



# 2-G

**REGION OF PEEL**  
WASTEWATER CAPACITY IMPROVEMENTS IN CENTRAL MISSISSAUGA  
APPENDIX 2-G

## **Geotechnical Report**

## Manhole (MH) Numbering

The Geotechnical Report was completed prior to finalizing the preferred design drawings. **Table 1** provides a summary of the changes in manhole numbering.

**Table 2: Manhole Number Updates**

Alignment	Intersection	Previous Proposed MH No. (Geotechnical Report)	Final MH No. (Vol 3, App E – Preliminary Design Drawings)
<b>Etobicoke Creek</b>	Sherway Drive	MH1A	MH1
<b>Queensway East</b>	Etobicoke Creek	MH2A, MH2B	MH2A, MH2B
<b>Queensway East</b>	Dixie Road	MH3A, MH3B	MH3A, MH3B
<b>Queensway East</b>	Cawthra Road	MH5A	MH4
<b>Queensway East</b>	Tedlo Street	MH6A, MH6B, MH6C, MH6D	MH5A, MH5B, MH5C, MH5D
<b>Queensway East</b>	Hensall Street	MH7A, MH7B, MH7C, MH7D	MH6A, MH6B, MH6C, MH6D
<b>Queensway East</b>	Cliff Road	MH8A, MH8B, MH8C	MH7A, MH7B, MH7C
<b>Queensway East</b>	Cooksville Creek	MH10A, MH1, MH2, MH3, MH4	MH8A, MH8B, MH8C, MH8D, MH8E
<b>Queensway East</b>	Hurontario Street	No proposed MHs	No proposed MHs
<b>Cawthra Road</b>	Dundas Street East	MH11A	MH10
<b>Burnhamthorpe Road</b>	Cawthra Road	MH12A	MH11
<b>Burnhamthorpe Road</b>	Central Parkway	MH12	MH12



**REPORT**

# Geotechnical Desktop Review Report

*Municipal Class Environmental Assessment, Capacity of Expansion of the Central Mississauga Wastewater System, Region of Peel Project No. 19-2590*

Submitted to:

**Chris Campbell, MTP, MCIP, RPP, MRTPI**

GM BluePlan Engineering Limited

Submitted by:

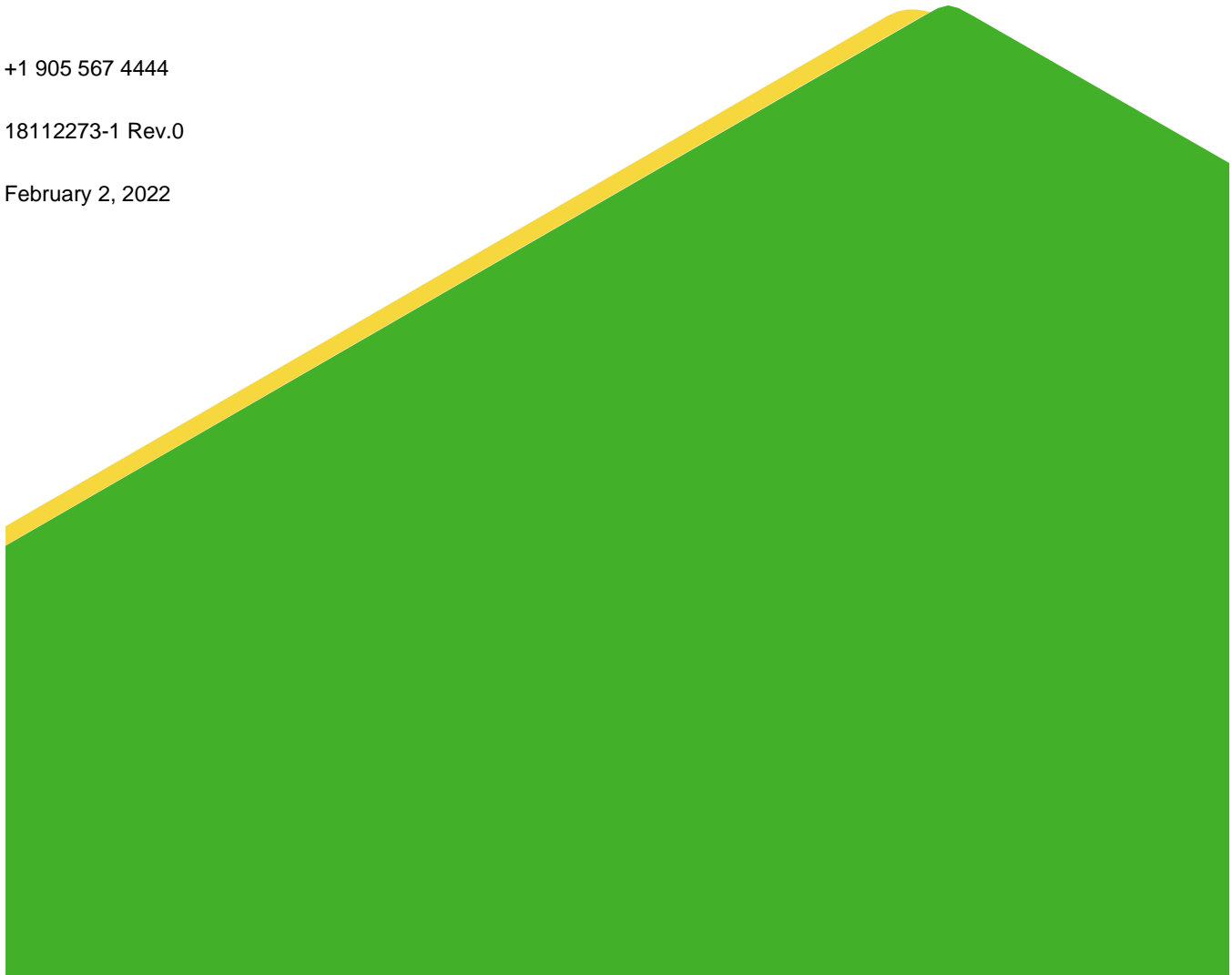
**Golder Associates Ltd.**

6925 Century Avenue, Suite #100, Mississauga, Ontario, L5N 7K2, Canada

+1 905 567 4444

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## Distribution List

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## 1.0 INTRODUCTION

Golder Associates Ltd. (Golder) has been retained by GM BluePlan on behalf of the Region of Peel (the Region) to carry out a geotechnical desktop study for the proposed trunk sanitary sewer and ancillary local sewer upgrades as part of the capacity expansion of the Central Mississauga Wastewater System (the Project), Region of Peel Project No. 19-2590, in the City of Mississauga, Ontario.

The Region has forecasted growth to 2041 and beyond and has identified a need to enhance the conveyance capacity of key trunk sewers, particularly those servicing urban growth centres, like the Mississauga City Centre (MCC). The MCC, with an area of approximately 246 hectares, is estimated to grow to 112,000 people and jobs by 2041, representing a growth of almost 58,000 people and jobs. The move to intensified development combined with the rise in increasingly intense wet weather events support the need to enhance the overall capacity of the sanitary sewer system in central Mississauga. The Project will address the increased demand from the Mississauga City Centre (MCC).

The purpose of this report is to present the results of the desktop study carried out in the study area of the proposed capacity expansion. This report was prepared for the exclusive use of GM BluePlan/The Region and is intended to be used for planning and early-stage design purposes as well as recommendations for aspects of future geotechnical investigations only. Any use that a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of the third party. The report is based solely on the review of historical and publicly available information and data obtained by Golder and/or provided by GM BluePlan/The Region as described in this report. Additional explorations of subsurface conditions will need to be carried out to better define the local geologic stratigraphy, groundwater levels, and the engineering properties of the subsurface materials for any further design activities.

The investigation data, preliminary 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. In addition, this report should be read in conjunction with the “Important Information and Limitations of This Report” contained in Appendix A of this report. 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 SITE AND PROJECT DESCRIPTION

The study area for the proposed capacity expansion is bounded by Etobicoke Creek to the east, Confederation Parkway to the west, Highway 403 to the north, and Queen Elizabeth Way (QEW) to the south, as shown on Figure 1. It is understood that the proposed trunk sewer will divert flow eastward from the existing Sanitary Trunk Sewer at Hurontario Street to the East Sanitary Trunk Sewer near Etobicoke Creek. The diversion sewer will have the potential to convey flow from several sewersheds, including Cooksville Creek, Cawthra, Little Etobicoke Creek, Dundas and Erindale.

Based on the Design Drawings issued for 100% review dated and provided to Golder by GM BluePlan October 2021, the following upgrades to the wastewater system are proposed:

- 1500 mm diameter sanitary sewer along Burnhamthorpe Road East between Central Parkway East and Cawthra Road (approximately 1005 m long);

- 1500 mm diameter sanitary sewer along Cawthra Road from Dundas Street E to the Queensway East (approximately 1021 m long);
- 1500 mm diameter sanitary sewer along the Queensway East from Hurontario Street to Cawthra Road (approximately 2114 m long), including a 328 m long trenchless crossing beneath Cooksville Creek;
- 1800 mm diameter sanitary sewer along the Queensway East from Cawthra Road to Etobicoke Creek (approximately 2948 m long); and
- 1800 mm diameter sanitary sewer along Etobicoke Creek within the Toronto and Region Conservation Authority (TRCA) regulated area from the Queensway East to Sherway Drive (approximately 402 m long), including a 75 m open cut crossing beneath Etobicoke Creek;

The proposed sanitary sewers are proposed to be installed by trenchless methods, except connections to local sewers, Cooksville Creek Trunk Sewer and beneath Etobicoke Creek, using construction / connection shafts that will be advanced at 15 of the 25 new manhole locations, as well as around existing Manholes MH6567075, MH2A and MH1786108. The proposed shafts range in depth from 6.5 m to 21.9 m below ground surface and are approximately 10 m in diameter. Based on the Design Drawings, the following manholes and shafts are proposed:

**Table 1: Summary of Proposed Manhole and Shaft Locations**

Sewer Location	Proposed Manhole I.D.	Proposed Shaft Type / Diameter	Station / Closest Intersection	Ground Surface Elevation (m) <sup>1</sup>	Invert Elevation (m)	Depth (m)
Burnhamthorpe Road East	MH12	Construction / 10 m	STA 2+170 / Central Parkway E	137.8	122.1	15.7
	MH12A <sup>2</sup>	Construction / 8.5 m <sup>3</sup>	STA 3+180 / Cawthra Rd.	143.5	120.7	22.8
Cawthra Road	MH11A	Construction / 10 m	STA 1+150 / Dundas St. E	123.6	106.7	16.9
	EX SAN MH2A	Connection / 10 m	STA 1+157 / Dundas St. E	124.1	117.5	6.6
	MH5A <sup>3</sup>	Construction / 10 m	STA 0+150 / Queensway E	110.0	94.2	15.8

Sewer Location	Proposed Manhole I.D.	Proposed Shaft Type / Diameter	Station / Closest Intersection	Ground Surface Elevation (m) <sup>1</sup>	Invert Elevation (m)	Depth (m)
Queensway East	EX SAN MH6567075 <sup>4</sup>	Connection / 10 m	STA 5+020 / Hurontario St.	105.9	96.2	9.7
	MH1	Connection / 10 m	STA 5+020 / Cooksville Creek	105.3	95.9	9.4
	MH2	Connection / 10 m	STA 5+329 / Cooksville Creek	105.3	95.9	9.4
	MH10A	Construction / 10 m	STA 5+333 / Cooksville Creek	105.3	95.9	9.4
	MH8A/8B	Construction / 10 m	STA 5+967 / Cliff St.	107.3	85.2	22.1
	MH8C	Connection / 10 m	STA 6+033 / Cliff St.	107.2	95.2	12
	MH7D	Connection / 10 m	STA 6+320 / Hensall St.	105.9	94.9	11
	MH7A/7B	Construction / 10 m	STA 6+418 / Hensall St.	106.2	94.8	11.4
	MH7C	Connection / 10 m	STA 6+453 / Hensall St.	106.3	94.8	11.5
	MH6A/6B	Construction / 10 m	STA 6+613 / Tedlo St.	107.7	94.7	13
	MH6C	Connection / 10 m	STA 6+658 / Tedlo St.	108.2	94.7	13.5
	MH6D	Connection / 10 m	STA 6+707 / Tedlo St.	108.7	94.7	14
	MH5A <sup>5</sup>	Construction / 10 m	STA 7+130 / Cawthra Rd.	108.9	94.1	13.2
	MH3A	Construction / 10 m	STA 9+207 / Dixie Rd.	112.0	92.1	19.9

Sewer Location	Proposed Manhole I.D.	Proposed Shaft Type / Diameter	Station / Closest Intersection	Ground Surface Elevation (m) <sup>1</sup>	Invert Elevation (m)	Depth (m)
	MH3B	Connection / 10 m	STA 9+158 / Dixie Rd.	111.7	92.1	19.6
	MH2A	Construction / 10 m	STA 10+066 / Etobicoke Creek	112.6	91.2	21.4
Etobicoke Creek (TRCA Regulated Area)	MH2B	Construction / 10 m	STA 1+475 / Queensway E	113.0	91.2	21.8
	Connection Shaft	Connection / 10 m	STA 1+160 / Sherway Dr.	97.5	90.7	6.8
	EX SAN MH 1786108	Connection / 10 m	STA 1+100 / Sherway Dr.	97.3	90.7	6.6
	MH1A	Connection / 10 m	STA 1+085 / Sherway Dr.	97.2	90.6	6.6
<b>Total (Proposed / Existing)</b>	<b>25 (22 / 3)</b>	<b>25 (22 / 3)</b>				

## Notes:

- Ground surface and invert elevations on drawings and shown in this table are from the design drawings issued for 100% review, and are assumed to be referenced to the Region of Peel Geodetic Datum (i.e. CGVD28:78).
- Proposed Manhole MH12A to be constructed inside an existing 8.5 m inside diameter construction shaft.
- Manhole MH5A connects the proposed 1500 mm diameter Cawthra Road sewer to the Queensway East sewer. The Queensway East sewer increases in diameter from 1500 mm to 1800 mm at Manhole MH5A.
- Existing MH6567075 will connect the proposed Queensway East sewer to an existing 1350 mm sanitary sewer located west of Hurontario Street.
- Manhole MH5A connects the proposed 1500 mm diameter Cawthra Road sewer to the Queensway East sewer. The Queensway East sewer increases in diameter from 1500 mm to 1800 mm at Manhole MH5A.

As shown in the table above and on the design drawings, the proposed sanitary sewers dip slightly from west to east along Burnhamthorpe Road East and the Queensway East (0.10% grade), from north to south along Cawthra Road and Etobicoke Creek (1.25% grade and 0.10% grade, respectively), with sewer inverts ranging in depth from,

- 15.8 m to 21.9 m along Burnhamthorpe Road from Central Parkway East to Cawthra Road (Elev. 122.3 m to Elev. 120.9 m);
- 21.0 m to 15.8 m along Cawthra Road from Dundas Street East to the Queensway East (Elev. 107.0 m to Elev. 94.2 m);
- 9.5 m to 8.1 m along Queensway East from Hurontario Street to Cooksville Creek (Elev. 96.5 m to Elev. 95.9 m), and from 8.1 m to 21.8 m from Cooksville Creek to Etobicoke Creek (Elev. 95.9 m to Elev. 91.2 m); and

- 21.8 m to 6.5 m along Etobicoke Creek from Queensway East to Sherway Drive (Elev. 91.2 m to Elev. 90.8 m).

The existing ground surface above the proposed alignments dips slightly from east to west along Burnhamthorpe Road East and the Queensway East, and more steeply from north to south along Cawthra Road and Etobicoke Creek, with local variations around Cooksville Creek and Etobicoke Creek. The approximate ground surface elevations range from about,

- Elev. 138 m to 144 m along Burnhamthorpe Road from Central Parkway East to Cawthra Road;
- Elev. 110 m to 124 m along Cawthra Road from Dundas Street East to the Queensway East;
- Elev. 105 m to 112 m along Queensway East from Hurontario Street to Etobicoke Creek. The local valley at Cooksville Creek ranges from Elev. 106 m to 100 m between Station 5+050 to 5+400; and
- Elev. 112 m to 97 m along Etobicoke Creek from Queensway East to Sherway Drive. Where the proposed alignment along Etobicoke Creek crosses the creek at about Station 1+120, the bottom of the riverbed is at about Elev. 94.5 m.

### 3.0 AVAILABLE INFORMATION

Existing borehole information within the study area was collected from previous geotechnical investigations carried out by Golder and the York Peel Durham Toronto database provided by the Region of Peel. Relevant borehole data was sourced from reports by Golder, WSP, SPL Consultants Limited, and Terraprobe Limited, which are listed below. Relevant borehole logs from these reports are shown on Figures 4 to 21 and are contained in Appendix B.

- WSP Global Inc., report titled “Geotechnical Data Report – Cawthra Road Sanitary Sewer and Watermain Replacement – Phase 2, Mississauga, ON”, dated November 2018.
- WSP Global Inc., report titled “Geotechnical Investigation Data Report – Cawthra Road Sanitary Sewer and Watermain Project – Phase 1, Mississauga, ON”, dated November 2017.
- SPL Consultants Limited, report titled "Geotechnical Investigation, Water Main Replacement, Abruz Boulevard and Area, Mississauga, Ontario, Contract No. 13-1345G, prepared for Region of Peel", dated April 2013.
- Terraprobe Limited, report titled “Geotechnical Investigation & Design Report, Region of Peel Watermain Replacement, ISF Assignment B, Contract 3, City of Mississauga, Project 09-1346S”, dated November 2009.
- Golder Associates Ltd., “Subsurface Investigation Etobicoke Creek Bridge (Queensway Extension), Country of Peel – Borough of Etobicoke”, dated March 1969. Project 69003.

In addition, the Ministry of Environment Water Well Information (MECP) was reviewed and the locations of the water well information are shown on Figures 4 to 21. In reviewing the available historical data, Golder has relied in good faith on information obtained by others as referenced above. We assume the information is factual and accurate and accept no responsibility for any deficiency, misstatements or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of others.



More detail about the available borehole information along each proposed sewer alignment is provided below. A summary of the relevant borehole information used to provide the summary of anticipated subsurface conditions is provided in Table B1 of Appendix B.

### 3.1 Burnhamthorpe Road East

As shown on Figure 4, a well record for Well No. 7151600 indicates that a borehole was advanced approximately 20 m south of the Burnhamthorpe Road East intersection on Central Parkway East to about 16 m below ground surface (Elev. 122 m). No relevant borehole information was reviewed along Burnhamthorpe Road East between Central Parkway East and Wilcox Road. As shown on Figure 6, four boreholes, designated as Boreholes BH2 16, BH2-15, and BH2-51, and BA-MW26-15 from the WSP, 2018 investigation were advanced along Burnhamthorpe Road East between Wilcox Road and Cawthra Road. Boreholes BH2-51 and BA-MW26-15 were advanced in the vicinity of proposed construction shaft MH11A.

### 3.2 Cawthra Road

As shown on Figures 7, 8 and 9, eight well records show that eight boreholes with relevant borehole information were advanced along Cawthra road between the Queensway East and Dundas Street East. The well records are designated as Well No. 7141979, 4909407, 7161951, 7224923, 7116747, 7219360, 7219359 and 4902250. The boreholes were advanced up to about 75 m from the proposed tunnel alignment, and to generally between 4.6 m and 5.6 m below ground surface (Elev. 106.5 m to 118.0 m), except for Well No. 4902250 which was advanced about 16.5 m below ground surface (Elev. 107.9 m). No relevant borehole information was review along Cawthra Road between Coxwell Street and Needham Lane. As shown on Figure 9, two boreholes from the WSP, 2018 report, designated as Boreholes BH17-36 and BH17-2, were advanced along Cawthra Road north of Dundas Street East. Borehole BH17-36 was advanced in the vicinity of proposed construction shaft MH10A.

### 3.3 Queensway East

As shown on Figures 10 to 20, the following information is available along the proposed sewer alignment on Queensway East;

- well records at Hurontario Street, Cawthra Road, and between Stanfield Road and Greenhurst Avenue;
- two boreholes from the Terraprobe, 2009 investigation, designated as Boreholes CN11 and CN12 advanced at the Cliff Road and Queensway intersection;
- four boreholes from the SPL, 2013 investigation, designated as Boreholes BH13-4, BH13-5, BH13-6 and BH13-7, advanced along Adena Court and Abruz Boulevard about 100 m north of the proposed sewer alignment; and
- two boreholes from the Golder, 1969 investigation, designated as Boreholes BH-7 and BH-8, advanced at Etobicoke Creek.

No relevant borehole information was reviewed along the Queensway East between station 5+400 to Cliff Road, Camilla Road to Cawthra Road and Cawthra Road to Stanfield Road.

### 3.4 Etobicoke Creek

As shown on Figure 21, two boreholes from the Golder, 1969 investigation, designated as Boreholes BH-7 and BH 8, were advanced at Etobicoke Creek in the vicinity of proposed construction shaft MH2A.

The borehole information along the Etobicoke Creek is limited. There are clusters of historical boreholes at the Queensway and the QEW crossing over the Etobicoke Creek. Along the Etobicoke Creek and to the west of the Etobicoke Creek, subsurface information is available from three test pits excavated on the ridge to the west of the Etobicoke Creek, as shown on Figure 21. The Etobicoke Creek has meandered westerly over the years, and as such, the historic boreholes may not represent the current shallow subsurface conditions.

The available subsurface information suggests the presence of about 1 m to 3 m of overburden soils over bedrock. The bedrock is expected to be the shale bedrock with interbeds of limestone/siltstone of the Georgian Bay Formation. It is also expected that the top few metres of shale bedrock be highly weathered.

## 4.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

### 4.1 Regional geology

The study area is located between Lake Ontario and the Oak Ridges Moraine within the South Slope and Iroquois Plain physiographic regions, as delineated in *The Physiography of Southern Ontario*<sup>1</sup>. Within the study area, the border between the two physiographic regions lies between Bloor Street and Dundas Street with the South Slope and Iroquois Plain regions located on the north and south sides, respectively (see *Physiographic Regions* Figure 2). As such, the proposed sewer along Burnhamthorpe Road East is within the South Slope region, whereas all other proposed sewers are within the Iroquois Plain region.

These regions have been subjected to extensive glaciations during the last 200,000 years. At least two periods of continental glaciation are known to have occurred within this period of time which were interrupted by warmer climate interglacial periods. The glaciers from the most recent glacial period (Wisconsin Glaciation) withdrew from the area approximately 8,000 years to 10,000 years ago.<sup>2</sup>

The South Slope region is the southern slope of the Oak Ridges Moraine and extends from the Niagara Escarpment to the Trent River. It is a smooth and drumlinized till plain that has been formed as a result of glacial action and deposition of till materials. Rivers within the region have cut through the overburden into the underlying shale creating steep shale bedrock valley walls. The bedrock valleys are filled with relatively recent fluvial sediments. The till plain in the South Slope region is predominantly comprised of the Halton Till, which is an interbedded deposit of cohesive and non-cohesive soils.

The Iroquois Plain region extends along the western part of Lake Ontario from the Niagara River to the Trent River and is a complex mix of till plains, drumlins and areas of glaciolacustrine sediments deposited by Lake Iroquois during the last glacial recession.

Within the study area, the overburden of the South Slope and Iroquois Plain physiographic regions overlies grey shale of the Georgian Bay Formation and reddish shale of the Queenston Formation, which are known to have medium strong to very strong interlayers of limestone, siltstone and dolostone. The oldest unit is the Georgian Bay Formation which is characterized by blue-grey shale interbedded with medium strong to very strong interbeds. Upward and northward interbeds of pale grey to cream, fossiliferous limestone and dolostone become more

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<sup>1</sup> Chapman, L. J. and Putnam, D. F., 1984. *The Physiography of Southern Ontario*; Ontario Geological Society, Special Volume 2, Third Edition. Accompanied by Map p. 2715, Scale 1:600,000.

<sup>2</sup> Eyles, N. and Miall, A. 2007. *Canada Rocks: The Geologic Journey*. Markham, ON: Fitzhenry and Whiteside Limited.

predominant. The Queenston Formation consists of brownish red to maroon, slightly calcareous to non-calcareous, sparsely fossiliferous and locally gypsiferous shale, interbedded with grey-green shale, bioclastic limestone and calcareous siltstone.<sup>3</sup>

## 4.2 Regional Hydrogeology

Precipitation contributes to recharge of the overburden and bedrock aquifer systems, although the low permeability of the soils and concrete/asphalt cover at this site limits infiltration rates. Groundwater recharge is estimated to be less than 100 mm/year at this site.<sup>4</sup> Regional groundwater flow direction is primarily from headwater areas to north of Brampton toward Lake Ontario although more variable flow directions may occur within the shallow overburden where local groundwater flow directions are influenced by small watercourses and anthropogenic features.

Mary Fix Creek and Kenollie Creek, tributaries of the Credit River, Cooksville Creek, Etobicoke Creek, and its tributary Little Etobicoke Creek, flow in a southerly direction to Lake Ontario within the study area.

## 4.3 Land Use

Prior to the mid-1900s, land of the South Slope and Iroquois Plain physiographic regions was used for various agricultural purposes starting with mixed, subsistence farming during the early settlements, to grain crops in the mid-1850s, to commercial mixed farming including beef, hog and dairy cattle livestock. Most of the gravel deposits have been excavated for construction<sup>1</sup>.

Today the South Slope and Iroquois Plain regions within our study area have become part of the Greater Toronto Area metropolis. The majority of the land use is residential with some commercial and industrial areas located at Burnhamthorpe Road and Hurontario Street, along Hurontario Street, and along the railway tracks between Dundas Street and the Queensway.

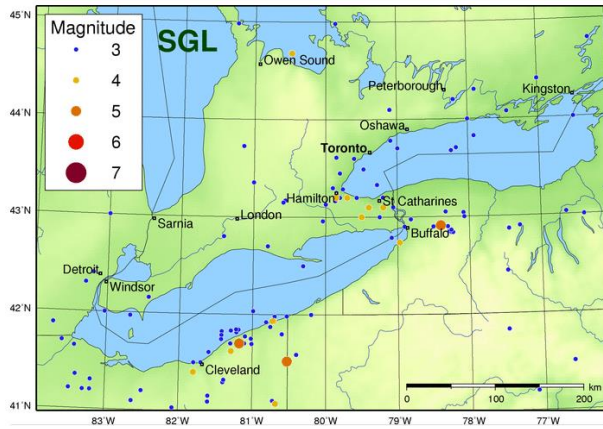
## 4.4 Seismicity

The study area falls within the Southern Great Lakes Seismic Zone (SGLSZ) according to the Geological Survey of Canada. The SGLSZ encloses the region of Lake Erie and Lake Ontario and constitutes a zone of low to moderate seismic activity when compared to the more active seismic zones to the east, along the Ottawa River and Quebec. Over the past 30 years on average two to three earthquakes with a magnitude of 2.5 or larger have been recorded in the SGLSZ. During the last 250 years three magnitude 5 earthquakes occurred in the SGLSZ, south of Lake Erie that were felt in southern Ontario but caused no reportable damage in Ontario.

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<sup>3</sup> Thurston, P.C. 1991. Geology of Ontario; Ministry of Northern Development and Mines, Ontario Geological Survey.

<sup>4</sup> Toronto and Region Conservation Authority, 2006. Turning Over a New Leaf: The Etobicoke and Mimico Creeks Watersheds Report Card.



**Southern Great Lakes Seismic Zone<sup>5</sup>**

### 4.5 Anticipated Subsurface Soil, Bedrock and Groundwater Conditions

Subsurface information within the study area is limited. Upon review of the available subsurface information, 14 borehole logs from previous geotechnical reports and 29 well records from the MECP were considered relevant borehole information, as shown in Table B1 of Appendix B, when summarizing the overburden conditions. As previously mentioned, in reviewing the available historical data Golder has relied in good faith on information obtained by others as referenced above. We assume the information is factual and accurate and accept no responsibility for any deficiency, misstatements or inaccuracies contained in this report as a result of omissions or misinterpretations of others.

The northings, eastings and elevations used in this report and shown in Table B1 are approximate and are based on coordinates and elevations and/or borehole locations plans reported by others. The coordinates were not always surveyed, nor were the reference systems / datums reported. Surveyed coordinates and elevations were provided on borehole records from the WSP, 2017 and WSP 2018 reports and are referenced to the UTM NAD83, Zone 17N system and a geodetic datum. Coordinates and elevations were provided on borehole records from the Terraprobe, 2009 report and are referenced to the UTM NAD83, Zone 17N system and a geodetic datum, but it is unknown whether they were surveyed. Elevations were provided on the borehole records from the SPL, 2013 report and are referenced to a geodetic datum, but it is unknown whether they were surveyed. Surveyed elevations were provided on the borehole records from the Golder, 1969 report and are referenced to the Township of Toronto Datum from 1969. Where coordinates were missing from borehole records (i.e. SPL, 2013 and Golder, 1969 reports) coordinates were assumed based off the borehole locations plans. The coordinates of the MECP well records are referenced to the UTM NAD83, Zone 17N system and were provided by MECP. The assumed elevations for the well records are sourced from a model, DEM - GTA Ortho DEM 2002 (2m DEM), based off the coordinates provided by MECP.

The SPT 'N'-values summarized below are what was measured during borehole advancement and have not been corrected.

<sup>5</sup> [www.earthquakescanada.gc.ca/zones/eastcan-en.php#SGLSZ](http://www.earthquakescanada.gc.ca/zones/eastcan-en.php#SGLSZ)

These boreholes are shown in plan and profile on Figures 4 to 21 (see attached). The following sections provide a summary of limited subsurface information available along the proposed alignments on Burnhamthorpe Road East, Cawthra Road, Queensway East, and Etobicoke Creek.

The stratigraphic boundaries shown on the borehole records are inferred from observations of drilling progress and non-continuous sampling and, therefore, represent transitions between soil types rather than exact planes of geological change. In general, the borehole information along the proposed alignments and at the shaft locations is limited. Further, consideration should be given to the offsets between the borehole locations and the profile line (up to about 150 m). The subsoil conditions should be expected to vary between and beyond the borehole locations and between the borehole locations and the profile shown on Figures 4 to 21.

### 4.5.1 General Soil Conditions

The overburden thickness within the study area is generally less than 10 m, however, there are localized areas where the overburden is thicker (i.e., between 10 m and 20 m thick), as shown on Figure 4.

Generally, the overburden soils consist of a surficial layer of topsoil or asphalt underlain by cohesive and non-cohesive fill soils. The fill soils are underlain by loose to very dense silt to sand deposits. The non-cohesive deposits are underlain, or in some places interlayered, by very dense non-cohesive to hard cohesive glacial till deposits. Cobbles and boulders should be expected within the glacial till deposits within the study area. Layers of gravel and silty clay were encountered in some boreholes.

In some areas, a heterogenous mixture consisting of a very dense non-cohesive till to hard cohesive till matrix containing broken bedrock fragments and slabs, locally known as the 'till/shale complex', was encountered between the till deposit and the bedrock surface. The 'till/shale complex' is glacially deposited.

#### 4.5.1.1 Burnhamthorpe Road East (South Slope Physiographic Region)

Well No. 7151600, advanced on Central Parkway East near Burnhamthorpe Road, encountered silty clay from ground surface to about 9.1 m below ground surface (Elev. 128.8 m), underlain by a 3.7 m thick layer of gravel from about 9.1 m to 12.8 m below ground surface (Elev. 125.2 m), further underlain by a 1.5 m thick layer of silty clay from about 12.8 m to 14.3 m below ground surface (Elev. 123.6 m). The well was terminated in a gravel layer beneath the lower silty clay layer after penetrating it for about 1.9 m from about 14.3 m to 16.2 m below ground surface (Elev. 121.8 m).

A summary of the conditions encountered in Boreholes BH2-16, BH2-15, and BH2-51, and BA-MW26-15 advanced along Burnhamthorpe Road East between Wilcox Road and Cawthra Road is provided below.

#### **Topsoil and Fill**

Surficial layers of topsoil about 80 mm to 150 mm thick were encountered in Boreholes BH2-16, BH2-51 and BA-MW26-15. Fill layers were encountered in Borehole BH2-15 at ground surface and Boreholes BH2-16, BH2-51 and BA-MW26-15 below the surficial layer of topsoil and extended to depths ranging between 1.7 m and 2.4 m below ground surface (Elev. 140.9 m and 141.8 m). The fill was described as silty sand to sand to gravelly sand to sand and gravel, and clayey silt to silty clay with trace gravel and trace organics.

SPT 'N'-values measured in the non-cohesive fill layers ranged from 4 blows to 15 blows to per 0.3 m of penetration, indicating a very loose to compact state of compactness. SPT 'N'-values measured in the cohesive fill layers range from 6 blows to 21 blows per 0.3 m of penetration, suggesting a firm to very stiff consistency.

The results of grain size distribution testing carried out on 2 samples of the non-cohesive fill and 1 sample of the cohesive fill are shown on borehole records for Boreholes BH2-15, BH2-16 and BH2-51 in Appendix B.

The results of Atterberg limits testing carried out on 2 samples of the cohesive fill are shown on borehole records for Boreholes BH2-16 and BH2-51 in Appendix B.

The unit weight measured on samples of sand and gravel fill and silty clay fill from Borehole BA-MW26-15 is 21.4 and 20.5 kN/m<sup>3</sup>, respectively.

### **Till Deposit**

A 0.6 m to 2.6 m thick till deposit consisting of sandy silty clay to silty sand soils containing trace to some gravel was encountered below the fill layers in Boreholes BH2-15, BH2-16, BH2-51 and BA-MW26-15 extending to about 4.6 m below ground surface (Elev. 138.7 m to 141.2 m). The till contains trace shale and limestone fragments in Borehole BH2-51 below a depth of about 3.0 m (Elev. 140.4 m).

An SPT 'N'-value measured in the non-cohesive till soil is 49 blows to per 0.3 m of penetration, indicating a very dense state of compactness. SPT 'N'-values measured in the cohesive till soils range from 14 blows to 34 blows per 0.3 m of penetration, with values of up to 91 blows per 0.15 m of penetration, suggesting a very stiff to hard consistency.

The results of grain size distribution testing carried out on 1 sample of the non-cohesive till and 5 samples of the cohesive till are shown on the borehole records in Appendix B.

The results of Atterberg limits testing carried out on 1 sample of the non-cohesive till and 5 samples of the cohesive till are shown on the borehole records in Appendix B.

The unit weight measured on a sample of silty clay till from Borehole BH2-16 is 22.2 kN/m<sup>3</sup>.

### **Till / Shale Complex**

A 2.3 m and 1.5 m thick deposit described as clayey silt till / shale complex was encountered below the till deposit in Boreholes BH2-16 and BH2-51 to about 4.6 m and 6.1 m below ground surface, respectively (Elev. 138.9 m and 137.3 m). The till / shale complex contains some sand, some gravel and shale fragments and is brown but becoming grey below 3.0 m and 3.6 m in Boreholes BH2-16 and BH2-51, respectively. Auger grinding was noted in this deposit below a depth of 4.8 m (Elev. 138.6 m) in Borehole BH2-51.

An SPT 'N'-values measured in the till / shale complex is 37 blows per 0.3 m of penetration, with values of up to 50 blows per 0.125 m of penetration, suggesting a hard consistency.

The results of grain size distribution and Atterberg limits testing carried out on 1 sample of the till / shale complex are shown on Borehole BH2-16 in Appendix B.

The unit weight measured on a sample of till / shale complex from Borehole BH2-16 is 20.5 kN/m<sup>3</sup>.

## **4.5.1.2 Cawthra Road, Queensway East and Etobicoke Creek (Iroquois Plain Physiographic Region)**

### **Asphalt, Concrete and Topsoil**

Boreholes drilled through the asphalt surface encountered approximately 80 mm to 260 mm of asphalt at ground surface. Borehole BH17-2, advanced through Cawthra Road, encountered approximately 220 mm of concrete



beneath the asphalt. Other boreholes advanced outside of the roadways encountered approximately 20 mm to 150 mm of topsoil at ground surface.

### **Fill**

Fill layers, generally comprised of non-cohesive soils, were encountered below the surficial asphalt, concrete and topsoil layers. In some Borehole BH13-4, a cohesive fill layer was encountered below the non-cohesive fill. The fill layers extend to depths ranging between 0.5 m and 3.3 m below ground surface (average 1.2 m), or between,

- Elev. 108.2 m to 127.5 m along Cawthra Road (from Dundas Street East to Burnhamthorpe Road); and
- Elev. 102.4 m to 112.4 m along Queensway Road East (from Hurontario Street to Etobicoke Creek).

The Standard Penetration Test (SPT) 'N'-values measured in the non-cohesive fill layers range from 7 blows to 20 blows to per 0.3 m of penetration, indicating a loose to compact state of compactness. SPT 'N'-values measured in the cohesive fill in Borehole BH13-4 is 9 blows per 0.3 m of penetration, suggesting a firm consistency.

The results of grain size distribution testing carried out on 2 samples of the non-cohesive fill are shown on borehole records for Boreholes BH17-2 and BH17-36 in Appendix B.

The results of Atterberg limits testing carried out on 2 samples of the non-cohesive fill are shown on borehole records for Boreholes BH17-2 and BH17-36 in Appendix B.

### **Silt to Sandy Silt to Silty Sand to Sand**

A non-cohesive deposit, generally consisting of silty sand to sand soils containing silt to sandy silt interlayering was encountered at ground surface or below the fill layers in most of the boreholes advanced along Cawthra Road and Queensway East. The non-cohesive deposit ranges in thickness between 0.6 m and 5.2 m (average 2.4 m) and extends to depths ranging from Elev. 107.6 m to 125.3 m along Cawthra Road and from Elev. 101.4 m to 110.8 m along Queensway East.

SPT 'N'-values measured in the generally silty sand to sand deposit range from 2 blows to 80 blows per 0.3 m of penetration, with values of up to 92 blows for 0.225 m of penetration, indicating a very loose to dense state of compactness consistency.

The results of grain size distribution testing carried out on 9 samples of the silt to silty sand to sand deposit are shown on borehole records for Boreholes BH17-36, CN11 and CN12, and on Figure 6 for Boreholes BH-7 and BH-8 in Appendix B.

The results of Atterberg limits testing carried out on 1 sample of sandy silt is shown on borehole record for Boreholes BH17-36.

### **Sand and Gravel to Gravel**

A non-cohesive deposit consisting of sand and gravel to gravel soils was encountered at ground surface, below surficial layers, fill layer or within/below the non-cohesive deposit in some boreholes advanced in some boreholes. The sand and gravel deposit ranges from 0.2 m to 0.8 m along Queensway East, extending to between Elev. 104.2 m and 109.4 m, but thicker sand and gravel to gravel deposits were encountered near proposed construction shafts MH10 at Cawthra Road and Dundas Street East and MH2A at Queensway East and Etobicoke Creek. The sand and gravel to gravel deposit encountered near the proposed construction shafts ranges in thickness from

1.7 m to 4.9 m and extends to Elev. 120.4 m near proposed shaft MH10 and to between Elev. 109.0 m and 109.3 m at proposed shaft MH2A.

SPT 'N'-values measured in the sand and gravel to gravel deposit range from 24 blows to 83 blows to per 0.3 m of penetration, with values of up to 50 blows for 0.25 m of penetration, indicating a compact to dense state of compactness.

The results of grain size distribution testing carried out on 5 samples of the sand and gravel to gravel deposit are shown on borehole records for Boreholes BH17-2 and BH17-36 in Appendix B.

### **Silty Clay**

A silty clay deposit was encountered at ground surface, below the fill layers, or within/below the non-cohesive deposit in some boreholes. The silty clay deposit ranges in thickness between 0.5 m and 3.1 m and extends to depths ranging from Elev. 100.9 m to 110.2 m.

An SPT 'N'-value measured in the silty clay deposit from Borehole CN11 is 41 blows per 0.3 m of penetration, suggesting a hard consistency.

The results of grain size distribution testing carried out on 1 sample of the silty clay deposit is shown on the borehole record for Boreholes CN12 in Appendix B.

### **Till Deposit**

A till deposit consisting of sandy silty clay to silty sand soils containing trace to some gravel was encountered below the fill layers or the non-cohesive deposit in some boreholes. The till deposit ranges in thickness between 0.2 m and 3.5 m and extends to Elev. 118.8 m at Cawthra Road and Dundas Street East, and to between Elev. 100.4 m and 107.2 m along Queensway East. The till deposit encountered in Boreholes BH-7 and BH-8 at Queenway East and Etobicoke Creek, near proposed construction shaft MH2A, describe the till as becoming bouldery below Elev. 106.2 m and 105.6 m, respectively. In Boreholes BH17-2, BH17-36 and BH13-7, the till is described as a till / shale complex and contains shale fragments.

SPT 'N'-values measured in the cohesive till soils range from 37 blows to 81 blows per 0.3 m of penetration, suggesting a hard consistency. An SPT 'N'-value measured on the portion of the till in Borehole BH13-7 is 36 blows per 0.3 m of penetration, and values of up to 100 blows for 0.15 m of penetration were measured in the till / shale complex in Boreholes BH17-2, BH17-36 and BH13-7, suggesting a hard consistency.

The results of grain size distribution testing carried out on 5 samples of the cohesive till deposit encountered in Boreholes BH-7 and BH-8 are shown on Figure 7 in Appendix B.

The results of Atterberg limits testing carried out on 3 samples of the cohesive till encountered in Boreholes BH-7 are shown on Figure 7 in Appendix B. Note that the till is described as sandy silt till in BH-7 and BH-8, however, the results of Atterberg limits testing show that the soil is a cohesive silty clay of low plasticity.

## **4.5.2 Shale Bedrock**

Based on the available information from the *Oak Ridges Moraine Groundwater Program*, the bedrock surface within the study area dips from northwest (about Elevation 140 m) to southeast (about Elevation 90 m), as shown on the Figure 3, *Bedrock Topography*.



The overburden soils are underlain by shale bedrock of the Georgian Bay Formation. Based on the available information, the depth to bedrock surface is generally less than 10 m, however there are localized areas where the bedrock surface is deeper. As is common in the Greater Toronto Area, the bedrock surface could be much deeper near exposed and buried bedrock river valleys (i.e. near the Credit River, Cooksville Creek, Etobicoke Creek or any tributaries to these rivers).

Bedrock of the Georgian Bay Formation typically consists of completely weathered to fresh, grey, fine to very fine grained, very weak to medium strong shale interbedded with medium strong to very strong limestone and siltstone layers. The mainly shale bedrock generally transitions with depth from completely weathered bedrock (i.e. residual soil) at bedrock surface to fresh bedrock. In some places, the completely to highly weathered bedrock layer is very thin or mixed into the 'till/shale complex' and the bedrock encountered during borehole drilling transitions from moderately weathered bedrock to fresh bedrock.

A summary of the bedrock surface encountered in the available borehole information is provided in the table below.

**Table 2: Summary of Available Bedrock Surface Information**

Sewer Location	Location	Station	Estimated Bedrock Surface		Notes
			Depth (m)	Elevation (m)	
Burnhamthorpe Road East	Central Parkway East to Wilcox Road	Station 2+150 to 3+050	Unknown	Unknown	No available bedrock information. Likely deeper than 16 m at Central Parkway East considering no bedrock encountered in Well No. 7151600
	Wilcox Road to Cawthra Road	Station 3+050 to 3+200	4.6 – 6.1	137.3 - 139.2	Bedrock confirmed by coring. About 2.3 m and 1.5 m of till / shale complex encountered above bedrock surface.
Cawthra Road	Queensway East to Orwell Street	Station 0+150 to 0+400	0.9 – 3.1	107.1 - 109.1	Inferred bedrock from well records.
	Orwell Street to Needham Lane	Station 0+400 to 0+700	Unknown	Unknown	No available borehole information.
	Needham Lane to Dundas Street East	Station 0+700 to 1+150	1.5 – 10.8	114.5 – 118.9	Inferred bedrock and bedrock confirmed by coring. Topography and bedrock surface dips steeply here.

Sewer Location	Location	Station	Estimated Bedrock Surface		Notes
			Depth (m)	Elevation (m)	
Queensway East	Hurontario Street to East of Cliff Road	Station 5+000 to 6+350	Unknown	Unknown	No available bedrock information. Boreholes advanced through overburden terminated between 3.5 m and 5.0 m bgs (Elev. 100.4 m to 104.2 m). Bedrock likely deeper than this.
	East of Cliff Road	Station 6+350	2.3	104.6	Inferred bedrock from split-spoon sampling.
	East of Cliff Road to Cawthra Road	Station 6+350 to 7+070	Unknown	Unknown	No available borehole information.
	Cawthra Road	Station 7+070	2.1	107.6	Inferred bedrock from well records.
	Cawthra Road to Stanfield Road	Station 7+070 to 8+330	Unknown	Unknown	No available borehole information.
	Stanfield Road to Etobicoke Creek	Station 8+330 to 10+070	0.9 – 9.6	104.4 – 114.0	Inferred bedrock and bedrock confirmed by coring.
Etobicoke Creek (TRCA Regulated Area)	Queensway East	Station 1+440 to 1+460	7.3 – 9.6	104.4 – 105.2	Bedrock confirmed by coring.
	Sherway Drive to Queensway East <sup>1</sup>	Station 1+100 to 1+440	Unknown	Unknown	No available borehole information.

Note:

- Four (4) boreholes were drilled at the QEW crossing over the Etobicoke Creek (Station 1+250). Shale bedrock was encountered in these boreholes at about Elevations 92 m to 91 m, suggesting that the bedrock slopes southerly toward Lake Ontario.

Shale bedrock was encountered below the till / shale complex in Borehole BH13-7 and was sampled by the split-spoons sampler. SPT 'N'-values measured in the shale in Borehole BH13-7 are 50 blows for 0.12 m of penetration and 50 lows for 0.10 m of penetration.

The results of Atterberg limits testing carried out on 1 sample of the shale bedrock is shown on the borehole record for Borehole BH17-36.

The shale was cored in Boreholes BH2-15, BH2-16, BH2-51, BA-MW26-15, BH17-2, BH17-32, BH-7 and BH-8 for lengths ranging from about 3.5 m to 20.7 m. The shale is generally described as moderately weathered to fresh, laminated to thinly bedded dark grey to grey, very weak to medium strong, SHALE and LIMY SHALE interbedded with medium strong to strong siltstone and limestone of the Georgian Bay Formation. The siltstone and limestone layers generally range in thickness from 50 mm to 150 mm, and the rock quality designation (RQD) measured on the core ranges from 0% to 100%, indicating a very poor to excellent quality rock. However, below the upper weathered portion of the bedrock, the RQD is generally above 50 percent, indicating a fair to excellent quality rock.

A summary of the point load index (PLI), uniaxial compressive strength (UCS), density and young's modulus (E) testing carried out on samples of cored bedrock from Boreholes BH2-15, BH2-16, BH2-51, BA-MW26-15, BH17-2 and BH17-32 is shown in the table below.

**Table 3: Summary of Available Bedrock Laboratory Testing**

Test Type	Shale (average)	Quantity	Limestone (average)	Quantity
Point Load Index Diametral (MPa)	0.8 – 9 (3.8)	39	1.4 – 92 (27.2)	5
Point Load Index Axial (MPa)	2.8 - 28.8 (14.8)	35	18.3 - 157.8 (78.8)	16
Density (g/cm <sup>3</sup> )	2.57 - 2.75 (2.7)	8	2.59 - 2.63 (2.6)	4
Uniaxial Compression (MPa)	7.86 - 24.39 (15.6)	8	31.76 - 97.1 (52.7)	4
Modulus E (MPa)	0.257 - 1.92 (1.2)	8	3.59 - 3.59 (3.6)	1
Poisson's ratio	0.21 - 0.27 (0.2)	5	0.21 - 0.21 (0.2)	1

Note:

1. Testing ranges given for shale and limestone lithologies are based on PLI and UCS results (i.e. 0 MPa < SHALE > 30 MPa, LIMESTONE > 30 MPa), as the lithological description of sample is not available information.

### 4.5.3 Groundwater Conditions

Groundwater level is subject to seasonal fluctuations and variations due to precipitation events and creek/river levels. "Perched" groundwater conditions are expected within the fill soils, above the cohesive till and/or above the bedrock. The upper weathered portion of the bedrock is also anticipated to contain perched groundwater, especially where shallow bedrock was encountered near the ground surface.

The available groundwater level information provided on the record of borehole in Appendix B and summarized in the table below.

**Table 4: Summary of Available Groundwater Level Information**

Sewer Location	Borehole I.D.	Station / Closest Intersection	Screened Stratigraphy	Groundwater Depth / Elev. (m)
Burnhamthorpe Rd East	7151600	STA 2+270 / Burnhamthorpe Road E	Gravel	14.3 / 123.7
	BA- MW26-15	STA 3+190 / Cawthra Road	Silty Clay Till to Shale	2.5 - 2.9 / 141.3 - 140.9
	BH2-16	STA 3+170 / Cawthra Road	Silty Clay Till / Shale Complex	2.6 – 3.6 / 140.9 – 139.9
	BH2-51	STA 3+180 / Cawthra Road	Shale Bedrock	1.3 – 2.9 / 142.1 – 140.5
Cawthra Rd East	7141979	STA 0+210 / Queensway E	Sand to Shale	3.0 / 106.7
	4902250 <sup>2</sup>	STA 1+020 / Cawthra Road	Shale Bedrock	2.4 / 121.9
	BH17-36	STA 1+170 / Dundas Street E	Shale Bedrock	8.7 / 120.4
Queensway East	7277560	STA 4+990 / Queensway E	Sand to Silty Clay	2.7 / 102.7
Queensway East	BH13-5	STA 6+070 / Queensway East	Silty Sand	1.8 / 105.9
	BH13-6	STA 6+180 / Queensway East	N/A	1.5 / 105.7 <sup>1</sup>
	BH13-7	STA 6+360 / Queensway East	Clayey Silt till / Shale Complex to Shale	2.4 / 104.5
	CN11	STA 6+040 / Queensway East	Sand	1.9 – 2.0 / 105.6 - 105.5
	CN12	STA 6+010 / Queensway East	Sand	1.5 – 1.6 / 105.0 - 104.9

Sewer Location	Borehole I.D.	Station / Closest Intersection	Screened Stratigraphy	Groundwater Depth / Elev. (m)
Etobicoke Creek	BH-7	STA 10+100 / Etobicoke Creek	Sand to Sandy Gravel to Silty Clay till to Shale	10.1 / 102.4
	BH-8	STA 10+080 / Etobicoke Creek	Shale Bedrock	4.7 / 104.7

Note:

1. Groundwater level measured in open borehole during borehole drilling.
2. Well details (i.e. screen length, depth etc.) not available for Well No. 4902250. It is assumed that the screen is in the shale bedrock.

## 5.0 SOIL AND ROCK PARAMETERS FOR DESIGN

This section of the desktop study report presents preliminary geotechnical design parameters for soil and bedrock as listed in Table 5. These preliminary parameters have been estimated based on our understanding and interpretation of the available data at the time of preparation of this report.

**Table 5: List of Parameters for Design**

Soil Parameter (Unit)	Rock Parameter (Unit)
Bulk Unit Weight (kN/m <sup>3</sup> )	Bulk Unit Weight (kN/m <sup>3</sup> )
Internal Friction Angle (°)	Uniaxial Compressive Strength, UCS (MPa)
Undrained Shear Strength (kPa)	Brazilian Tensile Strength (MPa)
Coefficients of Lateral Earth Pressure	Cerchar Abrasiveness (%)
Elastic Modulus, E (GPa)	Slake Durability Index (%)
Poisson's Ratio	Elastic Modulus, E (GPa)

The preliminary soil and rock parameters are presented in Table C1 and C2 in Appendix C following the text of this report. Where ranges of parameters are provided the preliminary design should be checked for the given range. All preliminary design work shall be carried out in accordance with the most recent versions of the Region of Peel Public Works Design, Specifications and Procedures Manual.

### 5.1 Bedrock Discontinuities

The shale bedrock of the Georgian Bay formation is typically characterized by persistent near horizontal bedding joints and two orthogonal steeply dipping joint sets. Bedding joints are typically planar to undulating and smooth to slightly rough, while the steep joints are smooth to rough and planar to undulating. The discontinuity surfaces are typically stained to slightly altered; where occasional discontinuity surfaces are partially to completely coated, or infilled, the dominant coating/infilling material is clay.

The thickness of the bedding, as separated by bedding joints (which are here defined as open discontinuities, i.e., joints, along planes of weakness created by sedimentary disposition), varies across the site. The bedrock at the site is generally thinly laminated to medium bedded.

## 5.2 In Situ Stresses in Rock

The shale bedrock of the Georgian Bay formation typically exhibits high horizontal stresses. Available literature and published results of tests carried out on this rock have reported that the in-situ stresses can be relatively high near the bedrock surface. Overstressing of the rock around the tunnel should be anticipated. This can be reflected as stress-induced slabbing of the rock in the crown and sidewalls, shearing along bedding joints and buckling of the floor slabs in the tunnels or shafts, during or shortly after excavation/construction activities. Based on our experience and available data in southwestern Ontario rock formations, the major and minor horizontal principal stresses typically range between 2 MPa and 9 MPa and between 1 MPa and 6 MPa, respectively. The literature generally suggests that the direction of the major principal horizontal stress is northeast-east; however, orienting in situ stress to the least favorable orientation for tunnel excavation and lining analyses is recommended because the orientation can vary widely. Table 6 summarizes a selection of published shallow in situ horizontal stress in Southern Ontario shale bedrock.

**Table 6: Summary of Published Shallow In Situ Horizontal Stress in Southern Ontario Shale Bedrock**

Source	Depth Below Ground Surface (m)	In Situ Horizontal Stress (MPa)
Morton, Lo and Belshaw (1975)	9 to 15	Up to 6.9
Lo and Morton (1976)	9 to 10	2 to 4
Lo, Devata and Yuen (1979)	6 to 16	1.6 to 9.2
Lo and Yuen (1981)	--	4.1
Trow and Lo (1989)	15 to 26	2.3 to 5.3

## 5.3 Time-Dependent Rock Deformation (Swelling)

The shale bedrock that the tunnel will be excavated through is expected to exhibit time-dependent (i.e., swelling) creep-like deformations that occur as a consequence of relief of in situ stresses upon excavation and volumetric changes related to the lithology and certain chemical characteristics of the rock. These time-dependent deformations typically persist beyond the initial elastic deformations and generally exceed the magnitude of the elastic movements.

Based on current knowledge, the time-dependent swelling mechanism observed in the shale bedrock of southwestern Ontario is a result of the dilution of pore water salt concentration that causes the space between the clay particles to expand (Lo, 2010). Responsible for the dilution are osmosis and diffusion processes, which allow water to move into the shale due to negative pore pressure if the rock is surrounded by a fluid of lower salt concentration. Therefore, preconditions for swelling are accessibility to fresh water and an outward gradient of salt concentration from the pore fluid to the ambient fluid. The relief of in situ stresses in the rock is considered the initiating mechanism for swelling. Furthermore, it was found that the swelling potential is affected by the inter-

particle bonding. If the bond strength is higher than the osmotic pressure, no swelling will occur and vice versa. The bond strength is governed by the calcite content of the bedrock which acts as a cementing agent between the clay particles. Other compounds such as iron oxide or aluminum oxide may also act as cementing agents.

The swelling potential of the bedrock should be investigated during subsequent subsurface investigations. A suite of swell tests on bedrock core samples should be carried out, as described below:

- Free swell conditions (samples are tested with no applied pressure allowing free swelling of the sample, results are described as swell potential as a % per log cycle of time);
- Semi-confined conditions (confining pressure applied to samples in the direction of the sample axis); and
- Null swell conditions (full restriction of swelling in the direction of the sample axis and measuring of the pressure applied to the sample to suppress the swelling, known as the suppression pressure).

The testing includes the determination of the moisture content and salinity of the pore fluid in the test specimen (at the start and completion of the test) and the calcite content of the sample.

A swell potential envelope of the bedrock is described using plots of the swelling potential of the shale versus the applied pressures (in log scale to base 10) under free swell, semi confined, and null swell conditions, and can be developed using the results of this testing.

## 5.4 Subsurface Gas

Combustible and toxic gas, including but not limited to methane, hydrogen sulphide and benzene are known to be present in the Georgian Bay formation shale bedrock and deep soils in the southwestern Ontario region. There was no indication of the presence of subsurface natural gas at the locations of the boreholes and well records reviewed. However, methane and other natural gases have been recorded during tunnelling projects in the Region of Peel and the Greater Toronto Area, typically in granular layers capped by cohesive soils and within the shale bedrock.

The contractor should be required to prepare and implement their own procedure and Health and Safety Plans that address all hazards from hydrocarbons and related hazardous gases, as well as other Volatile Organic Compound (VOC) subsurface gases that might be present during tunnelling and excavation activities. Appropriate venting and gas monitoring are essential in all confined excavation work.

Methane can form an explosive mixture with air and is a potential hazard for excavation and construction works and it should be assumed that it will be encountered in the bedrock at this site. Additionally, hydrogen sulphide is corrosive and toxic. Since methane and hydrogen sulphide are entrained within the groundwater, it is important to note that changes in groundwater pressure which may be caused by dewatering or seepage into underground spaces can lead to migration/release of these gases. Therefore, the absence of methane or hydrogen sulphide in a particular area should not be construed to indicate that there is no risk of their presence in future or in other site areas.

If the air/gases are not vented to the surface atmosphere, an explosive environment may develop within the tunnel or confined excavation and/or the presence of the vapours will pose a health concern to works. It is recommended that an air monitoring and an active ventilation system for control of exposure to adverse gas concentration be implemented throughout the tunnel/shaft construction. Additionally, special attention is required to avoid creating

areas in temporary or permanent structures where there is no air movement since this could lead to gas accumulation.

The tunnel should be considered as “potentially gassy”, according to the OSHA Underground Construction (Tunnelling) Regulations (29 CFR Part 1926.800, “Tunnels and Shafts.”).

### 5.5 Monitoring Well Decommissioning

Ontario Regulation (O.Reg.) 903, as amended, of the Ontario Water Resources Act requires that monitoring wells (piezometers) are properly decommissioned by qualified personnel. It is recommended that the decommissioning of the monitoring wells be carried out as part of the construction activities so that groundwater level measurements and any groundwater quality sampling that may be required can be taken up to construction.

## 6.0 GEOTECHNICAL CHALLENGES AND MITIGATION MEASURES

The following text of this report outlines, geotechnical challenges, associated potential impacts on construction, and suggested mitigation measures to minimize subsurface risks.

**Table 7: Geotechnical Challenges**

Geotechnical Challenges	Description of Potential Challenge	Mitigation Measures
<b>In Situ Stresses and Swelling of Shale Bedrock</b>	Shale bedrock may experience swelling when stresses are relieved due to excavation or tunnelling. The swelling and in situ stresses in the shale bedrock may impact the temporary and permanent tunnel and shaft liner design.	The Tunnel Designer is to consider in situ stresses and the potential for swelling in the liner design.
<b>Presence of Cobbles and Boulders</b>	The presence of cobbles and/or boulders should be considered in machine selection and adopted method for tunnelling through overburden and excavations at shaft locations. It should be assumed that cobbles/boulders are comprised of a variety of different lithology’s including native bedrock but also glacial erratics from the Canadian Shield with a wide range in strengths.	The Contract Documents should include provisions to manage the excavation and disposal of cobbles and boulders.



Geotechnical Challenges	Description of Potential Challenge	Mitigation Measures
<p><b>Naturally occurring BTEX and Subsurface Gases</b></p>	<p>Naturally-occurring benzene, toluene, ethylbenzene, and xylenes (collectively BTEX) and other naturally occurring subsurface gases (methane, hydrogen sulphide and carbon dioxide) have been encountered within shale bedrock and/or glacially derived till deposits during recent tunnelling projects in the Greater Toronto Area. Subsurface gases can impact tunnel boring machine selection, ventilation design, tunnel spoil management and disposal options.</p>	<p>Tunnel spoil disposal options and worker health and safety requirements should be developed during the detailed design and incorporated into the Contract Documents.</p>
<p><b>Water-Bearing Granular Zones/Groundwater Control</b></p>	<p>The tunnel is anticipated to be constructed below the groundwater table. Tunnelling and excavations for the construction of all shafts are expected to extend below the groundwater level. Water-bearing granular soil zones are anticipated to be present within the overburden. In addition, the proposed construction shafts and the sewer alignment will be excavated near the Etobicoke Creek and below the Etobicoke Creek level.</p>	<p>Detailed design of the shafts and tunnel should incorporate groundwater control methods to minimize the impact of dewatering on the watercourses, surrounding infrastructure and sensitive features.</p> <p>The design and construction should take into account the requirements for groundwater control (dewatering and unwatering) and the potential need for diverting the Etobicoke Creek stream during the construction. Consideration should be given to studying the seasonal flow of the creek to construct the shafts and install the pipe in the low flow season.</p>
<p><b>Mixed-Face and Overburden Tunnelling</b></p>	<p>The tunnel will encounter overburden and mixed-face conditions as such hybrid / dual mode tunnel boring machine (rock TBM with slurry or EPB capability) should be utilized.</p>	<p>Geotechnical Baseline Report to define the overburden/bedrock interface and alert the contractor about the risks associated with the mixed face conditions and tunnelling through soils.</p>
<p><b>Limited Soil Cover Thickness (Erosion and Scour Protection)</b></p>	<p>Available borehole records indicate that the overburden soils at/near the Etobicoke Creek have a total thickness of up to about 3 m and in cases as low as 1 m. The existing sewer has a soil cover of about 2 m. The overburden soils are primarily non-cohesive and as such prone to erosion.</p>	<p>It is understood that a fluvial geomorphology study was carried out to provide further information about the thickness of overburden, the condition of the banks and any exposures of the existing pipe and associated shafts. The design of the new sewer and connection points should ensure that the pipes will have adequate cover against erosion and scours.</p>

Geotechnical Challenges	Description of Potential Challenge	Mitigation Measures
<p><b>Construction of the Sewer across the Etobicoke Creek</b></p>	<p>Assuming a tunnel diameter of about 2 m, and considering the invert elevations of 91 m to connect to the existing shaft, the pipe is expected to have a cover of less than 2 m.</p>	<p>The installation by means of tunnelling will require additional intervention measures (such as pressurized face tunnel boring machine, grouting etc.) to increase the stability of the excavation and reduce the risk of frac-out. The additional intervention measures should be reviewed by the conservation authorities to ensure they do not pose risks to the Creek and the natural environment. The open cut excavation will require a cofferdam to divert the creek to construct the pipe in conditions suitable to implement the work and to provide for required inspection of the founding soils (or bedrock), placing pipe bedding, etc.</p>

## 7.0 RECOMMENDATIONS FOR FURTHER WORK FOR DETAIL DESIGN

As discussed in previous sections of this report, the soil conditions at the site are anticipated to consist of varying amounts of fill materials, underlain by granular deposits of silt to silty sand to sand, with some interlayers of sand and gravel to gravel, and silty clay based off the limited borehole information available. The granular and cohesive deposits are typically underlain by a glacial till deposit. The till deposit overlies shale bedrock of the Georgian Bay formation along the proposed trunk sewer alignment.

The subsurface conditions and stratigraphic profile shown on Figure 4 to 21 are based on limited borehole information and well records. Further borehole investigation is required to confirm the subsurface conditions in the vicinity of the proposed sewer alignment, and to minimize the risk of unforeseen ground conditions during construction (e.g. bedrock valleys etc.). Based on the limited borehole information available, the majority of the tunnel will be advanced through bedrock, and as such, further investigation is required to confirm the bedrock cover above the tunnel invert is sufficient and to define the potential for mixed face (soil and rock) conditions. Where there is potential for the tunnel to be advanced through overburden or mixed face conditions (i.e., near Etobicoke Creek or Burnhamthorpe Road East and Central Parkway East), further investigation is required to assess the tunneling suitability through the overburden.

Further, additional geotechnical investigation is recommended along the proposed trunk sewer alignment to:

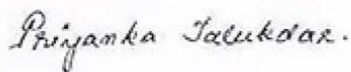
- Confirm the subsurface conditions encountered in previous geotechnical investigations and well records, fill in the gaps in the stratigraphic profile where subsurface information is not known, and minimize the risk of unforeseen ground conditions during construction.
- Advance boreholes at regularly spaced intervals along the proposed tunnel alignments (e.g. 75 m, 100 m or 150 m spacing) and at every proposed shaft location.
- Identify presence of fill materials at shaft locations and along open cut portions of the sanitary sewer.

- Delineate the bedrock surface and the thickness highly weathered rock by means of additional Standard Penetration Test (SPT) and/or PQ Soil Core) boreholes at all shaft locations and along the Etobicoke Creek alignment.
- Identify thickness / elevation of highly weathered bedrock in conjunction with borings and geophysical survey.
- Confirm strength of overburden and bedrock within the tunnel horizon.
- Collect current and representative groundwater levels along the alignment and at shaft locations.
- Identify potential elevated groundwater levels or pressurized aquifers along the Project alignment (i.e., near Etobicoke Creek).
- Test and assess environmental quality of soil and groundwater for handling, re-use and disposal.
- Target water bearing soil zones to assess the need for groundwater control and support of excavation options.
- Provide soil and bedrock parameters of the existing subsurface materials for design through in-situ (e.g., pressuremeter) and laboratory testing (e.g., swell) and analysis.

## 8.0 CLOSURE

This report was prepared by Ms. Darcy Hansen, EIT, a geotechnical engineer-in-training and was reviewed by Mr. Dave Walters, a senior geotechnical engineer of Golder. Preliminary construction considerations provided herein are limited and should be used for initial planning only. If you have any questions regarding the contents of this report, please do not hesitate to contact this office.

### **Golder Associates Ltd.**



Priyanka Talukdar, Ph.D.  
*Geotechnical Engineer*



Dave Walters, Ph.D., P.Eng  
*Geotechnical Engineer and Principal*

PT/DLW/ml

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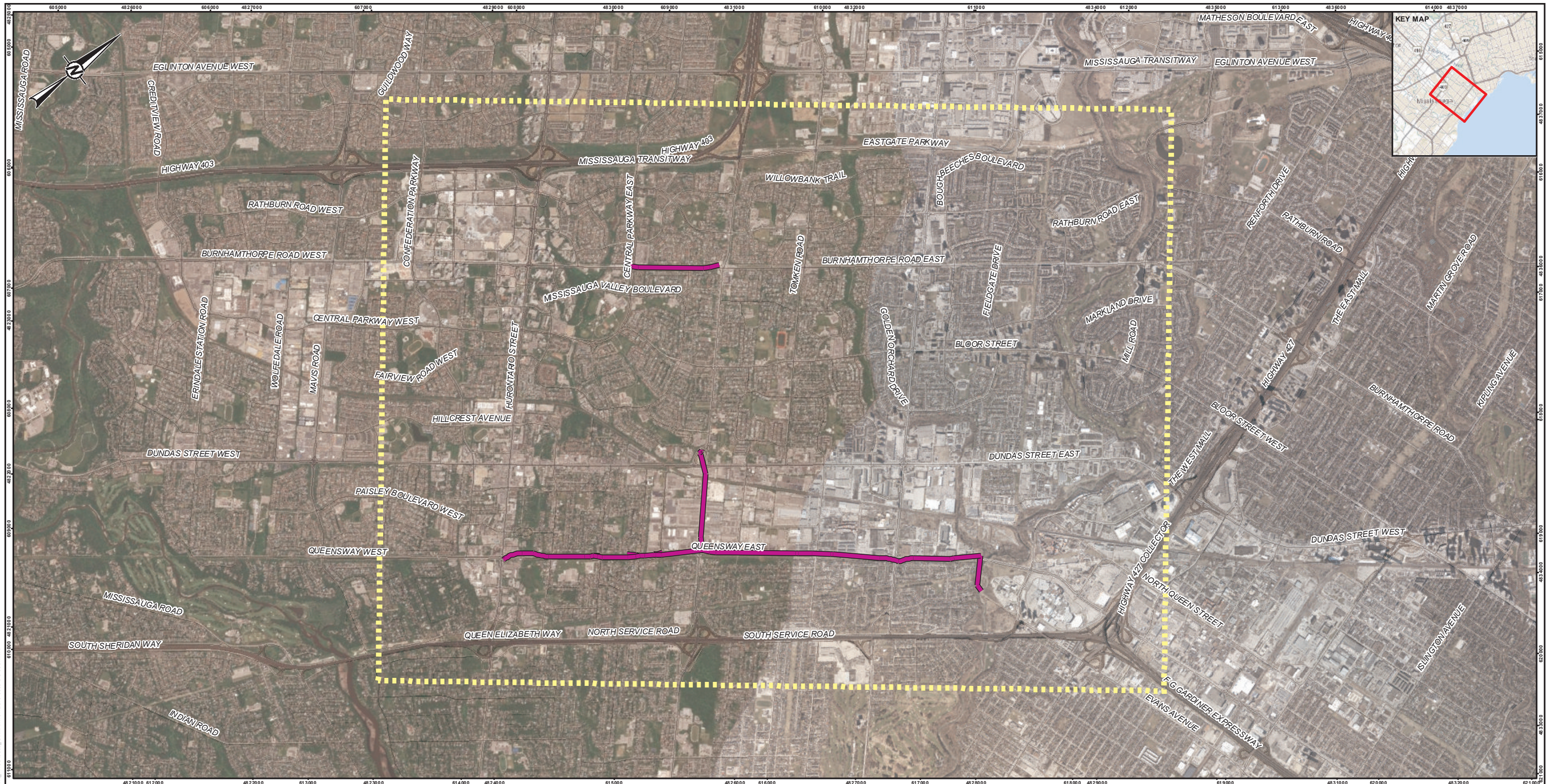
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ASTM Standards:

D7625 Standard Test Method for Laboratory Determination of Abrasiveness of Rock Using the CERCHAR Method





- LEGEND**
- Study\_Area
  - Project Components**
  - Proposed Sanitary Pipe



**NOTE(S)**

**REFERENCE(S)**

1. COORDINATE SYSTEM: NAD 1983 UTM ZONE 17N
2. IMAGERY SOURCE: ESRI, MAXAR, GEOEYE, EARTHSTAR GEOGRAPHICS, CNESA/IRBUS DS, USDA, USGS, AERGRID, IGN, AND THE GIS USER COMMUNITY

SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA

PROJECT  
**CENTRAL MISSISSAUGA  
 WASTEWATER SYSTEM CAPACITY EXPANSION**

CLIENT  
**GM BLUEPLAN ENGINEERING LIMITED**

CONSULTANT	DATE	DESCRIPTION
	2021-11-23	DESIGNED
	JR	PREPARED
	JR	REVIEWED
	--	APPROVED
	--	

TITLE		PROJECT NO.	CONTROL	REV.	FIGURE
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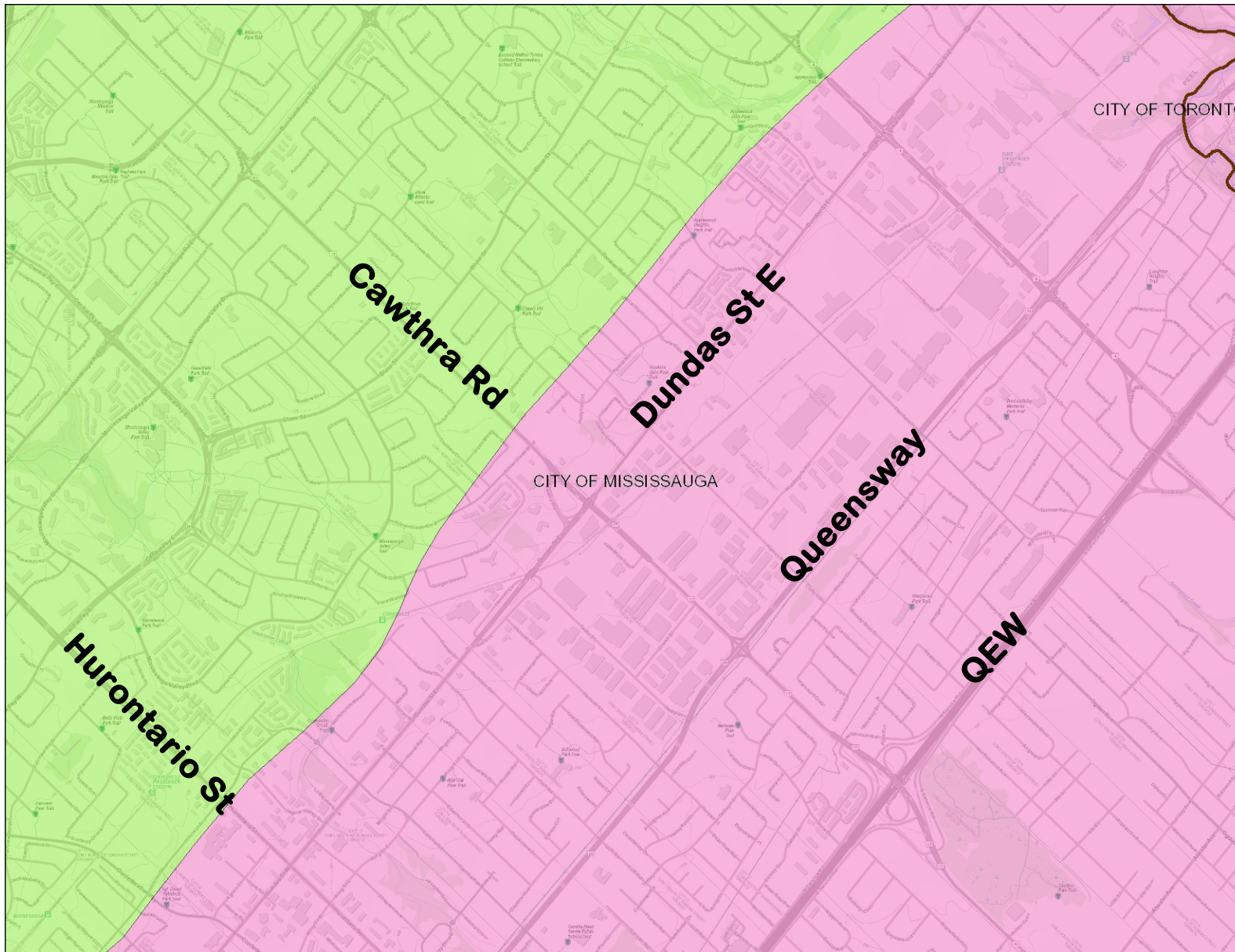


# Physiographic Regions

## Legend

### Physiographic Regions (OGS)

- Iroquois Plain
- South Slope



1,834.5 0 917.24 1,834.5 Metres

1: 36,112



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**Region of Peel**  
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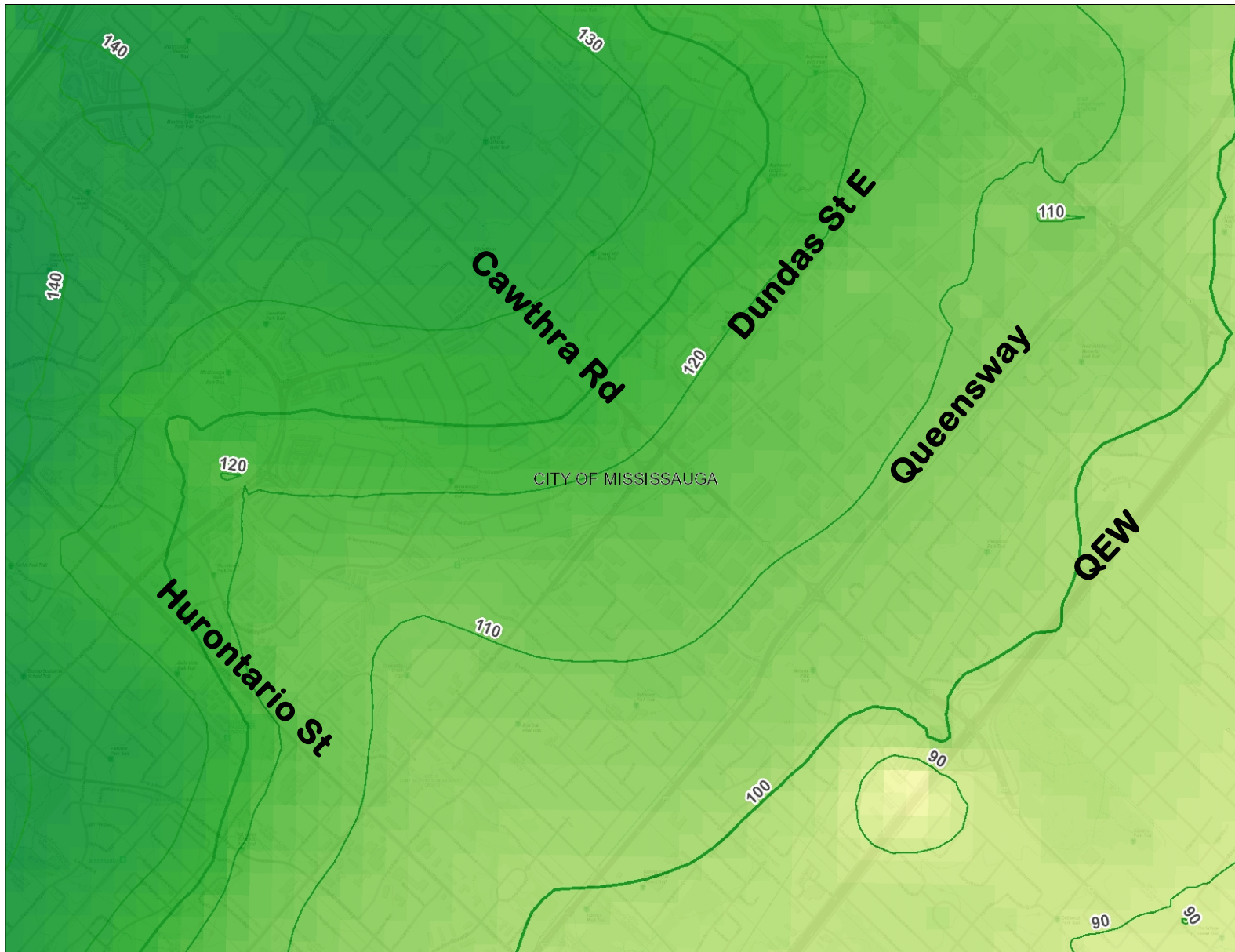
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FIGURE 2

# Bedrock Topography

## Legend

- Contour 25m
- Contour 10m
- Bedrock Topography ORMGP
- High : 522.812
- Low : 0.00202746



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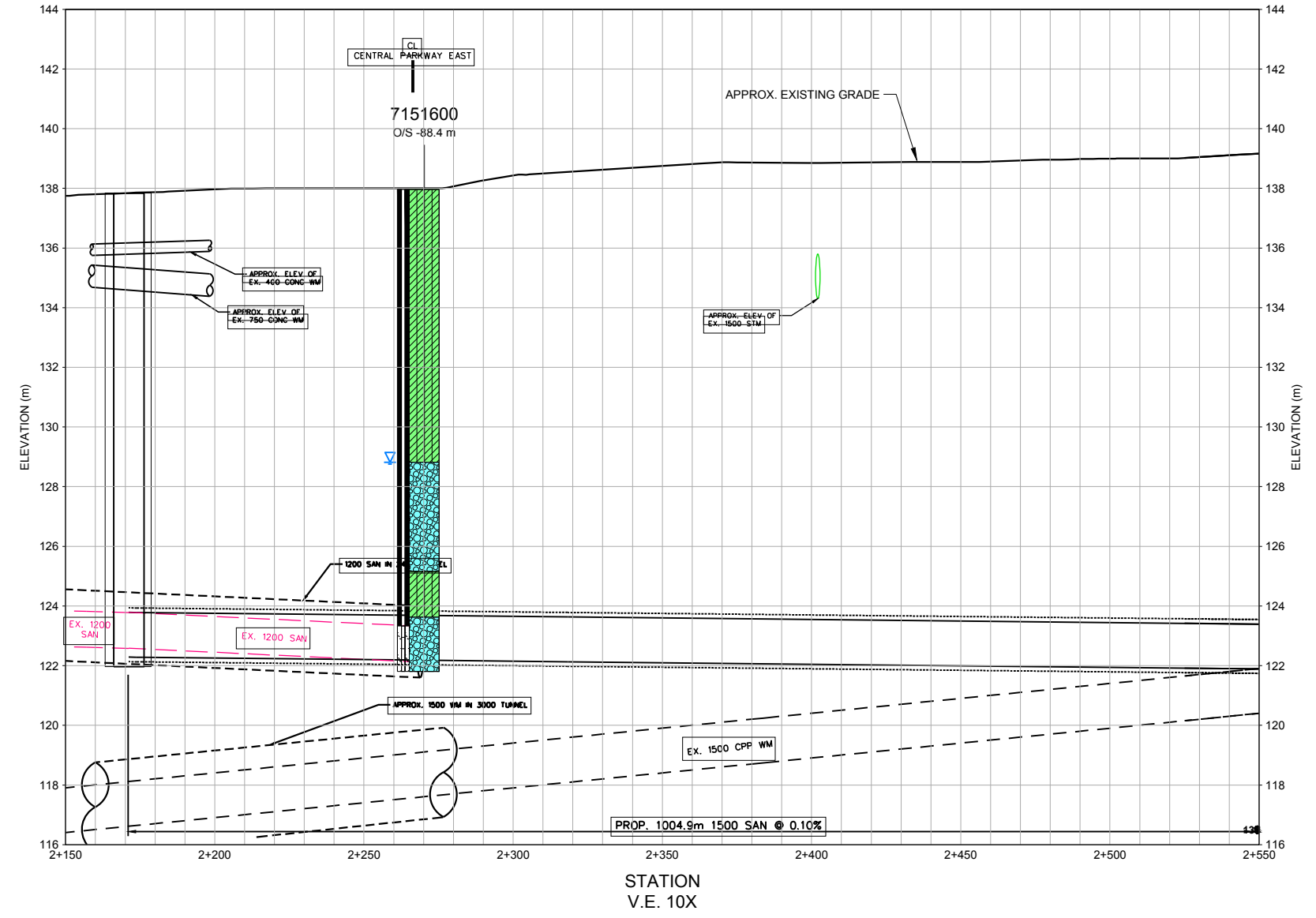
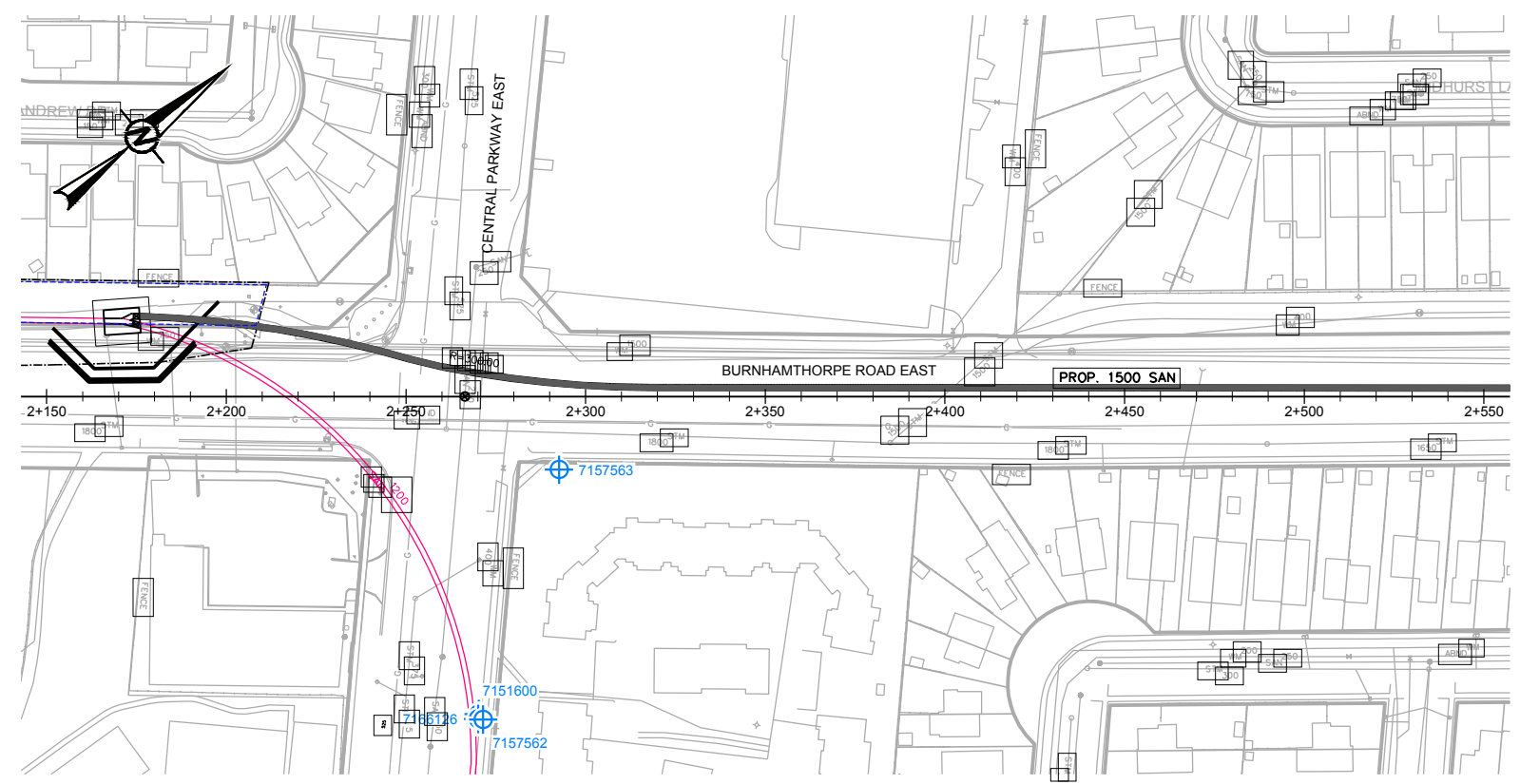


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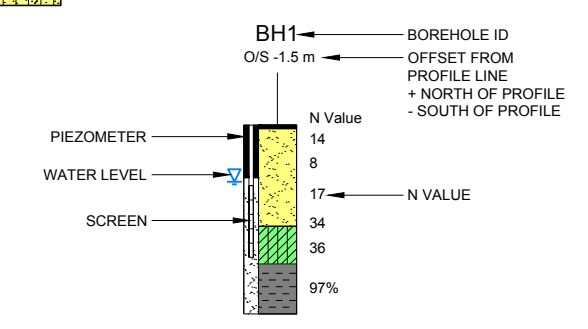


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	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
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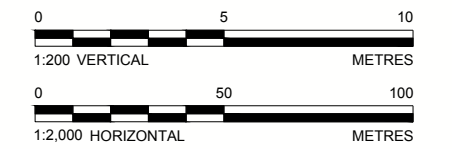


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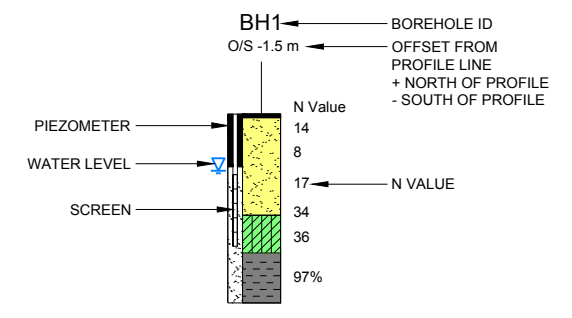
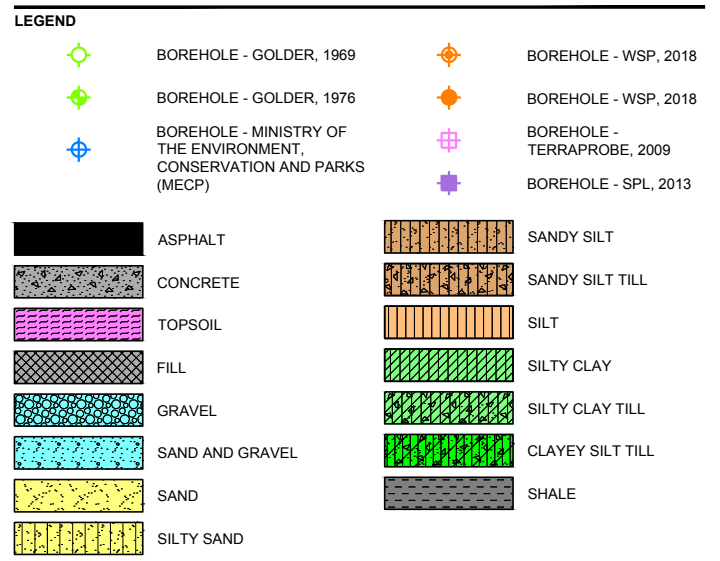
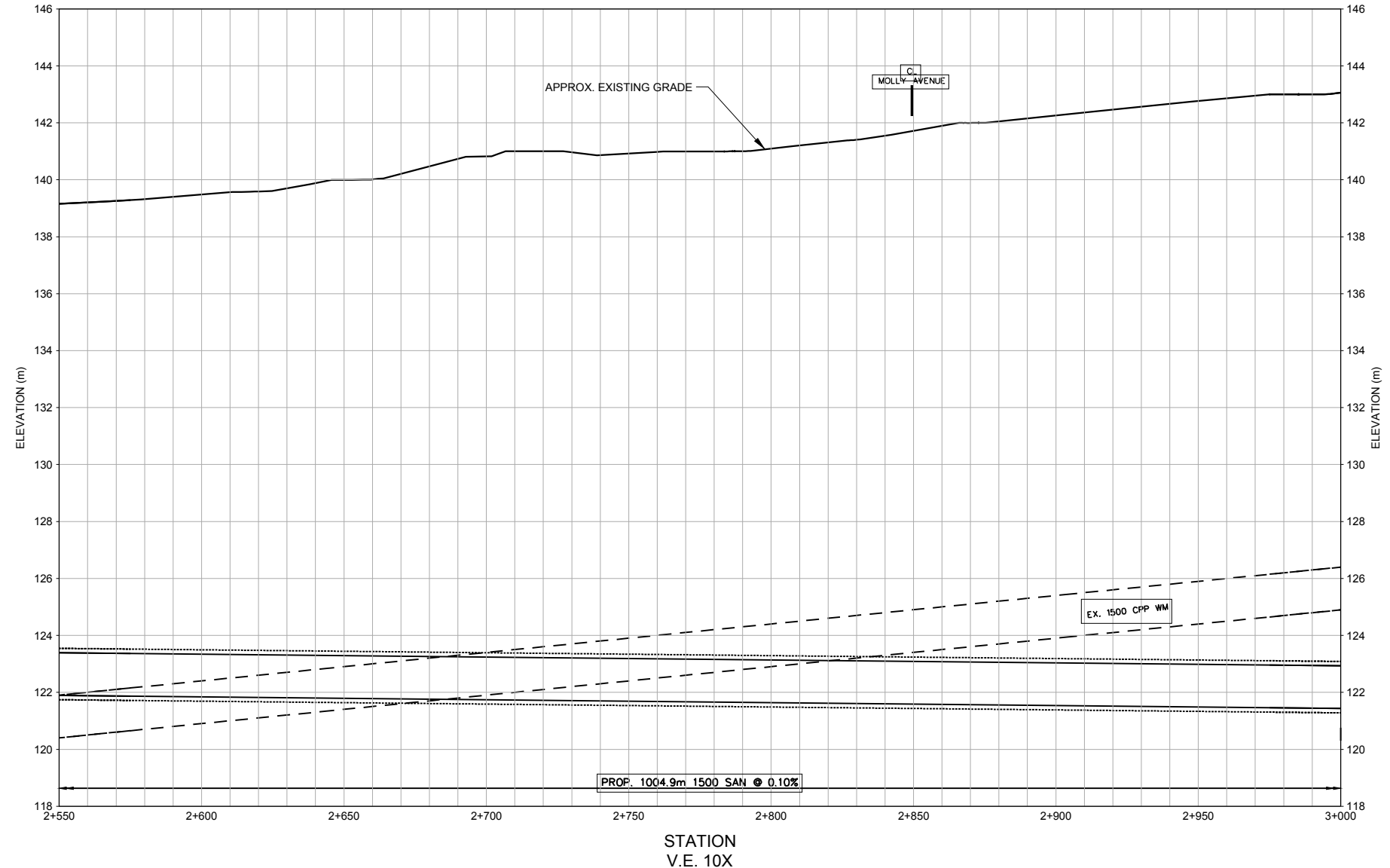
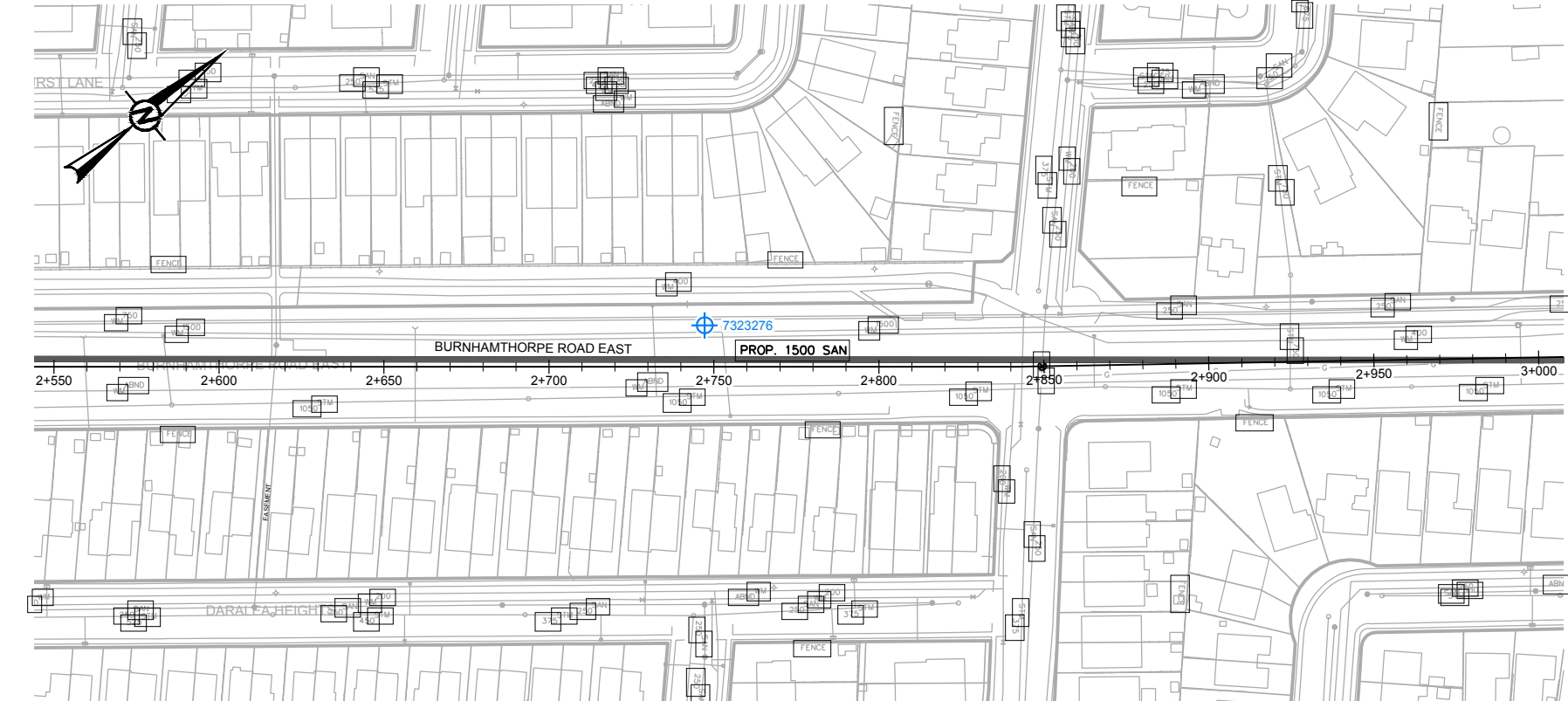
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CENTRAL MISSISSAUGA WASTEWATER SYSTEM

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BURNHAMTORPHE ROAD EAST, STA 2+150 TO 2+550

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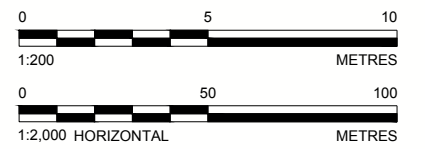
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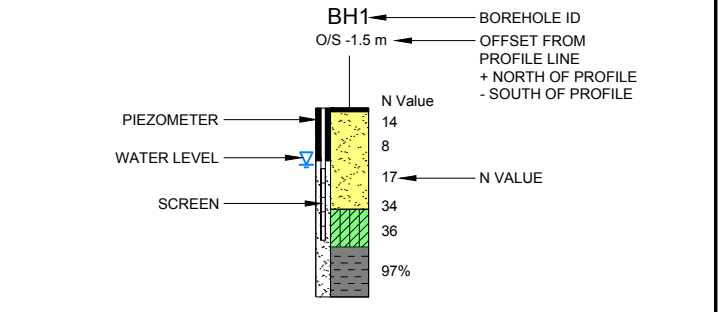
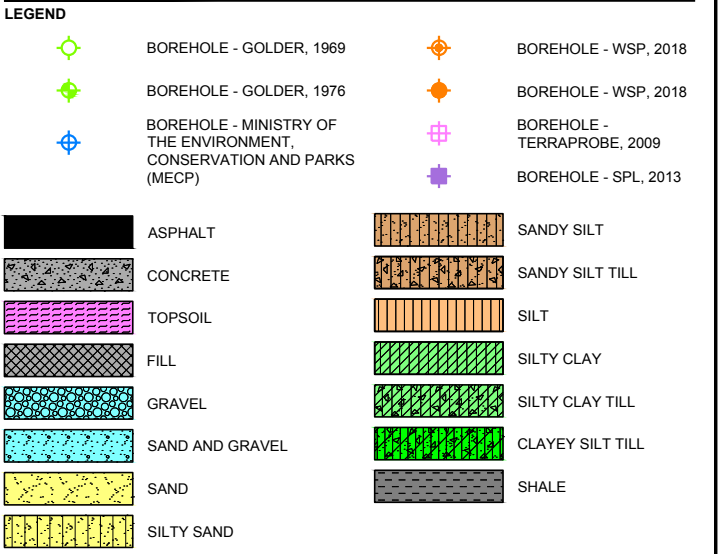
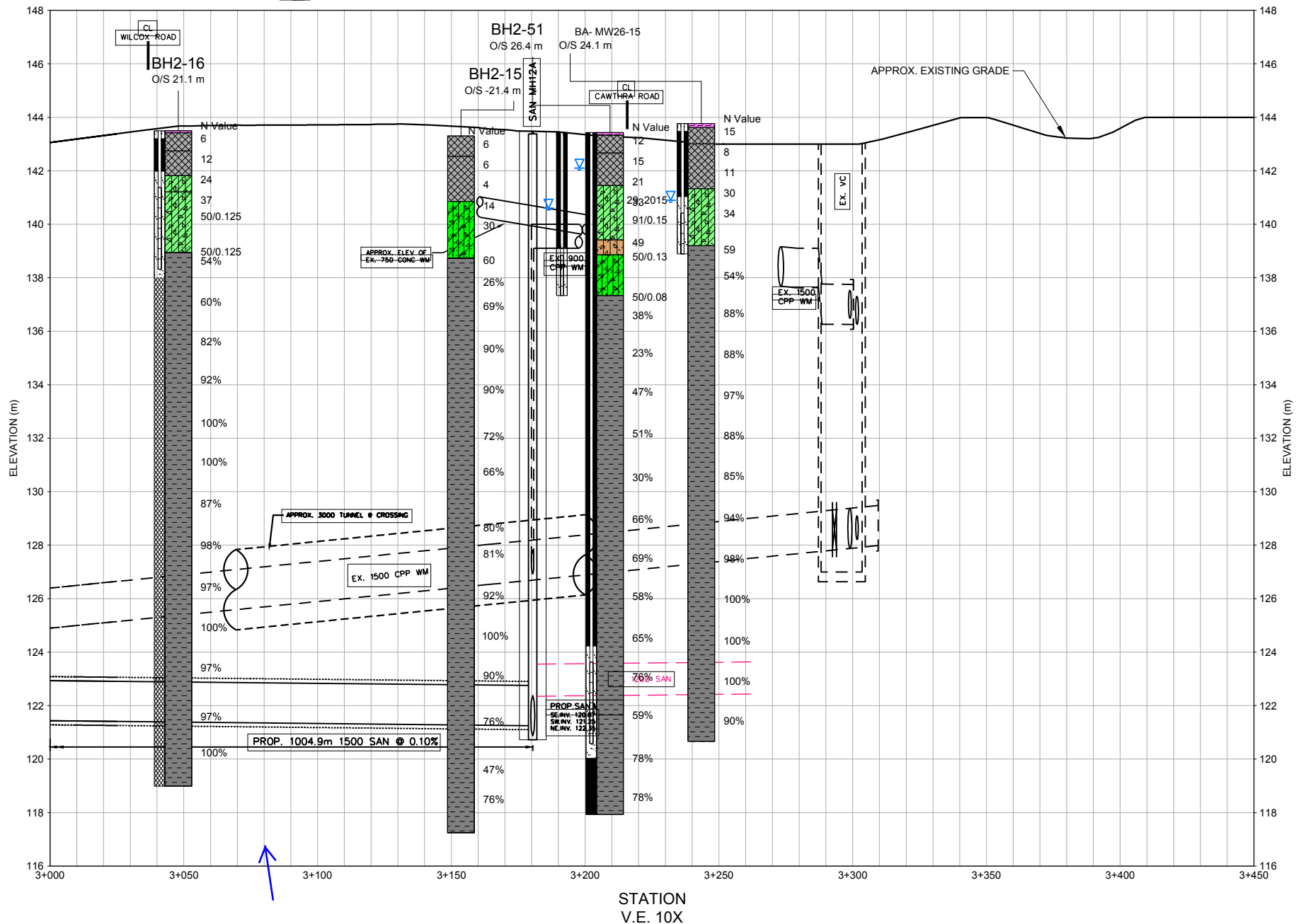
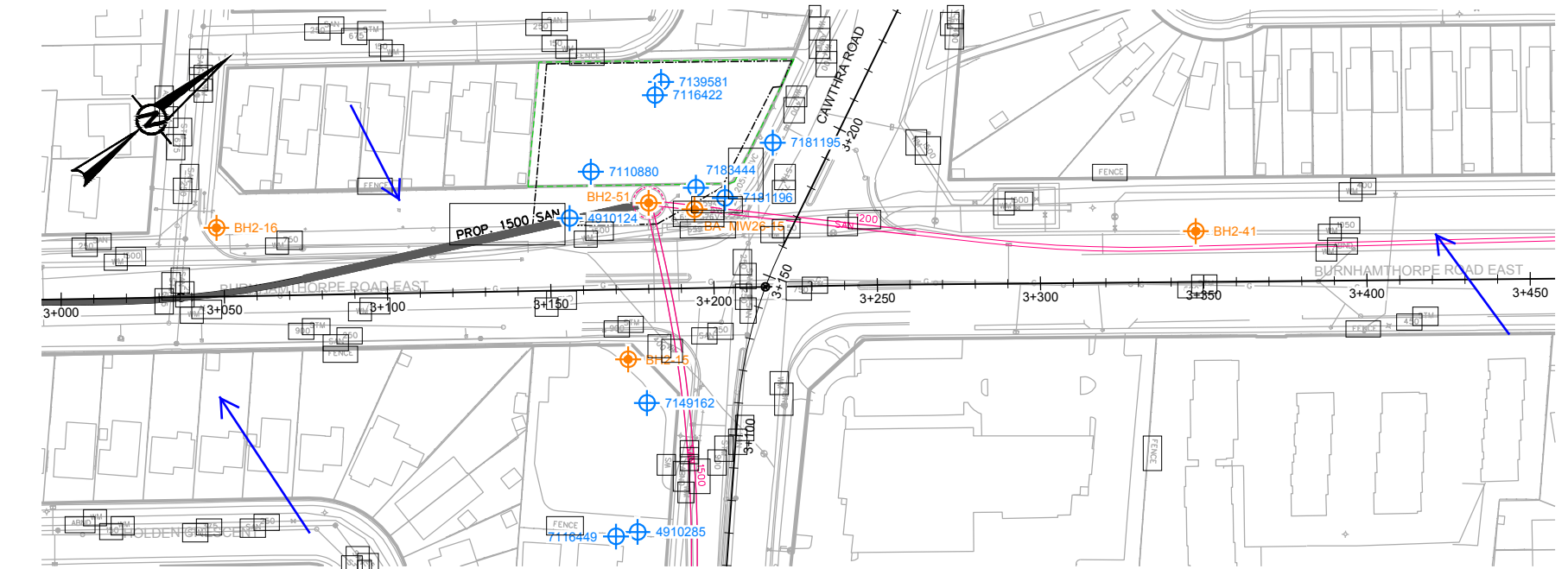
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 BOREHOLE LOCATION PLAN AND PROFILE BURNHAMTORPHE ROAD EAST, STA 2+550 TO 3+000

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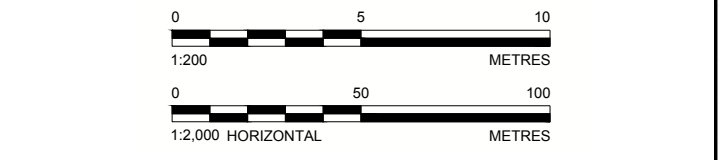
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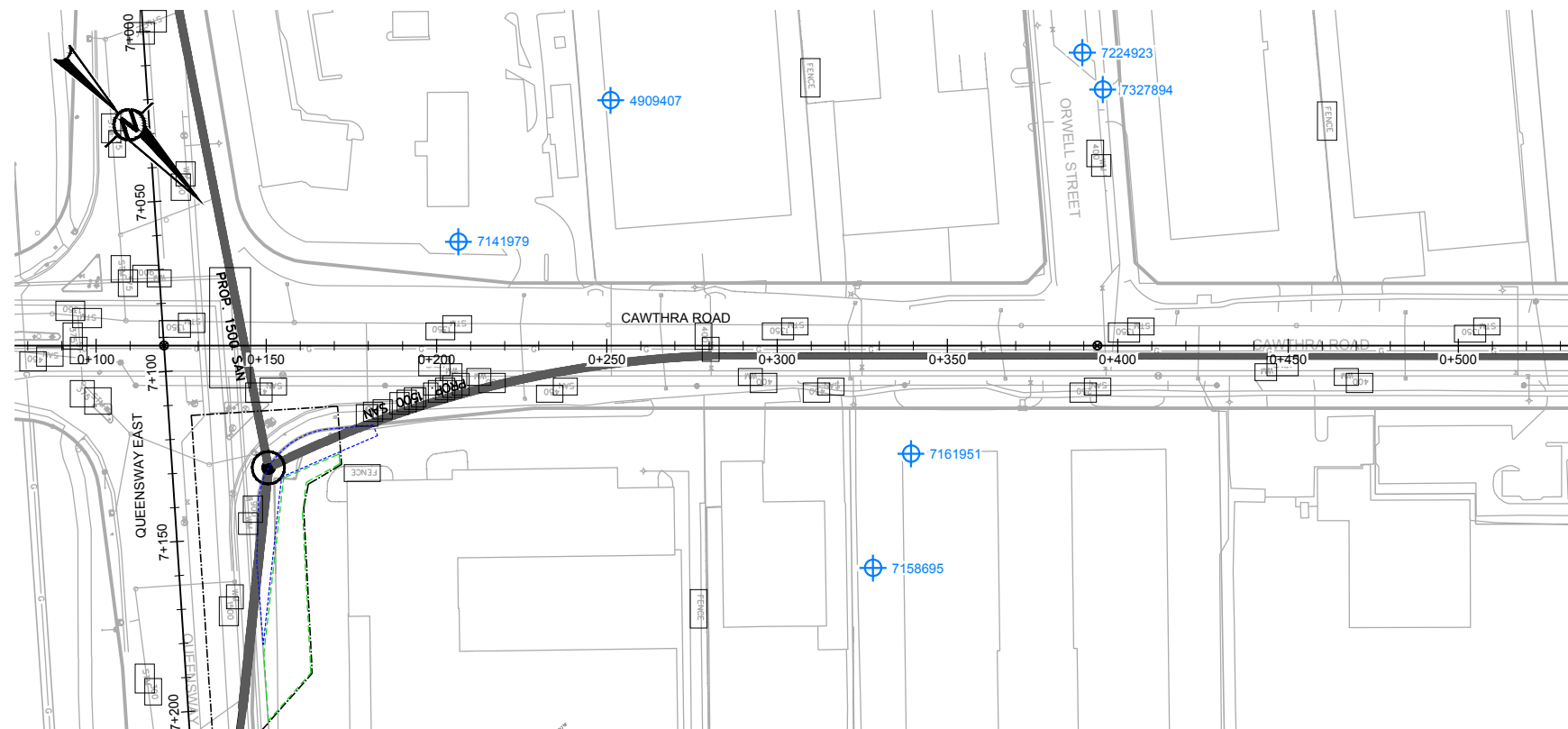
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BURNHAMTHORPE 3+000 TO 3+450

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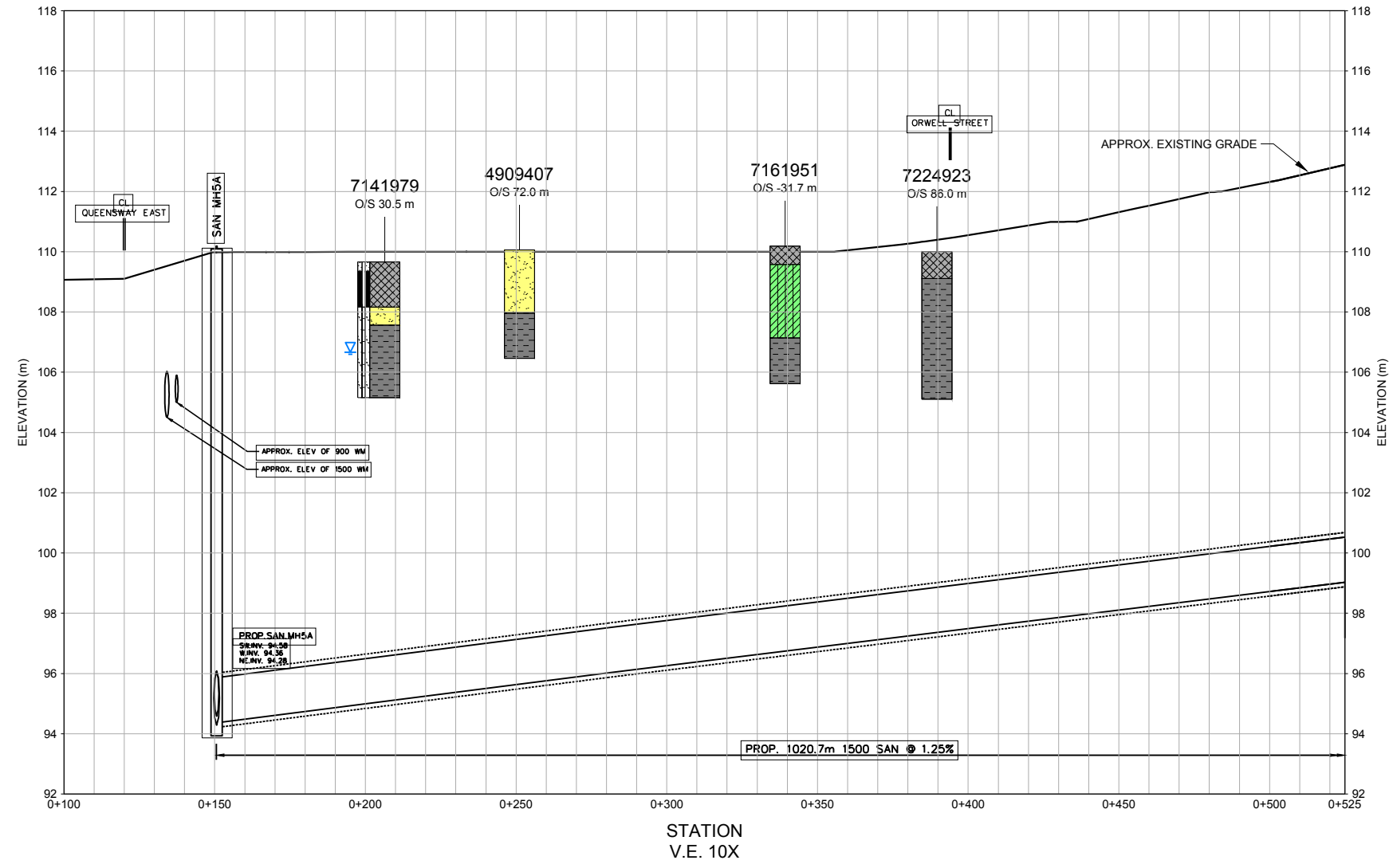
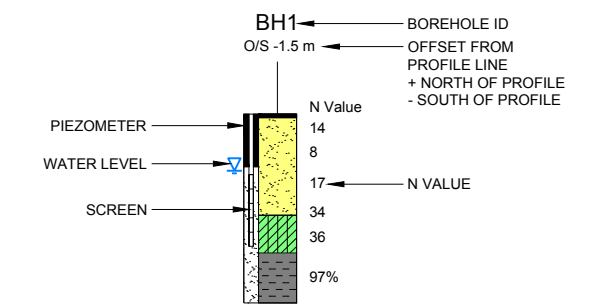
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**LEGEND**

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	SAND		SHALE
	SILTY SAND		

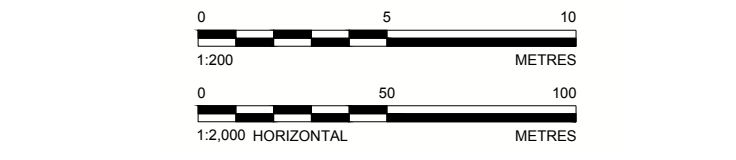


**NOTE(S)**

- THE NORTHINGS, EASTINGS AND ELEVATIONS SHOWN ARE APPROXIMATE AND ARE BASED ON COORDINATES AND ELEVATIONS AND/OR BOREHOLE LOCATIONS PLANS REPORTED BY OTHERS. THE COORDINATES WERE NOT ALWAYS SURVEYED, NOR WERE THE REFERENCE SYSTEMS / DATUMS REPORTED.
- THE GROUND SURFACE ELEVATION OF THE MECP WELLS SHOWN WAS NOT SURVEYED AND IS PULLED FROM A MODEL, DEM - GTA ORTHO DEM 2002 (2M DEM), USING THE NORTHING AND EASTINGS PROVIDED BY MECP.

**REFERENCE(S)**

- BASE PLAN PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-BASE.dwg, RECEIVED JULY 8, 2021 AND 718018-DESIGN.dwg, RECEIVED NOVEMBER 17, 2021.
- HORIZONTAL ALIGNMENT PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-DESIGN-alignments.xml, RECEIVED JULY 22, 2021.



CLIENT  
GM BLUEPLAN ENGINEERING LIMITED

PROJECT  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

TITLE  
**BOREHOLE LOCATION PLAN AND PROFILE**  
CAWTHRA ROAD, STA 0+100 TO 0+525

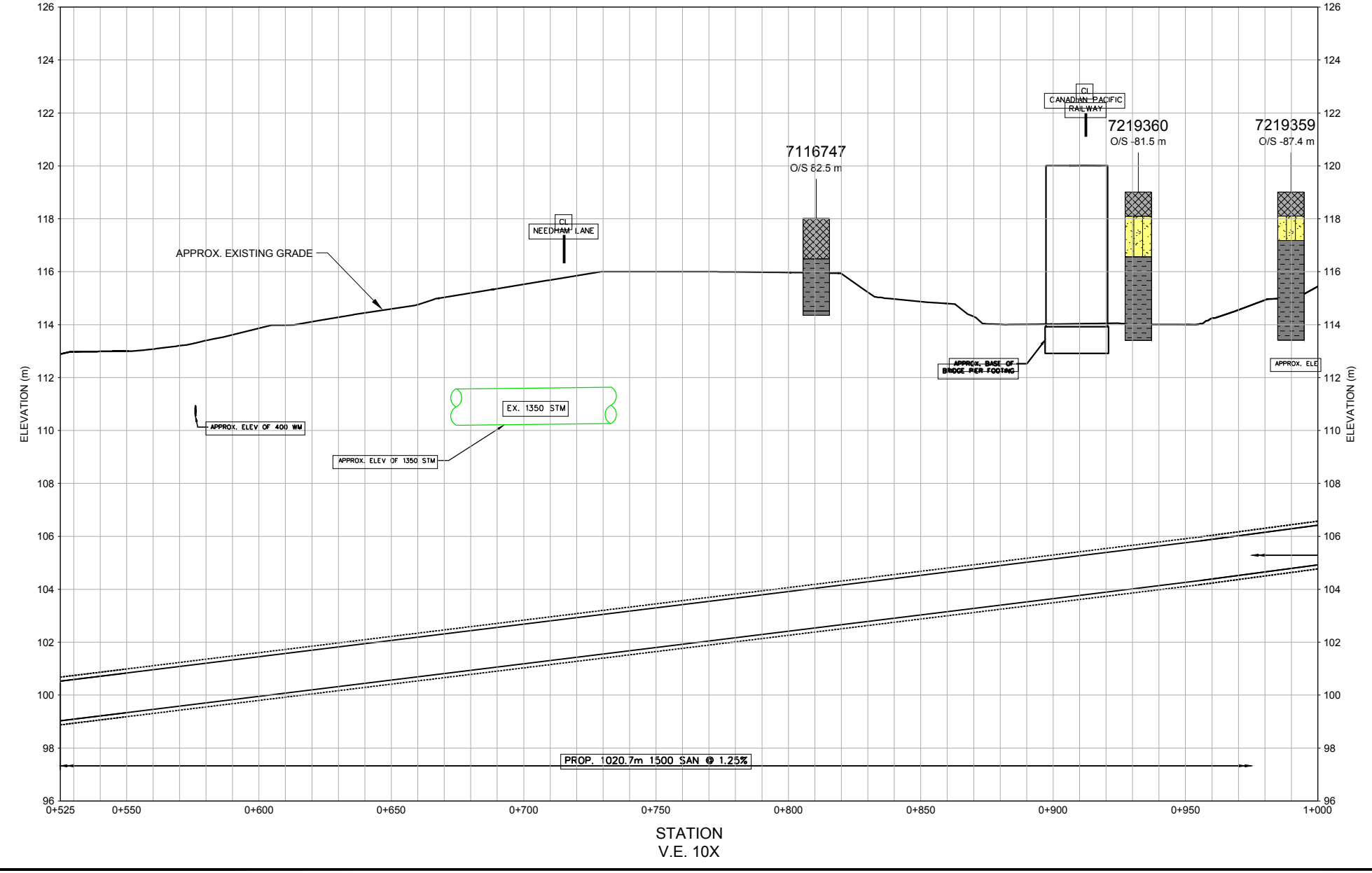
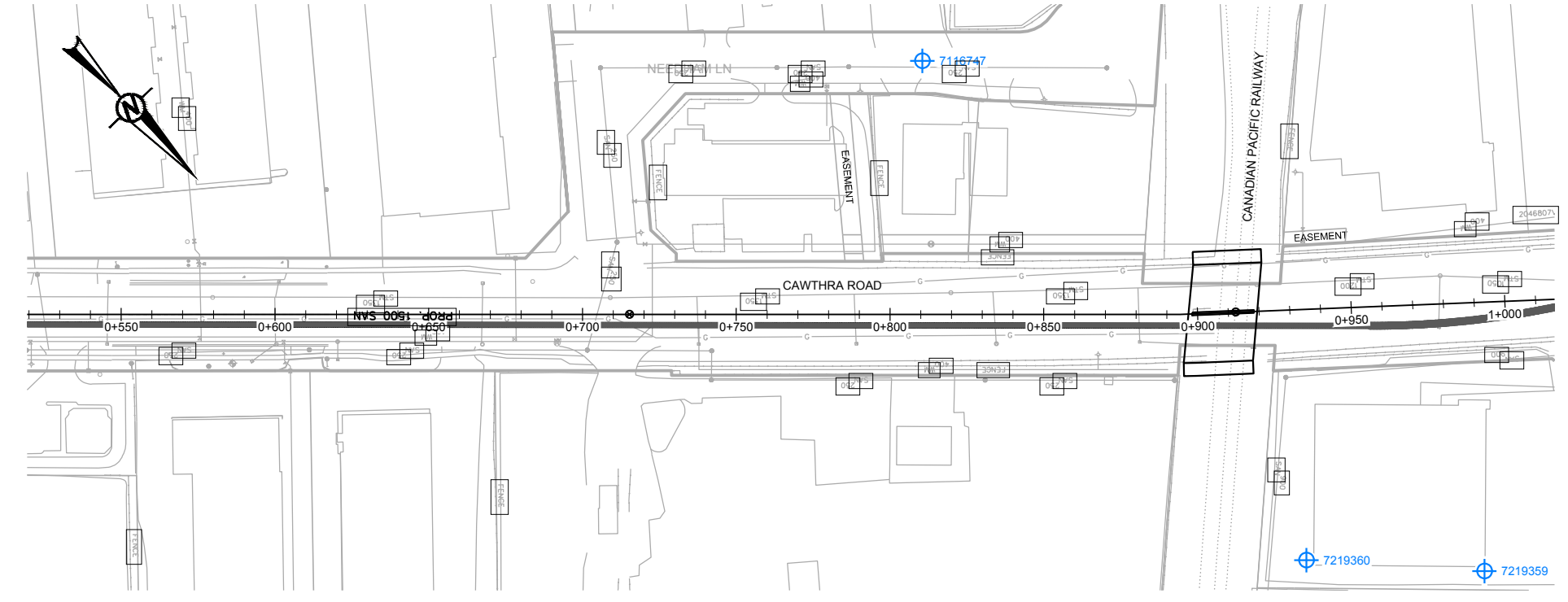
CONSULTANT	YYYY-MM-DD	2021-11-24
DESIGNED		
PREPARED		DD/SA
REVIEWED		DH
APPROVED		

PROJECT NO. 18112273 PHASE (4000) REV. 0 FIGURE 7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3 (841x1191 mm) TO A4 (297x420 mm)



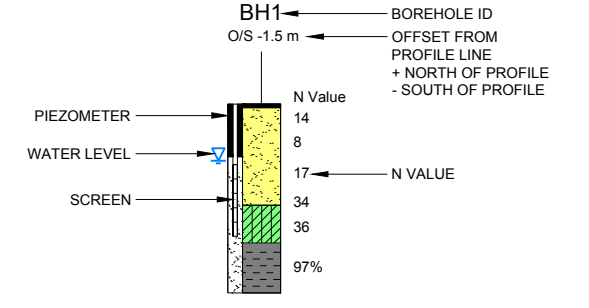
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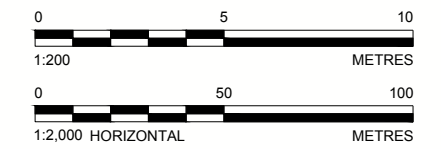
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	BOREHOLE - GOLDER, 1976		BOREHOLE - WSP, 2018
	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
			BOREHOLE - SPL, 2013

	ASPHALT		SANDY SILT
	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
	FILL		SILTY CLAY
	GRAVEL		SILTY CLAY TILL
	SAND AND GRAVEL		CLAYEY SILT TILL
	SAND		SHALE
	SILTY SAND		



- NOTE(S)**
- THE NORTHINGS, EASTINGS AND ELEVATIONS SHOWN ARE APPROXIMATIONS AND ARE BASED ON COORDINATES AND ELEVATIONS AND/OR BOREHOLE LOCATIONS PLANS REPORTED BY OTHERS. THE COORDINATES WERE NOT ALWAYS SURVEYED, NOR WERE THE REFERENCE SYSTEMS / DATUMS REPORTED.
  - THE GROUND SURFACE ELEVATION OF THE MECP WELLS SHOWN WAS NOT SURVEYED AND IS PULLED FROM A MODEL, DEM - GTA ORTHO DEM 2002 (2M DEM), USING THE NORTHING AND EASTINGS PROVIDED BY MECP.

- REFERENCE(S)**
- BASE PLAN PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-BASE.dwg, RECEIVED JULY 8, 2021 AND 718018-DESIGN.dwg, RECEIVED NOVEMBER 17, 2021.
  - HORIZONTAL ALIGNMENT PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-DESIGN-alignments.xml, RECEIVED JULY 22, 2021.



**CLIENT**  
GM BLUEPLAN ENGINEERING LIMITED

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**PROJECT**  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

---

**TITLE**  
**BOREHOLE LOCATION PLAN AND PROFILE**  
**CAWTHRA ROAD, STA 0+525 TO 1+000**

---

CONSULTANT	YYYY-MM-DD	2021-11-24
	DESIGNED	
	PREPARED	DD/SA
	REVIEWED	DH
	APPROVED	

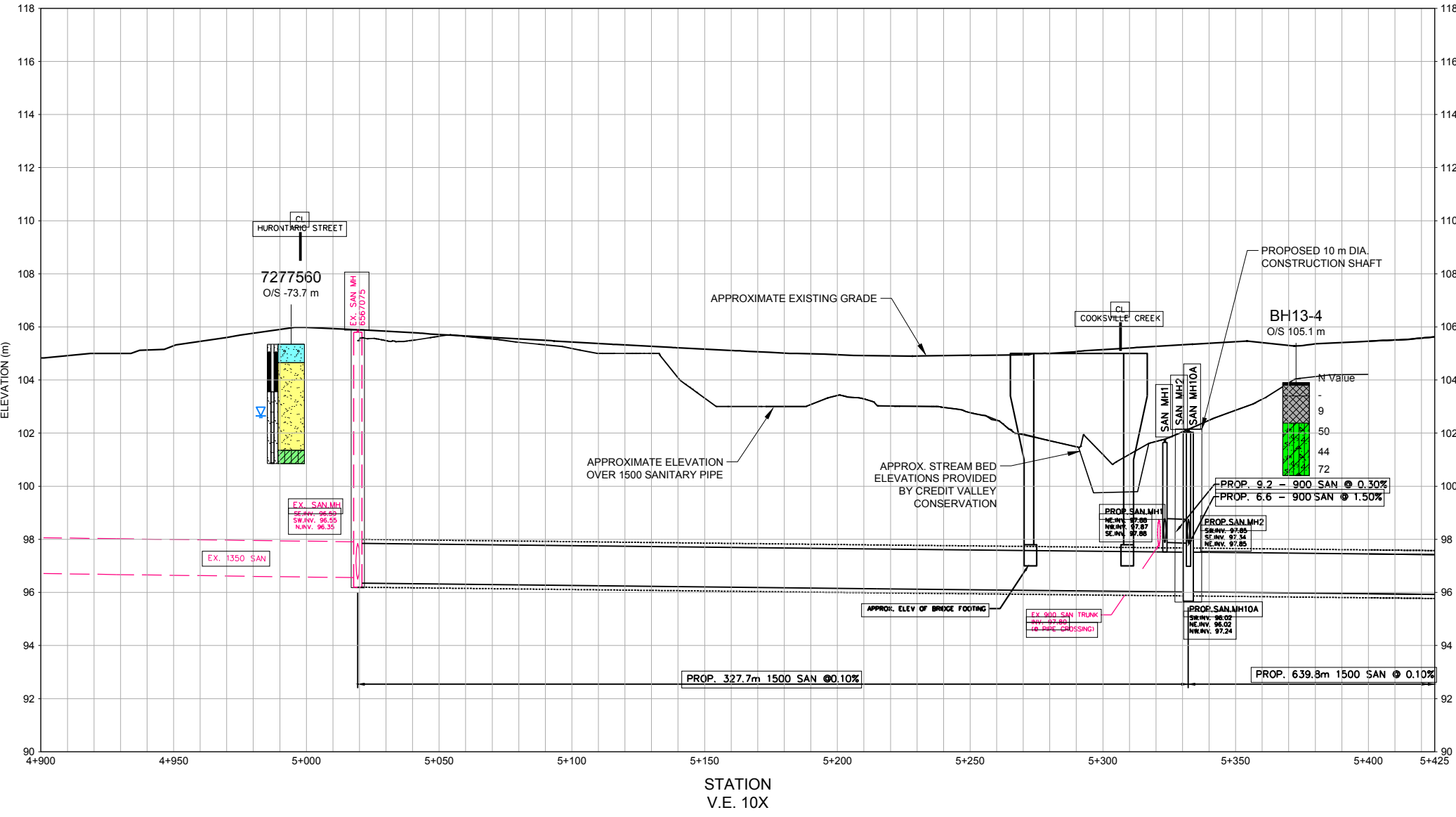
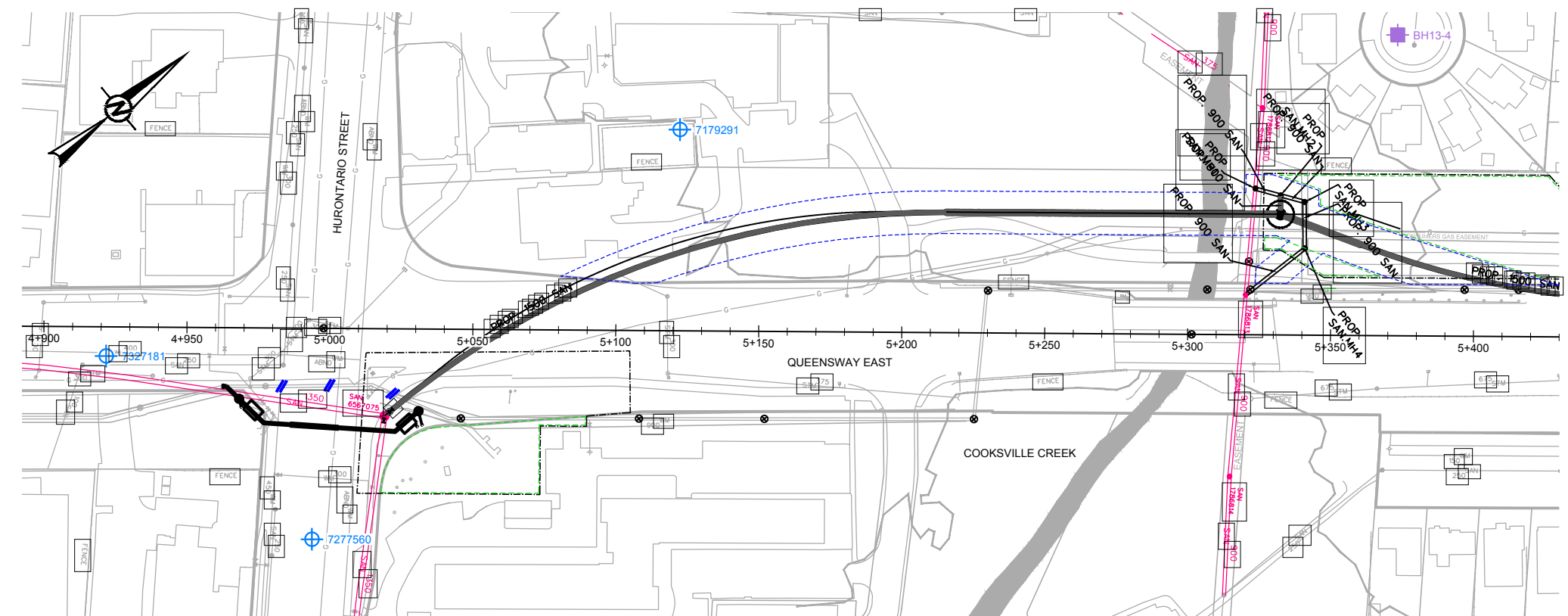
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PROJECT NO.	PHASE	REV.	FIGURE
18112273	(4000)	0	8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/B3 TO A4/B4

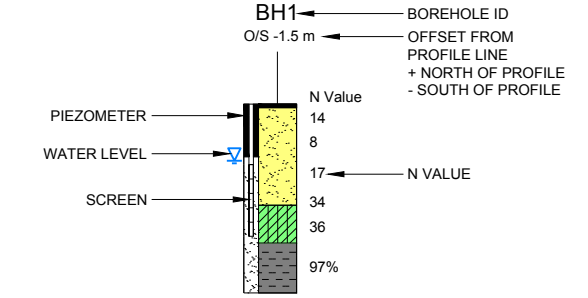


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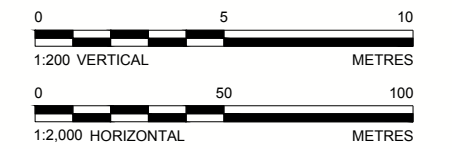


LEGEND			
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	BOREHOLE - GOLDER, 1976		BOREHOLE - WSP, 2018
	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
			BOREHOLE - SPL, 2013

	ASPHALT		SANDY SILT
	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
	FILL		SILTY CLAY
	GRAVEL		SILTY CLAY TILL
	SAND AND GRAVEL		CLAYEY SILT TILL
	SAND		SHALE
	SILTY SAND		



- NOTE(S)**
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  - THE GROUND SURFACE ELEVATION OF THE MECP WELLS SHOWN WAS NOT SURVEYED AND IS PULLED FROM A MODEL, DEM - GTA ORTHO DEM 2002 (2M DEM), USING THE NORTHING AND EASTINGS PROVIDED BY MECP.
- REFERENCE(S)**
- BASE PLAN PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-BASE.dwg, RECEIVED JULY 8, 2021 AND 718018-DESIGN.dwg, RECEIVED NOVEMBER 17, 2021.
  - HORIZONTAL ALIGNMENT PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-DESIGN-alignments.xml, RECEIVED JULY 22, 2021.



**CLIENT**  
GM BLUEPLAN ENGINEERING LIMITED

**PROJECT**  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

**TITLE**  
BOREHOLE LOCATION PLAN AND PROFILE  
QUEENSWAY EAST, STA 4+900 TO 5+425

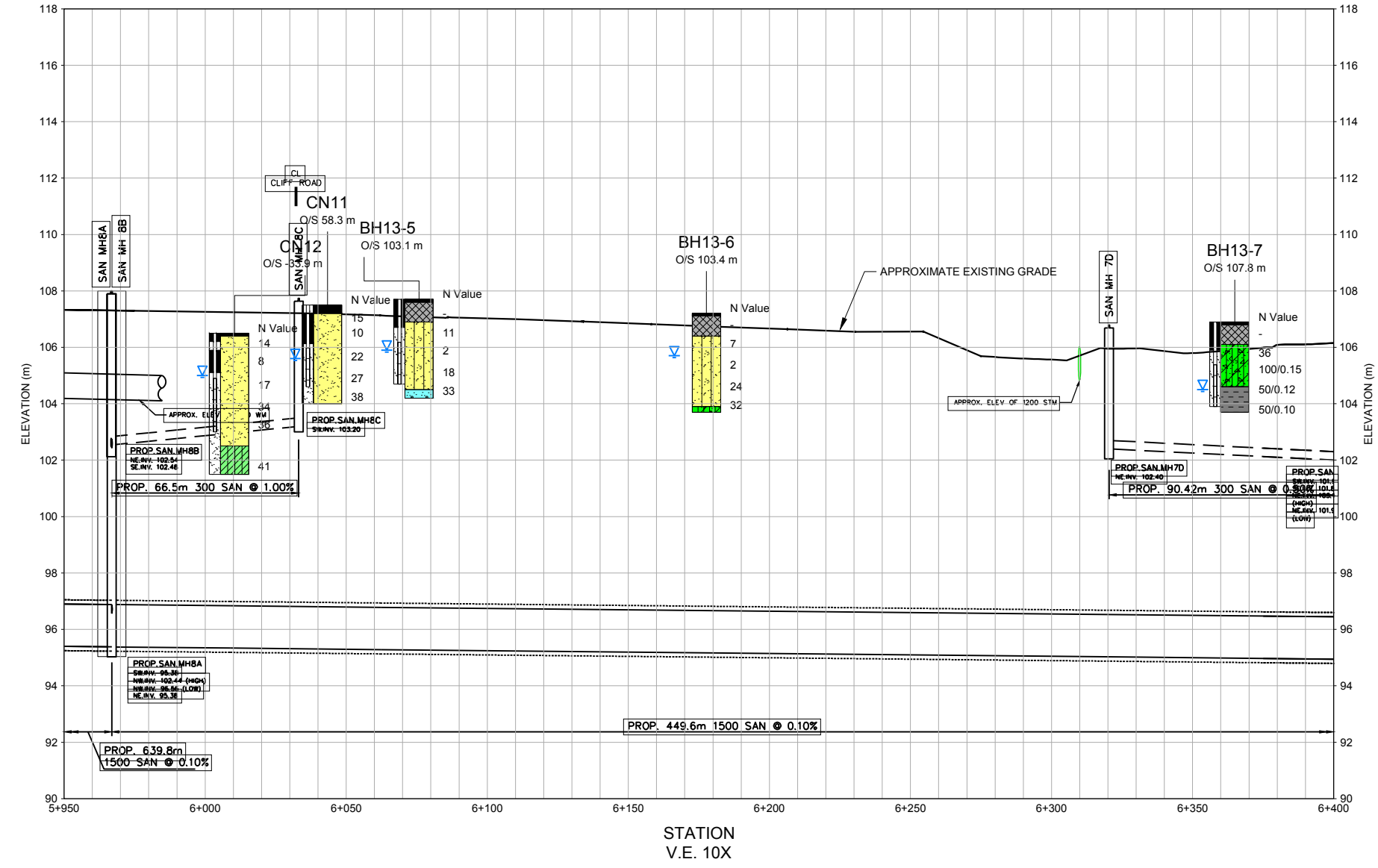
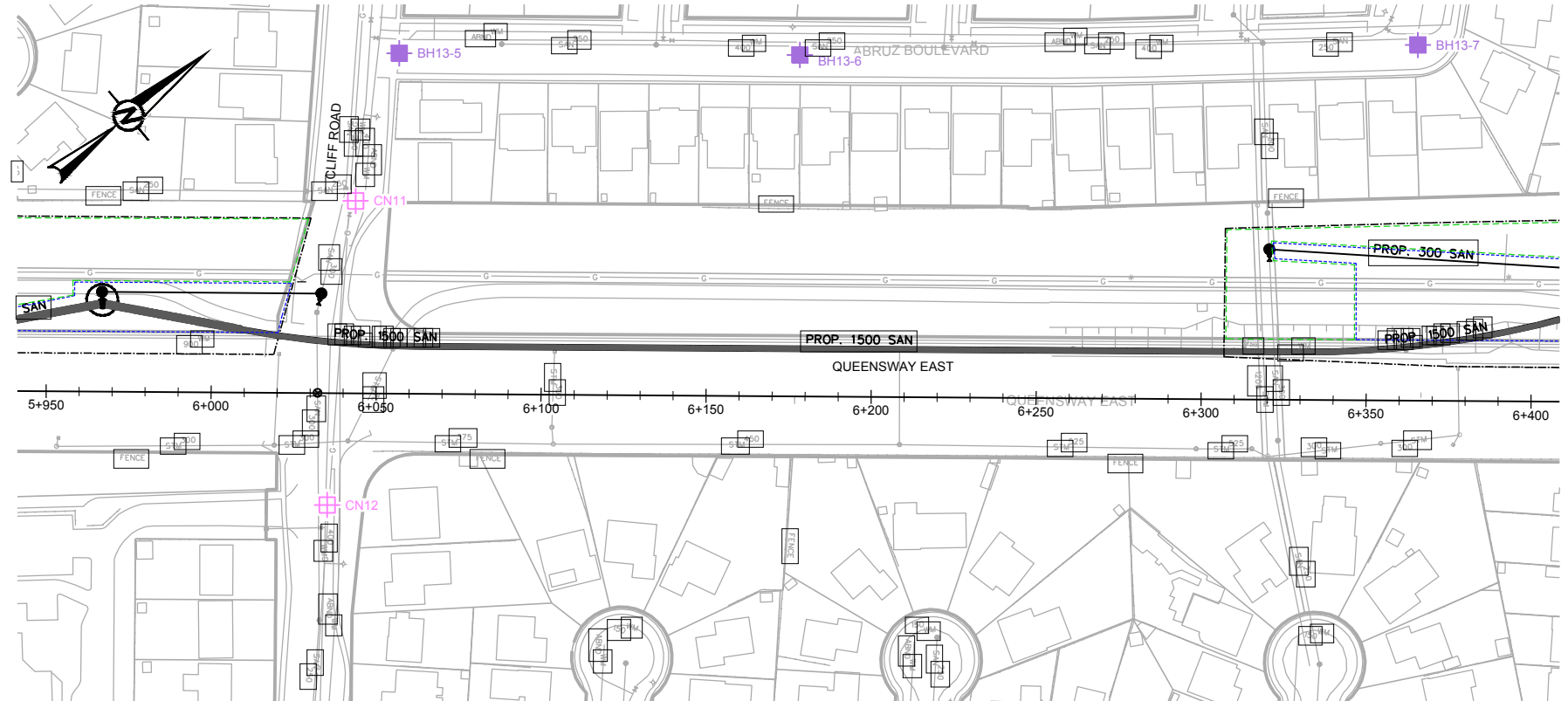
CONSULTANT	DATE	REVISION
YYYY-MM-DD	2021-11-24	
DESIGNED		
PREPARED	DD/SA	
REVIEWED	DH	
APPROVED		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3S/B





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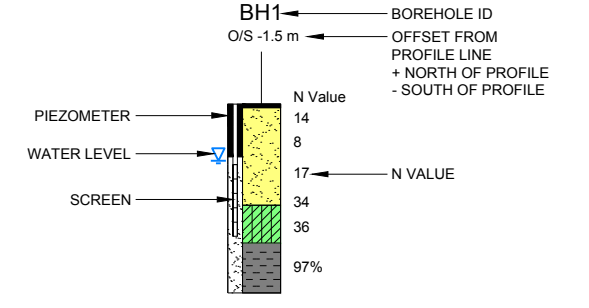


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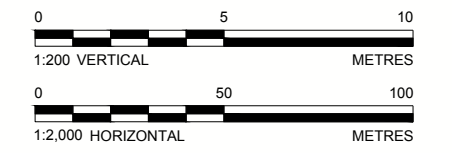
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	BOREHOLE - GOLDER, 1976		BOREHOLE - WSP, 2018
	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
			BOREHOLE - SPL, 2013

	ASPHALT		SANDY SILT
	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
	FILL		SILTY CLAY
	GRAVEL		SILTY CLAY TILL
	SAND AND GRAVEL		CLAYEY SILT TILL
	SAND		SHALE
	SILTY SAND		



- NOTE(S)**
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  - THE GROUND SURFACE ELEVATION OF THE MECP WELLS SHOWN WAS NOT SURVEYED AND IS PULLED FROM A MODEL, DEM - GTA ORTHO DEM 2002 (2M DEM), USING THE NORTHING AND EASTINGS PROVIDED BY MECP.
- REFERENCE(S)**
- BASE PLAN PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-BASE.dwg, RECEIVED JULY 8, 2021 AND 718018-DESIGN.dwg, RECEIVED NOVEMBER 17, 2021.
  - HORIZONTAL ALIGNMENT PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-DESIGN-alignments.xml, RECEIVED JULY 22, 2021.



**CLIENT**  
GM BLUEPLAN ENGINEERING LIMITED

**PROJECT**  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

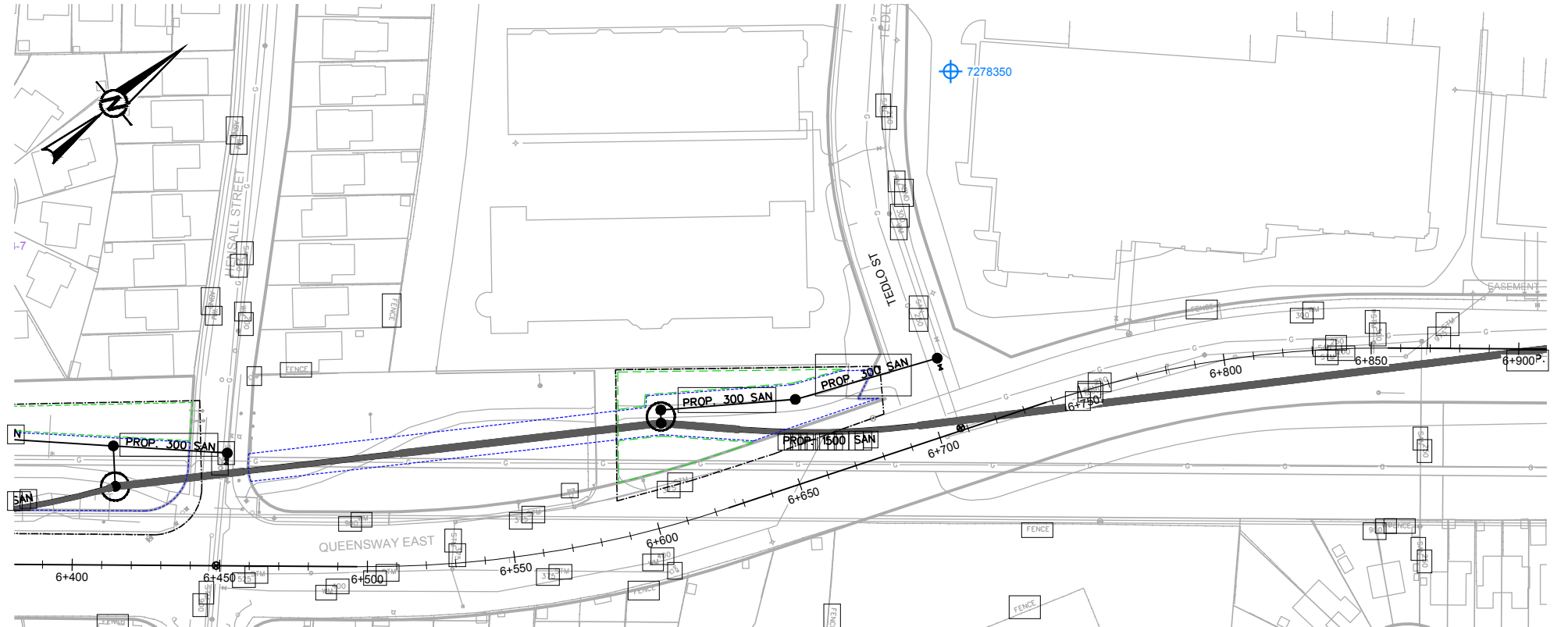
**TITLE**  
**BOREHOLE LOCATION PLAN AND PROFILE**  
**QUEENSWAY EAST, STA 5+950 TO 6+400**

CONSULTANT	YYYY-MM-DD	2021-11-24
DESIGNED		
PREPARED	DD/SA	
REVIEWED	DH	
APPROVED		

PROJECT NO.	PHASE	REV.	FIGURE
18112273	(4000)	0	12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/B3 TO A4/B4

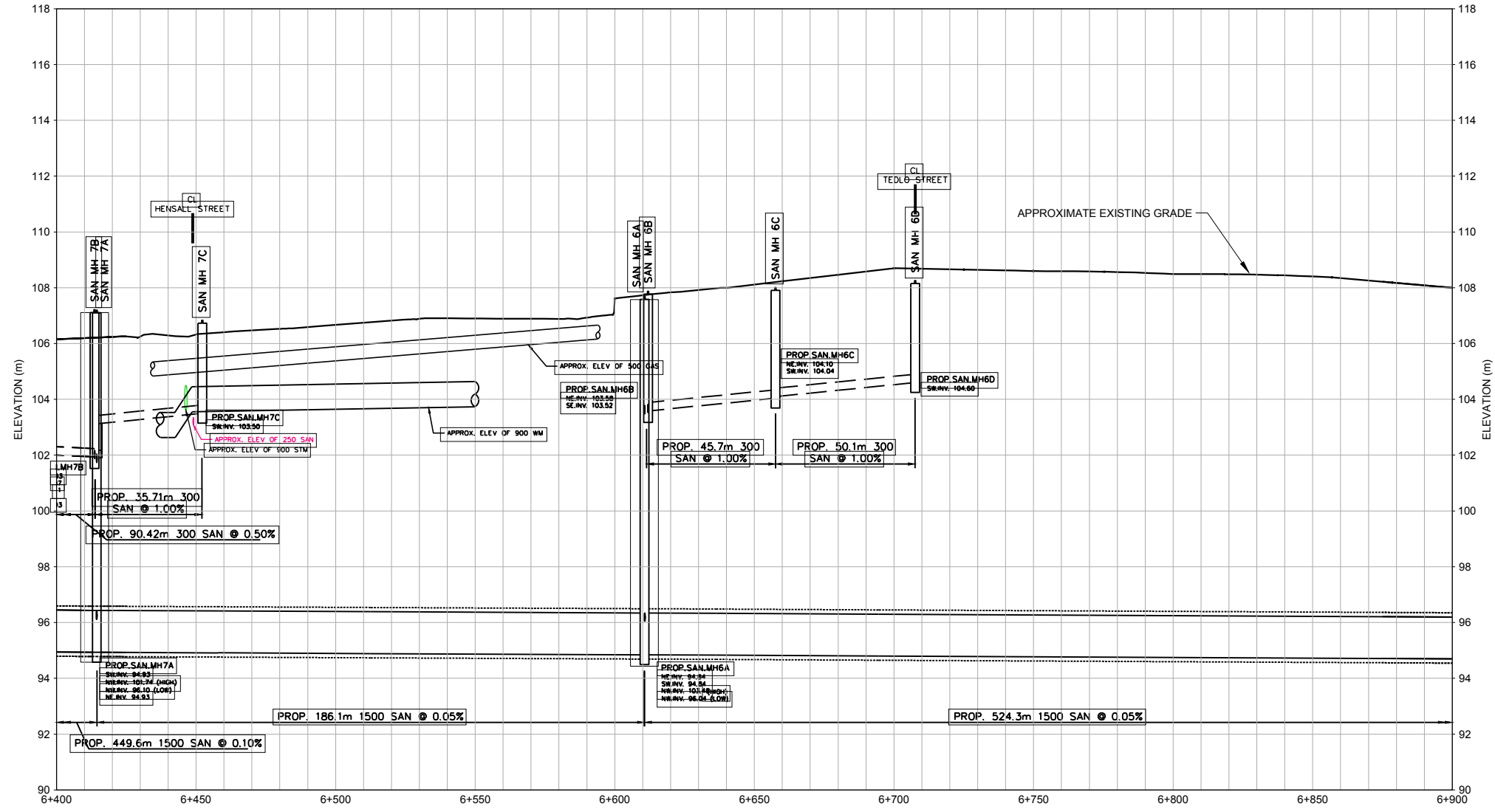
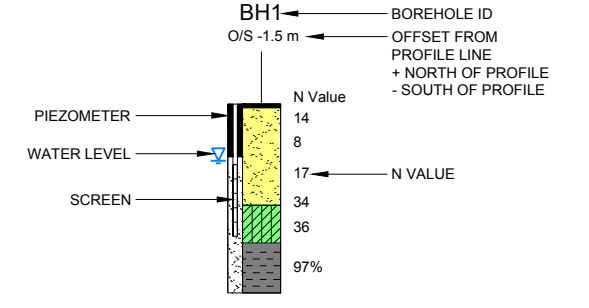
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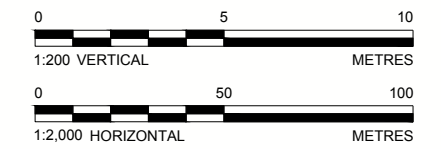
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	BOREHOLE - GOLDER, 1976		BOREHOLE - WSP, 2018
	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
			BOREHOLE - SPL, 2013

	ASPHALT		SANDY SILT
	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
	FILL		SILTY CLAY
	GRAVEL		SILTY CLAY TILL
	SAND AND GRAVEL		CLAYEY SILT TILL
	SAND		SHALE
	SILTY SAND		



- NOTE(S)**
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  - THE GROUND SURFACE ELEVATION OF THE MECP WELLS SHOWN WAS NOT SURVEYED AND IS PULLED FROM A MODEL, DEM - GTA ORTHO DEM 2002 (2M DEM), USING THE NORTHING AND EASTINGS PROVIDED BY MECP.

- REFERENCE(S)**
- BASE PLAN PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-BASE.dwg, RECEIVED JULY 8, 2021 AND 718018-DESIGN.dwg, RECEIVED NOVEMBER 17, 2021.
  - HORIZONTAL ALIGNMENT PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-DESIGN-alignments.xml, RECEIVED JULY 22, 2021.



CLIENT  
GM BLUEPLAN ENGINEERING LIMITED

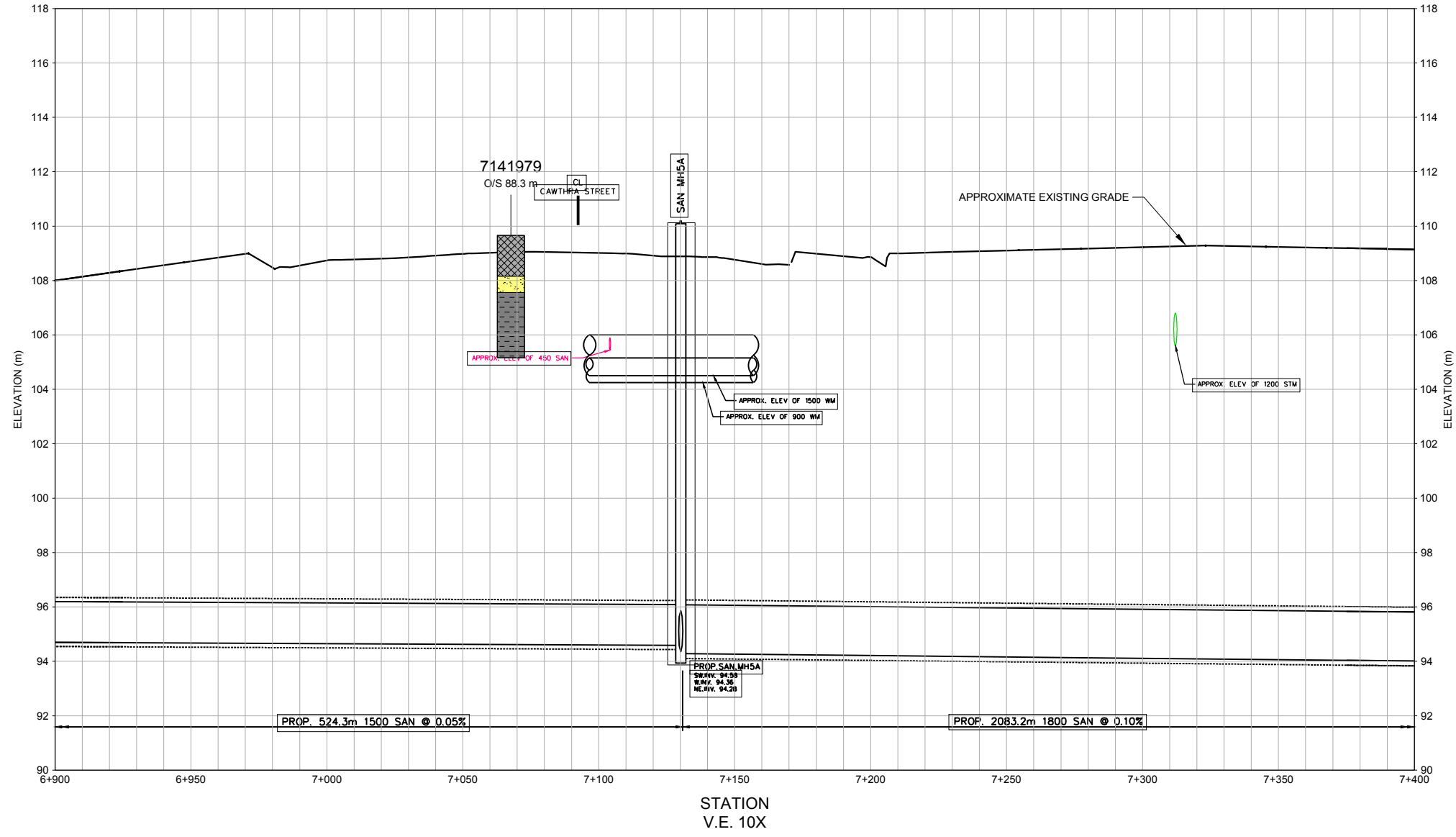
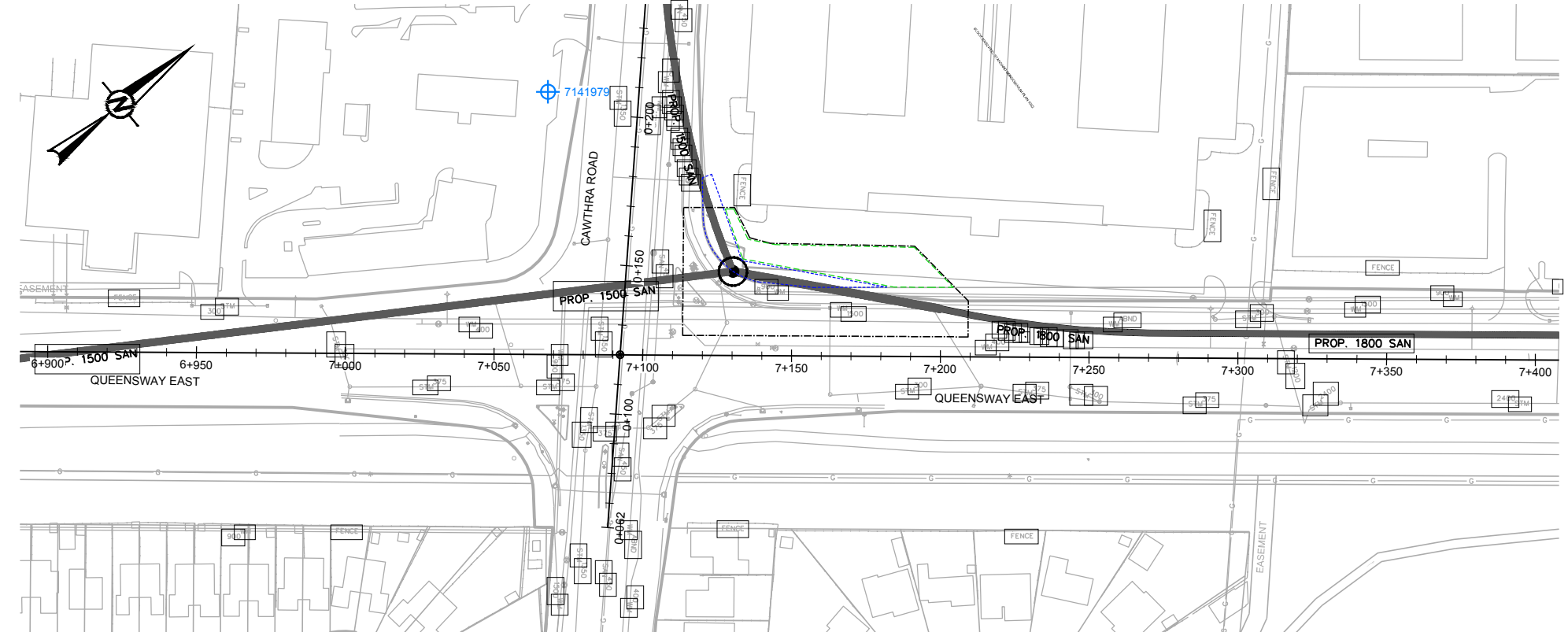
PROJECT  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

TITLE  
**BOREHOLE LOCATION PLAN AND PROFILE**  
**QUEENSWAY EAST, STA 6+400 TO 6+900**

CONSULTANT	YYYY-MM-DD	2021-11-24
	DESIGNED	
	PREPARED	DD/SA
	REVIEWED	DH
	APPROVED	

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3S18

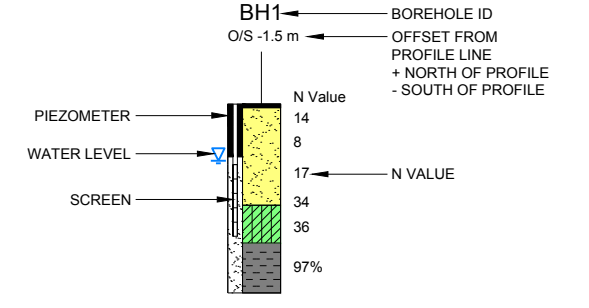
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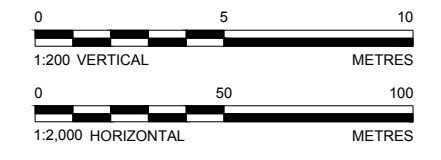
**LEGEND**

	BOREHOLE - GOLDER, 1969		BOREHOLE - WSP, 2018
	BOREHOLE - GOLDER, 1976		BOREHOLE - WSP, 2018
	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
			BOREHOLE - SPL, 2013

	ASPHALT		SANDY SILT
	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
	FILL		SILTY CLAY
	GRAVEL		SILTY CLAY TILL
	SAND AND GRAVEL		CLAYEY SILT TILL
	SAND		SHALE
	SILTY SAND		



- NOTE(S)**
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  - THE GROUND SURFACE ELEVATION OF THE MECP WELLS SHOWN WAS NOT SURVEYED AND IS PULLED FROM A MODEL, DEM - GTA ORTHO DEM 2002 (2M DEM), USING THE NORTHING AND EASTINGS PROVIDED BY MECP.
- REFERENCE(S)**
- BASE PLAN PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-BASE.dwg, RECEIVED JULY 8, 2021 AND 718018-DESIGN.dwg, RECEIVED NOVEMBER 17, 2021.
  - HORIZONTAL ALIGNMENT PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-DESIGN-alignments.xml, RECEIVED JULY 22, 2021.



**CLIENT**  
GM BLUEPLAN ENGINEERING LIMITED

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**PROJECT**  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

---

**TITLE**  
**BOREHOLE LOCATION PLAN AND PROFILE**  
**QUEENSWAY EAST, STA 6+900 TO 7+400**

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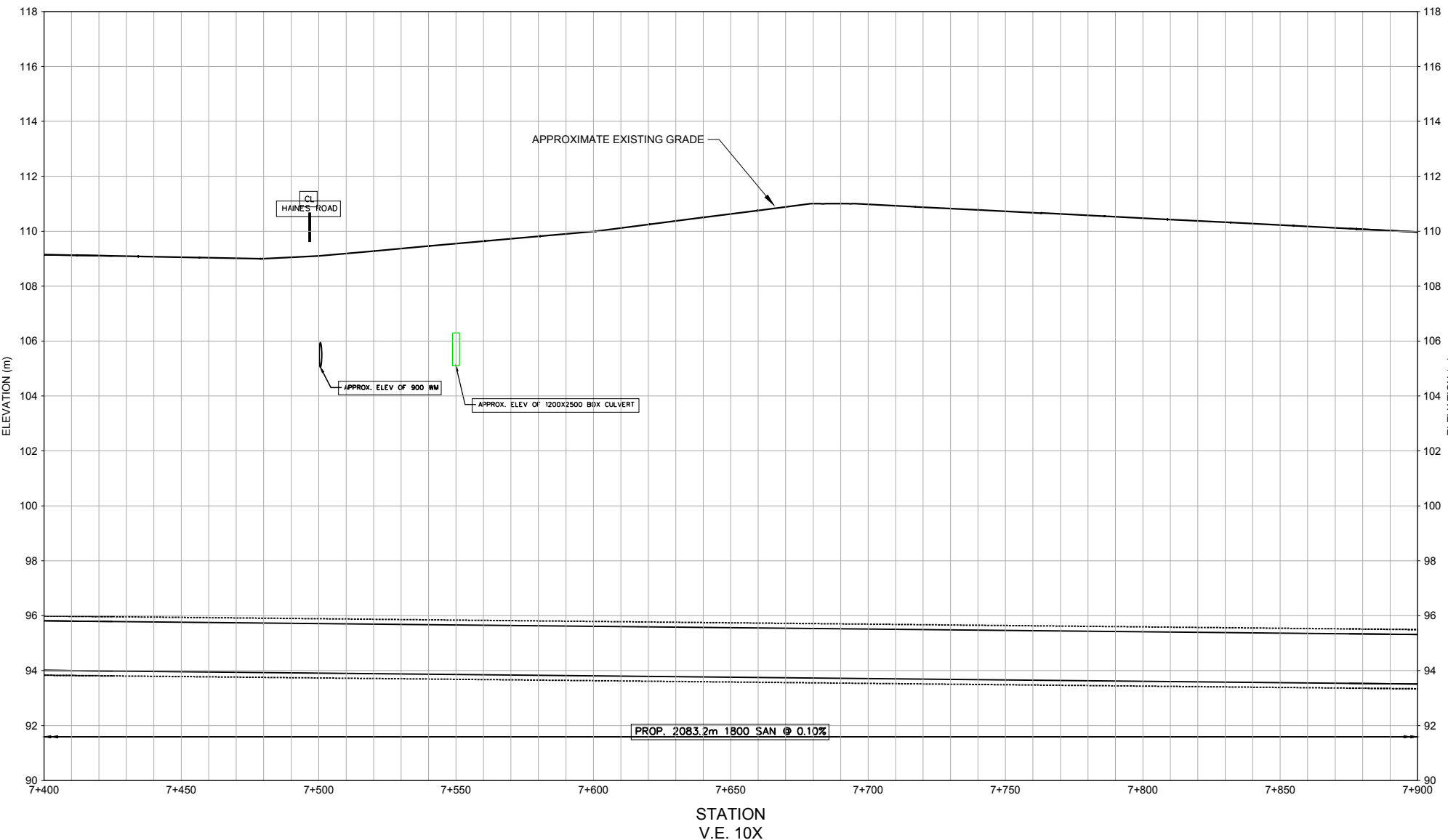
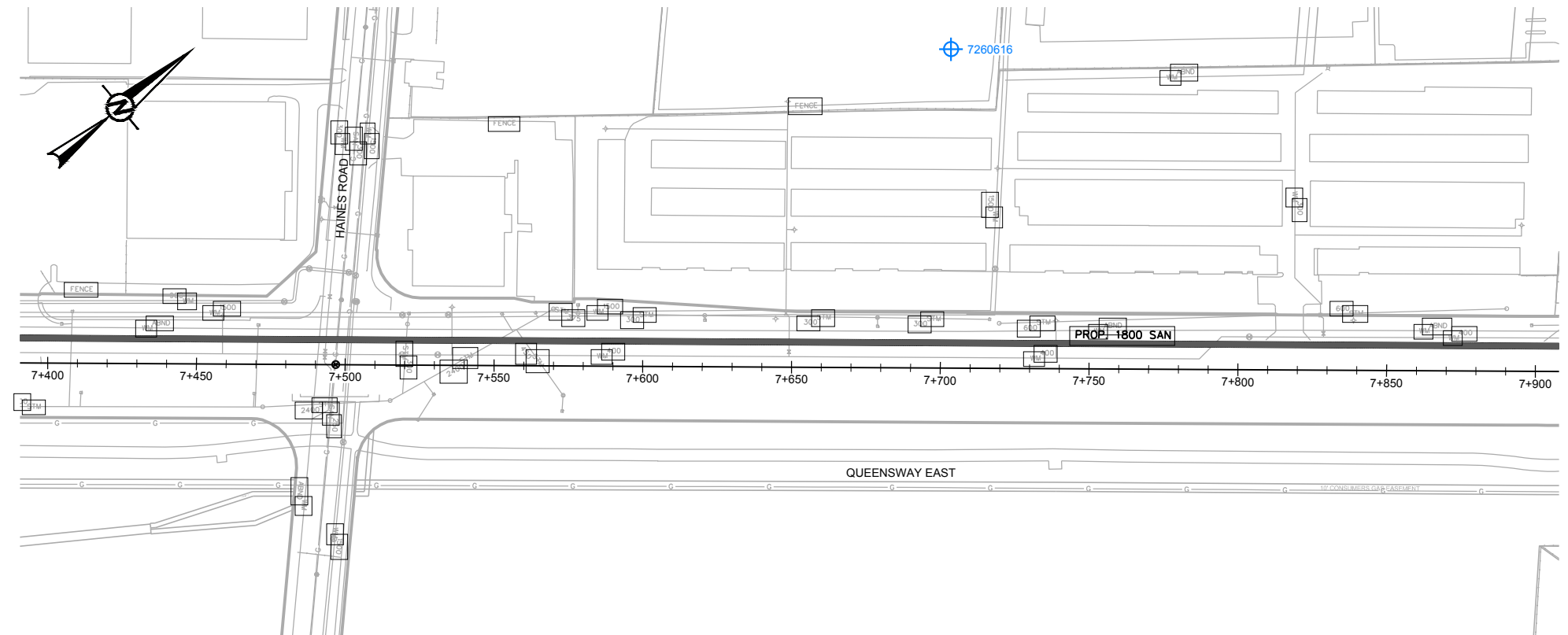
<b>CONSULTANT</b>	YYYY-MM-DD	2021-11-24
	DESIGNED	
	PREPARED	DD/SA
	REVIEWED	DH
	APPROVED	

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<b>PROJECT NO.</b>	<b>PHASE</b>	<b>REV.</b>	<b>FIGURE</b>
18112273	(4000)	0	14

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/B

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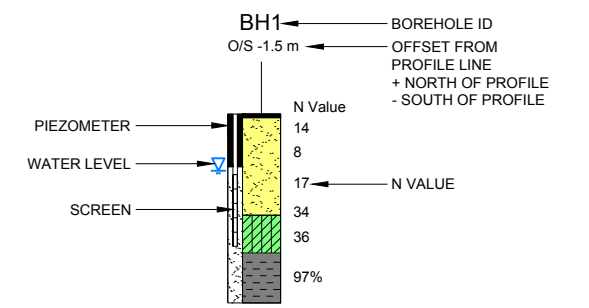


STATION  
V.E. 10X

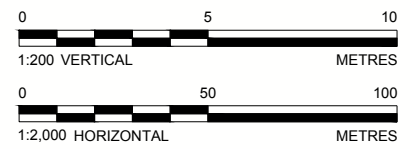
**LEGEND**

	BOREHOLE - GOLDER, 1969		BOREHOLE - WSP, 2018
	BOREHOLE - GOLDER, 1976		BOREHOLE - WSP, 2018
	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
			BOREHOLE - SPL, 2013

	ASPHALT		SANDY SILT
	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
	FILL		SILTY CLAY
	GRAVEL		SILTY CLAY TILL
	SAND AND GRAVEL		CLAYEY SILT TILL
	SAND		SHALE
	SILTY SAND		



- NOTE(S)**
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- REFERENCE(S)**
- BASE PLAN PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-BASE.dwg, RECEIVED JULY 8, 2021 AND 718018-DESIGN.dwg, RECEIVED NOVEMBER 17, 2021.
  - HORIZONTAL ALIGNMENT PROVIDED IN DIGITAL FORMAT BY GM BLUEPLAN, FILE NO. 718018-DESIGN-alignments.xml, RECEIVED JULY 22, 2021.



CLIENT  
GM BLUEPLAN ENGINEERING LIMITED

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PROJECT  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

---

TITLE  
**BOREHOLE LOCATION PLAN AND PROFILE**  
QUEENSWAY EAST, STA 7+400 TO 7+900

---

CONSULTANT	YYYY-MM-DD	2021-11-24
	DESIGNED	
MEMBER OF WSP	PREPARED	DD/SA
	REVIEWED	DH
	APPROVED	

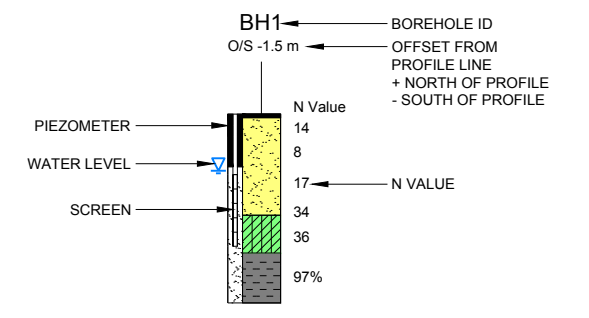
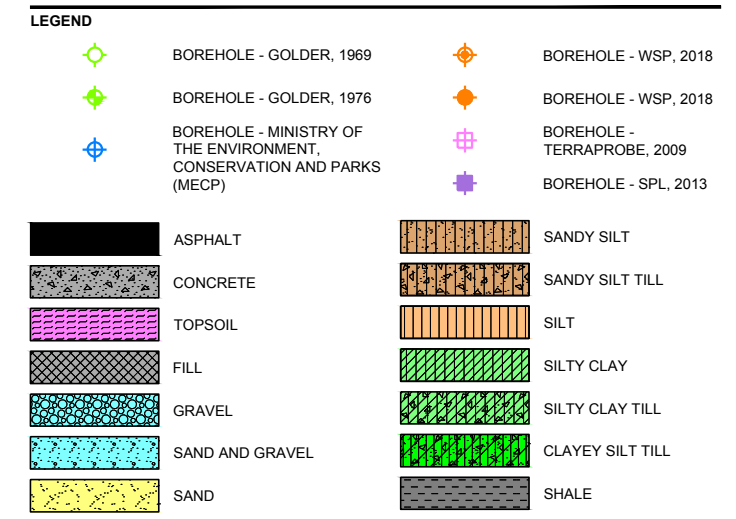
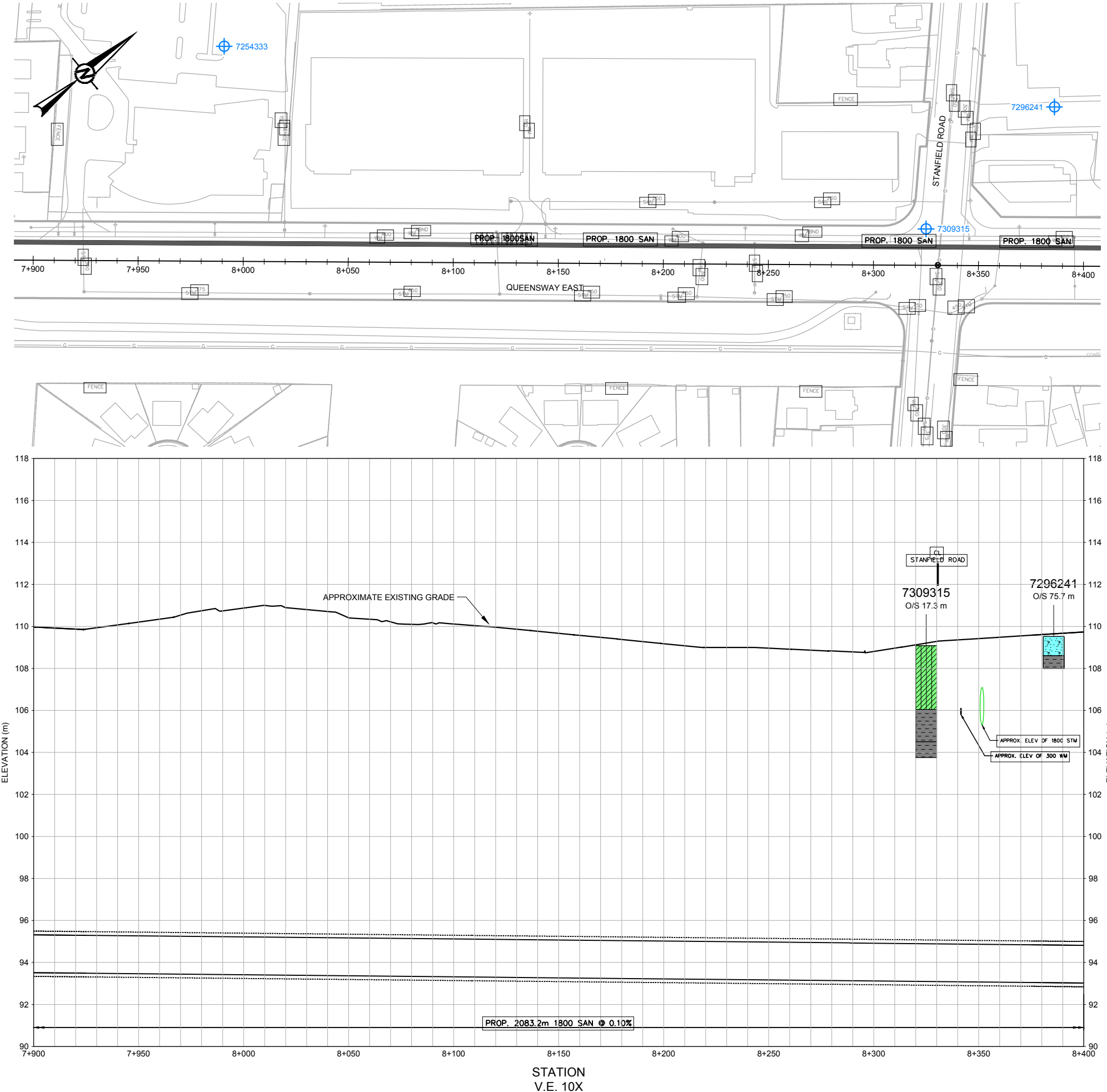
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PROJECT NO.	PHASE	REV.	FIGURE
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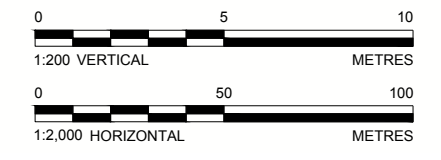
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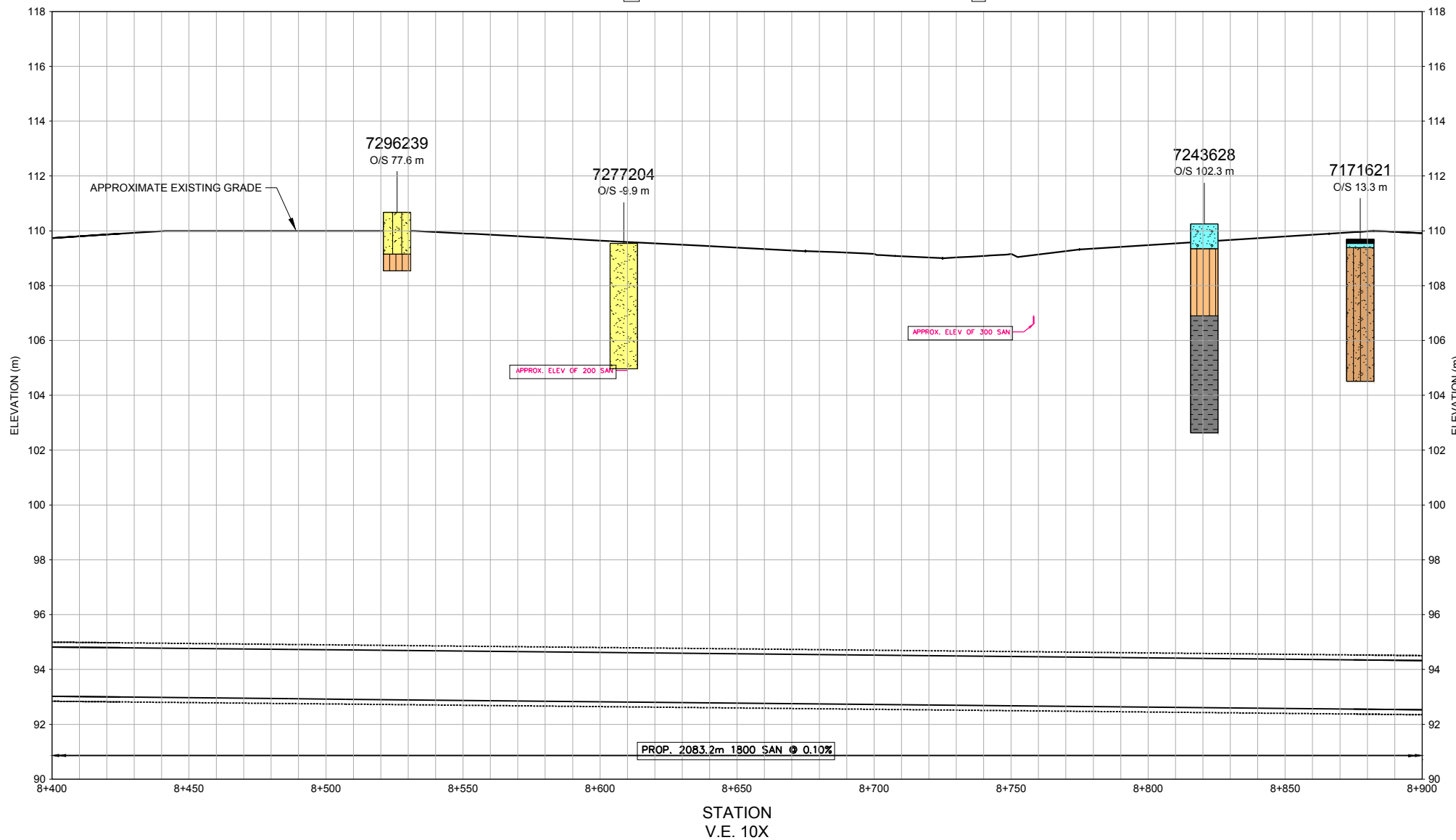
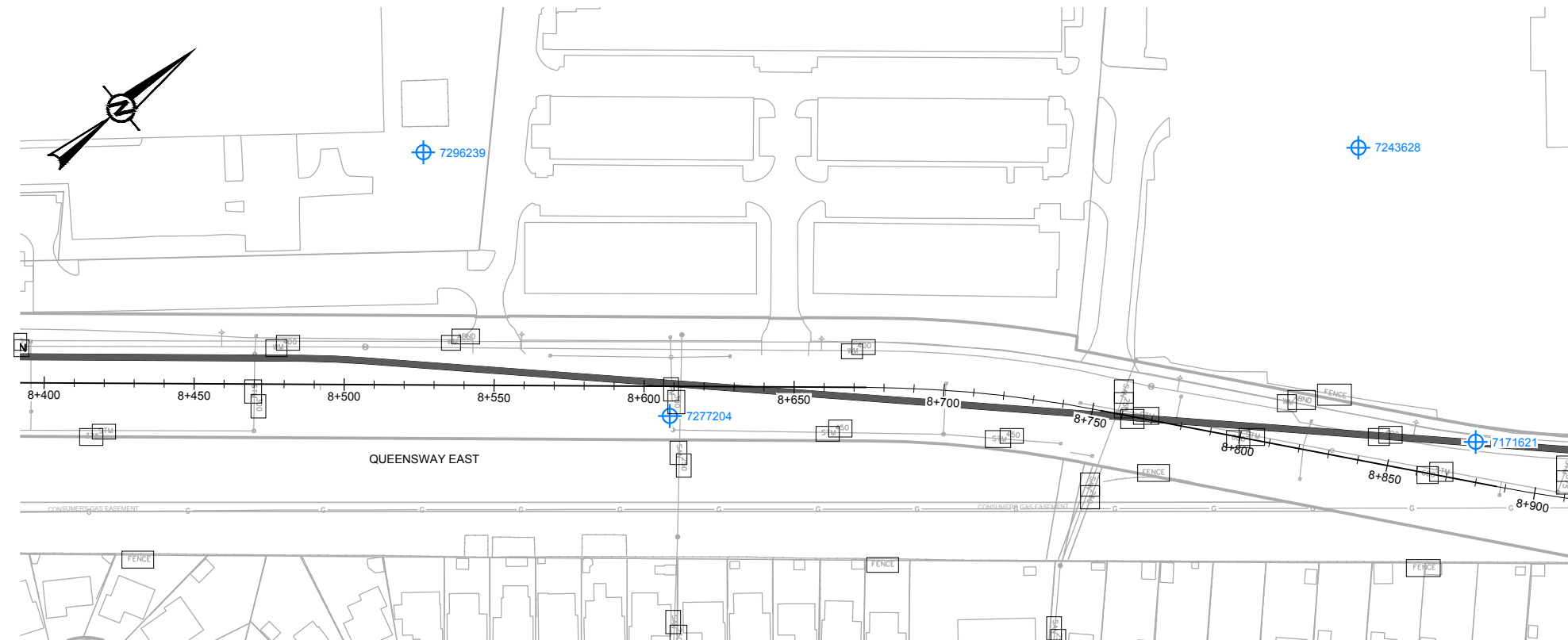
- ### NOTE(S)
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- 
- ### REFERENCE(S)
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CLIENT		
GM BLUEPLAN ENGINEERING LIMITED		
PROJECT		
GEOTECHNICAL DESKTOP STUDY MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT CENTRAL MISSISSAUGA WASTEWATER SYSTEM		
TITLE		
BOREHOLE LOCATION PLAN AND PROFILE QUEENSWAY EAST, STA 7+900 TO 8+400		
CONSULTANT	YYYY-MM-DD	2021-11-24
	DESIGNED	
	PREPARED	DD/SA
	REVIEWED	DH
	APPROVED	

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/B3 TO A4/B4

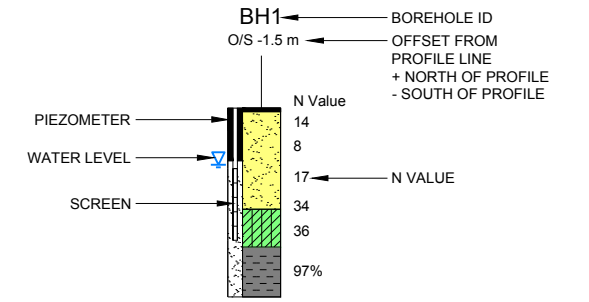
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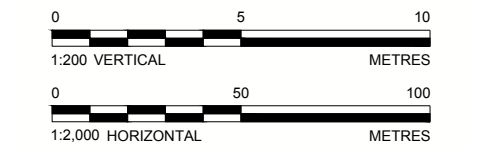
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	BOREHOLE - GOLDER, 1976		BOREHOLE - WSP, 2018
	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
			BOREHOLE - SPL, 2013

	ASPHALT		SANDY SILT
	CONCRETE		SANDY SILT TILL
	TOPSOIL		SILT
	FILL		SILTY CLAY
	GRAVEL		SILTY CLAY TILL
	SAND AND GRAVEL		CLAYEY SILT TILL
	SAND		SHALE
	SILTY SAND		



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PROJECT  
**GEOTECHNICAL DESKTOP STUDY  
 MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
 CENTRAL MISSISSAUGA WASTEWATER SYSTEM**

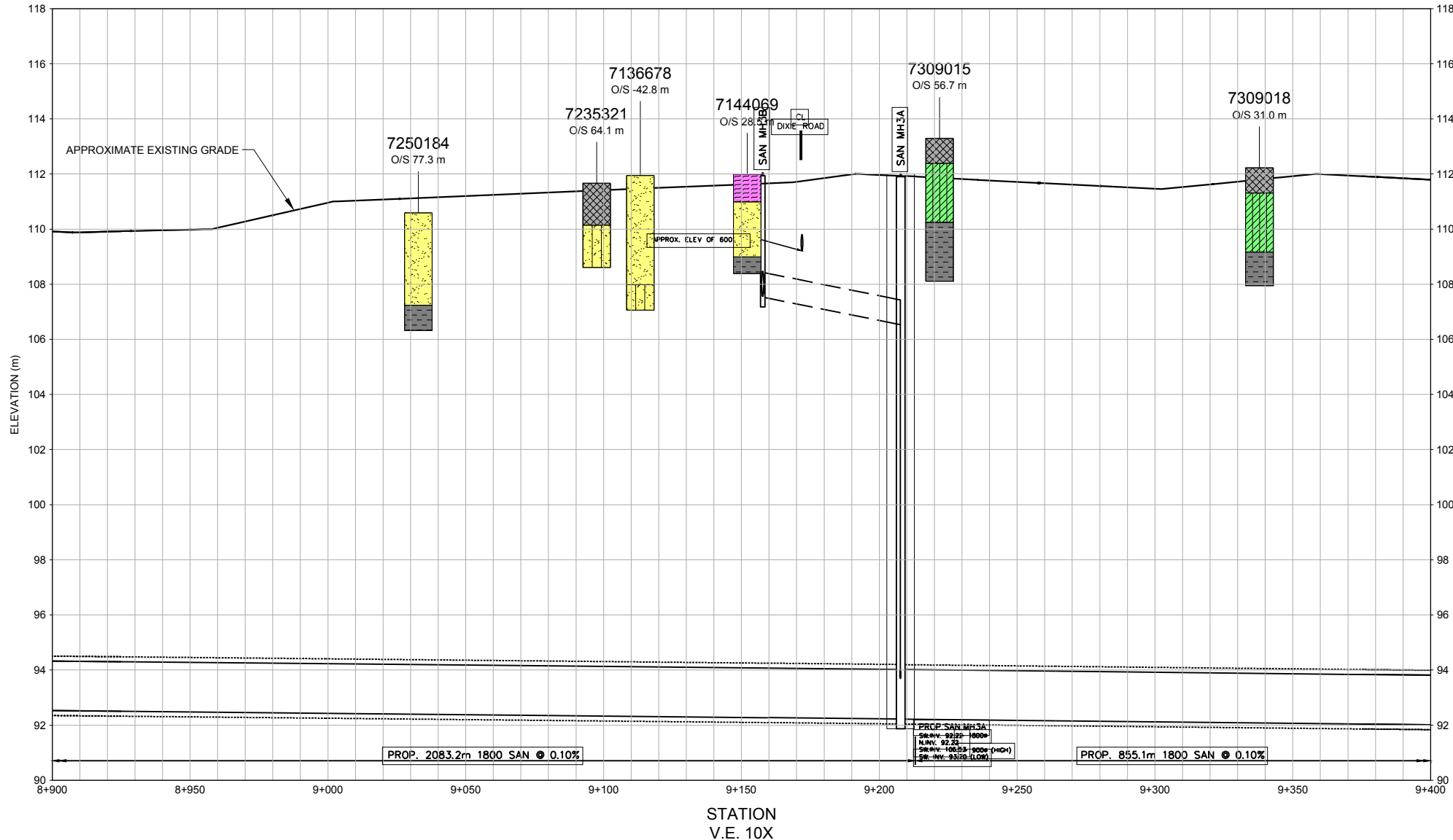
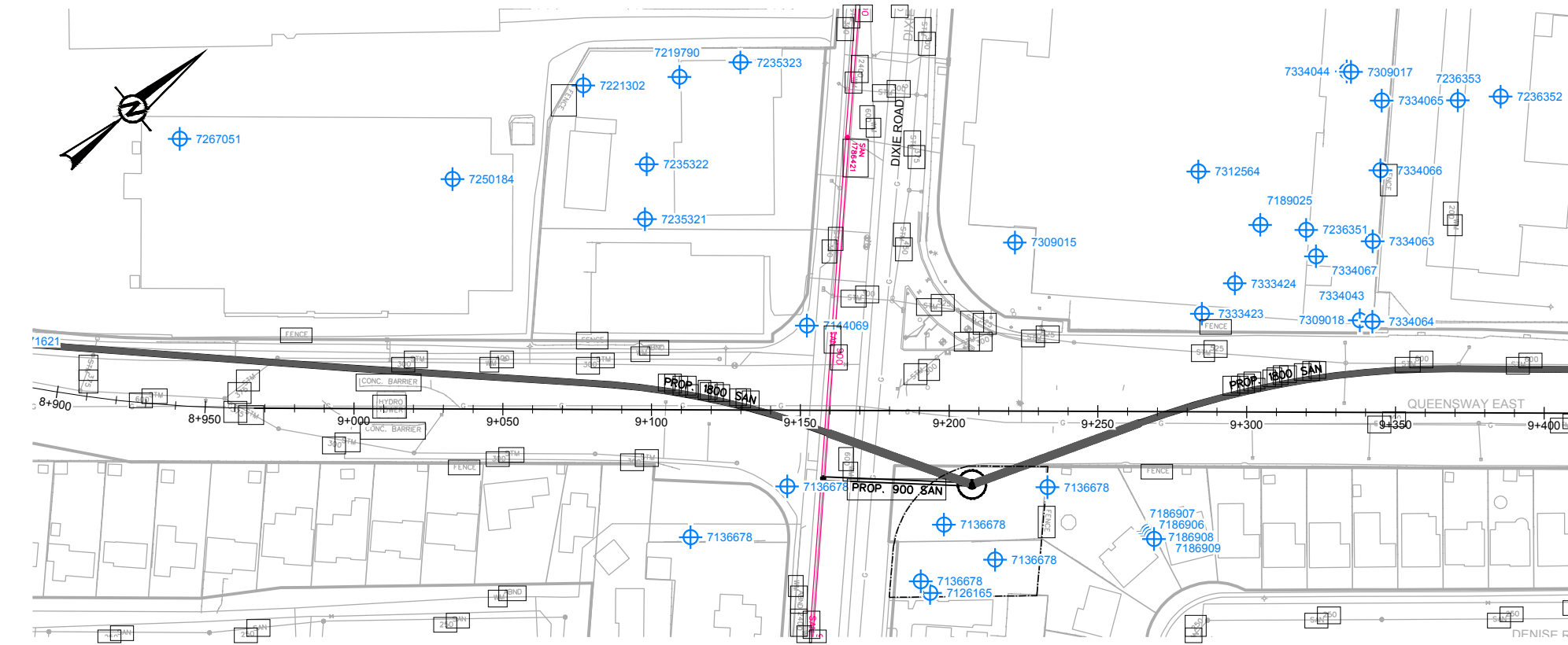
TITLE  
**BOREHOLE LOCATION PLAN AND PROFILE  
 QUEENSWAY EAST, STA 8+400 TO 8+900**

CONSULTANT	YYYY-MM-DD	2021-11-24
	DESIGNED	
	PREPARED	DD/SA
	REVIEWED	DH
	APPROVED	

PROJECT NO. 18112273      PHASE (4000)      REV. 0      FIGURE 17

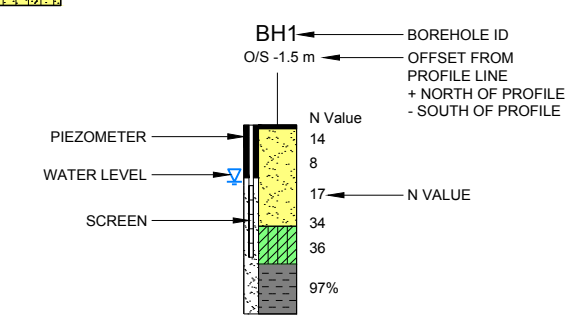
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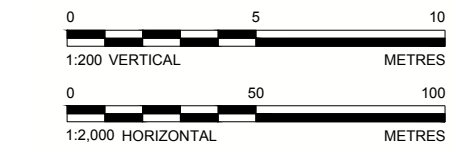


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	SILTY SAND		



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**PROJECT**  
GEOTECHNICAL DESKTOP STUDY  
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT  
CENTRAL MISSISSAUGA WASTEWATER SYSTEM

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**TITLE**  
**BOREHOLE LOCATION PLAN AND PROFILE**  
**QUEENSWAY EAST, STA 8+900 TO 9+400**

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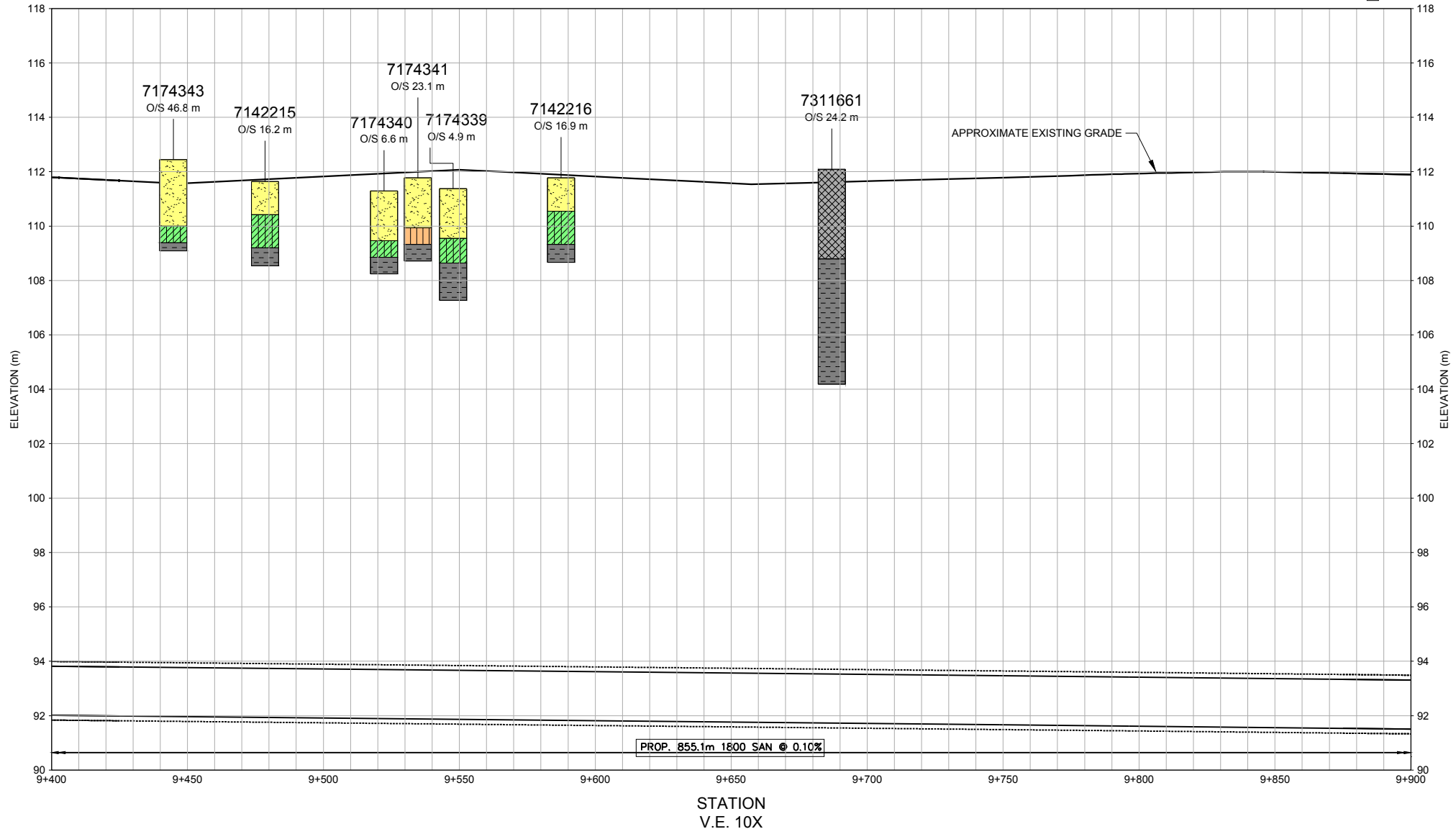
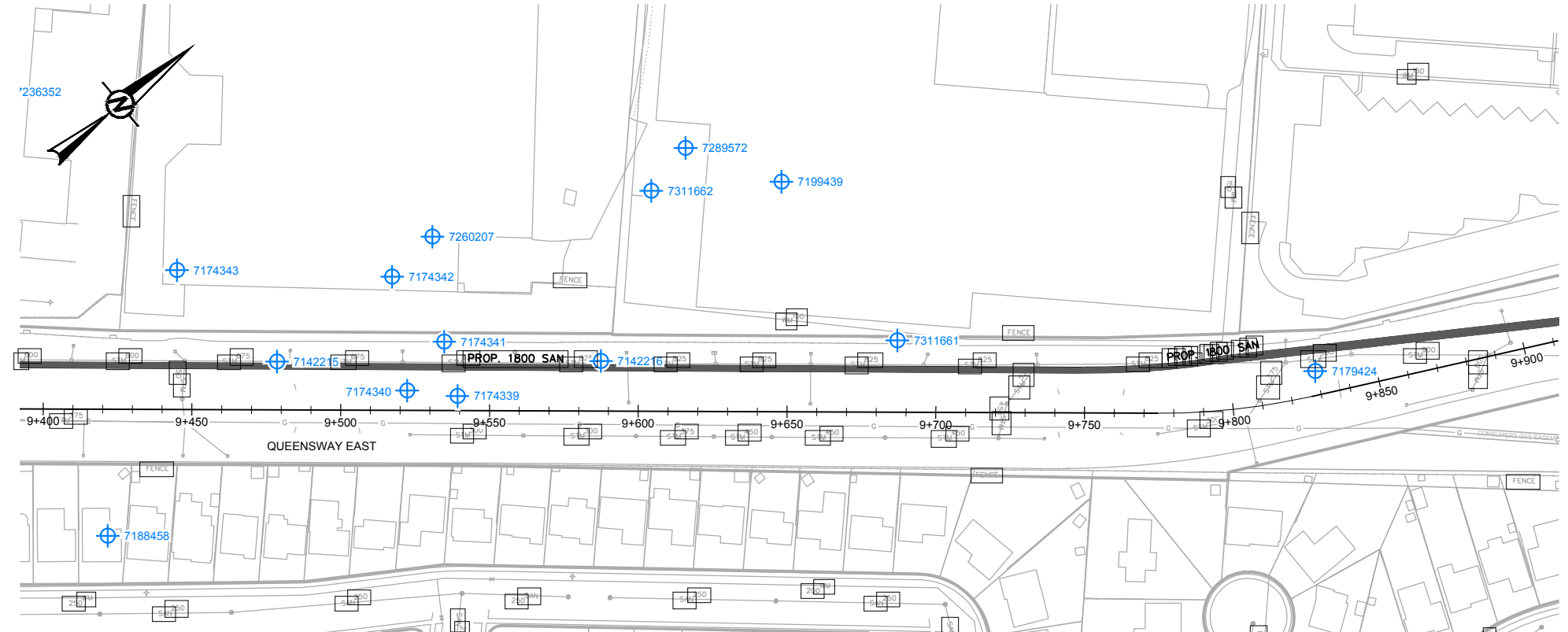
<b>CONSULTANT</b>	YYYY-MM-DD	2021-11-24
	DESIGNED	
	PREPARED	DD/SA
	REVIEWED	DH
	APPROVED	

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<b>PROJECT NO.</b>	<b>PHASE</b>	<b>REV.</b>	<b>FIGURE</b>
18112273	(4000)	0	18

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/B3 TO A4/B4

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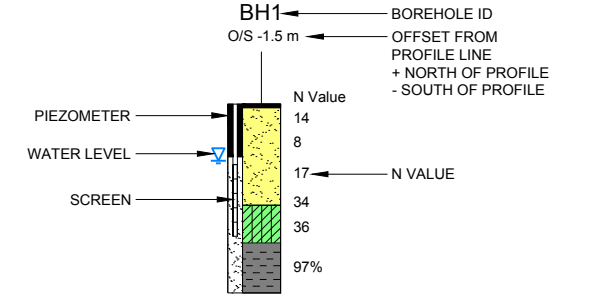


**LEGEND**

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	BOREHOLE - MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS (MECP)		BOREHOLE - TERRAPROBE, 2009
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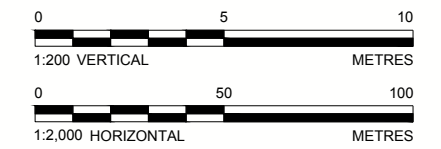
  

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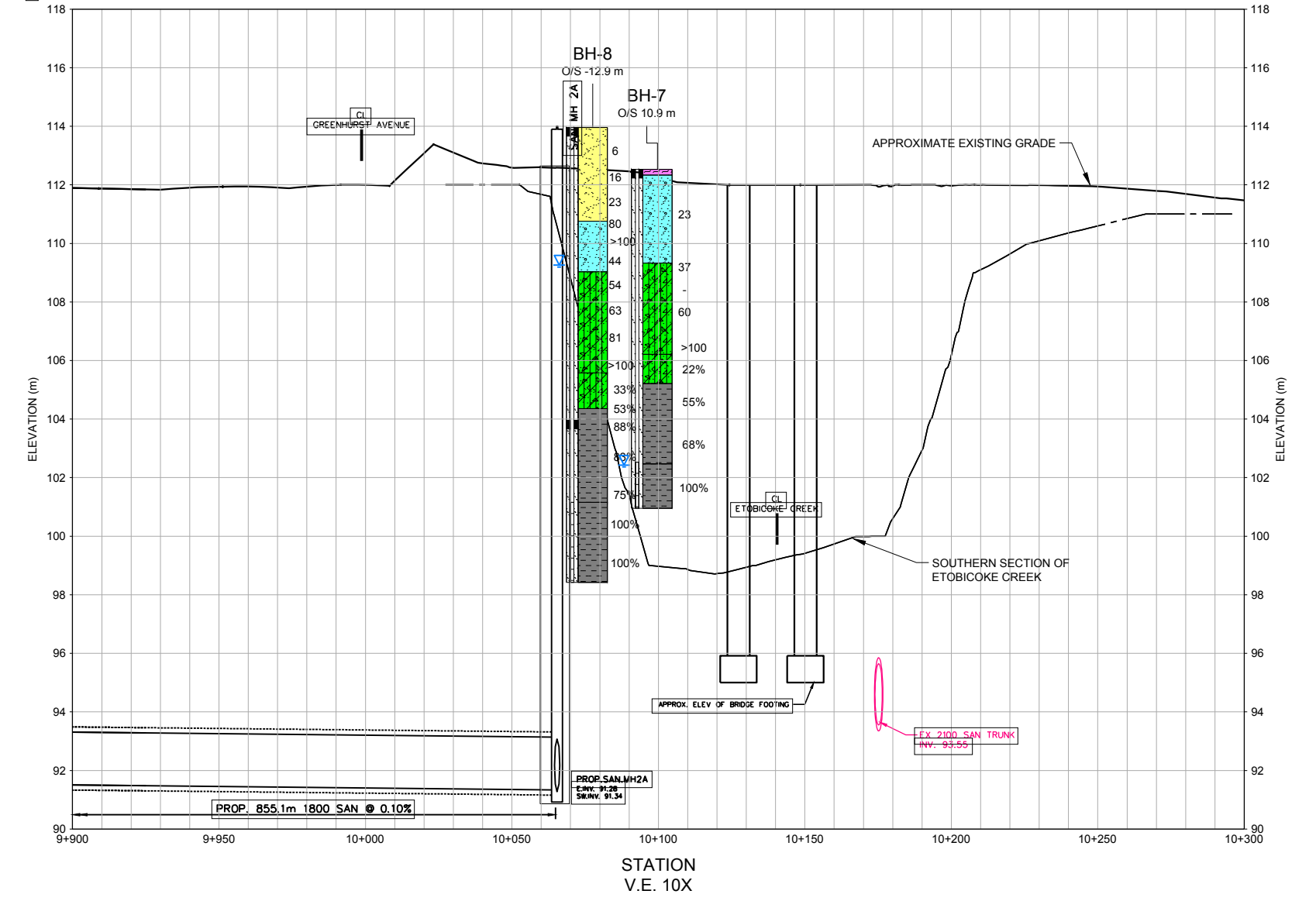
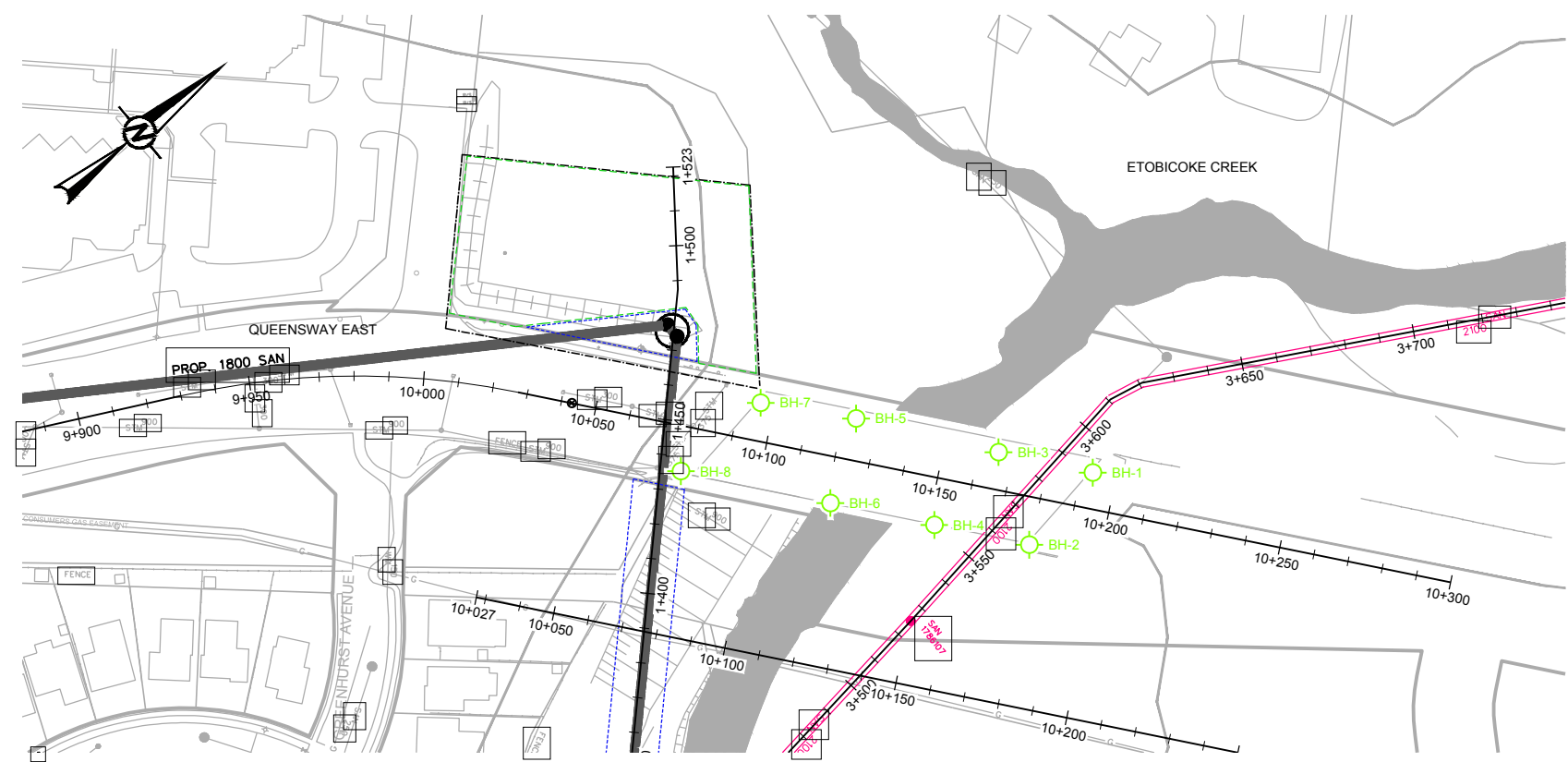


<b>CLIENT</b>		
GM BLUEPLAN ENGINEERING LIMITED		
<b>PROJECT</b>		
GEOTECHNICAL DESKTOP STUDY MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT CENTRAL MISSISSAUGA WASTEWATER SYSTEM		
<b>TITLE</b>		
BOREHOLE LOCATION PLAN AND PROFILE QUEENSWAY EAST, STA 9+400 TO 9+900		
<b>CONSULTANT</b>		
YYYY-MM-DD	2021-11-24	
DESIGNED		
PREPARED	DD/SA	
REVIEWED	DH	
APPROVED		

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3/B3 TO A4/B4



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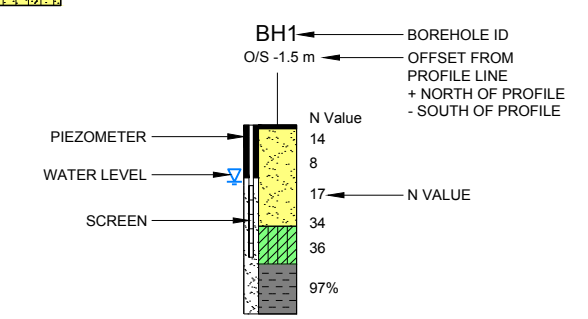


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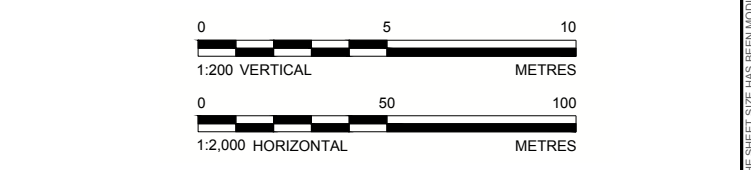
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GM BLUEPLAN ENGINEERING LIMITED			
<b>PROJECT</b>			
GEOTECHNICAL DESKTOP STUDY MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT CENTRAL MISSISSAUGA WASTEWATER SYSTEM			
<b>TITLE</b>			
BOREHOLE LOCATION PLAN AND PROFILE QUEENSWAY EAST, STA 9+900 TO 10+300			
<b>CONSULTANT</b>			
YYYY-MM-DD	2021-11-24		
DESIGNED			
PREPARED	DD/SA		
REVIEWED	DH		
APPROVED			
<b>PROJECT NO.</b>	<b>PHASE</b>	<b>REV.</b>	<b>FIGURE</b>
18112273	(4000)	0	20

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3S/B



**APPENDIX A**

# 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 practising 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 can not 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 can not 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**

# Historical Record of Borehole Logs



**Table B 1: Summary of Relevant Existing Borehole Information**

Sewer Location	Borehole ID	Station / Closest Intersection	Northing (m)	Easting (m)	Elevation (m)	Termination Depth / Elevation (m)	Monitoring Well Installed	Source
Burnhamthorpe Rd E	7151600	STA 2+270 / Burnhamthorpe Road E	4828446.0	610953.0	138.0	16.2 / 121.8	Yes	MECP
Burnhamthorpe Rd E	BA- MW26-15	STA 3+190 / Cawthra Road	4829240.5	611438.9	143.8	23.1 / 120.7	Yes	MTO, 1955, 30M11-151
Burnhamthorpe Rd E	BH2-15	STA 3+050 / Cawthra Road	4829195.9	611462.0	143.3	26.1 / 117.2	No	WSP, 2018
Burnhamthorpe Rd E	BH2-16	STA 3+170 / Cawthra Road	4829122.8	611351.6	143.5	24.5 / 119	Yes	WSP, 2018
Burnhamthorpe Rd E	BH2-51	STA 3+180 / Cawthra Road	4829230.8	611428.5	143.4	25.5 / 117.9	Yes	WSP, 2018
Cawthra Rd E	4909407	STA 0+250 / Queensway E	4827215.0	613538.0	110.1	3.6 / 106.5	Yes	MECP
Cawthra Rd E	7161951	STA 0+340 / Orwell Street	4827351.0	613544.0	110.2	4.6 / 105.6	Yes	MECP
Cawthra Rd E	7224923	STA 0+390 / Cawthra Road	4827299.0	613427.0	110.0	4.9 / 105.1	Yes	MECP
Cawthra Rd E	7141979	STA 0+210 / Queensway E	4827215.0	613599.0	109.7	4.5 / 105.2	Yes	MECP
Cawthra Rd E	7116747	STA 0+810 / Cawthra Road	4827588.0	613121.0	118.0	3.7 / 114.4	Yes	MECP
Cawthra Rd E	7219359	STA 0+990 / Canadian Pacific Railway	4827834.0	613100.0	123.0	5 / 118	Yes	MECP
Cawthra Rd E	7219360	STA 0+930 / Canadian Pacific Railway	4827792.0	613140.0	120.5	5.6 / 114.9	Yes	MECP
Cawthra Rd E	4902250	STA 1+020 / Cawthra Road	4827846.0	613064.6	124.3	16.5 / 107.9	Yes	MECP
Cawthra Rd E	BH17-2	STA 1+230 / Dundas Street E	4827931.7	612873.1	127.9	12.6 / 115.3	No	SPL, 2013
Cawthra Rd E	BH17-36	STA 1+170 / Dundas Street E	4827850.9	612861.5	129.1	26.5 / 102.6	Yes	SPL, 2013
Queensway E	7277560	STA 4+990 / Queensway E	4825465.0	612481.0	105.4	4.5 / 100.9	Yes	MECP
Queensway E	BH13-4	STA 5+370 / Queensway E	4825871.5	612581.4	103.9	3.5 / 100.4	No	SPL, 2013
Queensway E	BH13-5	STA 6+070 / Queensway East	4826400.1	613014.8	107.7	3.5 / 104.2	Yes	SPL, 2013
Queensway E	BH13-6	STA 6+180 / Queensway East	4826494.4	613091.3	107.2	3.5 / 103.7	No	SPL, 2013
Queensway E	BH13-7	STA 6+360 / Queensway East	4826642.3	613206.2	106.9	3.2 / 103.7	Yes	SPL, 2013
Queensway E	CN11	STA 6+040 / Queensway East	4826361.7	613041.4	107.5	3.5 / 104	Yes	Terraprobe, 2009
Queensway E	CN12	STA 6+010 / Queensway East	4826297.3	613107.8	106.5	5 / 101.5	Yes	Terraprobe, 2009
Queensway E	7296241	STA 8+390 / Stanfield Road	4828230.0	614440.0	109.5	1.5 / 108	Yes	MECP



Sewer Location	Borehole ID	Station / Closest Intersection	Northing (m)	Easting (m)	Elevation (m)	Termination Depth / Elevation (m)	Monitoring Well Installed	Source
Queensway E	7309315	STA 8+325 / Stanfield Road	4828146.0	614447.0	109.1	5.3 / 103.8	Yes	MECP
Queensway E	7171621	STA 8+880 / Stanfield Road	4828553.0	614822.0	109.7	5.2 / 104.5	Yes	MECP
Queensway E	7243628	STA 8+820 / Stanfield Road	4828584.0	614721.0	110.3	7.6 / 102.6	Yes	MECP
Queensway E	7277204	STA 8+610 / Stanfield Road	4828349.0	614647.0	109.5	4.6 / 105	Yes	MECP
Queensway E	7296239	STA 8+530 / Stanfield Road	4828340.0	614527.0	110.7	2.1 / 108.5	Yes	MECP
Queensway E	7136678	STA 9+120 / Dixie Road	4828693.0	615019.0	111.9	4.9 / 107.1	Yes	MECP
Queensway E	7144069	STA 9+150 / Dixie Road	4828768.0	614988.0	112.0	3.6 / 108.4	Yes	MECP
Queensway E	7235321	STA 9+100 / Dixie Road	4828748.0	614926.0	111.7	3.1 / 108.6	Yes	MECP
Queensway E	7250184	STA 9+030 / Dixie Road	4828706.0	614875.0	110.6	4.3 / 106.3	Yes	MECP
Queensway E	7309015	STA 9+220 / Dixie Road	4828840.0	615010.0	113.3	5.2 / 108.1	Yes	MECP
Queensway E	7309018	STA 9+340 / Dixie Road	4828914.0	615103.0	112.2	4.3 / 108	Yes	MECP
Queensway E	7142215	STA 9+480 / Dixie Road	4829014.0	615203.0	111.6	3.1 / 108.5	Yes	MECP
Queensway E	7142216	STA 9+580 / Dixie Road	4829099.0	615271.0	111.8	3.1 / 108.7	Yes	MECP
Queensway E	7174339	STA 9+550 / Dixie Road	4829054.0	615250.0	111.4	4.1 / 107.3	Yes	MECP
Queensway E	7174340	STA 9+520 / Dixie Road	4829042.0	615238.0	111.3	3.1 / 108.2	Yes	MECP
Queensway E	7174341	STA 9+530 / Dixie Road	4829062.0	615233.0	111.8	3.1 / 108.7	Yes	MECP
Queensway E	7174343	STA 9+440 / Dixie Road	4829007.0	615158.0	112.4	3.4 / 109.1	Yes	MECP
Queensway E	7311661	STA 9+690 / Dixie Road	4829181.0	615328.0	112.1	7.9 / 104.2	Yes	MECP
Etobicoke Creek	BH-7	STA 10+100 / Etobicoke Creek	4829498.7	615580.8	112.5	11.6 / 101	Yes	Golder, 1969
Etobicoke Creek	BH-8	STA 10+080 / Etobicoke Creek	4829468.6	615581.8	114.0	15.5 / 98.4	Yes	Golder, 1969

Note:

- The northings, eastings and elevations shown in the table above are approximate and are based on coordinates and elevations and/or borehole locations plans reported by others. The coordinates were not always surveyed, nor were the reference datums / systems reported. The elevations for the MECP wells are sourced from a model, DEM - GTA Ortho DEM 2002 (2m DEM), based on the northings and eastings reported in the well records.

## Explanation of Terms Used in the Record of Borehole

### Sample Type

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Dimension type sample
FS	Foil sample
RC	Rock core
SC	Soil core
SS	Spoon sample
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

### Penetration Resistance

#### Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) required to drive a 50 mm (2 in) drive open sampler for a distance of 300 mm (12 in).

#### Dynamic Cone Penetration Resistance, $N_d$ :

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in) to drive uncased a 50 mm (2 in) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in).

### Textural Classification of Soils

Classification	Particle Size
Boulders	>300 mm
Cobbles	75 mm-300 mm
Gravel (Gr)	4.75 mm-75 mm
Sand (Sa)	0.075 mm-4.75 mm
Silt (Si)	0.002 mm-0.075 mm
Clay (Cl)	<0.002 mm

### Coarse Grain Soil Description (50% greater than 0.075 mm)

Terminology	Proportion
Trace	0-10%
Some	10-20%
Adjective (e.g. silty or sandy)	20-35%
And (e.g. sand and gravel)	>35%

### Soil Description

#### a) Cohesive Soils

Consistency	Undrained Shear Strength (kPa)	SPT "N" Value
Very soft	<12	0-2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very stiff	100-200	15-30
Hard	>200	>30

#### b) Cohesionless Soils

Density Index (Relative Density)	SPT "N" Value
Very loose	<4
Loose	4-10
Compact	10-30
Dense	30-50
Very dense	>50

### Soil Tests

w	Water content
w <sub>p</sub>	Plastic limit
w <sub>l</sub>	Liquid limit
C	Consolidation (oedometer) test
CID	Consolidated isotropically drained triaxial test
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement
D <sub>R</sub>	Relative density (specific gravity, G <sub>s</sub> )
DS	Direct shear test
ENV	Environmental/ chemical analysis
M	Sieve analysis for particle size
MH	Combined sieve and hydrometer (H) analysis
MPC	Modified proctor compaction test
SPC	Standard proctor compaction test
OC	Organic content test
V	Field vane (LV-laboratory vane test)
γ	Unit weight

## Explanation of Terms Used in the Bedrock Core Log

### Strength (ISRM)

Term	Grade	Description	Unconfined Compressive Strength	
			(MPa)	(psi)
Extremely weak rock	RO	Indented by thumbnail	0.25-1.0	36-145
Very weak	R1	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0-5.0	145-725
Weak rock	R2	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0-25	725-3625
Medium Strong	R3	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	25-50	3625-7250
Strong rock	R4	Specimen require more than one blow of geological hammer to fracture it	50-100	7250-14500
Very strong rock	R5	Specimen requires many blows of geological hammer to fracture it	100-250	14500-36250
Extremely strong rock	R6	Specimen can only be chipped with geological hammer	>250	>36250

### Bedding (Geological Society Eng. Group Working Party, 1970. Q.J. of Eng. Geol. Vol. 3)

Term	Bed Thickness	
Very thickly bedded	>2 m	>6.5 ft
Thickly bedded	600 mm-2 m	2.00-6.50 ft
Medium bedded	200 mm-600 mm	0.65-2.00 ft
Thinly bedded	60 mm-200 mm	0.20-0.65 ft
Very thinly bedded	20 mm-60 mm	0.06-0.20 ft
Laminated	6 mm-20 mm	0.02-0.06 ft
Thinly laminated	<6 mm	<0.02 ft

### TCR (Total Core Recovery)

Sum of lengths of rock core recovered from a core run, divided by the length of the core run and expressed as a percentage.

### SCR (Solid Core Recovery)

Sum length of solid, full diameter drill core recovered expressed as a percentage of the total length of the core run.

### RQD (Rock Quality Designation, after Deere, 1968)

Sum of lengths of pieces of rock core measured along centreline of core equal to or greater than 100 mm from a core run, divided by the length of the core run and expressed as a percentage. Core fractured by drilling is considered intact. RQD normally quoted for N-size or H-size core.

RQD(%)	Rock Quality
90-100	Excellent
75-90	Good
50-75	Fair
25-50	Poor
0-25	Very poor

### Weathering (ISRM)

Term	Grade	Description
Fresh	W1	No visible sign of rock material weathering
Slightly weathered	W2	Discolouration indicates weathering of rock material and discontinuity surface. All the rock material may be discoloured by weathering and may be somewhat weaker than in its fresh condition
Moderately weathered	W3	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a framework or as corestone
Highly weathered	W4	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discoloured rock is present either as a continuous framework or as corestones
Completely weathered	W5	All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact
Residual soil	W6	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported

### (FI) Fracture Index

Expressed as the number of discontinuities per 300mm (1 ft). Excludes drill-induced fractures and fragmented zones. Reported as ">25" if frequency exceeds 25 fractures/0.3m.

### Broken Zone

Zone of full diameter core of very low RQD which may include some drill-induced fractures.

### Fragmented Zone

Zone where core is less than full diameter and RQD = 0.

### Discontinuity Spacing (ISRM)

Term	Average Spacing	
Extremely widely spaced	>6 m	>20.00 ft
Very widely spaced	2 m-6 m	6.50-20.00 ft
Widely spaced	600 mm-2 m	2.00-6.50 ft
Moderately spaced	200 mm-600 mm	0.65-2.00 ft
Closely spaced	60 mm-200 mm	0.20-0.65 ft
Very closely spaced	20 mm-60 mm	0.06-0.20 ft
Extremely closely spaced	<20 mm	>0.06 ft

Note: Excludes drill-induced fractures and fragmented rock.

### Discontinuity Orientation

Discontinuity, fracture and bedding plane orientations are cited as the acute angle measured with respect to the core axis. Fractures perpendicular to the core axis are at 90° and those parallel to the core axis are at 0°.

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2	REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring
PROJECT LOCATION: Various Streets, City of Mississauga	Diameter: 150 mm/63mm
DATUM: Geodetic	Date: Jan/31/2018
BH LOCATION: N 4829195.89 E 611462	CHECKED BY DT/MK

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	POCKET PEN. (30) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)							WATER CONTENT (%)
143.3	Ground Surface													GR SA SI CL	
0.0	FILL: sand mixed with silty clay pockets, trace gravel, trace organics, brown, moist, loose.		1	SS	6										
142.5			0.8	FILL: silty sand, some clay, trace gravel, trace organics, brown, moist, loose to compact.	2	SS	6								
			1		3	SS	4								9 43 33 15
			2		4	SS	14								
140.9	CLAYEY SILT TILL: sandy, trace gravel, brown, moist, stiff to very stiff.  contains silty sand seams/layers, greyish brown below 3.0m		5	SS	30									9 30 47 14	
			3	6	SS	60/ initial 150mm									
138.7	GEORGIAN BAY FORMATION: shale bedded with siltstone and limestone, grey.  Coring began at 5.33m Refer to Rock Core Log		1	RC											
			4	2	RC										
			5	3	RC										
			6												

Continued Next Page

GROUNDWATER ELEVATIONS

Shallow/ Single Installation Deep/Dual Installation

GRAPH NOTES

+ 3 × 3: Numbers refer to Sensitivity      ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2	REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring
PROJECT LOCATION: Various Streets, City of Mississauga	Diameter: 150 mm/63mm
DATUM: Geodetic	Date: Jan/31/2018
BH LOCATION: N 4829195.89 E 611462	CHECKED BY DT/MK
	ENCL NO.:
	ORIGINATED BY JZ
	COMPILED BY BW

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	POCKET PEN. (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)									
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20							40	60	80	100	20	40	60	80	100
	Continued																						
	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.		4	RC																			
	Coring began at 5.33m Refer to Rock Core Log(Continued)																						
11																							
			5	RC																			
12																							
13																							
			6	RC																			
14																							
15																							
			7	RC																			
16																							
17																							
			8	RC																			
18																							
19																							
			9	RC																			
20																							
			10	RC																			

Continued Next Page

GROUNDWATER ELEVATIONS

Shallow/ Single Installation  $\nabla$   $\nabla$  Deep/Dual Installation  $\nabla$   $\nabla$

GRAPH NOTES

+ 3, x 3: Numbers refer to Sensitivity  $\circ$  6=3% Strain at Failure



PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2	REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring
PROJECT LOCATION: Various Streets, City of Mississauga	ENCL NO.:
DATUM: Geodetic	ORIGINATED BY JZ
BH LOCATION: N 4829195.89 E 611462	COMPILED BY BW
	CHECKED BY DT/MK

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (ksi) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)						WATER CONTENT (%)		
						○ UNCONFINED      + FIELD VANE & Sensitivity ● QUICK TRIAXIAL    × LAB VANE	20	40	60	80	100	W <sub>p</sub> w      W <sub>L</sub> PLASTIC LIMIT      NATURAL MOISTURE CONTENT      LIQUID LIMIT	10	20	30	GR   SA   SI   CL
	Continued															
	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.															
	Coring began at 5.33m Refer to Rock Core Log(Continued)		11	RC												
21																
22			12	RC												
23																
24			13	RC												
25																
26			14	RC												
26.1	<b>END OF BOREHOLE</b> Note: 1) Borehole backfilled with bentonite upon completion.															



LOG OF ROCK CORE BH2-15

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2 REF. NO.: 171-08406-01  
 CLIENT: Region of Peel Method: Solid Stem Auger/HQ Coring ENCL NO.:  
 LOCATION: Various Streets, City of Mississauga Diameter: 150 mm/63mm ORIGINATED BY JZ  
 DATUM: Geodetic Date: Jan/31/2018 COMPILED BY BW  
 BH LOCATION: N 4829195.89 E 611462 CHECKED BY DT/MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE				ROD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE	TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)									
138.7	Rock Surface														
4.6	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to slightly weathered, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (80% to 97%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (3~20%). Bedding almost horizontal ( $\theta=90^\circ$ )  Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m) Thickness(mm) 5.46 90 13.08 60 13.45 60 15.47 90 18.63 50 22.11 50 22.17 50 23.81 50 24.51 50 25.10 80 25.30 50														
5.3		1	HQ	100	49	15	26	20	Fragmented zone: 5.33m-5.41m; 5.43m - 5.46m (W5 to W4) 5.55m-5.61m; 5.61m - 5.65m (W5 to W4) 5.65m-5.70m; 5.77m - 5.89m (W5 to W4) 5.94m - 5.98m (W5 to W4)	W3					
6.2		2	HQ	100	89	5	69	10	Fragmented zone: 6.27m-6.31m; 6.34m - 6.36m (W5 to W4) 6.36m-6.39m; 6.67m - 6.69m (W4 to W3) 6.69m-6.72m; 6.73m-6.74m Fracture: 6.31m-6.34m, $\theta=5^\circ$ ; 6.45m-6.48m, $\theta=15^\circ$ , closed	W3 to W2					
7.8		3	HQ	100	95	3	90	2	Fragmented zone: 7.80m-7.82m Fracture: 8.04m-8.07m, $\theta=0^\circ$ and $0^\circ$ , two sets	W2					
9.4		4	HQ	100	98	8	90	0	Fracture: 10.74m-10.78m, $\theta=10^\circ$	W2					
10.9		5	HQ	100	97	3	72	0	Fragmented zone: 11.89m-11.99m Fracture: 11.20m-11.24m, $\theta=30^\circ$ ; 12.18m-12.22m, $\theta=0^\circ$ and $10^\circ$ , two sets	W2		19.4	1.3		
12.4		6	HQ	100	92	16	66	5	Fragmented zone: 12.42m-12.46m; 12.48m-12.50m 12.79m - 12.87m (W5 to W4) Fracture: 12.50m-12.52m, $\theta=20^\circ$ ; 12.73m-12.78m, $\theta=15^\circ$ , closed; 13.06m-13.14m, $\theta=0^\circ$ ; 13.45m-13.51m, $\theta=5^\circ$	W2					
14.0								5	Broken zone: 14.38m-14.40m 14.12m - 14.15m (W5 to W4) Fracture: 14.11m-14.14m, $\theta=15^\circ$ , closed			11.1	6.3	12.56	2.71 1.34

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered  $\theta$  = angle to the core axis

E = Modulus of Elasticity  
\*: UCS [MPa] = 24 I<sub>50</sub>

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2	REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring
LOCATION: Various Streets, City of Mississauga	ENCL NO.:
DATUM: Geodetic	Diameter: 150 mm/63mm
BH LOCATION: N 4829195.89 E 611462	Date: Jan/31/2018
	ORIGINATED BY JZ
	COMPILED BY BW
	CHECKED BY DT/MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE												
Continued																
15	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to slightly weathered, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (80% to 97%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (3-20%). Bedding almost horizontal ( $\theta=90^\circ$ )  Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m)    Thickness(mm) 5.46            90 13.08          60 13.45          60 15.47          90 18.63          50 22.11          50 22.17          50 23.81          50 24.51          50 25.10          80 25.30          50 (continued)															
127.8		7	HQ	100	98	14	80	1	0	Broken zone: 14.38m-14.40m Fracture: 14.11m-14.14m, $\theta=15^\circ$ , closed (continued)	W2		24.9	5.4		
15.5								5	1	15.58m ~ 15.60m (W4) 15.68m ~ 15.70m (W4 to W3)			58.3	30.1		
16								0	1	Fracture: 16.42m-16.45m, $\theta=0^\circ$ , closed; 16.76m-16.79m, $\theta=0^\circ$ and $10^\circ$ , two sets	W2					
17								1	1							
17.0								4	3	Fracture: 17.34m-17.36m, $\theta=0^\circ$			13.7	8.1		
18								1	1							
18.5								1	1							
19								1	1							
20								1	1							
20.0							1	1								
21							1	1								
21.6							1	1								
22							1	1								
23							1	1								
121.7							1	1								
21.6							1	1								
22							14	2	Broken zone: 21.64m ~ 21.67m (W5 to W4) 21.74m-21.79m Fracture: 21.69m-21.74m, $\theta=0^\circ$ ; 22.23m-22.29m, $\theta=20^\circ$	W2		25.6	1.7			
23							0	4				16.0	8.0			
120.1							0	1								
23.2							6	2	Fragmented zone: 24.36m-24.38m 23.57m ~ 23.60m (W5 to W4) Fracture: 23.24m-23.25m, $\theta=0^\circ$ ; 23.54m-23.57m, $\theta=0^\circ$ ; 24.07m ~ 24.08m (W5 to W4) 24.09m ~ 24.1m (W4) 24.36m-24.37m, $\theta=0^\circ$ ; 24.38m-24.46m, $\theta=25^\circ$	W2		14.8	4.2	31.76	2.63 3.59	2.67 1.23

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered     $\theta$  = angle to the core axis

E = Modulus of Elasticity  
\*: UCS [Mpa] = 24 I<sub>s(50)</sub>

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2 CLIENT: Region of Peel LOCATION: Various Streets, City of Mississauga DATUM: Geodetic BH LOCATION: N 4829195.89 E 611462	Method: Solid Stem Auger/HQ Coring Diameter: 150 mm/63mm Date: Jan/31/2018	REF. NO.: 171-08406-01 ENCL NO.: ORIGINATED BY JZ COMPILED BY BW CHECKED BY DT/MK
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(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE												
18.6 24.7	Continued															
25									2	Fragmented zone: 24.66m - 24.68m (W5 to W4) 25.48m-25.53m 24.94m - 24.95m (W5 to W4)						
									2	Fracture: 24.88m-25.01m, $\theta=20^\circ$ , closed; 25.29m-25.41m, $\theta=5^\circ$ ;		71.1	5.9			
			14	HQ	100	95	20	76	9	25.42m - 25.44m (W5 to W4) 25.5m - 25.53m (W5 to W4)	W2					
17.2									0							
									1	25.74m-25.90m, $\theta=5^\circ$ , closed						
26.1	<b>END OF BOREHOLE</b> Note: 1) Borehole backfilled with bentonite upon completion.															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered     $\theta$  = angle to the core axis    E = Modulus of Elasticity  
 \*: UCS [Mpa] = 24 I<sub>S(50)</sub>



# LOG OF BOREHOLE BH2-16

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829122.81 E 611351.61

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Dec/12/2017

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY JZ  
 COMPILED BY BW  
 CHECKED BY DT/MK

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (γ <sub>sat</sub> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							
143.5	Ground Surface											
143.0	<b>TOPSOIL:</b> 80mm.											
142.7	<b>FILL:</b> clayey silt, sandy, trace gravel, trace organics, brownish grey, moist, firm.		1	SS	6		Concrete					
141.8	<b>FILL:</b> silty clay, sandy, trace gravel, trace organics, greyish brown, moist, stiff.		2	SS	12		Holeplug					1 24 43 32
141.2	<b>SILTY CLAY TILL:</b> sandy, trace to some gravel, brown, moist, very stiff.		3	SS	24		Sand					22.2 10 30 40 20
141.2	<b>SILTY CLAY TILL / SHALE COMPLEX:</b> some sand, some gravel, contains shale fragments, brown to grey, moist, hard.		4	SS	37							20.5 12 16 51 21
	grey below 3.0m		5	SS	50/ 25mm							
							W. L. 140.2 m Feb.01,2018 Screen					
138.9	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.		6	SS	50/ initial 75mm							
	Coring began at 4.72m Refer to Rock Core Log		1	RC			Sand					
			2	RC								
			3	RC								

Continued Next Page

GROUNDWATER ELEVATIONS

Shallow/Single Installation  $\nabla$   $\nabla$  Deep/Dual Installation  $\nabla$   $\nabla$

GRAPH NOTES

+ 3, x 3: Numbers refer to Sensitivity  
 ○ ε=3% Strain at Failure



PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2		REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring	ENCL NO.:
PROJECT LOCATION: Various Streets, City of Mississauga	Diameter: 150 mm/63mm	ORIGINATED BY JZ
DATUM: Geodetic	Date: Dec/12/2017	COMPILED BY BW
BH LOCATION: N 4829122.81 E 611351.61		CHECKED BY DT/MK

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT w <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT w <sub>L</sub>	POCKET PEN. (CU) (MPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)										
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20							40	60	80	100	20	40	60	80	100	10
	Continued		4	RC																				
	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.																							
	Coring began at 4.72m Refer to Rock Core Log(Continued)																							
11			5	RC																				
12																								
13			6	RC																				
14																								
15			7	RC																				
16																								
17			8	RC																				
18																								
19			9	RC																				
20																								
21			10	RC																				
22																								
23																								
24																								

Continued Next Page

GROUNDWATER ELEVATIONS

Shallow/ Single Installation  $\nabla$  1st  $\nabla$  2nd Deep/Dual Installation  $\nabla$  1st  $\nabla$  2nd

GRAPH NOTES + <sup>3</sup>, × <sup>3</sup>: Numbers refer to Sensitivity ○ ε=3% Strain at Failure

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2	REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring
PROJECT LOCATION: Various Streets, City of Mississauga	Diameter: 150 mm/63mm
DATUM: Geodetic	Date: Dec/12/2017
BH LOCATION: N 4829122.81 E 611351.61	ORIGINATED BY JZ
	COMPILED BY BW
	CHECKED BY DT/MK

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)										
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20							40	60	80	100	20	40	60	80	100	10
Continued	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.  Coring began at 4.72m Refer to Rock Core Log(Continued)		11	RC																				
21																								
12					12	RC																		
33																								
24																								
119.0			13	RC																				

24.5	<b>END OF BOREHOLE</b> Notes: 1) Borehole caved to 4.4m upon completion of augering. 2) 50mm dia. monitoring well was installed upon completion, screened at 2.13m to 5.18m.  Water level measured in monitoring well: Date                      W. L. Depth (m) Jan.11, 2018            2.63 Jan.16, 2018            3.58 Feb.01, 2018            3.32													
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LOG OF ROCK CORE BH2-16

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829122.81 E 611351.61

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Dec/12/2017

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY JZ  
 COMPILED BY BW  
 CHECKED BY DT/MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE												
138.9	Rock Surface															
138.8	<b>GEORGIAN BAY FORMATION</b>															
4.7	Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (72% to 97%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (3-28%). Bedding almost horizontal ( $\theta=90^\circ$ )		1	HQ	100	87	3	54	15	Fragmented zone: 4.75m-4.83m; 4.85m-4.88m; 5.11m-5.14m; 5.23m-5.26m Fracture: 6.20m-6.22m, $\theta=0^\circ$ , closed	Soft layer 4.88m - 4.89m (W5 to W4) 4.98m - 5.02m (W5 to W4)					
6.3	Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m) Thickness(mm) 7.06 50 7.15 150 7.47 60 7.70 50 8.46 100 9.42 70 14.66 110 15.13 50 15.68 60 18.39 50 18.95 50 19.46 50 21.30 50 23.01 50 24.37 140		2	HQ	97	91	28	60	8	Fragmented zone: 6.27m-6.29m; 7.02m-7.06m Fracture: 6.38m-6.41m, $\theta=0^\circ$ and $0^\circ$ , two sets; 6.43m-6.47m, $\theta=5^\circ$ , closed 7.11m - 7.15m (W5 to W4) 6.81m-6.83m, $\theta=5^\circ$ ; 7.06m-7.11m, $\theta=0^\circ$ ; 7.47m-7.49m, $\theta=0^\circ$ to $10^\circ$	6.55m - 6.57m (W5 to W4) 6.63m - 6.65m (W5 to W4)					
7.8			3	HQ	100	95	16	82	5	Fracture: 8.74m-8.79m, $\theta=5^\circ$ ; 8.99m-9.02m, $\theta=0^\circ$	7.85m - 7.87m (W5 to W4) 8.01m - 8.03m (W5 to W4)					
9.2			4	HQ	100	92	7	92	1	Fracture: 9.49m - 9.50m (W5 to W4) 9.49m-9.61m, $\theta=5^\circ$ , closed						
10.8			5	HQ	100	100	3	100	0							
12.2			6	HQ	100	100	14	100	1	Fracture: 12.24m-12.31m, $\theta=0^\circ$ and $30^\circ$ , two sets; 13.59m-13.63m, $\theta=15^\circ$ , closed						

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered  $\theta$  = angle to the core axis

E = Modulus of Elasticity  
 \*: UCS [Mpa] = 24 I<sub>s(50)</sub>



LOG OF ROCK CORE BH2-16

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829122.81 E 611351.61

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Dec/12/2017

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY JZ  
 COMPILED BY BW  
 CHECKED BY DT/MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm-sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)	
			NUMBER	SIZE													
Continued																	
15 128.1 15.4	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (72% to 97%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (3-28%). Bedding almost horizontal ( $\theta=90^\circ$ )  Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m) Thickness(mm) 7.06 50 7.15 150 7.47 60 7.70 50 8.46 100 9.42 70 14.66 110 15.13 50 15.68 60 18.39 50 18.95 50 19.46 50 21.30 50 23.01 50 24.37 140 (continued)		7	HQ	100	98	22	87	4 3 2	Fracture: 13.79m-13.86m, $\theta=0^\circ$ and $5^\circ$ , two sets; 14.49m-14.52m, $\theta=5^\circ$ ; 14.78m-14.81m, $\theta=0^\circ$ , closed; 15.13m-15.18m, $\theta=0^\circ$ , closed (continued) Fracture: 15.68m-15.75m, $\theta=0^\circ$ and $5^\circ$ , two sets; 16.41m-16.46m, $\theta=0^\circ$ and $5^\circ$ , two sets, closed; 16.61m-16.62m, $\theta=0^\circ$ , closed	W2 to W1		109.5	92.0			
16 126.6 16.9				8	HQ	100	98	19	98	0 3 1 0	Fracture: 15.68m-15.75m, $\theta=0^\circ$ and $5^\circ$ , two sets; 16.41m-16.46m, $\theta=0^\circ$ and $5^\circ$ , two sets, closed; 16.61m-16.62m, $\theta=0^\circ$ , closed	W2 to W1	no take	11.8	1.4		
18 125.1 18.4				9	HQ	100	100	13	97	0 0 1 3 0	Fracture: 18.39m-18.44m, $\theta=0^\circ$ and $5^\circ$ , two sets	W2 to W1		20.4	3.0		
19 123.6 19.9				10	HQ	100	100	18	100	0 0 0 0	Fracture: 19.89m-19.91m, $\theta=10^\circ$ , closed	W2 to W1	no take				
20 122.0 21.5				11	HQ	100	100	15	97	0 0 1 0		W2 to W1				14.96 2.75 1.66	
21 122.0 21.5				12	HQ	100	98	13	97	0 0 1 4 0	Fracture: 21.53m-21.56m, $\theta=0^\circ$ and $20^\circ$ , two sets; 21.56m-21.58m, $\theta=5^\circ$ , closed; 22.73m-22.75m, $\theta=0^\circ$ , closed	W2 to W1	no take	12.1	2.7		
22 120.4 23.1				13	HQ	100	100	21	100	0 1 1 0	Fracture: 23.44m-23.50m, $\theta=30^\circ$ , closed; 23.86m-23.89m, $\theta=30^\circ$ , closed; 24.37m-24.51m, $\theta=5^\circ$	W2 to W1				19.99 2.62 1.92	
23 119.0										1 1 2	22.95m ~ 22.96m (W4)  Fracture: 23.44m-23.50m, $\theta=30^\circ$ , closed; 23.86m-23.89m, $\theta=30^\circ$ , closed; 24.37m-24.51m, $\theta=5^\circ$	W2 to W1				15.41 2.70 1.70	

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered  $\theta$  = angle to the core axis

E = Modulus of Elasticity  
 \*: UCS [Mpa] = 24 I<sub>S(50)</sub>

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2	REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring
LOCATION: Various Streets, City of Mississauga	Diameter: 150 mm/63mm
DATUM: Geodetic	Date: Dec/12/2017
BH LOCATION: N 4829122.81 E 611351.61	CHECKED BY: DT/MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE												
24.5	<p><b>END OF BOREHOLE</b></p> <p>Notes: 1) Borehole caved to 4.4m upon completion of augering. 2) 50mm dia. monitoring well was installed upon completion, screened at 2.13m to 5.18m.</p> <p>Water level measured in monitoring well: Date                      W. L. Depth (m) Jan.11, 2018            2.63 Jan.16, 2018            3.58 Feb.01, 2018            3.32</p>															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered      θ = angle to the core axis      E = Modulus of Elasticity  
 \*: UCS [Mpa] = 24 I<sub>50</sub>(50)





LOG OF BOREHOLE BH2-51

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829230.83 E 611428.54

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Sep/26/2018

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY BS  
 COMPILED BY BW  
 CHECKED BY MK

SOIL PROFILE		SAMPLES			GROUND WATER LEVEL	GROUND WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	ELEVATION	ELEVATION	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>			GR SA SI CL
143.43	Ground Surface													
143.00	TOPSOIL: 100mm.													
142.67	FILL: gravelly sand, some silt, trace clay, trace organics, contains clayey silt pockets, brown, moist, compact.		1	SS	12	143	143			o				29 51 13 7
	FILL: silty clay, some sand, trace gravel, trace organics, brown, moist, stiff to very stiff.		2	SS	15	142	142			o				
			3	SS	21	141	141			o				
141.45	SILTY CLAY TILL: sandy, trace gravel, contains sand silt seams, brown, moist, very stiff to hard.		4	SS	33	141	141			o				8 25 43 24
	trace shale/limestone fragments, greyish brown below 3.0m		5	SS	91/150mm	140	140			o				
	grey below 3.8m		6T			139	139							
139.42	SILTY SAND TILL: some clay, trace gravel, trace shale fragments, grey, moist, dense.		6B	SS	49	139	139			o				4 49 34 13
138.86	CLAYEY SILT TILL / SHALE COMPLEX: some sand to sandy, trace gravel, contains shale/limestone fragments, grey, moist, hard.		7	SS	50/initial 125mm	138	138			o				auger grinding below 4.8m
	cobbles/boulders(inferred)													
137.33	GEORGIAN BAY FORMATION: shale bedded with siltstone and limestone, grey.		8	SS	>50/initial 75mm	137	137							hammer bouncing
	Coring began at 6.25m Refer to Rock Core Log		1	RC		136	136							
			2	RC		135	135							
			3	RC		134	134							

Continued Next Page

GROUNDWATER ELEVATIONS

Shallow/ Single Installation 1st 2nd Deep/Dual Installation 1st 2nd

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity

o = 3% Strain at Failure



LOG OF BOREHOLE BH2-51

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2	REF. NO.: 171-08406-01
CLIENT: Region of Peel	Method: Solid Stem Auger/HQ Coring
PROJECT LOCATION: Various Streets, City of Mississauga	Diameter: 150 mm/63mm
DATUM: Geodetic	Date: Sep/26/2018
BH LOCATION: N 4829230.83 E 611428.54	ORIGINATED BY BS
	COMPILED BY BW
	CHECKED BY MK

SOIL PROFILE		SAMPLES			GROUND WATER LEVEL	GROUND WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	ELEVATION	ELEVATION	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>			
	Continued													
	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.													
	Coring began at 6.25m Refer to Rock Core Log(Continued)													
11			4	RC		133								
12						132								
13			5	RC		131								
14						130								
15			6	RC		129								
16						128								
17			7	RC		127								
18						126								
19			8	RC		125								
20						124								
			9	RC										
						124								

WSP 02-0000-2018-09-17 08:46  
 WSP 02-0000-2018-09-17 08:46  
 WSP 02-0000-2018-09-17 08:46

Continued Next Page

GROUNDWATER ELEVATIONS

Shallow/ Single Installation Deep/Dual Installation

GRAPH NOTES

+ 3 , × 3 : Numbers refer to Sensitivity      ○ = 3% Strain at Failure



LOG OF BOREHOLE BH2-51

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829230.83 E 611428.54

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Sep/26/2018

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY BS  
 COMPILED BY BW  
 CHECKED BY MK

SOIL PROFILE		SAMPLES			GROUND WATER LEVEL	ELEVATION	GROUND WATER LEVEL	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE				"N" BLOWS 0.3 m	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT				WATER CONTENT (%)
Continued	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.  Coring began at 6.25m Refer to Rock Core Log(Continued)	[Strata Plot]	10	RC											
21															
22					11	RC									
23															
24			12	RC											
25															
26			13	RC											
117.90															
118															
25.53	<b>END OF BOREHOLE</b> Notes: 1) Borehole backfilled with bentonite upon completion. 2) 50mm dia. monitoring well was installed upon completion, screened at 19.81m to 22.86m. 3) Separate borehole was drilled adjacent to BH2-51 to install 50mm dia. Monitoring Well, screened at 4.57m to 6.10m .  Water level measured in monitoring shallow well (screen at 4.57m to 6.10m): Date                      W. L. Depth (m) Sept.28, 2018            2.88  Water level measured in monitoring deep well (screened at 19.81m to 22.86m): Date                      W. L. Depth (m) Sept.28, 2018            1.32														

GROUNDWATER ELEVATIONS      GRAPH NOTES      + 3, X 3: Numbers refer to Sensitivity      ○ = 3% Strain at Failure

Shallow/ Single Installation      Deep/Dual Installation



LOG OF ROCK CORE BH2-51

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829230.83 E 611428.54

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Sep/26/2018

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY: BS  
 COMPILED BY: BW  
 CHECKED BY: MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER LEVEL	ELEVATION	GROUND WATER LEVEL	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
					NUMBER	SIZE												
137.3	Rock Surface																	
136.2 6.3	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (79% to 99%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to very strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (1~21%). Bedding almost horizontal ( $\theta=90^\circ$ )		137		1	HQ	100	81	2	38	10 11 8 3	Soft layer 6.25m ~ 6.27m (W5 to W4) 6.44m ~ 6.46m (W5 to W4) Fracture: 6.50m-6.55m, $\theta=0^\circ$ and $5^\circ$ , two sets; 6.73m ~ 6.83m (W5 to W4) 6.91m-7.04m, $\theta=10^\circ$ 7.04m ~ 7.07m (W5 to W4) 7.14m ~ 7.15m (W5 to W4)	W3		6.9	5.7		
136.0 7.5	Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m) Thickness(mm) 10.44 50 13.46 50 20.54 50 21.56 90 21.98 150 23.11 50 24.18 50 24.28 50		136		2	HQ	100	83	4	23	2 7 7 12 8	Fracture: 7.47m-7.54m, $\theta=10^\circ$ closed; 8.16m-8.20m, $\theta=55^\circ$ ; 8.48m-8.51m, $\theta=0^\circ$ ; 8.04m ~ 8.06m (W5 to W4) 8.60m-8.66m, $\theta=35^\circ$ , closed 8.3m ~ 8.31m (W5 to W4) 8.36m ~ 8.43m (W5 to W4) 8.46m ~ 8.53m (W5 to W4) 8.59m ~ 8.60m (W5 to W4) 8.74m ~ 8.77m (W5 to W4)	W3		12.6	9.0		
134.4 9.0			135								5 5 2	Fracture: 9.21m ~ 9.22m (W5 to W4) 10.35m-10.38m, $\theta=15^\circ$ 9.59m ~ 9.60m (W5 to W4)	W2		10.7	0.8		
133.0 10.4			134			Holeplug	100	95	1	47	5 5	10.13m ~ 10.16m (W5 to W4)						
133.0 10.4			133								4 4	Fragmented zone: 11.23m-11.28m 10.72m ~ 10.73m (W5 to W4) Fracture: 11.05m-11.09m, $\theta=0^\circ$ ; 11.73m-11.84m, $\theta=5^\circ$			127.8			
131.3 12.1			132		4	HQ	100	93	6	51	13 1 6	11.28m ~ 11.30m (W4 to W3)	W2					
129.8 13.7			131		5	HQ	100	78	14	30	12 8 16	12.23m ~ 12.28m (W5 to W4) 12.59m ~ 12.62m (W5 to W4) 12.74m ~ 12.81m (W5 to W4) 12.88m ~ 12.92m (W5 to W4)	W2		10.8	2.6		
128.2 15.2			130								4 3	Fragmented zone: 12.20m-12.21m; 13.07m-13.08m Fracture: 12.80m-12.88m, $\theta=0^\circ$						
128.2 15.2			129		6	HQ	100	95	8	66	2 11 2 2	14.02m ~ 14.07m (W5 to W4) Fragmented zone: 14.15m-14.17m	W2 to W1		13.7	4.4		
128.2 15.2			128		7	HQ	100	94	12	69	5 5 8	Fragmented zone: 15.85m-15.90m Fracture: 15.62m-15.66m, $\theta=5^\circ$ ; 15.89m-15.90m, $\theta=0^\circ$ 15.84m ~ 15.85m (W4)	W2 to W1					
												16.05m ~ 16.07m (W4)	W2 to W1					

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered

E = Modulus of Elasticity  
 \*: UCS [Mpa]  $\approx 24 I_{s(60)}$



LOG OF ROCK CORE BH2-51

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829230.83 E 611428.54

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Sep/26/2018

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY BS  
 COMPILED BY BW  
 CHECKED BY MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER LEVEL	ELEVATION	GROUND WATER LEVEL	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> )		
					NUMBER	SIZE														
Continued																				
126.8	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (79% to 99%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to very strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (1~21%). Bedding almost horizontal ( $\theta=90^\circ$ )  Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m)    Thickness(mm) 10.44        50 13.46        50 20.54        50 21.56        90 21.98        150 23.11        50 24.18        50 24.28        50 (continued)		127								0				15.2	3.4	7.86	2.66	0.257	
16.6												1								
17												4	Fracture: 17.75m-17.79m, $\theta=10^\circ$ , closed							
18												5	17.11m - 17.13m (W5 to W4)							
18.1						8	HQ	100	98	17	58	4		W2 to W1		18.0	8.8			
18.1												2								
18.1												0								
18.1												2	Fragmented zone: 18.62m-18.63m; 18.95m-18.97m; 19.13m-19.18m			10.3	1.7	8.63	2.60	0.97
18.1												4	Fracture: 18.53m-18.55m, $\theta=0^\circ$ ; 18.85m-18.95m, $\theta=0^\circ$ ; 19.11m-19.13m, $\theta=0^\circ$ , closed; 19.41m-19.49m, $\theta=10^\circ$ ; 19.51m-19.66m, $\theta=10^\circ$							
18.1						9	HQ	100	94	11	65	7		W2 to W1						
18.1												5								
123.8												4	19.49m - 19.51m (W5 to W4)							
19.7												5	Fracture: 19.66m-19.69m, $\theta=5^\circ$ ; 19.72m-19.74m, $\theta=0^\circ$							
19.7												2	20.1m - 20.12m (W5 to W4)							
19.7												5	20.37m - 20.38m (W5 to W4)							
19.7						10	HQ	100	94	11	76	5		W2 to W1		96.2				
19.7												3								
122.5											2	Fragmented zone: 21.36m-21.41m; 21.97m-21.98m 21.29m - 21.31m (W5 to W4)			10.2	0.9				
21.0											17	21.46m - 21.53m (W5 to W4)								
21.0											6	Fracture: 21.41m-21.46m, $\theta=20^\circ$ and $5^\circ$ , two sets; 21.65m-21.73m, $\theta=10^\circ$ and $5^\circ$ , two sets; 21.73m-21.77m, $\theta=0^\circ$ ; 21.84m-21.97m, $\theta=0^\circ$ ; 22.14m-22.34m, $\theta=0^\circ$ , closed								
21.0					11	HQ	100	88	21	59	7		W2 to W1				24.39	2.57	0.873	
21.0											1	22.58m - 22.59m (W5 to W4)								
21.0											1	Fragmented zone: 23.98m-24.00m; 24.04m-24.07m								
21.0											1	Fracture: 23.62m-23.70m, $\theta=0^\circ$ and $5^\circ$ , two sets, closed; 24.00m-24.04m, $\theta=5^\circ$			15.6	8.5				
21.0					12	HQ	100	94	21	78	3		W2 to W1							
21.0											11	24.07m - 24.10m (W5 to W4)								
119.2											8	Fragmented zone: 24.33m-24.37m 24.51m - 24.54m (W5 to W4)								
24.2											1	Fracture: 24.29m-24.33m, $\theta=0^\circ$								
24.2											3	25.14m - 25.15m (W5 to W4) 25.18m - 25.20m (W5 to W4)			62.0					
24.2											2									
117.9																				
25.5	<b>END OF BOREHOLE</b> Notes: 1) Borehole backfilled with bentonite upon completion.																			

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered

E = Modulus of Elasticity  
 \*: UCS [Mpa]  $\approx 24 I_{s(60)}$



LOG OF ROCK CORE BH2-51

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 2  
 CLIENT: Region of Peel  
 LOCATION: Various Streets, City of Mississauga  
 DATUM: Geodetic  
 BH LOCATION: N 4829230.83 E 611428.54

Method: Solid Stem Auger/HQ Coring  
 Diameter: 150 mm/63mm  
 Date: Sep/26/2018

REF. NO.: 171-08406-01  
 ENCL NO.:  
 ORIGINATED BY BS  
 COMPILED BY BW  
 CHECKED BY MK

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER LEVEL	ELEVATION	GROUND WATER LEVEL	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)*	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
					NUMBER	SIZE												
	Continued																	
	<p>2) 50mm dia. monitoring well was installed upon completion, screened at 19.81m to 22.86m.</p> <p>3) Separate borehole was drilled adjacent to BH2-51 to install 50mm dia. Monitoring Well, screened at 4.57m to 6.10m .</p> <p>Water level measured in monitoring shallow well (screen at 4.57m to 6.10m):            Date W. L. Depth (m)            Sept.28, 2018 2.88</p> <p>Water level measured in monitoring deep well (screened at 19.81m to 22.86m):            Date W. L. Depth (m)            Sept.28, 2018 1.32</p>																	

WSP 02 000000114 00 01 006  
WSP 02 000000114 00 01 006  
WSP 02 000000114 00 01 006

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered  
 \* E = Modulus of Elasticity  
 \*: UCS [Mpa] ≈ 24 I<sub>s(60)</sub>





LOG OF BOREHOLE BA- MW26-15

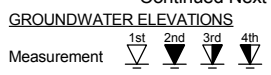
PROJECT: Burnhamthorpe Rd. WM Twinning Project  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Burnhamthorpe Road, Mississauga, Ontario  
 DATUM: Geodetic  
 BH LOCATION: See Borehole Location Plan N 4829240.5 E 611438.9

**DRILLING DATA**  
 Method: Hollow Stem Augers/PQ Coring  
 Diameter: 203 mm/122mm  
 Date: Jun/01/2015  
 REF. NO.: 10001702  
 ENCL NO.: MW26

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT			PLASTIC NATURAL LIQUID LIMIT			POCKET PEN. (Cu) (MPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	NUMBER	TYPE	"N" BLOWS 0.3 m			20 40 60 80 100	20 40 60 80 100	W <sub>p</sub>	W	W <sub>L</sub>	10 20 30			
143.8															
140.6	TOPSOIL: 150mm				Concrete										
0.2	FILL: sand and gravel, trace clay and silt, brown, moist, compact.	1	SS	15	Sand									21.4	
143.0						143									
0.8	FILL: silty clay, some sand, trace gravel, contains sand seams, brown, moist, stiff to hard.	2	SS	8											
141.3					Holeplug										
2.4	SILTY CLAY TILL: sandy, trace to some gravel, oxidized, brown, moist, hard.	3	SS	11		142								20.5	
	brown to grey below 3.0m					141									
		4	SS	30		141									15 22 41 22
					W. L. 140.9 m Sep 29, 2015										
		5	SS	34											2 31 43 24
					Screen										
						140									
139.2	GEORGIAN BAY FORMATION: shale bedded with siltstone and limestone, grey.	6	SS	59		139									auger refusal
4.6	Coring began at 5.89m Refer to Rock Core Log														
		1	RC			138									
						137									
		2	RC			136									
						135									
		3	RC			134									

SPL SOIL LOG-2015-1WELL\_10001702\_OCT.28.2015RMR\_MW21-MW30 - PRINT FOR FINAL REPORT.GPJ SPL.GDT\_10/30/15

Continued Next Page



GRAPH NOTES +3, x3: Numbers refer to Sensitivity  
 O = 3% Strain at Failure

PROJECT: Burnhamthorpe Rd. WM Twinning Project  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Burnhamthorpe Road, Mississauga, Ontario  
 DATUM: Geodetic  
 BH LOCATION: See Borehole Location Plan N 4829240.5 E 611438.9

**DRILLING DATA**  
 Method: Hollow Stem Augers/PQ Coring  
 Diameter: 203 mm/122mm  
 Date: Jun/01/2015  
 REF. NO.: 10001702  
 ENCL NO.: MW26

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)						
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)						WATER CONTENT (%)					
						20	40	60	80	100	W <sub>p</sub>	w	W <sub>L</sub>	GR	SA	SI	CL		
	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.  Coring began at 5.89m Refer to Rock Core Log(Continued)		4	RC															
133																			
132				5	RC														
131																			
130																			
129				7	RC														
128																			
127																			
126				9	RC														
125																			
124			10	RC															

SPL SOIL LOG-2015-1WELL\_10001702\_OCT.28.2015RMR\_MW21-MW30 - PRINT FOR FINAL REPORT.GPJ SPL.GDT\_10/30/15

Continued Next Page

GROUNDWATER ELEVATIONS  
 Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity  
 ○ ●=3% Strain at Failure

PROJECT: Burnhamthorpe Rd. WM Twinning Project CLIENT: Region of Peel PROJECT LOCATION: Burnhamthorpe Road, Mississauga, Ontario DATUM: Geodetic BH LOCATION: See Borehole Location Plan N 4829240.5 E 611438.9	<b>DRILLING DATA</b> Method: Hollow Stem Augers/PQ Coring Diameter: 203 mm/122mm Date: Jun/01/2015
	REF. NO.: 10001702 ENCL NO.: MW26

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT					POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20	40	60	80	100				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>
120.7 121 122 123	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.  Coring began at 5.89m Refer to Rock Core Log(Continued)		11	RC														
			12	RC														
23.1	<b>END OF BOREHOLE</b> Notes: 1) 50mm dia. monitoring well was installed upon completion at separate borehole about 1.0m from BA-MW26-15. 2) Water Level Readings: Date            W. L. Depth (m) Jun.29, 2015    2.51 Jul. 14, 2015    2.51 Aug. 20, 2015    2.67 Sep. 29, 2015    2.92																	

SPL SOIL LOG-2015-1WELL 10001702\_OCT.28.2015RMR\_MW21-MW30 - PRINT FOR FINAL REPORT.GPJ SPL.GDT 10/30/15

**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** +<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity    ○ ●=3% Strain at Failure



LOG OF ROCK CORE BA- MW26-15

PROJECT: Burnhamthorpe Rd. WM Twinning Project	<b>DRILLING DATA</b>	
CLIENT: Region of Peel	Method: Hollow Stem Augers/PQ Coring	REF. NO.: 10001702
LOCATION: Burnhamthorpe Road, Mississauga, Ontario	Diameter: 203 mm/122mm	ENCL NO.: MW26
DATUM: Geodetic	Date: Jun/01/2015	
BH LOCATION: See Borehole Location Plan N 4829240.5 E 611438.9		

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)																						
			NUMBER	SIZE																																		
139.2	Rock Surface																																					
4.6	<p><b>GEORGIAN BAY FORMATION</b> Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (78% to 95%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to very strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (5~22%). Bedding almost horizontal (<math>\theta=90^\circ</math>)</p> <p>Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths:</p> <table border="1"> <tr><th>Depth(m)</th><th>Thickness(mm)</th></tr> <tr><td>5.03</td><td>100</td></tr> <tr><td>5.30</td><td>75</td></tr> <tr><td>5.80</td><td>70</td></tr> <tr><td>10.62</td><td>50</td></tr> <tr><td>13.03</td><td>50</td></tr> <tr><td>17.42</td><td>50</td></tr> <tr><td>18.10</td><td>50</td></tr> <tr><td>19.74</td><td>50</td></tr> <tr><td>21.88</td><td>75</td></tr> <tr><td>22.28</td><td>160</td></tr> </table>	Depth(m)	Thickness(mm)	5.03	100	5.30	75	5.80	70	10.62	50	13.03	50	17.42	50	18.10	50	19.74	50	21.88	75	22.28	160															
Depth(m)		Thickness(mm)																																				
5.03		100																																				
5.30		75																																				
5.80		70																																				
10.62		50																																				
13.03		50																																				
17.42		50																																				
18.10		50																																				
19.74		50																																				
21.88		75																																				
22.28		160																																				
138.7																																						
5.0				1	PQ	100	62	22	54	11	Fragmented zone: 5.03m-5.13m; 5.13m ~ 5.27m (W3)																											
										1	5.73m-5.78m; 5.87m-5.88m; 5.97m-6.15m; 5.49m ~ 5.50m (W4 to W3)																											
									10	6.31m-6.35m Fracture: 5.66m-5.73m, $\theta=30^\circ$																												
									>25	5.72m ~ 5.73m (W3)																												
137.4										6.15m ~ 6.30m (W3)																												
6.4									4	Fracture: 6.46m ~ 6.48m (W4 to W3) 6.53m ~ 6.57m (W4 to W5)																												
									4	6.58m-6.65m, $\theta=5^\circ$ and $10^\circ$ , two sets; 6.91m-7.21m, $\theta=10^\circ$																												
			2	PQ	100	98	5	88	2	6.85m ~ 6.86m (W4)																												
									0																													
									0																													
135.9										Fragmented zone: 8.14m-8.17m; 8.18m-8.20m																												
7.9									5																													
									3																													
			3	PQ	100	95	5	88	1																													
									0																													
									0																													
134.4										Fragmented zone: 10.68m-10.72m																												
9.4									0																													
									0																													
									0																													
132.9										Fracture: 11.32m-11.34m, $\theta=0^\circ$ and $25^\circ$ , two sets; 12.09m-12.12m, $\theta=10^\circ$																												
10.9									4																													
									0																													
									3																													
			5	PQ	100	100	7	98	0																													
									2																													
									0																													
131.4										Fragmented zone: 12.90m-12.93m Fracture: 12.64m-12.66m, $\theta=0^\circ$ ; 12.83m ~ 12.85m (W3) 12.94m ~ 13.03m (W4)																												
12.4									3																													
									16																													
									1	12.73m-12.76m, $\theta=0^\circ$ , $45^\circ$ and $60^\circ$ , three sets; 12.87m-12.90m, $\theta=20^\circ$ ; 13.25m-13.30mm, $\theta=5^\circ$ ;																												
									0																													
									0																													
129.8										Fracture: 15.39m-15.43m, $\theta=0^\circ$ and $10^\circ$ , two sets																												
14.0									1																													
									1																													

SPL ROCK CORE-2014\_10001702\_OCT.28.2015RMR\_MW26-MW30 - PRINT FOR FINAL REPORT.GPJ SPL\_GDT\_10/30/15

Continued Next Page

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered  $\theta$  = angle to the core axis

E = Modulus of Elasticity  
\*: UCS [MPa] =  $24 I_{s(50)}$



PROJECT: Burnhamthorpe Rd. WM Twinning Project CLIENT: Region of Peel LOCATION: Burnhamthorpe Road, Mississauga, Ontario DATUM: Geodetic BH LOCATION: See Borehole Location Plan N 4829240.5 E 611438.9	<b>DRILLING DATA</b> Method: Hollow Stem Augers/PQ Coring Diameter: 203 mm/122mm Date: Jun/01/2015 REF. NO.: 10001702 ENCL NO.: MW26
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(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE												
	Aug. 20, 2015    2.67 Sep. 29, 2015    2.92															

SPL ROCK CORE-2014\_10001702\_OCT.28.2015RMR\_MW21-MW30 - PRINT FOR FINAL REPORT.GPJ SPL\_GDT 10/30/15

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered     $\theta$  = angle to the core axis    E = Modulus of Elasticity  
 \*: UCS [MPa]  $\approx$  24 I<sub>S(50)</sub>

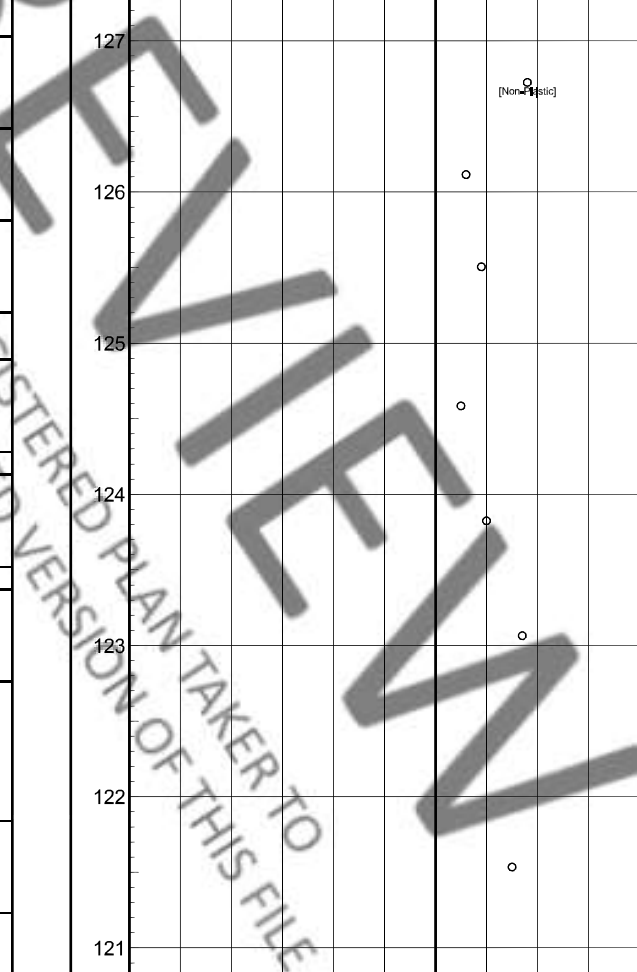


PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Cawthra Rd. from Dundas St. to Bloor St., Mississauga, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4827931.7 E 612873.1

REF. NO.: 171-08406-00  
 ENCL NO.: 2  
 ORIGINATED BY: JL  
 COMPILED BY: BW  
 CHECKED BY: DT

Method: Hollow Stem Auger/HQ Coring  
 Diameter: 203 mm/63mm  
 Date: Aug/01/2017

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)										
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20							40	60	80	100	20	40	60	80	100	10
127.94	Ground Surface																							
127.69	ASPHALT: 110mm																							
127.61	CONCRETE: 220mm																							
120.48	GRANULAR BASE / SUBBASE: 30mm, sand and gravel, brown, moist, compact. FILL: silty sand, trace clay, trace gravel, brown, moist, compact, saturated below 0.9m		1	SS	19																			
126.42	FILL: sand and gravel, some silt, trace clay, trace crushed stone, brown, moist, compact.		2	SS	19																			1 68 28 3
125.96	SAND: some silt, trace gravel, trace clay, brown, moist, compact. contains silt seams below 2.3m		3	SS	20																			
124.89	GRAVELLY SAND: some silt, trace clay, occasional shale fragments, brown, moist, very dense. contains clayey silt pockets, wet below 3.8m		4	SS	24																			7 71 18 4
123.37	SAND: some gravel, trace silt, trace clay, brown, saturated, compact.		5	SS	55																			29 54 13 4
120.78	SAND: some gravel, trace silt, trace clay, brown, saturated, compact. trace to some silt, trace gravel below 6.1m		6	SS	65																			spoon wet 11 78 8 3
118.80	SILTY CLAY TILL / SHALE COMPLEX: sandy, trace gravel, contains shale fragments, grey, moist, hard.		7	SS	29																			2 85 10 3
9.14			8	SS	50/ initial 25mm																			
			9	RC																				
			10	RC																				



WSP PROJECT: 171-08406-00  
 CLIENT: REGION OF PEEL  
 PROJECT: CAWTHRA ROAD SANITARY SEWER AND WATERMAIN PROJECT - PHASE 1  
 BOREHOLE: BH17-2  
 DATE: AUG 01 2017  
 DRAWN BY: [Name]  
 CHECKED BY: [Name]

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Cawthra Rd. from Dundas St. to Bloor St., Mississauga, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4827931.7 E 612873.1

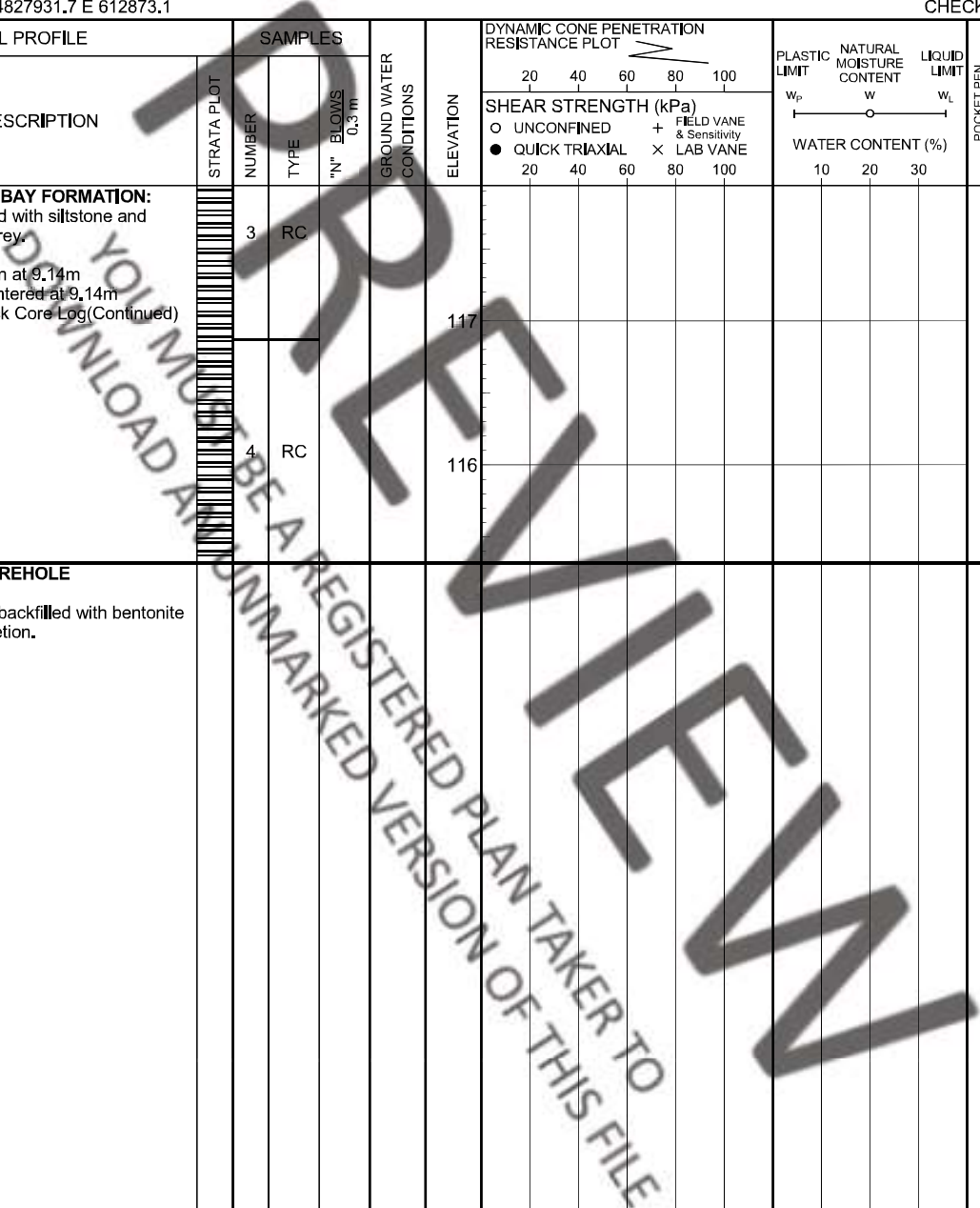
Method: Hollow Stem Auger/HQ Coring  
 Diameter: 203 mm/63mm  
 Date: Aug/01/2017

REF. NO.: 171-08406-00  
 ENCL NO.: 2  
 ORIGINATED BY: JL  
 COMPILED BY: BW  
 CHECKED BY: DT

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL LIMIT WT (w <sub>nat</sub> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20						
Continued	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.  Coring began at 9.14m Rock encountered at 9.14m Refer to Rock Core Log(Continued)		3	RC										
11														
12			4	RC										
115.32														
12.62	<b>END OF BOREHOLE</b> Note: 1) Borehole backfilled with bentonite upon completion.													

**GROUNDWATER ELEVATIONS**  
 Measurement

**GRAPH NOTES** +<sup>3</sup>, ×<sup>3</sup>: Numbers refer to Sensitivity      ○ ● = 3% Strain at Failure



WSP PROJECT: MISSISSAUGA - CAWTHRA RD SANITARY SEWER AND WATERMAIN PROJECT - PHASE 1  
 DRAWING: LOG OF BOREHOLE BH17-2  
 DATE: 2017-08-01  
 SCALE: AS SHOWN  
 SHEET: 1 OF 1



LOG OF ROCK CORE BH17-2

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1  
 CLIENT: Region of Peel  
 LOCATION: Cawthra Rd, from Dundas St. to Bloor St., Mississauga, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4827931.7 E 612873.1

Method: Hollow Stem Auger/HQ Coring  
 Diameter: 203 mm/63mm  
 Date: Aug/01/2017

REF. NO.: 171-08406-00  
 ENCL NO.: 2  
 ORIGINATED BY: JL  
 COMPILED BY: BW  
 CHECKED BY: DT

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0.3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE												
118.80	Rock Surface															
118.44	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (72% to 87%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to very strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (13-28%), Bedding almost horizontal ( $\theta=90^\circ$ )		1	HQ	100	100	14	100	0							
118.52			2	HQ	100	67	13	0	5	Soft layer 9.42m - 9.47m (W5 to W4)						
118.48									5	Fragmented zone: 10.18m-10.19m						
9.58									10	Fracture: 9.88m - 9.93m (W4)						
10				3	HQ	100	93	28	58	6	10.05m-10.13m, 10.24m - 10.25m (W5 to W4)					
									1	10.05m-10.13m, 10.24m - 10.25m (W5 to W4)			102.1	64.7		
									1	10.71m-10.74m, $\theta=0^\circ$ to $10^\circ$ ;						
									1	10.71m-10.74m, $\theta=65^\circ$ , closed						
116.87									0	10.78m - 10.79m (W4 to W3)						
11.07		Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m) Thickness(mm) 9.94 60 10.41 75 10.72 60 12.01 85 12.34 75							3	Fragmented zone: 11.16m - 11.18m (W4 to W3)						
								13	11.44m-11.56m; 12.13m-12.15m; 12.22m-12.24m							
			4	HQ	100	77	18	23	11	Fracture: 11.73m - 11.75m (W5 to W4) 12.35m-12.42m, 11.8m - 11.82m (W4 to W3)						
								8	$\theta=0^\circ$ to $35^\circ$ ; closed			108.5	34.0			
115.32								11	12.1m - 12.12m (W5 to W4)							
12.62	<b>END OF BOREHOLE</b> Note: 1) Borehole backfilled with bentonite upon completion.															

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered     $\theta$  = angle to the core axis    E = Modulus of Elasticity  
 \*: UCS [MPa] = 24 I<sub>s(50)</sub>

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Cawthra Rd. from Dundas St. to Bloor St., Mississauga, ON  
 DATUM: Geodetic  
 BH LOCATION: N 4827850.94 E 612861.52

REF. NO.: 171-08406-00  
 ENCL NO.: 9  
 ORIGINATED BY JL  
 COMPILED BY BW  
 CHECKED BY DT

Method: Hollow Stem Auger/HQ Coring

Diameter: 203 mm/63mm

Date: Jul/26/2017

SOIL PROFILE			SAMPLES			DYNAMIC CONE PENETRATION RESISTANCE PLOT	PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m							
129.12	Ground Surface											
128.99	TOPSOIL: 150mm.											
0.15	FILL: silty sand, some clay, trace gravel, trace organics, brown, moist, loose.		1	SS	9							
			2	SS	7							4 50 35 11
	contains sandy silt pockets below 1.5m		3	SS	8							
126.83	SANDY SILT: trace clay, brown, wet, loose.		4	SS	7							0 28 67 5
126.07	SILTY SAND: trace clay, brown, moist, loose.		5	SS	8							0 77 20 3
125.31	SAND AND GRAVEL: trace to some silt, trace clay, brown, moist, dense to very dense. cobbles/boulders(inferred)		6	SS	83/ 300mm							36 50 10 4
	wet to saturated below 4.6m		7	SS	46							
			8	SS	50/ initial 25mm							
	cobbles/boulders											
			9	SS	50/ 75mm							
	with silty clay layer below 7.6m											
120.43	SILTY SAND: with grey silt layer and sandy silt seams, trace clay, trace gravel, brown, saturated, very dense.		10	SS	92/ 225mm							1 59 35 5

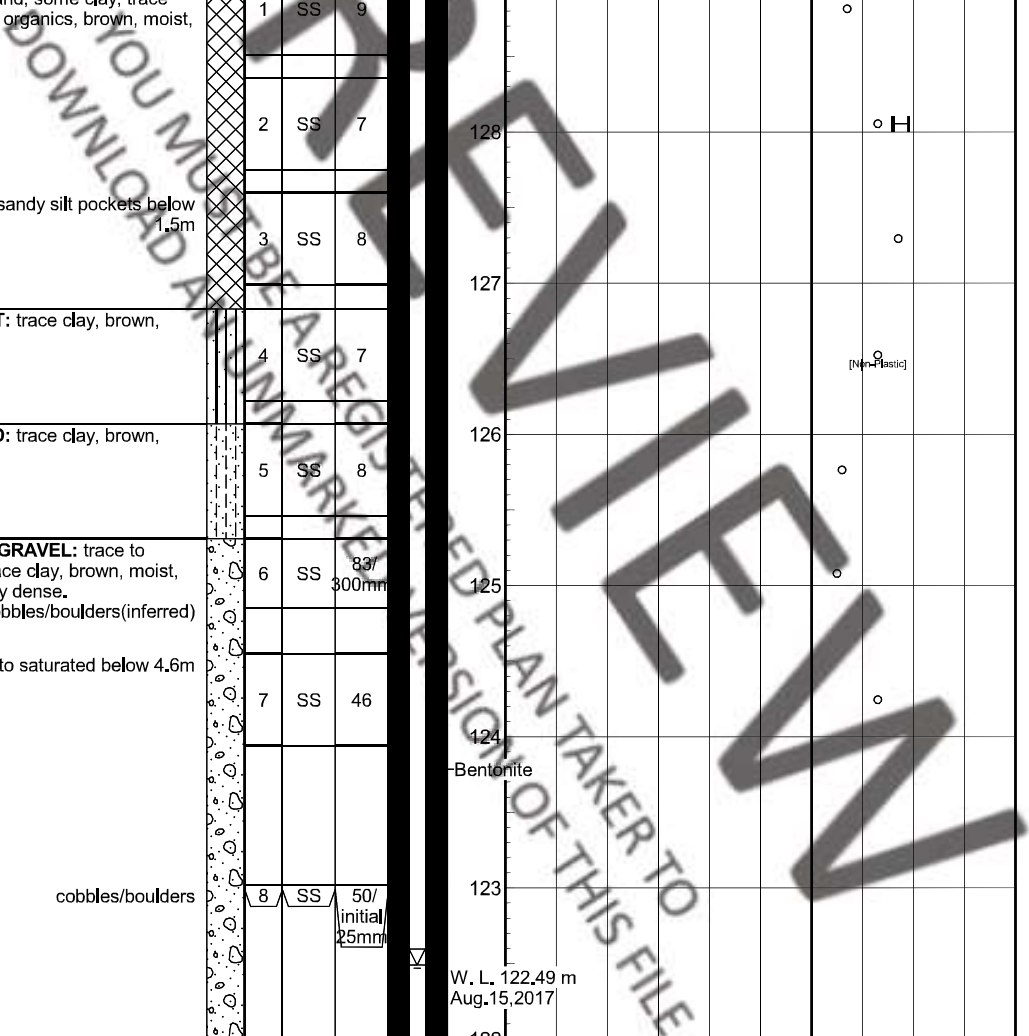
Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+3, ×3: Numbers refer to Sensitivity  
 ○ = 3% Strain at Failure



PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1

REF. NO.: 171-08406-00

CLIENT: Region of Peel

Method: Hollow Stem Auger/HQ Coring

ENCL NO.: 9

PROJECT LOCATION: Cawthra Rd. from Dundas St. to Bloor St., Mississauga, ON Diameter: 203 mm/63mm

ORIGINATED BY JL

DATUM: Geodetic

Date: Jul/26/2017

COMPILED BY BW

BH LOCATION: N 4827850.94 E 612861.52

CHECKED BY DT

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (C <sub>u</sub> ) (kPa)	NATURAL LIMIT WT (w <sub>nat</sub> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)												
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20							40	60	80	100	20	40	60	80	100	10	20	30
118.91	Continued																									
10.21	<b>SILTY SAND TILL / SHALE COMPLEX:</b> some gravel, trace clay, contains shale fragments, grey, very dense.																									
118.36			11	SS RC	50/ initial 25mm																					
10.76	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.  Coring began at 10.69m Rock encountered at 10.76m Refer to Rock Core Log		11	RC																						
11			1	RC																						
12			2	RC																						Atterberg Limits (rock)
13			3	RC																						
14			4	RC																						
15			5	RC																						
16			6	RC																						
17			7	RC																						
18																										
19																										
20																										

Continued Next Page

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES

+3, ×3: Numbers refer to Sensitivity

○ = 3% Strain at Failure

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1	REF. NO.: 171-08406-00
CLIENT: Region of Peel	Method: Hollow Stem Auger/HQ Coring
PROJECT LOCATION: Cawthra Rd. from Dundas St. to Bloor St., Mississauga, ON	Diameter: 203 mm/63mm
DATUM: Geodetic	Date: Jul/26/2017
BH LOCATION: N 4827850, 94 E 612861.52	ORIGINATED BY: JL
	COMPILED BY: BW
	CHECKED BY: DT

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT w	LIQUID LIMIT W <sub>L</sub>	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)								
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	SHEAR STRENGTH (kPa)									WATER CONTENT (%)			GR	SA	SI	CL	
Continued	<b>GEORGIAN BAY FORMATION:</b> shale bedded with siltstone and limestone, grey.																							
	Coring began at 10.69m Rock encountered at 10.76m Refer to Rock Core Log(Continued)																							
21			8	RC																				
22			9	RC																				
23			10	RC																				
24			11	RC																				
25			12	RC																				
26																								
102.60																								
26.52	<p><b>END OF BOREHOLE</b></p> <p>Notes: 1) 50mm dia. monitoring well was installed upon completion, screened at 11.28m to 14.33m.</p> <p>Water level measured in monitoring well:</p> <table border="0" style="width:100%"> <tr> <td>Date</td> <td>W. L. Depth (m)</td> </tr> <tr> <td>Aug,15,2017</td> <td>6.63m (before developing well)</td> </tr> <tr> <td>Aug,18,2017</td> <td>8.73m (after developing well)</td> </tr> </table>																		Date	W. L. Depth (m)	Aug,15,2017	6.63m (before developing well)	Aug,18,2017	8.73m (after developing well)
Date	W. L. Depth (m)																							
Aug,15,2017	6.63m (before developing well)																							
Aug,18,2017	8.73m (after developing well)																							

GROUNDWATER ELEVATIONS

Measurement 1st 2nd 3rd 4th

GRAPH NOTES + 3, x 3: Numbers refer to Sensitivity ○ = 3% Strain at Failure





LOG OF ROCK CORE BH17-36

PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1 REF. NO.: 171-08406-00  
 CLIENT: Region of Peel Method: Hollow Stem Auger/HQ Coring ENCL NO.: 9  
 LOCATION: Cawthra Rd, from Dundas St. to Bloor St., Mississauga, ON Diameter: 203 mm/63mm ORIGINATED BY JL  
 DATUM: Geodetic Date: Jul/26/2017 COMPILED BY BW  
 BH LOCATION: N 4827850,94 E 612861,52 CHECKED BY DT

(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0,3 m)	DISCONTINUITIES	Weathering Index W3	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)					
			NUMBER	SIZE																	
118.36	Rock Surface																				
118.76	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (69% to 100%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to very strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (0-31%). Bedding almost horizontal ( $\theta=90^\circ$ )		1	HQ	100	76	0	0	9	Fracture: 10.83m ~ 10.89m (W5 to W4) Soft layer 11.00m-11.02m, $\theta=15^\circ$ Fragmented zone: 11.24m ~ 11.26m (W5 to W4) 11.02m-11.07m; 11.29m ~ 11.48m (W5 to W4) 11.68m-11.75m; 11.87m-11.91m; 12.48m-12.50m; 12.59m-12.64m	W3		6,8								
118.10										12											
11.02										11											
12					2	HQ	100	80	4	39	11	Fracture: 11.09m-11.13m, $\theta=10^\circ$ , closed; 11.13m-11.18m, $\theta=5^\circ$ , closed; 11.34m-11.37m, $\theta=15^\circ$ , closed; 12.27m ~ 12.29m (W5 to W4)	W3 to W2								
116.42			Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m) Thickness(mm) 13,61 105 13,95 55 14,10 195 15,07 120 25,23 80								11	11.37m-11.42m, $\theta=30^\circ$ , closed; 11.65m-11.66m, $\theta=70^\circ$ , closed; 11.66m-11.68m, $\theta=0^\circ$ , closed; 12.59m-12.61m, $\theta=0^\circ$ , closed			18,3	5,1					
12.70												6	Fragmented zone: 12.98m-13.02m; 13.14m ~ 13.16m (W4 to W3) 13.77m-13.79m 13.18m ~ 13.21m (W4 to W3)								
13							3	HQ	100	83	17	48	8	Fracture: 13.44m ~ 13.46m (W5 to W4) 13.02m-13.04m, 13.58m ~ 13.62m (W4 to W3) $\theta=0^\circ$ , closed;	W2 to W1						
15.05													4	13.21m-13.23m, 13.85m ~ 13.86m (W5 to W4) $\theta=0^\circ$ and 5°(2 sets);	W2 to W1						
14.07													6	13.42m-13.45m, 14.01m ~ 14.03m (W5 to W4) 13.42m-13.45m, 14.04m ~ 14.1m (W5 to W4) $\theta=0^\circ$ and 5°(2 sets);	W2 to W1		115,7				
15													3	13.78m-13.81m, 14.28m ~ 14.31m (W4 to W3) $\theta=20^\circ$ closed	W2 to W1						
113.75							4	HQ	100	76	31	55	7	Fragmented zone: 14.49m-14.55m; 14,8m ~ 14,81m (W5 to W4) 14.82m-14.92m; 14,92m ~ 14,97m (W4 to W3) 15.04m-15.07m	W2 to W1						
15.37													6	Fracture: 14.78m-14.80m, 15.37m ~ 15.38m (W4 to W3) $\theta=0^\circ$ , closed;	W2 to W1		15,4	5,9			
16											0	15.07m-15.13m, $\theta=10^\circ$ to 0°	W2 to W1								
16											0	Fragmented zone: 16.51m-16.55m; 16.94m-17.01m	W2 to W1		31,7	1,6					
17					5	HQ	100	85	16	66	6	Fracture: 16.03m-16.08m, $\theta=0^\circ$ and 20°(2 sets); 16.08m-16.26m, $\theta=15^\circ$ , closed; 16.46m-16.51m, $\theta=0^\circ$ and 30°(2 sets);	W2 to W1								
112.03											13	16.71m-16.80m, $\theta=0^\circ$ ; 17.06m-17.09m, $\theta=0^\circ$	no take								
17.09									9	Fragmented zone: 17.38m-17.41m; 17,45m-17,49m; 17.98m-18.04m	W2 to W1										
18									7	Fracture: 17.09m-17.28m, $\theta=0^\circ$ to 10°; 17.41m-17.45m, $\theta=0^\circ$ ; 17.89m-17.98m, $\theta=0^\circ$ and 5°(2 sets); 18.04m-18.20m, $\theta=0^\circ$ , closed	W2 to W1		14,7	1,4							
110.50									4		W2 to W1										
18.62									5		W2 to W1										
19									1		W2 to W1										
19									0		W2 to W1										
108.77			7	HQ	100	100	9	100	0		no take		28,8	1,3							
20									0		no take										
20.35									0		no take										

Continued Next Page

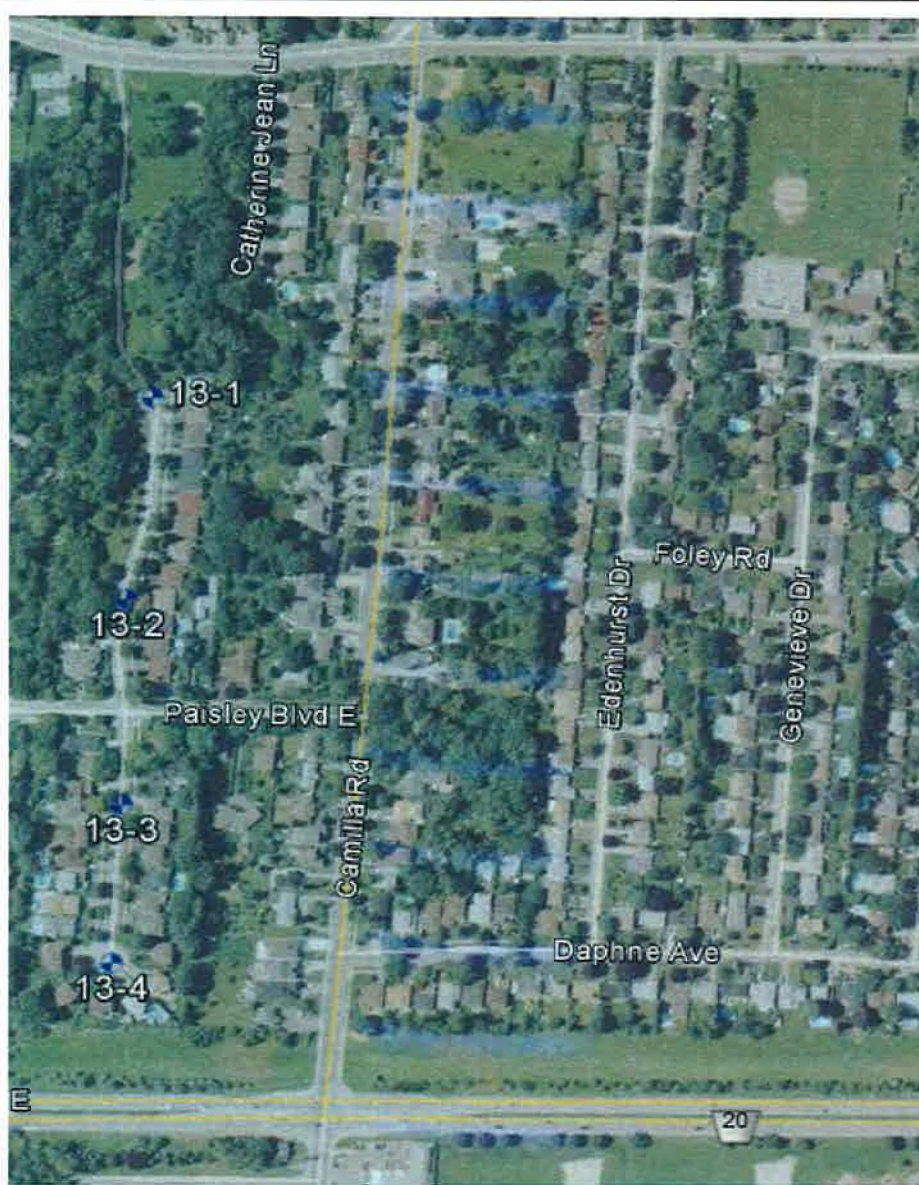
Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered  $\theta$  = angle to the core axis

E = Modulus of Elasticity  
\*: UCS [MPa] = 24 I<sub>s(50)</sub>

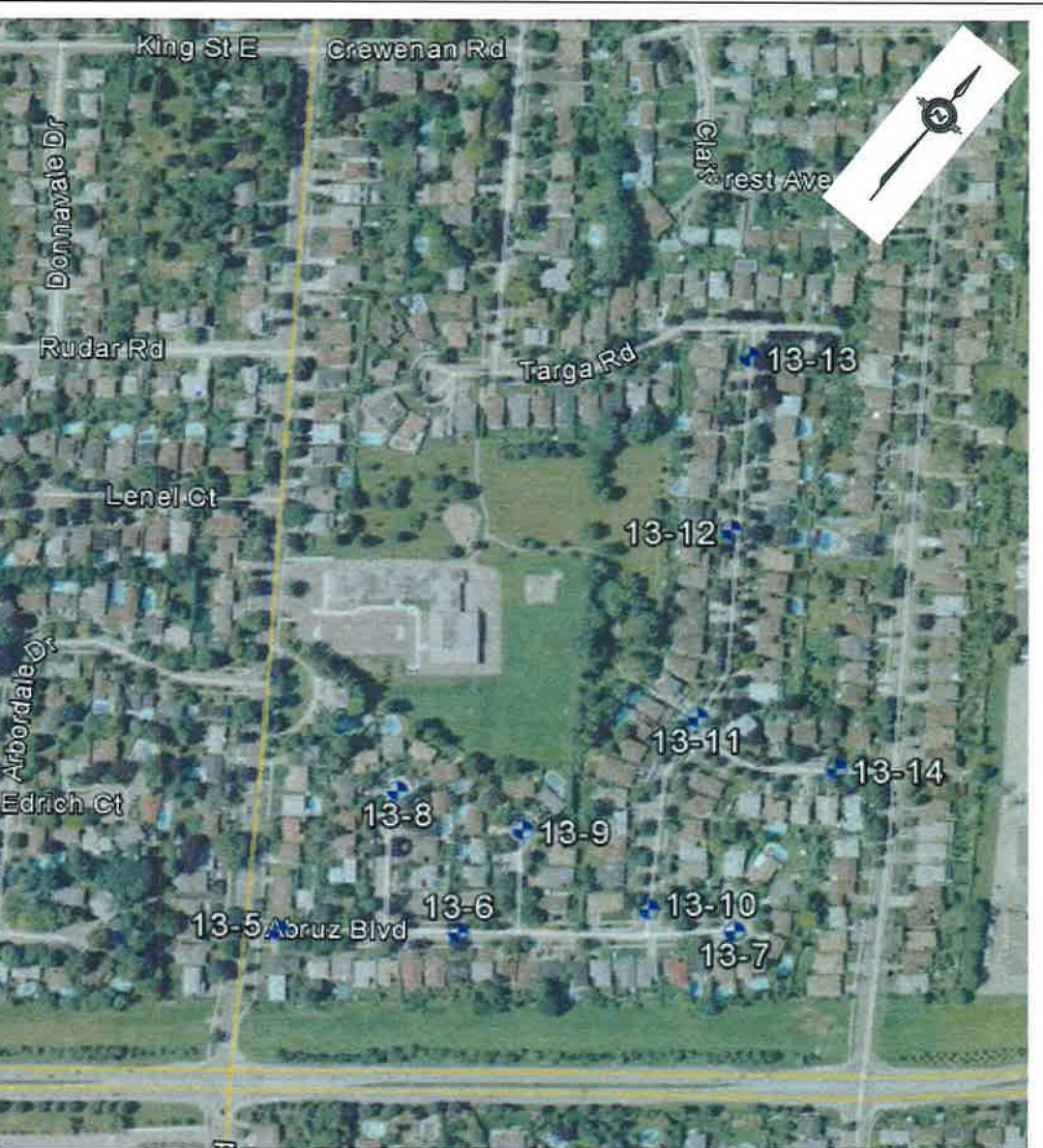
PROJECT: Geotechnical Investigation - Cawthra Road Sanitary Sewer and Watermain Project - Phase 1	REF. NO.: 171-08406-00
CLIENT: Region of Peel	Method: Hollow Stem Auger/HQ Coring
LOCATION: Cawthra Rd. from Dundas St. to Bloor St., Mississauga, ON	ENCL NO.: 9
DATUM: Geodetic	Diameter: 203 mm/63mm
BH LOCATION: N 4827850,94 E 612861,52	Date: Jul/26/2017
	ORIGINATED BY JL
	COMPILED BY BW
	CHECKED BY DT


(m) ELEV DEPTH	ROCK DESCRIPTION	GROUND WATER CONDITIONS	CORE SAMPLE		TOTAL CORE RECOVERY (%)	SOLID CORE RECOVERY (%)	HARD LAYER (%)	RQD (%)	FRACTURE INDEX (per 0,3 m)	DISCONTINUITIES	Weathering Index	HYDRAULIC CONDUCTIVITY (cm/sec)	POINT LOAD TEST UCS AXIAL (MPa)	POINT LOAD TEST UCS DIAMETRAL (MPa)*	UNIAXIAL COMPRESSION (MPa)	DENSITY (g/cm <sup>3</sup> ) E (GPa)
			NUMBER	SIZE												
Continued																
21 107.45 21.67	<b>GEORGIAN BAY FORMATION</b> Moderately weathered to fresh, laminated to thinly bedded, dark grey to grey, very weak to medium strong, <b>SHALE</b> and <b>LIMY SHALE</b> (69% to 100%), interbedded with thinly laminated to thinly bedded with slightly weathered to fresh, light grey, medium strong to very strong <b>SILTSTONE</b> and <b>LIMESTONE</b> (0-31%). Bedding almost horizontal ( $\theta=90^\circ$ )  Siltstone and limestone (hard) layers generally less than 50mm thick except at the following depths: Depth(m) Thickness(mm) 13,61 105 13,95 55 14,10 195 15,07 120 25,23 80 (continued)		8	HQ	100	100	8	100	0		W2 to W1					
22 105.93 23.19		9	HQ	100	97	16	97	0	2 1 3	Fracture: 21.67m-21.73m, $\theta=0^\circ, 5^\circ$ and $10^\circ$ (3 sets), closed; 21.84m-21.92m, $\theta=0^\circ$ , closed; 22.76m-22.83m, $\theta=20^\circ$ , closed; 22.83m-22.99m, $\theta=0^\circ$ and $5^\circ$ (2 sets), closed; 22.99m-23,10m, $\theta=10^\circ$ , closed	W2 to W1		16,8	1,7		
23 104.30 24.82		10	HQ	100	88	15	83	0	3 10 5	Fragmented zone: 24.10m-24.21m;24.71m-24.74m Fracture: 23.59m-23.74m, $\theta=20^\circ$ , closed; 23.74m-23.86m, $\theta=10^\circ$ and $10^\circ$ (2 sets), closed; 24.02m-24.10m, $\theta=5^\circ$ , closed; 24.74m-24,82m, $\theta=10^\circ$ to $0^\circ$	W2 to W1		12,0	1,3		
24 103.08 26.04		11	HQ	100	100	25	100	0	1 0 0		W2 to W1		113,3	50,9		
25 102.60 26.52	12	HQ	100	95	27	95	0	3	Fragmented zone: 26.04m-26.06m	W2 to W1		32,5	1,4			
<b>END OF BOREHOLE</b> Notes: 1) 50mm dia. monitoring well was installed upon completion, screened at 11,28m to 14,33m.  Water level measured in monitoring well: Date W. L. Depth (m) Aug,15,2017 6,63m (before developing well) Aug,18,2017 8,73m (after developing well)																

Weathering Index: W1-Fresh, W2-Slightly weathered, W3-Moderately weathered, W4-Highly weathered, W5-Completely weathered     $\theta$  = angle to the core axis    E = Modulus of Elasticity  
 \*: UCS [Mpa] = 24 I<sub>s(50)</sub>







Client	Region of Peel		Project No.	592-1125	Drawing No.	1
Drawn:	RA	Approved:	NW	Title: Borehole Location Plan		
Date:	Apr 2013	Scale:	NTS	Project: Geotechnical Investigation Watermain Replacement, Mississauga		
Original Size	Tabloid	Rev:	N/A	 <b>SPL Consultants Limited</b> <small>Geotechnical Engineering   Municipal Hydrogeology</small>		

PROJECT: Watermain Replacement-Abruz Boulevard and Area  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Mississauga, Ontario  
 DATUM: Geodetic  
 BH LOCATION: Adena Court

**DRILLING DATA**  
 Method: Solid Stem Auger  
 Diameter: 115 mm  
 Date: Mar/20/2013

REF. NO.: 592-1125  
 ENCL NO.: 5

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN (psi) (kPa)	NATURAL UNIT WT (Mg/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20 40 60 80 100						
103.9	ASPHALT: 90mm													
103.8	GRANULAR BASE: (sand and gravel) 390 mm													
103.4	FILL: clayey silt, trace gravel, trace organics, trace rootlets, brown, moist, loose	[Cross-hatched pattern]	1	AS										
103.4			2	SS	9									
102.4	CLAYEY SILT TILL: trace sand, trace gravel, brown, moist, hard	[Diagonal line pattern]	3	SS	50									
102.4			4	SS	44									
100.4			5	SS	72									
100.4	3.5													
END OF BOREHOLE Note: 1) Borehole open and dry upon completion.														

SPL SOIL LOG 592-1125 GPJ SPL GDT 12/4/13

GROUNDWATER ELEVATIONS

GRAPH NOTES

+ 3, X 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

Shallow/Single Installation ▽ ▽ Deep/Dual Installation ▽ ▽

PROJECT: Watermain Replacement-Abruz Boulevard and Area  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Mississauga, Ontario  
 DATUM: Geodetic  
 BH LOCATION: Abruz Blvd

**DRILLING DATA**  
 Method: Solid Stem Auger  
 Diameter: 115 mm  
 Date: Mar/20/2013

REF. NO.: 592-1125  
 ENCL NO.: 6

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN (psi) (kPa)	NATURAL UNIT WT (Mg/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20						
107.7	ASPHALT: 110mm													
107.0	GRANULAR BASE: (sand and gravel) 140 mm		1	AS										
106.9	SILTY SAND: brown, moist, very loose to compact		2	SS	11									
	wet at 1.5 m		3	SS	2									
			4	SS	18									
104.5	SAND AND GRAVEL: grey, wet, dense		5	SS	33									
104.2														
3.5	<b>END OF BOREHOLE</b> Note: 1) Water was at 1.5 m below ground surface during drilling and borehole was open upon completion. 2) 19 mm dia. piezometer installed upon completion 3) Water Level Readings in piezometer: Date            W. L. Depth (m) April 3, 2013    1.8													

W. L. 105.9 m  
 Apr 03, 2013

SPL SOIL LOG 592-1125 GPJ SPL GDT 12/4/13

GROUNDWATER ELEVATIONS

GRAPH NOTES

+ 3, × 3. Numbers refer to Sensitivity

○ e=3% Strain at Failure

Shallow/Single Installation ▼ ▼ Deep/Dual Installation ▼ ▼

PROJECT: Watermain Replacement-Abruz Boulevard and Area  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Mississauga, Ontario  
 DATUM: Geodetic  
 BH LOCATION: Abruz Blvd

**DRILLING DATA**  
 Method: Solid Stem Auger  
 Diameter: 115 mm  
 Date: Mar/21/2013

REF. NO.: 592-1125  
 ENCL NO.: 7

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (Mg/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)	
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m		ELEVATION	SHEAR STRENGTH (kPa)									WATER CONTENT (%)
107.2	ASPHALT: 80mm						20	40	60	80	100	W <sub>p</sub>	W	W <sub>L</sub>			
107.0	GRANULAR BASE: (sand and gravel) 160 mm		1	AS													
106.4	SILTY SAND: trace gravel, brown, moist, very loose to compact		2	SS	7												
	wet at 1.5 m		3	SS	2												
			4	SS	24												
103.9			5	SS	32												
3.3	CLAYEY SILT TILL: trace sand, trace gravel brown moist hard																
103.7																	
3.5	END OF BOREHOLE Note: 1) Groundwater was at 1.5 m below ground surface during and borehole was open upon completion.																

SPL SOIL LOG 592-1125 GPJ SPL.GDT 12/4/13

GROUNDWATER ELEVATIONS

GRAPH NOTES

+ 3, × 3: Numbers refer to Sensitivity

○ ε=3% Strain at Failure

Shallow/Single Installation ▽ ▽ Deep/Dual Installation ▽ ▽



PROJECT: Watermain Replacement-Abruz Boulevard and Area  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Mississauga, Ontario  
 DATUM: Geodetic  
 BH LOCATION: Abruz Blvd

**DRILLING DATA**  
 Method: Solid Stem Auger  
 Diameter: 115 mm  
 Date: Mar/21/2013

REF. NO.: 592-1125  
 ENCL NO.: 8

SOIL PROFILE		SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT				PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	POCKET PEN (kPa)	NATURAL UNIT WT (Mg/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%)			
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE			"N" BLOWS 0.3 m	20	40	60							80	100	W <sub>p</sub>
106.9	ASPHALT: 100mm																		
106.9 0.1	GRANULAR BASE: (sand and gravel) 200 mm		1	AS															
106.1	CLAYEY SILT TILL/SHALE COMPLEX: trace sand, trace gravel, trace shale fragments, brown, moist, hard		2	SS	36														
			3	SS	50/ 150mm														
			4	SS	50/ 25mm														
104.6	SHALE: weathered, grey		4	SS	50/ 25mm														
103.7	END OF BOREHOLE		5	SS	50/ 100mm														
3.2	Note: 1) Borehole open and dry upon completion 2) 19 mm dia. piezometer installed upon completion. 3) Water Level Readings in piezometer: Date            W. L. Depth (m) April 3, 2013    2.4																		

W. L. 104.5 m  
Apr 03, 2013

SPL\_SOIL LOG\_592-1125.GPJ SPL\_GDT\_12/4/13

PROJECT: Watermain Replacement-Abruz Boulevard and Area  
 CLIENT: Region of Peel  
 PROJECT LOCATION: Mississauga, Ontario  
 DATUM: Geodetic  
 BH LOCATION: Old Pheasant Road

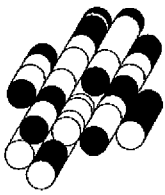
**DRILLING DATA**  
 Method: Solid Stem Auger  
 Diameter: 115 mm  
 Date: Mar/21/2013  
 REF. NO.: 592-1125  
 ENCL NO.: 11

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION	DYNAMIC CONE PENETRATION RESISTANCE PLOT		PLASTIC LIMIT W <sub>p</sub>	NATURAL MOISTURE CONTENT W	LIQUID LIMIT W <sub>L</sub>	POCKET PEN (C <sub>u</sub> ) (kPa)	NATURAL UNIT WT (Mg/m <sup>3</sup> )	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
(m) ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m			20 40 60 80 100	20 40 60 80 100						
106.7	ASPHALT: 130mm														
106.0	GRANULAR BASE: (sand and gravel) 180 mm		1	AS											
105.9	FILL: clayey silt, brown, very moist, loose		2	SS	37										
105.6	CLAYEY SILT TILL: trace sand, trace gravel, trace shale fragments, grey, hard														
105.2	SHALE: weathered, grey		3	SS	50/50mm										
104.9	END OF BOREHOLE Note: 1) Borehole open and dry upon completion. 2) Auger refusal encountered at 1.8 m.														

SPL SOIL LOG 592-1125 GPJ SPL GDT 12/4/13

**BOREHOLE LOGS**

<b>SAMPLING METHOD</b>  SS split spoon ST Shelby tube AS auger sample WS wash sample RC rock core  WH weight of hammer PH pressure, hydraulic	<b>PENETRATION RESISTANCE</b>  <b>Standard Penetration Test (SPT)</b> resistance ('N' values) is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a standard 50 mm (2 in.) diameter split spoon sampler for a distance of 0.3 m (12 in.).  <b>Dynamic Cone Test (DCT)</b> resistance is defined as the number of blows by a hammer weighing 63.6 kg (140 lb.) falling freely for a distance of 0.76 m (30 in.) required to advance a conical steel point of 50 mm (2 in.) diameter and with 60° sides on 'A' size drill rods for a distance of 0.3 m (12 in.).																																	
<b>SOIL DESCRIPTION - COHESIONLESS SOILS</b>  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Relative Density</th> <th style="text-align: left;">'N' value</th> </tr> </thead> <tbody> <tr> <td>very loose</td> <td>&lt; 4</td> </tr> <tr> <td>loose</td> <td>4 - 10</td> </tr> <tr> <td>compact</td> <td>10 - 30</td> </tr> <tr> <td>dense</td> <td>30 - 50</td> </tr> <tr> <td>very dense</td> <td>&gt; 50</td> </tr> </tbody> </table>	Relative Density	'N' value	very loose	< 4	loose	4 - 10	compact	10 - 30	dense	30 - 50	very dense	> 50	<b>SOIL DESCRIPTION - COHESIVE SOILS</b>  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Consistency</th> <th style="text-align: left;">Undrained Shear Strength, kPa</th> <th style="text-align: left;">'N' value</th> </tr> </thead> <tbody> <tr> <td>very soft</td> <td>&lt; 12</td> <td>&lt; 2</td> </tr> <tr> <td>soft</td> <td>12 - 25</td> <td>2 - 4</td> </tr> <tr> <td>firm</td> <td>25 - 50</td> <td>4 - 8</td> </tr> <tr> <td>stiff</td> <td>50 - 100</td> <td>8 - 15</td> </tr> <tr> <td>very stiff</td> <td>100 - 200</td> <td>15 - 30</td> </tr> <tr> <td>hard</td> <td>&gt; 200</td> <td>&gt; 30</td> </tr> </tbody> </table>	Consistency	Undrained Shear Strength, kPa	'N' value	very soft	< 12	< 2	soft	12 - 25	2 - 4	firm	25 - 50	4 - 8	stiff	50 - 100	8 - 15	very stiff	100 - 200	15 - 30	hard	> 200	> 30
Relative Density	'N' value																																	
very loose	< 4																																	
loose	4 - 10																																	
compact	10 - 30																																	
dense	30 - 50																																	
very dense	> 50																																	
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stiff	50 - 100	8 - 15																																
very stiff	100 - 200	15 - 30																																
hard	> 200	> 30																																
<b>SOIL COMPOSITION</b>  <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: left;">% by weight</th> </tr> </thead> <tbody> <tr> <td>'trace' (e.g. trace silt)</td> <td>&lt; 10</td> </tr> <tr> <td>'some' (e.g. some gravel)</td> <td>10 - 20</td> </tr> <tr> <td>adjective (e.g. sandy)</td> <td>20 - 35</td> </tr> <tr> <td>'and' (e.g. sand and gravel)</td> <td>35 - 50</td> </tr> </tbody> </table>		% by weight	'trace' (e.g. trace silt)	< 10	'some' (e.g. some gravel)	10 - 20	adjective (e.g. sandy)	20 - 35	'and' (e.g. sand and gravel)	35 - 50	<b>TESTS, SYMBOLS</b>  MH mechanical sieve and hydrometer analysis w, w <sub>c</sub> water content w <sub>l</sub> liquid limit w <sub>p</sub> plastic limit I <sub>p</sub> plasticity index k coefficient of permeability γ soil unit weight, bulk φ' angle of internal friction c' cohesion shear strength C <sub>c</sub> compression index																							
	% by weight																																	
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'some' (e.g. some gravel)	10 - 20																																	
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<b>GENERAL INFORMATION, LIMITATIONS</b>																																		
<p>The conclusions and recommendations provided in this report are based on the factual information obtained from the boreholes and/or test pits. Subsurface conditions between the test holes may vary.</p> <p>The engineering interpretation and report recommendations are given only for the specific project detailed within, and only for the original client. Any third party decision, reliance, or use of this report is the sole and exclusive responsibility of such third party. The number and siting of boreholes and/or test pits may not be sufficient to determine all factors required for different purposes.</p> <p>It is recommended Terraprobe be retained to review the project final design and to provide construction inspection and testing.</p>																																		



# Terraprobe

# LOG OF BOREHOLE CN11

PROJECT: Various Locations - Peel Region

COORDINATES: N:4826136 E:613027

DATE: September 23, 2009

LOCATION: Cliff Road, Mississauga, Ontario

EQUIPMENT: Truck-Mounted / Solid Stem Augers

CLIENT: Ainley Group

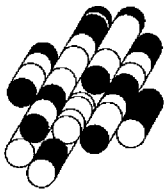
ELEVATION DATUM: Geodetic

FILE: 1-09-4160

SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT	NATURAL MOISTURE CONTENT	LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES							SHEAR STRENGTH kPa	W P	W	W L					
107.5	Ground Surface																			
107.2	260mm ASPHALT																			
0.3	SAND some silt, compact to dense, brown, moist to wet  grey		1	SS	15															
			2	SS	10															
			3	SS	22															
			4	SS	27															
			5	SS	38															
104.0	End of Borehole																			
3.5	Piezometer installation consists of 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Oct.01.09</td> <td>2.0</td> <td>105.5</td> </tr> <tr> <td>Oct.06.09</td> <td>1.9</td> <td>105.6</td> </tr> </tbody> </table>											Date	Depth(m)	Elevation(m)	Oct.01.09	2.0	105.5	Oct.06.09	1.9	105.6
Date	Depth(m)	Elevation(m)																		
Oct.01.09	2.0	105.5																		
Oct.06.09	1.9	105.6																		

**NOTES:**

Borehole was open to 2.1m and unstabilized water level at 2.0m upon completion of drilling.



# Terraprobe

# LOG OF BOREHOLE CN12

PROJECT: Various Locations - Peel Region

COORDINATES: N:4826072 E:613096

DATE: September 22, 2009

LOCATION: Cliff Road, Mississauga, Ontario

EQUIPMENT: Truck-Mounted / Solid Stem Augers

CLIENT: Ainley Group

ELEVATION DATUM: Geodetic

FILE: 1-09-4160

SOIL PROFILE			SAMPLES			PENETRATION RESISTANCE PLOT	PLASTIC LIMIT NATURAL MOISTURE CONTENT LIQUID LIMIT	ORGANIC VAPOUR (ppm)	STANDPIPE INSTALLATION OR REMARKS									
ELEV DEPTH	DESCRIPTION	STRAT PLOT	NUMBER	TYPE	"N" VALUES													
106.5	Ground Surface																	
106.0	80mm ASPHALT																	
0.1	SAND some silt, trace gravel, loose to dense, brown, moist to wet  --- grey		1	SS	14	GR. SA. SI & CL 3 77 20 sampler wet at 1.5m GR. SA. SI & CL 0 16 71 13	UNCONFINED POCKET PEN. FIELD VANE LAB VANE ○ ● ○ + ×	WATER CONTENT (%) WP W WL 10 20 30										
			2	SS	8													
			3	SS	17													
			4	SS	34													
			5	SS	36													
102.5	SILTY CLAY some sand, hard, grey, moist		6	SS	41													
4.0																		
101.5	End of Borehole																	
5.0	Piezometer installation consists of 19mm diameter, Schedule 40 PVC pipe with a 1.52m slotted screen.  Water Level Readings:  <table border="1"> <thead> <tr> <th>Date</th> <th>Depth(m)</th> <th>Elevation(m)</th> </tr> </thead> <tbody> <tr> <td>Oct.01.09</td> <td>1.6</td> <td>104.9</td> </tr> <tr> <td>Oct.06.09</td> <td>1.5</td> <td>105.0</td> </tr> </tbody> </table>									Date	Depth(m)	Elevation(m)	Oct.01.09	1.6	104.9	Oct.06.09	1.5	105.0
Date	Depth(m)	Elevation(m)																
Oct.01.09	1.6	104.9																
Oct.06.09	1.5	105.0																

**NOTES:**

Borehole was open to 4.6m and unstabilized water level at 2.1m upon completion of drilling.

## LIST OF ABBREVIATIONS

The abbreviations commonly employed on each "Record of Borehole," on the figures and in the text of the report, are as follows:

### I. SAMPLE TYPES

<i>AS</i>	auger sample
<i>CS</i>	chunk sample
<i>DO</i>	drive open
<i>DS</i>	Denison type sample
<i>FS</i>	foil sample
<i>RC</i>	rock core
<i>ST</i>	slotted tube
<i>TO</i>	thin-walled, open
<i>TP</i>	thin-walled, piston
<i>WS</i>	wash sample

### II. PENETRATION RESISTANCES

Dynamic Penetration Resistance: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch diameter, 60 degree cone one foot, where the cone is attached to 'A' size drill rods and casing is not used.

Standard Penetration Resistance, *N*: The number of blows by a 140-pound hammer dropped 30 inches required to drive a 2-inch drive open sampler one foot.

<i>WH</i>	sampler advanced by static weight—weight, hammer
<i>PH</i>	sampler advanced by pressure—pressure, hydraulic
<i>PM</i>	sampler advanced by pressure—pressure, manual

### III. SOIL DESCRIPTION

#### (a) Cohesionless Soils

<i>Relative Density</i>	<i>N, blows/ft.</i>
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

#### (b) Cohesive Soils

<i>Consistency</i>	<i>c<sub>u</sub>, lb./sq. ft.</i>
Very soft	Less than 250
Soft	250 to 500
Firm	500 to 1,000
Stiff	1,000 to 2,000
Very stiff	2,000 to 4,000
Hard	over 4,000

### IV. SOIL TESTS

<i>C</i>	consolidation test
<i>H</i>	hydrometer analysis
<i>M</i>	sieve analysis
<i>MH</i>	combined analysis, sieve and hydrometer <sup>1</sup>
<i>Q</i>	undrained triaxial <sup>2</sup>
<i>R</i>	consolidated undrained triaxial <sup>2</sup>
<i>S</i>	drained triaxial
<i>U</i>	unconfined compression
<i>V</i>	field vane test

### NOTES:

<sup>1</sup>Combined analyses when 5 to 95 per cent of the material passes the No. 200 sieve.

<sup>2</sup>Undrained triaxial tests in which pore pressures are measured are shown as  $\bar{Q}$  or  $\bar{R}$ .



## LIST OF SYMBOLS

### I. GENERAL

$\pi$	= 3.1416
$e$	= base of natural logarithms 2.7183
$\log_e a$ or $\ln a$	natural logarithm of $a$
$\log_{10} a$ or $\log a$	logarithm of $a$ to base 10
$t$	time
$g$	acceleration due to gravity
$V$	volume
$W$	weight
$M$	moment
$F$	factor of safety

### II. STRESS AND STRAIN

$u$	pore pressure
$\sigma$	normal stress
$\sigma'$	normal effective stress ( $\bar{\sigma}$ is also used)
$\tau$	shear stress
$\epsilon$	linear strain
$\epsilon_{xy}$	shear strain
$\nu$	Poisson's ratio ( $\mu$ is also used)
$E$	modulus of linear deformation (Young's modulus)
$G$	modulus of shear deformation
$K$	modulus of compressibility
$\eta$	coefficient of viscosity

### III. SOIL PROPERTIES

#### (a) Unit weight

$\gamma$	unit weight of soil (bulk density)
$\gamma_s$	unit weight of solid particles
$\gamma_w$	unit weight of water
$\gamma_d$	unit dry weight of soil (dry density)
$\gamma'$	unit weight of submerged soil
$G_s$	specific gravity of solid particles $G_s = \gamma_s / \gamma_w$
$e$	void ratio
$n$	porosity
$w$	water content
$S_r$	degree of saturation

#### (b) Consistency

$w_L$	liquid limit
$w_P$	plastic limit
$I_P$	plasticity index
$w_s$	shrinkage limit
$I_L$	liquidity index = $(w - w_P) / I_P$
$I_C$	consistency index = $(w_L - w) / I_P$
$e_{max}$	void ratio in loosest state
$e_{min}$	void ratio in densest state
$D_r$	relative density = $(e_{max} - e) / (e_{max} - e_{min})$

#### (c) Permeability

$h$	hydraulic head or potential
$q$	rate of discharge
$v$	velocity of flow
$i$	hydraulic gradient
$k$	coefficient of permeability
$j$	seepage force per unit volume

#### (d) Consolidation (one-dimensional)

$m_v$	coefficient of volume change = $-\Delta e / (1+e)\Delta\sigma'$
$C_c$	compression index = $-\Delta e / \Delta \log_{10} \sigma'$
$c_s$	coefficient of consolidation
$T_v$	time factor = $c_v t / d^2$ ( $d$ , drainage path)
$U$	degree of consolidation

#### (e) Shear strength

$\tau_f$	shear strength	
$c'$	effective cohesion	$\left. \begin{array}{l} \text{in terms of effective} \\ \text{stress} \\ \tau_f = c' + \sigma' \tan \phi' \end{array} \right\}$
$\phi'$	effective angle of shearing resistance, or friction	
$c_u$	apparent cohesion*	
$\phi_u$	apparent angle of shearing resistance, or friction	$\left. \begin{array}{l} \text{in terms of total stress} \\ \tau_f = c_u + \sigma \tan \phi_u \end{array} \right\}$
$\mu$	coefficient of friction	
$S_i$	sensitivity	

\*For the case of a saturated cohesive soil,  $\phi_u = 0$  and the undrained shear strength  $\tau_f = c_u$  is taken as half the undrained compressive strength.

# RECORD OF BOREHOLE 7

LOCATION See Figure 1 BORING DATE JANUARY 23, 24 & 27, 1969 DATUM TOWNSHIP OF TORONTO  
 BOREHOLE TYPE WASH AND ROTARY BORING BOREHOLE DIAMETER NX 6 BX SIZE  
 SAMPLER HAMMER WEIGHT 140 LB. DROP 30 INCHES PEN. TEST HAMMER WEIGHT - LB DROP - INCHES

SOIL PROFILE		SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE	COEFFICIENT OF PERMEABILITY $k_v$		ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FT	BLOWS / FT	CM. / SEC		
369.2	GROUND LEVEL									
0.0	SANDY TOPSOIL									
0.8	LOOSE (BECOMING COMPACT) BROWN SAND, TRACE GRAVEL TO A SANDY GRAVEL. TRACE SILT AT DEPTH OCCASIONAL PATCHES OF CLAYEY SAND		1	D.O.	23					
358.7			2	"	37					
10.5	HARD BROWN TO GREY SANDY SILT, SOME CLAY AND GRAVEL WITH OCCASIONAL THIN SAND SEAMS (TILL) BECOMING		3	W.S.	-					
			4	D.O.	60					
348.3			5	"	100					
20.9	<b>BOULDERY</b>		6	BXL RC.	-					
344.4			7	"	-					
24.8	<b>WEATHERED AND FRACTURED DARK GREY SHALE WITH LIMESTONE BANDS</b>		8	"	-					
336.2			9	"	-					
33.0										
331.2										
38.0	END OF HOLE									

% CORE RECOVERY	22
	55
	60
	100

EST % DRILL WATER RETURN	100
--------------------------	-----

DRILLING PRESSURE OCCASIONALLY UNSTEADY COULD INDICATE CLAY SEAMS  
 LIMESTONE BANDS UP TO 3" THICK  
 CORE LENGTH 1/4" TO 3 1/2" HORIZONTALLY BEDDED  
 LIMESTONE BANDS UP TO 10" THICK

SOUND DARK GREY SHALE WITH LIMESTONE BANDS AND OCCASIONAL FRACTURES.

15-0-5 Percent axial strain at failure

VERTICAL SCALE  
1 INCH TO 10'

GOLDER & ASSOCIATES

DRAWN *MJB*  
CHECKED *1/1/69*

09005



# RECORD OF BOREHOLE 8

LOCATION See Figure 1 BORING DATE JANUARY 20 TO 22, 1969 DATUM TOWNSHIP OF TORONTO.  
 BOREHOLE TYPE WASH AND ROTARY BORING BOREHOLE DIAMETER NX  $\frac{1}{2}$  BX SIZE  
 SAMPLER HAMMER WEIGHT LB. DROP INCHES PEN. TEST HAMMER WEIGHT - LB. DROP - INCHES

SOIL PROFILE		SAMPLES			ELEVATION SCALE	DYNAMIC PENETRATION RESISTANCE	COEFFICIENT OF PERMEABILITY $k_v$			ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION	
ELEV. DEPTH	DESCRIPTION	STRAT. PLOT	NUMBER	TYPE		BLOWS / FT.	BLOWS / FT.	CM. / SEC.				
							WATER CONTENT, PERCENT					
							$W_p$ $W$ $W_L$ 10      20      30      40					
							SHEAR STRENGTH $C_u$ , LB / SQ. FT					
373.9	GROUND LEVEL											
0.0	LOOSE (BECOMING COMPACT) BROWN MEDIUM TO FINE SAND, TRACE SILT, AND OCCASIONAL ZONES WITH SOME GRAVEL.  DENSE TO VERY DENSE BROWN SANDY GRAVEL WITH A TRACE OF SILT.  VERY HARD GREY CLAYEY TO SANDY SILT SOME CLAY AND GRAVEL (TILL)  BECOMING BOULDERY  WEATHERED AND FRACTURED DARK GREY SHALE WITH LIMESTONE BANDS.  SOUND DARK GREY SHALE.		1	2'								
			2	"	6							
			3	"	16							
			4	"	23							
363.4			5	"	86							
10.5			6	"	>100							
357.7			7	"	44							
16.2			8	"	54							
			9	"	63							
			10	"	91							
			11	"	>100							
346.3	BOULDERY		12	BXL								
27.6			PC									
343.3	WEATHERED AND FRACTURED DARK GREY SHALE WITH LIMESTONE BANDS.  SOUND DARK GREY SHALE.		13	"								
30.6			14	"								
			15	"								
			16	"								
331.9			17	"								
42.0			18	"								
322.9	END OF HOLE											
51.0												

PERCENT CORE RECOVERY	33
	66
	88
	83
	75
	100
	100

EST. % DRILL WATER RETURN 100

LIMESTONE BANDS UP TO 3" THICK. HORIZONTALLY BEDDED. DRILLING PRESSURE UNSTEADY - COULD INDICATE CLAY SEAMS.

HORIZONTALLY BEDDED. CORE LENGTH 1/2" TO 3".

15-0-5 Percent axial strain at failure



WATER LEVEL IN PIEZOMETER AT ELEV 349.5 ON FEB. 15, 1969

VERTICAL SCALE  
1 INCH TO 10'

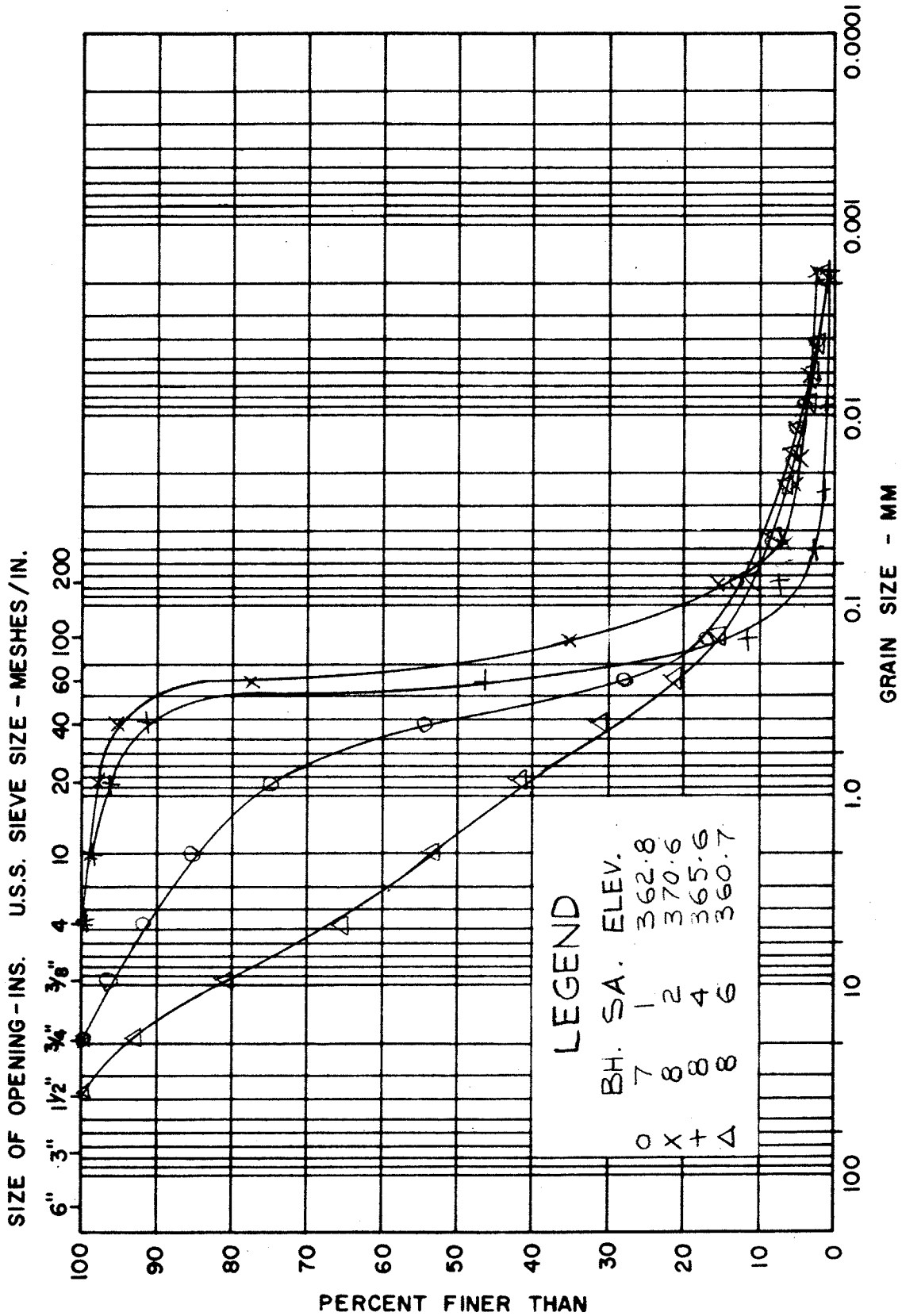
GOLDER & ASSOCIATES

DRAWN *M.Y. 15*  
CHECKED *H.A.*

# GRAIN SIZE DISTRIBUTION SAND AND GRAVEL (WEST BANK)

FIGURE 6

M.I.T. GRAIN SIZE SCALE

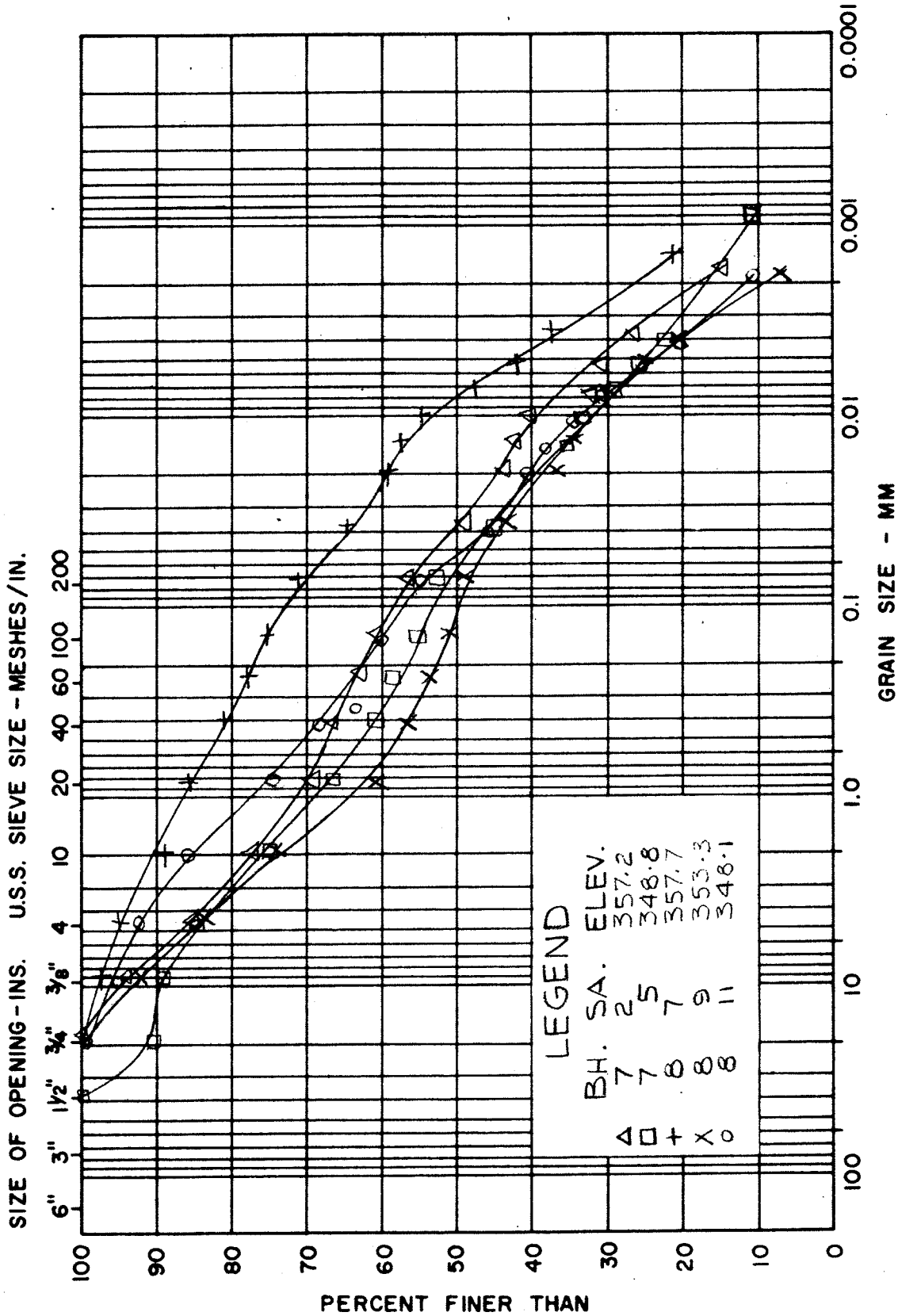


COBBLE SIZE	COARSE	MEDIUM	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE
	GRAVEL SIZE			SAND SIZE			FINE GRAINED	

# GRAIN SIZE DISTRIBUTION SILTY TILL (WEST BANK)

FIGURE 7

M.I.T. GRAIN SIZE SCALE



**LEGEND**

BH. SA.	ELEV.
7	357.2
7	348.8
8	357.7
8	353.3
8	348.1

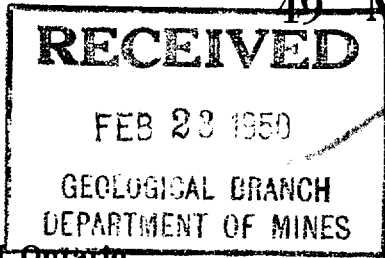
GOLDER & ASSOCIATES

UTM 17 Z 613050 E

Quadrants 4827623 N

Elev. 47.107 10.

Basin 24



49 No. 2250

The Well Drillers Act
Department of Mines, Province of Ontario

Water Well Record

MISSISSAUGA S.S.
Con. Lot 10 Pt. Lot
Acres

Date Completed May 17/50 Cost of Well (not including pump)

Pipe and Casing Record

Pumping Test AS=5

Casing diameter(s) 6
Length(s) of casing(s) 20 ft
Length of screen
Type of screen
Type of pump
Capacity of pump
Depth of pump setting
Date May 16
Developed Capacity 5 gpm
Duration of Test 1 day
Pumping Rate 5 gpm
Drawdown none
Static level of completed well 8' pl
Is well a gravel-wall type? no

Water Record

Kind (fresh or mineral) fresh
Quality (hard, soft, contains iron, sulphur etc.) hard
Appearance (clear, cloudy, coloured) clear
For what purpose(s) is the water to be used? factory
How far is well from possible source of contamination? 40 ft
What is source of contamination? septic tanks
Enclose a copy of any mineral analysis that has been made of water
Depth(s) to Water Horizon(s) 2 ft, 54 ft
Kind of Water fresh
No. of Feet Water Rises 46

Well Log

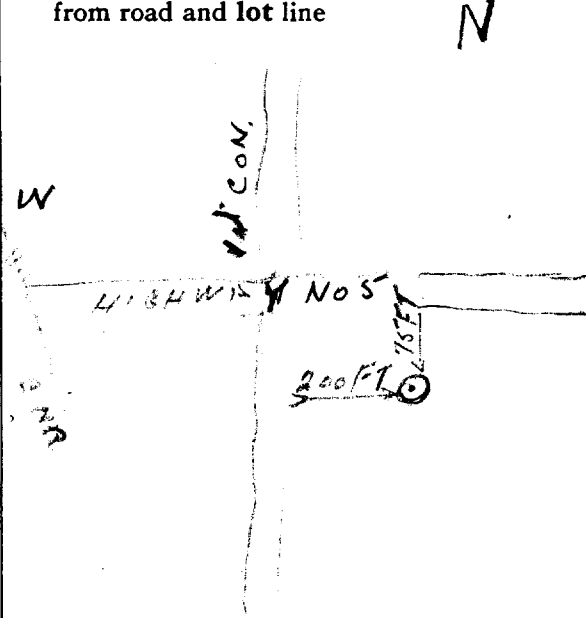
Drift and Bedrock Record

From To

Stoney Clay 0 ft. 20 ft.
Black Shale 20 54

Location of Well

In diagram below show distances of well from road and lot line



Situation: Is well on upland, in valley, or on hillside? upland
Drilling Firm B. Hoffman & Son
Address 10 Lake Shore Dr. New Toronto
Recorded by J. Hoffman Address 156 May Ave.
Date Feb 20, 50 Licence Number 366558





Ministry of the Environment

Well Tag Number (A 011693) A011693

Well Record Regulation 903 Ontario Water Resources Act

page \_\_\_ of \_\_\_

Instructions for Completing Form

- For use in the Province of Ontario only. This document is a permanent legal document. Please retain for future reference. All Sections must be completed in full to avoid delays in processing. Questions regarding completing this application can be directed to the Water Well Management Coordinator at 416-235-6203. All metre measurements shall be reported to 1/10th of a metre. Please print clearly in blue or black ink only.

Ministry Use Only

Address of Well Location (County/District/Municipality) 2350 Cawthra Road Township Lot Concession RR#/Street Number/Name City/Town/Village Mississauga Site/Compartment/Block/Tract etc. GPS Reading NAD Zone Easting Northing Unit Make/Model Mode of Operation: Undifferentiated Averaged Differentiated, specify

Log of Overburden and Bedrock Materials (see instructions)

Table with columns: General Colour, Most common material, Other Materials, General Description, Depth From, Metres To. Rows include: Brown Sand GRAVEL LOOSE 0.0 0.6, Brown Sand GRAVEL HARD 0.6 2.1, Grey shale Dense 2.1 3.6

Hole Diameter, Water Record, Chlorinated Yes No

Construction Record, Casing, Screen, No Casing or Screen

Test of Well Yield, Pumping test method, Draw Down, Recovery

Plugging and Sealing Record, Annular space, Abandonment

Location of Well, In diagram below show distances of well from road, lot line, and building. See attached sketch.

Method of Construction, Cable Tool, Rotary (air), Diamond, Digging, Rotary (conventional), Air percussion, Jetting, Other, Rotary (reverse), Boring, Driving

Water Use, Domestic, Industrial, Public Supply, Other, Stock, Commercial, Not used, Irrigation, Municipal, Cooling & air conditioning

Final Status of Well, Water Supply, Recharge well, Unfinished, Abandoned, (Other), Observation well, Abandoned, insufficient supply, Dewatering, Test Hole, Abandoned, poor quality, Replacement well

Well Contractor/Technician Information, Name of Well Contractor, Well Contractor's Licence No., Business Address, Well Technician's Licence No., Signature of Technician/Contractor, Date Submitted

Audit No. 2 11733, Date Well Completed 2004 03 19, Was the well owner's information package delivered? Yes No 2004 01 24

Ministry Use Only, Data Source, Contractor 7230, Date Received APR 29 2004, Date of Inspection, Remarks CSS 555, Well Record Number 4909407

Measurements recorded in:  Metric  Imperial

Page \_\_\_\_\_ of \_\_\_\_\_

Well Owner's Information

2526 Cawthra Rd.  
County/District/Municipality: \_\_\_\_\_ City/Town/Village: **Mississauga** Province: **Ontario** Postal Code: \_\_\_\_\_  
UTM Coordinates: Zone **17** Easting **613121** Northing **4827580** Municipal Plan and Sublot Number: \_\_\_\_\_ Other: \_\_\_\_\_

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)				
General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From To
Brown	Fill	Sand	Moist	0' 5'
Grey	Weathered shale	Clay	Dry-Moist	5' 11.5'
Grey	Bedrock		<del>Dry</del> Moist	11.5 12'

Annular Space		
Depth Set at (m/ft) From To	Type of Sealant Used (Material and Type)	Volume Placed (m <sup>3</sup> /ft <sup>3</sup> )
12' 6'	Sand	
6' 1'	Bentonite	
1' 0'	Sand, casing, concrete	

Results of Well Yield Testing				
After test of well yield, water was: <input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:  Pump intake set at (m/ft)  Pumping rate (l/min / GPM)  Duration of pumping hrs + min  Final water level end of pumping (m/ft)  If flowing give rate (l/min / GPM)  Recommended pump depth (m/ft)  Recommended pump rate (l/min / GPM)  Well production (l/min / GPM)  Disinfected? <input type="checkbox"/> Yes <input type="checkbox"/> No	Static Level			
	1		1	
	2		2	
	3		3	
	4		4	
	5		5	
10		10		
15		15		
20		20		
25		25		
30		30		
40		40		
50		50		
60		60		

Method of Construction		Well Use		
<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input type="checkbox"/> Public	<input type="checkbox"/> Commercial	<input type="checkbox"/> Not used
<input checked="" type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input type="checkbox"/> Domestic	<input type="checkbox"/> Municipal	<input type="checkbox"/> Dewatering
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input checked="" type="checkbox"/> Test Hole	<input type="checkbox"/> Monitoring
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Cooling & Air Conditioning	
<input type="checkbox"/> Air percussion		<input type="checkbox"/> Industrial		
<input type="checkbox"/> Other, specify _____		<input type="checkbox"/> Other, specify _____		

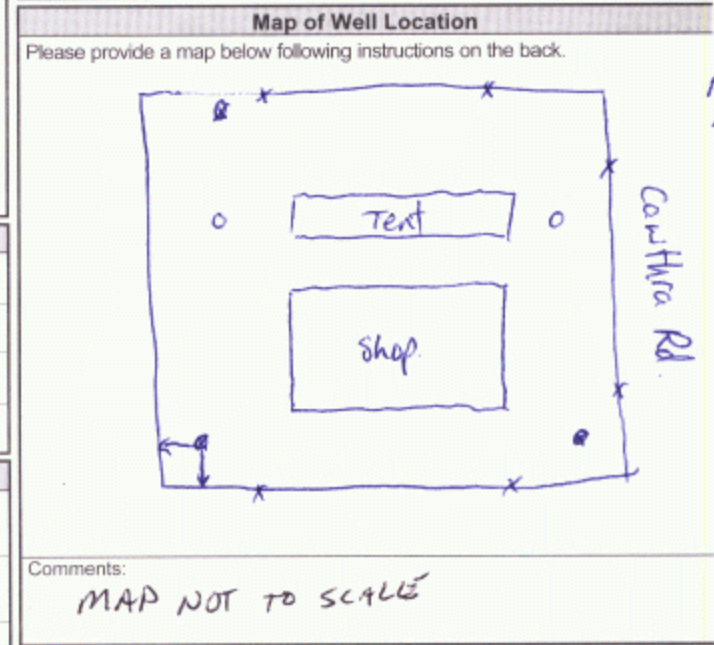
Construction Record - Casing				Status of Well	
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____
			From	To	
2"	Plastic	Sch.40	7'	0'	

Construction Record - Screen				
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
2"	Plastic	10	12'	7'

Water Details		Hole Diameter	
Water found at Depth (m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	Depth (m/ft) From To	Diameter (cm/in)
Water found at Depth (m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	12' 0'	4"
Water found at Depth (m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested		

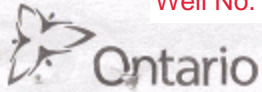
**Well Contractor and Well Technician Information**

Business Name of Well Contractor: **Profile Drilling Inc.** Well Contractor's Licence No.: **7215**  
 Business Address (Street Number/Name): **149 Norfinch Dr.** Municipality: **North York**  
 Province: **ON** Postal Code: **M3N1Y2** Business E-mail Address: \_\_\_\_\_  
 Bus. Telephone No. (inc. area code): **4160506444** Name of Well Technician (Last Name, First Name): **Stacki, Jason**  
 Well Technician's Licence No.: **2978** Signature of Technician and/or Contractor: \_\_\_\_\_ Date Submitted: **20080918**



Well owner's information package delivered <input type="checkbox"/> Yes <input type="checkbox"/> No	Date Package Delivered Y Y Y Y M M D D	<b>Ministry Use Only</b> Audit No. <b>Z 81549</b> Received <b>DEC 18 2008</b>
	Date Work Completed 20080918	





Ministry of the Environment

Well Tag No. for Master Well (Place Sticker and/or Print Below)

A 089121

A089121

Master Well Record for Cluster Well Construction

Regulation 903 Ontario Water Resources Act

Master Well Owner's and Land Owner's Information

Address: The Queensway & Dixie Road, City/Town/Village: Mississauga, Province: Ontario, Postal Code: WKQ-001961

UTM Coordinates: NAD 83 176150794828744, GPS Unit Make: Garmin, Model: Ctrex, Mode of Operation: Averaged

Table with 5 columns: General Colour, Most Common Material, Other Materials, General Description, Depth (Metres) From/To. Includes handwritten entries for sand and silt.

Hole Details table with 3 columns: Depth (Metres) From/To, Diameter (Centimetres). Includes handwritten entry for 16m depth and 10.92cm diameter.

Water Use section with checkboxes for Public, Industrial, Domestic, Commercial, Livestock, Municipal, Irrigation, Test Hole, Not used, Dewatering, Monitoring, Cooling & Air Conditioning.

Method of Construction section with checkboxes for Cable Tool, Rotary, Air Percussion, Diamond, Jetting, Driving, Digging, Boring, Other, specify. Includes handwritten 'Direct push'.

Status of Well section with checkboxes for Test Hole, Replacement Well, Dewatering Well, Alteration (Construction), Abandoned (Insufficient Supply, Poor Water Quality, Other, specify).

No Casing and Screen Used / Static Water Level Test section.

Construction Details table with 4 columns: Inside Diameter (Centimetres), Material, Wall Thickness, Depth (Metres) From/To. Includes handwritten entries for 1 3/4 inch diameter and plastic material.

Screen section with checkboxes for Galvanized, Steel, Fibreglass, Concrete, Plastic. Includes handwritten entry for 2.25 inch outside diameter and 10 slot size.

Annular Space/Abandonment Sealing Record

Table with 3 columns: Depth Set at (Metres) From/To, Type of Sealant Used (Material and Type), Volume Used (Cubic Metres).

Water Details section with checkboxes for Gas, Fresh, Salty, Sulphur, Minerals. Includes handwritten entries for depth and kind of water.

Disinfected section with checkboxes for Yes/No and Date Master Well Completed (Nov 26, 2009).

Cluster Information section with fields for Total Wells in Cluster (5) and Total Wells on this Property.

Location of Well Cluster section with instructions for map and check box for detailed map.

General contractor: Coffey Geotechnics

Well Contractor and Well Technician Information section including Business Name (Strata Soil Sampling Inc.), Address (147-2 West Beaver Creek Road), and Technician Name (Mike).

Audit No. (M 06330), Date Reported (DEC 21 2009), Well Contractor No., and Date of Inspection (Nov 29, 2009).





Ministry of the Environment

Imperial

Well Tag No. for Master Well (Print Well Tag No.)

A 089121

A089121

Cluster Well Information for Cluster Well Construction

Regulation 903 Ontario Water Resources Act

6910 Page 2 of 2

Address of Well Location (Street Number/Name, RR) The Queensway & Dixie Road  
 City/Town/Village Mississauga Province Ontario Postal Code \_\_\_\_\_  
 Lot \_\_\_\_\_ Concession \_\_\_\_\_ Township \_\_\_\_\_ County/District/Municipality \_\_\_\_\_  
 GPS Unit Make Garmin Model Etrex Unit Mode of Operation  Undifferentiated  Averaged  
 Differentiated, specify: \_\_\_\_\_

Signature of Technician/Contractor \_\_\_\_\_ Date (yyyy/mm/dd) \_\_\_\_\_

Well # on Sketch	Zone	UTM Coordinates		Full Depth of Hole (metres)	Hole Diameter (cm)	Method of Construction	Casing Material	Casing Length (metres)	Screen Interval (metres)		Annular Space Sealant Used	Static Water Level (metres)	Abandonment Sealant Used	Comments	Date of Completion (yyyy/mm/dd)
		Easting	Northing						From	To					
mw#2		176150694828762		13'	10.92	Geoprobe	Pvc	8'	8'	13'	Benseal			Dense / wet	09/11/23
mw#3		176150814828797		13'	10.92	Geoprobe	Pvc	8'	8'	13'	Benseal			- -	09/11/23
mw#4		176150894828768		13'	10.92	Geoprobe	Pvc	8'	8'	13'	- -			- -	09/11/23
mw#5		176150264828729		13'	10.92	- -	Pvc	8'	8'	13'	- -			- -	09/11/23
mw#6		176150194828693		13'	10.92	- -	Pvc	8'	8'	13'	- -			- -	09/11/23

General contractor: Coffey Geotechnics

**Well Contractor and Well Technician Information**

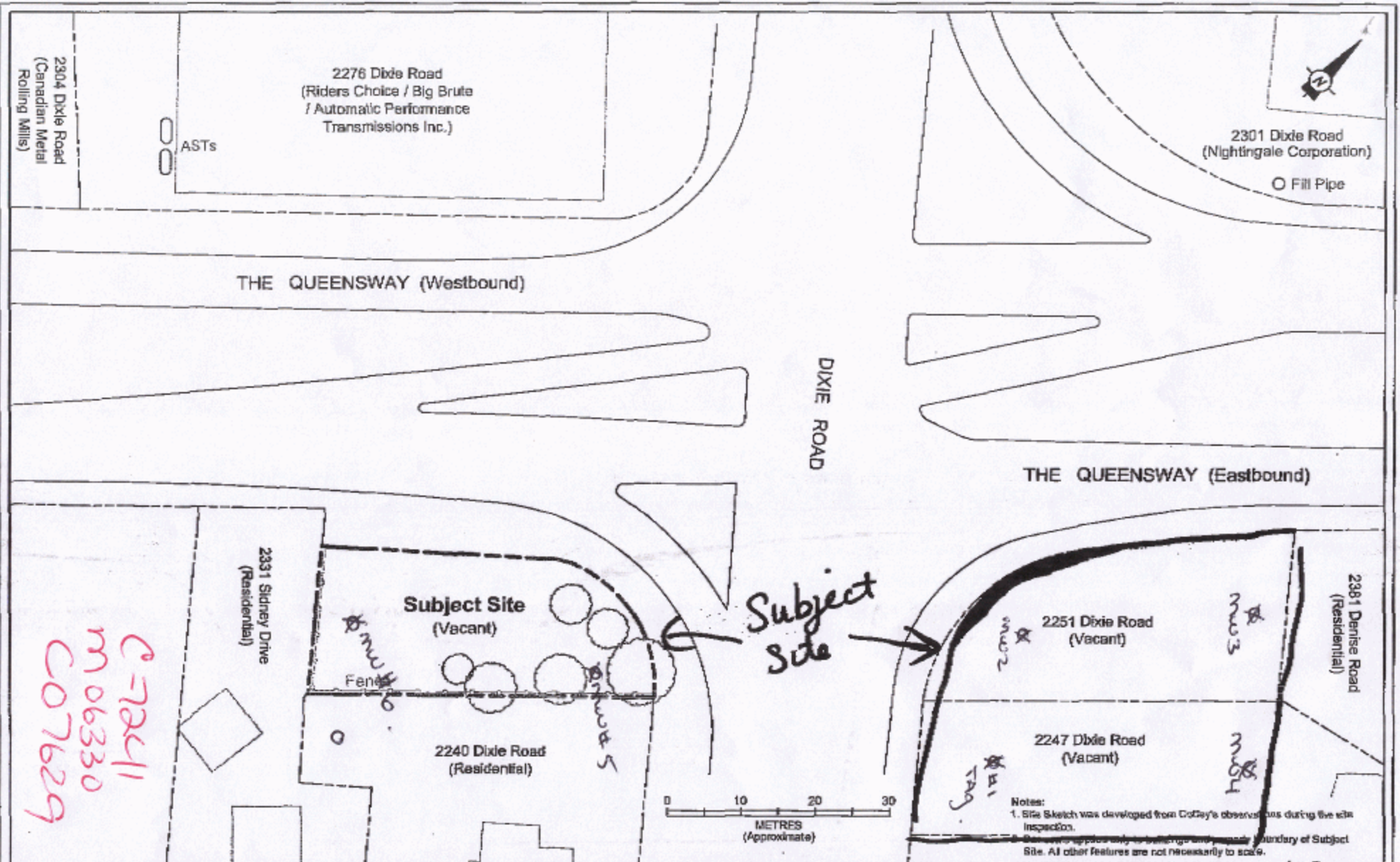
Business Name of Well Contractor Strata Soil Sampling Inc. Business Address (Street Number/Name, RR) 147-2 West Beaver Creek Road Municipality Richmond Hill Province Ontario  
 Postal Code L4B 1C6 Business Telephone No. (inc. area code) 905-764-9304 Well Contractor's Licence No. 7241 Business E-mail Address wrecords@stratasoil.com  
 Name of Well Technician (First Name, Last Name) Mike Muir Well Technician's Licence No. 3448 Date Submitted (yyyy/mm/dd) 2009/11/30 Signature of Technician [Signature]

Date 1st Well in Cluster Constructed (yyyy/mm/dd) \_\_\_\_\_ Date Last Well in Cluster Constructed (yyyy/mm/dd) \_\_\_\_\_

**Ministry Use Only**

Date Received (yyyy/mm/dd) DEC 21 2009 Date Inspected (yyyy/mm/dd) \_\_\_\_\_  
 Audit No. c07629 Remarks m06330





DEC 21 2009

F:\GEOTECH\Projects\ENVSETOB 1000000 to ENVSETOB 10205AA - Ph 1 ESA SW Corner of Dixie Rd and The Queensway.dwg

C-72411  
M06330  
C076229

LEGEND	
AST	Aboveground Storage Tank
	Adjoining and Neighbouring Property Boundary
	Property Boundary

drawn	TMMV
approved	DWS
date	OCT. 2009
scale	AS SHOWN
original size	Letter

**coffey**  
geotechnics  
SPECIALISTS MANAGING  
THE EARTH

client:	[REDACTED]
project:	PHASE 1 ENVIRONMENTAL SITE ASSESSMENT SOUTHWEST CORNER OF DIXIE ROAD AND THE QUEENSWAY MISSISSAUGA, ONTARIO
title:	SITE SKETCH
project no:	ENVSETOB10205AA
drawing no:	2

Notes:  
1. Site Sketch was developed from Coffey's observations during the site inspection.  
2. Boundaries shown are approximate only to bearings and property boundary of Subject Site. All other features are not necessarily to scale.



Master Well Owner's and Land Owner's Information

First Name: Suncor Energy Products, Last Name: Suncor Energy Products, Mailing Address: 3275 Rebecca St., Municipality: Oakville, Province: Ont, Postal Code: L6L 6N5, Telephone No.: 905 825 1696

Location and Construction of the Master Well in the Cluster

Address of Well Location: 655 Queens Way E., Township: Mississauga, City/Town/Village: Mississauga, Province: Ontario, Postal Code: [blank]

UTM Coordinates: NAD 83 176135994827215, Zone: 18, Easting: 613599, Northing: 4827215, GPS Unit: Magellan, Model: Explorer, Mode of Operation: Averaged

Overburden and Bedrock Materials (see instructions on the back of this form)

Table with 5 columns: General Colour, Most Common Material, Other Materials, General Description, Depth (Metres) From/To. Rows include: BROWN SAND & GRAVEL FILL PACKED 0.1 1.5, BROWN SAND LOOSE 1.5 2.1, GREY SHALE SOFT 2.1 4.5

Hole Details

Table with 3 columns: Depth (Metres) From/To, Diameter (Centimetres). Row: 0 4.5, 21

Water Use: Monitoring (checked), Other, specify: [blank]

Method of Construction: Boring (checked), Other, specify: [blank]

Status of Well: Other, specify: MONITORING (checked)

No Casing and Screen Used: No (checked), Static Water Level Test: [blank] Metres

Screen: Plastic (checked), Outside Diameter: 6.4

Construction Details

Table with 5 columns: Inside Diameter (Centimetres), Material, Wall Thickness, Depth (Metres) From/To. Rows: 5.1 PLASTIC CASING 0.65 0.1 1.5, 5.1 PLASTIC SCREEN 0.65 1.5 4.5

Water Details: Water found at Depth 3.0 Metres, Kind of Water: Fresh (checked)

Annular Space/Abandonment Sealing Record

Table with 4 columns: Depth Set at (Metres) From/To, Type of Sealant Used, Volume Used (Cubic Metres). Rows: 0 0.3 CONCRETE, 0.3 1.2 BENTONITE CHIPS

Disinfected: No (checked), Date Master Well Completed: 2010/02/18

Cluster Information: Total Wells in Cluster: 2, Total Wells on this Property: 2, Please indicate Number of Cluster Well Information Log Sheets Submitted: 1

Location of Well Cluster: Detailed Map must be provided as an attachment no larger than legal size (8.5" x 14").

Consent to release additional information concerning the cluster to the Director upon request. Signature of Technician/Contractor: [Signature], Date: 2010/02/19

Well Contractor and Well Technician Information

Business Name of Well Contractor: Geo Environmental, Well Contractor's Licence No.: 6607, Business Address: 340 Market Dr., Municipality: Milton, Province: Ont, Postal Code: L9T 5A4, Business E-mail Address: [blank], Bus. Telephone No.: 905 876 3388, Name of Well Technician: BLUMM, MATTHEW, Well Technician's Licence No.: 2158, Signature of Technician: [Signature], Date Submitted: 2010/02/19

Ministry Use Only: Audit No.: M 06500, Well Contractor No.: [blank], Date Received: MAR 24 2010, Date of Inspection: [blank], Remarks: [blank]



A094834

**Property Owner's Information**

First Name: SUNCOR ENERGY PRODUCTS  
 Last Name: PRODUCTS  
 Mailing Address (Street No./Name, RR): 3275 REBECCA ST  
 Municipality: OAKVILLE  
 Province: ONT  
 Postal Code: L6L6N5  
 E-mail Address: [blank]  
 Telephone No. (inc. area code): 9058251696

**Cluster Well Information**

Address of Well Location (Street Number/Name, RR): 655 QUEENS WAY E.  
 Lot: [blank]  
 Concession: [blank]  
 Township: [blank]  
 County/District/Municipality: [blank]  
 City/Town/Village: MISSISSAUGA  
 Province: Ontario  
 Postal Code: [blank]  
 GPS Unit Make: MAGELLAN  
 Model: & PLORISTIO  
 Unit Mode of Operation:  Undifferentiated  Averaged  
 Differentiated, specify: [blank]

C  
P  
S  
C  
upon request

Signature of Technician/Contractor: [Signature]  
 Date (yyyy/mm/dd): 2010/02/19

Well # on Sketch	UTM Coordinates		Full Depth of Hole (metres)	Hole Diameter (cm)	Method of Construction	Casing Material	Casing Length (metres)	Screen Interval (metres)		Annular Space Sealant Used	Static Water Level (metres)	Abandonment Sealant Used	Comments	Date of Completion (yyyy/mm/dd)
	Zone	Easting						Northing	From					
W308	17	6135784827218	4.5	21	BORING	PLASTIC	1.5	1.5	4.5	BENTONITE CHIPS	/			2010/02/19

**Well Contractor and Well Technician Information**

Business Name of Well Contractor: Geo-Environmental  
 Business Address (Street Number/Name, RR): 340 Market St  
 Municipality: Milton  
 Province: Ont  
 Postal Code: L9T5A4  
 Business Telephone No. (inc. area code): 9058763388  
 Well Contractor's Licence No.: 6607  
 Business E-mail Address: [blank]  
 Name of Well Technician (First Name, Last Name): MATTHEW BLUMEN  
 Well Technician's Licence No.: 2158  
 Date Submitted (yyyy/mm/dd): [blank]  
 Signature of Technician: [Signature]

Date 1st Well in Cluster Constructed (yyyy/mm/dd): 2010/02/18  
 Date Last Well in Cluster Constructed (yyyy/mm/dd): 2010/02/19

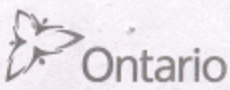
**Ministry Use Only**

Date Received (yyyy/mm/dd): MAR 24 2010  
 Date Inspected (yyyy/mm/dd): [blank]  
 Audit No.: C07274  
 Remarks: mob 500









Ministry of the Environment

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

A 097796

Well Record

Regulation 903 Ontario Water Resources Act

7202 Page 3 of 6

Measurements recorded in:  Metric  Imperial

Well Owner's Information

First Name, Last Name / Organization (Region of Peel / Public Works), E-mail Address, Mailing Address (9445 Airport Rd.), Municipality (Brampton), Province (ON), Postal Code (L6B 4J3), Telephone No.

Well Location

Address of Well Location (Dixie Road & Queensway/ S/E), Township, Lot, Concession, County/District/Municipality (Mississauga), City/Town/Village (Mississauga), Province (Ontario), Postal Code (W9K-0G2), UTM Coordinates (NAD 83 17 613 203 432 4014), Municipal Plan and Sublot Number (A0-A06)

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

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Includes handwritten entries for sand, gravel, and shale.

Annular Space table with columns: Depth Set at (m/ft) From, To; Type of Sealant Used (Material and Type); Volume Placed (m³/ft³). Includes handwritten entries for concrete, bentonite, and sand.

Results of Well Yield Testing table with columns: Draw Down (Time, Water Level), Recovery (Time, Water Level). Includes handwritten data for pumping rate and duration.

Method of Construction and Well Use section with checkboxes for Cable Tool, Rotary, Boring, etc., and Direct Push method.

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth (m/ft) From, To. Includes handwritten entry for plastic casing.

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth (m/ft) From, To. Includes handwritten entry for plastic screen.

Water Details and Hole Diameter table with columns: Water found at Depth, Kind of Water, Depth (m/ft) From, To, Diameter (cm/in).

Well Contractor and Well Technician Information section with fields for Business Name (Strata Soil Sampling Inc.), License No. (7241), Business Address (147-2 West Beaver Creek Road), Municipality (Richmond Hill), Province (Ontario), Postal Code (L4B 1C6), Business E-mail Address (wrecords@stratasoil.com).

Well Technician information section with fields for Bus. Telephone No. (905-764-9304), Name of Well Technician (Robinson Lewis), Signature, Date Submitted (20100305), Well Technician's License No. (31 B 9).

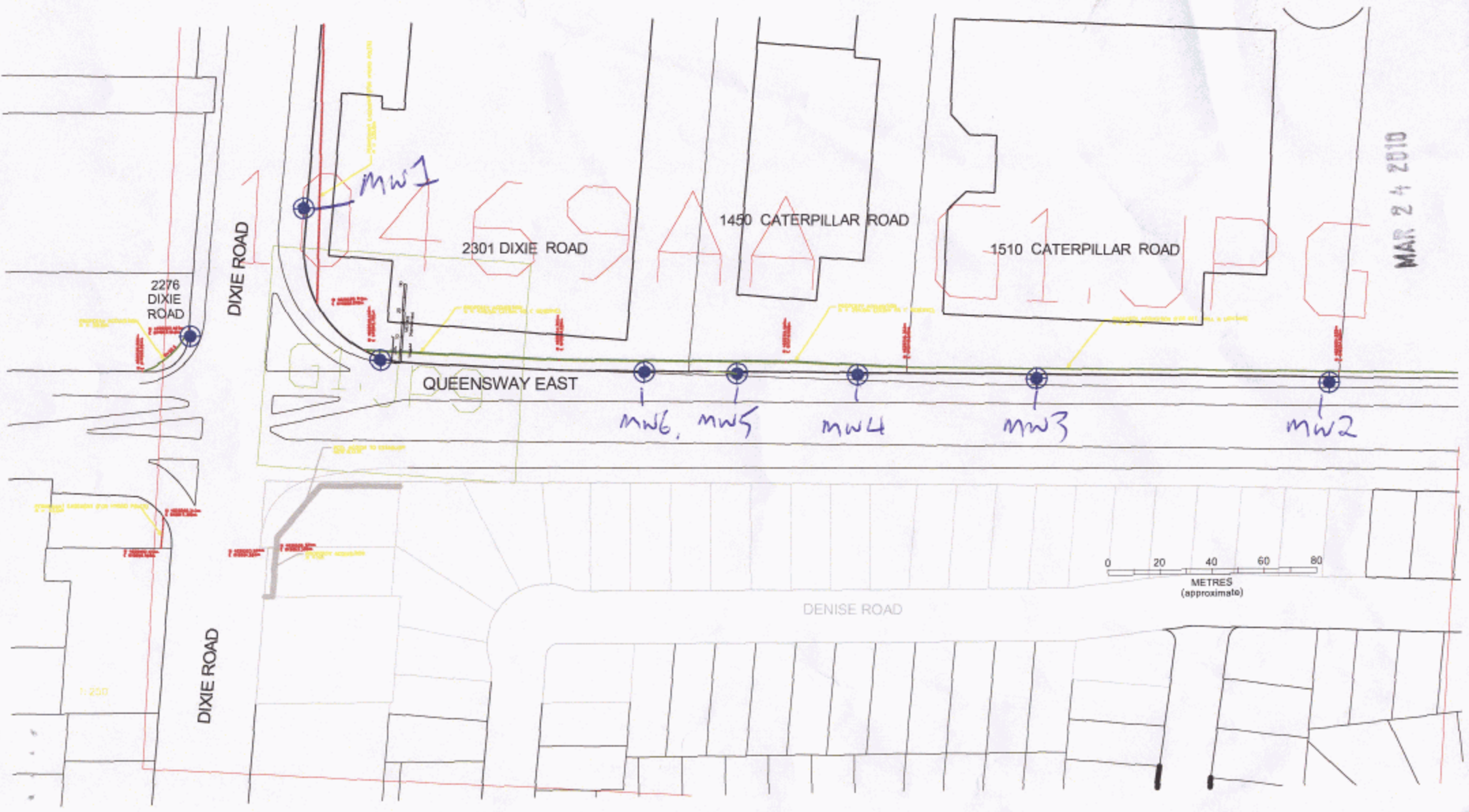
Map of Well Location section with handwritten notes: '500 attached.', 'mw3', and 'General contractor: Coffey Geotechnics'.

Ministry Use Only section with fields for Date Package Delivered, Date Work Completed (20100305), Audit No. (Z112766), and Received date (MAR 24 2010).



7202

11LE11Z  
01LE11Z  
99LE11Z  
89LE11Z  
1HELE11Z



MAR 24 2010

0 20 40 60 80  
METRES  
(approximate)

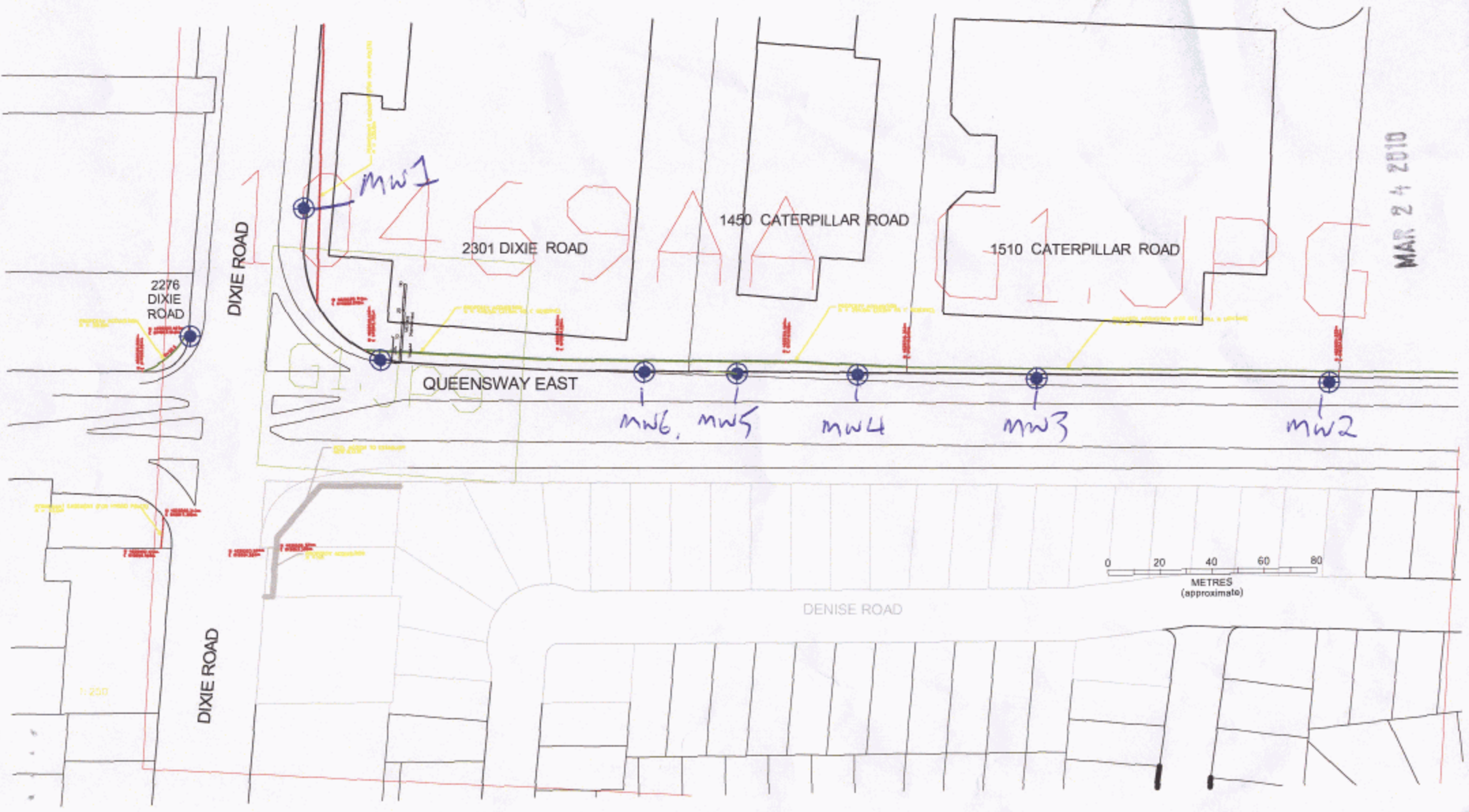






7202

11LE11Z  
01LE11Z  
99LE11Z  
89LE11Z  
1HELE11Z



MAR 24 2010

0 20 40 60 80  
METRES  
(approximate)

DIXIE ROAD

DIXIE ROAD

DENISE ROAD

1450 CATERPILLAR ROAD

1510 CATERPILLAR ROAD

2301 DIXIE ROAD

2276 DIXIE ROAD

mw1

mw6, mw5

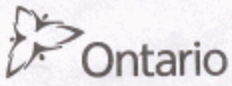
mw4

mw3

mw2

1:250





Ministry of the Environment

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

**A 096811**

A096811

**Well Record**

Regulation 903 Ontario Water Resources Act

7241 Page \_\_\_\_\_ of \_\_\_\_\_

Measurements recorded in:  Metric  Imperial

**Well Owner's Information**

Region of Peel  
Public Works  
9445 Airport Road, 3rd floor  
Brampton, ON L6S 4J3

E-mail Address \_\_\_\_\_

Province: On Postal Code: A9A 5R8 Telephone No. (inc. area code) \_\_\_\_\_

Well Constructed by Well Owner

**Well Location**

Address of Well Location (Street Number/Name): 2276 Dixie rd.

County/District/Municipality: \_\_\_\_\_ Township: \_\_\_\_\_ Lot: \_\_\_\_\_ Concession: \_\_\_\_\_

City/Town/Village: Mississauga Province: **Ontario** Postal Code: \_\_\_\_\_

UTM Coordinates: Zone 18 Easting 11761498848 Northing 28768 Municipal Plan and Sublot Number: \_\_\_\_\_ Other: \_\_\_\_\_

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)	
				From	To
<u>brown</u>	<u>topsoil</u>		<u>loose</u>	<u>0</u>	<u>1</u>
<u>brown</u>	<u>sand</u>	<u>gravel</u>	<u>loose, soft</u>	<u>1</u>	<u>3</u>
<u>grey</u>	<u>shale</u>		<u>hard</u>	<u>3</u>	<u>3.6</u>

**Annular Space**

Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m <sup>3</sup> /ft <sup>3</sup> )
<u>0 - 0.31</u>	<u>Concrete</u>	<u>.0026</u>
<u>0.31 - 1.8</u>	<u>Bentonite</u>	<u>.0070</u>
<u>1.8 - 3.6</u>	<u>Silica Sand</u>	<u>.0084</u>

**Method of Construction**

Cable Tool  Diamond  Public  Commercial  Not used

Rotary (Conventional)  Jetting  Domestic  Municipal  Dewatering

Rotary (Reverse)  Driving  Livestock  Test Hole  Monitoring

Boring  Digging  Irrigation  Cooling & Air Conditioning

Air percussion  Industrial

Other, specify \_\_\_\_\_  Other, specify \_\_\_\_\_

**Construction Record - Casing**

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
<u>5.20</u>	<u>PVC</u>	<u>.39</u>	<u>0</u>	<u>2.1</u>	<input checked="" type="checkbox"/> Test Hole <input checked="" type="checkbox"/> Observation and/or Monitoring Hole

**Construction Record - Screen**

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)		Status of Well
			From	To	
<u>6.03</u>	<u>PVC</u>	<u>10</u>	<u>2.1</u>	<u>3.6</u>	<input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

**Water Details**

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	Depth (m/ft)	Diameter (cm/in)
<u>0</u>	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	<u>0 - 3.6</u>	<u>10.9</u>

**Well Contractor and Well Technician Information**

Business Name of Well Contractor: Strata Soil Sampling Inc Well Contractor's Licence No.: 72411

Business Address (Street Number/Name): 147-2 West Beaver Creek rd. Richmond Hill Municipality: \_\_\_\_\_

Province: On Postal Code: L4B 1E6 Business E-mail Address: wrecords@strataso1.com

Bus. Telephone No. (inc. area code): 9057648304 Name of Well Technician (Last Name, First Name): Edman Tavis

Well Technician's Licence No.: 3159 Signature of Technician and/or Contractor: \_\_\_\_\_ Date Submitted: 20100307

**Results of Well Yield Testing**

After test of well yield, water was:  Clear and sand free  Other, specify \_\_\_\_\_

If pumping discontinued, give reason: \_\_\_\_\_

Pump intake set at (m/ft): \_\_\_\_\_

Pumping rate (l/min / GPM): \_\_\_\_\_

Duration of pumping: \_\_\_\_\_ hrs + \_\_\_\_\_ min

Final water level end of pumping (m/ft): \_\_\_\_\_

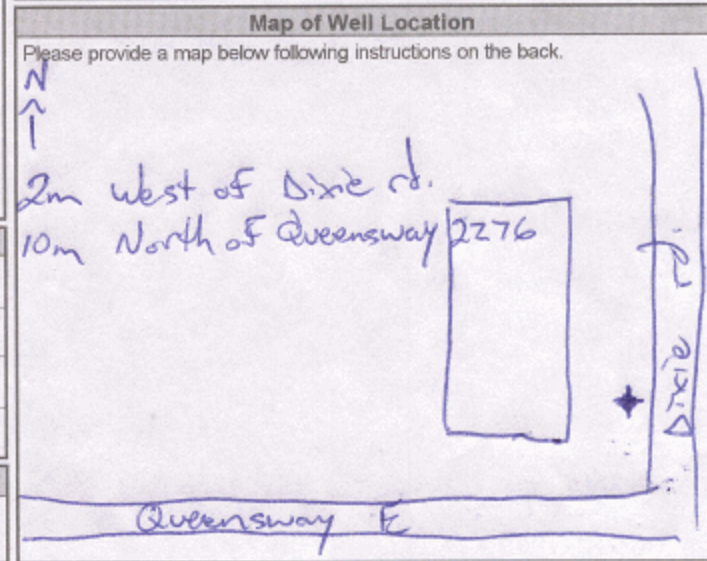
If flowing give rate (l/min / GPM): \_\_\_\_\_

Recommended pump depth (m/ft): \_\_\_\_\_

Recommended pump rate (l/min / GPM): \_\_\_\_\_

Well production (l/min / GPM): \_\_\_\_\_

Disinfected?  Yes  No



Comments: \_\_\_\_\_

Well owner's information package delivered:  Yes  No

Date Package Delivered: 20100307

Date Work Completed: 20100307

**Ministry Use Only**

Audit No.: z111134

Received: MAY 03 2010




 Ministry of  
the Environment

Well \_\_\_\_\_ (it Below)

**A 096685****Well Record**

Regulation 903 Ontario Water Resources Act

Page \_\_\_\_\_ of \_\_\_\_\_

Measurements recorded in:  Metric  Imperial**Well Owner's Information**

First Name	Last Name / Organization <b>REGION OF PEELE</b>	E-mail Address	<input type="checkbox"/> Well Constructed by Well Owner
Mailing Address (Street Number/Name) <b>10 PEELE CENTRE, SUITE A+B.</b>	Municipality <b>BRAMPTON</b>	Province <b>ONT.</b>	Postal Code
Telephone No. (inc. area code)			

**Well Location**

Address of Well Location (Street Number/Name) <b>BURNHAMTHORPE BOE + CENTRAL HWY E.</b>	Township	Lot	Concession
County/District/Municipality <b>PEELE</b>	City/Town/Village <b>MISSISSAUGA</b>	Province <b>Ontario</b>	Postal Code
UTM Coordinates NAD   8   3   <b>176109534823446</b>	Zone	Easting	Northing
Municipal Plan and Sublot Number		Other	

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)	
				From	To
Brown	Clay			0'	10'
grey	Clay			10'	30'
grey	gravel	Rocks		30'	42'
grey	Clay			42'	47'
grey	gravel	Rocks		47'	53'

Annular Space			
Depth Set at (m/ft)		Type of Sealant Used (Material and Type)	Volume Placed (m <sup>3</sup> /ft <sup>3</sup> )
From	To		
0'	20'	10 Bags 3/8 Holeplug	

Method of Construction		Well Use		
<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input type="checkbox"/> Public	<input type="checkbox"/> Commercial	<input type="checkbox"/> Not used
<input type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input type="checkbox"/> Domestic	<input type="checkbox"/> Municipal	<input checked="" type="checkbox"/> Dewatering
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input type="checkbox"/> Test Hole	<input type="checkbox"/> Monitoring
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Cooling & Air Conditioning	
<input type="checkbox"/> Air percussion		<input type="checkbox"/> Industrial		
<input checked="" type="checkbox"/> Other, specify <b>Air Rotary</b>		<input type="checkbox"/> Other, specify		

Construction Record - Casing				Status of Well	
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		
			From	To	
6	Steel	.219	0'	48'	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input checked="" type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify <input type="checkbox"/> Other, specify

Construction Record - Screen				
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
5	Steel	10'	48'	53'

Water Details		Hole Diameter	
Water found at Depth <b>47'</b> (m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	Depth (m/ft) From	To
Water found at Depth (m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested		Diameter (cm/in)
Water found at Depth (m/ft) <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested		

Well Contractor and Well Technician Information			
Business Name of Well Contractor <b>LONE STAR WELL RIGGING LTD</b>		Well Contractor's Licence No. <b>3413</b>	
Business Address (Street Number/Name) <b>P.O. Box 280</b>		Municipality <b>KEFROY</b>	
Province <b>ONT</b>	Postal Code <b>L0K1W0</b>	Business E-mail Address	
Bus. Telephone No. (inc. area code) <b>7054364359</b>	Name of Well Technician (Last Name, First Name) <b>MOORE, JAMES</b>		
Well Technician's Licence No. <b>T401</b>	Signature of Technician and/or Contractor <i>Jim Moore</i>	Date Submitted <b>20100902</b>	

Results of Well Yield Testing				
After test of well yield, water was: <input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:  Pump intake set at (m/ft) <b>53'</b> Pumping rate (l/min / GPM) <b>13 gpm</b> Duration of pumping hrs + min Final water level end of pumping (m/ft) <b>30'</b> If flowing give rate (l/min / GPM) <b>13 gpm</b> Recommended pump depth (m/ft) <b>53'</b> Recommended pump rate (l/min / GPM) <b>13 gpm</b> Well production (l/min / GPM) <b>13 gpm</b> Disinfected? <input type="checkbox"/> Yes <input type="checkbox"/> No	Static Level	<b>30'</b>		
	1		1	<b>43'</b>
	2		2	<b>38'</b>
	3		3	<b>35'6"</b>
	4		4	<b>33'</b>
	5		5	<b>31'6"</b>
10		10	<b>30'</b>	
15		15		
20		20		
25		25		
30		30		
40		40		
50		50		
60		60		

**Map of Well Location**

Please provide a map below following instructions on the back.

Well owner's information package delivered <input type="checkbox"/> Yes <input type="checkbox"/> No		Date Package Delivered Y Y Y Y M M D D <b>20100902</b>	Date Work Completed <b>20100902</b>
Ministry Use Only Audit No. <b>z111549</b>		SEP 20 2010	



Measurements recorded in:  Metric  Imperial

A 111949

Page \_\_\_\_\_ of \_\_\_\_\_

Well Owner's Information

First Name \_\_\_\_\_ Last Name Organization Agellan Capital Partners Inc. E-mail Address \_\_\_\_\_  Well Constructed by Well Owner

Mailing Address (Street Number/Name) 156 Front St. W Suite 303 Municipality Toronto Province ON Postal Code M5J 2L6 Telephone No. (inc. area code) 416 593 6806

Well Location

Address of Well Location (Street Number/Name) 2395-2399 Cawthra Rd. Township \_\_\_\_\_ Lot \_\_\_\_\_ Concession \_\_\_\_\_

County/District/Municipality \_\_\_\_\_ City/Town/Village Mississauga Province Ontario Postal Code \_\_\_\_\_

UTM Coordinates Zone 17 Easting 613544 Northing 4827351 Municipal Plan and Sublot Number \_\_\_\_\_ Other \_\_\_\_\_

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)	
				From	To
Brown	Fill		loose	0'	2'
Grey	silt	clay	hard	2'	10'
Grey	Shale		hard	10'	15'

Annular Space

Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m <sup>3</sup> /ft <sup>3</sup> )
15' 4'	Sand	
4' 1'	Bentonite	
1' 0'	Sand, casing, concrete.	

Results of Well Yield Testing

After test of well yield, water was: <input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason: _____	Static Level			
	1		1	
	Pump intake set at (m/ft)	2	2	
	Pumping rate (l/min / GPM)	3	3	
	Duration of pumping ____ hrs + ____ min	4	4	
	Final water level end of pumping (m/ft)	5	5	
If flowing give rate (l/min / GPM)	10		10	
	15		15	
	20		20	
	Recommended pump depth (m/ft)	25	25	
	Recommended pump rate (l/min / GPM)	30	30	
	Well production (l/min / GPM)	40	40	
Disinfected? <input type="checkbox"/> Yes <input type="checkbox"/> No	50		50	
	60		60	

Method of Construction

Rotary (Conventional)  Diamond  Public  Commercial  Not used

Rotary (Reverse)  Jetting  Domestic  Municipal  Dewatering

Boring  Driving  Livestock  Test Hole  Monitoring

Air percussion  Digging  Irrigation  Cooling & Air Conditioning

Other, specify \_\_\_\_\_  Industrial  Other, specify \_\_\_\_\_

Construction Record - Casing

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
2"	Plastic	sh40	5'	0'	<input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

Construction Record - Screen

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
2"	Plastic	10	15'	5'

Water Details

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested	Hole Diameter	
		Depth (m/ft)	Diameter (cm/in)
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	From To	
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	15' 0'	8"
	<input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____		

Well Contractor and Well Technician Information

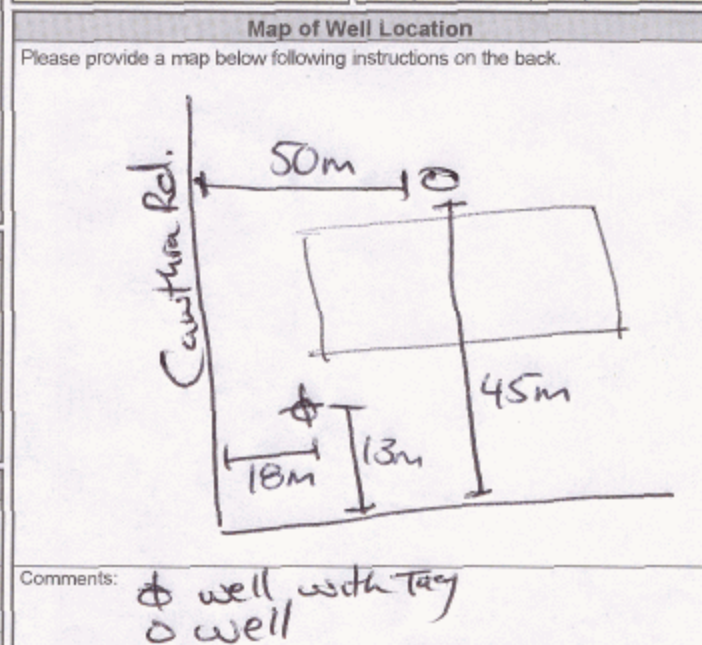
Business Name of Well Contractor Profile Drilling Inc. Well Contractor's Licence No. 7215

Business Address (Street Number/Name) 149 Northch Dr. Municipality North York

Province ON Postal Code M2N 1Y2 Business E-mail Address jason@profiledrilling.com

Bus. Telephone No. (inc. area code) 416 650 6444 Name of Well Technician (Last Name, First Name) Stocki, Jason

Well Technician's Licence No. 2978 Signature of Technician and/or Contractor [Signature] Date Submitted 2011 03 24



Comments: ø well with tag  
o well

Well owner's information package delivered <input type="checkbox"/> Yes <input type="checkbox"/> No	Date Package Delivered Y Y Y Y M M D D <u>20110522</u>	Ministry Use Only Audit No. <b>z129110</b> Received <b>APR 18 2011</b>
	Date Work Completed <u>20110522</u>	



Measurements recorded in:  Metric  Imperial

A116649

A116649

8958 Page 2 of 3

Address of Well Location (Street Number/Name) 2320 Dixie Road		Township	Lot	Concession
County/District/Municipality		City/Town/Village Mississauga	Province Ontario	Postal Code
UTM Coordinates NAD 83	Zone 17	Easting 148034	Northing 4828561	Municipal Plan and Sublot Number
			Other WKQ-004141	A 0 - A 02

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)				
General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From To
Black	Pavement		Pavement	0 0.5
Brown	Sand	Gravel	Loose	0.5 1
Gray	Silt	Sand	Dense	1 17

Annular Space		
Depth Set at (m/ft) From To	Type of Sealant Used (Material and Type)	Volume Placed (m <sup>3</sup> /ft <sup>3</sup> )
0 0.5	Concrete	0.0050
0.5 6	Bentonite	0.0030
6 17	Sand	0.0055

Results of Well Yield Testing					
After test of well yield, water was:		Draw Down		Recovery	
<input type="checkbox"/> Clear and sand free	<input type="checkbox"/> Other, specify _____	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:		Static Level			
Pump intake set at (m/ft)		1		1	
Pumping rate (l/min / GPM)		2		2	
Duration of pumping ____ hrs + ____ min		3		3	
Final water level end of pumping (m/ft)		4		4	
If flowing give rate (l/min / GPM)		5		5	
Recommended pump depth (m/ft)		10		10	
Recommended pump rate (l/min / GPM)		15		15	
Well production (l/min / GPM)		20		20	
Disinfected? <input type="checkbox"/> Yes <input type="checkbox"/> No		25		25	
		30		30	
		40		40	
		50		50	
		60		60	

Method of Construction		Well Use	
<input type="checkbox"/> Cable Tool	<input type="checkbox"/> Diamond	<input type="checkbox"/> Public	<input type="checkbox"/> Commercial
<input type="checkbox"/> Rotary (Conventional)	<input type="checkbox"/> Jetting	<input type="checkbox"/> Domestic	<input type="checkbox"/> Municipal
<input type="checkbox"/> Rotary (Reverse)	<input type="checkbox"/> Driving	<input type="checkbox"/> Livestock	<input checked="" type="checkbox"/> Test Hole
<input type="checkbox"/> Boring	<input type="checkbox"/> Digging	<input type="checkbox"/> Irrigation	<input type="checkbox"/> Monitoring
<input type="checkbox"/> Air percussion	<input type="checkbox"/> Digging	<input type="checkbox"/> Industrial	<input type="checkbox"/> Cooling & Air Conditioning
<input checked="" type="checkbox"/> Other, specify Direct Push		<input type="checkbox"/> Other, specify _____	

Construction Record - Casing			Status of Well		
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft) From To		
1.5	Plastic	0.14	0 7	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____	

Construction Record - Screen		Status of Well	
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft) From To
1.78	Plastic	10	7 17

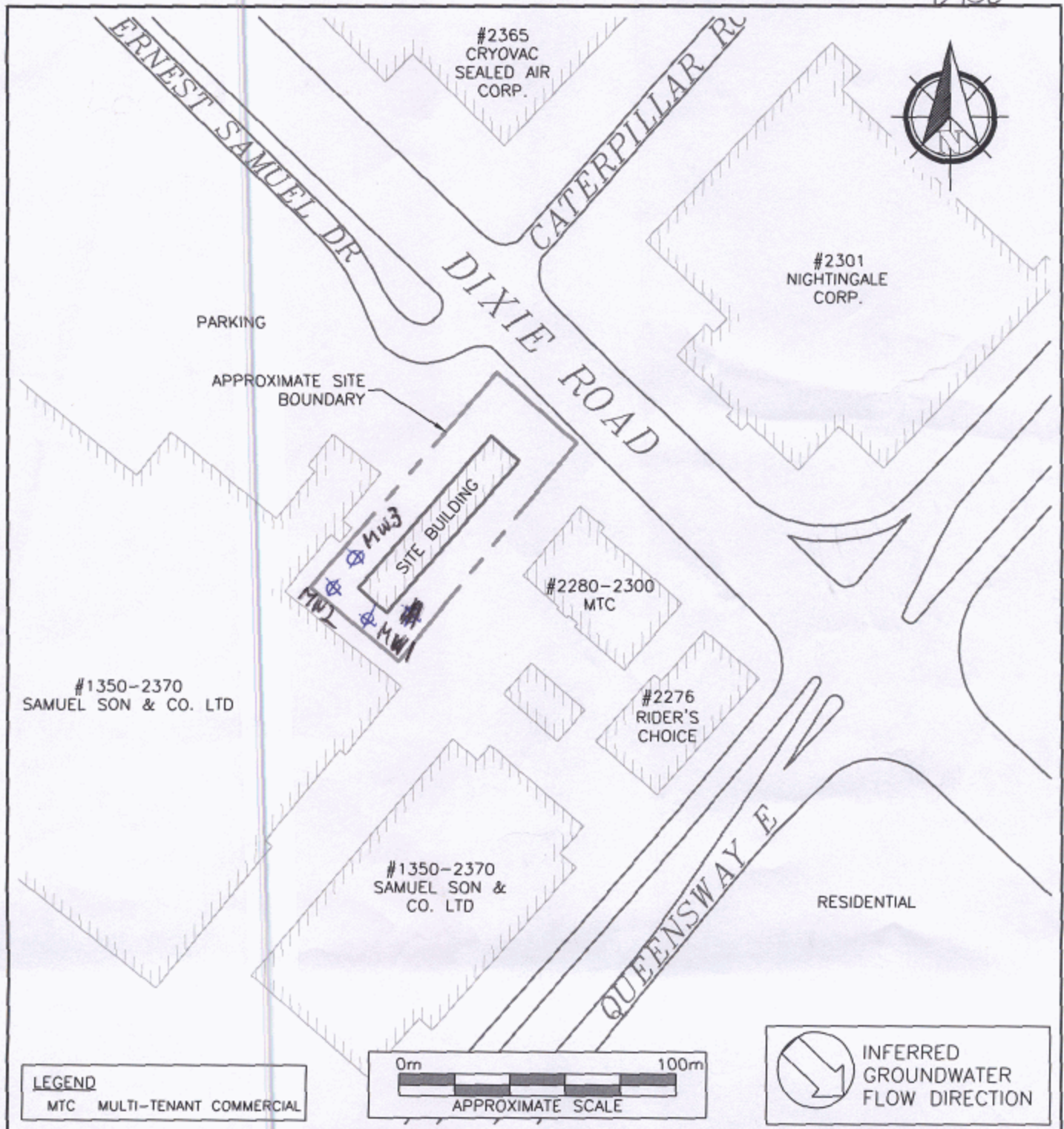
Water Details		Hole Diameter	
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Depth (m/ft) From To	Diameter (cm/in)
		0 17	3.25


Well Contractor and Well Technician Information			
Business Name of Well Contractor Strata Soil Sampling Inc.		Well Contractor's Licence No. 7 2 4 1	
Business Address (Street Number/Name) 147-2 West Beaver Creek Road		Municipality Richmond Hill	
Province Ontario	Postal Code L4B 1C6	Business E-mail Address wrecords@stratasoil.com	
Bus. Telephone No. (inc. area code) 905-764-9304	Name of Well Technician (Last Name, First Name) Andrew Vanderboor		
Well Technician's Licence No. 3 6 1 4	Signature of Technician and/or Contractor Andrew Vanderboor		Date Submitted 2011 09 16

Map of Well Location	
Please provide a map below following instructions on the back.	
See Map MW2	
Comments: General contractor: Pinchin Environmental	
Well owner's information package delivered <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Date Package Delivered Y Y Y Y M M D D 2011 08 25
Date Work Completed 2011 08 25	
Ministry Use Only Audit No. 2138751 NOV 15 2011 Received	



8958



	PROJECT NAME			FIGURE NO.
	PHASE II ENVIRONMENTAL SITE ASSESSMENT			
	CLIENT NAME			
	GRANBY BUILDING CORPORATION			
	PROJECT LOCATION			
2320 DIXIE ROAD, MISSISSAUGA, ONTARIO			2	
FIGURE NAME				
SITE AND SURROUNDING LAND USE PLAN				
APPROXIMATE SCALE	PROJECT NO.	DATE		
AS SHOWN	65199.001	MAR 2011		

C-7241

2138753, 2138752  
2138751,

NOV 15 2011



Ministry of the Environment

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

A116780

A116780

Well Record

Regulation 903 Ontario Water Resources Act

Page 1 of 6

Measurements recorded in:  Metric  Imperial

Well Owner's Information

First Name, Last Name / Organization (T.W.I. Foods Inc), E-mail Address, Mailing Address (1869 GAUGE COURT), Municipality (MISSISSAUGA), Province (Ont), Postal Code (L5S1L1S3), Telephone No.

Well Location

Address of Well Location (1550 Caterpillar Road), Township, Lot, Concession, City/Town/Village (Mississauga), Province (Ontario), Postal Code, UTM Coordinates, Zone, Easting, Northing, Municipal Plan and Sublot Number, Other (WKQ-004492)

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

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Rows include: Brown SAND, Grey SILT, Grey SHALE.

Annular Space table with columns: Depth Set at (m/ft) From, To; Type of Sealant Used (Material and Type); Volume Placed (m³/ft³). Rows include: 0-1' Concrete/Fluidmorb, 1'-7.5' BENSEAL, 7.5'-13' SAND.

Method of Construction and Well Use section with checkboxes for Cable Tool, Rotary, Boring, etc., and Public, Commercial, etc.

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth (m/ft) From, To. Row: 1.5" PVC, -25", 0, 8.5'.

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth (m/ft) From, To. Row: 1.75" PVC, 10, 8.5', 13.5'.

Water Details and Hole Diameter section with tables for water found at depth and hole diameter measurements.

Well Contractor and Well Technician Information section with fields for Business Name (Strata Soil Sampling Inc.), Address, and Technician Name (Max Mike).

Results of Well Yield Testing table with columns: Draw Down (Time, Water Level), Recovery (Time, Water Level). Includes rows for pump intake, pumping rate, and final water level.

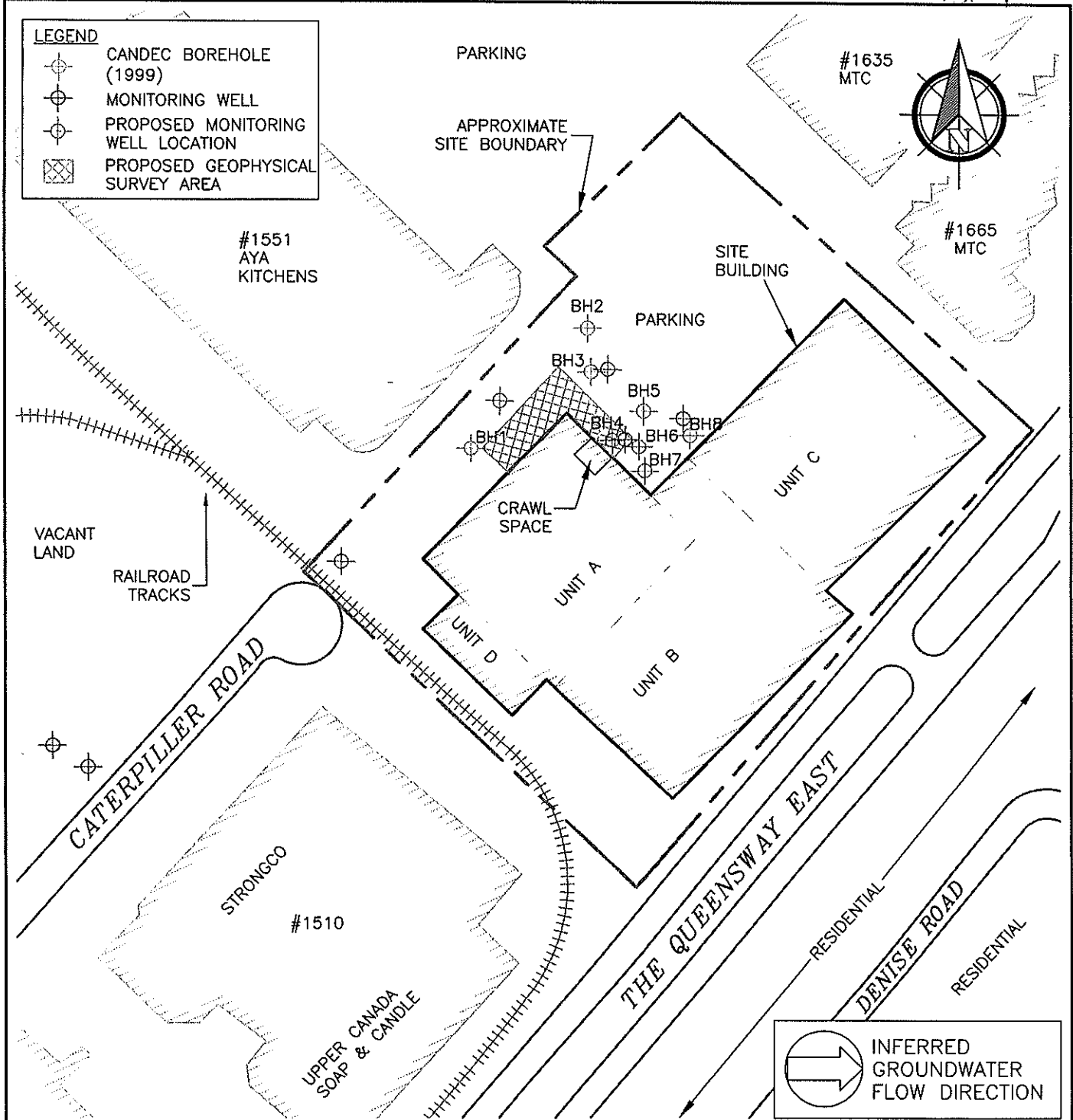
Map of Well Location section with instructions to provide a map following instructions on the back.

Comments: General contractor: Pinchin Environmental. Includes handwritten note: See Map BH.

Ministry Use Only section with fields for Date Package Delivered, Date Work Completed, and Audit No. (2143336).



9364



PROJECT NAME			
PHASE II ENVIRONMENTAL SITE ASSESSMENT			
CLIENT NAME			
BUSINESS DEVELOPMENT BANK OF CANADA			
PROJECT LOCATION			
1550 CATERPILLAR ROAD, MISSISSAUGA, ONTARIO			
FIGURE NAME			FIGURE NO.
MONITORING WELL LOCATION PLAN			1
APPROXIMATE SCALE	PROJECT NO.	DATE	
AS SHOWN	71421.001	NOV. 2011	

2143336 2143340 214339 C-7041  
 2112237 2113338  
 DEC 30 2011





Ministry of the Environment

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

Tag#: **A122453** *A122453*

Well Record

Regulation 903 Ontario Water Resources Act

93604 Page **2** of **6**

Measurements recorded in:  Metric  Imp

**Well Owner's Information**

First Name: \_\_\_\_\_ Last Name / Organization: **TWI FOODS Inc** E-mail Address: \_\_\_\_\_  Well Constructed by Well Owner

Mailing Address (Street Number/Name): **1869 GAUGE COURT** Municipality: **MISSISSAUGA** Province: **ONT** Postal Code: **L5S1S3** Telephone No. (inc. area code): \_\_\_\_\_

**Well Location**

Address of Well Location (Street Number/Name): **1550 Caterpillar Road** Township: \_\_\_\_\_ Lot: \_\_\_\_\_ Concession: \_\_\_\_\_

County/District/Municipality: \_\_\_\_\_ City/Town/Village: **Mississauga** Province: **Ontario** Postal Code: \_\_\_\_\_

UTM Coordinates: Zone **17** Easting **61151238** Northing **48291042** Municipal Plan and Sublot Number: \_\_\_\_\_ Other: **WKQ-004492**

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft)	
				From	To
<i>BROWN</i>	<i>SAND</i>		<i>Moist</i>	0	6'
<i>GREEN</i>	<i>SILT</i>	<i>CLAY</i>	<i>Wet</i>	6'	8'
<i>GREEN</i>	<i>SHALE</i>		<i>Weathered</i>	8'	10'

**Annular Space**

Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0 - 1'	<i>Concrete/Flushward</i>	
1' - 4'	<i>BENSEAL</i>	
4' - 10'	<i>SAND</i>	

**Results of Well Yield Testing**

After test of well yield, water was:	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
<input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____				
If pumping discontinued, give reason:	Static Level			
	1		1	
Pump intake set at (m/ft)	2		2	
Pumping rate (l/min / GPM)	3		3	
Duration of pumping _____ hrs + _____ min	4		4	
Final water level end of pumping (m/ft)	5		5	
	10		10	
If flowing give rate (l/min / GPM)	15		15	
	20		20	
Recommended pump depth (m/ft)	25		25	
Recommended pump rate (l/min / GPM)	30		30	
Well production (l/min / GPM)	40		40	
	50		50	
Disinfected? <input type="checkbox"/> Yes <input type="checkbox"/> No	60		60	

**Method of Construction**

Cable Tool  Diamond  Public  Commercial  Not used  
 Rotary (Conventional)  Jetting  Domestic  Municipal  Dewatering  
 Rotary (Reverse)  Driving  Livestock  Test Hole  Monitoring  
 Boring  Digging  Irrigation  Cooling & Air Conditioning  
 Air percussion  Industrial  
 Other, specify **Direct Push**  Other, specify \_\_\_\_\_

**Construction Record - Casing**

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
1.5'	PVC	.25"	0	5'	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

**Construction Record - Screen**

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)	
			From	To
1.75"	PVC	10	5'	10'

**Water Details**

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Hole Diameter	
		Depth (m/ft)	Diameter (cm/in)
		From	To
		0	10'
			3.25"

**Well Contractor and Well Technician Information**

Business Name of Well Contractor: **Strata Soil Sampling Inc.** Well Contractor's Licence No.: **7 2 4 1**

Business Address (Street Number/Name): **147-2 West Beaver Creek Road** Municipality: **Richmond Hill**

Province: **Ontario** Postal Code: **L4B 1C6** Business E-mail Address: **wrecords@stratasoil.com**

Bus. Telephone No. (inc. area code): **905-764-9304** Name of Well Technician (Last Name, First Name): **Mike**

Well Technician's Licence No.: **34418** Signature of Technician and/or Contractor: \_\_\_\_\_ Date Submitted: **2012/11/10**

**Map of Well Location**

Please provide a map below following instructions on the back.

*See Map BH #2*

Comments: **General contractor: Pinchin Environmental**

Well owner's information package delivered <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Date Package Delivered: <b>2012/11/10</b> Date Work Completed: <b>2012/11/10</b>	<b>Ministry Use Only</b> Audit No.: <b>2143337</b> <b>DEC 30 2011</b> Received
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Ministry of the Environment

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

Well Record

Regulation 903 Ontario Water Resources Act

Measurements recorded in:  Metric  Imperial

Tag#: A122516 A122516

Page 3 of 6

Well Owner's Information

First Name, Last Name / Organization, E-mail Address, Mailing Address, Municipality, Province, Postal Code, Telephone No.

Well Location

Address of Well Location, Township, Lot, Concession, County/District/Municipality, City/Town/Village, Province, Postal Code, UTM Coordinates, Zone, Easting, Northing, Municipal Plan and Sublot Number, Other

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To

Annular Space table with columns: Depth Set at (m/ft) From, To, Type of Sealant Used, Volume Placed

Results of Well Yield Testing table with columns: Draw Down, Recovery, Time, Water Level

Method of Construction, Well Use checkboxes

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth, Status of Well

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth

Water Details, Hole Diameter tables

Well Contractor and Well Technician Information form

Map of Well Location, Comments, Ministry Use Only section

SEE MAP BH #3





Ministry of the Environment

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

Tag#: A126482 A126482

Well Record

Regulation 903 Ontario Water Resources Act

9/26/11 Page 5 of 6

Measurements recorded in:  Metric  Imperial

Well Owner's Information

First Name Last Name / Organization E-mail Address  Well Constructed by Well Owner

Mailing Address (Street Number/Name) Municipality Province Postal Code Telephone No. (inc. area code)

Well Location

Address of Well Location (Street Number/Name) Township Lot Concession

County/District/Municipality City/Town/Village Province Postal Code

UTM Coordinates Zone Easting Northing Municipal Plan and Sublot Number Other

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

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To

Annular Space table with columns: Depth Set at (m/ft) From, To; Type of Sealant Used (Material and Type); Volume Placed (m³/ft³)

Results of Well Yield Testing table with columns: After test of well yield, water was; Draw Down; Recovery; Pumping rate; Duration of pumping; Final water level end of pumping; If flowing give rate; Recommended pump depth; Recommended pump rate; Well production; Disinfected?

Method of Construction and Well Use table with checkboxes for Cable Tool, Rotary, Boring, etc.

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth, Status of Well

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth

Water Details and Hole Diameter table with columns: Water found at Depth, Kind of Water, Depth, Diameter

Well Contractor and Well Technician Information table with fields for Business Name, Address, Licence No., etc.

Map of Well Location section with handwritten note: SEE MAP BH #5

Well owner's information package delivered table with checkboxes for Yes/No and Date Work Completed

Ministry Use Only table with fields for Audit No. and Received date





A160812

S-15262

Measurements recorded in:  Metric  Imperial

Page of

Well Owner's Information

First Name, Last Name / Organization (The Coming Generation), E-mail Address, Mailing Address (50-2455 Cowthra Rd), Municipality (Mississauga), Province (ON), Postal Code (L5A3P1), Telephone No.

Well Location

Address of Well Location (700 Dundas Street East), Township, Lot, Concession, County/District/Municipality (Mississauga), City/Town/Village (Mississauga), Province (Ontario), Postal Code, UTM Coordinates, Zone, Easting, Northing, Municipal Plan and Sublot Number, Other (WKQ-006750)

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Includes handwritten entries for Brown, Silty, weathered shale, and sand.

Annular Space table with columns: Depth Set at (m/ft) From, To, Type of Sealant Used (Material and Type), Volume Placed (m³/ft³). Includes handwritten entries for Flushment/concrete, Benseal, and sand.

Method of Construction and Well Use checkboxes. Includes options like Cable Tool, Rotary, Boring, Air percussion, Diamond, Jetting, Driving, Digging, Public, Commercial, Not used, Domestic, Municipal, Dewatering, Livestock, Test Hole, Monitoring, Irrigation, Cooling & Air Conditioning, Industrial, and Other.

Construction Record - Casing table with columns: Inside Diameter (cm/in), Open Hole OR Material, Wall Thickness (cm/in), Depth (m/ft) From, To, Status of Well. Includes handwritten entries for 2" PVC, 0.25" wall, and 0 to 6.5' depth.

Construction Record - Screen table with columns: Outside Diameter (cm/in), Material, Slot No., Depth (m/ft) From, To, Status of Well. Includes handwritten entries for 2.25" PVC, slot 10, and 6.5' to 16.5' depth.

Water Details and Hole Diameter tables. Water Details includes depth and kind of water. Hole Diameter includes depth and diameter.

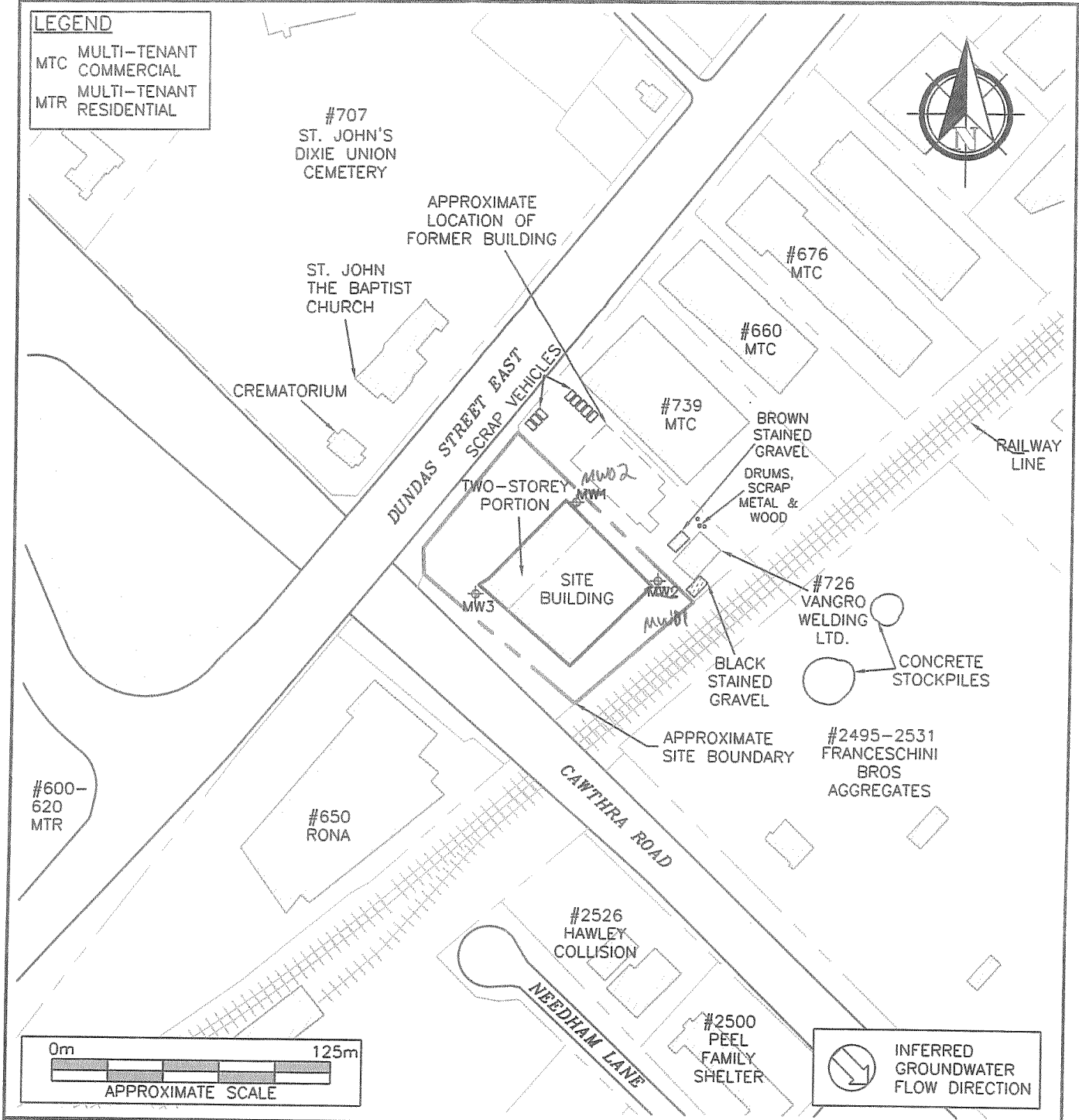
Well Contractor and Well Technician Information. Includes Business Name (Strata Soil Sampling Inc.), Business Address (147-2 West Beaver Creek Road), Province (Ontario), Postal Code (L4B 1C6), Business E-mail Address (wrecords@stratasoil.com), Business Telephone No. (905-764-9304), Name of Well Technician (CARNEAL MARK), Well Technician's Licence No. (3708), and Date Submitted (20110411).

Results of Well Yield Testing table. Includes columns for Draw Down (Time, Water Level) and Recovery (Time, Water Level) at various depths (1, 2, 3, 4, 5, 10, 15, 20, 25, 30, 40, 50, 60 m/ft).

Map of Well Location section. Includes text: 'Please provide a map below following instructions on the back.' and handwritten note: 'See Map MW-2.'

Ministry Use Only section. Includes Audit No. (185562), Date Work Completed (20110314), and Received stamp (APR 23 2014).

S-15262



	PROJECT NAME PHASE I ENVIRONMENTAL SITE ASSESSMENT		
	CLIENT NAME THE COMING GENERATION		
	PROJECT LOCATION 700 DUNDAS STREET EAST, MISSISSAUGA, ONTARIO		
	FIGURE NAME PROPOSED MONITORING WELL LOCATION PLAN		FIGURE NO. 1
	APPROXIMATE SCALE AS SHOWN	PROJECT NO. 88381.001	DATE FEB. 2014

ADD 2 3 2014

C-7241 2185562





Ministry of the Environment

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

Tag#: A160810

A160810

Well Record Regulation 903 Ontario Water Resources Act

Well No. 7219360

Page of

Measurements recorded in:  Metric  Imperial

Well Owner's Information

First Name, Last Name / Organization (The Coming Generation), E-mail Address, Mailing Address (50-2455 Cawthra Rd), Municipality (Mississauga), Province (ON), Postal Code (L5A3R1), Telephone No.

Well Location

Address of Well Location (700 Dundas Street East), Township, Lot, Concession, City/Town/Village (Mississauga), Province (Ontario), Postal Code, UTM Coordinates, Municipal Plan and Sublot Number, Other (WKQ-006750)

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Includes handwritten entries for fill, silty sand, and weathered shale.

Annular Space table with columns: Depth Set at (m/ft) From, To; Type of Sealant Used; Volume Placed. Includes handwritten entries for flushment/cement and BENSOL sand.

Method of Construction and Well Use checkboxes. Includes handwritten 'Direct Push' under Method of Construction.

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth (m/ft) From, To; Status of Well checkboxes. Includes handwritten 'PVC' and '0.35'.

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth (m/ft) From, To; Status of Well checkboxes. Includes handwritten 'PVC', '10', '8.5', '12.5'.

Water Details and Hole Diameter tables. Includes handwritten '0' and '18.5' for Hole Diameter.

Well Contractor and Well Technician Information. Includes Business Name (Strata Soil Sampling Inc.), Business Address (147-2 West Beaver Creek Road), Province (Ontario), Postal Code (L4B 1G6), Business E-mail Address (wrecords@stratasoil.com).

Well Technician's Licence No. (3708), Signature of Technician and/or Contractor, Date Submitted (20140314).

Results of Well Yield Testing table with columns: After test of well yield, water was; Draw Down (Time, Water Level); Recovery (Time, Water Level). Includes handwritten '10' and '15' for final water level end of pumping.

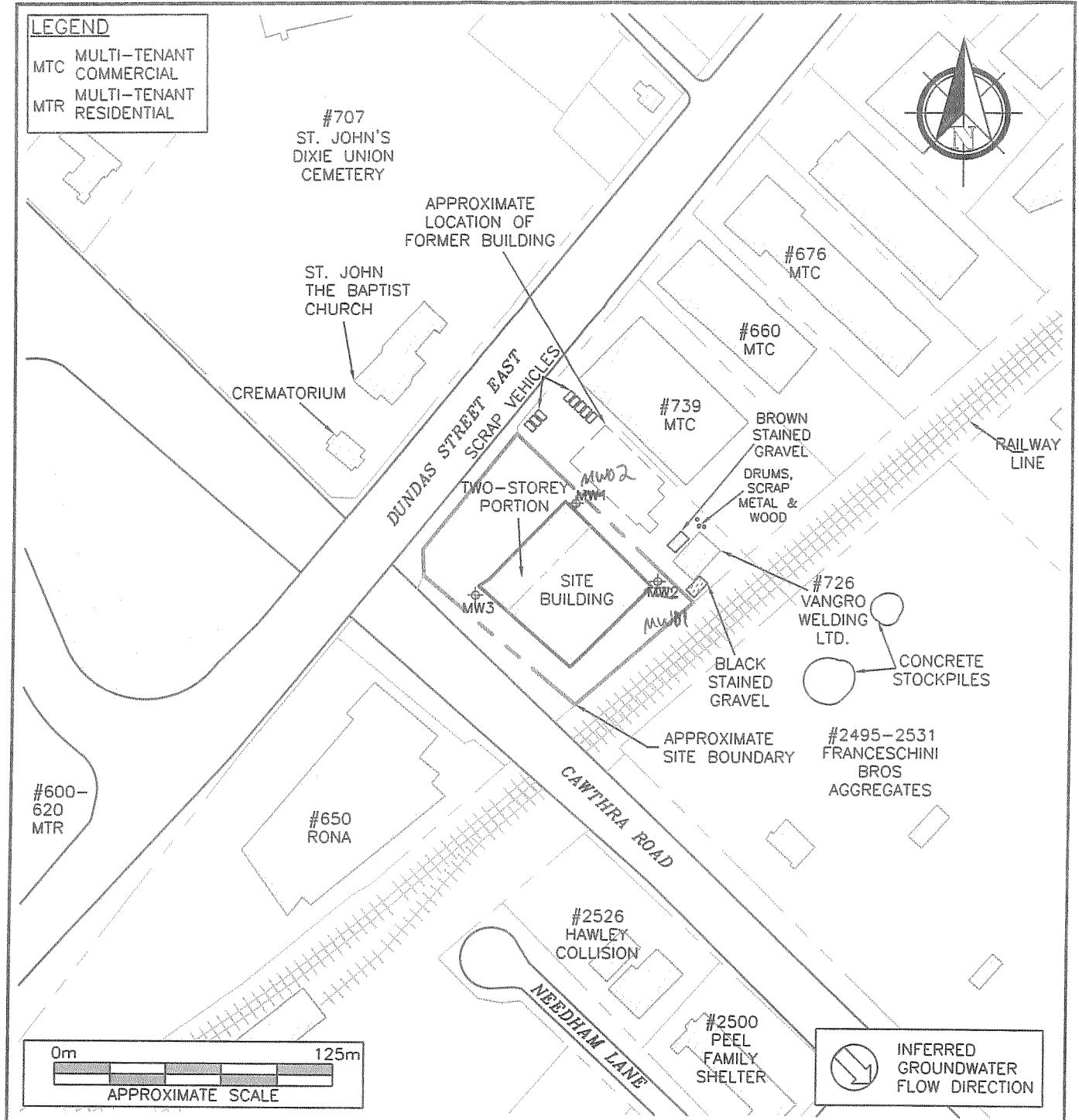
Map of Well Location

Please provide a map below following instructions on the back. SEE MAP MW-1

Ministry Use Only section. Includes Date Package Delivered, Date Work Completed (20140314), Audit No. (Z185563), and Received date (APR 23 2014).



S-15262



	PROJECT NAME PHASE I ENVIRONMENTAL SITE ASSESSMENT		
	CLIENT NAME THE COMING GENERATION		
	PROJECT LOCATION 700 DUNDAS STREET EAST, MISSISSAUGA, ONTARIO		
	FIGURE NAME PROPOSED MONITORING WELL LOCATION PLAN		FIGURE NO. 1
	APPROXIMATE SCALE AS SHOWN	PROJECT NO. 88381.001	DATE FEB. 2014

APR 23 2014

C-72411 2185563

# Overburden and Bedrock Materials Interval

Well No. 7224923

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	FILL	FSND	LOOS	0 m	.9 m
GREY	SHLE		PCKD	.9 m	4.9 m

# Overburden and Bedrock Materials Interval

Well No. 7235321

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	FILL	GRVL	LOOS	0 ft	5 ft
BRWN	SAND	SILT	LOOS	5 ft	10 ft



# Overburden and Bedrock Materials Interval

Well No. 7243628

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BLCK				0 ft	3 ft
BRWN	SAND	GRVL		3 ft	3 ft
BRWN	SILT	CLAY	SAND	3 ft	11 ft
GREY	SHLE		WTHD	11 ft	25 ft

# Overburden and Bedrock Materials Interval

Well No. 7250184

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	SAND	GRVL	STNS	0 ft	11 ft
GREY	SHLE			11 ft	14 ft

As of 1/1/2024, the well is currently in a state of...

# Overburden and Bedrock Materials Interval

Well No. 7277204

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
		SNDS		0 ft	1 ft
BRWN	SAND		LOOS	1 ft	9 ft
GREY	SAND			9 ft	15 ft



# Overburden and Bedrock Materials Interval

Well No. 7277560

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
BRWN	SAND	GRVL	PCKD	0 m	.7 m
BRWN	SAND		LOOS	.7 m	4 m
BRWN	SILT	CLAY	DNSE	4 m	4.5 m



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

A 230195

Measurements recorded in:  Metric  Imperial

Address of Well Location (Street Number/Name) **2327 Stanfield Rd** Township **-** Lot **-** Concession **-**

County/District/Municipality **Peel** City/Town/Village **Mississauga** Province **Ontario** Postal Code **\_\_\_\_\_**

UTM Coordinates Zone **18** Easting **8317614527** Northing **4828340** Municipal Plan and Sublot Number **\_\_\_\_\_** Other **\_\_\_\_\_**

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

General Colour	Most Common Material	Other Materials	General Description	Depth (m/ft) From	Depth (m/ft) To
Brown	Sand	Silt		0	5'
Grey	Silt	Clay		5'	7'

**Annular Space**

Depth Set at (m/ft) From	Depth Set at (m/ft) To	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
0	1	Cement	
1	3'	Bentonite	
3	7'	Silica sand	

**Method of Construction**

Cable Tool  Diamond  Public  Commercial  Not used

Rotary (Conventional)  Jetting  Domestic  Municipal  Dewatering

Rotary (Reverse)  Driving  Livestock  Test Hole  Monitoring

Boring  Digging  Irrigation  Cooling & Air Conditioning

Air percussion  Industrial  Other, specify \_\_\_\_\_

Other, specify \_\_\_\_\_

**Construction Record - Casing**

Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		Status of Well
			From	To	
2"	Plastic		+3	3	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input checked="" type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

**Construction Record - Screen**

Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)		Status of Well
			From	To	
2"	Plastic	.010	3'	7'	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input checked="" type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

**Water Details**

Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Hole Diameter Depth (m/ft) From	Hole Diameter Depth (m/ft) To	Hole Diameter Diameter (cm/in)
N/A		0	7'	8"

**Well Contractor and Well Technician Information**

Business Name of Well Contractor **Direct Environmental Drilling** Well Contractor's Licence No. **7320**

Business Address (Street Number/Name) **37 Shaw Valley Drive** Municipality **St Thomas**

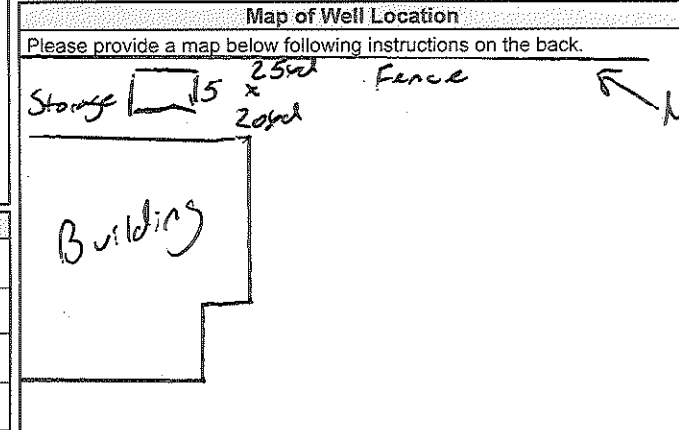
Province **ON** Postal Code **M5R 6J9** Business E-mail Address **ded@directenv.com**

Bus. Telephone No. (inc. area code) **519 868 0175** Name of Well Technician (Last Name - First Name) **Dawson, Matthew**

Well Technician's Licence No. **3963** Signature of Technician and/or Contractor **Matthew Dawson** Date Submitted **20170925**

**Results of Well Yield Testing**

After test of well yield, water was: <input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____	Draw Down		Recovery	
	Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:  Pump intake set at (m/ft)  Pumping rate (l/min / GPM)  Duration of pumping _____ hrs + _____ min  Final water level end of pumping (m/ft)  If flowing give rate (l/min / GPM)  Recommended pump depth (m/ft)  Recommended pump rate (l/min / GPM)  Well production (l/min / GPM)  Disinfected? <input type="checkbox"/> Yes <input type="checkbox"/> No	Static Level			
	1		1	
	2		2	
	3		3	
	4		4	
	5		5	
	10		10	
	15		15	
	20		20	
	25		25	
	30		30	
	40		40	
	50		50	
	60		60	



Comments: **Stanfield**

**Ministry Use Only**

Audit No. **2268781**

Date Package Delivered **20171008**

Date Work Completed **20170808**

Well owner's information package delivered  Yes  No

Received **OCT 12 2017**

Measurements recorded in:  Metric  Imperial

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

A 230199

Address of Well Location (Street Number/Name) 2327 Stanford Rd		Township	Lot	Concession
County/District/Municipality Peel		City/Town/Village Mississauga	Province Ontario	Postal Code
UTM Coordinates Zone	Easting	Northing	Municipal Plan and Sublot Number	
NAD 83	1761444048	28230	Other	

Overburden and Bedrock Materials/Abandonment Sealing Record (see instructions on the back of this form)				
General Colour	Most Common Material	Other Materials	Depth (m/ft)	
			From	To
Brown	Sand	Gravel	0	3'
Grey	Shale		3	5'

Annular Space		
Depth Set at (m/ft)	Type of Sealant Used (Material and Type)	Volume Placed (m³/ft³)
From	To	
0	1 Cement/Bentonite	
1	4 Silica sand	

Method of Construction	Well Use
<input type="checkbox"/> Cable Tool <input checked="" type="checkbox"/> Rotary (Conventional) <input type="checkbox"/> Rotary (Reverse) <input checked="" type="checkbox"/> Boring <input type="checkbox"/> Air percussion <input type="checkbox"/> Other, specify _____	<input type="checkbox"/> Diamond <input type="checkbox"/> Jetting <input type="checkbox"/> Driving <input type="checkbox"/> Digging <input type="checkbox"/> Public <input type="checkbox"/> Domestic <input type="checkbox"/> Livestock <input type="checkbox"/> Irrigation <input type="checkbox"/> Industrial <input type="checkbox"/> Other, specify _____
<input type="checkbox"/> Commercial <input type="checkbox"/> Municipal <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Cooling & Air Conditioning <input type="checkbox"/> Not used <input type="checkbox"/> Dewatering <input checked="" type="checkbox"/> Monitoring	

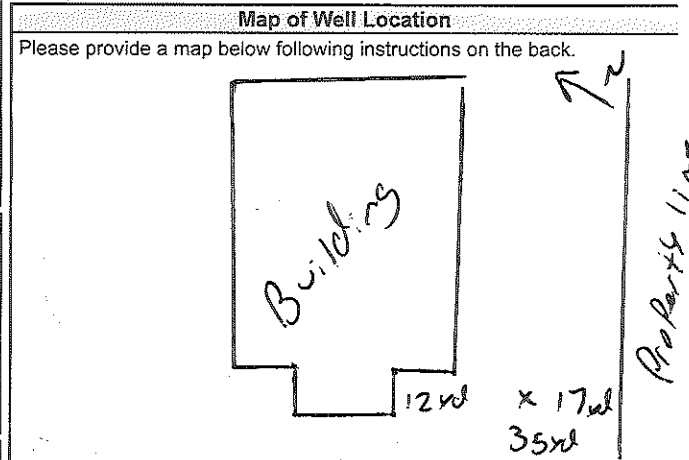
Construction Record - Casing				Status of Well	
Inside Diameter (cm/in)	Open Hole OR Material (Galvanized, Fibreglass, Concrete, Plastic, Steel)	Wall Thickness (cm/in)	Depth (m/ft)		
			From	To	
2"	Plastic		0	1	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input checked="" type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

Construction Record - Screen				Status of Well	
Outside Diameter (cm/in)	Material (Plastic, Galvanized, Steel)	Slot No.	Depth (m/ft)		
			From	To	
2"	Plastic	.010	1	5'	<input type="checkbox"/> Water Supply <input type="checkbox"/> Replacement Well <input checked="" type="checkbox"/> Test Hole <input type="checkbox"/> Recharge Well <input type="checkbox"/> Dewatering Well <input checked="" type="checkbox"/> Observation and/or Monitoring Hole <input type="checkbox"/> Alteration (Construction) <input type="checkbox"/> Abandoned, Insufficient Supply <input type="checkbox"/> Abandoned, Poor Water Quality <input type="checkbox"/> Abandoned, other, specify _____ <input type="checkbox"/> Other, specify _____

Water Details		Hole Diameter	
Water found at Depth (m/ft)	Kind of Water: <input type="checkbox"/> Fresh <input type="checkbox"/> Untested <input type="checkbox"/> Gas <input type="checkbox"/> Other, specify _____	Depth (m/ft)	Diameter (cm/in)
From	To	From	To
N/A		0	6"

Well Contractor and Well Technician Information			
Business Name of Well Contractor Direct Environmental Drilling		Well Contractor's Licence No. 7320	
Business Address (Street Number/Name) 37 Shaw Valley Drive		Municipality St Thomas	
Province ON	Postal Code N5R6J9	Business E-mail Address ded.andrew@gmail.com	
Bus. Telephone No. (inc. area code) 5198680175		Name of Well Technician (Last Name, First Name) Dawson, Matthew	
Well Technician's Licence No. 3963		Signature of Technician and/or Contractor Matthew Dawson	
		Date Submitted 20170825	

Results of Well Yield Testing					
After test of well yield, water was:		Draw Down		Recovery	
<input type="checkbox"/> Clear and sand free <input type="checkbox"/> Other, specify _____		Time (min)	Water Level (m/ft)	Time (min)	Water Level (m/ft)
If pumping discontinued, give reason:		Static Level			
		1		1	
Pump intake set at (m/ft)		2		2	
Pumping rate (l/min / GPM)		3		3	
Duration of pumping hrs + min		4		4	
Final water level end of pumping (m/ft)		5		5	
If flowing give rate (l/min / GPM)		10		10	
		15		15	
Recommended pump depth (m/ft)		20		20	
		25		25	
Recommended pump rate (l/min / GPM)		30		30	
		40		40	
Well production (l/min / GPM)		50		50	
Disinfected? <input type="checkbox"/> Yes <input type="checkbox"/> No		60		60	



Comments: Stanford Rd		Well owner's information package delivered <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Date Package Delivered YYYYMMDD 20170808	Date Work Completed YYYYMMDD 20170808	<b>Ministry Use Only</b> Audit No. 2268777 OCT 12 2017 Received
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Well Tag No. (Place Sticker and/or Print Below)

A241459

Well Record

Regulation 903 Ontario Water Resources Act

Page of

Measurements recorded in: Metric Imperial

Well Owner's Information

First Name Last Name / Organization E-mail Address Well Constructed by Well Owner

Mailing Address (Street Number/Name) Municipality Province Postal Code Telephone No. (inc. area code)

Well Location

Address of Well Location (Street Number/Name) Township Lot Concession

County/District/Municipality City/Town/Village Province Ontario Postal Code

UTM Coordinates Zone Easting Northing Municipal Plan and Sublot Number Other

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From To

Annular Space table with columns: Depth Set at (m/ft) From To, Type of Sealant Used, Volume Placed

Results of Well Yield Testing table with columns: Draw Down, Recovery, Time (min), Water Level (m/ft)

Method of Construction and Well Use table with checkboxes for Cable Tool, Rotary, Boring, etc.

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth

Water Details and Hole Diameter table with columns: Water found at Depth, Kind of Water, Depth, Diameter

Well Contractor and Well Technician Information table with columns: Business Name, Licence No., Address, Municipality

Map of Well Location section with a hand-drawn map of the well site at 2301 Dixie Rd.

Well Technician Information table with columns: Business E-mail Address, Bus. Telephone No., Name of Well Technician, Signature, Date Submitted

Ministry Use Only table with columns: Audit No., Date Package Delivered, Date Work Completed, Received 2018



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

A241456

Well Record

Regulation 903 Ontario Water Resources Act

Page of

Measurements recorded in: Metric Imperial

Well Owner's Information

First Name, Last Name / Organization (Nightingale Corp), E-mail Address, Mailing Address (2301 Dixie Rd), Municipality (Mississauga), Province (ON), Postal Code (L4Y1Z9), Telephone No.

Well Location

Address of Well Location (2301 Dixie Rd), Township, Lot, Concession, City/Town/Village (Mississauga), Province (Ontario), Postal Code (L4Y1Z9), UTM Coordinates, Zone, Easting, Northing, Municipal Plan and Sublot Number.

Overburden and Bedrock Materials/Abandonment Sealing Record

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Rows include Sand, Silt, shale, Gravel, clay, shale, Sand/gravel fill, silt with clay, grey shale.

Annular Space table with columns: Depth Set at (m/ft) From, To; Type of Sealant Used (Bentonite); Volume Placed (m³/ft³).

Results of Well Yield Testing table with columns: Draw Down (Time, Water Level), Recovery (Time, Water Level), Pumping rate, Duration of pumping, Final water level end of pumping, Recommended pump depth, Recommended pump rate, Well production.

Method of Construction (Auguring), Well Use (Monitoring).

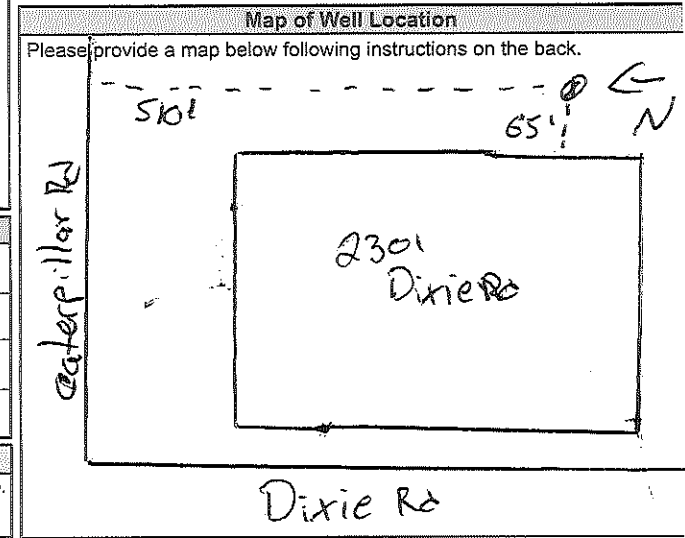
Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material (PVC), Wall Thickness (SCH. 40), Depth (m/ft) From, To, Status of Well.

Construction Record - Screen table with columns: Outside Diameter, Material (PVC), Slot No., Depth (m/ft) From, To.

Water Details table with columns: Water found at Depth, Kind of Water, Hole Diameter (Depth, Diameter).

Well Contractor and Well Technician Information: Business Name (GroundForce Environmental), Licence No. (7424), Business Address (75 Ardelt Pl), Municipality (Kitchener).

Well Technician Information: Name (Vanbesien, Dylan), Licence No. (3880), Signature, Date Submitted (20180405).



Comments:

Ministry Use Only: Audit No. (278306), Date Package Delivered, Date Work Completed (20180314), Received (APR 10 2017).

# Overburden and Bedrock Materials Interval

Well No. 7309315

General Colour	Most Common Material	Other Materials	General Description	Depth From	Depth To
GREY	CLAY			0 ft	5 ft
		CLAY		5 ft	10 ft
	SHLE			10 ft	15 ft
	ROCK			15 ft	17.5 ft





Tag #: A 232648

Measurements recorded in:  Metric  Imperial

Well Owner's Information

First Name, Last Name / Organization (248666 ONTARIO INC.), E-mail Address, Well Constructed by Well Owner

Mailing Address (Street Number/Name), Municipality (MISSISSAUGA), Province (ON), Postal Code (L4X1E7), Telephone No. (905) 874-8151

Well Location

Address of Well Location (Street Number/Name), Township, Lot, Concession

County/District/Municipality, City/Town/Village, Province (Ontario), Postal Code (L4X1E7)

UTM Coordinates Zone, Easting, Northing, Municipal Plan and Sublot Number, Other

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

Table with columns: General Colour, Most Common Material, Other Materials, General Description, Depth (m/ft) From, To. Includes entries for Concrete, Sand, Shale, Gravel/R.II, limestone, Packed, Layered.

Annular Space table with columns: Depth Set at (m/ft) From, To; Type of Sealant Used (Material and Type); Volume Placed (m³/ft³). Includes entries for Concrete and Bentonite Chips.

Results of Well Yield Testing table with columns: Draw Down (Time, Water Level), Recovery (Time, Water Level). Includes pumping rate, duration, and final water level data.

Method of Construction and Well Use checkboxes. Includes options like Cable Tool, Rotary, Boring, Diamond, Jetting, Driving, Digging, etc.

Construction Record - Casing table with columns: Inside Diameter, Open Hole OR Material, Wall Thickness, Depth (m/ft) From, To. Includes entry for PVC casing.

Map of Well Location

Please provide a map below following instructions on the back.

See map

Construction Record - Screen table with columns: Outside Diameter, Material, Slot No., Depth (m/ft) From, To. Includes entry for PVC screen.

Water Details and Hole Diameter tables. Water Details includes depth and kind of water. Hole Diameter includes depth and diameter.

Well Contractor and Well Technician Information

Business Name of Well Contractor (GEO - ENVIRONMENTAL DRILLING), Well Contractor's Licence No. (6607)

Business Address (Street Number/Name), Municipality (Halton Hills)

Province (ON), Postal Code (L7J0A1), Business E-mail Address (estimates@geo-environmentaldrilling.com)

Bus. Telephone No. (905) 876-3388, Name of Well Technician (Cochran, Ryan)

Well Technician's Licence No. (24161), Signature of Technician and/or Contractor, Date Submitted (20180205)

Comments:

Well owner's information package delivered (Yes/No), Date Package Delivered, Date Work Completed, Ministry Use Only (Audit No. 2266987, Received MAY 25 2018)

<b>UTM</b> N ▼ Hemis. 17 T 615328 x- <b>ea</b> 4829181 y-no. <input type="button" value="ok"/>	<b>dd.ddddd°</b> Latitude: 43.60668 °N Longitude: -79.57094 °E <input type="button" value="ok"/>	<b>dd° mm.mmm'</b> 43 ° 36.401 ' N ▼ 79 ° 34.256 ' W ▼ <input type="button" value="ok"/>	<b>dd° mm' ss.s"</b> 43 ° 36 ' 24.0 " N ▼ 79 ° 34 ' 15.4 " W ▼ <input type="button" value="ok"/>	<b>POI / WPT / Waypoints</b> *01-A "WP01-A" added 17 T 615328 4829181 43.60668°N -79.57094°E Elevation= 113.5m **all waypoints removed...
postal address or point of interest (poi) <input type="text"/> <input type="button" value="→"/> <input type="button" value="ok"/>		elevation in m ▼ <b>113.5</b>	<b>WP01-A</b> <input type="button" value="edit"/> <input type="button" value="←"/> <input type="button" value="01-A"/> <input type="button" value="→"/> <input type="button" value="→"/>	

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MAY 25 2018

**APPENDIX C**

# Soil and Bedrock Parameters



**Table C 1: Preliminary Soil Parameters for Design**

Soil Type <sup>1</sup>	Approximate Depths	Soil Unit Weight <sup>2</sup> , $\gamma$ (kN/m <sup>3</sup> )	Internal Friction Angle, $\Phi$ (°)	Coefficient of Lateral Earth Pressure			Undrained Shear Strength, $s_u$ (kPa)	Elastic Modulus (MPa)	Poisson's Ratio
				Active, $K_a$ <sup>3</sup>	At Rest, $K_0$	Passive, $K_n$			
<b>Granular (non-cohesive) Fill</b>	Ground Surface to a depth of 1.5 m	18 to 20	29 to 30	0.4	0.5	2.8	Not applicable	5 to 15	0.4
<b>Cohesive Fill</b>	Ground Surface to a depth of 0.8 m	17 to 19	28 to 29	0.4	0.5	2.8	15 to 40	5 to 10	0.5
<b>Very loose to dense silt to silty sand</b>	0.5 m to 4.0 m	18 to 21	29 to 32	0.4 to 0.3	0.5	2.9 to 3.3	Not Applicable	2 to 40	0.4
<b>Very soft to stiff silty clay</b>	1.5 m to 4.5 m	17 to 20	27 to 30	0.4 to 0.3	0.5	2.7 to 3.0	10 to 50	5 to 25	0.5
<b>Very stiff to hard cohesive till</b>	4.1 m to bedrock surface	20 to 22	31 to 34	0.3	0.5 to 0.4	3.1 to 3.7	75 to 300	50 to 125	0.4 to 0.5
<b>Very stiff to hard silty clay till / shale fragments</b>	4.5 m to 7.5 m	19 to 22	30 to 33	0.3	0.5	3.0 to 3.4	100 to 200	75 to 150	0.5 to 0.4

**Notes:**

1 – Cohesive soils are those which remain intact when rolled between the fingers. The term cohesive describes a soil which has an undrained shear strength. Granular (non-cohesive) soils may include both coarse grained and/or fine grained constituents, and are soils that fall apart when not confined.

2 – The effective unit weight (i.e.  $\gamma' = \gamma_{\text{bulk}} - \gamma_{\text{water}}$ ) should be used below the groundwater table.

3 – Geotechnical literature suggests that in situ horizontal stresses at-rest, often described in terms of the ratio of in situ horizontal to vertical effective stress ( $k_0$ ), within heavily over-consolidated glacial tills, may be higher and on the order of 1 or greater. Because of excavation processes, such high lateral stresses will likely be relieved to some degree. Although active stresses may be developed during excavation, relieving the in situ stresses at-rest, the permanent underground structures will likely be restrained against displacement and there may be some long term re-establishment of in situ stresses that are closer to the initial conditions. It should be noted however, that past construction of underground structures within the Greater Toronto Area have been successfully designed with a  $k_0$  of about 0.5. Once the detailed design and construction methods have been finalized further refinement of  $k_0$  can be considered.

**Table C 2: Preliminary Bedrock Parameters for Design**

Property (Unit)	Fractured/Moderately Weathered Shale at Bedrock-Overburden Interface	Fresh to Slightly Weathered Shale	Hard Layers (Limestone/Siltstone)
Unit Weight (kN/m <sup>3</sup> )	22 to 24	23.5 to 26.5	23.5 to 26.5
Uniaxial Compressive Strength, UCS (MPa)	5 to 20	10 to 40	50 to 250
Young's Modulus, E (GPa)	0.2 to 2.0	2 to 6	10 to 40
Cerchar Abrasiveness	0.2 to 0.5	0.2 to 0.5	0.5 to 2.0
Slake Durability Index – 2 <sup>nd</sup> Cycle (%)	35 to 80	60 to 85	Not Applicable

Note: Rock properties given above are for rock only. Moderately weathered bedrock can have up to 50% soil like material which will behave similar to a soil



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