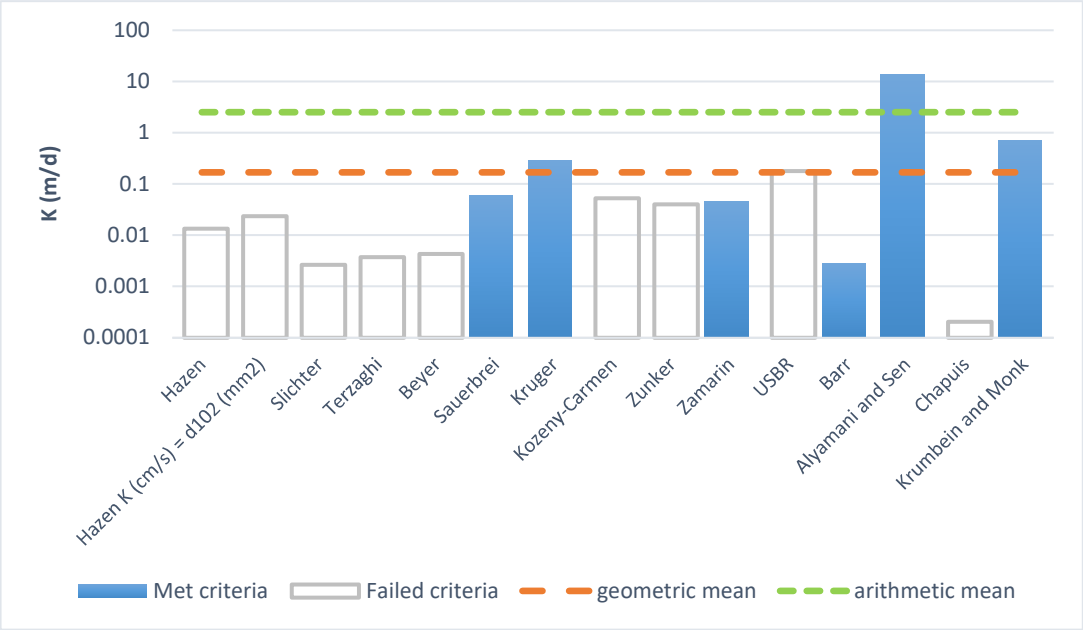
Date: 18-May-21

Sample Name: TRP-205-SS3

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



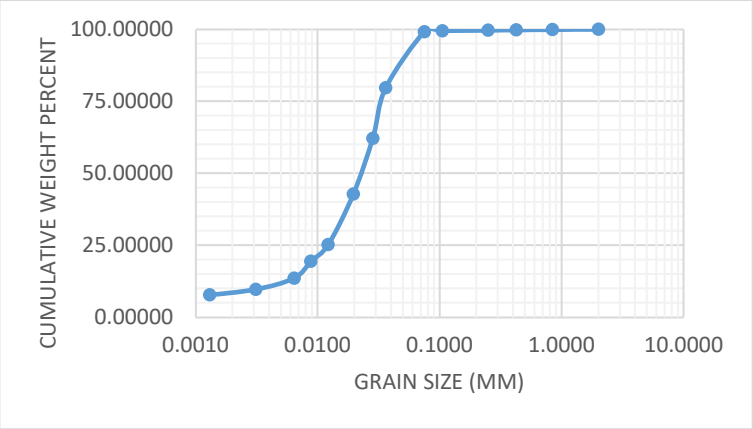
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.5E-05	1.5E-07	0.01	
Hazen K (cm/s) = d_{10} (mm)	2.7E-05	2.7E-07	0.02	
Slichter	3.0E-06	3.0E-08	0.00	
Terzaghi	4.3E-06	4.3E-08	0.00	
Beyer	5.0E-06	5.0E-08	0.00	
Sauerbrei	6.9E-05	6.9E-07	0.06	
Kruger	3.3E-04	3.3E-06	0.29	
Kozeny-Carmen	6.1E-05	6.1E-07	0.05	
Zunker	4.6E-05	4.6E-07	0.04	
Zamarin	5.4E-05	5.4E-07	0.05	
USBR	2.1E-04	2.1E-06	0.18	
Barr	3.3E-06	3.3E-08	0.00	
Alyamani and Sen	1.6E-02	1.6E-04	14.06	
Chapuis	2.3E-07	2.3E-09	0.00	
Krumbein and Monk	8.4E-04	8.4E-06	0.73	
geometric mean	2.0E-04	2.0E-06	0.17	
arithmetic mean	2.9E-03	2.9E-05	2.53	

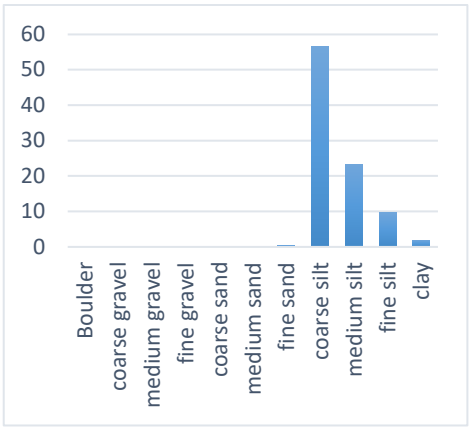
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-205-SS5

Mass Sample (g): 100 T (oC) 20

Poorly sorted silt low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
2	0	0	100
0.84	0.1	0.001	#REF!
0.425	0.1	0.001	#REF!
0.25	0.1	0.001	#REF!
0.105	0.2	0.002	#REF!
0.075	0.3	0.003	#REF!
0.0361	19.5	0.195	#REF!
0.0283	17.49	0.1749	#REF!
0.0196	19.44	0.1944	#REF!
0.0122	17.5	0.175	#REF!
0.0088	5.83	0.0583	#REF!
0.0064	5.83	0.0583	#REF!
0.0031	3.89	0.0389	#REF!
0.0013	1.94	0.0194	#REF!
			#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.003	Uniformity Coef.	8.18
d17	0.008	n computed	0.31
d20	0.009	g (cm/s^2)	980.00
d50	0.023	ρ (g/cm^3)	0.9981
d60	0.027	μ (g/cm s)	0.0098
de (Kruger)	0.017	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.009	tau (Sauerbrei)	1.053
de (Zunker)	0.009	$d_{geometric\ mean}$	0.029
de (Zamarin)	0.009	σ_ϕ	1.606
lo (Alyameni)	-0.002		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	0
0.5 - 2	coarse sand	0.1
0.25 - 0.5	medium sand	0.2
0.063 - 0.25	fine sand	0.5
0.016 - 0.063	coarse silt	56.43
0.008 - 0.016	medium silt	23.33
0.002 - 0.008	fine silt	9.72
<0.002	clay	1.94

K from Grain Size Analysis Report

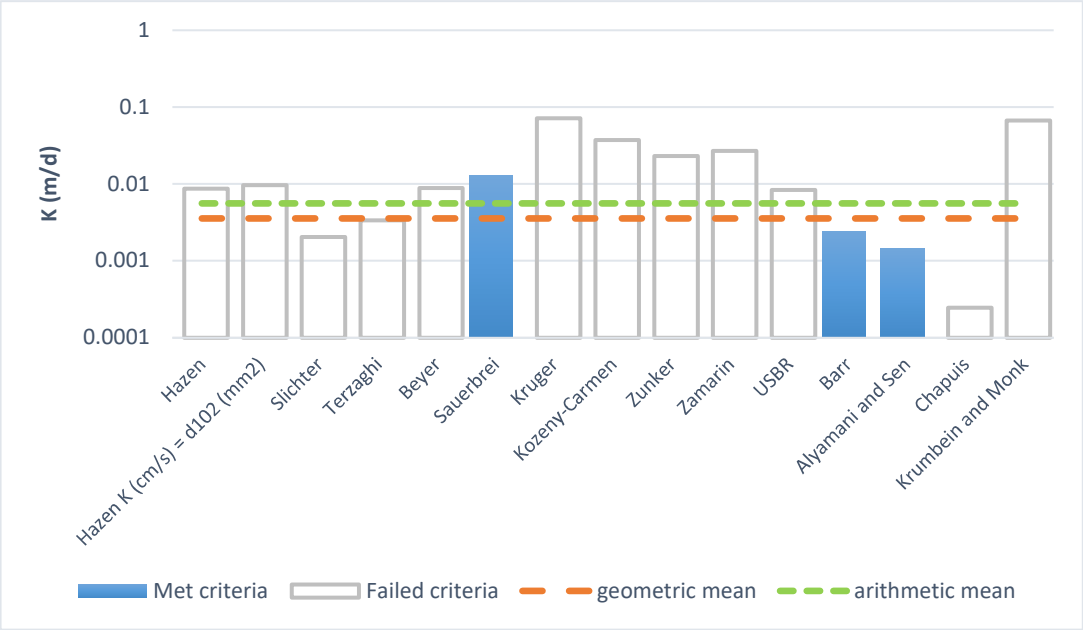
Date: 18-May-21

Sample Name: TRP-205-SS5

Mass Sample (g): 100

T (oC) 20

Poorly sorted silt low in fines



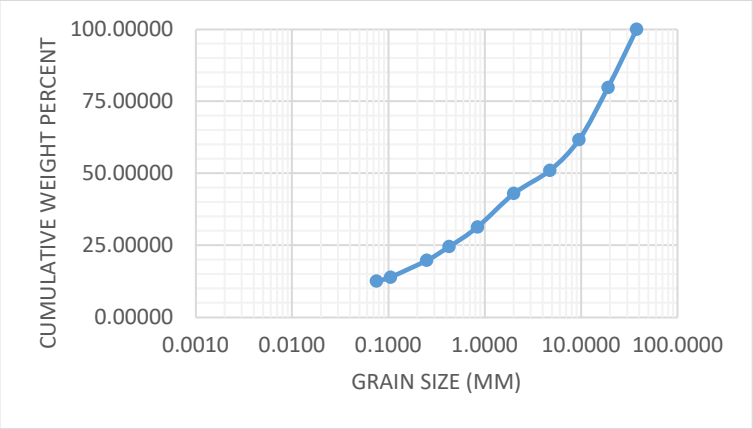
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.0E-05	1.0E-07	0.01	
Hazen K (cm/s) = d_{10} (mm)	1.1E-05	1.1E-07	0.01	
Slichter	2.4E-06	2.4E-08	0.00	
Terzaghi	3.9E-06	3.9E-08	0.00	
Beyer	1.0E-05	1.0E-07	0.01	
Sauerbrei	1.5E-05	1.5E-07	0.01	
Kruger	8.3E-05	8.3E-07	0.07	
Kozeny-Carmen	4.3E-05	4.3E-07	0.04	
Zunker	2.7E-05	2.7E-07	0.02	
Zamarin	3.1E-05	3.1E-07	0.03	
USBR	9.7E-06	9.7E-08	0.01	
Barr	2.8E-06	2.8E-08	0.00	
Alyamani and Sen	1.7E-06	1.7E-08	0.00	
Chapuis	2.8E-07	2.8E-09	0.00	
Krumbein and Monk	7.8E-05	7.8E-07	0.07	
geometric mean	4.1E-06	4.1E-08	0.00	
arithmetic mean	6.5E-06	6.5E-08	0.01	

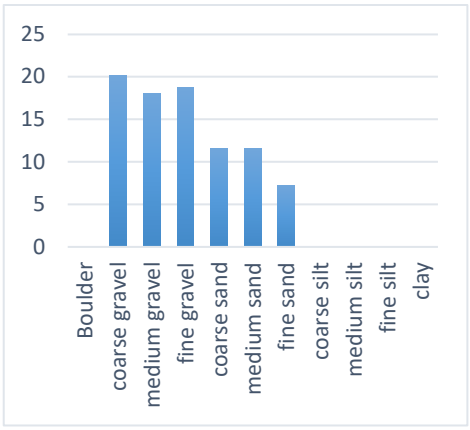
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-206-SS10

Mass Sample (g): 100 T (oC) 20

Poorly sorted sandy gravel low in fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
37.5	0	0	100
19	20.13	0.2013	#REF!
9.5	18.11	0.1811	#REF!
4.75	10.67	0.1067	#REF!
2	8.09	0.0809	#REF!
0.84	11.61	0.1161	#REF!
0.425	6.84	0.0684	#REF!
0.25	4.73	0.0473	#REF!
0.105	5.85	0.0585	#REF!
0.075	1.37	0.0137	#REF!
			#REF!
			#REF!
			#REF!
			#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.060	Uniformity Coef.	146.44
d17	0.180	n computed	0.26
d20	0.257	g (cm/s^2)	980.00
d50	4.379	ρ (g/cm^3)	0.9981
d60	8.716	μ (g/cm s)	0.0098
de (Kruger)	1.149	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	1.011	tau (Sauerbrei)	1.053
de (Zunker)	1.055	$d_{geometric\ mean}$	3.415
de (Zamarin)	1.102	σ_ϕ	3.331
lo (Alyameni)	-1.020		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	20.13
8 - 16	medium gravel	18.11
2 - 8	fine gravel	18.76
0.5 - 2	coarse sand	11.61
0.25 - 0.5	medium sand	11.57
0.063 - 0.25	fine sand	7.22
0.016 - 0.063	coarse silt	
0.008 - 0.016	medium silt	
0.002 - 0.008	fine silt	
<0.002	clay	

K from Grain Size Analysis Report

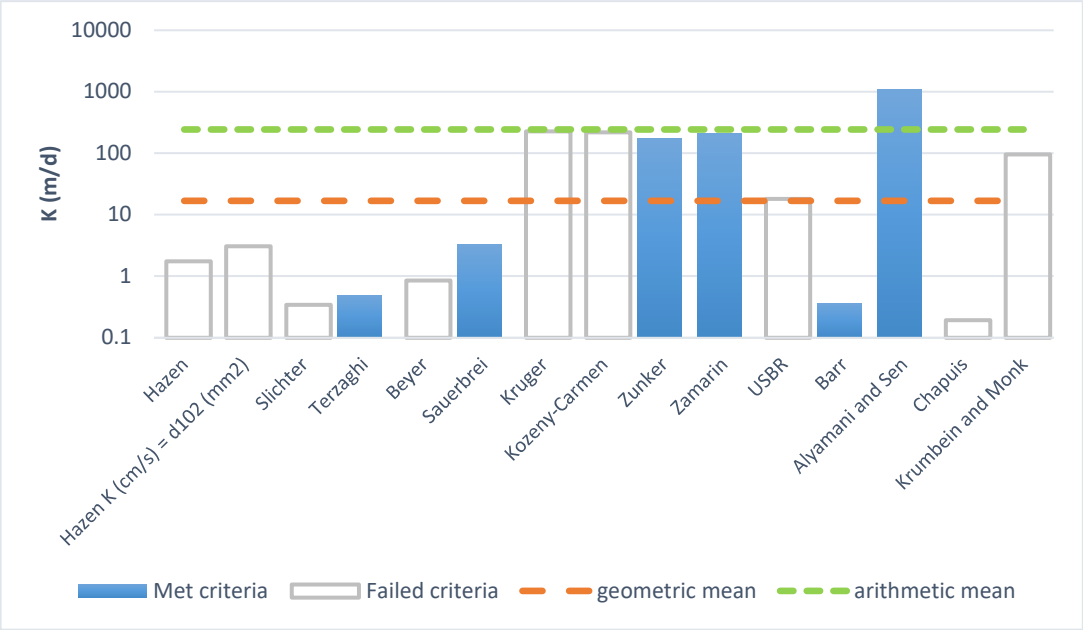
Date: 18-May-21

Sample Name: TRP-206-SS10

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy gravel low in fines



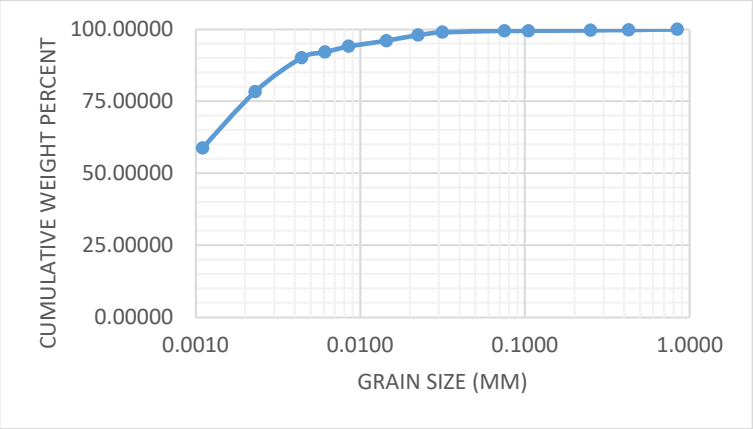
Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	2.0E-03	2.0E-05	1.73	
Hazen K (cm/s) = d_{10} (mm)	3.5E-03	3.5E-05	3.06	
Slichter	3.9E-04	3.9E-06	0.34	
Terzaghi	5.6E-04	5.6E-06	0.49	
Beyer	9.8E-04	9.8E-06	0.84	
Sauerbrei	3.8E-03	3.8E-05	3.28	
Kruger	2.6E-01	2.6E-03	226.27	
Kozeny-Carmen	2.5E-01	2.5E-03	217.31	
Zunker	2.0E-01	2.0E-03	173.31	
Zamarin	2.5E-01	2.5E-03	214.35	
USBR	2.1E-02	2.1E-04	18.04	
Barr	4.2E-04	4.2E-06	0.37	
Alyamani and Sen	1.3E+00	1.3E-02	1082.37	
Chapuis	2.2E-04	2.2E-06	0.19	
Krumbein and Monk	1.1E-01	1.1E-03	95.54	
geometric mean	2.0E-02	2.0E-04	16.91	
arithmetic mean	2.8E-01	2.8E-03	245.70	

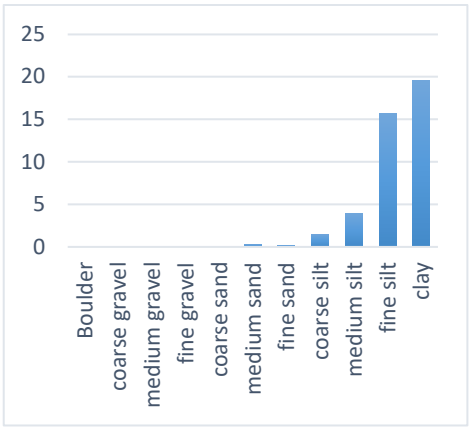
Grain Size Analysis Report Date: May 18, 2021

Sample Name: TRP-206-SS15

Mass Sample (g): 100 T (oC) 20

Poorly sorted clay with fines





Sieve opening (ps) di (mm)	Mass of retained (mr) (g)	mass fraction (mf)	Percent Passing (pp)
0.84	0	0	100
0.425	0.2	0.002	#REF!
0.25	0.1	0.001	#REF!
0.105	0.2	0.002	#REF!
0.075	0	0	#REF!
0.0315	0.49	0.0049	#REF!
0.0224	0.98	0.0098	#REF!
0.0144	1.96	0.0196	#REF!
0.0085	1.96	0.0196	#REF!
0.0061	1.96	0.0196	#REF!
0.0044	1.96	0.0196	#REF!
0.0023	11.77	0.1177	#REF!
0.0011	19.6	0.196	#REF!
			#REF!
			#REF!
			#REF!
			#REF!

Effective Grain Diameters (mm)		Other Useful Parameters	
d10	0.000	Uniformity Coef.	6.27
d17	0.000	n computed	0.33
d20	0.000	g (cm/s^2)	980.00
d50	0.001	ρ (g/cm^3)	0.9981
d60	0.001	μ (g/cm s)	0.0098
de (Kruger)	0.006	ρg/μ (1/cm s)	9.9327E+04
de (Kozeny)	0.002	tau (Sauerbrei)	1.053
de (Zunker)	0.002	$d_{geometric\ mean}$	0.094
de (Zamarin)	0.002	σ_ϕ	1.911
lo (Alyameni)	0.000		

mm	0	% in sample
>64	Boulder	
16 - 64	coarse gravel	
8 - 16	medium gravel	
2 - 8	fine gravel	
0.5 - 2	coarse sand	0
0.25 - 0.5	medium sand	0.3
0.063 - 0.25	fine sand	0.2
0.016 - 0.063	coarse silt	1.47
0.008 - 0.016	medium silt	3.92
0.002 - 0.008	fine silt	15.69
<0.002	clay	19.6

K from Grain Size Analysis Report

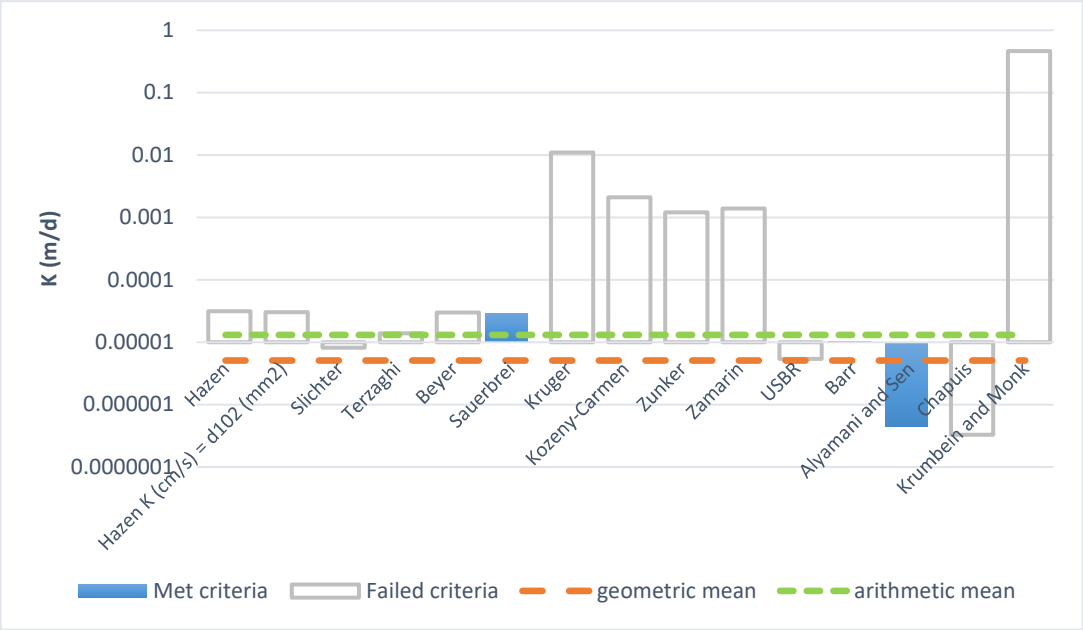
Date: 18-May-21

Sample Name: TRP-206-SS15

Mass Sample (g): 100

T (oC) 20

Poorly sorted clay with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	3.6E-08	3.6E-10	0.00	
Hazen K (cm/s) = d_{10} (mm)	3.5E-08	3.5E-10	0.00	
Slichter	9.5E-09	9.5E-11	0.00	
Terzaghi	1.6E-08	1.6E-10	0.00	
Beyer	3.4E-08	3.4E-10	0.00	
Sauerbrei	3.3E-08	3.3E-10	0.00	
Kruger	1.3E-05	1.3E-07	0.01	
Kozeny-Carmen	2.4E-06	2.4E-08	0.00	
Zunker	1.4E-06	1.4E-08	0.00	
Zamarin	1.6E-06	1.6E-08	0.00	
USBR	6.3E-09	6.3E-11	0.00	
Barr	1.2E-08	1.2E-10	0.00	
Alyamani and Sen	5.3E-10	5.3E-12	0.00	
Chapuis	3.8E-10	3.8E-12	0.00	
Krumbein and Monk	5.4E-04	5.4E-06	0.47	
geometric mean	5.9E-09	5.9E-11	0.00	
arithmetic mean	1.5E-08	1.5E-10	0.00	

K from Grain Size Analysis Report

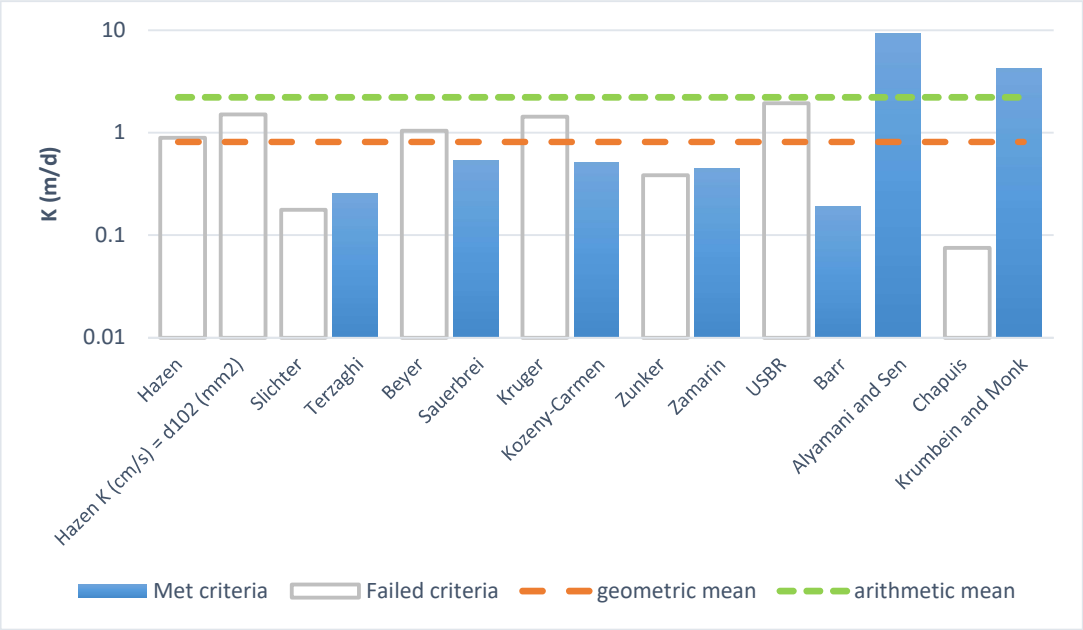
Date: 06-Oct-21

Sample Name: BH 302

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	1.0E-03	1.0E-05	0.89	
Hazen K (cm/s) = d_{10} (mm)	1.8E-03	1.8E-05	1.51	
Slichter	2.0E-04	2.0E-06	0.18	
Terzaghi	3.0E-04	3.0E-06	0.25	
Beyer	1.2E-03	1.2E-05	1.05	
Sauerbrei	6.2E-04	6.2E-06	0.53	
Kruger	1.7E-03	1.7E-05	1.44	
Kozeny-Carmen	5.9E-04	5.9E-06	0.51	
Zunker	4.4E-04	4.4E-06	0.38	
Zamarin	5.2E-04	5.2E-06	0.45	
USBR	2.2E-03	2.2E-05	1.94	
Barr	2.2E-04	2.2E-06	0.19	
Alyamani and Sen	1.1E-02	1.1E-04	9.35	
Chapuis	8.7E-05	8.7E-07	0.08	
Krumbein and Monk	4.9E-03	4.9E-05	4.26	
geometric mean	9.4E-04	9.4E-06	0.81	
arithmetic mean	2.6E-03	2.6E-05	2.22	

K from Grain Size Analysis Report

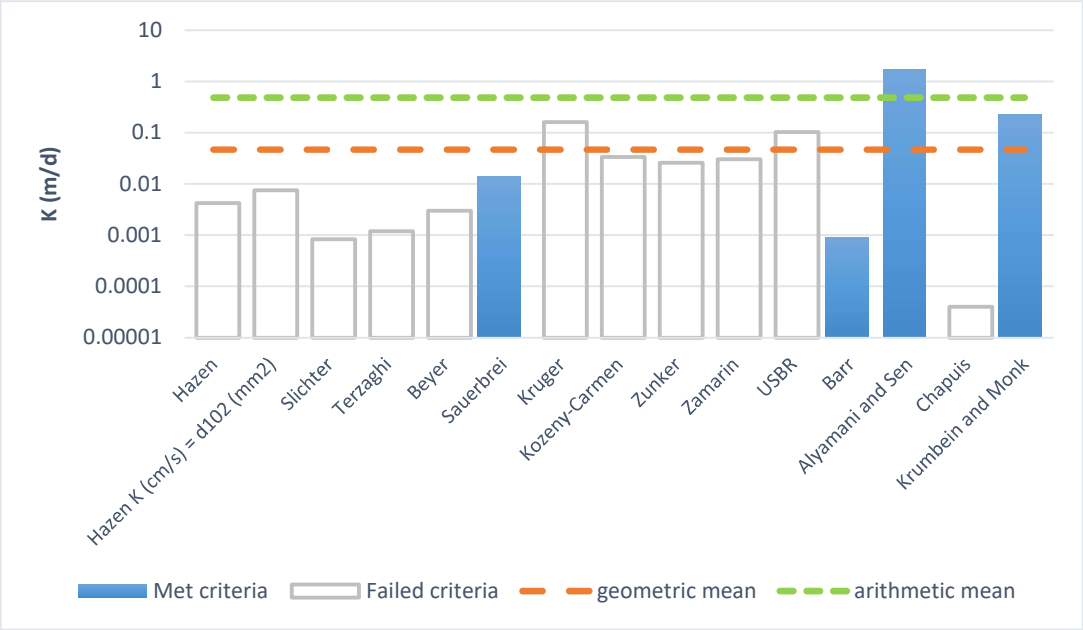
Date: 06-Oct-21

Sample Name: BH 303

Mass Sample (g): 100

T (oC) 20

Poorly sorted gravelly sand with fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	4.9E-06	4.9E-08	0.00	
Hazen K (cm/s) = d_{10} (mm)	8.6E-06	8.6E-08	0.01	
Slichter	9.6E-07	9.6E-09	0.00	
Terzaghi	1.4E-06	1.4E-08	0.00	
Beyer	3.4E-06	3.4E-08	0.00	
Sauerbrei	1.6E-05	1.6E-07	0.01	
Kruger	1.9E-04	1.9E-06	0.16	
Kozeny-Carmen	3.9E-05	3.9E-07	0.03	
Zunker	3.0E-05	3.0E-07	0.03	
Zamarin	3.5E-05	3.5E-07	0.03	
USBR	1.2E-04	1.2E-06	0.10	
Barr	1.0E-06	1.0E-08	0.00	
Alyamani and Sen	2.0E-03	2.0E-05	1.70	
Chapuis	4.6E-08	4.6E-10	0.00	
Krumbein and Monk	2.7E-04	2.7E-06	0.23	
geometric mean	5.4E-05	5.4E-07	0.05	
arithmetic mean	5.6E-04	5.6E-06	0.49	

K from Grain Size Analysis Report

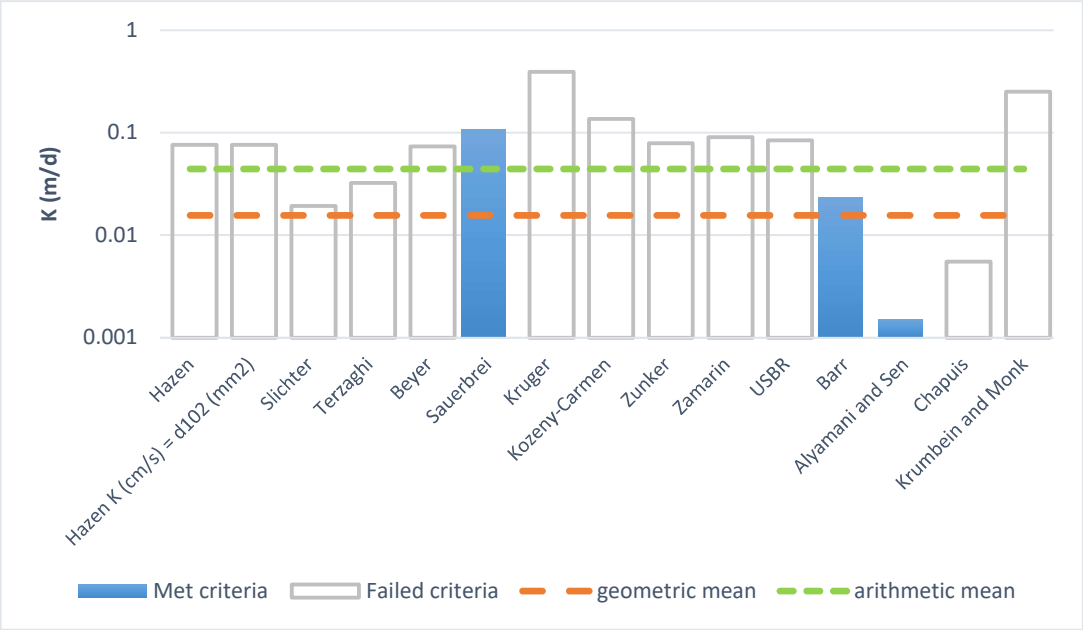
Date: 06-Oct-21

Sample Name: BH 304

Mass Sample (g): 100

T (oC) 20

Poorly sorted sandy silt low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	8.8E-05	8.8E-07	0.08	
Hazen K (cm/s) = d_{10} (mm)	8.8E-05	8.8E-07	0.08	
Slichter	2.2E-05	2.2E-07	0.02	
Terzaghi	3.7E-05	3.7E-07	0.03	
Beyer	8.5E-05	8.5E-07	0.07	
Sauerbrei	1.3E-04	1.3E-06	0.11	
Kruger	4.5E-04	4.5E-06	0.39	
Kozeny-Carmen	1.6E-04	1.6E-06	0.14	
Zunker	9.2E-05	9.2E-07	0.08	
Zamarin	1.0E-04	1.0E-06	0.09	
USBR	9.8E-05	9.8E-07	0.08	
Barr	2.7E-05	2.7E-07	0.02	
Alyamani and Sen	1.7E-06	1.7E-08	0.00	
Chapuis	6.4E-06	6.4E-08	0.01	
Krumbein and Monk	2.9E-04	2.9E-06	0.25	
geometric mean	1.8E-05	1.8E-07	0.02	
arithmetic mean	5.1E-05	5.1E-07	0.04	

K from Grain Size Analysis Report

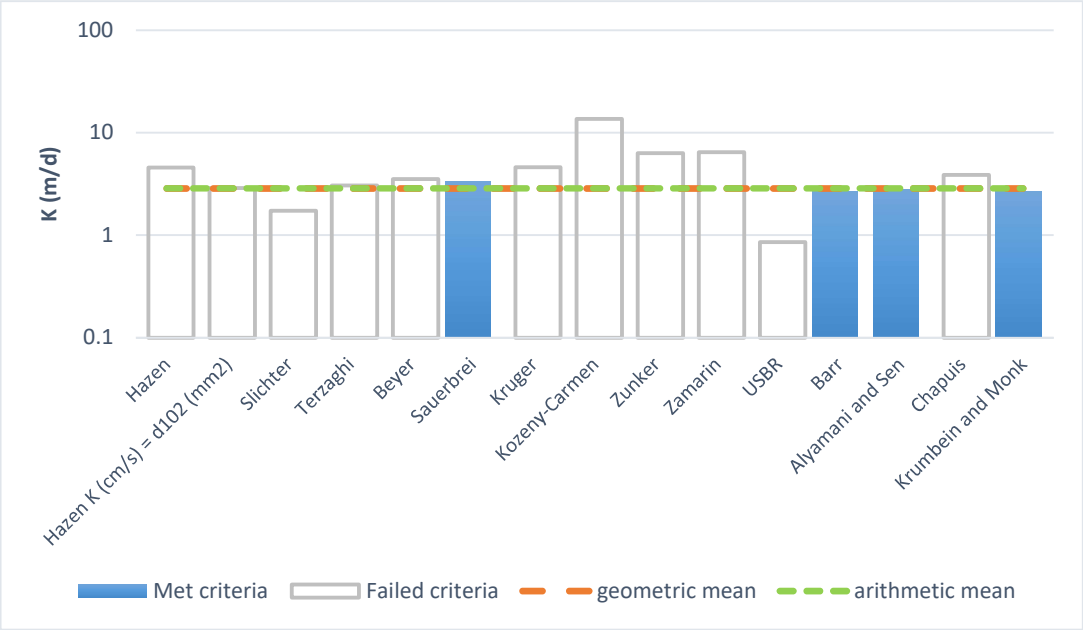
Date: 06-Oct-21

Sample Name: BH 305

Mass Sample (g): 100

T (oC) 20

Moderately well sorted sand low in fines



Estimation of Hydraulic Conductivity	cm/s	m/s	m/d	de
Hazen	5.3E-03	5.3E-05	4.58	
Hazen K (cm/s) = d_{10} (mm)	3.3E-03	3.3E-05	2.89	
Slichter	2.0E-03	2.0E-05	1.73	
Terzaghi	3.5E-03	3.5E-05	3.05	
Beyer	4.1E-03	4.1E-05	3.53	
Sauerbrei	3.9E-03	3.9E-05	3.35	
Kruger	5.3E-03	5.3E-05	4.60	
Kozeny-Carmen	1.6E-02	1.6E-04	13.67	
Zunker	7.3E-03	7.3E-05	6.33	
Zamarin	7.5E-03	7.5E-05	6.44	
USBR	9.9E-04	9.9E-06	0.85	
Barr	3.1E-03	3.1E-05	2.70	
Alyamani and Sen	3.2E-03	3.2E-05	2.77	
Chapuis	4.5E-03	4.5E-05	3.87	
Krumbein and Monk	3.1E-03	3.1E-05	2.66	
geometric mean	3.3E-03	3.3E-05	2.86	
arithmetic mean	3.3E-03	3.3E-05	2.87	

APPENDIX L

Guelph Permeameter

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**
Enter water Head Height ("H" in cm): **5**
Enter the Borehole Radius ("a" in cm): **3**

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

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

Steady State Rate of Water Level Change ("R" in cm/min): **0.1000**

Res Type 35.22
H 5
a 3
H/a 1.667
a* 0.12
C0.01 0.809
C0.04 0.842
C0.12 0.803
C0.36 0.803
C 0.803
R 0.100
Q 0.059
pi 3.142

α^*= **0.12** cm^{-1}

C = **0.803154**
Q = **0.0587**

K_{fs} = **1.07E-04** *cm/sec*
6.41E-03 *cm/min*
1.07E-06 *m/sec*
2.52E-03 *inch/min*
4.20E-05 *inch/sec*

Φ_m = **8.90E-04** cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**
Enter water Head Height ("H" in cm): **10**
Enter the Borehole Radius ("a" in cm): **3**

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

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

Steady State Rate of Water Level Change ("R" in cm/min): **0.2000**

Res Type 35.22
H 10
a 3
H/a 3.33333
a* 0.12
C0.01 1.21841
C0.04 1.29023
C0.12 1.28754
C0.36 1.28754
C 1.28754
R 0.200
Q 0.1174
pi 3.1415

α^*= **0.12** cm^{-1}

C = **1.287543**
Q = **0.1174**

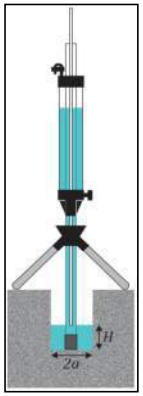
K_{fs} = **1.27E-04** *cm/sec*
7.63E-03 *cm/min*
1.27E-06 *m/ses*
3.00E-03 *inch/min*
5.01E-05 *inch/sec*

Φ_m = **1.06E-03** cm^2/min

Average

K_{fs} = **1.17E-04** *cm/sec*
7.02E-03 *cm/min*
1.17E-06 *m/s*
2.76E-03 *inch/min*
4.61E-05 *inch/sec*

Φ_m = **9.75E-04** cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**

Enter the first water Head Height ("H1" in cm): **5**
Enter the second water Head Height ("H2" in cm): **10**

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

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

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

α^*= **0.12** cm^{-1}

α= **0.4292**

Steady State Rate of Water Level Change ("R1" in cm/min): **0.1000**
Steady State Rate of Water Level Change ("R2" in cm/min): **0.2000**

Q_1 = **0.0587**

Q_2 = **0.1174**

Res Type: 35.22
H1/a: 1.666667
H2/a: 3.333333
C1-0.01: 0.809485
C2-0.01: 1.21841
C1-0.04: 0.842059
C2-0.04: 1.290234
C1-0.12: 0.803154
C2-0.12: 1.287543
C1-0.36: 0.803154
C2-0.36: 1.287543
G-Denominator: 1525.687

C_1 = **0.803154**

C_2 = **1.287543**

G_1 = **0.005264**

G_2 = **0.00422**

G_3 = **0.055692**

G_4 = **0.024148**

K_{fs} = **1.86E-04** *cm/sec*
1.12E-02 *cm/min*
1.86E-06 *m/sec*
4.40E-03 *inch/min*
7.34E-05 *inch/sec*

Φ_m = **4.34E-04** cm^2/min

Θ_{fs} = **0.65** cm^3/cm^3

Θ_i = **0.4** cm^3/cm^3

Sorptivity **0.0147** $(cm\ min^{-.5})$

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

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

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

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

Guelph Permeameter

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

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

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

Steady State Rate of Water Level Change ("R" in cm/min): 0.1000

Res Type	35.22
H	5
a	3
H/a	1.667
a*	0.12
C0.01	0.809
C0.04	0.842
C0.12	0.803
C0.36	0.803
C	0.803
R	0.100
Q	0.059
pi	3.142

α^*= 0.12 cm^{-1}

C = 0.803154
Q = 0.0587

K_{fs} = 1.07E-04 cm/sec
6.41E-03 cm/min
1.07E-06 m/sec
2.52E-03 inch/min
4.20E-05 inch/sec

Φ_m = 8.90E-04 cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

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

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

Steady State Rate of Water Level Change ("R" in cm/min): 0.3000

Res Type	35.22
H	10
a	3
H/a	3.33333
a*	0.12
C0.01	1.21841
C0.04	1.29023
C0.12	1.28754
C0.36	1.28754
C	1.28754
R	0.300
Q	0.1761
pi	3.1415

α^*= 0.12 cm^{-1}

C = 1.287543
Q = 0.1761

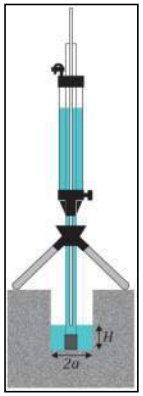
K_{fs} = 1.91E-04 cm/sec
1.14E-02 cm/min
1.91E-06 m/ses
4.51E-03 inch/min
7.51E-05 inch/sec

Φ_m = 1.59E-03 cm^2/min

Average

K_{fs} = 1.49E-04 cm/sec
8.93E-03 cm/min
1.49E-06 m/s
3.51E-03 inch/min
5.86E-05 inch/sec

Φ_m = 1.24E-03 cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): 35.22

Enter the first water Head Height ("H1" in cm): 5
Enter the second water Head Height ("H2" in cm): 10

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

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

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

α^*= 0.12 cm^{-1}

α= -0.4414

Steady State Rate of Water Level Change ("R1" in cm/min): 0.1000
Steady State Rate of Water Level Change ("R2" in cm/min): 0.3000

Q_1 = 0.0587

Q_2 = 0.1761

Res Type:	35.22
H1/a:	1.666667
H2/a:	3.333333
C1-0.01:	0.809485
C2-0.01:	1.21841
C1-0.04:	0.842059
C2-0.04:	1.290234
C1-0.12:	0.803154
C2-0.12:	1.287543
C1-0.36:	0.803154
C2-0.36:	1.287543
G-Denominator:	1525.687

C_1 = 0.803154
C_2 = 1.287543
G_1 = 0.005264
G_2 = 0.00422
G_3 = 0.055692
G_4 = 0.024148

K_{fs} = 4.34E-04 cm/sec
2.60E-02 cm/min
4.34E-06 m/sec
1.03E-02 inch/min
1.71E-04 inch/sec

Φ_m = -9.83E-04 cm^2/min

Θ_{fs} = 0.65 cm^3/cm^3

Θ_i = 0.4 cm^3/cm^3

Sorptivity #NUM! $(cm\ min^{-.5})$

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

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

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

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

Guelph Permeameter

Input

Result

Single Head Method (1)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**
Enter water Head Height ("H" in cm): **5**
Enter the Borehole Radius ("a" in cm): **3**

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

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

Steady State Rate of Water Level Change ("R" in cm/min): **0.3000**

Res Type	35.22	
H	5	
a	3	
H/a	1.667	
a*	0.12	
C0.01	0.809	
C0.04	0.842	
C0.12	0.803	
C0.36	0.803	
C	0.803	
R	0.300	
Q	0.176	
pi	3.142	

α^*= **0.12** cm^{-1}

C = **0.803154**
Q = **0.1761**

K_{fs} = **3.20E-04** *cm/sec*
1.92E-02 *cm/min*
3.20E-06 *m/sec*
7.57E-03 *inch/min*
1.26E-04 *inch/sec*

Φ_m = **2.67E-03** cm^2/min

Single Head Method (2)

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**
Enter water Head Height ("H" in cm): **10**
Enter the Borehole Radius ("a" in cm): **3**

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

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

Steady State Rate of Water Level Change ("R" in cm/min): **0.9000**

Res Type	35.22	
H	10	
a	3	
H/a	3.33333	
a*	0.12	
C0.01	1.21841	
C0.04	1.29023	
C0.12	1.28754	
C0.36	1.28754	
C	1.28754	
R	0.900	
Q	0.5283	
pi	3.1415	

α^*= **0.12** cm^{-1}

C = **1.287543**
Q = **0.5283**

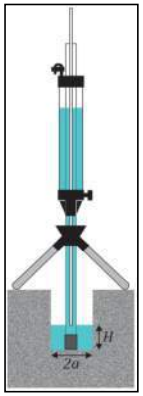
K_{fs} = **5.72E-04** *cm/sec*
3.43E-02 *cm/min*
5.72E-06 *m/ses*
1.35E-02 *inch/min*
2.25E-04 *inch/sec*

Φ_m = **4.77E-03** cm^2/min

Average

K_{fs} = **4.46E-04** *cm/sec*
2.68E-02 *cm/min*
4.46E-06 *m/s*
1.05E-02 *inch/min*
1.76E-04 *inch/sec*

Φ_m = **3.72E-03** cm^2/min



Double Head Method

Reservoir Cross-sectional area in cm^2 (enter "35.22" for Combined and "2.16" for Inner reservoir): **35.22**

Enter the first water Head Height ("H1" in cm): **5**
Enter the second water Head Height ("H2" in cm): **10**

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

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

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

α^*= **0.12** cm^{-1}

α= **-0.4414**

Steady State Rate of Water Level Change ("R1" in cm/min): **0.3000**
Steady State Rate of Water Level Change ("R2" in cm/min): **0.9000**

Q_1 = 0.1761

Q_2 = 0.5283

Res Type:	35.22
H1/a:	1.666667
H2/a:	3.333333
C1-0.01:	0.809485
C2-0.01:	1.21841
C1-0.04:	0.842059
C2-0.04:	1.290234
C1-0.12:	0.803154
C2-0.12:	1.287543
C1-0.36:	0.803154
C2-0.36:	1.287543
G-Denominator:	1525.687

C_1 = 0.803154

C_2 = 1.287543

G_1 = 0.005264

G_2 = 0.00422

G_3 = 0.055692

G_4 = 0.024148

K_{fs} = **1.30E-03** *cm/sec*
7.81E-02 *cm/min*
1.30E-05 *m/sec*
3.08E-02 *inch/min*
5.13E-04 *inch/sec*

Φ_m = **-2.95E-03** cm^2/min

Θ_{fs} = **0.65** cm^3/cm^3

Θ_i = **0.4** cm^3/cm^3

Sorptivity **#NUM!** $(cm\ min^{-.5})$

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

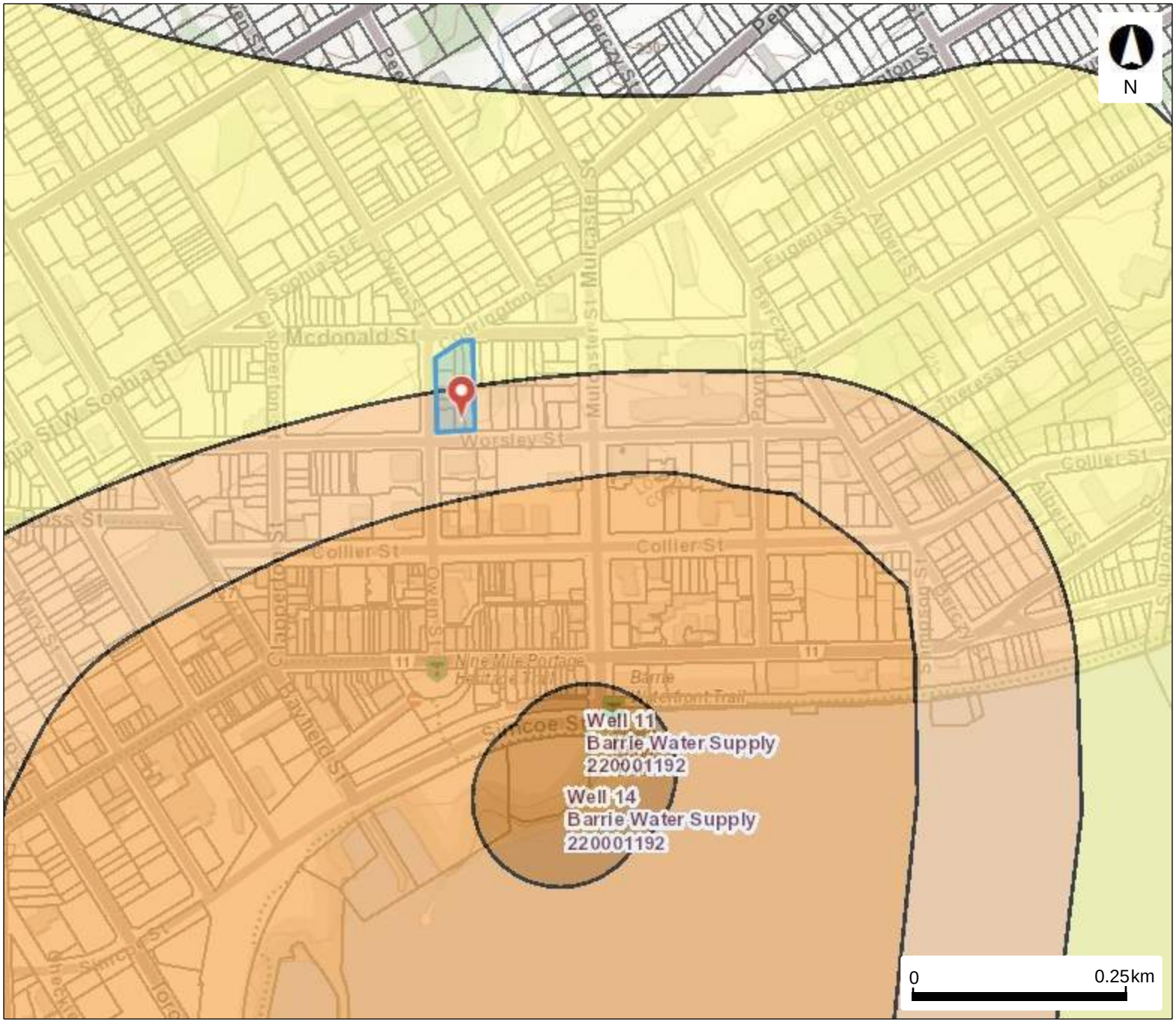
Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured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

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

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

APPENDIX M

Wellhead Protection Area



Legend

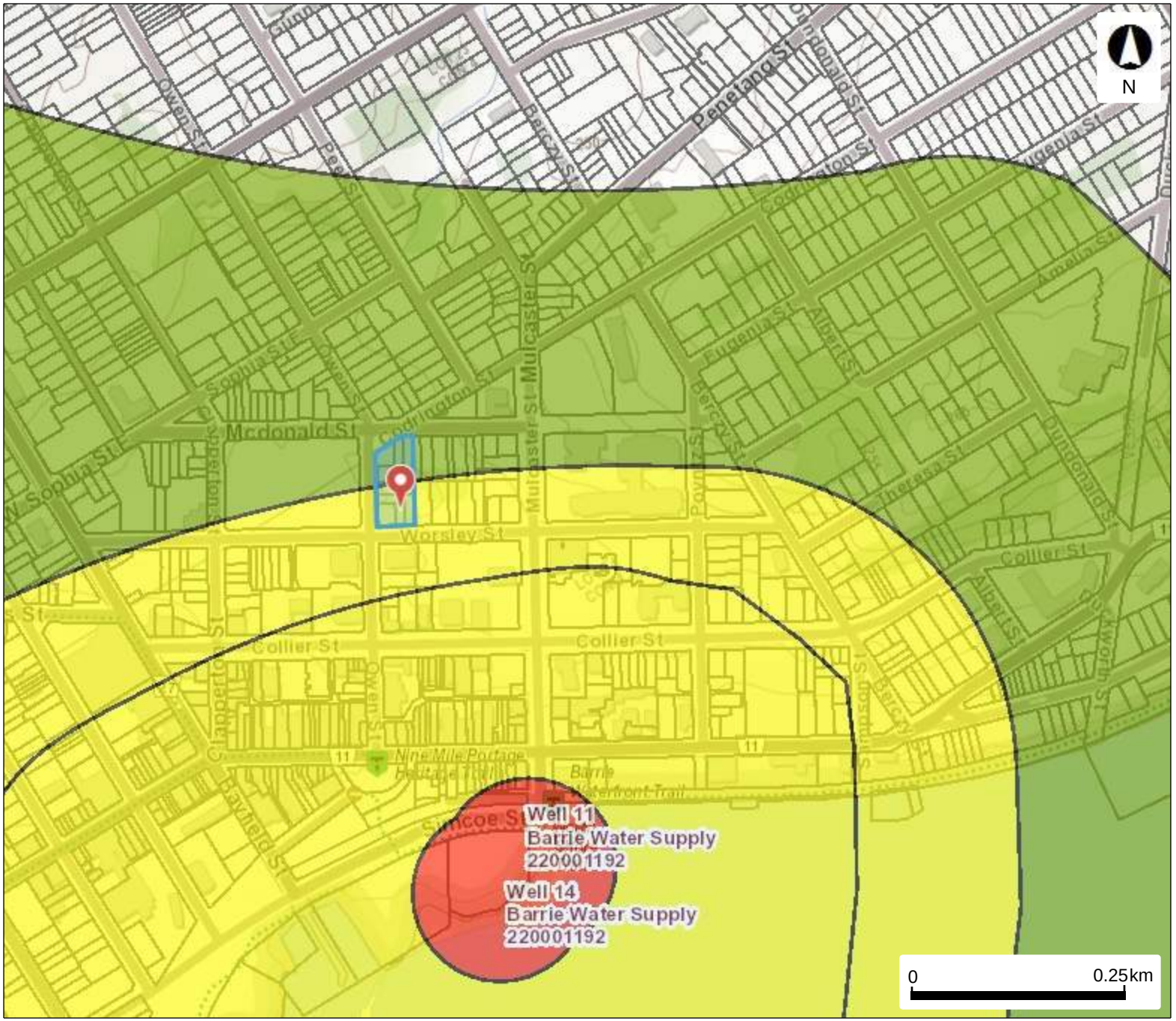
- Wellhead Protection Area Nam
- Wellhead Protection Area
  - A
  - B
  - C
  - C1
  - D
  - F
- Event Based Areas
- Assessment Parcel

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

Ontario

Map Created: 5/19/2021
Map Center: 44.39081 N, -79.68561 W

Vulnerable Scoring Area - Ground Water



Legend

- Wellhead Protection Area Nam
- Vulnerable Scoring Area - Groundwater
  - 2
  - 4
  - 6
  - 8
  - 10
- Assessment Parcel

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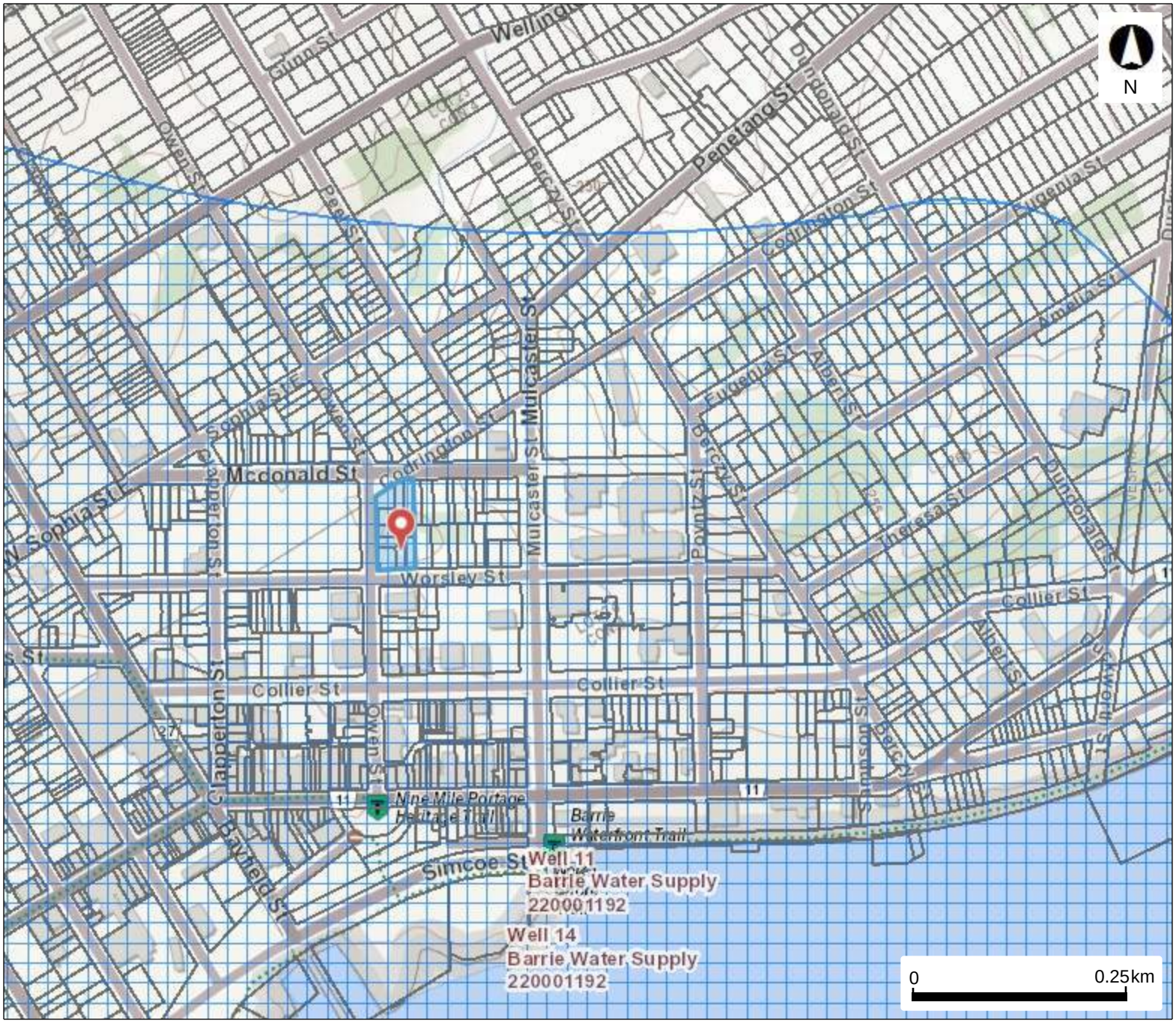
Ontario

Map Created: 5/19/2021
Map Center: 44.39179 N, -79.68476 W

Issue Contributing Area



Legend

- Wellhead Protection Area Nam
- Issue Contributing Areas
- Event Based Areas
- Assessment Parcel

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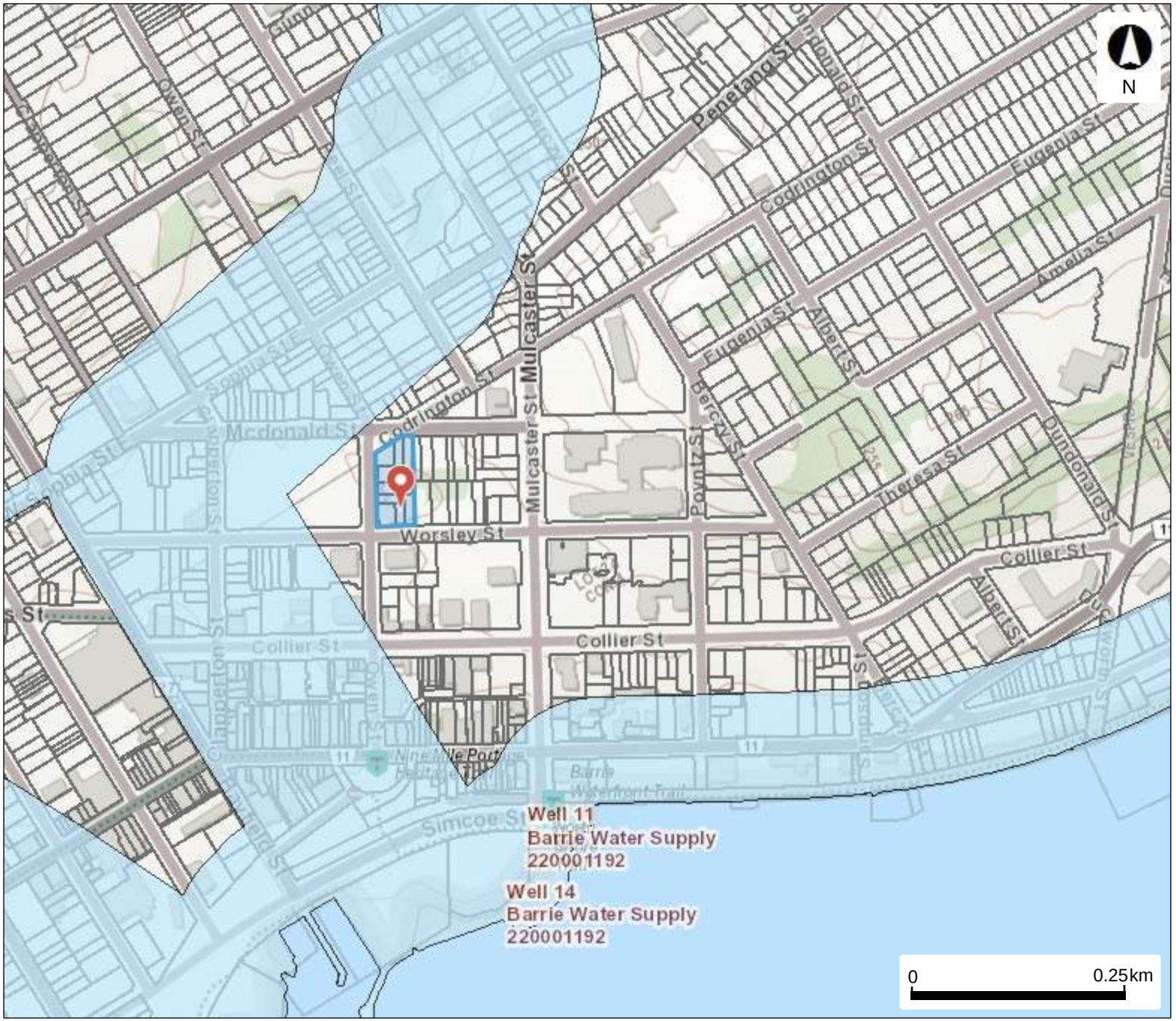
Ontario

Map Created: 5/19/2021
Map Center: 44.39222 N, -79.68476 W

Intake Protection Zone



Legend

- Wellhead Protection Area Nam
- Intake Protection Zone Name
- Intake Protection Zone 1
- Event Based Areas
- Intake Protection Zone 2
- Intake Protection Zone 3
- Assessment Parcel

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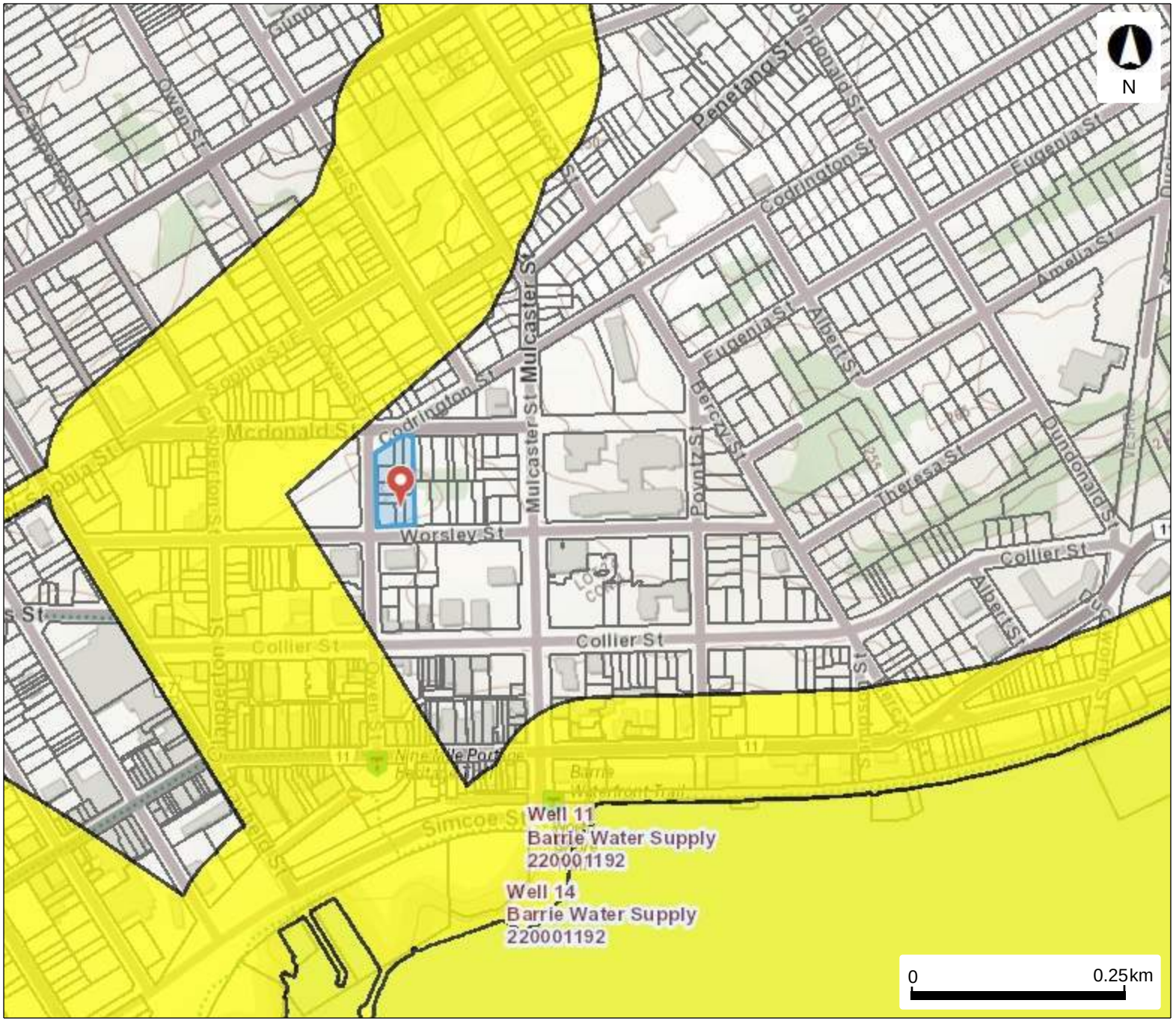
Ontario

Map Created: 5/19/2021
Map Center: 44.39179 N, -79.68476 W

Vulnerable Scoring Area - Surface Water



Legend

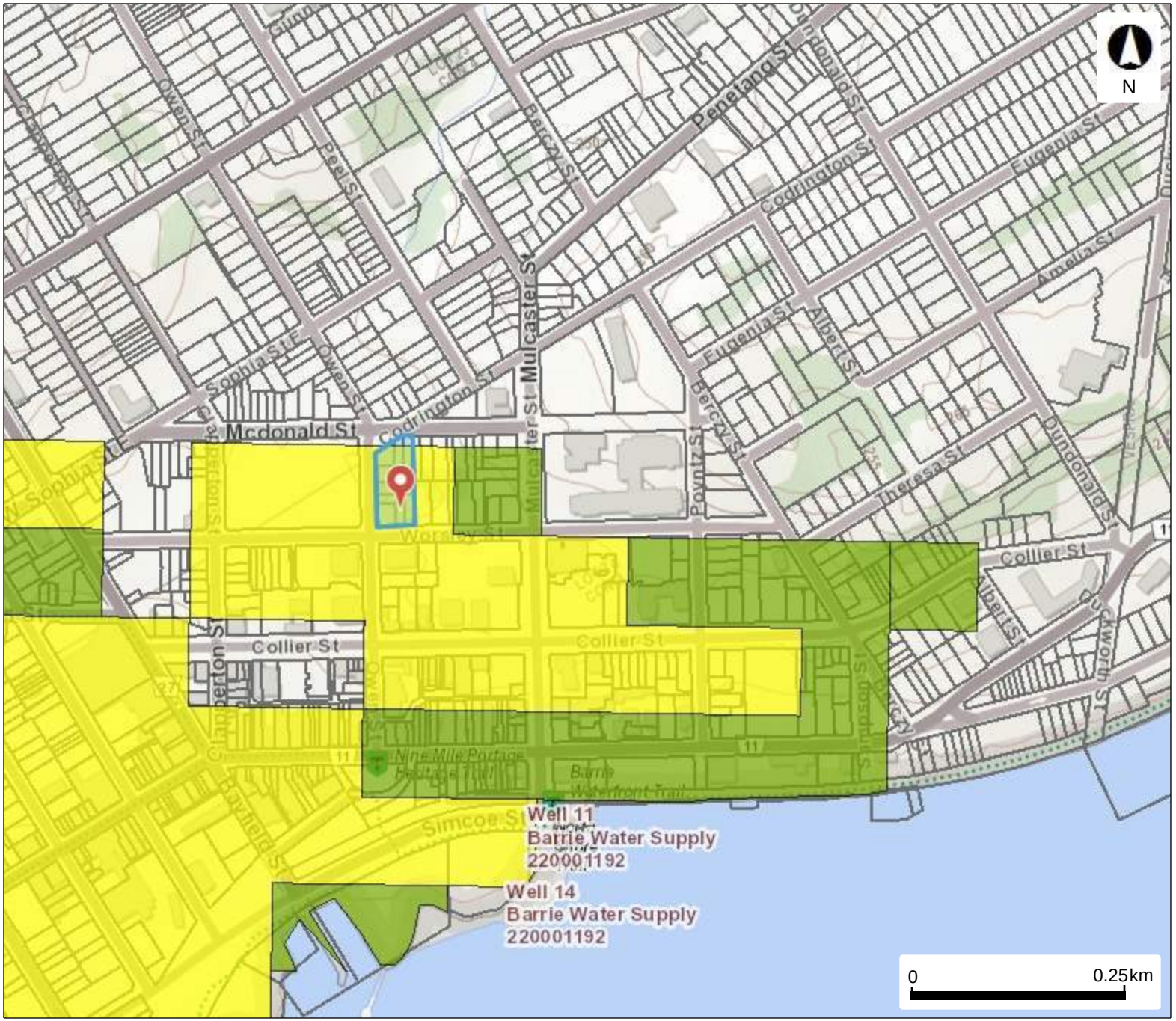
- Wellhead Protection Area Nam
- Event Based Areas
- Vulnerable Scoring Area - Surface Water
  - 0 - 3.9
  - 4 - 7.9
  - 8 - 8.9
  - 9 - 10
- Assessment Parcel

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

Ontario

Map Created: 5/19/2021
Map Center: 44.39179 N, -79.68476 W

Significant Groundwater Recharge Area



Legend

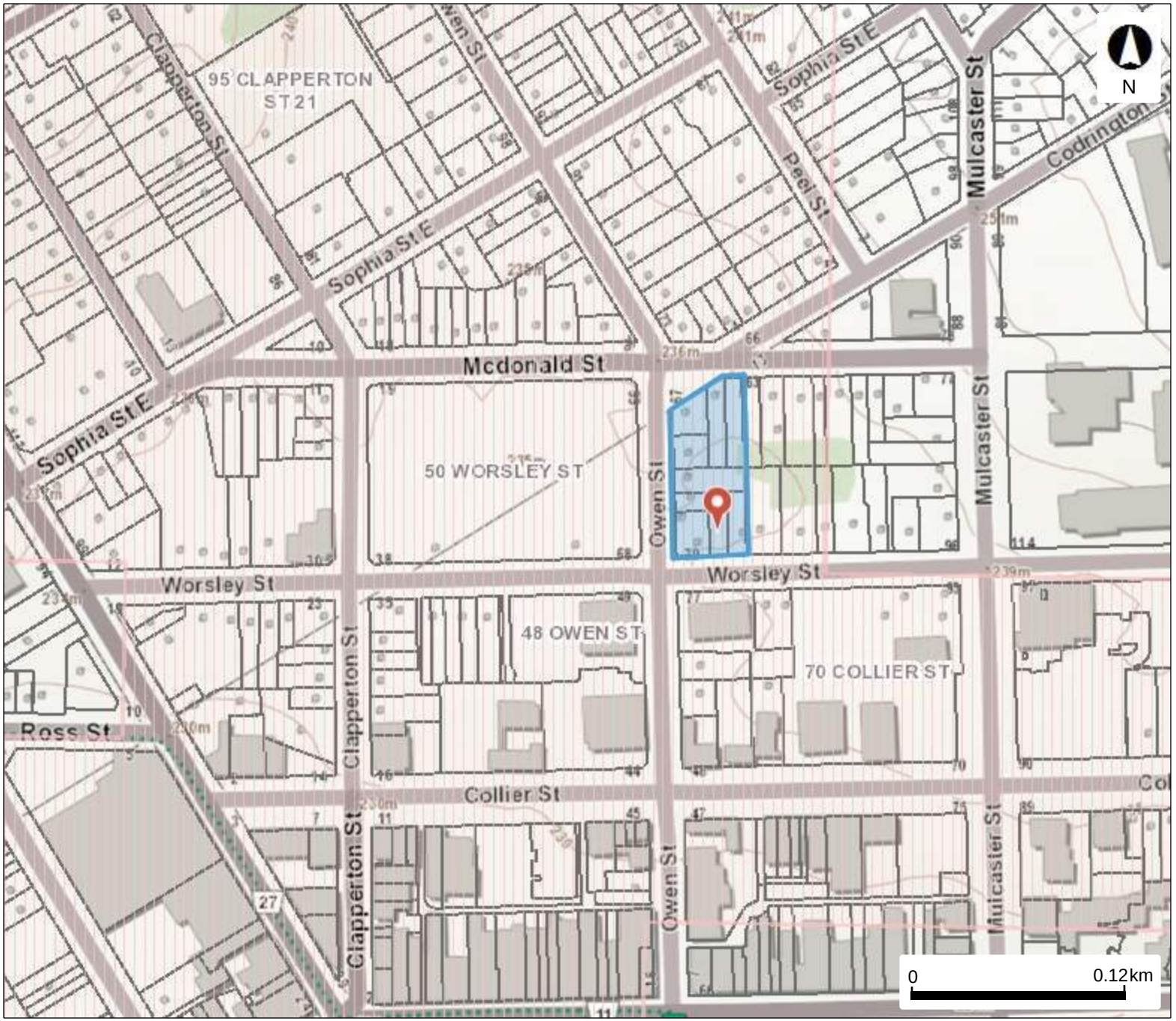
- Wellhead Protection Area Nam
- Significant Groundwater Recharge Area
  - 0
  - 2
  - 4
  - 6
- Assessment Parcel

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

Ontario

Map Created: 5/19/2021
Map Center: 44.39179 N, -79.68476 W

Highly Vulnerable Aquifer



Legend

- Wellhead Protection Area Nam
- Highly Vulnerable Aquifers
- Assessment Parcel

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

Ontario

Map Created: 5/19/2021
Map Center: 44.39187 N, -79.68839 W

OFFICIAL PLAN
Schedule F
Conservation Authority Regulation Limits
Office Consolidation
January 2018

Watercourse

30 Metre Watercourse Setback

Waterbody

Lake Simcoe Region Conservation Authority Regulation Limits

Nottawasaga Valley Conservation Authority Regulation Limits

Lake Simcoe Regional Conservation Authority

Nottawasaga Valley Conservation Authority

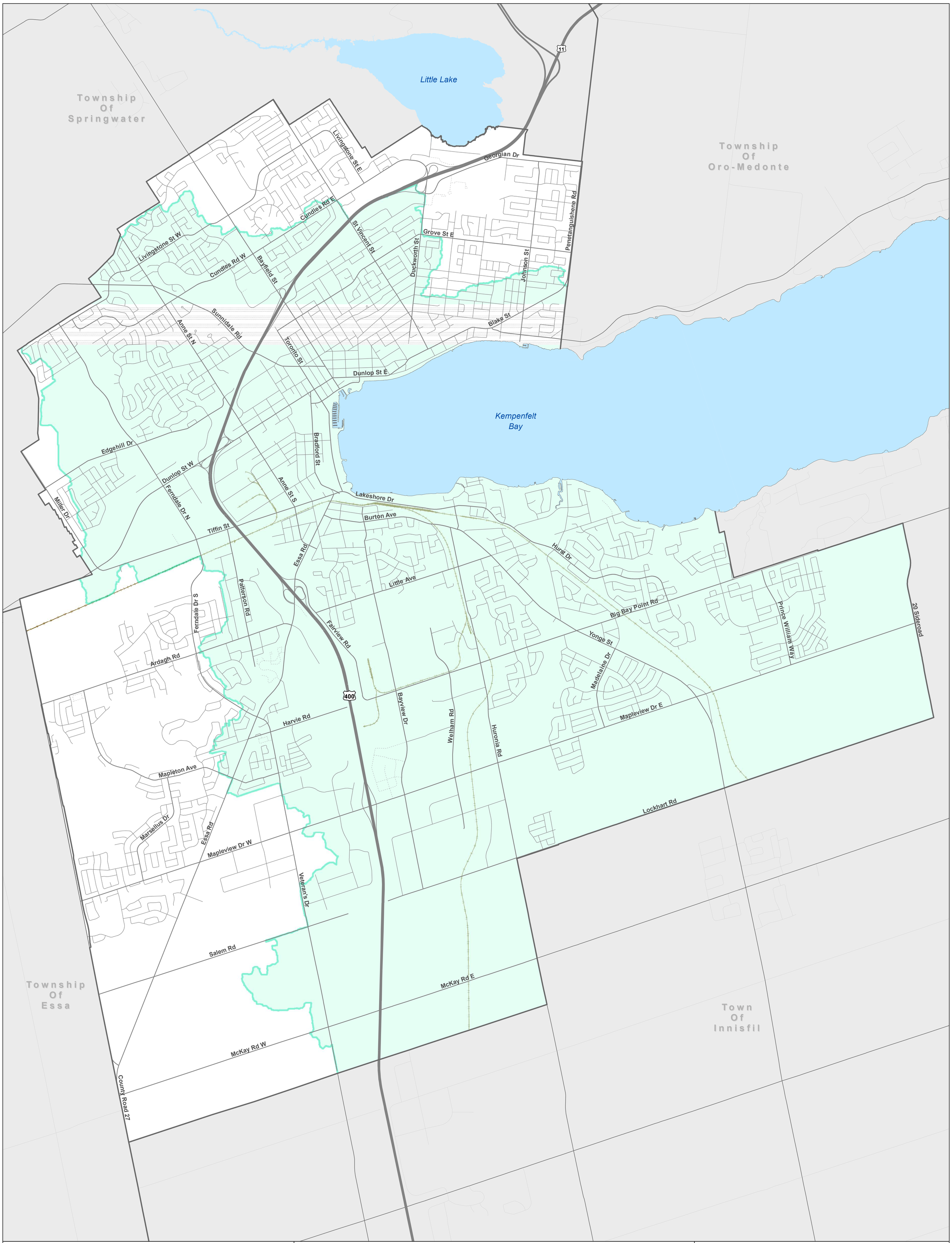
Barrie

1:20,000

0 0.5 1 2 km

N

GIS Branch 4/26/2018



OFFICIAL PLAN

Schedule J
Lake Simcoe Watershed

Office Consolidation
January 2018

Lake Simcoe Watershed Boundary

1:20,000

0 0.5 1 2 km

N

GIS Branch 4/26/2018

Appendix N

Water Balance - 67 Owen Street, Barrie, ON

1. Climate Information

Precipitation	952	mm/a	0.95 m/a *
Evapotranspiration	446	mm/a	0.45 m/a *
Water Surplus	506	mm/a	0.51 m/a

2. Infiltration Rates

Seletcted Approach **Table 3**

Table 2 Approach - Infiltration Factors

Topography - Flat land	0.3	*
Soil - Open Sandy Loam	0.4	*
Cover - Cultivated lands	0.1	*
TOTAL:	0.8	

Infiltration (Infil. Fac - Water Surplus)	404.8	mm/a	0.4048 m/a
Run-off (Water Surplus - B19)	101.2	mm/a	0.1012 m/a

Table 3 Approach - Typical Recharge Rates

coarse sand and gravel	250+	mm/a *
fine to medium sand	200 - 250	mm/a *
silty sand to sandy silt	150 - 200	mm/a *
silt	125 - 150	mm/a *
clayey silt	100 - 125	mm/a *
clay	< 100	mm/a *

The site development area is underlain by sands to sandy silt till

Based on the above, the recharge rate is	200	mm/a	0.200 m/a
with runoff of	306	mm/a	0.306 m/a

3. Property Statistics - Pre-development

Area Covered by Existing Building	713	m^2	0.07 ha
Area Covered by Existing Hard Surface Paving	1,483	m^2	0.15 ha
Area Covered by Existing Landscaped area	1,857	m^2	0.19 ha
TOTAL	4,053	m^2	0.41 ha

4. Property Statistics - Post-development

Area Covered by Building with Additions	3,452	m^2	0.35 ha
Area Covered by Hard Surface Paving	347	m^2	0.03 ha
Area Covered by Landscaped Area	254	m^2	0.03 ha
TOTAL:	4,053	m^2	0.41 ha

*Based on published information

Water Balance - 67 Owen Street, Barrie, ON

5. Annual Water Balance Before Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building	713	679	-	-	-	679
Hard Surface Paving	1,483	1,412	-	-	-	1,412
Landscape Area	1,857	1,768	828	-	371	568
TOTAL	**4,053**	**3,858**	**828**	**0**	**371**	**2,659**

6. Annual Water Balance After Building Additions

Land Use	Area (m^2)	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Building	3,452	3,286	-	-	-	3,286
Hard Surface Paving	347	330	-	-	-	330
Landscape Area	254	242	113	-	51	78
TOTAL	**4,053**	**3,858**	**113**	**0**	**51**	**3,694**

7. Comparison of Pre-Development (before buidling additions) and Post-Development (after building additions)

	Precipitation (m^3)	Evapotranspiration (m^3)	Evaporation (m^3)	Infiltration (m^3)	Run-Off (m^3)
Pre-Development	3,858	828	-	371	2,659
Post-Development	3,858	113	-	51	3,694

8. Requirement for Infiltration of Roof Runoff

Volume of roof (building additions) run-off captured (90%)	2,958	m^3
Volume of post-development infiltration without roof run-off	51	m^3
Volume of roof run-off required to match pre-development infiltration rates	321	m^3
Percentage of roof run-off (building additions roof) required to match pre-development infiltration	11%	

APPENDIX O

NORTH PORTION

$R_0 = 3000*dH*K^{0.5}$

$r_s = (a+b)/3.14$ applies when a/b <1.5 and R_0>>rs

$r_s = ((a*b)/3.14)^{0.5}$

$$Q = \frac{3.14*K*(H^2-h_w^2)}{\ln(R_0/r_s)}$$

	Site		
Ground Surface	235	masl	
Highest Water Level	228	masl	
Base of Excavation	228	masl	
Drawdown Target	226.8	masl	
Aquifer Bottom	224	masl	
Rain Fall	25.0	mm	
Factor of Saftey	1.5		
Hydrualic Gradient	1		
K =	3.60E-06	m/s	Hydrulic Conductivity
H =	4.0	m	Depth from static wate table to the assumed aquifer bottom
h_w =	2.8	m	Depth from the dewatering target to the assumed aquifer bottom
dH =	1.2	m	Dewatering thickness
$R_{0=}$	6.83	m	
$r_s + R_{0=}$	39	m	
a =	60	m	Length of Exvation
b =	40	m	Width of Excavation
$r_{s=}$	32	m	

Q =	**41,014**	**L/day**	
Q =	**61,521**	**L/day**	**SF = 1.5**

$Q_{RAIN =}$	**60,000**	**L/day**

Reference: J. Patrick Powers… [et al.] (2007), "Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd ed." Wiley, Hoboken, NJ.

SOUTH PORTION

$R_0 = 3000*dH*K^{0.5}$

$r_s = (a+b)/3.14$ applies when a/b <1.5 and R_0>>rs

$r_s = ((a*b)/3.14)^{0.5}$

$$Q = \frac{3.14*K*(H^2-h_w^2)}{\ln(R_0/r_s)}$$

	Site		
Ground Surface	235	masl	
Highest Water Level	226	masl	
Base of Excavation	224.8	masl	
Drawdown Target	223.6	masl	
Aquifer Bottom	216	masl	
Rain Fall	25.0	mm	
Factor of Saftey	1.5		
Hydrualic Gradient	1		
K =	3.60E-06	m/s	Hydrulic Conductivity
H =	10.0	m	Depth from static wate table to the assumed aquifer bottom
h_w =	7.6	m	Depth from the dewatering target to the assumed aquifer bottom
dH =	2.4	m	Dewatering thickness
$R_{0=}$	13.66	m	
$r_s + R_{0=}$	39	m	
a =	41	m	Length of Exvation
b =	40	m	Width of Excavation
$r_{s=}$	26	m	

Q =	**97,071**	**L/day**	
Q =	**145,607**	**L/day**	**SF = 1.5**

Q_{RAIN} =	**41,000**	**L/day**

Reference: J. Patrick Powers… [et al.] (2007), "Construction Dewatering and Groundwater Control: New Methods and Applications, 3rd ed." Wiley, Hoboken, NJ.