REPORT

Hydrogeological Investigation

Shining Hill (Phase 3), 162, 306, 370, 434 & 488 St. John's Sideroad West, Aurora, Ontario

Submitted to:

Shining Hill Estates Collection Inc. c/o SCS Consulting Group Ltd.
30 Centurian Drive, Suite 100
Markham, ON,
L3R 8B8
Attention: Ms. Sarah Kurtz, P.Eng.

Submitted by:

Golder Associates Ltd.
100 Scotia Court,
Whitby, Ontario, L1N 8Y6, Canada

20360612 (1000)

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Distribution List

E-copy - Shining Hill Estates Collection Inc. c/o SCS Consulting Group Ltd.

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1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by Shining Hill Estates Collection Inc. c/o SCS Consulting Group Ltd. (SCS) to conduct a hydrogeological investigation in support of the draft plan submission process for the proposed residential subdivision development located at 162, 306, 370, 434 & 488 St. John’s Sideroad West in Aurora, Ontario (the site), at the location shown on the Key Plan (Figure 1).

The purposes of this hydrogeological investigation are to assess the existing hydrogeological conditions, to prepare a pre- and post-development water budget assessment for the entire site based on current designs, to assess potential low impact development (LID) options and to assess the potential hydrogeological impacts of development. In addition, a preliminary assessment of the need for construction dewatering permitting is included. Based on a meeting with SCS, Beacon Environmental (Beacon) and the Lake Simcoe Region Conservation Authority (LSRCA) on February 3, 2021, it is our understanding that catchment-based water budgets will be required for the off-site willow mineral thicket swamp located southwest of the site and the off-site unevaluated wetland located northeast of the site (discussed in further detail in Section 2.2). As part of the catchment-based water budgets for the willow mineral thicket swamp and the unevaluated wetland, additional instrumentation and water level monitoring will be conducted in these areas, the results of which will be provided in separate reports.

The factual data, interpretations and recommendations contained in this report pertain to a specific project as described in the report and are not applicable to any other project or site location. If the project is modified in concept, location, elevation, or if the project is not initiated within eighteen months of the date of the report, Golder should be given an opportunity to confirm that the recommendations are still valid. In addition, this report should be read in conjunction with the attached "Important Information and Limitations of This Report" which are included in Appendix A. The reader’s attention is specifically drawn to this information, as it is essential for the proper use and interpretation of this report.

2.0 BACKGROUND

2.1 Site and Project Description

The site is located at 162 St. John’s Sideroad West in Aurora, to the northwest of the intersection of St. John’s Sideroad and Yonge Street (see Figure 1 and Figure 2A, Site Plan). The property is currently occupied by a three-storey residence in the northwest portion of the site, a swimming pool, an indoor horse arena with stables, several outdoor horse arenas, a one-storey residence in the southeast corner of the site, and private roadways. A former ice rink was located in the southeast portion of the site. The majority of the site is grass-covered with paved areas adjacent to the three-storey residence, indoor horse arena and former ice rink.

The site is bordered by the Town of Newmarket municipal boundary, an outdoor horse arena and agricultural land to the north, by St. John’s Sideroad West and residential homes to the south, by undeveloped lands with light to dense vegetation to the east, and by agricultural land and undeveloped lands with light to dense vegetation to the west.

The Draft Plan of Subdivision prepared by Malone Given Parsons Ltd. (MGP) for the proposed development is provided in Appendix B (MGP, 2021). Based on the Draft Plan of Subdivision, it is understood that the overall development area is approximately 31.8 ha in size and is to be comprised of 88 single-detached homes, a mid/high rise residential building (Block 89), Saint Anne’s School (Block 90), a park block (Block 91), a servicing block (Block 93), road widening, internal roads, and a trail head. A natural heritage system / open space block (i.e., Block 92), approximately 17.7 ha in size, will be located west of the site and is not discussed further in this report.

Based on the Proposed Servicing Plan prepared by SCS (SCS, 2021; see Appendix B), the proposed depths of underground service trenches (e.g., sewers, watermain) range from approximately 2 m to 6.5 m below existing grade. A proposed underground stormwater retention tank is to be located on the east side of the proposed park block, with an invert of 263.22 metres above sea level (masl) and dimensions of about 75 m by 20 m.

A figure showing the Proposed Development Plan is provided as Figure 2B. Details of the proposed development (i.e., building structures, building inverts, etc.) were not available at the time of preparation of this report. However, it is understood that the mid/high rise residential building may include up to two levels of underground parking.

2.2 Topography and Drainage

The site is located within the Tannery Creek sub-watershed of the East Holland River sub-watershed which ultimately reports to Lake Simcoe. Tannery Creek is located at distances ranging from approximately 50 m to 200 m east of the site and has an elevation of approximately 246 masl. Its associated valley lands are generally located adjacent to the eastern limit of the site. A tributary of Tannery Creek (herein referred to as “Tannery Creek West Tributary”) is located approximately 75 m southwest of the site, and has an elevation ranging from approximately 258 masl at St. John’s Sideroad to 270 masl near the western limit of the site. An on-line man-made pond is located approximately 20 m southwest of the site, which discharges to Tannery Creek West Tributary via a riser pipe outlet structure (see Figure 2A). Another tributary of Tannery Creek (herein referred to as “Tannery Creek North Tributary”) is located at distances ranging from approximately 25 m north to 100 m northeast of the site, and has an elevation ranging from approximately 250 masl to 268 masl in the vicinity of the site (refer to Figure 2A).

Based on the Natural Heritage Evaluation prepared by Beacon (Beacon, 2021), it is our understanding that the Tannery Creek North Tributary is a coldwater and intermittent stream. Tannery Creek and the Tannery Creek West Tributary are understood to be coldwater and permanently flowing streams. Downstream of the confluence of the Tannery Creek North Tributary and Tannery Creek, the thermal regime of Tannery Creek is understood to transition to warmwater.

Based on the ecological land classification information (Beacon, 2021; see Appendix B), the site is primarily comprised of anthropogenic land use, mineral cultural meadow, mixed forest, hedgerow and mineral cultural thicket. A mineral meadow marsh (MAM2) is located in a localized low-lying area in the southeast portion of the site. It is noted that this feature will not be retained as part of the development.

The Tannery Creek valley lands located east of the site are primarily comprised of dry-fresh deciduous forest (FOD4), which is not considered to be a groundwater-dependent feature and is therefore not discussed any further.

Southwest of the site, the land surrounding the pond and the Tannery Creek West Tributary is generally comprised of forested areas. Around the perimeter of the pond, Beacon has identified a relatively small forb mineral meadow marsh (MAM2-10), approximately 0.02 ha in size, and a cattail mineral shallow marsh (MAS2-1), approximately 0.03 ha in size. A mineral meadow marsh (MAM2), approximately 0.1 ha in size, is located approximately 15 m east of the pond. A willow mineral thicket swamp (SWT2-2), approximately 0.4 ha in size, is also located southwest of the site further downstream of the pond. As mentioned previously, a catchment-based water budget will be prepared by Golder for the willow mineral thicket swamp and will be provided in a separate report.

A reed-canary grass mineral meadow marsh (MAM2-2) / cattail mineral shallow marsh (MAS2-1) is located approximately 65 m northeast of the site and is situated primarily on the northern adjoining property on the north side of the Newmarket boundary. It is noted that a separate report will be prepared by Golder for this property, which will include a catchment-based water budget for this feature.

Based on available on-line natural heritage mapping from the Ministry of Natural Resources and Forestry (MNRF; http://www.gisapplication.lrc.gov.on.ca), an unevaluated wetland is located south of the site, immediately south of the willow mineral thicket swamp (SWT2-2) mapped by Beacon and adjacent to the Tannery Creek West Tributary (see Figure 2A). The portion of the unevaluated wetland that is situated north of St. John's Sideroad West is approximately 0.1 ha in size and the portion of the wetland located south of St. John's Sideroad West is approximately 1.5 ha in size. Also, MNRF mapping indicates that an unevaluated wetland is located approximately 65 m northeast of the site. This feature is inferred to coincide with the abovementioned reed-canary grass mineral meadow marsh (MAM2-2) / cattail mineral shallow marsh (MAS2-1) mapped by Beacon. As mentioned above, a catchment-based water budget will be prepared for this feature and issued in a separate report to be prepared by Golder.

The site is generally located on tableland areas between Tannery Creek and the north and west tributaries of Tannery Creek, situated at elevations ranging from approximately 266 masl to 272 masl. As indicated on the Existing Storm Drainage Plan prepared by SCS (SCS, 2021; see Appendix B), the site is divided into a total of five catchments, defined as Catchments 101 to 105.

Stormwater runoff in Catchments 101 (4.12 ha in size) and 105 (2.68 ha) generally drain in a south to southwest direction towards the on-site mineral meadow marsh (MAM2), the Tannery Creek West Tributary, the willow mineral thicket swamp (SWT2-2), the off-site mineral meadow marsh (MAM2), the forb mineral meadow marsh (MAM2-10), the cattail mineral shallow marsh (MAS2-1), and the on-line pond. In Catchments 102 (3.62 ha) and 104 (1.06 ha), stormwater runoff generally drains in a northeast direction towards the Tannery Creek North Tributary and the reed-canary grass mineral meadow marsh (MAM2-2) / cattail mineral shallow marsh (MAS2-1). In Catchment 103 (2.39 ha), stormwater runoff generally drains in an east direction towards Tannery Creek.

Available on-line LSRCA mapping (https://maps.lsrca.on.ca) indicates that portions of the site are located within LSRCA regulated areas (see Figure 3). Also, based on MNRF mapping, the western portion of the site is located within the Oak Ridges Moraine Conservation Plan Area (Ontario Regulation 140/02) and is part of the Greenbelt, as shown on Figure 3, Regulated Areas.

2.3 Physiography and Geology

The site is mapped within the physiographic region of southern Ontario known as the Schomberg Clay Plains. The physiographic region known as the Oak Ridges Moraine is mapped approximately 700 m west of the site (Chapman and Putnam, 2007). However, as mentioned in Section 2.2, available Region mapping indicates that the western portion of the site is located within the Oak Ridges Moraine Conservation Plan Area (Ontario Regulation 140/02), as shown on Figure 3.

According to published mapping and as presented on Figure 5, Quaternary Soils Map, the surficial soil conditions are composed of fine-textured glaciolacustrine deposits of silt and clay. Off-site to the east and west, the fine-textured glaciolacustrine deposits are overlain by modern alluvial deposits that are mapped parallel to the Tannery

Creek valley lands and the Tannery Creek West Tributary. A flow terrace is mapped to the east of the site, on the west side of the Tannery Creek valley lands.

The geologic mapping is generally consistent with the conditions encountered during the site-specific subsurface investigation conducted by Soil Engineering Ltd. (see Section 3.2), which indicates relatively thin non-cohesive silt and sand deposits underlain by thick silty clay deposits are predominant.

2.4 Wellhead Protection Areas (WHPA)

Available on-line Region of York (Region) mapping (https://ww6.yorkmaps.ca) indicates that the site is located within an area designated by the Region as Wellhead Protection Areas WHPA-Q1 and -Q2, where WHPA-Q1 is an area designated as being within the cone of influence of a municipal well and WHPA-Q2 is an area where future reduction in recharge would significantly impact that area. Further with respect to the WPHA-Q1 area, the site is located within areas designated as WHPA-B/C/D areas, or the 2-, 5- and 25-year travel time zones, respectively, as shown on Figure 4, Wellhead Protection Areas.

Two municipal wells (nos. 6918411 and 7285109) are located approximately 600 m east of the site and one municipal well (no. 6916976) is located approximately 1.3 km northeast of the site. It is noted that the site is not located within a Significant Groundwater Recharge Area (SGRA), which is defined by the Region as areas with porous soils such as sand or gravel that have higher than average infiltration rates and that are hydraulically connected to a groundwater supply well. Refer to Section 2.5, Water Well Records, for further discussion on the two municipal supply wells.

2.5 Water Well Records

Water well records were obtained from the Ministry of the Environment, Conservation and Parks (MECP). Approximately 20 water well records were reported within 500 m of the site, three of which are reported to be located on the site (nos. 6901581, 6915585 and 6923894). The locations of the reported water well records are shown on Figure 6, Recorded Wells. A table summarizing the water well record data is provided in Appendix C, MECP Recorded Wells. It is noted that historically there was not a requirement to register dug wells with the MECP, and they can be under-represented in the water well record database.

Little information was provided on one of the records (no. 7326065), which is not discussed further. The remaining 19 wells were constructed between 1949 and 2017 and include six test holes/observation wells and 13 water supply wells. The water supply wells are comprised of:

- Two public use wells (i.e., nos. 6901581 and 6915585) and one domestic well (i.e., no. 6923894) located on the east side of the site, all of which are drilled wells with well depths ranging from 49.7 metres below ground surface (mbgs) to 81.4 mbgs. The three wells were constructed between 1961 and 1997. The status of these wells is not known to Golder, and it is recommended that, if present, they be decommissioned in accordance with applicable legislation as part of site development activities;
- One public use well (i.e., no. 6913488) located approximately 100 m east of the site. This drilled well is situated on the west side of Tannery Creek in the valley lands, with a ground surface elevation of approximately 251.8 masl, and with a reported well depth of 50.3 m; and
- Seven domestic wells, all of which are drilled wells with well depths ranging from about 29.2 mbgs to 116.4 mbgs and two livestock wells, both of which are bored wells with well depths ranging from about 10.1 mbgs to 13.7 mbgs.

Cross sections summarizing the reported soil stratigraphy on the well records are provided on Figures 6A and 6B, MECP Section A - A' and B - B', respectively. In general, the wells were reported to encounter thick clay or till soil units at surface, which contained confined sand or gravel layers/units or were underlain by confined sand or gravel units at various depths. These various confined sand or gravel layers/units are inferred to be the primary aquifers utilized by the private wells. At the three wells present on the site, the reported thickness of the clay/till is on the order of 50 m or more.

Based on the MECP water well record search and our experience in the area, active private well use may be expected generally to the northwest of the intersection of St. John's Sideroad and Yonge Street. The relatively recent subdivision developments located south of St. John's Sideroad and northeast of the intersection of Bathurst Street and St. John's Sideroad West in the Town of Aurora, and about 700 m northeast of the site in the Town of Newmarket are municipally serviced by groundwater-based supplies, although remnant private wells may be present on properties that pre-date the recent developments.

As mentioned in Section 2.4, available on-line Region mapping indicates that two municipal wells (nos. 6918411 and 7285109) are located approximately 600 m east of the site and one municipal well (no. 6916976) is located approximately 1.3 km northeast of the site, as shown on Figures 4 and 6. These municipal wells are screened in a deep confined sand and gravel unit at depths ranging from approximately 97.6 mbgs to 106.7 mbgs and overlain by thick clay/till units.

2.6 Previous Reports

The following geotechnical reports have been prepared for the site by Soil Engineering Ltd. (Soil Eng.) and were provided to Golder:

- Soil Engineering Ltd. (January 2021). *A Geotechnical Investigation And Slope Stability Assessment For Proposed Residential Development, Shining Hill Phase 3, 162 St. John's Sideroad, Town of Aurora*. (Soil Eng., 2021A); and
- Soil Engineering Ltd. (January 2021). *A Geotechnical Investigation For Proposed School Block, Shining Hill Phase 3, 306 St. John's Sideroad, Town of Aurora*. (Soil Eng., 2021B).

The factual subsurface data and information obtained in these geotechnical investigation reports were reviewed and pertinent data was used in preparation of this report. The existing borehole and monitoring well locations from the geotechnical investigation are shown on Figure 2A, and the accompanying Record of Borehole sheets are attached in Appendix D.

3.0 SITE CHARACTERIZATION

3.1 Drilling and Monitoring Well Installation

As reported in the geotechnical investigation reports prepared by Soil Eng. (Soil Eng., 2021A/B), the geotechnical field investigation was carried out in September 2020, during which time fourteen boreholes (designated as BH101 to BH108 and BH201 to BH206) were advanced to depths ranging from approximately 6.6 mbgs to 35.3 mbgs. The borehole locations are shown on Figure 2A. The reader is referred to the geotechnical reports for additional details.

Twelve groundwater monitoring wells were installed by Soil Eng. in selected boreholes to monitor groundwater levels and to facilitate Golder's hydrogeological field program. Single groundwater monitoring wells were installed in BH101 to BH108, BH202 and BH205, and a nested groundwater monitoring well was installed at BH206 located near the on-line pond and the Tannery Creek West Tributary (i.e., BH206-D [deep] and BH206-S [shallow]). The wells consist of 50 mm diameter PVC pipe screens surrounded with filter sand pack and completed with a flush-mount or stick-up monument casings.

In addition, one shallow piezometer (P) and staff gauge (SG) pair, P1/SG1, was manually installed by Golder on November 16, 2020, in the Tannery Creek West Tributary. P1/SG1 is also located within the willow mineral thicket swamp (SWT2-2), as shown on Figure 2A. The shallow piezometer (19 mm inside diameter stainless steel drive point model) was installed to an approximate depth of 1.5 mbgs. The pair was installed to assess the vertical hydraulic gradient at the Tannery Creek West Tributary.

The as-installed piezometer and staff gauge locations and the ground surface and top-of-pipe/gauge elevations were surveyed by Golder using a Trimble Geo 7X GPS capable of 0.1 m accuracy. The ground surface elevations are referenced to geodetic datum.

The subsurface soil and groundwater conditions encountered in the boreholes, and details of the monitoring well installations are provided on the Record of Borehole sheets (Appendix D).

3.2 Subsurface Soil Conditions

A detailed summary of subsurface soil conditions encountered at the borehole locations is provided in Soil Eng.'s geotechnical investigation reports (Soil Eng., 2021A/B), to which the reader is referred. The Record of Borehole sheets, grain size distribution curves and Atterberg limits testing results for selected soil samples are provided in Appendix D.

The surficial materials encountered at the borehole locations generally consist of topsoil, pavement structure, fill materials and surficial deposits of native silt and sand.

The fill or topsoil fill was encountered in all boreholes except for BH102, BH104, BH106 and BH206. The fill consisted predominantly of topsoil and silty sand, with silty clay, sandy silt or silt encountered at some locations. Where encountered, the fill extended to depths ranging between 0.8 mbgs and 3.3 mbgs, with an average thickness of approximately 1.7 m.

The topsoil and fill were generally underlain by a non-cohesive native deposit ranging in gradation from silt to sand, with an average thickness of approximately 3.2 m. The non-cohesive unit was encountered in all boreholes except for BH101 and BH107.

A deposit of silty clay was generally encountered below the non-cohesive unit or below the fill (e.g., in BH101 and BH107), and was encountered in all boreholes except for BH201 and BH202. Where encountered, the silty clay unit extended to the depth of exploration, which ranged from approximately 6.6 mbgs to 35.3 mbgs.

Cross sections summarizing the encountered soil stratigraphy are provided on Figures 7A to 7C, Site Sections A - A', B - B' and C - C', respectively.

3.3 Water Level Monitoring

Groundwater levels were manually measured at the monitoring wells by Soil Eng. on September 29, 2020, and by Golder on November 16, November 24 and December 1, 2020, and January 19, 2021. Water level depths and elevations are provided in Table E-1, Water Level Depths and Elevations (Appendix E). It should be noted that these observations reflect the groundwater conditions encountered at the time of the field investigation and some seasonal and annual fluctuations should be anticipated. Further, stabilized groundwater conditions may not have been present at BH106 on September 29, November 16, November 24, and December 1, 2020.

The depth to groundwater at the monitoring wells ranged from 1.33 mbgs (BH104 on January 19, 2021) to 4.70 mbgs (BH202 on November 24, 2020) and from elevations of 258.30 masl (BH107 on September 29, 2020) to 271.68 masl (BH206-D [deep] on January 19, 2021) on the dates monitored. The groundwater elevation data on September 29, 2020 are shown on the Record of Borehole Sheets (Appendix D), and the groundwater elevation data on December 1, 2020 and January 19, 2021 are shown on Figures 7A to 7C, Site Sections A - A', B - B' and C - C', respectively. The groundwater elevation data from January 19, 2021 is presented on Figure 8, Water Table (January 2021). In general, shallow groundwater flow is inferred to follow topography, with flow in an eastern direction towards Tannery Creek, in a northeast direction towards the Tannery Creek North Tributary, and in a south to southwest direction towards the Tannery Creek West Tributary and the pond, depending on location (refer to Figure 8).

The groundwater elevations at BH206-D (deep) ranged from about 1.9 m to 2.2 m higher than at BH206-S (shallow) during the monitoring events, indicating an upward vertical gradient at that location. It is noted that the monitoring well in BH105 was installed by Soil Eng. for geotechnical purposes and was screened in the silty clay unit at a lower elevation (i.e., 250.0 masl to 253.1 masl) relative to the other monitoring wells. Therefore, the groundwater levels measured in BH206-D and BH105 are not considered representative of water table conditions.

At staff gauge SG1, located in the Tannery Creek West Tributary, a water depth ranging from 0.26 m to 0.29 m was recorded on the monitoring events on November 16, November 24 and December 1, 2020, and January 19, 2021; flowing water was observed in the Tannery Creek West Tributary on those dates. A downward hydraulic gradient was observed at P1/SG1 on November 16, November 24 and December 1, 2020. An upward hydraulic gradient was observed at P1/SG1 on January 19, 2021. Below grade water levels were recorded at P1 on the monitoring events on November 16, November 24 and December 1, 2020, and January 19, 2021.

Automatic data loggers (i.e., pressure transducers) were installed at BH102, BH107, BH206-D (deep) and BH206-S (shallow) on December 1, 2020, set to record every four hours and downloaded on January 19, 2021. Daily precipitation data was obtained from Environment and Climate Change Canada (ECCC) for the Toronto North York Meteorological Station (ID 615S001), which was the nearest station to the site with daily precipitation data for this period. Hydrographs of the logger data with daily precipitation data are provided as Figures E-2 to E-5, Appendix E. As shown, the data indicate that the groundwater elevation in BH102 and BH107 and increases in delayed response to some rain events during this period. A similar but muted groundwater elevation trend is observed at BH206-D (deep), while a steady groundwater elevation increase was observed at BH206-S (shallow). It is noted that the data loggers will remain in these four monitoring wells until the summer of 2021 (or until construction begins) to monitor seasonal groundwater levels at the site, the results of which will be reported under separate cover.

3.4 Hydraulic Testing

Single well response testing (i.e., rising head tests) was carried out at BH103, BH108 and BH202 on November 16, 2020, and at BH101 and BH206-S (shallow) on December 1, 2020. The rising head tests were carried out by rapidly lowering the water levels by purging with a dedicated Waterra footvalve and tubing. The resulting water level recoveries were monitored with an electronic water level tape and automatic data logger. The recovery data were analyzed using the AQTESOLV for Windows (1996 – 2007) Version 4.5 software. The Bouwer and Rice (1976) method for unconfined conditions was applied to the rising head test data. Estimates of hydraulic conductivity (K) obtained from the rising head tests are summarized below in Table 1. Summary printouts of the rising head test data and results from AQTESOLV are included in Appendix F.

Table 1: Summary of Estimated Hydraulic Conductivity

Borehole	Unit Screened	Depth of Monitoring Well (mbgs)	Method	K (cm/s)
BH101	SILTY CLAY	7.6	Bouwer and Rice (1976), unconfined	$2x10^{-6}$
BH103	SANDY SILT	4.6	Bouwer and Rice (1976), unconfined	$1x10^{-3}$
BH108	SANDY SILT	4.6	Bouwer and Rice (1976), unconfined	$5x10^{-4}$
BH202	SILTY FINE SAND	6.1	Bouwer and Rice (1976), unconfined	$4x10^{-4}$
BH206-S (shallow)	SILTY CLAY	7.6	Bouwer and Rice (1976), unconfined	$3x10^{-6}$

Notes:
mbgs – metres below ground surface. cm/s – centimetres per second

The hydraulic conductivity estimates for the non-cohesive sandy silt and silty fine sand soils ranged from $4x10^{-4}$ cm/s to $1x10^{-3}$ cm/s, with a geometric mean of $6x10^{-4}$ cm/s (n=3). The hydraulic conductivity estimates for the silty clay unit ranged from $2x10^{-6}$ cm/s to $3x10^{-6}$ cm/s, with a geometric mean of $3x10^{-6}$ cm/s (n=2). The estimated hydraulic conductivity values are considered reasonable for the units tested.

3.5 Guelph Permeameter Testing

Soil infiltration rate testing was carried out on November 24, 2020 in the unsaturated zone using a Guelph Permeameter (Soilmoisture Equipment Corp., Model 2800K1). The Guelph Permeameter was operated in general accordance with the procedures outlined by the manufacturer (Soilmoisture Equipment Corp., 2012) using a single head method. The apparatus was installed at the base of hand-augered test holes.

Once the outflow of water at the depth of installation reached a steady-state flow rate, the field-saturated hydraulic conductivity, K_{fs}, of the soil was estimated using the following equation (Elrick et. al., 1989):

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

Where: C_1 = shape factor
Q_1 = flow rate (cm^3/s)
H_1 = water column height (cm)
a = well radius (cm)
α^* = alpha factor (0.12 cm^{-1} for Type 3 soils)

The field data and analysis of the infiltration rate tests are presented as Figures F-1 to F-5, Appendix F. Based on the resulting K_{fs} (cm/s), the corresponding infiltration rates (mm/hr) were estimated using the approximate relationship presented in the *Low Impact Development Stormwater Management Planning and Design Guide* (or "*Design Guide*") (TRCA and CVCA, 2010). A summary of the infiltration rate test results is presented in Table 2, below.

Table 2: Summary of Estimated Infiltration Rates

Test	Soil Description	Depth Relative to Grade (mbgs)	Est. Field-Saturated Hydraulic Conductivity K_{fs} (cm/s)	Estimated Infiltration Rate [1] (mm/hr)	Correction Factor	Corrected Estimated Infiltration Rate [2] (mm/hr)
GP-101 (near BH101)	Inferred SILTY SAND (FILL)[3]	1.0	9×10^{-5}	49	3.5	14
GP-102 (near BH102)	SILT	0.7	1×10^{-5}	30	2.5[5]	12
GP-105 (near BH105)	SAND	0.8	1×10^{-4}	50	3.5	14
GP-106 (near BH106)	Inferred SILTY FINE SAND[4]	1.1	3×10^{-4}	62	3.5	18
GP-206 (near BH206)	SAND	0.7	1×10^{-3}	75	2.5[5]	30

Notes:

mbgs – metres below ground surface. cm/s - centimetres per second. mm/hr – millimetres per hour

[1] – based on Table C1 from TRCA and CVCA (2010).

[2] – correction factor in accordance with Table C2 from TRCA and CVCA (2010).

[3] – the base of the test hole was near the contact point between silty sand fill and the underlying silty clay unit. In Golder's opinion, this result is more representative of silty sand fill.

[4] – the base of the test hole was near the contact point between silty fine sand and the underlying silty clay unit. In Golder's opinion, this result is more representative of silty fine sand.

[5] – should the clearance between the invert of the LID feature(s) and the underlying silty clay unit be less than 1.5 m, the correction factor should be increased to 3.5.

The field-saturated hydraulic conductivity values of the silty sand fill, silt, silty fine sand, and sand ranged from approximately 1×10^{-5} cm/s to 1×10^{-3} cm/s, with corresponding infiltration rates ranging from 30 mm/hr to 75 mm/hr.

The infiltration rate estimates from this investigation are based on the test methods discussed above and are for the corresponding fill/soil types encountered. They represent the fill/soil conditions at the tested locations and depths only; conditions may vary between and beyond the tested locations. Care should be taken during construction of any proposed infiltration measures to preserve the existing soil structure and avoid compaction and re-working which could reduce its infiltrative properties.

For preliminary design purposes, a correction factor was applied to estimate the design infiltration rate in accordance with guidance provided in TRCA and CVCA (2010), to account for potential reductions in soil permeability due to compaction, smearing during the construction of a given infiltration feature and the gradual accumulation of fine sediments over the lifespan of the infiltration feature. Based on the guidance, a correction factor of 2.5 to 3.5 was applied to the estimated infiltration rates. The corrected infiltration rate estimate ranges from approximately 12 mm/hr to 30 mm/hr, with a geometric mean of 17 mm/hr (n=5). As noted above in Table 2, should the clearance between the invert of the LID feature(s) and the underlying silty clay unit be less than 1.5 m, the correction factor should be increased to 3.5 where applicable.

3.6 Summary

The site is currently occupied by a three-storey residence in the northwest portion of the site, a swimming pool, an indoor horse arena with stables, several outdoor horse arenas, a one-storey residence in the southeast corner of the site, and private roadways. The majority of the site is grass-covered with paved areas adjacent to the three-storey residence, indoor horse arena and former ice rink. The site is generally located on tableland areas between Tannery Creek and the North and West Tributaries of Tannery Creek and is divided into a total of five stormwater catchments, defined by SCS as Catchments 101 to 105. Portions of the site are mapped within LSRCA regulated areas, and the western portion of the site is mapped within the Oak Ridges Moraine Conservation Plan Area and Greenbelt.

Based on the results of the subsurface investigation, a non-cohesive deposit ranging in gradation from silt to sand is the predominant surficial native soil type at the site. The non-cohesive deposit had an average thickness of about 3.2 m but was locally absent at two of 14 borehole locations. It was generally overlain by about 0.8 m to 3.3 m of fill, typically comprised of topsoil fill and silty sand fill, except at boreholes BH102, BH104, BH106 and BH206 where the fill was absent. The estimated geometric mean hydraulic conductivity (below the water table) of the surficial non-cohesive sandy silt and silty fine sand soils was $6x10^{-4}$ cm/s (n=3). The estimated geometric mean design infiltration rate (above the water table) of the silt, silty fine sand, and sand was 17 mm/hr (n=4). A relatively thick deposit of silty clay was encountered below the non-cohesive unit or below the fill (e.g., in BH101 and BH107) in all boreholes except for BH201 and BH202. Where encountered, the silty clay unit extended to the depth of exploration, which ranged from approximately 6.6 mbgs to 35.3 mbgs. On-site water well records indicate the silty clay unit is on the order of 50 m thick. The estimated geometric mean hydraulic conductivity (below the water table) of the silty clay unit was $3x10^{-6}$ cm/s (n=2).

The depth to groundwater at the monitoring wells ranged from 1.33 mbgs to 4.70 mbgs and from elevations of 258.30 masl to 271.68 masl on five monitoring events between September 2020 and January 2021, although seasonal and annual fluctuations should be expected. In general, shallow groundwater flow is inferred to follow topography, with flow in an eastern direction towards Tannery Creek, in a northeast direction towards the Tannery Creek North Tributary, and in a south to southwest direction towards the Tannery Creek West Tributary and the pond, depending on location.

Off-site to the southwest along the Tannery Creek West Tributary, Beacon has identified a relatively small forb mineral meadow marsh (MAM2-10) and a cattail mineral shallow marsh (MAS2-1) around the perimeter of an on-line pond, an off-site mineral meadow marsh (MAM2) approximately 15 m downstream of the pond, and an off-site willow mineral thicket swamp (SWT2-2) further downstream. During the five monitoring events carried out to date, the vertical hydraulic gradient was upwards at the bi-level monitoring well installed at BH206. This result is consistent with discharging groundwater conditions and information provided by Beacon that the Tannery Creek West Tributary is a permanently flowing coldwater stream, as is Tannery Creek off-site to the east. Piezometer/staff gauge pair P1/SG1 was installed in the Tannery Creek West Tributary and within the willow mineral thicket swamp. A downward hydraulic gradient was observed at P1/SG1 on November 16, November 24 and December 1, 2020, indicating recharging conditions on those dates. An upward hydraulic gradient was observed at P1/SG1 on January 19, 2021. Below grade water levels were recorded at P1 on the monitoring events on November 16, November 24 and December 1, 2020, and January 19, 2021. As mentioned previously, a catchment-based water budget will be prepared by Golder for the willow mineral thicket swamp and will be provided in a separate report.

Off-site to the northeast, Beacon has identified a reed-canary grass mineral meadow marsh (MAM2-2) / cattail mineral shallow marsh (MAS2-1) situated primarily on the northern adjoining property within the Newmarket municipal boundary. Beacon indicates that the Tannery Creek North Tributary adjacent to the marsh areas is a coldwater and intermittent stream. A separate report will be prepared by Golder for this property, which will include a catchment-based water budget for this feature.

Stormwater runoff in Catchments 101 and 105 generally drain in a south to southwest direction towards the on-site mineral meadow marsh (MAM2), the Tannery Creek West Tributary, the willow mineral thicket swamp (SWT2-2), the off-site mineral meadow marsh (MAM2), the forb mineral meadow marsh (MAM2-10), the cattail mineral shallow marsh (MAS2-1), and the on-line pond. In Catchments 102 and 104, stormwater runoff generally drains in a northeast direction towards the Tannery Creek North Tributary and the reed-canary grass mineral meadow marsh (MAM2-2) / cattail mineral shallow marsh (MAS2-1). In Catchment 103, stormwater runoff generally drains in an east direction towards Tannery Creek.

Most of the infiltration at the site is inferred to discharge locally toward the Tannery Creek North Tributary, the Tannery Creek West Tributary and the Tannery Creek valley lands. A smaller fraction will likely recharge deeper aquifers and result in groundwater base flow further downstream in the East Holland River sub-watershed. The site represents only a portion of the catchment area of these tributaries, and therefore contributes a roughly commensurate portion of the potential groundwater discharge that occurs.

Groundwater use in the area is expected primarily from municipal wells at distances beyond 500 m from the site utilizing a deep confined aquifer (well depths of 97.6 mbgs to 106.7 mbgs). The site is mapped within a Wellhead Protection Area (i.e., within the WHPA-Q1/-Q2 areas, and with respect to the WHPA-Q1, the site is located within the WHPA-B/C/D or the 2-, 5- and 25-year zones, respectively, depending on location). Active private well use within 500 m of the site is generally expected to the northwest of the intersection of St. John’s Sideroad and Yonge Street. Thirteen private water supply wells are recorded within 500 m of the site, comprised of two bored wells (depths of 10.1 mbgs and 13.7 mbgs) and 11 deep drilled wells (depths ranging from 29.2 mbgs to 116.4 mbgs), which are inferred to utilize various confined aquifers. Three of the drilled private wells are indicated to be present on the site.

4.0 GROUNDWATER CONTROL

At the time of writing, site designs are at a conceptual or preliminary stage. This section provides a preliminary assessment of short-term (construction) dewatering needs and potential permitting requirements. The assessment can be confirmed once additional details concerning site designs are known. A detailed assessment of construction dewatering needs and potential impacts to receptors should be carried out at the time of detailed design and in conjunction with obtaining dewatering permitting from the MECP.

4.1 Temporary Construction Dewatering Permitting

Based on the Proposed Servicing Plan prepared by SCS (SCS, 2021; see Appendix B), the proposed depths of underground service trenches (e.g., sewers, watermain) range from approximately 2 m to 6.5 m below existing grade. An underground stormwater retention tank is proposed to be located on the east side of the park block, with an invert of 263.22 masl and dimensions of about 75 m by 20 m. Details of the depths and dimensions of the underground parking structure for the mid/high rise residential building are not currently available. However, it is understood that there may be up two levels of underground parking provided.

As shown on Table E-1 (Appendix E), groundwater levels across the site were observed to range from approximately 1.3 mbgs to 4.7 mbgs on the dates monitored. In the vicinity of the proposed underground stormwater retention tank, groundwater levels ranged from about 2.3 mbgs to 3.2 mbgs on the dates monitored. In the vicinity of the proposed underground parking structure, groundwater levels ranged from about 2.2 mbgs to 4.2 mbgs on the dates monitored. Seasonal and annual groundwater fluctuations should be anticipated.

With linear servicing ranging from approximately 2 m to 6.5 m below existing grade, the underground stormwater retention tank at depth of approximately 5 m below existing grade, and the two-level underground parking structure at an assumed depth of 6 m below finished grade (i.e., about 4 m below existing grade), the need for temporary groundwater control during construction is anticipated.

The method of construction dewatering should be solely determined by the Contractor based on their own assessment of the site-specific conditions, and likely by their specialist dewatering contractor. In any case, the groundwater level should be lowered to a minimum of 1 m below the inverts in advance of the excavation reaching the invert levels. Surface water runoff must be directed away from any open excavation.

It is recommended that a licensed, specialist dewatering subcontractor supervise the installation, operation and decommissioning of any dewatering systems for this project, in accordance with applicable legislation. It is understood that a dewatering plan from a specialist subcontractor has not yet been prepared.

Water takings in excess of 50 m^3/day are regulated by the MECP. Certain takings of groundwater and storm water for construction site dewatering purposes with a combined total less than 400 m^3/day qualify for self-registration on the MECP's Environmental Activity and Sector Registry (EASR). A Category 3 Permit to Take Water (PTTW) is required where the proposed water taking is greater than 400 m^3/day. The MECP is currently considering modifications to eligibility criteria for construction water takings under the EASR process where the 400 m^3/day water taking limit would only apply to groundwater takings only, with contributions from stormwater no longer included in determining eligibility. At the time of preparation of this report, the MECP is in the process of deliberating any such amendments to eligibility criteria.

The rate of groundwater inflow to excavations will vary during construction. Initially, higher inflow rates will occur as groundwater is removed from storage within the zone of influence. With time, rates will decrease toward a steady-state condition. Incident precipitation into excavations will also need to be managed with the groundwater contributions and, under the current eligibility criteria, must be factored into the total pumping rate.

Groundwater input from the silty clay unit to servicing trenches, the underground stormwater retention tank excavation and the underground parking structure excavation is expected to be negligible, with more significant seepage anticipated from the overlying saturated non-cohesive soils (i.e., silt to sand).

Based on the hydrogeological conditions encountered at the borehole locations, steady state groundwater inflow rates for a typical open length of servicing trench, to the underground stormwater retention tank excavation or to the underground parking structure excavation, may not individually exceed 50 m^3/day. However, including the removal of groundwater from storage and the management of incident precipitation from the excavation, and to allow for multiple dewatering activities to proceed simultaneously, the total combined pumping rates are likely to exceed 400 m^3/day. Accordingly, the need to obtain a temporary PTTW is conservatively anticipated if all of the construction dewatering occurs simultaneously. In practice, it is likely that the development will be staged, and construction dewatering will be sequential and not simultaneous. This will likely allow construction dewatering to be carried out under the EASR process, but this assessment will need to be confirmed once additional details are available.

5.0 HYDROLOGIC WATER BALANCE

A water balance assessment for the 14.1 ha site was carried out to assess the potential hydrogeological impacts of the proposed site development with respect to post-development infiltration rates, including potential impacts to groundwater-dependent resources. The assessment included the pre- and post-development conditions within the property boundary, and considered all development proposed for the entirety of the site.

5.1 Methods

The water balance assessment was based on meteorological data obtained from ECCC for the Toronto Buttonville A Meteorological Station (ID 6158409), which was the nearest station to the site with a substantial period of historical data (1986 to 2017), information on current and proposed land uses, and native soil types as identified through the subsurface investigation activities at the site.

Water balance calculations are based on the following equation, which is described in more detail below:

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

Where: P = precipitation;

S = change in soil water storage;

ET = evapotranspiration;

R = surface runoff; and

I = infiltration (groundwater recharge).

Precipitation data obtained from ECCC for the Toronto Buttonville A station indicate a mean annual precipitation (P) of 864 mm/yr.

Short-term or seasonal changes in soil water storage (S) are anticipated to occur on an annual basis as demonstrated by the typically dry conditions in the summer months and the wet conditions in the winter and spring. Long-term changes (e.g., year to year) in soil water storage are considered to be negligible in this assessment.

Evapotranspiration (ET) refers to water lost to the atmosphere from vegetated surfaces. The term combines evaporation (i.e., water lost from soil or water surfaces) and transpiration (i.e. water lost from plants and trees). Potential ET refers to the loss of water from a vegetated surface to the atmosphere under conditions of an unlimited water supply. The actual rate of ET is typically less than the potential rate under dry conditions (e.g. during the summer months when there is a moisture deficit). The mean annual potential ET for the areas considered in the water balances is approximately 635 mm/yr based on data provided by ECCC.

The mean annual water surplus is the difference between P and the actual ET. The water surplus represents the total amount of water available for either surface runoff (R) or groundwater infiltration (I) on an annual basis. On a monthly basis, surplus water remains after actual evapotranspiration has been removed from the sum of rainfall and snowmelt, and maximum soil or snow pack storage is exceeded. Maximum soil storage is quantified using a water holding capacity (WHC) specific to the soil type and land use. The WHC data obtained from ECCC are shown in Table G-1, Appendix G.

Infiltration rates were estimated using the method presented in the Ontario Ministry of the Environment (MOE) *Stormwater Management Planning and Design (SWM) Manual* (MOE, 2003). There are three main factors that determine the percent infiltration of the water surplus: topography, soil type and ground cover. The sum of the fractions representing these three factors establishes the approximate annual percentage of surplus which can be infiltrated in an area with a sufficient downward groundwater gradient. Wetlands (e.g., the on-site mineral meadow marsh) were assumed to have an upward or negligible downward gradient (i.e., the latter in this instance), resulting in all surpluses being contained in these areas, which were assumed to provide increased evaporation and no infiltration. Pertinent assumptions for pre-development and post-development conditions are described in the following subsections.

5.1.1 Pre-Development Condition

Land use at the site under existing (pre-development) conditions was inferred from details shown on the Topographic Survey (Llyod & Purcell, 2020; see Appendix B) and the ecological land use classification (Beacon, 2021; see Appendix B). The site was considered to be comprised of two sections: the private residential property located west of the hedgerow (Block 90), and the remainder of the private recreational area to the east of the hedgerow. The private residence section includes a three-storey stone residence, a garage, and a courtyard. The private residential property also includes a section of mineral cultural meadow and hedgerow along the north boundary. The south border of the private residential property is situated adjacent to the Tannery Creek West Tributary.

The eastern private recreational area includes an ice rink and a one-storey frame dwelling in the southeast, and an arena / horse stables in the north. The section also includes scattered sections of mineral cultural meadow, mineral cultural thicket, hedgerows, and mixed forest throughout the property, as well as a section of mineral meadow marsh and coniferous plantations towards the south boundary. The surface treatments at both the private residential property and recreational area include gravel, asphalt, and grassed lawns.

5.1.2 Post-Development Condition

Land use at the site under post-development conditions was based on the Draft Plan of Subdivision (see Appendix B). The three-storey stone residence, garage, and adjoining grounds (i.e., Block 90) are proposed to be redeveloped as Saint Anne's School, with no change from the existing land uses. The development on the east side of the site will include single detached houses, a mid/high rise residential development (Block 89) and a neighbourhood park (Block 91). The imperviousness of each land use type was estimated as follows, in accordance with the Proposed Storm Drainage Plan (SCS, 2021; see Appendix B) and information provided to Golder:

- Park: 85% impervious;
- Single detached houses: 59% impervious, of which 25% is paved;
- Mid / High rise residential building: 80% impervious;
- 9.2 m Laneway: 100% impervious;
- 15 m road right of way (ROW): 69% impervious;
- 18 m road right of way (ROW): 78% impervious; and
- 23 m road right of way (ROW): 80% impervious.

5.2 Water Balance Parameters

Based on the results of subsurface investigation activities at the site (see Section 3), the existing surficial soil types (predominantly silt to sand) was considered for the purposes of this report to be silt loam based on the U.S. Bureau of Soils classification system and the relative percentages of sand, silt and clay obtained from selected soil samples. For the purpose of this report, the post-development surficial soil type was also considered to be silt loam, noting that this assumption will need to be confirmed during detailed design on the basis of grading plans and any soil importation requirements. Water holding capacities were assigned to this soil type using the values listed in Table 3.1: Hydrologic Cycle Component Values, from the MOE *SWM Manual* (MOE, 2003), as summarized in Table G-2, Appendix G.

The surplus data obtained from ECCC for the respective water holding capacities were split into infiltration and runoff components by applying an infiltration factor based on Table 3.1 from the MOE *SWM Manual* (MOE, 2003). The infiltration factors were based on a sum of site-specific topography, surficial soil type and vegetative cover factors as presented in Table G-2 of Appendix G. Based on the Topographic Survey (Lloyd and & Purcell, 2020; see Appendix B) and the Preliminary Grading Plan (SCS, 2021, see Appendix B), topography factors of 0.1, representing hilly land (with an average slope of 28 m/km to 47 m/km), 0.2, representing rolling land (with an average slope 2.8 m/km to 3.8 m/km), and 0.15, representing land with an average slope between the factors of 0.1 and 0.2 were applied to the pre-development and post-development conditions at the site, where applicable. The silt loam soil was considered to have infiltration properties in between open sandy loam and medium combinations of clay and loam. Therefore, the soil was assigned a soils factor of 0.3. Grass-covered areas, meadows and shrubs were assigned a cover factor of 0.1, representing cultivated land. Forested areas (i.e., thicket, mixed forest, and hedgerow) were assigned a cover factor of 0.2, representing woodland. For impervious surfaces (buildings, gravel, and paved areas), no infiltration factor was applied.

The water balance analysis was developed under the following assumptions:

- WHCs were chosen based on Table 3.1 in the MOE *SWM Manual* (2003) corresponding to the silt loam soil type, existing land uses and proposed post-development conditions.
  - Mineral Cultural Thicket / Mixed Forest / Hedgerow / Plantation (Mature Forest): 400 mm WHC and 0.65 infiltration factor (pre- and post-development conditions).
  - Mineral Cultural Meadow (Pasture and Shrubs): 250 mm WHC and 0.55 infiltration factor (pre- and post-development conditions).
  - Lawn (Urban Lawn): 125 mm WHC and 0.50 or 0.55 infiltration factor, depending on topography (pre- and post-development conditions).
  - Mineral Meadow Marsh: Surplus assumed to equal precipitation minus potential evapotranspiration, with a null (i.e., 0%) infiltration factor.
  - Neighborhood Park (Urban Lawn): 125 mm WHC and 0.60 infiltration factor (post-development).
  - Impervious Areas (i.e., paved parking lots, artificial turf, roads and rooftops): Surplus assumed as 90% of precipitation and null (i.e., 0%) infiltration factor (Conservation Authorities Geoscience Group, 2013).
- Net surplus was estimated by multiplying the estimated monthly surplus (mm/month) for the assumed WHC by the associated drainage area. Annual evapotranspiration and surplus values were obtained from the

meteorological data from the Toronto Buttonville A ECCC Meteorological Station based on the WHC assigned to each land use area.

- Runoff was calculated as the difference between surplus and infiltration.

5.3 Water Balance Results

Average annual water balance assessments were carried out on a site-wide basis as described in Sections 5.1 and 5.2. The results for the pre-development, post-development, and mitigated post-development scenarios are presented in this section.

5.3.1 Pre-Development Condition

Based on the results of the assessment, the average annual pre-development water balance was estimated as summarized in Table 3, and as detailed in Table G-3, Appendix G.

Table 3: Pre-Development Average Annual Water Balance Results

Component	Average Annual Volume m^3/yr
	Site-Wide
Precipitation (P)	121,825
Evapotranspiration (ET)	73,230
Surplus (S)	48,255
Infiltration (I)	17,110
Runoff (R)	31,145

For the pre-development condition, the estimated average annual runoff from the site is approximately 31,145 m^3 and the average annual infiltration on the site is approximately 17,110 m^3.

5.3.2 Post-Development Condition

Based on the results of the assessment, the average annual post-development water balance was estimated as summarized in Table 4, and as detailed in Table G-3, Appendix G.

Table 4: Post-Development Average Annual Water Balance Results

Component	Average Annual Volume m^3/yr
	Site-Wide
Precipitation (P)	121,825
Evapotranspiration (ET)	44,245
Surplus (S)	77,470
Infiltration (I)	10,005
Runoff (R)	67,465

For the post-development condition, the estimated average annual runoff from the site is approximately 67,465 m^3 and the estimated average annual infiltration on the site is approximately 10,005 m^3. As a result of land use changes from site development, runoff is expected to increase by 117% (i.e., 31,145 m^3 to 67,465 m^3) and infiltration is expected to decrease by 42% (i.e., 17,110 m^3 to 10,005 m^3) on an average annual basis.

5.3.3 Post-Development Condition Including Mitigation

Average annual infiltration volumes at the site are expected to decrease relative to pre-development conditions and runoff volumes are expected to increase as a result of development. Groundwater recharge from the site is inferred to mainly discharge towards Tannery Creek, the Tannery Creek West Tributary and the Tannery Creek North Tributary valley lands, which are considered to be intermittent and permanent coldwater streams. In addition, the western portion of the site is within the Oak Ridges Moraine Conservation Plan area, and the site is within the WHPA-Q1 (i.e., within the WHPA-B/C/D areas of York Region municipal wells to the east) and WHPA-Q2 areas. Therefore, it is considered prudent to incorporate low impact development (LID) measures into the development design to mitigate against reductions to post-development infiltration rates to the extent practical. Further, the use of LID measures for stormwater runoff from development sites assists to support the natural hydrologic cycle by helping to maintain groundwater recharge, provide additional water quality treatment and reduce the volume of runoff from a site.

The conceptual LID measures proposed for the site as part of the Functional Servicing design by SCS are presented on the LID Plan (SCS, 2021; see Appendix B), and are comprised of catchbasin infiltration trenches, rear-yard infiltration trenches, catchbasin filtration trenches, bioswales, and on-site infiltration as described below. The neighborhood park (Block 91) will also have an underground storm water storage tank that will not impact infiltration or evapotranspiration and will release runoff to the Tannery Creek North Tributary. The designed retention volumes for each of the measures were provided by SCS. The LID measures are located throughout the site so that the enhancements to post-development infiltration rates and the attenuation of storm water volumes will benefit Tannery Creek and the North and West Tributaries of Tannery Creek.

Catchbasin Infiltration Trenches

The Draft Plan of Subdivision (see Appendix B) includes 12 single-detached homes on Street A (Blocks 5-13, 18-20, and 33-34) and 4 on Street C (Blocks 21, 22, 31, and 32). Catchbasin infiltration trenches along the front portion of the proposed single detached units and the adjacent Street A (between Street B and Lane A), including half of the road north of Street B, are proposed to capture flow from roof runoff and other impervious surfaces for these proposed dwellings and road via overland flow.

The catchbasin infiltration trench should be designed in accordance with guidance from the *Low Impact Development Stormwater Management Planning and Design Guide* (TRCA & CVC, 2010). It is understood that the infiltration trench along Street A, adjacent to the Neighbourhood Park above Street B, will be designed to retain up to a 27.3 mm storm event. The infiltration trench south of the Neighbourhood Park along Street A will be designed to retain up to a 9.2 mm storm event. The preliminary infiltration trench designs are shown in the Catchbasin Infiltration Trench Detail in Appendix B (SCS, 2021).

A frequency analysis of precipitation observed at the Toronto Buttonville A station (1986 to 2017) was conducted based on the available storage of the proposed infiltration galleries. Resultant runoff reduction factors of 81% and 57% were applied to the impervious area draining to the infiltration trench north and south of Street B, adjacent to the Neighbourhood Park.

Rear-Yard Infiltration Trenches

The Draft Plan of Subdivision (see Appendix B) includes 9 single detached houses along Street A (Blocks 5-13), 31 along Street B (Blocks 14-17 and 53-79), and 4 along Street C (Blocks 26-29) of the site. Rear-yard infiltration trenches along the proposed single detached units of Street A; adjacent to Tannery Creek, Street B; adjacent to the Tannery Creek West Tributary, and Street C are proposed to capture flow from rear roof runoff for these proposed dwellings via overland flow.

The infiltration trenches should be designed with guidance from the *Low Impact Development Stormwater Management Planning and Design Guide* (TRCA & CVC, 2010). It is understood that the infiltration trenches will be designed to retain up to a 25 mm storm event. The preliminary rear yard infiltration trench design is shown in the Rear Yard Infiltration Trench Detail in Appendix B (SCS, 2021).

A frequency analysis of precipitation observed at the Toronto Buttonville A station (1986 to 2017) was conducted based on the available storage of the proposed infiltration trenches. A resultant runoff reduction factor of 80% was applied to the area draining to the infiltration trenches.

Catchbasin Filtration Trenches

The Draft Plan of Subdivision (see Appendix B) includes 18 single-detached homes along the east side of Street B (Blocks 36-52), 31 along the west and north sides of Street B (Blocks 14-17 and 53-79), 12 on Street C, and 6 on Street A. Catchbasin filtration trenches along the front portion of the proposed single detached units of Streets A, B, and C, the adjacent Street B (18 m ROW), half of the north section of Street B (15 m ROW), and a section of Street A (south of Street B) are proposed to capture flow from both front and full roof runoff and other impervious surfaces for these proposed dwellings and road via overland flow.

The catchbasin filtration trench should be designed in accordance with guidance from the *Low Impact Development Stormwater Management Planning and Design Guide* (TRCA & CVC, 2010). It is understood that the filtration trench will be designed with an impermeable liner, which will promote attenuation and settlement of sediments but will not increase infiltration. The preliminary filtration trench design is shown in the Catchbasin Filtration Trench Detail in Appendix B (SCS, 2021).

Bioswales

The following locations have been identified for the use of bioswales to collect and retain runoff (refer to the Draft Plan of Subdivision; Appendix B):

- Half of the Street A north of Street B is proposed to incorporate a bioswale which will be designed to capture runoff from the street with a design retention of up to a 33.3 mm storm event.
- A portion of Street B adjacent to the Neighbourhood Park is proposed to incorporate a bioswale which will be designed to capture runoff from the street with a design retention of up to a 26.7 mm storm event.
- The front impervious portions of nine lane-access single detached houses along Lane A, including Lane A, will be collected by a bioswale with a design retention of up to a 29.2 mm storm event.

The bioswales should be designed with guidance from the *Low Impact Development Stormwater Management Planning and Design Guide* (TRCA & CVC, 2010). A frequency analysis of precipitation observed at the Toronto Buttonville A station (1986 to 2017) was conducted based on the available storage of the proposed bioswales.

Resultant runoff reduction factors of 82%, 81% and 81% were applied to the areas draining towards Street A, Street B and Lane A, respectively.

On-site Infiltration

The Draft Plan of Subdivision (see Appendix B) includes a neighborhood park (Block 91) to the north, a mid/high rise residential area (Block 89) to the northeast adjacent to Tannery Creek, and a school block for Saint Anne's School (Block 90) to the west adjacent to the Tannery Creek West Tributary. It is anticipated that the school and mid/high rise residential blocks will direct impervious runoff flow to on-site LID features, such as infiltration trenches or bioswales, to achieve 25 mm volume control. The park block will utilize proposed underground storage along the east boundary of the block adjacent to Street A, as shown on the Proposed Servicing Plan (SCS, 2021; see Appendix B). The underground storage measure will provide attenuation to stormwater flows but will not impact infiltration or evapotranspiration. Designs for these LID features are not available at this time but will be demonstrated at the site plan control stage. For the purpose of this assessment, no runoff reduction was considered for these blocks.

Groundwater Elevations

At this time, a conceptual design of the LID measures described above has been completed and details such as final grades and the inverts of LID measures will be available as designs progress. Also, groundwater level monitoring during a time of seasonally high groundwater conditions has not yet been carried out. Groundwater monitoring is on-going and will continue until the summer 2021 (or until construction begins).

The mitigated post-development scenario presented below assumes that a 1 m separation between the subsurface LID inverts and seasonally high groundwater elevations will be maintained. Based on the available data, the depth to groundwater could present challenges to the implementation of subsurface infiltration features used as LID measures. During the September 29, 2020 monitoring event, the average depth to groundwater in the subdivision area (i.e., monitoring wells BH101 to BH104 and BH107 to BH108) was 3.3 m below existing grade. During the January 19, 2021 monitoring event, the average depth to groundwater in the subdivision area (i.e., as above, but including BH106) was 2.2 m below existing grade.

In the event that a 1 m separation distance cannot be maintained, a subsurface LID would still enhance post-development infiltration rates, especially at times of seasonally low groundwater conditions, provided that the outlet or overflow of the LID remains above the seasonally high groundwater level. If the separation distance is less than 1 m, less average annual infiltration and more average annual runoff would be achieved than presented below. In any event, the infiltration features also function to capture and attenuate precipitation events at the site and provide a benefit to the storm water management scheme. The findings presented below should be re-assessed at the time of detailed design and on the basis of seasonal high groundwater elevation data.

Results

Based on the above, the average annual mitigated post-development water balance was estimated as summarized in Table 5, and as detailed in Table G-3, Appendix G.

Table 5: Mitigated Post-Development Average Annual Water Balance Results

Component	Annual Volume m^3/yr
	Site-Wide
Precipitation (P)	121,825
Evapotranspiration (ET)	44,245
Surplus (S)	77,470
Infiltration (I)	20,640
Runoff (R)	56,830

The proposed LID mitigation scheme is estimated to increase average annual infiltration by approximately 10,635 m^3 and reduce average annual runoff similarly, compared to the un-mitigated post-development condition. As a result, on a site-wide basis, average annual infiltration is estimated to increase by 21% (i.e., 17,110 m^3 to 20,640 m^3) and average annual runoff is expected to increase by 82% (i.e., 31,145 m^3 to 56,830 m^3) as a result of development compared to pre-development conditions. As discussed above, if the separation distance between the LID inverts and the seasonally high groundwater elevations is less than 1 m, less average annual infiltration and more average annual runoff would be achieved than presented in Table 5.

6.0 DISCUSSION

The site is generally located on tableland areas between Tannery Creek and the North and West Tributaries of Tannery Creek. Portions of the site are mapped within LSRCA regulated areas, and the western portion of the site is mapped within the Oak Ridges Moraine Conservation Plan Area and Greenbelt.

The findings of the subsurface investigation indicate that shallow native soils at the site are predominantly comprised of a non-cohesive deposit (ranging in gradation from silt to sand) with an average thickness of about 3.2 m and with moderate hydraulic conductivity. The thick underlying deposit of silty clay has moderate to low hydraulic conductivity. Based on MECP water well records, the thickness of the clay/till aquitard at the site is on the order of 50 m or more. Shallow groundwater flow is inferred to follow topography, with flow in an eastern direction towards Tannery Creek, in a northeast direction towards the Tannery Creek North Tributary, and in a south to southwest direction towards the Tannery Creek West Tributary and the man-made on-line pond, depending on location. The on-line pond discharges to the Tannery Creek West Tributary.

A bi-level groundwater monitoring well was installed at BH206 near the on-line pond and the Tannery Creek West Tributary. During the five monitoring events carried out to date, the vertical hydraulic gradient was upwards. This result is consistent with discharging groundwater conditions and information provided by Beacon that the Tannery Creek West Tributary is a permanently flowing coldwater stream, as is Tannery Creek off-site to the east.

Piezometer/staff gauge pair P1/SG1 was installed in the Tannery Creek West Tributary and within the willow mineral thicket swamp. A downward hydraulic gradient was observed at P1/SG1 on November 16, November 24 and December 1, 2020, indicating recharging conditions on those dates. An upward hydraulic gradient was observed at P1/SG1 on January 19, 2021, indicating discharging conditions. Below grade water levels were recorded at P1 on all monitoring events. As mentioned previously, a catchment-based water budget will be prepared by Golder for the willow mineral thicket swamp in a separate report.

Off-site to the northeast, Beacon has identified a reed-canary grass mineral meadow marsh (MAM2-2) / cattail mineral shallow marsh (MAS2-1) situated primarily on the northern adjoining property within the Newmarket municipal boundary. Beacon indicates that the Tannery Creek North Tributary, located adjacent to the marsh, is a coldwater and intermittent stream. A separate report will be prepared by Golder for this property, which will include a catchment-based water budget for this feature.

The proposed site development is understood to be comprised of 88 single-detached homes, a mid/high rise residential building (Block 89), Saint Anne's School (Block 90), a park block (Block 91), a servicing block (Block 93), road widening, internal roads, and a trail head.

Site designs are at a conceptual or preliminary stage, and therefore a preliminary assessment of short-term (construction) dewatering needs and permitting requirements is provided at this time. The need for temporary construction dewatering during the construction of linear underground site services, an underground stormwater retention tank and the multi-level underground parking structure is expected. The need to obtain a temporary PTTW is conservatively anticipated if all of the construction dewatering activity occurs simultaneously. In practice, it is likely that the development will be staged, and construction dewatering will be sequential and not simultaneous. This will likely allow construction dewatering to be carried out under the EASR process, but this assessment will need to be confirmed once additional details are available. A detailed assessment of potential impacts to receptors should be carried out at the time of detailed design and in conjunction with obtaining dewatering permitting from the MECP.

Site-wide water balance estimates were carried out to assess the potential hydrogeological impacts of the proposed development with respect to average annual post-development infiltration rates. The development of the 14.1 ha site, without the implementation of mitigation measures, is expected to result in a 42% reduction in average annual infiltration.

The proposed LID strategy includes the following measures to enhance post-development infiltration rates:

- catchbasin infiltration trenches that will receive runoff from the front roofs of 12 single-detached homes on Street A and 4 on Street C as well as drainage from the adjacent section of Street A (area between Street B and Lane A), half of the Street A (north of Street B), and other impervious areas.
- rear-yard infiltration trenches: the runoff from the rear roofs of 9 single detached houses along Street A will be directed to a rear-yard infiltration trench adjacent to Tannery Creek; the runoff from the rear roofs of 31 single detached houses along Street B will be directed to a rear-yard infiltration trench adjacent to the Tannery Creek West Tributary; and, the runoff from the rear roofs of 4 single detached houses along Street C will be directed to a rear-yard infiltration trench.
- the runoff from the front roofs of 9 lane-access single detached houses on Lane A as well as the drainage from Lane A, half of Street A (north of Street B), and north half of Street B (adjacent to Neighbourhood Park) will be directed to three separate bioswales.

It is also expected that additional LID features to enhance post-development infiltration rates will be implemented for Saint Anne's School (Block 90) and the mid/high rise residential block (Block 89) that were not included in this assessment.

Other LID measures are proposed that will promote storm water attenuation and settlement of sediments but will not increase infiltration. The neighborhood park (Block 91) will have an underground storm water storage tank that will not impact infiltration or evapotranspiration and will release runoff to the Tannery Creek North Tributary. Catchbasin filtration trenches with an impermeable liner along the front portion of the proposed single detached units of Streets A, B, and C, the adjacent Street B (18 m ROW), half of the north section of Street B (15 m ROW), and a section of Street A (south of Street B) are proposed to capture flow from both front and full roof runoff and other impervious surfaces for these proposed dwellings and road via overland flow.

In the mitigated post-development scenario, average annual infiltration is estimated to increase by approximately 21% (i.e., 17,110 m^3 to 20,640 m^3) and average annual runoff is estimated to increase by approximately 82% (i.e., 31,145 m^3 to 56,830 m^3), relative to pre-development rates. It is recommended that the LID measures be designed to target a mitigated post-development infiltration rate within 10% of pre-development rates. However, as discussed in Section 5.3.3, if the separation distance between the LID inverts and the seasonally high groundwater elevations is less than 1 m, less average annual infiltration would be achieved than presented above. It is therefore recommended that these findings be re-assessed at the time of detailed design and on the basis of seasonal high groundwater elevation data.

The site is expected to contribute a portion of the potential groundwater discharge that occurs to the Tannery Creek North Tributary, the Tannery Creek West Tributary and the Tannery Creek valley lands proportional to its size within the catchment areas of these features, with a smaller fraction likely recharging deeper aquifers resulting in groundwater base flow further downstream in the East Holland River sub-watershed. Based on the above assessment, no reduction in post-development infiltration rates is anticipated and therefore no reduction in baseflow contributions from the site to these watercourses is anticipated.

Two municipal groundwater supply wells are located approximately 600 m east of the site and one municipal well is located approximately 1.3 km northeast of the site. The site is located within the WHPA-Q1 (i.e., within the WHPA B/C/D or the 2-, 5- and 25-year travel time zones, respectively) and the WHPA-Q2 areas. According to Region mapping, the site is not located within a SGRA. Given that no reduction in post-development infiltration rates is estimated at this time, no water quantity reduction to the municipal wells is anticipated. Further, these three municipal wells are screened in a deep confined sand and gravel unit at depths ranging from approximately 97.6 mbgs to 106.7 mbgs, and therefore recharge to this aquifer is expected to occur from a broad lateral extent outside of the WHPA-Q1 area.

Based on the MECP water well record search and our experience in the area, active private well use within 500 m of the site is generally expected to the northwest of the intersection of St. John’s Sideroad and Yonge Street. Three private wells are reported to be present on the site that, if present, are recommended to be decommissioned as part of site development activities. Ten other private water well records are reported within 500 m of the site. Given that no reduction in post-development infiltration rates is estimated at this time, no water quantity reduction to any remaining off-site private wells is anticipated.

Given the proposed LID strategy described above, precipitation falling on certain roof and paved areas will be directed to infiltration trenches, catchbasin infiltration systems and bioswales for infiltration. Other areas will infiltrate to grassed areas. The infiltration of runoff from residential roof areas is considered have a low potential to degrade groundwater quality. Runoff from paved areas such as low traffic roads, parking areas and sidewalks typically has increased concentrations of one or more of metals, oil and grease, and road salt and should be pre-treated to remove large and fine particulate from runoff using devices such as oil and grit separators, or sedimentation chambers or sumps. With properly designed pre-treatment for paved areas, this infiltration is expected to be moderately clean and is expected to have a low potential to degrade groundwater quality at the site, noting that, with the exception of road salt, these materials quickly become immobile in the shallow subsurface. Given the presence of a shallow groundwater flow regime, where most infiltration at the site is expected to report to Tannery Creek and the North and West Tributaries of Tannery Creek, the potential for water quality impacts to off-site private and municipal water wells using primarily deep confined aquifers is considered to be low.

7.0 RECOMMENDATIONS

Based on the findings of this hydrogeological investigation, the following are recommended:

- The monitoring well network should be maintained and used for further monitoring of groundwater levels. It is understood that data loggers will remain in BH102, BH107, BH206-D (deep) and BH206-S (shallow) and additional manual groundwater level monitoring will occur until the summer of 2021 (or until construction begins) to monitor seasonal groundwater levels at the site. Once the monitoring wells are no longer required, decommissioning should occur in accordance with applicable legislation.
- A detailed assessment of construction dewatering needs and potential impacts to receptors should be carried out at the time of detailed design and in conjunction with obtaining dewatering permitting from the MECP. In this regard, a door-to-door private well survey can be carried out to identify any groundwater users within the zone of influence, if required.
- It is recommended that the LID measures be designed to target a mitigated post-development infiltration rate within 10% of pre-development rates. If the separation distance between the LID inverts and the seasonally high groundwater elevations is less than the 1 m assumed in this assessment, less average annual infiltration would be achieved than presented herein. It is therefore recommended that these findings be re-assessed at the time of detailed design and on the basis of seasonal high groundwater elevation data.
- Other LID measures to promote infiltration should be investigated at the time of detailed design for the areas currently designated as On-Site Infiltration in the LID Plan.
- The presence of any private water wells on the site should be investigated. All existing private water wells should be decommissioned in accordance with applicable legislation as part of site development activities.

8.0 CLOSURE

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

Signature Page

Yours truly,

Golder Associates Ltd.

Joel Gopaul

LICENSED PROFESSIONAL ENGINEER
D. P. HINTON
PROVINCE OF ONTARIO

Joel Gopaul, B.A.Sc.
Geo-Environmental Consultant

David Hinton, P.Eng.
Surface Water Engineer

PROFESSIONAL GEOSCIENTIST
CHRISTOPHER M. KOZUSKANICH
PRACTISING MEMBER
0315
ONTARIO

Chris Kozuskanich, P.Geo.
Associate, Senior Hydrogeologist

JJG/MR/DH/MK/CMK/lb

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Soil Engineering Ltd. (January 2021). A Geotechnical Investigation For Proposed School Block, Shining Hill Phase 3, 306 St. John’s Sideroad, Town of Aurora. (Soil Eng., 2021B).

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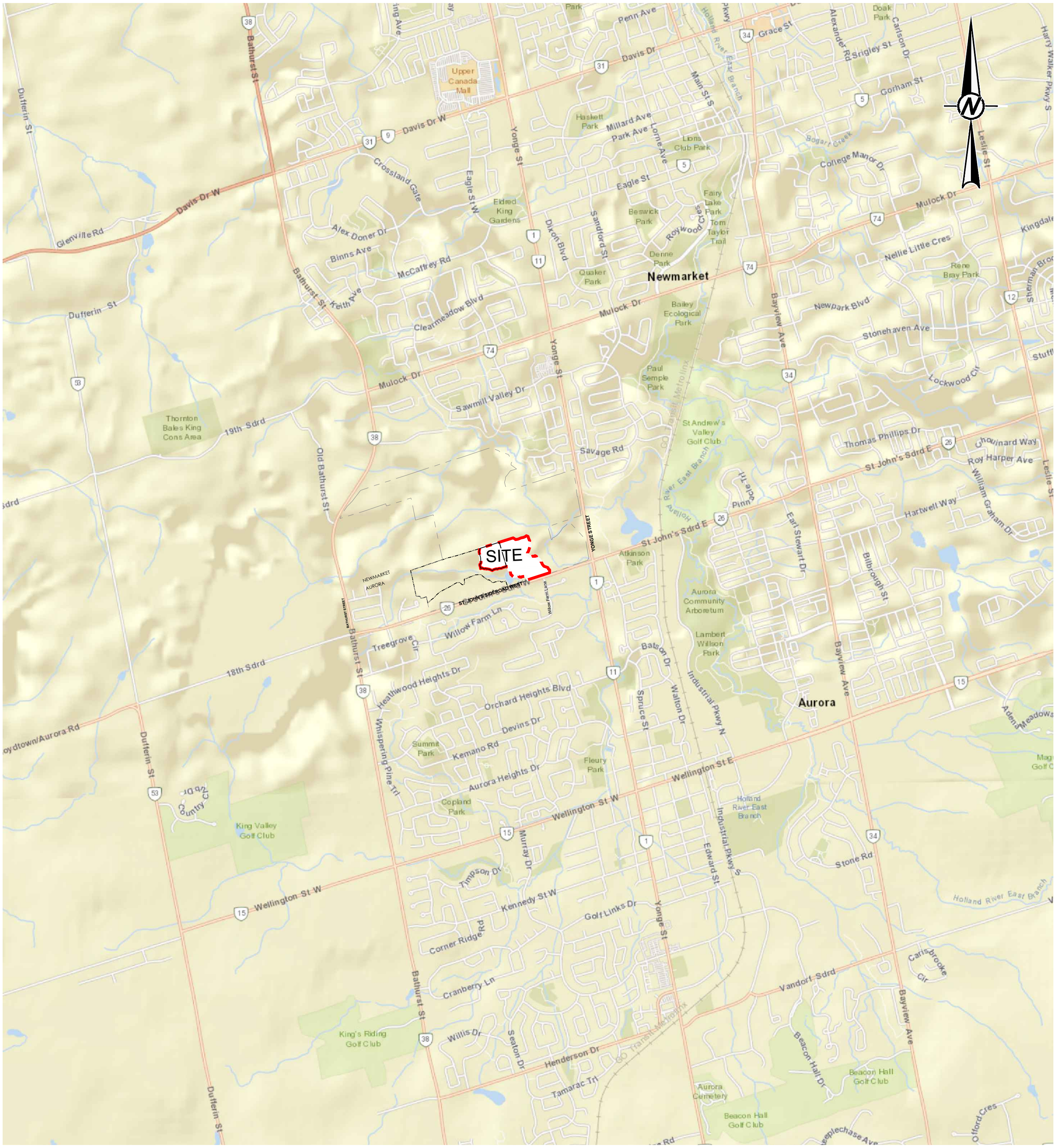
FIGURES



LEGEND

PHASE 3 (AURORA) SITE BOUNDARY

REFERENCES AND NOTES

1. Worldwide Street Maps; Compilation of ESRI & Geographic Partners
2. Malone Given Parson, Draft Plan of Subdivision 16th February 2021

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CLIENT
SHINING HILL ESTATES COLLECTION INC.
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PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

CONSULTANT

GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

TITLE
KEY PLAN

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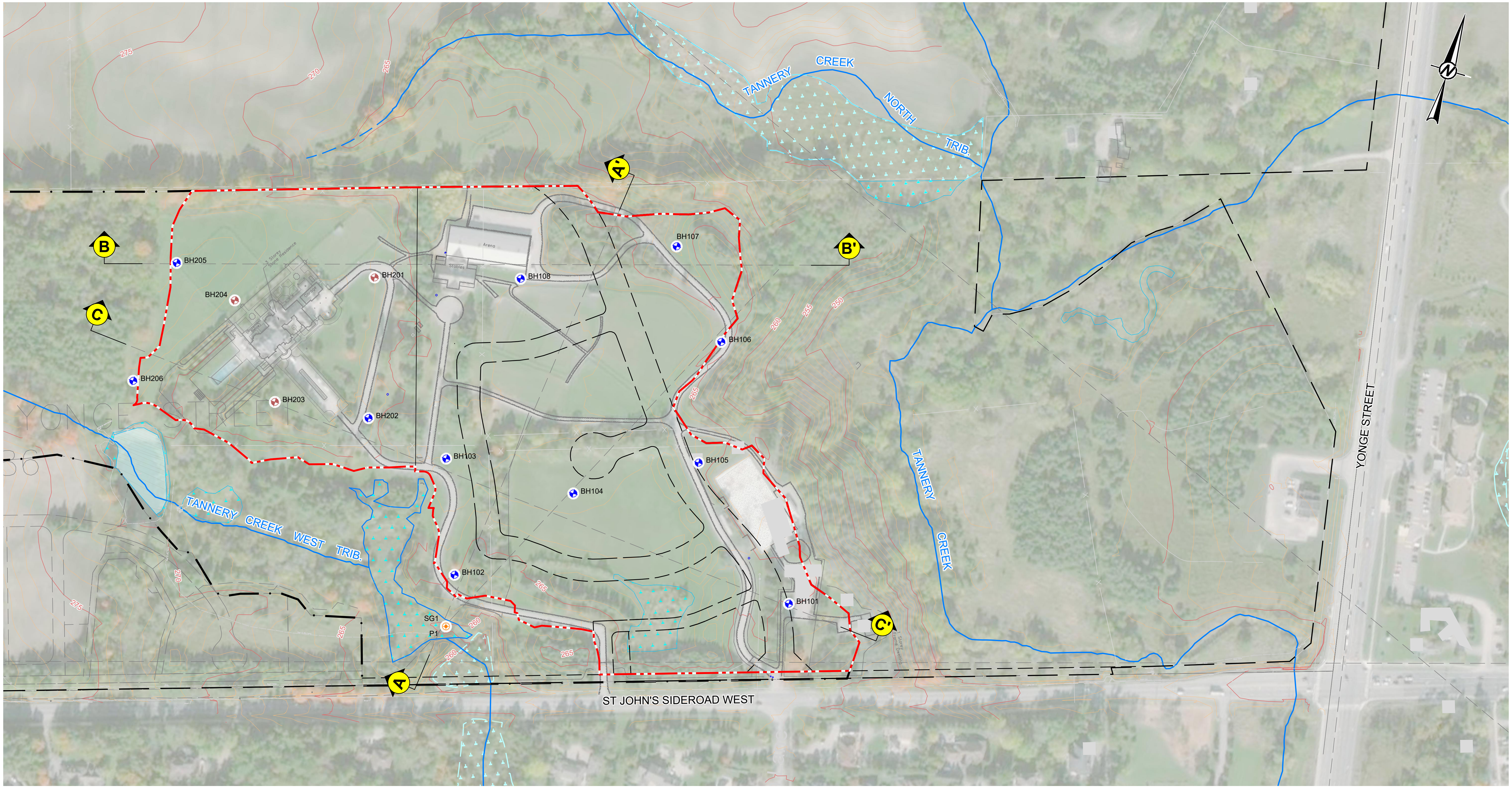

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🟥	PHASE 3 (AURORA) SITE BOUNDARY
●	SOIL ENG MONITORING WELL
●	SOIL ENG BOREHOLE
●	GOLDER PIEZOMETER / STAFF GAUGE
A	LINE OF SECTION
▨	UNEVALUATED WETLAND (MNRF)
▨	MAPPED WETLAND (BEACON)
—	SITE CONTOURS (1 masl INTERVAL)

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE

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SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE PLAN

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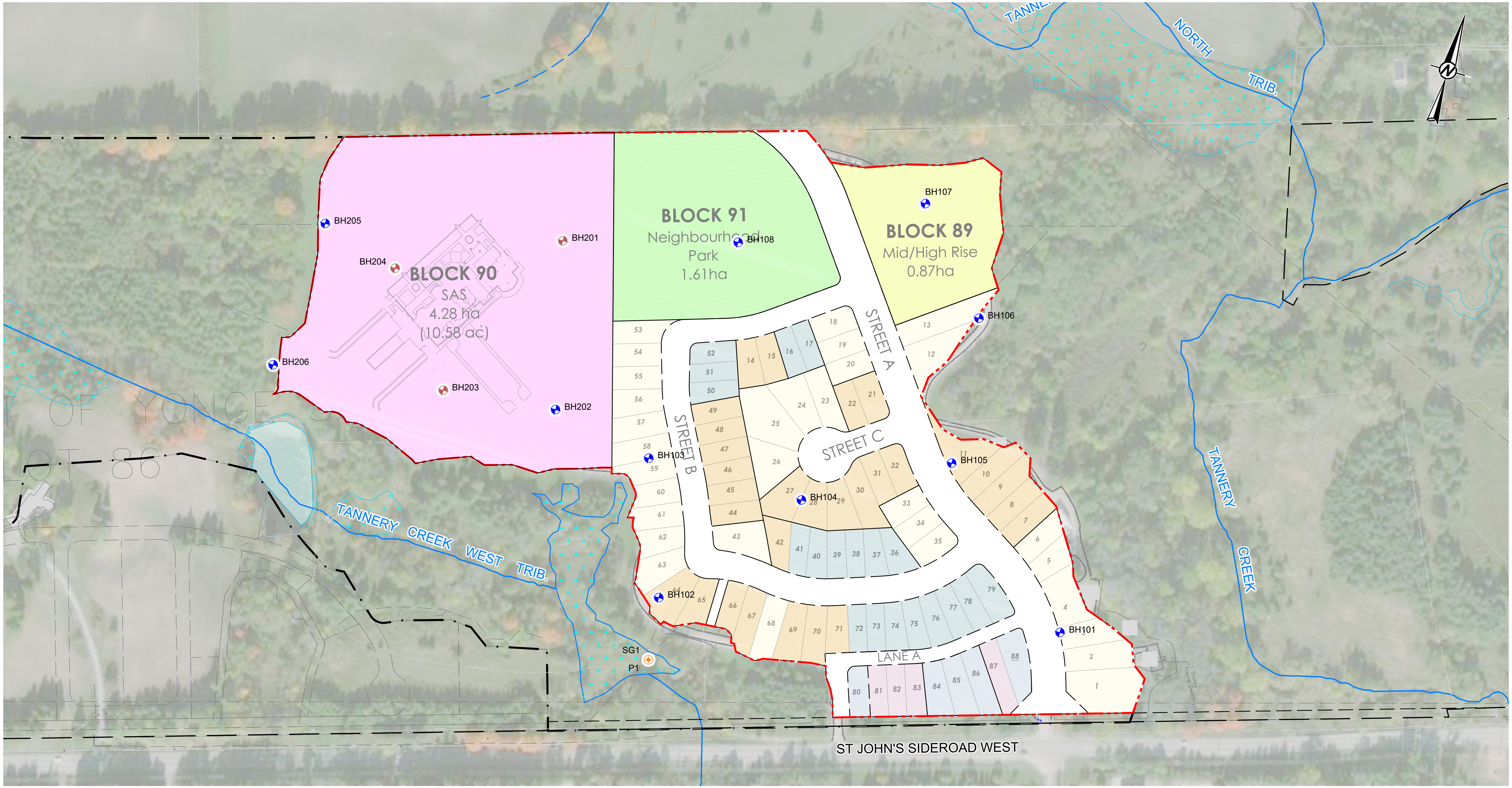

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─ · · ─	PHASE 3 (AURORA) SITE BOUNDARY	▨	SCHOOL BLOCK (EXISTING)
		▨	PARK BLOCK 91
●	SOIL ENG MONITORING WELL	▨	MID-HIGH RESIDENTIAL
		▨	RESIDENTIAL 15 m FRONTS
●	SOIL ENG BOREHOLE	▨	RESIDENTIAL 12 m FRONTS
		▨	RESIDENTIAL 13 m FRONTS
●	GOLDER PIEZOMETER / STAFF GAUGE	▨	RESIDENTIAL 13 m LANE
		▨	RESIDENTIAL 12 m LANE

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE
4. DRAFT PLAN, MALONE GIVEN PARSONS; FEBRUARY 2021

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SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

CONSULTANT

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TITLE
PROPOSED DEVLOPMENT PLAN

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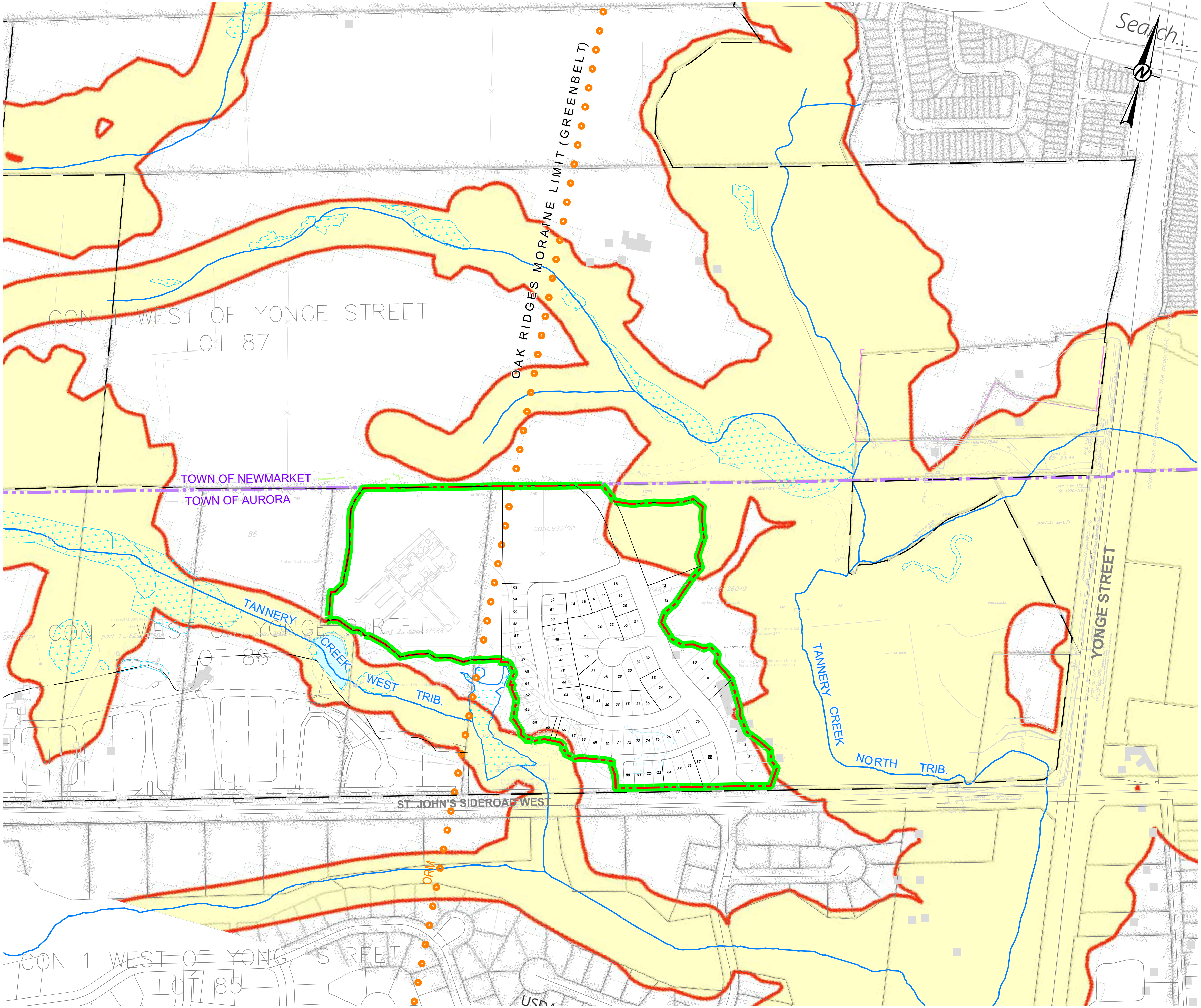

LEGEND

🟩	PHASE 3 (AURORA) LIMITS
	MAPPED WETLANDS (BEACON)
	LSRCA REGULATED AREA (see note)
● ● ● ●	OAK RIDGES MORAINE LIMIT (GREENBELT)

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Regulated Areas, Lake Simcoe Region Conservation Authority
3. Mapped Features and Locations are Approximate and Not to Scale

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SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
REGULATED AREAS

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REVIEWED	JG
APPROVED	CMK

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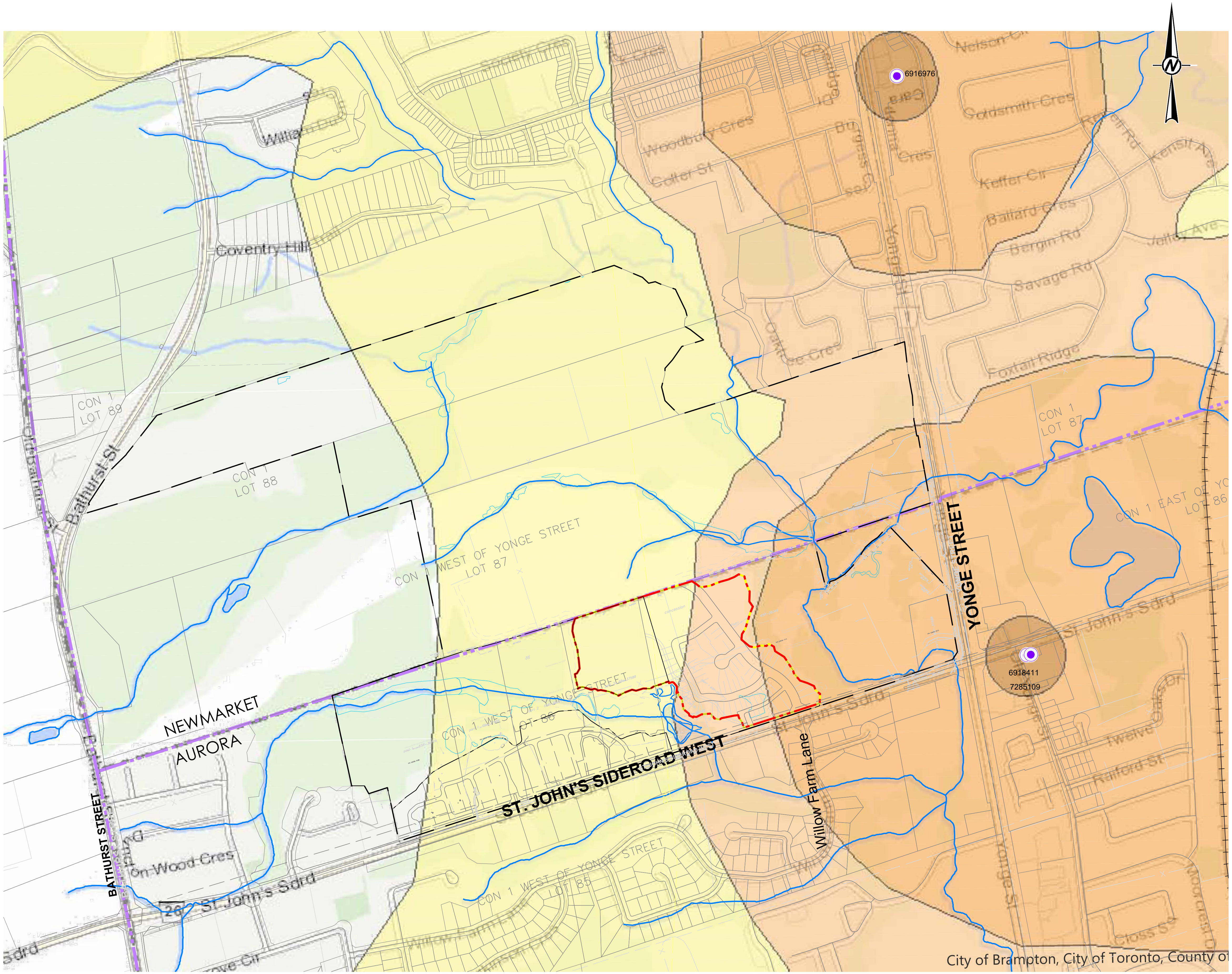

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🟥 - · - 🟥	PHASE 3 (AURORA) SITE BOUNDARY
◉	MUNICIPAL SUPPLY WELL
▨	100 m WHPA A
▨	2 YEAR WHPA ZONE
▨	5 YEAR WHPA ZONE
🟨	25 YEAR WHPA ZONE

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Selected MOE Centroid Well Locations have been relocated based on Drillers Record
3. Region of York, Source Water Protection
4. Mapped Features and Locations are Approximate and Not to Scale

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162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
WELLHEAD PROTECTION AREAS

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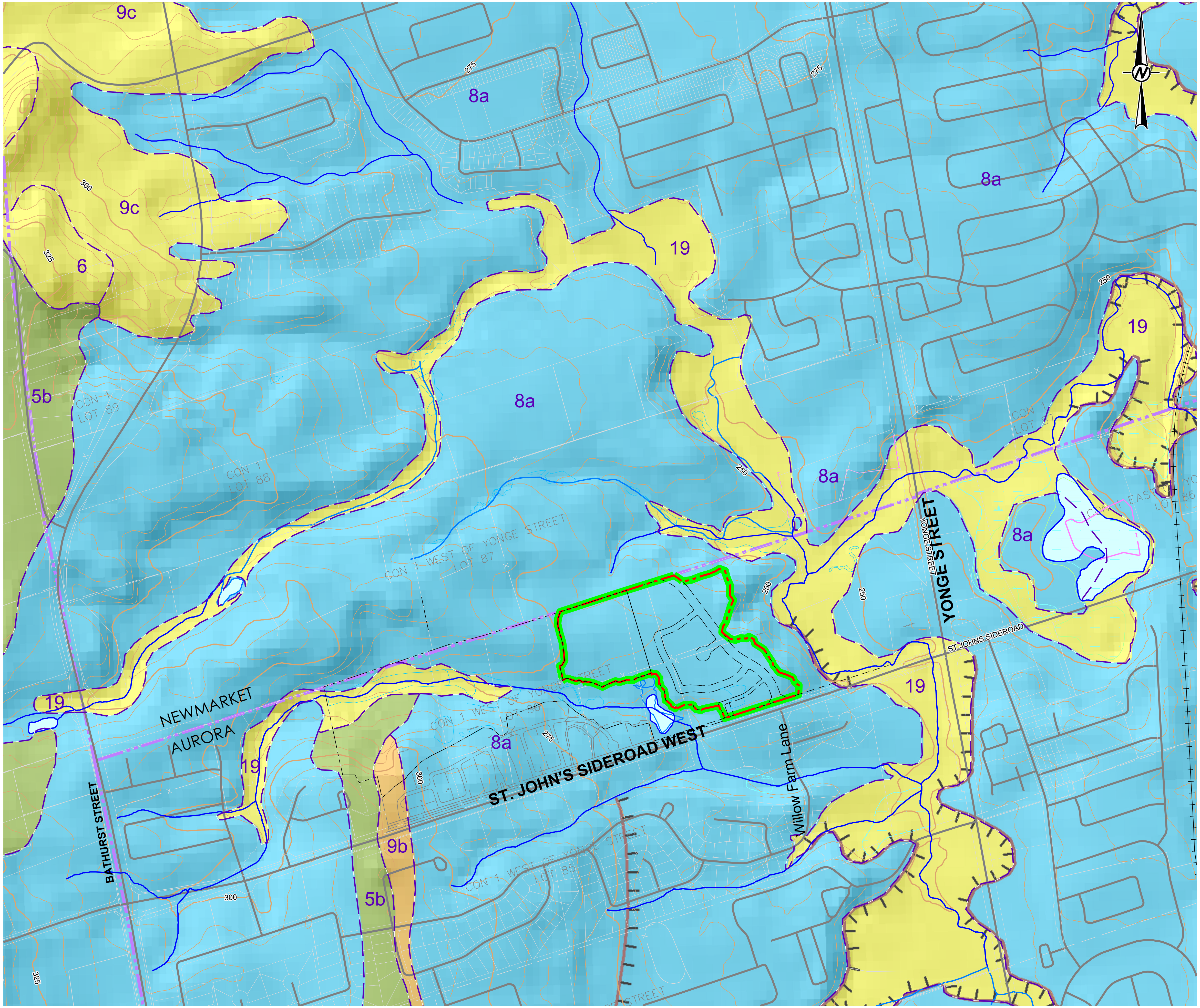

LEGEND

🟩		PHASE 3 (AURORA) BOUNDARY
🟨	19	FLUVIAL SILT, SAND, GRAVEL
🟧	9b	GLACIOLACUSTRINE SAND DEPOSITS
🟨	9c	GLACIOLACUSTRINE SILT & SAND DEPOSITS
🟦	8a	GLACIOLACUSTRINE DEEP WATER DEPOSITS
🟧	6	ICE CONTACT SEDIMENTS, ESKERS
🟩	5b	ABLATION TILL
┴┴┴┴┴┴		FLOW TERRACE

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Quatenary Geology, OGS / GSC Digital Compilation, Queen's Printer

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PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
QUATERNARY SOILS MAP

CONSULTANT

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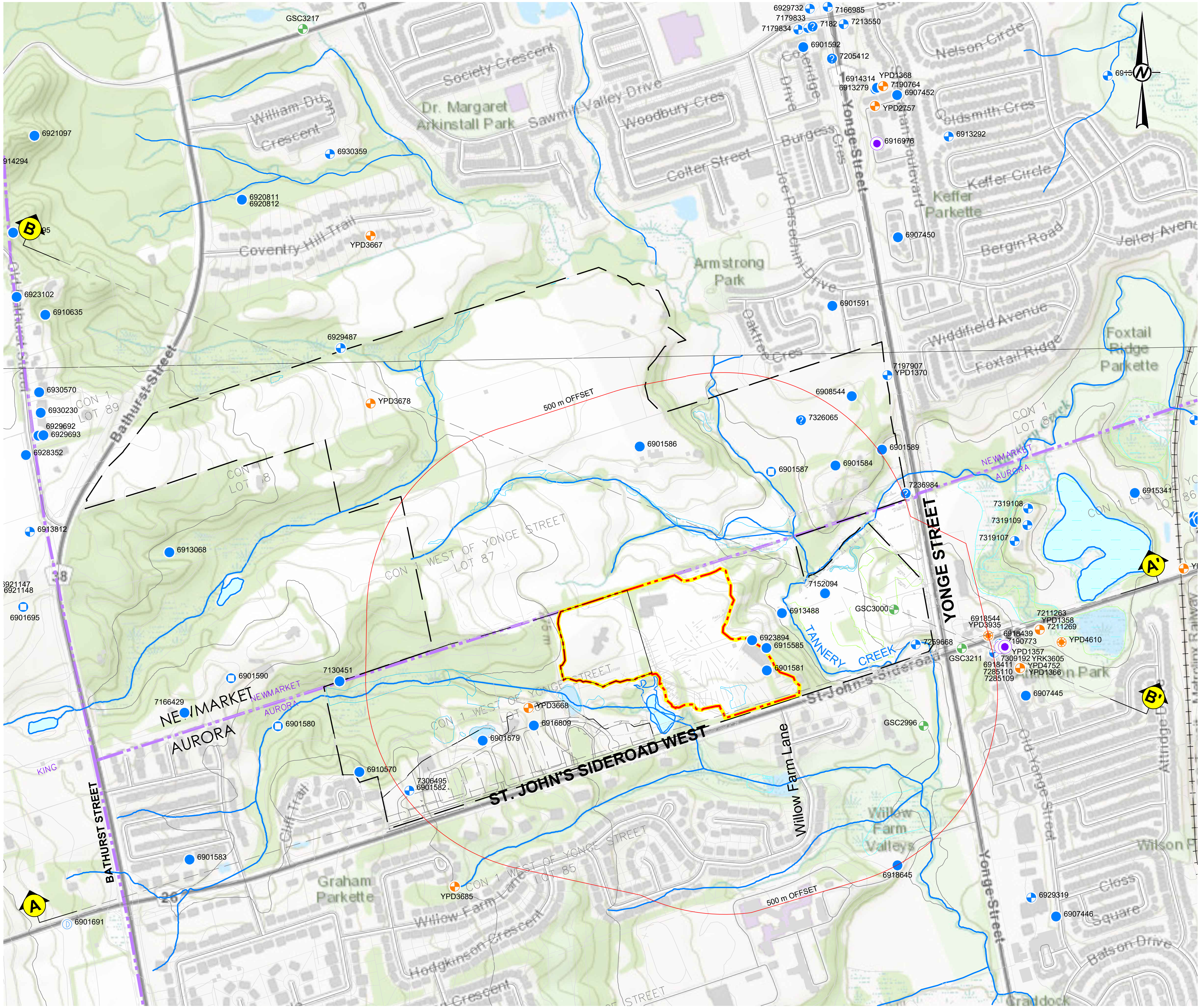

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PHASE 3 (AURORA) SITE BOUNDARY

MOE WATER WELL RECORD		OAK RIDGES MORAINE DATABASE	
●	TEST OR OBSERVATION WELL	●	OGS / GSC BOREHOLE
Ⓓ	DUG WELL	●	MONITORING WELL
▢	BORED WELL	✺	TEST HOLE TO BEDROCK
●	DRILLED WELL		
✺	DRILLED TO BEDROCK		
●	MUNICIPAL SUPPLY WELL		
6200000	MOE NUMBER		

REFERENCES AND NOTES

1. Mapping based on ESRI Geography Network OBM Features and Client CAD Compilations
2. Selected MOE Centroid Well Locations have been relocated based on Drillers Record
3. Abandoned wells, Centroid located wells, and Temporary Shallow Dewatering wells excluded
4. Mapped Features and Locations are Approximate and Not to Scale
5. Minsitry Water Well Records, Queen's Printer 2020
6. Conservation Authorities Oak Ridges Moraine (ORM) Coalition / TRCA Database

0 200 400 600 m

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PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
MINISTRY RECORDED WELLS

CONSULTANT

GOLDER

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PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
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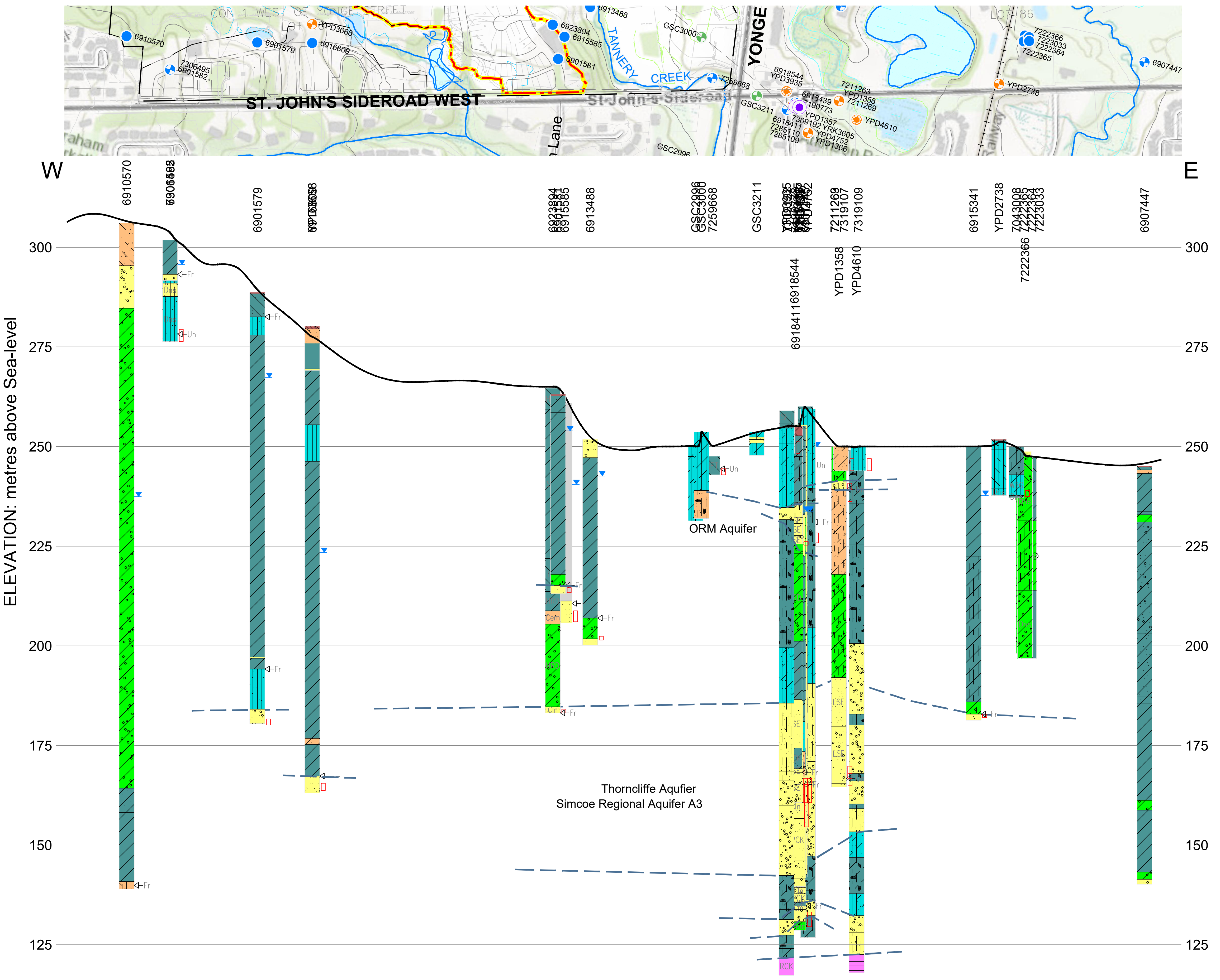


PLAN LEGEND

- Ⓓ SHALLOW DUG OR BORED <10 M
- ○ DEEP BORED WELL >10 M
- ● DRILLED OVERBURDEN WELL
- ◐ TEST OR OBSERVATION WELL
- ◍ DRILLED BEDROCK WELL
- ◉ MUNICIPAL / PUBLIC SUPPLY
- ⊗ RECORD OF ABANDONMENT

OAK RIDGES MORAINE DATABASE

- ◐ OGS / GSC BOREHOLE
- ◐ MONITORING WELL
- ✺ TEST HOLE TO BEDROCK

SOIL PATTERN LEGEND AND GENERIC SHADING

▨	UNOXIDIZED CLAY BLUE, GREY WHITE, OR UNDEFINED	⬜	UNKNOWN
▧	OXIDIZED CLAY BROWN, RED, YELLOW	🟫	PEAT/LOAM
▥	SILT	🟨	SANDS & GRAVELS
░	SAND	🟧	GRANULAR TILL
∴	GRAVEL	🟦	SILT
∘	STONES, PEBBLES	🟦	SILT CLAYEY
○	BOULDER	🟦	CLAY
⁘	TILL	🟩	TILL
▤	SHALE	🟪	LIMESTONES
▦	LIMESTONE	🟪	SHALES

23453 MOE RECORDED PRIVATE WELL

▼ RECORDED STATIC WATER LEVEL

↱ FLOWING WELL

◁ WATER PRODUCING ZONE

▯ SCREEN

NOTES

MINISTRY OF ENVIRONMENT WATER WELL INFORMATION SYSTEM, QUEEN'S PRINTER. LOCATION AND ELEVATIONS OF FIELD VERIFIED WELLS ARE SUBJECT TO REVISION.

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

0 200 400 600 m

1:10000

CLIENT

SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT

HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE

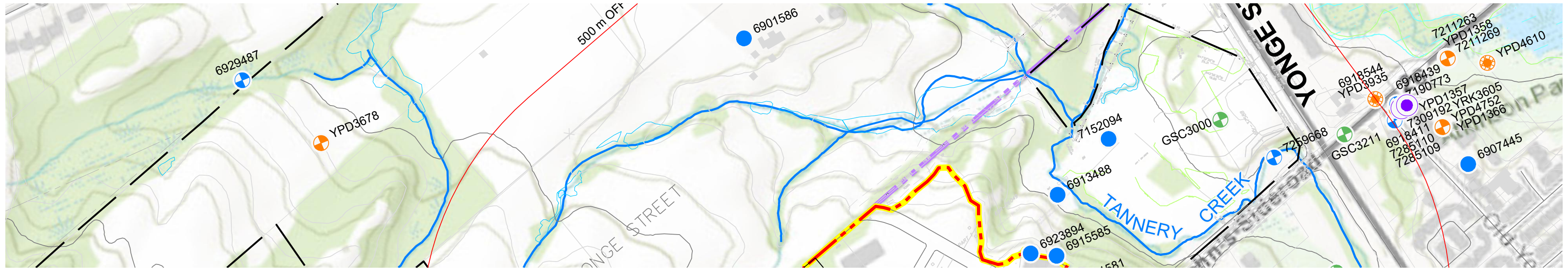
AREA CROSS-SECTION A - A'

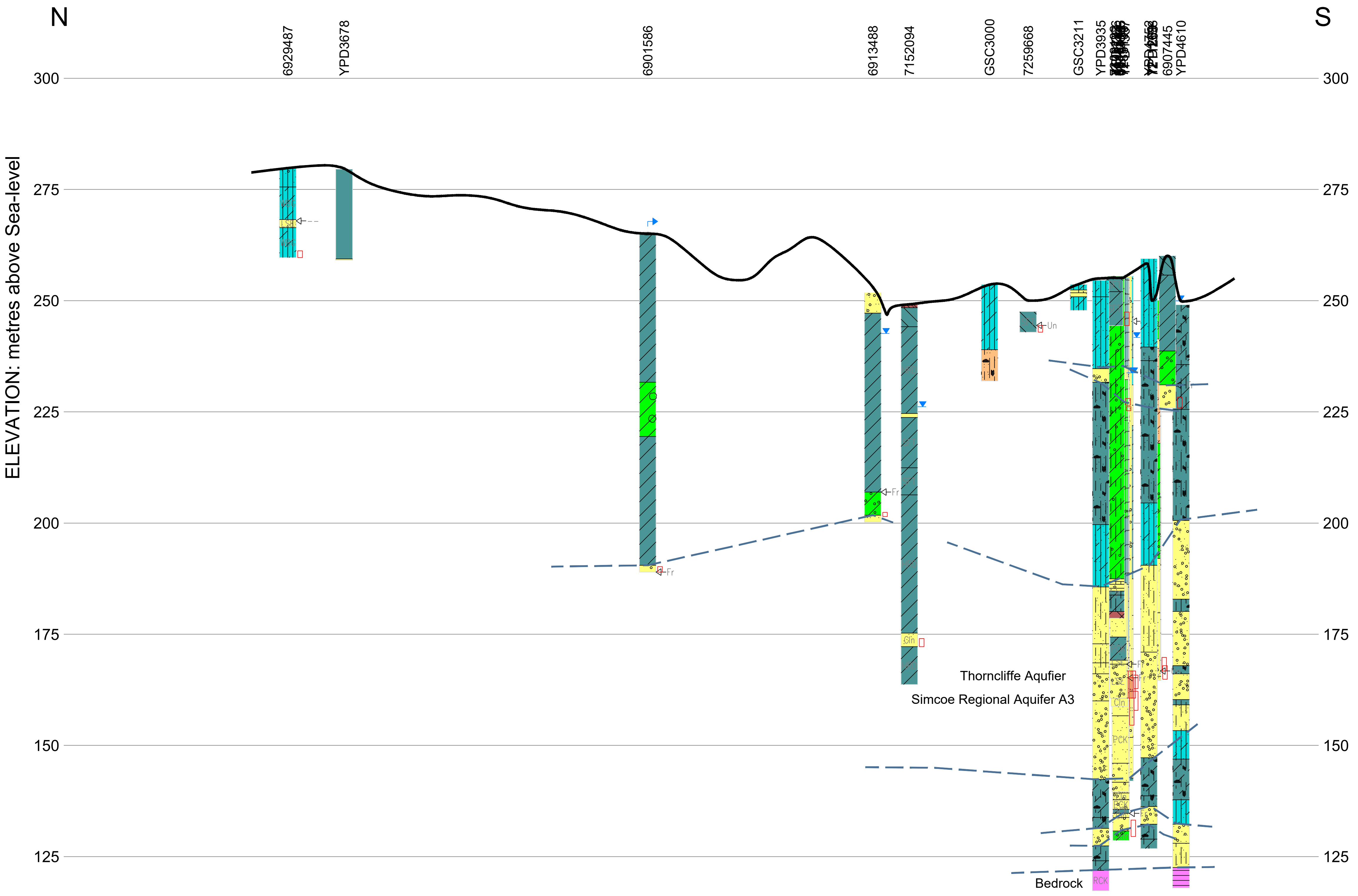
CONSULTANT

GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	----	6A





PLAN LEGEND

- ⓓ SHALLOW DUG OR BORED <10 M
- ▢ DEEP BORED WELL >10 M
- ● DRILLED OVERBURDEN WELL
- ◕ TEST OR OBSERVATION WELL
- ⊕ DRILLED BEDROCK WELL
- ◉ MUNICIPAL / PUBLIC SUPPLY
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OAK RIDGES MORAINE DATABASE

- ◕ OGS / GSC BOREHOLE
- ◕ MONITORING WELL
- ⊕ TEST HOLE TO BEDROCK

SOIL PATTERN LEGEND AND GENERIC SHADING

▨	UNOXIDIZED CLAY BLUE, GREY WHITE, OR UNDEFINED	⬜	UNKNOWN
▧	OXIDIZED CLAY BROWN, RED, YELLOW	🟥	PEAT/LOAM
▥	SILT	🟨	SANDS & GRAVELS
⁘	SAND	🟧	GRANULAR TILL
△	GRAVEL	🟦	SILT
○	STONES, PEBBLES	🟦	SILT CLAYEY
◯	BOULDER	■	CLAY
⁙	TILL	🟩	TILL
▤	SHALE	🟪	LIMESTONES
▦	LIMESTONE	🟪	SHALES

23453 MOE RECORDED PRIVATE WELL

▼ RECORDED STATIC WATER LEVEL

↱ FLOWING WELL

◁ WATER PRODUCING ZONE

▯ SCREEN

NOTES

MINISTRY OF ENVIRONMENT WATER WELL INFORMATION SYSTEM, QUEEN'S PRINTER. LOCATION AND ELEVATIONS OF FIELD VERIFIED WELLS ARE SUBJECT TO REVISION.

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0 200 400 600 m

1:10000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN’S SIDEROAD WEST, AURORA

TITLE
AREA CROSS-SECTION B - B'

CONSULTANT

GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	----	6B

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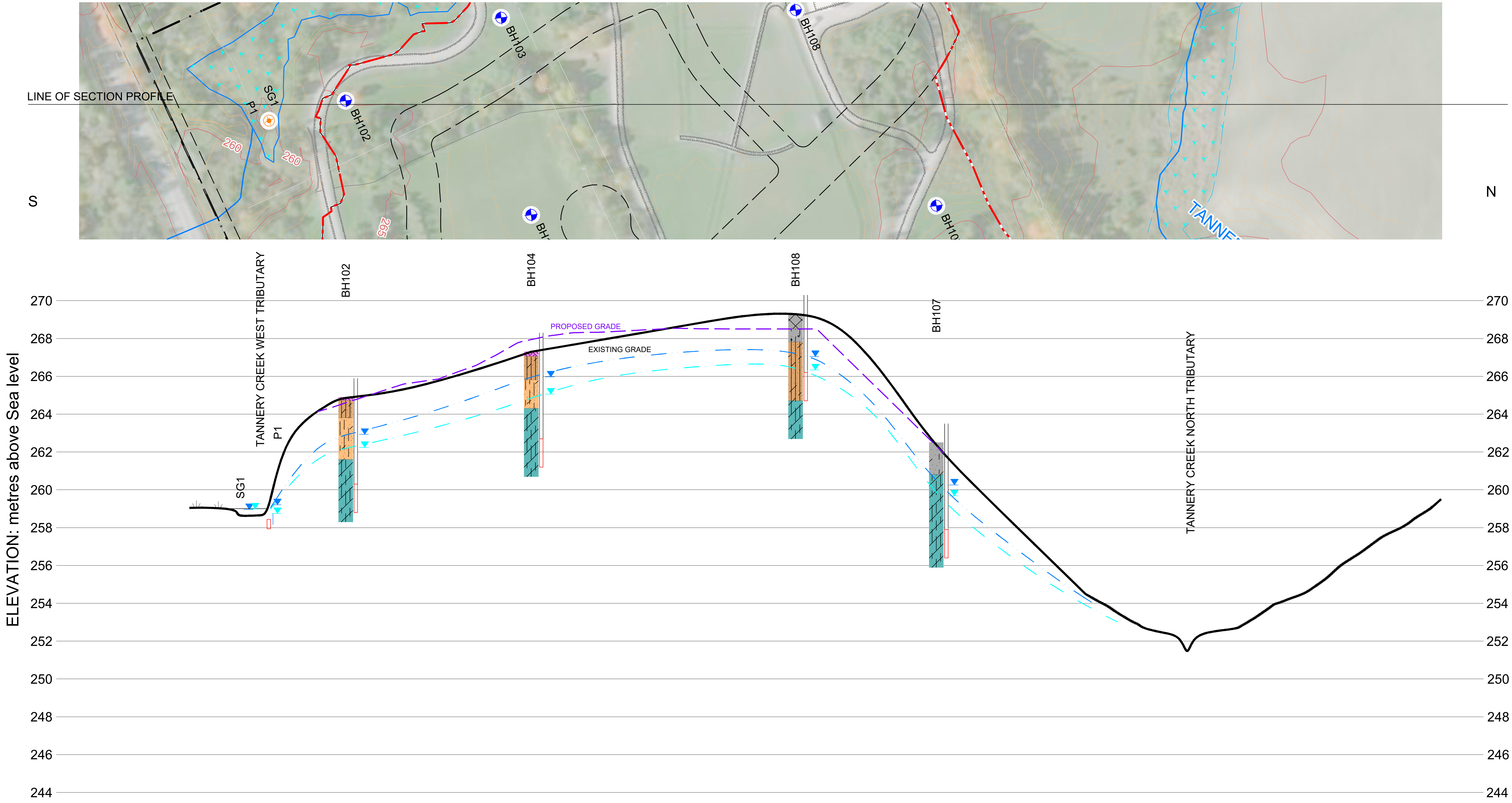

SOILS LEGEND

▨	EARTH / TOPSOIL FILL
▨	GRANULAR FILL
▨	SAND
▨	SAND TRACE SILT
▨	SILTY SAND
▨	TOPSOIL
▨	SILTY SAND TRACE CLAY
▨	SANDY SILT WITH TO TRACE CLAY
▨	SILTY CLAY

SECTION LEGEND

BH1	BOREHOLE ID
▼	RECORDED STATIC WATER LEVEL 1st DECEMBER 2020
▼	RECORDED STATIC WATER LEVEL JANUARY 2020
▯	SCREEN

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE SECTION A - A'

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	----	7A

Path: \\golder.gds\complexdata\office\mississauga\sim\Clients\Shining_Hill_Estates_Aurora\162_St_Johns_SideRoad\99_PROJ\20360612_SCS\40_PROD\0001-HydroG\ | File Name: 20360612-0001-CH-0002.dwg | Last Edited By: jregier Date: 2021-03-05 Time:3:36:20 PM | Printed By: jregier Date: 2021-03-09 Time:2:54:44 PM

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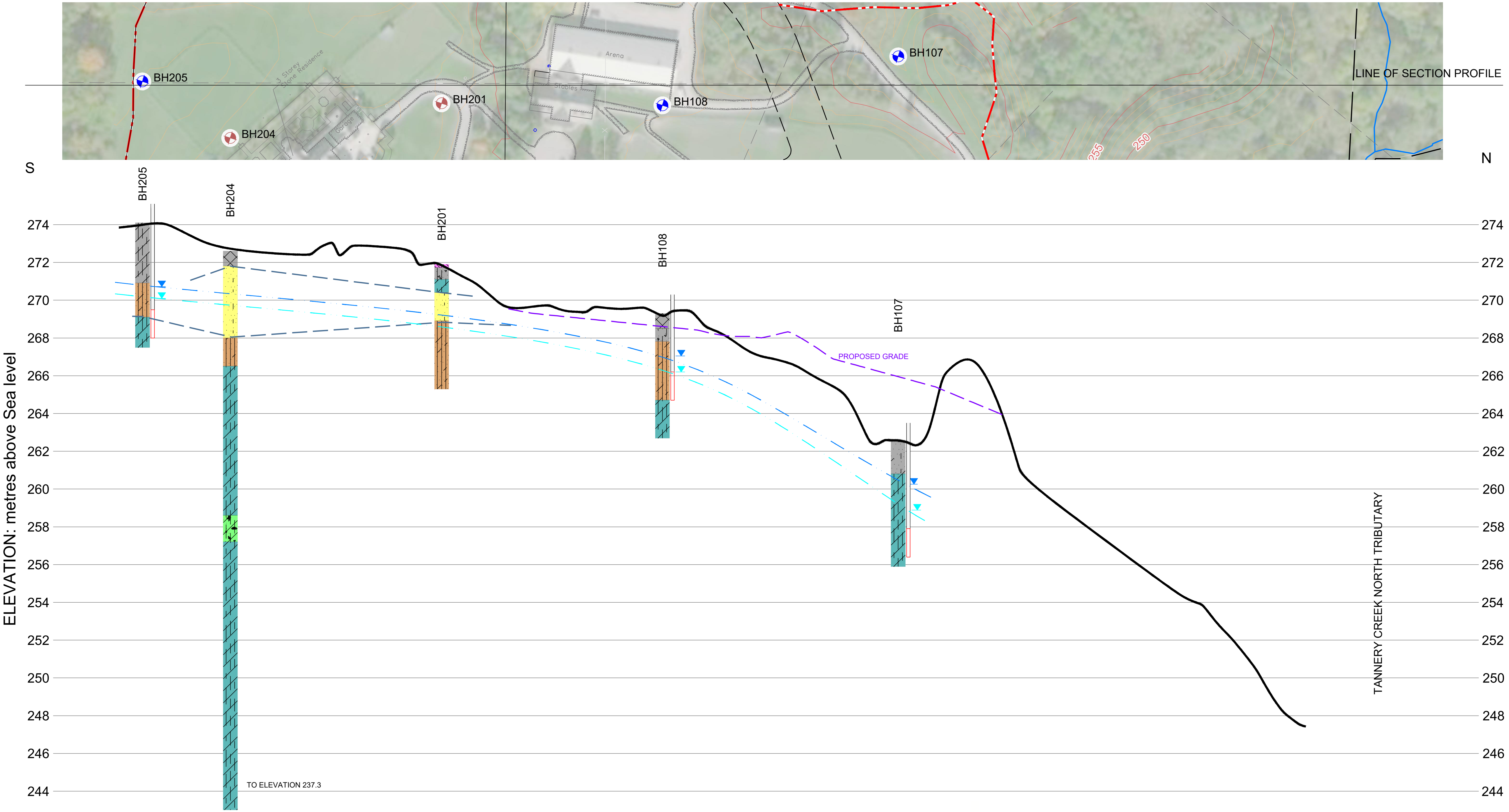


0 40 80 120 m
1:2000

SOILS LEGEND

▨	EARTH / TOPSOIL FILL	▨	TOPSOIL		
▨	GRANULAR FILL	▨	SILTY SAND TRACE CLAY		
▨	SAND	▨	SANDY SILT WITH TO TRACE CLAY	▨	SILTY SAND DIAMICT
▨	SAND TRACE SILT SILTY SAND	▨	SILTY CLAY	▨	SILTY CLAY DIAMICT

SECTION LEGEND

BH1 BOREHOLE ID

▼ RECORDED STATIC WATER LEVEL 1st DECEMBER 2020

▼ RECORDED STATIC WATER LEVEL JANUARY 2020

▯ SCREEN

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

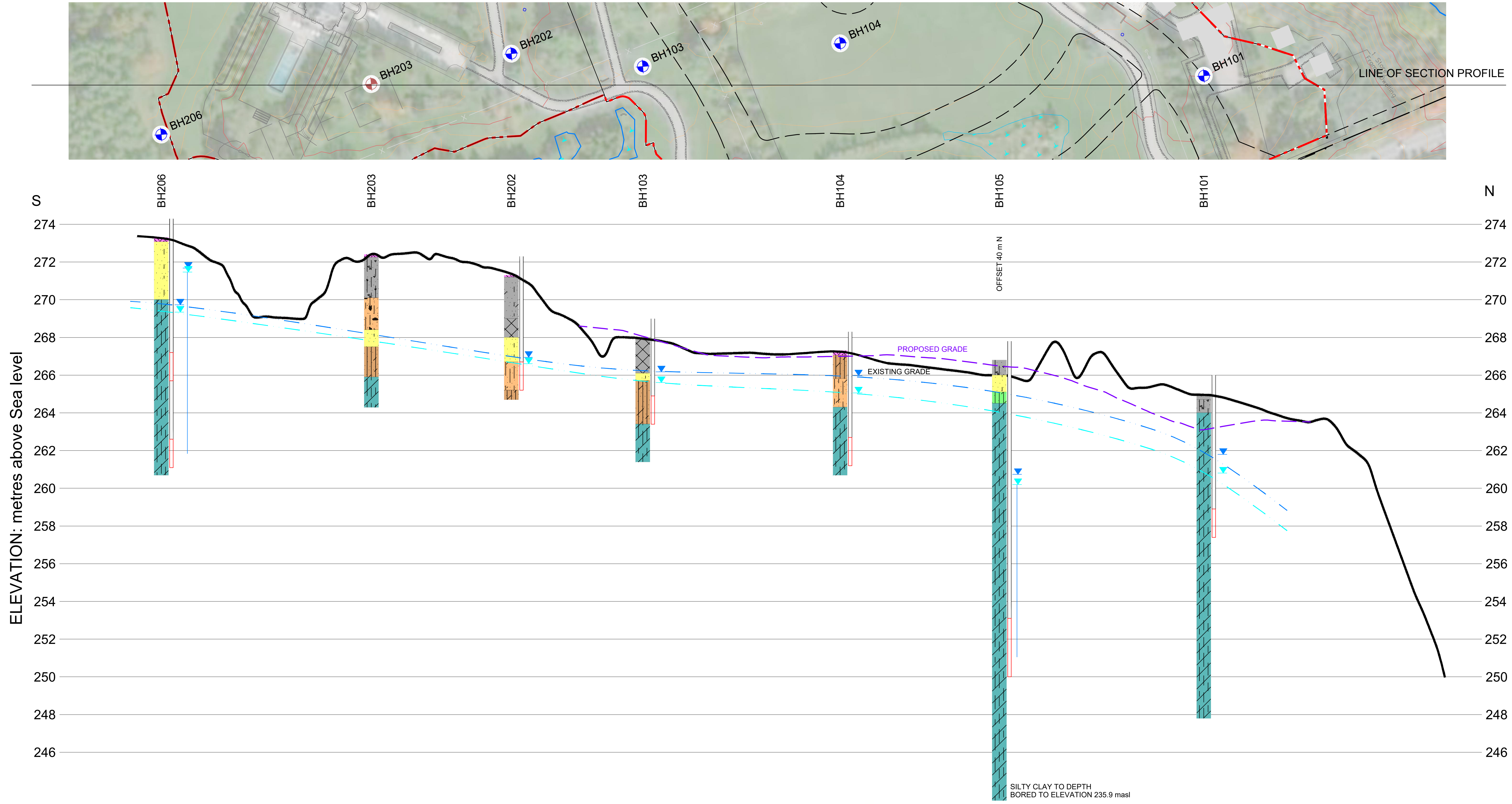
CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE SECTION B - B'

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	----	7B



SOILS LEGEND

- ☒ EARTH / TOPSOIL FILL
- ▨ GRANULAR FILL
- ▨ SAND
- ▨ SAND TRACE SILT
- ▨ SILTY SAND
- ▨ TOPSOIL
- ▨ SILTY SAND TRACE CLAY
- ▨ SANDY SILT WITH TO TRACE CLAY
- ▨ SILTY CLAY
- ▨ SILTY SAND DIAMICT
- ▨ SILTY CLAY DIAMICT

SECTION LEGEND

- BH1 BOREHOLE ID
- ▼ RECORDED STATIC WATER LEVEL 1st DECEMBER 2020
- ▼ RECORDED STATIC WATER LEVEL JANUARY 2020
- ▯ SCREEN

BOUNDARIES BETWEEN SOIL STRATA HAVE BEEN DETERMINED ONLY AT WELL AND TEST WELL LOCATIONS. BETWEEN THE WELLS AND TEST WELLS, BOUNDARIES ARE NOT PROVEN BUT ARE ASSUMED FROM GEOLOGICAL EVIDENCE.

0 40 80 120 m
1:2000

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER

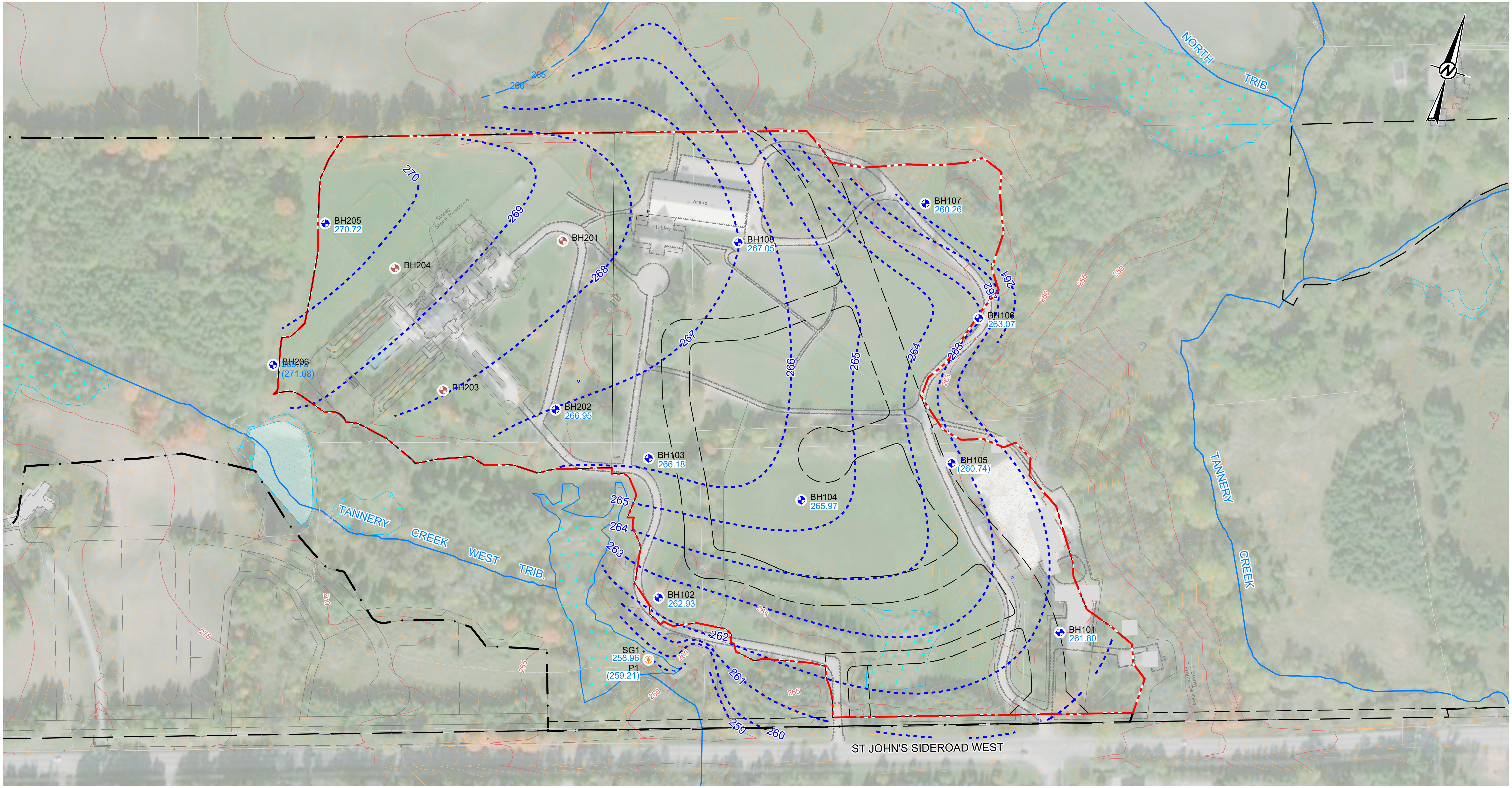
YYYY-MM-DD	2021-03-09
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
SITE SECTION C - C'

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	----	7C

Path: \\golder.gds\complexdata\office\mississauga\sim\Clients\Shining_Hill_Estates_Aurora\162_St_Johns_SideRoad\99_PROJ\20360612_SCS\40_PROD\0001-HydroG\ | File Name: 20360612-0001-CH-0002.dwg | Last Edited By: jregier Date: 2021-03-05 Time:3:36:20 PM | Printed By: jregier Date: 2021-03-09 Time:2:55:44 PM



0 50 100 150 m

1:2500

LEGEND

🟥	PHASE 3 (AURORA) BOUNDARY
●	SOIL ENG MONITORING WELL
●	SOIL ENG BOREHOLE
●	GOLDER PIEZOMETER / STAFF GAUGE
262.42	STATIC WATER LEVEL (JANUARY 2021)
(258.99)	LOWER SCREENED POTENTIAL (masl)
⋯	WATER TABLE CONTOUR (masl)
▨	WETLAND (BEACON)
—	SITE CONTOURS (1 masl INTERVAL)

REFERENCES AND NOTES

1. MAPPING BASED ON ESRI GEOGRAPHY NETWORK OBM FEATURES AND CLIENT CAD COMPILATIONS
2. WETLAND AND ECOLOGICAL FEATURES, BEACON, FEBRUARY 2021
3. MAPPED FEATURES AND LOCATIONS ARE APPROXIMATE AND NOT TO SCALE
4. BETWEEN THE WELLS AND TEST WELLS, CONTOURED SURFACES ARE NOT PROVEN.
5. LOWER SCREENED POTENTIALS (LEVELS IN BRACKETS) NOT USED FOR INTERPOLATION.

CLIENT
SHINING HILL ESTATES COLLECTION INC.
C/O SCS CONSULTING GROUP LTD.

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	
PREPARED	JPR
REVIEWED	JG
APPROVED	CMK

PROJECT
HYDROGEOLOGICAL INVESTIGATION
SHINING HILL (PHASE 3)
162, 306, 370, 434 & 488 ST. JOHN'S SIDEROAD WEST, AURORA

TITLE
WATER TABLE JANUARY 2021

PROJECT NO.	CONTROL	REV.	FIGURE
20360612	0001	----	8

APPENDIX A

Important Information and Limitations of this Report

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder cannot be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder cannot be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Ground water Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report. The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client’s expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder’s report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder’s report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder’s report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder’s report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder’s responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

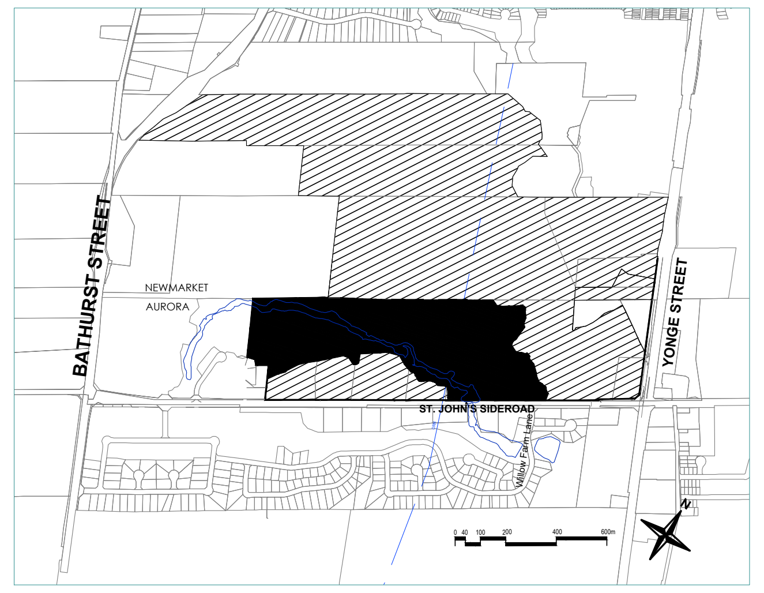
APPENDIX B

Supporting Documentation

DRAFT PLAN OF SUBDIVISION

Part of Lot 86, Concession 1
Town of Aurora
Regional Municipality of York

KEY PLAN



■ SUBJECT PROPERTY

▨ OTHER LANDS OWNED BY APPLICANT

SCHEDULE OF LAND USE

LOT / BLOCK	LAND USE	UNITS	AREA
1-79	Single Detached Min. 15.24m ☐	31	2.01
	Single Detached Min. 13.70m +	29	1.59
	Single Detached Min. 12.20m O	19	0.83
80-88	Lane Access Single Detached Min. 13.70m ^	5	0.30
	Lane Access Single Detached Min. 12.20m ~	4	0.19
89	Mid / High Rise Residential		0.87
90	Saint Anne's School		4.28
91	Neighbourhood Park		1.61
92	Natural Heritage / Open Space		17.72
93	Servicing Block		0.02
94	Trail Head		0.02
95	Road Widening		0.24
96-97	0.3m Reserves		0.01
Street A	23.0m Right of Way 436m		1.02
Street B-C	18.0m Right of Way 420m		0.81
Street B	15.0m Right of Way 108m		0.16
Lane A	9.2m Right of Way 141m		0.14
TOTAL		**88**	**31.79**

OWNER'S AUTHORIZATION

I hereby authorize Malone Given Parsons Ltd. to prepare and submit this Draft Plan of Subdivision to the Town of Aurora.

Angelo DeGasperis
Date

SURVEYOR'S CERTIFICATE

I hereby certify that the boundaries of the lands to be subdivided and their relationship to the adjacent lands are correctly shown.

Neil A. LeGrow
Date

ADDITIONAL INFORMATION

AS REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT, CHAPTER P.13(R.S.O. 1990).
(a),(e),(f),(g),(j),(l) - As shown on the Draft Plan.
(b),(c) - As shown on the Draft and Key Plan.
(d) - Land to be used in accordance with the Schedule of Land Use.
(i) - Soil is clay loam and sandy loam.
(h),(k) - Full municipal services to be provided.

Prepared by:

MGP Malone Given Parsons.

140 Renfrew Drive, Suite 201
Markham, Ontario, L3R 6B3
Tel: (905) 513-0170
www.mgp.ca

Prepared for:
SHINING HILL ESTATE COLLECTION INC.

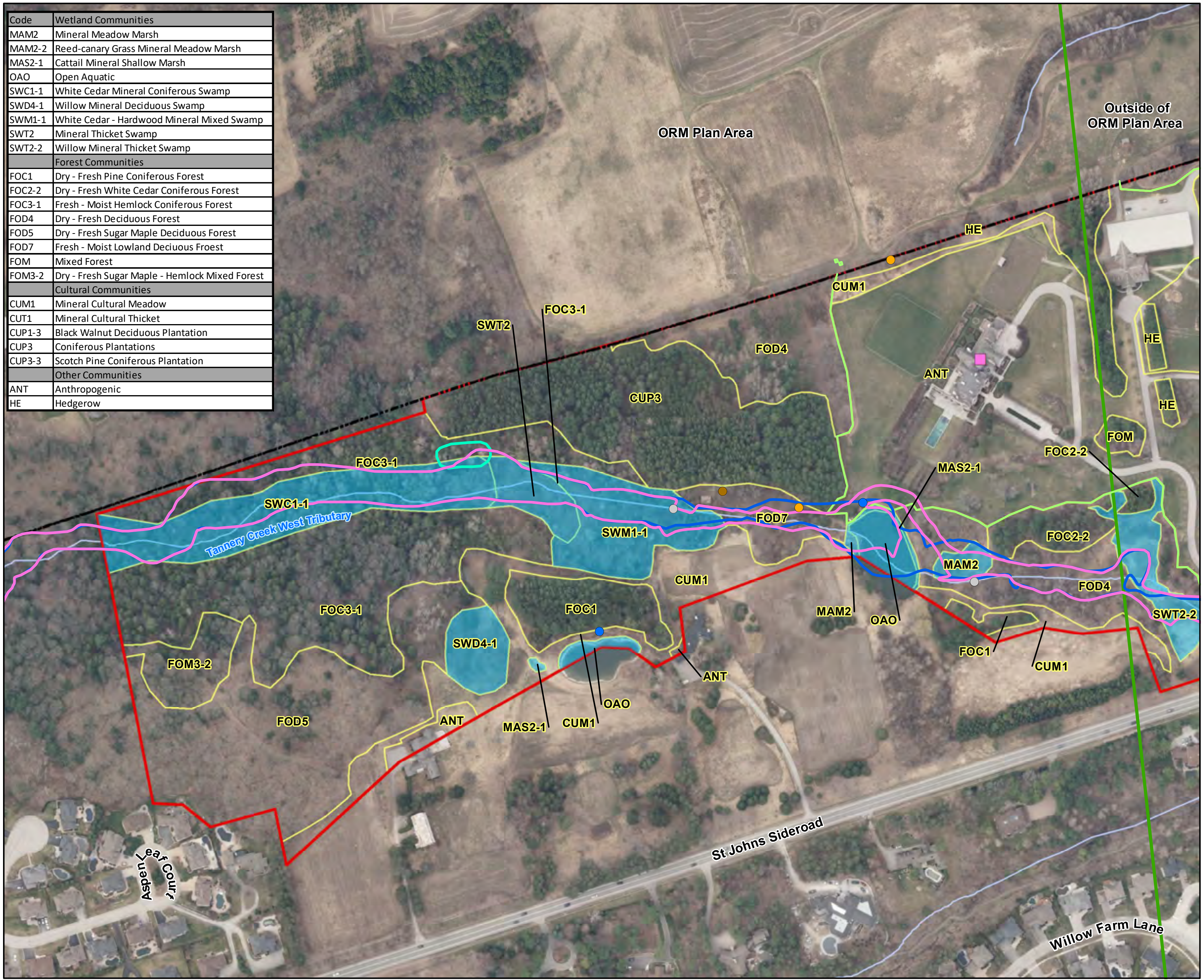
Date: March 2, 2021

Project No.: 15-2374

Existing Conditions

Figure 2A

Shining Hill Estate Collection Inc.



Code	Wetland Communities
MAM2	Mineral Meadow Marsh
MAM2-2	Reed-canary Grass Mineral Meadow Marsh
MAS2-1	Cattail Mineral Shallow Marsh
OAO	Open Aquatic
SWC1-1	White Cedar Mineral Coniferous Swamp
SWD4-1	Willow Mineral Deciduous Swamp
SWM1-1	White Cedar - Hardwood Mineral Mixed Swamp
SWT2	Mineral Thicket Swamp
SWT2-2	Willow Mineral Thicket Swamp
	Forest Communities
FOC1	Dry - Fresh Pine Coniferous Forest
FOC2-2	Dry - Fresh White Cedar Coniferous Forest
FOC3-1	Fresh - Moist Hemlock Coniferous Forest
FOD4	Dry - Fresh Deciduous Forest
FOD5	Dry - Fresh Sugar Maple Deciduous Forest
FOD7	Fresh - Moist Lowland Deciuous Froest
FOM	Mixed Forest
FOM3-2	Dry - Fresh Sugar Maple - Hemlock Mixed Forest
	Cultural Communities
CUM1	Mineral Cultural Meadow
CUT1	Mineral Cultural Thicket
CUP1-3	Black Walnut Deciduous Plantation
CUP3	Coniferous Plantations
CUP3-3	Scotch Pine Coniferous Plantation
	Other Communities
ANT	Anthropogenic
HE	Hedgerow

Legend

- □ Study Area
- — Staked Dripline (LSRCA, July 21, 2020)
- — Long Term Stable Top of Slope (Soil Engineers Ltd. 2020)
- — Watercourse (MNRF 2019)
- — Staked Dripline (LSRCA 24 Aug 2015)
- — Staked Top of Slope (LSRCA 24 Aug 2015)
- □ Chimney Crayfish Locations
- □ ELC Communities
- ⬚ Municipal Boundary (MNRF 2019)
- — Regional Floodline (LSRCA)
- — Proposed Regional Floodline (Schaeffers Consulting Engineers, 2020)
- ■ Nesting Chimney Swift
- ■ Wetlands (Beacon 2020)
- ● Amphibian Monitoring Locations
- ● Culvert Location
- □ Oak Ridges Moraine Boundary (MNRF 2020)

Butternut Locations

- ● Category 1
- ● Category 2

Project: 220166
Last Revised: March, 2021

Client: Shining Hill Estate Collection Inc.

Prepared by: BD
Checked by: CS

N

1:3,000

0 60 120 m

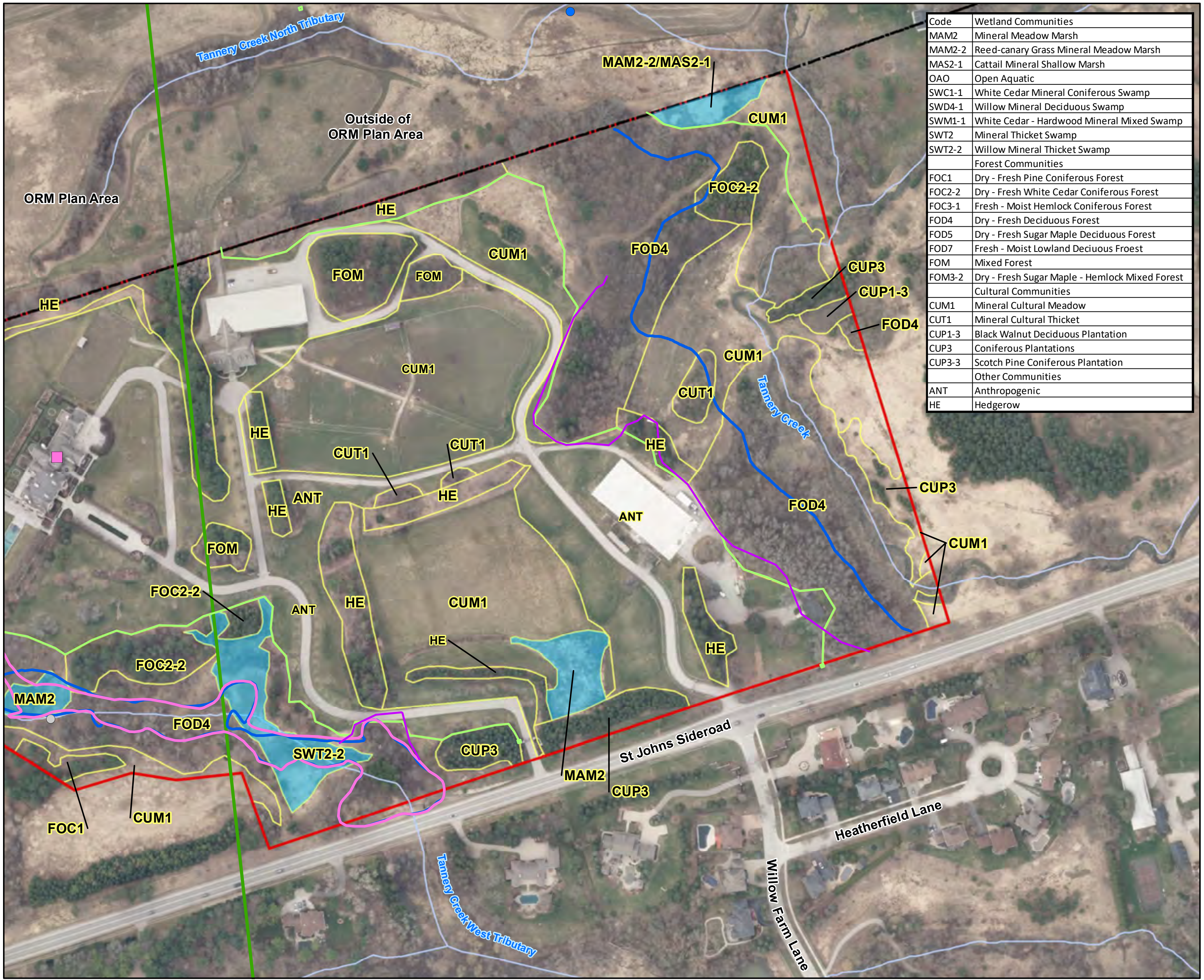
Orthoimagery Baselayer: 2019 (FBS)

C:\Dropbox\Dropbox (Beacon)\All GIS Projects\2020\220166 Shining Hill Phase 2 NHE\MXD\2020-10-28_Figure02_ExistingConditionsAuroraWest_220166.mxd

Existing Conditions

Figure 2B

Shining Hill Estate Collection Inc.



Code	Wetland Communities
MAM2	Mineral Meadow Marsh
MAM2-2	Reed-canary Grass Mineral Meadow Marsh
MAS2-1	Cattail Mineral Shallow Marsh
OAO	Open Aquatic
SWC1-1	White Cedar Mineral Coniferous Swamp
SWD4-1	Willow Mineral Deciduous Swamp
SWM1-1	White Cedar - Hardwood Mineral Mixed Swamp
SWT2	Mineral Thicket Swamp
SWT2-2	Willow Mineral Thicket Swamp
	Forest Communities
FOC1	Dry - Fresh Pine Coniferous Forest
FOC2-2	Dry - Fresh White Cedar Coniferous Forest
FOC3-1	Fresh - Moist Hemlock Coniferous Forest
FOD4	Dry - Fresh Deciduous Forest
FOD5	Dry - Fresh Sugar Maple Deciduous Forest
FOD7	Fresh - Moist Lowland Deciuous Froest
FOM	Mixed Forest
FOM3-2	Dry - Fresh Sugar Maple - Hemlock Mixed Forest
	Cultural Communities
CUM1	Mineral Cultural Meadow
CUT1	Mineral Cultural Thicket
CUP1-3	Black Walnut Deciduous Plantation
CUP3	Coniferous Plantations
CUP3-3	Scotch Pine Coniferous Plantation
	Other Communities
ANT	Anthropogenic
HE	Hedgerow

Legend

- 🟥 Study Area
- — Staked Dripline (LSRCA, July 21, 2020)
- — Long Term Stable Top of Slope (Soil Engineers Ltd. 2020)
- — Watercourse (MNRF 2019)
- ☐ Chimney Crayfish Locations
- ☐ ELC Communities
- ☐ Municipal Boundary (MNRF 2019)
- — Regional Floodline (LSRCA)
- — Proposed Regional Floodline (Schaeffers Consulting Engineers, 2020)
- ■ Wetlands (Beacon 2020)
- ● Amphibian Monitoring Locations
- ● Culvert Location
- ■ Nesting Chimney Swift
- ☐ Oak Ridges Moraine Boundary (MNRF 2020)

Butternut Locations

- ● Category 1
- ● Category 2

BEACON ENVIRONMENTAL

Project: 220166
Last Revised: March, 2021

Client: Shining Hill Estate Collection Inc.

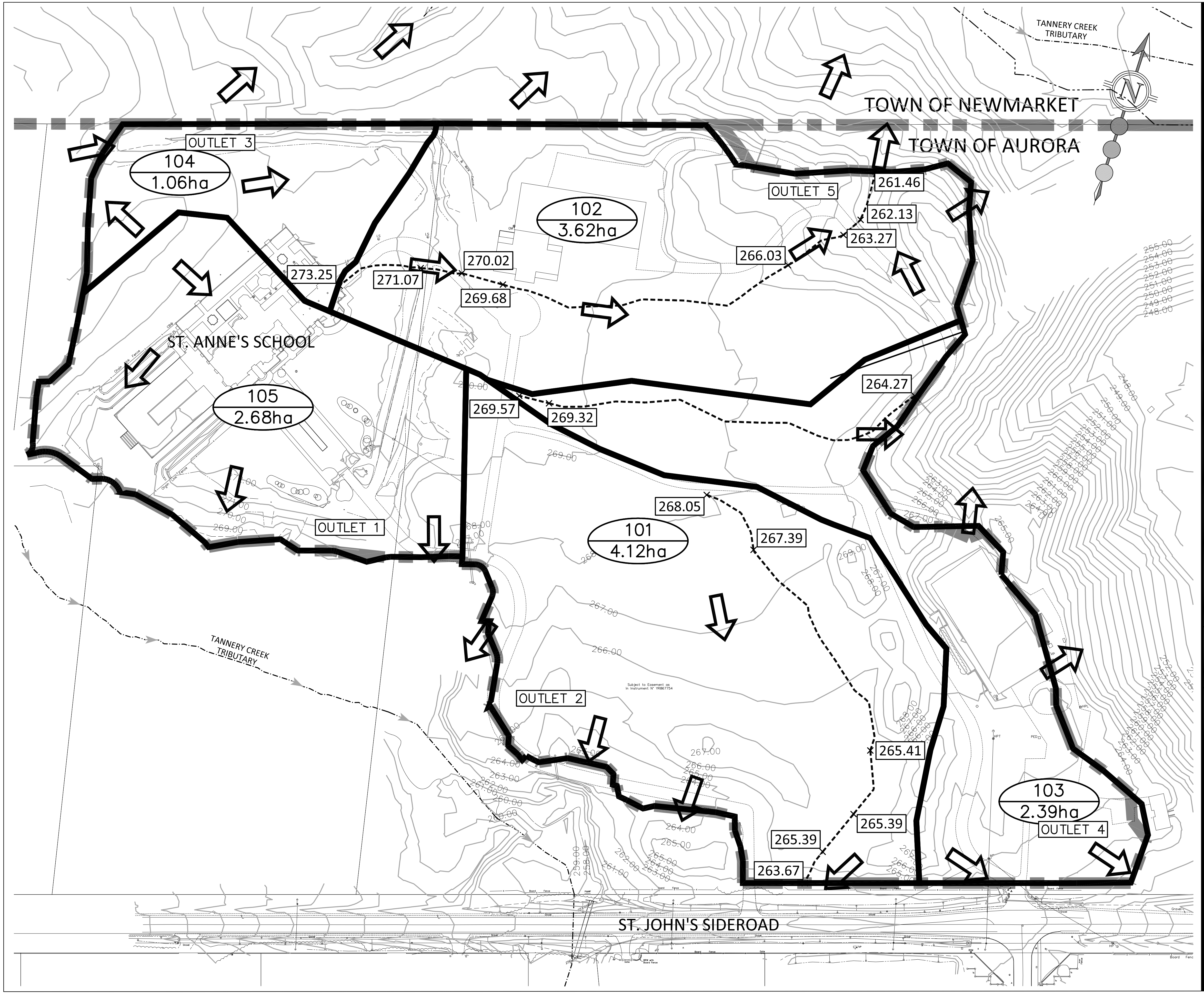
Prepared by: BD
Checked by: CS

N

1:2,550

0 50 100 m

Orthoimagery Baselayer: 2019 (FBS)



LEGEND:

- ▬ ▪ ▪ ▬ MUNICIPAL BOUNDARY
- ▬ ▪ ▬ LIMIT OF DEVELOPMENT
- 255.00 EXISTING CONTOUR AND ELEVATION
- -·-·-·- WETLAND BOUNDARY
- ▬▬▬ STORM DRAINAGE BOUNDARY
- - - - - TIME TO PEAK LENGTH
- ×273.25 TIME TO PEAK ELEVATION
- ⇨ OVERLAND FLOW DIRECTION
- 0.50 CATCHMENT ID
- 0.20ha DRAINAGE AREA (HECTARES)

SCS consulting group ltd

30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

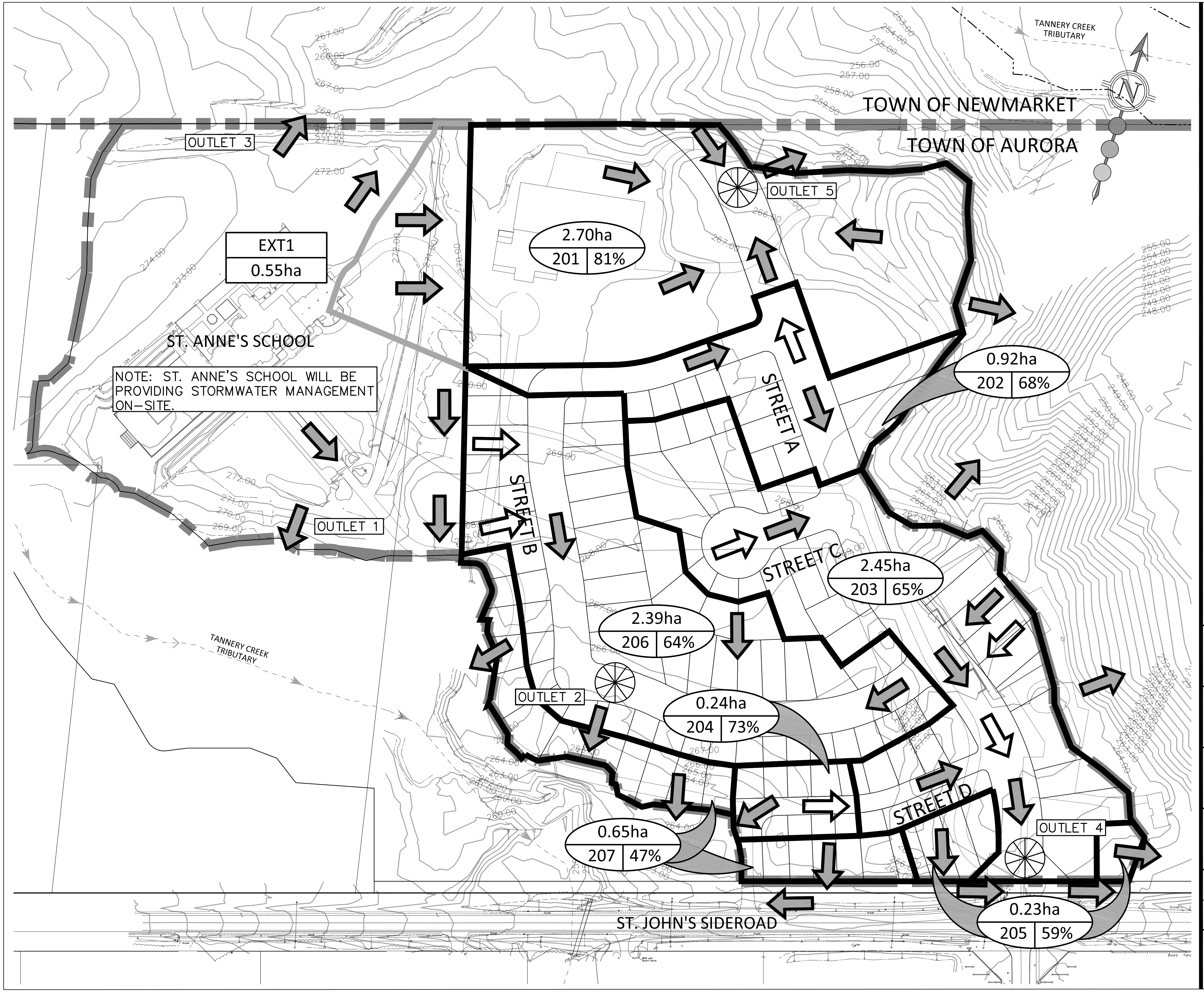
SHINING HILL ESTATES COLLECTION INC.

SHINING HILL ESTATES PHASE 3 - FSSR (AURORA)

EXISTING STORM DRAINAGE

DESIGNED BY:	B.B.O.	CHECKED BY:	S.E.K.
SCALE:	1:2000	DATE:	MARCH 2021
PROJECT No:	2183	FIGURE No:	2.1

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-STRM-EXST-2.1.dwg – Revised by <LYULE> : Mon, Mar 01 2021 – 1:11pm



NOTE: ST. ANNE'S SCHOOL WILL BE PROVIDING STORMWATER MANAGEMENT ON-SITE.

LEGEND:

- MUNICIPAL BOUNDARY
- LIMIT OF DEVELOPMENT
- 255.00 EXISTING CONTOUR AND ELEVATION
- ➡ MAJOR SYSTEM - OVERLAND FLOW
- ⇨ MINOR SYSTEM - STORM SEWER
- WETLAND BOUNDARY
- STORM DRAINAGE BOUNDARY
- EXTERNAL STORM DRAINAGE BOUNDARY
- ⊛ 100 YEAR CAPTURE LOCATION

2.39ha — DRAINAGE AREA (HECTARES)
206 | 64% — RUNOFF COEFFICIENT / CATCHMENT ID

EXT1 — EXTERNAL CATCHMENT ID
0.55ha — DRAINAGE AREA

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

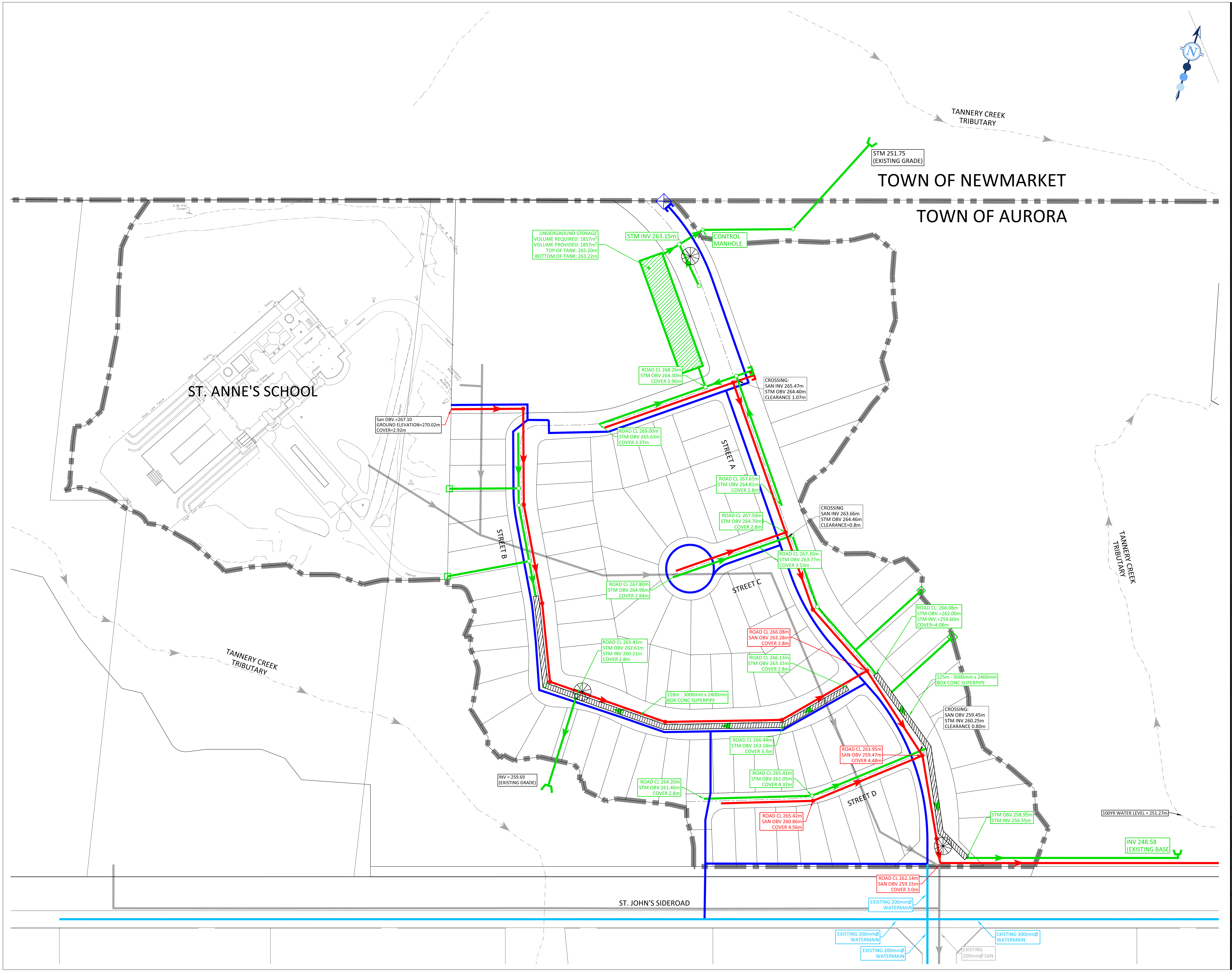
SHINING HILL ESTATES COLLECTION INC.

SHINING HILL ESTATES PHASE 3 - FSSR (AURORA)

PROPOSED STORM DRAINAGE

DESIGNED BY:	B.B.O.	CHECKED BY:	S.E.K.
SCALE:	1:2000	DATE:	MARCH 2021
PROJECT No:	2183	FIGURE No:	2.2

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-STRM-PROP-2.2.dwg – Revised by <LYULE> : Mon, Mar 01 2021 – 1:10pm



LEGEND:

- LIMIT OF DEVELOPMENT
- MUNICIPAL BOUNDARY
- STORM SEWER
- SUPERPIPE STORM SEWER
- SANITARY SEWER
- EXISTING SANITARY SEWER
- WATERMAIN
- EXISTING WATERMAIN
- REAR YARD CATCHBASIN
- PROPOSED UNDERGROUND STORAGE
- METER CHAMBER AND PRESSURE REDUCING VALVE
- 100 YEAR CAPTURE LOCATION

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

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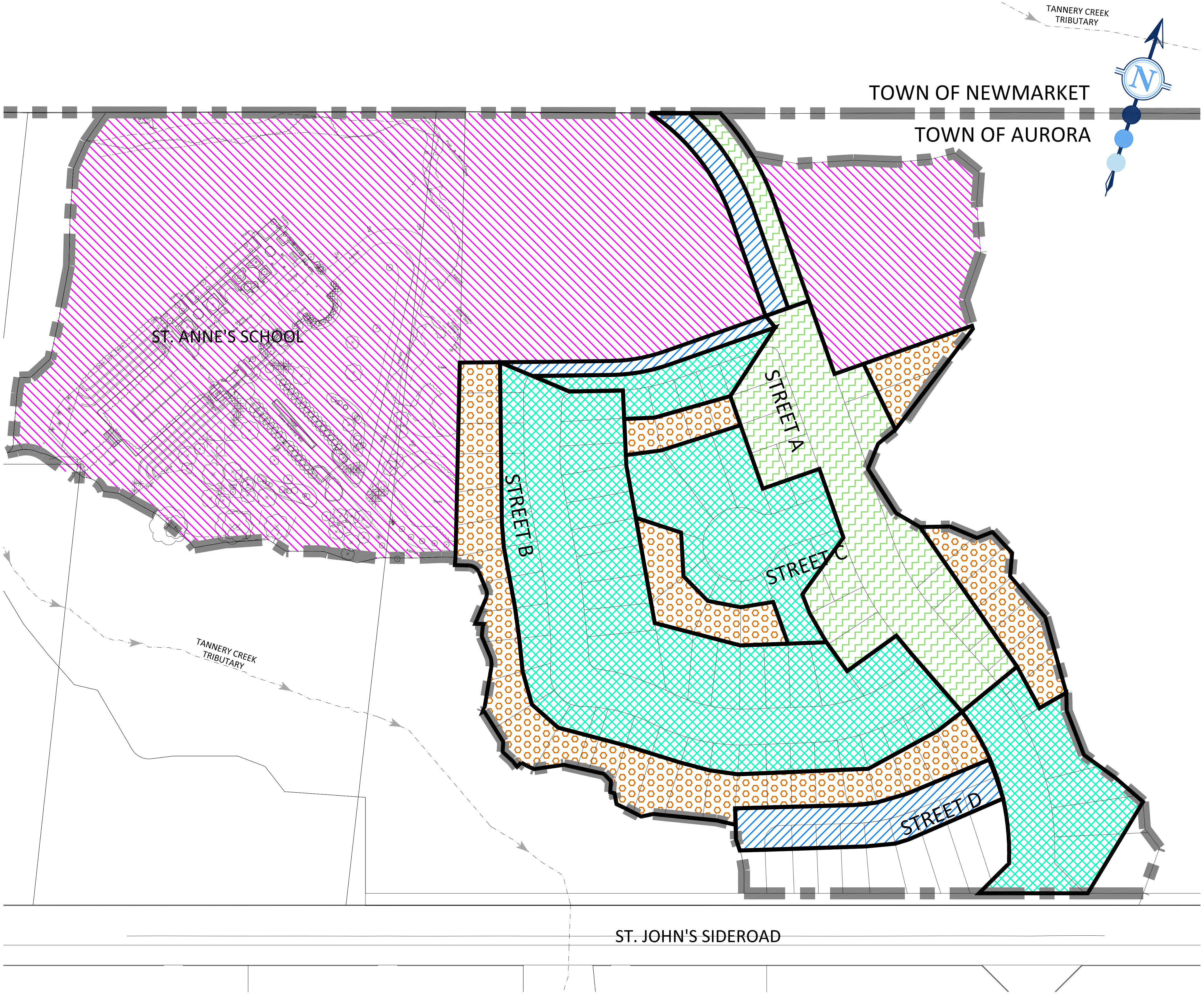
COLLECTION INC.

SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

PROPOSED SERVICING PLAN

DESIGNED BY:	B.B.O.	CHECKED BY:	S.E.K.
SCALE:	1:1000	DATE:	MARCH 2021
PROJECT No:	2183	FIGURE No:	2.3

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-SERV-2.3.dwg – Revised by <DDILAY> : Tue, Mar 09 2021 – 10:23am



LEGEND:

- MUNICIPAL BOUNDARY
- LIMIT OF DEVELOPMENT
- STORM DRAINAGE BOUNDARY
- REAR YARD INFILTRATION TRENCH (25 mm/imp-ha)
- CATCHBASIN INFILTRATION SYSTEM
- CATCHBASIN FILTRATION SYSTEM
- ON-SITE INFILTRATION (25 mm/imp-ha)
- BIOSWALE (25 mm/imp-ha)

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
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FAX: (905) 475-8335

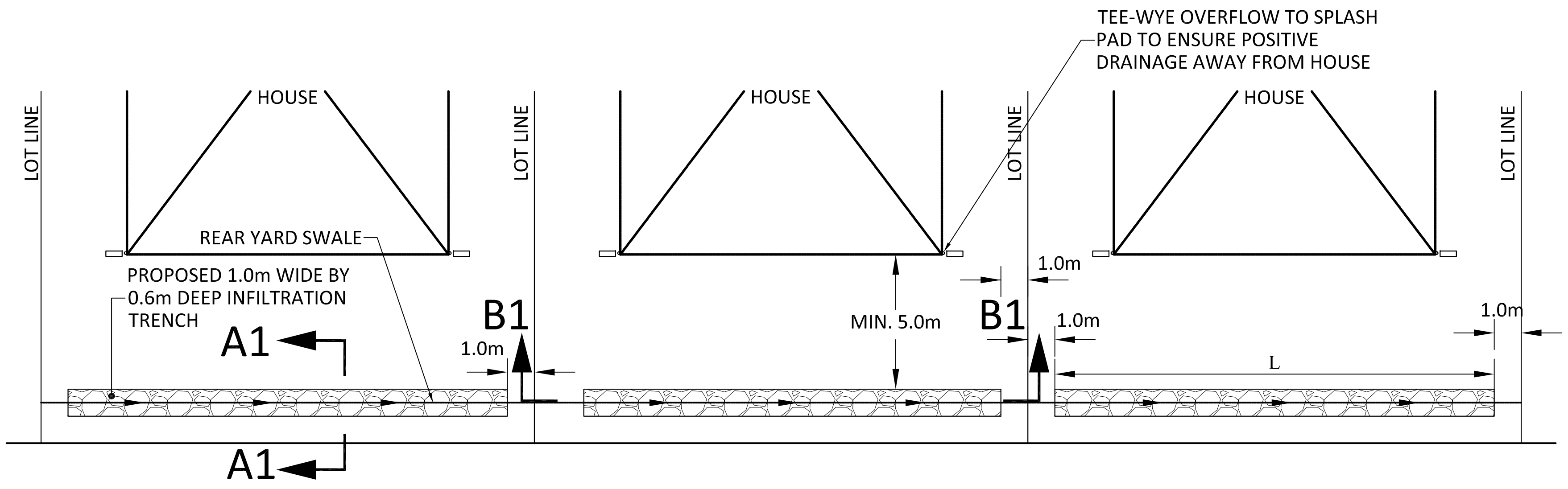
SHINING HILL ESTATES COLLECTION INC.

SHINING HILL ESTATES PHASE 3 - FSSR (AURORA)

LID PLAN

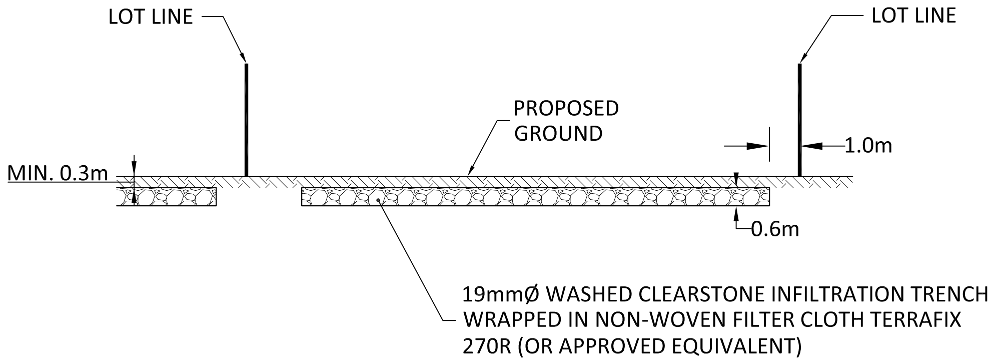
DESIGNED BY:	B.B.O.	CHECKED BY:	S.E.K.
SCALE:	1:2000	DATE:	MARCH 2021
PROJECT No:	2183	FIGURE No:	2.5

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-LIDS-2.5.dwg – Revised by <LYULE> : Mon, Mar 01 2021 – 1:22pm



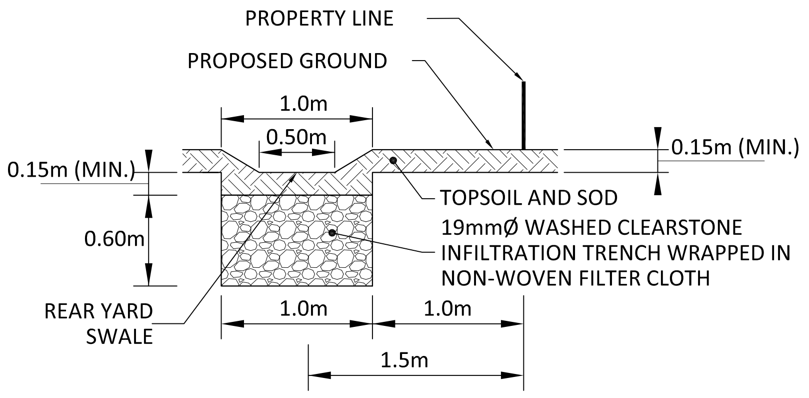
SPLIT DRAINING LOTS PLAN

SCALE 1:250



SECTION B1-B1

SCALE 1:250



SECTION A1-A1 INFILTRATION TRENCH ASSEMBLY

SCALE 1:50

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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COLLECTION INC.

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

LEGEND:

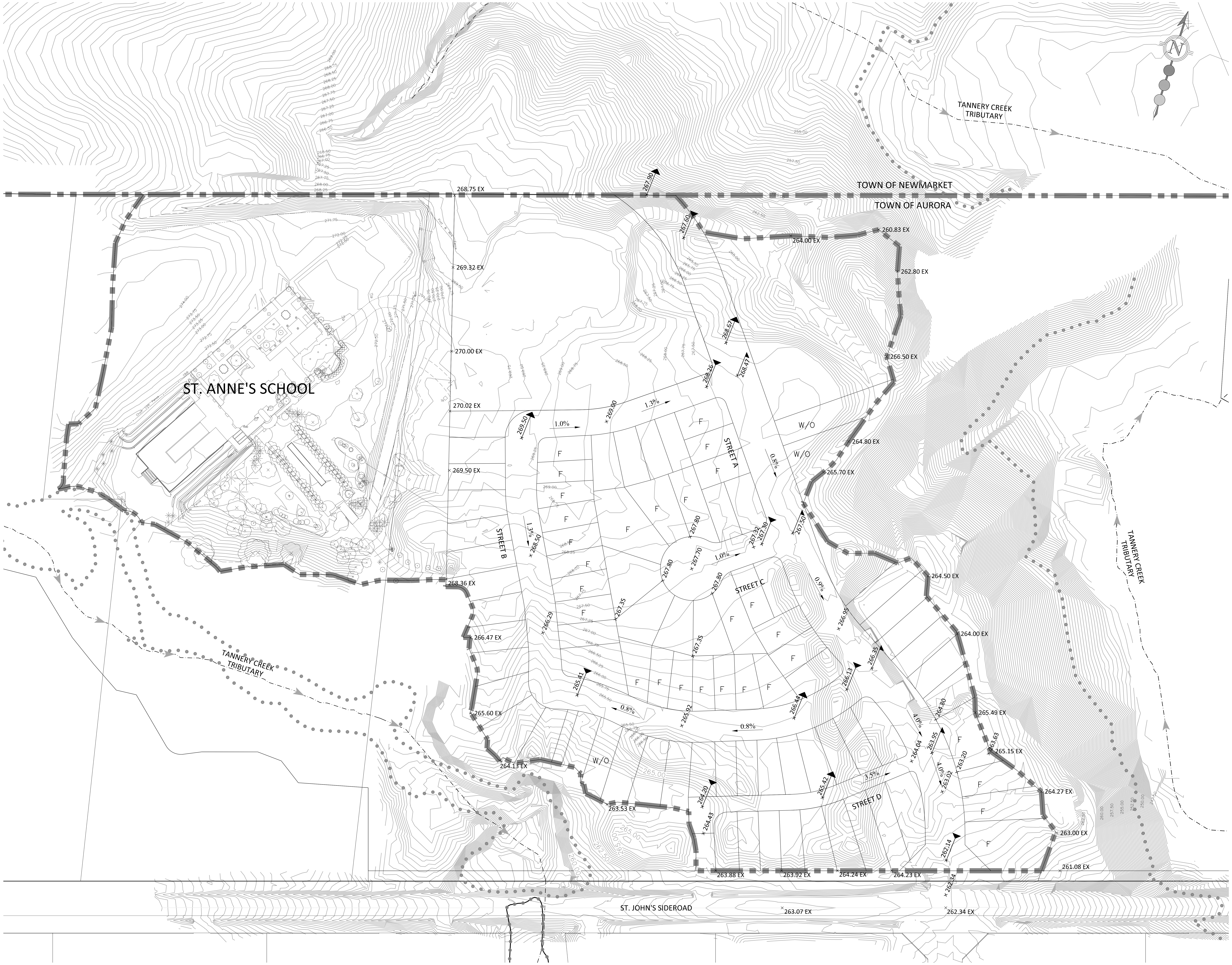
SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

DESIGNED BY: B.B.O.
CHECKED BY: S.E.K.
SCALE: AS SHOWN
DATE: MARCH 2021

REAR YARD INFILTRATION
TRENCH DETAIL

PROJECT No: 2183
FIGURE No: 2.8

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-DETL-REAR-YARD-INFL-2.8.dwg — Revised by <DDILAY> : Tue, Mar 02 2021 — 2:28pm



LEGEND:

▬ ▪ ▪ ▬	MUNICIPAL BOUNDARY
▬ ▪ ▬	LIMIT OF DEVELOPMENT
255.25	EXISTING CONTOUR AND ELEVATION
255.25	PROPOSED CONTOUR
× 262.80 EX	EXISTING ELEVATION
× 255.09	PROPOSED ELEVATION
╥╥╥	PROPOSED 3:1 MAX SLOPE
1.0% →	PROPOSED ROAD GRADE
↗ ↗	PROPOSED ROAD HIGH / LOW POINT
● ● ● ● ●	EXISTING REGULATORY FLOODLINE
F	FRONT DRAINING LOT
W/O	WALKOUT LOT

NOTE: ALL SINGLE RESIDENTIAL LOTS ARE SPLIT DRAINING UNLESS OTHERWISE NOTED.
*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

SHINING HILL ESTATES
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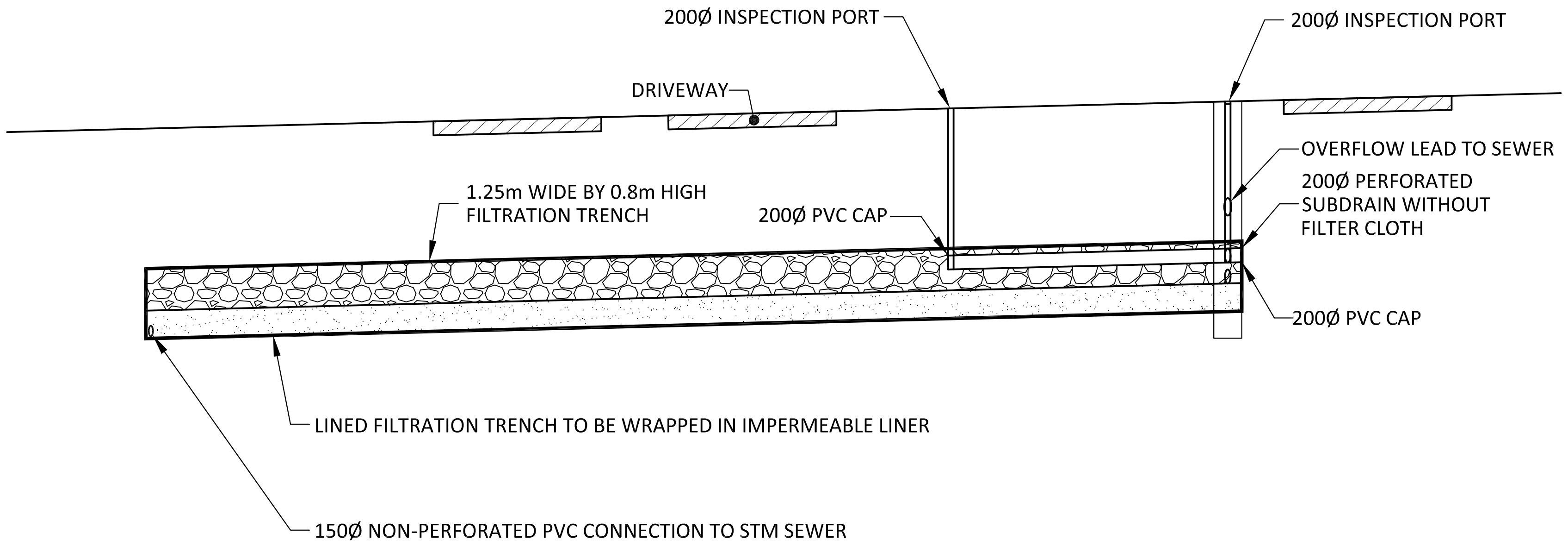
SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

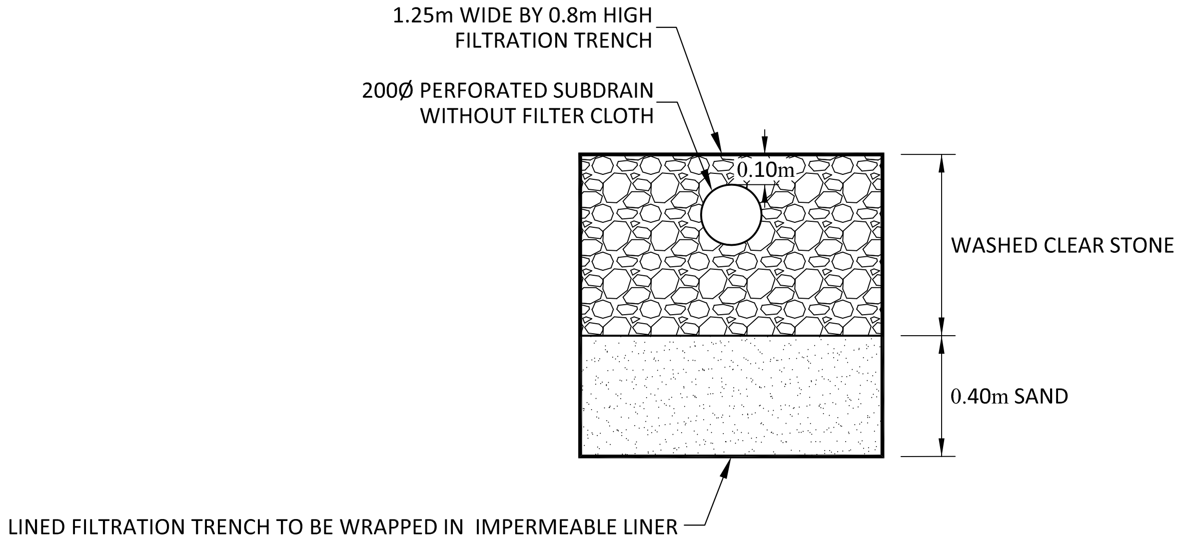
PRELIMINARY GRADING PLAN

DESIGNED BY:	B.B.O.	CHECKED BY:	S.E.K.
SCALE:	1:1000	DATE:	MARCH 2021
PROJECT No:	2183	FIGURE No:	5.1



PRELIMINARY FILTRATION TRENCH - PROFILE VIEW

SCALE: N.T.S.



PRELIMINARY FILTRATION TRENCH CROSS-SECTION

SCALE: N.T.S.

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

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COLLECTION INC.

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

LEGEND:

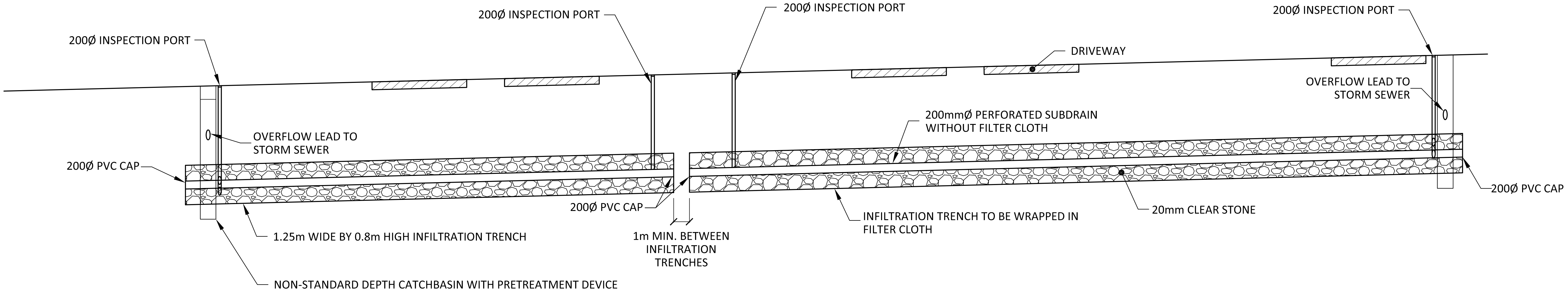
SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

DESIGNED BY: B.B.O.
CHECKED BY: S.E.K.
SCALE: AS SHOWN
DATE: MARCH 2021

CATCHBASIN FILTRATION
TRENCH DETAIL

PROJECT No: 2183
FIGURE No: 6.7

File: P:\2183 Shining Hill Estates\Drawings\FSSR–Phase 3\Fig\Report Figures\2183P–FIGS–DETL–CSBN–FILT–6.7.dwg – Revised by <LYULE> : Mon, Mar 01 2021 – 12:45pm



PRELIMINARY INFILTRATION TRENCH - PROFILE VIEW

SCALE: N.T.S.

*NOTE: LAYOUT IS SCHEMATIC ONLY, DETAILS TO BE PROVIDED AT DETAILED DESIGN STAGE.

SHINING HILL ESTATES
COLLECTION INC.

LEGEND:

SHINING HILL ESTATES
PHASE 3 - FSSR (AURORA)

CATCHBASIN INFILTRATION
TRENCH DETAIL

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30 CENTURIAN DRIVE, SUITE 100
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FAX: (905) 475-8335

DESIGNED BY:	B.B.O.	CHECKED BY:	S.E.K.	PROJECT No:	FIGURE No:
SCALE:	AS SHOWN	DATE:	MARCH 2021	2183	6.8

File: P:\2183 Shining Hill Estates\Drawings\FSSR-Phase 3\Fig\Report Figures\2183P-FIGS-DETL-CSBN-INFL-6.8.dwg - Revised by <LYULE> : Mon, Mar 01 2021 - 12:46pm

APPENDIX C

MECP Water Well Records

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR FND mbgl Qu	SCR TOP LEN mbgl m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
6901579	1 86	Aug-57	621280 4874782	288.6	94.5 Fr 6.1 Fr	107.0 -1.5	21.3	14	2160	29.0	4823 CT	WS DO	**MOE# 6901579** 0.0 TPSL 0.3 YLLW CLAY MSND 6.1 SILT MSND 10.7 GREY CLAY 91.4 GRVL 91.7 BLUE CLAY 94.5 SILT MSND 104.5 MSND GRVL 108.2
6901581	1 86	Nov-61	622013 4874963	263.0	47.9 Fr	48.5 -1.2	9.1	23	480	21.3	2310 CT	WS PU	**MOE# 6901581** 0.0 TPSL 0.3 CLAY MSND 4.6 BLUE CLAY 45.1 CLAY GRVL 47.9 MSND 50.0
6901582	1 86	Jan-62	621090 4874655	301.8	8.5 Fr		6.1	9			4102 CT	WS ST	**MOE# 6901582** 0.0 BLUE CLAY 8.5 GRVL 10.1
6901584	1 87	Apr-59	622190 4875492	254.8	75.6 Fr	76.2 -1.2	1.2	55	300	2.7	2310 CT	WS DO	**MOE# 6901584** 0.0 YLLW CLAY 25.9 STNS 48.8 GREY CLAY 73.2 CLAY 75.6 MSND 77.4
6901586	1 87	Jul-49	621685 4875541	265.2	76.2 Fr	75.0 -1.2	FLW	27			2310 CT	WS DO	**MOE# 6901586** 0.0 CLAY 33.5 CLAY BLDR 45.7 CLAY 74.7 GRVL 76.2
6901587	1 87	Jul-62	622024 4875476	249.0	9.1 Fr		3.0	9			4102 BR	WS ST	**MOE# 6901587** 0.0 BLUE CLAY 9.1 GREY CLAY MSND 13.7
6901589	1 87	Oct-63	622310 4875533	250.5	69.2 Fr	70.1 -1.2	4.6	36	60	24.4	2310 CT	WS DO	**MOE# 6901589** 0.0 TPSL 0.6 GREY CLAY 6.7 BLUE CLAY 35.1 MSND GRVL CLAY 40.2 CLAY MSND 53.3 BLUE CLAY 67.1 CLAY GRVL 69.2 CSND 71.6
6907445	1 85	Aug-62	622681 4874898	260.0	29.0 Fr	31.7 -2.4	10.1	68	120	15.2	2310 CT	WS DO	**MOE# 6907445** 0.0 RED CLAY 4.3 GREY CLAY 21.3 CLAY STNS 29.0 GRVL 34.1
6908544	1 87	Apr-68	622232 4875671	256.3	74.7 Fr	73.8 -2.1	8.5	45	120	15.2	2310 CT	WS DO	**MOE# 6908544** 0.0 GREY CLAY 4.3 BLUE CLAY 32.3 BLUE CLAY GRVL STNS 61.9 BLUE CLAY 74.7 MSND 75.9
6910570	1 86	Apr-71	620962 4874701	306.0	166.1 Fr		68.6	23	540	82.3	1663 CT	WS DO	**MOE# 6910570** 0.0 BRWN MSND CLAY 10.7 BRWN GRVL MSND 21.3 BLUE CLAY STNS 141.7 BLUE CLAY MSND 147.8 BLUE CLAY 165.2 BLCK MSND SILT CLAY 167.0
6913488	1 86	Sep-76	622052 4875111	251.8	44.8 Fr	49.4 -0.9	9.1	23	4800	48.2	2341 CT	WS PU	**MOE# 6913488** 0.0 BRWN SAND STNS 4.6 BLUE CLAY 44.8 CLAY GRVL 50.0 SAND 51.5
6915585	1 86	Sep-80	622012 4875021	260.9	50.3 -	52.1 -2.7	20.4	45	300	25.0	3108 RC	WS PU	**MOE# 6915585** 0.0 PRDR 49.7 SAND 55.2
6916809	1 86	Nov-83	621412 4874821	280.1	112.8 -	114.6 -1.8	56.7	23	240	85.3	3108 RC	WS DO	**MOE# 6916809** 0.0 TPSL 0.6 BRWN SAND CLAY 7.9 BLUE CLAY 24.7 BLUE SILT 33.8 BLUE CLAY 103.3 BLUE SAND CLAY 104.9 BLUE CLAY 112.8 BLUE FSND VERY 117.0

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR FND mbgl Qu	SCR TOP LEN mbgl m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
6918411	1 85	Dec-86	622617 4875023	255.1	89.9 Fr	89.9 -10.7	21.3	909	480	22.9	1413 RC	WS MU	**MOE# 6918411** 0.0 BRWN CLAY DNSE 3.7 GREY CLAY SILT SOFT 19.8 BRWN GRVL SAND PCKD 22.9 GREY CLAY STNS HARD 32.0 GREY CLAY STNS HARD 53.9 GREY CLAY DNSE 68.9 GREY SAND MGRD CLN 81.7 GREY SAND PCKD 86.0 GREY SAND LOOS 88.4 GREY GRVL STNS HARD 89.9 GREY GRVL CLN LOOS 94.5 GREY GRVL SAND CLN 96.3
6918439	1 85	Jan-87	622623 4875028	255.1	120.4 Fr	88.4 -6.1 121.9 -3.7	21.3	227	480	45.7	1413 RC	TH NU	**MOE# 6918439** 0.0 BRWN CLAY DNSE 3.7 GREY CLAY SILT SOFT 19.8 BRWN GRVL SAND PCKD 22.9 GREY CLAY STNS HARD 32.0 GREY CLAY STNS HARD 53.9 GREY CLAY DNSE 68.6 BRWN SAND CLN LOOS 80.8 GREY CLAY SAND PCKD 86.0 GREY SAND CLN LOOS 86.9 GREY GRVL SAND CLN 95.1 GREY GRVL PCKD 109.1 GREY GRVL CLN LOOS 111.3 GREY GRVL 113.4 GREY CLAY DNSE 114.3 GREY GRVL SAND PCKD 115.8 GREY GRVL SAND CLN 117.3 GREY GRVL SAND PCKD 119.5 GREY CLAY SAND PCKD 120.4 GREY SAND CLN 121.3 GREY GRVL SAND CGRD 124.4 GREY CLAY STNS CMTD 126.5
6918544	1 85	Feb-87	622614 4875023	255.1	86.9 Fr	88.4 -6.1	21.3	2728	240	48.8	1413 RC	TH NU	**MOE# 6918544** 0.0 BRWN CLAY DNSE 3.7 GREY CLAY SILT SOFT 19.8 BRWN GRVL SAND PCKD 22.9 GREY CLAY STNS HARD 32.0 GREY CLAY STNS HARD 53.9 GREY CLAY DNSE 68.6 BRWN SAND CLN LOOS 80.8 GREY CLAY SAND PCKD 86.0 GREY SAND CLN LOOS 86.9 GREY GRVL SAND LOOS 94.5
6918645	1 85	Sep-86	622350 4874460	253.0	29.3 Fr	27.4 -1.8	6.1	27	130	29.0	5459 CT	WS DO	**MOE# 6918645** 0.0 BRWN CLAY 5.2 BLUE CLAY SOFT 29.3 BRWN SAND MGRD 31.1
6923894	1 86	May-97	621975 4875041	264.6	81.4 Fr	80.5 -0.9	NR	114	150	76.2	1413 RA	WS DO	**MOE# 6923894** 0.0 BRWN CLAY HARD 5.2 GREY CLAY SOFT 42.7 BRWN CLAY SAND LYRD 50.9 GREY CLAY HARD 55.8 BRWN SAND GRVL CMTD 59.1 GREY CLAY STNS HARD 79.9 BRWN FSND CLN 81.4
7130451	1 87	Jun-08	620911 4874935	285.6	102.7 Un	107.6 -1.5	77.4	50	60	91.1	1663 RC	WS DO	**MOE# 7130451 TAG#A075076** 0.0 BRWN SAND 4.9 BRWN CLAY SILT 7.0 GREY CLAY GRVL 23.8 BRWN SAND CLAY 29.6 GREY SILT CLAY 82.9 BRWN SAND STNS CLAY 86.3 GREY CLAY GRVL 102.7 GREY FSND SILT LYRD 109.1
7152094	1 86	Sep-10	622163 4875162	249.0		75.0 -1.8	22.9		2880	22.9	6300 RC	WS -	**MOE# 7152094 TAG#A081679** 0.0 TPSL 0.6 BRWN CLAY 4.9 BLUE CLAY HARD 24.4 GRVL 25.3 BLUE CLAY SOFT 36.6 BLUE CLAY SOFT 42.7 BLUE CLAY HARD 73.8 SAND CLN 76.8 BLUE CLAY HARD 85.3

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR FND mbgl Qu	SCR TOP LEN mbgl m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
7190773	1 85	Oct-12	622613 4875032	255.1		29.0 0.0	NR				5459 RA	OW MO	**MOE# 7190773 TAG#A124709** 0.0 GREY FILL SOFT 2.4 GREY CLAY SOFT 7.6 GREY CLAY SILT LYRD 19.2 RED BLDR DNSE 19.5 GREY MSND GRVL SILT 22.9 GREY MSND STNS LOOS 24.4 BRWN MSND LOOS 27.4 GREY CSND GRVL LOOS 29.6
7236984		Dec-14	622371 4875420	249.3			NR				6032 -	- -	**MOE# 7236984 TAG#A102044** 0.0
7259668	1 86	Feb-16	622397 4875030	247.5	3.0 Un	3.0 -1.5	NR				7147 BR	OW MO	**MOE# 7259668 TAG#A198730** 0.0 BRWN CLAY SOFT 4.6
7285109		Sep-16	622627 4875024	255.4	10.1 Un	93.3 -4.3 89.6 -3.0	13.7	3300	4320	18.6	7564 RC	WS MU	**MOE# 7285109 TAG#A172641** 0.0 TPSL 0.6 BRWN CLAY 6.4 GREY CLAY SOFT 19.8 GREY GRVL SAND 33.5 GREY CLAY GRVL 49.1 GREY CLAY DNSE 67.4 GREY SILT 73.2 GREY FSND 87.8 GREY GRVL SAND 99.7
7285110		Sep-16	622627 4875024	255.4			NR				7564 -	- -	**MOE# 7285110 TAG#A172641** 0.0 MSND GRVL 102.7
7306495		Aug-17	621091 4874653	NR	13.4 Un	12.2 -3.0	NR				7247 RC	OW TH	**MOE# 7306495 TAG#A201420** 0.0 BRWN SILT SAND WTHD 0.6 BRWN SAND SILT DNSE 4.0 BRWN SILT SAND DNSE 15.2
7309192	1 85	Dec-16	622599 4875009	NR		7.6 -3.0	NR				6032 BR	OW MO	**MOE# 7309192 TAG#A194356** 0.0 BRWN CLAY SOFT 3.0 GREY CLAY SOFT 10.7
7326065	1 87	Nov-18	622101 4875609	NR			NR				7230 -	- -	**MOE# 7326065 TAG#A253727** 0.0
GSC2996		Jan-01	622417 4874820	249.9			NR				-	- -	**MOE# GSC2996** 0.0 SILT CLAY CLYY 2.4 SILT CLAY CLYY 18.6
GSC3000		Jan-01	622341 4875120	253.6			NR				-	- -	**MOE# GSC3000** 0.0 SILT CLAY CLYY 14.6 SAND SLTY TILL 21.6
GSC3211		Jan-01	622516 4875020	253.6			NR				-	- -	**MOE# GSC3211** 0.0 SILT CLAY CLYY 1.2 SAND SLTY 1.8 GRVL SAND GRVL 2.7 SILT CLAY CLYY 5.8
YPD1357		Jan-13	622629 4875020	255.4			NR				-	- -	**MOE# YPD1357** 0.0 BRWN SILT CLAY 6.1 GREY CLAY 15.2 GREY CLAY 18.3 GREY SILT SAND GRVL 24.4 BRWN SAND 29.0 BRWN SAND GRVL 33.5 GREY CLAY HARD 68.0 GREY SAND FGRD 76.2 GREY SAND 79.2 GREY SAND FGRD 86.9 GREY SAND GRVL 99.1 GREY SAND 103.6 GREY SAND 112.8 GREY CLAY 113.4
YPD1366		Oct-12	622609 4875025	255.4		27.4 -1.5	NR				-	- -	**MOE# YPD1366** 0.0 GREY CLAY SILT GRVL 68.0 GREY SAND GRVL 68.6 GREY SAND SILT FGRD 69.2 SAND GRVL 70.1 GRVL SAND SILT 70.7 CLAY SILT LYRD 71.6 CLAY SILT 75.3 BRWN FILL 76.8
YPD3668		Jan-01	621398 4874866	275.8			NR				-	- -	**MOE# YPD3668** 0.0 6.4 SAND 6.7

LABEL	CON LOT	DATE mmm-yr	EASTING NORTHING	ELEV masl	WTR FND mbgl Qu	SCR TOP LEN mbgl m	SWL mbgl	RATE L/min	TIME min	PL mbgl	DRILLER METHOD	TYPE STAT	WELL NAME DESCRIPTION OF MATERIALS
YPD3935		Jan-01	622584 4875053	254.5			NR				-	- -	**MOE# YPD3935** 0.0 SILT SAND CLAY 3.7 SILT SAND CLAY 19.8 GRVL SAND 22.9 TILL SILT SAND 54.9 SILT SAND CLAY 68.9 SAND SILT 81.7 SAND SILT 86.0 SAND SILT 88.4 GRVL SAND 94.5 GRVL SAND 112.2 TILL CLAY SILT 120.7 TILL CLAY SILT 123.1 GRVL SAND 127.1 TILL CLAY SILT 130.5 CLAY SILT 132.6 ROCK 137.2
YPD4752		Jan-01	622666 4874969	259.4			NR				-	- -	**MOE# YPD4752** 0.0 SILT SAND CLAY 19.8 TILL SAND SILT 22.9 TILL SILT SAND 54.9 SILT SAND CLAY 68.9 SAND SILT 88.4 GRVL SAND 112.2 TILL CLAY SILT 120.7 TILL SILT SAND 123.1 GRVL SAND 127.1 TILL CLAY SILT 130.5 CLAY SILT 132.6

QUALITY:		TYPE:		USE:				METHOD :	
Fr	Fresh	WS	Water Supply	CO	Comercial	NU	Not Used	CT	Cable Tool
Mn	Mineral	AQ	Abandoned Quality	DO	Domestic	IR	Irrigation	JT	Jetting
Sa	Salty	AS	Abandoned Supply	MU	Municipal	AL	Alteration	RC	Rotary Conventional
Su	Sulphur	AB	Abandonment Record	PU	Public	MO	Monitoring	RA	Rotary Air
--	Unrecorded	TH	Test Hole or Observation	ST	Stock	-	Not Recorded	BR	Boring

Easting and Northings UTM NAD 83 Zone 17, Translated from Recorded UTM NAD, subject to Field Verified Location or Improved Location Accuracy.

APPENDIX D

List of Abbreviations and Description of Terms

Record of Borehole Sheets
BH101 to BH108
& BH201 to BH206

Plasticity Chart and Grain Size Analysis

(Soil Eng. 2021A and 2021B)

LIST OF ABBREVIATIONS AND DESCRIPTION OF TERMS

The abbreviations and terms commonly employed on the borehole logs and figures, and in the text of the report, are as follows:

SAMPLE TYPES

AS	Auger sample
CS	Chunk sample
DO	Drive open (split spoon)
DS	Denison type sample
FS	Foil sample
RC	Rock core (with size and percentage recovery)
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

PENETRATION RESISTANCE

Dynamic Cone Penetration Resistance:

A continuous profile showing the number of blows for each foot of penetration of a 2-inch diameter, 90° point cone driven by a 140-pound hammer falling 30 inches.

Plotted as '—●—'

Standard Penetration Resistance or 'N' Value:

The number of blows of a 140-pound hammer falling 30 inches required to advance a 2-inch O.D. drive open sampler one foot into undisturbed soil.

Plotted as '○'

WH	Sampler advanced by static weight
PH	Sampler advanced by hydraulic pressure
PM	Sampler advanced by manual pressure
NP	No penetration

SOIL DESCRIPTION

Cohesionless Soils:

'N' (blows/ft)	Relative Density
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

Cohesive Soils:

Undrained Shear Strength (ksf)	'N' (blows/ft)	Consistency
less than 0.25	0 to 2	very soft
0.25 to 0.50	2 to 4	soft
0.50 to 1.0	4 to 8	firm
1.0 to 2.0	8 to 16	stiff
2.0 to 4.0	16 to 32	very stiff
over 4.0	over 32	hard

Method of Determination of Undrained Shear Strength of Cohesive Soils:

x 0.0	Field vane test in borehole; the number denotes the sensitivity to remoulding
△	Laboratory vane test
☐	Compression test in laboratory

For a saturated cohesive soil, the undrained shear strength is taken as one half of the undrained compressive strength

METRIC CONVERSION FACTORS

1 ft = 0.3048 metres
1lb = 0.454 kg
1 inch = 25.4 mm
1ksf = 47.88 kPa

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GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1

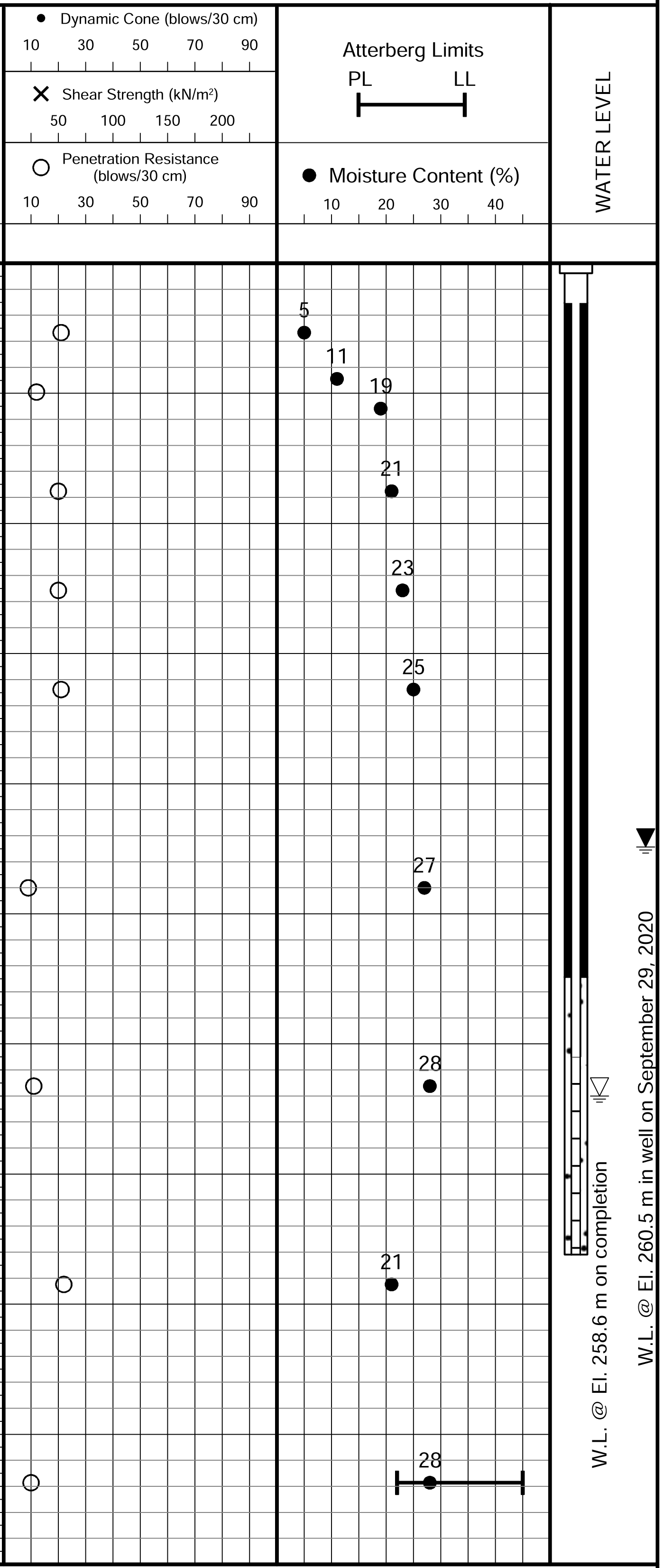
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 10 and 11, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
265.0	Pavement Surface				
0.0	**80 mm ASPHALT CONCRETE** **300 mm GRANULAR FILL**				0
	Brown **EARTH FILL** **(Silty Sand)** a trace of gravel	1	DO	21	
264.0 1.0		2A 2B	DO	12	1
	Stiff to very stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers	3	DO	20	2
		4	DO	20	3
		5	DO	21	4
	brown grey	6	DO	9	5
		7	DO	11	6 7
		8	DO	22	8 9
		9	DO	10	
255.0	*(Continued on next page)*				10



W.L. @ El. 258.6 m on completion

W.L. @ El. 260.5 m in well on September 29, 2020

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1

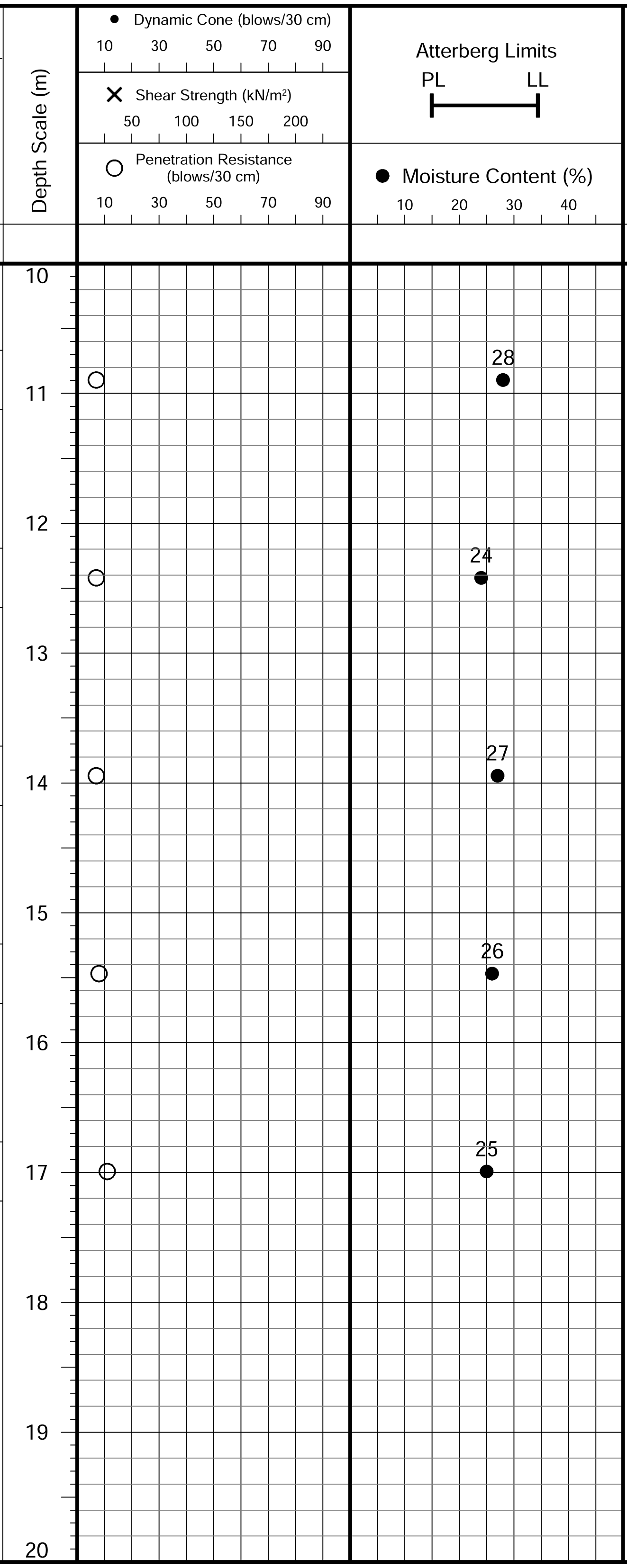
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 10 and 11, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
10.0	*(Continued)* Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt seams and layers	10	DO	7	
		11	DO	7	
		12	DO	7	
		13	DO	8	
		14	DO	11	
247.8 17.2	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen) Sand backfill from 5.5 m to 7.6 m Bentonite holeplug from 0.3 m to 5.5 m Provided with a flushmount casing Sealed with 0.3 m concrete to surface with top and bottom caps				



JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 102

FIGURE NO.: 2

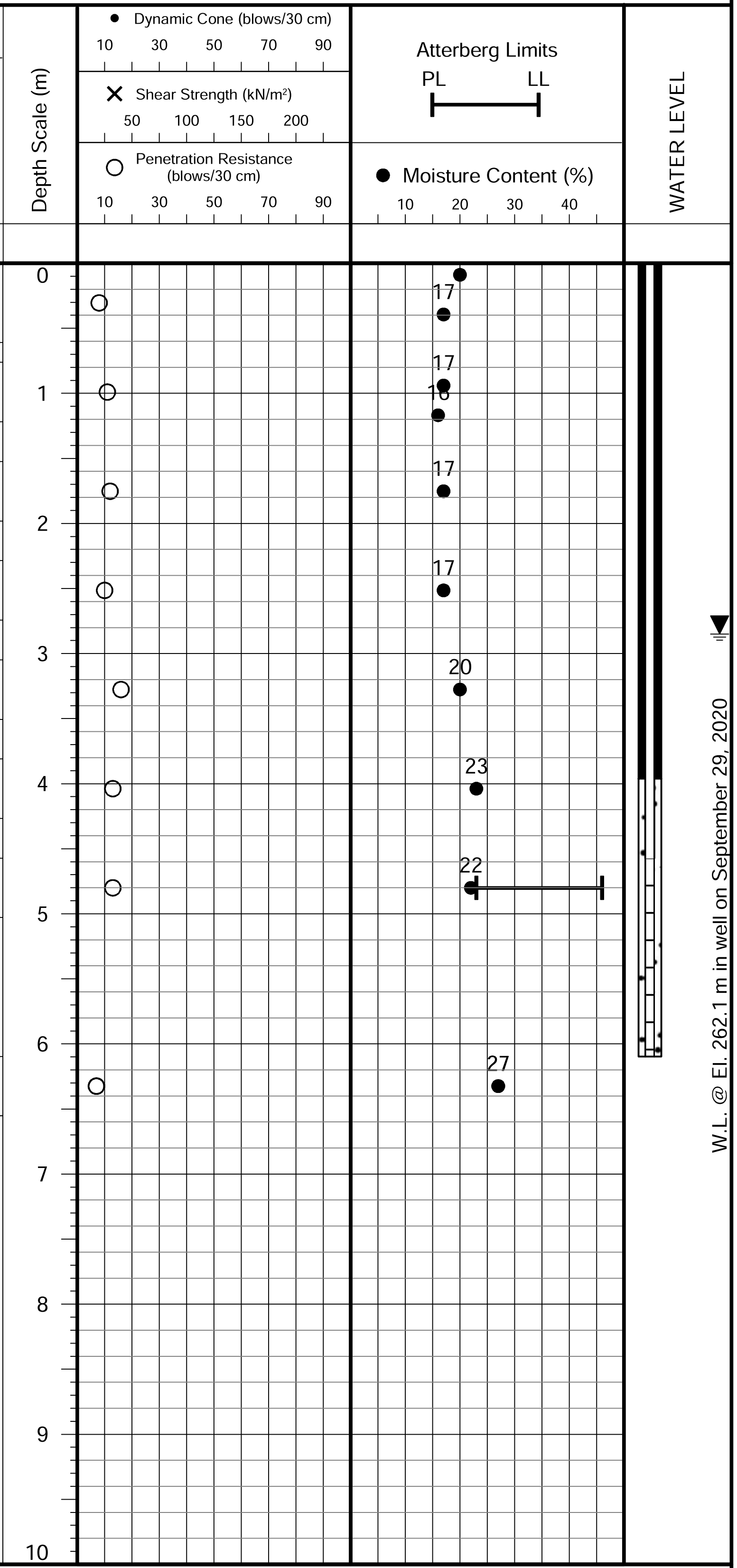
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
264.9	Ground Surface			
0.0	**18 cm TOPSOIL**	1A		
	Brown, loose to compact, weathered **SILT** a trace of clay a trace to some sand	1B	DO	8
		2A	DO	11
263.8 1.1	Brown, loose to compact **SILTY FINE SAND** — — weathered a trace of clay occ. gravel	2B		
		3	DO	12
		4	DO	10
261.6 3.3	Grey, firm to stiff **SILTY CLAY** a trace of sand	5	AS	16
		6	DO	13
		7	DO	13
		8	DO	7
258.3 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen) Sand backfill from 4.0 m to 6.1 m Bentonite holeplug from 0 m to 4.0 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



W.L. @ El. 262.1 m in well on September 29, 2020

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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 103

FIGURE NO.: 3

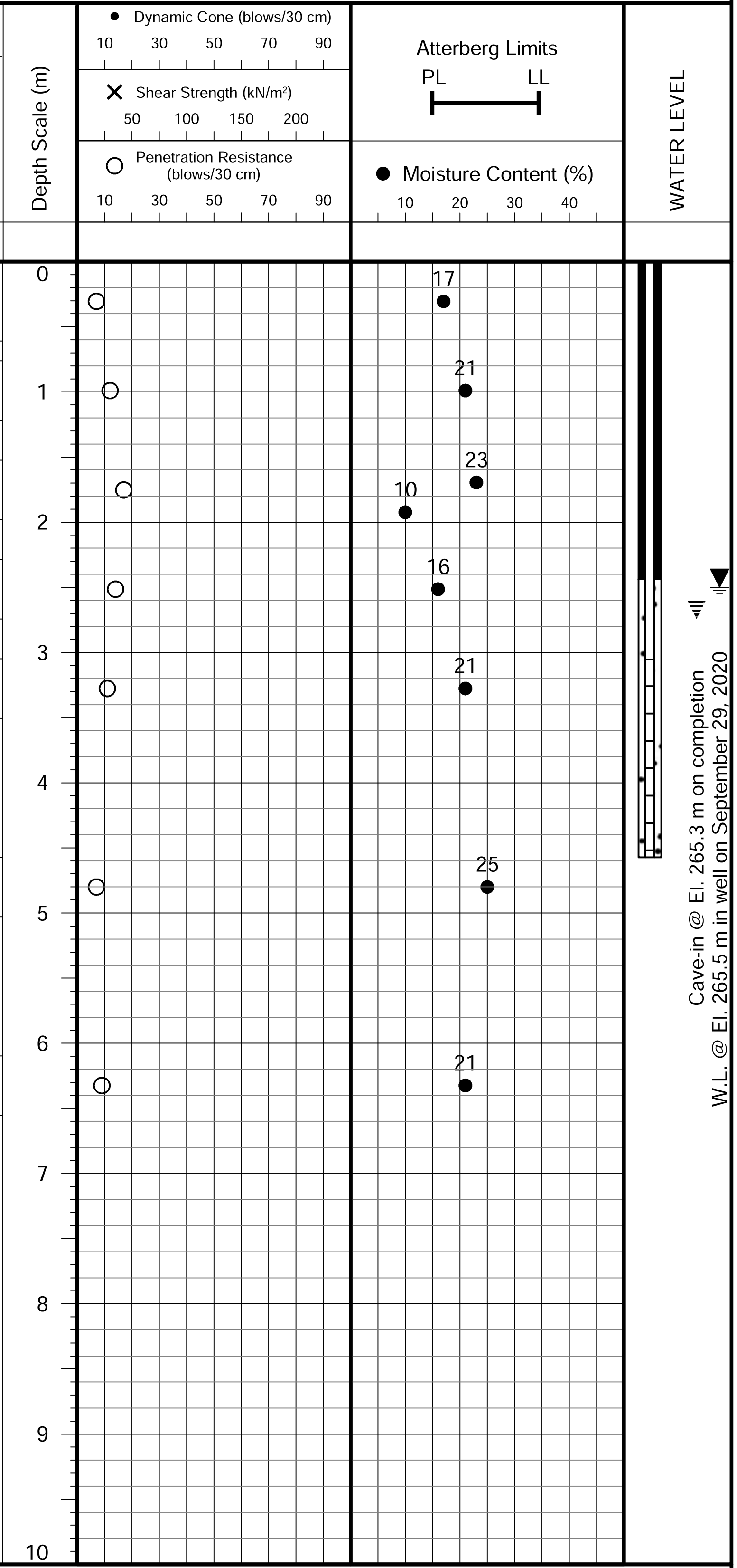
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
268.0	Ground Surface			
0.0	**TOPSOIL FILL** (mixed with clay and silt)	1	DO	7
		2	DO	12
		3A	DO	17
266.1 1.9	Brown, compact **SAND** fine to coarse grained a trace of silt	3B		
265.7 2.3	Brown, compact **SANDY SILT** a trace of clay occ. silt layers	4	DO	14
		5	DO	11
263.4 4.6	Grey, firm to stiff **SILTY CLAY** a trace of sand with sand and silt seams, and occ. gravel	6	DO	7
		7	DO	9
261.4 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 4.6 m (1.5 m screen) Sand backfill from 2.4 m to 4.6 m Bentonite holeplug from 0 m to 2.4 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Cave-in @ El. 265.3 m on completion

W.L. @ El. 265.5 m in well on September 29, 2020

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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 104

FIGURE NO.: 4

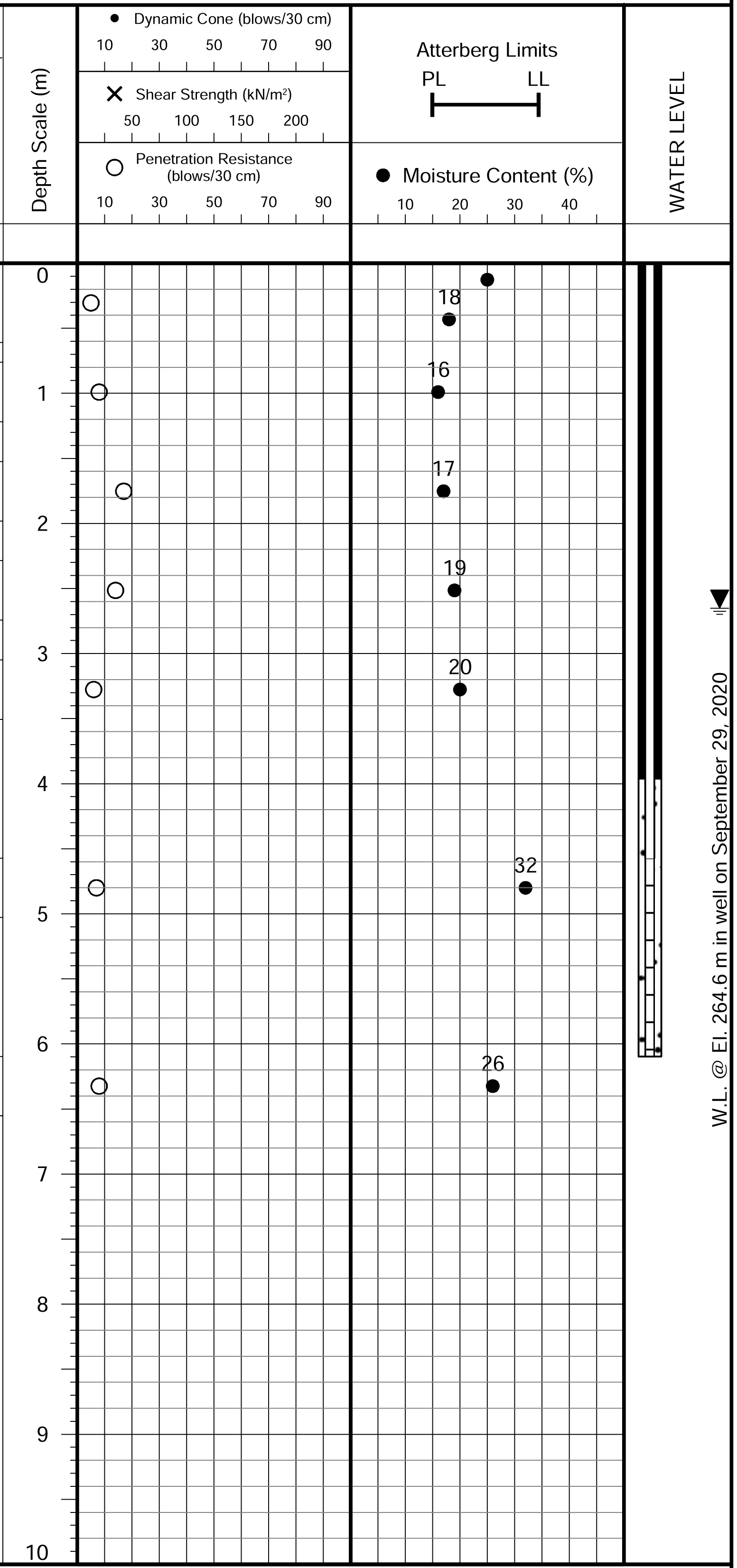
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 11, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
267.3	Ground Surface			
0.0	**25 cm TOPSOIL**	1A	DO	5
	Brown, loose, weathered **SILT** a trace of clay a trace to some sand occ. sand layers	1B		
		2	DO	8
265.8 1.5	Brown, compact **SILTY FINE SAND** a trace of clay	3	DO	17
		4	DO	14
264.3 3.0	Firm **SILTY CLAY** a trace of sand with sand and silt seams and layers silt/ brown — — — grey	5	DO	6
		6	DO	7
		7	DO	8
260.7 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen) Sand backfill from 4.0 m to 6.1 m Bentonite holeplug from 0 m to 4.0 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



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Page: 1 of 1

JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

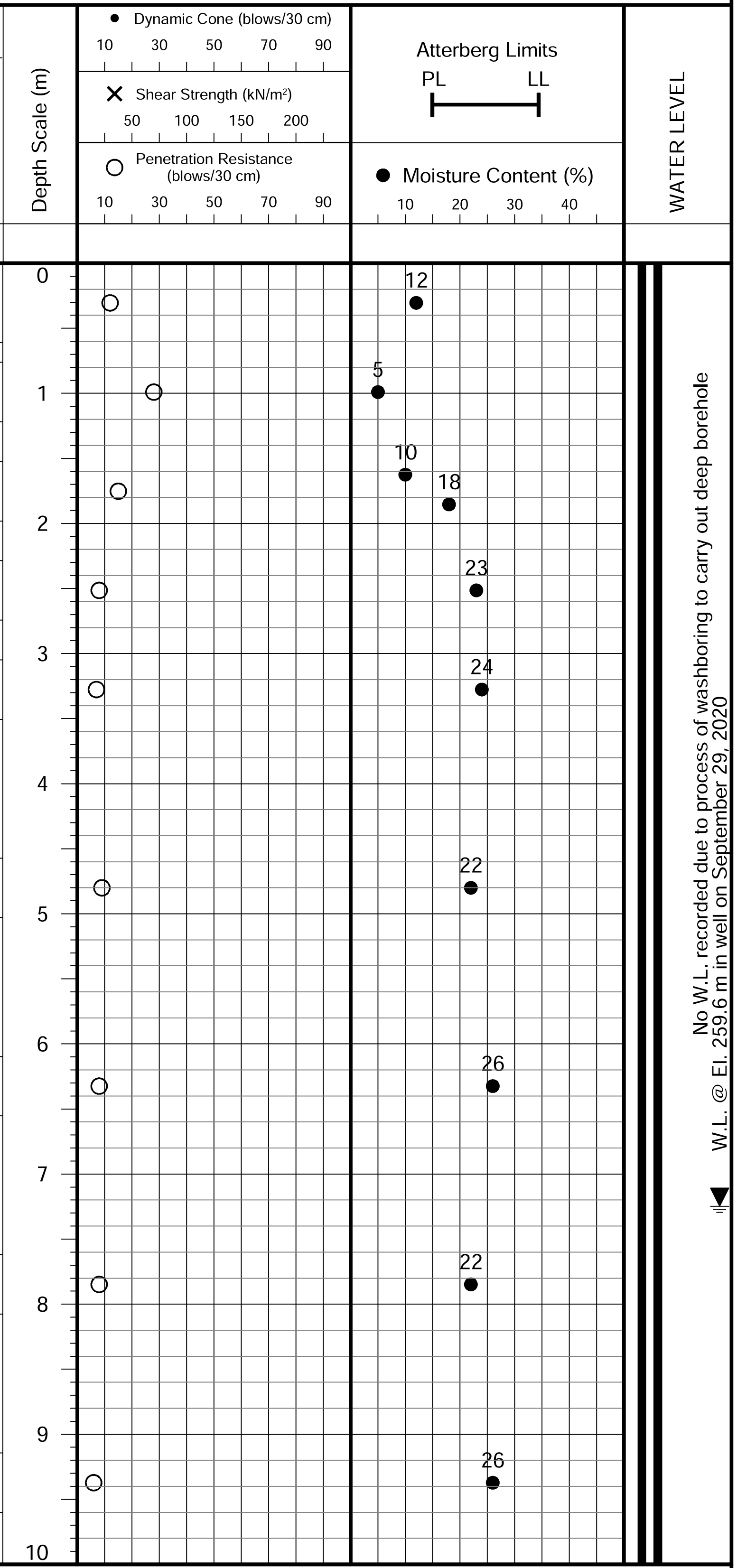
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
266.8	Ground Surface			
0.0	Brown **EARTH FILL** **(Silty Sand)** traces of clay and gravel with organic inclusions	1	DO	12
266.0 0.8	Brown, compact **SAND** fine grained a trace to some silt	2	DO	28
265.1 1.7	Brown, compact **SILT** some clay, a trace of sand	3A 3B	DO	15
264.5 2.3	Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt seams and layers	4	DO	8
		5	DO	7
		6	DO	9
		7	DO	8
		8	DO	8
		9	DO	6
256.8	*(Continued on next page)*			



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

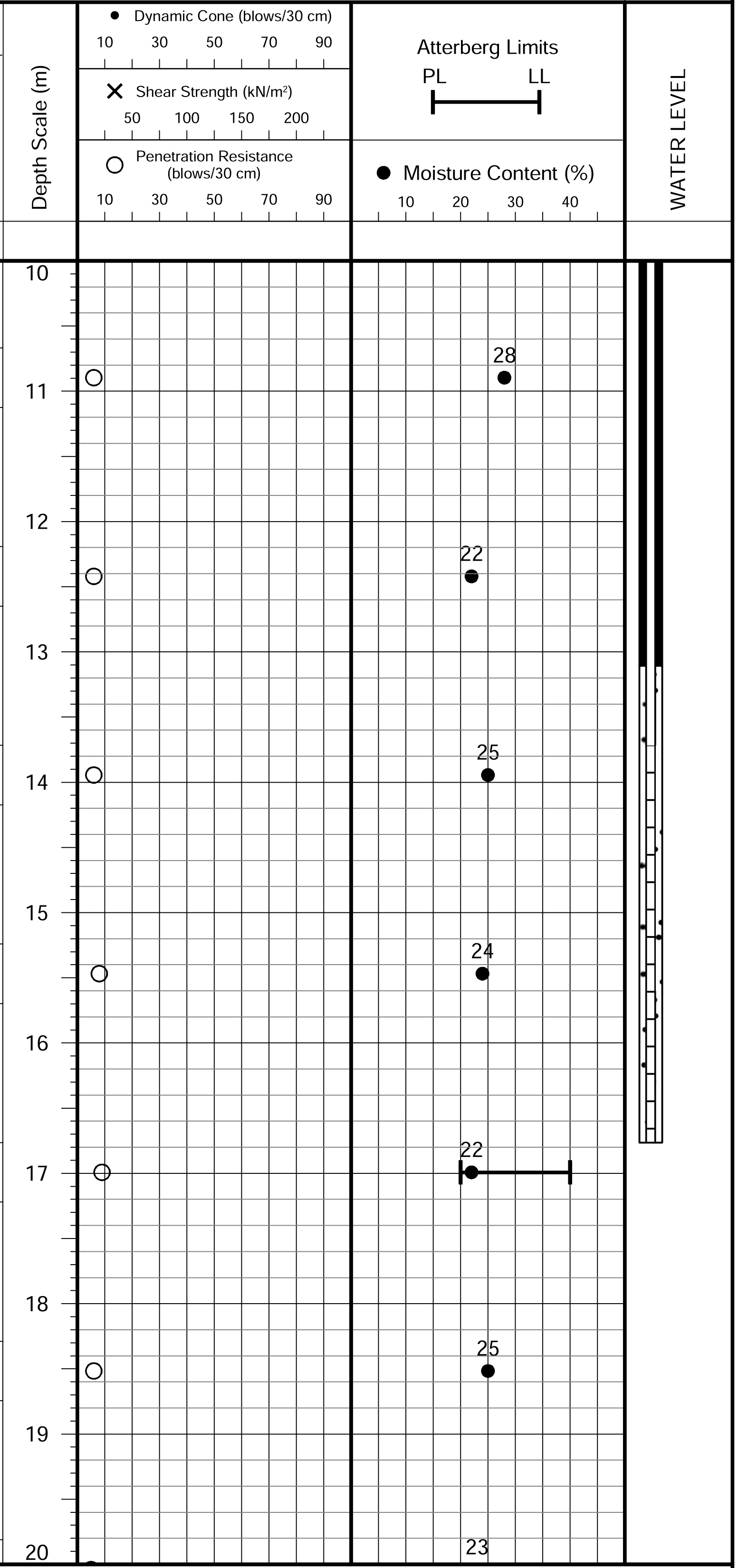
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
10.0	*(Continued)* Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers			
		10	DO	6
		11	DO	6
		12	DO	6
		13	DO	8
		14	DO	9
		15	DO	6
246.8	*(Continued on next page)*			



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

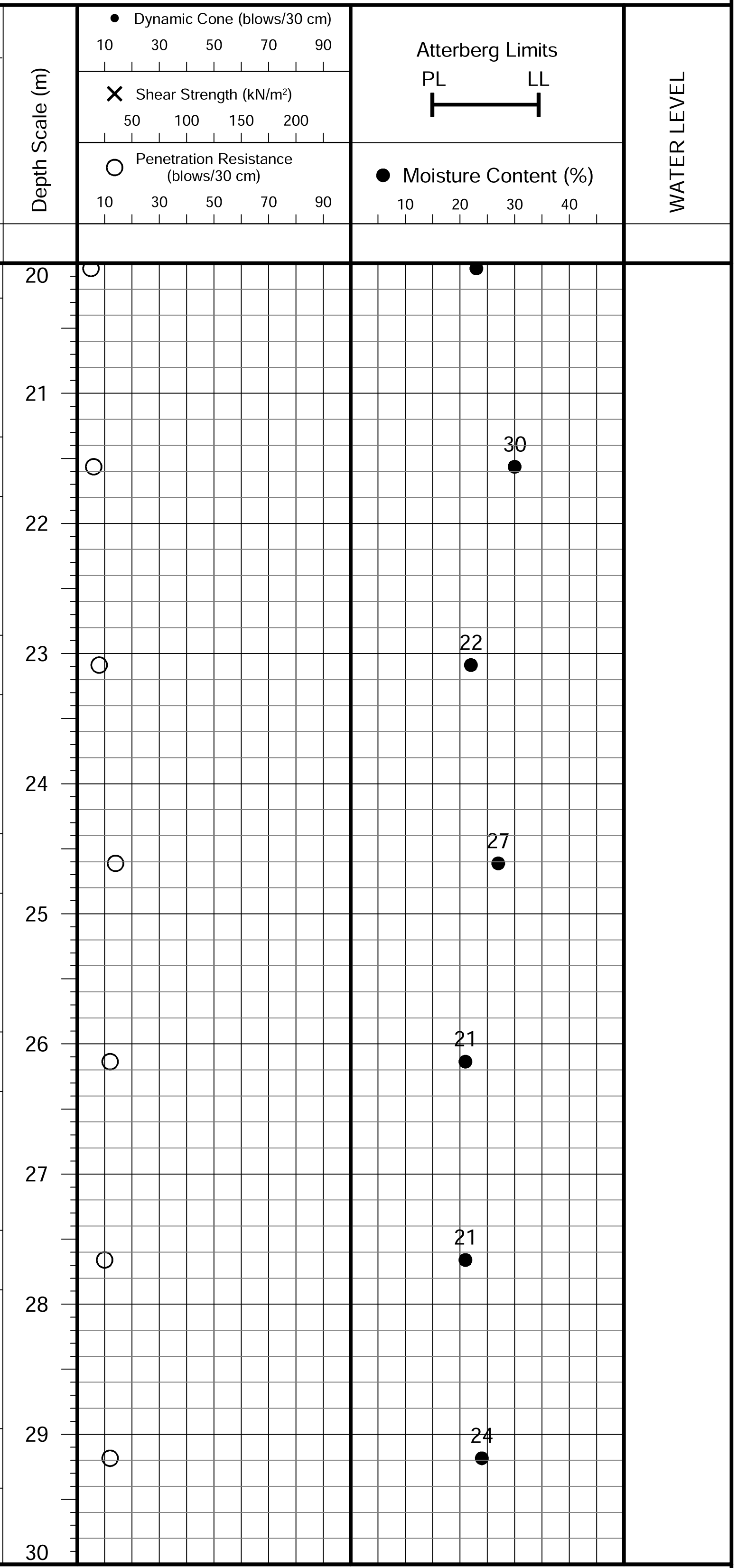
METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
20.0	*(Continued)* Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers	16	DO	5
		17	DO	6
		18	DO	8
		19	DO	14
		20	DO	12
		21	DO	10
		22	DO	12
236.8				

(Continued on next page)



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 105

FIGURE NO.: 5

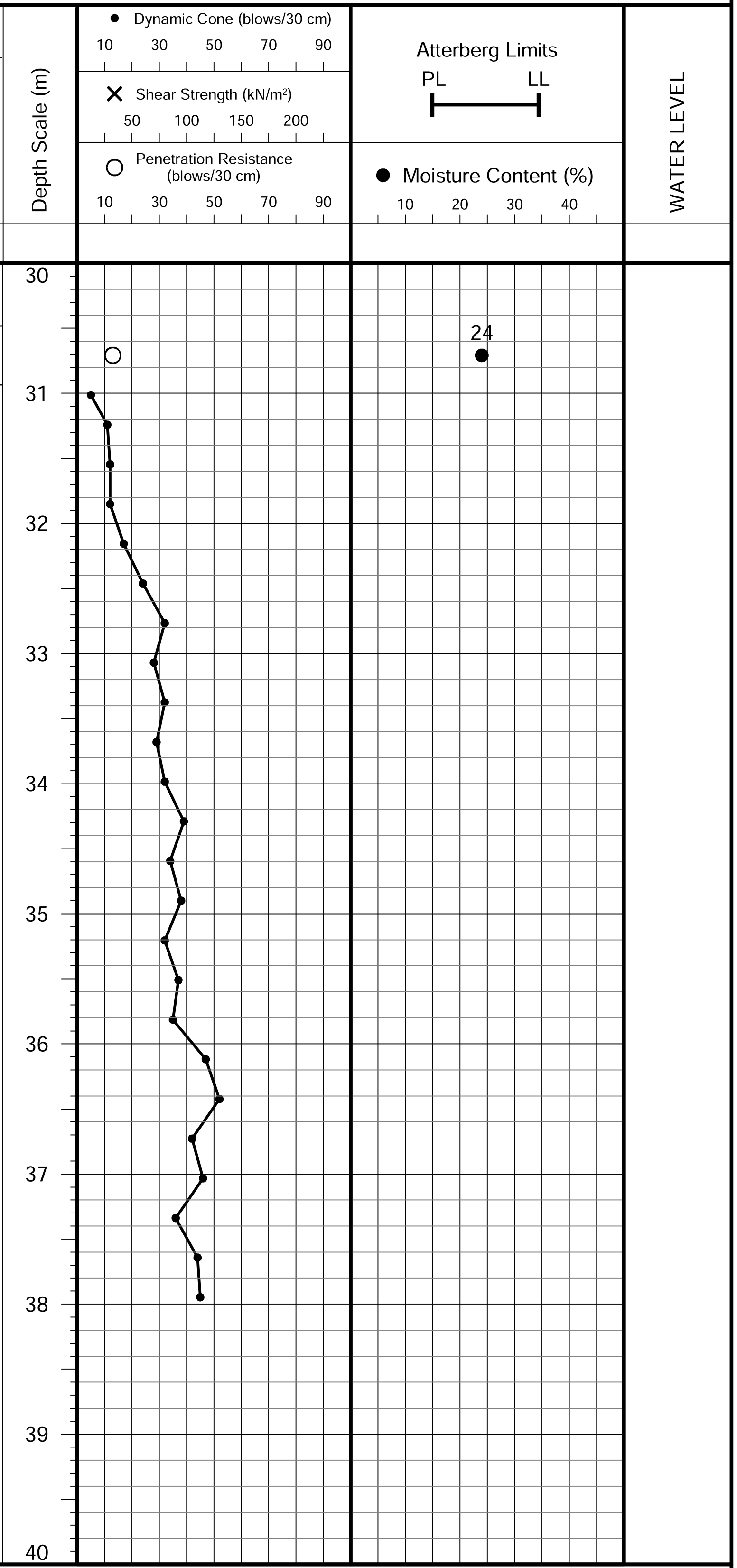
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Hollow Stem Augers Washbore with Tri-Cone and Dynamic Cone

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 9, 10, 14 and 15,

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
30.0	*(Continued)* Grey, stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers	23	DO	13
235.9 30.9	**END OF BOREHOLE** **DYNAMIC CONE PENETRATION TEST**			
228.7 38.1	**END OF DYNAMIC CONE TEST** Installed 50 mm Ø PVC monitoring well to 16.8 m (3.0 m screen) Sand backfill from 13.1 m to 16.8 m Bentonite holeplug from 0 m to 13.1 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 106

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

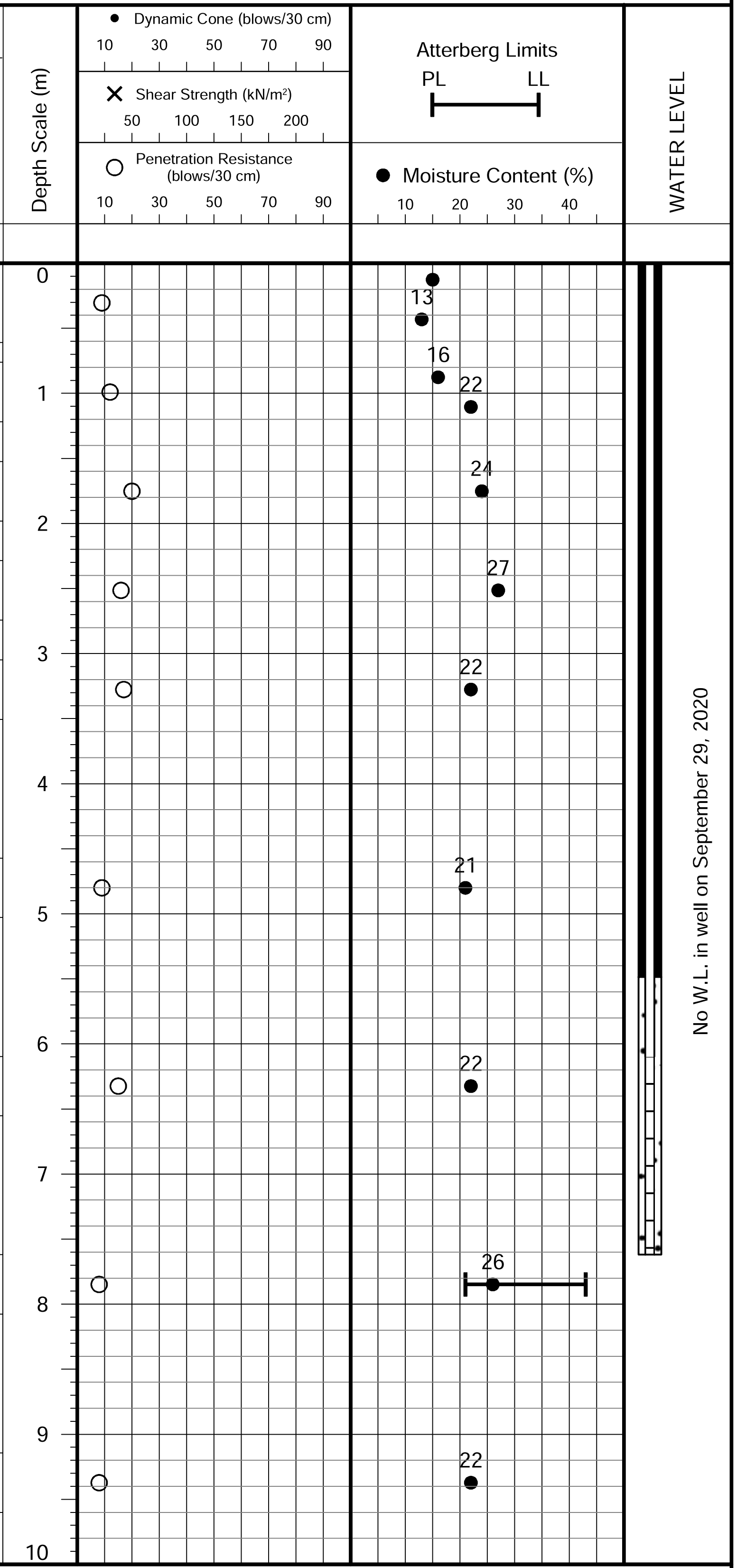
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 11 and 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION
265.3	Ground Surface
0.0	**25 cm TOPSOIL**
	Brown, loose, weathered **SILT** a trace of clay a trace to some sand
264.5 0.8	
264.3 1.0	Brown, compact, weathered **SILTY FINE SAND** a trace of clay
	Firm to very stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers weathered (to approx. 1.5 m) brown / grey (at approx. 4.5 m)
255.3	*(Continued on next page)*

SAMPLES Number	Type	N-Value
1A	DO	9
1B		
2A	DO	12
2B		
3	DO	20
4	DO	16
5	DO	17
6	DO	9
7	DO	15
8	DO	8
9	DO	8



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 106

FIGURE NO.: 6

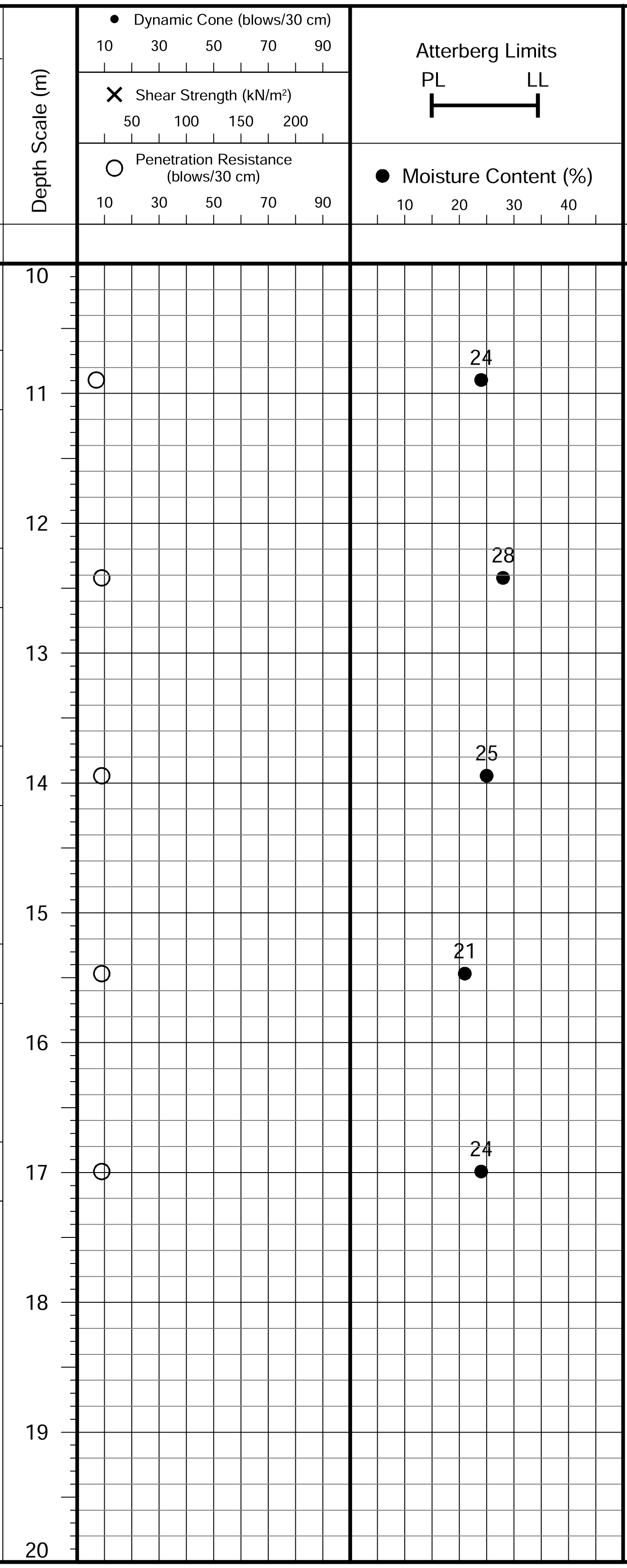
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 11 and 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	WATER LEVEL
10.0	*(Continued)* Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers				
		10	DO	7	
					▽ W.L. @ El. 253.7 m on completion
		11	DO	9	
		12	DO	9	
		13	DO	9	
		14	DO	9	
248.1 17.2	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen) Sand backfill from 5.5 m to 7.6 m Bentonite holeplug from 0 m to 5.5 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock				



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 107

FIGURE NO.: 7

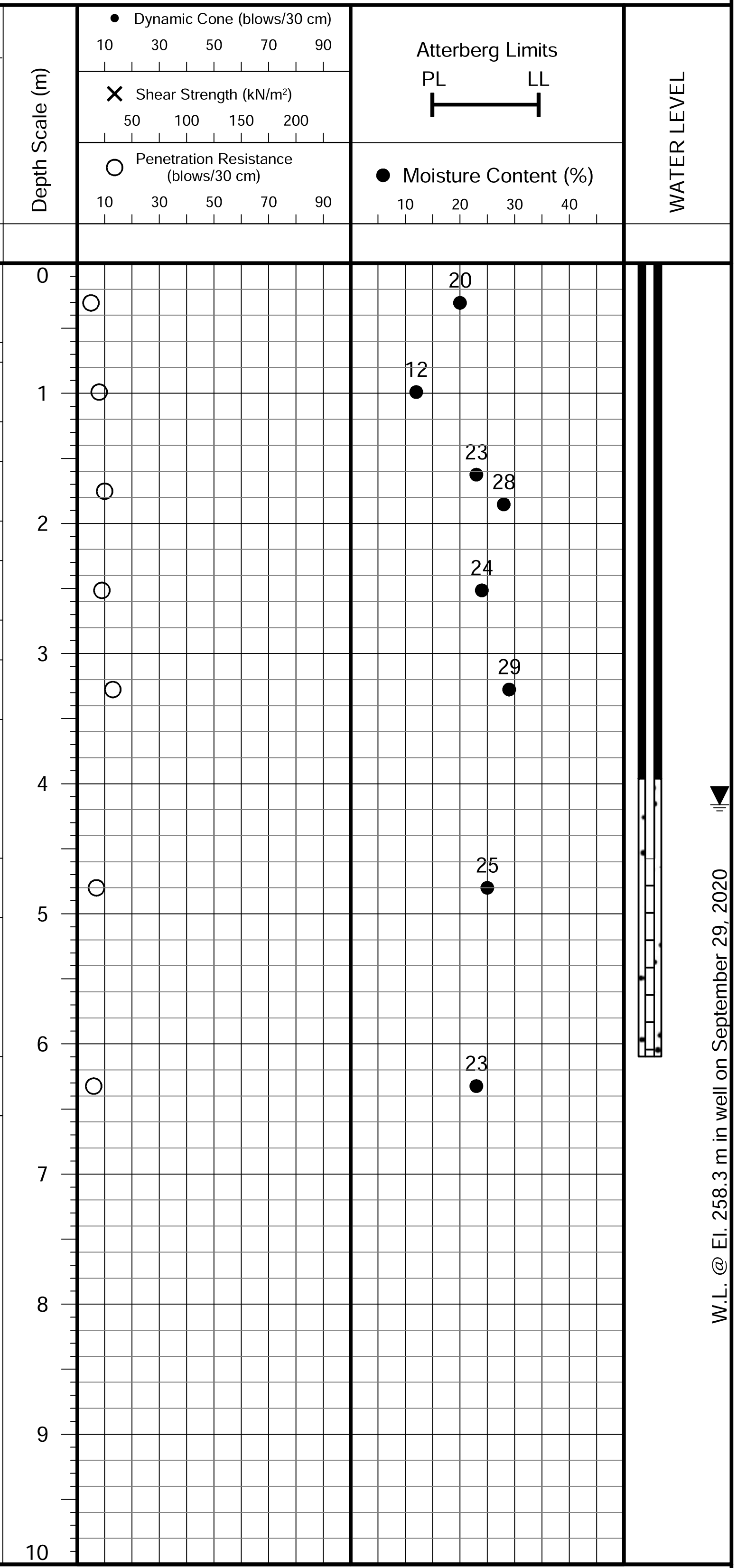
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 14, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
262.5	Ground Surface			
0.0	Brown/grey/dark brown **EARTH FILL** **(Silty Clay and Sandy Silt)** a trace of gravel with topsoil/organic inclusions	1	DO	5
		2	DO	8
260.8 1.7	Firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers	3A 3B	DO	10
		4	DO	9
		5	DO	13
	— — — brown grey	6	DO	7
		7	DO	6
255.9 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen) Sand backfill from 4.0 m to 6.1 m Bentonite holeplug from 0 m to 4.0 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



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JOB NO.: 2008-S135A

LOG OF BOREHOLE NO.: 108

FIGURE NO.: 8

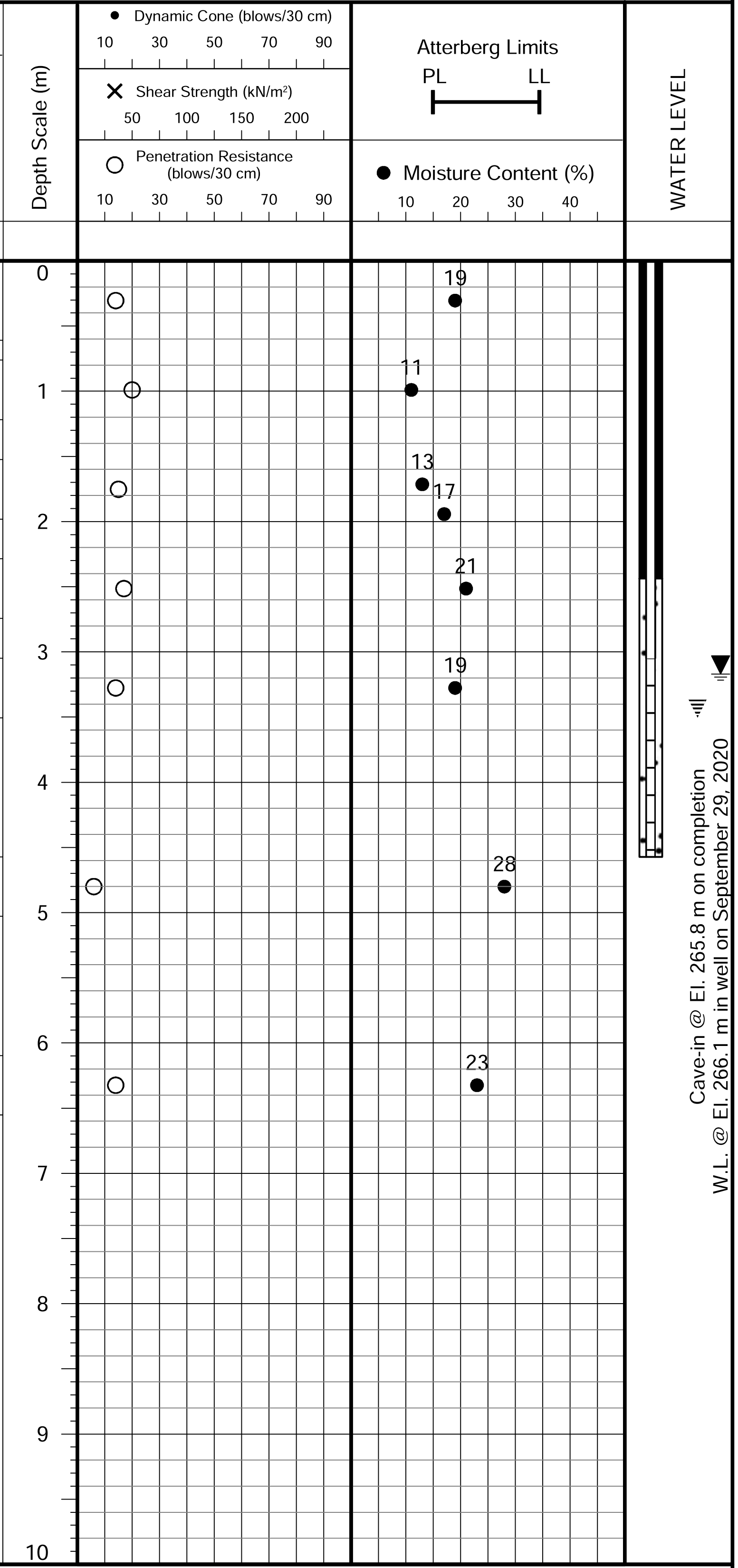
PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
162 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 15, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
269.3	Ground Surface			
0.0	**TOPSOIL FILL** (mixed with silty sand)	1	DO	14
268.5 0.8	Brown **EARTH FILL** **(Silty Sand)** a trace of gravel	2	DO	20
267.8 1.5	Brown, compact **SANDY SILT** a trace of clay occ. sand and silt layers silty fine sand layer	3A 3B	DO	15
		4	DO	17
		5	DO	14
264.7 4.6	Grey, firm to stiff **SILTY CLAY** a trace of sand with silt seams	6	DO	6
		7	DO	14
262.7 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 4.6 m (1.5 m screen) Sand backfill from 2.4 m to 4.6 m Bentonite holeplug from 0 m to 2.4 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Cave-in @ El. 265.8 m on completion

W.L. @ El. 266.1 m in well on September 29, 2020

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JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 201

FIGURE NO.: 1

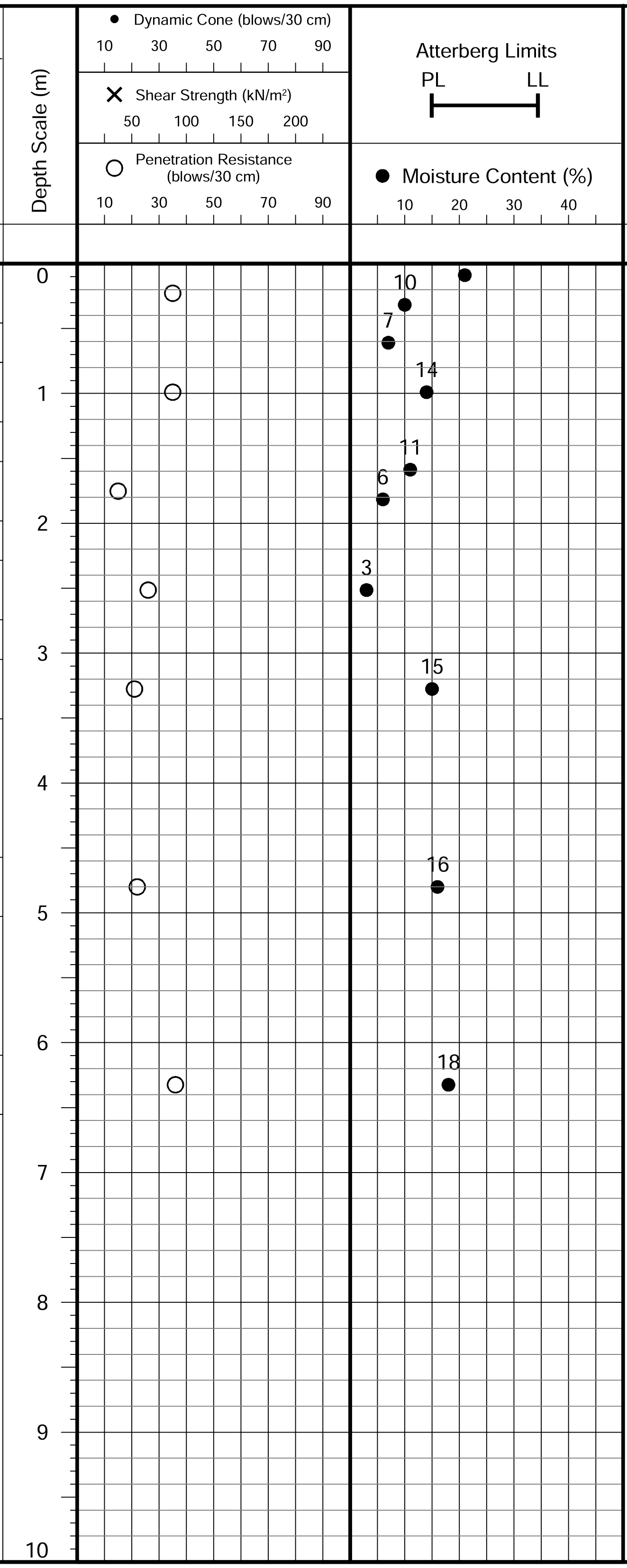
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 15, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
271.9	Ground Surface			
0.0	**18 cm TOPSOIL**	1A	DO	35
	Brown **EARTH FILL** **(Silty Sand)** a trace of clay, some gravel	1B		
		2	AS	-
271.1 0.8	Brown, hard **SILTY CLAY** a trace of sand with silt layers, and occ. gravel	3	DO	35
270.4 1.5	sandy silt layer	4A	DO	15
	Brown, compact **SAND** fine grained a trace to some silt	4B		
		5	DO	26
268.9 3.0	Brown, compact to dense **SANDY SILT** a trace of clay	6	DO	21
		7	DO	22
		8	DO	36
265.3 6.6	**END OF BOREHOLE**			



WATER LEVEL

Cave-in @ El. 267.6 m on completion

Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed School Block

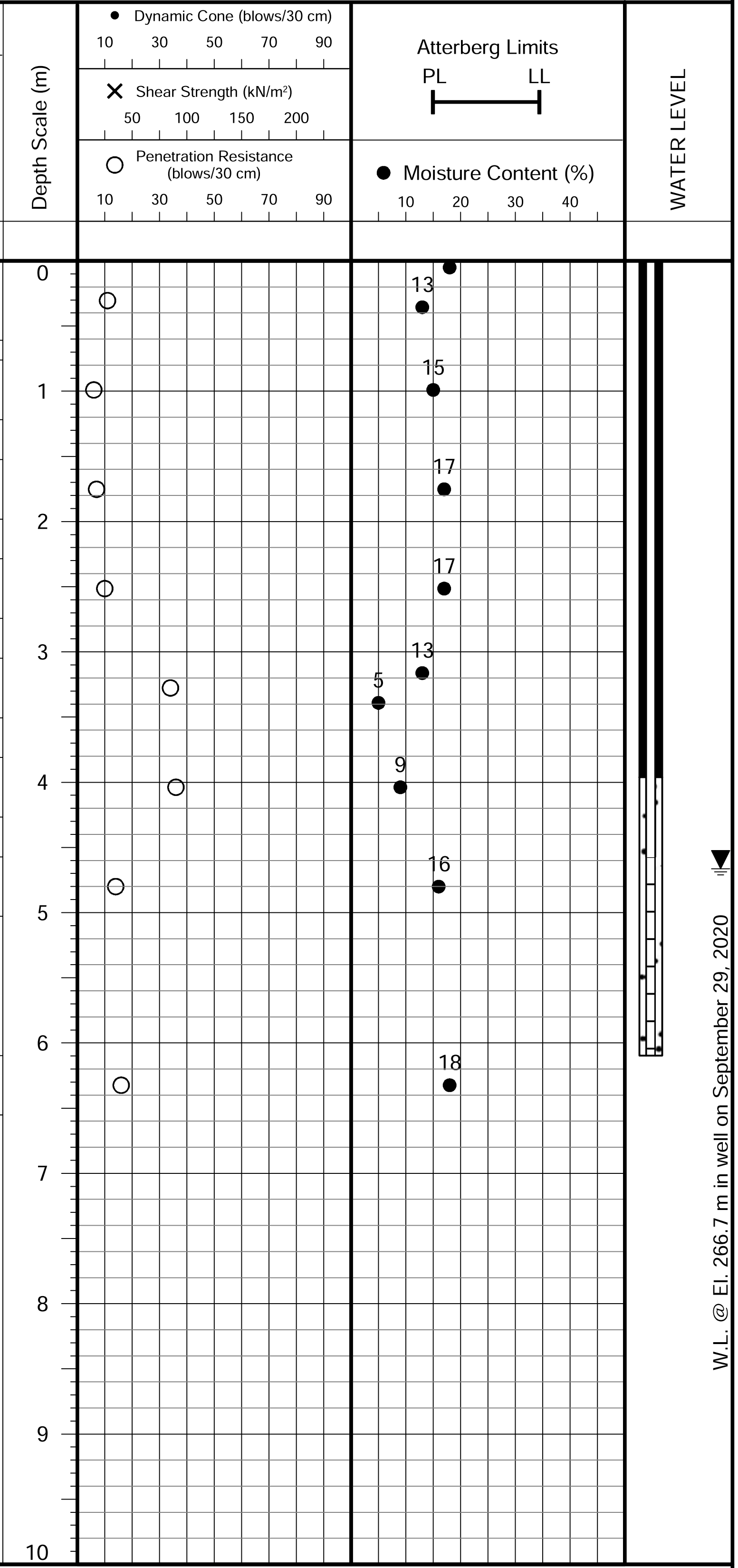
METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
271.3	Ground Surface			
0.0	**10 cm TOPSOIL**	1A		
	Brown **EARTH FILL** **(Silty Clay and Sandy Silt)** a trace of gravel	1B	DO	11
	organic inclusions	2	DO	6
		3	DO	7
	silty clay sandy silt topsoil inclusions	4	DO	10
268.0 3.3	Brown, dense **SAND** fine to medium grained a trace to some silt	5A 5B	DO	34
		6	DO	36
266.7 4.6	Brown, compact **SILTY FINE SAND** a trace of clay	7	DO	14
265.2 6.1	Brown, compact **SILT** traces of clay and sand	8	DO	16
264.7 6.6	**END OF BOREHOLE**			

Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen)
Sand backfill from 4.0 m to 6.1 m
Bentonite holeplug from 0 m to 4.0 m
Provided with a 4x4 steel monument casing with top and bottom caps, and lock



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 203

FIGURE NO.: 3

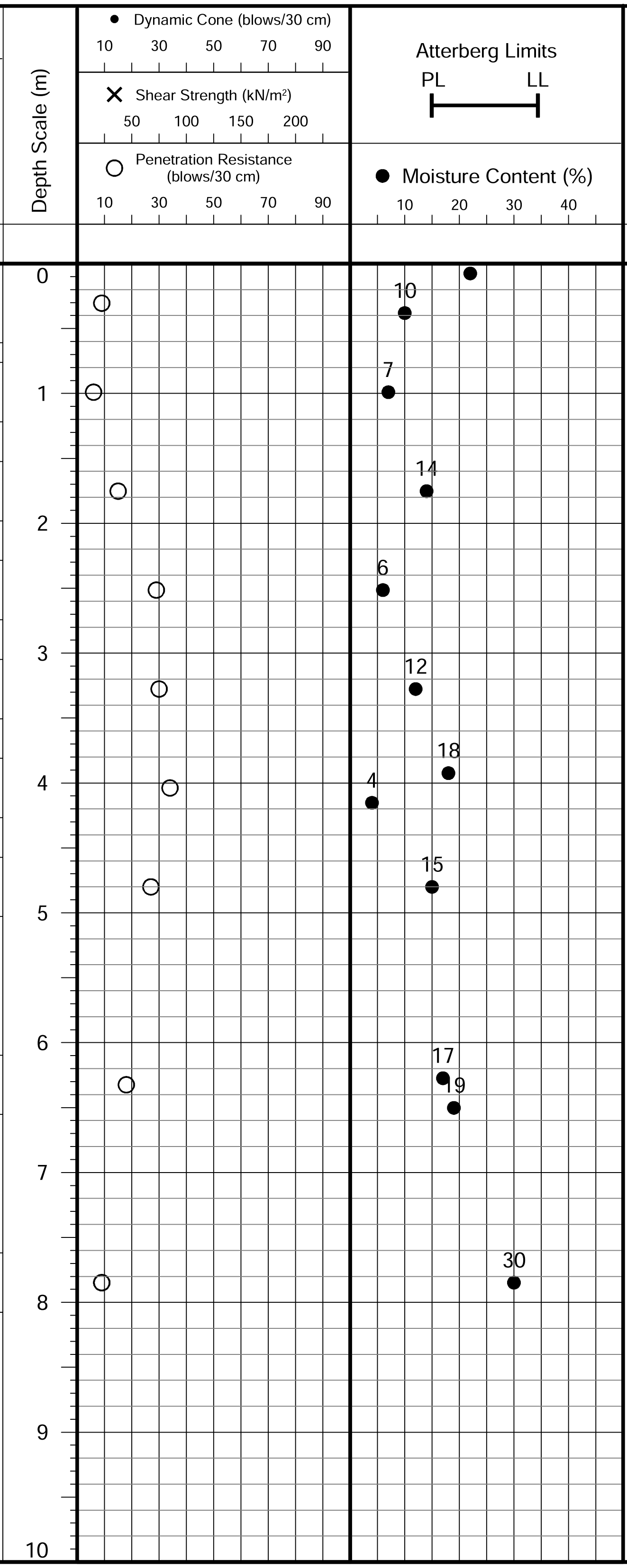
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
272.4	Ground Surface			
0.0	**15 cm TOPSOIL**	1A		
	Brown **EARTH FILL** **(Silty Sand)** a trace of clay	1B	DO	9
		2	DO	6
	organic inclusions	3	DO	15
270.1 2.3	Brown, compact **SILTY SAND TILL** a trace of clay a trace to some gravel occ. sand seams and layers, cobbles and boulders	4	DO	29
		5	DO	30
268.4 4.0	Brown, compact to dense **SAND** fine to coarse grained a trace of silt	6A 6B	DO	34
		7	DO	27
267.5 4.9	Brown, compact **SANDY SILT** a trace of clay	8A	DO	18
265.9 6.5	Stiff **SILTY CLAY** a trace of sand	8B		
	brown grey	9	DO	9
264.3 8.1	**END OF BOREHOLE**			



WATER LEVEL

Cave-in @ El. 267.2 m on completion

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

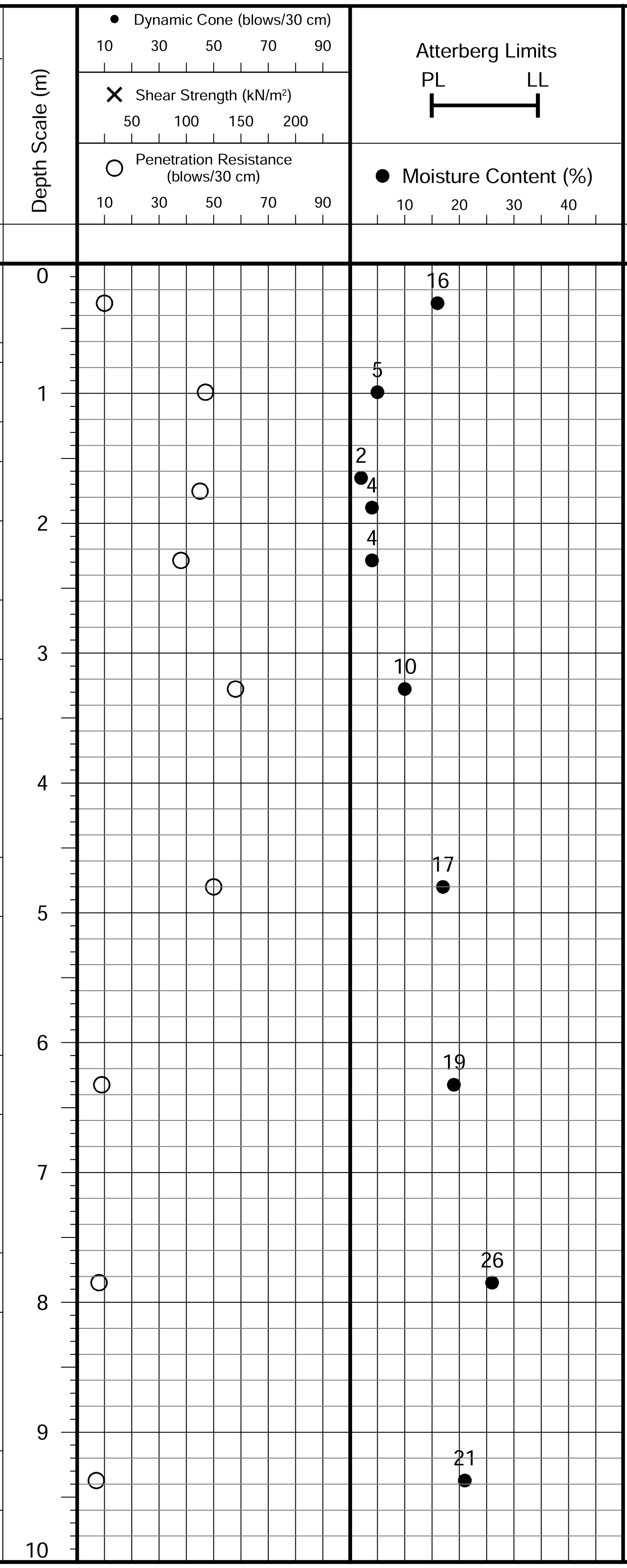
PROJECT DESCRIPTION: Proposed School Block

PROJECT LOCATION:
Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
272.6	Ground Surface			
0.0	**TOPSOIL FILL**	1	DO	10
271.8 0.8	Brown, dense to very dense **SAND** fine and fine to medium grained a trace of silt	2	DO	47
	gravelly	3A 3B	DO	45
		4	DO	38
	silt layers	5	DO	58
268.0 4.6	Brown, dense **SANDY SILT** a trace of clay	6	DO	50
266.5 6.1	Grey, firm to stiff **SILTY CLAY** **(varved)** a trace of sand with silt layers occ. gravel	7	DO	9
		8	DO	8
		9	DO	7
262.6	*(Continued on next page)*			



WATER LEVEL

No W.L. recorded due to process of washboring to carry out deep borehole

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

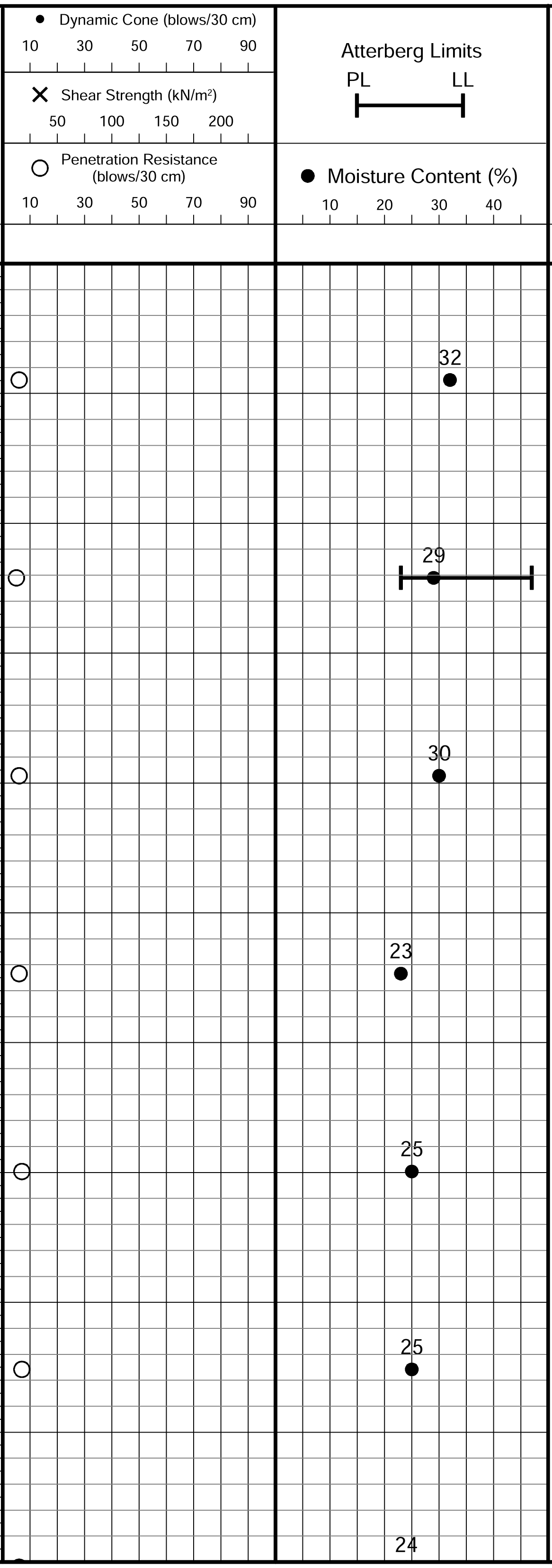
PROJECT DESCRIPTION: Proposed School Block

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
10.0	*(Continued)* Grey, firm **SILTY CLAY (varved)** a trace of sand with silt layers occ. gravel				10
		10	DO	6	11
					12
		11	DO	5	
					13
		12	DO	6	14
	— — — — — silty clay till layer — — — — —				15
		13	DO	6	
					16
		14	DO	7	17
					18
		15	DO	7	
					19
252.6	*(Continued on next page)*				20



WATER LEVEL

Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

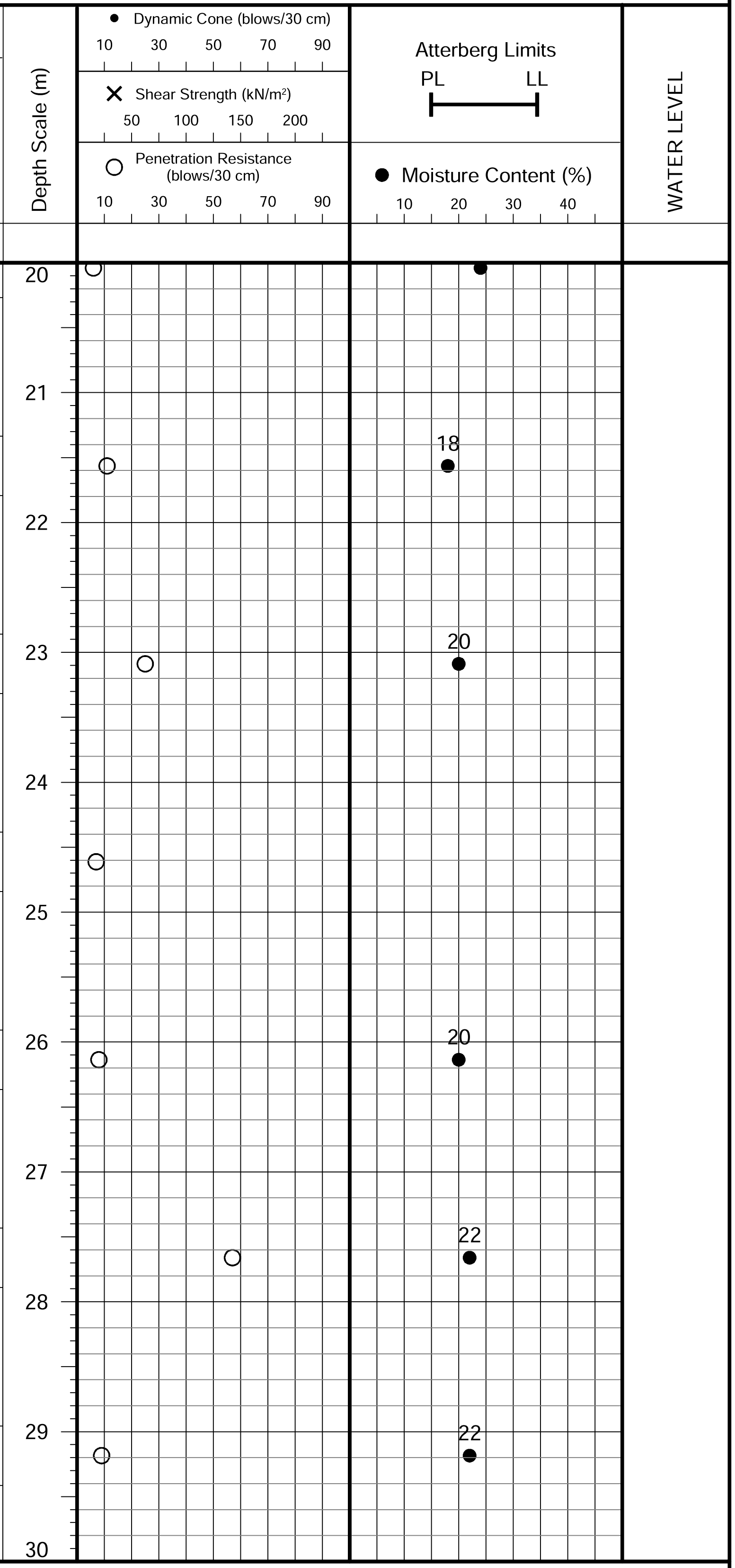
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
20.0	*(Continued)* Grey, firm to hard **SILTY CLAY** **(varved)** a trace of sand with silt layers occ. gravel	16	DO	6
		17	DO	11
		18	DO	25
		19	DO	7
		20	DO	8
		21	DO	57
		22	DO	9
242.6	*(Continued on next page)*			



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

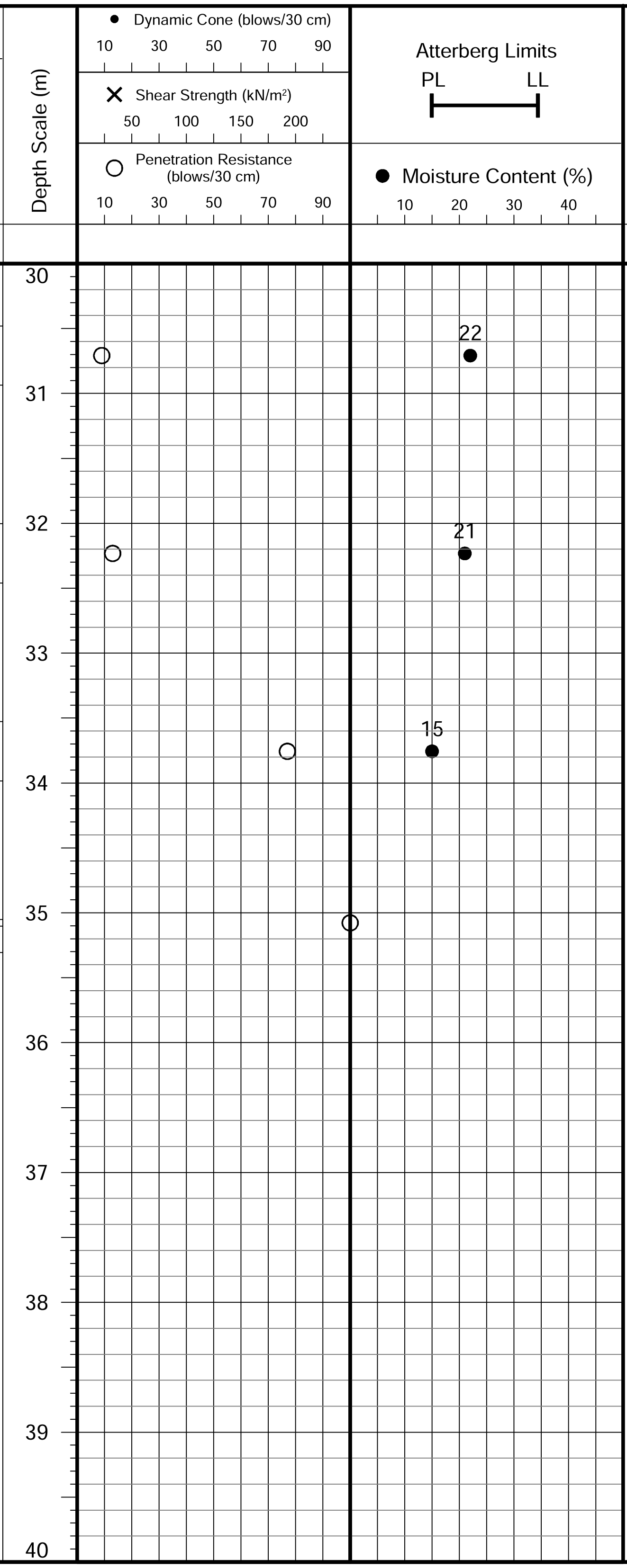
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers and Washbore with Tri-Cone

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17 to 21, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	WATER LEVEL
30.0	*(Continued)* Grey, stiff to hard **SILTY CLAY (varved)** a trace to some sand with silt layers occ. gravel	23	DO	9	
	silty clay till layer	24	DO	13	
		25	DO	77	
	cobbles/boulders/ hard augering/ spoon bouncing	26	DO	50/5	
237.3 35.3	**END OF BOREHOLE (Refusal to Auger)**				



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 205

FIGURE NO.: 5

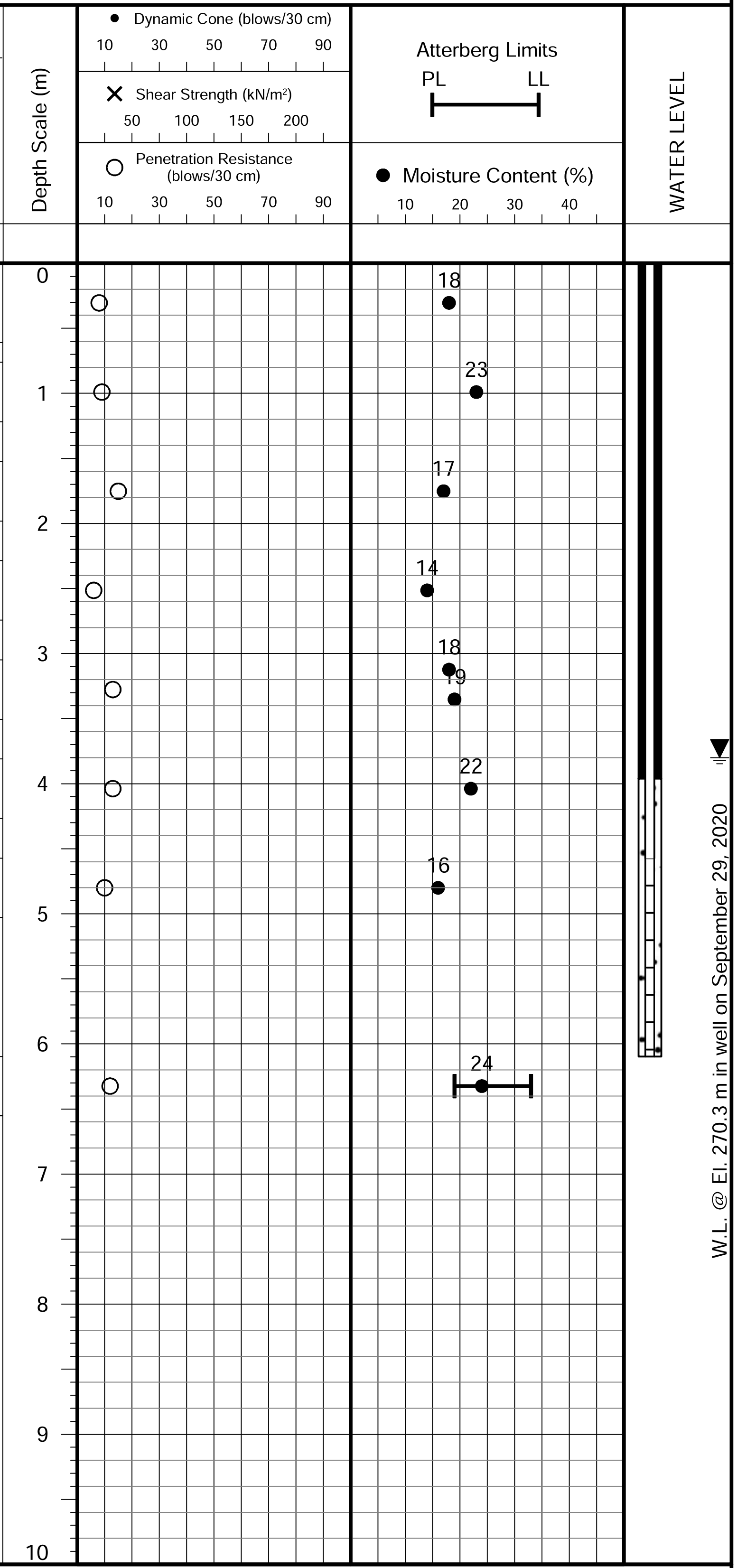
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
274.1	Ground Surface			
0.0	Brown **EARTH FILL** **(Topsoil, Silty Clay and Silt)**	1	DO	8
	a trace to some sand	2	DO	9
	topsoil/silty clay mix			
	silty clay	3	DO	15
	silt	4	DO	6
	topsoil inclusions	5A		
270.9 3.2	Brown, loose to compact **SILT**	5B	DO	13
	a traces to some clay a trace of sand occ. gravel	6	DO	13
		7	DO	10
269.1 5.0	Grey, very stiff **SILTY CLAY** some sand occ. gravel			
		8	DO	12
267.5 6.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 6.1 m (1.5 m screen) Sand backfill from 4.0 m to 6.1 m Bentonite holeplug from 0 m to 4.0 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 206D

FIGURE NO.: 6A

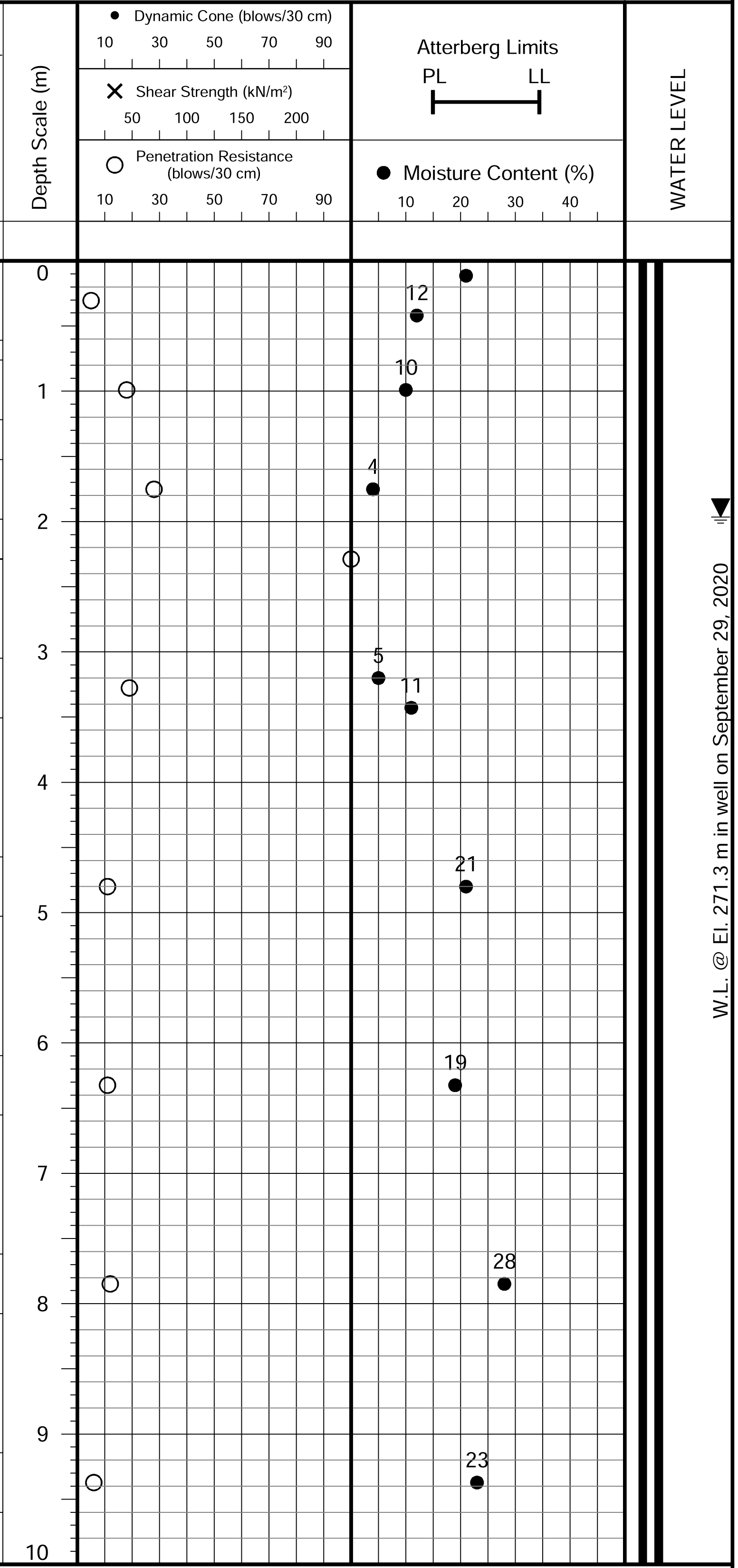
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16 to 17, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
273.3	Ground Surface			
0.0	**23 cm TOPSOIL**	1A	DO	5
	Brown, loose to very dense **SAND** fine and fine to medium grained a trace to some silt	1B		
	weathered	2	DO	18
	fine grained	3	DO	28
	hard augering/ gravelly/ cobbles and boulders	4	DO	50/0
	fine to medium grained	5A	DO	19
270.0 3.3	Firm to very stiff **SILTY CLAY** **(varved)** a trace of sand with sand and silt seams and layers	5B		
	silty clay till layer/ brown grey	6	DO	11
		7	DO	11
		8	DO	12
		9	DO	6
263.3	*(Continued on next page)*			



W.L. @ El. 271.3 m in well on September 29, 2020

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 206D

FIGURE NO.: 6A

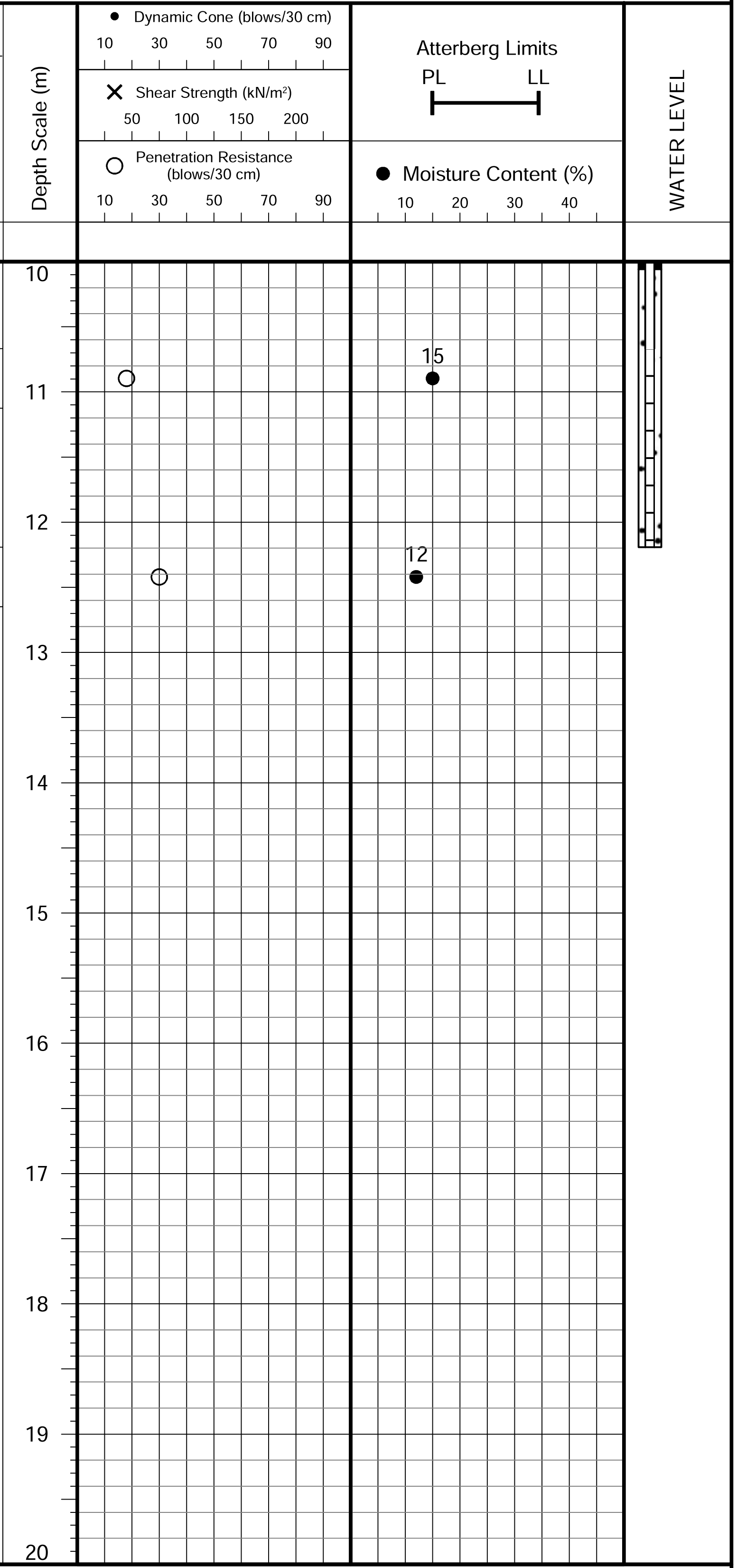
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Hollow Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 16 to 17, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value
10.0	*(Continued)* Grey, very stiff **SILTY CLAY (varved)**			
		10	DO	18
	a trace to some sand with silt layers occ. gravel sandy silt till layer			
260.7		11	DO	30
12.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 12.2 m (1.5 m screen) Sand backfill from 10.1 m to 12.2 m Bentonite holeplug from 0 m to 10.1 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock			



Soil Engineers Ltd.

JOB NO.: 2008-S135B

LOG OF BOREHOLE NO.: 206S

FIGURE NO.: 6B

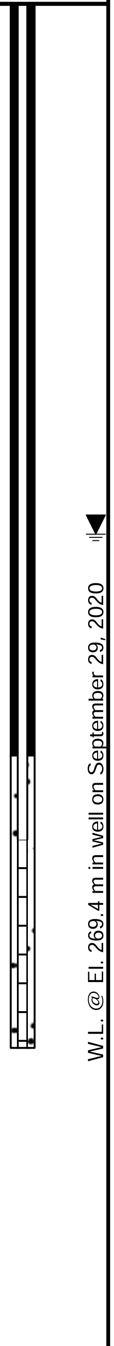
PROJECT DESCRIPTION: Proposed School Block

METHOD OF BORING: Solid Stem Augers

PROJECT LOCATION: Shining Hill Phase 3
306 St. John's Sideroad
Town of Aurora

DRILLING DATE: September 17, 2020

El. (m) Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)	● Dynamic Cone (blows/30 cm) 10 30 50 70 90 × Shear Strength (kN/m²) 50 100 150 200 ○ Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL ● Moisture Content (%) 10 20 30 40	WATER LEVEL
273.3	Ground Surface							
0.0	**STRAIGHT AUGERING FOR INSTALLATION OF NESTED WELL**				0 1 2 3 4 5 6 7			
265.7 7.6	**END OF BOREHOLE** Installed 50 mm Ø PVC monitoring well to 7.6 m (1.5 m screen) Sand backfill from 5.5 m to 7.6 m Bentonite holeplug from 0 m to 5.5 m Provided with a 4x4 steel monument casing with top and bottom caps, and lock				8 9 10			



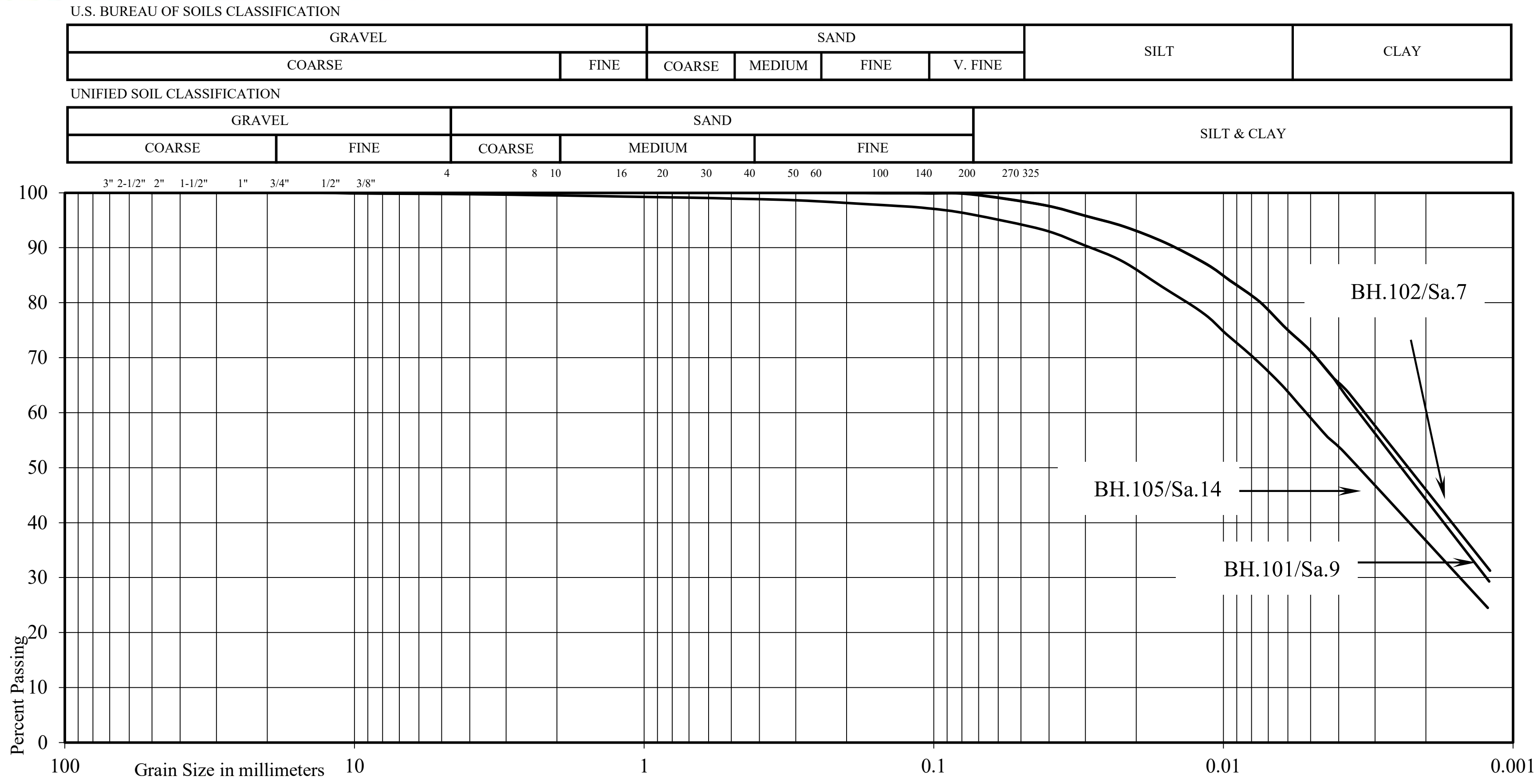
W.L. @ El. 269.4 m in well on September 29, 2020

Soil Engineers Ltd.

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (A)



Project: Proposed Residential Development

Location: Shining Hill Phase 3

162 St. John's Sideroad, Town of Aurora

Borehole No:	101	102	105
Sample No:	9	7	14
Depth (m):	9.4	4.8	17.0
Elevation (m):	255.6	260.1	249.8

BH./Sa.	101/9	102/7	105/14
Liquid Limit (%) =	45	46	40
Plastic Limit (%) =	22	23	20
Plasticity Index (%) =	23	23	20
Moisture Content (%) =	28	22	22
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}	10^{-7}

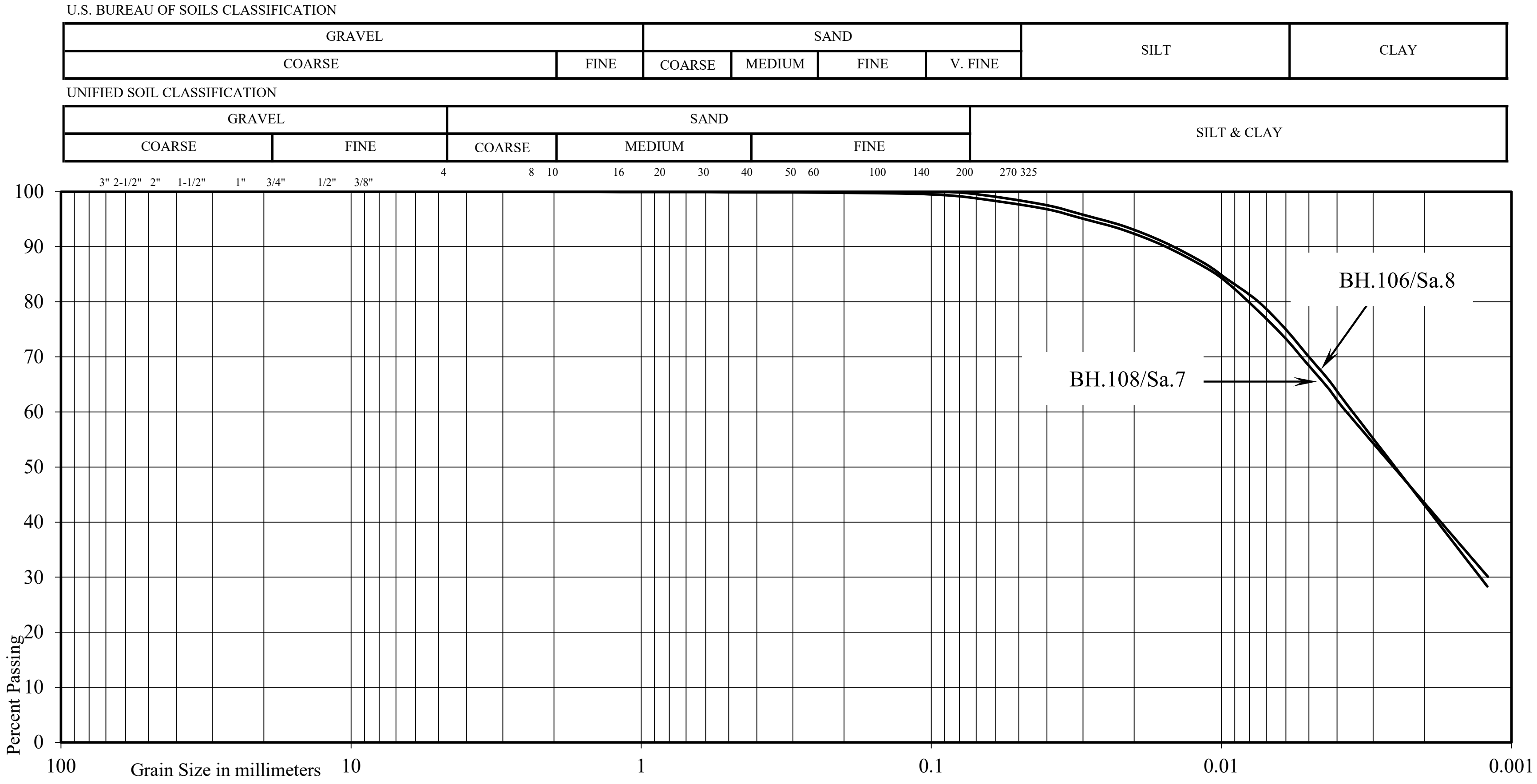
Classification of Sample [& Group Symbol]: SILTY CLAY, a trace of sand

Figure: 9

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (A)



Project: Proposed Residential Development

Location: Shining Hill Phase 3

162 St. John's Sideroad, Town of Aurora

Borehole No:	106	108
Sample No:	8	7
Depth (m):	7.8	6.3
Elevation (m):	257.5	263.0

BH./Sa.	106/8	108/7
Liquid Limit (%) =	43	-
Plastic Limit (%) =	21	-
Plasticity Index (%) =	22	-
Moisture Content (%) =	26	23
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}

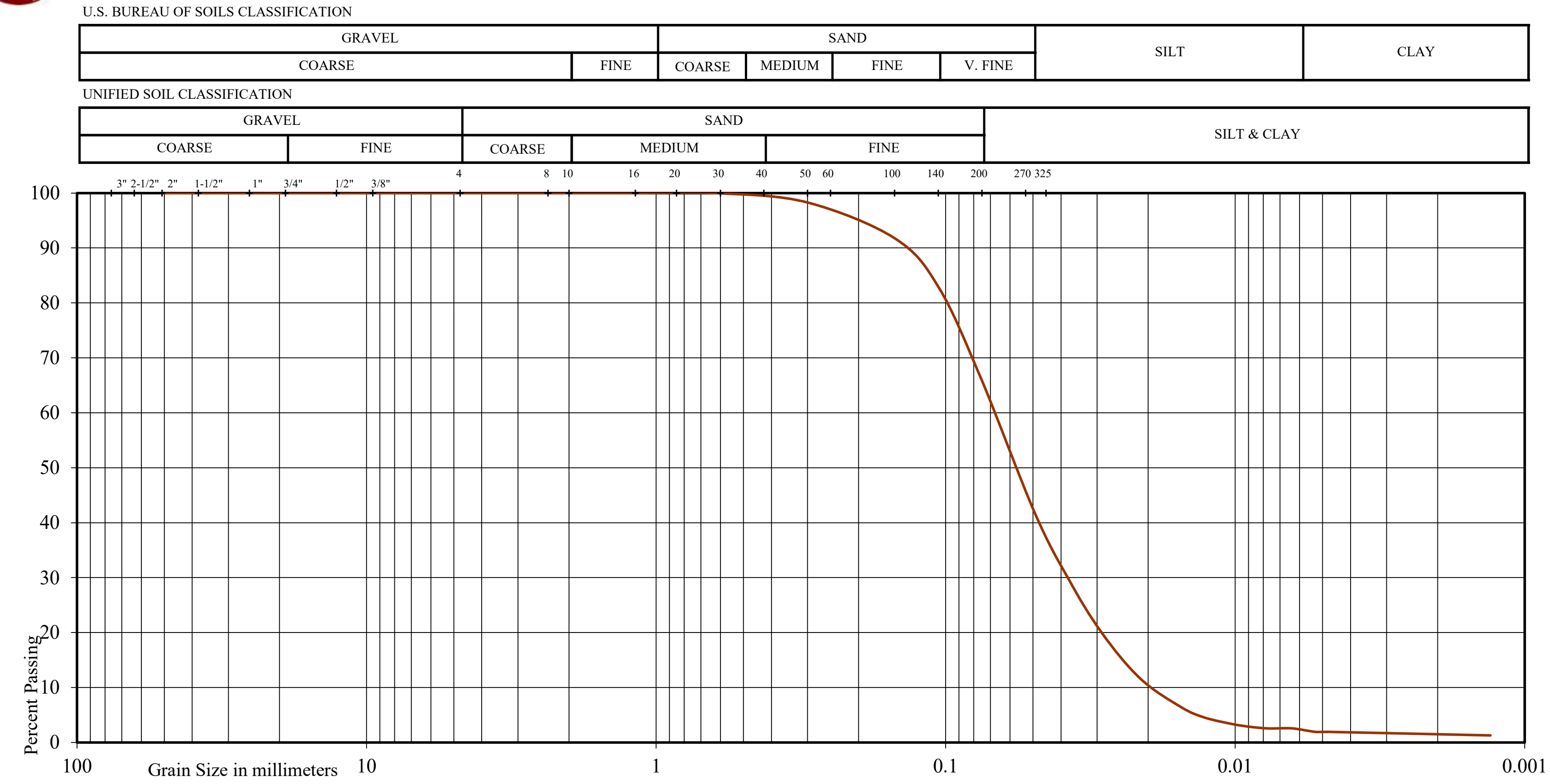
Classification of Sample [& Group Symbol]: SILTY CLAY, a trace of sand

Figure: 10

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (A)



Project: Proposed Residential Development

Location: Shining Hill Phase 3

162 St. John's Sideroad, Town of Aurora

Borehole No: 103

Sample No: 5

Depth (m): 3.3

Elevation (m): 264.7

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 21

Estimated Permeability

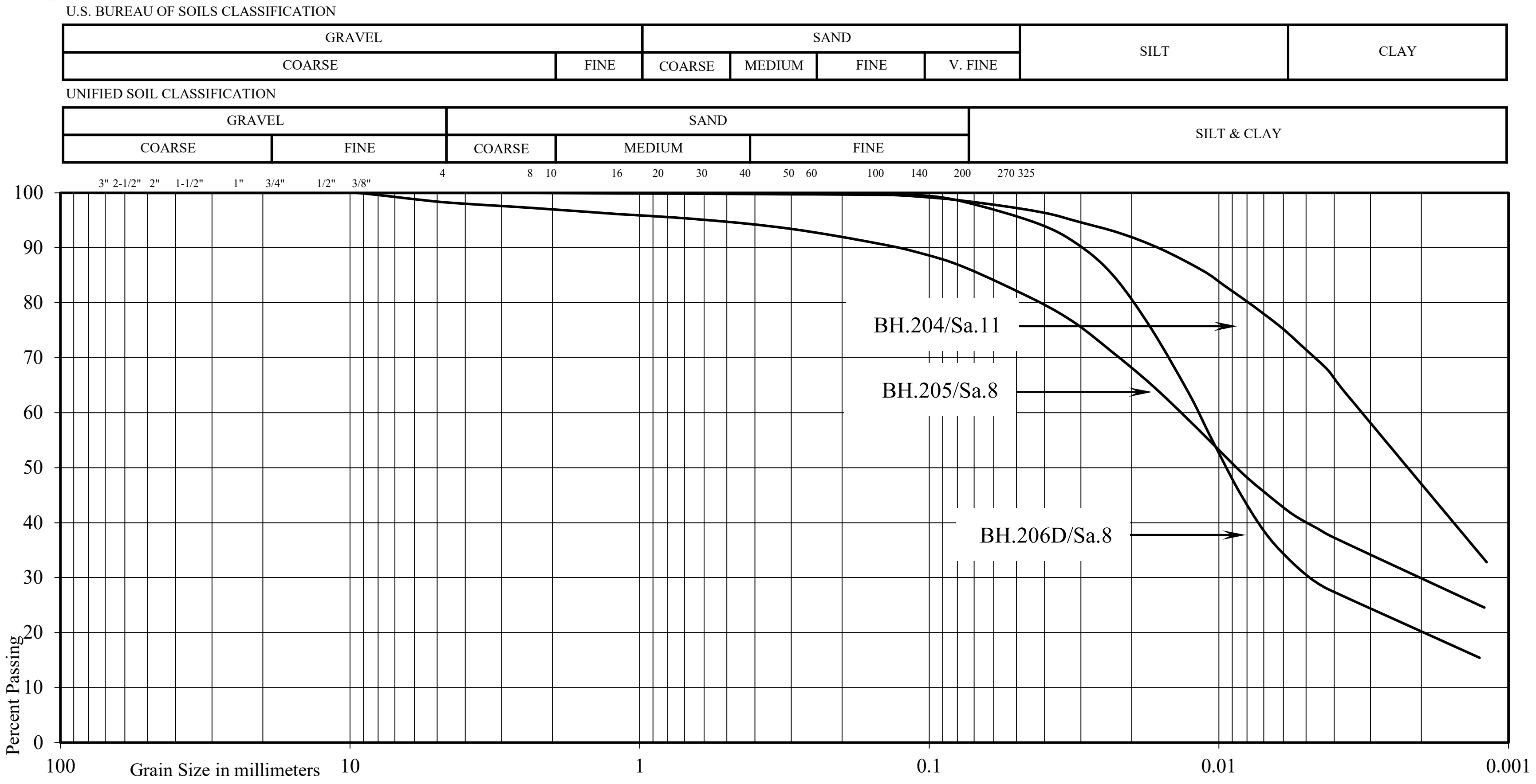
(cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]: SANDY SILT, a trace of clay

Figure: 11

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (B)



Project: Proposed School Block

Location: Shinning Hill Phase 3

306 St. John's Sideroad, Town of Aurora

Borehole No:	204	205	206D
Sample No:	11	8	8
Depth (m):	12.4	6.3	7.9
Elevation (m):	260.2	267.8	265.4

BH./Sa.	204/11	205/8	206D/8
Liquid Limit (%) =	47	33	-
Plastic Limit (%) =	23	19	-
Plasticity Index (%) =	24	14	-
Moisture Content (%) =	29	24	28
Estimated Permeability (cm./sec.) =	10^{-7}	10^{-7}	10^{-7}

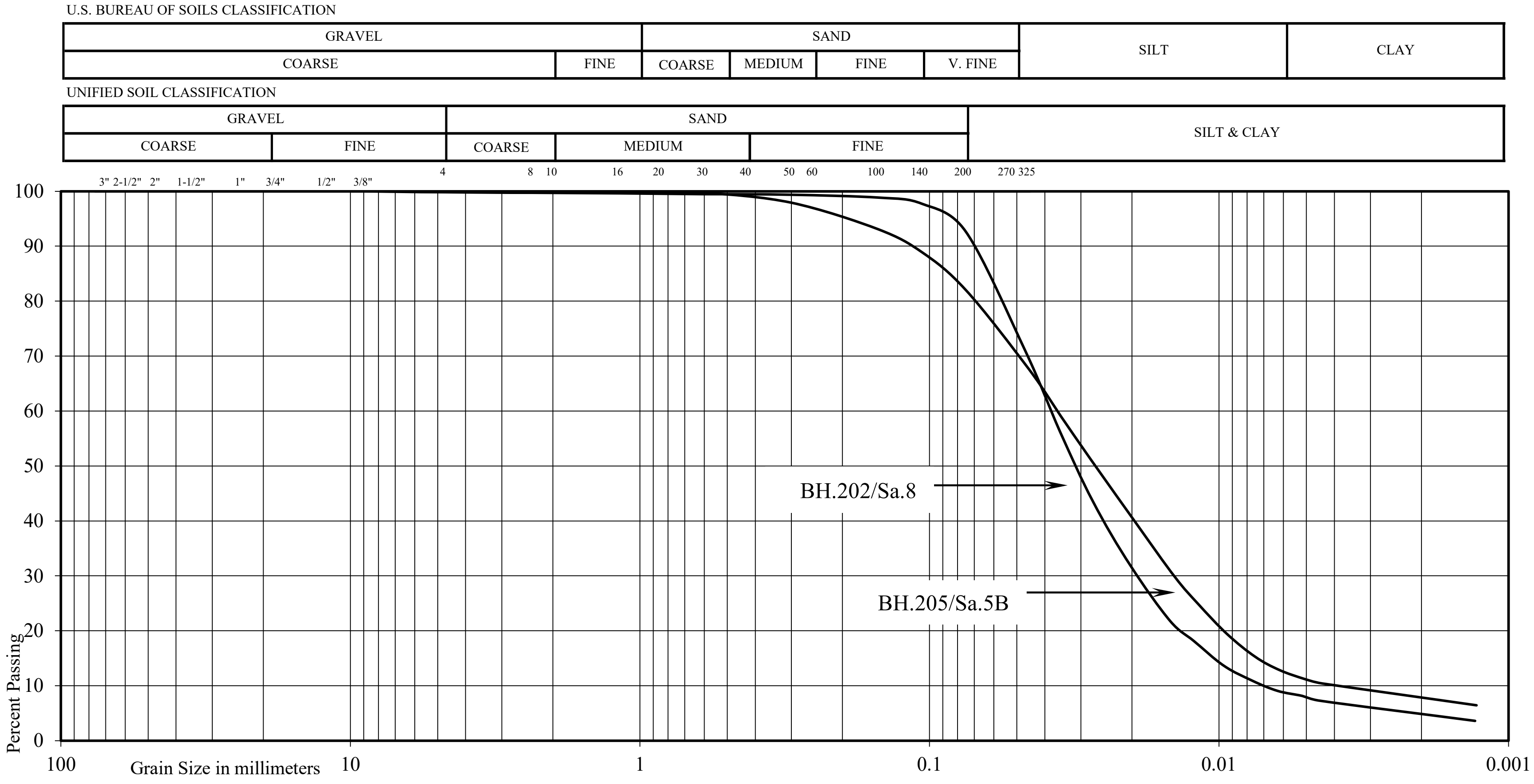
Classification of Sample [& Group Symbol]: SILTY CLAY, a trace to some sand, occasional gravel

Figure: 7

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (B)



Project: Proposed School Block

Location: Shinning Hill Phase 3

306 St. John's Sideroad, Town of Aurora

Borehole No:	202	205
Sample No:	8	5B
Depth (m):	6.3	3.4
Elevation (m):	265.0	270.7

BH./Sa.	202/8	205/5B
Liquid Limit (%) =	-	-
Plastic Limit (%) =	-	-
Plasticity Index (%) =	-	-
Moisture Content (%) =	18	19
Estimated Permeability (cm./sec.) =	10^{-4}	10^{-5}

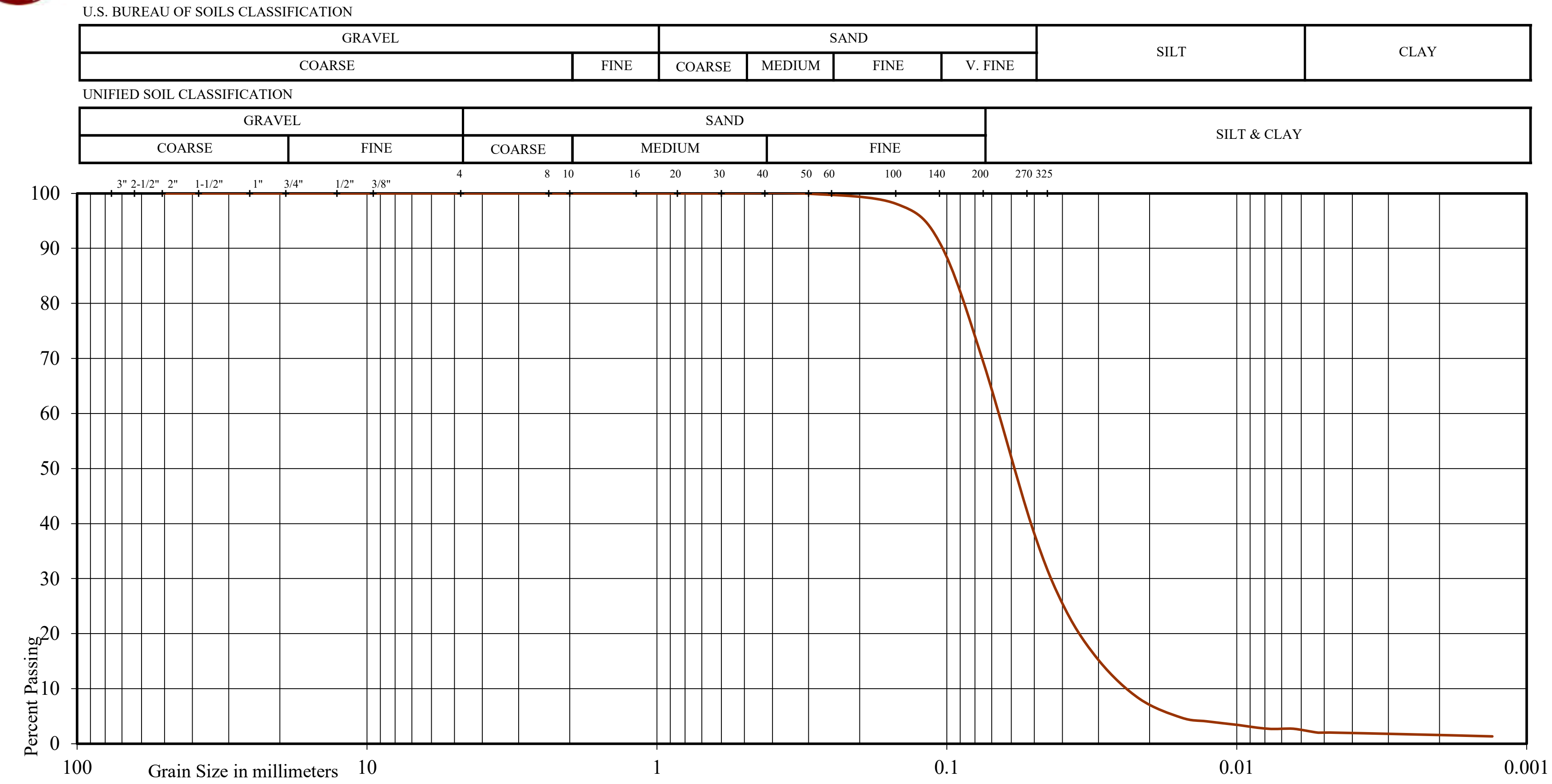
Classification of Sample [& Group Symbol]: SILT, a trace of clay, a trace to some sand

Figure: 8

Soil Engineers Ltd.

GRAIN SIZE DISTRIBUTION

Reference No: 2008-S135 (B)



Project: Proposed School Block

Location: Shinning Hill Phase 3

306 St. John's Sideroad, Town of Aurora

Borehole No: 201

Sample No: 6

Depth (m): 3.3

Elevation (m): 268.6

Liquid Limit (%) = -

Plastic Limit (%) = -

Plasticity Index (%) = -

Moisture Content (%) = 15

Estimated Permeability

(cm./sec.) = 10^{-3}

Classification of Sample [& Group Symbol]: SANDY SILT, a trace of clay

Figure: 9

APPENDIX E

Water Level Measurements

Table E-1 - Water Level Depths and Elevations
Hydrogeological Investigation
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario

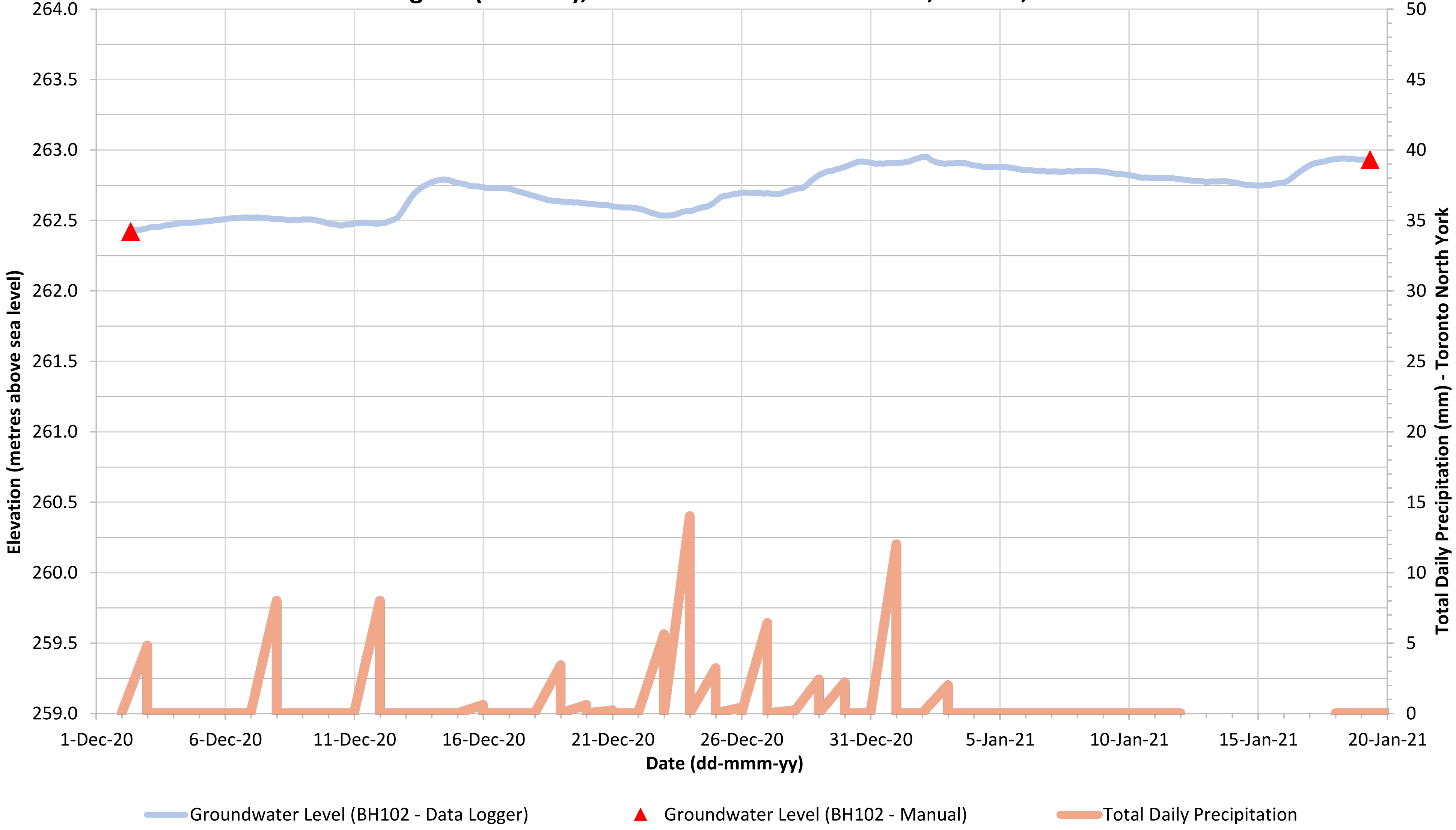
Monitoring Well ID	Ground Surface Elevation (masl)	Screen Interval (masl)	29-Sep-20		16-Nov-20		24-Nov-20		01-Dec-20		19-Jan-21	
			Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)	Depth (mbgs)	Elevation (masl)
BH101	265.00	257.4 to 258.9	4.50	260.50	4.13	260.87	4.19	260.81	3.89	261.11	3.20	261.80
BH102	264.90	258.8 to 260.3	2.80	262.10	2.66	262.24	2.67	262.24	2.48	262.42	1.97	262.93
BH103	268.00	263.4 to 265.0	2.50	265.50	2.40	265.61	2.40	265.61	2.26	265.75	1.82	266.18
BH104	267.30	261.2 to 262.7	2.70	264.60	2.24	265.06	2.24	265.06	2.18	265.12	1.33	265.97
BH105	266.80	250.0 to 253.1	7.20	259.60	6.78	260.02	6.72	260.08	6.60	260.20	6.06	260.74
BH106	265.30	257.7 to 259.2	DRY	DRY	6.92	258.38	5.92	259.38	3.69	261.61	2.24	263.07
BH107	262.50	256.4 to 257.9	4.20	258.30	3.56	258.94	3.61	258.89	2.82	259.68	2.24	260.26
BH108	269.30	264.7 to 266.3	3.20	266.10	3.08	266.22	3.10	266.20	2.97	266.34	2.25	267.05
BH202	271.30	265.2 to 266.7	4.60	266.70	4.69	266.61	4.70	266.61	4.64	266.67	4.35	266.95
BH205	274.10	268.0 to 269.5	3.80	270.30	3.97	270.13	4.00	270.10	3.78	270.33	3.38	270.72
BH206-D	273.30	261.1 to 262.6	2.00	271.30	1.83	271.48	1.84	271.47	1.73	271.57	1.62	271.68
BH206-S	273.30	265.7 to 267.2	3.90	269.40	3.92	269.38	3.92	269.38	3.89	269.42	3.57	269.73
P1	259.43	-			DRY	DRY	1.11	258.32	0.68	258.75	0.22	259.21
SG1	258.70	-			-0.27	258.97	-0.27	258.97	-0.29	258.99	-0.26	258.96

Notes:

1. mbgs = metres below ground surface
2. masl = metres above sea level
3. Monitoring wells 101 to 108, 202, 205 and 206D/S were installed by Soil Engineers Ltd. in September 2020. The elevations provided are understood to be referenced to a geodetic datum.
4. D = deep, S = shallow
5. P = piezometer, SG = staff gauge; installed by Golder Associates Ltd. on November 16, 2020.
6. Elevation data for ground surface at the location of the P1 and SG1 were surveyed by Golder Associates Ltd. and are referenced to a geodetic datum.
7. Groundwater level data from September 29, 2020, were measured by Soil Engineers Ltd.
8. Stabilized groundwater conditions may not have been present at BH106 on Sept. 29, Nov. 16, Nov. 24, and Dec. 1, 2020.

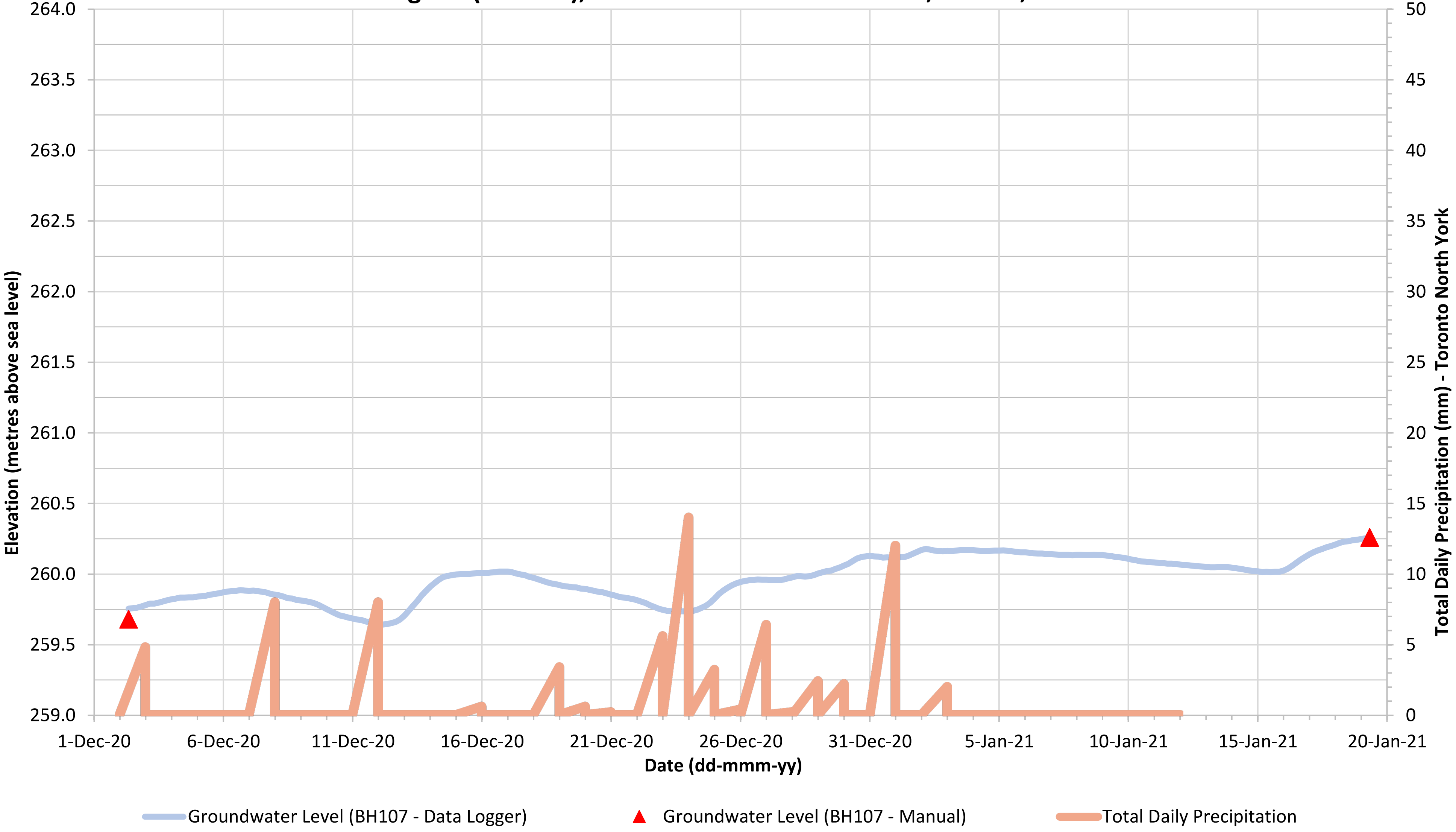
Input by: AGB/JJG
Checked by: CMK

Figure E-2: BH102 Hydrograph
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario



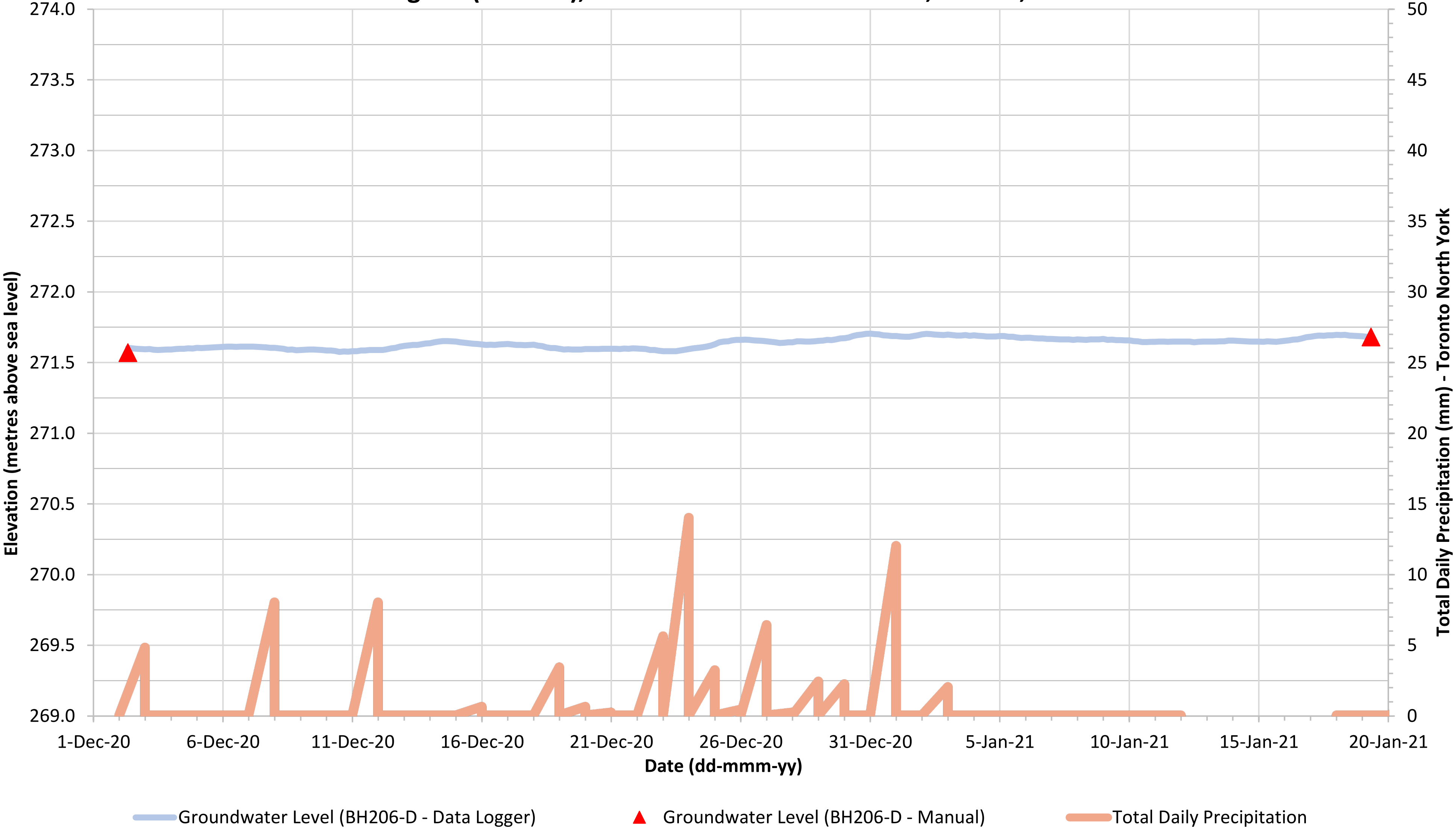
Entered by: AGB/JJG
Checked by: CMK

Figure E-3: BH107 Hydrograph
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario



Entered by: AGB/JJG
Checked by: CMK

Figure E-4: BH206-D Hydrograph
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario

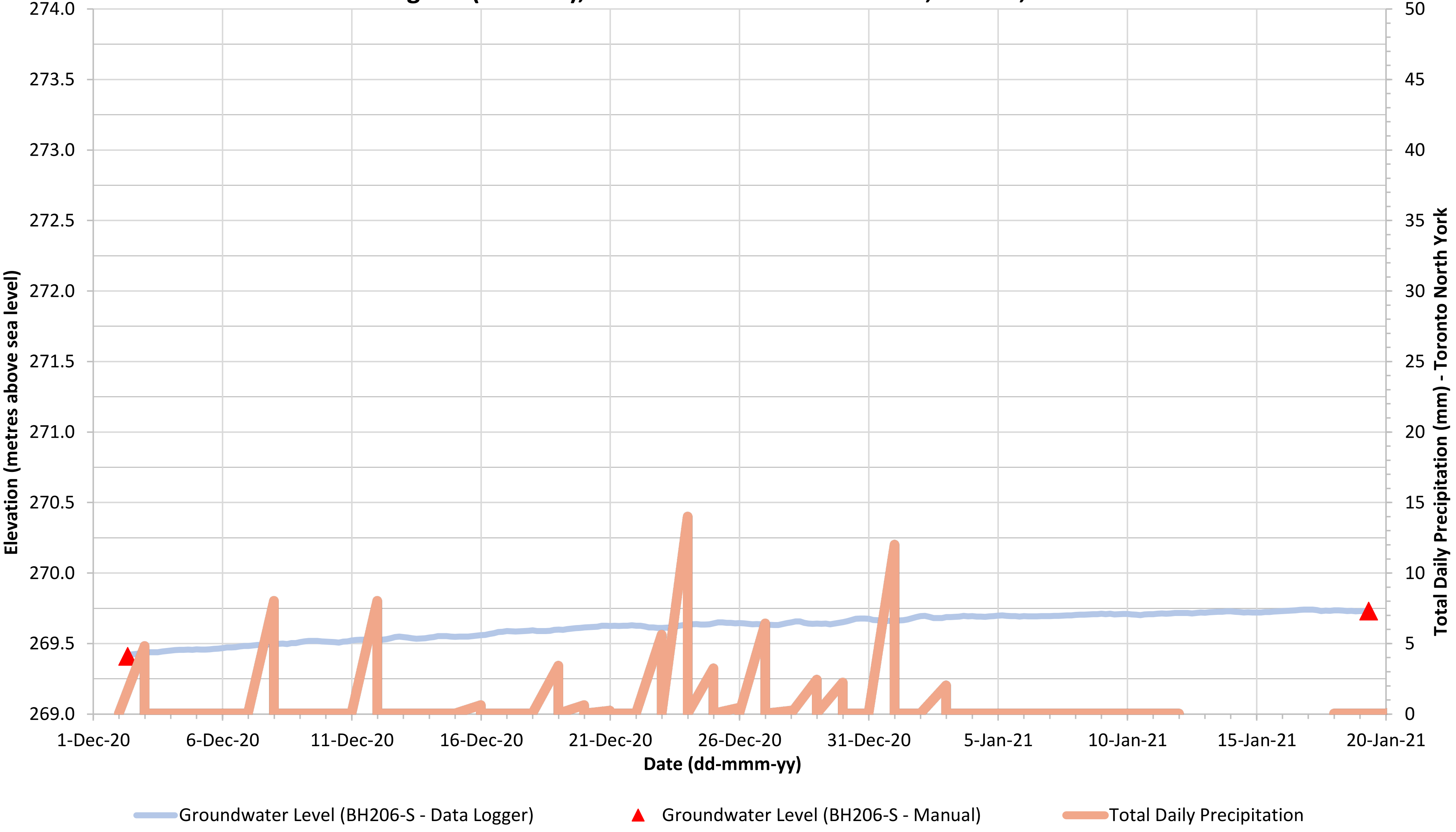


Entered by: AGB/JJG
Checked by: CMK

Golder Associates Ltd.

Figure E-5: BH206-S Hydrograph

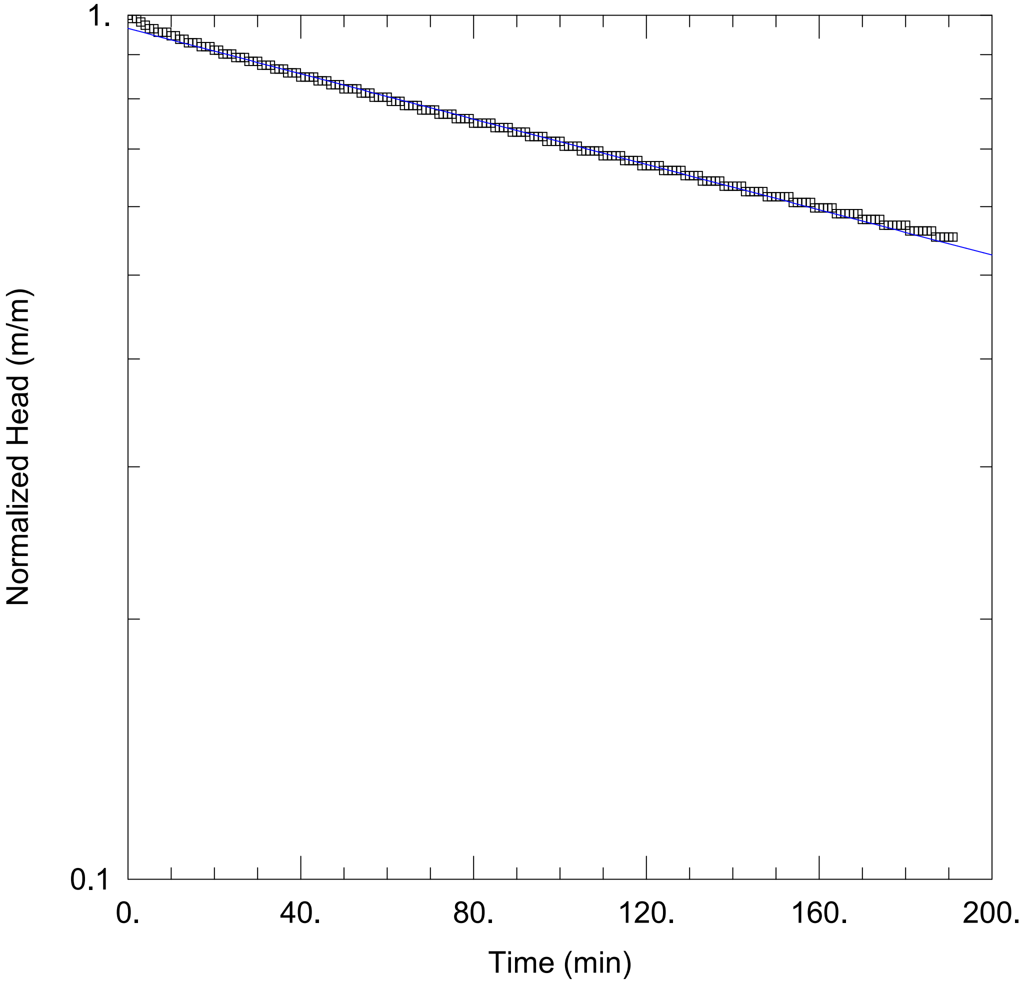
Shining Hill (Phase 3), 162 St. John's Sideroad West, Aurora, Ontario



Entered by: AGB/JJG
Checked by: CMK

APPENDIX F

Hydraulic Conductivity Testing



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH101 (logger).aqt
Date: 03/04/21 Time: 16:10:21

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH101
Test Date: December 1, 2020

AQUIFER DATA

Saturated Thickness: 3.71 m
Anisotropy Ratio (Kz/Kr): 1.

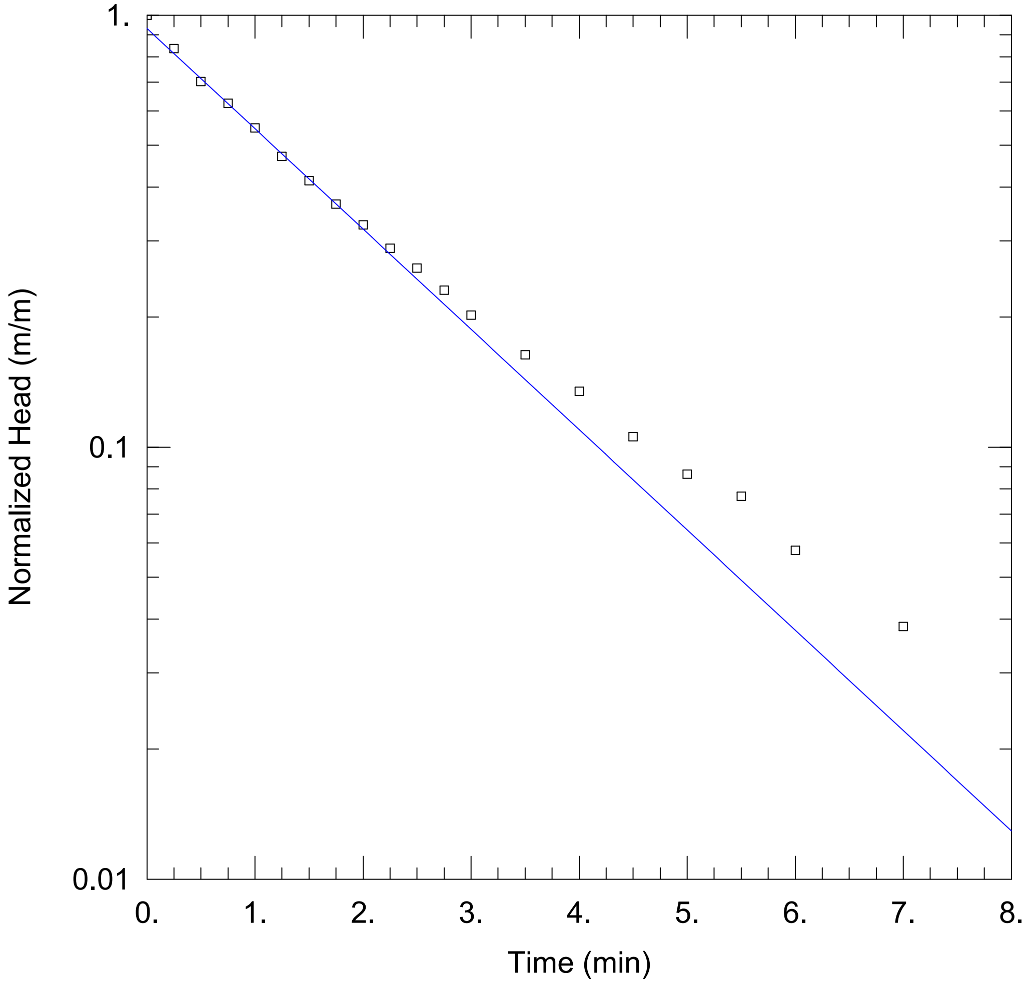
WELL DATA (BH101)

Initial Displacement: 1.12 m
Static Water Column Height: 3.71 m
Total Well Penetration Depth: 3.7 m
Screen Length: 2.1 m
Casing Radius: 0.025 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 2.165E-6 cm/sec
y0 = 1.081 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH103.aqt
Date: 03/04/21 Time: 17:39:03

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH103
Test Date: November 16, 2020

AQUIFER DATA

Saturated Thickness: 2.21 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH103)

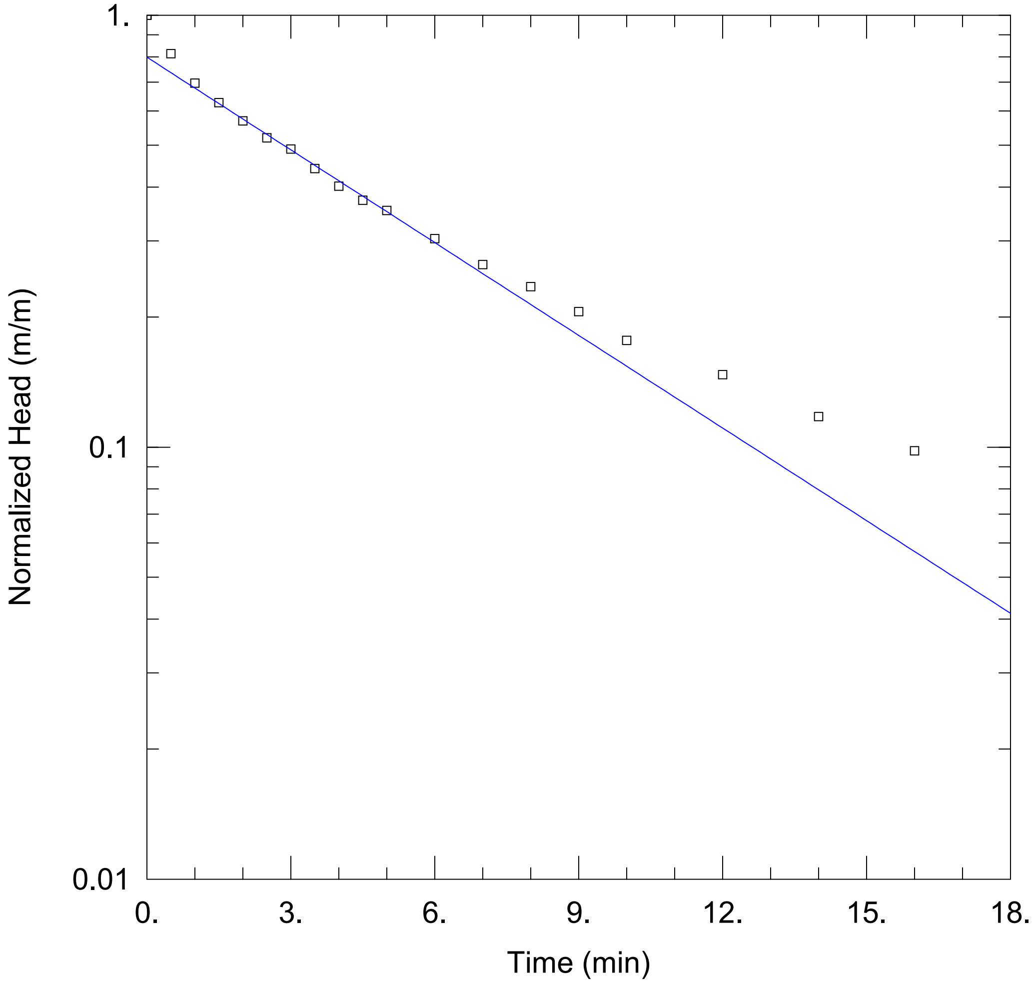
Initial Displacement: 1.04 m
Total Well Penetration Depth: 2.16 m
Casing Radius: 0.047 m

Static Water Column Height: 2.21 m
Screen Length: 2.16 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.0011 cm/sec y0 = 0.9682 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH108.aqt
Date: 03/04/21 Time: 16:39:23

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH108
Test Date: November 16, 2020

AQUIFER DATA

Saturated Thickness: 1.52 m
Anisotropy Ratio (Kz/Kr): 1.

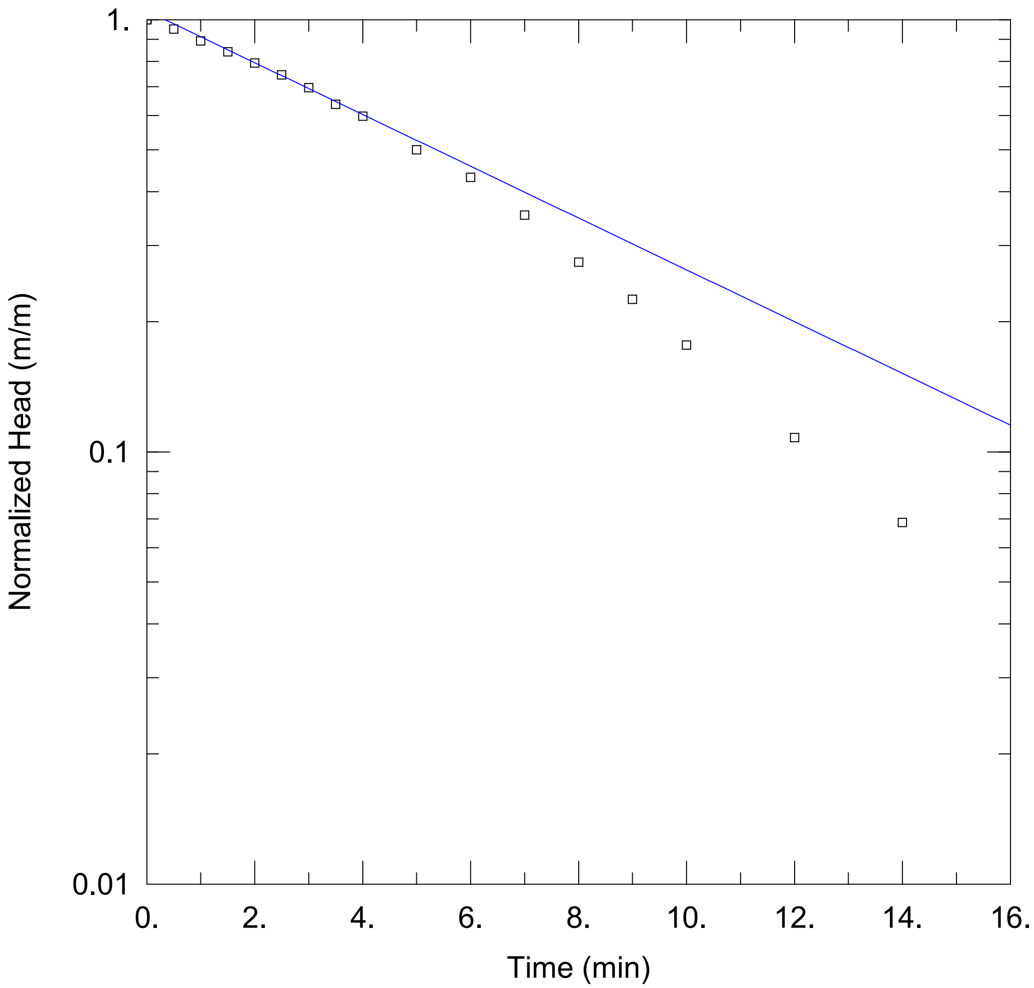
WELL DATA (BH108)

Initial Displacement: 1.02 m
Total Well Penetration Depth: 1.52 m
Casing Radius: 0.05 m
Static Water Column Height: 1.52 m
Screen Length: 1.52 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0004911 cm/sec
y0 = 0.8149 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH202.aqt
Date: 03/04/21 Time: 17:03:42

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH202
Test Date: November 16, 2020

AQUIFER DATA

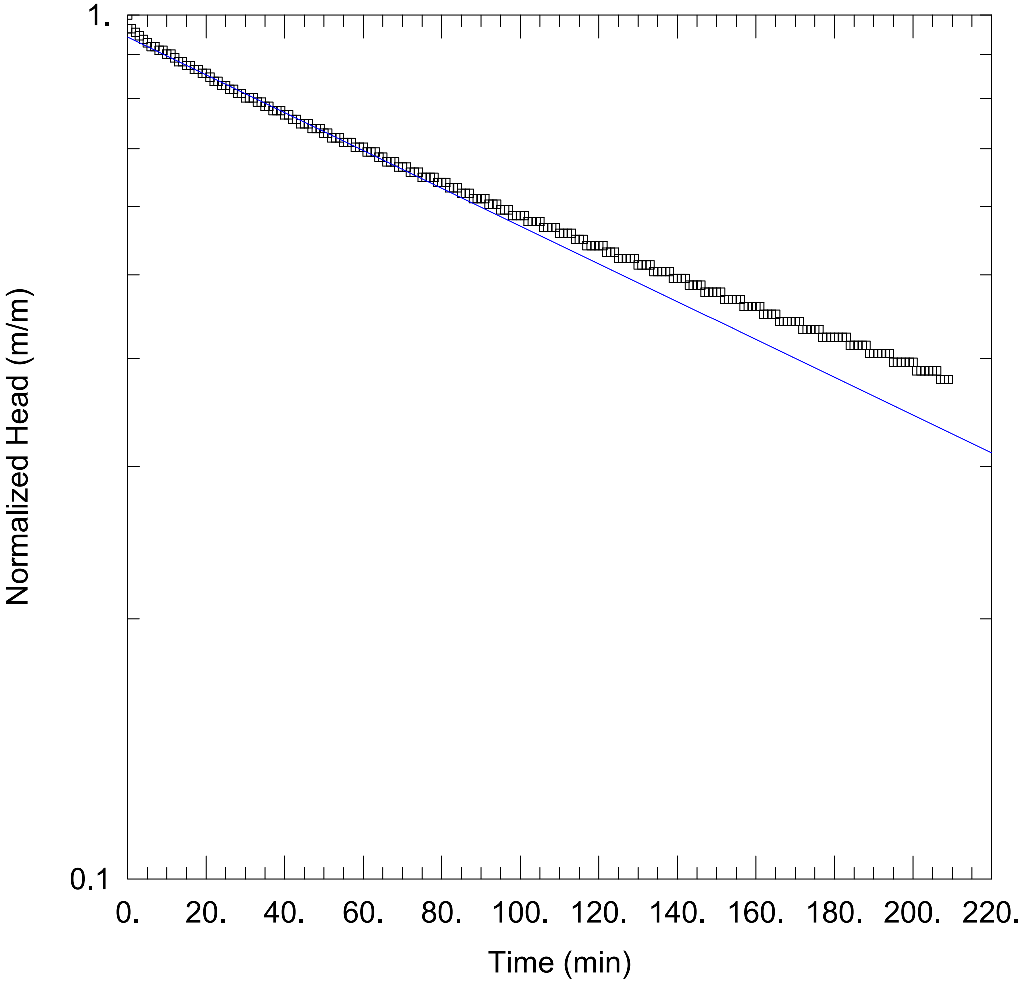
Saturated Thickness: 1.91 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH202)

Initial Displacement: 1.02 m
Static Water Column Height: 1.91 m
Total Well Penetration Depth: 1.41 m
Screen Length: 1.41 m
Casing Radius: 0.05 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003809 cm/sec
y0 = 1.068 m



WELL TEST ANALYSIS

Data Set: C:\Users\JGopaul\Desktop\Shining Hill\Analysis\RHTs\BH206-S (logger).aqt
Date: 03/04/21 Time: 17:15:18

PROJECT INFORMATION

Company: Golder Associates Ltd.
Project: 20360612
Test Well: BH206-S
Test Date: December 1, 2020

AQUIFER DATA

Saturated Thickness: 3.72 m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (BH206-S)

Initial Displacement: 1.11 m
Static Water Column Height: 3.72 m
Total Well Penetration Depth: 3.72 m
Screen Length: 2.1 m
Casing Radius: 0.025 m
Well Radius: 0.08 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

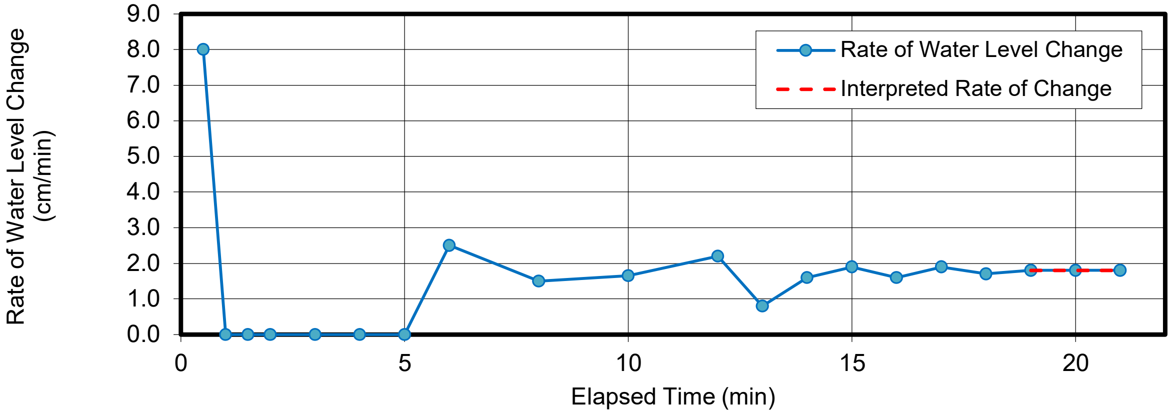
K = 3.498E-6 cm/sec
y0 = 1.046 m

Constant Head Permeameter Test Report - Test GP-101

Approximate Location: **30 m southwest of BH-101**
Test Depth: **1.0 mbgs**

Figure F-1

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	2.5	-	-
0.5	6.5	4.0	8.0
1.0	6.5	0.0	0.0
1.5	6.5	0.0	0.0
2.0	6.5	0.0	0.0
3.0	6.5	0.0	0.0
4.0	6.5	0.0	0.0
5.0	6.5	0.0	0.0
6.0	9.0	2.5	2.5
8.0	12.0	3.0	1.5
10.0	15.3	3.3	1.7
12.0	19.7	4.4	2.2
13.0	20.5	0.8	0.8
14.0	22.1	1.6	1.6
15.0	24.0	1.9	1.9
16.0	25.6	1.6	1.6
17.0	27.5	1.9	1.9
18.0	29.2	1.7	1.7
19.0	31.0	1.8	1.8
20.0	32.8	1.8	1.8
21.0	34.6	1.8	1.8

Soil Type 3 - Inferred
SILTY SAND (FILL)

Interpreted Rate of:

Water Level Change (R_1) = 3.0E-02 cm/s

Steady Intake Water Rate (Q_1) = 6.5E-02 cm^3/s

hole radius (a) = 3 cm

Water column height in hole (H_1) = 7.5 cm

Shape factor for H_1/a = (C_1) = 1.06 -

Soil Type Coefficient α^* = 0.12 cm^{-1}

Single Head Analysis

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

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **9E-05** cm/s

🟩 =input data

DATE: 2020-11-24
PROJECT: 20360612

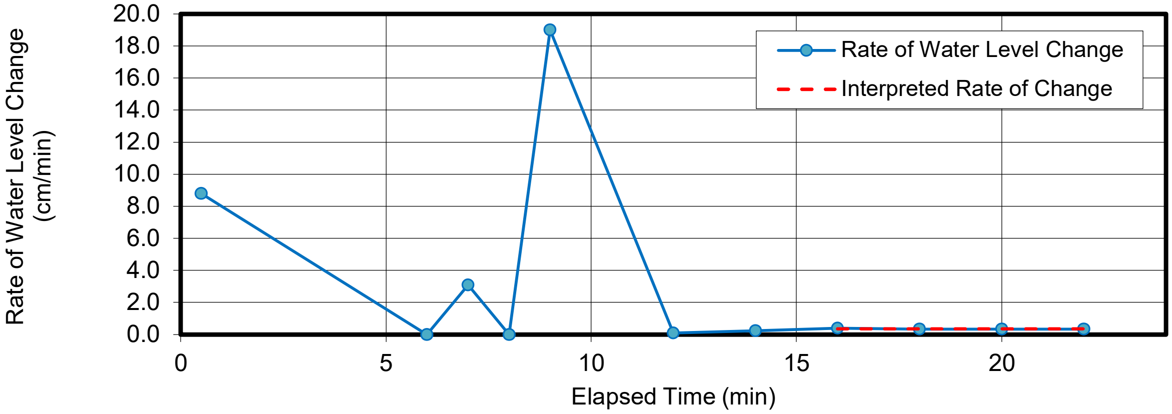
PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-102

Figure F-2

Approximate Location: 1 m north of BH-102
Test Depth: 0.7 mbgs

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	3.0	-	-
0.5	7.4	4.4	8.8
6.0	7.4	0.0	0.0
7.0	10.5	3.1	3.1
8.0	10.5	0.0	0.0
9.0	29.5	19.0	19.0
12.0	29.8	0.3	0.1
14.0	30.3	0.5	0.3
16.0	31.1	0.8	0.4
18.0	31.8	0.7	0.4
20.0	32.5	0.7	0.4
22.0	33.2	0.7	0.4

Soil Type 3 - SILT

Interpreted Rate of:

Water Level Change (R_1) =	6.0E-03	cm/s
Steady Intake Water Rate (Q_1) =	1.3E-02	cm^3/s
hole radius (a) =	3	cm
Water column height in hole (H_1) =	14	cm
Shape factor for H_1/a = (C_1) =	1.60	-
Soil Type Coefficient α* =	0.12	cm^{-1}

Single Head Analysis

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

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **1E-05** cm/s

🟩 =input data

DATE: 2020-11-24
PROJECT: 20360612

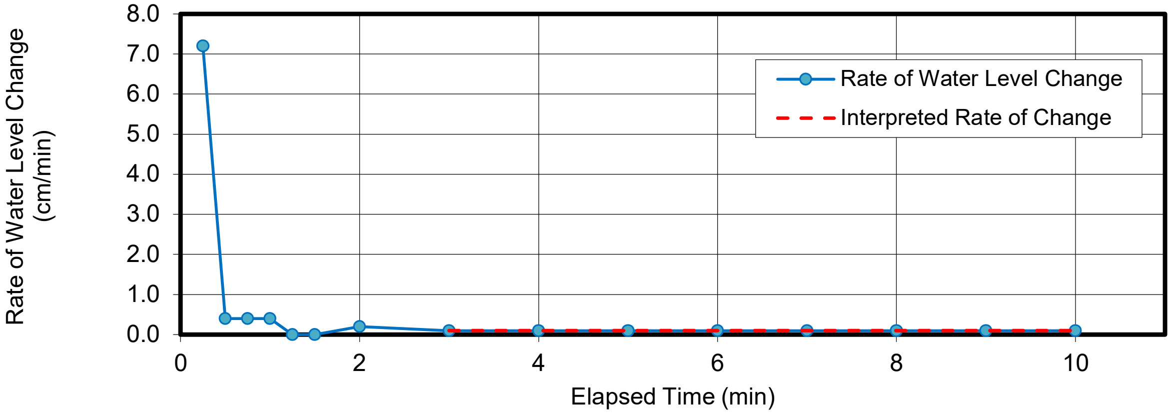
PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-105

Figure F-3

Approximate Location: 2 m north of BH-105
Test Depth: 0.8 mbgs

Rate of Water Level Change vs. Time



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	3.2	-	-
0.25	5.0	1.8	7.2
0.5	5.1	0.1	0.4
0.75	5.2	0.1	0.4
1.0	5.3	0.1	0.4
1.25	5.3	0.0	0.0
1.5	5.3	0.0	0.0
2.0	5.4	0.1	0.2
3.0	5.5	0.1	0.1
4.0	5.6	0.1	0.1
5.0	5.7	0.1	0.1
6.0	5.8	0.1	0.1
7.0	5.9	0.1	0.1
8.0	6.0	0.1	0.1
9.0	6.1	0.1	0.1
10.0	6.2	0.1	0.1

Soil Type 3 - SAND

Interpreted Rate of:

Water Level Change (R_1) =	1.7E-03	cm/s
Steady Intake Water Rate (Q_1) =	5.9E-02	cm^3/s
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm
Shape factor for H_1/a = (C_1) =	0.80	-
Soil Type Coefficient α^* =	0.12	cm^{-1}

<u>Single Head Analysis</u>

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

<u>Field Saturated Hydraulic Conductivity (K_{fs})</u>

K_{fs} = **1E-04** cm/s

🟩 =input data

DATE: 2020-11-24
PROJECT: 20360612

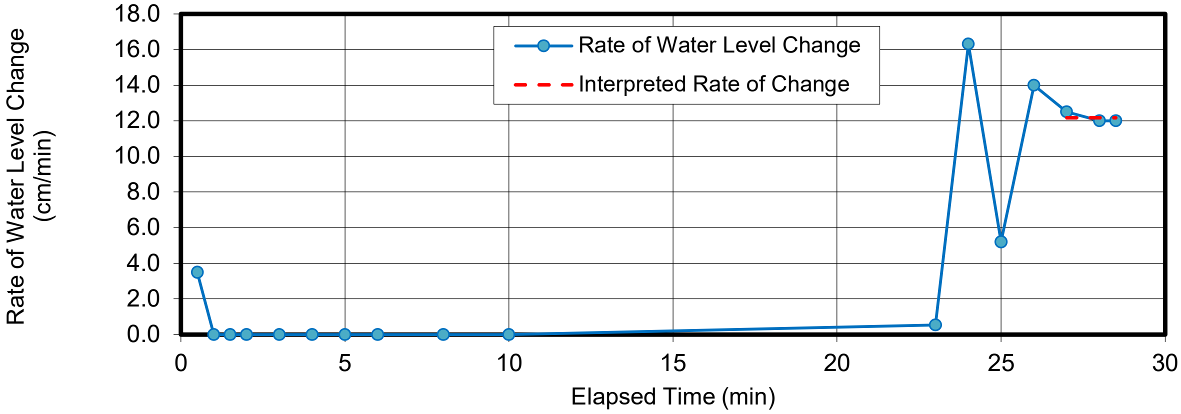
GOLDER

PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-106

Approximate Location: 1 m north of BH-106
Test Depth: 1.1 mbgs

Figure F-4


Rate of Water Level Change vs. Time

Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	1.3	-	-
0.5	3.0	1.8	3.5
1.0	3.0	0.0	0.0
1.5	3.0	0.0	0.0
2.0	3.0	0.0	0.0
3.0	3.0	0.0	0.0
4.0	3.0	0.0	0.0
5.0	3.0	0.0	0.0
6.0	3.0	0.0	0.0
8.0	3.0	0.0	0.0
10.0	3.0	0.0	0.0
23.0	10.0	7.0	0.5
24.0	26.3	16.3	16.3
25.0	31.5	5.2	5.2
26.0	45.5	14.0	14.0
27.0	58.0	12.5	12.5
28.0	70.0	12.0	12.0
28.5	76.0	6.0	12.0

Soil Type 3 - Inferred
SILTY FINE SAND

Interpreted Rate of:

Water Level Change (R_1) = 2.0E-01 cm/s

Steady Intake Water Rate (Q_1) = 4.4E-01 cm^3/s

hole radius (a) = 3 cm

Water column height in hole (H_1) = 19 cm

Shape factor for H_1/a = (C_1) = 1.92 -

Soil Type Coefficient α^* = 0.12 cm^{-1}

Single Head Analysis

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

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **3E-04** cm/s

🟩 =input data

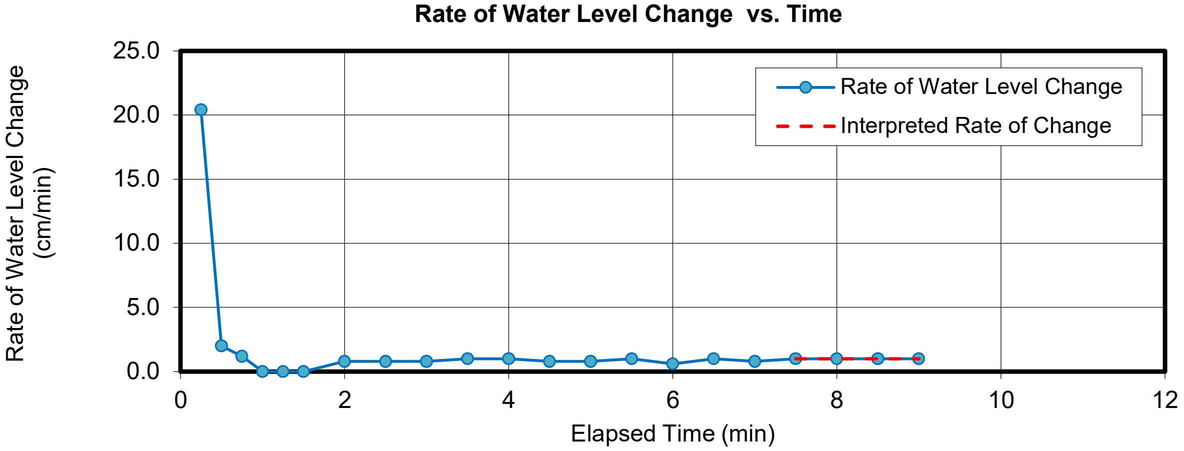
DATE: 2020-11-24
PROJECT: 20360612

PREPARED BY: AGB
REVIEW: CMK

Constant Head Permeameter Test Report - Test GP-206

Figure F-5

Approximate Location: **2.5 m south of BH-206**
Test Depth: **0.7 mbgs**



Elapsed Time (min)	Water Level in Reservoir (cm)	Water Level Change (cm)	Infiltration (cm/min)
0.0	1.9	-	-
0.25	7.0	5.1	20.4
0.5	7.5	0.5	2.0
0.75	7.8	0.3	1.2
1.0	7.8	0.0	0.0
1.25	7.8	0.0	0.0
1.5	7.8	0.0	0.0
2.0	8.2	0.4	0.8
2.5	8.6	0.4	0.8
3.0	9.0	0.4	0.8
3.5	9.5	0.5	1.0
4.0	10.0	0.5	1.0
4.5	10.4	0.4	0.8
5.0	10.8	0.4	0.8
5.5	11.3	0.5	1.0
6.0	11.6	0.3	0.6
6.5	12.1	0.5	1.0
7.0	12.5	0.4	0.8
7.5	13.0	0.5	1.0
8.0	13.5	0.5	1.0
8.5	14.0	0.5	1.0
9.0	14.5	0.5	1.0

Soil Type 3 - SAND

Interpreted Rate of:

Water Level Change (R_1) =	1.7E-02	cm/s
Steady Intake Water Rate (Q_1) =	5.9E-01	cm^3/s
hole radius (a) =	3	cm
Water column height in hole (H_1) =	5	cm
Shape factor for H_1/a = (C_1) =	0.80	-
Soil Type Coefficient α^* =	0.12	cm^{-1}

Single Head Analysis

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

Field Saturated Hydraulic Conductivity (K_{fs})

K_{fs} = **1E-03** cm/s

🟩 =input data

DATE: 2020-11-24
PROJECT: 20360612

GOLDER

PREPARED BY: AGB
REVIEW: CMK

APPENDIX G

Water Balance Results

Table G-1
Meteorological Data

Buttonville A Water Budget Means for the period 1986-2017 6158409

Water Holding Capacity	125	mm
Heat Index	39.55	
Lower Zone	75	mm
A	1.122	
Date Range	1986	2017

Date	**Temperature**	**Precipitation**	**Rain**	**Melt**	**Potential Evapo-transpiration**	**Actual Evapo-transpiration**	**Deficit**	**Surplus**	**Snow**	**Soil**	**Accumulated Precipitation**
	(°C)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-5.8	60	26	19	2	2	0	38	27	124	272
February	-5.6	51	20	24	1	1	0	42	33	125	323
March	-0.4	55	36	49	10	10	0	75	4	125	378
April	6.7	75	71	7	34	34	0	45	0	124	453
May	13.4	80	80	0	80	80	0	15	0	110	534
June	18.7	90	90	0	116	116	0	8	0	76	622
July	21.3	82	82	0	136	118	-18	0	0	40	705
August	20.3	77	77	0	120	87	-33	4	0	27	777
September	16.0	83	83	0	80	68	-12	7	0	35	855
October	9.2	73	73	0	40	38	-2	7	0	63	73
November	3.2	74	68	5	13	13	0	20	0	103	148
December	-2.6	64	37	15	3	3	0	32	12	119	211
Average	7.8										
Total		864	743	119	635	570	-65	293			

Table G-1
Meteorological Data

Water Holding Capacity	250	mm
Heat Index	39.55	
Lower Zone	150	mm
A	1.122	
Date Range	1986	2017

Date	Temperature	Precipitation	Rain	Melt	Potential Evapo-transpiration	Actual Evapo-transpiration	Deficit	Surplus	Snow	Soil	Accumulated Precipitation
	(^{o}C)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-5.8	60	26	19	2	2	0	22	27	236	272
February	-5.6	51	20	24	1	1	0	34	33	244	323
March	-0.4	55	36	49	10	10	0	69	4	250	378
April	6.7	75	71	7	34	34	0	45	0	249	453
May	13.4	80	80	0	80	80	0	15	0	235	534
June	18.7	90	90	0	116	116	0	8	0	201	622
July	21.3	82	82	0	136	135	-2	0	0	148	705
August	20.3	77	77	0	120	109	-11	4	0	113	777
September	16.0	83	83	0	80	73	-7	7	0	116	855
October	9.2	73	73	0	40	38	-2	6	0	144	73
November	3.2	74	68	5	13	13	0	11	0	193	148
December	-2.6	64	37	15	3	3	0	26	12	216	211
Average	7.8										
Total		864	743	119	635	614	-22	247			

Entered by: MR
Checked by: MK

Table G-1
Meteorological Data

Water Holding Capacity	400	mm
Heat Index	39.55	
Lower Zone	240	mm
A	1.122	
Date Range	1986	2017

Date	**Temperature**	**Precipitation**	**Rain**	**Melt**	**Potential Evapo-transpiration**	**Actual Evapo-transpiration**	**Deficit**	**Surplus**	**Snow**	**Soil**	**Accumulated Precipitation**
	(°C)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-5.8	60	26	19	2	2	0	21	27	371	272
February	-5.6	51	20	24	1	1	0	28	33	385	323
March	-0.4	55	36	49	10	10	0	62	4	398	378
April	6.7	75	71	7	34	34	0	44	0	399	453
May	13.4	80	80	0	80	80	0	15	0	384	534
June	18.7	90	90	0	116	116	0	8	0	350	622
July	21.3	82	82	0	136	136	0	0	0	296	705
August	20.3	77	77	0	120	118	-2	3	0	252	777
September	16.0	83	83	0	80	77	-3	7	0	251	855
October	9.2	73	73	0	40	39	-1	6	0	279	73
November	3.2	74	68	5	13	13	0	10	0	328	148
December	-2.6	64	37	15	3	3	0	24	12	353	211
Average	7.8										
Total		864	743	119	635	629	-6	228			

Table G-2
Annual Infiltration Rates

PRE-DEVELOPMENT SCENARIO

Type	WHC	Type of Land Use	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Residential & Recreational Buildings	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Private Property - Residence	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Private Property - Driveways / Concrete Structures	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.00
Private Property - Lawns	125 mm	Urban Lawns	Silt Loam	0.1	0.3	0.1	0.50
Grassed - Lawns	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Asphalt Roads & Concrete Structures	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.00
Gravel Pathways	90% Precip	Gravel	Impervious	0.00	0.0	0.0	0.00
Mineral Meadow	250 mm	Pastures and Shrubs	Silt Loam	0.15	0.3	0.1	0.55
Thicket / Forest / Hedgerows / Plantations	400 mm	Mature Forest	Silt Loam	0.15	0.3	0.2	0.65
Mineral Marsh	Precip - PET	Pond	Silt Loam	0.0	0.0	0.0	0.00

POST-DEVELOPMENT SCENARIO

Type	WHC	Type of Material	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Residential Lawns	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Neighbourhood Park	125 mm	Urban Lawns	Silt Loam	0.20	0.3	0.1	0.60
Neighbourhood Park - Recreational Amenities / Walkways	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.00
Mineral Meadow	250 mm	Pastures and Shrubs	Silt Loam	0.15	0.3	0.1	0.55
Forest / Hedgerows	400 mm	Mature Forest	Silt Loam	0.15	0.3	0.2	0.65
Roads, Sidewalks, Parking & Paths	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Single Detached - Roofs	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.00
Single Detached - Driveways	90% Precip	Paved	Impervious	0.0	0.0	0.0	0.00
Mid / High Rise Residential	90% Precip	Buildings	Impervious	0.0	0.0	0.0	0.00
Mid / High Rise Residential - Lawns	125 mm	Urban Lawns	Silt Loam	0.1	0.3	0.1	0.50
Private Property - School	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.00
Private Property - Driveways / Concrete Structures	90% Precip	Paved / Structure	Impervious	0.0	0.0	0.0	0.00
Private Property - Lawns	125 mm	Urban Lawns	Silt Loam	0.1	0.3	0.1	0.50

Entered by: MR
Checked by: MK

Table G-2
Annual Infiltration Rates

POST-DEVELOPMENT MITIGATION SCENARIO

Type	WHC	Type of Material	Soil Type	Infiltration Factor (%)			
				Topo	Soils	Cover	Total
Residential Lawns	125 mm	Urban Lawns	Silt Loam	0.15	0.3	0.1	0.55
Neighbourhood Park - Lawn	125 mm	Urban Lawns	Silt Loam	0.20	0.3	0.1	0.60
Neighbourhood Park - Recreational Amenities / Walkways	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.00
Mineral Meadow	250 mm	Pastures and Shrubs	Silt Loam	0.15	0.3	0.1	0.55
Forest / Hedgerows	400 mm	Mature Forest	Silt Loam	0.15	0.3	0.2	0.65
Roads, Sidewalks, Parking & Paths	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.00
Single Detached - Roofs	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.00
Single Detached - Roofs (to Catchbasin Filtration Trench)	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.00
Single Detached - Driveways / Roadways (to Catchbasin Filtration Trench)	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.00
Single Detached - Roofs (to Rear Yard Infiltration Trench)	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.80
Single Detached - Roofs (to Catchbasin Infiltration Trench - 9.2 mm)	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.57
Single Detached - Driveways / Roads (to Catchbasin Infiltration Trench - 9.2 mm)	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.57
Roadways (to Catchbasin Infiltration Trench- 27.3 mm)	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.81
Single Detached - Roofs (to Bioswale - 29.2 mm)	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.81
Single Detached - Driveways / Laneway (to Bioswale - 29.2 mm)	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.81
Roadways (to Bioswale - 33.3 mm)	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.82
Roadways (to Bioswale - 26.7 mm)	90% Precip	Paved	Impervious	0.00	0.0	0.0	0.81
Mid / High Rise Residential	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.00
Mid / High Rise Residential - Lawns	125 mm	Urban Lawns	Silt Loam	0.10	0.3	0.1	0.50
Private Property - School	90% Precip	Buildings	Impervious	0.00	0.0	0.0	0.00
Private Property - Driveways / Concrete Structures	90% Precip	Paved / Structure	Impervious	0.00	0.0	0.0	0.00
Private Property - Lawns	125 mm	Urban Lawns	Silt Loam	0.1	0.3	0.1	0.50

Notes:
WHC - Water Holding Capacity
The infiltration factor is estimated by summing a factor for topography, soils and cover

Table G-3
Summary of Results

Table 1: Pre-development Scenario Water Balance Results

Catchment	Area (m^2)	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
		(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential & Recreational Buildings	4,560	(864) 3,940	(86) 395	(778) 3,545	(0) 0	(778) 3,545
Private Property - Residence	1,168	(864) 1,010	(86) 100	(778) 910	(0) 0	(778) 910
Private Property - Driveways / Concrete Structures	5,158	(864) 4,455	(86) 445	(778) 4,010	(0) 0	(778) 4,010
Private Property - Lawns	28,669	(864) 24,770	(570) 16,340	(293) 8,400	(147) 4,200	(147) 4,200
Grassed - Lawns	23,362	(864) 20,185	(570) 13,315	(293) 6,845	(161) 3,765	(132) 3,080
Asphalt Roads & Concrete Structures	9,756	(864) 8,430	(86) 845	(778) 7,585	(0) 0	(778) 7,585
Gravel Pathways	1,074	(864) 925	(86) 95	(778) 835	(0) 0	(778) 835
Mineral Meadow	41,415	(864) 35,785	(614) 25,430	(247) 10,230	(136) 5,625	(111) 4,605
Thicket / Forest / Hedgerows / Plantations	23,761	(864) 20,530	(629) 14,945	(228) 5,420	(148) 3,520	(80) 1,900
Mineral Marsh	2,078	(864) 1,795	(635) 1,320	(229) 475	(0) 0	(229) 475
Total	**141,000**	**121,825**	**73,230**	**48,255**	**17,110**	**31,145**

Table 2: Proposed Development Scenario Water Balance Results - Without Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	24,649	(864) 21,300	(570) 14,050	(293) 7,220	(161) 3,970	(132) 3,250
Neighbourhood Park	2,415	(864) 2,085	(570) 1,375	(293) 710	(176) 425	(117) 285
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,185	(778) 10,640	(0) 0	(778) 10,640
Mineral Meadow	1,338	(864) 1,155	(614) 820	(247) 330	(136) 180	(111) 150
Forest / Hedgerows	6,567	(864) 5,675	(629) 4,130	(228) 1,500	(148) 975	(80) 525
Single Detached - Roofs	21,827	(864) 18,860	(86) 1,890	(778) 16,970	(0) 0	(778) 16,970
Single Detached - Driveways	7,242	(864) 6,255	(86) 625	(778) 5,630	(0) 0	(778) 5,630
Mid / High Rise Residential	6,960	(864) 6,015	(86) 600	(778) 5,410	(0) 0	(778) 5,410
Mid / High Rise Residential - Lawns	1,740	(864) 1,505	(570) 995	(293) 510	(147) 255	(147) 255
Private Property - School	1,168	(864) 1,010	(86) 100	(778) 910	(0) 0	(778) 910
Private Property - Driveways / Concrete Structures	5,158	(864) 4,455	(86) 445	(778) 4,010	(0) 0	(778) 4,010
Private Property - Lawns	28,669	(864) 24,770	(570) 16,340	(293) 8,400	(147) 4,200	(147) 4,200
Roads, Sidewalks, Parking & Paths	19,582	(864) 16,920	(86) 1,690	(778) 15,225	(0) 0	(778) 15,225
Total	**141,000**	**121,830**	**44,245**	**77,465**	**10,005**	**67,460**

Table G-3
Summary of Results

Table 3: Proposed Development Scenario Water Balance Results - With Mitigation

Catchment	Area	Precipitation	Evapo-transpiration	Surplus	Infiltration	Runoff
	(m^2)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)	(mm/yr) (m^3/yr)
Residential Lawns	24,649	(864) 21,295	(570) 14,050	(293) 7,220	(161) 3,970	(132) 3,250
Neighbourhood Park - Lawn	2,415	(864) 2,085	(570) 1,375	(293) 710	(176) 425	(117) 285
Neighbourhood Park - Recreational Amenities / Walkways	13,685	(864) 11,825	(86) 1,185	(778) 10,640	(0) 0	(778) 10,640
Mineral Meadow	1,338	(864) 1,155	(614) 820	(247) 330	(136) 180	(111) 150
Forest / Hedgerows	6,567	(864) 5,675	(629) 4,130	(228) 1,495	(148) 975	(80) 520
Single Detached - Roofs	1,376	(864) 1,190	(86) 120	(778) 1,070	(0) 0	(778) 1,070
Single Detached - Roofs (to Catchbasin Filtration Trench)	11,163	(864) 9,645	(86) 965	(778) 8,680	(0) 0	(778) 8,680
Single Detached - Driveways / Roadways (to Catchbasin Filtration Trench)	14,391	(864) 12,435	(86) 1,245	(778) 11,190	(0) 0	(778) 11,190
Single Detached - Roofs (to Rear Yard Infiltration Trench)	5,656	(864) 4,885	(86) 490	(778) 4,400	(622) 3,520	(156) 880
Single Detached - Roofs (to Catchbasin Infiltration Trench - 9.2 mm)	2,547	(864) 2,200	(86) 220	(778) 1,980	(443) 1,130	(334) 850
Single Detached - Driveways / Roads (to Catchbasin Infiltration Trench - 9.2 mm)	5,138	(864) 4,440	(86) 445	(778) 3,995	(443) 2,275	(334) 1,720
Roadways (to Catchbasin Infiltration Trench- 27.3 mm)	1,060	(864) 915	(86) 90	(778) 825	(630) 670	(148) 155
Single Detached - Roofs (to Bioswale - 29.2 mm)	1,084	(864) 940	(86) 95	(778) 845	(630) 680	(148) 165
Single Detached - Driveways / Laneway (to Bioswale - 29.2 mm)	2,123	(864) 1,835	(86) 180	(778) 1,650	(630) 1,335	(148) 315
Roadways (to Bioswale - 33.3 mm)	1,060	(864) 915	(86) 90	(778) 825	(638) 675	(140) 150
Roadways (to Bioswale - 26.7 mm)	552	(864) 475	(86) 50	(778) 430	(630) 350	(148) 80
Mid / High Rise Residential	6,960	(864) 6,015	(86) 600	(778) 5,410	(0) 0	(778) 5,410
Mid / High Rise Residential - Lawns	1,740	(864) 1,505	(570) 995	(293) 510	(147) 255	(147) 255
Private Property - School	1,168	(864) 1,010	(86) 100	(778) 910	(0) 0	(778) 910
Private Property - Driveways / Concrete Structures	5,158	(864) 4,455	(86) 445	(778) 4,010	(0) 0	(778) 4,010
Private Property - Lawns	28,669	(864) 24,770	(570) 16,340	(293) 8,400	(147) 4,200	(147) 4,200
Roads, Sidewalks, Parking & Paths	2,500	(864) 2,160	(86) 215	(778) 1,945	(0) 0	(778) 1,945
Total	**141,000**	**121,825**	**44,245**	**77,470**	**20,640**	**56,830**

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